

The later of the two disturbances, after crossing the Bering Sea during the 15th and 16th, was centered on the 17th and 18th over the eastern Aleutians, with lowest pressure, 984 millibars (29.06 inches) at Dutch Harbor on the 18th. This cyclone was locally stormiest on the 17th, when gales of force 8 to 9 occurred within the small region near 53°-54° N., 161°-162° W., according to radio reports received from two ships. The storm during the 19th again traversed the Bering Sea on its way to the Arctic Ocean.

During the 16th to 18th strong northerly winds occurred off the California coast along the eastern slope of an oceanic high. The highest velocity reported by a ship was of force 8 on the 17th.

Tropical cyclones.—A number of tropical disturbances, including typhoons and depressions, occurred in the Far East during August, and contributed to the remarkably low average barometer for the month observed at Guam, Manila, and Naha, as shown in table 1. Two of these cyclones, which originated late in July, were described by the Rev. Bernard F. Doucette, S. J., Manila, P. I., in his report in the July issue of the REVIEW. One of the storms, it may be added, that of July 28 to August 8, attained great violence on August 4-5 between 25° N., 155° E. and 36° N., 144° E., while moving northwestward toward Japan, as shown by the reports of the following vessels: British steamer *Toorak*, 4th, near 27° N., 154° E., maximum wind from the east-southeast, force 11, lowest barometer 984.4 millibars (29.07 inches); Dutch motorship *Manoeran*, 4th, near 30° N., 149° E., maximum wind from north and west, force 11, with hurricane gusts, lowest barometer 959 millibars (28.33 inches); Norwegian motorship *Gefion*, 5th, near 35° N., 145° E., maximum wind from southeast, force 11, lowest barometer 978.3 millibars (28.89 inches).

On August 12 the American steamer *Steelmaker* encountered a southeast gale of force 9, lowest barometer 995.9 millibars (29.41 inches), near 25° N., 128° E., in connection with a cyclone of which we have almost no information, but which will undoubtedly receive ample notice in the August report from Manila.

On the 10th of the month a low appeared to the eastward of Guam. As it moved northward it deepened, and on the 14th the British motorship *Cingalese Prince*, in 26°20' N., 157°30' E., had a low barometer of 978.3 millibars (28.89 inches), with a south-southwest gale of force 9. Later, on the 14th the American steamer *Robin Hood* had a similar gale, but with higher barometer, near 29° N., 154° E. This typhoon then appeared to be advancing in an almost due north direction, and on the 15th the United States Army transport *Meigs*, near 36° N., 153° E., met a southeast gale of force 10, barometer 985.8 millibars (29.11 inches). A few hours later the American motorship *Potter* had a southeast gale of force 9 about 200 miles farther northward. The typhoon was subsequently lost to observation.

On August 20 a deep depression lay over the Marianas. It took a generally northwest course, passing to the eastward of Naha, Nansei Islands, on the 27th, and entering the Yellow Sea on the 30th. At Naha our a. m. map of the 27th shows the island to have had a north gale of force 8, while the p. m. map shows a low barometer of 979 millibars (28.91 inches). At coastal stations of the Yellow Sea violent gales occurred on the 30th, accompanied by pressure readings below 982 millibars (29.00 inches).

In the American Tropics there were no disturbed conditions until the 31st, when a small depression was entered by the Norwegian motorship *Brajara* during the

early morning. The ship had an east-southeast gale of force 8, barometer 1,003.3 millibars (29.63 inches), at 5 a. m., in 17°42' N., 103°36' W.

Fog.—Fog continued frequent in August, as in the previous July, along a great stretch of the northern routes, north of the fortieth parallel, particularly between longitudes 155° E. and 150° W., where it occurred on 20 to 35 percent or more of the days, scattered throughout the month. Fog was reported near the Alaska Peninsula on 5 days; off the Washington coast on 10 days; off Oregon on 13 days; off California on 16 days; and off Lower California on 2 days. West of Costa Rica fog was observed on the 29th and 30th.

TYPHOONS AND DEPRESSIONS OVER THE FAR EAST

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Depression, August 3-6, 1939.—First appearing during the afternoon of August 3, this depression moved north-east from a position about 120 miles south of Hong Kong to the central portion of the Formosa Channel east-southeast of Amoy. It then shifted its course to the northwest, moving about 150 miles, and then inclined to the north-northeast, passing close to and northwest of Shanghai. It disappeared over the Yellow Sea, apparently of mild intensity during its short career.

Typhoon, August 7-15, 1939.—A depression very likely originating east of the Mariana Islands first made its appearance on the weather map of August 7 about 300 miles north-northeast of Guam. A westerly movement of about 700 miles during the next three days preceded an inclination to the west-northwest and an intensification to typhoon strength. On August 11, the typhoon was central about 600 miles east-by-north of Aparri, from which location it moved first northwest, then west-northwest, thus crossing Formosa (August 13) and entering China (August 14) a short distance north of Amoy. No trace of the disturbance was found on the afternoon map of August 15.

Depression, August 12-18, 1939.—A depression, apparently of mild intensity, formed far to the east-northeast of Guam and moved in a westerly direction over the ocean until it reached the region about 450 miles east of Aparri where it inclined to the north. For about 120 miles it moved in this direction, and then made a sharp turn to the east, disappearing August 18.

Depression, August 16-20, 1939.—A mild depression, as far as can be determined from available information, formed about 300 miles northwest of Guam. It moved in a northeasterly direction, then inclined to the north when it reached the 145th meridian. It did not proceed very far along this course before it gradually changed its direction to the west-northwest, passing about 100 miles south of the Bonins. It disappeared over the ocean regions east of the Nansei (Loochoo) Islands.

Observations from ships were adequate to provide complete data on all these disturbances. The typhoon especially was well located, and its intensity definitely known from observations received from the United States Army transport *Meigs*, and the steamships *Pres. Van Buren*, *Washington*, *Adrastus*, and *Marchen*. Pressure values reported showed that there certainly was a typhoon, yet the winds were not strong and dangerous. The center probably was small and could not exert its influence over long distances.

Up to August 18 very little power was manifested in the upper winds over the regions of the Far East. Over

Guam, southwest and west winds predominated with velocities less than 40 k. p. h. except on August 15 and 16. The winds over the Philippines were from the southwest quadrant, with tendencies to shift to the west and even west-northwest at times. Velocities were, as a rule, below 40 k. p. h., with 50 k. p. h. being reported once in a while and then only in isolated groups of the pilot code. On the other hand, Thailand and southern Indo-China stations often reported winds over their regions steadily maintaining velocities of 50 k. p. h. and more. This strength was not evident over the Philippines at any time. The stations of the Netherlands East Indies had east quadrant winds, except Tarakan and Menado, which changed to the west and southwest quadrants on various days. Medan, however, seemed to be in the same air stream that was flowing over Thailand. In general, a quiet situation persisted during this part of the month.

Depression, August 18-22, 1939.—A depression formed about 180 miles west-by-north of Guam and moved westerly, gradually inclining to the west-northwest. It vanished when about 350 miles east of northern Luzon. This depression seemed to be of minor importance.

Typhoon, August 21-September 2, 1939.—The first indication of the existence of this storm came with the Guam observations of August 21, the falling pressure and the northerly winds showing the approach of a disturbance. Very likely it had formed over the Eastern Caroline Islands before August 21 and was undoubtedly moving along a northwesterly course toward Guam. During the afternoon and evening of this same day, it passed about 100 miles north of Guam, at the same time inclining to the southwest, following the latter course for 180 miles, more or less. The morning of August 22 showed the center to be about 150 miles west by south of Guam, starting a west-northwest course toward the Philippines. There was no doubt during these days, August 22 to 25, that it was a severe and intense typhoon, exerting its influence far from the center. Until August 25 it threatened northern Luzon, but fortunately for the whole archipelago, it recurved to the northeast when about 360 miles east by south of Aparri. For a day it proceeded along this northeasterly course and then inclined to the north-northwest when it reached the neighborhood of latitude $21^{\circ}30'$ N., longitude 132° E. August 27 and 28 it moved along this course and then changed to the northwest on August 29, a course which it followed across the Eastern Sea after it had passed close to and south of Borodino Island and then about 150 miles north of Naha Island. An inclination to the north-northwest as the center approached China caused the storm to pass about 80 miles to the northeast of Shanghai, after which the storm gradually weakened. Approaching Shantung Peninsula along a north-northwest course, the typhoon passed over land for the first time in its career, on August 31, moving inland about 50 miles north of Tsingtao. A change to the west on September 1 carried the center well into the continent, where it finally disappeared on September 2.

There is no doubt that this typhoon is to be considered as one of the major storms occurring over these regions and it is very fortunate that practically its whole course was over the ocean regions, far from populated centers. The following data will show the reader the magnitude and intensity of this typhoon. Soon after the center passed Guam, it caused the pressure at Yap to fall, the lowest value reported during these days being 749.8 mm. (999.7 mb) with southwest winds, force 6. There were many ships sending observations, those from the steamships *Bengalen*, *Nonsuco*, *Sagoland*, *Steel Trader*, and *Steel*

Navigator deserving special mention, as they helped very much in locating the typhoon center. The first important series of observations, however, came from the S. S. *John A. Brown*, which was traveling along a westerly course toward San Bernardino Strait while the typhoon center moved west-northwest, passing North of the ship's course. The S. S. *John A. Brown* had north quadrant winds, backing to the southwest and increasing to force 9 and 11. The lowest pressure reported during the series of observations sent to Manila was 746.0 mm. (994.6 mb) with west-southwest winds, force 9, from latitude 13.0° N., longitude 132.0° E. (August 24, 8 a. m.). About this time, the second important series of observations began to arrive from the S. S. *Deroche*, traveling along a northeasterly course from the locality of the Balintang Channel. These observations showed definitely that the typhoon was recurving and the series is given below in some detail. August 24, 3 p. m., lat. 20.7° N., long. 126.3° E., pressure 750.8 mm. (1,001.0 mb) with winds north-northeast, force 6. August 25, 8 a. m., lat. 22.0° N., long. 128.5° E., pressure 749.3 mm. (999.0 mb) winds northeast, force 7. August 25, 2 p. m., lat. 21.8° N., long. 129.3° E., pressure 746.3 mm. (995.0 mb), winds north-northeast, force 7. August 26, 6 a. m., lat. 21.2° N., long. 131.3° E., pressure 741.7 mm. (988.8 mb), winds northwest, force 7. August 26, 3 p. m., lat. 21.3° N., long. 132.6° E., pressure 736.2 mm. (981.5 mb) winds west, force 7. At this time the center began to move in a northwesterly direction and Borodino Island felt its effect the next morning, August 27, 5 a. m., when a pressure of 716.3 mm. (955.0 mb), with northeast winds, force 7, was reported. At 6 a. m. August 30, when the typhoon center was approximately 60 miles northeast of Shanghai, a pressure value of 738.9 mm. (985.1 mb), with northwest winds, force 7, was reported from that city. Tsingtao, on August 31, 6 a. m., with the typhoon center approaching the locality from the southeast, reported a pressure of 730.3 mm. (973.7 mb) with north-northeast winds, force 9. The U. S. S. *Chamont*, located at lat. 28.5° N., long. 119.3° E. or nearby, made observations almost every hour during the day and evening. The winds were north-northeast, force 10, veering to northeast and east and weakening late in the afternoon. The lowest pressure reported was 995 mb (746.3 mm.) at 0400 G. M. T. (noon, local time). These observations show the shift of movement to the west.

The upper winds during these days had many characteristics of interest. The pilot balloon data from Guam preceding August 20 showed southeast quadrant winds, under 40 k. p. h. August 21, a mild northerly current was flowing, velocities under 40 k. p. h., changing during the afternoon hours to the west-northwest, west, and west-southwest, with the velocities increasing to values slightly over 50 k. p. h. The next day, (22d), however there was a strong southeasterly current with velocities from 30 to 80 k. p. h., the first indication of the strength of the typhoon. The U. S. S. *Gold Star* was approaching Guam from the north, traveling along the 142d and 143d meridians. There were a few short ascents reported from this vessel when traveling between lats. 24° and 18° N., which showed the presence of an easterly current, with velocities at these lower levels less than 40 k. p. h. There was a powerful easterly current, however, which affected Aparri and changed the air stream over that station from the southwest quadrant to the east quadrant. The velocities at Aparri were not strong, but there were some long ascents during the period from August 19 to 22, which showed the height of this easterly current to be

about 7,000 meters. Menado, Netherlands East Indies, gave early indications of the strength of the typhoon. On August 17 weak variable winds were reported over this station; August 18, northwest and west quadrant winds, with velocities up to 40 k. p. h. (which are quite strong for Menado). No data were received August 19 and 20. On August 21 and the following days, west and southwest quadrant winds were continually blowing, with velocities from 15 to 60 k. p. h. Every ascent reported had at least one group with velocities of 50 k. p. h. or more. Menado pilot balloon data were excellent in giving advance notice of the violence of this typhoon. Over the Philippines, after August 22, a very strong southwest quadrant current was flowing. Thailand and southern Indo-China should be included with the Philippines, being under the influence of the same air stream. Cebu reported the strongest velocities from the Archipelago, having velocities 90 k. p. h. and 100 k. p. h. and over, twice. Thailand stations regularly had velocities between 50 and 90 k. p. h. with values over 100 k. p. h. reported a few times. This current extended to Guam and even to Wake Island, where it changed to the southwest quadrant August 29. The southern extent of this powerful current was approximately the latitude of Batavia, where east quadrant winds prevailed during these days. These details indicate the tremendous activity which accompanied this storm. After the center passed Shanghai, the only pilot runs reported were from the U. S. S. *Augusta*, where one ascent was made on September 1, after the typhoon had crossed Shantung Peninsula. The ship was at lat. 36.0° N., long. 120.8° E. and the upper winds up to 500 meters were from the south, velocities 44 to 62 k. p. h. (September 1, 1000 G. M. T.).

Scarcely anything is to be mentioned concerning loss of life and property damage. The newspapers of Manila had dispatches of the loss of two lives in Shanghai, and that seems to be the only information available. It is possible that there were heavy rains over China due to this typhoon, thereby causing floods, but no reports were received. It is very fortunate that the typhoon center kept away from populated regions almost throughout its course.

Typhoon, August 22-24, 1939.—First appearing as a depression central about 180 miles west-northwest of Aparri, this storm moved west, then west-northwest, intensifying to typhoon strength when about 200 miles

south of Hong Kong. From this position, it moved rapidly west, across the Gulf of Tong King into the Continent where it soon disappeared. Winds of force 7 with pressure values close to 749.5 mm. (999.2 mb) were reported from stations around the Gulf of Tong King, August 24, 6 a. m., the wind directions showing that the center was close to the coast of Indochina.

MEAN MONTHLY ISENTROPIC CHART

The mean isentropic chart (chart XII) for August 1939, $\theta=315^\circ$, is characterized by a significant departure from the pattern which is regarded as normal for August (see Wexler and Namias, Mean Monthly Isentropic Charts and Their Relation to Departures of Summer Rainfall, Trans. Amer. Geophys. Union, 1938, Part I). There is a definite eastward displacement of the moist and dry tongues over the eastern part of the country.

The dry tongue, which usually is observed entering the country over Lake Michigan, is seen to enter over Lakes Erie and Ontario, and may be associated with the drought over the Northeastern States, the Ohio Valley, and Tennessee. Its extension into Louisiana and eastern Texas corresponds roughly to the subnormal precipitation there. The moist tongue usually observed over the Southeastern States is displaced off the coast, and is correlated with the excess of precipitation to its left, covering the Middle and South Atlantic Coast. The large excess of precipitation over Alabama and Georgia, however, is not to be associated with any circulation pattern to be seen on the mean chart, since it is due to the tropical storm which moved inland and remained almost stationary over those states for 5 days. The effect of this storm on the mean circulation for the entire month would not be noticeable, while its influence on the precipitation departures is dominant in that area.

The displacement eastward of the dry tongue permitted the southwestern moist tongue to evidence upslope motion over the middle Mississippi Valley in the average picture, with consequent positive departures from the normal precipitation there.

(NOTE.—In chart XII, the red and black arrows, introduced this month, are to be considered not as actual trajectories, but rather as identifying the axes of the moist and dry tongues.)