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OF
Celebes Sea Area

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CHAPTER V

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JOINT ARMY-NAVY INTELLIGENCE STUDY

OF

CELEBES SEA AREA

CLIMATE AND WEATHER

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Note: This Chapter is based on material available in Washington, D.C., on 25 April 1944.

CLIMATE AND WEATHER

50. General Description

In all seasons, the climate of most of the Celebes Sea area is characterized by gentle winds, monotonous heat, extremely high humidity, heavy cloudiness, and frequent intense rain showers. Every few years a typhoon may sweep across the northern part of the area. The mountains rise into a cool zone of persistent cloudbanks. Only the highest peaks have snow. Soil conditions are persistently muddy and there are occasional floods.

A. Seasonal variation.

Two great air streams, known locally as the northeast and southwest monsoons, dominate the surface air circulation over the Celebes Sea region. These streams originate in the great middle latitude high pressure centers of the Northern and Southern Hemispheres, respectively. They converge toward the equatorial low pressure trough, where they meet along the intertropic front or doldrum belt.

The intertropic front migrates northward and southward with the changing seasons (FIGURE V - 1). From December through March, while the intertropic front normally lies well to the south, the northeast monsoon blows steadily over the Celebes Sea region. From April through June, the front is moving gradually northward over the Celebes Sea; the northeast monsoon and the southwest monsoon each dominates part of the area, with variable winds near the front. From July through September, when the front usually lies well to the north, the southwest monsoon dominates the Celebes Sea; from October through November, during its southward migration, the intertropic front again lies across that region.

In spite of the complete reversal of wind flow from season to season, in most respects the climate of the Celebes Sea region is monotonously uniform throughout the year. Both monsoons have generally had sufficiently long journeys over tropical seas to be warm and moist by the time they arrive over this area. All seasons are characterized, over most of the area, by gentle winds, remarkably high temperature and humidity, good visibility, much cloudiness, and frequent rainshowers. However, seasonal variation in some weather elements is sufficiently great to be a significant factor in planning certain operations; these elements are discussed in detail in Topic 51 of this chapter.

B. Diurnal variation.

There is considerable variation in most weather elements, associated with daily heating and cooling of the atmosphere and of ground and water surfaces. In the case of wind velocity, temperature, relative humidity, visibility, and cloudiness, the magnitude of the regular diurnal variation is commonly greater than the seasonal variation. Diurnal variation of critical weather elements is discussed in Topic 51.

C. Areal contrasts.

There are significant, though not extreme, climatic contrasts among different parts of this region. Broad regional contrasts are associated with differences between land and sea surfaces, between windward and leeward slopes of the major mountain ranges, and between different latitudinal positions. In addition, minor topographic differences cause large place-to-place contrasts in most weather elements; slight local differences in slope or exposure commonly give nearby places dissimilar wind and rainfall regimes. Areal contrasts in critical weather elements are discussed in Topic 51.

D. Day-to-day variation.

In contrast to the fairly regular climatic processes described above, day-to-day weather changes are quite irregular.

The monsoons, although remarkably steady in comparison to winds in most middle latitude regions, are subject to nonperiodic variations in speed and direction of flow. In like manner, the intertropic front undergoes erratic shifts in position and intensity. Moreover, moving pressure disturbances sometimes traverse this area. Such disturbances are generally quite weak and are reflected in the weather chiefly through intensifying or weakening local convective activity. Disturbances of sufficient intensity to cause widespread bad weather appear occasionally. At very rare intervals, such disturbances develop into violent tropical cyclones—typhoons. The Celebes Sea lies well to the south of the zone of greatest typhoon danger.

Only by short-range forecasts can these irregular weather changes be anticipated. They are discussed in more detail in Topic 52 of this chapter. Because of the sparse network of synoptic stations in the western Pacific before the Japanese occupation, the nature of day-to-day weather variations in the Celebes Sea area is only incompletely understood. Forecasting of such variations is not easy, even if synoptic reports are available from the entire western Pacific. With reports from neighboring areas cut off by enemy occupation, accurate forecasting is extremely difficult.

51. Weather and Operations

Reference should be made to Topic 53 for detailed climatological information and to Topic 52 for detailed discussion of weather associated with different synoptic situations. The present section is restricted to general discussion and conclusions.

A. Ground operations.

The chief weather factors which may restrict ground operations in this region are precipitation, temperature, humidity, and wind speed. Precipitation is a critical factor in flooding, soil trafficability, and erosion. Precipitation, temperature, and humidity affect maintenance of materiel, storage of supplies, and health and comfort of personnel. High wind speeds, approaching hurricane force in this region at rare intervals, may cause casualties and material damage.

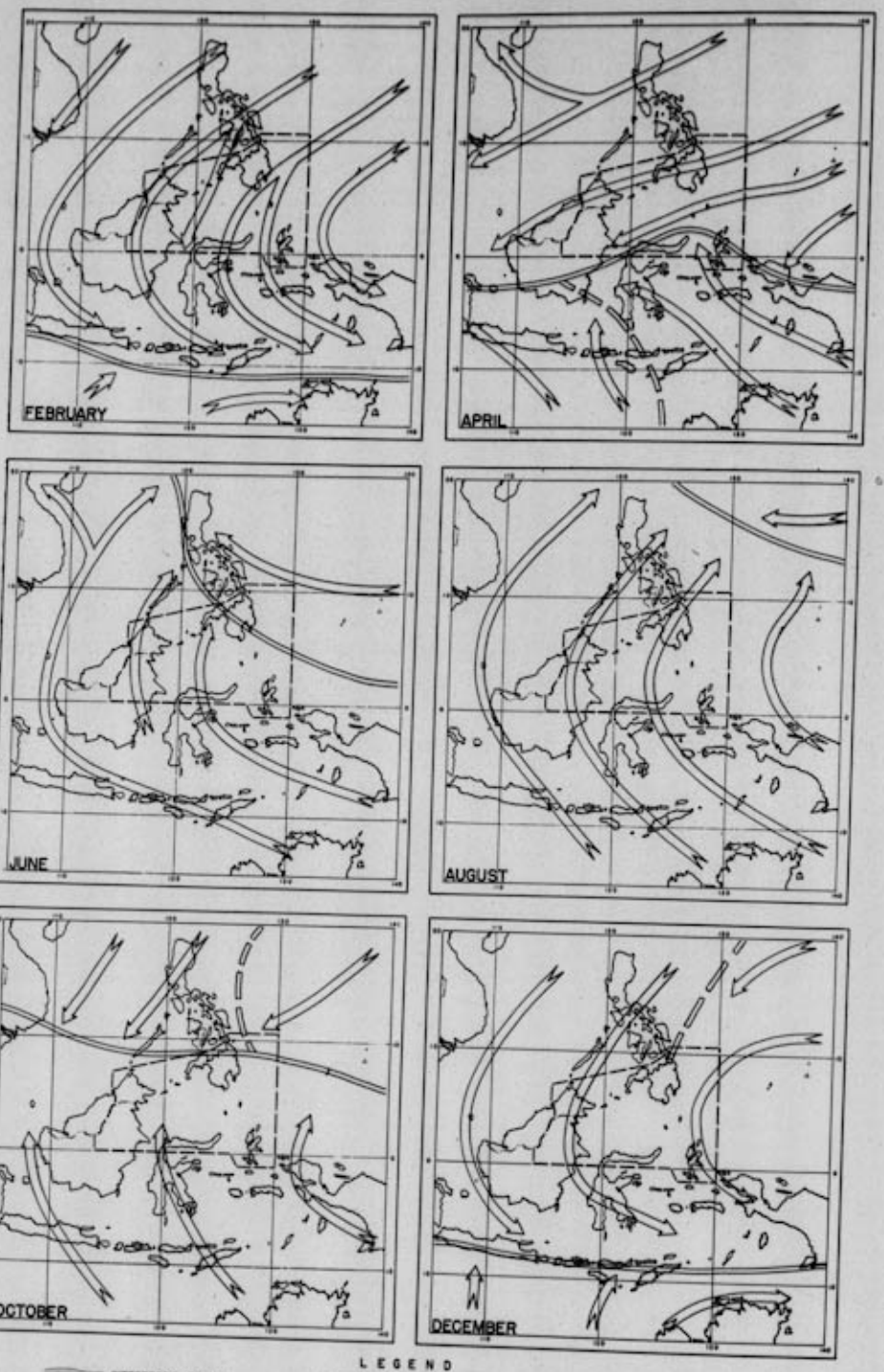


FIGURE V - 1.
Mean Wind Flow and Fronts.

(1) Precipitation.

(a) Type of precipitation. Over the lowlands, all precipitation falls as rain. Snow occurs only on the highest mountain peaks.

(b) Amount: areal contrasts. Over the lowlands, average precipitation is moderately heavy; most of the lowlands receive an average of between 50 and 150 inches a year. Areal contrasts are irregular and are controlled largely by local relief. For example, Amoerang and Bojong, located only about 10 miles apart in the Northern Celebes, have average annual rainfall amounts of 65 and 173 inches respectively. Rainfall is undoubtedly much heavier on exposed mountain slopes than over the lowlands, although quantitative information is lacking.

(c) Amount: seasonal variation. Over much of this area, seasonal variation is insignificant. However, many places have marked seasonal variation associated with the influence of mountains on exposure to winds. Places exposed to the northeast monsoon generally have a relatively wet season in winter; places exposed to the southwest monsoon tend to have most rain in summer. At many places the wettest month has twice as much rainfall as the driest month. At a few places in northeastern Mindanao, the wettest month has 10 times as much rainfall as the driest.

(d) Amount: diurnal variation. Considerable rain falls at all hours of the day. Over the interior, rainfall is generally heaviest in the afternoon. This tendency toward an afternoon maximum extends to the coast when the wind is blowing offshore. When the wind is onshore, this tendency is less marked, being partially offset by an increase in night and early morning rainfall. Following are the mean monthly amounts of rainfall in inches at Manado (Northern Celebes) during different parts of the day:

Hours (local time)	Northeast Monsoon Season	Southwest Monsoon Season	Transition Season
0000-0400	3.3	0.5	0.9
0400-0800	2.2	0.5	0.7
0800-1200	2.3	0.3	1.0
1200-1600	4.0	2.0	3.2
1600-2000	2.2	0.5	1.3
2000-2400	2.4	0.2	1.0
Total	16.3	4.0	8.1

It is evident that the largest proportion of night and early morning rainfall occurs when northeast (onshore) winds prevail.

(e) Amount: year-to-year variation. In individual years, significant departures from average rainfall conditions occur. However, rainfall is seldom more than twice the normal in any month. Rainless or nearly rainless months are possible at most places in this region, but are quite rare.

(f) Frequency. Over most of the lowlands, rain normally falls on 100 to 200 days a year. However, some lowland places, including most of the stations in northeastern Mindanao, have rain on more than 200 days a year. On exposed mountain slopes, rain falls almost every day. Rainfall frequencies resemble rainfall amounts in areal, seasonal, diurnal, and year-to-year variations.

(g) Duration. Over the lowlands, rain is usually in the form of brief showers. At Manado, rain lasts for an average of 434 hours a year. In the mountains, rain is more persistent, sometimes lasting for days with only short letups. Rain generally lasts longest in the months that have the greatest average amounts of rainfall. For example, at Manado there is an average of 73 hours of rain a month in January and February; 9 hours a month during July, August, and September.

(h) Intensity. Over the lowlands, rainfall is usually in the form of intense showers. On an ordinary rainy day, over ½ inch of rain falls.

Days with more than 2 inches of rainfall occur in most months, and nearly every year has one or more days with over 4 inches of rainfall. The highest 24-hour rainfall recorded in this area is 19 inches. On the lower slopes of the mountains, probably even greater intensities occur. Maximum intensities generally occur in the months which have the greatest average amounts of rainfall.

(2) Temperature.

In all seasons, over all the lowlands of this area temperature normally ranges from 70° or 75° F. in the cool of the morning to 85° or 90° F. in the heat of the day. Temperatures below 65° or above 95° F. are very infrequent. Cooler conditions can be expected in the highlands. The rate of decrease in temperature with increase in elevation is generally 3 or 4° F. per 1,000 feet.

(3) Humidity.

Extremely high humidity is characteristic of this region in all seasons. Relative humidity generally averages 80 to 90% throughout the year. Humidities below 50% are very infrequent. Relative humidity increases with higher elevation, averaging more than 90% at medium elevations on the mountains.

Diurnal variation is much greater than seasonal variation. There is usually a difference of 20 or 30% between the early morning maximum and the midday minimum in relative humidity.

(4) Wind speed.

Strong winds and gales are very rare in this area. However, occasional typhoons, following a track far to the south of their usual course, cause destructive winds over this area. Such destructive typhoons can be expected every few years in the far north of this area; in the far south, destructive winds are practically unknown. During the 16 years from 1903 to 1918, Surigao Province on Mindanao had 4 destructive typhoons; other provinces on Mindanao had 1 or none; the Sulu Archipelago had one. Typhoons may occur in any season, but are most likely to occur in this area in winter.

B. Air operations.

(1) Low-level operations.

The chief weather factors which may restrict low-level air operations over this area are low ceilings, restricted visibility, and turbulence. Surface winds and upper winds, although seldom restrictive except during passage of a tropical cyclone, are of interest in planning operations.

(a) Ceilings. Although cloud formation is heavy throughout this area in all seasons, the bases of the lower clouds generally lie well above 1,000 feet elevation. Therefore, low-level operations over the lowlands will rarely encounter widespread low ceilings. However, bases of isolated cumulonimbus clouds often lie below 1,000 feet, or even below 500 feet in rain. Over hilly and mountainous areas, low ceilings are frequent; there is great local variation, depending on site and exposure.

(*b*) *Visibility.* Horizontal visibility is generally good in this area, but is occasionally limited by fog, cloud, mist, haze, or rain.

Fog, reducing visibility to less than ½ mile, is rare over the sea and along the coasts. In the interior, dense morning fogs are frequent in all seasons over many river valleys, lakes, and marshes. Fog rarely persists long after sunrise.

Clouds cause very bad visibility conditions on mountain slopes in all seasons. Above the condensation level, which usually lies at 1,000 to 3,000 feet elevation on windward slopes, the frequent thick cloudbanks have the same effect as fog.

Mist and haze, reducing visibility to less than 6 miles, are encountered occasionally in all seasons. Haze occurs in stable air streams and is apparently the result of strong winds, whipping condensation nuclei into the air. Haze is intensified by dust, volcanic ash, or smoke from brush fires. The maximum haze frequency occurs in September and October, at the end of the southwest monsoon season, when haze can be expected 5 to 10% of the time over the southern Celebes Sea, though not so frequently over the northern part.

Rain generally reduces visibility to less than 4 miles. In torrential downpours, visibility may be practically nil. Rain occurs ordinarily in the form of brief local showers, which can generally be avoided by planes in flight. However, the rain associated with fronts or tropical cyclones is steady and must be approached with care.

(*c*) *Turbulence.* Turbulence is severe in cumulonimbus clouds and thunderstorms, and is extremely violent in well-developed tropical cyclones.

Cumulonimbus clouds are reported in about 10% of the ship observations in the Celebes Sea during all seasons, and are even more frequent over the land, especially over hills and mountains. They may extend from below 1,000 feet to above 40,000 feet. The violent turbulence in cumulonimbus clouds can best be avoided by either flying beneath the cloud base or by approaching the cloud at an altitude of more than 20,000 feet. The decision depends upon whether or not the plane can fly at high altitudes and upon the nature of the terrain.

Thunderstorms may be encountered over any part of this area in any season. They are least frequent during the northeast monsoon season, from December through March.

Well-developed tropical cyclones are very rare in the Celebes Sea area.

(*d*) *Surface winds.* Over this area in general, northeast winds prevail from December through March, southwest winds from July through September. In the transition months, winds are more variable, but northeast winds prevail over the northern parts of the area, southwest winds over the southern parts.

Topography causes great local variation in wind direction. In the mountains, winds are funneled through valleys and passes. Even minor topographic features produce local variations in the characteristically weak air flow.

Along the coasts and in interior valleys, there is a tendency toward regular daily variation in wind direction. On exposed portions of the coast, this tendency causes only a slight deflection of the prevailing monsoon. However, in sheltered bays, local breezes often completely obliterate the monsoons. The land (offshore) breeze sets in during the evening and usually abates at about 0900. The sea (onshore) breeze sets in around midday and abates after sunset. The land breeze normally occupies a shallow layer which seldom exceeds 500 feet in depth. The sea breeze is generally deeper and may exceed 1,000 or even 3,000 feet in depth. The land breeze is perceptible only within a few miles of the coast; the sea breeze is sometimes perceptible for a distance of 50 miles or more on both sides of the coast line, but is usually strongly developed only within 20 miles of the coast. Many interior valleys experience a similar daily variation in wind direction. Mountain (downslope) breezes are common at night, valley (upslope) breezes in the daytime.

Wind speeds are moderate over most of the area. Throughout the area, speeds occasionally exceed 30 m.p.h. in thundersqualls. Gales can be expected only during passage of one of the rare typhoons.

(*e*) *Upper winds.* In the lower levels, upper air winds closely resemble the surface circulation. From December, through March, winds below 5,000 feet are predominantly northeasterly over the northern Philippines, shifting to northerly near the Equator, and northwesterly south of the Equator. From July through September, winds below 5,000 feet are predominantly southeasterly south of the Equator, shifting to southerly near the Equator, and southwesterly over the Philippines. In the transition months, upper winds over the Celebes Sea area are quite variable even in the lower levels.

In the upper levels, there is a tendency for circulation to parallel the Equator, with westerly and easterly winds frequent, northerly and southerly winds infrequent in all months.

At all levels, wind speeds are normally moderate. Speeds greater than 30 knots are encountered only a small percentage of the time.

(2) High-level operations.

High-level operations may be restricted by the same weather factors which affect low-level operations. In addition, high-level operations are restricted by cloudiness at intermediate and low levels and by icing.

(*a*) *Intermediate and low cloudiness.* Although cloud formation seldom interferes with low-level operations in this area, it severely restricts high-level operations. Frequent heavy cumulus and stratocumulus cloud, with bases at about 1,500 feet elevation, are characteristic of the entire area in all seasons.

Available cloudiness data refer to total sky cover by clouds at all levels. Such data include observations of cirrus clouds, sometimes so high that they do not affect even high-level operations. However, since the bulk of the cloud formation in this area is at intermediate levels, data on total sky cover provide a fair approximation of the amount of cloud to be expected within the normal altitude zone of high-level operations.

The seasonal variation of rainfall at a given station is usually a reliable indication of the seasonal variation of cloud.

Over most of the area, mean annual cloudiness is about 50% or more. Clear sky (less than 25% cloud cover) can be expected less than ⅓ of the time in all seasons, and rarely lasts more than a few hours. Cloudy sky (more than 65% cover) can be expected more than ⅓ of the time in all seasons.

There are moderate areal differences in cloudiness. Over the sea, an average of approximately half of the sky is cloud covered. Over the lowlands, an average of about two-thirds of the sky is covered. Over many hill and mountain regions, cloud formation is even heavier.

Seasonal variation is not great. Over the sea there is a slight

summer maximum in cloudiness in the northern part of the area, a slight winter maximum in the south. Over the land, seasonal variation is largely controlled by topography. Over slopes facing north and east, cloudiness tends to reach a maximum in winter, during the northeast monsoon. Over slopes facing south and west, cloudiness tends to reach a maximum in summer, during the southwest monsoon. Following are the mean cloudiness values, in percentage of sky covered by cloud, at stations with northeast and southwest exposures.

	NORTHEAST MONSOON DEC-MAR	SOUTHWEST MONSOON JUL-SEP
Northeast Exposure (Mean of 3 Stations)	75	67
Southwest Exposure (Mean of 3 Stations)	62	71

Cloudiness is usually greater from 0600 to 1800 than at night.

(*b*) *Icing.* The freezing level is normally close to 15,000 feet and rarely descends as low as 12,000 feet. Icing conditions can generally be avoided by descending to lower levels when clouds are encountered in which icing conditions exist. The greatest danger occurs when it is necessary to fly through cumulonimbus clouds at high levels.

(3) Incendiary bombing operations.

Incendiary bombing may be restricted by the same weather factors which affect high- and low-level operations. In addition, incendiary burning is limited by rainfall, humidity, and wind speed.

(*a*) *Rainfall.* Over most of the area, rain falls on 10 to 20 days a month in all seasons. Some places expect as few as 5 rainy days in individual months. Rainfall is heavy, with over ½ inch falling on an average rainy day. Long drought periods are rare.

(*b*) *Humidity.* Extremely high humidity is characteristic of all of this region in all seasons. Relative humidity generally averages 80 or 90%. Humidities below 50% are very infrequent.

(*c*) *Wind speed.* Wind speeds are generally too low to produce satisfactory incendiary burning conditions. Except at a few exposed highland places, wind speeds over 30 m.p.h. are rare. Along the coasts, calms are frequent and winds do not often exceed 10 m.p.h. except in the early afternoon, when the sea breeze is strongest.

(4) Parachute operations.

Parachute operations are endangered by high surface wind speeds and by good visibility.

(*a*) *Surface wind speed.* In all seasons and in all parts of the area, surface wind speeds are frequently low enough for safe parachute landings. On the coasts, low wind speeds are most probable around sunrise and sunset, when there is a period of calm between the daily breezes. Dangerous wind speeds are most probable in the early afternoon.

(*b*) *Visibility.* Visibility low enough to mask parachute landings effectively, is infrequent in most of this area. Fog can be expected over restricted portions of the interior lowlands on calm mornings. Haze would occasionally produce effective concealment. Haze is most frequent in September and October.

C. Naval operations.

Normally, good weather conditions are desired for combined naval operations, however, it may occasionally be more desirable to use bad weather as a cover to conceal fleet movements. Consequently, the chief weather factors to be considered in planning naval operations are wind, sea and swell, cloud cover, and visibility. It has been shown that in the Celebes Sea area, all seasons are characterized by light winds, good visibility, much cloudiness, and frequent precipitation. Still, the seasonal variation is sufficient to be of interest for planning.

(1) Wind.

(*a*) *December through March.* During this season the intertropic front is well to the south of the Celebes Sea so that northeast winds prevail throughout the area. These winds, which are remarkably steady, blow with an average velocity of about 8 m.p.h. Strongest mean velocities, 9 to 12 m.p.h., are observed off the northwest coast of Borneo and eastern Mindanao.

(*b*) *April through June.* During these months the intertropic front moves slowly northward over the Celebes Sea and as a result, both northeast and southeast winds dominate a portion of the area, except near the front where directions become more variable. Velocities decrease slightly, averaging 6 to 7 m.p.h.

(*c*) *July through September.* Throughout these months the intertropic front lies to the north of the Celebes Sea. The southwest monsoon dominates the entire area during this period. Mean velocities are highest during this period, 8 to 9 m.p.h.

(*d*) *October through November.* In October, the intertropic front reenters the northern Celebes Sea and migrates towards the south during the period. The southeast trades give way in advance of the retreating front so that northeast winds again dominate the entire area by the end of November. Over the area as a whole, velocities average 7 m.p.h.

(2) Sea and swell.

Data on sea and swell are of special interest in the planning of operations involving the use of aircraft carriers or small craft.

The prevailing low wind velocities are reflected in the low frequency of heavy sea and swell. Within the Celebes Sea both sea and swell are predominantly low throughout the year. Available data show that 90% of all observations report calm or low seas, and over 90% of all observations report low or no swell. Almost all occurrences of medium and high sea and swell have been observed on the extreme edges or outside the Celebes Sea proper.

(*a*) *November through April.* During these months, which represent the northeast monsoon season, sea is predominantly from the northeast. Sea conditions are most disturbed during this period, especially in December and January. Within the Celebes Sea, high seas (over 9 feet) have not been observed and medium seas (2 to 9 feet) show a frequency of only 13%. These values, however, increase rapidly to the north and east. Off the south coast of Borneo and off the west and east coasts of Mindanao, medium sea reaches a frequency of 30 to 40%, and high seas a frequency of 2 to 5%.

Swell, which is also predominantly from the northeast, is lowest during this period. High swell (over 12 feet) has a frequency of 1%, while moderate swell (6 to 12 feet) shows a frequency of only 2%. As in the case of sea conditions, these

percentages increase noticeably to the north and east. To the east and west of Mindanao and off the north coast of Borneo moderate swell occurs from 24 to 26% of the time, and high swell 2 to 4% of the time.

(*b*) *May through October.* The sea is least disturbed during these months, especially in May and June. The Celebes Sea has medium seas only 10% of the time and high seas have not been observed. To the east and west of Mindanao medium seas maintain a frequency of 20% and high seas a frequency of 2%. Most disturbed conditions for the area are reported off the northwest coast of Borneo. In this portion of the area medium seas are observed on 37% of all observations and high seas on 5% of the observations. Since this is the southwest monsoon season, direction of sea is predominantly south or southwest.

Within the Celebes Sea, the frequency of moderate swell increases from 2 to 3%, while the frequency of high swell remains at 1%. Off eastern Mindanao the occurrence of moderate and high swell drops off over 50%, to 10% and 1% respectively. In the Sulu Sea area, off the west coast of Mindanao, no swell and low swell predominate, since the amount of moderate swell decreases to only 2% and the frequency of high swell to 1%. Roughest conditions still persist off the northwest coast of Borneo. In this portion of the area, moderate swell fall off to 18%, but high swell increases to a frequency of 7%. Directions of swell are somewhat more variable during this month, but south and southwest directions apparently prevail throughout the entire area.

More detailed information on sea and swell may be found in Chapter III.

(3) Cloud cover.

Over the sea, mean cloudiness averages about 5 tenths with a slight summer maximum in the northern part, and a slight winter maximum in the southern part. Clear skies may be expected between 15 and 20% of the time, but rarely last for more than a few hours. Overcast skies (7 tenths cloud cover) can be expected 35 to 40% of the time in all seasons.

All months are characterized by broken skies with instability clouds, cumulus, predominating. Ceilings normally are well above 1,000 feet, however, bases of isolated cumulonimbus often lie below 1,000 feet.

Should cloud cover be desired to conceal fleet movements, it is expected that most suitable conditions would be found during the times when the intertropic front lies over the Celebes Sea. From April through June the front moves northward over the area and should offer ample opportunities for a complete overcast cloud cover. The intertropic front, being formed as a result of the converging trades, undergoes irregular movements and can change in intensity very rapidly. Present knowledge of its behavior is rather limited, but its daily variations can be forecast if sufficient data are available. Winds aloft soundings have proven to be a very valuable tool in this respect.

Along the edges of the intertropic front may be found frequent shower and thunderstorm activity, as well as low ceilings and reduced visibilities. Most rain showers and thunderstorms are of short duration, but occasionally intermittent moderate or heavy rain may persist for several days.

The intertropic front also lies over the Celebes Sea in October and November, during its retreat toward the south. Cloud conditions similar to that experienced in April, May, and June may also be expected in these months.

Throughout the year and particularly during the winter season, moving pressure systems traverse this area, occasionally accompanied by frontal systems. They are normally weak, however, and are usually only reflected in the weather by intensifying or weakening the local convective activity. Disturbances of sufficient intensity to cause wide spread bad weather are very rare.

(4) Visibility.

Visibility is most often reduced by precipitation. Rain showers of short duration ordinarily lower visibility to less than 4 miles, or in heavy showers to less than ½ mile. However, rain associated with the zone of convergence, fronts, or tropical disturbances is often of a steady character and will restrict visibility to less than 6 miles for long periods.

Fog is very rare over the sea and never persists for more than an hour or so after sunrise. Visibility may occasionally be reduced below 6 miles by haze. Haze is most often found in stable air streams which are most frequent (5 to 10% of the time) at the end of the southwest monsoon season, September and October.

(5) Humidity.

Relative humidity is very high throughout the year. Humidities of 90% or more may be expected almost every day.

D. Amphibious operations.

The weather factors limiting amphibious operations are the same as those affecting naval operations, namely: wind, sea and swell, visibility, and cloudiness.

(1) Wind and state of sea and swell.

On shores exposed toward the north and east, swell is frequent only from November through April, when northeast winds are frequent. On shores exposed toward the south and west, swell is frequent only from June through September, when southwest winds are frequent. The low speeds of the prevailing winds are reflected in the low frequency of heavy swell. Occasional distant hurricanes are the chief cause of heavy swell.

Disturbed sea conditions are possible in any season during a thundersquall, when wind velocities sometimes exceed 30 m.p.h. The prevailing winds, averaging only 5 or 10 m.p.h., are usually too gentle to cause disturbed sea conditions. Disturbed sea is most frequent when the prevailing winds are onshore and are intensified by the daily afternoon sea breeze.

(2) Visibility.

Visibility low enough to conceal landing operations effectively is infrequent in this area. Sea fog and coastal fog are rare. Haze occasionally reduces visibility below 5 miles, most frequently in September and October.

(3) Cloudiness.

Cloud cover is often sufficiently heavy to conceal landing operations from high-flying planes. However, ceilings below 1,000 feet are unusual, so that clouds cannot be expected to provide protection against low-level attacks.

E. Chemical warfare.

The chief weather factors which may limit chemical operations are: surface wind direction and speed, turbulence near the

ground, temperature, humidity, and precipitation. Wind direction is not only of prime importance in use of cloud gas, but it is also significant when high concentrations of persistent agents are placed on targets close to friendly troops. Wind speed and degree of turbulence in the surface air are important in controlling the concentration of cloud gases as well as the persistency of persistent agents. Temperature affects the rate of evaporation of persistent agents, thereby controlling their effective period. Humidity and precipitation affect the rate of hydrolysis of many chemical agents.

(1) Surface wind.

From December through March, winds are generally from the quarter north to east; from July through September, winds are generally from the quarter south to west. In the transition months, winds are more variable, but northeast winds prevail over the northern parts, southwest winds over the southern parts. However, even minor topographic features produce local variations in the characteristically weak air flow.

Along the coasts and in interior valleys, there is a tendency toward regular daily variation in wind direction. On exposed portions of the coast, this tendency produces only a slight deflection of the prevailing monsoon. However, in sheltered bays, local breezes often completely obliterate the monsoon. The land (offshore) breeze sets in during the evening and continues until about 0900; the sea (onshore) breeze sets in around midday and often continues until sunset. The land breeze is perceptible only within a few miles of the coast; the sea breeze is sometimes perceptible for a distance of 50 miles on both sides of the coast line. Many interior valleys experience a similar daily variation in wind direction. Mountain (downslope) breezes are common at night, valley (upslope) breezes in the daytime.

Wind speeds are usually low in this area. Along the coasts, calms are frequent, and winds do not often exceed 10 m.p.h. except in the early afternoon, when the sea breeze is strongest.

(2) Turbulence.

Turbulence and instability of the surface air, prevalent over the whole area in all seasons, would greatly restrict chemical operations. Relatively stable conditions prevail in the early morning hours, usually from 0000 to 0600. Lapse rates are usually steepest between 1000 and 1800.

(3) Temperature.

In the lowlands, the air is constantly warm, with very little seasonal temperature variation. In all months temperatures normally range from 70° or 75° F. in the early morning to 85° or 90° F. at midday. Following are mean temperatures at different hours (local time):

0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	2400
TARAKAN (Northeast Borneo)											
74	74	74	78	81	83	85	84	80	77	75	74
MANADO (Northern Celebs)											
74	73	73	77	82	85	84	83	81	78	77	75

Lower temperatures can be expected in the highlands.

(4) Humidity.

The extremely high humidity characteristic of this area causes rapid hydrolysis of some chemical agents. Specific humidity probably averages between 15 and 20 grams per kilogram.

Relative humidity generally averages 80 to 90% in all seasons. Diurnal variation is much greater than seasonal variation. Following are mean relative humidities at different hours (local time):

0200	0400	0600	0800	1000	1200	1400	1600	1800	2000	2200	2400
TARAKAN (Northeast Borneo)											
95	96	96	92	85	77	73	76	89	94	94	95
MANADO (Northern Celebes)											
92	93	94	86	76	74	75	78	83	89	90	91

(5) Precipitation.

Over most of the area, rain falls on 10 to 20 days a month in all seasons. Some places expect as few as 5 rainy days in individual months. Rainfall is heavy, with over ½ inch falling on an average rainy day.

52. *Forecasting Techniques*

The Celebes Sea and surrounding islands are comparatively uncharted from a meteorological standpoint. Many of the weather elements which are most significant in military operations have been observed at very few places in this area, and in these places for just a short period before the present war. Thus, much of our knowledge of this area must be inferred from experiences in nearby regions. A meteorologist called upon to forecast for the Celebes Sea area will be pioneering in the application of techniques found successful in other tropical areas.

It is possible to derive only a general picture of the nature of air masses, weather disturbances, effects of topography, and types of synoptic situations which the forecaster will encounter. An outline of these phenomena is presented in this section.

A. Nature of air masses.

(1) Origin of air masses.

In the northern winter a tremendous anticyclone builds up over continental Siberia. At the same time a thermal low pressure area is formed over the desert area of western Australia. The combined push and pull results in a broad sweep of air out into the Pacific from the Asiatic mainland, which swings into a northeast flow over the Celebes Sea region. This air stream of Asiatic origin is termed northeast monsoon or norther air. February is normally the month when the northers are most fully developed. This flow may extend as far eastward as the International Date Line. It is bounded on the east by the trade winds of the eastern Pacific anticyclone.

However, even in the middle of winter, during periods when the northers are weak, the northeast trade air may invade the Celebes Sea area from the east. By March the northeast trades are almost as frequent in the Celebes Sea area as the northers.

During April there is usually some incursion of Southern Hemisphere air into this area, either in the form of southwest monsoon air, from the Indian Ocean *high*, or as southeast trade air from the South Pacific or Australian *highs*. During May and June the Celebes Sea area is a battleground between Northern and Southern Hemisphere air masses.

In the northern summer the Asiatic anticyclone is replaced by a weak low pressure area, while the anticyclone of the south Indian Ocean has moved northward, and more or less persistent anticyclones occupy the Australian continent and the South Pacific. From July through September, the Celebes Sea area is dominated by a strong flow from the Southern Hemisphere. This flow is called the southwest monsoon or southeast trade, depending on its source and trajectory.

In September, northeast trade air may occasionally enter the surface picture from the east. In October and November, Northern Hemisphere air becomes more and more frequent in this area, and by December is usually in full possession.

Thus the forecaster in the Celebes Sea area will have 4 air masses to deal with at the surface: northeast monsoon and northeast trade in winter, the southwest monsoon and southeast trade in summer, with combinations of all 4 during the transition seasons.

(2) Characteristics of air masses.

(*a*) *Northeast monsoon.* The northeast monsoon, although of polar continental origin, has had a long trajectory over the warm waters of the tropical North Pacific before arriving over the Celebes Sea. The norther air stream is shallow south of 20° to 25° N., rarely being over 4,000 feet deep even in the vicinity of Hong Kong. Near the south China coast, the norther stream is overrun at about that level by warm, dry, westerly winds, and further to the east by an easterly extension of the northeast trades.

Over the ocean, there is little rainfall or cloud formation in norther air. However, since the air mass is conditionally unstable, any kind of lifting produces cumulus formation and rain showers. Low cloud forms are characteristically small, sharply defined cumuli, with a uniform level of cloud tops at the inversion level, usually about 4,000 feet.

(*b*) *Northeast trade.* Unlike the northeast monsoon, the northeast trade is of tropical maritime origin. However, the surface temperatures and humidities of the 2 air streams are almost identical by the time they reach the Celebes Sea. Following are the mean equivalent potential temperatures (in degrees Absolute) of the 2 air masses, according to meteorograph soundings at Manila:

	Surface	1,600 Ft.	3,300 Ft.	6,600 Ft.	9,800 Ft.
NE Monsoon	337	334	334	333	329
NE Trade	338	337	338	332	330

The trade air in this region ordinarily retains the temperature inversion at 6,000 to 8,000 feet which is characteristic of its source region, but is warmer and moister below that level than it was when it left the North Pacific *high*.

When the northeast trade air flow is smooth and undisturbed, fair weather conditions prevail, with only scattered light showers. However, like the northeast monsoon, the northeast trade air is conditionally unstable, and any lifting produces cumulus formation and rainshowers. As in the northeast monsoon, low cloud forms are predominantly cumulus. However, in the trade air the cumuli are less sharply defined, rise to higher levels, and are sometimes accompanied by altostratus in several layers.

(*c*) *Southeast trade.* Like its Northern Hemisphere counterpart, the southeast trade is characterized by a temperature inversion at 6,000 to 8,000 feet. Above the first few thousand feet, it is usually very dry and stable.

This air mass has less cloud than any other in this area. There is some fair weather cumulus formation over land areas in the afternoon. Heavy cloud and rainfall occur only at places orographically exposed to its strong, steady flow. This stream is often hazy; however, haze is confined to the levels below the inversion. Grimes cites a case in September 1941 when haze was so bad over the entire Netherlands East Indies that it was impossible to see objects on the ground from 2,000 feet. Normally such conditions persist for only a few days, but in this case they lasted for several weeks.

(*d*) *Southwest monsoon.* The southwest monsoon has had an extremely long path over warm water before reaching the Celebes Sea. It is moist to high levels. Following are the mean equivalent potential temperatures (in degrees Absolute) of the southwest monsoon according to meteorograph soundings at Manila:

	Surface	1,600 Ft.	3,300 Ft.	6,600 Ft.	9,800 Ft.
SW Monsoon	345	343	340	339	340

The southwest monsoon lacks the inversion which is typical of other air masses in this area, and is therefore very squally and stormy. It is not a steady flow, but comes in surges, with which are associated very heavy rains at exposed stations. The low clouds are very dark and heavy, being frequently classified as nimbus or nimbostratus. Visibility is good except in heavy rain.

B. Weather disturbances.

(1) Types of weather disturbances.

The basic cause of disturbances in the weather is convergence, accompanied by instability and low pressure. Convergence occurs along fronts between air masses and also occurs within air masses. Tropical cyclones, the severest weather disturbances in this area, may develop out of either frontal or air mass disturbances.

(*a*) *Frontal disturbances.* The intertropic front, or equatorial front, forms the boundary between the convergent air streams from the Northern and Southern Hemispheres. It is usually found in the equatorial pressure trough, which follows the seasonal migrations of the thermal Equator. The position of the front is subject to irregular day to day oscillations. In extreme cases the daily movement may exceed 200 miles. Since the Northern and Southern Hemisphere air masses have almost identical temperatures and humidities in the Celebes Sea region, this front is not a strong density discontinuity, as in extratropical disturbances, but rather a pressure trough and wind discontinuity.

The intensity of the intertropic front varies greatly according to the intensity and orientation of the converging air flows. With weak, nearly parallel flows, the front deteriorates to a doldrum zone, with only local cumulus formation and rain showers. With strongly convergent air streams, the front becomes more sharply defined, with a belt of turbulence, heavy cumulonimbus cloud, and rain.

The front between the northeast monsoon and the northeast trades is usually not very active in this region, as the 2 air streams are almost identical in characteristics and direction of flow. The *norther-trade* front usually advances southward over the Philippines in an east-west alignment. Near the Asiatic continent, fresh outbreaks of norther air retain a temperature differential across the front as far south as Singapore. However, on reaching the Celebes Sea, these norther air outbreaks have been modified greatly by passing over the warm water of the Japanese current and temperature contrasts along the front are slight. Nevertheless, strong surges in the form of a freshening of the monsoon, are felt even below the Equator, with resultant increased convective activity and precipitation.

The front, between the southeast trades and the southwest monsoon, is rarely very active in the Celebes Sea region.

(*b*) *Convergence within air masses.* The forecaster must watch for the development of convergent flow within any one

of the major air streams. In some cases, such convergence is associated with a trough or frontal boundary moving into this region from higher latitudes. In other cases, convergence develops locally.

Caribbean meteorologists have noted that a deep easterly stream over that area often had disturbances moving from east to west within the stream in the form of traveling isallobaric waves. FIGURES V-2 and V-3 illustrate conditions during passage of one of these waves, according to the analysis of the Institute of Tropical Meteorology at San Juan, Puerto Rico. During any season except the height of the southwest monsoon, the Celebes Sea area can be flooded with a deep easterly flow.

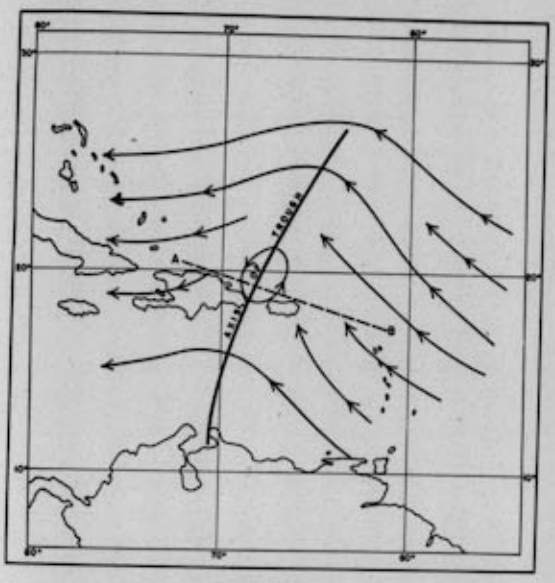


FIGURE V - 2.
Model of a Wave in the Easterlies:
Streamlines at 15,000 feet.

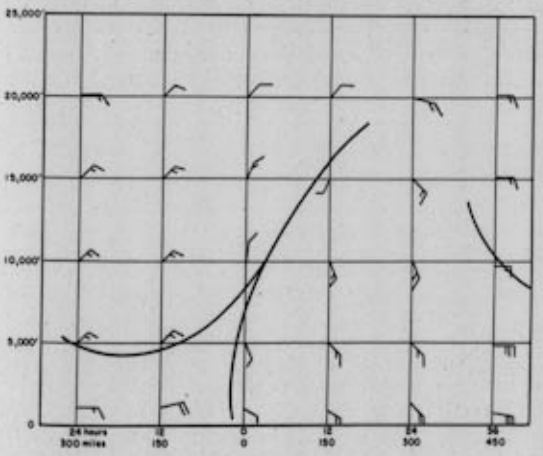


FIGURE V - 3.
Model of a Wave in the Easterlies: Vertical Cross-Section along Line A-B of Figure V-2.

Near the source region in the central or eastern Pacific, this flow is characterized by marked stability and a sharp decrease in moisture above 6,000 to 8,000 feet, but on the western equatorial side of the high pressure cell this inversion is greatly weakened, permitting increased convective activity. Meteorologists working on the area in the Pacific which corresponds to the Caribbean in the Atlantic have always been plagued by a lack of data, but it is probable that similar disturbances move from the Carolines across the Celebes Sea, and during certain seasons may even enter the Asiatic continent. In the Caribbean, one or two waves are expected to pass a station each week, but they are probably less frequent in the Celebes Sea region. Convergence is found to the rear of the wave and divergence to the front. Large cumulonimbi and squall lines are usually found in the zone of most active convergence, while well ahead of the wave, the moist layer is very shallow and fine weather usually prevails.

These waves vary, not only in intensity, but also in becoming stronger or weaker. Deepening often occurs when such a wave becomes a part of the circulation at the intertropic front.

(*c*) *Tropical cyclones.* The tropical cyclones of the Southern Hemisphere remain far to the south of the Celebes Sea area, coming closest during the month of April. In this area, such a storm could do no more than influence, very indirectly, the stability of the air and the direction of stream flow. On the other hand, a considerable proportion of the tropical cyclones of the North Pacific pass over the Philippines and have a bearing on the weather in the Celebes Sea.

The storms which are significant in the weather of this area originate either just east of the northern Philippines or in the vicinity of the Caroline Islands. Most typhoons originate on the intertropic front at a time when the degree of convergence is unusually great, particularly when the southwest monsoon is actively surging. Some typhoons develop from deepening of pressure waves in the easterlies. This latter type of typhoon, although much less frequent than the intertropic front type, is more likely to affect the Celebes Sea region. It is most frequent in winter.

There is tremendous variation in the morphology, trajectory, and rate of movement of tropical cyclones. However, a cyclone of hurricane intensity usually moves westward from its point of origin, at an average speed of about 12 m.p.h. It may recurve to the northward anywhere along its trajectory, or may continue westward into the Asiatic continent. Cirrus clouds are usually encountered 500 miles from the storm center, cyclonic wind circulation at 300 to 400 miles, low fractocumulus cloud with intermittent squalls and showers at 200 or more miles, with heavy nimbostratus and continuous torrential rain at 100 to 150 miles from the center. Wind speeds of over 25 m.p.h. may be expected at 150 to 200 miles from the storm center, and of over 75 m.p.h. at 35 miles from the center. In the center of the storm there is an area, averaging about 8 miles in diameter, with clearing sky and light winds or absolute calm.

Except in very rare cases, typhoon centers pass too far north to cause hurricane winds in the Celebes Sea area. Typhoons or depressions which enter Luzon or pass to the north of the Philippines do not directly affect this area except that the southwest wind flow is strengthened, with increased low cloud and air mass weather. Heavy rains may occur in Mindanao, particularly on the eastern side, with the approach of a typhoon whose circulation extends far enough south to produce strong northeast winds. If the center of the storm passes through or south of

the central Philippines, increased rainfall may be expected over the entire Celebes Sea area during the passage of the storm.

(2) Aids in forecasting disturbances.

(*a*) *Cloud sequences.* Prefrontal cloud sequences, which the forecaster of middle latitudes, finds so dependable, are of very limited value in this area. The cloud sequence associated with a typhoon (TOPIC 52, B, (1) (c)) has some prognostic value. However, cirriform clouds are nearly always present to some extent and are not as trustworthy indicators of storm activity as in middle latitudes. The presence of altostratus or altocumulus clouds is often symptomatic of frontal or convergent activity. During the presence of easterly waves in the trades or the formation of depressions on the intertropic front, several layers of very thick altocumulus may develop over a wide area. Altostratus occurring below 10,000 feet, instead of at the usual level of 12,000 to 14,000 feet, is often a sign of a nearby front.

(*b*) *Streamline analysis.* A useful method for discovering areas of convergence and divergence is streamline analysis, as illustrated in FIGURE V-4. Lines are drawn parallel to the wind flow at the desired level, and closeness of spacing of streamlines is roughly proportional to the force of the wind. Such lines disappear in a region of convergence and reappear in a region of divergence. Experienced forecasters have found such charts, drawn regularly and for several levels, to be almost indispensable in forecasting new developments and in evaluating weather over regions where only flight reports and scattered pilot balloon observations are available.

(*c*) *Pressure changes.* Zones of convergence usually lie in pressure troughs or *lows*. However, *lows* are difficult to spot on ordinary synoptic charts of this area. The pressure fields are very flat, except in the case of tropical cyclones. Barometers have often gone for long periods unchecked, and even small inaccuracies at isolated stations may greatly influence the analysis. The diurnal variation of pressure is often more than 4 mb., which is greater than the ordinary synoptic variations of the region. The amplitude of the diurnal pressure curve varies with the amount of insolation. These facts unite to make the customary three-hourly tendencies almost useless. A solution for this difficulty is to compute 24-hour pressure changes, either for each synoptic time, or, as Deppermann suggests, for the morning observation, when insolation is least important. These values assist both in analysis and in the critical evaluation of the surface pressure report. An isobaric interval of 1 to 2-mb. is usually necessary.

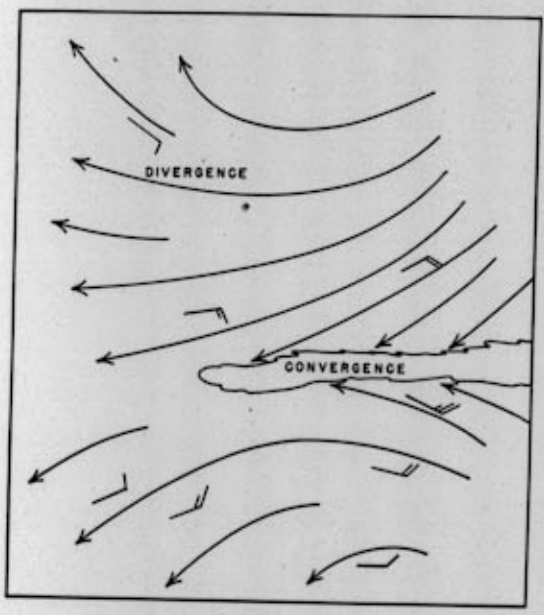


FIGURE V - 4.
Example of Use of Streamlines in Synoptic Analysis.

In forecasting disturbances in the easterly flow, the analyst should be alert to 24-hour pressure changes of more than 2 mb. in the islands to the east of the Philippines, as well as to heavy rainfall associated with veering winds. In forecasting typhoon development, a 24-hour pressure decrease at Guam or Yap in excess of 3 to 4 mb. should be watched carefully, especially if it is associated with a cyclonic wind shift indicating a *low* to the west or northwest.

(*d*) *"Canned" maps.* Changes in the streamflow pattern and incursions of new or less modified air masses into this region can often be anticipated days in advance, if the forecaster is informed of developments in the higher latitudes on both sides of the Equator. As the forecaster often has neither the time nor the facilities to plot and analyze the necessary areas, it is to his advantage to utilize the weather analyses available from those regions in order to prognosticate the movement of formations, or their influences, into the area in question.

C. Effects of topography.

A basic requirement for successful forecasting in this area is a thorough knowledge of the climatology of the individual stations within the forecast area. To a great extent, topography controls distribution of convective phenomena within the major air streams. Topography modifies the movements and morphology of fronts of all types. It is also important in land- and sea-breeze effects, which often produce local circulations that completely mask the effects of large scale synoptic changes.

These effects are exceedingly complex. Slight contrasts in slope or exposure may produce quite different weather at nearby stations under identical synoptic situations. For this reason, forecasting requires intensive knowledge of local peculiarities. Acquaintance with local topographic effects is essential even in forecasting for patrol areas over the sea, since orographic effects may extend far out to sea.

D. Synoptic situations.

Various synoptic types which may be expected over the Celebes Sea region are presented below. The situations are based in part upon the daily classifications used by Deppermann, in part upon a study of daily precipitation at Surigao and Zamboanga over a period of several years as related to the synoptic situation in the Northern Hemisphere. (No charts were available for the corresponding period in the Southern Hemisphere.) As the 2 stations are of roughly opposite rainfall regimes, their precipitation is believed to be indicative of the relative distribution of weather between orographically exposed and protected places.

(1) Type I—Pure trade air flow (November to April.)

This type is particularly common during the spring months,

when the cold flow of norther air from Siberia weakens, and a deep flow of trade air invades the Celebes Sea from the east. However, it may occur any time during the fall and winter when a new front, moving off the Asiatic continent, limits the southern extent of the cold air, if the air south of this front is true trade air.

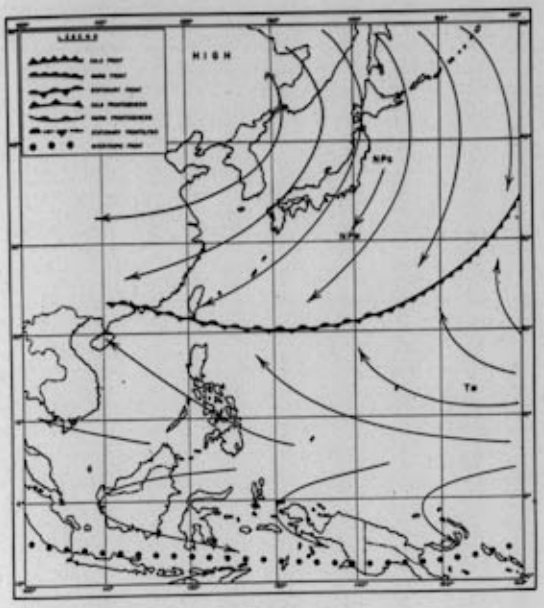


FIGURE V - 5.
Type I Synoptic Pattern: Pure Trade Air Flow (Nov. to Apr.)

The weather associated with this situation is generally fair, with rainfall of the afternoon shower type falling mainly on windward coasts and slopes. Aside from these rainshowers, scattered clouds and good visibilities prevail. As a general rule, the greater the tendency of the air to recurve northward, the finer the weather.

The NPc-Tm front, surging or stationary, may be anywhere from Japan to the northern Philippines. Its position or activity will not materially affect the weather in the Celebes Sea area as long as a deep, undisturbed trade flow occupies the area. During November, December, and April the intertropic front may be near the Equator, bringing greatly increased cloudiness and more frequent and violent rainshowers to the southern portions. Also, the Type I synoptic pattern may often be conplicated by a Type VI "easterly disturbance."

(2) Type II—Strong polar outbreak.

When a strong outbreak of cold NPc air from the Asiatic continent occurs, it may reach the Philippine Islands a few days after it leaves the latitude of Japan. In the case of very strong pushes, this strong flow may penetrate south of the Equator even as far east as the Caroline Islands.

As the front surges southward, the weather is generally fair, with scattered cumulus ahead of the front with its passage, however, cloudiness increases to broken or overcast, and very heavy rains may fall in regions which are exposed to the strong northeast flow. Even protected stations may get showers from the

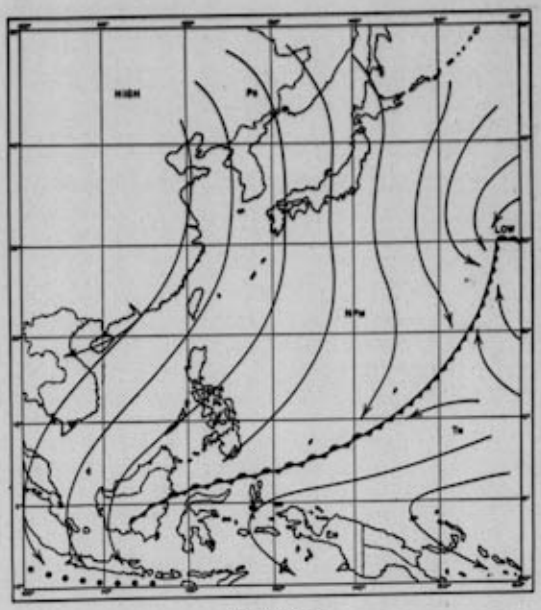


FIGURE V - 6.
Type II Synoptic Pattern: Strong Polar Outbreak (Oct. to Mar.)

convergent activity at the front. In heavy rain, visibility may be temporarily reduced below contact limits for short intervals. Near and north of the front, the cloud forms are altocumulus or altostratus and stratocumulus, with some cirrus from the overrunning trade air. Cumulonimbus formations may build up over the hills. Temperatures behind the front may drop to around 75° F., and the decrease in humidity is sometimes marked.

As the front moves farther southward and eastward, the weather improves; and the norther air, taking longer and longer trips over the Pacific, turns to a more easterly direction, and attains trade characteristics. On rare occasions, the trade flow may strengthen, and the front may return over the area as a warm front with drizzle type precipitation.

(3) Type III—Frontogenesis off the South China Coast (October-March.)

If the strong norther flow of Types I and II continues, the dissimilar trajectories within the polar air mass tend to induce frontogenesis near the latitude of Formosa. The formation of a new front here reduces the southerly penetration of the old front to the south, often causing it to become stationary. As the air flow to the north of the front is increasingly modified, the front may be reduced to a mere wind shear line and finally disappear.

This type is important in the southern Philippines only in that the rapid development of the northern front must be anticipated in order to forecast its effect upon the front to the south. This produces improving weather in the Philippines, as the northern front usually deepens and moves eastward, going into a Type I situation.

Deppermann mentions that a veering of the wind at Basco from NE to SE or S gives advance warning of such a development.

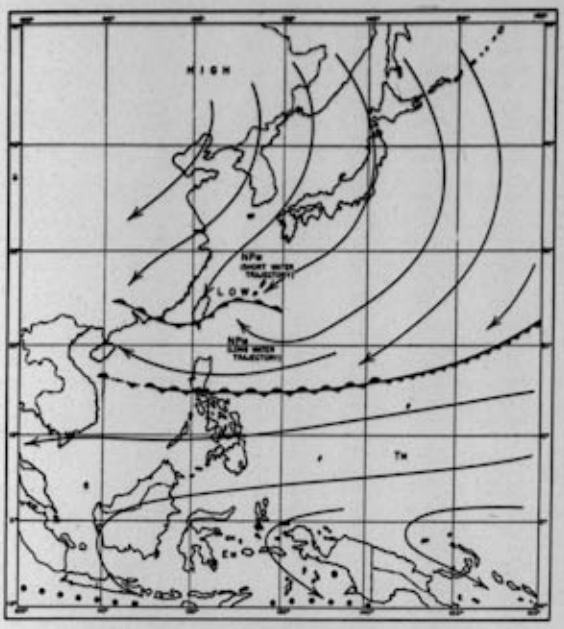


FIGURE V - 7.
Type III Synoptic Pattern: Frontogenesis off South China Coast (Oct. to Mar.)

(4) Type IV—Sequence of polar outbreaks (October-March.)

This type produces a sequence very similar to alternating Type I and Type II situations. A high cell breaks off the Siberian cell and moves eastward, both preceded and followed by an outbreak of polar air. Here, as in Type III, the southern front may become weaker and disappear as the cell moves farther eastward and warms up from subsidence.

The weather encountered may be anywhere from the fair weather of Type I to the strong frontal weather of Type II, according to the strength of the successive outbreaks.

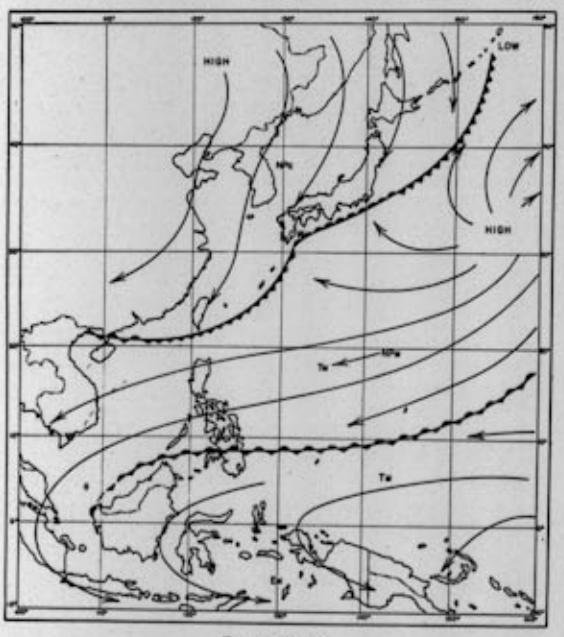


FIGURE V - 8.
Type IV Synoptic Pattern: Sequence of Polar Outbreaks (Oct. to Mar.)

(5) Type V—Intertropic front in Celebes Sea Area (Spring and Fall.)

During the transition months between the monsoons, the intertropic front is frequently found lying east-west between the Equator and the Philippines. It may vary from an inactive "doldrum" situation with a rather large area of calm to a narrow definite zone of convergence, which may be stationary or surging in either direction.

The doldrum situation is typified by variable cloudiness and afternoon thunderstorms over land masses. The weather is oppressively humid, with very little wind to bring relief. Rainfall is localized and, although it may be very heavy, is chiefly of the shower type.

When the air flow on either or both sides of the front strengthens, convergence increases at the front and may occupy a zone 50-100 miles across of thick altostratus, associated with violent cumulonimbus clouds along the front and over mountain areas. At these times, violent turbulence may be experienced in clouds which penetrate the icing level of 14,000 to 16,000 feet.

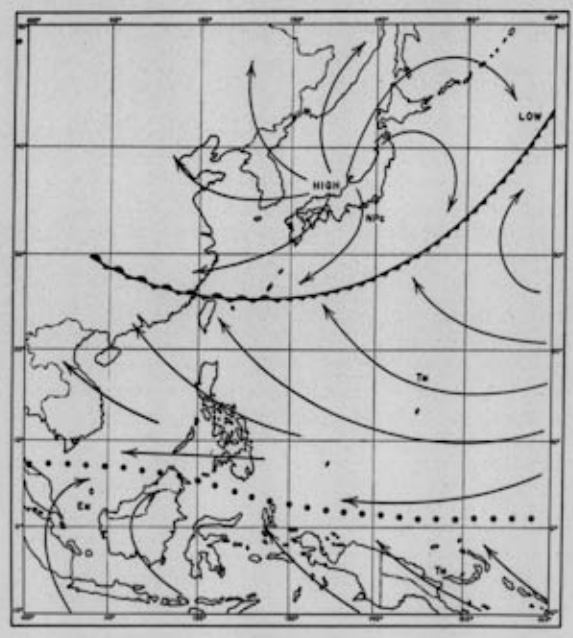


FIGURE V - 9.
Type V Synoptic Pattern: Intertropic Front in Celebes Sea area (Spring and Fall)

(6) Type VI—Trough or wave in the easterlies (Fall, Winter, Spring.)

Situations which have a deep flow of easterlies in the Philippines normally bring fair weather, but may be complicated by the passage from east to west of isallobaric waves which may show up on the surface isobaric pattern as a slight trough or a closed *low*, according to the amplitude of the wave.

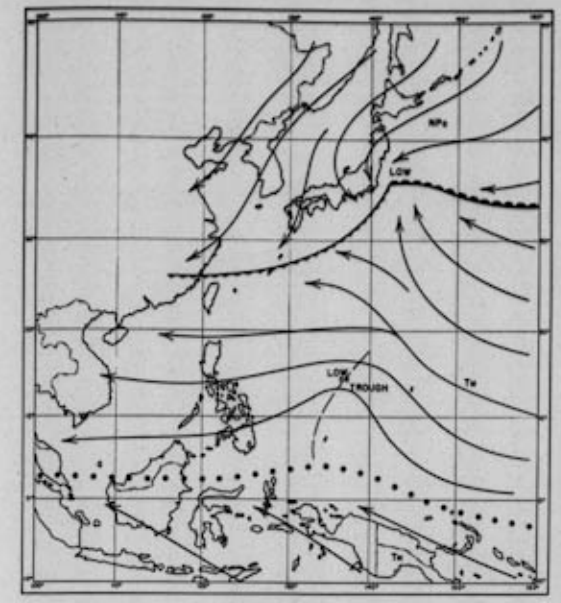


FIGURE V - 10.
Type VI Synoptic Pattern: Trough or Wave in Easterlies
(Fall, Winter, and Spring)

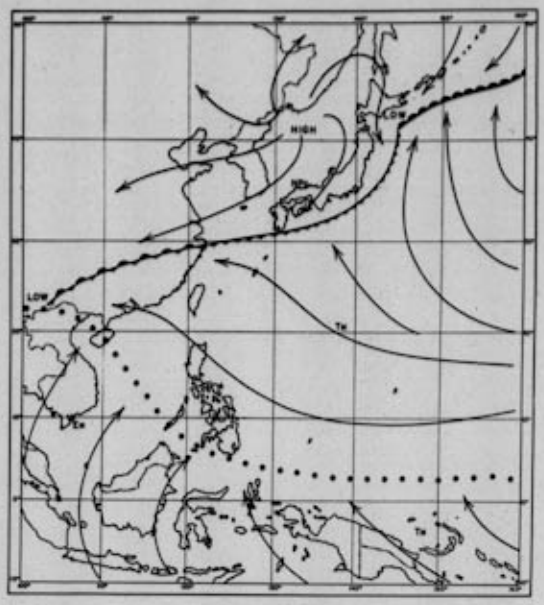


FIGURE V - 11.
Type VII Synoptic Pattern: Intertropic Front West of Philippines
(Apr. to Sept.)

The circulation in such a trough produces convergence on the eastern side behind the trough, and divergence ahead of the trough to the west. Thus, several hundred miles ahead of the trough the weather may be unusually fine, deteriorating with the approach of the trough, and heavy rains with intense convective activity are frequently experienced during the day following its passage. Lines of cumulonimbi oriented with the wind may be found in the area of maximum convergence, with low nimbostratus ceilings and limited visibilities associated with the heavy rain.

A careful check should be kept on the stations in the Marshalls and Carolines for abnormal 24-hour pressure changes and for heavy rains which cannot be associated with frontal activity. Unusually heavy rains at Palau are an indication of bad weather in the southern Philippines 24-48 hours later.

(7) Type VII—Intertropic front west of Philippines (April-September.)

During the summer, the Celebes Sea is a battleground between the southwest and the northeast air flows. Near the Equator, the flow from the Southern Hemisphere in the longitude of the Celebes Sea may be a continuation of the southeast trades. Thus, as long as the intertropic front lies south and west of the Philippines, mild weather will be experienced except in the vicinity of the front itself.

Near the front, the weather is generally broken to overcast middle cloud, with showers from swelling cumulus and cumulonimbus clouds in the afternoon over land areas, and in the early morning over the ocean and coastal regions.

This type is most frequent in the early summer and fall, but may occur in midsummer when the southwest flow is cut off, permitting the trades to push westward.

(8) Type VIII—Intertropic front over or north of the Philippines (May-Oct.)

Although the illustration represents a situation at the height of the southwest monsoon penetration, it is intended to include other cases when the SW air dominates the Celebes Sea area. As the southwest monsoon is not a steady flow, but comes in surges,

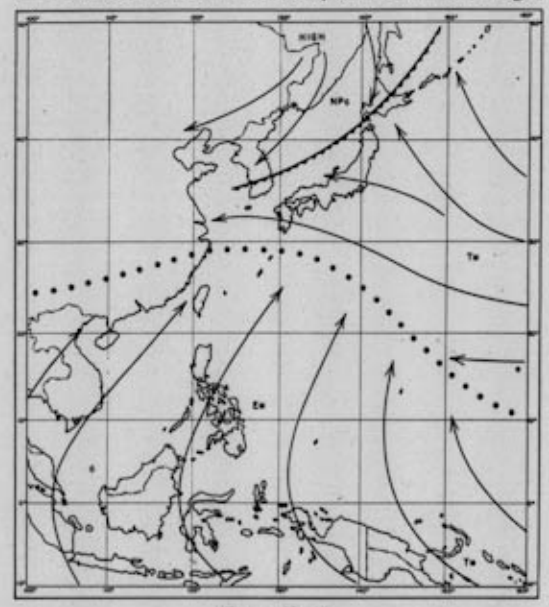


FIGURE V - 12.
Type VIII Synoptic Pattern: Intertropic Front Over or North of Philippines (May to Oct.)

the summer situation varies between Type VII and Type VIII, with occasional tropical storms to complicate the situation.

Because of the potency of southwest monsoon air, rainfall is more frequent and cloudiness greater than in other air masses. Any slight convergence will produce squally weather. Widespread areas of rain are usually associated with the presence of the intertropic front.

Sometimes during August, a week or so of fine weather occurs in the Philippines when the intertropic front is far to the north. Deppermann ascribes this to the intrusion of a westerly flow of dry continental air into this area.

During exceptionally dry years in Australia, the southeast trade stream, which crosses the Equator east of 120-125°, may contain little cloud and a characteristic haze in the lower levels. It can be readily distinguished from southwest air by its lower relative humidities as well as the lack of cloud.

53. *Climatic Summary*

A. Precipitation.

Precipitation data for the Celebes Sea area and locations of meteorological stations are shown on Figures V - 13 to V - 17.

TABLE V - 1

MAXIMUM DAILY RAINFALL

Maximum recorded 24-hour rainfall, in inches.*

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YR REC
HALMAHERA														
Akelamo	—	—	—	—	—	—	—	—	—	—	—	—	5	10
Boeli-serani	—	—	—	—	—	—	—	—	—	—	—	—	6	10
Djailolo	—	—	—	—	—	—	—	—	—	—	—	—	7	16
Ganedidalem	—	—	—	—	—	—	—	—	—	—	—	—	8	10
Inggelang	—	—	—	—	—	—	—	—	—	—	—	—	7	6
Kaoe	—	—	—	—	—	—	—	—	—	—	—	—	5	7
Laboeha	—	—	—	—	—	—	—	—	—	—	—	—	9	42
Loloda	—	—	—	—	—	—	—	—	—	—	—	—	8	10
Ternate	—	—	—	—	—	—	—	—	—	—	—	—	10	50
Tobelo	—	—	—	—	—	—	—	—	—	—	—	—	4	21
Wajaboela	—	—	—	—	—	—	—	—	—	—	—	—	5	10
Weda	—	—	—	—	—	—	—	—	—	—	—	—	6	10
SANGIHE-TALAUD														
Beo	—	—	—	—	—	—	—	—	—	—	—	—	8	12
Liroeng	—	—	—	—	—	—	—	—	—	—	—	—	9	31
Tahoena	—	—	—	—	—	—	—	—	—	—	—	—	14	33
MINDANAO														
Butuan	6	6	4	3	3	2	3	3	5	5	19	13	19	16
Cagayan	2	1	2	1	3	3	2	3	3	3	3	5	5	16
Caraga	5	6	5	3	5	2	4	2	2	5	3	7	7	5
Cotabato	2	3	2	2	4	5	3	3	3	4	4	3	5	16
Dapitan	4	5	2	8	4	5	3	3	2	6	5	5	8	16
Davao	3	3	5	4	4	4	3	4	5	5	3	6	6	16
Surigao	7	8	9	3	5	3	3	3	3	5	9	12	12	16
Zamboanga	5	3	1	1	2	2	2	2	5	5	3	6	6	16
SULU ARCHIPELAGO														
Jolo	6	9	2	3	9	3	5	4	5	4	5	3	9	16
NORTHEAST BORNEO														
Antjaloeng	—	—	—	—	—	—	—	—	—	—	—	—	7	6
Bloegg	—	—	—	—	—	—	—	—	—	—	—	—	8	24
Jesselton	4	3	2	4	5	6	4	12	6	7	6	6	12	13
Laham	—	—	—	—	—	—	—	—	—	—	—	—	6	14
Lg. Nawan	—	—	—	—	—	—	—	—	—	—	—	—	6	11
Malinau	—	—	—	—	—	—	—	—	—	—	—	—	7	6
Sandakan	15	8	7	5	6	5	4	4	5	6	5	13	15	28
Sangkoelirang	—	—	—	—	—	—	—	—	—	—	—	—	8	6
Tg. Redeb	—	—	—	—	—	—	—	—	—	—	—	—	6	16
Tg. Selor	—	—	—	—	—	—	—	—	—	—	—	—	8	35
Tarakan	—	—	—	—	—	—	—	—	—	—	—	—	9	18
NORTHERN CELEBES														
Boeol	—	—	—	—	—	—	—	—	—	—	—	—	6	11
Bojong	—	—	—	—	—	—	—	—	—	—	—	—	11	35
Bolaängoeki	—	—	—	—	—	—	—	—	—	—	—	—	9	7
Gorontalo	—	—	—	—	—	—	—	—	—	—	—	—	8	47
Kampoengbaroe	—	—	—	—	—	—	—	—	—	—	—	—	10	47
Koeandang	—	—	—	—	—	—	—	—	—	—	—	—	9	47
Manado	10	6	7	4	6	5	8	8	4	3	6	8	10	41
Modajag	—	—	—	—	—	—	—	—	—	—	—	—	5	15
Molobagoe	—	—	—	—	—	—	—	—	—	—	—	—	10	12
Paleleh	—	—	—	—	—	—	—	—	—	—	—	—	11	27
Soedimampir	—	—	—	—	—	—	—	—	—	—	—	—	4	10
Talise	—	—	—	—	—	—	—	—	—	—	—	—	8	14
Tilamoeta	—	—	—	—	—	—	—	—	—	—	—	—	4	13
Tinombo	—	—	—	—	—	—	—	—	—	—	—	—	7	12
Tomohon	—	—	—	—	—	—	—	—	—	—	—	—	6	30

*Blank columns indicate that data are lacking.

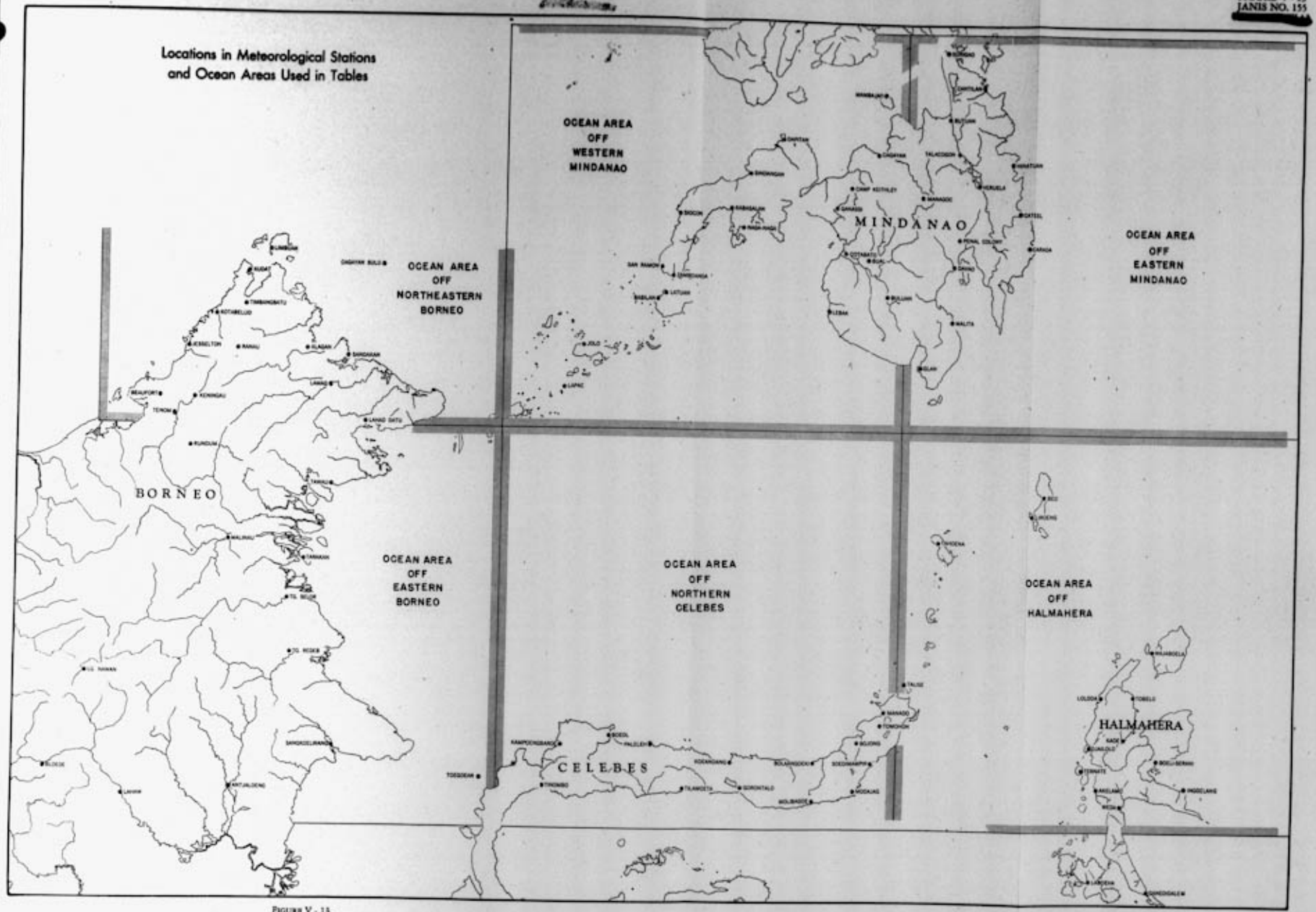


FIGURE V - 15.
Locations of Meteorological Stations
And Ocean Areas Used in Tables.

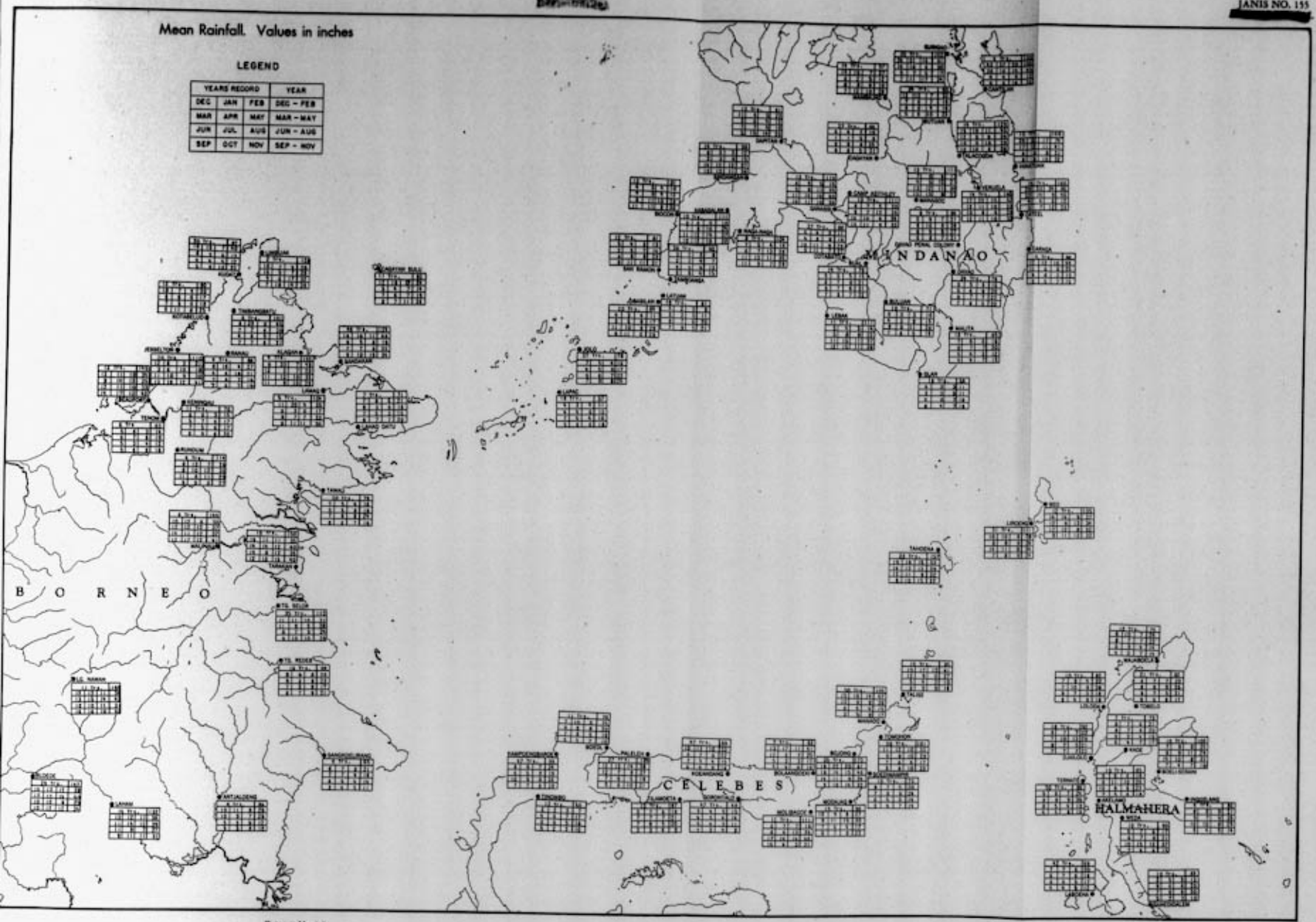


FIGURE V - 14.
Mean Rainfall.

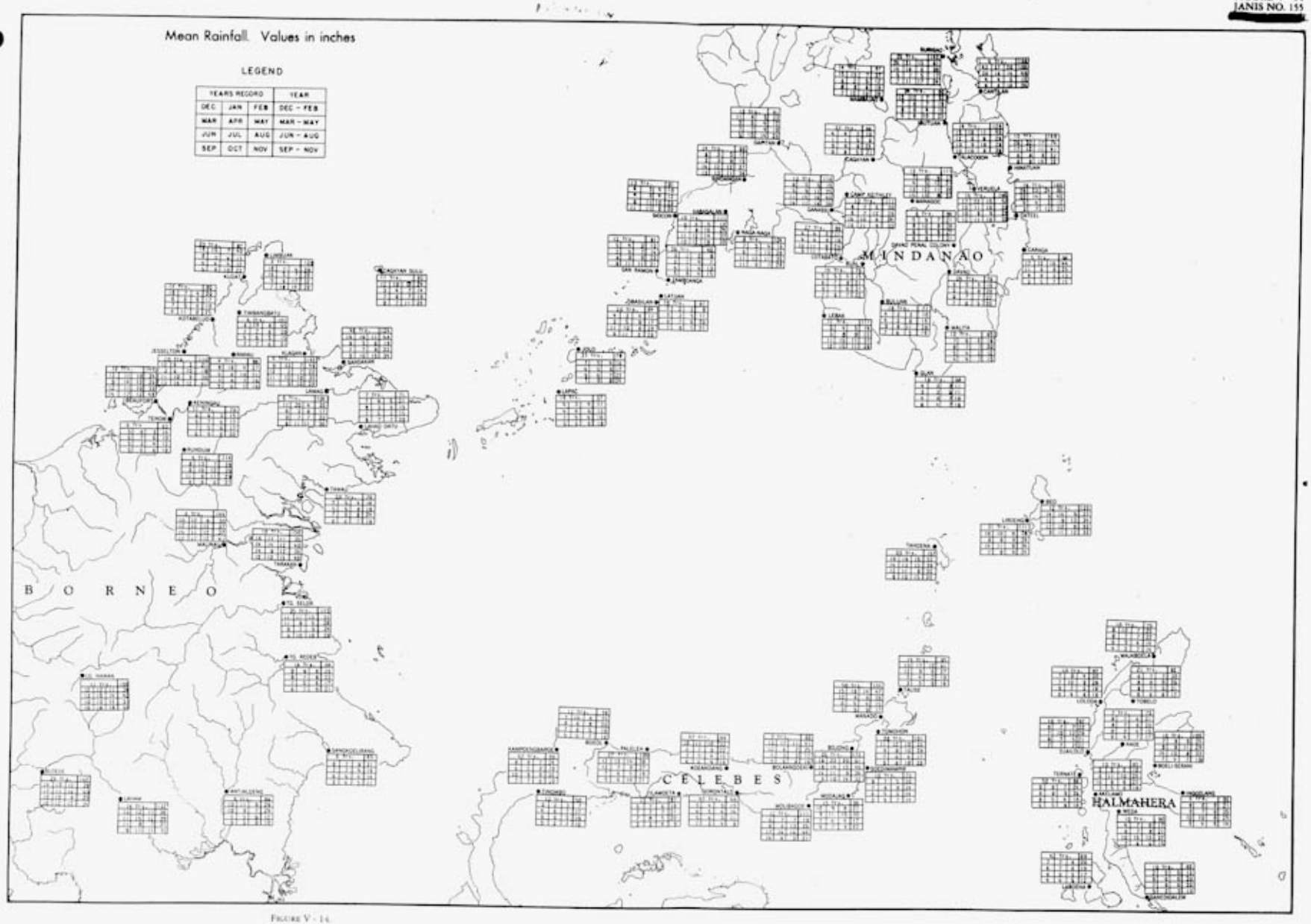


FIGURE V - 14
Mean Rainfall

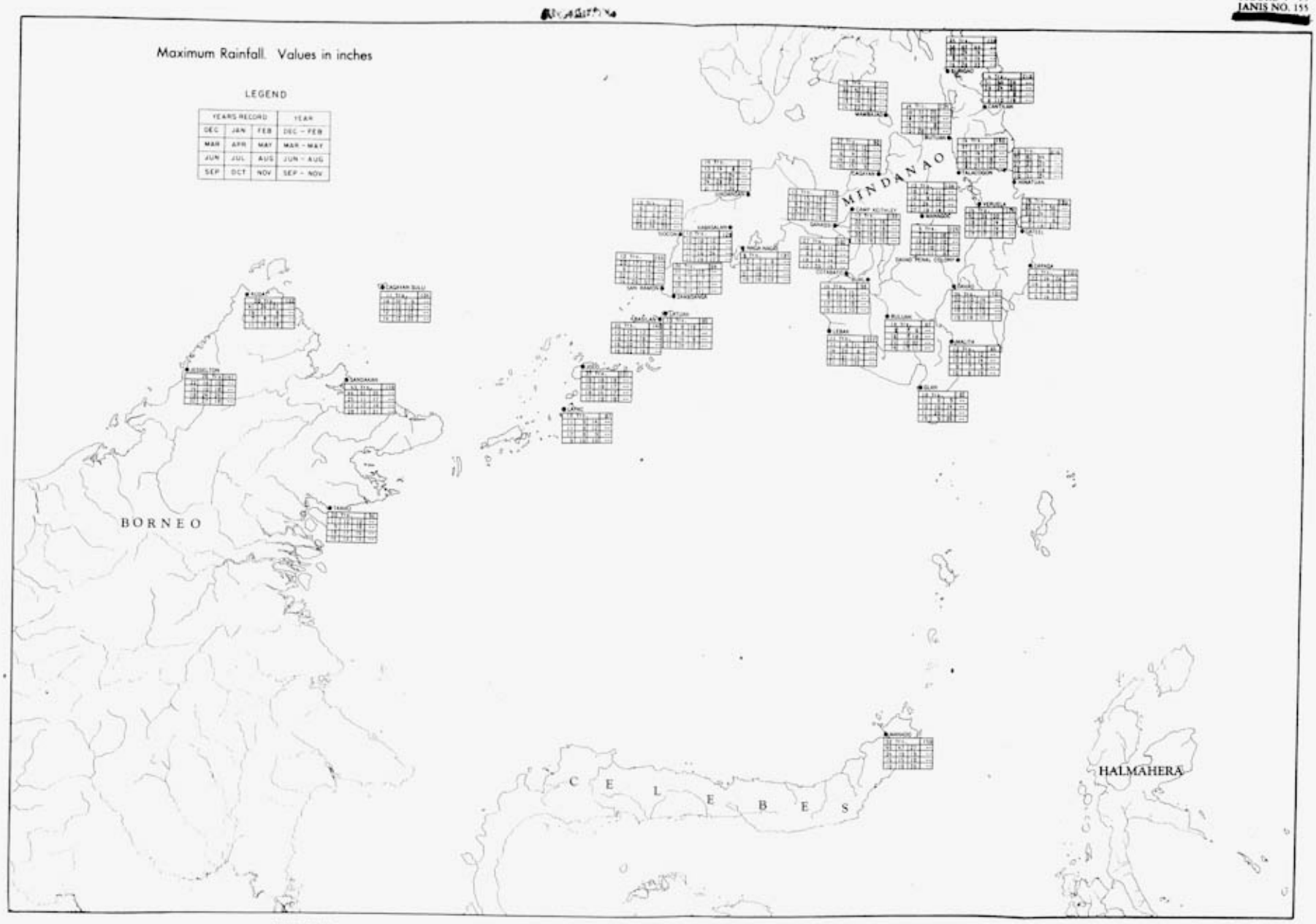


FIGURE V - 15
Maximum Rainfall

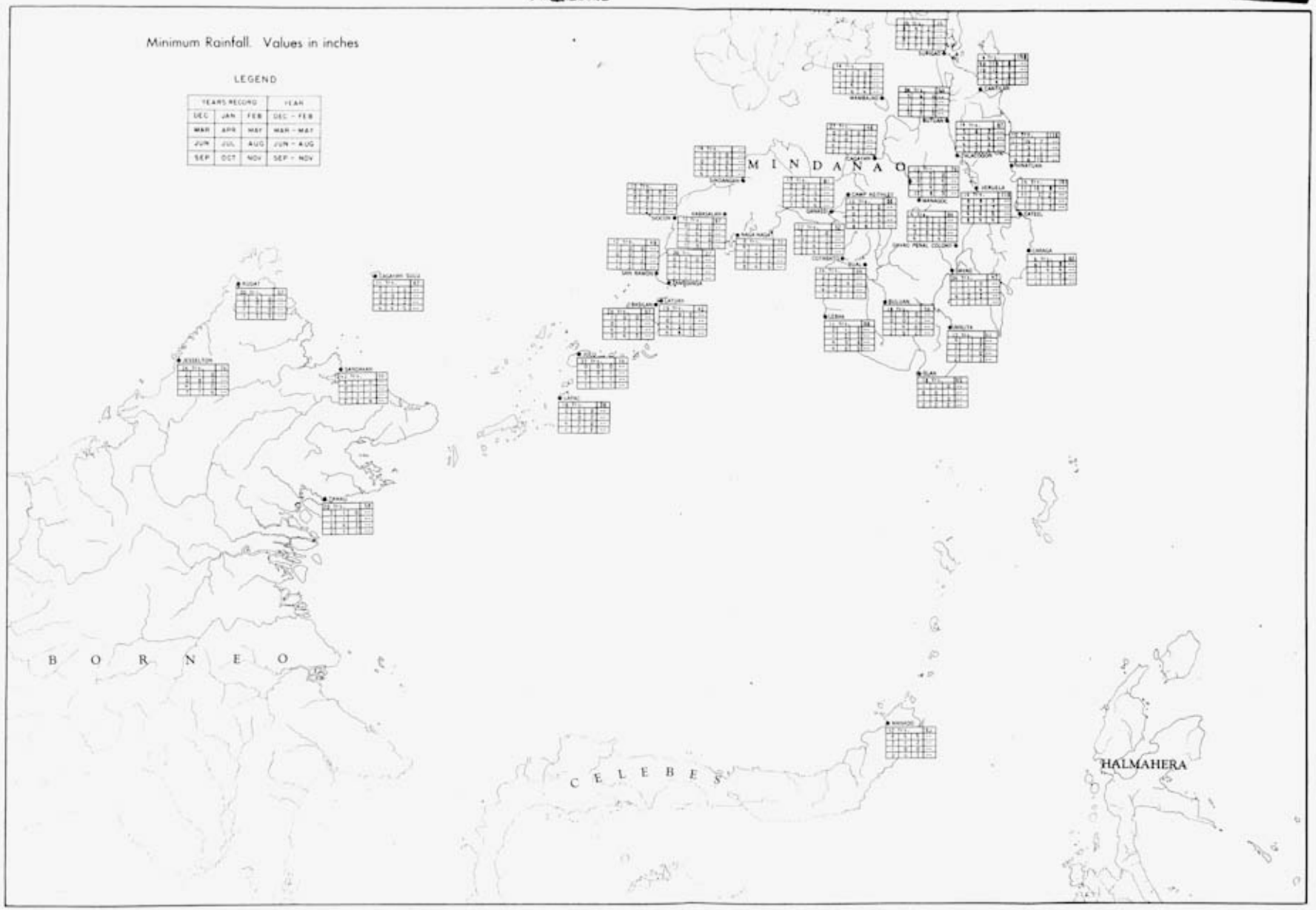


FIGURE V - 16.
Minimum Rainfall

Rainy Days. Mean number of days with over .004 inch of rainfall in Mindanao and Sulu Archipelago, over .04 inch of rainfall in Borneo, Celebes, Halmahera.

LEGEND

YEARS RECORD			YEAR
DEC	JAN	FEB	DEC - FEB
MAR	APR	MAY	MAR - MAY
JUN	JUL	AUG	JUN - AUG
SEP	OCT	NOV	SEP - NOV

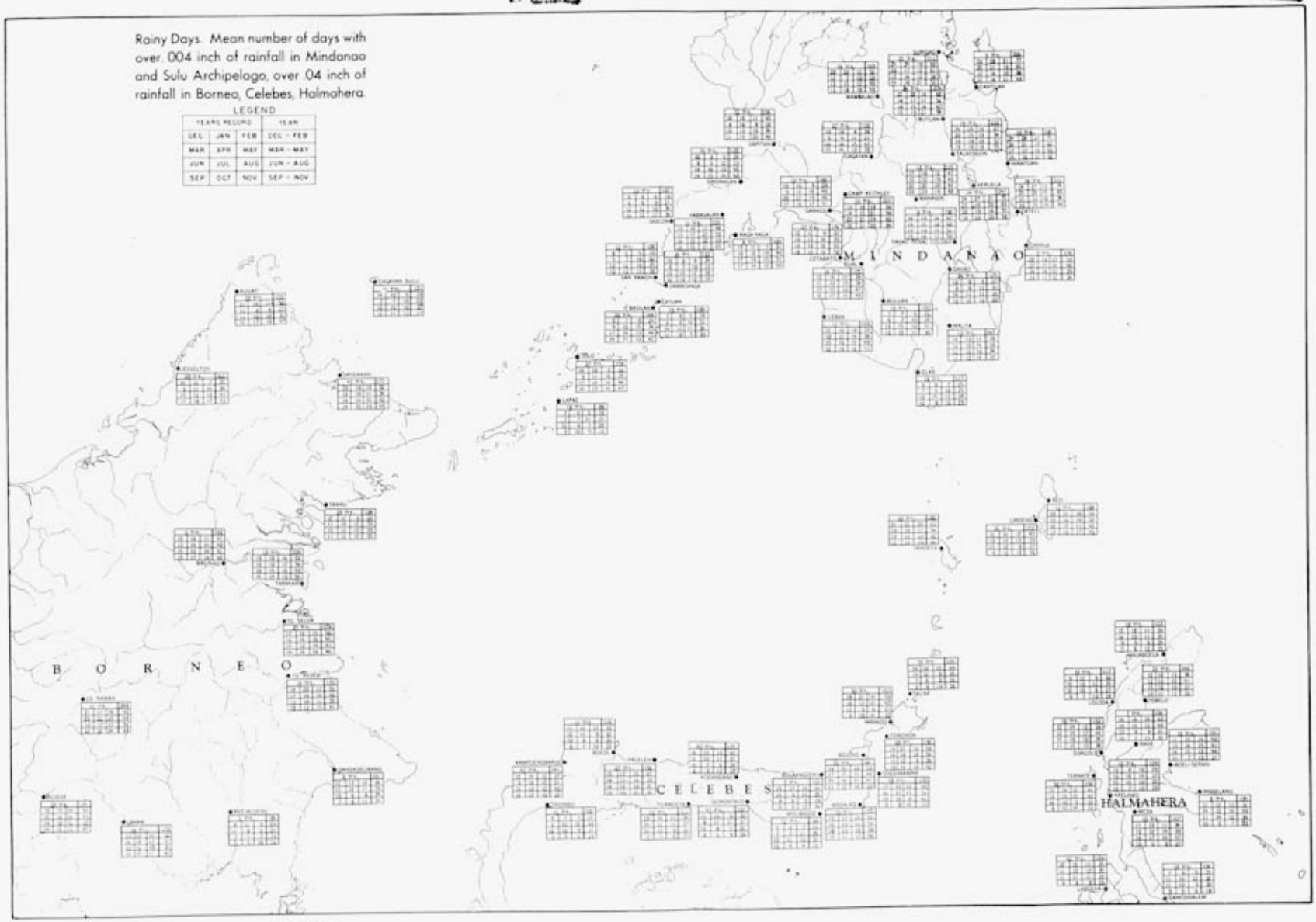


FIGURE V - 17
Rainy Days

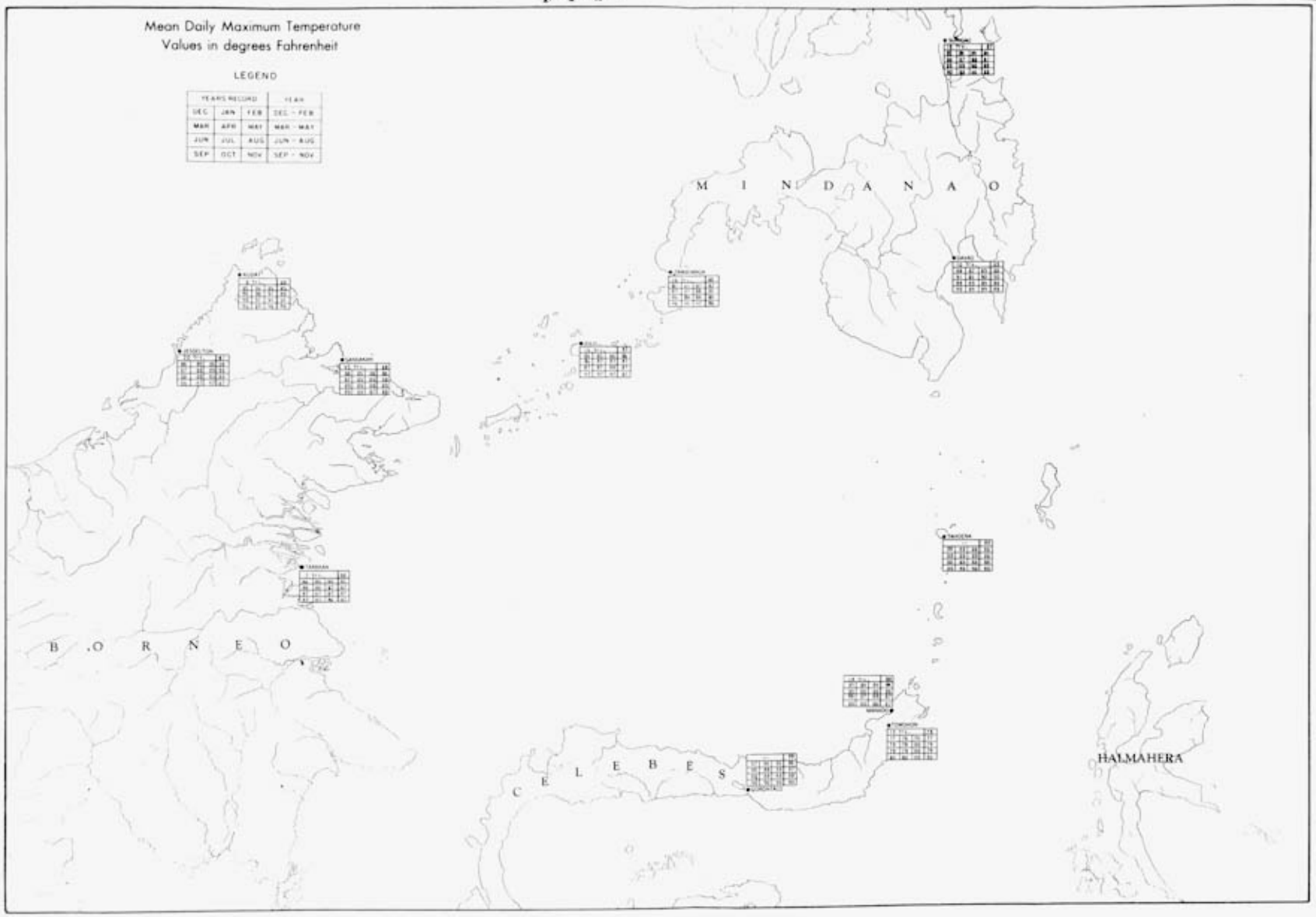


FIGURE V - 18
Mean Daily Maximum Temperature

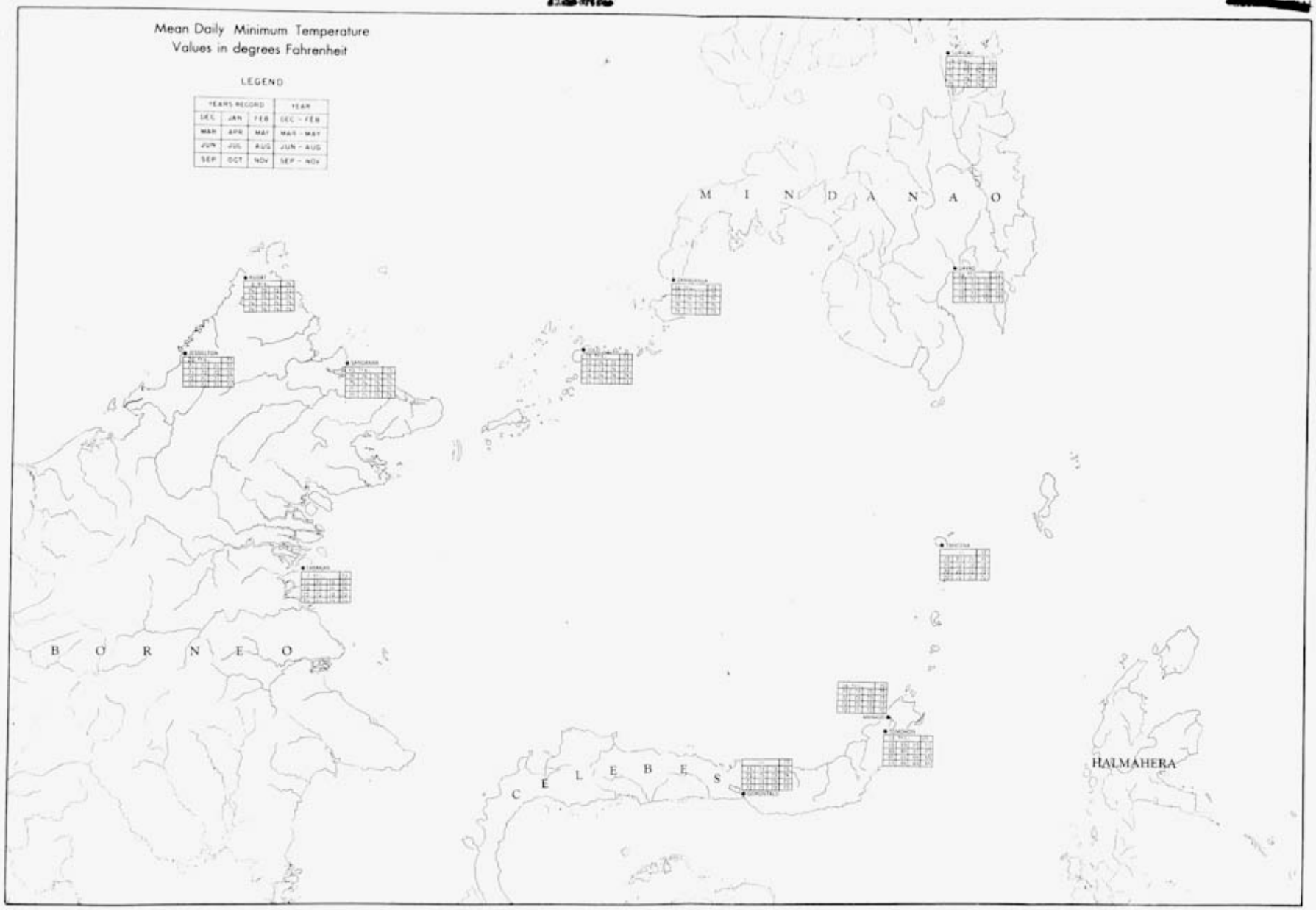


FIGURE V - 19
Mean Daily Minimum Temperature

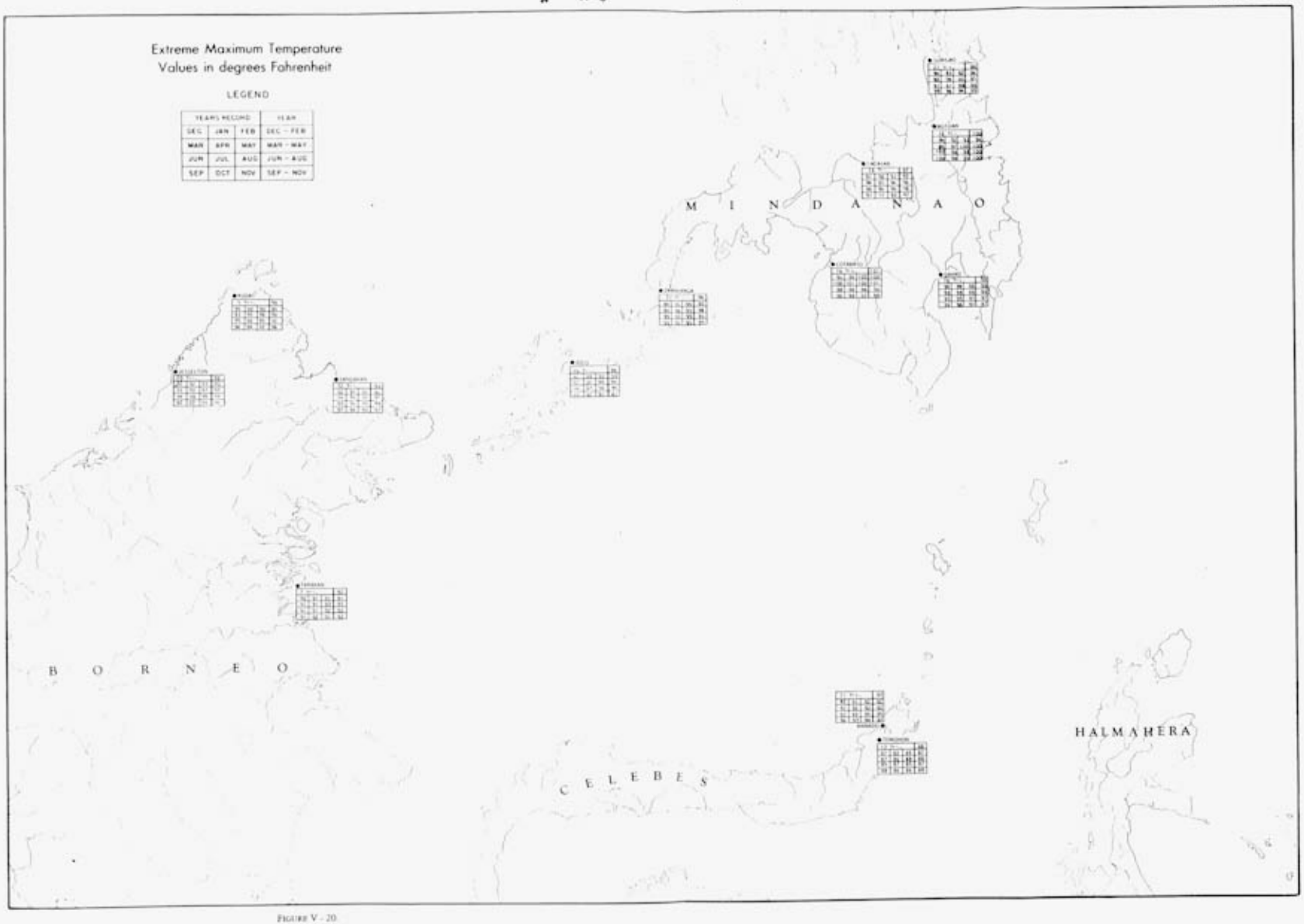


FIGURE V - 20
Extreme Maximum Temperature

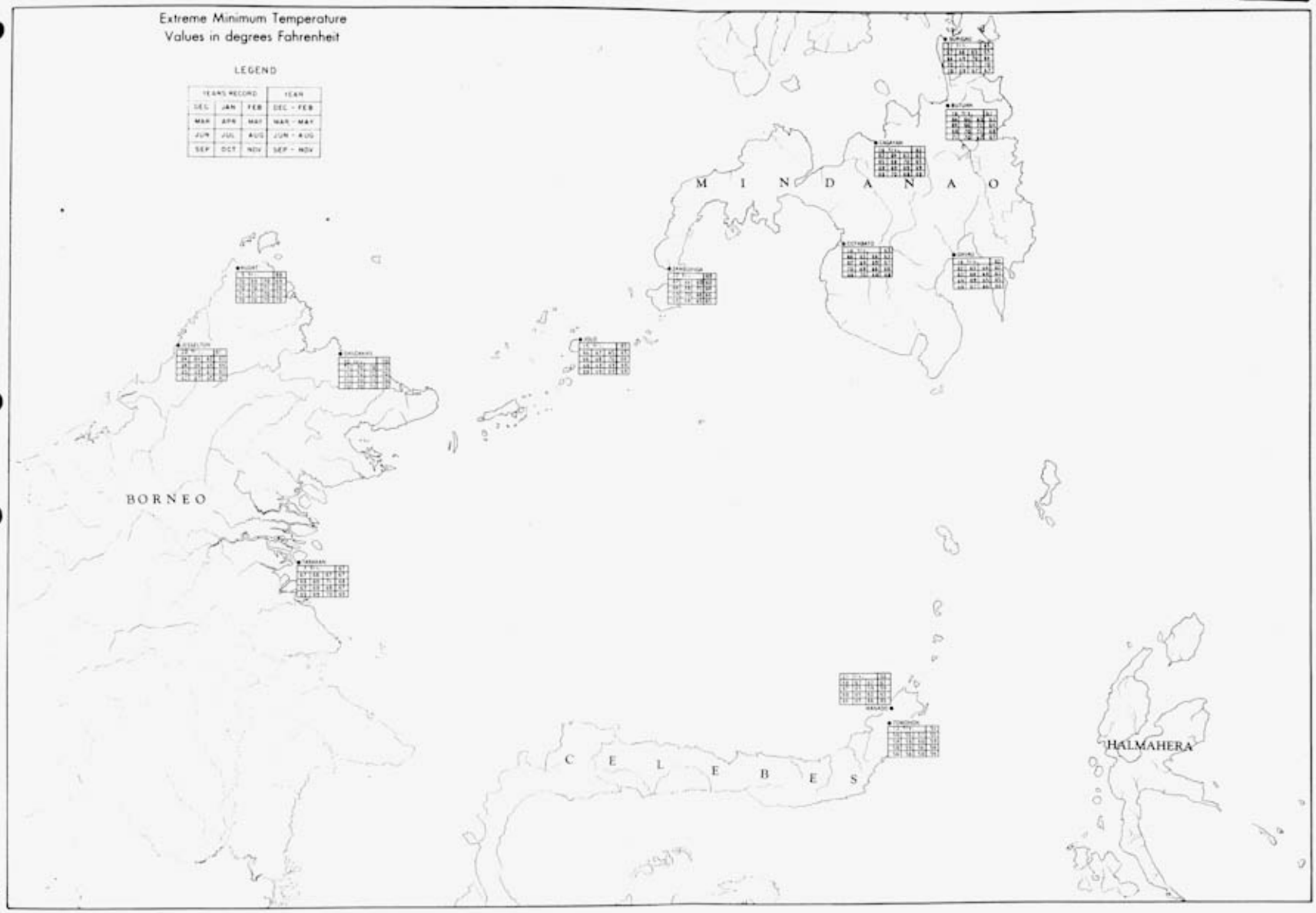


FIGURE V - 21
Extreme Minimum Temperature

TABLE V - 2

WET SPELLS

Mean number of occurrences of wet spells of specified durations. The duration of a wet spell is determined by the number of consecutive days with over .004 inch of rainfall.

STATION AND DAYS DURATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Davao														
1 to 2	4.2	3.9	4.4	4.7	4.9	5.0	4.6	5.3	4.8	4.8	4.4	4.9	55.7	20
3 to 6	0.9	0.6	0.8	0.9	1.7	1.3	1.1	0.7	1.0	1.4	1.0	0.8	12.4	20
Over 6	0.1	0.1	0.0	0.0	0.2	0.3	0.1	0.0	0.1	0.0	0.0	0.0	0.9	20
Surigao														
1 to 2	0.9	1.2	1.6	1.7	3.0	4.1	3.8	3.3	3.3	2.8	1.7	1.2	28.4	20
3 to 6	0.8	1.7	1.7	1.3	1.0	1.4	2.1	1.7	1.6	2.0	1.7	0.8	17.4	20
Over 6	1.4	1.4	1.1	1.1	0.7	0.4	0.2	0.3	0.4	1.0	1.2	1.5	10.4	20

B. Temperature.

Temperature data at various stations in the Celebes Sea area are shown below, in FIGURES V - 18 to V - 21.

C. Humidity.

Humidity data for various stations in the Celebes Sea area are shown below in Tables V - 3, V - 4, and V - 5.

TABLE V - 3

MEAN RELATIVE HUMIDITY

Mean relative humidity at the hours specified (L.C.T.).

STATION AND HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Cotabato														
0600	93	93	93	94	95	95	95	96	95	96	95	94	94	5
1400	66	65	64	64	67	69	70	68	68	70	70	67	67	5
Davao														
0600	95	95	95	96	96	96	96	96	96	96	96	96	96	5
1400	70	70	67	64	69	71	71	71	70	69	71	72	70	5
Surigao														
0200, 0600,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1000, 1400,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1800, 2200	88	86	86	86	84	84	80	78	81	84	87	88	84	34
Zamboanga														
0600	89	89	88	88	89	90	90	90	90	90	90	90	90	8
1400	75	74	74	77	78	77	78	77	77	79	78	74	76	8
0200, 0600,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1000, 1400,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1800, 2200	83	83	82	84	85	85	86	84	86	86	86	84	84	15
SULU ARCHIPELAGO														
Jolo														
0600	92	93	94	94	94	93	92	92	92	94	94	93	93	8
1400	78	78	77	77	77	76	74	72	74	77	78	77	76	8
NORTHEAST BORNEO														
Sandakan														
0600, 0900,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1400, 2000 (?)	82	81	79	77	78	79	78	78	78	79	81	82	79	24
Tarakan														
0600	96	96	98	96	95	96	96	97	96	96	96	96	96	6
1400	76	74	75	74	75	73	72	70	70	71	74	75	73	6
2000	94	94	95	94	93	94	94	94	93	94	94	94	94	6
Bihourly	89	88	90	89	88	88	88	88	87	88	89	89	89	6
NORTHERN CELEBES														
Manado														
0600	97	96	96	96	96	94	89	88	89	93	96	97	94	7
1400	82	79	77	80	79	75	68	65	66	71	78	81	75	7
2000	95	92	92	93	92	89	82	79	81	85	93	94	89	7
Bihourly	91	89	88	89	88	85	79	76	78	81	88	90	85	7

TABLE V - 4

MEAN DAILY MAXIMUM AND MINIMUM RELATIVE HUMIDITY

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
NORTHEAST BORNEO														
Tarakan														
Maximum	98	98	99	97	97	97	97	98	97	97	97	98	97	6
Minimum	69	67	69	69	69	68	69	64	64	65	68	69	68	6
NORTHERN CELEBES														
Manado														
Maximum	98	97	97	97	97	96	91	91	91	94	97	98	95	7
Minimum	75	72	71	72	71	68	62	58	59	62	69	74	68	7

TABLE V - 5

EXTREME MAXIMUM AND MINIMUM RELATIVE HUMIDITY

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
NORTHEAST BORNEO														
Tarakan														
Maximum	100	100	100	100	100	100	100	100	100	100	100	100	100	6
Minimum	47	42	51	52	45	47	50	47	38	44	44	45	38	6
NORTHERN CELEBES														
Manado														
Minimum	100	100	100	100	100	100	100	100	100	100	100	100	100	7
Minimum	54	43	51	46	47	45	43	37	33	34	48	48	33	7

D. Surface Wind.

Surface wind data at various stations in the Celebes Sea area are shown below, in Tables V - 6 to V - 9.

TABLE V - 6

FREQUENCY OF SURFACE WIND DIRECTIONS

Mean percentage frequency of surface winds from specified directions at specified hours (L.C.T.).

STATION, HOURS DIRECTION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Cotabato—0600, 1400														
N.	1	0	1	1	*	0	0	1	—	1	0	1	1	5
NE.	2	3	3	3	1	1	1	2	1	1	2	1	2	5
E.	16	16	13	5	12	14	12	13	13	14	8	12	12	5
SE.	5	4	6	7	5	3	3	5	5	7	5	9	5	5
S.	3	0	1	1	1	1	0	0	—	—	1	3	1	5
SW.	3	1	2	5	7	5	7	6	5	5	7	5	5	5
W.	15	15	14	23	23	20	24	24	28	26	25	26	22	5
NW.	6	7	11	8	7	12	12	13	12	11	8	4	9	5
Calm	49	54	49	47	44	44	41	36	36	35	44	39	43	5
Davao—0600, 1400														
N.	72	61	60	50	43	42	36	38	36	41	50	63	49	8
NE.	11	13	14	13	8	3	1	2	1	5	7	9	7	8
E.	6	11	12	13	9	6	3	2	1	2	10	6	7	8
SE.	2	1	2	4	6	4	9	7	8	8	6	3	5	8
S.	5	9	9	16	28	35	37	39	39	34	17	12	23	8
SW.	—	—	—	—	1	1	1	1	1	1	1	—	1	8
W.	—	—	—	1	—	1	2	1	2	1	1	—	1	8
NW.	4	5	3	3	5	8	11	10	12	8	8	7	7	8
Calm (<1 m.p.h.)	0	—	—	0	0	0	0	0	0	0	0	0	—	8
*Surigao—0200, 0600, 1000, 1400, 1800, 2200														
N.	11	11	6	6	6	4	2	2	2	4	5	7	6	16
NE.	32	29	31	22	14	8	3	3	3	7	16	24	16	16
E.	14	16	20	20	15	11	4	3	3	6	9	15	11	16
SE.	3	3	5	6	5	5	1	1	2	3	3	4	3	16
S.	2	2	3	3	6	8	9	10	8	6	6	3	6	16
SW.	2	2	2	3	6	12	26	36	30	19	11	4	13	16
W.	1	2	1	2	4	6	13	12	12	9	4	2	6	16
NW.	6	4	3	3	4	5	5	4	5	5	8	6	5	16
Calm	29	31	29	35	40	41	37	29	35	41	38	35	34	16

TABLE V - 6 (cont.)

FREQUENCY OF SURFACE WIND DIRECTIONS

Mean percentage frequency of surface winds from specified directions at specified hours (L.C.T.).

OCEAN AREA, HOUR, DIRECTION		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
Zamboanga—0200, 0600, 1000, 1400, 1800, 2200														
N	15	14	15	16	20	18	18	18	16	14	16	17	16	10
NE	14	9	10	7	9	9	8	6	6	10	9	12	9	10
E	7	6	4	3	4	3	4	4	4	2	4	9	4	10
SE	8	10	12	10	11	11	9	11	9	8	7	8	9	10
S	3	4	1	2	2	2	2	2	2	5	3	3	3	10
SW	13	14	14	14	16	16	21	18	18	18	15	13	16	10
W	18	16	16	19	16	18	18	21	20	18	18	14	18	10
NW	4	4	5	7	7	8	7	7	6	6	4	3	6	10
Calm	18	23	23	22	15	15	13	13	19	19	26	21	19	10
*Data apparently derived from observations of 16 directions, by adding NNE. to N., ENE. to NE., etc.														
SULU ARCHIPELAGO														
Jolo—0600, 1400														
N	24	22	17	10	7	5	5	4	6	8	15	19	12	10
NE	26	25	24	12	4	4	2	3	2	3	6	18	11	10
E	4	2	3	3	2	3	1	2	4	4	2	2	2	10
SE	6	5	5	6	6	8	5	6	8	10	9	9	7	10
S	9	9	9	14	24	22	38	39	31	24	17	12	21	10
SW	1	2	2	4	9	13	13	9	6	10	9	3	7	10
W	5	4	7	9	12	13	10	11	15	17	16	10	11	10
NW	4	3	3	4	3	4	3	3	2	2	4	6	3	10
Calm	21	28	30	38	33	28	23	23	26	22	22	21	26	10
NORTHEAST BORNEO														
Sandakan—0600, 0900, 1400, 2000 (?)														
N	21	12	12	13	3	2	2	2	4	7	9	13	8	4
NE	20	18	19	20	10	7	6	6	4	8	9	14	12	4
E	5	5	5	3	6	5	3	5	2	3	3	4	4	4
SE	1	4	2	5	13	13	13	9	7	6	3	4	7	4
S	3	5	5	7	12	15	20	16	19	14	7	5	11	4
SW	6	5	8	12	25	25	27	25	24	16	12	10	16	4
W	5	3	4	6	11	9	7	10	11	7	11	9	8	4
NW	14	9	7	8	4	4	2	3	2	4	9	8	6	4
Calm	25	39	38	26	16	20	20	24	27	35	37	33	28	4
OFF HALMAHERA—2000														
N		35	28	28	30	0	3	0	0	0	3	8	29	14
NE		28	30	42	19	14	8	3	2	3	12	0	13	14
E		4	3	6	8	20	13	8	0	0	3	4	4	6
SE		0	3	0	11	14	29	21	27	0	18	6	2	11
S		4	3	6	0	12	18	45	40	31	22	10	4	16
SW		0	0	4	4	11	16	8	24	36	18	24	6	13
W		2	11	0	11	6	6	11	7	14	9	30	11	10
NW		13	22	6	15	8	5	3	0	8	3	8	27	10
Calm (<1 m.p.h.)		12	3	6	4	17	3	3	0	8	9	12	2	6
No. of obs.		44	38	48	27	42	39	40	47	38	36	50	49	498
OFF EASTERN MINDANAO—2000														
N		27	13	28	17	3	4	6	4	0	5	10	19	11
NE		69	75	54	43	13	17	6	4	6	7	34	29	30
E		4	3	3	13	17	23	6	4	3	4	3	10	8
SE		0	0	3	0	17	13	15	8	13	12	0	0	7
S		0	3	3	4	20	25	22	38	29	18	10	6	15
SW		0	0	3	4	3	6	34	27	22	27	24	6	13
W		0	0	0	0	13	2	0	4	10	2	13	10	4
NW		0	6	6	9	3	4	0	4	6	12	0	12	5
Calm (<1 m.p.h.)		0	0	0	9	10	4	9	8	10	10	3	6	6
No. of obs.		26	31	33	23	34	49	35	27	36	42	32	32	400
OFF WESTERN MINDANAO—2000														
N		30	29	17	17	9	8	8	3	6	14	22	24	16
NE		33	22	29	23	4	5	2	4	8	10	25	22	16
E		8	10	4	13	7	8	8	4	7	9	4	9	8
SE		6	9	7	6	11	14	8	9	7	9	3	10	8
S		8	5	2	6	15	20	22	23	15	11	7	4	12
SW		0	4	7	13	18	16	26	32	18	16	9	7	14
W		4	4	12	9	14	14	16	10	15	10	7	8	10
NW		6	11	7	8	10	4	6	6	8	12	10	10	8
Calm (<1 m.p.h.)		6	6	13	8	16	12	6	9	18	10	11	7	10
No. of obs.		55	106	99	108	132	107	107	110	133	108	94	128	1287

TABLE V - 6 (cont.)

FREQUENCY OF SURFACE WIND DIRECTIONS

Mean percentage frequency of surface winds from specified directions at specified hours (L.C.T.).

OCEAN AREA, HOUR, DIRECTION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
OFF NORTHERN BORNEO—2000													
N.	21	30	22	17	6	4	3	3	11	10	15	19	13
NE.	65	59	59	29	12	14	7	4	6	15	31	52	29
E.	4	4	9	12	14	14	0	8	3	11	3	3	7
SE.	4	1	1	10	8	16	12	5	3	7	0	2	6
S.	0	1	0	2	12	18	16	24	8	12	11	7	9
SW.	1	1	2	12	21	18	44	38	35	22	10	5	17
W.	0	3	3	9	12	10	8	8	27	13	6	4	9
NW.	3	0	1	0	2	2	0	5	8	5	16	5	4
Calm (<1 m.p.h.)	1	0	1	7	15	6	9	5	0	4	7	3	5
No. of obs.	74	88	71	44	51	53	68	60	40	79	91	59	778
OFF NORTHEASTERN BORNEO—2000													
N.	18	32	12	20	0	6	3	4	4	18	21	24	14
NE.	9	23	40	24	18	6	6	4	0	16	17	24	16
E.	4	10	4	8	14	28	3	4	4	6	4	4	8
SE.	13	14	4	8	5	24	10	12	15	2	5	4	10
S.	4	0	8	16	14	12	48	39	23	6	21	4	16
SW.	4	9	8	8	18	6	18	31	41	22	5	8	15
W.	30	0	4	0	5	6	3	0	4	12	5	8	6
NW.	8	9	12	4	0	0	0	4	4	6	10	24	7
Calm (<1 m.p.h.)	9	5	8	12	27	9	10	4	7	14	14	0	10
No. of obs.	25	23	28	33	26	32	42	26	28	51	47	27	388
OFF NORTHERN CELEBES—2000													
N.	24	14	11	6	4	6	10	9	5	13	6	8	10
NE.	28	39	53	29	18	4	2	3	13	4	8	22	19
E.	4	4	9	29	15	6	8	15	5	12	3	11	10
SE.	4	0	3	6	15	12	16	21	11	10	0	4	8
S.	0	2	0	2	17	25	18	21	17	4	3	0	9
SW.	4	12	6	13	12	19	22	15	24	16	11	22	15
W.	16	2	6	2	4	12	6	9	8	21	33	11	11
NW.	12	17	8	9	6	4	6	6	12	14	29	14	11
Calm (<1 m.p.h.)	8	7	6	3	9	10	12	3	6	8	10	7	7
No. of obs.	29	42	41	61	49	50	51	36	65	59	40	49	572

TABLE V - 7

PREVAILING SURFACE WIND DIRECTION

Most frequent surface wind direction at specified hours (L.C.T.).

STATION AND HOURS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
SANGIHE-TALAUD														
Tahoena														
— —.	N	N	N	N	SW.	S	SW	S	S	S	NW	N	—	—
MINDANAO														
Cotabato														
0600, 1400	E	E	W	W	W	W	W	W	W	W	W	W	W	5
Davao														
0600, 1400	N	N	N	N	N	N	S	S	S	N	N	N	N	8
Surigao														
0200, 0600, 1000, 1400, 1800, 2200	NE	NE	NE	NE	NE	SW	SW	SW	SW	SW	NE	NE	NE	16
Zamboanga														
0200, 0600, 1000, 1400, 1800, 2200	W	W	W	W	N	W	SW	W	W	W	W	N	W	10
SULU ARCHIPELAGO														
Jolo														
0600, 1400	NE	NE	NE	S	S	S	S	S	S	S	S	N	S	10
NORTHEAST BORNEO														
Sandakan														
0600, 0900, 1400, 2000 (?)	N	NE	NE	NE	SW	SW	SW	SW	SW	SW	SW	NE	SW	4
Tarakan														
.....	N	N	N	N	NW	W	S	S	S	S	W	NW	—	—

TABLE V - 7

PREVAILING SURFACE WIND DIRECTION

Most frequent surface wind direction at specified hours (L.C.T.).

STATION AND HOURS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
NORTHERN CELEBES														
Gorontalo														
— —	N	NW	N	NE	S	S	S	S	S	S	N	N	—	—
Manado														
0800	SE	S	E	E	E	E	E	SE	E	E	E	SW	—	2
1400	W	W	NW	W	NW	W	W	W	W	NW	W	W	—	2
2100	S	SE	E	E	E	E	E	E	SE	E	E	SE	—	2
Talise														
0600	NW	N	N	NE	S	S	SE	SE	S	S	W	W	—	7
1200	NW	N	N	N	S	S	SE	S	S	S	W	W	—	7
Toegoean														
0600	NE	NE	NE	E	SE	S	S	S	SE	SE	SE	SE	—	7
1200	N	N	N	W	SW	SW	SW	SW	SW	SW	W	SW	—	7
1800	N	NE	NE	NE	S	S	S	S	SW	SW	S	SW	—	7
2400	NE	NE	NE	E	SE	SE	S	S	SE	SE	E	SE	—	7
Tomohon														
0600	NW	NW	NW	NW	SE	SE	S	S	SE	SE	W	NW	—	13
1200	NW	NW	NW	NW	W	SE	S	S	S	S	W	NW	—	13
1800	NW	NW	NW	NW	SW	SE	S	S	SE	S	W	NW	—	13

OCEAN AREA AND HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	NO OBS
OFF HALMAHERA														
2000	N	NE	NE	N	E	SE	S	S	SW	S	W	N	S	498
OFF EASTERN MINDANAO														
2000	NE	NE	NE	NE	S	S	SW	S	S	SW	NE	NE	NE	400
OFF WESTERN MINDANAO														
2000	NE	N	NE	NE	SW	S	SW	SW	SW	SW	NE	N	N	1287
OFF NORTHERN BORNEO														
2000	NE	NE	NE	NE	SW	SW	SW	SW	SW	SW	NE	NE	NE	778
OFF NORTHEASTERN BORNEO														
2000	W	N	NE	NE	NE	E	S	S	SW	SW	N	NE	S	388
OFF NORTHERN CELEBES														
2000	NE	NE	NE	NE	NE	S	SW	S	SW	W	W	NE	NE	572

TABLE V - 8

FREQUENCY OF SURFACE WIND SPEEDS

Mean percentage frequency of surface winds of specified speed (m.p.h.) at specified hours (L.C.T.).

STATION, HOURS, SPEED	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Davao—0600, 1400														
<1	0	—	—	0	0	0	0	0	0	0	0	0	—	8
1-7	74	76	81	85	92	93	92	91	89	88	90	76	86	8
8-18	25	23	18	15	8	7	8	9	11	12	9	23	14	8
19-31	1	1	1	0	0	0	0	*	0	0	1	1	—	8
>31	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Surigao—0600, 1400														
<1	31	33	31	33	42	36	35	55	35	46	35	34	37	7
1-7	54	53	52	57	51	53	48	28	53	46	53	52	50	7
8-18	14	13	16	10	7	10	15	15	11	8	9	13	12	7
19-31	1	1	1	—	—	1	2	2	1	—	3	—	1	7
>31	0	0	0	0	0	0	—	0	0	0	—	1	—	7

TABLE V - 9

MEAN SURFACE WIND SPEED

Mean surface wind speed (m.p.h.) at specified hours (L.C.T.).

STATION AND HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YEARS RECORD
SANGIHE-TALAUD														
Tahoena														
— —.....	6	6	6	6	6	6	7	9	6	6	6	6	6	—
MINDANAO														
Cotabato														
0600, 1400.....	2	1	2	2	2	2	2	2	2	2	2	2	2	5
Davao														
0600, 1400.....	2	2	2	2	2	2	2	2	2	2	2	2	2	5
Surigao														
0200, 0600, 1000,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1400, 1800, 2200 (?).....	7	7	6	5	4	4	6	6	6	5	5	5	5	7
Zamboanga														
0200, 0600, 1000,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1400, 1800, 2200 (?).....	4	4	5	5	5	5	6	6	6	6	5	4	5	5
SULU ARCHIPELAGO														
Jolo														
0600, 1400.....	7	6	6	5	6	6	8	7	7	7	7	7	6	5
NORTHEAST BORNEO														
Sandakan														
— —.....	6	6	6	6	6	6	6	6	6	6	4	5	6	—
Tarakan														
— —.....	6	6	6	6	6	6	6	6	6	5	3	5	6	—
NORTHERN CELEBES														
Gorontalo														
— —.....	5	5	5	5	5	5	5	5	5	5	5	5	5	—
Manado														
0800.....	6	7	5	5	5	5	5	6	5	6	6	8	—	2
1400.....	12	13	11	11	8	8	10	10	10	10	10	13	—	2
2100.....	7	6	4	4	4	5	6	6	6	5	4	6	—	2
OFF HALMAHERA														
2000.....	7	8	7	8	7	6	8	14	10	8	7	8	8	498
OFF EASTERN MINDANAO														
2000.....	9	12	11	10	7	6	8	10	9	7	8	10	9	400
OFF WESTERN MINDANAO														
2000.....	7	7	6	6	5	6	7	8	7	7	7	9	7	1287
OFF NORTHERN BORNEO														
2000.....	12	12	9	7	6	7	9	10	9	8	7	10	9	778
OFF NORTHEASTERN BORNEO														
2000.....	6	7	7	6	5	6	8	8	10	6	6	8	7	388
OFF NORTHERN CELEBES														
2000.....	8	7	9	7	6	7	5	8	7	6	7	7	7	572

E. Sea and swell.

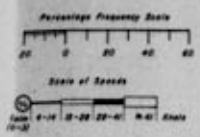
Data on sea and swell are presented in Chapter III.

F. Upper winds.

Upper wind data for the Celebes Sea area are shown on FIGURES V - 22 to V - 25.

UPPER WINDS – DECEMBER, JANUARY, FEBRUARY

MEAN PERCENTAGE FREQUENCY OF UPPER WINDS OF SPECIFIED DIRECTIONS AND SPEEDS AT VARIOUS ELEVATIONS
FIGURES BELOW THE ROSES INDICATE THE NUMBER OF OBSERVATIONS



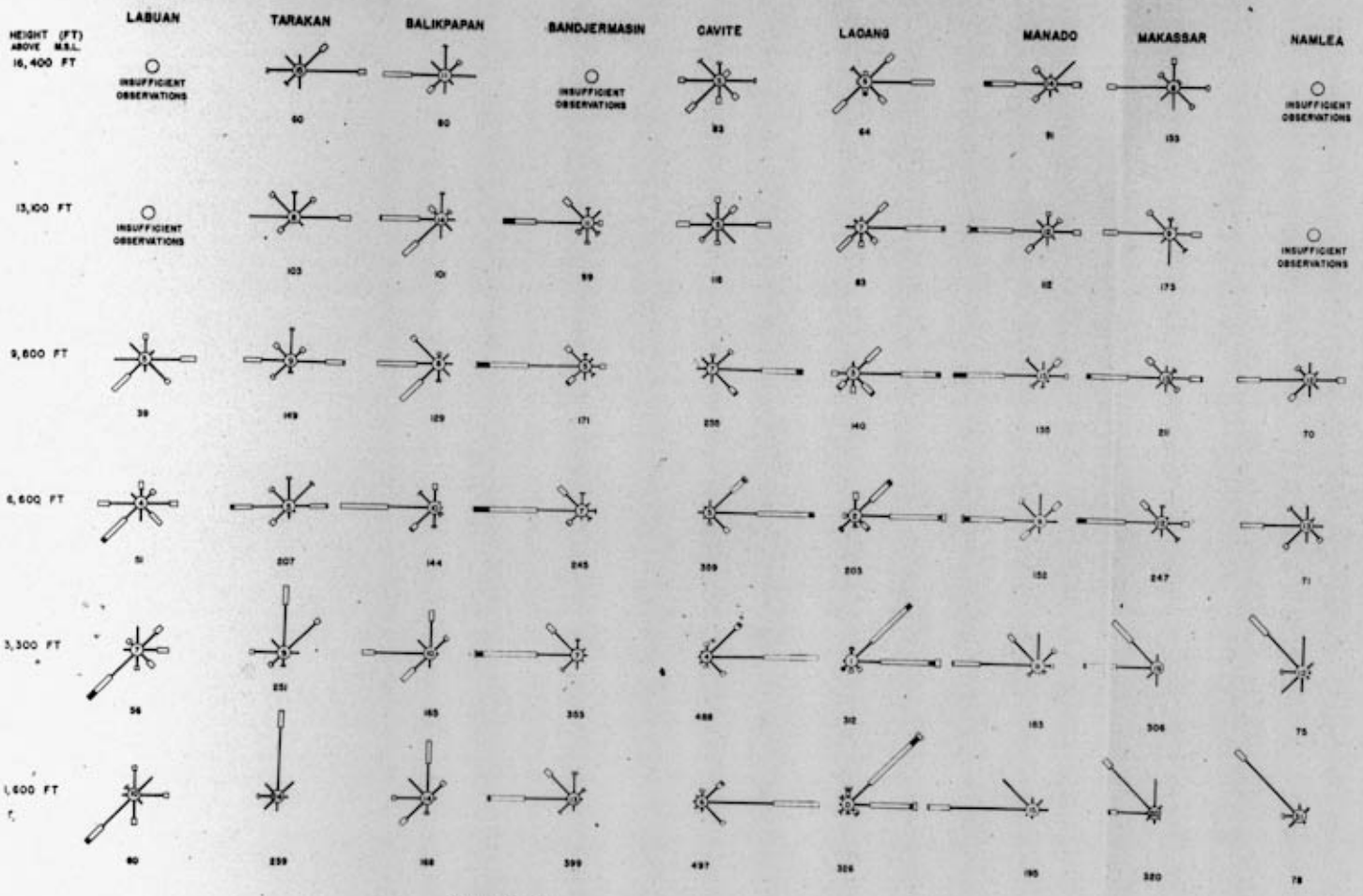


FIGURE V - 22.
Upper Winds: December, January, February.

UPPER WINDS - MARCH, APRIL, MAY

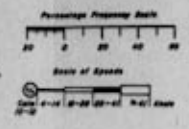
MEAN PERCENTAGE FREQUENCY OF UPPER WINDS OF SPECIFIED DIRECTIONS AND SPEEDS AT VARIOUS ELEVATIONS
FIGURES BELOW THE ROSES INDICATE THE NUMBER OF OBSERVATIONS

HEIGHT, (FT) ABOVE M.S.L.	LABUAN	TARAKAN	BALIKPAPAN	BANDJERMASIN	CAVITE	LAOANG	MANADO	MAKASSAR	NAMLEA
16,400 FT	INSUFFICIENT OBSERVATIONS	90	66	3	136	223	142	256	INSUFFICIENT OBSERVATIONS
13,100 FT	INSUFFICIENT OBSERVATIONS	107	84	171	246	296	108	313	INSUFFICIENT OBSERVATIONS
9,800 FT	65	139	105	250	376	46	184	369	86
6,600 FT	90	170	124	318	449	480	201	406	73
3,300 FT	106	206	136	410	493	553	223	445	73
1,600 FT	120	211	142	465	496	565	228	447	73

FIGURE V - 23.
Upper Winds: March, April, May

UPPER WINDS - JUNE, JULY, AUGUST

MEAN PERCENTAGE FREQUENCY OF UPPER WINDS OF SPECIFIED DIRECTIONS AND SPEEDS AT VARIOUS ELEVATIONS
FIGURES BELOW THE ROSES INDICATE THE NUMBER OF OBSERVATIONS



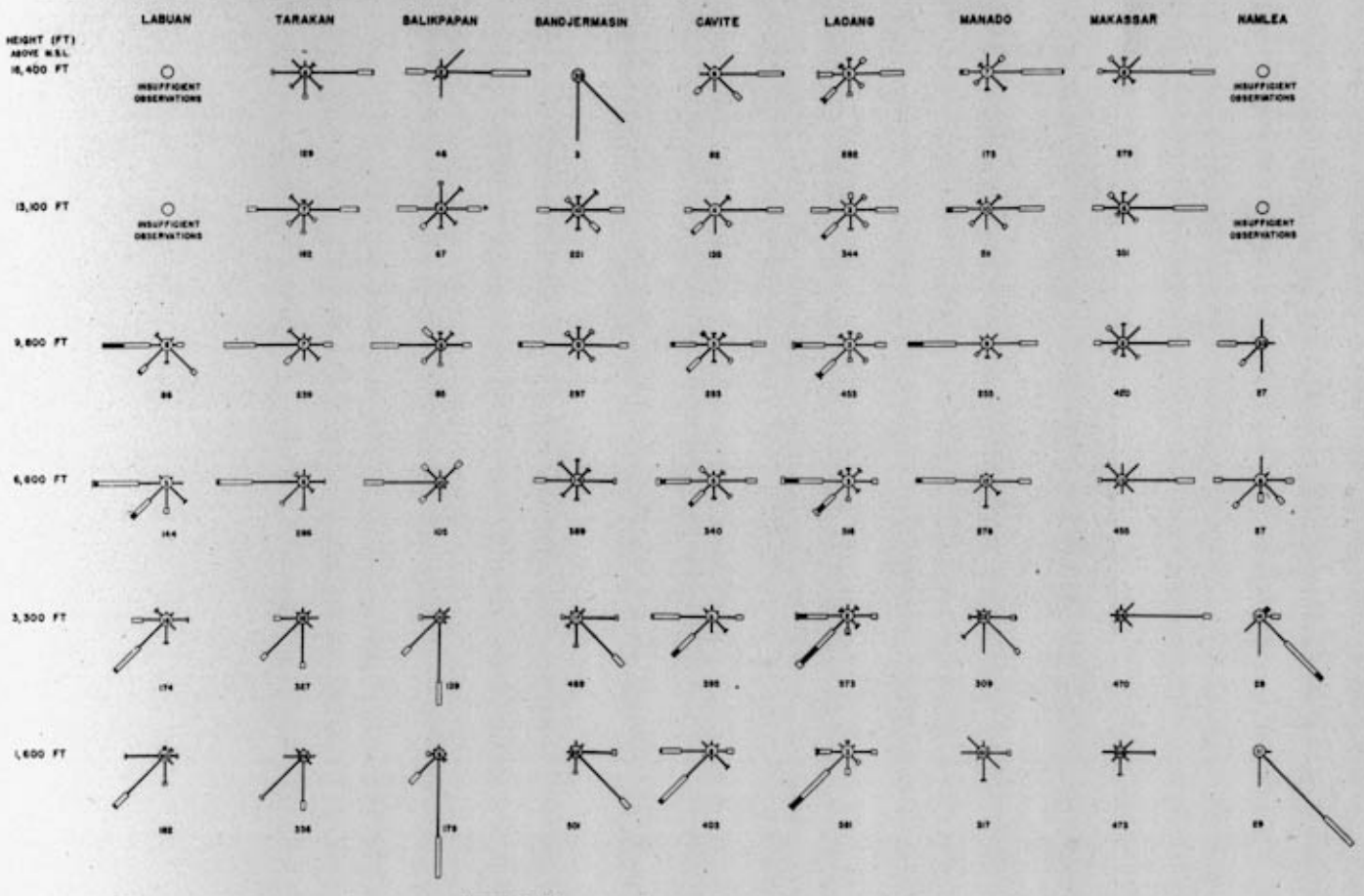


FIGURE V - 24.
Upper Winds: June, July, August.

UPPER WINDS - SEPTEMBER, OCTOBER, NOVEMBER

MEAN PERCENTAGE FREQUENCY OF UPPER WINDS OF SPECIFIED DIRECTIONS AND SPEEDS AT VARIOUS ELEVATIONS
FIGURES BELOW THE ROSES INDICATE THE NUMBER OF OBSERVATIONS

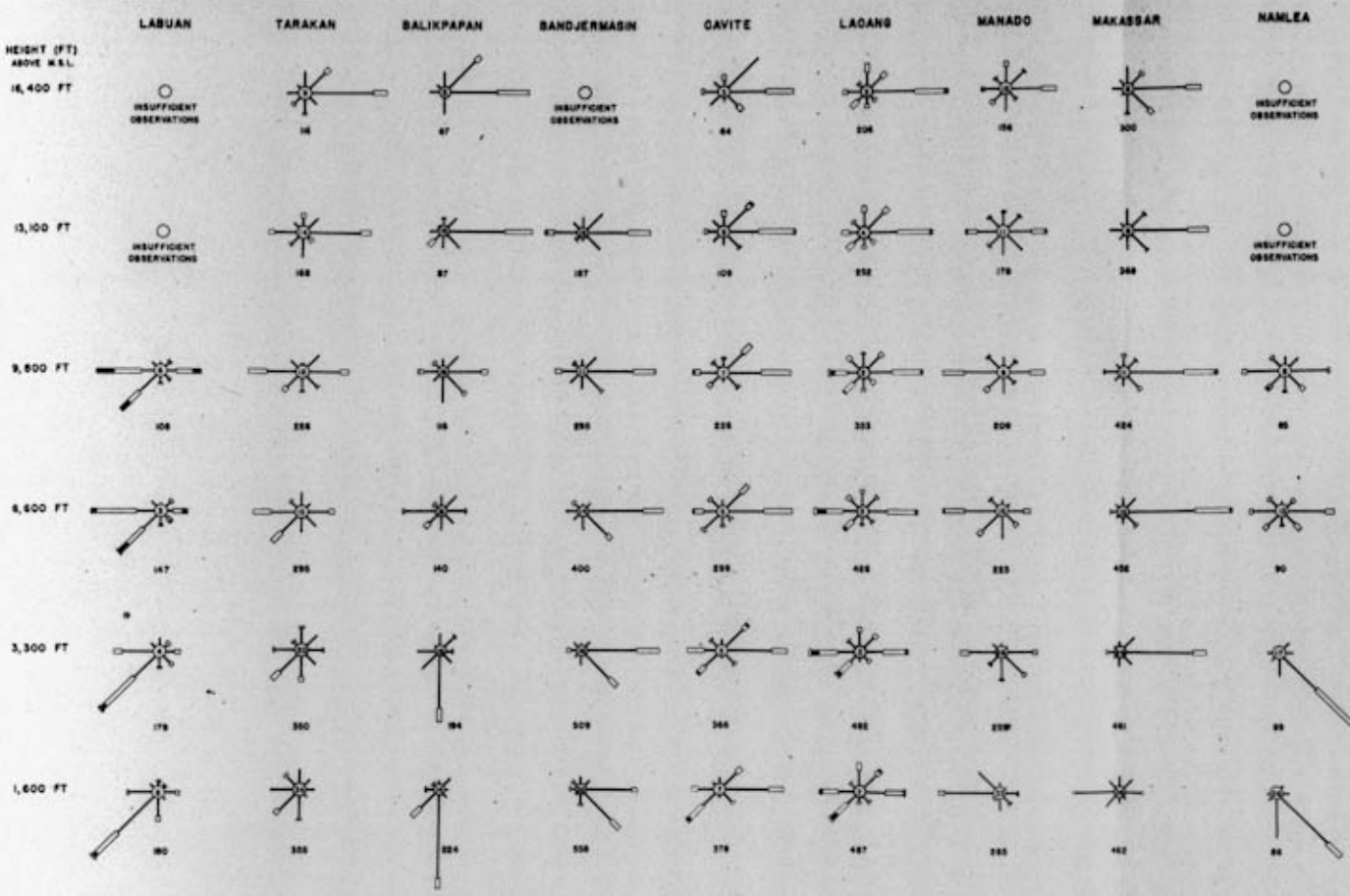


FIGURE V - 25.
Upper Winds: September, October, November.

G. Cloud.

Cloud data at various stations in the Celebes Sea area are shown below, in Tables V - 10, V - 11 and V - 12.

TABLE V - 10

CLOUDINESS

Mean percentage of sky covered by cloud, regardless of height, at specified hours (L.C.T.).

STATION AND HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Cotabato														
0600	64	61	52	55	65	72	78	77	75	66	67	64	66	5
1400	67	68	61	57	65	69	73	69	67	67	67	68	66	5
Davao														
0600	60	50	50	60	59	63	62	60	60	60	62	65	59	5
1400	67	53	53	62	62	65	66	65	65	63	66	69	63	5
Surigao														
0200, 0600, 1000,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1400, 1800, 2200 (?)	74	70	65	60	59	62	71	66	69	68	70	76	68	34
Zamboanga														
0600	74	71	66	67	74	76	76	79	80	77	74	74	74	8
1400	69	67	63	67	74	72	74	72	76	74	73	70	71	8
0200, 0600, 1000,														
1400, 1800, 2200	66	63	61	62	70	75	79	76	77	75	72	67	70	15
SULU ARCHIPELAGO														
Jolo														
0600	79	79	73	70	71	72	75	76	73	75	74	79	75	8
1400	76	74	71	70	74	75	76	75	78	79	77	76	75	8
NORTHEAST BORNEO														
Sandakan														
0600, 0900, 1400,	—	—	—	—	—	—	—	—	—	—	—	—	—	—
2000 (?)	75	72	75	68	65	69	73	65	75	76	78	78	71	4
NORTHERN CELEBES														
Tomohon														
0600	76	80	68	54	50	59	59	53	49	49	58	67	60	13
1200	85	85	83	80	78	77	73	65	72	78	77	82	78	13
1800	82	79	76	68	68	66	66	60	60	64	72	77	70	13
OFF HALMAHERA														
2000	44	44	43	37	43	58	55	55	47	42	48	45	47	498
OFF EASTERN MINDANAO														
2000	44	48	50	49	52	56	51	53	49	50	43	51	50	400
OFF WESTERN MINDANAO														
2000	39	40	40	44	54	52	68	64	58	63	54	48	52	1287
OFF NORTHERN BORNEO														
2000	53	47	38	35	37	49	57	50	42	55	56	52	48	778
OFF NORTHEASTERN BORNEO														
2000	60	49	41	47	40	42	54	43	48	42	49	54	47	388
OFF NORTHERN CELEBES														
2000	46	50	41	40	47	47	45	46	52	47	49	52	47	572

TABLE V - 11

CLEAR DAYS

Mean number of days with mean cloudiness (percentage of sky covered by cloud, regardless of height) less than 15 per cent.

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Davao	0	0	0	0	0	0	0	0	0	0	0	0	0	11
Surigao	0	0	s	s	s	0	0	0	0	0	0	0	s	9
SULU ARCHIPELAGO														
Jolo	0	0	0	0	0	0	s	0	0	0	0	s	s	10

TABLE V - 12

CLOUDY DAYS

Mean number of days with mean cloudiness (percentage of sky covered by cloud, regardless of height) more than 75 per cent.

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Davao	26	22	23	20	22	21	25	23	21	22	21	23	270	11
Surigao	22	16	16	11	12	13	19	16	15	20	20	24	204	9
SULU ARCHIPELAGO														
Jolo	16	13	12	9	10	17	18	16	15	16	15	13	170	10
NORTHEAST BORNEO														
Sandakan	15	12	16	9	7	11	14	8	14	15	16	16	153	4

H. Turbulence and Thunderstorms.

Data on thunderstorms are shown below, in TABLES V - 13 and V - 14.

TABLE V - 13

DAYS WITH THUNDERSTORMS

Mean number of days with thunderstorms at any time of day.

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Cotabato	9	5	7	12	15	6	8	8	8	12	6	9	104	5
Davao	2	3	2	7	12	5	6	5	7	9	5	3	66	5
Surigao	0	1	1	2	4	4	4	3	6	7	5	1	37	6
Zamboanga	2	4	4	7	9	6	3	5	4	5	3	3	56	5
SULU ARCHIPELAGO														
Jolo	3	3	3	7	12	6	3	4	5	5	1	3	54	5
NORTHEAST BORNEO														
Sandakan	1	1	1	1	2	3	3	3	6	5	4	2	31	5
NORTHERN CELEBES														
Manado	1	2	2	4	4	4	2	2	4	6	6	1	38	6

TABLE V - 14

FREQUENCY OF THUNDERSTORMS

Mean percentage frequency of thunderstorms at 2000 L.C.T.

OCEAN AREA	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	NO REC
OFF HALMAHERA	14	8	10	11	26	10	8	6	8	8	20	6	11	498
OFF EASTERN MINDANAO	4	6	0	4	6	6	23	4	8	12	0	0	6	400
OFF WESTERN MINDANAO	5	7	5	25	19	13	9	11	11	19	9	2	11	1287
OFF NORTHERN BORNEO	4	1	0	5	6	0	1	7	0	1	2	2	2	778
OFF NORTHEASTERN BORNEO	4	9	14	9	8	3	2	4	7	6	4	0	6	388
OFF NORTHERN CELEBES	0	5	5	3	16	8	6	0	8	7	10	6	6	572

I. Icing.

No data are available on icing conditions in this area. Discussion is presented in TOPIC 51, B, 2, (2) of this chapter.

J. Visibility, Fog, Haze, Dust, Smoke.

Data on fog and visibility are shown below, in TABLE: V - 15 and V - 16.

TABLE V - 15

DAYS WITH FOG

Mean number of days with fog at any time of day.

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR	YRS REC
MINDANAO														
Davao	s	1	0	1	1	1	s	s	0	0	0	1	6	5
Surigao	s	2	4	3	2	s	0	0	s	1	s	1	13	5
NORTHEAST BORNEO														
Sandakan	s	0	0	0	0	0	0	0	0	0	0	s	1	4

TABLE V - 16

VISIBILITY AT SANDAKAN

Mean number of days with visibility less than specified limits at specified hours (L.C.T.) at Sandakan, Northeast Borneo. (4 years record)

LIMIT AND HOUR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
½ mile													
0600	s	0	0	0	0	0	0	0	0	0	0	s	s
0900	0	0	0	0	0	0	0	0	0	0	0	0	0
1400	0	0	0	0	0	0	0	0	0	0	0	s	s
2½ miles													
0600	3	1	1	0	0	0	0	0	0	0	1	2	7
0900	1	1	s	s	0	0	0	0	0	0	s	s	3
1400	1	1	1	0	0	s	0	0	0	0	0	s	3
6 miles													
0600	6	3	2	1	0	0	s	0	0	1	2	4	19
0900	3	1	1	s	0	0	0	0	0	s	1	2	9
1400	3	1	1	0	s	s	s	0	0	0	s	1	6
12 miles													
0600	22	23	23	8	1	1	1	s	2	1	2	11	95
0900	7	4	4	2	1	s	0	0	1	s	2	4	25
1400	7	3	3	0	s	1	1	0	s	0	1	3	19

s Less than 1 day

K. Local names for weather elements.

See TABLE V - 17, below.

TABLE V - 17

LOCAL NAMES FOR WEATHER ELEMENTS

NAME	REGION	MEANING
Baguio	Philippines	Tropical cyclone
Barat	Celebes	West wind
Broebroe	Celebes	Dry nocturnal land breeze
Colla	Philippines	Strong squally SW winds
Dongi	Celebes	North wind
Habagad	Philippines	Strong squally SW winds
Slatan	Celebes	S or SE wind
Tandongkasa	Celebes	S wind
Timoer	Celebes	S wind
Tongara	Celebes	Nocturnal land breeze
Typhoon	China, etc.	Tropical cyclone

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CHAPTER VI

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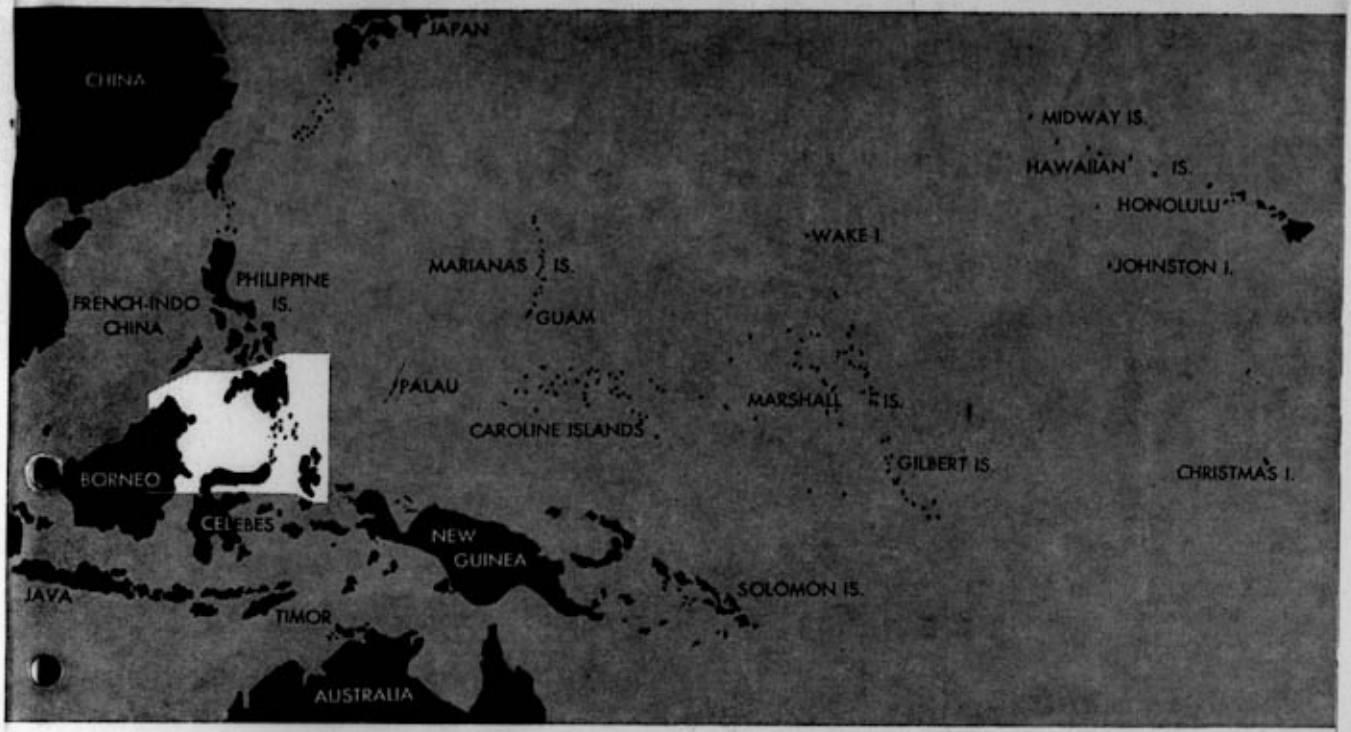

JOINT ARMY-NAVY INTELLIGENCE STUDY

OF

CELEBES SEA AREA

PORT FACILITIES

MAY 1944

List of Effective Pages, Chapter VI

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Table of Contents

Note: This chapter is based on material available in Washington, D. C., on 25 April 1944.

PORT FACILITIES

60. General Description

There were no ports in the Celebes Sea area which could be classified as "major" in the sense in which the word is used in Europe and North America. The highest estimated handling capacity for general cargo for any port was 450 short tons per 8-hour day, although some specialized ports, such as those for lumber and oil, would exceed that figure for their special product. The term "major ports," however, has been used here to classify those which, because of developed facilities or trade volume, stand out above the others. Fifteen ports fall in this category.

The term "minor ports" has been used for all those coastal towns or villages not listed as major ports, which had any cargo handling facilities at all or which were ports of call for merchant vessels. One hundred and thirteen localities are covered under this heading.

Both major ports and minor ports have been listed according to the following geographic divisions:

Halmahera Sector — 1 major port, 22 minor ports.
Sangihe-Talaud Sector — no major ports, 9 minor ports.
Mindanao Sector — 8 major ports, 57 minor ports.
Sulu Archipelago — 1 major port, 9 minor ports.
Northeast Borneo — 3 major ports, 9 minor ports.
Northern Celebes Sector — 2 major ports, 14 minor ports.

61. Major Ports

A. Halmahera Sector.

(1) Ternate, Ternate Island (0° 47′ N, 127° 23′ E).

Ternate lies on the southeastern coast of Ternate Island, about 7 miles west of Dodinga Bay, on the western coast of Halmahera Island (FIGURE VI - 1). The island is approximately circular, about 7 miles in diameter. The coast falls steeply to the sea, almost entirely without any drying bank. About 1 mile to the south-southeast of Ternate Island, and separated from it by Gamme Lamo channel, lie Tidore and Maitara islands, and about 1 mile northward from the northern extremity of Ternate Island is the island of Hiri.

The most important locality in the Northern Moluccas, it is the commercial center of and has the best port facilities in the Halmahera group.

(a) Harbor. Ternate roads, the harbor of Ternate, is an open roadstead with depths of 15 fathoms about ¼ mile offshore, and 30 fathoms at about 800 yards. The southwestern approach, through Gamme Lamo channel, has a least depth of 19 fathoms in the fairway. The approaches from the northward and southward are deep and generally clear.

Fixed red and green lights were shown at the head of the northern and southern piers, respectively.

Before occupation by the enemy the best anchorage in the roadstead was in a depth of 15 fathoms, about 350 yards offshore, with the Residency flagstaff bearing 298°, and the head of the southern pier 215°. In a lesser depth a vessel would be too close to the reef. The roadstead is fairly well protected, but the holding ground is bad, the bank steep, and the tidal stream strong. In December, there is frequently a heavy swell.

There is both a diurnal and a semidiurnal tide, but the latter predominates. The spring highs and the spring lows of the two tides may coincide. The highest water level under such conditions occurs in June and December. The maximum rise and fall that can be expected are, respectively, about 2.3 feet above and 1.6 feet below mean sea level.

A strong current sets through the roadstead at times. High water is accompanied by a current setting to the northward and low water by a current setting to the southward.

The climate is characterized by the absence of excessive heat and by fresh sea breezes and moderate rainfall. The mean annual temperature is 80.7°. The average annual rainfall is 85 inches. There is no well-defined wet season.

The prevailing wind from November through March varies from west and northwest to northeast. From April through October winds from southeast to south-southwest prevail.

Troublesome rollers may be experienced in the roadstead from December to April. Southerly winds cause a broken sea when the currents set to the southward.

(b) Landing facilities. The waterfront of the town is bordered by a drying coral reef which attains its greatest width off Fort Oranje, about midway between the Residency Pier and the Sultan's Pier (Reference numbers 3 and 4, TABLE VI - 1 and FIGURE VI - 1).

The principal facilities are listed in TABLE VI - 1 and are keyed to the port plan (FIGURE VI - 1). Hertog Hendrik Pier (Reference number 2), a T-head pier of open pile construction (FIGURES VI - 2, VI - 3, and VI - 4), was the only commercial pier in the port. A small pier served the Japanese fishing settlement near the southern end of the shore reef (Reference number 1). There was a pier for small boats (Reference number 3) near the Residency but care was necessary to avoid rocks at low tide. The Sultan's Pier (Reference number 4), a private pier for small craft, was located at the northern end of the waterfront. Several other small piers and landings of no commercial importance were located in front of the town.

The estimated volume of cargo which could be handled daily at the vessel berth at Hertog Hendrik Pier (Reference number 2) is based upon the handling of general cargo. An 8-hour day is assumed.

At the root of Hertog Hendrik Pier were: a customs cargo shed, 225 feet by 40 feet, stone and tile construction; the Koninklijke Paketvaart Maatschappij (K.P.M.) cargo shed, 100 feet by 60 feet, stone and shingle construction; and Chinese storage sheds, 120 feet by 80 feet, wood and corrugated iron construction. In the area adjacent to and southward of the pier a number of structures, believed to be warehouses, have been built by the Japanese. Ample open storage space was available about 200 yards from the pier and beyond. About 20 motorboats were based at Ternate.

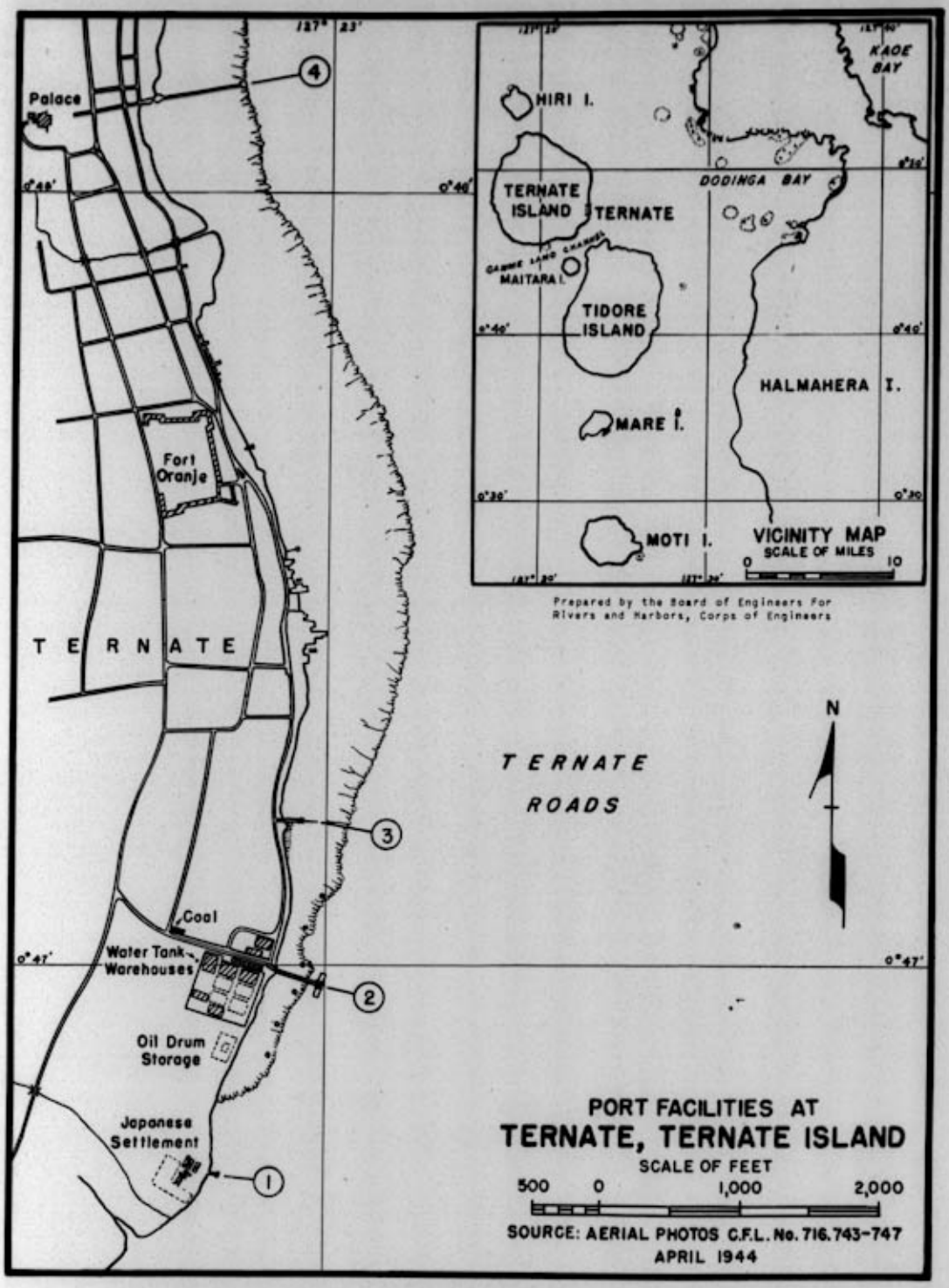

FIGURE VI - 1. *Ternate.*
Sketch showing location of Ternate (inset) and port plan showing location of facilities.

TABLE VI - 1

PIERS AND WHARVES AT TERNATE, TERNATE ISLAND

Reference number on map (FIGURE VI - 1)	1			2		
NAME	PIER			HERTOG HENDRIK PIER		
Location on water front	At Japanese settlement 1,600 yards south of Fort Oranje			About 1,100 yards south of Fort Oranje		
Owned and Operated by	No data			No data		
Purpose for which used	Landing for fishing boats			Handling general cargo		
Type of construction	No data; T-head pier, with 10-foot wide approach to pierhead			Metal screw piles, timber deck; T-head pier, with approach about 18 feet wide		
Description	Face (feet)	South side (feet)	North side (feet)	Face (feet)	South side (feet)	North side (feet)
Dimensions	40	20+15+60	20+15+60	198	40+90+300	40+90+300
Depth of water	No data	No data	No data	13	Under 13	Under 13
Berthing space available	40	None	None	198	40+90	40+90
Width of apron	Open wharf			Open wharf		
Deck above L.W.O.S.T.	No data			No data		
Capacity per square foot (lbs.)	No data			No data		
Lighted or unlighted	No data			Lighted		
Transit sheds	None			None		
Mechanical handling facilities	None			None		
Railway connections	None			2 narrow-gauge tracks along approach; trackage on pierhead		
Water supply	No data			Fresh water is available		
Electric current	No data			Electric current believed available		
Estimated capacity of terminal, short tons per day				Capacity 160 short tons per day		
Remarks	—			Depth of 33 feet at 66 feet off pierhead. Two buoys and 6 dolphins make berthing possible in depths from 13 to 33 feet, as convenient. Berthage 1,200-foot vessel with 12-foot draft		

Reference number on map (FIGURE VI - 1)	3			4		
NAME	RESIDENCY PIER			SULTAN'S PIER		
Location on waterfront	About 770 yards south of Fort Oranje			About 775 yards north of Fort Oranje		
Owned and Operated by	Netherlands East Indies Government			Sultan of Ternate		
Purpose for which used	Boat landing			Landing for small craft		
Type of construction	Timber open-pile			Timber open-pile		
Description	Face (feet)	South side (feet)	North side (feet)	Face (feet)	South side (feet)	North side (feet)
Dimensions	10	250	250	40	40+15+800	40+15+600
Depth of water	2	2-0	2-0	Shallow	—	—
Berthing space available	10	None	None	40	None	None
Width of apron	Open wharf			10	10	10
Deck above L.W.O.S.T.	No data			No data		
Capacity per square foot (lbs.)	No data			No data		
Lighted or unlighted	No data			No data		
Transit sheds	None			None		
Mechanical handling facilities	None			None		
Railway connections	None			None		
Water supply	None			No data		
Electric current	No data			No data		
Estimated capacity of terminal, short tons per day	—			—		
Remarks	Pavilion on inner end of pier, 60 by 20 feet			Pierhead lies at edge of shore reef. Circular pavilion, about 20-foot diameter, on pierhead.		

(*c*) *Clearance facilities.* The narrow-gauge tracks on Hertog Hendrik Pier ran inland about 700 feet to a coal storage shed and yard. Trucks had access from the 3 northernmost piers (Reference numbers 2, 3 and 4, TABLE VI - 1 and FIGURE VI - 1) to the island road system.

Vessels of the K.P.M. called regularly at Ternate.

The clearance capacity of the port is estimated to have been 160 short tons (2,000 pounds) of general cargo daily, handled at vessel berths, assuming an 8-hour day.

(*d*) *Availability of supplies.* Drinking water was obtained from a well near the Hertog Hendrik Pier. A motor pump connected to a pipe line on the pier had a capacity of 40 tons per day.

A storage depot for oil in drums and tins, located on the shore about 200 yards southwest of Hertog Hendrik Pier, has probably been destroyed by the Dutch.

A coal shed was located about 700 feet inland from Hertog Hendrick Pier.

(*e*) *Repair facilities.* A small repair shop, owned by local Japanese fishermen, was the only facility for the repair of vessels at Ternate.

FIGURE VI - 2. *Ternate.*
Hertog Hendrik Pier (Reference No. 2, Table VI-1 and Figure VI-1), showing T-head, looking northwest. Before 1938.

FIGURE VI - 3. *Ternate.*
Hertog Hendrik Pier (Reference No. 2, Table VI-1 and Figure VI-1), showing type of construction and railway tracks on approach to T-head, looking west.

FIGURE VI - 4. *Ternate.*
Hertog Hendrik Pier (Reference No. 2, Table VI-1 and Figure VI-1), showing steamer berthed alongside T-head, looking southeast.

B. Mindanao Sector.

(1) Surigao, Mindanao Island (9° 47′ N, 125° 30′ E).

Surigao is on the southwestern side of Hinatuan Passage near the northern tip of Mindanao Island (FIGURE VI - 5). It was a place of considerable importance, since most of the trade of eastern Mindanao passed through it. There were no landing facilities of commercial importance at Surigao itself. The port facilities and warehouses were at Bilanbilan, about ⅔ mile southeast of Surigao, with which it was connected by a good road.

Surigao River, discharging on the west side of the town, has about 1 foot of water on its bar at low water. Only small boats can enter. The ruins of an iron bridge near the mouth prevent large boats from entering.

(*a*) *Harbor.* Bilanbilan Bay is open to the northward, with depths of 10 to 15 fathoms. It is about 1¼ miles wide between Surigao lighthouse and a dangerous shoal to the east

A cove in the northwestern corner of Bilanbilan Bay forms a natural harbor, open northeastward (FIGURE VI - 5). The entrance to the harbor, about 400 yards wide, has depths of 6¾ to 10 fathoms. It recedes 400 yards westerly where it is 5 fathoms deep. There is a 4¼-fathom shoal in the middle and rocky obstructions off the southern side.

The port facilities were on Bilanbilan Point, the north side of the entrance to the cove (FIGURE VI - 5). Depths along the wharves were 7½ to 30 feet. Depths offshore increase rapidly. A narrow channel, with a controlling depth of 9 feet, rounds the southwestern end of the point.

A jetty northeast of the main wharf (Reference number 2, TABLE VI - 2 and FIGURE VI - 5) projected 80 feet seaward at right angles to the shore. It was awash at low water and although marked by a small beacon, constituted a danger in approaching the main wharf.

A fixed red light, 22 feet above high water and visible 7 miles, was exhibited from a concrete tower rising from the sea on the edge of the shore reef off Bilanbilan Point. Vessels could pass fairly close to the light as the water deepens rapidly outside it.

There is good anchorage about ¼-mile eastward or southeastward from the light in 14 to 16 fathoms over sandy bottom. Small vessels might find shelter in 9 feet of water behind the harbor point.

The tide at Surigao is chiefly diurnal. The mean higher high water interval is 10 hours, 47 minutes with range of 3.4 feet. The lowest tide is 1.5 feet below mean lower low water.

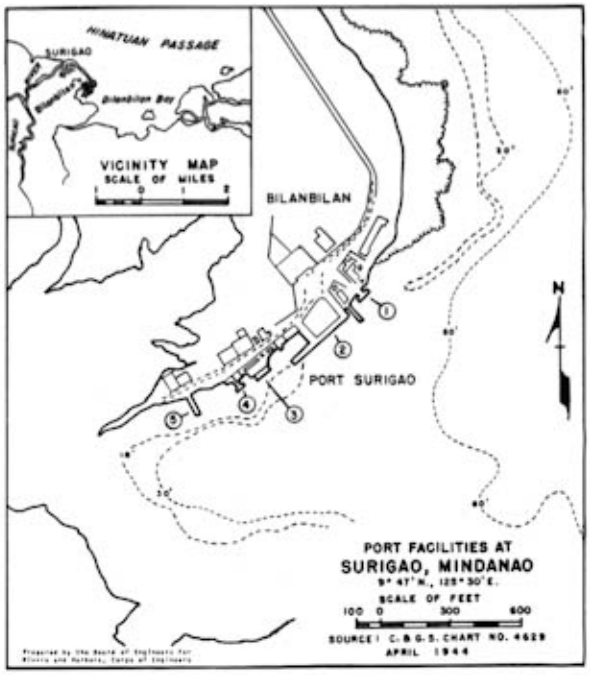

FIGURE VI - 5. *Surigao.*
Sketch showing location of Surigao (inset) and port plan showing location of facilities.

The mean annual temperature at Surigao is 80°, with a maximum of 90.8° and a minimum of 71.6°. The average annual rainfall is 142.49″ and the mean relative humidity 84.4 per cent. The prevailing winds from November through May are from northeast to east-southeast and from southwest to west-northwest the remainder of the year.

(*b*) *Landing facilities.* The facilities at Bilanbilan (Port Surigao) are listed in TABLE VI - 2 and are keyed into the port plan (FIGURE VI - 5).

The principal facility was the reinforced concrete wharf near the northeastern end of the waterfront (Reference number 2, TABLE VI - 2, and FIGURE VI - 5). In 1937 an extension of 69 feet was under way at the southern end and another extension of 98 feet on the northern end was proposed. Other proposed improvements included filling in the small basin behind the southern end of the wharf and construction of warehouses on the open area between the wharf and the road. The present status of this construction has not been determined. In June 1938, depths outside the protecting pile clusters ranged from 13 feet at the northeastern end to 30 feet at low water at the southwestern end. In December 1938, there was a depth of 21 feet at the westerly end of the wharf with shoaling to eastward. The controlling depth of 13 feet alongside the face of the wharf restricts berthage accommodation to one 200-foot vessel of 12-foot draft.

There was a warehouse at the Ong Hing Lian wharf (Reference number 3, TABLE VI - 2, and FIGURE VI - 5). Other warehouses were located at Bilanbilan. The main wharf was backed by an open area of over 10,000 square feet, apparently suitable for open storage.

Several tugs were based at Surigao and a few lighters were available.

TABLE VI - 2

PIERS AND WHARVES AT SURIGAO

REF. NO. ON MAP (Fig. VI-5)	FACILITY	LOCATION	DIMENSIONS	DEPTH OF WATER	REMARKS
1	T-head pier	Seaward of jetty, NE of concrete wharf (Ref. No. 2)	No data	2' off head	
2	Main wharf	Near NE end of waterfront, close inside of jetty	325' long (face) 29½' wide.	13' NE end 30' SW end	Reinforced concrete
3	Ong Hing Lian wharf	SW of main wharf (Ref. No. 2)	85' long (face)	7½'-18' at these landings	Wooden construction
4	T-head pier	SE of Ong Hing Lian wharf (Ref. No. 3)	No data		
5	Pier	SE end of waterfront	About 100'		

(*c*) *Clearance facilities.* There were 2 short roadways, each over 20 feet wide, connecting the concrete wharf with the provincial road which paralled the entire improved waterfront at Bilanbilan and provided the only road connection with Surigao.

Regular weekly steamship service was maintained with Cebu and Manila and small vessels operated from the port to points along the east coast of Mindanao and to nearby islands.

The clearance capacity of the port is estimated to have been 240 short tons (2,000 pounds) of general cargo daily, handled at the berth at the concrete wharf, assuming an 8-hour day.

(*d*) *Availability of supplies.* Diesel oil was stored in bulk and piped to an unidentified point on the waterfront, probably the main wharf. Supplies of food, gasoline, and lubricating oil were available in moderate quantities. A fresh-water pipe connection was available near the concrete wharf.

(*e*) *Repair facilities.* There were no facilities for repair work other than a small machine shop.

(2) Cagayan, Mindanao Island (8° 28' N, 124° 38' E).

Cagayan is on the Cagayan River about 2 miles from its mouth (FIGURE VI - 6). There were no landing facilities of commercial importance at Cagayan itself. The landing place for the town was located about 600 yards southward from the lighthouse on Macabalan Point (8° 30' N, 124° 39' E) near the head of Macajalar Bay. A good road connected it with Cagayan about 1¾ miles southwestward.

The Cagayan River, which discharges into the head of Macajalar Bay, has 1½ fathoms on its bar at low water, but the depths and direction of the channel across it are constantly changing with the freshets of the rainy season. Shoal water extends about ⅜ mile seaward from the river mouth. Small boats can enter the river at high water and proceed to the town above which the river is not navigable.

(*a*) *Harbor.* The harbor is an open roadstead south of Macabalan Point near the head of Macajalar Bay. The point is low and sandy, with deep water on its eastern side, but shoal water extends nearly ½ mile from the northern side.

Macajalar Bay is 16 miles wide at the entrance between Gorda and Sulauan Points and recedes about 12 miles southeastward. The shore of Gorda Point is clear and steep. The eastern shore of the bay is high and is formed by sandy beaches separated by low rocky points. The head of the bay is fringed by narrow coral reefs. The western shore is low and fringed by steep coral reefs. A coral reef, partly bare at low water, extends ¾ mile northward from Malugan Point and between this point and Sulauan Point there are 5 small detached reefs, none of which is ½ mile from shore. The shore of Sulauan Point consists of low coral cliffs alternating with sandy beaches. It is fringed by a coral reef to a distance of less than ½ mile. Part of the reef bares at low water.

The middle of the bay is deep and clear. There are no known detached dangers except Alutaya Reef, 3½ miles 240° from Gorda Point. The center of the reef bares at low water. The channel between the reef and the shore is about 2½ miles wide, with depths of over 100 fathoms.

Vessels could find anchor in 8 to 30 fathoms with the wharf bearing 328°.

A buoy moored in 3 fathoms, about 600 yards northward from the lighthouse, marked the eastern edge of shoal water northward of Macabalan Point. A fixed red light, 58 feet above high water and visible 9 miles, was shown from a tower on the north side of Macabalan Point.

The mean high water interval is 11 hours 27 minutes, with a diurnal range of tide of 4.2 feet and the mean range of tide is 2.7 feet.

(*b*) *Landing facilities.* The only facility at the port was a reinforced concrete wharf, about 380 feet long and 30 feet wide, located about 600 yards south of Cagayan Light near the head of Macajalar Bay (FIGURE VI - 6). Depths alongside varied (1938) from 25 feet at the northern end to 16 feet at the southern end with 19 feet midway along the face of the wharf. In 1939, a least depth of 20 feet was reported alongside. The area between the wharf and shore had been reclaimed. The wharf was lighted. Extensions to the wharf were proposed (1939), but the present status of these improvements is not known. Assuming a minimum depth of 20 feet, the wharf could provide berthing accommodations for one 350-foot vessel with a draft of 20 feet.

There were a cargo shed and a number of warehouses near the wharf.

(*c*) *Clearance facilities.* A good road connected the port with the town. A number of vessels called weekly from Cebu.

The unloading capacity of the port is estimated to have been 300 short tons (2,000 pounds) of general cargo daily, handled at the vessel berth, assuming an 8-hour day.

(*d*) *Availability of supplies.* Gasoline and lubricating oil were stocked in tins in small quantities. Diesel oil was not always available. The wharf was lighted. Fresh water was not available.

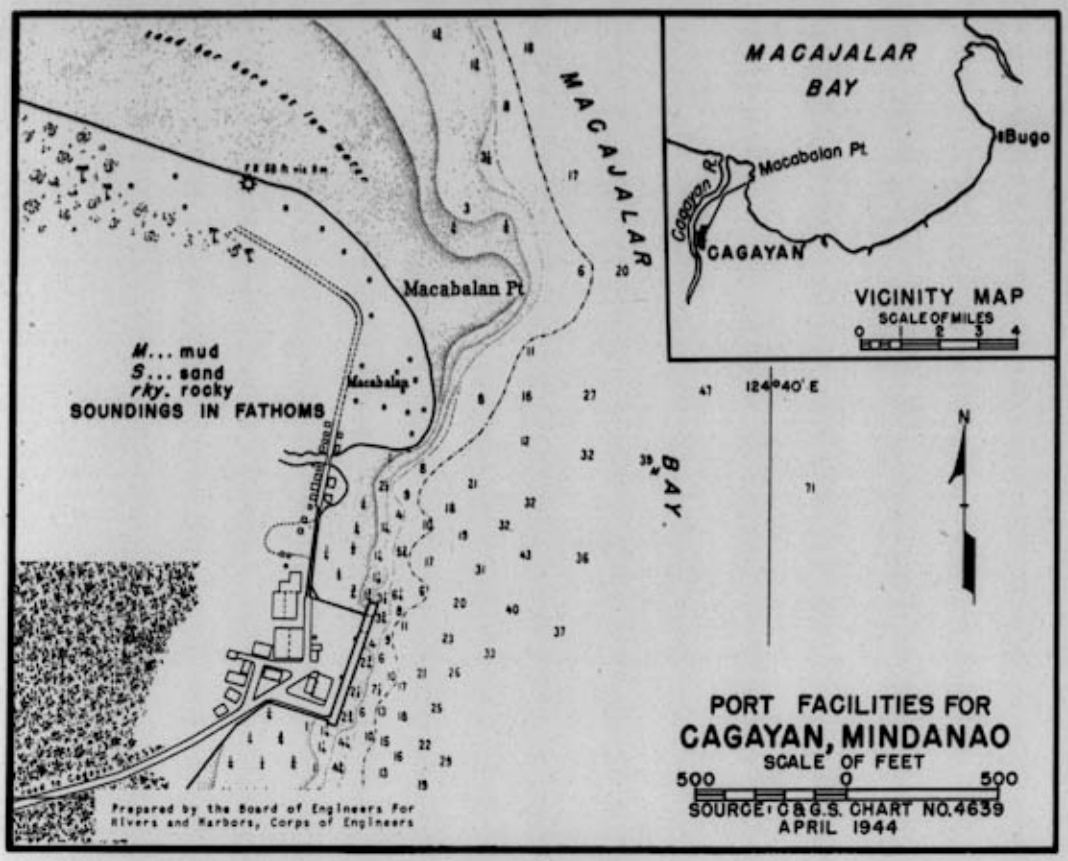

FIGURE VI - 6. *Cagayan.*
Sketch showing location of Cagayan (inset) and port plan showing location of facilities.

(*e*) *Repair facilities.* There were several small machine shops at Cagayan, where minor repairs could be made. Welding equipment was available, but no foundry work could be done.

(3) Iligan, Mindanao Island (8° 14' N, 124° 14' E).

Iligan is in the southeastern corner of Iligan Bay, on the north shore of the Iligan River, at its mouth (FIGURE VI - 7). It is the port through which the commerce of the Lake Lanao district of central Mindanao passed. The landing facilities were on the bay side of the town, north of the river entrance (FIGURE VI - 8).

The Iligan River empties into the bay on the south side of the town. It is small and unimportant, having less than 3 feet of water on its bar at low water.

(*a*) *Harbor.* The harbor is an open roadstead in the southeast corner of Iligan Bay. Iligan Bay, between Initao Point eastward and Polo Point westward, is about 33 miles wide and indents 23 miles.

The anchorage is bad and at times, during the northeast monsoon, is untenable. At such times vessels seek shelter in Quinalang Cove, 3 miles northward of Iligan, where anchorage, sheltered from the northeast monsoon, may be found in 20 to 25 fathoms, about ⅛ mile from the edge of the shore reef.

A fixed red light, 37 feet above mean high water and visible 7 miles, was shown from a tower located at the shore end of the pier.

The tidal currents at ebb run northward across the pier and are exceptionally strong when the Iligan River is in flood. The prevailing winds are northeast to east-northeast.

(*b*) *Landing facilities.* The only landing facility at Iligan was a reinforced concrete pier, 272 feet long and 39 feet wide (FIGURE VI - 7). Depths alongside range from 36 feet at the head to about 12 feet at the inshore end. A rock causeway 308 feet long and 36 feet wide connected the inner end of the pier to the shore. An area 36 by 66 feet was reclaimed on the north side of the causeway at its outer end. A shed 20 by 40 feet was constructed on this area. A rock bulkhead 98 feet long was constructed to the south at right angles to the outer end of the causeway.

The concrete pier was equipped with metal bollards and fender piles (FIGURE VI - 9). The pier was lighted.

Two 200-foot vessels with a draft of 12 feet could berth here, one on each side of the pier. A few broken piles mark the sites of the wharves formerly located at Camp Overton and Tominobo, about 2 and 1½ miles, respectively, south of Iligan.

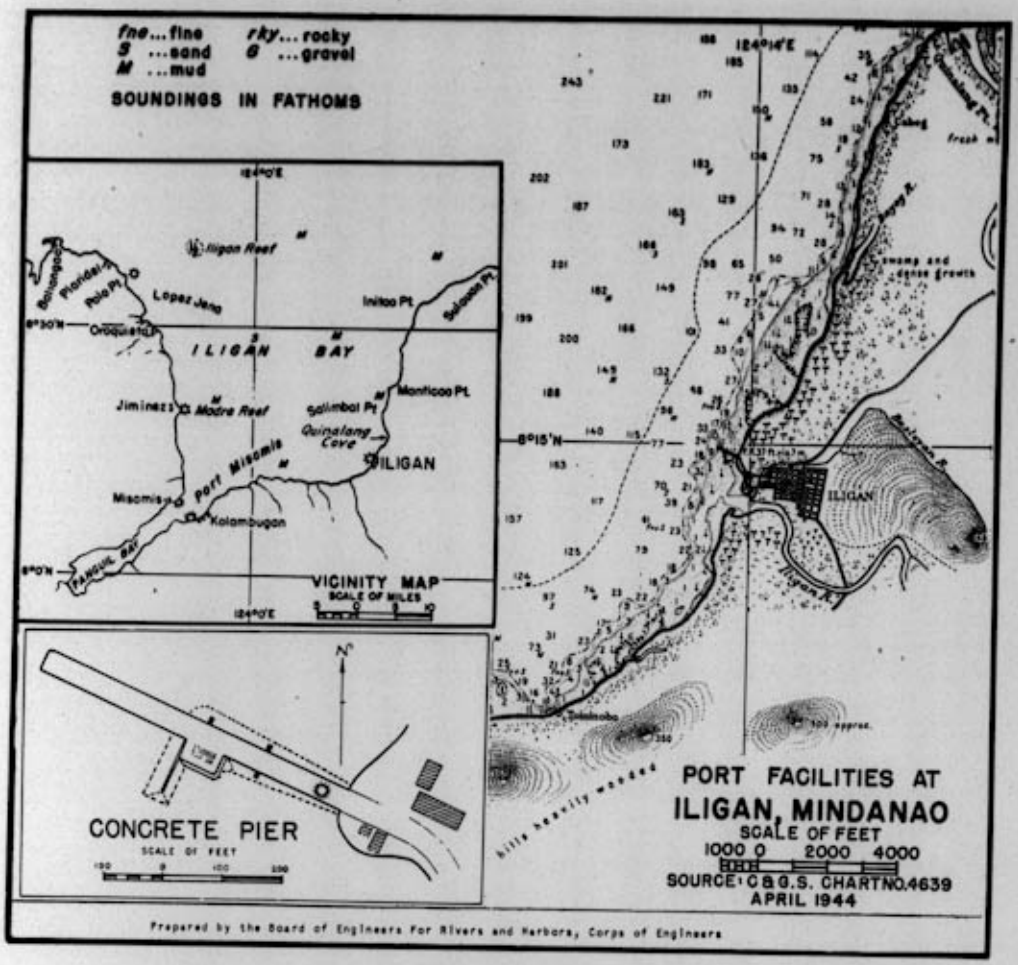

FIGURE VI - 7. *Iligan.*
Sketch showing location of Iligan (inset), details of pier (inset) and port plan showing location of facilities.

In addition to the cargo shed on the pier, 2 storage buildings were located at the root of the approaching causeway.

(*c*) *Clearance facilities.* A roadway connected the pier with the town. There was regular and frequent steamship connection with Cebu.

The unloading capacity of the port is estimated to have been 240 short tons (2,000 pounds) of general cargo daily, handled at the vessel berths, assuming an 8-hour day.

(*d*) *Availability of supplies.* Fresh water could be secured from pipe connection at the outer end of the pier. Gasoline, diesel oil, and lubricating oils were available in small quantities.

(4) Misamis, Mindanao Island (8° 09′ N, 123° 51′ E).

Misamis is on the northern shore of Port Misamis, an inlet in the southwestern corner of Iligan Bay (FIGURE VI - 10). The port was of considerable importance as an export point for lumber, corn, and copra. The landing facilities were about ¼ mile southeast of the town, near Misamis Point (FIGURE VI - 10).

(*a*) *Harbor.* The harbor, a small natural bay about 1 mile wide at its entrance between Misamis and Malaubang Points, recedes about ½ mile into the north shore of Port Misamis. Open to the southeast, it is protected from northeast winds by Misamis Point. Depths at the entrance average 4½ fathoms, decreasing toward the head of the bay. The 5-fathom contour does not enter the bay.

Port Misamis, including Panguil Bay, is a long narrow inlet extending southwesterly for about 22 miles. It is 9 miles wide at the entrance between Binuni and Loculan Points, and narrows until it is less than 1 mile wide about 12 miles from the entrance, beyond which it spreads to form Panguil Bay, a large shoal basin, which is navigated only by small launches. Binuni Point is low and surrounded by a fringing coral reef to a distance of about ⅓ mile. The shores of Port Misamis are low and covered with mangroves. North of Misamis Point there is an extended sandy shore. Immediately southward, on the opposite coast, there are high hills. Loculan Point, the western limit of Port Misamis, is low and sandy.

FIGURE VI - 8. *Iligan.*
Town and harbor, showing concrete pier near mouth of Iligan River, looking northwest.

FIGURE VI - 9. *Iligan.*
Concrete pier and causeway showing type of construction, looking southeast.

A number of charted reefs and shoals, some of which were marked by buoys, lie within the entrance to Port Misamis. The entrance should be approached cautiously.

There are two channels that lead into Panguil Bay and to Misamis, of which the eastern channel is the wider and most generally used.

Iligan Bay is described under Topic 61, C, (3), (a).

Good anchorage may be found southward and westward from Misamis Point, according to draft. A good berth for a large vessel is in 4½ fathoms of water, with the light bearing 36° true distant ¼ mile. Small vessels may anchor farther northward, about 200 yards southward from the piers.

A fixed red light visible 7 miles was shown from a tower on the southwest corner of the old fort at Misamis Point.

The high water interval at Misamis is 11 hours, 32 minutes. Higher high water height is 4.4 feet, and the lowest tide reaches 1.5 feet below mean low water.

The tidal currents at ebb flow eastward across the ends of the piers at Misamis.

(*b*) *Landing facilities.* The facilities at Misamis consisted of two piers, one privately owned and operated, and the other owned and operated by the Government.

The Government pier, easternmost of the two (Reference number 1, FIGURE VI - 10), consisted of a dumped rock causeway 235 feet long and 27 feet wide, with a 40-foot square steel sheet piling head, terminating in a reinforced concrete pier 187 feet long and 40 feet wide, on concrete piling. The depths alongside the pier were 20 feet in 1939. This pier had berths for 2 vessels 350 feet long with draft of 20 feet, one on each side, but the lengths of the berths would only permit 2 hatches on each vessel to be worked simultaneously.

The western lumber mill pier (Reference number 2, FIGURE VI - 10) consisted of a rock and earth causeway about 200 feet long with the pier extending about 250 feet seaward from its extremity. The pier was probably of timber construction. Depths were reported to range from 16 to 13 feet alongside at low water. This pier was lighted and water was piped onto it. There were industrial tracks on the causeway which lead to the mill. This pier could provide berthing accommodations for 2 vessels 200 feet long and 12 feet draft, one on each side.

(*c*) *Clearance facilities.* There was industrial trackage on the causeway but not on the pier at the lumber mill. Roads led from the piers to the town. There were no railroads.

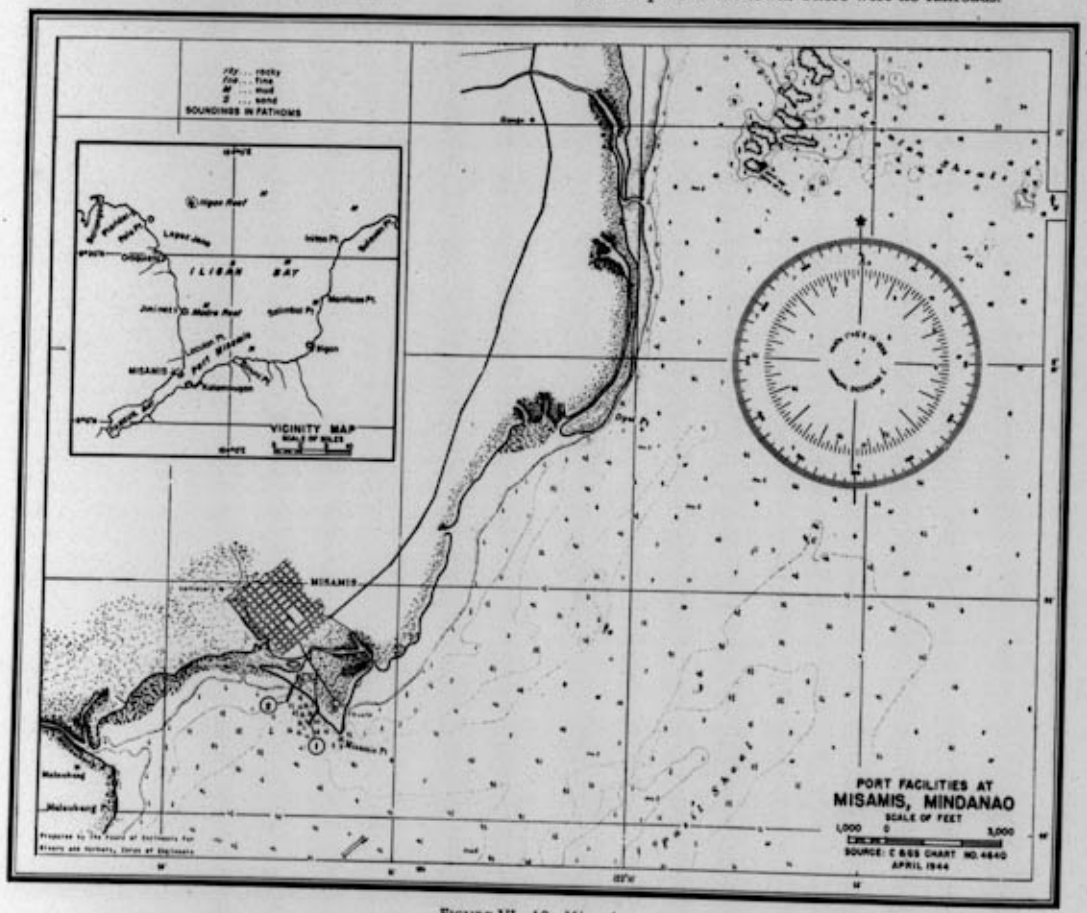

FIGURE VI - 10. *Misamis.*
Sketch showing location of Misamis (inset) and port plan showing location of facilities.

The unloading capacity of the port is estimated to have been 600 short tons (2,000 pounds) of general cargo daily, handled at vessel berths, assuming an 8-hour day.

(*d*) *Availability of supplies.* Water was available on the western pier. Gasoline in tins and diesel oil in drums were available in small quantities. The western pier was lighted. There were no coal supplies.

(*e*) *Repair facilities.* Minor machine-shop work could be done, but no welding or foundry equipment were available.

(5) Oroquieta, Mindanao Island (8° 29′ N, 123° 48′ E).

Oroquieta is on the western side of Iligan Bay on the northern coast of Mindanao Island, on the left bank and at the mouth of the Oroquieta River (FIGURE VI - 11). The landing is at Loboc, about 1 mile northwest of Oroquieta, with which it is connected by road. The Oroquieta River enters the bay just south of the town. There is only 1½ feet of water on the bar at low tide.

(*a*) *Harbor.* Loboc Cove, the harbor for Oroquieta, is an indentation in the coral reef, about 350 yards wide and 500 yards long, located about 1 mile northwest of the town. Approach to the pier is through a narrow break in the off-lying coral reef. A basin 500 feet wide is reported to have been dredged in the cove, which provides turning room for only small vessels. The cove is open to the eastward. Charted depths range from 6¼ fathoms at the entrance to about 3 fathoms at head of the pier, although depths along the northern side of the pier are reported to be 27 feet. The coral reef surrounding the cove, awash at low water, provides some protection from northerly and southerly seas. The hills of the coast provide some protection from southerly winds and good protection from westerly winds.

Iligan Bay is described under Topic 61, C, (3), (a).

Anchorage, protected from southerly and westerly winds, with good holding ground may be found about ¼ mile from shore in 12 fathoms of water, over muddy bottom, with the church bearing 227°. During the northeast monsoon this anchorage is untenable. Small steamers find sheltered anchorage in Loboc Cove where vessels moor fore and aft.

There were no navigation lights at Oroquieta.

(*b*) *Landing facilities.* The only facility at Oroquieta consisted of a dumped rock causeway 135 feet long and 20 feet

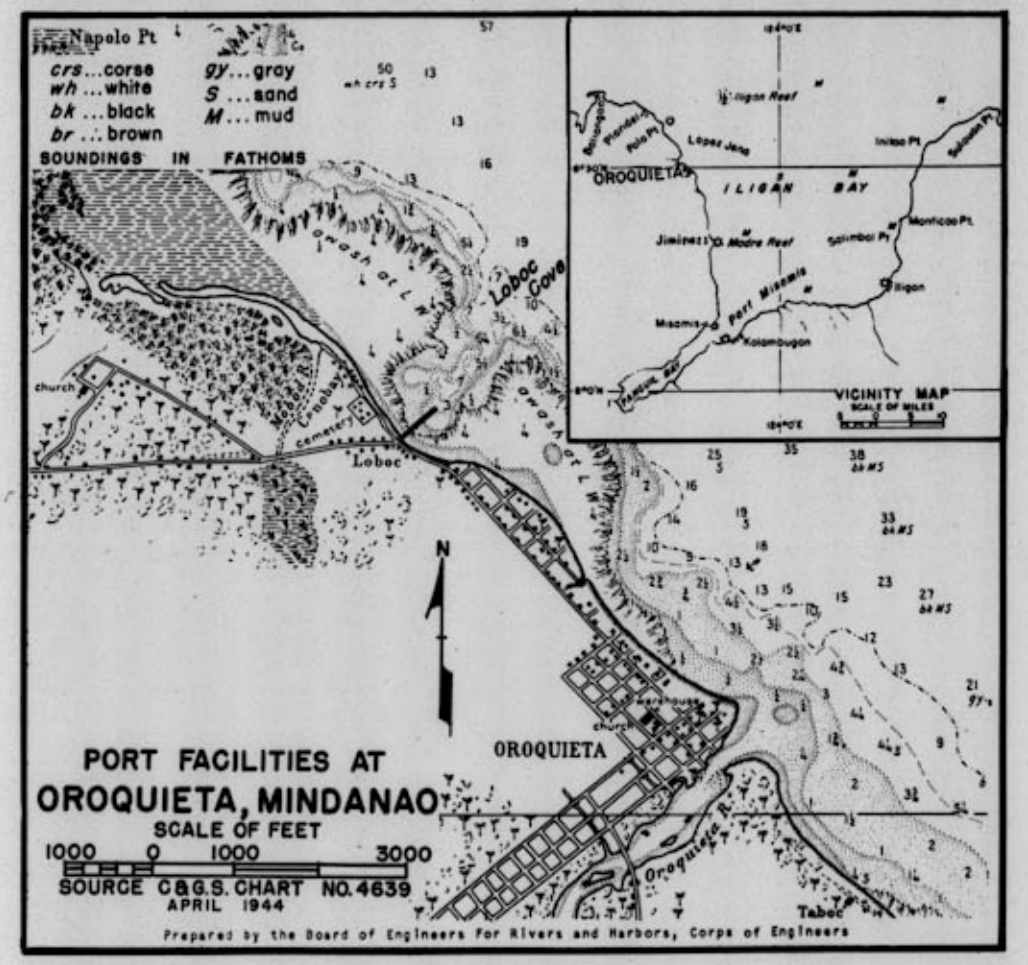

FIGURE VI - 11. *Oroquieta.*
Sketch showing location of Oroquieta (inset) and port plan showing location of facilities.

wide, with a rock-filled crib head 27 feet long and 33 feet wide, terminating in a reinforced concrete pier, 194 feet long and 30 feet wide, on piling (FIGURE VI - 11).

Depths of 10 feet were reported along the southern face and 27 feet along the northern face. Inadequate depths along the southern side of the pier and limited space in the harbor for maneuvering vessels are believed to have restricted the usefulness of the port to a berth for one 200-foot vessel of 12-foot draft along the northern side of the pier.

A large warehouse was reported to have been located in the town of Oroquieta. Proposed new port work included the construction of a cargo shed but the present status of the project is not known.

(*c*) *Clearance facilities.* There were no railroads. Roads led from the pier to the town of Oroquieta and to other points along the coast. Regular steamer communication was maintained with Cebu.

The discharge capacity of the port is estimated to have been 200 short tons (2,000 pounds) of general cargo daily, handled at the vessel berth, assuming an 8-hour day.

(6) Zamboanga, Mindanao Island (6° 54′ N, 122° 04′ E).

Zamboanga is on the southwestern extremity of Mindanao Island, facing Basilan Strait (FIGURE VI - 12). It is the principal city of Mindanao and the center of trade for southwestern Mindanao and the northern portion of the Sulu Archipelago. The only facilities of commercial importance were at the Government wharf, which consisted of a modern concrete pier and its accessory piers and wharves fronting an extensive reclaimed area on the southwestern side of the town (FIGURE VI - 13).

(*a*) *Harbor.* The harbor is an open roadstead in Basilan Strait. The harbor limits inclose an area about 2 miles long and ½ mile wide, with depths ranging from 10 to 45 fathoms. It is protected on the south by Little and Great Santa Cruz Islands, but is exposed to gales from the west and southeast. During the northeast monsoon the roadstead is sheltered and the water smooth.

An inner small boat harbor was formed behind a rock jetty, which projected about 900 feet south-southeasterly from the shore. A detached rock breakwater, about 420 feet long, lay about 200 feet southwest of and parallel to the bulkhead at the

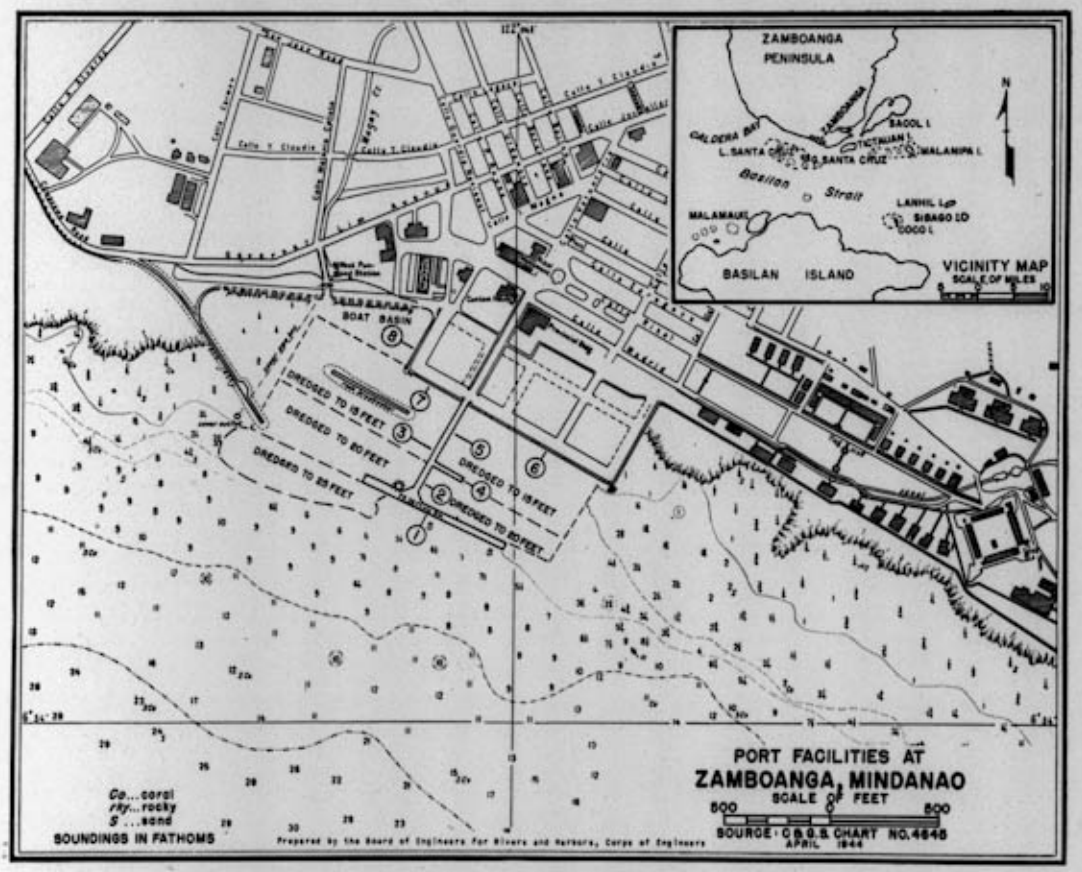

FIGURE VI - 12. *Zamboanga.*
Sketch showing location of Zamboanga (inset) and port plan showing location of facilities.

FIGURE VI - 13. *Zamboanga.*
Aerial view, looking southwest, showing harbor works. 9 January 1939.

root of the approach to the Government Wharf. The eastern extremity was about 200 feet westward from the approach. Depths in this inner harbor ranged from 5 to 20 feet.

A sewer outfall, marked by 4 piles, projecting but a short distance above high water, lay 215 yards from and on line with the outer face of the T-head of the Government Wharf and crossed the western part of the inner harbor.

Basilan Strait, separating Mindanao from Basilan Island, is 8½ miles wide and 24 miles long. The Santa Cruz Islands and Bank, on the Mindanao side of the strait, divide it into 2 channels, both equally navigable. The northern channel, although the narrower, is generally preferred by sailing vessels as it offers the advantage of an anchorage in case of a calm.

Santa Cruz Bank is a coral bank, the northern edge of which is 1½ miles from the coast of Mindanao. A channel with a least depth of 8 fathoms crosses the middle of the bank in a northwest-southeast direction.

Little Santa Cruz Island, on the northern edge of Santa Cruz Bank, about 2 miles southwestward from Zamboanga, is ¾ mile long and ⅛ mile wide. Each end is prolonged by a drying reef. Shoal water extends from the western reef for a distance of 1½ miles from the island.

Great Santa Cruz Island on the eastern end of the bank southeastward from the smaller island (from which it is separated from Little Santa Cruz by a channel 6 to 8 fathoms deep) is 1⅓ miles long and nearly 1 mile wide. It is fringed by a narrow reef.

The anchorage off Zamboanga is not good. The coast drops off rapidly and outside the 12-fathom contour the bottom is hard and uneven. Vessels anchor anywhere in front of the town, not going inside the 10-fathom contour as the water shoals rapidly. This anchorage is exposed to gales from the west and southeast. A heavy sea sets in with these gales and is increased when the flood stream sets against the wind.

An occulting white light, 64 feet above high water and visible 13 miles, was shown from the summit of Little Santa Cruz Island.

Before the war a fixed red light, 36 feet above high water and visible 9 miles, was shown from the T-head of the Government Wharf at Zamboanga.

At Zamboanga there are generally two tides in the lunar day; but at equinoctial quarterings, and when the moon has a high declination, there may be but one tide.

The high water interval at Zamboanga is 6 hours 29 minutes. The higher high water height is 3.3 feet, and the lowest tide subsides to minus 1.5 feet below mean lower low water.

In Basilan Strait, the tidal streams follow the direction of the channel. Near islands and shoals they follow the edge of the reefs, attaining velocities of 5 to 6 knots. The current sets both west and east with equal strength in the roadstead off Zam-

boanga, but it has been observed to set continuously eastward with varying velocity for 24 hours during a period of northwesterly winds. A current indicator is located on the wharf at Zamboanga.

The mean annual temperature is 79.8°, with a maximum of 92.1°, and 71.2° is the minimum. The average annual rainfall is 43.07 inches, and the mean relative humidity, 84.6 per cent.

(*b*) *Landing facilities.* The facilities at Zamboanga consisted of a reinforced concrete T-head wharf, approached by a reinforced concrete pier which extended from a reclaimed area fronted by a concrete bulkhead. A reinforced concrete boat pier extended eastward from the approach pier and parallel to the T-head wharf (FIGURE VI - 14). These facilities are listed in TABLE VI - 3 and are keyed to the port plan (Reference numbers 1 to 8, FIGURE VI - 2). The estimated unloading capacity is based on the handling of general cargo. An eight-hour day is assumed.

TABLE VI - 3

PIERS AND WHARVES AT ZAMBOANGA, MINDANAO ISLAND

Reference number on map (FIGURE VI - 12)	*1*			*2*
NAME	GOVERNMENT WHARF (T-head)			GOVERNMENT WHARF (Approach Pier—Outer end, eastern side)
Location on water front	Outer end of approach pier in front of town			Extends from Boat Pier to T-head
Owned and Operated by	State			State
Purpose for which used	General cargo and passengers			Coastal and medium sized craft. General cargo
Type of construction	Reinforced concrete deck on concrete piling. Has pile cluster feeders			Reinforced concrete deck on concrete piling
	Face or Outer Side	Inner Western Side (feet)	Inner Eastern Side (feet)	Face (feet)
Description				
Dimensions	800	165	480	140
Depth of water	25-30	20	20	20
Berthing space available	800	165	480	140
Width of apron	Open wharf			Open wharf
Deck above low water	No data			No data
Capacity (lbs. per sq. ft.)	No data			No data
Lighted or unlighted	Lighted			Lighted
Transit sheds	None			None
Mechanical handling facilities	None			None
Railway connections	None			None
Water supply	Fresh water available			Fresh water available
Electric current	No data			No data
Estimated capacity of terminal, short tons per day	1,100			
Remarks	Berthage for one 600-foot, 450-foot, and 200-foot vessel with drafts of 30, 20, and 12-foot, respectively			

Reference number on map (FIGURE VI - 12)	*3*	*4*		
NAME	GOVERNMENT WHARF (Approach Pier-Western side)	GOVERNMENT WHARF (Boat Pier)		
Location on water front	Extends from shore to T-head	Extends eastward from approach pier		
Owned and Operated by	State	State		
Purpose for which used	Coastal and small craft, general cargo	Coastal and small craft, general cargo		
Type of construction	Reinforced concrete deck on concrete piling	Reinforced concrete deck on concrete piling		
Description	Face (feet)	Face (feet)	North side (feet)	South side (feet)
Dimensions	465	29.5	178	178
Depth of water	15-20	20	15	20
Berthing space available	465	29.5	178	178
Width of apron	Open wharf	Open wharf		
Deck above low water	No data	No data		
Capacity (lbs. per sq. ft.)	No data	No data	No data	No data
Lighted or unlighted	Lighted	Lighted	Lighted	Lighted

TABLE VI - 3 (Continued)

Reference number on map (FIGURE VI - 12)	3	4
Transit sheds	None	None
Mechanical handling facilities	None	None
Railway connections	None	None
Water supply	Fresh water available	Fresh water available
Electric current	No data	No data
Estimated capacity of terminal, short tons per day	400	100
Remarks	Berthage: 2 class F	Berthage: 1 class F (south side)

Reference number on map (FIGURE VI - 12)	5	6
NAME	GOVERNMENT WHARF (Approach Pier—inshore end, eastern side)	GOVERNMENT WHARF (Eastern bulkhead)
Location on water front	In rear of Government Wharf	Eastward from approach pier and fronting reclaimed area
Owned and Operated by	State	State
Purpose for which used	Lighters and small coastal craft	Lighters and small craft. General cargo
Type of construction	Reinforced concrete deck on concrete piling	Concrete bulkhead wall with a filled area behind
Description	Face	Face
Dimensions	(feet)	(feet)
Depth of water	280	850
Berthing space available	15	15
Width of apron	280	850
Deck above low water	Open wharf	Open wharf
Capacity (lbs. per sq. ft.)	No data	No data
Lighted or unlighted	No data	Unlimited
	Lighted	No data
Transit sheds	None	None
Mechanical handling facilities	None	None
Railway connections	None	None
Water supply	Fresh water available	No data
Electric current	No data	No data
Estimated capacity of terminal, short tons per day	120	450
Remarks	Berthage: 1 Class F	Berthage: 2 class F Has 5 stairway landings at intervals along face

Reference number on map (FIGURE VI - 12)	7	8
NAME	GOVERNMENT WHARF (Western bulkhead)	GOVERNMENT WHARF (Boat Basin Quay)
Location on water front	Westward from approach pier and fronting reclaimed area.	Western end of reclaimed area
Owned and Operated by	State	State
Purpose for which used	Lighters and small craft. General cargo.	Lighters and small craft. General cargo
Type of construction	Concrete bulkhead wall with fill area behind.	Concrete bulkhead wall with fill area behind.
Description	Face	Face
Dimensions	(feet)	(feet)
Depth of water	300	300
Berthing space available	15	4½-6
Width of apron	300	300
Deck above low water	Open wharf	Open wharf
Capacity (lbs. per sq. ft.)	No data	No data
Lighted or unlighted	Unlimited	Unlimited
	No data	No data
Transit sheds	None	None

TABLE VI - 3 (Continued)

Reference number on map (FIGURE VI - 12)	7	8
Mechanical handling facilities	None	None
Railway connections	None	None
Water supply	No data	No data
Electric current	No data	No data
Estimated capacity of terminal, short tons per day	250	—
Remarks	Berthage: 1 class F	

FIGURE VI - 14. *Zamboanga.*
Aerial view of Government Wharf prior to completion of bulkheads and breakwaters, showing type of construction. 15 September 1936.

The reclaimed section, probably available for open storage, had an area of about 11 acres. There were about 1,970 linear feet of bulkhead, of which about 1,450 linear feet were usable as quays by small craft (FIGURE VI - 15).

There were a customs warehouse and numerous private warehouses and storage sheds. The private warehouses had a capacity of about 5,000 tons.

A commercial towing company had 4 light towing launches and 2 small sea-going tugs. Six sea-going and 4 harbor lighters of 50 to 100 tons capacity were available.

(*c*) *Clearance facilities.* There were no cranes. All cargo was handled by ship's tackle and was hauled to and from the ship's side by trucks.

There were no railroads.

Roads led from the wharf to the town and warehouses and connected to the highways which extended along the coast.

Experienced gangs of native stevedores were available. The discharging rate was from 15 to 30 tons per stevedoring gang per hour depending on the cargo. The loading rate for lumber was about 10,000 board feet per hatch per hour.

The discharge capacity of the port is estimated to have been 2,420 short tons (2,000 pounds) of general cargo daily, handled at vessel berths, assuming an 8-hour day.

(*d*) *Availability of supplies.* Water in ample quantities and of good quality was available on the wharf.

No bunker coal or fuel oil was available. The wharf was lighted.

(*e*) *Repair facilities.* There were no dry docks. Facilities for repairs were limited. The marine railway at Zamboanga was capable of hauling out a vessel of 50 tons, with a length of 100 feet and draft of 9 feet. There was a machine shop in Zamboanga where small repair work could be done.

(7) Cotabato, Mindanao Island (7° 14′ N, 124° 15′ E).

Cotabato is on the left bank of the north branch of the Mindanao River about 5¼ miles above Cotabato entrance through

FIGURE VI - 15. *Zamboanga.*
Aerial view, looking northwest, showing reclaimed area and detached breakwater. 9 January 1939.

which it reaches Illana Bay (FIGURE VI - 16). It was the center of trade for the Mindanao Valley and the surrounding coastal area. The landing facilities were located in front of the town along the south shore of the Mindanao River.

(*a*) *Harbor.* It is a river port, communicating with Illana Bay by a channel with a least width of about 60 yards and a controlling depth (1939) of 5 feet over the bar at the entrance. The bar at Cotabato entrance is reported to be shoaling gradually, and is subject to change during freshets. In 1939 it could be crossed at high water by small vessels drawing 8 to 9 feet. Local knowledge is necessary both for crossing the bar and navigating the river.

At 21 miles above the sea the river divides into 2 arms which discharge into Illana Bay about 4½ miles apart, forming an extensive delta. Numerous small channels connect the 2 arms. The northern arm on which Cotabato is located, is the wider and deeper and is navigable for small steamers to the port. Local river boats drawing 5 to 7 feet normally operate from Cotabato to Paidu-Pulangi, 27 miles upstream, and at periods of high water the same boats continue up the river a distance of 52 miles. The larger ocean-going vessels which formerly called at Cotabato now anchor outside and discharge into lighters. A number of private beacons marked the channel to Cotabato.

Opposite the town the river is from 300 to 400 yards wide. The bottom is soft mud. The channel, between the town waterfront and 2 islets in midstream (FIGURE VI - 17), forms a basin with an area of about 15 acres and depths of 5 to 18 feet. Because of the strong current it is difficult to turn a vessel during ebb tide.

The best anchorage is in Illana Bay, northwest of Cotabato entrance, in depths of 5 to 20 fathoms over mud bottom about 1 mile from shore. At times during the height of the southwest monsoon this anchorage becomes decidedly uncomfortable. Small vessels can anchor closer inshore, in depths of 9 to 15 feet, over mud on the edge of the reef northeastward of Panalisan Point, the northern point of Cotabato entrance.

A flashing white light, 33 feet above high water and visible 7 miles from 65° to 204°, was located on the southern point of Cotabato entrance.

The high water interval at Cotabato is 7 hours, 05 minutes. The height of higher high water is 3.5 feet above mean lower low water. The lowest tide is 1.5 feet below mean lower low water. The currents in Mindanao River are strong. Tide rips occur off Cotabato entrance. The tidal currents in Illana Bay flood southward and ebb northward.

The mean annual rainfall is 89.73 inches.

(*b*) *Landing facilities.* The facilities at Cotabato are keyed to the port plan (FIGURE VI - 16). A concrete and sheet piling quay about 725 feet long was constructed along the river bank (Reference number 1, FIGURE VI - 16). The depths alongside in June, 1937, ranged from 7 to 14 feet at low water. The eastern of two small municipal wharves (Reference number 3, FIGURE VI - 16) had a depth of 14 feet alongside; the western wharf (Reference number 2, FIGURE VI - 16) had a depth of 4 feet. There were no cranes.

A shed, approximately 200 feet by 25 feet, in the rear of the quay, was probably a warehouse (FIGURE VI - 18). In the immediate vicinity of the quay an area of about 2 acres was available for open storage space.

Lighters and tugs were available for the transportation of cargo to and from the anchorage off the river mouth.

(*c*) *Clearance facilities.* Before the war there was regular steamboat communication with Davao and with Manila via Zamboanga. Several small river steamers or motorboats made daily trips to Paidu-Pulangi, 27 miles up the river from Cotabato, and at periods of high water these boats continued up the river to Fort Pikit, a distance of 52 miles. There were no railroad facilities in the port. Trucks had access from the waterfront to the island road system.

(*d*) *Availability of supplies.* Fresh water was scarce. Diesel oil, gasoline, and kerosene were obtainable.

(*e*) *Repair facilities.* Only minor repairs were possible at a small machine shop. Welding equipment was available.

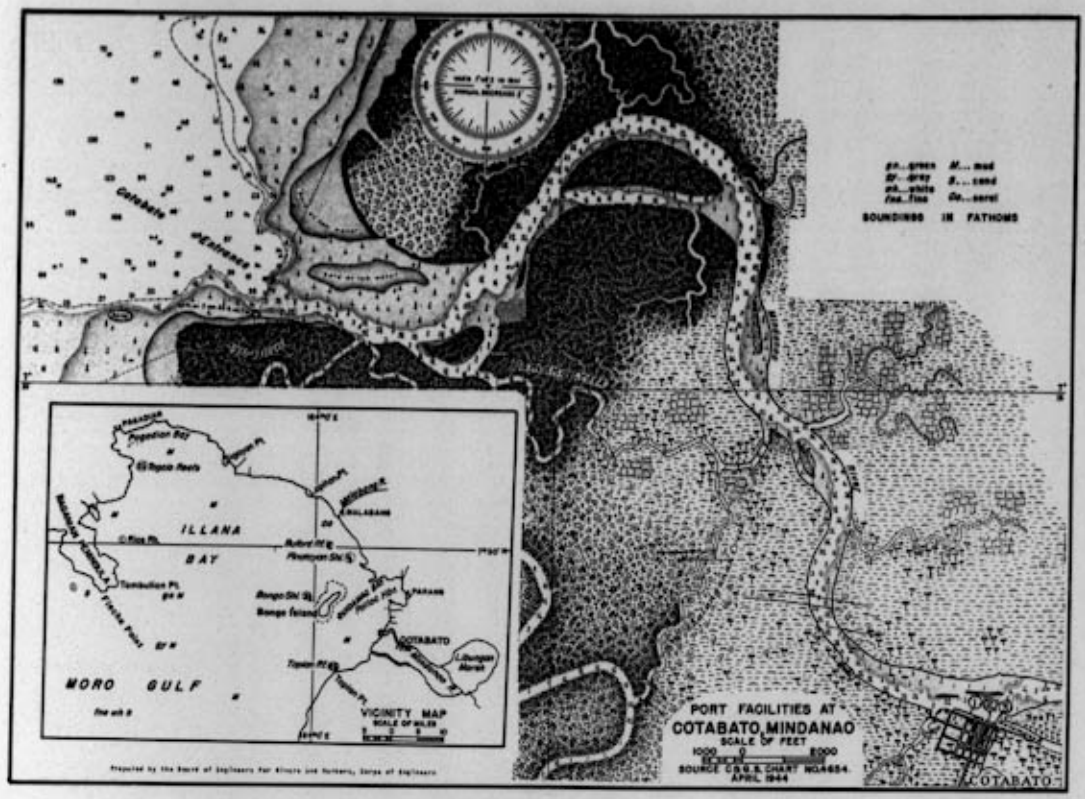

FIGURE VI - 16. *Cotabato.*
Sketch showing location of Cotabato (inset) and port plan showing location of facilities.

(8) Davao, Mindanao Island (7° 04′ N, 125° 37′ E).

Davao is close to the mouth and on the north bank of Davao River in the northwestern part of Davao Gulf (FIGURE VI - 19). It was the commercial center of southern Mindanao and the leading Philippine port for the export of hemp. The port area is at Santa Ana, about 1 mile to the east-northeastward. Practically all of the trade of Davao was handled at the Government Pier at Santa Ana, which had highway connection to Davao. Other landings within the harbor limits were located at Ipil, Lanang Point, the petroleum terminal for Davao (FIGURE VI - 20), Ilang and Tambungon, 1½, 3¼, 7¼, and 10¾ miles, respectively, northeast of Santa Ana.

The Davao River was little used except by fishermen, and local knowledge is necessary for crossing the shoal area across its mouth. There are depths of only 2 or 3 feet on the bar at low water and the channel changes frequently in freshets.

(a) Harbor. The limits of Davao Harbor include the area of Davao Gulf, west and northwest of Samal Island, from Dumalag Point, about 3 miles southwest of the mouth of the Davao River, to the mouth of the Lasang River, about 13½ miles northeast of the Davao River (FIGURE VI - 19).

Davao Gulf is about 35 miles wide at the entrance between Cape San Agustin and Calian Point, and recedes northward about 70 miles. Samal and Talikud Islands lie in the northern part of the gulf. The area north of the islands is well protected and rarely becomes rough, even at the height of the monsoon. The middle of the gulf is deep and clear. The shoals which fringe the western shore do not extend seaward over 1½ miles, while in the eastern part of the gulf there are a number of dangerous detached shoals and reefs lying from 3 to 4 miles from the coast and foul ground at a lesser distance.

The harbor at Santa Ana is naturally sheltered from west to north by the mainland, and to some extent from northeast to east by Samal Island. During the southwest monsoon the sea is choppy. Off Santa Ana, the 5-fathom contour is 200 to 400 yards offshore. The approach from the southward is deep and clear of dangers. The northern approach is through Pakiputan Strait, which separates Samal Island from the mainland and has a minimum mid-channel depth of 14 fathoms. This strait is ½ mile wide and has a depth of 19 fathoms in the narrowest part. A 2¼-fathom rocky detached shoal lies near the southern entrance, ½ mile offshore and 2 miles 56° from the northern entrance point to the Davao River. There are several dangers in the northern part of the strait.

From Dumalag Point to the mouth of the Davao River, the coast is low, swampy, and bordered by a sandy beach. Shoal water extends about ¼ mile offshore, beyond which the water deepens rapidly.

The harbor at Ipil is a small basin formed by a break in the shore reef, near the southern entrance to Pakiputan Strait.

FIGURE VI - 17. *Cotabato.*
Aerial view of Cotabato, looking northwest.

At Lanang Point, the harbor is an open roadstead on the western side of Pakiputan Strait. The strait at this point is narrow and there are several dangers in the approaches. From the Davao River to Lanang Point the coast is sandy and has broad sand flats exposed at low water, the outer edges of which are steep for the first 2 miles. Along the last 3 miles of this coast, the underlying coral is exposed at low water along the outer edge of the sand flat.

Ilang, on the mainland west of Bassa Point at the northern extremity of Samal Island, was the shipping terminal of a lumber company. A narrow channel winds among the reefs to a small anchorage near the shore. It was marked by private buoys but was navigable only by small boats with local knowledge. A beacon marked the northern side of the entrance.

Tambungon, a shipping point for logs, lies in a bight midway between the Bunawan and Lasang Rivers, near the northern limit of Davao Harbor. Midway in the bight there is a coral reef ¾ mile long and ⅛ mile wide, which is awash at the lowest tides.

From Lanang Point to the mouth of the Lasang River the coast is low and flat, with heavy timber and jungle growth to the water's edge.

There is anchorage for large vessels off the Santa Ana pier. Vessels anchor either 450 yards northeast or southeast of the end of the pier in a depth of 12 fathoms over mud bottom. The anchorage is open to southerly and southwesterly winds.

A fixed red light, 53 feet above high water and visible 7 miles, was located on the beach at Santa Ana, southwest of the pier.

At Ilang, vessels anchor in 20 fathoms, over mud, off the southernmost of 2 mooring floats which were maintained for the use of log rafts. A small anchorage near the shore, with depths of 4 to 5 fathoms, is accessible to small craft with local knowledge of the narrow winding channel.

At Tambungon there is anchorage about 0.6 mile offshore in 10 to 20 fathoms, over mud.

The high water interval at Santa Ana is 6 hours, 13 minutes. Higher high water rises 5.1 feet above mean lower low water. The lowest tide is 1.5 feet below mean lower low water. Off Santa Ana, the tidal current runs parallel to the shore with a velocity of about 2 knots.

The currents in Pakiputan Strait run about 2½ knots, and occasionally set southward both with a rising and falling tide, usually during strong northerly winds, or after water has been accumulated at the head of the gulf by a southwest gale.

The mean annual temperature is 80.4°, with a maximum of 99.1° and a minimum of 62.4°. The average relative humidity at 6 a.m. and 2 p.m. is, respectively, 96.0 and 68.2 per cent, and the average annual rainfall is 90.14 inches. From December through April the prevailing winds are from north to east-northeast, and from May through November, southeast to west-northwest.

(*b*) *Landing facilities.* The principal facilities in Davao Harbor are keyed to the port plan (FIGURE VI - 19).

The Government Pier at Santa Ana (Reference number 1, FIGURE VI - 19) consisted of a reinforced concrete outer section 75 feet by 326 feet and a solid-fill inner section 75 feet by 238 feet, with steel sheet piling along the north side. In August 1940, the depth at the head of the pier was 25 feet. On the north side there was 25 feet at the outer end, gradually shoaling to 10 feet about 180 feet inshore. On the south side, there was 16 feet at the outer end, gradually shoaling to 6 feet about 180 feet inshore. Dredging proposed would have provided a berth on the north side of the pier about 490 feet long, with a depth of 30 feet, and a berth 260 feet long and 15 feet deep along the outer part of the south side. The present status of this improvement is unknown.

All cargo was moved by flat rail trucks from wharf to warehouse.

The pier was lighted. The pier could probably accommodate 1 vessel 200 feet long with 12-foot draft on the north side.

At Ipil, 1½ miles northeast of Santa Ana, there was a small pier (Reference number 2, FIGURE VI - 19).

At Lanang Point, 3¼ miles northeast of Santa Ana, were the wharf and buildings of the International Harvester Company and the wharf and oil storage tanks of the Asiatic Petroleum Company (References numbers 3 and 4, FIGURE VI - 19). These wharves, about 150 yards apart, the former of open timber pile, and the latter of concrete construction, were built parallel to shore, with approach platforms. The outer face of each wharf was about 200 feet long, with a depth of about 26 feet alongside. The Asiatic Petroleum Company wharf had a 1-ton hand crane and pipelines to the storage tanks. (FIGURES VI - 20 and VI - 21).

At Ilang, 7¼ miles north-northeast of Santa Ana, there was a small timber pier (Reference number 5, FIGURE VI - 19) serving the sawmill, which was the terminus of a logging railway.

Tambungon, 10¾ miles north-northeast of Santa Ana, was the terminus of a logging railway. A stone pier (Reference number 6, FIGURE VI - 19), 1,300 feet long, with a depth of 15 feet at its end, extended from shore over a mud flat, which is practically bare at low tide.

There were several private warehouses in the rear of the Government Pier at Santa Ana. Details of 5 of these are shown in TABLE VI - 4.

FIGURE VI - 18. *Cotabato.*
Aerial view of Cotabato showing port facilities. 21 January 1935.

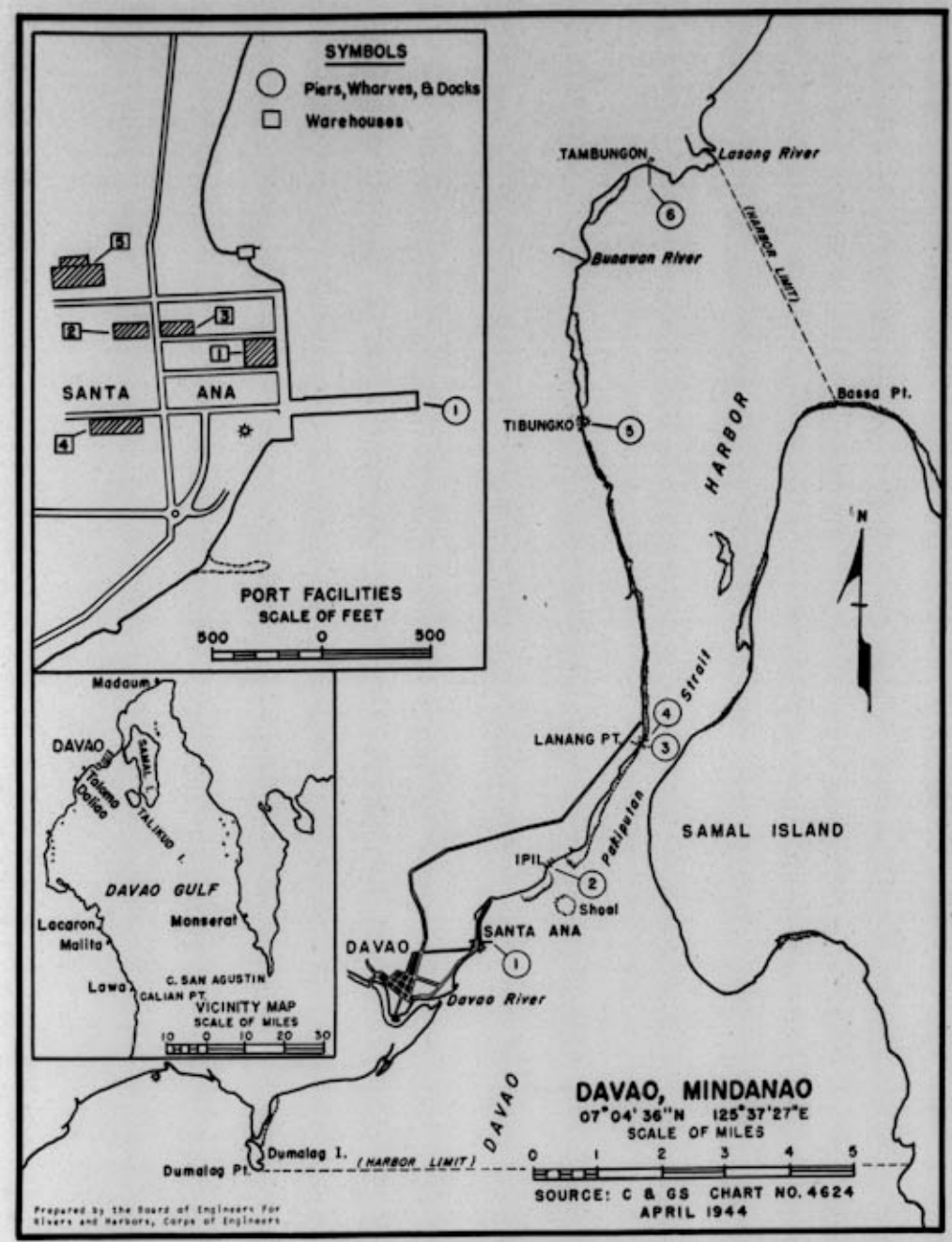

FIGURE VI - 19. *Davao.*
Sketch showing location of Davao (inset), port plan showing location of facilities (inset) and area within the harbor limits.

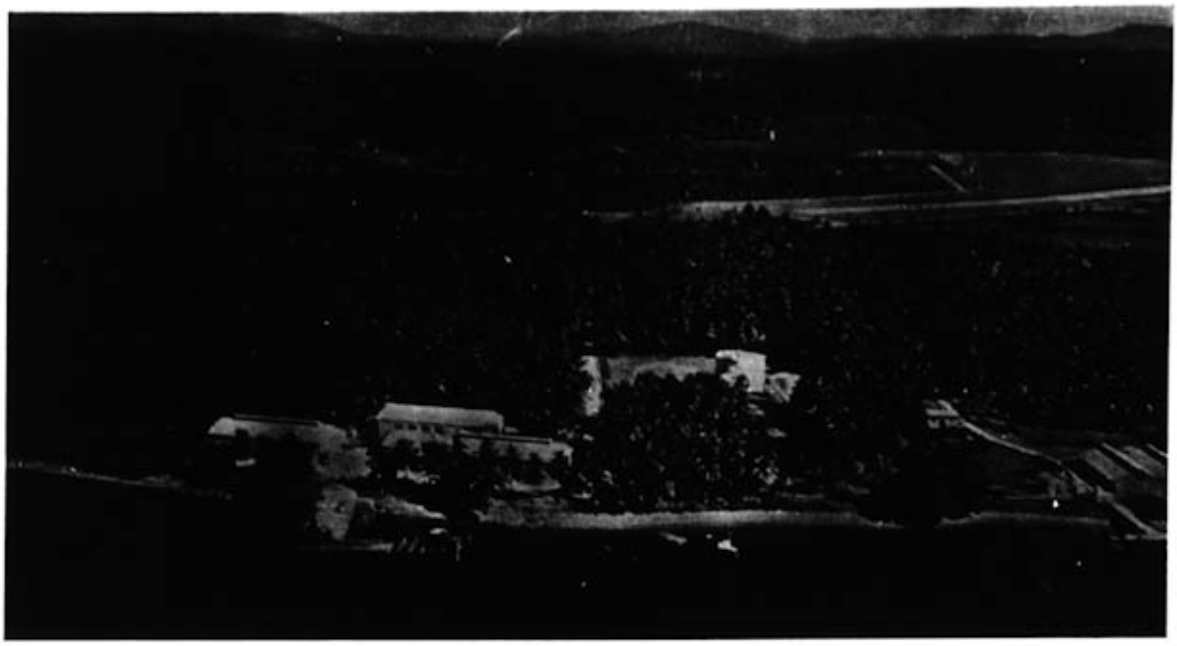

FIGURE VI - 20. *Davao.*
Aerial view of Lanang Point installations, looking west-northwest, showing facilities of International Harvester Company (left) and Asiatic Petroleum Company (right).

TABLE VI - 4
WAREHOUSES AT DAVAO, MINDANAO

REF. NO. ON MAP (FIGURE VI-19)	OWNER OR OPERATOR	APPROXIMATE DIMENSIONS	ESTIMATED GROSS FLOOR SPACE
1	Ker & Co. (FIG. VI - 22)	125′ x 130′	16,250 sq. ft.
2	Hanson, Orth & Stevenson	160′ x 65′	10,400 sq. ft.
3	Columbian Rope Co.	135′ x 90′	12,150 sq. ft.
4	International Harvester Co.	235′ x 65′	15,275 sq. ft
5	Mitsui Bussan Kaisha	225′ x 120′	27,000 sq. ft.
	Total		81,075 sq. ft.

The storage capacity of the warehouses has been estimated at about 4,000 tons. Open storage space, about 1 acre in extent, was available in a park adjacent to the pier.

There were 2 warehouses at Ipil. A warehouse, 180 feet by 100 feet, was located in the rear of the Asiatic Petroleum Company wharf, at Lanang Point.

Harbor craft based at the port on June 30, 1940 is listed in TABLE VI - 5.

TABLE VI - 5
HARBOR CRAFT AT DAVAO, MINDANAO

NUMBER	TYPE	NET REG. TONS
15	Lighters	1,785
11	Scows	1,635
33	Fishing boats	——
35	Launches	——

Two sea-going tugs were also available. There were no lighters for handling bulk liquid.

(*c*) *Clearance facilities.* A road connected Davao with Santa Ana, Lanang Point, and Ilang. There were no railroad facilities at Santa Ana, and only logging railways to Tibungko and Tambungon.

Stevedores were available. The loading rate for hemp and copra was 10 tons per gang per hour, and for logs or lumber, 8,000 to 10,000 board feet per gang per hour. The rate of discharge was 20 tons per gang per hour for general cargo, and 6,000 to 10,000 board feet for lumber per gang per hour.

(*d*) *Availability of supplies.* Fresh water, suitable for boiler purposes, was piped to the pier at Santa Ana. Coal and bunker fuel oil were not available. Gasoline, diesel oil, and lubricating oil in tins and drums were available at Santa Ana. At the Asiatic Petroleum Company Wharf at Lanang Point, diesel oil and gasoline were supplied to shipside by pipelines from 2 large and 2 small storage tanks. Food, ice, and other supplies were available.

(*e*) *Repair facilities.* Japanese sources report that a shipbuilding yard for medium-sized vessels has been established at Santa Ana. Only minor repairs were possible. There was a machine shop in the town and welding and casting equipment were available. About 600 yards north of the pier at Santa Ana there was a small private marine railway, entirely bared at low water, for handling craft up to 40 feet long and not over 4 feet draft.

C. Sulu Archipelago.

*(1) **Jolo, Jolo Island.*** (6° 04′ N, 121° 00′ E, HO chart 4513).

Jolo is a provincial capital and a port of entry at the northeast corner of a small indentation in the northwestern part of the island of Jolo. It was the only important port in the Sulu Archipelago and had an extensive trade, primarily with the other islands of the Philippines (FIGURE VI - 23).

FIGURE VI - 21. *Davao.*
International Harvester Company Wharf, looking south-southeast, showing type of construction. After 1938.

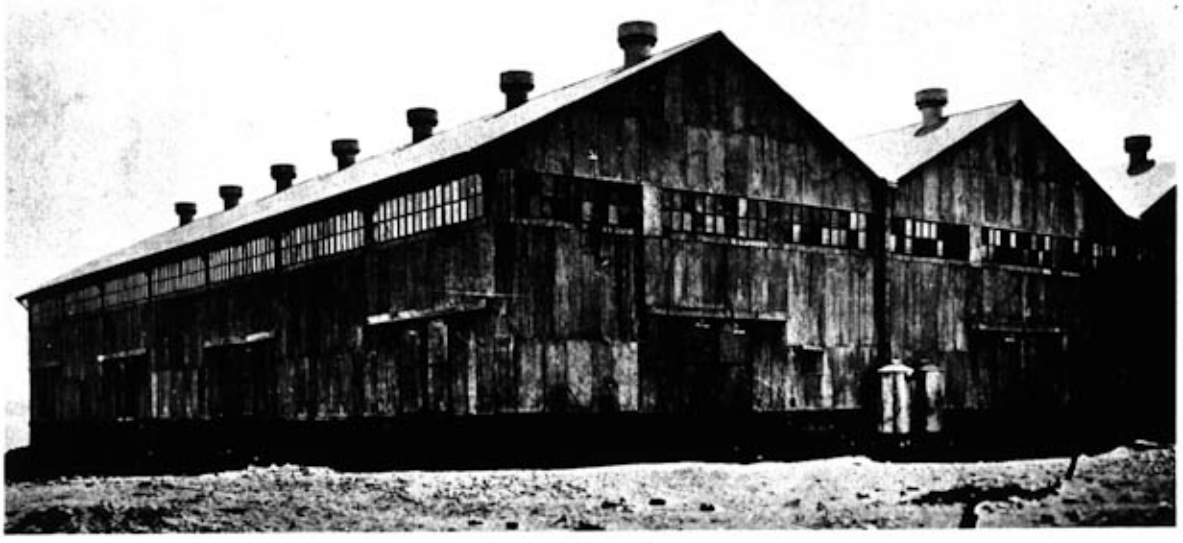

FIGURE VI - 22. *Davao.*
Warehouse (Reference number 1, FIGURE VI - 19), in port area at Santa Ana. 1939.

(*a*) *Harbor.* Jolo Harbor is defined as the waters within the following boundaries: from Belan Point along an imaginary line extending from Belan Point to the southwest point of Marongas Point to its intersection with an imaginary line drawn due west from Daingapic Point; thence along an imaginary line from this point of intersection to Daingapic Point; thence along the northwest shore of Jolo Island to Belan Point, the place of commencement. The water shoals rapidly inshore. The 60-foot line is less than 500 feet from the end of the pier. The entrance channel is clear of reefs, and has sufficient depth for any vessel which could berth at the principal pier.

The port is sheltered from the southwest but fairly open in all other directions. The best anchorage is northwest of the lighthouse on the main pier. Depths here are from 72 to 84 feet at mean lower low water. Along a line drawn parallel to the shore at the 84-foot point there should be about five first-class berths. Additional berths within the limits of Jolo Harbor could be secured by anchoring further offshore but the shelter would be increasingly poor.

During the northeast monsoon ships may have to anchor in the lee of Marongas Island across the channel from the port. Because of strong tidal currents, this anchorage is poor.

There was a fixed red light on the north side of the main pier. It was on a white steel frame tower 54 feet high and was visible for seven miles.

Tides on the north coast are chiefly diurnal. The diurnal range is 2.8 feet.

(*b*) *Landing facilities.* There were only two piers. The principal pier was a concrete structure at the end of a stone causeway which extended northwest from the north gate of the town (FIGURE VI - 24). The seaward face was 280 feet long and had a depth alongside of 30 feet; the northeast side was 245

feet long and had depths of 12 to 27 feet; the southwest side was 162 feet long and had depths of 16 to 38 feet. These depths are at mean lower low water. There was a small boat basin on the southwest side. The Chinese pier, south of the principal pier, was a wooden structure with houses of the Chinese settlement along one side. The bottom alongside the pier dried at low water.

A cargo shed was on the main pier and warehouses were in the town. They could accommodate about 30,000 tons of cargo.

There was no cargo-handling equipment.

There were privately owned gasoline launches and native boats but neither tugs nor lighters.

(*c*) *Clearance facilities.* Jolo was connected by road to all the principal settlements on the island.

In normal times regular steamship services were maintained with all ports of the Philippines. Service with Borneo and Singapore was irregular.

The discharge capacity of the port is estimated to have been about 225 short tons (2,000 pounds) per day.

(*d*) *Availability of supplies.* Fresh water for drinking purposes was piped to the principal pier. A charge of 50 centavos per cubic meter was made.

Supplies of food were limited.

Gasoline, diesel oil, and lubricating oil in drums were available in small quantities.

Ice was manufactured in Jolo.

(*e*) *Repair facilities.* There was a small marine railway a short distance north of the pier. It could handle launches up to 50 feet long with a draft of up to 5 feet.

Two small machine shops were available for minor repairs. One was in the ice plant and the other in the garage.

D. Northeast Borneo.

(1) Jesselton. (5° 59′ N, 116° 04′ E, HO 2441 and HO 2303).

Jesselton is about 1¼ miles south southwest from Limpat Point, on the eastern side of Gaya Bay. It was the chief town and port of the northwest coast of Borneo and was the usual residence of the Governor for about half the year (FIGURES VI - 25 and VI - 26).

(*a*) *Harbor.* The harbor is about 2,400 feet wide off the end of the pier. Vessels up to 7,000 tons could be accommodated. The approach is easy and no dredging is necessary to maintain depths in the harbor.

General depths in Jesselton Harbor are from 36 to 48 feet. Depths in the entrance north of Gaya are sufficient to admit any vessel which can lie in the harbor. Though there are many shoals, they were well marked. The least depth in a southern entrance used by small craft is 6 feet at mean lower low water.

The harbor is partially open to the north, but is protected to a certain extent by Plompong Island Reef and Sapangar Island.

There is a fairly secure anchorage with depths of 36 feet about 900 feet from the pier light. It should provide one first class and one second class berth. There is another first class berth in Gaya Harbor. Sapangar Bay which is the northern part of

FIGURE VI - 24. *Jolo.*
Airview of Jolo looking east-southeast. In the left center is the principal pier to which an extension has been added since the photograph was taken. 25 June 1935.

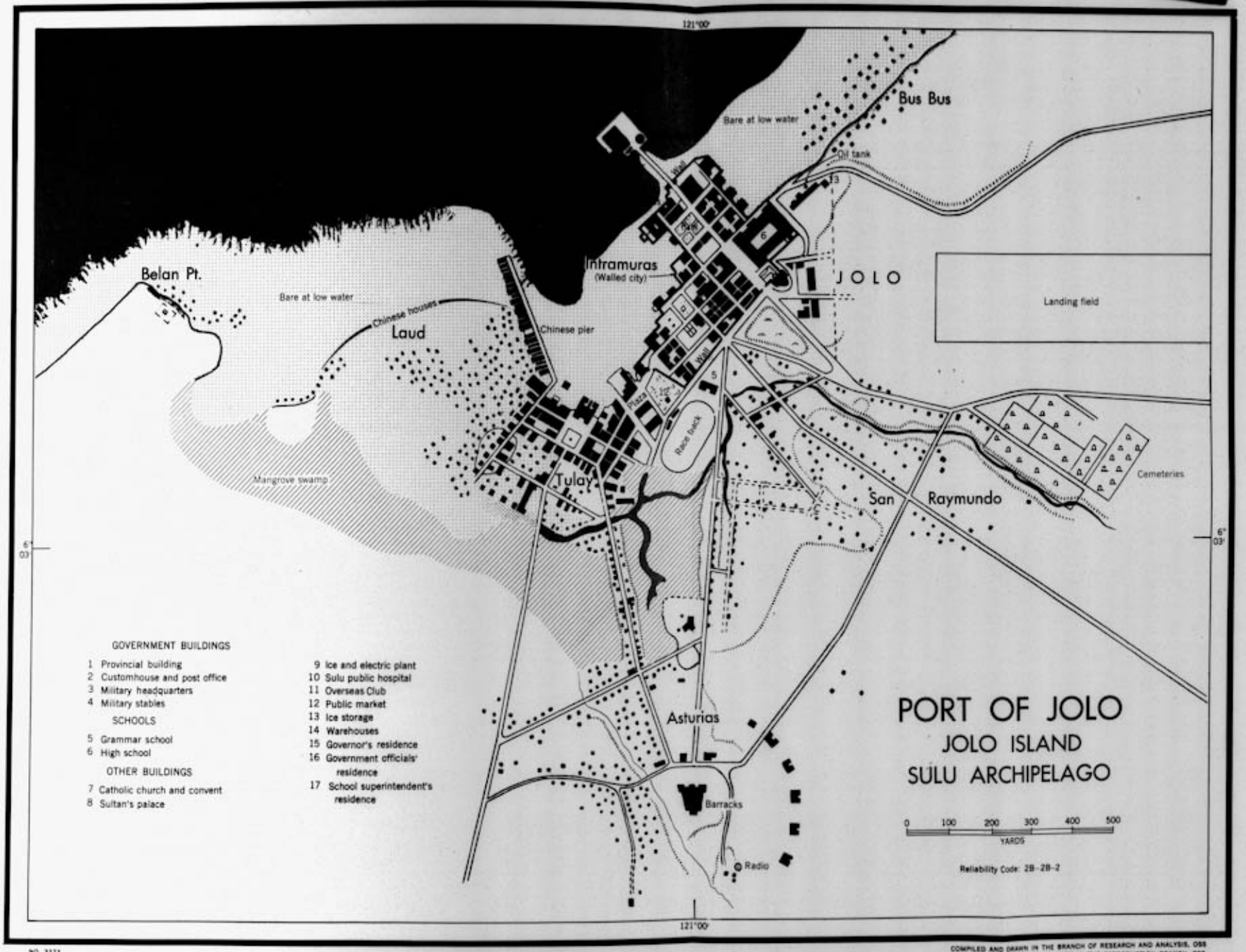

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FIGURE VI - 23. *Map of Jolo.*

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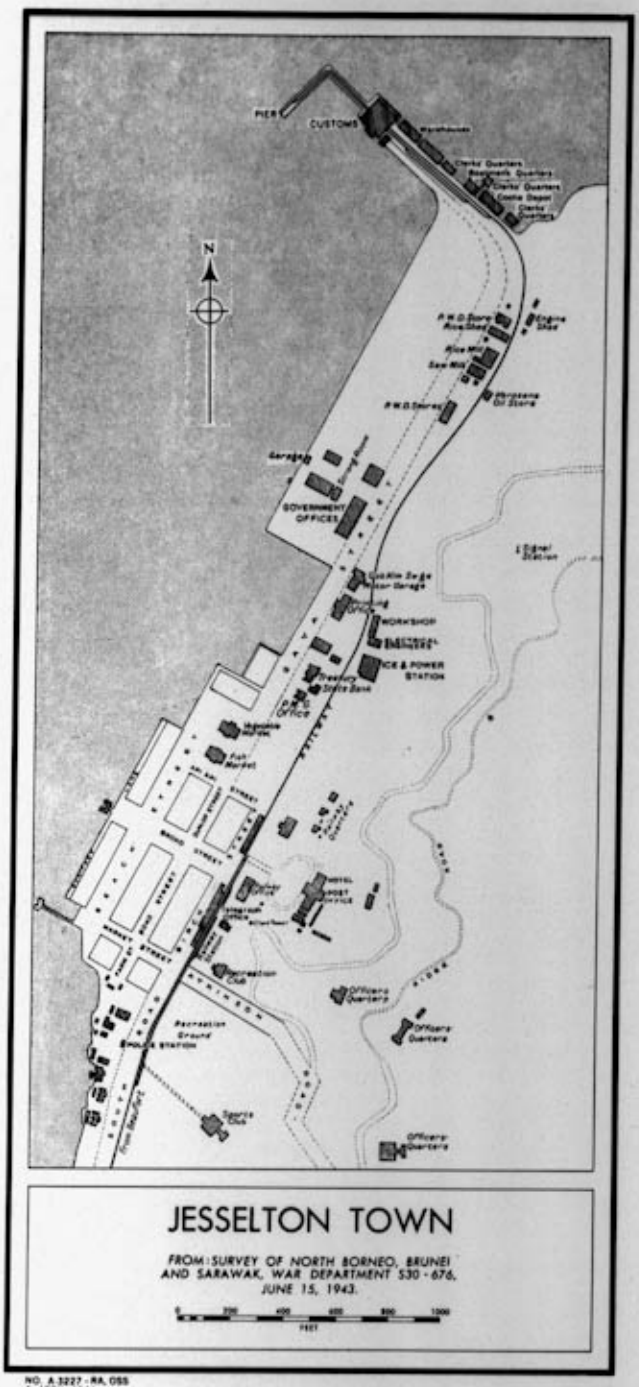


FIGURE VI - 25. *Map of Jesselton.*

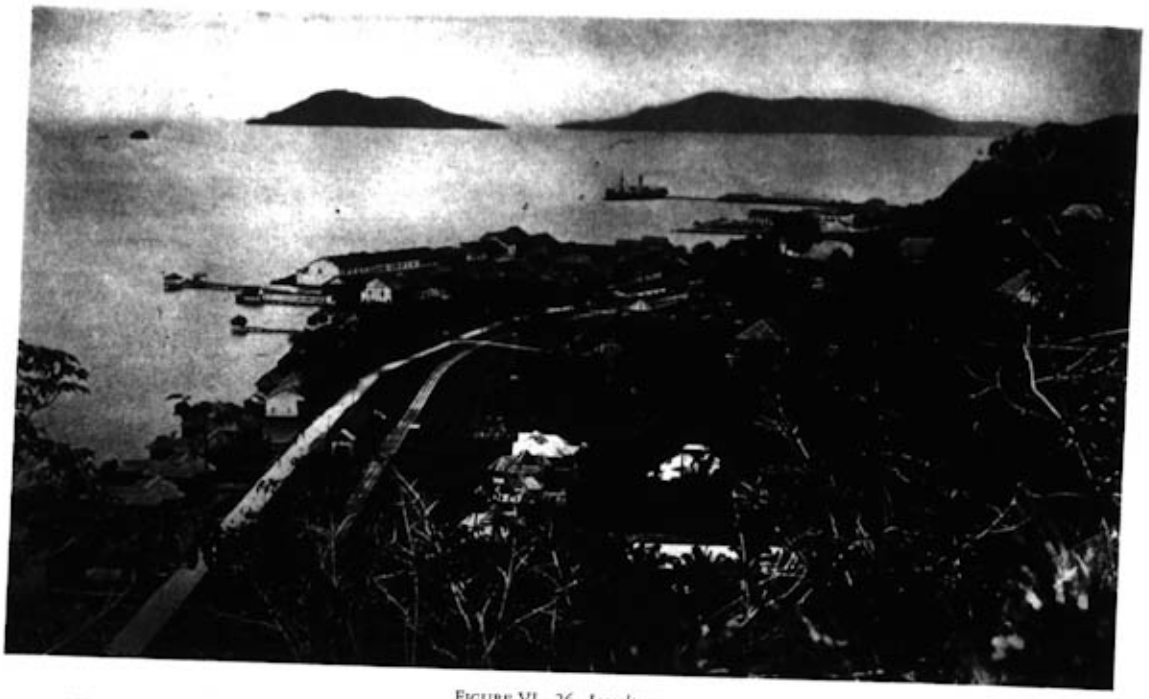


FIGURE VI - 26. *Jesselton.*
View of Jesselton harbor looking north and showing pier, railway and road. Gaya Bay is in the background. No date.

Gaya Bay has space for from 30 to 40 first-class berths and Malohom Bay which is the southern part has space for about three first-class berths. There is ample space between Sapangar and Malohom Bays, but the entrance of Gaya Bay is 1⅓ miles wide and the water here is exposed to the northwest.

The entrance was marked by 2 lights and 3 beacons. There was a fixed green light (under 100 candlepower) on the east side of Grieve Reef at 6° 00′ N, 116° 04′ E. It was on a white iron column 24 feet high. The light was visible for 3 miles. At the inner end of the pier elbow there was a fixed white light (300 candlepower) on an iron standard. The light was 23 feet above mean high water level.

Gueritz Reef was marked by a red beacon with a can top. Hewlett Reef, with a least depth of 1 foot, was marked by a black and white checkered beacon with a conical top. The northeastern extremity of a reef 180 feet west of Harris Reef was marked by a black beacon with a conical top.

It is high water, full and change at 10 hr. 30 m. Mean sea level is highest with a northeast monsoon and lowest with a southwest monsoon. Springs rise approximately 5 feet, neaps 3.5 feet above mean low water springs. There is only one high water in 24 hours when the moon is at its maximum declination. The currents vary from ½ to 1½ knots after strong southwest winds.

(*b*) *Landing facilities.* The only pier where ocean-going vessels could be secured was 2,400 feet northeast of the town (FIGURE VI - 27). It was a reenforced, L-shaped, concrete structure, 225 feet long in a northwesterly direction and 25 feet wide. It provided berthing space 328 feet long. Depths close alongside the arm were 18 to 26 feet at low water. They were 21 to 26 feet at a distance of 10 feet off the pier. The best landing place was at the concrete steps on the west side. The pier was illuminated by electricity. Cargo was handled by coolie labor, and there were also some cranes with capacities of up to 20 tons.

Southwest of the pier were several small docks. They were apparently dry alongside at low water.

The customhouse and the port administration building were located on the pier. The customs warehouse had a floor area of 6,622 square feet. There were two other warehouses on the root of the pier. Each measured 100 by 300 feet. There was also a small bonded warehouse with a floor area of 870 square feet.

No harbor craft are reported.

(*c*) *Clearance facilities.* A road connected Jesselton with Petras, 100 miles distant in a northeast direction. Various feeder lines extended from this road over the lowlands and the hills.

Jesselton was the terminus of a railroad from Weston in Brunei, a distance of 96 miles. The pier was served by railway tracks (FIGURE VI - 28). They ran through the customs warehouse and were flush with its floor. Goods could be handled without lifting.

Vessels of the Straits Steamship Company had a weekly service from Singapore. The Sabah Steamship Company maintained a local fortnightly service with Sandakan.

There was a government radio station at Jesselton and this town had telegraphic communication with Sandakan and Labuan.

Discharge capacity of the port is estimated to have been about 340 short tons (2,000 pounds) per day.

(*d*) *Availability of supplies.* Boiler water was piped onto the pier and could be taken from any berth. Drinking water had to be boiled. The flow of the water during the day was slow, but after dark from 10 to 15 tons per hour could be taken.

Fresh provisions were of good quality and plentiful if suffi-

cient notice were given. Some vegetables and bread were available.

Deck and engineering supplies were available in limited quantities.

The Shell Oil Company had storage capacity for 6,000 gallons of gasoline and usually kept that amount on hand. The Socony Oil Company had storage facilities for 1,000 gallons. Gasoline was available in 4 gallon tins and 65 gallon drums.

The Jesselton Ice and Power Company, Ltd. provided Jesselton with ice, electric light, and power. It was located near the shore between the pier and the town.

(*e*) *Repair Facilities.* There were no ships' repair facilities at Jesselton. However, there was a railway repair shop where minor repairs might be accomplished. There was an electric spot welding plant at the Jesselton Ice and Power Company.

(2) Sandakan (5° 50′ N, 118° 07′ E HO 2797).

Sandakan on the northeast coast of Borneo, is on the northern shore of Sandakan harbor ¾ of a mile inside of Tanjong Papat (FIGURE VI - 29). It was the principal town of North Borneo and the headquarters of the British North Borneo Company. The port could handle general cargo.

There was a radio station and a local automatic telephone system.

(*a*) *Harbor.* The harbor is large, 1½ miles wide at its entrance between Bahala Island and Tanjong Aru, and more than four or five miles long. According to the Pilot, the port consists of the whole of Sandakan Bay which is defined as those waters bounded (1) by a line drawn in a west southwesterly direction from the north point of Bahala Island to the mainland, (2) by another point drawn from the north point of Bahala Island to the easternmost extremity of Tanjong Aru and (3) by the south side of the bay, together with the rivers and the arms thereof so far as navigable. At least half this area has depths of more than 24 feet at mean lower low water.

From the entrance to the head of the harbor, depths vary from 18 to 96 feet at mean lower low water, but a bar with depths of from 18 to 30 feet lies across the whole mouth of the harbor. The least charted depth in the track over the bar is 24 feet, but nothing less than 30 feet has been reported. On 22 March 1931, the Cunard liner *Franconia,* drawing 26 feet, entered the port at high water spring tide.

Shelter is excellent throughout most of the harbor.

North of Pulo Bai, the harbor widens into a spacious basin about three miles in diameter and this constitutes the usual anchorage. Elton Bank immediately north of Pulo Bai has depths of from 6 to 18 feet at mean lower low water, but throughout most of this basin depths are from 30 to 54 feet. In this basin there is room for about 40 first-class berths. The most convenient anchorage is about 2,100 to 3,600 feet south of the government pier. Depths here are from 42 to 54 feet.

On the main wharf (5° 50′ N, 118° 07′ E) there was a fixed red light with a green vector (100 candlepower) on a tower 38 feet high. This light was visible for 7 miles. The red sector was visible east of Atjeh Rock; the green, west of Atjeh Rock.

A light buoy, painted red, flashing a white light every 3 seconds marked the western side of Atjeh Rock. This rock was the only detached danger off the town of Sandakan. It bears 110° from the eastern extremity of the south pier and is 2,100 feet distant.

FIGURE VI - 27. *Jesselton.*
Looking west at the pier. The buildings are the customhouse, warehouses and quarters for coolie labor. No date. ONI 129-247.

FIGURE VI - 28. *Jesselton.*
Looking southwest at the railroad tracks on the pier.
No date. ONI 129-452.

A cone and ball tide signal was hoisted on a small mast on the center of the government pier to show the state of the tide to approaching vessels. The cone point down indicated flood tide; the cone point up, ebb tide; the ball, slack water.

At Sandakan the spring range is 4 feet. The tidal currents turn with the time of high and low water by the shore. At springs the ebb attains a maximum velocity of 1¼ knots.

(*b*) *Landing facilities.* The only important wharf was the property of the government (FIGURE VI - 30). It was substantially built, 450 feet long, and for 225 feet had a width of 44 feet. The remainder was built against reclaimed land. The depth alongside was 19 feet at mean low water springs. Twenty feet in front of the wharf there was a depth of 23 feet at mean low water springs. By breasting off for this distance vessels drawing 26 feet could use the wharf at high water. Vessels loaded or discharged either alongside or by lighter. Electricity was available.

Near the shipyard about 1,800 feet northeast of the government wharf there was a pier with a depth of 11 feet at its head (FIGURE VI - 31). On it was a 15-ton fixed hand crane. The coal dock west of the government wharf has been demolished. In addition, near Sandakan, there were four small jetties, privately owned.

There were good storage facilities at the wharf. A bonded store under the customhouse measured 70 by 61 feet. The wharf warehouse No. 1 measured 59 by 50 feet, No. 2, 45 by 37 feet, and No. 3, 50 by 46 feet.

There were 26 lighters with a total capacity of 8,000 tons which could be used for loading ships anchored in the stream.

(*c*) *Clearance facilities.* The roads at Sandakan were asphalt and well-kept. They were 20 feet wide. The two longest were Leila Road which ran almost west from Sandakan for several miles, and a road which ran about 17 miles north by northwest into the jungle.

There was a small narrow-gauge railway on the pier northwest of the government wharf. Another short line ran 8 miles into the jungle.

There was a weekly steamship service to Singapore and local ports, a monthly service to Hong Kong and Australia and bimonthly service to Manila, Australia, and Hong Kong.

The discharge capacity of the port is estimated to have been about 450 short tons (2,000 pounds) per day.

(*d*) *Availability of supplies.* Water for drinking purposes could be obtained from a hydrant on the government wharf.

Beef, bread, and vegetables could be normally obtained in small quantities.

Engineering and deck supplies were obtainable. A stock of 160,000 gallons of gasoline was maintained. No oil was available.

(*e*) *Repair facilities.* There were no drydocks available at Sandakan. There was a patent slip belonging to the British Borneo Timber Company near the pier. It had an extreme length of 400 feet, and a cradle 150 feet long. The draft on the keel blocks was 5.6 feet forward and 10.6 feet aft at mean high water springs. The lifting power of the slip was 500 tons.

Near the patent slip was a small foundry and a shipbuilding yard with two launching berths. The yard was about 1,800 feet northeast of the government wharf. Lighters up to 100 tons displacement had been built in this yard.

*(3) **Linkas (Tarakan) Tarakan Island*** (3° 17′ N, 117° 35′ E, BA 3577, HO 3095).

The port of Linkas is on Tarakan Island 2 miles from Tarakan (FIGURE VI - 32) and was primarily an oil exporting port.

There was a radio station 3 miles from the landing in a slight depression 900 feet northeast of the road from Linkas to Pamoesian.

(*a*) *Harbor.* Depths are ample, and deep draft vessels (drawing at least 30 feet) could come alongside the oil docks at all times. There were no bars in the channel and the entrance was well marked. In normal times pilotage was compulsory.

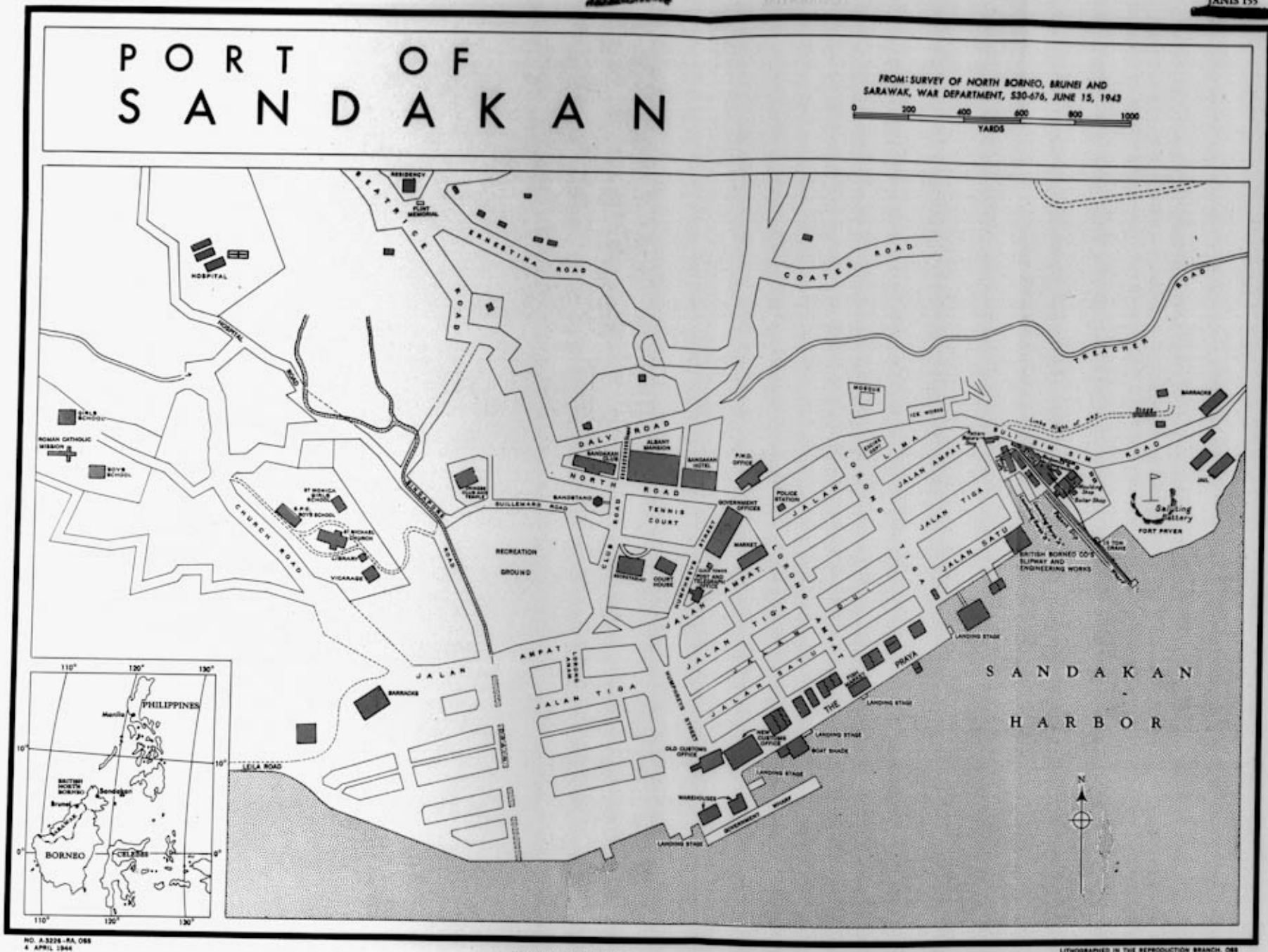
The limits of the port of Linkas are defined as follows: those waters within a circle with a radius of 1.5 miles described from the head of the north wharf.

The harbor is secure in all weather.

Ships could anchor safely in 66 to 72 feet of water close to the pier, and further offshore there is reported to be space for 12 to 15 1,800 foot berths in 42 feet and many berths in 24 to 30 feet. These depths are believed to be at mean lower low water.

Another anchorage north of Linkas can accommodate a large number of destroyers or submarines. The entrance has two channels. The least depth in either is 36 feet, the least width ½ a mile.

The port was well marked by a light vessel, 3 lights, a beacon, and 2 light buoys. They were as follows:



NO. A-3226-RA, OSS
4 APRIL 1944

FIGURE VI - 29. *Sandakan.*
Map of Port of Sandakan.

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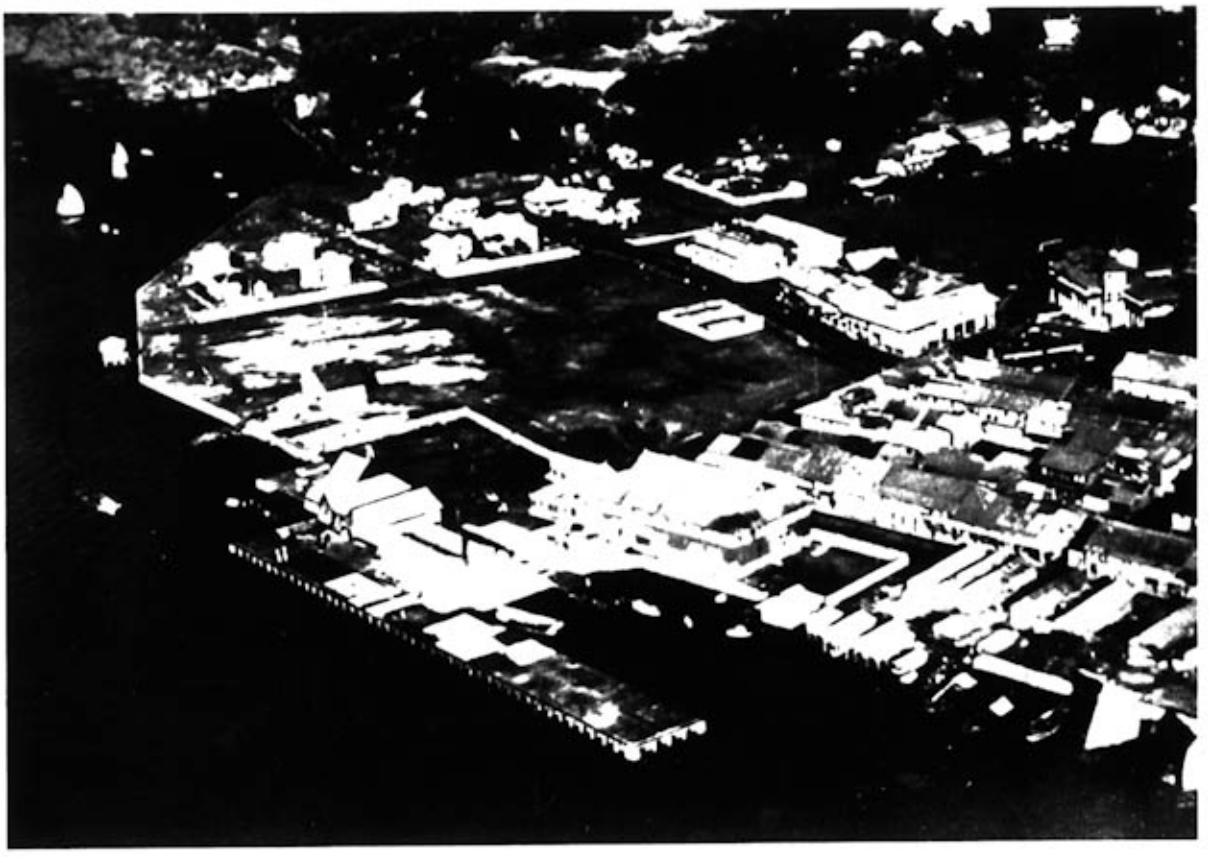

FIGURE VI - 30. *Sandakan.*
Air view of the government wharf looking NNW. 1935-1936. ONI 130-208.

FIGURE VI - 31. *Sandakan.*
Looking ESE at the shipyard pier. 1936. ONI 187-994.

Tarakan Pilot Light Vessel (3° 14′ 30″ N, 117° 52′ 30″ E), a two masted black vessel with "Tarakan" painted in white letters on the side. It showed a flashing white light (220 candlepower; period 15 seconds, flashing 3 seconds, eclipsed 12 seconds) 59 feet above high water and was visible for 12 miles. A fixed red light over a fixed white light indicated that pilots were not available.

Linkas approach range-front (3° 14′ N, 117° 37′ E), a fixed red light (30 candlepower) on a white iron framework 33 feet high, visible for 7 miles.

Linkas approach range-rear, a flashing white light (period 3 seconds, flashing 1 second, eclipse 2 seconds, 130 candlepower) on a white iron frame 59 feet high. The light was visible for 12 miles.

The 2 range lights were 3,000 feet apart.

Mengachu point light, a fixed red light (20 candlepower) on a white iron framework 26 feet high. It was on the edge of a reef on the west side of the point at 3° 15′ N, 117° 37′ E and was visible for 6 miles.

A black concrete beacon with a truncated cone top marking a shoal with a depth of 18 feet and about 2,025 feet west from the head of the northern pier.

A light buoy, painted white, moored on the eastern side of a shoal with a depth of 19.5 feet which lay about 1,500 feet south of the outer end of the northern pier at Linkas.

A light buoy painted black, marking a shoal with a depth of 19.5 feet of water about ½ mile south of the northern pier.

Tides vary but are dominantly semi-diurnal. The spring range is 9.3 feet. During May and June and November and December the highest possible tide that can be expected is 2.2 feet above the mean level. The lowest possible tide that can be excepted is about 4.5 feet below the mean level and occurs at all semi-diurnal spring tides.

(*b*) *Landing facilities.* There were two T-shaped piers at Linkas. The northern pier was about 1,050 feet long with a depth at the head of the pier of 30 feet at mean low water springs (FIGURE VI - 33). The southern pier was 1,362 feet long with a depth of 33 feet at mean low water springs alongside its seaward face (FIGURE VI - 34). However, one report indicates that the depths given above may have been increased by dredging to 39 feet. Both piers were 6 feet above water at high tide. Ships lay at the head of the T-shaped piers and tied up to mooring pilings on each side.

On the south pier there was a crane of 10-ton capacity mounted on tracks, and a boat hoisting gear capable of lifting a 50-foot motor launch. A floating crane of 15-ton capacity was normally moored between the piers.

A warehouse had been built at the end of the north pier. It extended south for about 60 feet along the water front.

(*c*) *Clearance facilities.* There was good road about 5 miles long which connected the piers and the town to the oil fields.

A narrow-gauge railroad, on the south pier, led to the oil fields. There were no railroad tracks on the north pier.

Weekly steamship service to Surabaya was maintained by steamers of 1,500-2,500 gross tons.

Linkas was almost entirely an oil port but discharge capacity for general cargo is estimated to have been about 225 short tons (2,000 pounds) per day.

(*d*) *Availability of supplies.* Water for domestic purposes was obtained from rainfall, each house having its own supply

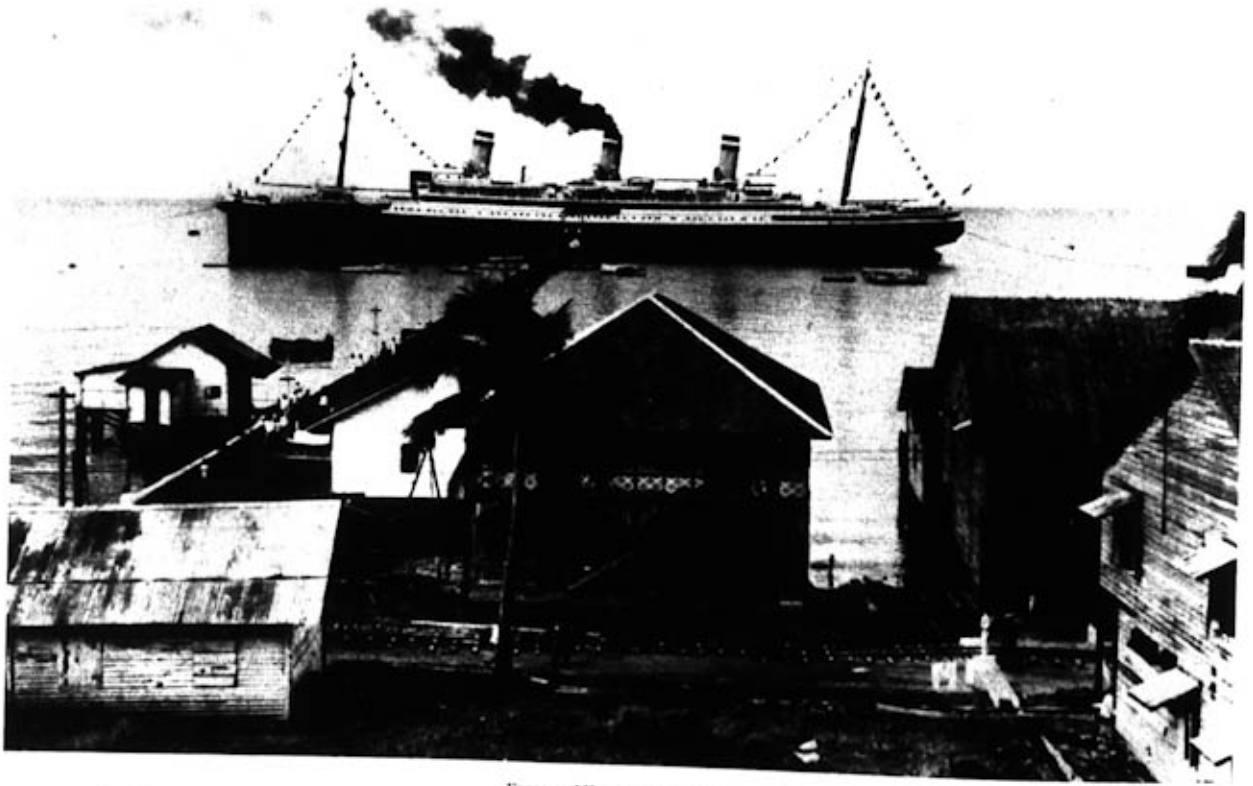

FIGURE VI - 33. *Tarakan.*
Looking south-southeast at the North pier. The vessel is the Resolute with a draft of 28.1 feet. No date. OSS 56584.

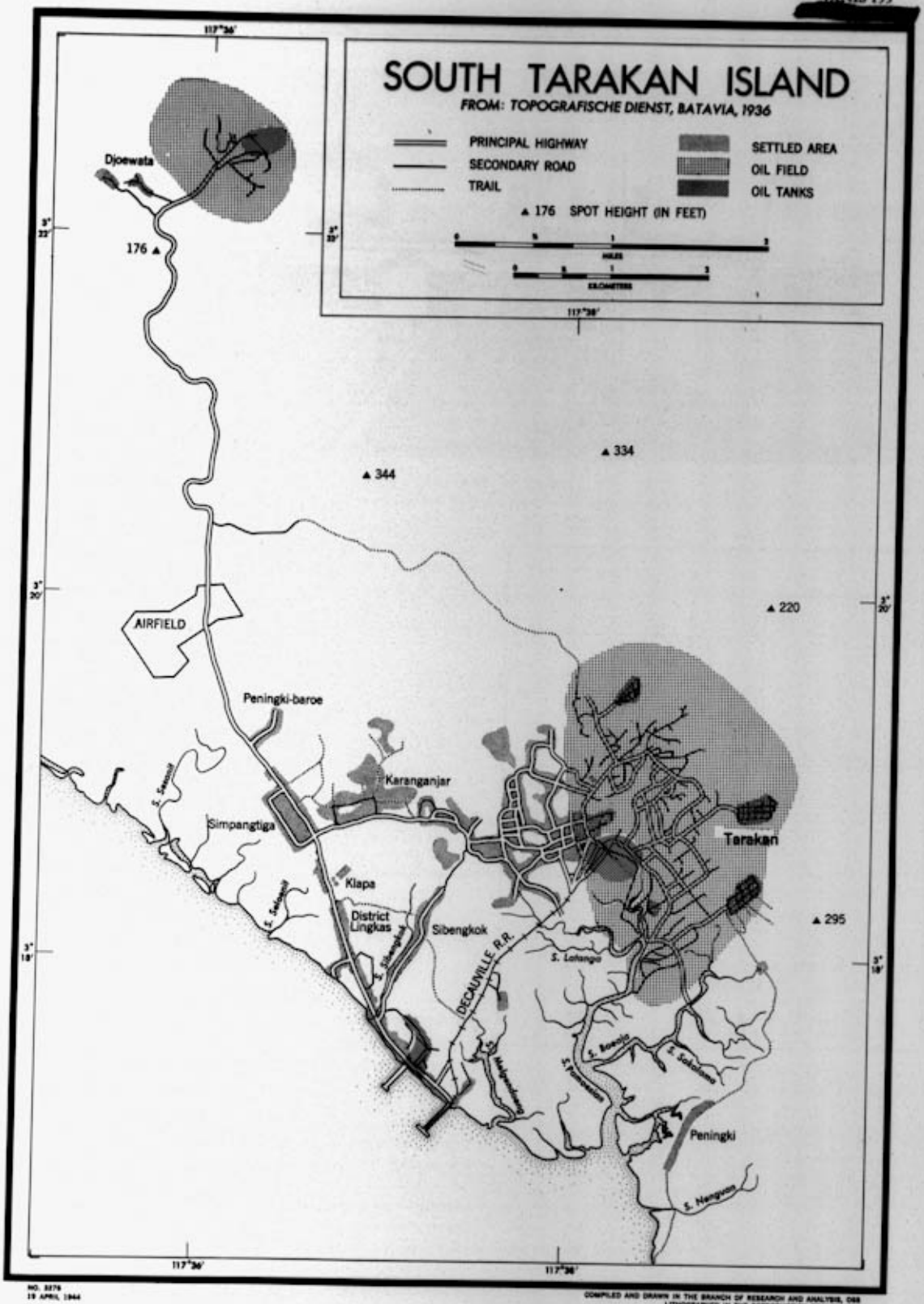

FIGURE VI - 32. *Linkas (Tarakan).*
Map of Tarakan.

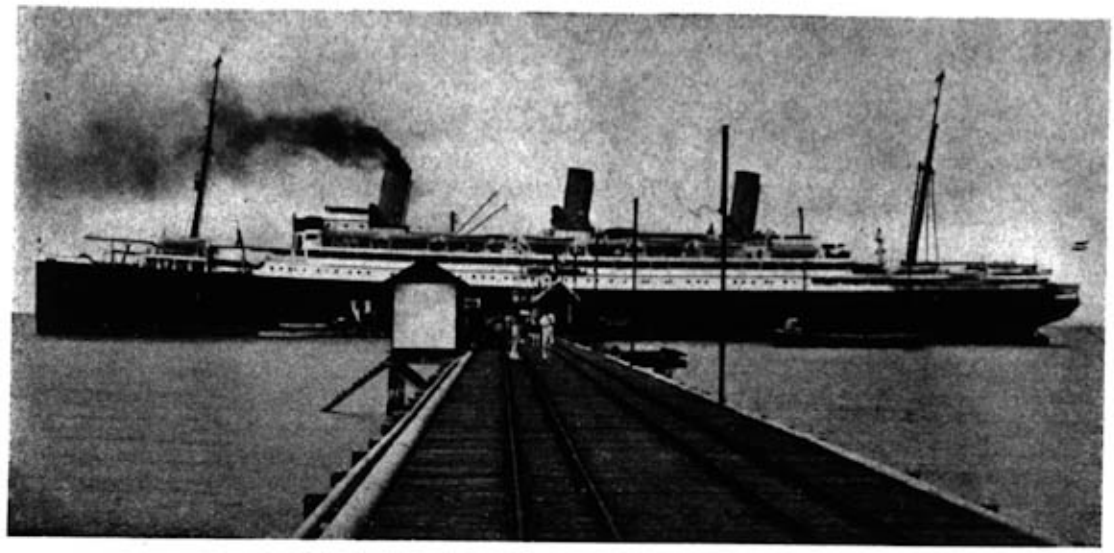

FIGURE VI - 34. *Tarakan.*
Looking southwest at the South pier. The liner is bunkering from the Shell installations. No date. ONI 165-053.

reservoir. The industrial supply was pumped from the Pamoesian River to a reservoir on the top of a hill ¾ of a mile south of the pumping station. This water was not suitable for drinking purposes. Water was piped onto both piers. The connections were of 3-inch caliber. Salt water for fire fighting was supplied by a pump house on the north pier.

Food supplies were available in small quantities.

At the north pier fuel oil could be obtained through two 6-inch lines and one 4-inch line (standard fittings); on the south pier there were two 10-inch lines and one 6-inch line. The pipeline was laid alongside the road which ran from the pier to the oil field. The maximum simultaneous discharge to both piers was 7,200 pounds per hour. The maximum discharge to the south pier alone was 4,800 pounds per hour. It was discharged by gravity, forced feed, or both. No gasoline was produced at Tarakan; that needed for local consumption was obtained at Balik Papan.

There was a good ice plant and a distillery. Power was obtained from the electricity plant.

(*e*) *Repair facilities.* The only repair facilities available were at the oil field (Pamoesian). There were no drydocks at Linkas.

E. Northern Celebes Sector.

(1) Gorontalo, Celebes Island (0° 30′ N, 123° 03′ E).

Gorontalo is on the north coast of the Gulf of Tomini, 2 miles northward of Gorontalo roads, on the tongue of land at the confluence of the Bolango and Bone Rivers, the united flow of which forms the Gorontalo River (FIGURE VI - 35). The Gorontalo River discharges into the head of Gorontalo Roads. There are steep mountains on both sides of the mouth, with a wide plain between them at the junction of the Bolango and Bone rivers.

(*a*) *Harbor.* Gorontalo roads, the harbor for Gorontalo, is a natural inlet in the mountainous coast, receding northward about 530 yards. The entrance, between Batoe Lajar and

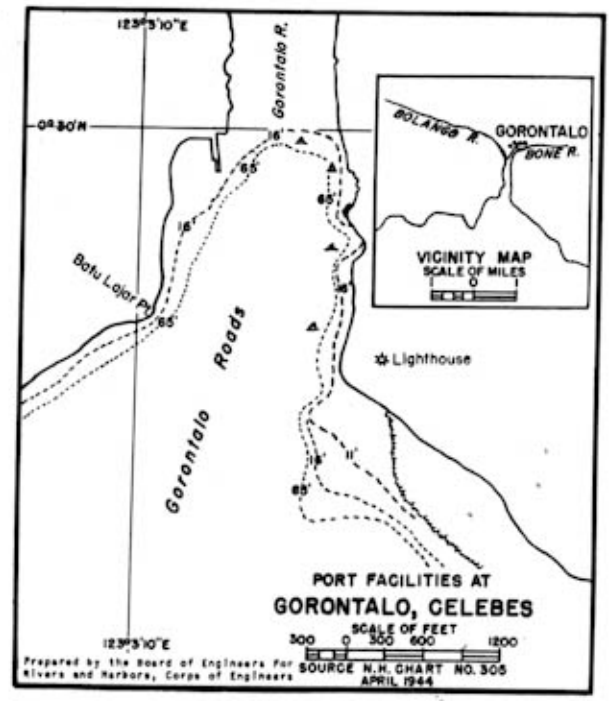

FIGURE VI - 35. *Gorontalo.*
Sketch showing location of Gorontalo (inset) and port plan showing location of facilities.

the lighthouse on the east shore, is 425 yards wide and has depths of 70 fathoms, decreasing to 30 fathoms near the head, where it is about 200 yards wide. Silt deposited by the Gorontalo River has reduced the depth to 3 feet or less at the extreme north end of the inlet.

The roadstead affords poor anchorage on account of the great depths, limited space for maneuvering, and the strong

current from the river. There were 3 mooring buoys on the east side, and 4 buried anchors on the east shore for shore moorings. Vessels should not pass northward of the northernmost buoy, as the depths in 1925 were considerably less than shown on the chart. During the south monsoon, strong winds cause a heavy sea and allow little opportunity for vessels to anchor on the west side of the anchorage. On the east side vessels obtain shelter by lying as close as possible to the shore. The best berth is in a small bight on the east side, off the sheds of the K. P. M., where vessels bring a stern hawser to the buried anchors, hauling close under the shore (FIGURE VI - 36). Small coastal vessels moor southward of this place. Vessels can moor farther inside close to the bank of the river, dropping the starboard anchor in 8 to 10 fathoms, veering 45 to 60 fathoms of chain, and dropping the port anchor in about 30 fathoms. A small stern hawser may be brought ashore. There is also anchorage outside the river with the lighthouse bearing from 12° to 34°, distant 200 to 300 yards. The coast reef here is very steep (FIGURE VI - 37).

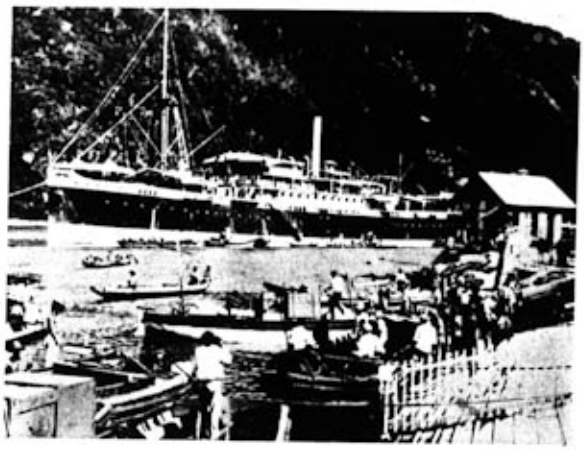

FIGURE VI - 36. *Gorontalo.*
View showing vessel at anchor on east side of Gorontalo Roads.

A flashing white light was shown from the east bank of the roadstead.

Tides are both diurnal and semi-diurnal, the latter predominating. Spring springs rise 2½ feet, and neaps, from 1 to 1½ feet.

During the south monsoon the temperature is generally below 70° in the morning and seldom rises to more than 85°. During the north monsoon the temperature is higher. The average annual rainfall is 47.8 inches.

(*b*) *Landing facilities.* A pier was located on the west side of the roadstead.

The K. P. M. had some sheds on the east side of the harbor. Warehouses on the west side were damaged by enemy planes on December 27, 1941.

Lighters were available (FIGURE VI - 38), but no tugboats. A small steamer of the Gorontalo Commercial Association would render assistance, if necessary.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. The roads were well-kept and lighted.

(*d*) *Availability of supplies.* Water was bad and difficult to obtain. There were no facilities for supplying it to vessels.

*(2) **Manado, Celebes Island*** (1° 30′ N, 124° 50′ E).

Manado is at the head of Manado Bay, on the southern side of the mouth of the Manado River, near the northeastern extremity of Celebes Island (FIGURE VI - 39 and PLAN 62). It was the principal town of the Minahasa district, exporting about 3,000 tons of copra monthly, in addition to coffee, rubber, and other commodities. There were no wharves for large vessels. Landing facilities consisted of a basin for praus, inside the river mouth, and a wharf south of the river entrance.

(*a*) *Harbor.* The port is an open roadstead at the head of Manado Bay. The prau harbor is an artificial basin located on the left bank of the Manado River at its mouth.

Manado Bay is about 7 miles wide between Pisok Point and Kalasei Point and extends eastward about 4 miles. Depths are great except close under the shore. There are no outlying shoals or dangers. The reef projecting 800 yards westward of Pisok Point is steep and the greater part dries at low water. Sario Reef, ½ mile southward of the light, extends about 700 yards offshore. The 10-fathom contour is close to the coast reef. The bay is open to the west and northwest. High hilly land flanks it on the northeast, the higher mountains on the east and south.

Manado River is shallow, but can be entered at high water by craft drawing 5 feet. After heavy rains there is generally a very strong current from the river. A stone breakwater, at the mouth of the Manado River on the right bank, was 498 feet long. Another, on the left bank, was 205 feet long. The prau harbor, about 350 feet long and 150 feet wide, was used by sea-going praus drawing 6½ feet.

Although the bay is spacious and free from danger, it affords an insecure anchorage during the northwest monsoon, particularly from December through February.

A group occulting white light, 39 feet above high water and visible 10 miles, was located near the beach south of the Manado River.

Fixed green and red lights were shown from the heads of the north and south breakwaters, respectively.

The tide varies from 2 to 7 or 8 feet.

The climate is healthful. The mean temperature is 79°, maximum 97°, and minimum 65°; the average annual rainfall is 104.8 inches. The driest months are August and September and the wettest from December to February. From December through February, winds from northwest and west-northwest raise such high sea and swell that communication with the shore is entirely interrupted.

(*b*) *Landing facilities.* There were no wharves for large vessels. Alongside the prau basin there were 2 sets of landing steps, with a depth of 2 feet alongside. The basin was served by a 1-ton crane.

A wharf, about 210 feet long, was located on the southern side of the river entrance, which could be used from 3 hours before to 3 hours after high water.

On the west side of the prau harbor was the K. P. M. warehouse. On the east side and also on the opposite side of the river were large copra sheds. A Socony warehouse was located on the right bank of the river, near the root of the northern breakwater.

A lighterage company owned 24 lighters of from 4 to 15 tons capacity. There was a Government wrecking tug of about 150 horse-power, and a steam waterboat of 18 tons capacity.

FIGURE VI - 37. *Gorontalo.*
View of Gorontalo Roads, looking south-southeast, showing pier. 1942.

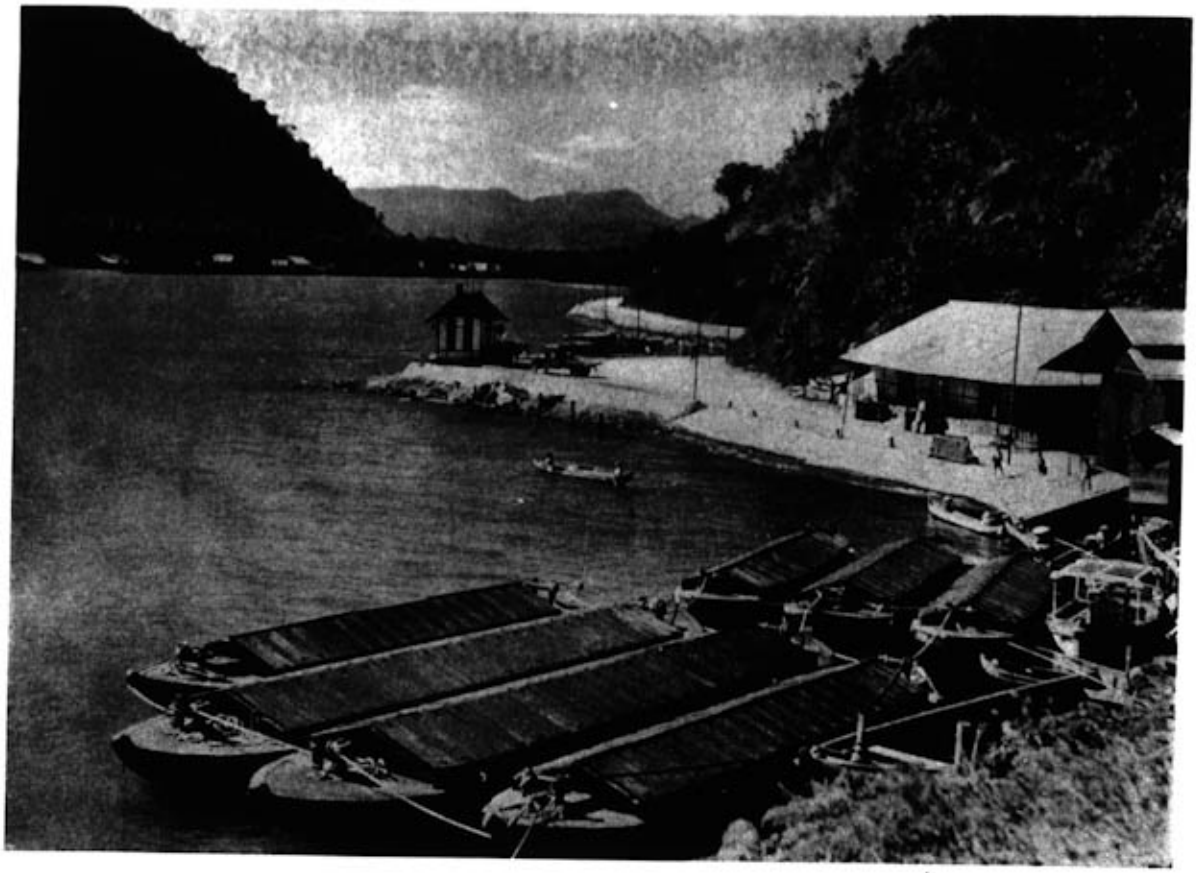

FIGURE VI - 38. *Gorontalo.*
View of harbor showing type of lighters based at Gorontalo. 1937.

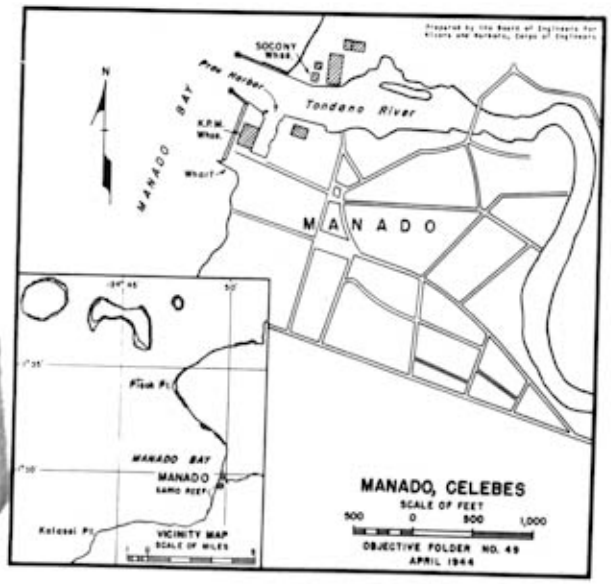

FIGURE VI - 39. *Manado.*
Map showing location of Manado (inset) and port plans showing location of facilities.

(*c*) *Clearance facilities.* K. P. M. and Java-China-Japan line vessels called regularly. The roads were good. Coolies were used to load lighters.

(*d*) *Availability of supplies.* Drinking water was available. A waterboat of 18 tons capacity could deliver about 10 tons per hour, but with any sea running this operation was difficult.

Fuel oil was scarce and could be obtained only in small quantities. At the Shell yard, 3,600 feet south of Manado River, short pipes extended down the shore into the sea and were connected to submarine pipe lines, permitting ships to discharge and refuel about 900 feet offshore. Coal was not obtainable.

(*e*) *Repair facilities.* About 1,200 feet east of the south breakwater was the K. P. M. slipway. On the open beach, 1,050 feet north of the north breakwater, was the former Japanese slipway. Repairs to small boats and small metal castings could be made.

62. Minor Ports

A. Halmahera Sector.

(1) Weda, Halmahera Island (0° 20′ N, 127° 52′ E).

Weda is on the western shore of Weda Bay, at the base of the southern arm of Halmahera (FIGURE VI - 40). It was important as a storage place for copra and jungle products. Port facilities consisted of a wharf, with a warehouse, located about ¼ mile northeast of the village.

(*a*) *Harbor.* Weda roads, the habor located in the northwestern corner of Weda Bay, is entirely open and affords no shelter during the southeast monsoon. Jef and Koelefoe islands, as well as the mainland shore, are fringed by drying reefs. Beacons mark the edges of the reefs adjacent to the channels and detached shoals south and southeast of Koelefoe. Depths in the harbor are from 6½ to 11 fathoms.

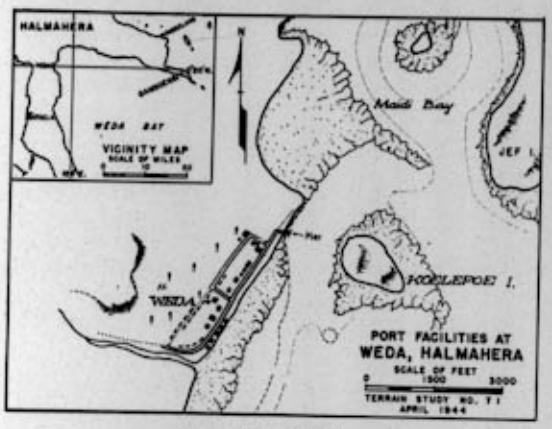

FIGURE VI - 40. *Weda.*
Map showing location of Weda (inset) and port plan showing location of facilities.

Weda Bay is the large indentation in the coast line between the southeastern and southern peninsula.

Small vessels can anchor in front of the wharf in depths of 6½ to 8 fathoms. Larger ships can anchor off the town in 18 fathoms, over coral. These anchorages are not protected from southerly or southeasterly winds.

The currents, setting northward along the shore with a rising tide and southward with a falling tide, are weak.

No data are available concerning tides.

Rainfall is comparatively heavy during every month of the year. The annual rainfall is 86 inches with 14 inches in July, the wettest month, and 3 inches in November, the month of least rainfall.

(*b*) *Landing facilities.* A wharf extended from the shore about ¼ mile north of town. A warehouse was located near the wharf.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. A trail connected Weda and Saketa, across the island.

(2) Gamsoengi (Patani), Halmahera Island (0° 16′ N, 128° 45′ E).

Gamsoengi is on the north shore of Weda Bay, near the extremity of the southeastern arm of Halmahera Island (FIGURE VI - 41). It was the principal trading center on the north coast of Weda Bay. A small pier provided the only facilities for landing.

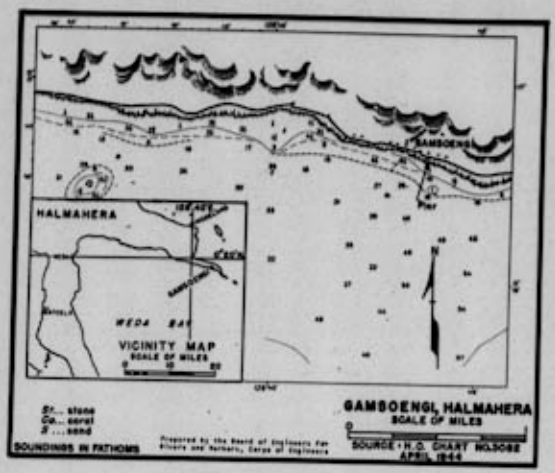

FIGURE VI - 41. *Gamsoengi.*
Map showing location of Gamsoengi (inset) and port plan showing location of facilities.

(*a*) *Harbor.* The harbor is in Gamsoengi (Patani) roads, an open roadstead on the north shore of Weda Bay, 9½ miles west-northwest of Ngolopopo Point, the southeastern extremity of Halmahera. It is exposed to winds from east-southeast, through south, to west-northwest. The shore is bordered by a drying reef. The bottom slopes steeply, the 10-fathom contour being about 200 yards from the beach. A 1-fathom patch lies close off the village.

Weda Bay is described under Topic 62, A, (1), (a).

Anchorage is available in 30 fathoms, over coral bottom, with the pier bearing northwest.

There is both a diurnal and a semidiurnal tide. The spring highs of the 2 tides may coincide. The highest water level occurs in June and December. The maximum rise and fall that can be expected are, respectively, about 2 feet above and 1 foot below mean sea level. Tidal currents set along the coast but are not strong.

(*b*) *Landing facilities.* A small wooden pier extended out on the drying reef abreast the village.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly.

(3) Inggelang, Inggelang Island (0° 34′ N, 128° 28′ E).

Inggelang is on the south shore of Inggelang Island, off the east coast of Halmahera, near the southern entrance point of Boeli Bay (FIGURE 42). The only facility was a pier for proas.

(*a*) *Harbor.* The harbor is in the narrow channel along the south side of Inggelang Island, about 1½ miles northwest of Inggelang Point, the southern entrance point of Boeli Bay. The channel, with controlling depths of about 3½ fathoms, is about 300 yards wide. It is well sheltered, but the western end was not marked and is dangerous.

Boeli Bay, which is 31 miles wide at the entrance between

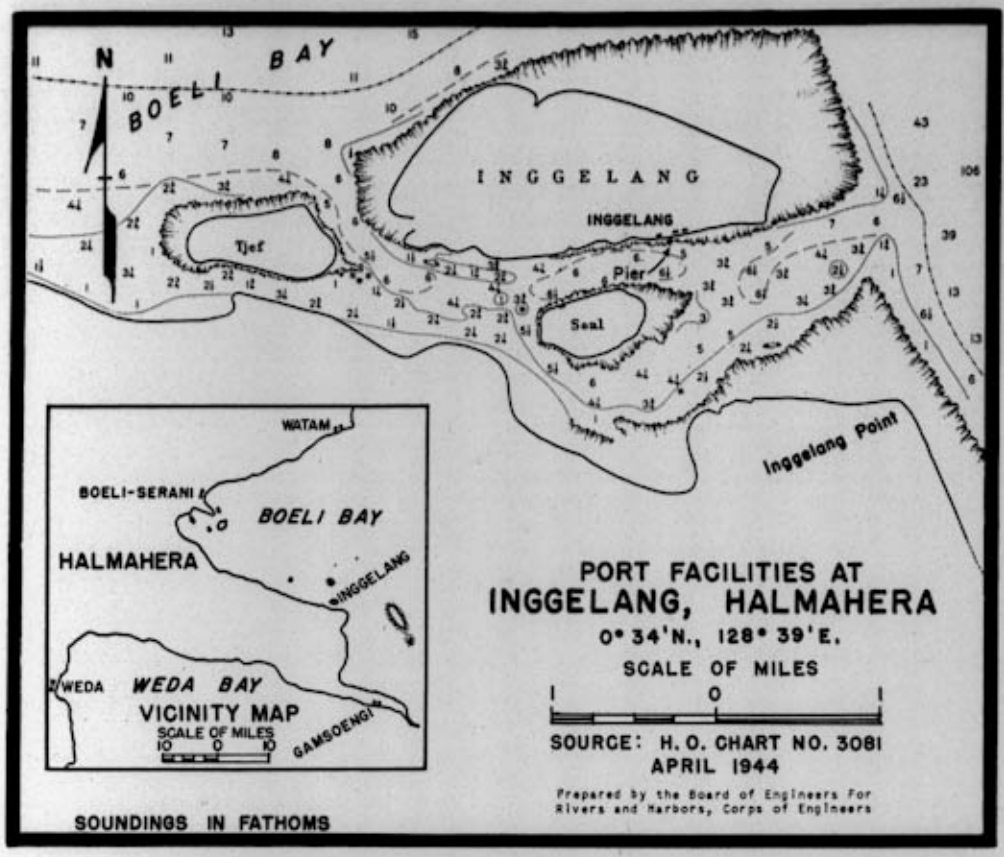

FIGURE VI - 42. *Inggelang.*
Map showing location of Inggelang (inset) and port plan showing location of facilities.

Inggelang and Wajamli points, has numerous shoals and reefs inside the 100-fathom curve.

Well sheltered anchorage may be found in the channel off the town.

Tidal currents in the channel off the village may attain a velocity of 1½ knots. In Boeli Bay, tides are both diurnal and semidiurnal, but the latter predominates.

The spring lows of the two tides almost coincide at times. The lowest water level occurs in June or July, and in December or January. The maximum rise and fall that can be expected are, respectively, about 2 feet above and 3 feet below mean sea level. The high water interval is 6 hours 8 minutes, and the spring range is 5 feet. In the inner parts of Boeli Bay, tidal currents are noticeable but they do not exceed one knot. The average annual rainfall at Inggelang is 81 inches with 9 inches in July, the wettest month, and 3½ inches in October, the month of least rainfall.

(*b*) *Landing facilities.* A pier for proas was located in front of the village.

(4) Boeli-serani, Halmahera Island (0° 52′ N, 128° 18′ E).

Boeli-serani lies on the northwest shore of Boeli Bay, on the east coast of Halmahera (FIGURE VI - 43). The village is divided into 2 sections, Boeli-serani and Boeli-islam. It was a shipping center for copra and jungle products. The landing place was at a pier about ½ mile north of the village.

(*a*) *Harbor.* The harbor is in Boeli roads, an open roadstead in the northwestern corner of Boeli Bay, north of Pakal and Gei islands. The store is fronted by patches of drying reef. A channel, formerly marked by beacons, leads through the drying reefs to the pier. The channel is about 4½ fathoms deep over a bottom width of about 75 yards.

Boeli Bay is described under Topic 62, A, (3), (a). The best anchorage is in 11½ to 13½ fathoms, west of the 5-fathom shoal lying south-southeast of a conspicuous shed near the boat pier. The annual rainfall is about 100 inches, with 12½ inches in June, the wettest month, and 4 inches in October, the month of least rainfall.

(*b*) *Landing facilities.* A small pier for native vessels extended about 100 feet across the fringing reef, about ½ mile north of the town.

A large shed was located near the shore end of the pier.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called at Boeli.

(5) Lolobata, Halmahera Island (1° 15′ N, 128° 06′ E).

Lolobata is on the north shore of Wasile Bay, an arm of Kaoe Bay, on the north coast of Halmahera (FIGURE VI - 44). It had no commercial importance until recently, when considerable shipping activity was observed. On 24 November 1943, at least 11 freighters and transports, totalling about 30,000 tons, and on 15 January 1944, 19 ships were reported in the area. The landing facilities were located east of the village.

(*a*) *Harbor.* The harbor is an open roadstead. There was no port as such. The harbor consisted merely of such anchorage facilities as might be offered by Wasile Bay, which in itself provides protection in general from most weather. The bottom in front of town drops off steeply to 16 fathoms, with the 5-fathom contour within ¼ mile of shore. A fringing reef borders the shore in front of the village. Anchorage is available in front of the town in depths of 16 to 20 fathoms over mud and sand.

(*b*) *Landing facilities.* Photographs of 15 February 1944 show 3 new piers in the vicinity of Lolobata (FIGURE VI - 45).

(6) Goeroea, Halmahera Island (1° 08′ N, 128° 05′ E).

Goeroea is on the south side of Wasile Bay, an arm of Kaoe Bay, on the north coast of Halmahera (FIGURE VI - 44). It was of no commercial importance, but considerable shipping

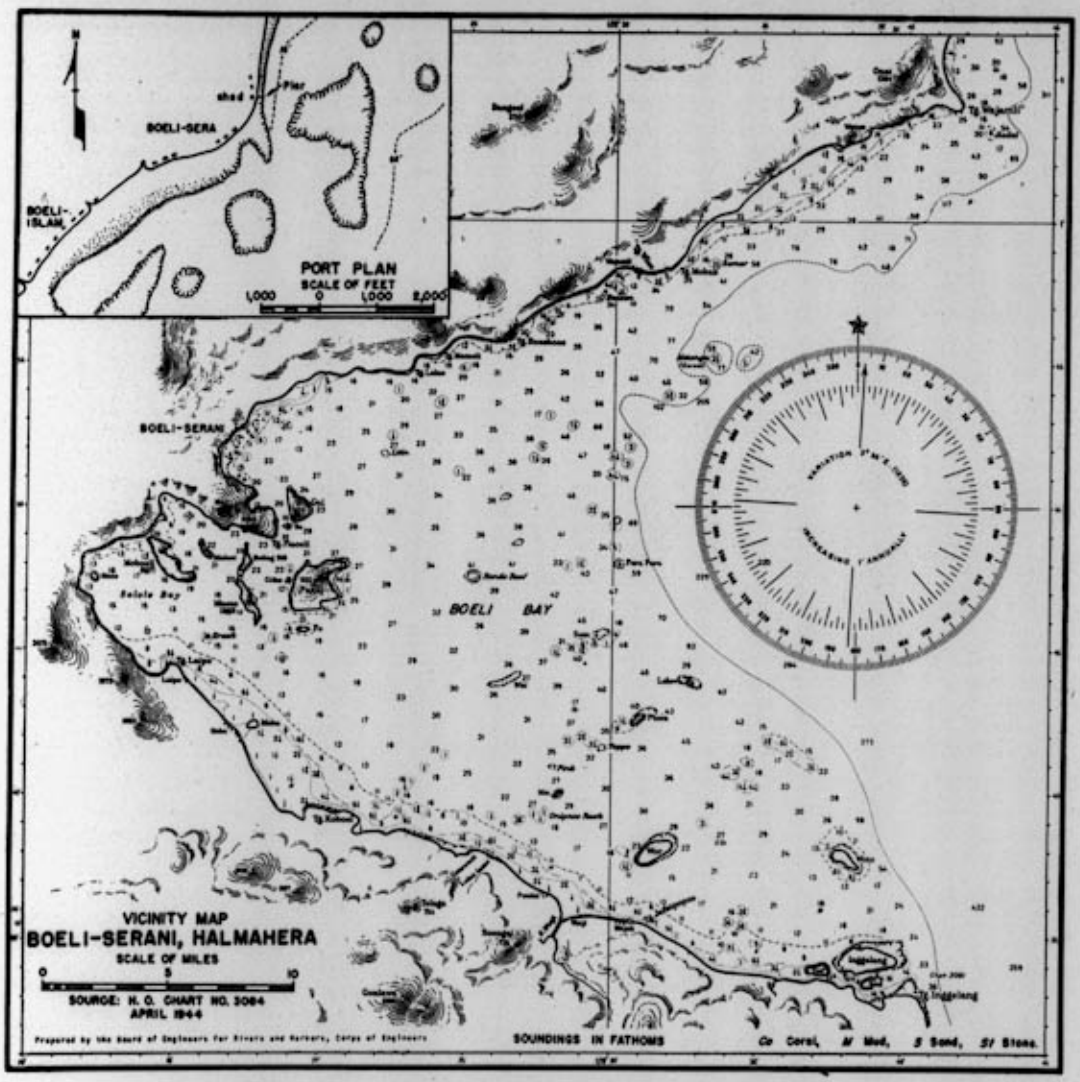

FIGURE VI - 43. *Boeli-Serani.*
Map showing location of Boeli-Serani and port plan showing location of facilities (inset).

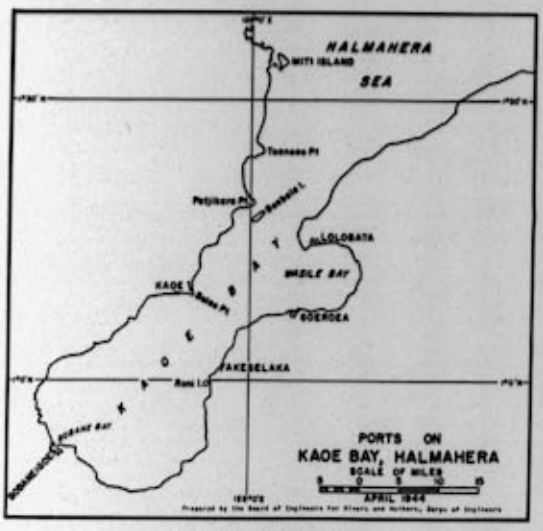

FIGURE VI - 44. *Kaoe Bay.*
Map showing location of ports.

activity has been observed recently, details of which are discussed under Topic 62, A, (5). The landing was in front of the village.

(*a*) *Harbor.* The harbor includes Goeroea Bay and the open roadstead in Wasile Bay, off the village. Goeroea Bay is a small bight on the south side of Wasile Bay, immediately south of Goeroea Point and about 5 miles inside the entrance to Wasile Bay.

Wasile Bay is described under Topic 62, A, (5), (a).

Vessels can anchor in Wasile Bay in depths of 16 to 22 fathoms over mud.

(*b*) *Landing facilities.* Photographs of 15 February 1944 show a new pier at Goeroea village (FIGURE VI - 45).

(7) Akeselaka (Ake Selaka), Halmahera Island (1° 02′ N, 127° 57′ E).

Akeselaka is on the southeastern shore of Kaoe Bay, an indentation in the north coast of Halmahera (FIGURE VI - 44).

It was a village of some importance and the storage place for jungle products. No landing facilities are reported.

(*a*) *Harbor.* The harbor is in Akeselaka roads, about 2 miles north of Roni, a small islet lying close to the eastern shore of Kaoe Bay. The bottom drops off somewhat steeply with the 10-fathom contour about 250 yards offshore. A reef is reported to lie 1 mile north of Babem (Akeselaka) (Babing) Island and about 870 yards offshore. The channel behind Babem Island is about 9 fathoms deep and about 150 yards wide.

Kaoe (Kau) Bay is entered at Boebale (Bobale) Island where it is 4½ miles wide, extending 33 miles southwestward to its head, where it is separated by a narrow isthmus from Dodinga Bay, on the west coast of Halmahera. The inner part of the bay has a maximum depth of 270 fathoms. The main channel into Kaoe Bay is close east of Boebale Island. It is deep in the fairway, but there is a 5½ fathom patch on its western side, and the eastern side is formed by a shoal bank with a least depth of 3½ fathoms. This bank is separated from the reefs along the eastern shore of the entrance by another deep but narrow channel. The channel west of Boebale Island is not recommended because of several shoals and the currents. The maximum velocity of the current on both sides of Boebale Island is 1½ knots. When the winds blow from the direction opposite to the set of the current, a difficult sea is experienced.

Anchorage is available in 22 fathoms, over mud and sand, southwest of Babem Island. Small vessels can anchor in 9 fathoms or less behind Babem Island.

(*b*) *Landing facilities.* No facilities are reported. Landings were probably made on the beach.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly.

(8) Bobaneigoe (Bobane Igoe), Halmahera Island (0° 52′ N, 137° 40′ E).

Bobaneigoe is at the head of Kaoe Bay on the north coast of Halmahera (FIGURE VI - 44). The town is strategically located on the northeastern side of the narrow isthmus which separates Kaoe Bay from Dodinga, on the west coast of Halmahera, distant about 2 miles. There was a pier in front of the village.

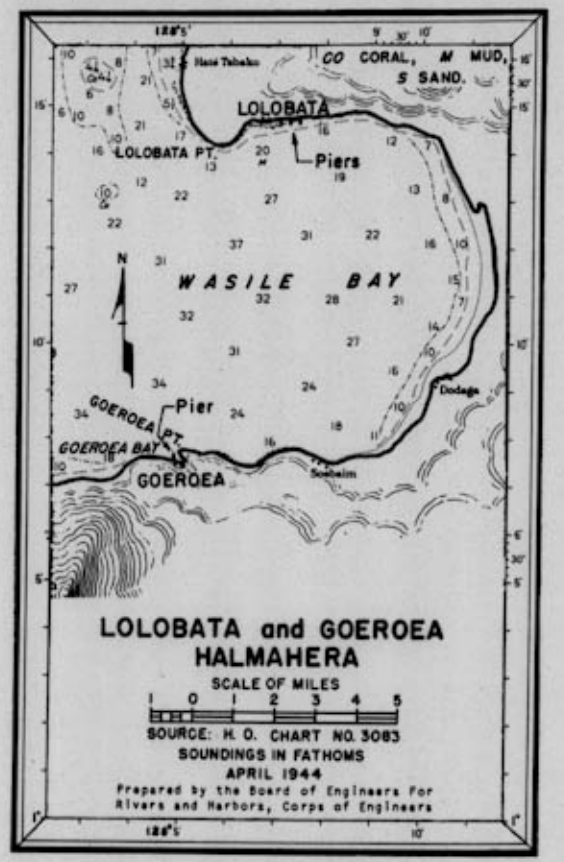

FIGURE VI - 45. *Lolobato.*
Port plan showing location of facilities at Lolobato and Goeroea.

(*a*) *Harbor.* The harbor is in Bobane Bay, a small but well-protected inlet at the head of Kaoe Bay. The bay is about 1 mile long, southeast-northwest. The entrance, opening north-northeasterly, is about ½ mile long and 350 yards wide. Charted depths are from 5 to 12 fathoms in the bay and from 12 to 18 fathoms in the entrance. Except for a small drying reef in the northeastern corner the shores of the bay are fronted by mud shoals.

Kaoe Bay is described under Topic 62, A, (7), (a).

Anchorage is available in either end of the bay in 6½ to 9 fathoms, over mud. The recommended anchorage is in 6½ fathoms, over mud, in the eastern end with the entrance points in range and the pier at Bobaneigoe bearing somewhat east of south.

(*b*) *Landing facilities.* A small pier extended from shore in front of town to a charted depth of 3 feet in the mud shoal (FIGURE VI - 46).

(*c*) *Clearance facilities.* A road led from the pier to Pasirpoetih (Pasir Poetih), east of the entrance to Bobane Bay, and a trail led to Dodinga, on the opposite side of the isthmus.

(9) Kaoe, Halmahera Island (1° 10′ N, 127° 54′ E).

Kaoe is on the west shore of Kaoe Bay, which indents the north coast of Halmahera (FIGURE VI - 44). The village was the most important trading center for Kaoe Bay. There was a pier at Kaoe.

(*a*) *Harbor.* Kaoe (Kau) roads, the harbor, is an open roadstead about 9 miles southwest of Boebale Island, which is located at the entrance to Kaoe Bay. The pier is approached by a channel which follows the shore to the northward. The entrance, about ½ mile north of the pier, was marked by a beacon on the shore. The bank on the east side of the channel was usually marked by poles. The water is shallow near shore and the bottom slopes gradually to the 5-fathom contour, more than 1 mile offshore in front of the pier.

Kaoe Bay is described under Topic 62, A, (7), (a). Anchorage may be had about 1¼ miles off the pier in depths of more than 5 fathoms over mud and sand. Vessels must approach slowly while sounding and anchor when 5½ fathoms is obtained. There is both a diurnal and semidiurnal tide, but the latter predominates. The spring lows of the two tides may coincide. The lowest low water level occurs between January and March and between July and October. The maximum rise and fall that can be expected are, respectively, about 2.6 above and 3.9 below mean sea level. The high water interval is 7 hours, 21 minutes.

(*b*) *Landing facilities.* A pier extended from shore at the north end of the village to a charted depth of 1½ feet of water (FIGURE VI - 47).

(*c*) *Clearance facilities.* A road ran northward for over 15 miles. Vessels of the K. P. M. called regularly.

FIGURE VI - 46. *Bobaneigoe.*
Port plan showing location of facilities at Bobaneigoe.

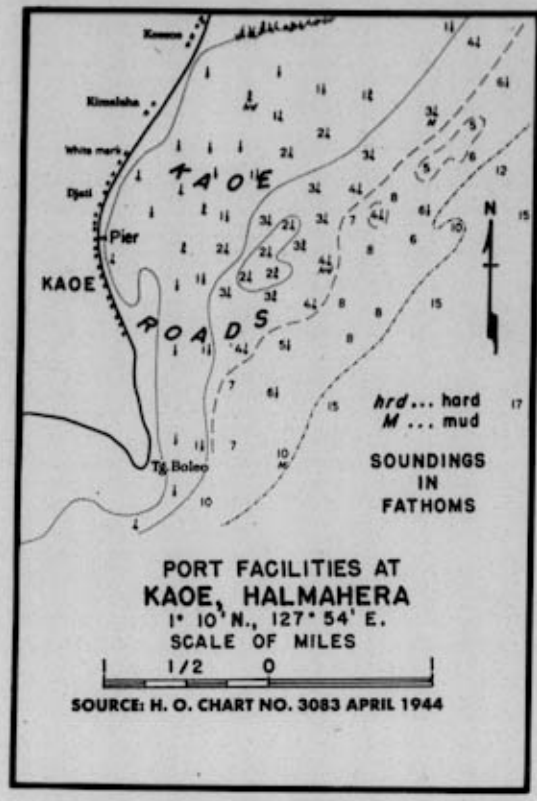

FIGURE VI - 47. *Kaoe.*
Port plan showing location of facilities at Kaoe.

(10) Miti Island (1° 34′ N, 128° 04′ E).

Miti Island lies about 1 mile off the eastern shore of the northwest arm of Halmahera about 9 miles south of Tobelo (FIGURE VI - 44). The town of Miti is on the western shore, near the southern end of the island.

(*a*) *Harbor.* The harbor is on the west side of the island. The best approach to the island is around its northern end, between Miti and the drying reefs to the northward. The shoals are well marked by discoloration. Proas enter from the southward, between Magalihoe (Makaliso) and Goemoelamo (Goemi Lamo), 2 small islets between Halmahera and the southern end of Miti.

There is suitable anchorage in 14 fathoms sheltered against all but northerly winds, between Miti village and Mawea, on Halmahera.

(*b*) *Landing facilities.* There were no landing facilities at Miti village, but a jetty is reported to be near the northern end of the island.

(11) Tobelo, Halmahera Island (1° 44′ N, 128° 01′ E).

Tobelo is on the east coast of the northwestern arm of Halmahera (FIGURE VI - 48). It was an important export point for copra. There were 2 piers, one north and the other south of the village.

(*a*) *Harbor.* The harbor in Tobelo roads is formed and sheltered by Koemoekoemoe (Koemoe) Island and the reef which connects it with Halmahera. Charted depths are 6 fathoms or less with controlling depths in the passages of 3¼ fathoms.

A fringing reef borders the shore between piers. Several shoals are located in the roads and 2 drying reefs lie southwest of Koemoekoemoe Island. The detached reefs and the shore reef on the southeast side of Koemoekoemoe were marked by beacons.

Large vessels anchor south of Madode (Toelang) Island, in depths of 8 to 10 fathoms, approached by channel between Koemoekoemoe and the detached drying reef southeast

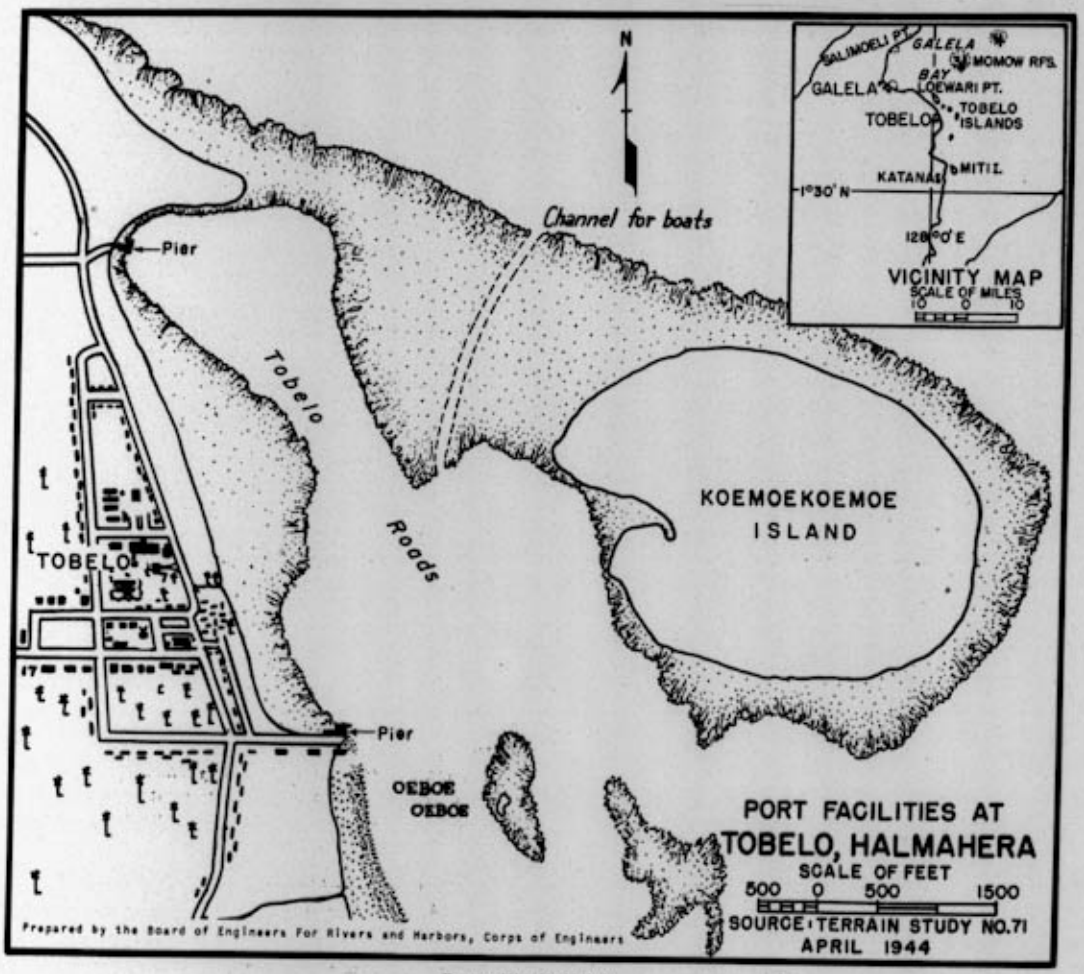

FIGURE VI - 48. *Tobelo.*
Map showing location of Tobelo (inset) and port plan showing location of facilities.

of it. Small vessels will find anchorage in the inner harbor. This anchorage is approached by way of the channel between Koemoekoemoe and the two drying reefs southwest of it.

(*b*) *Landing facilities.* At the southern end of the village there was a small pier, alongside which there was sufficient water for boats. North of the village there was another pier with 8 feet of water alongside.

A building at the southern end of the town, abreast the southern pier, was probably a warehouse.

(*c*) *Clearance facilities.* A road connected Tobelo with nearby coastal villages. Vessels of the K. P. M. called regularly.

(12) Galela, Halmahera Island (1° 50′ N, 127° 51′ E).

Galela is at the southwestern corner of Galela Bay, on the eastern coast of the northwest arm of Halmahera (FIGURE VI - 49). It was the only important village in the Galela Bay area. There were 2 piers south of the town.

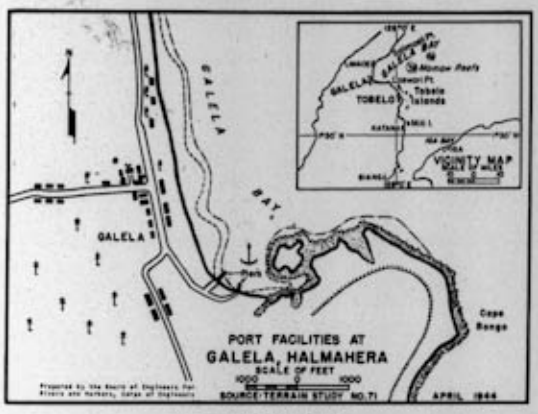

FIGURE VI - 49. *Galela.*
Map showing location of Galela (inset) and port plan showing location of facilities.

(*a*) *Harbor.* The harbor is in Galela roads at the southwest corner of Galela Bay. Depths range from 11 to 17 fathoms. It is sheltered during the southeast monsoon, but is not safe during the northwest monsoons.

Vessels that can use the limited swinging area can anchor in the bight in depths of 11 to 17 fathoms over fine sand.

Tides are both diurnal and semidiurnal but the latter predominates. Neither the spring highs nor the spring lows of the 2 tides coincide. The lunitidal interval is 6 hours and 2 minutes and the spring range is 4 feet. Tidal currents are negligible.

(*b*) *Landing facilities.* A photograph of 17 October 1943 shows 2 piers projecting from the shore, south of the town (FIGURE VI - 50).

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly.

(13) Sangowo, Morotai Island (2° 06′ N, 128° 33′ E).

Sangowo is on the southeast coast of Morotai Island which lies northeast of Halmahera (FIGURE VI - 51). No landing facilities are reported.

(*a*) *Harbor.* The harbor is a small basin in the drying reef in front of town with depths of 3½ to 5 fathoms. At the 3-fathom contour, the basin is about 75 yards wide at its mouth and 110 yards at its widest part by about 250 yards long. In front of town the drying reef is about 150 yards wide. The shore in the vicinity drops off steeply. There was a beacon on the western side of the entrance and another ashore at the head of the basin.

Anchorage is available in the basin in depths of 3½ to 5 fathoms over mud or sand. Anchorage is also available outside the basin in 16 to 22 fathoms, over sand, but rollers are usually experienced.

(*b*) *Landing facilities.* No piers are reported at Sangowo. Boats can always land safely in the basin.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called occasionally.

(14) Djiko (Wajaboela), Morotai Island (2° 16′ N, 128° 12′ E).

Djiko is at the western extremity of Morotai Island, which lies northeast of Halmahera (FIGURE VI - 52). It was the shipping port for the entire west coast of Morotai. There was a pier at Djiko on the south side of Wajaboela Point. Wajaboela village lies on the northern side of the point, northwestward of the port.

(*a*) *Harbor.* The harbor is an open roadstead in Wajaboela Bay (roads), which lies south and southwest of Wajaboela Point. The shore is fringed by drying reefs. The water area is obstructed by several drying reefs that offer some protection against seas from the south. The harbor affords good protection against northerly and easterly winds. The useful water area is small and of irregular shape, the greatest dimension being about 1 mile. Depths range from 1 to 8 fathoms in front of town and from 8 to 22 fathoms in clear areas among the reefs.

Anchorage is available southeasterly of the pier, inside the drying reefs, in depths of 18 to 22 fathoms, over stone. Small craft can probably anchor in the comparatively shallow waters immediately in front of town.

(*b*) *Landing facilities.* A pier extended across the drying reef in front of Djiko to a charted depth of 2¾ fathoms (FIGURE VI - 52). The inshore end was built of stones and sand, and the seaward end was timber.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly.

(*d*) *Availability of supplies.* Drinking water can be obtained, but it is brackish and unclean.

(15) Djailolo, Halmahera Island (1° 04′ N, 127° 28′ E).

Djailolo is on the west coast of Halmahera (FIGURE VI - 53). The main village lies inland and cannot be seen from the sea. The beach portion is south of the village, near the pier (FIGURE VI - 54).

(*a*) *Harbor.* The harbor is a basin on the north side of Djailolo (Jailolo) Bay, formed and protected by 2 drying reefs. It is about 150 yards wide across its mouth and about 200 yards long, with depths of ½ to 16 fathoms. The controlling depth at the inner end of the harbor is ½ fathom.

Djailolo Bay is 3¼ miles wide at the entrance between Kailoepa (Kailupa) and Goeai (Guai) points. Drying reefs extend more than 300 yards from shore. The bay is open to west winds. Small vessels anchor in the harbor in 16 fathoms. Large

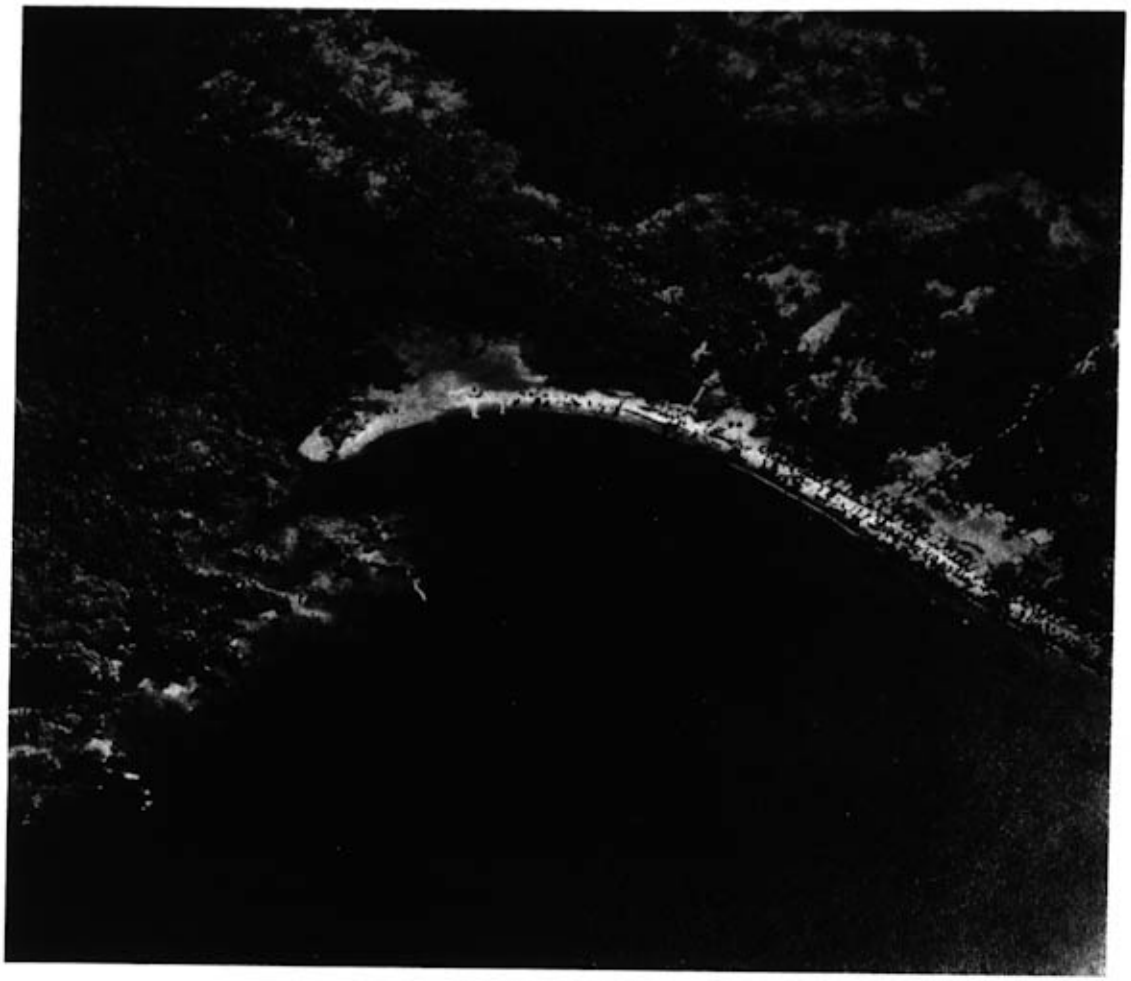

FIGURE VI - 50. *Galela.*
Aerial view of Galela showing location of port facilities. 17 October 1943.

vessels can anchor outside the harbor in 16 to 22 fathoms, over sand and coral.

(b) Landing facilities. There was a pier at the head of the harbor, about 590 feet long, with a charted depth of 3 feet at its head (FIGURE VI - 55). The inshore end for about 540 feet was of stone construction. The outer 50 feet was timber.

(c) *Clearance facilities.* A good motor road led northward for about 10 miles.

*(16) **Mare, Mare Island*** (0° 35′ N, 127° 24′ E).

Mare is on the east coast of Mare Island, which lies off the west coast of Halmahera, 2 miles south of Tidore Island (FIGURE VI - 56). There was a small pier at the village.

(a) *Harbor.* The harbor is an open roadstead, on the western side of the channel between Mare and Halmahera Island. The shore in the vicinity of the town is bordered by a fringing reef. The bottom of sand and rocks, drops off steeply with the 10-fathom contour about 100 yards offshore.

Anchorage is available in 27 fathoms off the village.

(b) *Landing facilities.* There was a small pier at Mare (FIGURE VI - 57).

*(17) **Ngofakiaha, Makian Island*** (0° 22′ N, 127° 25′ E).

Ngofakiaha is on the northwest shore of Makian Island, which lies off the west coast of Halmahera, about 8½ miles south of Mare Island (FIGURE VI - 56). There was a small pier at the village.

(a) *Harbor.* The harbor is an open roadstead, on the western side of the strait between Makian and Halmahera islands. The bottom drops off steeply, with the 10-fathom contour less than 40 yards offshore.

There is good anchorage in 16 to 33 fathoms, over sand, off the village.

(b) *Landing facilities.* A small pier for boats extended approximately 50 feet in front of the village (FIGURE VI - 58). Rollers may be troublesome at this landing at times.

(18) Batoela, Halmahera Island (0° 01′ S, 127° 42′ E).

Batoela is on the west coast of Halmahera Island, abreast the southern part of Kajoa (Ngailo) Island (FIGURE VI - 56). The town is not visible from seaward. From the charts, there appears to be a landing place southwest of the village.

(*a*) *Harbor.* The harbor is in Batoela roads, an open roadstead 2 miles south of Tandjoeng Mari-toesa.

The roads affords good anchorage in 16 fathoms. Shelter is provided against winds from the east.

(*b*) *Landing facilities.* A shore installation, having the appearance of a small pier, is charted southwest of the town. A shed was available for storage (FIGURE VI - 59).

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly.

(19) Waisabatang (Sabatang), Batjan Island (0° 26′ S, 127° 39′ E).

Waisabatang is on the northeast coast of Batjan Island, westward of the south arm of Halmahera (FIGURE VI - 56). There was a small pier at the village.

(*a*) *Harbor.* The harbor is an open roadstead on the western side of Patinti Strait, about 2 miles northwest of Toeada (Ruige) Point, the northeastern extremity of the island. Patinti Strait separates Batjan and Halmahera islands. The bottom slopes gradually, with the 10-fathom contour about 300 yards from the pier. The shore in front of town is fringed by a drying reef. Except for 2 shoals in front of town, the area is free of dangers.

Anchorage is available in 7½ to 9 fathoms between a drying reef north of the flagstaff and a 3¼-fathom patch located outside the 10-fathom contour. There is both a diurnal and a semidiurnal tide. The spring highs and the spring lows of the two tides

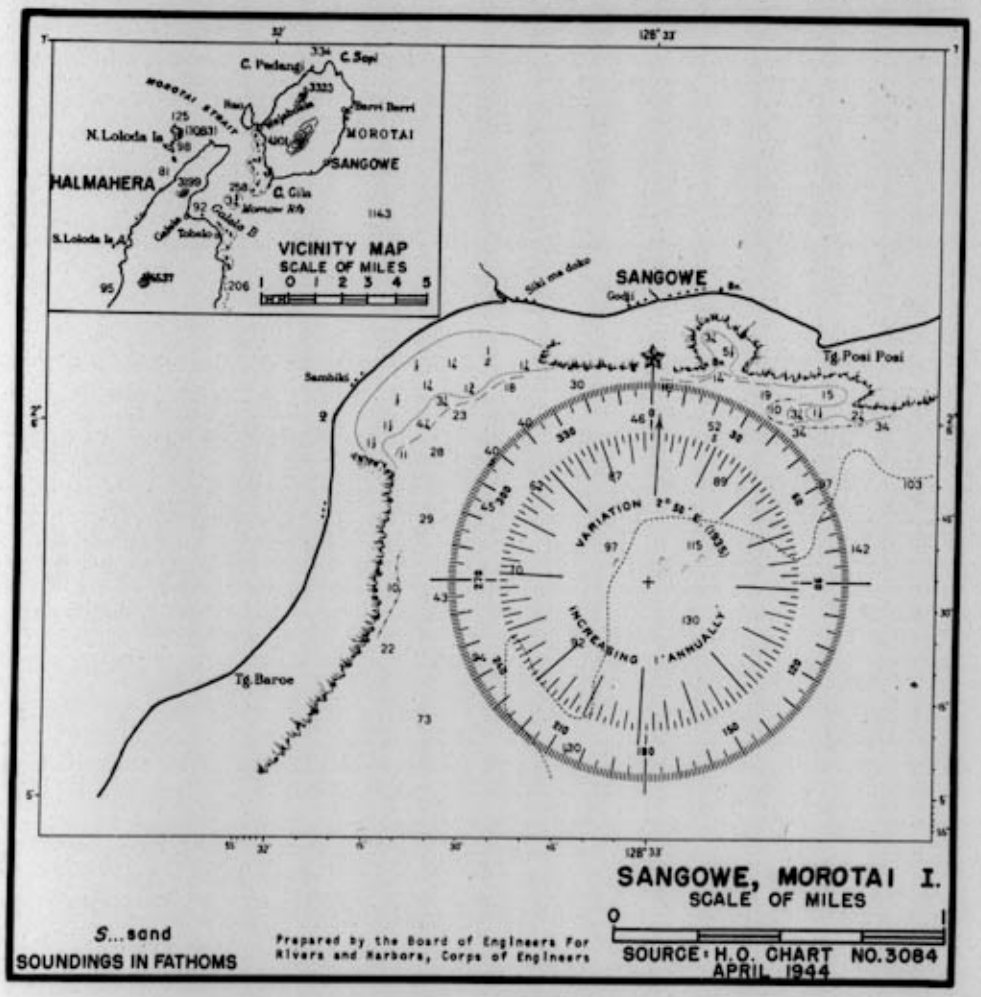

FIGURE VI - 51. *Sangowo.*
Map showing location of Sangowo (inset) and plan of port.

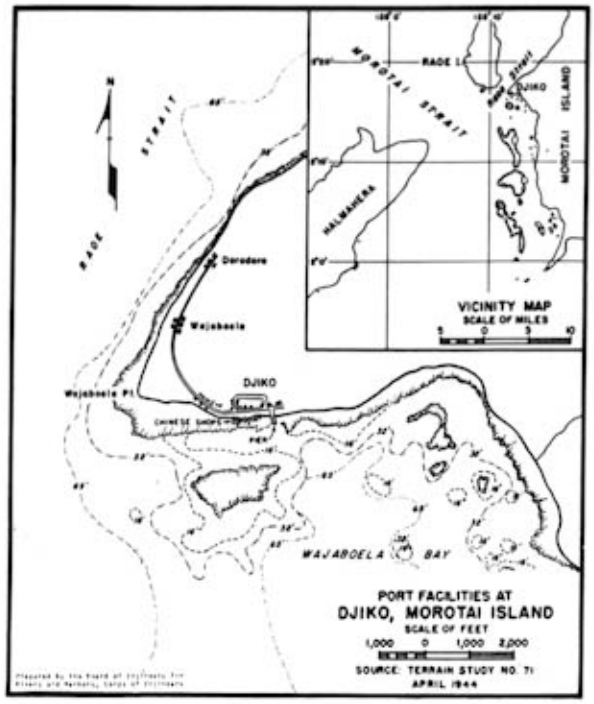

FIGURE VI - 52. *Djiko.*
Map showing location of Djiko (inset) and port plan showing location of facilities.

FIGURE VI - 53. *Djailolo.*
Map showing location of Djailolo (inset) and port plan showing location of facilities.

may coincide. The highest water level occurs in May or June and in November or December. The maximum rise and fall that may be expected are, respectively, about 2.6 feet above and 1.3 feet below mean sea level.

(*b*) *Landing facilities.* A small pier for boats extended across the fringing reef in front of town (FIGURE VI - 60).

(20) Laboeha, Batjan Island (0° 38′ S, 127° 28′ E).

Laboeha is at the head of Laboeha Bay, on the west coast of Batjan Island (FIGURE VI - 56). It was the center of trade for the bay area. There was a pier at Laboeha and another at the adjoining village of Amasing.

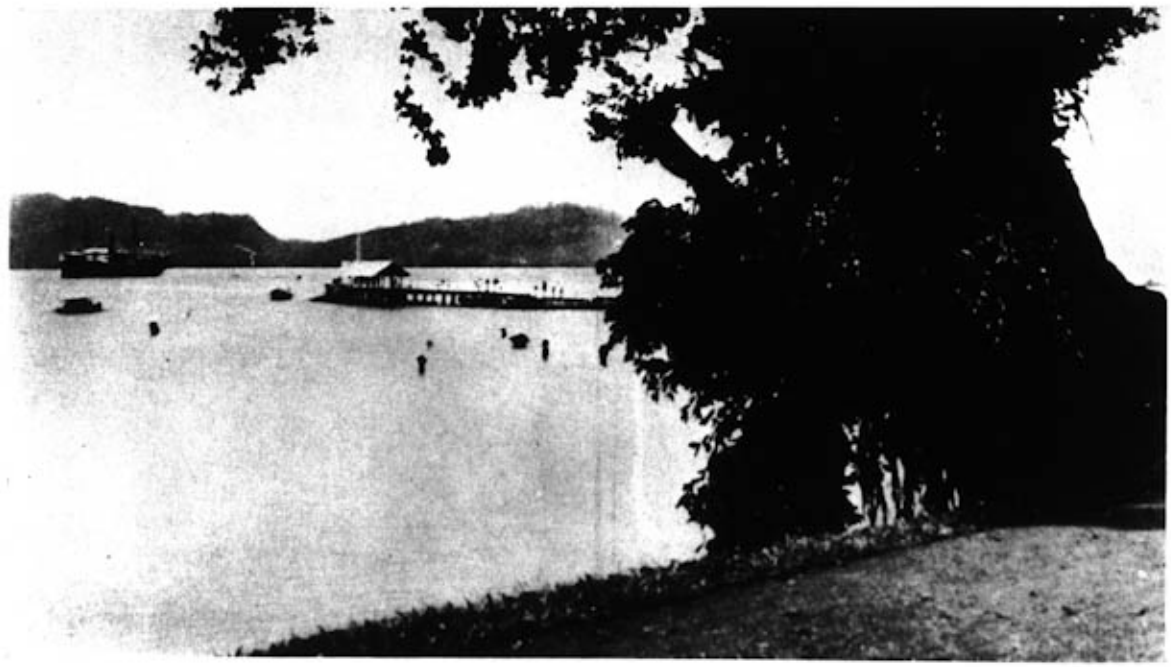

FIGURE VI - 54. *Djailolo.*
View showing pier at Djailolo. 1939.

FIGURE VI - 55. *Djailolo.*
Aerial view of Djailolo showing location of port facilities. 20 January 1943.

(*a*) *Harbor.* The harbor is an open roadstead in the northeast corner of Laboeha Bay. In front of the town, depths are generally from 9 to 11 fathoms. The 5-fathom contour is within 200 yards of the pier at Laboeha, and within 100 yards of the south end of the village. Shelter is offered from northerly and easterly winds but the southern monsoon may cause dangerous breakers on shore. Vessels may anchor within 600 yards of the pier in 6½ to 10 fathoms, over soft mud. There is both a diurnal and a semidiurnal tide, but the latter predominates. The tidal range is small and does not affect navigation. During the south monsoon, in July and August, the wind can blow with considerable strength and cause breakers, rendering communication with shore difficult at times. During the west monsoon, in January and February, a squall of great strength from the southwest may occur occasionally, but it never lasts more than 20 minutes. Otherwise conditions are favorable.

(*b*) *Landing facilities.* A pier extended about 75 feet from shore in front of Laboeha to a charted depth of 9 feet. Another pier was located at Amasing, immediately adjoining Laboeha on the northwest (FIGURE VI - 61).

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly at Laboeha, which was also a port of call for inter-island vessels. A road led across the island from the village.

*(21) **Penamboean, Batjan Island*** (0° 43′ S, 128° 27′ E).

Penamboean is about 3 miles south of Laboeha Bay, on the west coast of Batjan Island (FIGURE VI - 56). It was the site of a large plantation. There was a small pier at the settlement.

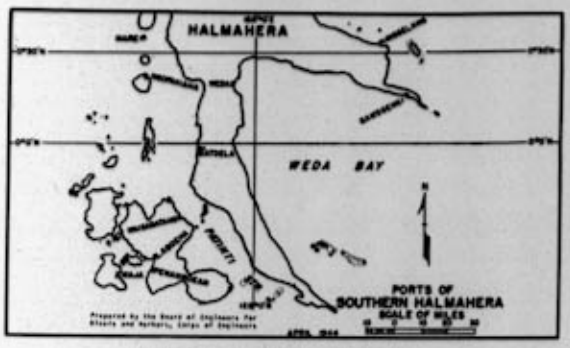

FIGURE VI - 56. *Southern Halmahera.*
Map showing location of ports.

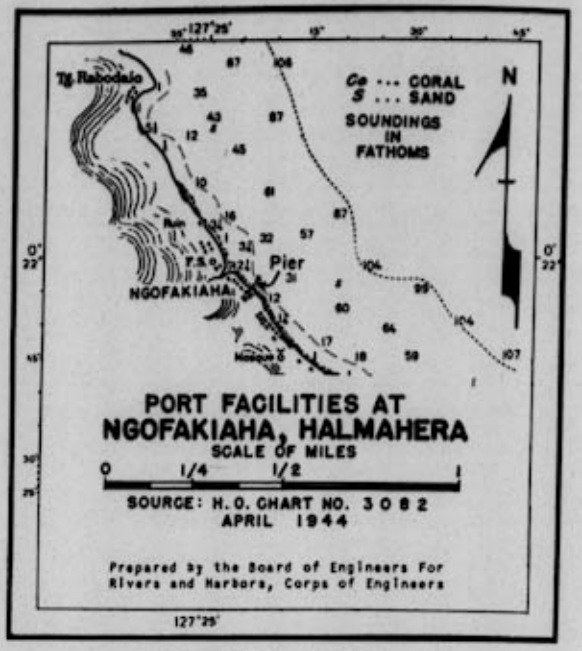

FIGURE VI - 58. *Ngofakiaha.*
Port plan showing location of facilities.

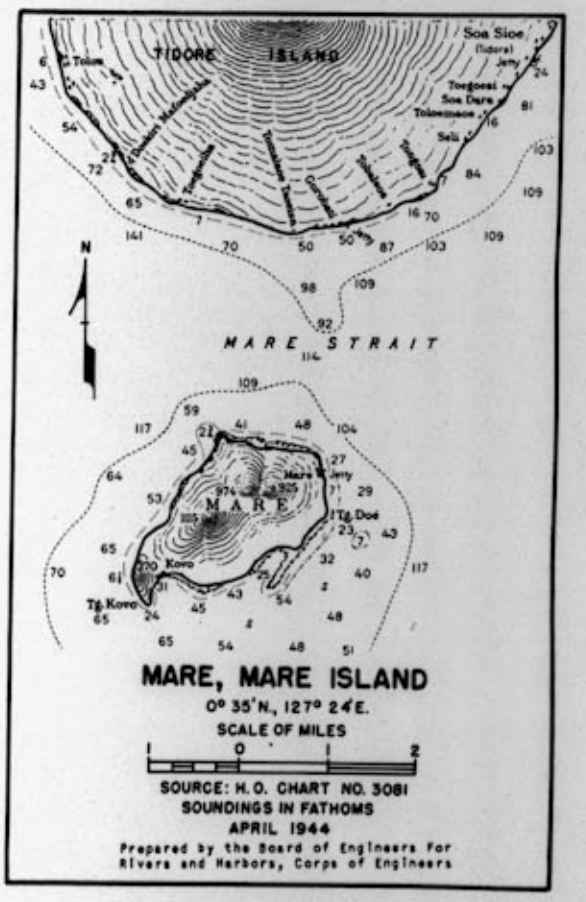

FIGURE VI - 57. *Mare.*
Port plan showing location of facilities.

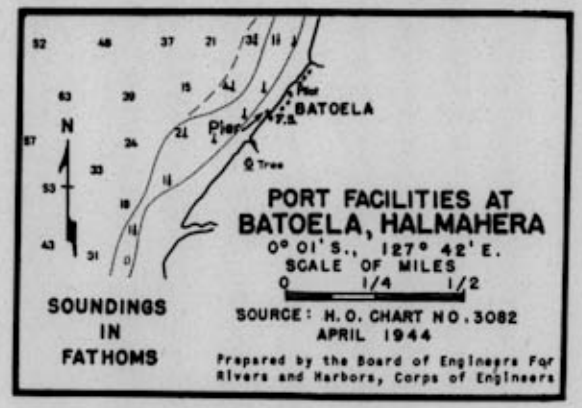

FIGURE VI - 59. *Batoela.*
Port plan showing location of facilities.

(*a*) *Harbor.* The harbor is a bight, ¼ mile wide and opening northward, on the eastern side of Batjan Strait, which is used as a protected anchorage.

(*b*) *Landing facilities.* A small pier, suitable for boats, was located at Penamboean.

(22) Waja, Mandioli Island (0° 43′ S, 127° 17′ E).

Waja is on the east coast of Mandioli Island, which lies southwest of Batjan Island (FIGURE VI - 56). There was a small pier at the village.

(*a*) *Harbor.* Waja Bay, opening to the eastward off Batjan Strait, used as a boat anchorage and harbor, is comparatively shallow. It is about 400 yards wide at its mouth and about 600 yards long, outside the 5-fathom contour. A small area of

lesser depth lies inside the 5-fathom contour. Good shelter is offered from all weather.

Anchorage is available in Waja Bay in depths of 10 to 3 fathoms, over mud and sand.

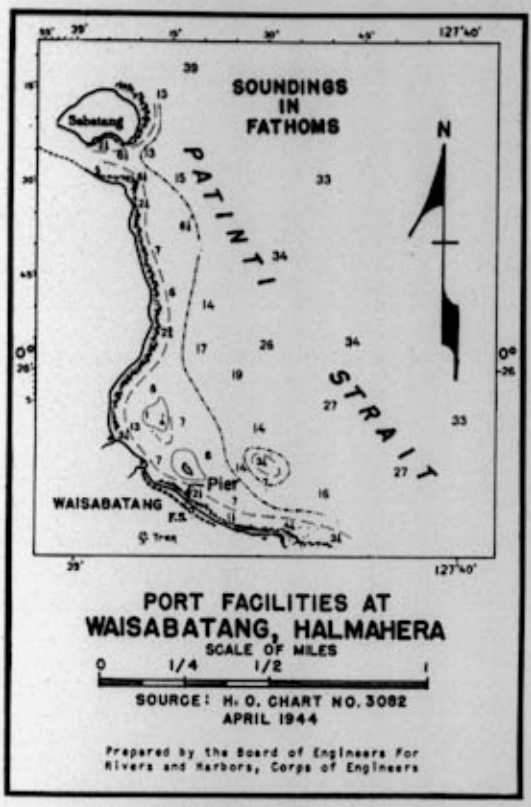

FIGURE VI - 60. *Waisabatang.*
Port plan showing location of facilities.

(*b*) *Landing facilities.* A small pier for proas extended from shore in front of the town for about 400 feet.

B. Sangihe-Talaud Sector.

(1) *Beo, Talaud Islands* (4° 14′ N, 126° 49′ E).

Beo is on the western side of Karakelong Island, the northernmost of the Talaud Islands (FIGURE VI - 62). There was a pier at the village.

(*a*) *Harbor.* The harbor is an open roadstead on the south side of Beo Bay. The bay is about 2 miles wide at the entrance and recedes about ¾ mile. It is fronted by a drying shore bank, which is coral in the southern part of the bay.

There are no dangers outside the 5-fathom curve, but within this curve the depths shoal rapidly to from 10 to 3 feet. At Beo, the 5-fathom curve is about 500 yards off shore, while ½ mile north it is within 200 yards of the shore, and in the northern part of the bay, it is 1,000 yards from shore. The bay is entirely open to the sea and wind from the southwest and northwest.

The best anchorage was on the axis of the pier in a depth of 38 fathoms, over mud and sand, but the bottom is steep.

A fixed red light, 11 feet above high water and visible 2 miles, was shown from the head of the pier.

(*b*) *Landing facilities.* There was a stone pier 426 feet long, with a depth of 5 feet at the head (FIGURE VI - 63).

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly.

(*d*) *Availability of supplies.* Provisions could be obtained.

(2) *Liroeng, (Lirung) Talaud Islands* (3° 57′ N, 126° 42′ E).

Liroeng is on the northeast coast of Salebaboe Island, the middle island of the Talaud group (FIGURE VI - 62). There were no piers. Landing was made on the beach.

(*a*) *Harbor.* The harbor, Liroeng road, is an open roadstead between Salebaboe Island and Sara Ketjil and Sara-besar islands. The 5-fathom curve is about 100 yards off shore at Liroeng. Depths near the center of the roadstead are from 20 to 40 fathoms.

Good anchorage in 16 fathoms, over mud, sand and rocks, is available with the flagstaff at the village bearing 198°. It is safe during both monsoons.

At Liroeng road, there is both a diurnal and semidiurnal tide, but the latter predominates. Neither the spring highs nor the spring lows of the 2 tides coincide. The highest water level occurs in April or May and in October or November; the lowest, in January or February and in July or August. The maximum rise and fall that can be expected are, respectively, about 3 feet above and 3 feet below mean sea level. The currents caused by the semidiurnal tides set northwestward along the coast around high water and southeastward around low water. They can attain a velocity of 2 to 3 knots.

FIGURE VI - 61. *Laboeha.*
Port plan showing location of facilities.

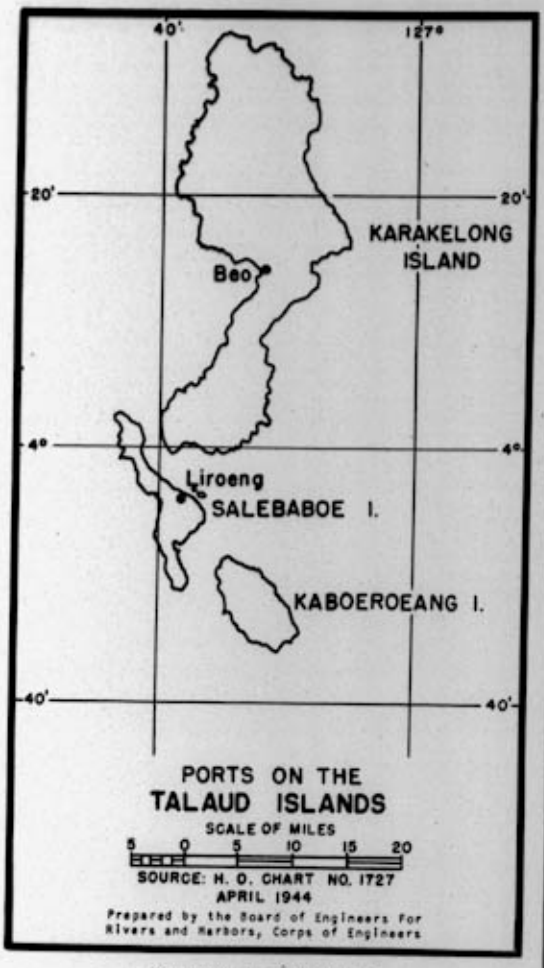

FIGURE VI - 62. *Talaud Islands.*
Location of ports.

(*b*) *Landing facilities.* No piers are reported at Liroeng. The best landing place was near the flagstaff, where the beach is free from rocks.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. Horse paths led along the shore to the north and south.

(*d*) *Availability of supplies.* Provisions could be obtained.

(3) Peta, Sangihe (Sangi) Island (3° 39′ N, 125° 33′ E).

Peta is at the head of Peta Bay, on the east coast of Sangihe Island, which lies southwest of the Talaud Islands (FIGURE VI - 64). No piers or other landing facilities are reported.

(*a*) *Harbor.* The harbor is in Peta Bay, a small bight used as an anchorage, opening northeast. The entrance to the bay was marked by buoys. The harbor is about 350 yards wide between dangers and about 1,500 yards long, with depths of 3¾ to 24 fathoms. The shores on either side are fringed by drying reefs. The reef on the southeastern side is fronted by a sand shoal. The beach in front of the town is sandy. It was possible to load or unload cargo at any time. Vessels over 360 feet are advised to anchor outside. Vessels more than 195 feet long require local knowledge.

Vessels anchored in 12½ fathoms in the inner part of the bay with a mooring line secured to an iron ring near a warehouse on shore. There is danger of drifting on to the shore reef if mooring is not quickly executed. There is both a diurnal and a semidiurnal tide, but the latter predominates. The spring highs of the two tides coincide. The highest water level occurs in May and November. The maximum rise and fall that can be expected are, respectively, about 4.3 feet above and 3 feet below mean sea level. A fixed red light, visible 3 miles, was shown at the head of the bay.

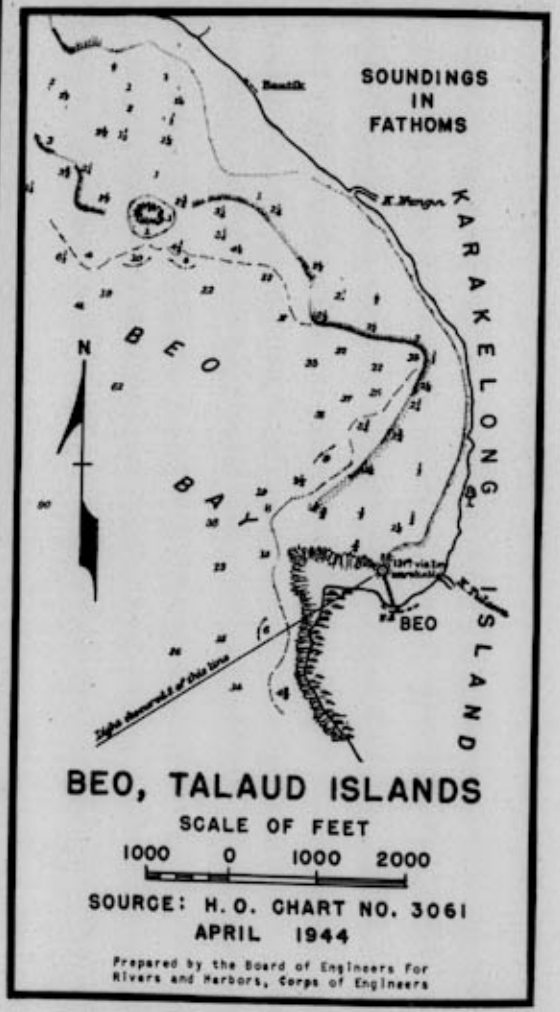

FIGURE VI - 63. *Beo.*
Port plan showing location of facilities.

(*b*) *Landing facilities.* No piers are reported. Landings are probably made on the beach in front of the town. There was a warehouse at the port.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. A good road led northward from the town, and a trail crossed the island.

(4) Taboena (Taroena), Sangihe Island (3° 37′ N, 125° 29′ E).

Tahoena is on the west coast of Sangihe Island (FIGURE VI - 64). It was the principal village and export centre of the Sangihe Islands. There was a small pier at the village.

(*a*) *Harbor.* The harbor is in Tahoena Bay which opens westerly. It is about ½ mile wide and 1⅓ miles long. It is deep and, except for a fringing reef on the south shore and a shoal in the northeast corner, it is free of danger and can be entered at night in clear weather. At the northeast corner of the bay is the entrance to a lagoon that is used as a proa harbor during bad weather.

Anchorage is available in the eastern end of the harbor in 19 to 30 fathoms, over black sand.

There is both a diurnal and semidiurnal tide, but the latter predominates. The spring highs of the 2 tides coincide. The highest water level occurs in May and November. The maximum rise and fall that can be expected are, respectively, about 3.6 feet above and 2.6 feet below mean sea level. The high water interval is 5 hours, 47 minutes. The spring range is 5.8 feet.

The bay is usually calm, but during the north monsoon season, westerly winds may spring up and last from 1 to 4 days. They are not dangerous to vessels but cause much surf on the beach. Westerly winds, which occur at other times of the year, as well as frequent strong southwest winds, are of shorter duration and less intensity, but they often hinder loading or unloading.

(*b*) *Landing facilities.* There was a small pier with 3 feet alongside at low water. The pier consisted of a stone approach, with an open pile and timber extension (FIGURE VI - 65).

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. Trails led to other villages on the island.

(5) Tamako, Sangihe Island (3° 28′ N, 125° 30′ E).

Tamako is on the west coast of Sangihe Island (FIGURE VI - 64). No landing facilities have been reported.

(*a*) *Harbor.* The harbor is in Tamako roads.

Anchorage is available in 30 fathoms in front of the village, but it is advisable to anchor farther out, in 33 fathoms, with the flag pole on shore bearing 80°.

(*b*) *Landing facilities.* No piers are reported.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. A trail connected Tamako with other nearby villages.

(6) Dagho, Sangihe Island (3° 27′ N, 125° 33′ E).

Dagho is at the head of Dagho Bay, on the southwest coast of Sangihe Island (FIGURE VI - 64). There was a pier at the village.

(*a*) *Harbor.* The harbor is a sheltered basin in the head of Dagho Bay, about ⅜ mile wide between the 5-fathom contours at the entrance and ¾ mile long, with depths of 26 fathoms in the middle. There are 2 shoals on the northwest side. The

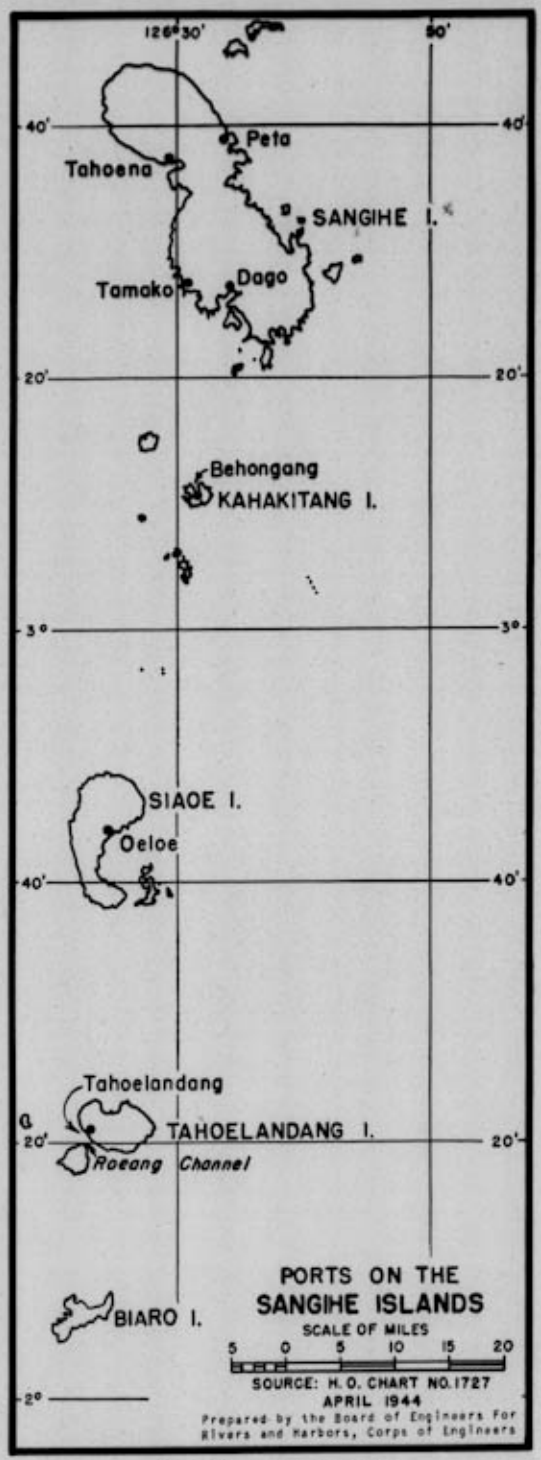

FIGURE VI - 64. *Sangihe Islands.*
Map showing location of ports.

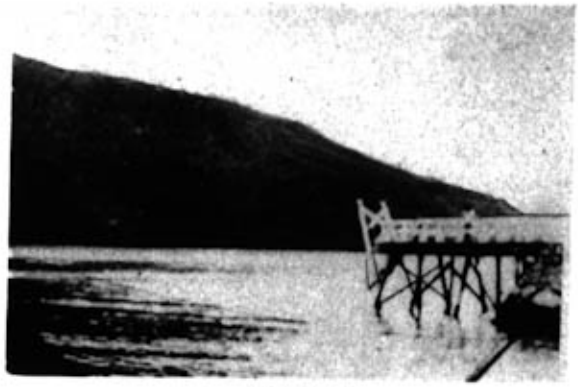

FIGURE VI - 65. *Taboena.*
View of pier showing type of construction. 1939.

shores are bordered by fringing reefs, the one on the southeast shore being narrow, but on the northwest shore the reef in places extends out for as much as 300 yards. The bay is about 1¼ miles wide at its mouth and about 2½ miles long (FIGURE VI - 66).

Good anchorage with protection from all weather is available above Sama Island in depths up to 26 fathoms, over mud and sand. Immediately below Sama Island, fair weather anchorage is available in depths from 15 to 40 fathoms, over mud and sand, with room for one large vessel and several smaller craft.

(*b*) *Landing facilities.* A stone pier, about 600 feet long, extended from shore across the drying reef in front of the town (FIGURE VI - 66).

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. A trail connected Dagho with other villages along the coast.

(7) Behongang, Kahakitang (Karakitang) Island (3° 10′ N, 125° 31′ E).

Behongang is at the head of Behongang Bay, on the north coast of Kahakitang Island, which lies close southward of Sangihe Island (FIGURE VI - 64). There was a pier at the village.

(*a*) *Harbor.* The harbor is in Behongang Bay, which is about 700 yards wide at its mouth and recedes about 1½ miles. The shore is bordered by a fringing reef, the extremities of which are easily distinguished.

Sheltered anchorage is available in a depth of 44 fathoms in front of the village.

(*b*) *Landing facilities.* A stone pier, with wooden superstructure and a depth of 6½ feet alongside, was a good landing place for boats.

(8) Hoeloe (Ulu), Siaoe (Siau) Island (2° 44′ N, 125° 25′ E).

Hoeloe is near the northern end of a large bight on the east coast of Siaoe Island, one of the Sangihe islands (FIGURE VI - 64). There was a wharf in front of the village.

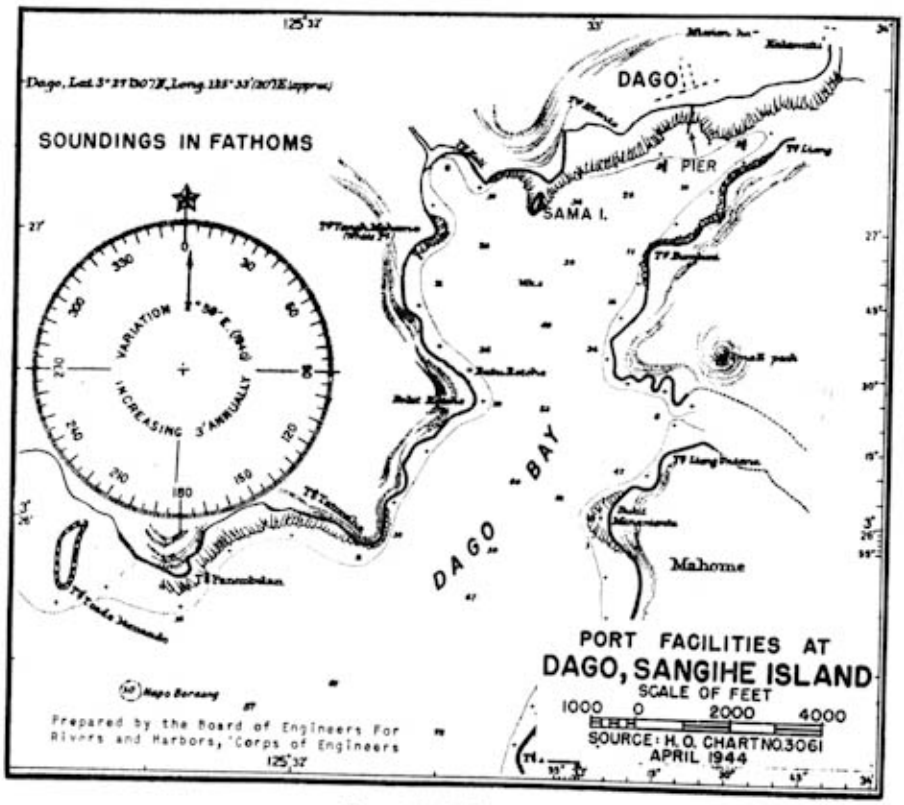

FIGURE VI - 66. *Dagho.*
Port plan showing location of facilities.

(*a*) *Harbor.* The harbor is an open roadstead on the northern side of a large bight which opens between Boeloede (Bulude) and Pihise points.

There is anchorage about 330 yards offshore in a depth of 44 fathoms, with a conspicuous white pillar on shore bearing 0°. During westerly storms good anchorage may also be found in 26 fathoms, with the white pillar bearing 10° and the flagpole bearing 296°. From the beginning of January to the middle of April this road is not safe on account of the northeast and east winds.

A fixed red light, visible 3 miles, was shown from the Government Wharf on arrival of vessels.

(*b*) *Landing facilities.* A Government wharf was located at Hoeloe.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. Roads led north and south along the shore and across the island.

(*d*) *Availability of supplies.* Provisions could be obtained in limited quantities.

(9) Tahoelandang (Boebias), Tahoelandang Island (2° 21′ N, 125° 24′ E).

Tahoelandang is on the southwest side of Tahoelandang (Tagoelandang) Island, one of the southern Sangihe islands (FIGURE VI - 64). There was a pier in front of the town.

(*a*) *Harbor.* The harbor is an open roadstead. The shore from the pier southward is bordered by a narrow fringing reef, but at a point about 1¼ miles north of the pier the reef is ¾ mile wide. The bottom drops off sharply from the reef. The 10-fathom contour is close inshore. Roeang Channel between Roeang and Tahoelandang islands, which is of little importance to navigation, has depths of 1 to 8 fathoms over a width of about 1,000 yards.

In Roeang Channel, strong currents set to the southeastward with the flood tide and to the northwestward with the ebb.

Anchorage is available close inshore near the lighthouse in 44 fathoms, over sand. There is anchorage in 38 fathoms somewhat more northwestward and farther from the reef, where currents which set through Roeang Channel are less troublesome.

(*b*) *Landing facilities.* A pier extended from the shore in front of town near the lighthouse. Customs sheds or warehouses were available. No other data concerning landing facilities are at hand.

(*c*) *Clearance facilities.* Vessels of the K. P. M. called regularly. A road extended southeasterly and northwesterly from the town.

C. Mindanao Sector.

(1) Mati, Mindanao Island (6° 57′ N, 126° 13′ E).

Mati is at the head of Pujada Bay, on the southeast coast of Mindanao Island (FIGURE VI - 67). It was the most important of this section and an important shipping center for hemp and copra. There was a pier at the town.

(*a*) *Harbor.* The harbor is in Pujada Bay, which is 6 miles wide at the entrance between Lamigan and Tumadgo Points, and recedes 12 miles northwestward. The entrance narrows to 4 miles in width and is divided into 2 deep, clear channels by Pujada Island. The shores are fringed by coral reefs.

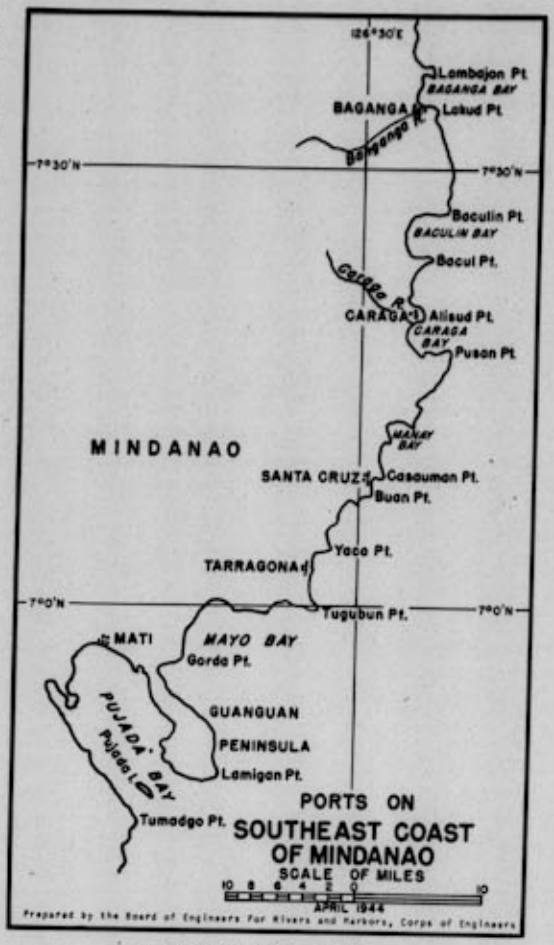

FIGURE VI - 67. *Mindanao, SE Coast.*
Map showing location of ports.

Pujada Bay is too deep for good anchorage, although well sheltered and protected. There is anchorage off Mati in 15 to 18 fathoms of water, over sand bottom, about 400 yards from shore.

A fixed red light, 36 feet above high water and visible 7 miles, was shown from the shore end of the pier.

The high water interval in Pujada Bay is 6 hours 12 minutes. The higher high water height is 4.8 feet and the lowest tide is 1.5 feet.

(*b*) *Landing facilities.* Landing facilities consisted of a rock and earth causeway, 23 feet wide and 530 feet long, from which a reinforced concrete pier, 29.5 feet wide, extended 39.5 feet to a reinforced concrete T-head landing, 39.5 feet wide and 147 feet long. There was a depth of 20 feet alongside the head at low water. This wharf provided 1 berth for a 200-foot vessel with 12-foot draft.

(*c*) *Clearance facilities.* There was regular steamship service with other ports on Mindanao and with Manila. There were

no railroad connections. Roads and trails connected the towns along the coast and the eastern shore of Davao Gulf.

(*d*) *Availability of supplies.* There was no fresh water at the pier. Food supplies could be obtained in the town.

(2) Tarragona, Mindanao Island (7° 03′ N, 126° 27′ E).

Tarragona is on the southeast coast of Mindanao Island (FIGURE VI - 67). It was a port of call for coastwise steamers. No landing facilities are reported.

(*a*) *Harbor.* The harbor is in a bay formed between Yaco and Tugubun points. Depths at the entrance are 45 to 116 fathoms and 16 to 21 fathoms close in. Off the shore reef there are depths of 4¼ to 8 fathoms. The approach is clear except for a 1½ to 4¾ fathom shoal which extends about 1 mile from shore, about 1¼ mile southeast of the town.

Heavy seas frequently prevail along this coast and there is a strong constant southerly current of about 2.2 knots with heavy tide rips at the points. Tidal currents are weak.

The bay affords indifferent anchorage open to eastward and southward.

(*b*) *Landing facilities.* No piers are reported.

(*c*) *Clearance facilities.* Tarragona was a port of call for coastwise steamers.

(3) Holy-Cross, Mindanao Island (7° 09′ N, 126° 31′ E).

Holy-Cross is on the southeast coast of Mindanao, at the head of a small bay (FIGURE VI - 67). It was a port of call for coastwise steamers. No landing facilities are reported.

(*a*) *Harbor.* The harbor is in a small bay which is 1½ miles wide at the entrance between Casauman and Buan Points, and recedes westward about ⅔ mile. The bay is clear of dangers. Depths are 39 to 103 fathoms in the bay and 18 to 31 fathoms off the town. The shore appears to be free of fringing reef but there is a broad shoal, with 2½ fathoms, along the shore in front of the town.

The bay is open to the east and southeastward affording indifferent anchorage.

Heavy tide rips frequently exist off Casauman Point.

(*b*) *Landing facilities.* No piers are reported.

(*c*) *Clearance facilities.* Holy-Cross was a port of call for coastwise steamers.

(4) Caraga, Mindanao Island (7° 20′ N, 126° 34′ E).

Caraga is on the southeast coast of Mindanao Island on the north side of the entrance to Caraga Bay, at the mouth of the Caraga River (FIGURE VI - 67). It was an important shipping point for local products. No landing facilities are reported.

The Caraga River, which discharges into the northern part of Caraga Bay, just west of the town, can be entered by small boats at half or full tide. Heavy breakers extend across the entrance, even in moderate weather.

(*a*) *Harbor.* The harbor is in Caraga Bay which is about 2½ miles wide at the entrance between Alisud and Pusan Points and recedes westward about 1½ miles. It is open to northeastward, with depths of 39 to 232 fathoms at the entrance and 49 to 53 fathoms inside. Two small coves have 4 to 9 fathoms close in. The bay is clear of dangers.

The anchorage in front of Caraga, is available in fair weather only. The depth of water and character of bottom make it unsafe during heavy weather. Anchorage, protected in easterly and southeasterly weather, may be found in the southwest corner in front of Santiago village.

At Caraga Bay, the high water interval is 6 hours 13 minutes. The mean range of tide is 4.1 feet and the diurnal range of tide is 5.0 feet.

The lowest tide is 2.0 feet below mean lower low water.

Even in moderate weather heavy rips and swirls are encountered off Pusan, apparently caused by the constant 2.2-knot southerly current which exists off the east coast of Mindanao.

(*b*) *Landing facilities.* No piers are known to exist.

(*c*) *Clearance facilities.* Caraga was a weekly port of call for coastwise steamers.

(*d*) *Availability of supplies.* Supplies of any kind were scarce.

(5) Baganga, Mindanao Island (7° 35′ N, 126° 34′ E).

Baganga is on the southeast coast of Mindanao on the southwestern shore of Baganga Bay, at the mouth of the Baganga River (FIGURE VI - 67). It was the only important town in this area. No landing facilities are reported.

The Baganga River, close northwestward of the town, cannot be entered at low water.

(*a*) *Harbor.* The harbor is in Baganga Bay which indents the coast about 1¼ mile. The entrance is about 2 miles wide between Lambajon (Lambayon) and Lakud Points, with depths of 25 to 113 fathoms. The bay is open to the eastward. A coral reef extends ⅓ mile southward of Lambajon Point and a detached breaking reef lies ½ mile 228° from the point.

There is good anchorage, protected from all but southeasterly weather, in 7 fathoms, over mud bottom, about ½ mile westward of Point Lambajon and ¼ mile offshore. The reef which divides the approach to this anchorage into 2 channels is visible at low tide, but breaks only in rough weather. The western channel is the better, being wider and having an even bottom. Anchorage, protected from all but northeasterly winds, may be found in the southern part of the bay in 5 fathoms, over sand bottom ¼ mile offshore.

(*b*) *Landing facilities.* No piers are known to exist.

(*c*) *Clearance facilities.* Small vessels called weekly from Davao and Cebu.

(*d*) *Availability of supplies.* Some food, but no gasoline or oil, could be obtained.

(6) Hinatuan, Mindanao Island (8° 22′ N, 126° 20′ E).

Hinatuan is on the east coast of Mindanao, at the mouth of the Hinatuan River, in the northwest corner of Hinatuan Bay (FIGURE VI - 68). It was an important shipping center for this section of the island. The landing was along the river bank, on the eastern side of the town.

There are charted depths of only ½ fathom in the Hinatuan River entrance, but vessels drawing 7 feet cross the bar at high water and go alongside the wall along the river bank. About 1 mile above its mouth, rocks obstruct the passage of larger boats, but native craft ascend the river for more than 20 miles.

(*a*) *Harbor.* The harbor, in Hinatuan Bay, is open to eastward, and is obstructed by numerous islands, reefs and shoals. The approach is through a straight passage with depths decreasing gradually from 25 to 5 fathoms. It narrows to about 1 mile

at the inner end between the reefs of Manomawan and Maowa Islands.

The usual anchorage for Hinatuan is about 1½ miles southeast of the river mouth in 4 fathoms, over mud bottom. Better protected anchorage may be found behind the reefs to the northward in 7 fathoms, over mud bottom, with Manomawan Islet bearing 120°, distant ½ mile. There is good holding ground with four 500-yard and six 300-yard berths with moderate protection except from easterly gales.

At Hinatuan, the high water interval is 6 hours 21 minutes. The mean range of tide is 4 feet and the diurnal range is 4.9 feet. Strong tidal currents run in and out of the Hinatuan River, fair with the channel, which is usually marked with stakes or beacons.

(*b*) *Landing facilities.* Hinatuan had a small landing along the bank of the river where the depths are charted at 2 fathoms.

(*c*) *Clearance facilities.* Vessels called regularly.

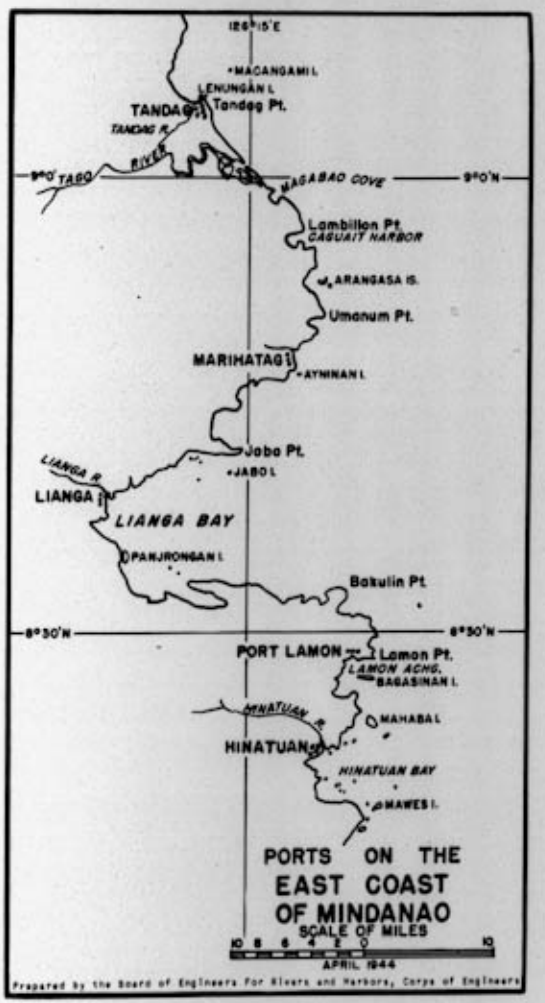

FIGURE VI - 68. *Mindanao, East Coast.* Map showing location of ports.

(7) Port Lamon, Mindanao Island (8° 28′ N, 126° 23′ E).

Port Lamon is on the east coast of Mindanao Island, south of Lianga Bay (FIGURE VI - 68). It was primarily a lumber port, the wharf, on north side of the bay formed southward of Lamon Point, was reserved for vessels calling at the mill, which was located immediately westward of the town. Interisland vessels calling at the port anchored in the harbor and communicated with the shore by boats.

(*a*) *Harbor.* Lamon anchorage, the harbor, is in the bay formed southward of Lamon Point. The bay is almost filled by a large coral reef on which lies Bagasinan Island. Lamon anchorage lies between the detached island reef and the shore reef to the northward. It is about 2 miles long, east and west, and from 450 to 1,100 yards wide. The entrance is about 1,000 yards wide between Lamon Point shore reef and the reef southward. Westward the harbor narrows between the reefs to 450 yards, and then widens to about 1,100 yards between 5-fathom curves, at the inner end. Shoals, marked by buoys, lie on the northern side of the entrance, south and southwest of Lamon Point. Private range beacons marked the fairway of the channel. The harbor affords fairly sheltered anchorage in 6 to 7 fathoms, over mud bottom. This anchorage is open to eastward but although a swell makes in during northeast weather some protection is afforded from the wind and sea from that direction.

(*b*) *Landing facilities.* The lumber mill had an L-head wharf on the north side of the bay, extending southward about 1,000 feet from the shore across the wide shore reef to near the 5-fathom curve (FIGURE VI - 69). The head was 150 to 180 feet long. It appeared to be about 15 to 20 feet wide. Depths at the face varied from 24 to 28 feet (1937), with the greatest depth at the western end. There was a pile cluster at the western end of the L-head which provided about 300 feet of berthing space across the face. There was also a pile cluster on each side of the pier, near the edge of the reef. Depths near the reef are charted at 2½ to 3 fathoms.

(*c*) *Clearance facilities.* Interisland vessels called at the town.

(*d*) *Availability of supplies.* The wharf was lighted. Fresh water, unsuitable for boiler use, was available. Limited supplies of food and ice were available at the mill and a small amount of diesel oil, gasoline, lubricating oil, and coal was stored for local use.

(*e*) *Repair facilities.* Minor repairs could be effected at the machine shop maintained by the lumber company.

(8) Lianga, Mindanao Island (8° 38′ N, 126° 05′ E).

Lianga lies at the head of Lianga Bay, about ¾ mile south of the mouth of the Lianga River, on the east coast of Mindanao (FIGURE VI - 68). No piers are reported.

(*a*) *Harbor.* The harbor is in Lianga Bay, formed on the east coast of Mindanao Island which is about 11 miles wide at the entrance between Jobo and Bakulin Points and extends 13 miles westward, being entirely open to the eastward. Depths gradually decrease from 65 fathoms at the entrance to 17 fathoms off the town. Opposite the southern part of the town the shore reef is quite narrow with depths of 5¾ fathoms close in. On both sides a point of the reef extends about ¼ to ⅓ mile from shore.

Anchorage sheltered only during the southwest monsoon may be found in about 20 fathoms over muddy bottom, with

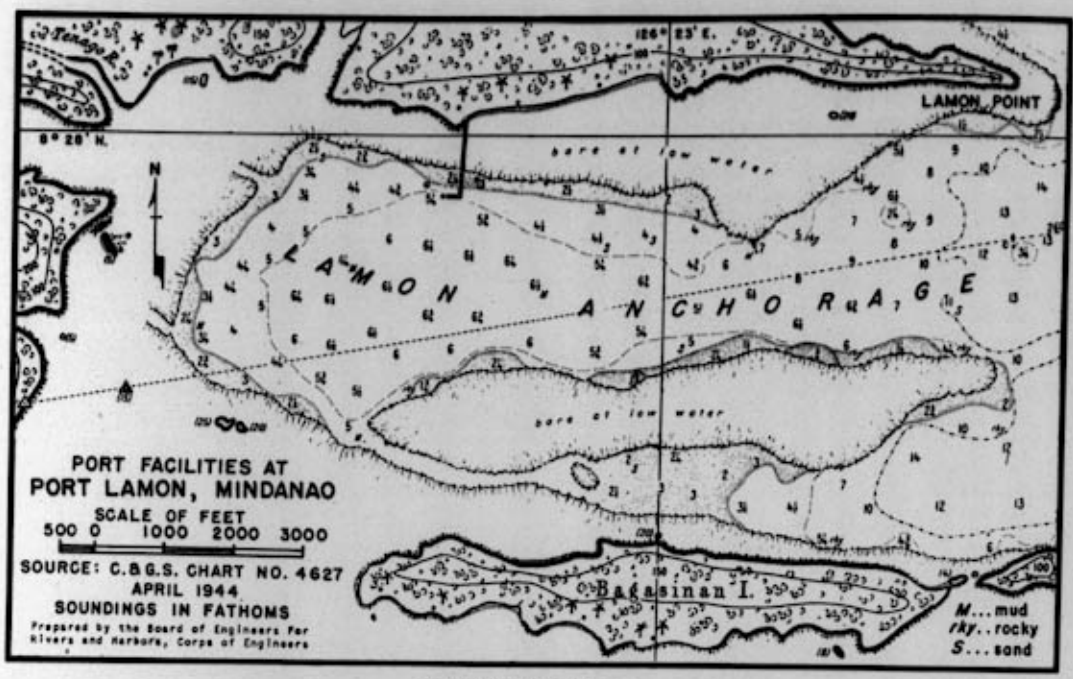

FIGURE VI - 69. *Port Lamon.*
Map showing location of facilities.

the church bearing 289°, and about ⅜ mile southeastward from the 35-foot rock on the shore reef, ¼ mile eastward of the northern part of the town.

(*b*) *Landing facilities.* There are no known piers. The coral reef in front of the town makes landing at low water or at night difficult.

(*c*) *Clearance facilities.* Lianga was a weekly port of call for small coasting steamers from Cebu.

(9) Marihatag, Mindanao Island (8° 48′ N, 126° 18′ E).

Marihatag is on the south side of the mouth of the Marihatag River, 3 miles southwestward of Umanun Point, on the east coast of Mindanao (FIGURE VI - 68). It was a small port from which hemp and copra were shipped. No landing facilities are reported.

The Marihatag River discharges through a narrow mouth about 20 yards wide. It has very little water over its bar. At high water small boats can enter the river and ascend it about 3 miles.

(*a*) *Harbor.* The harbor is an open roadstead off the Marihatag River. A reef about ¼ mile long east-west and 300 yards wide, which breaks in moderate weather at all stages of the tide, lies 1 mile eastward from the mouth of the river. Immediately southward of this reef there is a small 2¾-fathom patch. About ¼ mile westward from the breaking reef there is another small breaking reef, with a 14-fathom channel between them. Ayninan Islet lies 1½ miles southward from the mouth of the river, with a channel about 200 yards wide and 11 to 13 fathoms deep between it and the shore reef. At Marihatag, two points of the shore reef project over ¼ mile from shore. Between them, the reef is narrower, with 2½ fathoms close in and 9 fathoms off the reef points.

Vessels usually anchor about ¾ mile northeastward from Ayninan Islet and ½ mile southward from the outer breaking reef, in 16 to 18 fathoms of water.

(*b*) *Landing facilities.* There are no known piers.

(*c*) *Clearance facilities.* Marihatag was a port of call for small coastwise steamers.

(10) Tandag, Mindanao Island (9° 05′ N, 126° 12′ E).

Tandag is on the east coast of Mindanao Island, on Tandag Point, between the mouth of the Tandag River and the ocean (FIGURE VI - 68). It was a place of considerable commercial importance as the shipping point for products of the Tandag and Tago River valleys. There was a pier at the village but it could only be used by small boats (1938). Cargo was landed on the beach.

The Tandag River discharges through a narrow channel between Lenungan Island and the mainland. The mouth is not visible from seaward. The entrance is approached from northward in depths of 7 fathoms. Between Lenungan Island on the eastern side of the channel and an outreaching shore reef on the west, charted depths are 3 to 1½ fathoms. There is very little water on the bar, but small vessels can enter at high water.

(*a*) *Harbor.* The harbor is in a small cove formed by Lenungan Island, an unnamed island eastward of Lenungan, and Tandag Point. The narrow entrance channel between Lenungan and the eastern island has depths of 5 to 19 fathoms. A shoal point usually marked by a stake, about midway through

the channel and extending southeastward from Lenungan Island, must be avoided. A reef surrounding the eastern island extends about ½ mile eastward from it and closes the opening between it and Tandag Point.

Anchorage, sheltered from all but winds from north to east, may be found in 7 to 10 fathoms, over mud bottom, ¼ mile westward from the north end of Lenungan Island. Vessels of 4 or 5 feet draft may find sheltered anchorages at the mouth of the Tandag River, behind Lenungan Island.

Small interisland vessels anchor in 5 fathoms in the middle of the small cove formed by the two islands and Tandag Point. A heavy swell makes into this anchorage during the northeast monsoon and vessels cannot then enter due to the confused water at the entrance.

The high water interval at Tandag is 6 hours 22 minutes. Higher high water height is 4.7 feet and the lowest tide is 2.0 feet below mean lower low water, with an extreme range of 6.7 feet.

(*b*) *Landing facilities.* A stone pier extended westward from the south end of the eastern island, with a causeway connection to Tandag Point. The causeway was proposed to be 10 feet wide and 965 feet long with a cribwork landing at the end.

The pier had (1938) a depth of 6 feet at its end but could not be utilized by any but ships' boats. Cargo was landed on the beach.

(*c*) *Clearance facilities.* Small interisland vessels called at Tandag. An average of 2 vessels each week called from Cebu.

(*d*) *Availability of supplies.* Food supplies, gasoline, and a small amount of lubricating oil were available.

(11) Cantilan, Mindanao Island (9° 20′ N, 125° 59′ E).

Cantilan, on the east coast of Mindanao, is on the northwest side of Lanuza Bay at the mouth of the Cantilan River, about 4 miles south of Capungan Point (FIGURE VI - 70). No landing facilities are known to exist.

The Cantilan River has very little water on its bar. The sandy point, through which it discharges, is surrounded by a reef, bare at low water, to a distance of about ¾ mile. The valley between the Cantilan and Lanuza Rivers, which discharges into the head of Lanuza Bay, about 8 miles southeast of the Cantilan, is intersected by a network of waterways forming a delta. The 4 mouths of these rivers are connected, making a through inland waterway from Cantilan to Lanuza village, which is navigable for small boats.

(*a*) *Harbor.* The harbor is an open roadstead in the northwestern corner of Lanuza Bay.

The bay is about 15 miles wide at the entrance, between Capungan and Cauit Points, and extends 8 miles southwestward. It is open to northeastward. Off Capungan Point and northeastward from Cantilan the bay is obstructed by General, Auqui, and Unamao Islands and numerous shoals and reefs. Southward from east-northeast of the town the bay is clear, with depths of 55 to 10 fathoms. Cantilan Shoals lie 1½ to 3 miles northeastward from Cantilan. There is a depth of 9 fathoms between the shoals and the outer end of the shore reef, but this passage is not recommended. The 5-fathom curve closely approaches the shore on both sides of the projecting reef.

Vessels usually anchor north-northeastward from the town in 7 fathoms, over mud bottom. Vessels approaching this anchorage should pass close southward of Unamao Island and

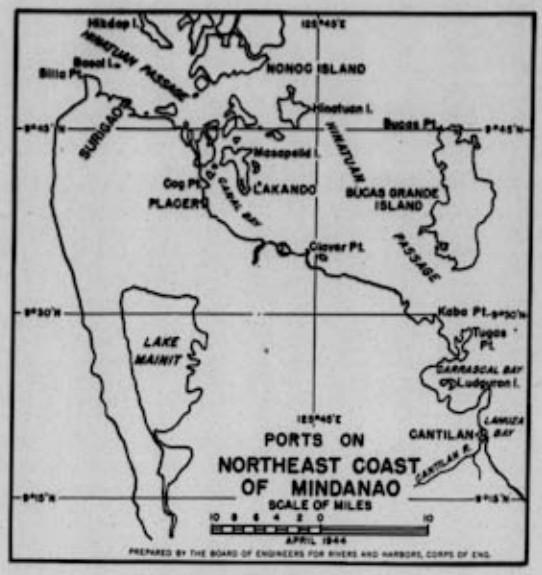

FIGURE VI - 70. *Mindanao, N.E. Coast.*
Map showing location of ports.

not attempt to pass inside the Cantilan Shoals. The anchorage is about 1 mile square, with 5 to 10 fathoms of water.

A flashing white light, 55 feet above high water and visible 12 miles, was shown from Cauit Point, the southeastern entrance point of Lanuza Bay.

At General Island, off the northwestern entrance point of Lanuza Bay, the high water interval is 6 hours 23 minutes. Mean range of tide is 3.8 feet and diurnal range is 4.6 feet. The lowest tide is 2.0 feet below mean lower low water.

(*b*) *Landing facilities.* No piers have been reported.

(*c*) *Clearance facilities.* Cantilan was a regular weekly port of call for small coastwise steamers.

(12) Lakando (Lakandola), Masapelid Island (8° 41′ N, 125° 39′ E).

Lakando lies on Canal Bay, near the southwest end of Masapelid Island (FIGURE VI - 70). A pier was located about 1 mile north of Lakandola.

(*a*) *Harbor.* The harbor is an open roadstead on the eastern side of Canal Bay, a large indentation in the southwest side of Masapelid Island. The bay is about 2½ miles wide at the entrance and extends northward about 2 miles. It is obstructed by numerous small islands and dangerous shoals. A small reef that bares at low water, lies ½ mile southeast of the southern extremity of Masapelid Island.

(*b*) *Landing facilities.* The pier, owned and operated by the KM73 Mining Company, consisted of a causeway, between 400 and 500 feet long and about 15 feet wide, with a timber T-head about 80 feet long (FIGURE VI - 71). Pile clusters extended along the outer face of the wharf. There were 2 small sheds on stone projections of the causeway and a larger building at the outer end which were probably used for storage.

(*c*) *Clearance facilities.* There appears to be a narrow gauge railway track running the full length of the pier.

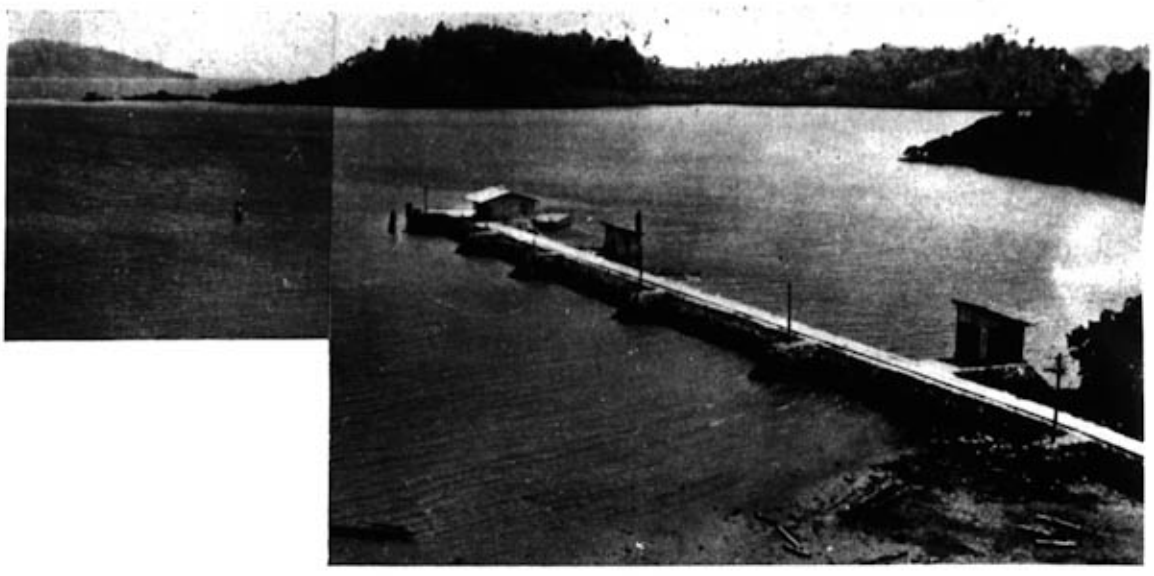

FIGURE VI - 71. *Lakando.*
View of pier, looking northwest.

(*d*) *Availability of supplies.* The pier appears to be lighted, and there are indications of a pipeline.

(13) Placer, Mindanao Island (9° 39′ N, 125° 36′ E).

Placer is on the east coast of Mindanao, about 1 mile southward of Cog Point (FIGURE VI - 70). It was the shipping point for the surrounding mining district. There was a pier at the port.

(*a*) *Harbor.* The harbor, in the southwestern corner of the cove between Cog Point and the point on which the town is situated, is formed by a large drying reef which projects about ⅝ mile northeastward from the town and surrounds Bancay Islet. A ½-fathom shoal lies nearly in the middle of the harbor, about 450 yards northward from Bancay Islet. The cove, open to the east, has depths of 5 to 13 fathoms.

Two or 3 small vessels can find sheltered anchorage in 6 to 9 fathoms, over muddy bottom, in an area about 400 yards in extent back of the shoal.

(*b*) *Landing facilities.* The only landing facility was a rock and timber pier 20 feet wide and 402 feet long, which consisted of a rock causeway, 345 feet long, from which a 21 foot pile and timber structure, extended seaward 57 feet. The outer 36 feet of the timber section was to be the middle of a proposed T-head, which would have been 85 feet long and 36 feet wide. The controlling depth (1937) was 13 feet at low tide. The pier was used by small coasters.

(*c*) *Clearance facilities.* There were regular steamship connections with Surigao and Cebu. There was also a road over which hemp and other articles were trucked for shipment.

(14) Pilar, Siargao Island (9° 52′ N, 126° 6′ E).

Pilar lies on the north side of the mouth of the Pilar River, at the northwest corner of Port Pilar, the only large indentation on the east coast of Siargao Island (FIGURE VI - 72). The settlement was small. No landing facilities are known to exist.

The Pilar River discharges into the northwest part of Port Pilar. Small craft can enter the river. A shoal spot, usually marked by a stake, lies in the middle of the fairway, about 300 yards south of the town. The better channel passes to the northward.

(*a*) *Harbor.* The harbor is in Port Pilar, formed between Sharp Point and Pilar Point. The southern half of the bay is

FIGURE VI - 72. *Siargao Island.*
Map showing location of ports.

filled with reefs, near the northern edge of which is Isda Islet and several large rocks. Between Isda Islet and Point Pilar the entrance to the port is about 1,300 yards wide and narrows to about 450 yards between shore reefs at the western end. Depths decrease from 79 fathoms in the bay to 3½ fathoms in the river.

Port Pilar affords the best anchorage on the east coast of Siargao Island but its use is not recommended as, even in the southwest monsoon, a heavy sea usually sets in around Pilar Point. Anchorage may also be found in 7 or 8 fathoms, about ½ mile east-southeastward from Pilar. Small craft can enter the Pilar River and find perfectly sheltered anchorage 200 or 300 yards above the village in depths of 6½ to 8 fathoms. Beyond this point the river shoals to 1 fathom.

At Port Pilar the high water interval is 6 hours 30 minutes. The mean range of tide is 3.2 feet. The lowest tide is 2.0 feet below mean lower low water.

(*b*) *Landing facilities.* No piers have been reported.

(*c*) *Clearance facilities.* A small interisland vessel called every two weeks.

(*d*) *Availability of supplies.* Supplies of any kind were scarce.

(15) Numancia, Siargao Island (9° 52′ N, 125° 58′ E).

Numancia lies on the western side of Siargao Island, about 8 miles northwestward from the western entrance to Dapa Channel and 2 miles from the sea (FIGURE VI - 72). This coast is bordered by an extensive area of mangrove flats, intersected by mangrove sloughs with numerous islands separated from Siargao and each other by narrow, shallow, mangrove-bordered channels. There was a pier at the village.

(*a*) *Harbor.* The harbor is on Libas Channel, which separates Siargao Island from Tona Island.

Beyobo Channel, through which Numancia is approached, is narrow, tortuous, and mangrove-fringed. The entrance is made by approaching the coast nearly ¾ mile northwest from a small, white-sand islet which is awash at high water. The offlying reefs have several openings with 2½ to 16 fathoms, and the depths in Beyobo Channel are ½ to 4 fathoms. This channel should not be attempted without local knowledge, as there are several small shoals which cannot be seen until close over them. The most dangerous shoal is in the center of the channel about ⅓ mile south of the pier. It bares at extreme low water but there is deep water close to the mangroves to the westward.

Numancia may also be approached through Sayug Channel, which leads southward from the head of Litalit Bay to Baban Lagoon. Tona Channel leads into Baban Lagoon from the southwest. From the lagoon Libas Channel leads southward to the town. These channels are narrow, shoal, mangrove-fringed and only suitable for small native craft.

The slough or channel at Numancia appears to be about 400 yards wide and provides sheltered anchorage in 3 to 3½ fathoms for the vessels of about 8-foot draft which are able to navigate the channels.

In the channel near town, the currents run with considerable velocity and there are dangerous whirlpools in places.

(*b*) *Landing facilities.* There was a stone pier, which extended about 200 yards into the mangrove slough. Small steamers, drawing about 8 feet, reached the town at high water and anchored off this pier. Depths of 3½ fathoms are charted near the end of the pier.

(*c*) *Clearance facilities.* The pier appeared to be connected to streets of the town.

(16) Dapa, Siargao Island (9° 45′ N, 126° 03′ E).

Dapa is at the southwestern end of Siargao Island, on the northern shore of Dapa Channel (FIGURE VI - 73). There were 2 piers in front of the town, one of which did not extend to the edge of the shore reef.

(*a*) *Harbor.* The harbor is at the mouth of a small cove formed inside Cambasac Point, on the northern side of Dapa Channel. Dapa Channel separates the southern end of Siargao Island from East Bucas Island. It is ½ mile wide at the western entrance between Cambasac Point, and San Miguel Point, the northern extremity of East Bucas Island. It is nearly blocked by islets, reefs and shoals, leaving three, narrow, tortuous channels through which the currents run with considerable velocity. The reefs show plainly, defining the channels, and Dapa Channel is safe for small, carefully-navigated steamers. Cambasac Point is fringed by a narrow, steep reef. Quico and Barrabas Reefs, and the rock off the north end of Bucas Grande Island are the only detached dangers in the western approach to the channel.

The middle channel, between Abanay and Bancuyo Islets, is the best, it being fairly straight, 7 to 14 fathoms deep, and having a least width of 100 yards. The southern channel between Bancuyo Islet and East Bucas Island is narrow and tortuous, and its use is not recommended. It has depths of 3½ to 19 fathoms. The northern channel west and north of Abanay Islet is the most generally used in reaching Dapa from the west. Its southwestern end is about 100 yards wide and 7 fathoms deep between the shore reefs of Cambasac Point and Abanay Islet, with 6 to 8 fathoms in the channel northward. Turning eastward, the channel is about 300 yards wide between shore reefs on the northern end of Abanay Islet and the southern side of Siargao Island, with depths of 5½ to 9 fathoms in the channel to Dapa. Opposite the town the channel is 3½ fathoms deep and about 100 yards wide between the shoals. The eastern entrance of Dapa Channel is about 700 yards wide between the Siargao shore and Dapa Reef, with depths of 14 to 5¼ fathoms. It is obstructed by two rocky shoal spots, one about 1 mile east-southeastward from the town and ¼ mile from the shore, and the other about 500 yards eastward.

Anchorage is usually made in 5 fathoms, over mud bottom, about ⅜ mile southwestward from the town. Opposite the town pier it has an extreme width of about 600 yards between 5-fathom curves, narrowing to about 250 yards in the middle, and is about 1,000 yards long. In the western end is a dangerous rock. This anchorage is open to the east and southeast and partly protected from the south by Abanay Islet and Dapa Reef. The cove behind Cambasac Point had depths of 5 to 10 fathoms, over mud bottom, and appears clear and well-protected.

At San Miguel, on the southern side of the western entrance to Dapa Channel, the high water interval is 6 hours, 35 minutes. The mean range of tide is 3.2 feet. The lowest tide is 2.0 feet below mean lower low water. At the western entrance of Dapa Channel the flood tide flows westward and the ebb sets to eastward.

(*b*) *Landing facilities.* The landing facilities consisted of 2 piers, which are keyed to the port plan (FIGURE VI - 73).

A narrow pier, 555 feet long, extended southwestward across

the shore reef toward the 5-fathom curve abreast the center of the town (Reference number 1, FIGURE VI - 73). It consisted of a rock causeway, 20 feet wide and 450 feet long, extended 115 feet by a reinforced concrete pier, 30 feet wide, with a depth of 20 feet (1937) at the end and from 12 to 13 feet along the sides. Construction of a shed was proposed (1937).

Another narrow causeway (Reference number 2, FIGURE VI - 73) extended southward from the shore at the eastern edge of the town, but its rounded outer end did not reach the edge of the shore reef. A wide shoal with ¼ to ¾ fathom lies off the end of this pier.

(*c*) *Clearance facilities.* Streets of the town connected with both piers. Small steamers occasionally called at the port.

(17) Dinagat, Dinagat Island (9° 58′ N, 125° 36′ E). Dinagat is on the southwest coast of Dinagat Island, at the western end of Dinagat Point which forms the southern and western sides of Dinagat Cove (FIGURE VI - 74). There was a pier on the eastern side of the town.

(*a*) *Harbor.* Dinagat Cove is a well-protected harbor, nearly landlocked with good holding ground. The outer bay is about ¾ mile wide between Masiub and Dinagat Points and is partially protected from the westward by Capaquian Island. It has depths of 10 to 31 fathoms but shoals extend far out from all sides. A rock, awash, lies midway between the points. The entrance to Dinagat Cove is about 200 yards wide between shoals, with depths of 25 to 27 fathoms, decreasing gradually to 7 fathoms at the eastern extremity. It is about 1 mile long and ½ mile wide, but shoals reduce the anchorage area.

Dinagat Point is fringed with shore reef and a wide shoal area.

At Dinagat, the mean higher high water interval is 10 hours 20 minutes and the diurnal range of tide is 3.4 feet. The lowest tide is 1.5 feet below mean lower low water.

(*b*) *Landing facilities.* At the back of the town was a perfectly sheltered pier which, one report states, has 5 feet of water at its end. The chart however, indicates that there is less than 3 feet.

(18) Butuan, Mindanao Island (8° 57′ N, 125° 33′ E). Butuan is on the west bank of the Agusan River, which discharges into the head of Butuan Bay, about 57 miles south of Bilaa Point, the northern extremity of Mindanao (FIGURE VI - 75). There was considerable trade in hemp and copra, principally with Cebu. There were 2 landing stages at the port (FIGURE VI - 76).

(*a*) *Harbor.* Butuan is a river port on the Agusan River, 5 miles above its mouth. The river discharges into the south-

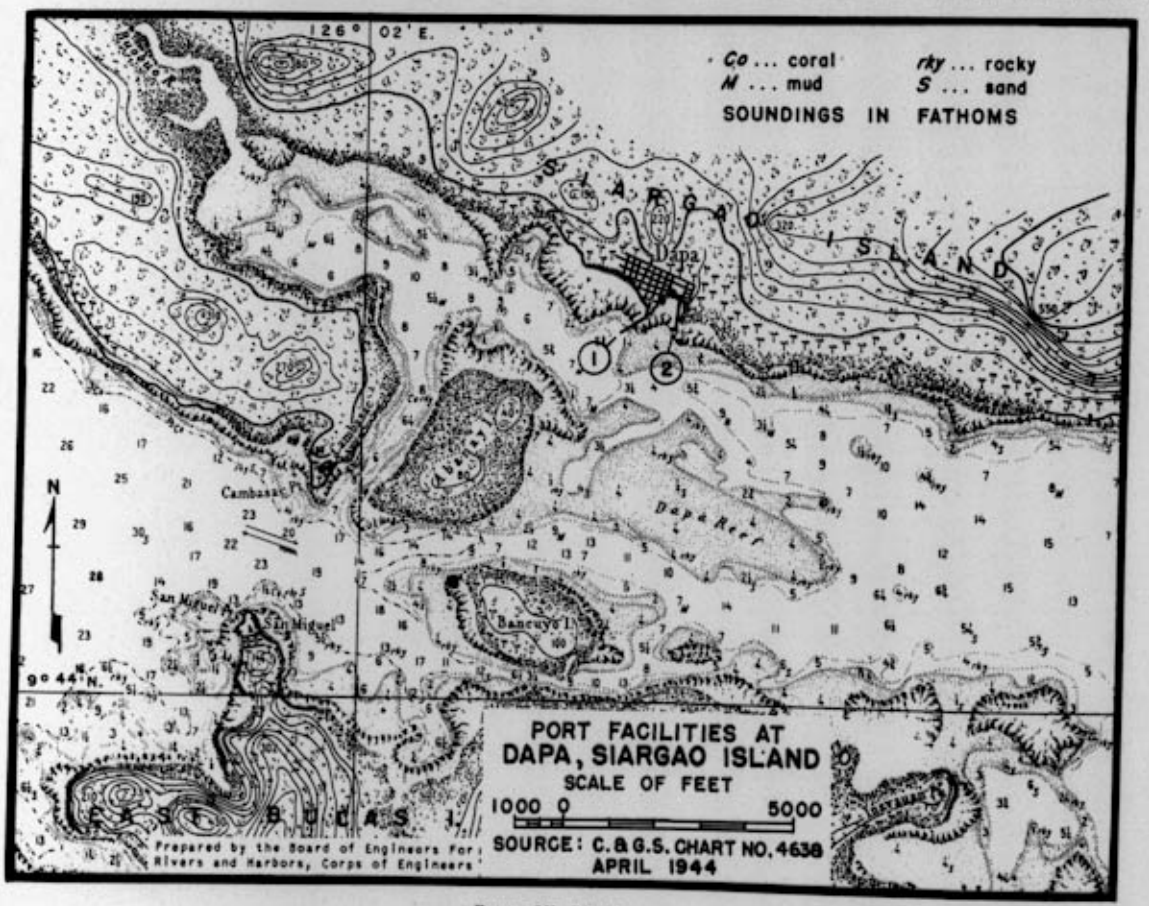

FIGURE VI - 73. *Dapa.*
Map showing location of facilities.

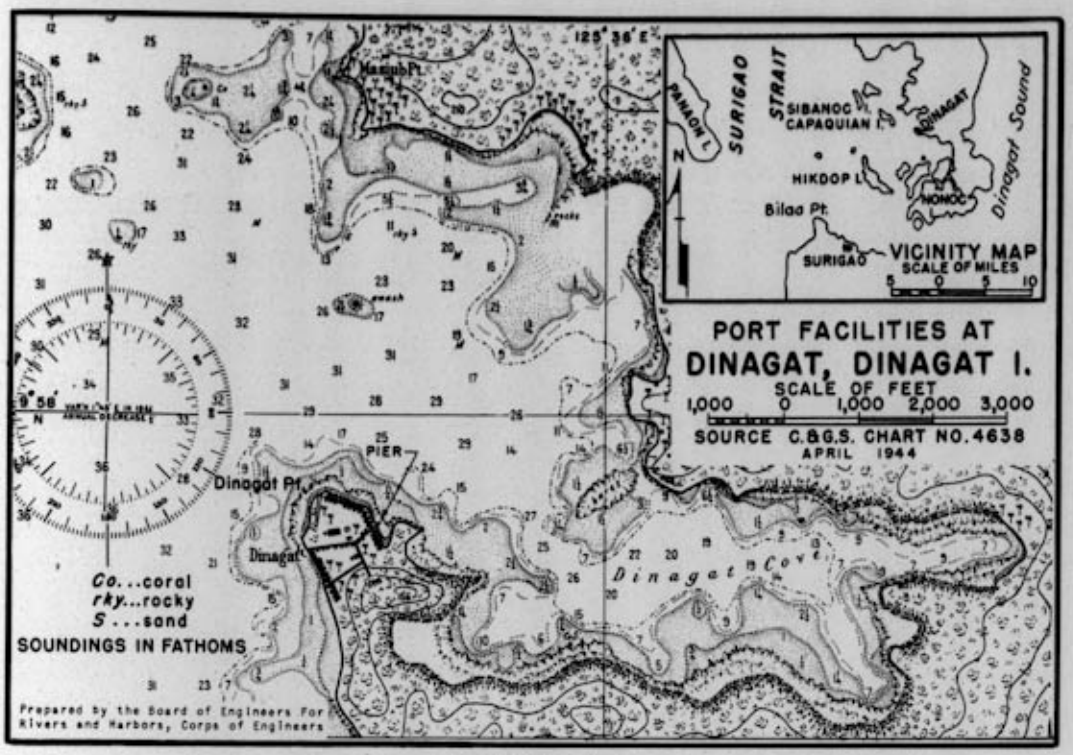

FIGURE VI - 74. *Dinagat.*
Map showing location of Dinagat (inset) and port plan showing location of facilities.

eastern corner of Butuan Bay. Its mouth is divided into 2 channels by Pontod Island. The bar of the northern entrance, purposely blocked by sunken stones, has a depth of only 3 feet and is not used for navigation. The western entrance has a minimum width of about 150 yards, depths of 9 or 10 feet over the bar at low water, and 12 to 14 feet at ordinary high water. The best water over the bar was marked by range beacons.

Depths from the bar to the town are from 2½ to 5 fathoms.

Butuan Bay is about 20 miles wide at the entrance between Tubay and Diuata Points, and recedes southward 10 miles. It is deep and clear.

There is no good anchorage outside the river entrance. Good anchorage for small vessels is found at the mouth of the Baug River, which enters the Agusan just inside the bar. Vessels anchoring in the stream at Butuan should lie below the upper wharf, as the river higher up is contracted by a shoal making off from the west bank.

A fixed red light, 39 feet above high water and visible 7 miles, was located inside the river entrance.

The high water interval at the river entrance is 11 hours, 30 minutes. Higher high water height is 3.8 feet and lowest tide is −1.5 feet. During floods the river rises from 12 to 36 feet. The rainy season is from November to February. The river is lowest during September and October. The current in the river is strong. Currents at the entrance flow out at all tides.

(*b*) *Landing facilities.* The principal facilities were 2 landing platforms, which are keyed to the port plan (FIGURE VI - 75).

The downstream landing (Reference number 1, FIGURE VI - 75) had a controlling depth of 14 feet along the face, and consisted of a timber deck and apron on concrete piles and substructure, with a timber approach from the shore. The deck was about 31 feet by 72 feet, with an apron along the face about 10 feet by 72 feet, and 15 feet by 21 feet on either side of the cargo shed (FIGURE VI - 77). The cargo shed was about 21 feet by 43 feet. The upstream landing (Reference number 2, FIGURE VI - 75) could only be used by small boats. There was a shed covering the entire deck.

(*c*) *Clearance facilities.* Piers were served by connections with the coastal highway. There were regular motor vessel connections. Small boats and launches of 4-foot draft can ascend the Agusan River for about 70 miles to Bunawan 20 miles north of Moncayo, the northerly terminus of the Davao road.

(*d*) *Availability of supplies.* Gasoline, diesel oil, and ice were available in small quantities.

(19) Nasipit, Mindanao Island (8° 59' N, 125° 20' E).

Nasipit is on the southern shore of Butuan Bay, 10 miles west of the mouth of the Agusan River (FIGURE VI - 78). It was a shipping point for copra and logs. There was a pier about 1 mile south of the town, near the head of Nasipit Harbor.

(*a*) *Harbor.* Nasipit Harbor is formed by an opening between bluff rock headlands about ⅜ mile apart and extends about 1 mile southward. The harbor has depths of from 4 to 12 fathoms over an area about ¾ mile long and about 300

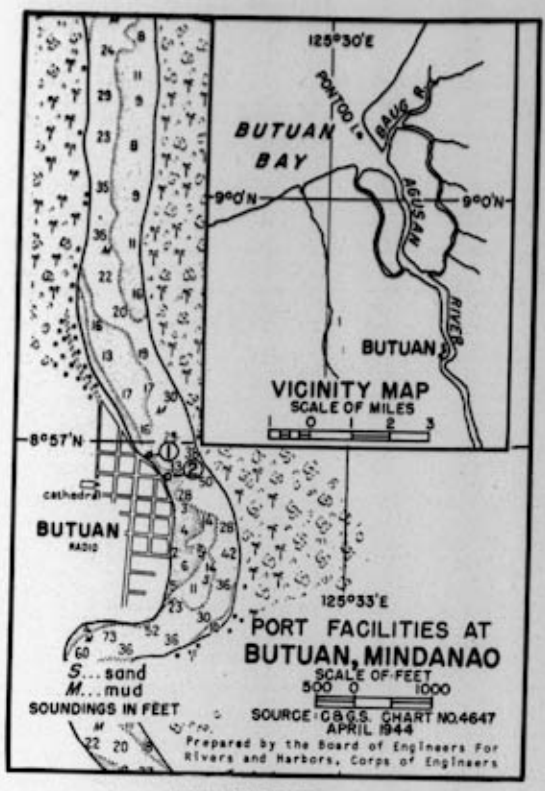

FIGURE VI - 75. *Butuan.*
Map showing location of Butuan (inset) and port plan showing location of facilities.

yards wide. Both entrance points to the harbor are fringed by reefs which show plainly on a clear day.

The reef on the western side of the entrance extends about ¼ mile northeastward. The reef on the eastern side continues much farther in than that on the western side and the sandspits apparently extend farther into the channel than charted. Private buoys marked the western edge of the shoal water.

Vessels can anchor in the harbor in depths of 4 to 12 fathoms, over mud.

A flashing white light, 94 feet above high water and visible 15 miles, was located on the western shore of the harbor, about ½ mile from the entrance.

The high water interval is 11 hours 25 minutes. Higher high water rises 4.1 feet and the lowest tide is −1.5 feet, respectively, above and below mean lower low water.

(*b*) *Landing facilities.* The only facility at the port was an L-head pier (FIGURE VI - 77), which consisted of a causeway, about 375 feet long and 25 feet wide, from shore to deep water, with an extension approximately 100 feet long and 50 feet wide, to the L-head, which was about 150 feet long and 40 feet wide. It was proposed to convert the pier to a T-head by additional construction southward, but the status of the project has not been determined.

(*c*) *Clearance facilities.* Foreign vessels called regularly to load logs and coasting vessels maintained communication with Cebu. A highway led to Butuan.

(20) Odiongan, Mindanao Island (8° 51′ N, 125° 10′ E).

Odiongan is located on the east bank of Odiongan River, which discharges into the southeastern corner of Gingoog Bay (FIGURE VI - 79). The only landing facility was at the lumber company's pier in a small bight 0.9 mile west of Odiongan.

(*a*) *Harbor.* The harbor is an open roadstead, near the head of Gingoog Bay. The bay is 20 miles wide at the entrance, between Diuata and Sipaca Points, and extends 13 miles southward. The shores are fringed with narrow, steep, coral reefs. The center of the bay is deep and clear. There are no off-lying dangers, except a shoal northwest of Gingoog village, at the head of the bay, and another off Talisayan, near Sipaca Point. A small shelf of coral and sand with depths of 3 to 7 fathoms, lies northward of the eastern side of the entrance to the Odiongan River. This shoal affords excellent anchorage for small vessels.

(*b*) *Landing facilities.* The Anakan Lumber Company had a T-head pier in the bight west of Odiongan. The face of the pier was 350 feet long and had a depth of 30 feet alongside.

(*c*) *Clearance facilities.* The port is on the coastal highway. The lumber company operated a railroad for a distance of 18.6 miles and had 3 locomotives.

(*d*) *Availability of supplies.* Fresh water, suitable for boiler purposes, was piped to the pier. Food and ice were available.

(21) Gingoog, Mindanao Island (8° 50′ N, 125° 06′ E).

Gingoog lies on the southern shore of Gingoog Bay, about 4 miles west of Odiongan (FIGURE VI - 79). It was a lumber port, the only landing facility being a pier operated by the lumber company (FIGURES VI - 80 and VI - 81).

(*a*) *Harbor.* The harbor is an open roadstead at the head of Gingoog Bay. A small coral shoal covered by a least depth of 1½ fathoms exists about 1 mile northwestward from the town and ¾ mile from the shore. There is a deep channel about ½ mile wide between this shoal and the shore reef. Northwest of Gingoog the shores are fringed by a steep coral reef.

Good anchorage in 15 fathoms, sand bottom, may be found about ¼ mile from shore directly in front of the town.

(*b*) *Landing facilities.* An open timber pile L-head pier, with a wood deck extended about 400 feet from the shore. The face of the L-head was about 230 feet long, but was still under construction. Tracks were laid on the pier, which was lighted (FIGURES VI - 80 and VI - 81).

(*c*) *Clearance facilities.* Gingoog is on the coastal road. The lumber company had 2.5 miles of railroad. Vessels called regularly each week from Cebu.

(22) Talisayan, Mindanao Island (9° 0′ N, 124° 53′ E).

Talisayan is near the northwestern entrance to Gingoog Bay about 1 mile southeastward of Sipaca Point (FIGURE VI - 79). It was the principal town in Gingoog Bay. No landing facilities have been reported.

FIGURE VI - 76. *Butuan.*
Aerial view of town and waterfront, showing location of landing facilities.

FIGURE VI - 77. *Butuan.*
View of downstream landing, looking north. January 1938.

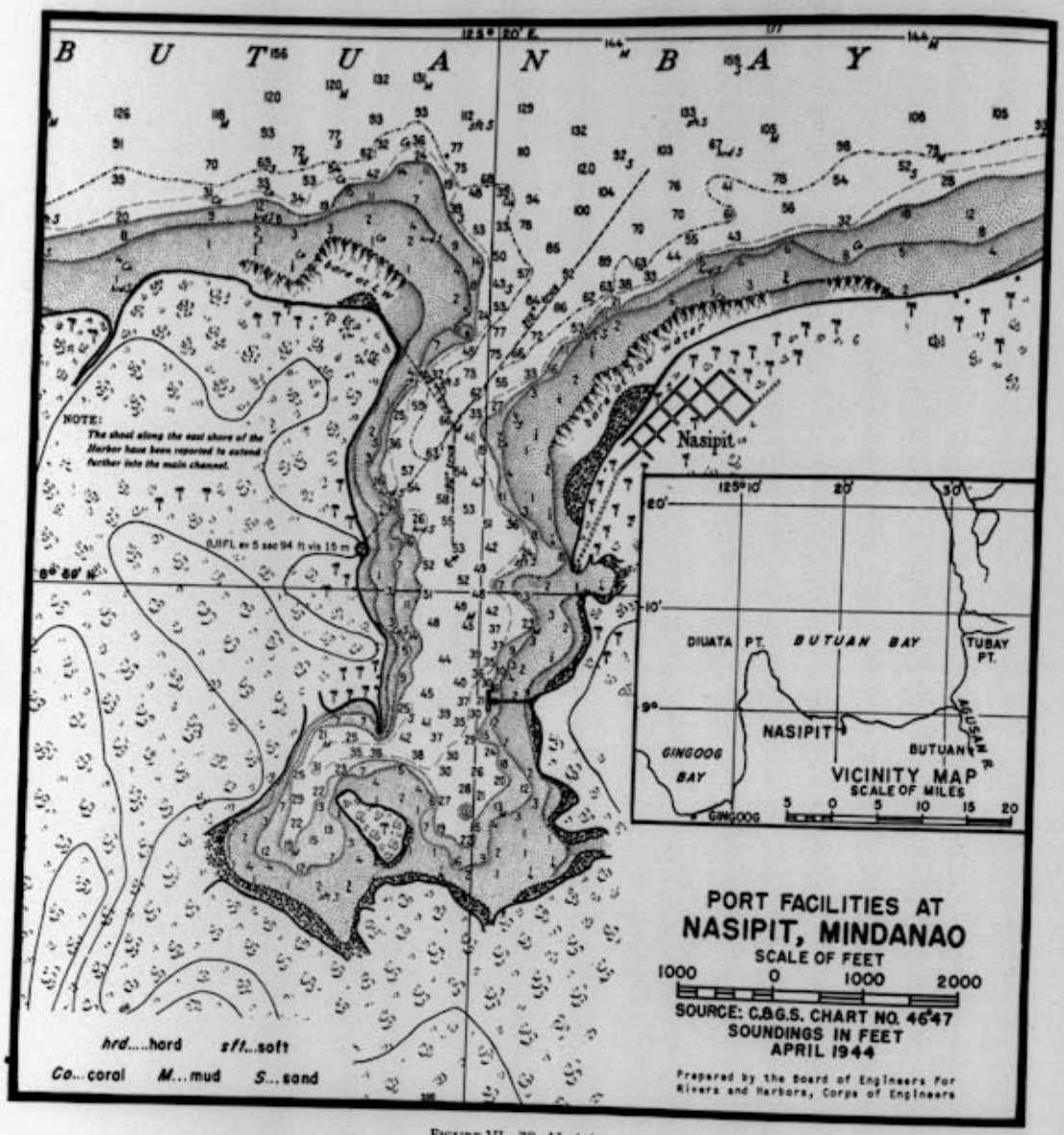

FIGURE VI - 78. *Nasipit.*
Map showing location of Nasipit (inset) and port plan showing location of facilities.

(*a*) *Harbor.* The harbor is an open roadstead just inside the northwestern entrance point of Gingoog Bay. A detached coral shoal, with a least depth of 4 fathoms, lies ¼ mile from shore. There is a deep, clear channel, about ¼ mile wide, between it and the shore reef.

Anchorage may be found close to the shore reef northward of the town in 20 fathoms, but the anchorage is exposed to northeast winds. Vessels occasionally anchor on the 4-fathom shoal, off the village.

(*b*) *Landing facilities.* No piers are known to exist.

(*c*) *Clearance facilities.* Talisayan is on the coastal highway.

(23) Balinguan, Mindanao Island (9° 0′ N, 124° 50′ E).

Balinguan is about 1¾ miles westward from Sipaca Point, the western entrance point to Gingoog Bay (FIGURE VI - 79). It was the terminus of a ferry which operated to Camiguin Island. A small wharf was used as the ferry landing.

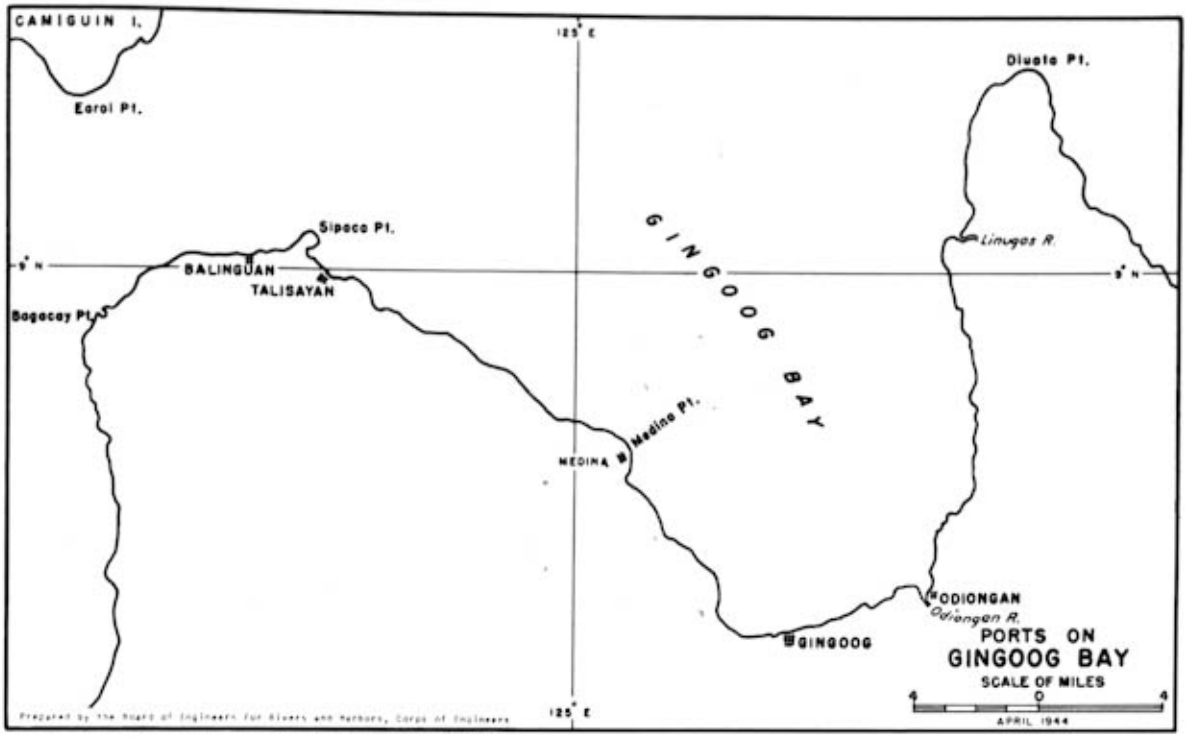

FIGURE VI - 79. *Gingoog Bay.*
Map showing location of ports.

FIGURE VI - 80. *Gingoog.*
View of port, showing pier.

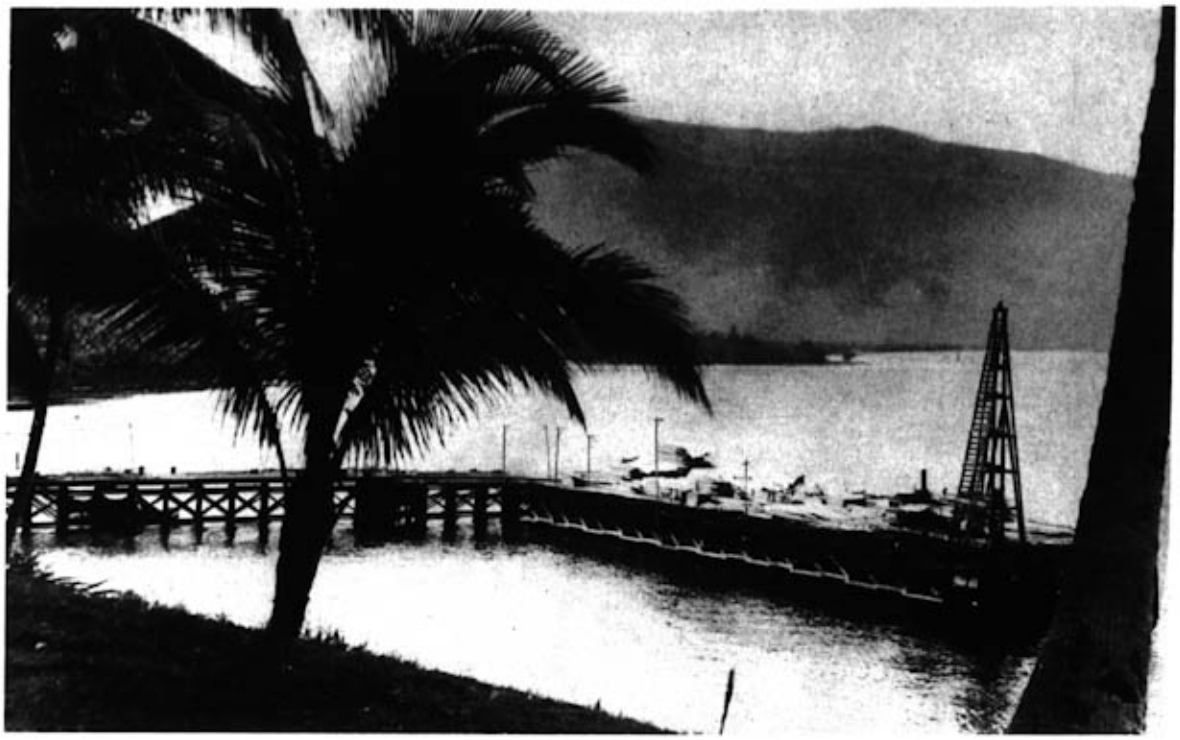

FIGURE VI - 81. *Gingoog.*
View of pier, showing type of construction.

(*a*) *Harbor.* Canauayor Anchorage, the harbor for Balinguan, lies southward of Canauayor Islet, which lies about 1¾ miles west of Sipaca Point and about ¼ mile from shore. A wide fringing reef is bordered by narrow shoal areas. The 5- and 10-fathom curves are close in. A shoal area which is nearly bare at low water extends from Canauayor Islet in a southeasterly direction to the mainland.

Westward from the islet and close to it, there is a natural channel leading to protected anchorage for small craft in 8 to 9 fathoms, over hard sand, about 300 yards northward from the western part of the village. The approach is clear with depths of 18 to 27 fathoms and a width in the entrance of about 120 yards between 5-fathom curves. The anchorage is only about 190 yards wide opposite the pier and about 400 yards east-west to the 5-fathom line.

High water interval is 11 hours 25 minutes. The mean range of tide is 2.6 feet. The lowest tide is 1.5 feet below mean lower low water.

(*b*) *Landing facilities.* A small pier (FIGURE VI - 82), used as a ferry landing, had a depth of 8 feet at the end (1938). The pier extended about 450 feet northward from shore.

(*c*) *Clearance facilities.* The ferry made 3 trips daily to Binone, on Camiguin Island. There was a road paralleling the shore at the root of the pier.

(24) Binone, Camiguin Island (9° 09′ N, 124° 48′ E).

Binone is near the south end of the east coast of Camiguin Island, which lies 8 miles northwest of Sipaca Point, the western entrance point of Gingoog Bay (FIGURE VI - 83). Binone was the Camiguin Island terminus of the ferry operating to Balinguan, or Mindanao. A break in the shore reef provides a well-protected landing place for coasting vessels.

(*a*) *Harbor.* The harbor is an open roadstead, with a charted depth of 2 fathoms. The bottom drops off steeply.

(*b*) *Landing facilities.* A small pier used as the ferry landing, had 6 feet of water at its face.

(*c*) *Clearance facilities.* A road paralleled the shore, and connected Binone with other harbors and villages of the island. Binone was the terminus of a ferry that operated 3 trips daily to Balinguan, on Mindanao Island.

(25) Mambajao, Camiguin Island (9° 15′ N, 124° 43′ E).

Mambajao is on the northern end of Camiguin Island (FIGURE VI - 83). It was the principal town on the island and a shipping point for hemp and copra. There was a pier in front of the town.

(*a*) *Harbor.* The harbor is an open roadstead. A fringing shore reef widens at the town to about 250 yards. An opening in the reef, about 100 yards wide, extends about 375 yards southerly to the shore line. Depths in the entrance are from 1¾ to 1 fathom, decreasing shoreward.

Anchorage at Mambajao is indifferent and because of the depth of water must be close in. The 5-fathom curve is about 150 yards outside the edge of the reefs. Vessels anchor in 18 fathoms, over sandy bottom, with Mambajao Light bearing 204°, distant about ¼ mile. Small vessels may anchor closer in, with the light on the same bearing, in 11 fathoms,

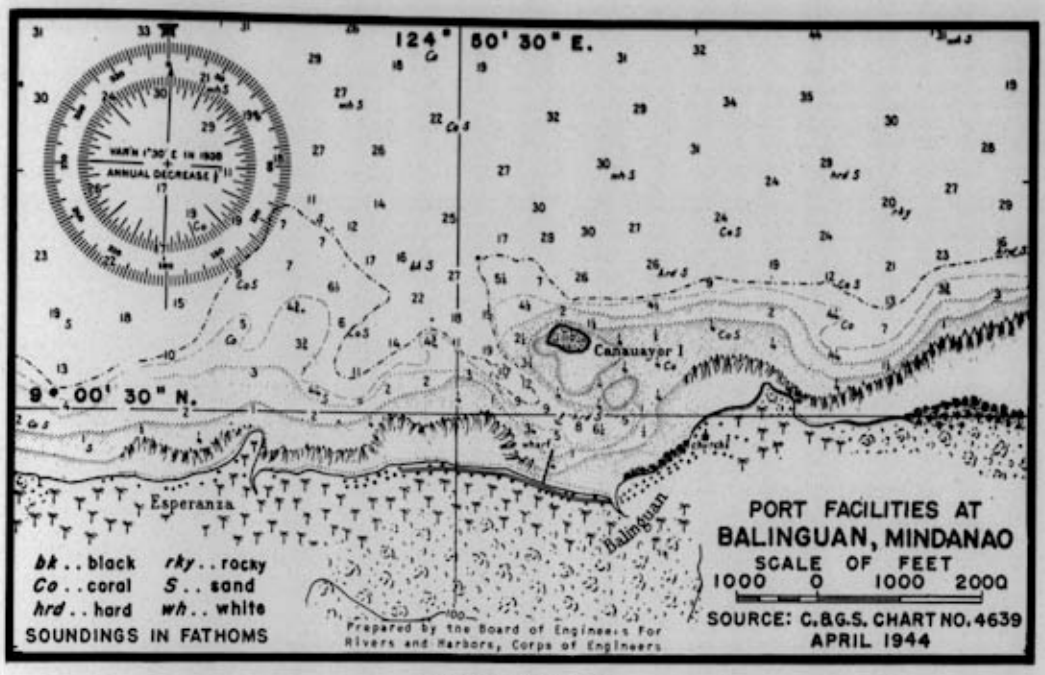

FIGURE VI - 82. *Balinguan.*
Map showing location of port facilities.

over sand and coral, with Medano Islet just open off a small single tree on the extremity of the point westward from Mambajao.

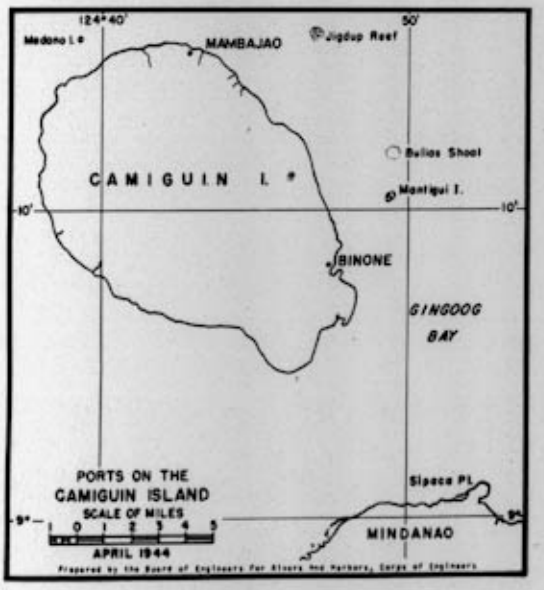

FIGURE VI - 83. *Camiguin Island.*
Map showing location of ports.

At Mambajao the mean high water interval is 11 hours 28 minutes. Mean range of tide is 2.5 feet. The lowest tide is 1.5 feet below mean lower low water. Flood tidal currents flow westward, parallel to the pier end. Tide rips form near adjacent islands.

A fixed red light, 32 feet above water and visible 7 miles, was shown from the pier.

(*b*) *Landing facilities.* The pier extended over 1,000 feet from shore along the eastern side of the gap in the reef to open water (FIGURE VI - 84). It consisted of a stone causeway, with a timber extention. The causeway, 40 feet wide, extended northerly about 500 feet to an enlarged end about 80 feet square, beyond which the pier, which was partly causeway but for the most part of open timber pile construction, extended 620 feet north-northeasterly with a width of 20 feet, widening to 30 feet at the outer 115 feet of pier. In 1938, there was a depth of 14 feet at the end and depths of 6 to 15 feet along the western side, where about 450 feet of berthing space was available. The pier was exposed to the northeast monsoon.

A small cargo shed was built on the wide midsection of the pier.

Limited open storage might be had on the 80-foot square enlargement of the pier or at the 175-foot square area at the shore end of the pier.

(*c*) *Clearance facilities.* The pier had road connections. Vessels called weekly from Cebu.

(*d*) *Availability of supplies.* Supplies were scarce. A few tins of gasoline and some diesel oil in drums were available. Fresh water, suitable for boilers was piped to the wharf.

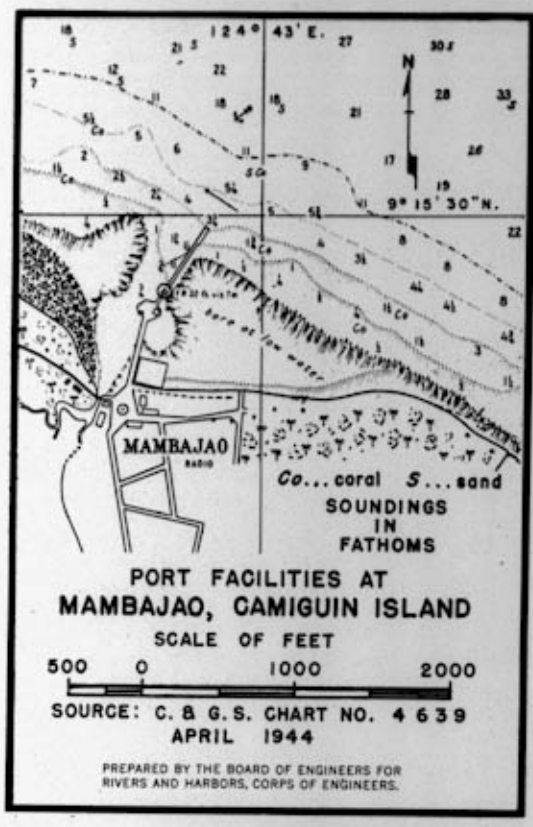

FIGURE VI - 84. *Mambajao.*
Map showing location of port facilities.

(26) Bugo, Mindanao Island (8° 30′ N, 124° 45′ E).

Bugo is near Cagayan on the southeastern shore of Macajalar Bay on the north coast of Mindanao (FIGURE VI - 6). The Philippine Packing Company had a wharf and packing plant on the waterfront.

(*a*) *Harbor.* The harbor is an open roadstead near the head of Macajalar Bay. It is protected from all points except the northwest. Depths of 7 fathoms extend about ¼ mile from the shore.

Macajalar Bay is described under Topic 61, C, (2), (a).

The tidal currents parallel the wharf face, flowing southward on the flood with a velocity of about 1 knot.

(*b*) *Landing facilities.* The pier consisted of a rock causeway with a pile and timber T-head wharf, the face of which was 200 feet long and had depths of 30 feet alongside (1930). Dolphins were provided at each end of the T-head. Railroad tracks extended from the packing plant to the face of the pier (FIGURE VI - 85). The pier was lighted.

(*c*) *Clearance facilities.* In addition to the railroad leading to the pier, a highway paralleled the coast.

(*d*) *Availability of supplies.* Fresh water was available at the pier.

(27) Kolambugan, Mindanao Island (8° 07′ N, 123° 53′ E).

Kolambugan is on Kolambugan Bay, which lies on the eastern side of Port Misamis, opposite the port of Misamis (FIGURE VI - 10). The port is southwest of the town, near Migcaniguing Point, where the Kolambugan Lumber Company had a pier.

(*a*) *Harbor.* The harbor is an open roadstead in Kolambugan Bay, eastward of Pasil Shoal. Depths in the bay vary from 3 to 15 fathoms, with general depths of 7 fathoms along the entrance range. Pasil Shoal is a long narrow shoal extending nearly 3 miles in a northeast direction from Palalagoya Point, with depths varying from ¼ to 4¾ fathoms over it. The northern extremity was marked by a buoy.

Port Misamis is described under Topic 61, C, (4), (a).

Anchorage may be obtained eastward of Pasil Shoal, in 4 to 5 fathoms, over fine sand bottom. The anchorage is well sheltered except from the north.

The variation of tide is about 5¾ feet.

(*b*) *Landing facilities.* The wharf of the lumber company was about 1,950 feet in length, and was constructed of wood piling, with wood decking. There was a depth (1938) of 25 feet at the outer end, decreasing gradually to 16 feet 300 yards shoreward. Tracks were laid on the pier. The wharf was lighted (FIGURES VI - 86 and VI - 87).

(*c*) *Clearance facilities.* Kolumbugan was the southern terminal of the coastal highway running northward along the eastern coastline of Iligan Bay.

(*d*) *Availability of supplies.* Fresh water, ice, and food supplies were available. Some diesel oil and gasoline were stocked by the lumber mill.

(*e*) *Repair facilities.* There was a machine shop at the mill.

(28) Jimenez, Mindanao Island (8° 20′ N, 123° 51′ E).

Jimenez is on the western side of Iligan Bay about 9 miles north of Loculan Point, the western entrance point of Port Misamis (FIGURE VI - 88). The town lies inland on the Palilan River. The port facilities were located about 1 mile eastward, on Iligan Bay.

The Palilan River which discharges about 0.9 mile northwest of Tabu Point, has very little water on its bar at low tide.

(*a*) *Harbor.* The harbor is an open roadstead approximately ¾ mile long in a northwest-southeast direction and about ¼ mile wide, between the 5-fathom contours. The offlying reefs, principally Madre and Poricos, lie ¼ to ½ mile offshore and extend to 1 mile on their outer edges where there is deep water. These reefs provide protection against most seas. A number of channels lead between the reefs to the harbor but the most used are the southern and northern entrances, between the reefs and the mainland. Buoys marked the edges of the reefs in the channels.

The harbor provides one first-class, two second-class, and one third-class anchorages which are safe, except during northeast monsoons when it is reported that a heavy swell sometimes occurs. Anchorage may be found about 250 yards off the pier in 6 fathoms, over sand bottom, and elsewhere in the roadstead in depths of 3 to 12 fathoms, over mud and sand bottom.

A fixed red light, 32 feet above high water and visible 7 miles, was located on the beach at Tabu Point.

The high water interval at Jimenez is 11 hours 25 minutes. The higher high water height is 4.1 feet and the lowest tide recedes to 1.5 feet.

(*b*) *Landing facilities.* The facilities consisted of a rock and earth causeway with a reinforced concrete pier, 39.5 feet wide and 275 feet long, at its seaward extremity (FIGURE VI - 88). There was a depth (1939) of 20 feet at the pier head. Vessels usually berthed along the southern side. A heavy swell sometimes reached the pier during the northeast monsoons. A black warehouse was located near the root of the pier. A cargo shed was reported under construction (1937).

(*c*) *Clearance facilities.* The pier was at the end of the main street of the town.

(29) Plaridel, Mindanao Island (8° 36′ N, 123° 44′ E).

Plaridel is about 2½ miles westward of Polo Point, the western entrance point of Iligan Bay, on the north coast of Mindanao (FIGURE VI - 89). The town lies on the coast, about 1 mile northwest of the landing facilities on the northwestern side of Inamucan Bay.

(*a*) *Harbor.* The harbor of Plaridel is in Inamucan Bay, about 1 mile southeastward from Plaridel, and about 1½ miles westward from Polo Point. It is about ¾ mile long and ¼ mile wide, but reefs extending from both entrance points reduce the navigable entrance channel to a width of 300 yards. Open to the north, it provides good protection from other quadrants. Baubaon Point, the eastern entrance point, is fronted by a fringing reef, and at Inamucan Point, the western entrance point, a reef extends about ¼ mile from shore. These reefs bare at low water. The depths at the entrance are 32 fathoms, decreasing to 4 fathoms at the head of the bay.

Anchorage space in the bay is limited to an area about 300 yards in diameter, where vessels anchor in 5 to 11 fathoms, over mud. Vessels may also anchor in 10 fathoms, ½ mile from shore, north of the village.

The high water interval at Plaridel is 11 hours 05 minutes. The higher high water height is 4.1 feet and the lowest tide recedes to −1.5 feet.

A fixed red light, 60 feet above high water and visible 7 miles, was located on Polo Point.

(*b*) *Landing facilities.* There were originally 2 wooden landings, each 20 feet wide and 65 feet long (FIGURE VI - 89), which were built by the municipality. A reinforced concrete wharf or pier, 30 feet wide and 69 feet long, was constructed from the end of one of these timber wharves. The timber section was to have been removed and replaced by a rock causeway under the proposed plans. It is not known whether this work has been done. The concrete pier had a depth of 13 feet at its head, and the timber wharf had a depth of 16 feet at its end.

(*c*) *Clearance facilities.* A road led from the piers to the town.

(30) Baliangao, Mindanao Island (8° 40′ N, 123° 36′ E).

Baliangao is at the head of Baliangao Bay, situated in the northeastern corner of Murcielagos Bay, on the northern coast of Mindanao (FIGURE VI - 90). It was the shipping point for copra produced in the vicinity. A landing for small boats was located at the town and the Government pier was located at Miray Point, about 1 mile west-southwest of the town.

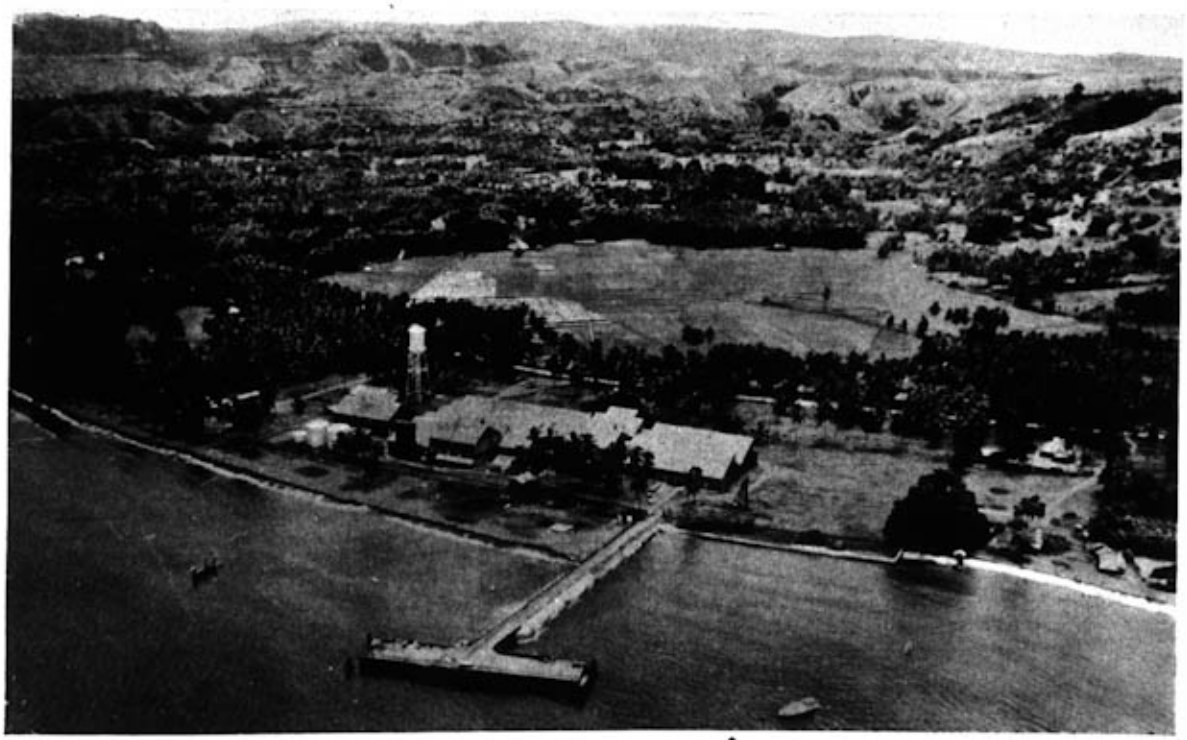

FIGURE VI - 85. *Bugo.*
Aerial view, showing pier. 18 September 1936.

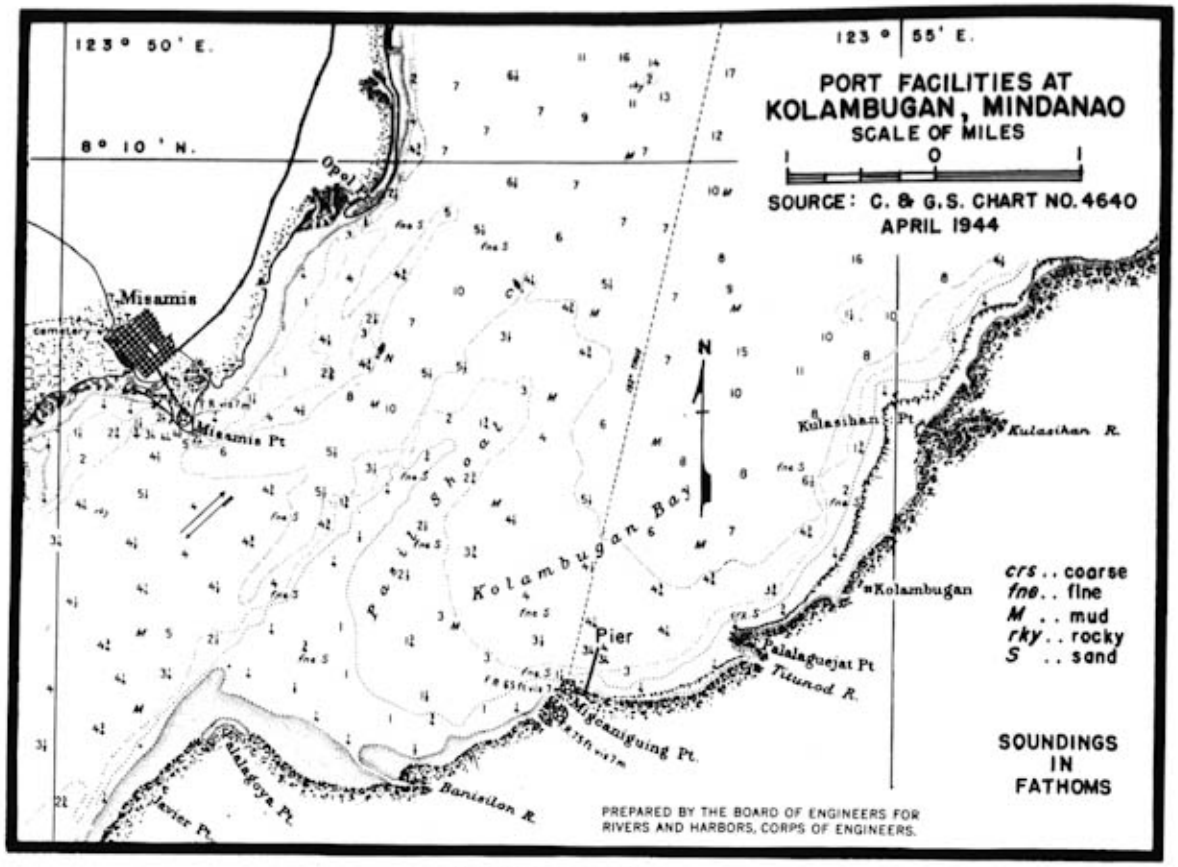

FIGURE VI - 86. *Kolambugan.*
Map showing location of port facilities.

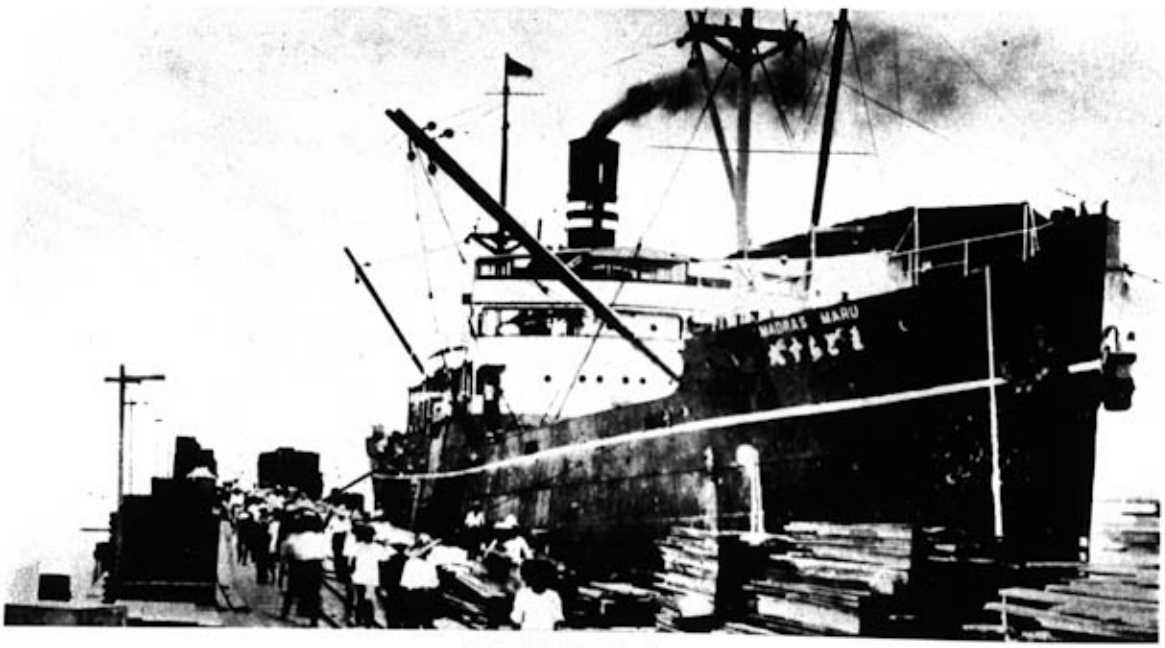

FIGURE VI - 87. *Kolambugan.*
View of pier, looking north-northeast, showing type of construction, railroad trackage and class of vessel that can be berthed.

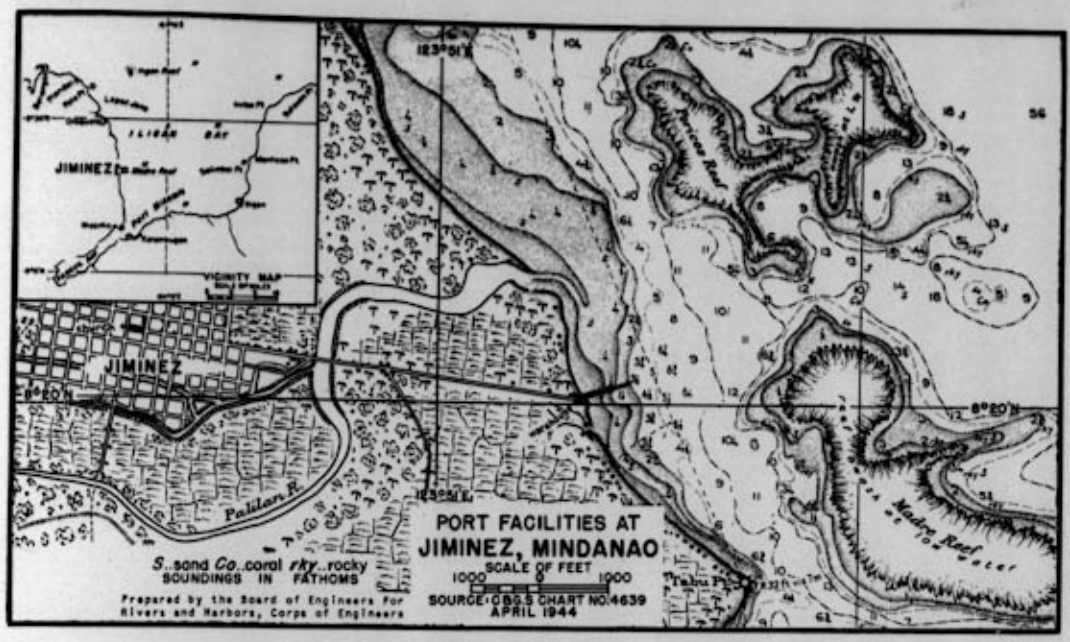

FIGURE VI - 88. *Jiminez.*
Map showing location of Jiminez (inset) and port plan showing location of facilities.

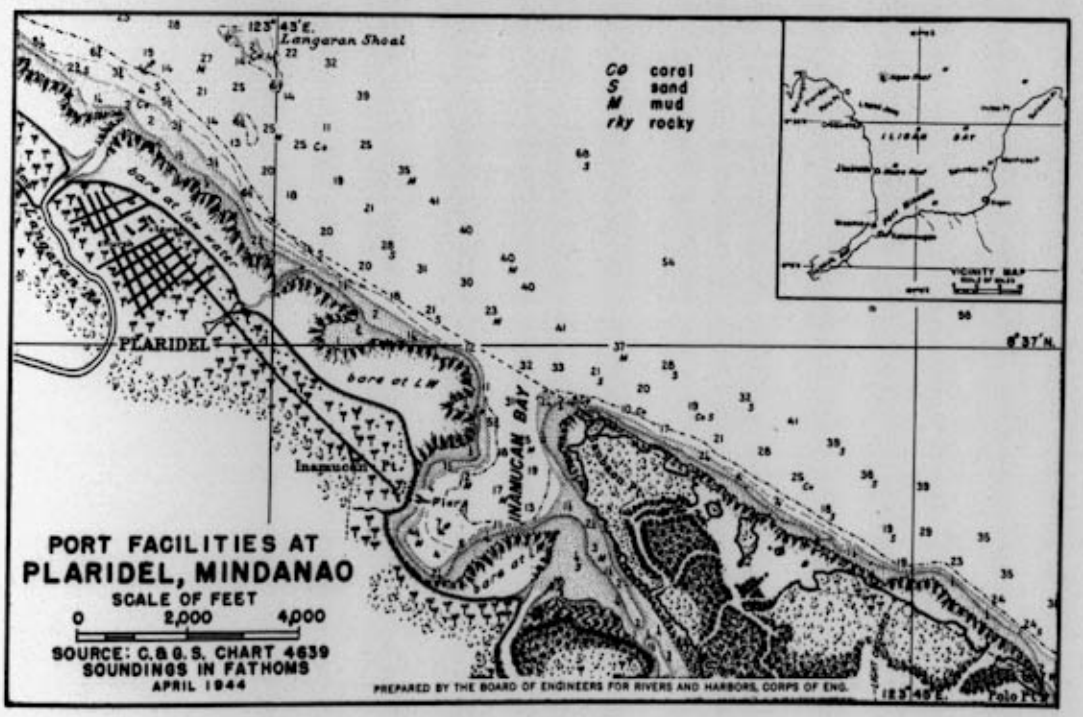

FIGURE VI - 89. *Plaridel.*
Map showing location of Plaridel (inset) and port plan showing location of facilities.

(*a*) *Harbor.* The harbor is in Baliangao Bay, a small indentation in the coast, about 1 mile wide between the entrance points, Miray Point and Sulong Point, and about 1 mile long in a northeast-southwest direction. The southern ⅔ of the bay is shallow. The depths in the northern ⅓ range from about 8 fathoms in the channel entrance southwestward from Miray Point, to about 3 fathoms 1 mile farther in. The 5-fathom contour just enters the bay, stopping off Miray Point. The bay is sheltered from all winds and seas except those from the southwest. The entrance channel was marked by buoys. The edges of the inner channel may readily be seen when the water surface is not choppy.

There is anchorage off Miray Point in about 6½ fathoms with Miray Point bearing north, distant about 400 yards.

(*b*) *Landing facilities.* A stone pier (Reference number 1, FIGURE VI - 90), located at the town, could only be approached by small boats at high water. Approach should not be attempted without local knowledge.

The Government pier at Miray Point (Reference number 2, FIGURE VI - 90) consisted of a dumped rock causeway, 20 feet wide and 110 feet long, with a reinforced concrete pier at its extremity, 29.5 feet wide and 165 feet long, with a depth of 10 feet at the head.

(*c*) *Clearance facilities.* A road led from the pier on Miray Point to the town.

(*d*) *Availability of supplies.* Food supplies and a few tins of gasoline and kerosene were usually obtainable.

(31) Dapitan, Mindanao Island (8° 39′ N, 123° 25′ E).

Dapitan is about ⅜ mile from the beach on the eastern side of Dapitan Bay, south of the mouth of the Dapitan River, on the northwestern coast of Mindanao (FIGURE VI - 91). A road led northward from the town to a landing pier, ⅜ mile eastward of Estacion Point. There was no water at the end of the pier at low tide.

The Dapitan River, discharging into the head of Dapitan Bay, at the north end of the town, has very little water on its bar at

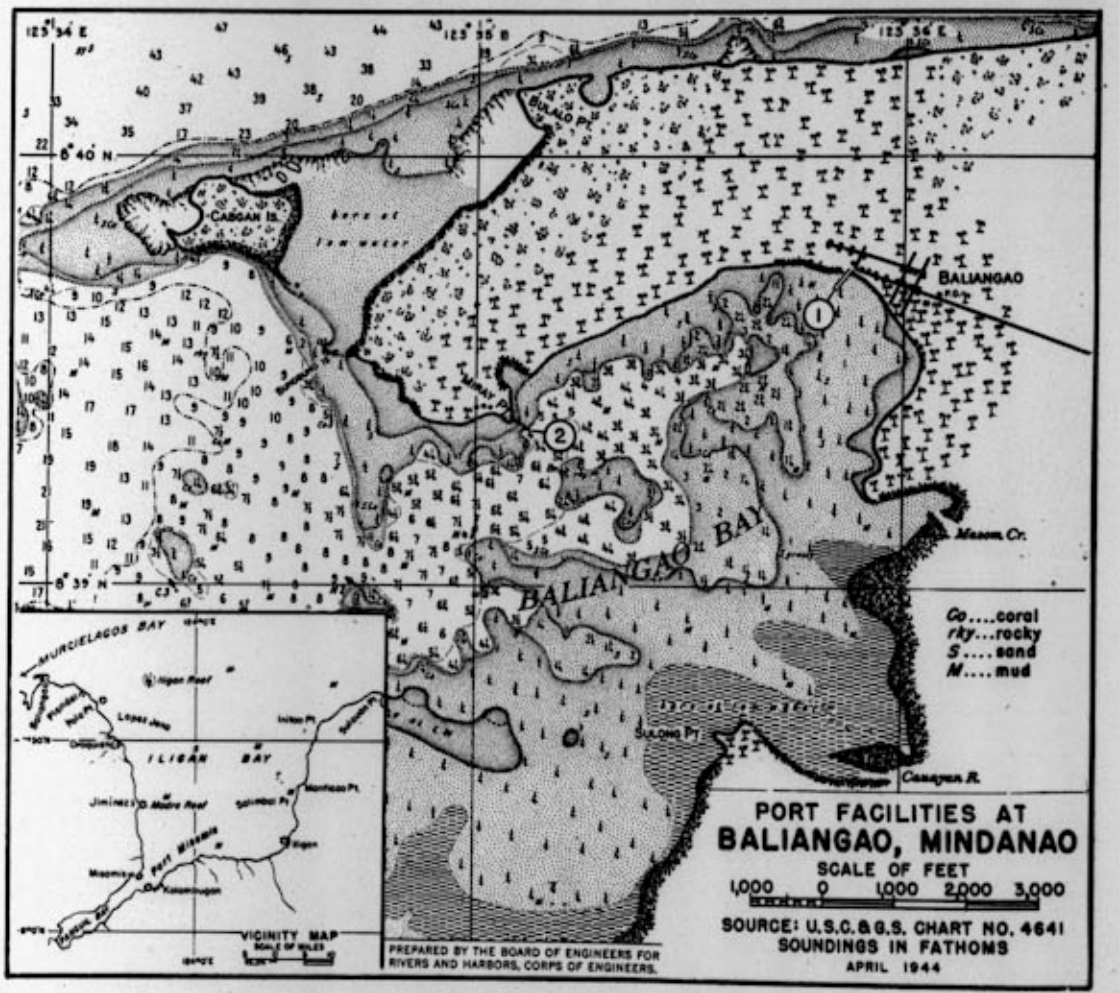

FIGURE VI - 90. *Baliangao.*
Map showing location of Baliangao (inset) and port plan showing location of facilities.

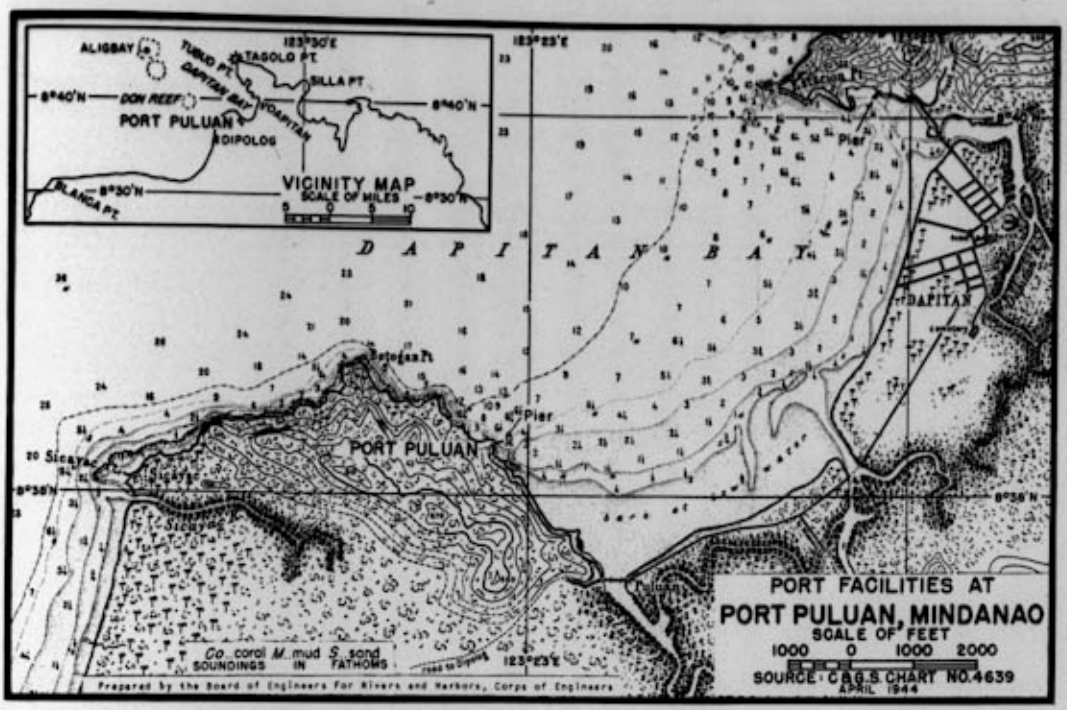

FIGURE VI - 91. *Port Puluan.*
Map showing location of Port Puluan (inset) and port plan showing location of facilities.

low tide. At high water and with a smooth sea, small lighters can cross. A bridge crossed the mouth of the river at the town.

Port Puluan, the deep-water terminal for Dapitan, is described under Topic 62, C, (31).

(32) Port Puluan, Mindanao Island (8° 38′ N, 123° 23′ E).

Port Puluan is on the southwest side of Dapitan Bay, ⅞ mile southeast of Botogan Point, on the northwestern coast of Mindanao Island (FIGURE VI - 91). The facilities at Port Puluan served the adjacent towns of Dapitan and Dipolog, which lie about equidistant on either side of the port and were connected to it by a road.

(*a*) *Harbor.* The harbor is an open roadstead on the southwestern side of Dapitan Bay, which is about 3¾ miles wide at the entrance between Tubud and Botogan Points, narrowing to an average of 2½ miles farther in, and is about 3 miles long. It is open to the northwest. The depths at the entrance are 28 fathoms, decreasing gradually to the beach at the head of the bay.

Good anchorage may be found in any part of Dapitan Bay, sheltered from all except northwesterly winds. The usual anchorage is off Dapitan, about ⅜ to ½ mile from shore, in 3½ fathoms of water, over a mud bottom, with the church bearing 92°. Good anchorage may also be found in a depth of 7 fathoms, about ⅜ mile southward from the small islet off Estacion Point.

The high water interval in Dapitan Bay is 10 hours 57 minutes. The higher high water height is 4.4 feet, and the lowest tide recedes to −1.5 feet. At ebb tide the current flows outward or westerly along the pier end.

(*b*) *Landing facilities.* The facilities at Port Puluan consisted of a dumped rock causeway 200 feet long and 20 feet wide with a steel sheet piling head 32 feet long and 30 feet wide, terminating in a reinforced concrete pier 138 feet long and 30 feet wide on piling. The pier had fender piles at the head and a pile cluster at the inner end. There was a depth (1937) of 27 feet off the fender piles at the head, decreasing to 15 feet at the cluster piles at the inner end on the western side.

Proposed improvements included a reclaimed area fronted by a rock bulkhead, for port and terminal activities, and a cargo shed. It is not known whether this work has been completed.

(*c*) *Clearance facilities.* A road led from the pier at Port Puluan, to Dipolog and Dapitan. Bridges crossed the several rivers.

(*d*) *Availability of supplies.* Small supplies of food, ice, gasoline, kerosene and lubricating oil were obtainable at Dapitan and Dipolog.

(33) Dipolog, Mindanao Island (8° 35′ N, 123° 20′ E).

Dipolog is on the northwestern coast of Mindanao, about 2½ miles south of Sicayac Point (FIGURE VI - 91). It lies on the south side of the mouth of the Dipolog River, slightly back from the beach. It was a shipping point for copra, corn, hemp, and lumber. There was regular weekly boat connection with Cebu and Misamis. A road led to Port Puluan and Dapitan.

The water in front of the town shoals gradually, the 5-fathom curve being ⅜ mile from shore. No piers have been reported.

The Dipolog River has very little water on its bar, but can be entered by small boats at high water.

Port Puluan, the deep-sea terminal for Dipolog, is described under Topic 61, C, (32).

(34) Sindangan, Mindanao Island (8° 14′ N, 123° 00′ E).

Sindangan is at the eastern end of Sindangan Bay, on the northwestern coast of Mindanao (FIGURE VI - 92). Copra and corn were shipped in small quantities. No landing facilities have been reported.

(*a*) *Harbor.* The harbor is an open roadstead, with no shelter from west to north. The 30-foot contour runs from 0.5 to 0.7 mile offshore, and the approach is deep and clear.

Anchorage can be taken from ¾ to 1 mile off the village, the depths ranging from 30 to 84 feet, over mud.

(*b*) *Landing facilities.* No piers are known to exist.

(*c*) *Clearance facilities.* Access to the interior was limited to trails. Interisland steamers formerly called biweekly, providing connection with Zamboanga and Cebu.

(*d*) *Availability of supplies.* Supplies of any kind were scarce.

FIGURE VI - 92. *Sindangan.*
Map showing location of Sindangan.

(35) Port Santa Maria, Mindanao Island (7° 46′ N, 122° 07′ E).

Port Santa Maria is on the western coast of Mindanao Island, about 60 miles northward from Zamboanga (FIGURE VI - 93). It was the site of a small lumber mill which had a pier on the northern side of the eastern arm of the port.

(*a*) *Harbor.* Port Santa Maria, the harbor, is practically landlocked, with high hills surrounding it. It is not readily seen by vessels passing at a considerable distance offshore. About a mile wide at the entrance, it narrows to about ⅜ mile and then widens out into two bights, separated by a small peninsula and a coral reef, which projects about 300 yards northward from it. The eastern bight is the largest. The bay is about 1½ miles long. The depths at the entrance are 22 fathoms with depths in either bight ranging from 12 to 15 fathoms. The shore at the entrance is composed of rocks and cliffs, with a narrow fringing coral reef, but at the head of the bay there are some sand beaches. A shoal formerly marked by a beacon, lies about 150 yards westward of the end of the pier.

The harbor affords the best sheltered anchorage on the west coast of Mindanao. Good anchorage for small vessels in 12 to 15 fathoms, over mud or sand, may be found in the southern bight. Space for one second- and one third-class anchorage berths is vailable in the eastern bight, and for one second- and four third-class berths in other parts of the harbor.

The high water interval at Port Santa Maria is 10 hours 54 minutes. The higher high water height is 4.2 feet and the lowest tide recedes to −1.5 feet.

(*b*) *Landing facilities.* The facilities consisted of a timber pier on piling, approximately 150 feet long and 100 feet wide (FIGURE VI - 94), located on the northern side of the eastern bight. There was a depth (1937) of 11 to 15 feet alongside the end of the pier, with deeper water immediately offshore. It was used primarily for loading of lumber for export. Vessels moored at the head of the pier, lying to an anchor, bow to westward. Several sheds and mill buildings were located on the shore adjacent to the pier.

(*c*) *Clearance facilities.* Regular weekly steamer communication was maintained with Manila and other Philippine ports. There were industrial tracks on the wharf, leading from the mill.

(*d*) *Availability of supplies.* Fresh water was not available at the pier. A few drums of diesel oil were stocked for the use of the mill.

(36) Caldera Bay, Mindanao Island (6° 57′ N, 121° 58′ E).

Caldera Bay is about 7 miles westward of Zamboanga, at the southwestern end of Mindanao (FIGURE VI - 12). The Philippine Desiccated Coconut Company had 2 wharves on the bay.

(*a*) *Harbor.* Caldera Bay is a natural harbor, open to the south, with a small inner arm in the northwestern part which is accessible to small vessels only. The bay is about 1 mile wide at the entrance, and recedes about ½ mile into the coast. The depths in the outer portion of the bay range from 6 to 9 fathoms, with the 5-fathom contour skirting the shore line at a distance of about 300 to 400 yards, but not entering the small inner part. The inner arm is about 70 yards wide at the entrance and 200 yards long, with depths of about 2½ fathoms at the entrance, decreasing to 3 feet inside. The bay is sheltered from westerly, northerly, and northeasterly winds and seas, but open to southerly winds.

Good anchorage may be found in the outer bay in depths of 6 to 8 fathoms, over sand bottom.

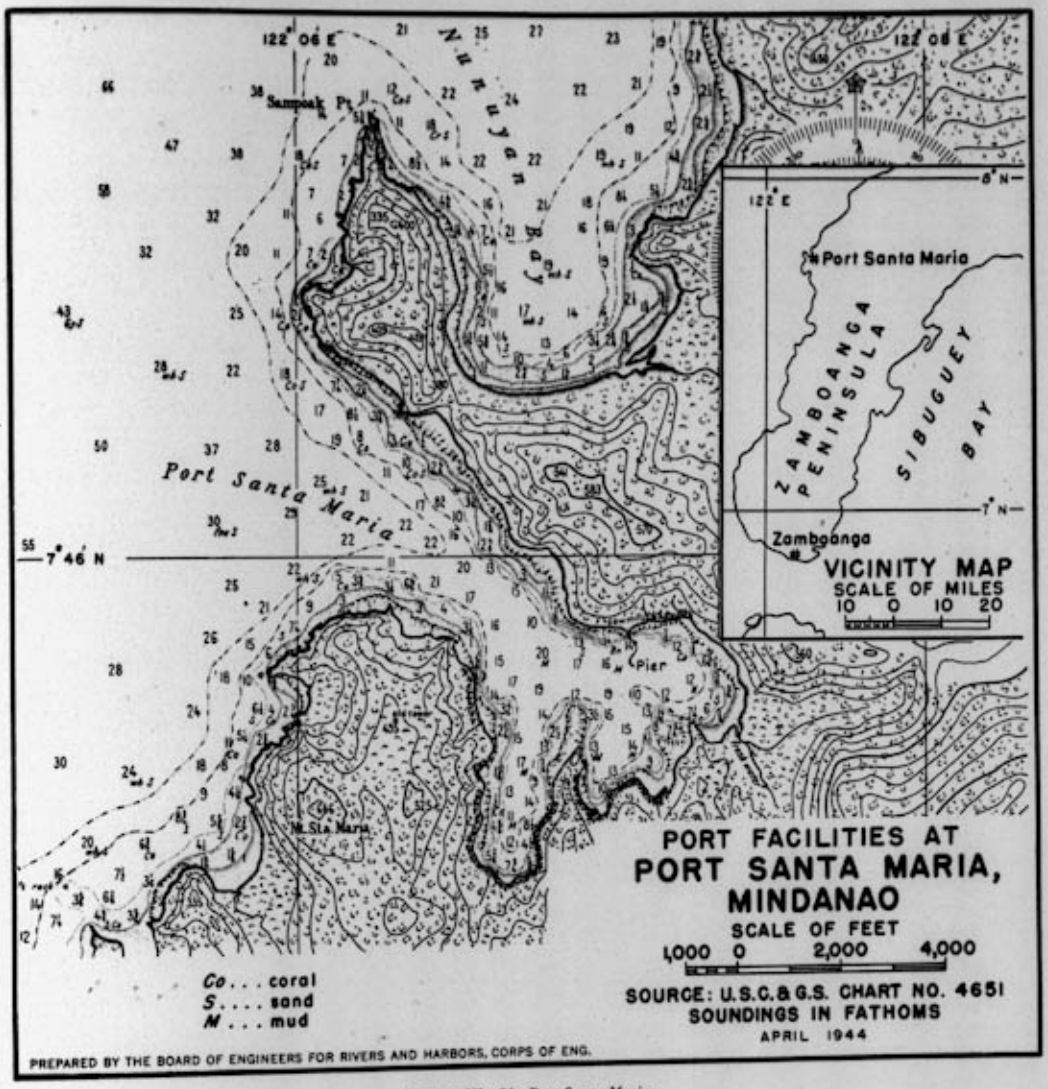

FIGURE VI - 93. *Port Santa Maria.*
Map showing location of Port Santa Maria (inset) and port plan showing location of facilities.

(*b*) *Landing facilities.* The Philippine Desiccated Coconut Company had 2 small timber wharves, with 28 feet and 14 feet of water at their ends. The exact locations of these wharves are not known. One (FIGURE VI - 95) is of timber pile construction.

There were numerous sheds and potential warehouses. A number of coconut oil tanks were located on the shore.

(*c*) *Availability of supplies.* The Asiatic Petroleum Company had a fuel tank at Caldera with a pipe line leading on to the wharf, with 28 feet at its head, where ships could be supplied.

(*d*) *Repair facilities.* A marine railway in Caldera Bay was capable of handling vessels of 50 tons weight, 90 feet in length and 8 feet draft (aft). No machine work facilities were available at the yard.

(37) Kabasalan, Mindanao Island (7° 48' N, 122° 44' E).

Kabasalan is on the Kabasalan River, which discharges into the northeast corner of Sibuguey Bay, on the south coast of Mindanao (FIGURE VI - 96). It was the headquarters of the Goodyear Rubber Plantations Company, which had a wharf about 0.8 mile from the town.

(*a*) *Harbor.* Kabasalan is a river port, about 2½ miles upstream from the mouth of the Kabasalan River. The river is entered through a narrow and tortuous channel which winds through the mud flats of Sibuguey Bay. This channel has a depth

FIGURE VI - 94. *Port Santa Maria.*
View of pier, looking north, showing type of construction. 1940.

FIGURE VI - 95. *Caldera Bay.*
View of pier, showing type of construction. Prior to April 1935.

of 8 feet, but local knowledge is required for passage through it and into the river. The Kabasalan River, inside its mouth, is wide and sufficiently deep, for vessels of 6 feet draft to ascend the main channel for about 2 miles and thence about ½ mile up a side channel, which enters the river on the right side, to the wharf on the north side of the stream.

(*b*) *Landing facilities.* The wharf was of timber construction and had a depth alongside (1937) of about 10 feet. Turning space was limited to about 40 feet at low tide.

(*c*) *Clearance facilities.* Biweekly boat service was maintained to Zamboanga.

(38) Lumarao, Mindanao Island (7° 33′ N, 122° 48′ E).

Lumarao is on the southwest side of Taba Bay, an inlet on the eastern side of Sibuguey Bay, on the south coast of Mindanao (FIGURE VI - 97). It was the headquarters of the Hercules Lumber Company, which had a wharf at the town.

(*a*) *Harbor.* The harbor, Taba Bay, is about 4 miles long with an average clear width of ¾ mile. It is comparatively easy to enter at any stage of the tide, and at low water the edges of the coral fringes and reefs are clearly defined. The shores of the bay are generally lined with mangroves and the fringing reefs are narrow. The head of the bay is shoal and in the southeast corner are mud flats, bare at low water. The Cabog Islands lie on a reef, part of which bares at low water. This reef extends northward to within ½ mile of Patan Point, the northern entrance point to the bay, and forms with Cabog Point, the western protective arm for the bay.

The depths at the entrance are 14 to 16 fathoms, decreasing to about 2 fathoms off the pier at the southwestern end. The channel through the bay was marked by beacons located on the reefs and shoals. The channel between the Cabog Island and

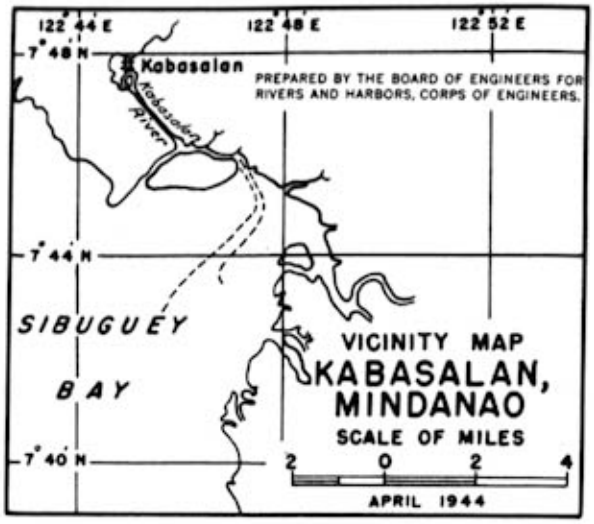

FIGURE VI - 96. *Kabasalan.*
Map showing location of Kabasalan.

Cabog Point was marked by beacons. There is a depth of about 2 fathoms in this channel but local knowledge is required for passage.

Taba Bay is considered the best sheltered anchorage on the east side of Sibuguey Bay. There is anchorage most anywhere in the bay according to draft. A fixed red light was shown from the outer end of the wharf.

The high water interval in Taba Bay is 6 hours 16 minutes. The higher high water height is 6.0 feet and the lowest tide recedes to −1.5 feet.

(*b*) *Landing facilities.* The wharf was a timber pile bulkhead with sawdust fill (FIGURE VI - 97). It was in fair condition (1937), but inaccessible to boats having a draft of more than 10 feet (FIGURE VI - 98). Vessels berthed alongside the east face. The wharf was lighted. Railway tracks were laid on the wharf and lead to the mill and forest. A small tug and several lighters were available. A number of sheds and mill buildings were located at the rear of the pier. Lumber stock yards were rather extensive.

(*c*) *Clearance facilities.* Railroad tracks were laid on the pier. Vessels called every 2 weeks for lumber.

(*d*) *Availability of supplies.* Fresh water was piped to the mill but was not available on the wharf. The wharf was lighted. A few drums of diesel oil and gasoline in tins were stocked for use in the mill. The lumber company maintained a store where supplies could be obtained in small amounts.

(*e*) *Repair facilities.* Minor repairs could be made in the lumber mill machine shop.

(39) Naga-Naga (Chinkang), Mindanao Island (7° 31′ N, 122° 56′ E).

Naga-Naga is on the eastern shore of Tantanang Bay, the northern arm of Port Sibulan, on the southern coast of Mindanao (FIGURE VI - 99). The town, about ¾ mile northward of Kaladis Point, the eastern entrance point of the bay, was the site of the sawmill and pier of the Mindanao Lumber Company (FIGURE VI - 100).

(*a*) *Harbor.* The harbor is an open roadstead at the entrance to Tantanang Bay, which is nearly 3 miles wide at the entrance between Tantanang and Kaladis Points, and extends over 2 miles northward. The 10-fathom contour does not enter the bay, but extends partly across the entrance. The bay shoals gradually from the entrance to its head, with the 5-fathom contour following the coast about 300 yards offshore and crossing the bay about 1¼ miles from the entrance. It is well sheltered from practically all winds and seas.

The channel was marked by a buoy and beacons.

There is good sheltered anchorage in Tantanang Bay in any desired depth.

The high water interval in the bay is 6 hours 12 minutes. The higher high water height is 5.8 feet, and the lowest tide recedes to −1.5 feet. The flood tide currents run northward, parallel to the shore and pier face.

(*b*) *Landing facilities.* The Mindanao Lumber Company had an open pile and timber T-head pier, 390 feet long across the face and about 50 feet wide. Depths alongside the T-head (1937) were 19 to 24 feet, the deeper water being toward the south end. Vessels docked starboard side to in order to have the least depth at the bow. There were no mooring bollards or cleats. Vessels were required to use kedge anchors while along-

FIGURE VI - 97. *Lumarao.*
Map showing location of Lumarao (inset) and port plan showing location of facilities.

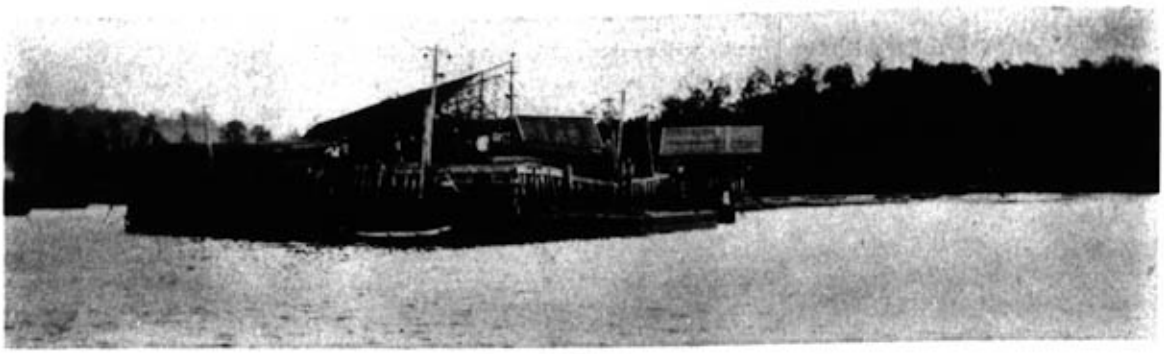

FIGURE VI - 98. *Lumarao.*
View of pier, showing type of construction. Prior to April 1935.

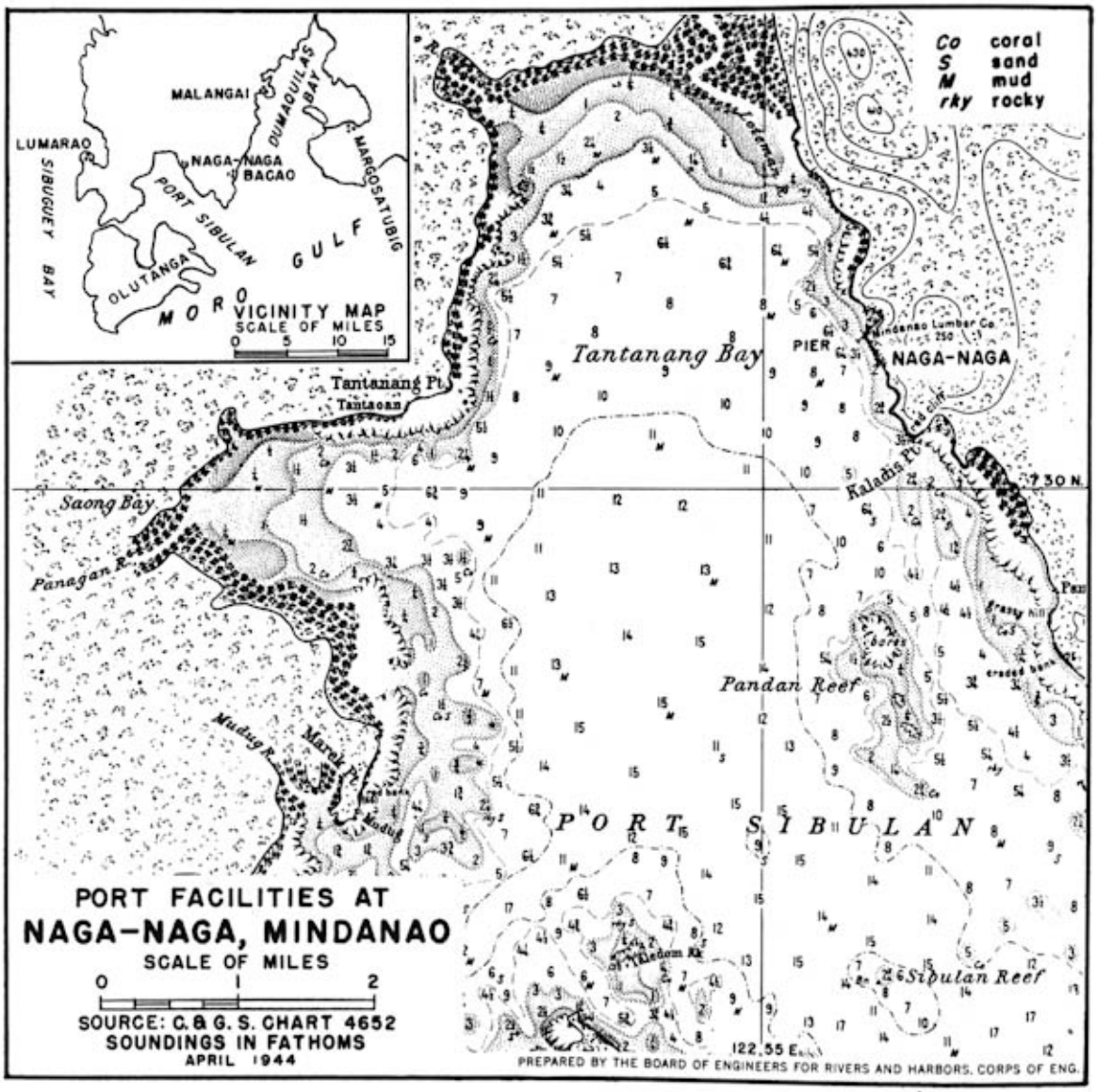

FIGURE VI - 99. *Naga-Naga.*
Map showing location of Naga-Naga (inset) and port plan showing location of facilities.

side. Lines were made fast to the wharf stringers. Railroad tracks serve the pier. The pier was lighted (FIGURES VI - 100 and VI - 101).

(*c*) *Clearance facilities.* The railroad extended from the pier to the mill and storage yards, and inland to the forests. There was weekly steamship connection with Cotabato and Zamboanga.

(*d*) *Availability of supplies.* Fresh water, suitable for boiler purposes, was piped to the pier. The wharf was lighted. Food supplies were limited.

(40) Bacao, Mindanao Island (7° 33′ N, 123° 02′ E).

Bacao is near Naga-Naga, about 7 miles east-northeast of the western entrance point of Dumanquilas Bay, on the south coast of Mindanao (FIGURE VI - 99). The only landing facility was the Mindanao Lumber Company pier, which was in poor condition and could only be reached by small boats at high water. Logs were hauled to Margosatubig (Topic 62, C, (42)).

(*a*) *Harbor.* The harbor is an open roadstead, sheltered from winds from westerly directions only. A coral reef fringes the shore and extends out in places about 500 yards. Mangroves line the shore except in a few spots. The 10-fathom contour lies about 1,000 yards offshore opposite Bacao, and the 5-fathom contour lies 600 yards offshore.

The anchorage in favorable weather is about ½ mile offshore in depths of 8 to 10 fathoms of water.

(*b*) *Landing facilities.* The facilities at Bacao consisted of a timber pile pier, about 20 feet wide, which projected about 450 feet from the shore. The pier was in poor condition and was accessible to small boats only, at high tide. Vessels moored to pile dolphins and mooring piles located along the outer edges of the reef. A railway track was laid on the pier and led a short distance inland. Lumber was not exported from the port. The logs were made into rafts and hauled across the bay to Margosatubig (FIGURES VI - 102 and VI - 103).

(*c*) *Clearance facilities.* The pier was the terminus of a short lumber railway.

(41) Malangai, Mindanao Island (7° 38′ N, 123° 02′ E).

Malangai is on the western shore of Dumanquilas Bay, on the south coast of Mindanao Island (FIGURE VI - 99). It was the shipping point for the coal mines of the Sibuguey district. A pier, with mechanical equipment for loading coal, was located on a point just east of the village (FIGURE VI - 104).

(*a*) *Harbor.* The harbor, Malangas Bay, is a small indentation on the coast south and westward from Igai Point. It is about 1¼ miles wide at the entrance and about 1½ miles long. The average width between the 5-fathom contours is about 600 yards. The southwestern side is shallow, the shoal flats partly baring at low water. The northern shore shoals rapidly, the 5-fathom contour lying 200 to 400 yards offshore. The depths at the entrance are 12 fathoms, with average depths of 8 fathoms in the bay. The 10-fathom contour just enters the bay.

Good anchorage may be found in the bay in 6 to 10 fathoms of water, over a mud bottom. The area is sufficient for 5 first-class anchorage berths.

(*b*) *Landing facilities.* Landing facilities consisted of a reinforced concrete T-head pier, on concrete piles, 160 feet long and about 40 feet wide at the extremity of a causeway extending

FIGURE VI - 100. *Naga-Naga.*
Aerial view of waterfront, showing location of pier.

FIGURE VI - 101. *Naga-Naga.*
View of pier, showing type of construction.

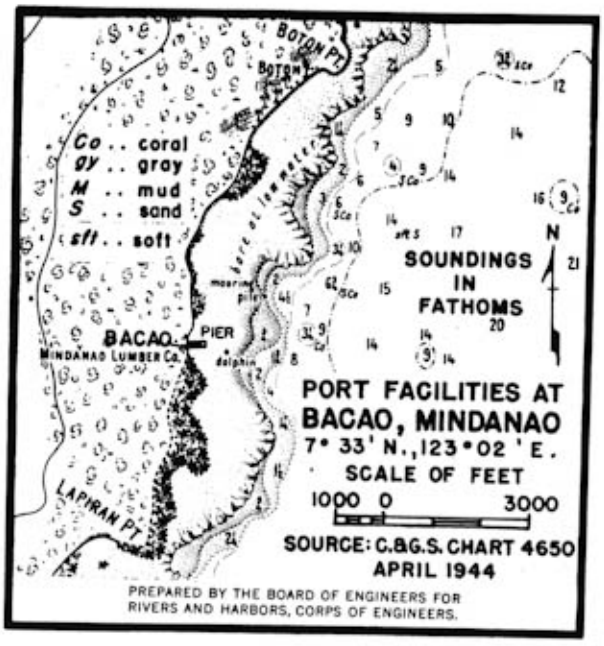

FIGURE VI - 102. *Bacao.*
Map showing location of port facilities.

from the shore for about 200 feet. Depths (1941) alongside the face were 27 feet at low water. A belt conveyor extended along the western side of the causeway to the face of the pier, permitting ships to load coal directly into the hold from a stockpile at the shore-end of the pier. The pier was provided with pile dolphins along both outer and inner faces, and had mooring bollards at intervals along its face. Ships berthed along the outer side but smaller vessels could come alongside the inner side (FIGURES VI - 105 and VI - 106).

A small storage warehouse was located near the stockpile, and small sheds were located just west of the root of the causeway.

(*c*) *Clearance facilities.* A new road led from the pier to the mines and to the town, westward from the pier.

(*d*) *Availability of supplies.* Water was available. A 115-watt, 220-volt diesel generator for the radio station was located at the root of the pier. Food supplies were obtainable in small amounts.

(42) Margosatubig, Mindanao Island (7° 35′ N, 123° 10′ E).

Margosatubig is on the southern side of Igat Bay, the eastern arm of Dumanquilas Bay, on the south coast of Mindanao.

The Mindanao Lumber Company's pier was used by large vessels calling for lumber. The municipal wharf was used by coastal commercial vessels (FIGURES VI - 107 and VI - 108).

(*a*) *Harbor.* The harbor is in Igat Bay, a large inlet on the eastern side of Dumanquilas Bay. It is perfectly landlocked and is considered the best anchorage section of Dumanquilas Bay. Igat Bay, 3½ miles wide at its entrance between Linokaedanum Point and Igat Point and extending 5 miles southeastward, has three hundred and sixty-two 350-yard, and one hundred and seventy-eight 500-yard berths. The depths at the entrance range from 12 to 20 fathoms, decreasing to 5 fathoms at the head. The average depth is about 12 fathoms.

Anchorage may be found most any where in the harbor, according to draft.

The high water interval at Margosatubig is 6 hours 10 minutes. The higher high water height is 5.3 feet, and the lowest tide recedes to 1.5 feet.

(*b*) *Landing facilities.* The facilities at Margosatubig consisted of 2 open pile timber T-head piers.

The lumber company pier (Reference number 1, FIGURE VI - 107) consisted of a T-head, 180 feet long on its outer face and about 30 feet wide, with an approach about 60 feet long and 30 feet wide. Depths alongside (1937) were 20 feet near the center of the wharf face, with deeper water towards the ends.

FIGURE VI - 103. *Bacao.*
View of pier, looking east, showing type of construction and railroad trackage. Prior to April 1935.

It was provided with warping dolphins at each end and pile fenders along the outer face (FIGURE VI - 109).

The municipal wharf (Reference number 2, FIGURE VI - 107) was located about 100 yards westward from the lumber company wharf. It consisted of a T-head, 40 feet long and about 20 feet wide, at the end of a timber approach. Depths (1937) were 10 feet alongside the face. The wharf was provided with warping dolphins at each end, and a stairway landing at the east end (FIGURE VI - 110).

Motor launches were reported available.

(*c*) *Clearance facilities.* The lumber company operated a logging railroad 7.1 miles long. The road had 2 locomotives. Motor launches and small interisland vessels furnished connection with Zamboanga, 3 times each week.

(*d*) *Availability of supplies.* Fresh water was piped to the municipal wharf, but it would have to be boiled for drinking purposes. Provisions were obtainable in small quantities.

(43) Flecha Point, Mindanao Island (7° 22′ N, 123° 25′ E).

Flecha Point is on the tip of Baganian Peninsula on the southern coast of Mindanao (FIGURE V - 16). The landing was at the pier of the Santa Clara Lumber Company.

(*a*) *Harbor.* The harbor is a small bight lying between Flecha and Tambulian Points. Open to the south, it is insecure except in favorable weather. It is sheltered only from north-northeast, and northwest winds. The harbor is about 1½ miles wide at the entrance, receding for about ¾ mile into the coast. The depths at the entrance are 35 fathoms, with a depth of 20 fathoms about 500 yards from the head of the bight. There is a live coral reef, with a least depth of 9 feet, about 130 yards southward from the end of the pier.

Anchorage may be found in 21 to 23 fathoms of water over coral sand bottom, about 550 yards 137° from the end of the pier.

In strong winds, a heavy sea sets around Flecha Point.

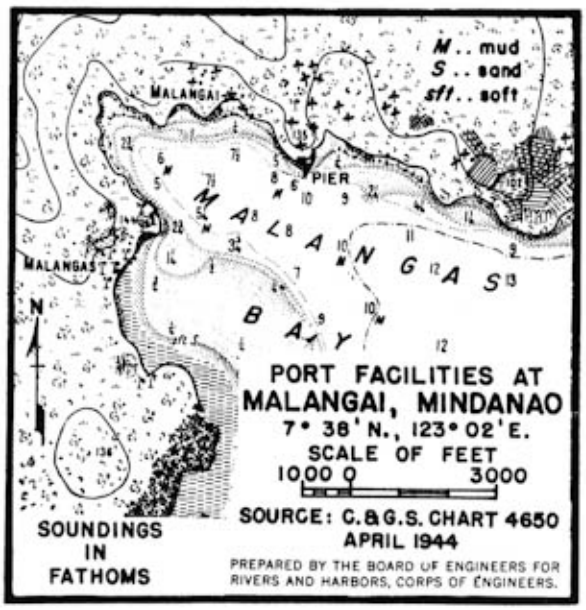

FIGURE VI - 104. *Malangai.*
Map showing location of port facilities.

(*b*) *Landing facilities.* The facilities at Flecha Point consisted of a timber T-head wharf. Depths (1937) ranged from 13 to 35 feet along the face, with the deeper water at the eastern end. Vessels were advised to approach the wharf from the southeastward and drop a kedge anchor.

(*c*) *Clearance facilities.* There was regular monthly steamship connection with Manila. Foreign vessels called occasionally for lumber.

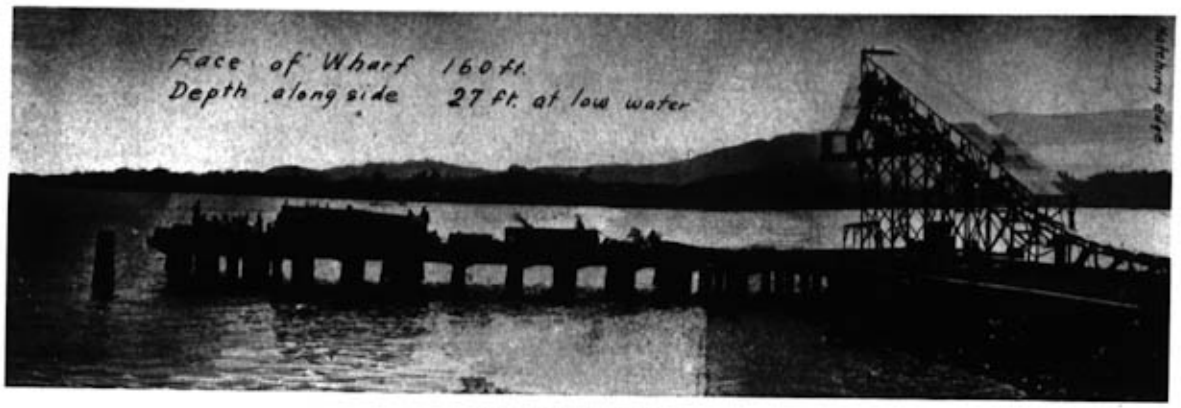

FIGURE VI - 105. *Malangai.*
View of pier before completion, showing type of construction and coal-loading equipment. May 1941.

(*d*) *Availability of supplies.* Fresh water, suitable for boiler purposes, was piped to the pier. A small amount of diesel oil, stocked for use in the mill, was available in an emergency.

(44) Pagadian, Mindanao Island (7° 49′ N, 123° 26′ E).

Pagadian is in the northern part of Pagadian Bay, the northwestern arm of Illana Bay, on the south coast of Mindanao (FIGURE VI - 111). It was a village of some importance, and had a landing at the end of the main street of the town.

(*a*) *Harbor.* Pagadian Anchorage, the harbor, in the northern part of Pagadian Bay, is about 1½ miles wide at the entrance and a little over 1 mile long. It is partly divided by a reef and shoal which project southeastward from a small peninsula on the northwest shore. It is fringed with reefs and in the northern part there are several reefs awash at low water. The remainder is clear and provides 11 first-class anchorage berths. Depths at the entrance are about 20 fathoms, with 9 to 16 fathoms inside. The 10-fathom contour follows the shore line at an average distance of 500 yards from the shore. The bay is open to the southeast, but is protected from northeast and westerly winds.

Good anchorage may be found about ½ mile southward of Lampaqui Islet, or about 600 yards northeastward of the islet, in 13 fathoms, over a mud bottom.

The high water interval in Pagadian Bay is 6 hours 16 minutes. The higher high water height is 5.7 feet, and the lowest tide recedes to −1.5 feet.

(*b*) *Landing facilities.* The landing at Pagadian consisted of rock and earth mole, about 6 feet wide, with a small timber landing at the end. It projected about 300 yards southward from the end of the main street of the town, and about halfway to the edge of the reef (Reference number 1, FIGURE VI - 111). There was no water at the end of the mole at low tide (FIGURE IV - 112).

Another small stone landing extended southwestward from the extremity of the small peninsula just west of Pagadian (Reference number 2, FIGURE VI - 111). It was about 300 feet long and extended to the edge of the reef.

(*c*) *Clearance facilities.* A road was under construction from Pagadian to Panguil Bay on the north coast which would have connected with the pier at Pagadian. There was launch service with Cotabato 3 times weekly.

(*d*) *Availability of supplies.* Food supplies, including beef, were obtainable in moderate quantities.

(45) Malabang, Mindanao Island (7° 36′ N, 124° 04′ E).

Malabang is on the Malabang River, which flows into the northeastern part of Illana Bay on the south side of Mindanao (FIGURE V - 16). There was a landing at the village.

(*a*) *Harbor.* Malabang is a river port about ¾ mile above the mouth of the Malabang River, which is navigable only by small boats.

Vessels calling at Malabang anchor off the shore in the open roadstead of Illana Bay. The usual anchorage is in depths of 12 to 15 fathoms, about 600 to 800 yards off a prominent cargo shed on the beach.

Tidal currents flood northwestward along the coast and ebb southeastward.

According to observations over a period of 7 years, the average annual rainfall is 152.42 inches. The driest months are generally December and January through March.

(*b*) *Landing facilities.* There was a boat landing at Malabang. There was a shed on the beach of Illana Bay.

(*c*) *Clearance facilities.* A poor sandy road leads from the cargo shed to the town, which is on the main coastal highway. Small vessels called occasionally at the port for copra.

(*d*) *Availability of supplies.* A limited supply of food, gasoline, diesel oil, kerosene, and lubricating oil was stored in the town. Fresh beef was available at nearby plantations.

(46) Parang, Mindanao Island (7° 22′ N, 124° 15′ E).

Parang is at the head of Polloc Harbor, which opens from Illana Bay, on the south side of Mindanao (FIGURE V - 16). There was a pier at the town.

(*a*) *Harbor.* Polloc Harbor is a natural harbor, with an area of about 18½ square miles. The depths across the entrance, which is about 3½ miles wide, are over 24 fathoms. Within the entrance, depths range from 15 to 25 fathoms, and along the fringing shore reef there is a depth of about 5 fathoms. The shore reef is very narrow on the north side of the harbor, but projects from the eastern shore, at one point nearly 2 miles, and extends 400 to 700 yards from the southern shore.

FIGURE IV - 105. *Malangi* (continued)

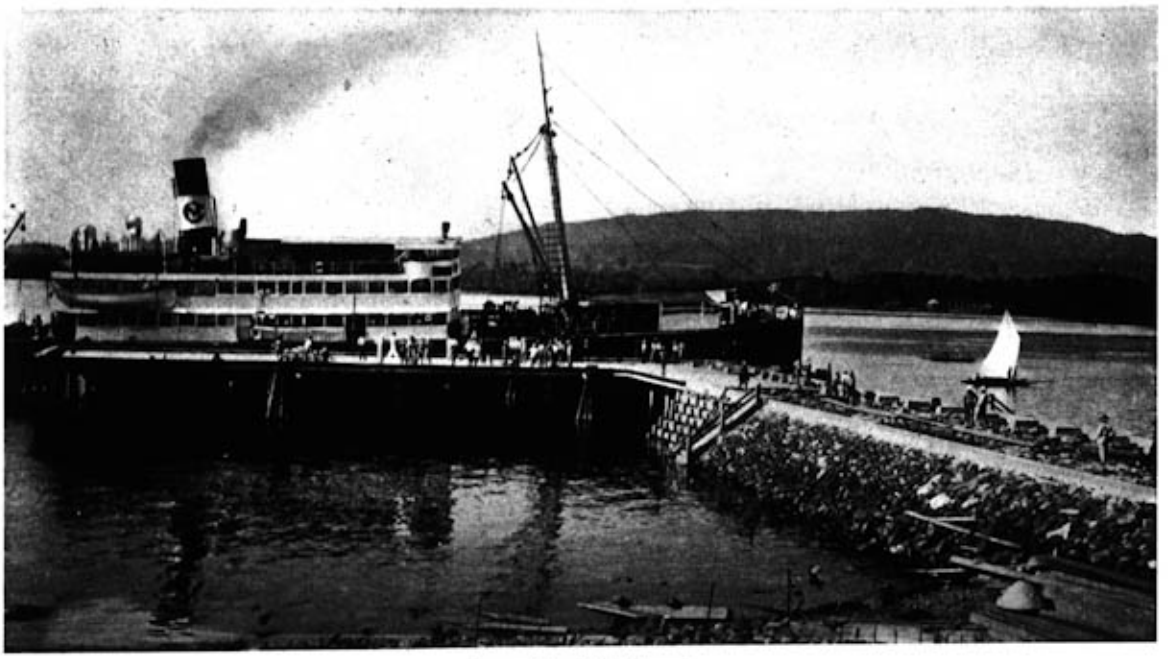

FIGURE VI - 106. *Malangai.*
View of pier before completion, showing type of construction and class of vessels using outside berth.

Polloc Harbor is for the most part open to the westward, but is partially protected from westerly winds by Bongo Island, 5 miles west-southwest of its northern entrance point. Good anchorage for large vessels is available about ¼ mile off the pier at Parang in depths of 14 to 15 fathoms, over mud bottom. Anchorage for large vessels with protection from the southwest may be found on a prolongation of a ruined stone mole on the eastern side of Polloc Island, at about 750 yards, in a depth of 17 fathoms, over muddy bottom. Small vessels can anchor closer inshore, but must keep outside the 14-fathom contour since the banks on the south side of the harbor are very steep. There is anchorage with protection from west and north winds on the eastern side of Quidamak Bay, in a depth of 48 feet, over mud bottom. Parang Anchorage provides space for 50 first-class anchorage berths.

There are 2 tides daily, with rare exceptions. The average rise and fall is 4.8 feet, and the diurnal range is 5.6 feet. Tidal currents reverse at high and low waters. Flood currents run clockwise in the harbor and ebb currents counter-clockwise.

During the first months of the year, when the wind is well established from the northeast, there are often squalls in the afternoon from the north, accompanied by much lightning, wind and rain. Before a squall begins the wind blows from the northwest and west, and after it is over the land breeze sets in until the following morning. During the southwest monsoon the wind freshens after midday and varies from southwest to

FIGURE VI - 108. *Margosatubig.*
Aerial view of harbor, showing location of port facilities.

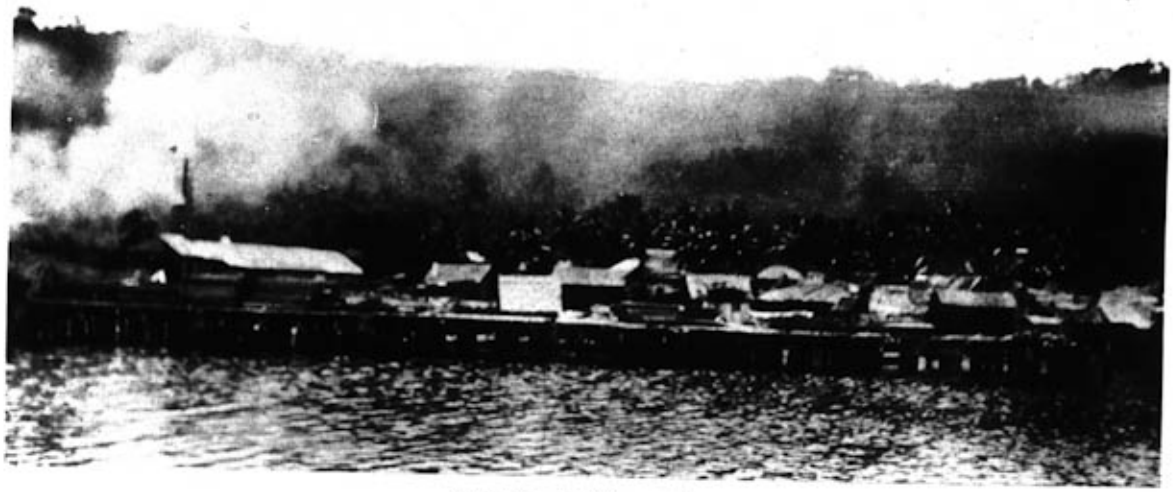

FIGURE VI - 109. *Margosatubig.*
View of Mindanao Lumber Company pier, looking southwest, showing type of construction.

west and northwest. During this period rain falls in abundance and heavy thunderstorms occur.

(*b*) *Landing facilities.* The wharf at Parang was an L-shaped pier, consisting of a causeway approach 564 by 39 feet and a reinforced concrete pierhead at about a 125° angle, 39 feet wide and about 300 feet long in 1941 (FIGURE VI - 113). Fender piles had been placed along both the outer and inner faces of the pierhead, but not at the end. The preferable side for berthing was the outer (south) face. In July, 1938 the depths alongside this face decreased gradually from 30 feet at the western end to 4 feet at the eastern end, and alongside the inner (north) face varied similarly from 17 to 6 feet.

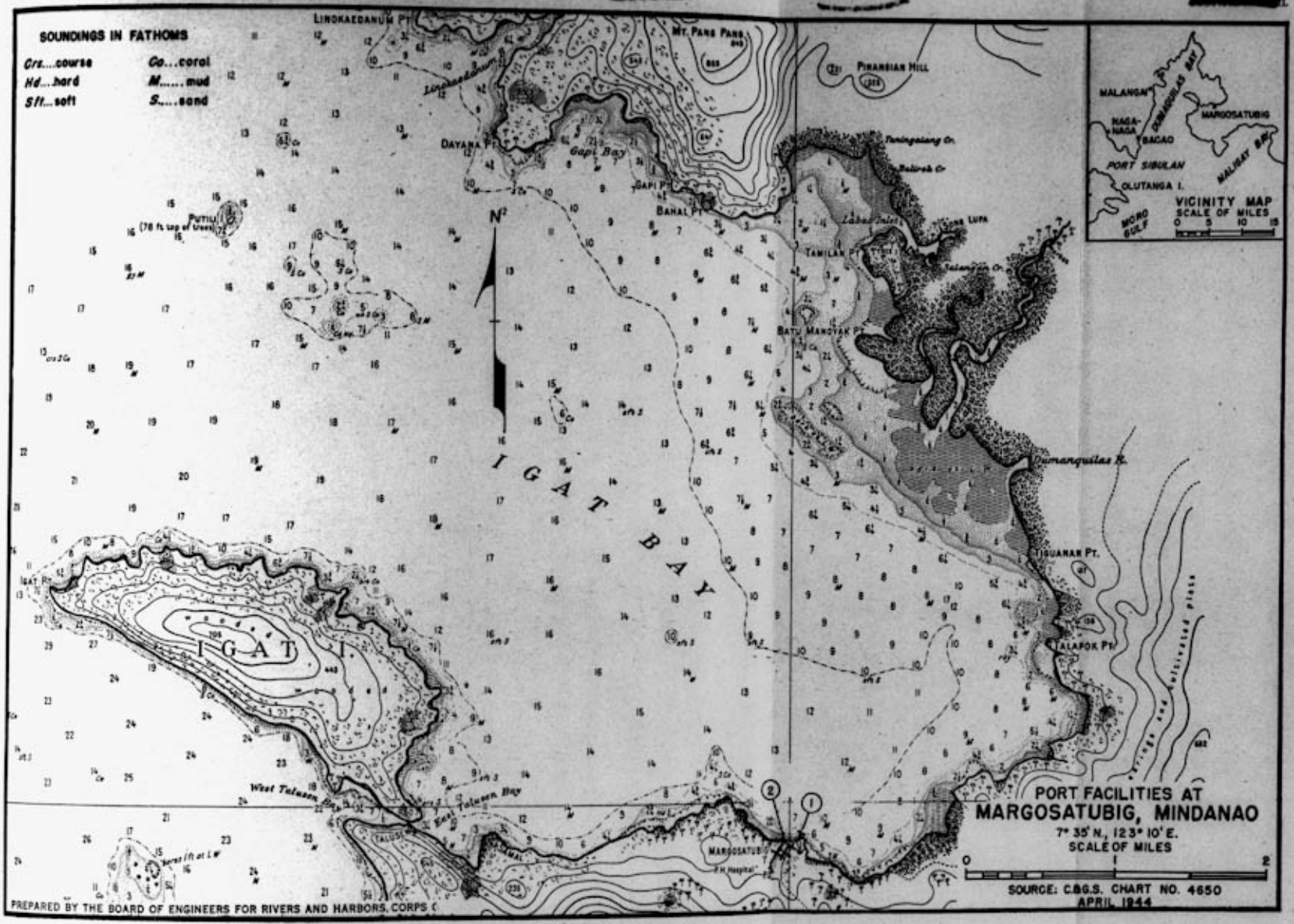

FIGURE VI - 107. *Margosatubig.*
Map showing location of port (inset) and port plan showing location of facilities.

Proposed port improvement included land reclamation and the construction of a cargo shed.

(*c*) *Clearance facilities.* Trucks had access from the wharf to the coastal road and to the island road system.

(*d*) *Availability of supplies.* Cotabato was the usual source of supplies for visiting vessels. Fresh water was not available at the pier.

(47) Kalamansig (Port Lebak), Mindanao Island (6° 33′ N, 124° 03′ E).

Kalamansig is on the south coast of Mindanao, and on the east coast of Moro Gulf, at about the middle of the north shore of Port Lebak (FIGURE VI - 114). No landing facilities have been reported.

(*a*) *Harbor.* Port Lebak is the harbor for Kalamansig. It is a natural harbor, with depths shoaling gradually from 39 fathoms at its entrance to 8 fathoms, ¼ mile from its head. The

FIGURE VI - 110. *Margosatubig.*
View of municipal pier, looking southwest, showing type of construction.

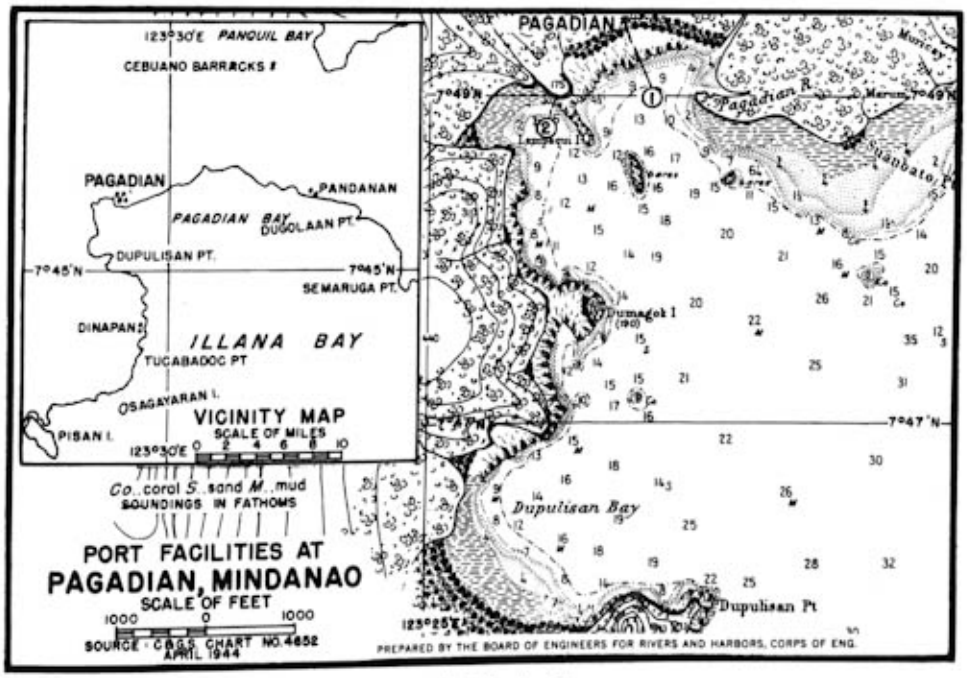

FIGURE VI - 111. *Pagadian.*
Map showing location of Pagadian (inset) and port plan showing location of facilities.

FIGURE VI - 112. *Pagadian.*
View of pier showing type of construction.

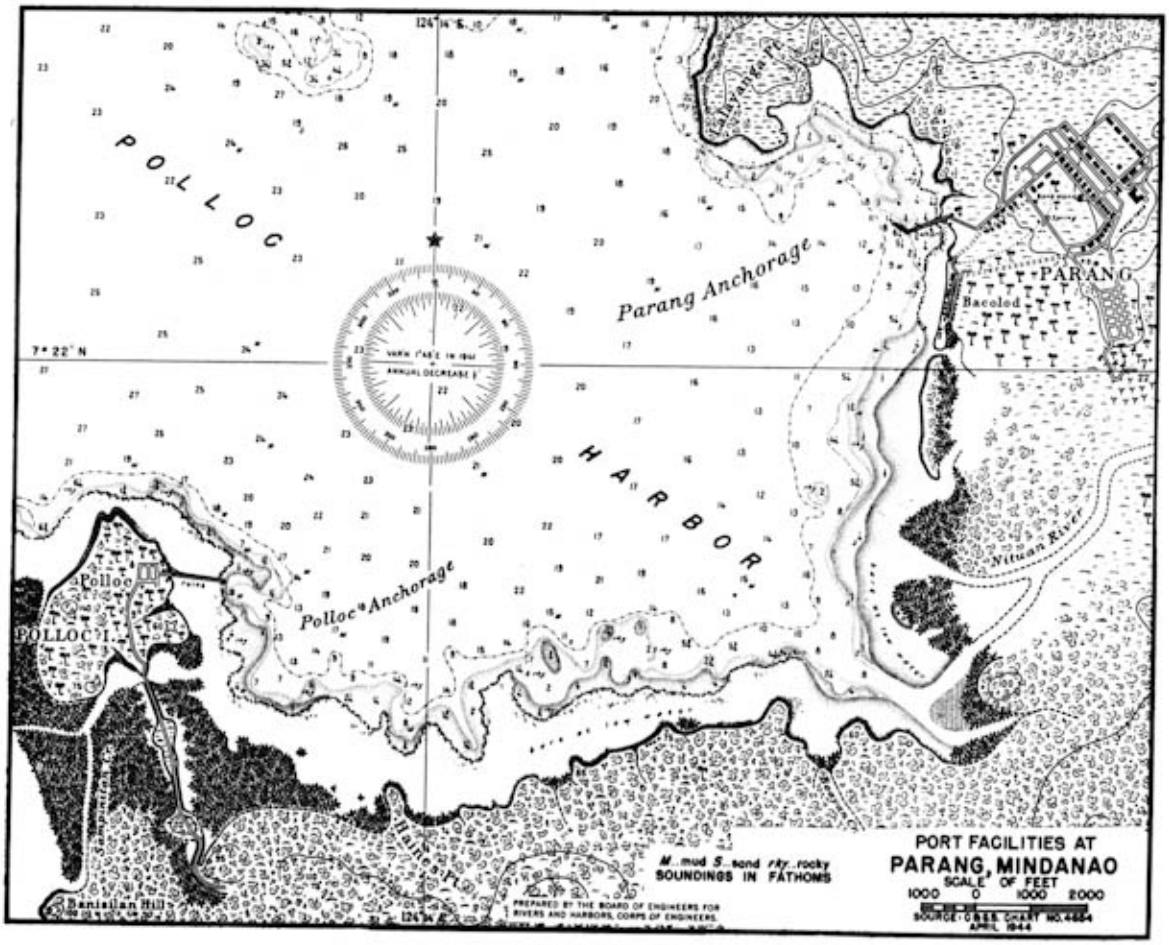

FIGURE VI - 113. *Parang.*
Map showing location of port facilities.

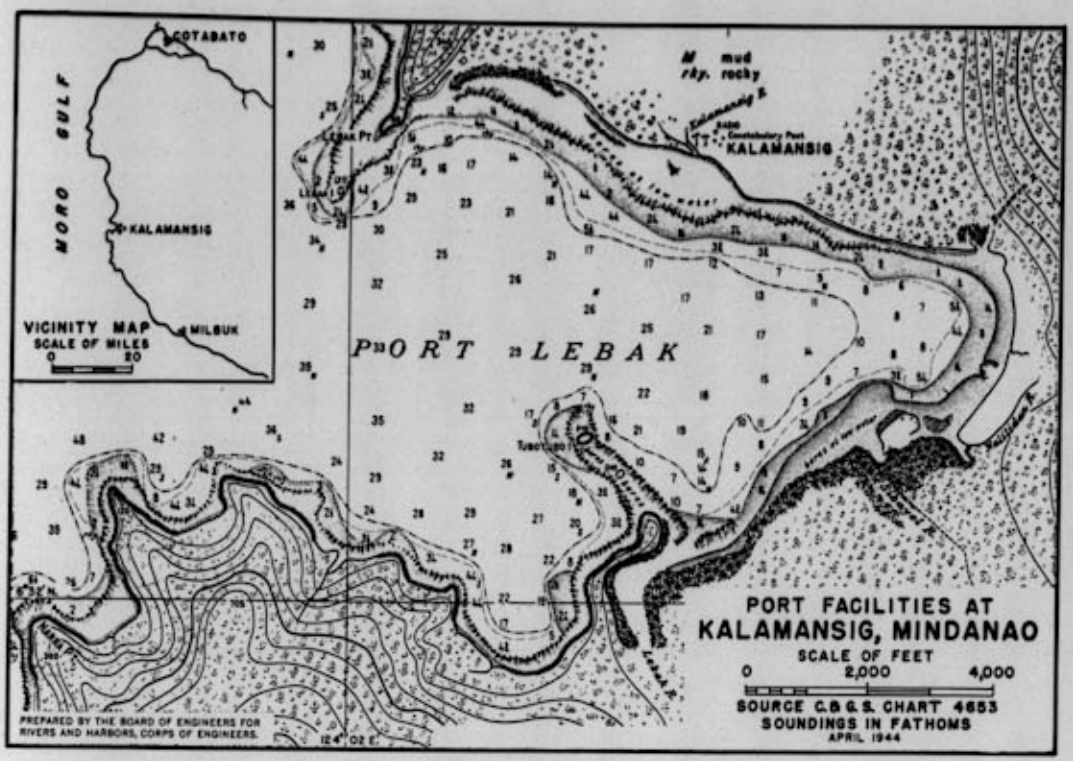

FIGURE VI - 114. *Kalmansig.*
Map showing location of Kalmansig (inset) and plan showing harbor.

entrance is about 1 mile wide, but shore reefs, bare at low water, reduce the width of the entrance channel to about 1,300 yards. From its entrance, the harbor extends eastward about 2 miles, with depths of over 30 feet available not more than 500 yards from shore.

The shores of Port Lebak are mangrove, fronted by a coral reef, 100 to 300 yards wide. From about the middle of the southern side of the harbor a coral reef, which bares at half tide, projects northwestward about 700 yards from the coast and forms a natural breakwater. Further protection from westerly winds is afforded by the reef extending south-southwestward about 500 yards from Lebak Point, the northern entrance point of the harbor. With good shelter available from all winds, Port Lebak is the best protected anchorage in this part of Mindanao. Fifteen first-class anchorage berths open to west winds in depths of 12 fathoms, or more over mud bottom, are available. One protected first-class anchorage berth is available in depths of 16 to 23 fathoms, over mud, eastward of Lebak Point, and 2 in depths of 10 to 22 fathoms, over mud, eastward of Tubotubo Island, and 1 second-class anchorage in 8 fathoms, at the inner end of the bay.

The average annual rainfall is 113.99 inches. The driest months were generally from December through March.

(*b*) *Landing facilities.* There are no known wharves in the port.

(*c*) *Clearance facilities.* Port Lebak was the terminus of a short logging railway. Access to the interior was limited to trails. A small coasting vessel called every 2 weeks at Kalamansig.

(48) Milbuk, Mindanao Island (6° 09′ N, 124° 16′ E).

Milbuk is on the southern coast of Mindanao, on the east side of Moro Gulf (FIGURE VI - 115). It was a small lumber town, but latest reports (1937) indicate that the mill is no longer in operation and the wharf is in ruins.

(*a*) *Harbor.* Milbuk harbor is a natural harbor with general depths of from 5 to 10 fathoms. It is about 1 mile wide at its entrance between fringing coral shore reefs, bare at low water, and indents the coast about ½ mile in a north-northeasterly direction. The harbor is open to the southward, but partially protected by outlying shoals and reefs.

Anchorage can be taken in the channel between these dangers and the shore in depths of 15 to 20 fathoms, over mud bottom. Good anchorage for large vessels within the harbor can be obtained in depths of 9 to 10 fathoms, over mud bottom, 150 yards south-southeast of the end of a ruined wharf at the head of the harbor. Shore reefs reduce the effective width of the harbor near the anchorage to about 400 yards.

A moderate littoral current, little affected by tide or weather, sets northwestward along the shore, but offshore a strong southeasterly current is encountered.

(*b*) *Landing facilities.* The only known landing was a pier at the head of the harbor, in ruins for several years. The pier was

about 500 feet long and 25 feet wide, with a depth of about 18 feet at its end, shoaling rapidly inshore.

(*c*) *Clearance facilities.* A logging railway terminated in Milbuk.

(*d*) *Availability of supplies.* Provisions were scarce.

(49) Makar, Mindanao Island (6° 06′ N, 125° 09′ E).

Makar is in the northwest corner of Sarangani Bay, on the south side of Mindanao, ¼ mile north of the mouth of Makar River, on the northwest shore of Makar Cove (FIGURE VI - 116). It was a shipping point for produce of the Sarangani valley. There was a small landing at the town.

(*a*) *Harbor.* The harbor is in Makar Cove, a small natural harbor on the west side of Sarangani Bay, near its head. The depths in the cove are too great for anchorage, except close to shore. The 10-fathom contour runs about 200 yards offshore, and the 30-fathom contour about 300 yards from shore.

The anchorage area is small but partially protected from the southerly wind and sea that usually prevail during the southwest monsoon, and the bight affords a safe boat landing. Anchorage can be taken in a depth of 20 fathoms, over mud, about 275 yards from shore. A conspicuous 1-story building with a red roof, on the waterfront, bears 321° from the anchorage.

(*b*) *Landing facilities.* The only facility was a small boat landing, about 50 feet long and 20 feet wide (FIGURE VI - 117).

Proposed construction included a causeway with a pier at its seaward end, 328 feet by 39 feet, having a depth of 30 feet at low tide. Up to 1938 no work had been done on this project.

(*c*) *Clearance facilities.* Interisland vessels called frequently to load cattle and copra. Trucks had access from the waterfront to a road leading northward, reported under construction (1939), which would provide a connection with the island road system.

(50) Glan, Mindanao Island (5° 50′ N, 125° 12′ E).

Glan is near the southern end of Mindanao Island, at the head of Canalasan Cove, a small indentation on the eastern side of Sarangani Bay (FIGURE VI - 118). It was the largest settlement in Sarangani Bay, and a town of growing importance as a shipping point for copra and hemp. There was a pier at the town.

(*a*) *Harbor.* The harbor is in Canalasan Cove, a small natural harbor, with depths too great for anchorage in its central part. The 10-fathom contour runs from 200 to 500 yards from shore, and bottom depths rapidly increase offshore. The cove is exposed to the north winds, which are experienced between

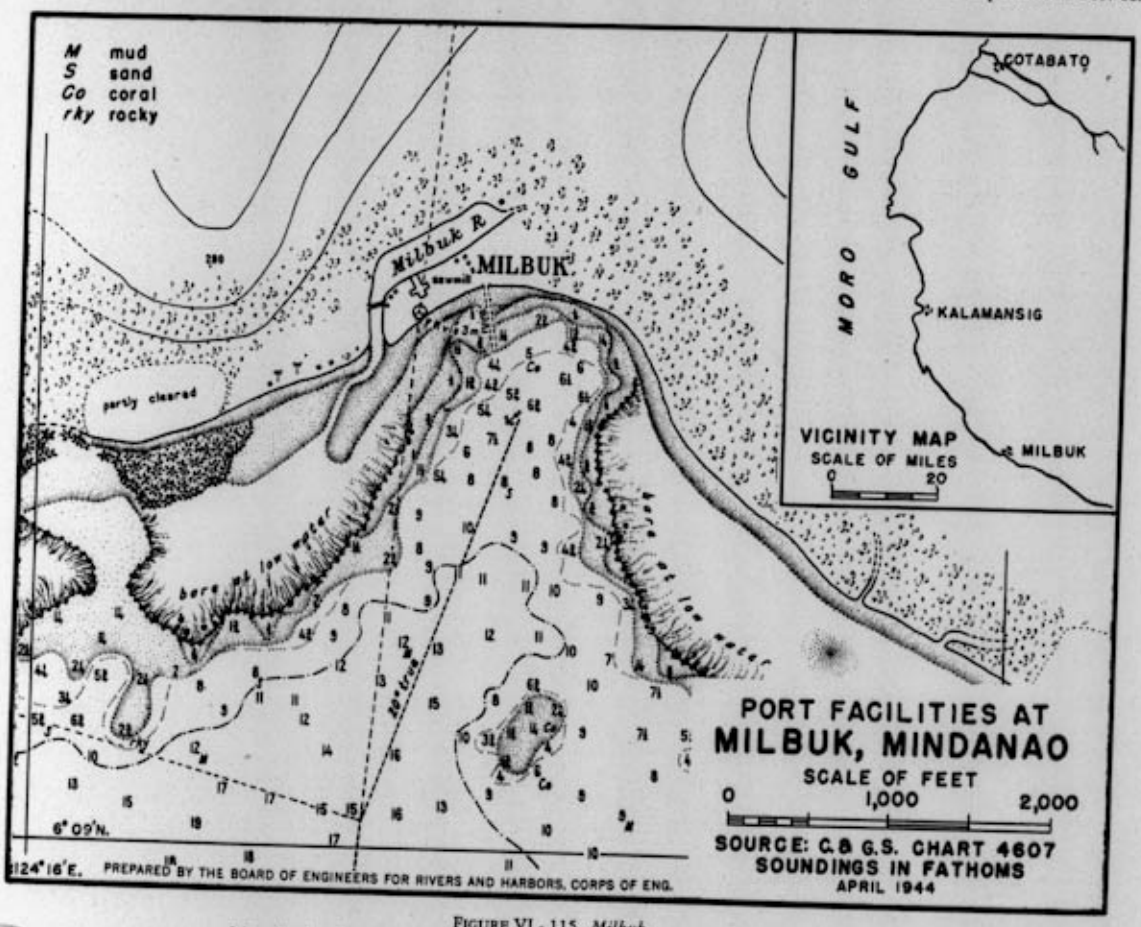

FIGURE VI - 115. *Milbuk.*
Map showing location of Milbuk (inset) and port plan showing location of facilities.

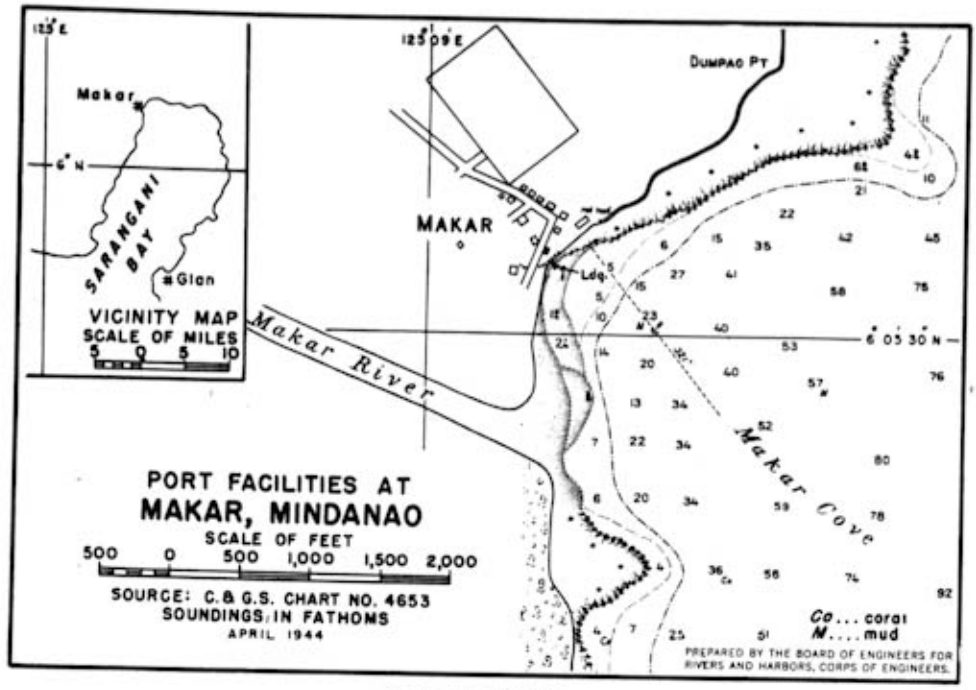

FIGURE VI - 116. *Makar.*
Map showing location of Makar (inset) and port plan showing location of facilities.

FIGURE VI - 117. *Makar.*
View of pier, looking northwest, showing type of construction. 1926.

November and March, and it is reported that there are times when landing cannot be made.

Anchorage can be taken northwestward of the town in depths of 9 to 15 fathoms. The bottom is generally mud, with some sand and coral.

The mean annual rainfall is 58.35 inches.

(*b*) *Landing facilities.* Facilities at the port consisted of a reinforced concrete pierhead 82 feet long and 29½ feet wide, connected to shore by a causeway (FIGURE VI - 119). The outer face of the wharf had depths of 12 to 18 feet (1937) outside the fender piles, the greater depth being at the western end. The water deepens rapidly off the pierhead and also shoals rapidly toward shore. Approach to the pier had to be made from the northward or westward, as extremely shoal water lies immediately eastward of the pierhead.

(*c*) *Clearance facilities.* Interisland steamers called about every 12 days, furnishing communication with Davao and Manila. Access to the interior was limited to trails.

(*d*) *Availability of supplies.* A small amount of diesel oil, gasoline, and lubricating oil was stocked for local use. Hogs, chickens, and eggs could be secured but vegetables were scarce.

(51) Lawa, Mindanao Island (6° 12′ N, 125° 42′ E).

Lawa is on the western shore of Davao Gulf, about ½ mile north of Calian Point (FIGURE V - 19). There was a pier at the town.

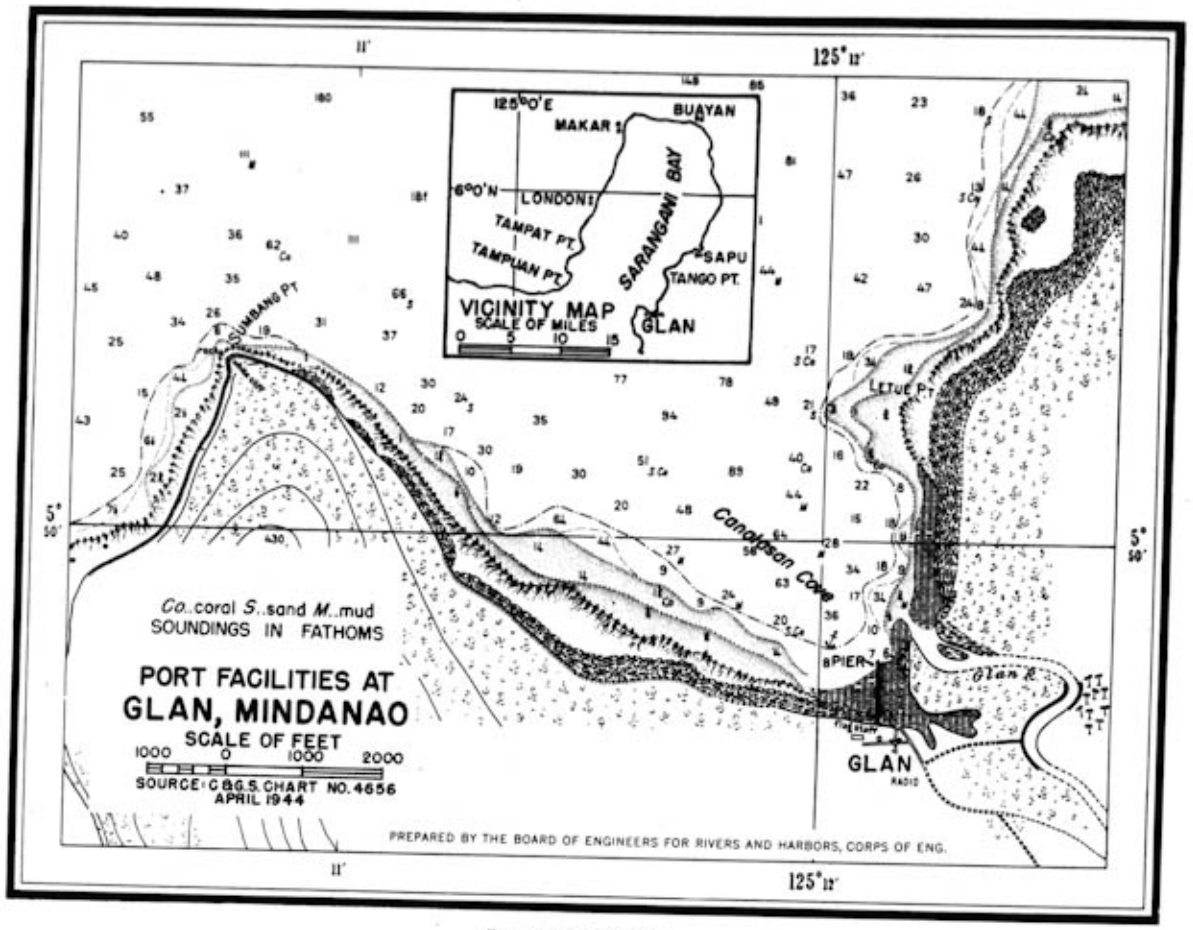

FIGURE VI - 118. *Glan.*
Map showing location of Glan (inset) and port plan showing location of facilities.

FIGURE VI - 119. *Glan.*
View of pier showing type of construction. Prior to April 1935.

(*a*) *Harbor.* The harbor is an open roadstead, off the western shore of Davao Gulf.

(*b*) *Landing facilities.* Facilities at Lawa consisted of an open pile and timber pier, about 300 feet long, with a depth of 3 feet at the end (1937). It was maintained in good condition (FIGURE VI - 120).

(*c*) *Clearance facilities.* A launch made weekly trips to Davao.

(52) Malita, Mindanao Island (6° 24′ N, 125° 37′ E). Malita is on the western shore of Davao Gulf, about 40 miles south of Davao (FIGURE V - 19). It was the largest settlement

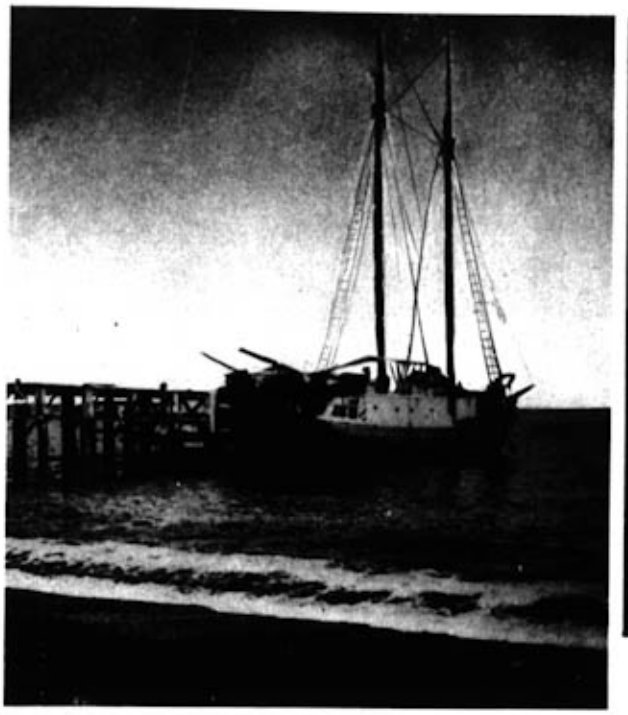

FIGURE VI - 120. *Lawa.*
View of pier at low tide, looking northeast, showing type of construction.

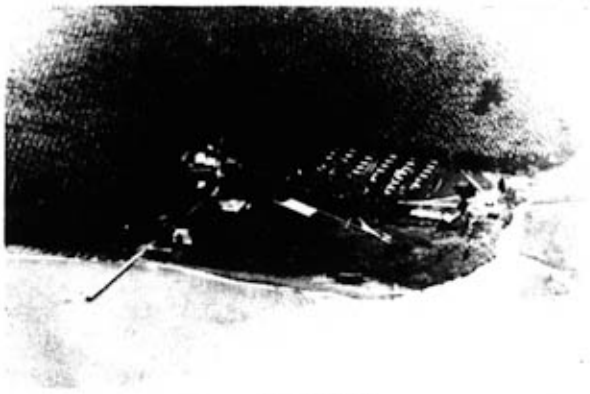

FIGURE VI - 121. *Malita.*
Aerial view of harbor, showing location pier.

along this section of the coast. There was a pier for the shipment of hemp and copra (FIGURE VI - 121).

(*a*) *Harbor.* The harbor is an open roadstead, with depths too great for anchorage up to about 300 yards from shore.

A small stream which enters the gulf at a point about 550 yards north of the pier deposits sediment which makes anchorage inadvisable near its mouth. Vessels should anchor to the southeastward, where there are depths of 15 fathoms, over sand, about 200 yards off the pier.

The mean annual rainfall is 71.51 inches.

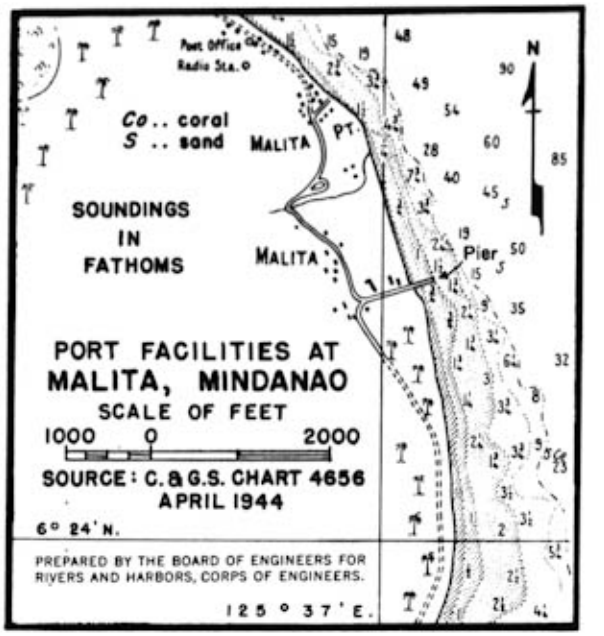

FIGURE VI - 122. *Malita.*
Port plan showing location of facilities.

(*b*) *Landing facilities.* Landing facilities consisted of an open pile timber pier (FIGURE VI - 122), about 250 feet long and 30 feet wide, with a depth of 9 feet (1937) at the end (FIGURE VI - 123).

Storage space in the plantation warehouses and open space in the coconut groves near the pier were probably available.

(*c*) *Clearance facilities.* There were only trails leading from the pier.

(*d*) *Availability of supplies.* Fresh water could be taken from the stream to the north of the pier. Ice was obtainable in small quantities. A small amount of diesel oil and gasoline was normally stocked for plantation use.

(53) Lacaron, Mindanao Island (6° 27′ N, 125° 35′ E).

Lacaron is midway along the east coast of Davao Gulf, 3 miles northwestward of Malita (FIGURE V - 19). The landing was only suitable for small boats.

(*a*) *Harbor.* The harbor is an open roadstead off the western shore of Davao Gulf.

There appears to be no appreciable shore reef and the shoal along the shore is relatively narrow. There are depths of 21 to 49 fathoms, over sand bottom, offshore. Anchorage would be exposed to all but westerly directions.

(*b*) *Landing facilities.* The landing at Lacaron was small and suitable only for small launches.

(*c*) *Clearance facilities.* A launch made weekly trips to Davao.

(54) Daliao, Mindanao Island (7° 01′ N, 125° 30′ E).

Daliao is at the mouth of Daliao River, on the west side of Davao Gulf, about 7¾ miles southwest of Davao (FIGURE V -

19). It was the headquarters of the Furakawa Plantation Company. A pier was located at the plantation.

(*a*) *Harbor.* The harbor is an open roadstead, with depths too great for anchorage up to about ½ mile from shore. It is open to the southeast and protected to some extent from the southward by Daliao Reefs, which lie about ½ mile south of Daliao.

Anchorage is available about ¼ mile southeast of the wharf in 10 fathoms, over mud. A mooring buoy was anchored off the wharf in a depth of about 23 feet.

The tides in the vicinity of Daliao flood northward and ebb southward.

(*b*) *Landing facilities.* Facilities at the port consisted of a timber pier approximately 600 feet long, with a depth of 14 feet at its end (1937). An industrial railway served the pier. Fresh water was piped to an outlet about midway between the shore and the pierhead. Traveling, 15-ton, motor-operated cranes were available.

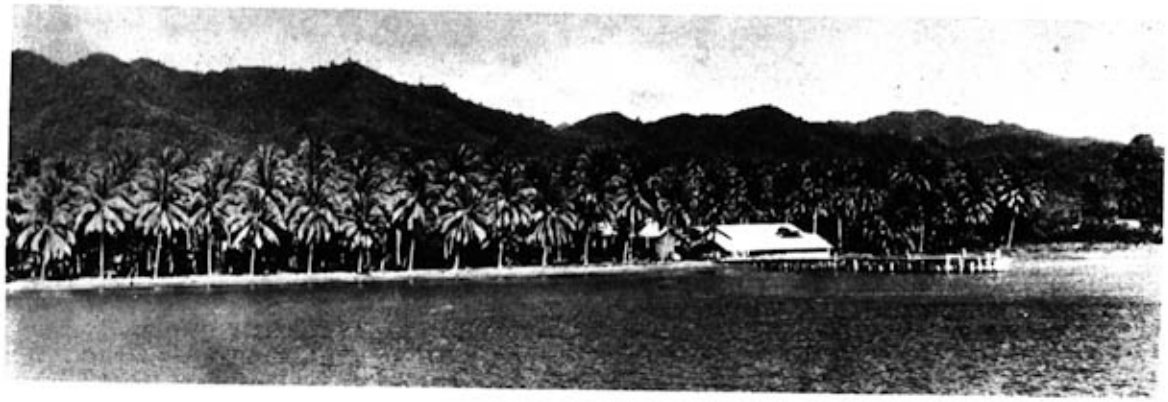

FIGURE VI - 123. *Malita.*
View of pier, looking northwest, showing type of construction. Prior to April 1935.

There were 3 large concrete and galvanized iron warehouses. Open storage space was available in the surrounding area (FIGURES VI - 124 and V -125).

(*c*) *Clearance facilities.* Trucks had access from the wharf to the Davao-Cotabato road. Large interisland steamers called regularly for hemp, but most of it was lightered to Santa Ana, for export.

(*d*) *Availability of supplies.* Fresh water was available at the pier.

(*e*) *Repair facilities.* Only minor repairs were possible.

(55) Talomo, Mindanao Island (7° 03′ N, 125° 33′ E).

Talomo is on the north side of Talomo Bay, a bight on the west coast of Davao Gulf, about 4 miles west-southwest of Davao (FIGURE VI - 126). The Ohta Development Company had a pier at its plantation.

(*a*) *Harbor.* Talomo Bay is a natural harbor about 2½ miles wide at its entrance and indenting the coast about 1 mile in a northerly direction. The 10-fathom contour runs from 175 to 475 yards offshore, and the 30-fathom contour from 600 to 800 yards offshore. The approach is deep and clear. The bay is open to southerly winds.

Anchorage can be taken in depths of from 10 to 30 fathoms, over mud and sand bottom, from 475 to 800 yards from shore. The depths farther offshore are too great for anchorage. There are four first-class, and seven second-class anchorage berths available in the bay.

(*b*) *Landing facilities.* Facilities at the port consisted of an open-pile timber pier, about 350 feet long, widened at the outer end (FIGURE VI - 127). Vessels berthed along the western side of this platform, about 75 feet long, where the depths ranged from 18 to 13 feet (1937).

In the rear of the pier were large warehouses. Open storage space was limited to the adjacent cultivated fields, which were thickly planted with abaca. Lighterage of cargo in the port was accomplished by use of barges and scows based at Santa Ana, Davao.

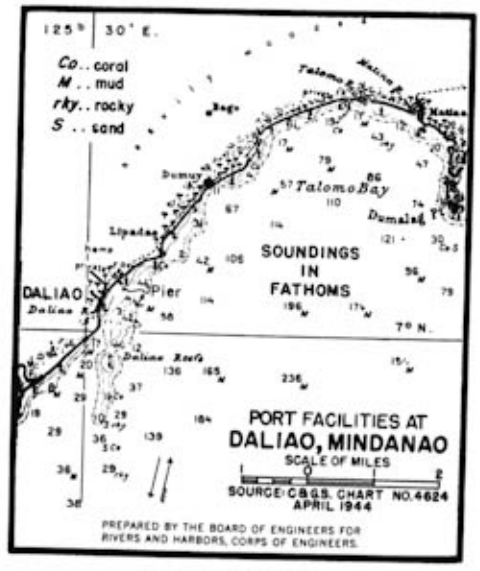

FIGURE VI - 124. *Daliao.*
Port plan showing location of facilities.

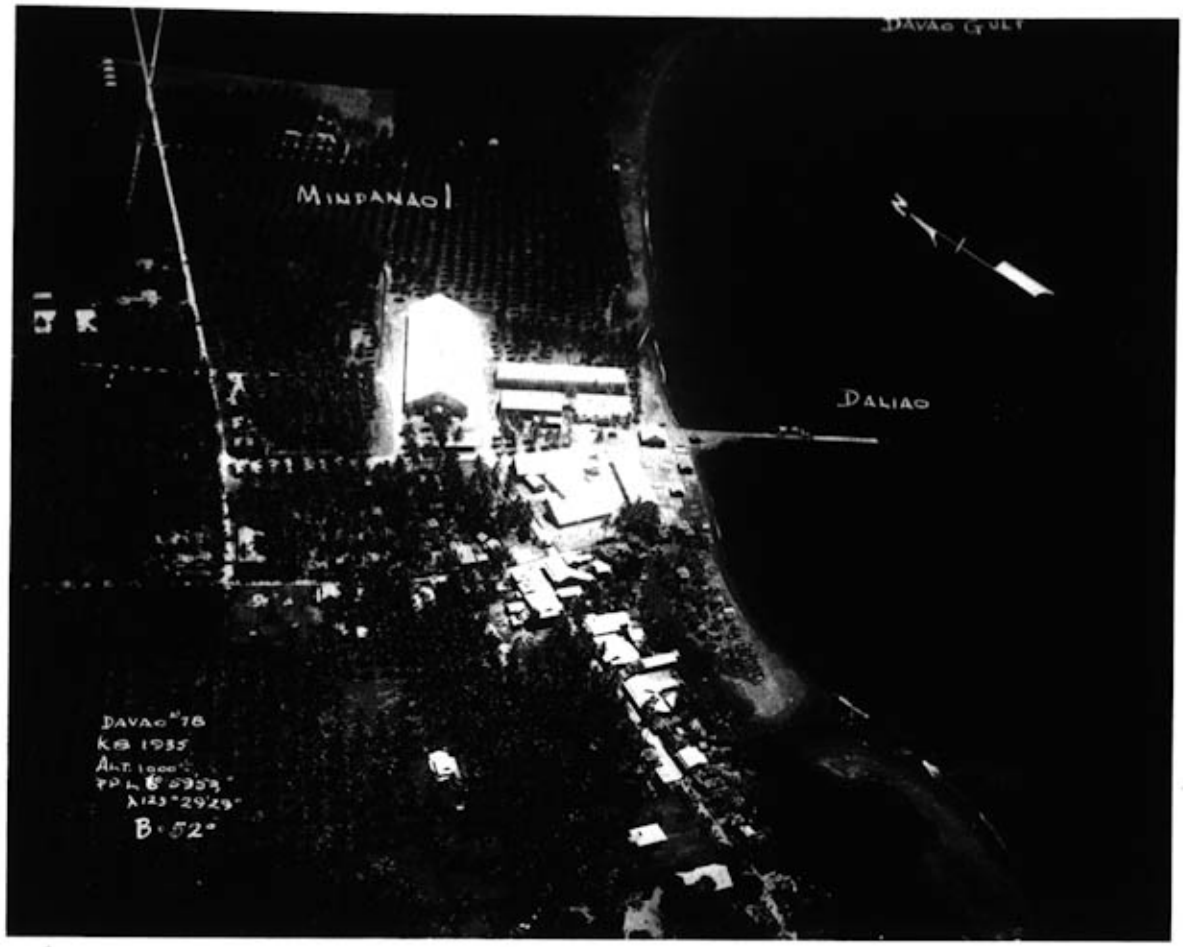

FIGURE VI - 125. *Daliao.*
Aerial view showing pier, warehouses and open storage areas. 1935.

(*c*) *Clearance facilities.* A highway connected the pier to the Davao-Cotabato road. Large interisland steamers called weekly for hemp, but most of it was lightered to Santa Ana for export.

(*d*) *Availability of supplies.* Food and water were available.

(*e*) *Repair facilities.* There are not known to be any facilities at the port for the repair of vessels.

(56) Madaum, Mindanao Island (7° 22′ N, 125° 48′ E).

Madaum is on the north bank of the Madaum River, which discharges into the head of Davao Gulf, between the Tagum and Hijo Rivers (FIGURE VI - 26). It was the headquarters of a large hemp plantation, just inside the river entrance, where there was a landing.

(*a*) *Harbor.* Madaum is a river port, on the Madaum River, which is hardly more than a slough. It has 2 feet of water on the bar at low tide and 12 feet inside. On the eastern side of the mouth is a small coral point covered with mangroves, where the river turns sharply westward. The gulf shore is sand beach, about 200 yards wide, with depths of 45 to 65 fathoms, mud bottom, in the gulf and 11 fathoms off the river entrance.

(*b*) *Landing facilities.* The landing consisted of a pier which projected from the eastern side of a marginal wharf along the north bank of the river (FIGURE VI - 128). This landing appeared to be of timber piling construction, and probably about 20 feet wide and less than 100 feet long.

(*c*) *Clearance facilities.* A roadway connected the pier to the large open area around the buildings. Small launches called daily from Davao.

(57) Monserat, Mindanao Island (6° 36′ N, 126° 05′ E).

Monserat is at the head of Borot Cove, on the eastern side of Davao Gulf, on the south coast of Mindanao Island (FIGURE V - 114). There is a landing at the village.

(*a*) *Harbor.* The harbor is in Borot Cove which is about ⅜ mile wide at the entrance between Borot and Salun Points, and extends nearly ½ mile northeastward. Both entrance points and the head of the cove are fringed with reefs, leaving a contracted anchorage space. Open to the west-southwest, the cove is

well protected from wind and seas from all other quadrants. Little sea enters the cove. The cove is deep, with depths at the entrance of 17 fathoms, decreasing to 4 fathoms near head. Borot Reef, covered with very little water, and with rocks awash near its southern edge, lies about ½ mile off the entrance to the cove.

The anchorage space is an area about 400 yards in extent in the northern part of the cove. There is reported to be little swing room. The minimum charted depths are 4 fathoms, over a sandy bottom.

(*b*) *Landing facilities.* The landing consisted of a small concrete pier, located in front of the town, at the head of the cove, with a controlling depth of 13 feet alongside the face. Vessels went alongside after dropping a stern anchor or bower as the cove is deep and there is little swinging room.

(*c*) *Availability of supplies.* Fresh water could be secured at the head of the landing.

D. Sulu Archipelago.

(1) *Isabela, Basilan Island* (6° 42′ N, 121° 58′ E, HO 4511 and 4543).

Isabela is on the northwest coast of Basilan Island. It is on the eastern side of the channel between Basilan Island and Malamaui Island. The port was formerly the site of a navy yard and repair shops and was the headquarters for rubber, coconut, and lumber companies.

(*a*) *Harbor.* It was a small port limited by the width of the channel which in some places was not more than 1,200 feet wide.

Depths are generally 30 feet or more at mean lower low water, both in the harbor and in the two entrance channels. However, in the western entrance channel there are several shoal patches, including one which is bare at low water.

The port is protected from winds in all directions except possibly northeast.

There are two anchorages. One, west of the wharf, has depths of 36 to 54 feet at lower low water. In it there is barely room for one second-class berth. The bottom is coral and sand. The other anchorage is in the channel north of Kalut Island. In the latter swinging room is limited, parts of this channel being only 600 feet wide. Large vessels can secure by running lines to mangroves on shore.

The diurnal tidal range is 2.2 feet. The tidal currents through the channel are very strong. The ebb flows northeast with a velocity of 4 to 5 knots. The velocity of the flood is about 1 knot less. The period of ebb is longer than the period of flood.

(*b*) *Landing facilities.* There were two wharves at Isabela, but only one was used to any extent. This wharf had 200 feet of berthing space. At mean lower low water depth alongside was 18 feet at the west end and 29 feet at the east end. It was capable of loading 70,000 feet of lumber per hatch every 24 hours.

There was also a small landing with 12 feet of water alongside. It was used by small interisland boats.

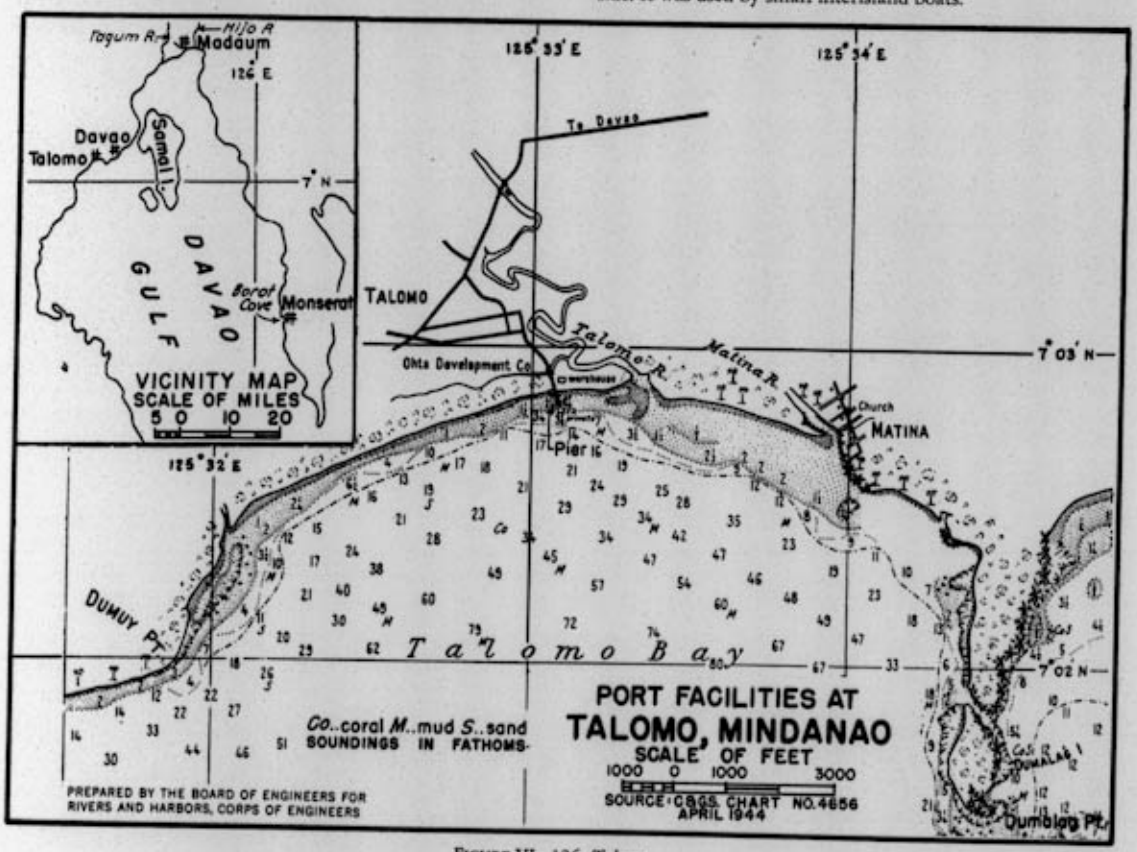

FIGURE VI - 126. *Talomo.*
Map showing location of Talomo (inset) and port plan showing location of facilities.

FIGURE VI - 127. *Talomo.*
Aerial view showing pier, warehouses and open storage areas.

FIGURE VI - 128. *Madaum.*
Aerial view of harbor, showing pier.

(*c*) *Clearance facilities.* A road ran across the island from Isabela to Lamitan and Bojelebung.

There was a radio station maintained by the Bureau of Posts.

(*d*) *Availability of supplies.* Fresh water was available at the pier.

Small quantities of supplies, provisions, and gasoline could be obtained.

(2) Port Holland, Basilan Island (6° 33′ N, 121° 52′ E, HO 4540).

Port Holland, primarily a lumber exporting port, is on the northwest coast of Basilan Island. It receives its protection from Great Gounan Island to the northwest.

(*a*) *Harbor.* The water area in front of the wharves is approximately 1,100 feet long and from 600 to 900 feet wide.

Throughout most of its area, the port has depths of from 30 to 72 feet. The best entrance is from the southeast. Depths here are from 42 to 60 feet. In the middle of the northern entrance there is a shoal with mean low water depths of 22.5 feet.

The anchorage is well sheltered, but due to its limited area, it is available only to small vessels.

The Basilan Lumber Company maintained a fixed red light at the western end of their large wharf. There were also 2 small tripod beacons with red targets at the outer end of the reef extending from the south edge of Great Gounan Island. These beacons could be passed fairly close to.

The mean tidal range is 2.2 feet, the diurnal range 3 feet. The Basilan Lumber Company reports that currents along the face of the dock lag about ½ hour behind the tides, and have a maximum strength of 2 or 3 knots. They are strongest on the ebb, which sets southwest against the face of the dock. On the flood, the tidal current sets northeast and off the wharf face.

(*b*) *Landing facilities.* There were two wharves. The Basilan Lumber Company wharf had a face about 513 feet long with depths alongside of 17 to 29 feet at mean lower low water (FIGURE VI - 129). It was capable of loading 7,000-8,000 feet of lumber per hatch per hour up to 500,000 feet in 24 hours. There was an extension for launches at the east end of the large wharf. Its face was about 85 feet long. It was parallel to and set back 4 feet from the face of the large wharf. There was a large anchor at the eastern side of the wharf, and a chain set in rocks and concrete about 120 feet southwest of the west end. These were for the lines of large vessels.

FIGURE VI - 129. *Port Holland.*
Looking southwest toward log storage pond and large wharf. No date. ONI 88089.

A small wharf 390 feet east of the large wharf had a face 55 feet long and a depth alongside of 6 feet at mean lower low water.

(*c*) *Clearance facilities.* Rail tracks were reported behind the main wharf for use locally by the lumber company.

There was weekly steamship connection between Port Holland, Cebu, Manila, and Zamboanga.

(*d*) *Availability of supplies.* Water was piped to the large wharf but could be obtained only in small quantities.

Limited food supplies and some gasoline and diesel oil were available.

(*e*) *Repair facilities.* A large machine shop maintained by the Basilan Lumber Company was available for minor repairs.

*(3) **Kulibato Point (Lamitan), Basilan Island*** (6° 39′ N, 122° 08′ E, HO 4511).

Kulibato Point is on the northeast coast of Basilan Island. It was the port for Lamitan, 2 miles southwest and up the Gubauan River. A very small port, it was used primarily as a port of call for interisland steamers.

(*a*) *Harbor.* The depth close to shore is about 18 feet at mean low water. Depth increases rapidly seaward.

It is somewhat protected to the northwest but exposed to the north, northeast and east. It is well protected from the west through south to southeast.

No tidal information is available.

(*b*) *Landing facilities.* There was only 1 pier at Kulibato Point. It had a face 40 feet long and a depth alongside of 21 feet at mean lower low water.

(*c*) *Clearance facilities.* A road led from the port to Lamitan. At Lamitan it connected with the principal road of the island.

There was telephone service between Kulibato Point and Lamitan, thence to Isabela and Bojelebung.

(*d*) *Availability of supplies.* Small quantities of food and gasoline were obtainable.

*(4) **Tandu Bato, Jolo Island*** (6° 00′ N, 121° 18′ E, HO 4513).

Tandu Bato is on the southwest shore of Dalrymple Harbor on the north coast of Jolo Island. Protection comes from Tulayan Island.

(*a*) *Harbor.* Depths between Tandu Bato and Tulayan Island are from 11 to 32 feet at lower low water. The best entrance is east of Tulayan Island. Depths in this entrance are up to 78 feet, but there are several shoal patches. The western entrance is very greatly obstructed by shoals.

There is no information regarding tides at Tandu Bato, but the diurnal range at Tulayan Island, across the channel, is 2.4 feet.

(*b*) *Landing facilities.* Formerly there was a stone mole and wooden pier. The wooden pier has been removed but the end of the mole should not be approached as broken piles are still there. In 1937 a depth of 6 feet at mean low water was reported at the end of the causeway.

(*c*) *Clearance facilities.* A good road connected Tandu Bato and Jolo.

(*d*) *Availability of supplies.* A few tins of gasoline were stocked near the end of the causeway to be used by the bus line in an emergency.

(*e*) *Potentiality.* The wooden pier probably could be reconstructed for use by small vessels.

*(5) **Siasi, Siasi Island*** (5° 33′ N, 120° 49′ E, HO 4513).

The town of Siasi is on the west side of Siasi Island facing the channel between Siasi and Lapoc Islands (FIGURE VI - 130). Siasi is a constabulary post and the little port serves it.

(*a*) *Harbor.* Depths in mid-channel range from 30 to 60 feet at mean lower low water. When entering Siasi the deepest water is along the west side of the channel until opposite the town of Siasi when the deepest section is near the center.

There is an anchorage in mid-channel southwest of the wharf. Depths are 36 to 60 feet at mean low water.

Diurnal tide range is 4.1 feet. The tidal current runs strong through the strait. It flows north on the flood and south on the ebb. At springs it reaches a velocity of about 5 knots.

(*b*) *Landing facilities.* There was a small government wharf with a face 47 feet long and a depth alongside of 20 feet at mean lower low water (FIGURE VI - 131).

(*c*) *Clearance facilities.* A motor boat service connected Siasi to Jolo, Zamboanga, Bongao, and Sitankai.

(*d*) *Availability of supplies.* Fresh water was piped to the dock.

Food supplies were obtained in limited quantities. Beef was plentiful if sufficient notice were given. There was a public market at Siasi. No gasoline or oil was available.

There was a light plant which supplied electricity to the town.

(*e*) *Repair facilities.* None.

(6) Bongao, Bongao Island (5° 02' N, 119° 46' E, HO 4546).

The port of Bongao lies in the passage between Bongao and Sanga Sanga Islands near the southwestern end of the Sulu Archipelago (FIGURE VI - 132). The port facilities were on Bongao. The port served Bongao, which is the largest town in the vicinity and was a constabulary post.

(*a*) *Harbor.* Depths in the harbor are generally from 22.5 to 42 feet at mean lower low water. Except for a shoal with 16.5 feet of water, the entrance channel has depths of 21 or more feet at mean lower low water.

FIGURE VI - 130. *Siasi.*
Airview of Siasi, looking east at town and harbor. 25 June 1935. OSS 99023.

FIGURE VI - 131. *Siasi.*
Looking south-southeast at Siasi wharf. In the background is Siasi Channel and the eastern edge of Lapoc Island. March 1941. OSS 93956.

FIGURE VI - 132. *Bongao.*
Air view of the town and port of Bongao. No date. ONI 219-578.

Shelter is excellent, there being good protection from all directions.

There is an anchorage almost due north of Dila Point with depths of 26 to 42 feet. It is very small, however, the harbor being not more than 1,800 feet wide at this point. Outside of the harbor there is another anchorage in Aguada Bay. It would provide one first class and one second class berth but use of these would crowd the entrance to Bongao.

At the extremity of the reef there was a fixed red light, visible for 7 miles, on a concrete tower 32 feet high.

Mean tidal range is 3.3 feet. Diurnal range is 4.2 feet.

(*b*) *Landing facilities.* There was a well-constructed wooden pier (FIGURE VI - 133) about 50 feet long near the northeast end of the island. A narrow causeway connected it with the shore. The depth alongside was 18 feet at mean lower low water (June 1937) but there was little room for maneuvering.

(*c*) *Clearance facilities.* Small steamers went to Jolo, Sibutu, and Siasi. Native vessels sailed at irregular intervals for various islands of the group.

(*d*) *Availability of supplies.* Water came from wells but was not plentiful.

No marine or ship's supplies were available.

(*e*) *Repair facilities.* None

FIGURE VI - 133. *Bongao.*
The wooden pier and causeway. Looking north-northwest. No date. ONI 28576.

*(7) **Sitankai*** (4° 40′ N, 119° 23′ E, HO 4515).

Sitankai is on the first small island south of Tumindao Island near the southwestern end of the Sulu Archipelago. Sitankai itself is surrounded by reefs which are mostly bare at low water. Its single wharf was at the edge of the reef 1.5 miles to the northeast and could only be reached by small boats at high water. Despite its unusual situation, Sitankai is reported to have been a center for trade between North Borneo and Bongao and was the headquarters of a deputy collector of customs.

(*a*) *Harbor.* There is no information regarding tides at Sitankai, but at nearby Tumindao Island the mean range is 3.1 feet and the diurnal range is 3.8 feet.

(*b*) *Landing facilities.* The concrete landing on the edge of the reef was 65 feet wide and 98 feet long with a depth alongside the pile clusters of 18 feet at mean lower low water. Depths increase off rapidly to the east.

(*c*) *Clearance facilities.* A causeway connecting the dock to Tumindao Island was contemplated in 1937, but as recently as 1941 no work had been done.

A customs launch was stationed at the settlement.

(*d*) *Availability of supplies.* Fresh water was scarce. It was secured from rainwater cisterns or brought in jars from the wells on Sibutu Island.

Some food supplies could be purchased at the Chinese store in town.

(*e*) *Repair facilities.* None.

*(8) **New Batu Batu, Tawi Tawi Island*** (5° 04′ N, 119° 53′ E, HO 4546).

New Batu Batu is on the east side of Batu Batu Bay, which is in the southernmost part of Tawi Tawi Island. It is easy of access. The town lies behind a mound and cannot be seen from the bay.

(*a*) *Harbor.* There is 36 to 60 feet of water at mean lower low water to within a short distance of the pier.

Mean tidal range is 3.4 feet, diurnal range 4.4 feet. There is little current.

(*b*) *Landing facilities.* There was a small landing with a depth of 16 feet at its face at mean lower low water. A reef extending from the shore almost to the end of the landing interfered with its use by large vessels. In June 1937 the pier was reported to be in poor repair.

(*c*) *Clearance facilities.* About 7 miles of road extended into the jungle.

(*d*) *Availability of supplies.* Drinking water was supplied by wells and had to be boiled before drinking.

There was a small store in town where some provisions could be obtained.

(*e*) *Repair facilities.* None.

*(9) **Cagayan De Sulu, Sulu Island*** (6° 59′ N, 118° 32′ E, HO 4348)

Cagayan de Sulu, on Cagayan, Sulu Island, is on the eastern shore of Gunboat Harbor, about 1 mile west of Tandotao Point. It is almost completely landlocked and was a port of call for interisland vessels. Copra was the chief export.

(*a*) *Harbor.* Gunboat Harbor is about ¾ of a mile long and ½ a mile wide, but deep water is very limited.

During the northeast monsoon the best anchorage is at the southwest anchorage about 7 miles west of the port. Depths are

54 to 66 feet at mean lower low water. The bottom is sand and coral. During heavy weather a swell sometimes breaks communication with the shore. There is also an anchorage on the south side of the island off the middle of three remarkable crater basins. The depth is 60 feet.

In 1940 a light on a white concrete tower 32 feet high was to be established at position 6° 59′ N, 118° 33′ E. There is no information as to whether it is in place.

High water interval is 8 hours. The height of higher high water is 4.2 feet; the lowest tide is −1.5 feet.

(*b*) *Landing facilities.* A pier, consisting of a causeway 21 feet wide and 84 feet long, and a wharf 34 feet wide and 101 feet long provided a berth 131 feet long with a depth at mean lower low water of 13 feet (FIGURE VI - 134). Interisland vessels of not more than 12 feet draft used the wharf.

(*c*) *Clearance facilities.* There was a road leading northwest across the island to the north shore.

A radio station was maintained by the Bureau of Posts and was located ½ mile from the pier.

(*d*) *Availability of supplies.* Rain water furnished the town's water supply. At half tide water could be obtained from a spring at the landing place near the southwest anchorage, and at a watering place inside Jurata Bay on the south side of the island.

Supplies were extremely limited but fresh beef could be secured.

(*e*) *Repair facilities.* None.

E. Northeast Borneo.

(1) ***Usukan Bay*** (6° 22′ N, 116° 21′ E, HO 3050).

Usukan Bay is about 4 miles north of Ambong Bay on the north coast of Borneo. There was a government settlement at Usukan Bay, and the port was the principal outlet of trade from the interior.

(*a*) *Harbor.* General depths are from 42 to 54 feet at mean lower low water.

The bay is open to the northwest, but otherwise is well protected.

Usukan Bay, nearly 1¾ miles long and from ¾ to 1 mile wide, provides the most secure anchorage north of Gaya Bay, but it has little or no protection from the west. There are reported to be three 1,800-foot berths in 42 or more feet of water, but only one of these is protected from westerly weather. During the northeast monsoon protection would be better and a fourth berth south of Usukan Island could be used. There is space for about 15 900-foot berths, but only two of these have any protection from the west. The normal anchorage is about half a mile from the customhouse with the latter bearing 80°.

High water, full and change, is at 10 hours 15 minutes. Springs rise 6 feet and neaps 4.5 feet.

(*b*) *Landing facilities.* A single lightly constructed pier had shallow depths alongside and only ships' boats could use it (FIGURE VI - 135).

There were no lifting appliances available and no storage facilities.

(*c*) *Availability of supplies.* Water was available from the streams at the head of the Bay except possibly after a long drought.

(*d*) *Repair facilities.* None.

(2) ***Kudat Harbor*** (6° 53′ N, 116° 51′ E, HO 2119, HO 2798, HO 2799).

Kudat Harbor is on the western side of Marudu Bay on the north coast of Borneo. It was a settlement of the North Borneo Company and the distributing center for the various tobacco and rubber estates in this vicinity. Kudat Harbor served this settlement.

(*a*) *Harbor.* The harbor is 4 miles deep and, between Tanjong Bornugus on the north and Tanjong Tigasamil on the south, is 1⅓ miles wide.

From Sandilands Rock to a point one-half mile west of the pier depths are from 18 to 60 feet. West of that the harbor grows increasingly shallow.

The harbor is sheltered from the swell of the northeast monsoon by a reef of sand and coral that extends from Tanjong Bornugus.

Between Sandilands Rock Light and the 36-foot line there are five 1,800-foot berths in depths of from 36 to 54 feet at mean lower low water. Twenty-two 900-foot berths could be located in the same area. Between the 18 and 36 foot lines there are 17 additional berths.

The entrance to the port was well marked and lighted. Sandilands Rock Light was a flashing white light (period 3 seconds,

FIGURE VI - 134. *Cagayan de Sulu.*
The pier at Gunboat Bay. Prior to April 1935. ONI 56408.

FIGURE VI - 135. *Usukan Bay.*
Looking south at the pier. No date. ONI 130-200.

flash .3 second, eclipse 2.7 seconds, candlepower 100) on a pile 10 feet high on a red tower at 6° 52′ N, 116° 52′ E. It was visible for 9 miles. Wharf light was a fixed red light (under 100 candlepower) 15 feet high on the pier at 6° 52′ N, 116° 51′ E. It was visible for 2 miles, but obscured over the west part of the harbor.

Gueritz Rock Beacon was on Gueritz Rock which lies bearing 150°, 1,800 feet distant from the wharf light. It was a wooden beacon 12 feet high surmounted by a white top mark. When a vessel was expected a light was shown from this beacon.

It is high water, full and change at about 10 hours 50 minutes. Mean diurnal range is 4.5 feet. Tidal currents are weak.

(*b*) *Landing facilities.* At the town there was a jetty with a face 132 feet long (FIGURE VI - 136). During the southwest monsoon it had a depth alongside of 14 feet at mean lower low water. During the northeast monsoon it had a depth of 16 feet. There was a mooring buoy southwest of the jetty.

Photographs show a second smaller jetty east of the first one. There is no information as to the depth alongside.

FIGURE VI - 136. *Kudat.*
Air view of Kudat Harbor looking northwest. 1938. ONI 124-786.

There was a bonded warehouse in the customs building. It was 40 feet long and 25 feet wide. There was a rice warehouse about 150 feet from the customhouse. It was 48 feet long and 23 feet wide.

(*c*) *Clearance facilities.* There were 30 miles of metalled roads in the vicinity.

The Straits Steamship Company maintained weekly schedules from Singapore, and the Sabah Steamship Company had a fortnightly service to Sandakan, Labuan, and nearby ports.

(*d*) *Availability of supplies.* Water was piped to the pier but was not especially good. It should be boiled before use for drinking purposes. Excellent water could be obtained at Mempakit on the eastern shore of Marudu Bay.

Vegetables were obtainable; fruits were plentiful.

No fuel or marine supplies were available.

(*e*) *Repair facilities.* None.

(3) Tanjong Batu (6° 37′ N, 116° 51′ E, HO 2798).

Tanjong Batu is on the southern shore of Marudu Bay in British North Borneo. The settlement is four miles southwest from Ridge Point.

(*a*) *Harbor.* The deep water area is small and has no protection from the north.

One or two vessels of 15 feet or more draft could anchor about ¾ mile northwest of the pier in depths of 31.5 feet at mean lower low water. Those of less draft anchor 2,400 feet northwest of the pier in a depth of about 24 feet. The bottom is muddy.

No information on tides is available.

(*b*) *Landing facilities.* Three quarters of a mile south of Tanjong Batu was a pier 414 feet long. The depth at the outer end was 5 feet at mean low water springs.

(*c*) *Clearance facilities.* A railroad 3 miles long connected the head of the pier with the manganese mine situated at Taritipan.

(*d*) *Repair facilities.* None.

(4) Lahad Datu (5° 02′ N, 118° 20′ E, HO 3044).

Lahad Datu is on the northwestern shore of a bay formed by the north coast of Sakar Island and the mainland of Borneo. It is on Borneo's east coast. The port served the small settlement which was the headquarters of the Resident of the District and also of the Darval Bay Tobacco Company.

(*a*) *Harbor.* Depths range from 24 to 96 feet at mean low water springs. No dredging is required to maintain depths. The harbor is almost 5 miles long and approximately 2 miles wide at its widest point.

North of Sakar Island there are about 15 1,800-foot berths in depths of 48 to 96 feet at mean lower low water, and 15 900-foot berths in 24 feet or more. Anchorage in 30 feet over mud bottom is also found between Voorwyk and Gray Reefs off the pierhead. There is no information as to its size.

Aids to navigation at Lahad Datu are shown in TABLE VI - 6.

TABLE VI - 6
AIDS TO NAVIGATION AT LAHAD DATU

TRIPOD BEACON TYPE	MARKED	LOCATION
Triangle top	7	Western extremity of Tingger Reef
Red cylindrical top	8	Halloran Reef, 2,400 feet off the center of NW coast of Sakar Island
Red cylindrical top	9	Southern extremity of Voorwyk Reef
Red cylindrical top	10	Western extremity of Voorwyk Reef
Red cylindrical top	10	One third of a mile south of Gray Reef
Triangle top	12	Western extremity of Gosungan Reef
Red cylindrical top	12	Gray Reef—small coral reef 2,400 feet south of the pier
Circular top	13	Southern extremity of Bershesherk, coral patch
Triangle top	14	Edge of shore reef about 3,990 feet east of pier
Red cylindrical top	14	Eastern extremity of Tingger Reef
Red cylindrical top	16	Eastern extremity of Voorwyk Reef
Red cylindrical top	18	Northern extremity of Gosungan Reef

The spring tidal range is 5 feet.

(*b*) *Landing facilities.* There were 2 piers at Lahad Datu. A T-shaped pier 1,350 feet long and 90 feet wide at the head extended in a southeasterly direction from the southwestern corner of the settlement (FIGURE VI - 137). The depth at the head was 18 feet at mean low water springs.

A wooden pier, with native houses on it, projected a short distance from the shore. Rails on it were connected with the light railway.

No cargo-lifting appliances were available.

There were 8 warehouses. The government rice warehouse had an area of 1,600 square feet. The customhouse and warehouse each had an area of 1,444 square feet. The Darvel Tobacco Company warehouse had an area of 2,300 square feet. The Lahad Datu Cultuur Maatschapping warehouse had an area of 1,230 square feet. There also were 3 Chinese-owned warehouses, each having an area of 1,100 square feet.

(*c*) *Clearance facilities.* Surfaced roads extended a few miles over the lowlands of the coast from Lahad Datu. A light railway led north from the Darvel Bay Tobacco Company estate to the Segama River estate about 10 miles distant. It also connected with the wooden pier.

Lahad Datu was connected by telegraph and telephone with Sandakan.

(*d*) *Availability of supplies.* Water was supplied to the village by a pipeline from a small creek about ¼ mile away. It had to be boiled before using it for drinking purposes. Water was not piped onto the pier.

Vegetables and bread were plentiful but beef was difficult to obtain.

(*e*) *Repair facilities.* None. However, the harbor could accommodate a drydock.

(5) Simporna (4° 29′ N, 118° 37′ E, HO 3044).

Simporna is on the east coast of Borneo not far from Tawao. It was the residence of the highest native chief.

(*a*) *Harbor.* The port lies on a narrow channel, Trusan Tando Bulong, in which depths range from 66 to 120 feet at mean lower low water except where a reef with a depth of 30 feet extends ⅔ of the way across the channel from the eastern side of the entrance.

Trusan Tando Bulong was very well marked by small wooden tripod beacons which had been erected in the following positions:

Two beacons ½ mile apart on the eastern edge of the reef northward of Simporna;
Four beacons on the eastern edge of the reef eastward of Hood Hill;
Three beacons on the southeastern edge of the reef southward of Hood Hill;
Two beacons nearly ½ mile apart, north and south, on the eastern edge of the reef off the northwestern point of Bumbum Island;
One beacon on the northwestern edge of the reef, off the northwestern point of Bumbum Island and nearly 1 mile northward of that point;
Two beacons on the coral patch close off the western edge of Creagh Reef at about ½ mile northwestward of Sipangao Island.

Spring tidal range is 5.2 feet.

(*b*) *Landing facilities.* A pier projected nearly ¼ mile over a reef into deep water (FIGURE VI - 138). Local steamers lie alongside the pier when visiting Simporna.

No cargo handling equipment and no warehouse facilities were available.

(*c*) *Clearance facilities.* No information.

(*d*) *Availability of supplies.* Good water could be obtained from wells about ½ a mile from the pier.

(*e*) *Repair facilities.* None.

(6) Tawao (4° 15′ N, 117° 53′ E, HO 3052).

Tawao is at the mouth of the Tawao River on the north shore of a long bay lying between Sibitik Island and the mainland of British North Borneo. The port served the settlement of Tawao, which was the headquarters of the district officer and the center of a large trade in rubber, coconuts, agricultural products, livestock, and timber.

(*a*) *Harbor.* Tawao itself is a small port but the bay on which it lies is more than 20 miles long and from 3 to 6 miles wide.

Mean low water depths range from 30 feet off the western end of Sibitik Island to 102 feet south by east of Tawao.

With strong southeast to southwest winds it was dangerous for ships to remain alongside the main pier. In all other winds shelter is good.

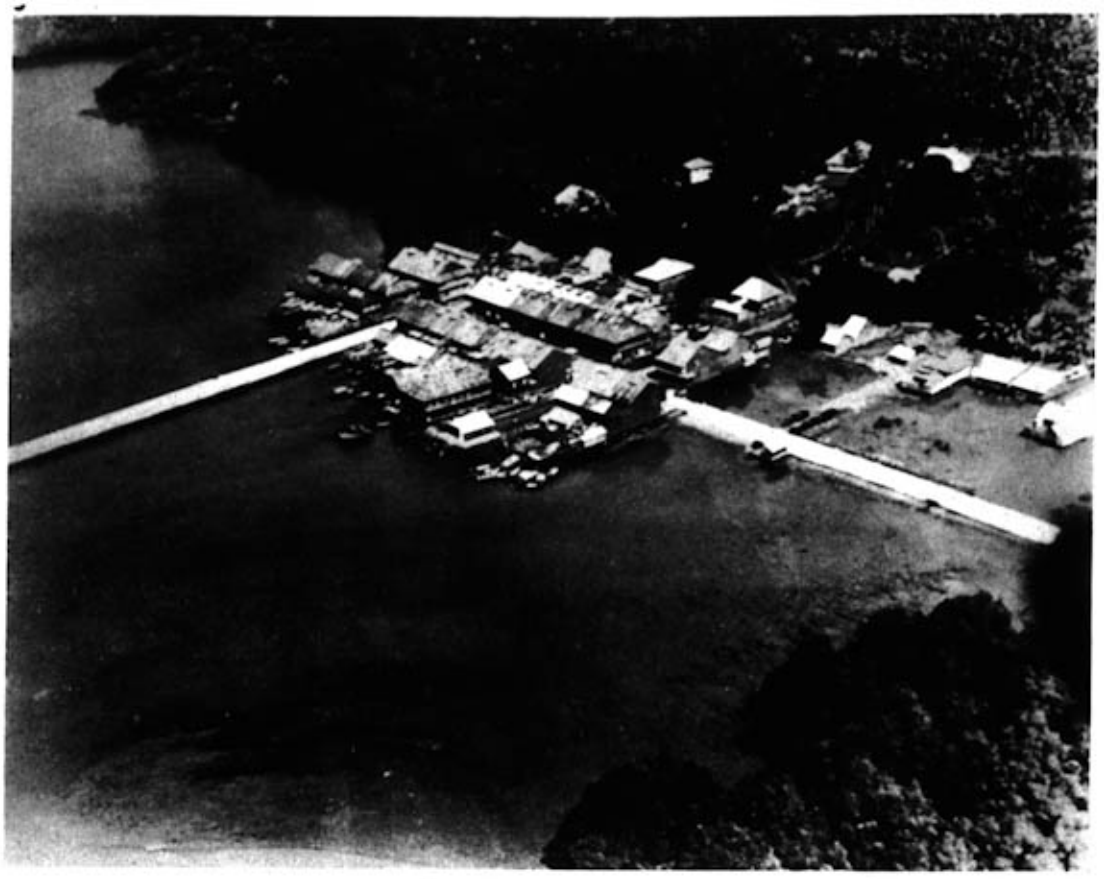

FIGURE VI - 137. *Labad Datu.*
Air view of village and causeway leading to wharf. Looking west. No date. ONI 124-753.

Vessels usually anchor in 78 feet about 1,500 feet off Tawao point; small vessels may approach closer. In the bay in front of Tawao there is room for a large number of ships.

There was a fixed white light (100 candle-power) on the outer end of Tawao pier. The light was on an iron framework tower 30 feet high and was visible 6 miles.

Spring tides rise 9 feet, neaps 6 feet. The spring range is 8 feet. High water is 6 hours and 50 minutes after the moon passes overhead. Tides are usually semidiurnal. The current in the bay ranges from 1¾ knots at flood to 2¾ knots at ebb tide.

(*b*) *Landing facilities.* A pier 726 feet long with a T-shaped head 150 feet long and 40 feet wide had a depth alongside of 10 feet at low water springs at its western end and 23 feet at low water springs at its eastern end. There was a small pier owned by the Borneo Fishing Company about 1 mile east of the wharf. Large steamers unloaded by lighters in the stream.

A few lighters with capacities of 14 to 250 tons were available.

(*c*) *Clearance facilities.* The small pier was connected by a double hand trolley line (1′ 8″ gauge) to the Tawao Rubber estate, 6 miles distant.

A radio station and a telephone system were at Tawao.

(*d*) *Availability of supplies.* Well water was usually available but was not suitable for drinking purposes.

Eggs, beef, and buffalo meat were moderately plentiful; pork, fish, and fresh coconuts were to be had in abundance. With 2 days notice unlimited quantities of fresh vegetables were available.

(*e*) *Repair facilities.* None.

(7) Tanjong Selor (2° 50′ N, 117° 22′ E, HO 3044).

Tanjong Selor is a river port at the head of the delta of the Boelangan River about 40 miles inland from the mouth. The estuary is formed by 3 main branches connected by many channels.

(*a*) *Harbor.* The river is navigable to Tanjong Selor by steamers of 11 foot draft. There is always at least 11.8 feet of water.

The port is limited by the width of the river and only 1 vessel can be accommodated at a time.

There is an anchorage opposite the Sultan's house with depths of 18 feet at mean lower low water.

The Muara Makapan fairway buoy marked one of the entrance channels. The channel leading to the Muara Salinbatu was marked by a black can buoy.

The following tide signals were made from the government pier:

Blue flag or 2 red lights at night	ebb current;
Red flag or 1 red light at night	flood current;
White flag or no lights shown at night	slack water.

Tides are single or double daily depending on the moon's declination. Springs rise 7½ feet, neaps 3 feet. Spring tides reach as far as Tanjong Selor. The ebb current attains its greatest speed (2 knots) at spring tides and 1.5 knots at neap tides near low tide.

(*b*) *Landing facilities.* There were 3 piers. The government pier was 65 feet long and had 13 feet of water alongside at mean low water springs; the other 2 piers were 82 feet long and had 12 feet of water alongside at mean low water springs.

There was a customhouse near the government quay.

(*c*) *Availability of supplies.* Supplies were difficult to obtain and then only in limited quantities.

There was a radio station and telephone cables were laid across the river at Tanjong Selor.

(*d*) *Repair facilities.* None.

(8) Tanjong Redeb (approximately 2° 12′ N, 128° 00′ E, HO 3044).

Tanjong Redeb lies where the Sungais Makam (Makam River) and the Kelai River join to form the Beraue River. It is 56 miles upstream from the mouth of the river. It was the headquarters of a government official and the center of jungle trade.

(*a*) *Harbor.* The minimum depth in the channel is 12 feet at mean low water springs. The Kelai is navigable for vessels of 10-foot draft as far as the village of Merasa, a distance of about 27 miles above Tanjong Redeb. The Makam is navigable for vessels 12 to 13 feet draft as far as the junction of the Sidoeng tributary 22 miles above Redeb. Pilots are essential for navigation on these rivers.

Local knowledge or a large scale chart showing the existing state of the buoyage would be necessary for proceeding up river.

Spring tides rise 9 feet on the bar near Sokkan and 5 feet at Redeb. Ebb current in the river had a speed of about 3 knots, flood current a speed of 2 knots. From 2 days before until 2 days after semidiurnal spring tides about .3 foot should be added to the mean level and from 2 days before until 2 days after neap tides the same amount subtracted. On other days the influence of the semidiurnal tide is negligible.

(*b*) *Landing facilities.* The government wharf was 140 feet long and had 24 feet of water alongside. It was in front of the customhouse. There were 4 other wharves for use of native craft only.

Limited storage facilities were available.

There was a coal loading place for vessels of the K.P.M. at Telock Bayur (Bedawata). This settlement is on the right bank of the Sungai Makam, about 5 miles above Tanjong Redeb.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called regularly.

There was a radio station at Tanjong Redeb.

(*d*) *Availability of supplies.* There was no pure water available.

Coal provisions were available in small quantities.

(*e*) *Repair facilities.* None.

(9) Benoa Baru (0° 59′ N, 117° 59′ E, HO 3053).

Benoa Baru is also called Sangkoelirang. It is at the mouth of the Sangkoelirang River on the northwestern shore of the Makassar Straits.

(*a*) *Harbor.* The size is limited by the width of the river. At Benoa Baru it is more than ½ mile wide.

The entrance was well marked. The depth is 26 feet. Vessels drawing 20 feet can reach Benoa Baru at all times.

There was flashing white light (period 8 seconds, flashing 2 seconds, eclipse 6 seconds) at 0° 46′ N, 118° 05′ E. It was visible for 11 miles. The light was obscured behind Miang Besar and Miang Kechil.

A fixed white light was shown from the head of the pier at Benoa Baru.

At Miang Besar at the mouth of the river there are double daily tides from December to February inclusive, those in the evening being higher than those in the morning. Only at neaps is a single daily tide sometimes observed. The spring range is 8.4 feet.

(*b*) *Landing facilities.* In front of the village there was a wharf about 50 feet long. The depth alongside is reported to have been 20 feet at mean low water springs. It was used by coastal vessels of not more than 700 to 800 gross tons. The South Sea Forestry floating dock, about 150 to 160 feet long, was also used for disembarkation.

There were sheds on the wharf.

(*c*) *Clearance facilities.* Regular boat service was maintained to Samarinda.

FIGURE VI - 138. *Simporna.*
Looking approximately south at the pier and landing stage. No date. ONI 130-194.

A wireless telegraph station was located at Benoa Baru.

(*d*) *Availability of supplies.* No pure water was available. Food was obtainable in small quantities. Fuel was not available in this port.

(*e*) *Repair facilities.* None.

F. Northern Celebes Sector.

(1) Tomini, Celebes Island (0° 30′ N, 120° 33′ E).

Tomini is on the south coast of the northern arm of Celebes Island near its western end (FIGURE VI - 139). The landing was in front of the village.

(*a*) *Harbor.* The harbor, Tomini road, is an open roadstead in the northwest corner of the Gulf of Tomini. The 10-fathom contour lies about 200 yards offshore.

The anchorage is off the western part of the village, with the flagstaff bearing about 0°. Eastward of the anchorage are 2 reefs with 7 and 1 fathoms of water over them. The latter was marked by a beacon.

(*b*) *Landing facilities.* There was a pier or landing stage about 250 feet long, near the Rajah's house, which extended to the edge of the coral reef.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called regularly.

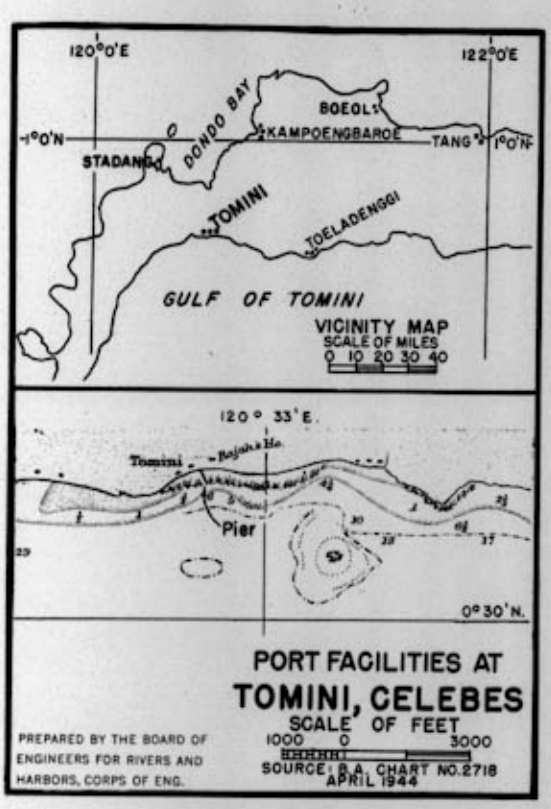

FIGURE VI - 139. *Tomini.*
Map showing location of port (inset) and port plan showing location of facilities.

FIGURE VI - 140. *Tilamoeta.*
Map showing location of port (inset) and port plan showing location of facilities.

(2) Toeladenggi (Tuladenggi, Celebes Island (0° 24′ N, 121° 09′ E).

Toeladenggi is on the Toeladenggi River, which flows into the western end of the Gulf of Tomini, Celebes Island (FIGURE VI - 139). The river is navigable for large praus. No landing facilities have been reported.

(*a*) *Harbor.* The harbor is an open roadstead. The 10-fathom contour lies 300 yards offshore. A partly drying bank of mud and sand projects 600 yards from Toeladenggi Point, with some detached reefs southward of it. The reefs near the 100-fathom contour, about 4 miles offshore, are all marked by discoloration.

Anchorage is available in 18 to 20 fathoms, over a mud bottom, off the mouth of the river.

(*b*) *Landing facilities.* There were no piers at Toeladenggi.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called regularly.

(3) Tilamoeta (Tilamuta), Celebes Island (0° 30′ N, 122° 21′ E).

Tilamoeta is on the northwest shore of Tilamoeta Bay, an arm of the Gulf of Tomini, on the southern side of the northern arm of Celebes Island (FIGURE VI - 140). There was a pier in front of the town.

(*a*) *Harbor.* Tilamoeta Bay is a natural harbor, with depths ranging from 30 fathoms at the entrance to 10 fathoms at its head. The width between the 10-fathom contours ranges from about 1 mile at the entrance to about 200 yards at the head of the bay, and is about 1 mile long northwest-southeast. It is open to the southeast.

There is good, but confined, anchorage in Tilamoeta Bay, in 20 fathoms, over a mud bottom, for four first-class anchorage berths.

The average annual rainfall is 67.3 inches.

(*b*) *Landing facilities.* Landing facilities consisted of a pier about 200 feet long, with charted depths of 2 or 3 feet on its head.

(*c*) *Clearance facilities.* Tilamoeta was a port of call for the K.P.M.

(*d*) *Availability of supplies.* Provisions were not obtainable.

(4) Kotaboena (Kotabuna), Celebes Island (0° 48′ N, 124° 40′ E).

Kotaboena is on the southeast coast of the northeastern peninsula of the Celebes Island, about 50 miles south-southwest of Manado (FIGURE VI - 141). No landing facilities are reported.

(*a*) *Harbor.* The harbor in Kotaboena road is an open roadstead between Koemeke (Kumeke) Island and the mainland. The 10-fathom contour lies from 175 to 300 yards offshore. The western end of Koemeke Island is about 475 yards

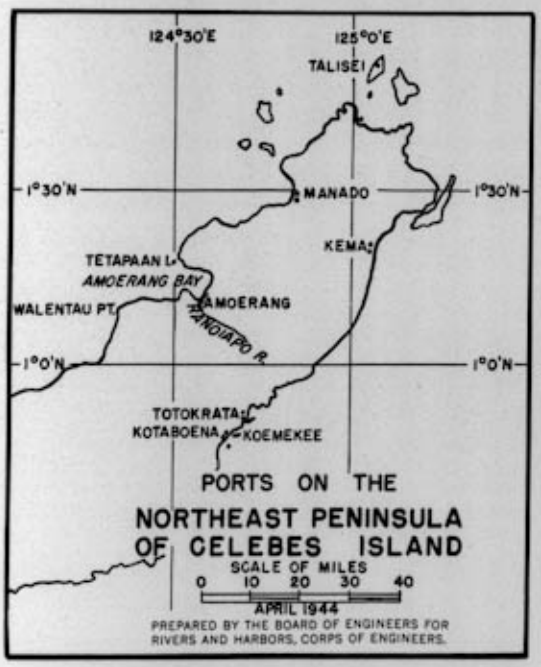

FIGURE VI - 141. *Celebes Island, NE Peninsula.*
Map showing location of ports.

off the mainland. The width of the channel, between the mainland and Koemeke Island, is from 150 to 285 yards between the 10-fathom contours, with a minimum depth of 16 fathoms.

There is safe but confined anchorage in 12 to 15 fathoms, abreast some coconut trees on Koemeke.

(*b*) *Landing facilities.* No piers are known to exist.

(*c*) *Clearance facilities.* Kotaboena was a port of call for vessels of the K.P.M.

(5) Totok, Celebes Island (0° 51′ N, 124° 42′ E).

Totok is on the western shore of Totok Bay, on the east coast of the northeastern peninsula of Celebes Island, 4 miles north of Kotaboena (FIGURE VI - 141). The village was of little importance, except as the site of the Totok Goldmine Company, which had a pier south of the village.

(*a*) *Harbor.* Totok Bay is a spacious natural harbor. The south side of the bay is formed by a narrow tongue of land, which terminates in a reef with some rocky islets on it. The bay can be entered between Toelang (Tulang) Island and the mainland, or between Hogaoe (Hogow) and Dakokajoe (Dakokayu) Islands. Both channels are wide and clean. A river north of the village usually discolors the water so that the shore reef cannot be seen.

The anchorage is eastward of the pier in 12 to 15 fathoms.

(*b*) *Landing facilities.* Facilities at the port consisted of a pier (FIGURE VI - 142), 330 feet long, belonging to the mining company, which also maintained several large warehouses and storage places.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called every 2 weeks.

FIGURE VI - 142. *Totok.*
Map showing location of port facilities.

(6) Kema, Celebes Island (1° 22′ N, 125° 05′ E).

Kema is in a bight on the east coast of the northeastern peninsula of Celebes Island, about 19 miles southeast of Manado (FIGURE VI - 141). It was a complimentary port to Manado, providing perfect shelter in the northwest monsoon when Manado road is unsafe. No landing facilities are reported.

North of Kema, the Sawangan River discharges into the harbor. The entrance is dry at low water.

(*a*) *Harbor.* The harbor, Kema road, is an open roadstead. The 3-fathom contour lies from 230 to 430 yards offshore; the 5-fathom contour from 350 to 630 yards; and the 10-fathom contour from 1,150 to 1,500 yards offshore.

On the northern side of the roadstead, outside the 10-fathom contour, at a distance of 500 yards offshore, is a detached rock with 3 fathoms of water over it. 1 mile 76° from the mouth

of Sawangan River. A shoal with a least depth of 3 feet lies 600 yards 161° from Kema Light. The width of the shore reef of Kema increases to the northeastward. Depths over it are uneven. When approaching from southward vessels must avoid the reef extending from the south point of the bight.

There is good anchorage at Kema road through the greater part of the year, although open to easterly and southerly winds. There is anchorage southeastward of the village in 5 to 10 fathoms.

A fixed red light, 24 feet above high water and visible 3 miles, was shown when vessels were expected.

Tides rise up to 3½ feet. A current sets northward along the coast with a velocity of 1 to 1½ knots.

The average rainfall is 65.6 inches.

(*b*) *Landing facilities.* No piers are known to exist. Landings were probably made on the beach (FIGURE VI - 143). During the southeast monsoon, from June through September, the swell breaks heavily on the beach, but landing can always be made at the southern part of the roadstead by the old coal sheds.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called regularly. Roads connected the port with Manado and Amoerang (Amurang).

(*d*) *Availability of supplies.* The water from Sawangan River is fit for use.

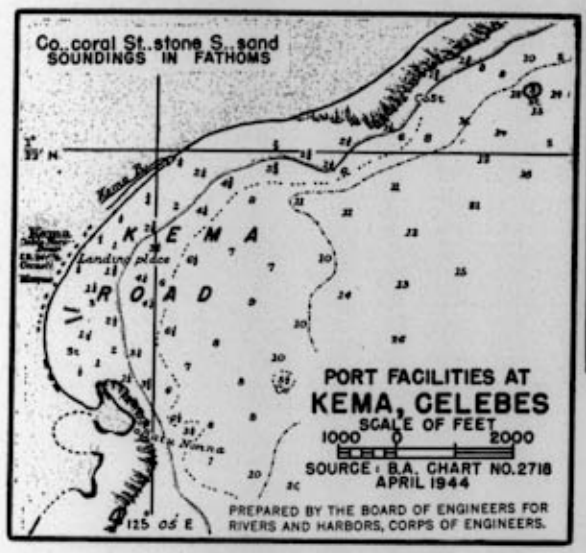

FIGURE VI - 143. *Kema.*
Map showing location of landing places.

(7) Talise Island (1° 50′ N, 125° 04′ E).

Talise is on the southeastern point of Talise Island, which is about 5 miles off the northeasternmost point of Celebes Island (FIGURE VI - 141). The Molukka Trading Company had a pier in front of the village.

(*a*) *Harbor.* Talise road is a natural harbor, sheltered by surrounding islands. The 10-fathom contour lies from 300 to 625 yards offshore at Talise.

There is good anchorage in a depth of 10 to 12 fathoms, with the house near the root of the pier bearing 309°, and the west tangent of Kinabahoetan Island 47°, between the head of the pier and a reef of 4½ fathoms. Small vessels could anchor between the pier and a black can buoy in the roadstead, with a stern hawser to the pier.

Spring tides rise from 2 to 7 feet, and neaps from ½ to 5½ feet. The flood current runs northwestward through the passage between Gangga, Tendila, and Talise, and to the north between Talise and Bangka. The flood current on the west side of Talise runs due north, and meeting the current from between Talise and Bangka, forms a rip tide which is encountered 3 miles to the northwest of the north point of Talise Island.

The ebb current runs between the islands to the southeast and fair through Bangka Strait. Tide rips are formed off all the salient points, and there are heavy races to the northward and northeastward of Bangka.

(*b*) *Landing facilities.* The stone mole, which extended to the edge of the coral reef (FIGURE VI - 144), was about 300 feet long, and had a shed at the end.

(*c*) *Clearance facilities.* Talisei was a port of call for K.P.M.

(*d*) *Availability of supplies.* Good water was obtained from a spring near the mole. There was a small government coal depot of about 6,000 tons capacity at Talise, where coal could be taken in at the rate of 200 tons per day.

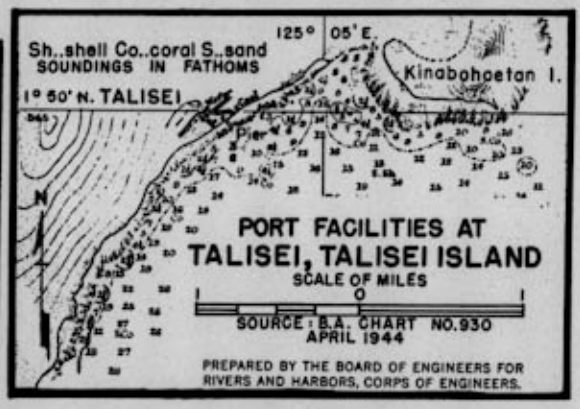

FIGURE VI - 144. *Talise.*
Port plan showing location of facilities.

(8) Amoerang (Amurang), Celebes Island (1° 12′ N, 124° 34′ E).

Amoerang is in the southwest part of the head of Amoerang Bay, on the northeast coast of Celebes Island, about 29 miles southwest of Manado (FIGURE VI - 141). No landing facilities are reported.

(*a*) *Harbor.* The harbor in Amoerang road is an open roadstead, in the southwestern part of an inner bay formed by a tongue of land which projects from the south shore of Amoerang Bay. Amoerang Bay is deep and free of dangers. The 10-fathom contour lies 25 to 325 yards offshore. It is about 8 miles wide at the entrance, between Tetapaan Island and Walintau Point, and 5 miles wide at the head. It indents the coast about 8 miles eastward. The bay is open to the west and northwest. The roadstead is safe during the entire year, but the bottom is very steep, and it is necessary to secure astern with a shore mooring.

The best anchorage is in 40 fathoms, about 200 yards from the beach, with the flagstaff of the old Lunet bearing about 148°. Vessels should approach the shore with about 40 fathoms of chain out changing to 90 or 95 fathoms when the anchor holds, and then securing with a shore mooring or stern anchor. One half mile northwestward of the mouth of the Ranorapo River, near the coffee warehouse, there is another secure anchorage.

The tidal range is from 3.2 to 5.2 feet.

The mean temperature is about 79°, maximum 90°, and minimum 73°. The average annual rainfall is 123 inches.

(*b*) *Landing facilities.* There were no piers.

(*c*) *Clearance facilities.* Vessels of K.P.M. called every 4 weeks.

(9) Koeandang (Kwandang), Celebes Island (0° 51′ N, 122° 55′ E).

Koeandang is a village and harbor located on Koeandang Bay, which opens on the north coast of Celebes Island (FIGURE VI - 145). There was a pier at the head of the harbor.

(*a*) *Harbor.* The harbor, which lies along the southeastern shore of Koeandang Bay, is about 2 miles wide at its mouth by about 2 miles long, outside the 5-fathom contour, with depths up to 16 fathoms. It is formed and largely protected by Pajoenga (Payunga) Island. Phoenix reef, marked by a beacon, lies in the western part of the harbor's mouth. The shoreline south and east of the anchorage is of mud and coral while the shore of Pajoenga Island is generally bordered by a fringing reef.

Anchorage which is safe in both monsoons, is available along the east shore of Pajoenga Island in depths of 6 to 16 fathoms. Anchorage is prohibited within 3 miles of the cable house between 168° and 188°. A flashing white light, 46 feet above high water and visible 12 miles, was shown at the entrance to Koeandang Bay. A fixed red light, 17 feet high and visible 5 miles, was shown from a point on shore in front of Kwandang.

(*b*) *Landing facilities.* Facilities at the port consisted of a pier, about 250 feet long, located at the end of the continuation of the road on which the police station was located.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called regularly.

(*d*) *Availability of supplies.* Poultry and fish were available.

FIGURE VI - 145. *Koeandang and Soemalata.* Map showing location of ports.

(10) Soemalata (Sumalata), Celebes Island (0° 59′ N, 122° 31′ E).

Soemalata is on the north coast of Celebes Island, about 8 miles west of the western entrance point to Koeandang Bay. (FIGURE VI - 144). There was a pier at the village.

(*a*) *Harbor.* The harbor, in Soemalata road, is protected from easterly winds by Dojanoemo (Dojanumo) Island and the reef south of its east point and another reef southwesterly from its western point. There are narrow channels between the island and the reefs. A mile northwestward of Dojanoema Island is Hoelwa (Ulawa) Islet, and ¾ mile northeastward there is a large drying reef. A 4-fathom shoal is located about ¾ mile south-southeastward of the eastern point of Dojanoema Island. The channel off the eastern end of Dojanoema Island is about 150 yards wide with a central depth of 13 fathoms, and that off the western end is about 100 yards wide with a central depth of 10 fathoms; while the channel in Soemalata road, in front of the village, is about 800 yards wide, with depths up to 19 fathoms. All widths are between the 5-fathom contours. The beach in the vicinity of Soemalata is sandy with the 5-fathom contour 100 to 300 yards offshore.

Soemalata road furnishes good anchorage in the south monsoon and fair anchorage in the northwest monsoon. During the northwest monsoon, there is safe anchorage in 17 fathoms, over sand, south of Dojanoema Island. A hawser should be run to shore.

(*b*) *Landing facilities.* There was a pier at Soemalata.

(*c*) *Clearance facilities.* Loading and unloading was carried on by lighters. In bad weather and a heavy sea the cargo is first taken to Dojanoemo and afterwards carried to Soemalata. Vessels of the K.P.M. called every 4 weeks.

(11) Tang, Celebes Island (1° 03′ N, 121° 58′ E).

Tang is on the western shore of a large bay that lies between Capes Loboe (Lobu) and Kanjai (Kandjai) on the north coast of Celebes Island (FIGURE VI - 139). The landing pier was located south of the village.

(*a*) *Harbor.* The harbor is in Paleleh roads. Minor protection is provided by Paleleh Island, Jellesma Islet, and the high tongue of land that lies between Tang and Paleleh village. Paleleh Island is surrounded by a partly drying reef, while a 4-fathom shoal extends about 300 yards southwesterly from Jellesma Islet. Although the bay is comparatively shallow, with depths of 10 to 30 fathoms, the bottom near the shore, in the vicinity of Tang, drops off steeply, with the 10-fathom contour within 200 yards of the beach. The shore is sandy. A small 3-fathom patch lies 2,100 yards 99° from the south point of Paleleh Island.

The best anchorage is southward of Jellesma Islet in depths of 12 to 15 fathoms, over mud.

The average annual rainfall is 104.2 inches, with 12.6 inches in January, the wettest month, and 5.1 inches in August, the month of least rainfall. A fixed red light, visible 2 miles, was shown from the outer end of the pier.

(*b*) *Landing facilities.* A landing pier extended about 425 feet from shore at a point about 100 yards south of the village, to a depth of about 1-fathom.

(*c*) *Clearance facilities.* Vessels of the K.P.M. called every 4 weeks.

(12) Boeol, Celebes Island (1° 10′ N, 121° 27′ E).

Boeol is on the north coast of Celebes Island, about 250 miles west of Manado (FIGURE VI - 139). No landing facilities are reported.

(a) Harbor. The harbor is in Boeol roads an open roadstead, open to the eastward. The 10-fathom contour is 570 yards offshore. Inside the 15-fathom curve, depths decrease rapidly. During easterly winds the roadstead is unsafe.

Anchorage is available in 30 fathoms about ½ mile offshore.

(b) *Landing facilities.* There were no piers.

(c) *Clearance facilities.* No data are available.

Boeol was a port of call for the K.P.M.

(d) *Availability of supplies.* Good water could be obtained from the river.

(13) Kampoengbaroe, Celebes Island (1° 02′ N, 120° 49′ E).

Kampoengbaroe is on the eastern shore of Tolitoli Bay, on the northwest coast of Celebes Island (FIGURE VI - 139). It was the center of trade for the surrounding country. There was a pier at the village and another on Laboean Dedeh Point.

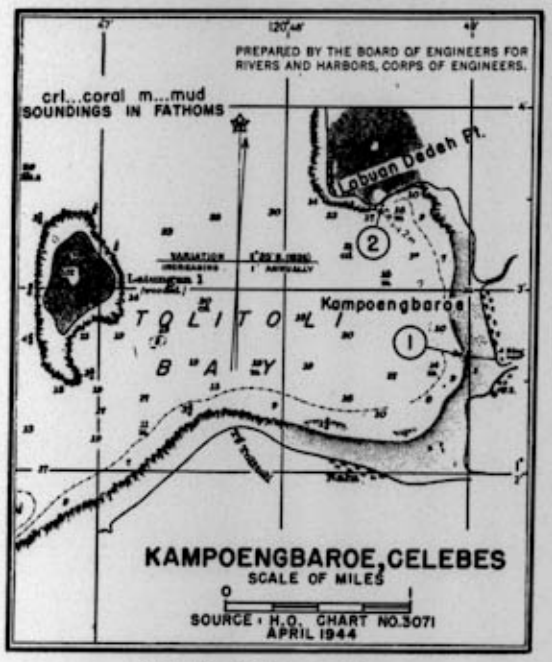

FIGURE VI - 146. *Kampoengbaroe.*
Map showing location of port facilities.

(a) *Harbor.* Tolitoli Bay is a natural harbor. There are depths of 18 fathoms in the bay, decreasing rapidly within the 10-fathom contour which lies between 60 and 550 yards offshore. The bay is about 1⅓ miles in diameter. It is open to the northwest.

The bay affords secure anchorage in all seasons. Anchorage is available in the eastern part, ½ mile off Kampoengbaroe in depths of 18 fathoms, over a mud bottom. It is advisable not to anchor in less than 16 to 18 fathoms.

A fixed red light, 14 feet above high water and visible 2 miles, was shown just westward of the pier at Laboean Dedeh Point.

The tide varies from ½ to 2¼ feet.

(b) *Landing facilities.* The facilities in Tolitoli Bay consisted of a pier at Kampoengbaroe at the head of the bay, and another eastward of Laboean Dedeh Point, the north point of the bay.

A stone pier at Kampoengbaroe (Reference number 1, FIGURE VI - 146) was 885 feet long and had a depth of 24 feet along the head.

A wooden pier founded on screw piles, eastward of Laboean Dedeh Point (Reference number 2, FIGURE VI - 146), was 85 feet long and 42 feet wide at the head, with 30 feet of water alongside. There were no mooring bollards or buoys, but hawsers could be made fast to the neighboring trees. With strong westerly winds it is advisable to moor with bow to the southwestward. There is ample swinging room.

(c) *Clearance facilities.* Vessels of the K.P.M. called at Tolitoli Bay.

(d) *Availability of supplies.* Drinking water was not obtainable. Provisions were scarce.

(14) Stadang, Celebes Island (0° 52′ N, 120° 20′ E).

Stadang is on the west shore of Bananga Bay, an arm of Dondo Bay, on the northwest coast of Celebes Island (FIGURE VI - 139). There was a pier at the village.

(a) *Harbor.* Bananga Bay, which is about 2 miles wide at its mouth and indented about 2 miles, is rocky on the east shore and sandy on its south and west shores.

Sheltered anchorage is available in 38 fathoms, about 500 yards from shore in front of town, with Banga Point bearing 12°, a zinc roof in the village 298°, and Cape Senyangang 80°.

(b) *Landing facilities.* Facilities at the port consisted of a pier of light native material.

(c) *Clearance facilities.* Vessels of the K.P.M. called occasionally to load copra.

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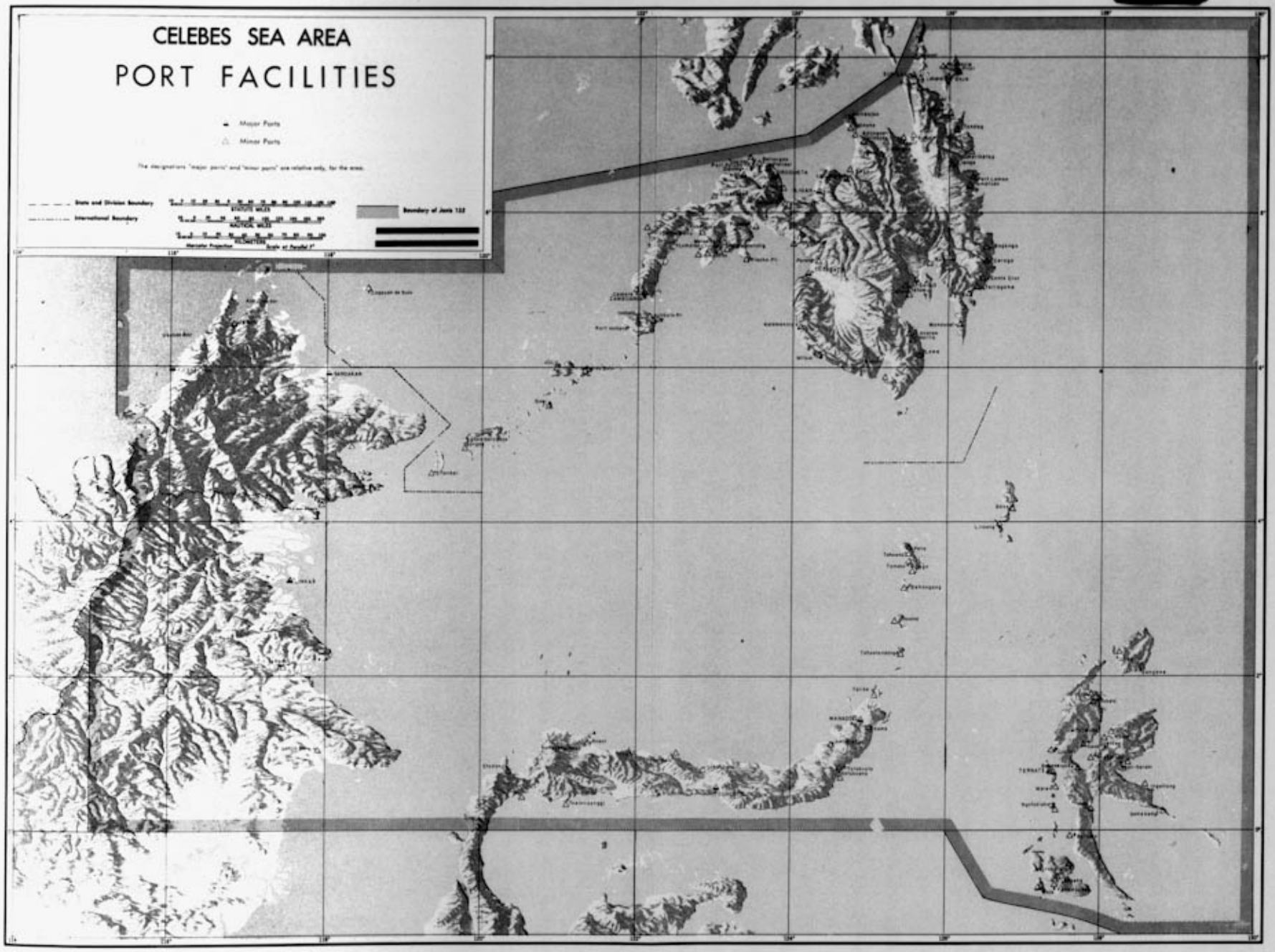
FIGURE VI - 147
JANIS 155



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