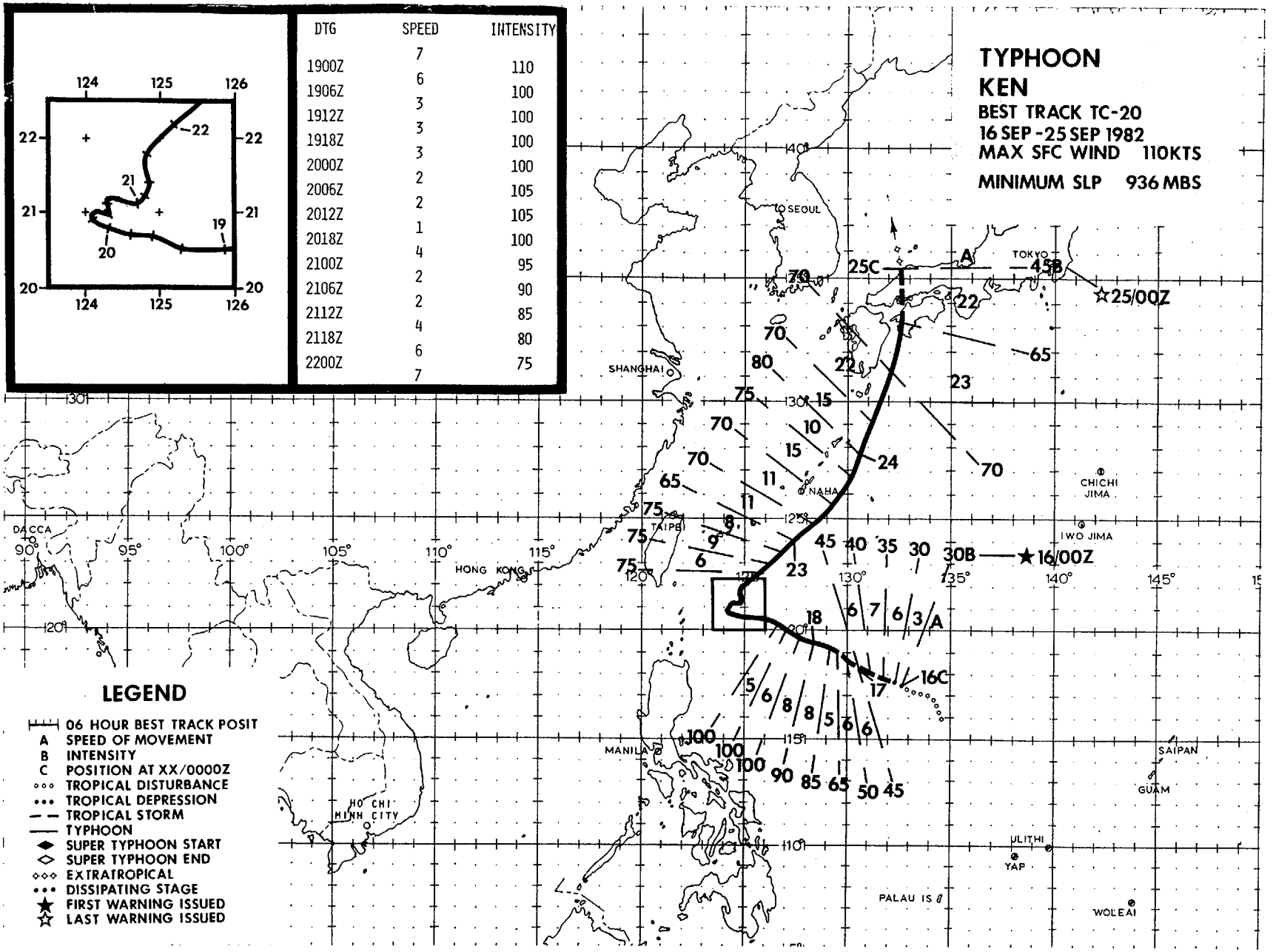
TYPHOON
KEN
BEST TRACK TC-20
16 SEP - 25 SEP 1982
MAX SFC WIND 110KTS
MINIMUM SLP 936 MBS
DTG SPEED INTENSITY
1900Z 7 110
1906Z 6 100
1912Z 3 100
1918Z 3 100
2000Z 3 100
2006Z 2 105
2012Z 2 105
2018Z 1 100
2100Z 4 95
2106Z 2 90
2112Z 2 85
2118Z 4 80
2200Z 6 75
☆25/00Z
★16/00Z
LEGEND
06 HOUR BEST TRACK POSIT
A SPEED OF MOVEMENT
B INTENSITY
C POSITION AT XX/0000Z
TROPICAL DISTURBANCE
TROPICAL DEPRESSION
TROPICAL STORM
TYPHOON
SUPER TYPHOON START
SUPER TYPHOON END
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
SEOUL
TOKYO
SHANGHAI
NAHA
TAIPEI
HONG KONG
MANILA
DACCA
HO CHI MINH CITY
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI

Typhoon Ken formed in mid-September in the western portion of an elongated monsoon trough in the Philippine Sea. Satellite imagery on 14 and 15 September showed a persistent convective disturbance near 17N 134E with evidence of upper- and lower-level circulation centers. A reconnaissance aircraft mission early on 16 September closed off a surface circulation near 18N 133E, with 10 to 35 kt (5 to 18 m/sec) winds and a minimum sea level pressure of 1003 mb. Based on this information, JTWC elected to forgo the issuance of a Tropical Cyclone Formation Alert and, at 160300Z, the initial warning was issued on Ken as Tropical Depression 20.

Ken was upgraded to tropical storm status on the 161200Z warning after aircraft reconnaissance reported a 999 mb central pressure and sustained winds of 35 kt (18 m/sec). Initial warnings for Ken anticipated movement toward the west, passing near the northern tip of Luzon within 72 hours. These forecasts were based on the apparent strength of the mid-level steering flow along the southern periphery of the subtropical ridge which was centered between Taiwan and Okinawa. Thirty-three hours after the initial warning was issued, Ken was upgraded to typhoon status when aircraft reconnaissance data showed a central pressure of 976 mb, equivalent to an intensity of 65 kt (33 m/sec) (Atkinson and Holliday, 1977). Ken underwent a rapid intensification during the following 24 to 36 hours, with its intensity surpassing 100 kt (51 m/sec) on 18 September. Up to this point in its development Ken was characterized as a compact system; for example, aircraft data at 180600Z indicated a 938 mb central pressure in a 10 nm (19 km) diameter eye with a maximum surface wind of 100 kt (51 m/sec) located within a band of maximum winds only 15 nm (28 km) from the center.

Ken moved much slower than anticipated, and toward the west-northwest, for the first four days in warning status. During this period, a gradual but significant change in the subtropical ridge was taking place; by 19 September the ridge had retrograded southwestward and strengthened over southern China and the northern portion of the South China Sea. JTWC forecasts during this period expected this slow movement to be short-lived based on a forecast strengthening of the ridge north of Ken and a corresponding weakening of the ridge over the South China Sea which would allow Ken to resume its movement westward. This forecast scenario never materialized and, aided by analysis and prognostic fields from the 191200Z data base which provided indications that westward movement was not likely to occur, JTWC forecast tracks turned toward the north commencing with the 200000Z warning. Some of the indicators which prompted JTWC to change the forecast track were: the numerical forecast fields were starting to show a persistent break in the ridge north of Ken vice a strengthening of the ridge; the dynamic tropical cyclone models (OTCM, NTCM) began to consistently forecast a northward movement; and analysis data began to show significant height falls at the 700 mb level were starting to occur north of the ridge over southern Japan.

Despite all the signs predicting a northward movement, Ken eventually became quasi-stationary on 20 September (Figure 3-20-1 shows Ken at its westernmost position) and the character of the associated circulation pattern began to change dramatically; aircraft reconnaissance missions found the center expanding, with the strongest wind bands moving away from the center. The diameter and character of the eye (when observed) was also changing from mission to mission. A possible explanation of what

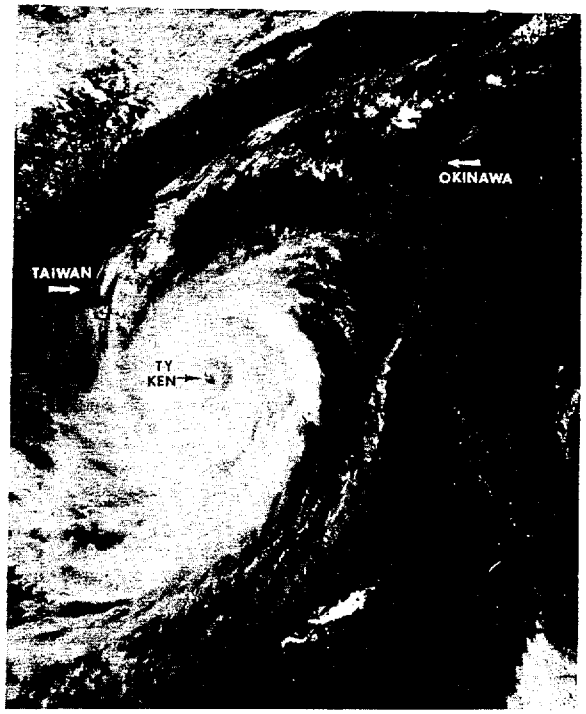

Figure 3-20-1. Typhoon Ken, at its westernmost position and just beginning a period of very little movement. Note the strong banding toward Ken's center. Within the next two days, much of this center would erode, leaving a nearly cloud-free area 60 nm (111 km) in diameter. 200542Z September (NOAA 7 visual imagery provided by Det 4, 1WW Clark AB RP).

caused Ken to undergo such drastic changes could be the interaction with mid-latitude westerlies advecting much cooler air into Ken's center, thus accounting for formation of the large cloud-free center. The 201200Z 500 mb analysis (Figure 3-20-2) shows the winds from the west moving into Ken's circulation about the time that these changes began. However, this does not explain why Ken's eye dissipated and then reformed within the otherwise cloud-free center, unless the westerlies were diverted from the center for short periods of time, allowing warm, moist air to reenter the center and assist in the reformation of the eye.

Ken's eye was last observed at 212011Z during a double-fix aircraft mission. On the first penetration, the mission Aerial Reconnaissance Weather Officer (ARWO) indicated the eye was 7 nm (13 km) in diameter but on the second penetration, at 212327Z, the ARWO reported "... the eye was so large we couldn't even pick it up on our radar ..."[1]. Further, the band of maximum winds were observed some 60 to 95 nm (111 to 176 km) from Ken's center.

On 21 September, satellite imagery and upper air analysis data indicated the trough north of the subtropical ridge had begun to

[1] Candis L. Weatherford, Capt, USAF, mission ARWO.

deepen. In response, Ken began to move erratically toward the northeast and by 211800Z was on a steady course toward Okinawa. The possibility of significant acceleration was examined as continued interaction with the mid-latitude westerlies seemed likely. A recently developed JTWC forecast aid, TAPT (Weir, 1982), indicated Ken might undergo acceleration near 25N. Indeed, as Ken approached 26N, its forward speed began to increase and acceleration continued until landfall on the island of Shikoku, Japan. During this acceleration period Ken passed 78 nm (143 km) southeast of Okinawa; maximum winds recorded at Kadena AB were 35 kt (18 m/sec) at 230955Z and a peak gust of 58 kt (30 m/sec) at 231135Z. Ken also brought a significant, and much needed, rainfall to Okinawa; 11.09 inches (28.2 cm) were recorded at Kadena on 23 September.

Once past Okinawa, Ken began to gradually weaken under strong mid- and upper-level westerlies. Aircraft reconnaissance missions continued to find the belt of maximum surface winds moving farther away from the center with every fix. Satellite imagery showed a steady decline in convection as Ken continued to move toward Japan. Ken made landfall upon Shikoku at 241700Z, crossed the inland sea, and then moved through western Honshu into the Sea of Japan where it became extratropical at 250000Z.

Ken was the fourth typhoon of the season to hit the main islands of Japan; it brought torrential rains and high winds, which triggered mudslides that flooded or wrecked thousands of homes and paralyzed both air and ground transportation. Reports from the region indicated that a peak gust of 114 kt (59 m/sec) was recorded on Shikoku during Ken's passage along with 8.7 inches (22.1 cm) of rain over one six-hour period.

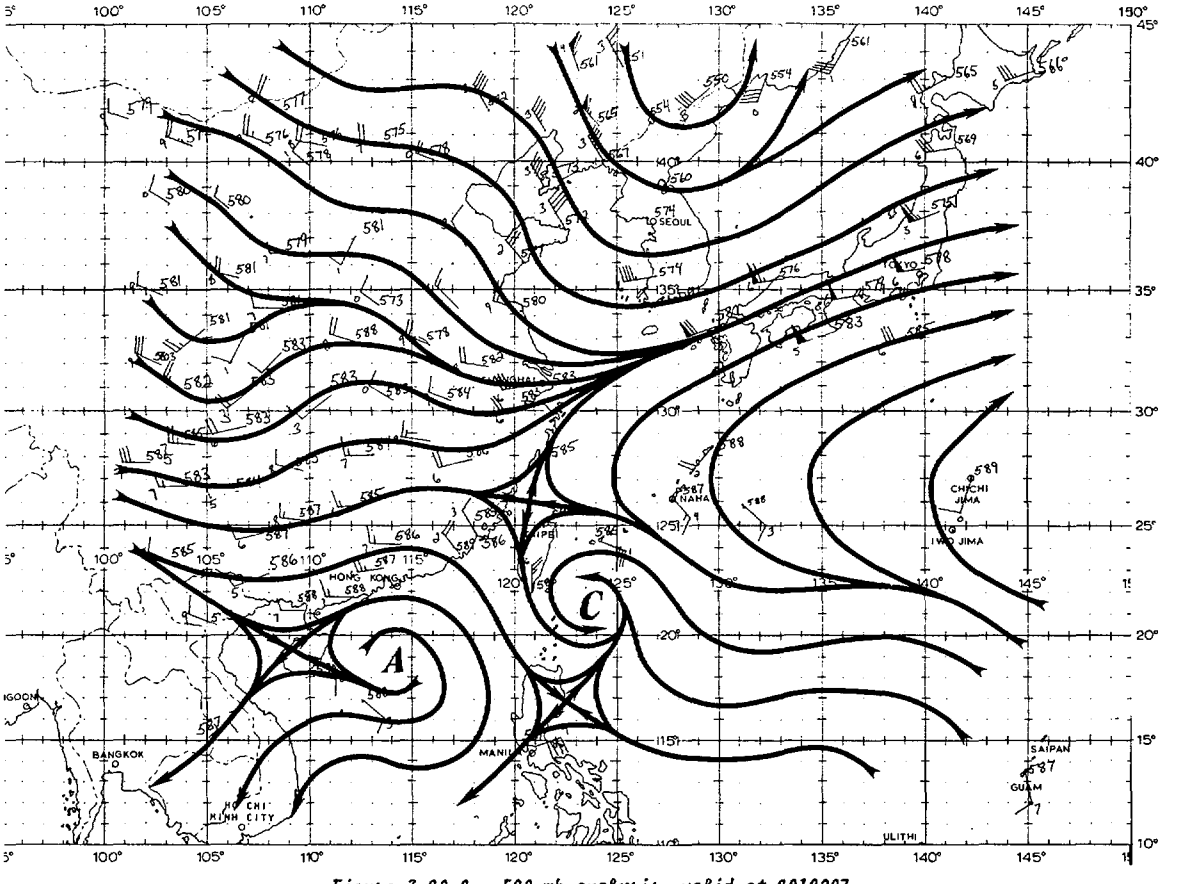

Figure 3-20-2. 500 mb analysis, valid at 201200Z. The strength of the subtropical ridge over China had diminished during the previous 12-hour period. This process allowed mid-latitude westerlies to move further southward and become involved with Ken's circulation pattern. The break in the east-west extension of the ridge, north of Ken, can also be seen. Wind speeds are in knots.