gale winds from about 6 p. m. of the 17th until the early morning of the 20th. The ship's lowest pressure, at midnight of the 17th-18th, occurred near 46° N., 171° E. The wind was then southwest, force 11. During the forenoon of the 18th the wind at ship was most of the time of force 11, but for several hours in the afternoon was of hurricane velocity. It very slowly decreased over most of the period thereafter until the 20th, when the ship was near 47° N., 162° W., with the wind still of fresh to strong gale force.

The *Kunikawa Maru* had scarcely escaped this violent storm area than she ran into another of equal wind intensity, but much lower pressure, her minimum barometer being 28.16, in 45° N., 143°34′ W., on the 22d. From early morning until late that night she encountered violent gales, mostly of force 11 to 12 from easterly to westerly directions, thereafter rapidly moderating as the storm moved toward the Gulf of Alaska from the eastern part of the northern steamer routes.

In east longitudes, so far as present reports indicate, stormy weather of extratropical type had ceased by the 20th, but in west longitudes it continued until late in the month. The last severe storm was that of the 26th–27th which overspread northeastern waters and caused scattered gales over a considerable area from the Washington coast southwestward. The strongest gale reported was of force 11 from south-southwest, barometer 29.29, encountered by the Swedish motorship *Dagmar Salen*, in 38°34′ N., 140°38′ W., late on the 26th. Ten degrees to the westward on the following morning the Japanese motorship *Amagisan Maru* had a force-10 gale, barometer 28.94. At the entrance to the Strait of Juan de Fuca on the 26th the Swiftsure Bank Lightship reported a southeaster of force 8. This was one of three strong southeasters reported during the month off the coast of the United States. The first was reported in a special letter to the Weather Bureau by the second officer on the American-Hawaiian steamer *Columbian*. This southbound vessel, after passing St. George's Reef on the 3d, ran into a small depression in which a southeast wind of force 9 was encountered. The third coast gale, of force 8, occurred off the lower coast of Oregon on the 30th.

Tropical cyclones—typhoons.—Elsewhere in this REVIEW appears a report by the Rev. Bernard F. Doucette, S. J., of the Weather Bureau at Manila, P. I., on the Far Eastern typhoons and depressions of October 1938. There remains little to be added except in connection with the typhoon which struck southern Japan on the 21st with considerable loss to life and property. On that day the British steamer *Empress of Canada*, while 50 to 75 miles southeast of Yokohama, ran into the north gales of the typhoon at 4 a. m., then into south winds of hurricane force toward 11 a. m., lowest barometer 28.60. The storm appears to have disintegrated rapidly thereafter, as no trace of it was to be seen on the following day.

Tropical disturbances of the southeastern Pacific.—Two tropical cyclones, of apparently brief existence, occurred in southeastern waters. The earlier was reported only by the American steamer *Ensley City*, Honolulu to Balboa, on the 9th. The ship was under the influence of the disturbance for 11 hours, with changing winds which reached their highest velocity, force 8 from west-northwest, at 4 p. m., lowest barometer 29.43.

The second cyclone was severely encountered by two north-bound Japanese ships, the *Nozima Maru* and the *Asuka Maru*, close off the Mexican coast between Manzanillo and Acapulco, on the 22d. In both instances the advance winds of the storm were experienced from southeasterly directions, quickly changing and rising to highest velocity from the northwest shortly after 8 a. m. On the *Nozima Maru* the heaviest wind was of force 10, lowest barometer 29.64 in and near 17°24′ N., 102°11′ W. On the *Asuka Maru* the wind attained force 11, lowest barometer 29.31, in 17°44′ N., 102°25′ W. Both ships were out of the gale before noon.

Fog.—On the open Pacific remote from land, fog was reported on only 3 days. Along the American coast ships reported fog as follows: Off Washington on 3 days; off Oregon on 2 days; off California on 10 days; off Lower California on 1 day.

TYPHOONS AND DEPRESSIONS OVER THE FAR EAST OCTOBER 1938

BERNARD F. DOUCETTE, S. J.

[Weather Bureau, Manila, P. I.]

Typhoon, September 28 to October 4, 1938.—A low pressure area formed about 400 miles east-northeast of San Bernardino Strait and intensified into a typhoon after moving along a west-northwesterly course. It inclined to the west-by-north and entered Luzon during the afternoon and evening hours of September 30, passing a short distance south of Tuguegarao, Cagayan Province. It was not very strong at this part of the course, but in the China Sea, it rapidly acquired energy as it continued along a west-by-north course. On October 2 and 3, it was almost stationary about 90 miles east of Hainan Island, until the afternoon hours (October 3) when it proceeded a short distance to the northeast. A change to the west-northwest carried the storm into the continent where it disappeared over the regions north of Hainan Island. After the storm center passed the Philippines, no reports of serious damage were received.

On September 30, when the center crossed northern Luzon, surface winds from stations affected by the storm were not stronger than force 3, and the pressure values varied between 748 mm and 750 mm (29.449 and 29.528 inches). This was due to the mountainous nature of the region, which also caused the winds to be very irregular, so that hardly any indication of circulation was apparent.

When this typhoon formed, the typhoon of September 16–29, 1938, was disappearing over the Formosa Channel and consequently a southwesterly current had been flowing over the Archipelago. A front appeared, extending east to west across the China Sea and northern Luzon, Aparri reporting northeast and east quadrant winds, while Manila and southern stations remained in the southwesterly current. Velocities at Aparri were between 30 and 45 k. p. h. as the typhoon passed about 60 miles south of the station, altitudes of 2,100 and 3,500 m being attained. The strength of the southwest winds increased from values between 20 and 40 k. p. h. to about 60 k. p. h. (at Cebu, September 30) as the storm crossed Luzon, afterwards decreasing. On October 1 and the following days, when the typhoon was moving across the China Sea, the upper winds over northern Indo China were from the northwest, north, and northeast with velocities as high as 60 k. p. h. Over southern Indo China was the extension of the front over Luzon, which separated these northerly winds from the southwesterly current flowing over Saigon and the stations of Siam, where velocities as high as 90 k. p. h. were reported before October 5, afterwards decreasing.

Typhoon, September 30 to October 9, 1938.—This typhoon appeared about 200 miles south-southwest of Guam, apparently well developed, moving along a west-northwesterly course, and gradually inclining to the west-by-north as it moved. In 3 days it was about 600 miles east

of San Bernardino Strait, from which position it moved toward the southwest, thus threatening Samar Island and the regions around Surigao Strait. It seemed to be moving west for a short time as it approached Surigao Strait, but actually, it had changed to a course almost parallel to the eastern coast line of Samar, that is, approximately north-northwest or northwest. An inclination to the west-northwest occurred after the center had passed the eastern part of San Bernardino Strait, which carried it between Catanduanes Island and southern Luzon. Its further movement was practically northwest, bringing the center to the Luzon coastline a short distance south of Baler, Tayabas Province. It changed to the west, thus crossing Luzon south of the mountainous regions, and changed again to the north-northwest as it entered Lingayen Gulf. Another shift occurred very soon to the west, when the center was about 90 miles northwest of Baguio, Mountain Province. A rapid movement took the storm to the region of the Paracels, where it inclined to the northwest and entered the Continent a short distance north of Phulien, moving west-by-north, after which no trace of it could be found.

Baler, Tayabas Province, reported a barometric minimum of 726.01 mm (28.583 inches) with south-southeast winds force 12 (October 6, 12:13 a. m.). After the winds had shifted from the northwest quadrant to north and then were changing to the southeast quadrant, a lull of about 15 seconds was observed, just before the fury of the south-southeast winds arrived. Cabanatuan, North Ecija Province, reported 746.46 mm (29.388 inches) as the minimum, with west winds, force 4, at midnight. Dagupan, Pangasinan Province, had 742.29 mm (29.224 inches) with southwest winds, force 5, as its lowest value, occurring at 3:15 a. m. October 6. San Fernando, La Union Province, at 4 a. m., had a value of 741.59 mm (29.197 inches) as the minimum.

The total number of deaths due to this storm was about 33, the greatest loss being due to the foundering of the motorboat *Dumaguete* near Oslob, Cebu Province. The passengers and crew left the motorboat in three lifeboats, two of which reached shore, the third, however, being lost, with 12 people aboard.

Over Guam, September 30 and October 1, the upper winds were from the east and southeast quadrants, velocities increasing from values close to 25 k. p. h. to 60 k. p. h. and then decreasing after October 2. Over the Philippines an easterly current, in advance of the typhoon, replaced the southwest winds which had prevailed since the preceding typhoon. Aparri, north of the typhoon track, had east-southeast and southeast winds, increasing in velocity to 70 k. p. h. as the typhoon entered the China Sea, October 6. At Manila the upper winds changed from the southwest quadrant to the east quadrant, October 4, velocities ranging from 15 to 50 k. p. h. When the typhoon center was 200 miles east-by-south of Manila, a balloon was followed to the altitude of about 2,000 m, indicating winds from the north-northwest veering to north-northeast, with velocities varying from 25 to 50 k. p. h. Cebu and Zamboanga had southwest quadrant winds during the whole period, Cebu reporting velocities higher than Zamboanga, the former station having values as high as 65 k. p. h. on October 6, decreasing afterwards. This current from the southwest remained over the Philippines until the typhoon disappeared into the continent.

Typhoon, October 7 to 16, 1938.—A low-pressure area moved in a generally west-southwesterly direction from a location about 250 miles west-northwest of Guam. It changed to the west October 9, and then to the north-northwest the next day, when it reached the latitude of San Bernardino Strait. October 11 found it about 350 miles east of northern Luzon, definitely a typhoon, and moving rapidly north-northwest, passing about 60 miles east-northeast of Ishigakijima, Nansei (Loochoo) Islands during the early hours of October 12. An inclination to the northeast and east-northeast, a sudden shift to the east, and the storm was north of Naha, Nansei Islands. Here, it began its course over the Pacific, moving east-northeast at first, and then inclining to the east after it passed southern Japan.

During the formation of this storm, when it was a low-pressure area, Guam had southwest quadrant winds, changing to the southeast as the disturbance moved toward the Philippines. Velocities reported were not over 35 k. p. h. The Philippine stations showed the presence of two currents, Aparri in the northeast quadrant current, Manila, Cebu, and Zamboanga in the southwest quadrant winds. Aparri had velocities between 10 and 35 k. p. h. increasing to 50 k. p. h. on October 14, then weakening. The southwest quadrant current over the southern part of the archipelago had velocities often as high as 50 k. p. h. during these days, the highest values reported being 85 k. p. h. from Cebu on October 12. The few observations received from Tarakan, Borneo, confirmed the supposition that velocities decreased over stations southwest of Cebu, for almost all the time Zamboanga had weaker winds aloft than Cebu. Manila, likewise, did not have the velocities reported by Cebu. A study of the situation indicates that the southwest winds were flowing along the easiest path, that is, over the locality of San Bernardino Strait, to the typhoon center. When the typhoon reached the eastern sea, October 12 to 14, it caused a powerful northeast quadrant current to flow southward. This affected the upper winds over Hong Kong and northern Indochina, and on October 15, it changed the directions at Siam stations and Saigon, Indochina, to the east quadrant, which until that time had southwest quadrant directions. Velocities at Shanghai, reported from U. S. S. *Augusta*, reached values as high as 79 k. p. h. on October 16.

Typhoon, October 12 to 20, 1938.—A depression appeared east-northeast of Guam, and moved in a westerly direction for three days. It recurved to the north-northeast and northeast when about 500 miles east of northern Luzon, at the same time intensifying into a typhoon. When the center reached the locality north of the Bonin Islands, it probably filled up, but observations are not available for confirmation.

At Guam, there were west and southwest winds, velocities increasing to approximately 50 k. p. h. on October 12 and then decreasing.

Depression, October 15 to 17, 1938.—Appearing south of the Bonins, this depression moved in an irregular course toward the north-northeast to the regions about 600 miles northeast of these islands where it disappeared. According to observations available, it was not intense.

Typhoon October 19 to 21, 1938.—This storm appeared rather suddenly, undoubtedly of typhoon strength, about 300 miles east-southeast of Naha, Nansei Islands. It apparently formed as a secondary to the typhoon of October 12 to 20 and may have been developing for some time before the stations of the Nansei Islands were affected. It moved north, then north-northeast, thus approaching the locality of Tokyo (afternoon of October 21), then changed to the east, after which observations were lacking and its further movement and history undetermined.

Newspaper dispatches from Japan reported that nearly 250 lives were lost, and about 35,000 people rendered homeless as a result of this typhoon.