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Life history of the 12 May 1979 tropical cyclone as seen by TIROS-N satellite

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ABSTRACT. The evolution and dissipation of a tropical cyclone over the Bay of Bengal as seen by the TIROS-N environmental satellite is described. The tropical cyclone crossed the east coast of India on 12 May 1979 and caused extensive property damage. The TIROS-N direct readout images received by ground stations of the India Meteorological Department enabled the Meteorological Service to issue advance storm warnings and save many lives. The usefulness of good quality satellite images for tracking the tropical cyclones over the data sparse area like Bay of Bengal is emphasized in this article.

1. Introduction

Over large parts of the tropical oceans, the environmental satellites provide the only source of information on atmospheric conditions. From 1960, with the launching of the first meteorologic satellite, hundreds of tropical storms have been observed in various stages of development providing meteorologists with abundance of data. The cloud images obtained from satellite information have been used for tropical storm analysis (Sadler 1962, 1964; Fett and Brand 1975; Fritz *et al.* 1966; Hubert and Timchalk 1969) and methods were devised to estimate the intensity of these storms by studying the cloud features. Recently improved procedures have been developed for analysis and forecasting of tropical cyclone intensity and to estimate the central pressure and wind velocity within the storms (Dvorak 1973, 1975).

2. Data used

Images used in this study were received from the TIROS-N visible channel. A full description of TIROS-N series of satellites has already been published elsewhere (Schwalb 1978) and will not be repeated here. Only a very short description of this new generation of polar orbiting satellites will be provided in this article. The TIROS-N is in a near polar sun-synchronous orbit and is at an altitude of approximately 850 km. The local equator crossing time is 1500 local time and the orbital period is about 102 minutes. There are four primary instrument systems on the satellite and one of them is the Advanced Very High Resolution Radiometer (AVHRR), which has four channels (two in the infrared and two in the visible spectral range) with a spatial resolution of 1 km. The AVHRR scans perpendicular to the subsatellite track and a combination of the scanning motion and the satellite motion provide continuous information to construct an image. The images shown in Figs. 1 to 11 are obtained from one of the visible channels. The information from the visible channels was recorded on board the satellite and was transmitted back to one of the ground receiving stations in the USA for further processing to generate the images. The TIROS-N AVHRR also has the capability of transmitting images directly and many ground stations with proper receiving equipment can obtain the images. In fact, the images that were used by the India Meteorological Department were received directly from the satellite.

3. Interpretation of images

The images received from the TIROS-N visible channel during the period 3–14 May 1979, over the Indian Ocean and Bay of Bengal are shown in Figs. 1–11. Table 1 shows the location of the tropical disturbance as determined from the images and the central pressure and wind speed estimated from Dvorak's technique (1973, 1975). These

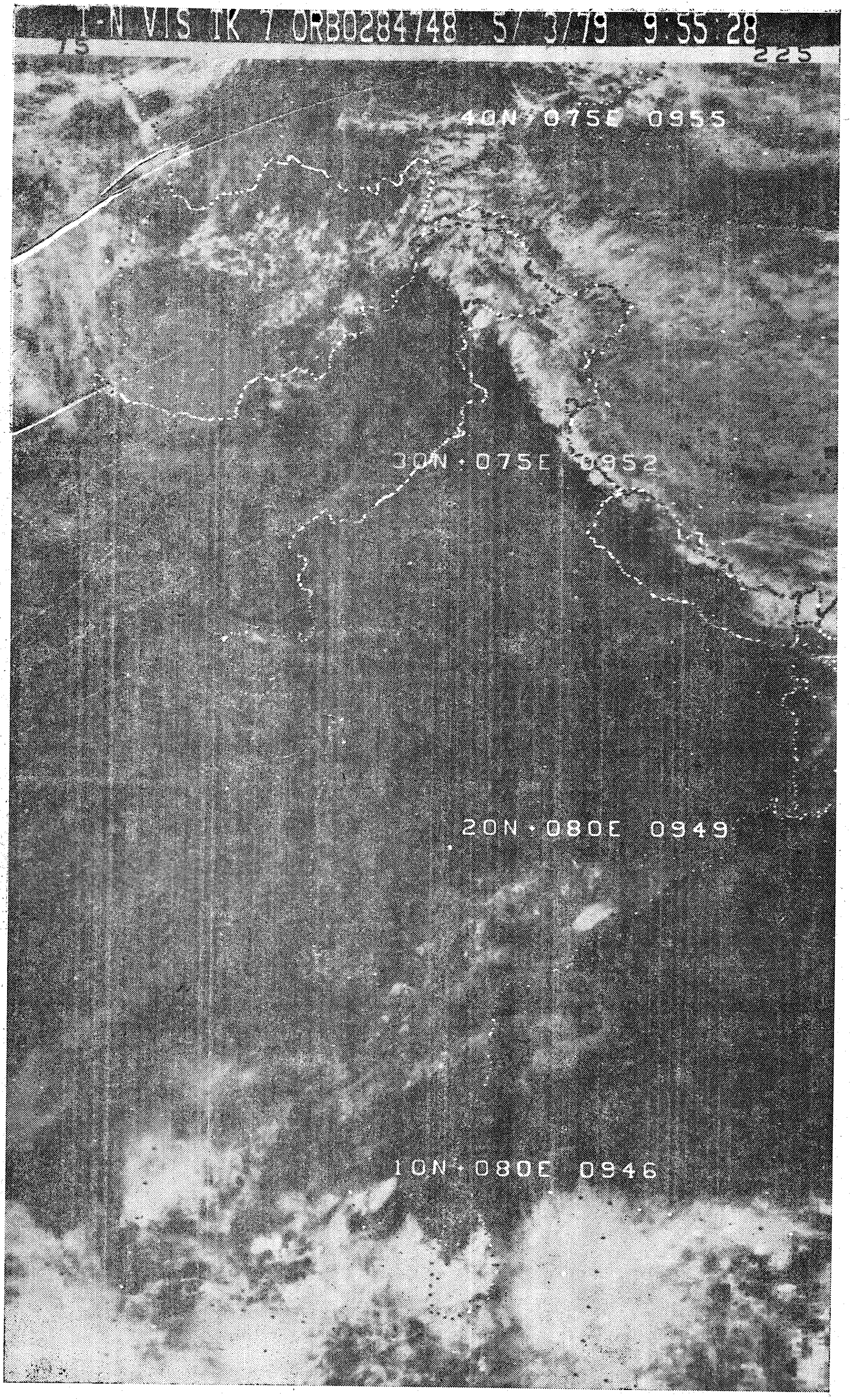

Fig. 1. TIROS-N visible image, 3 May 1979

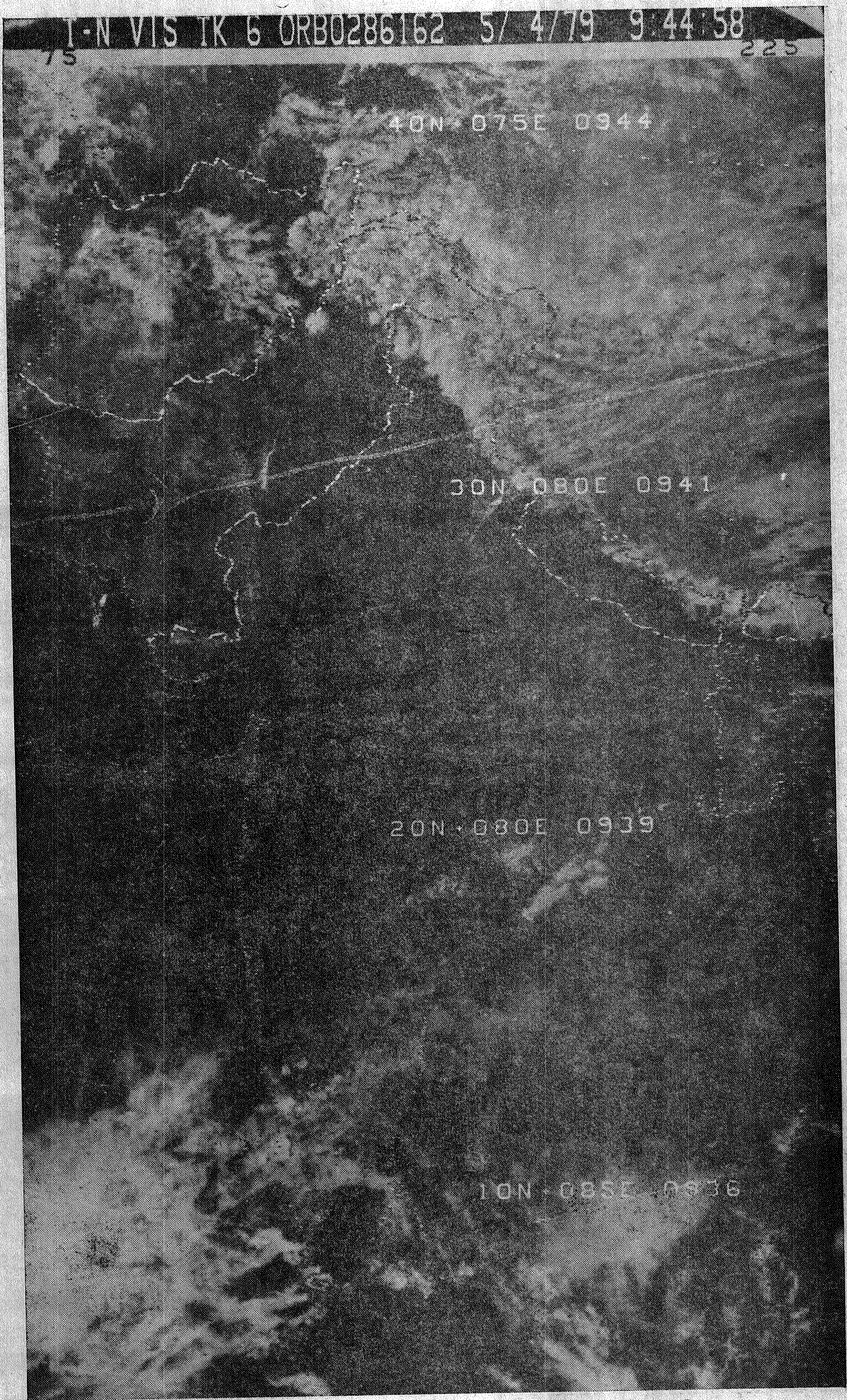

Fig. 2. TIROS-N visible image, 4 May 1979

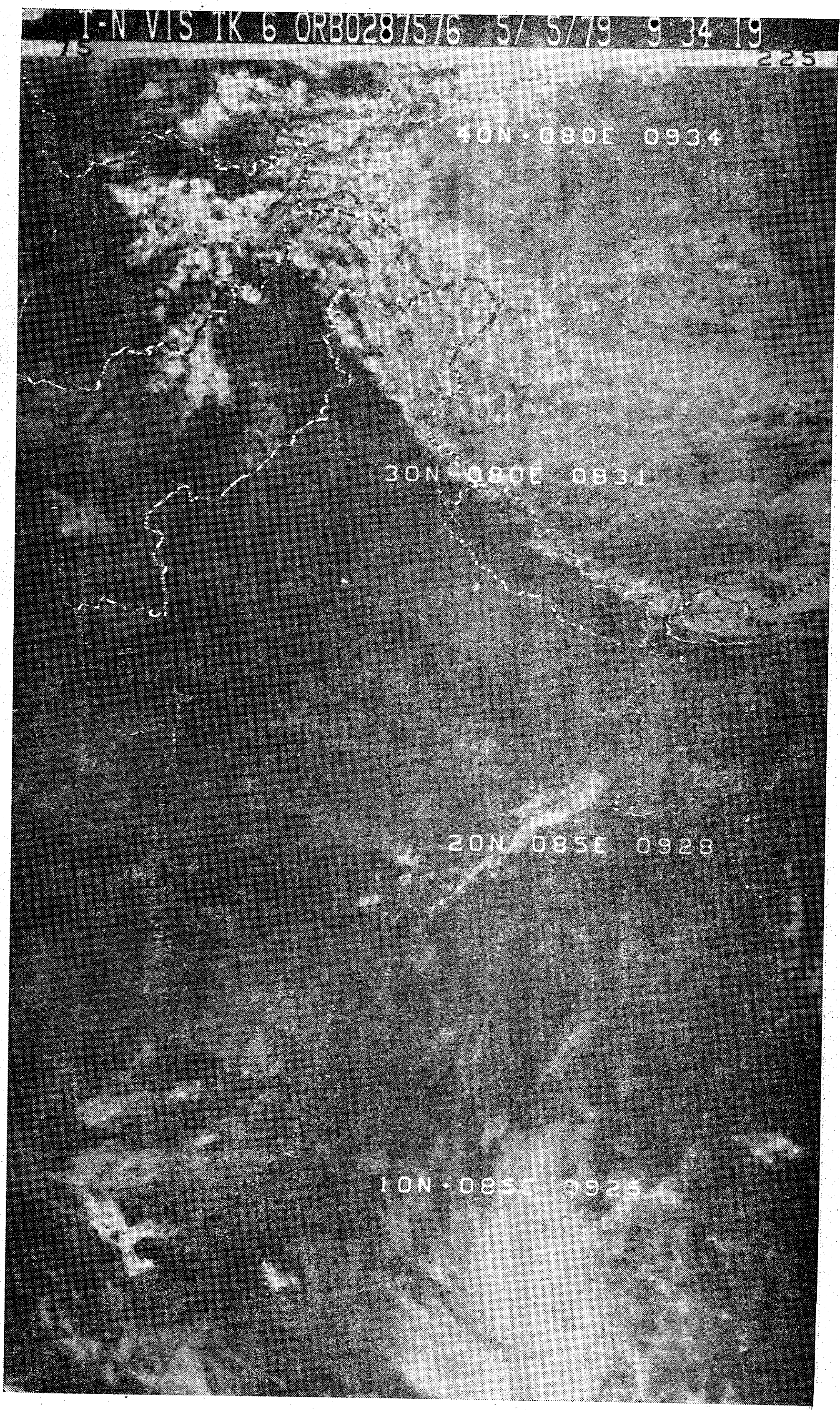

Fig. 3. TIROS-N visible image, 5 May 1979

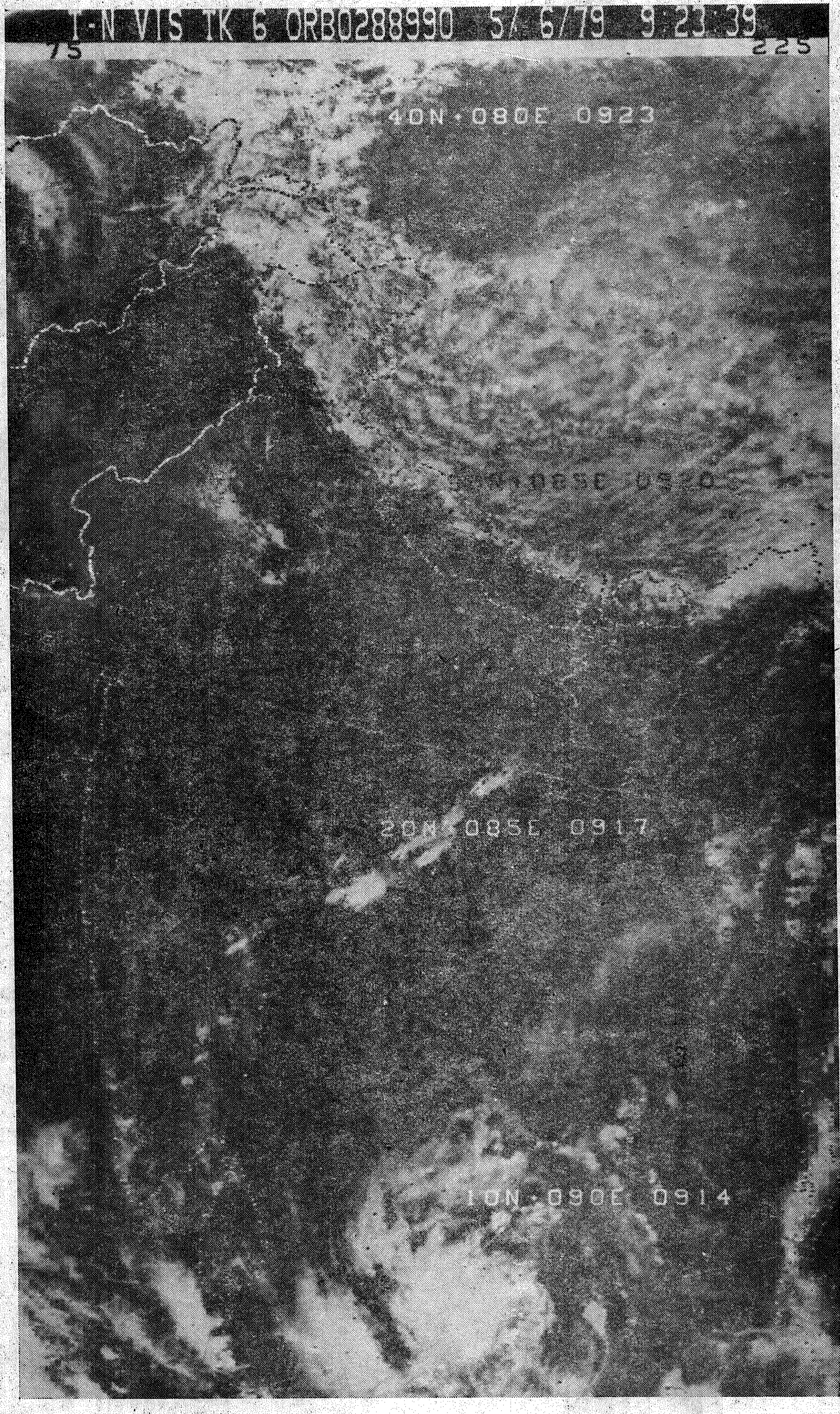

Fig. 4. TIROS-N visible image, 6 May 1979

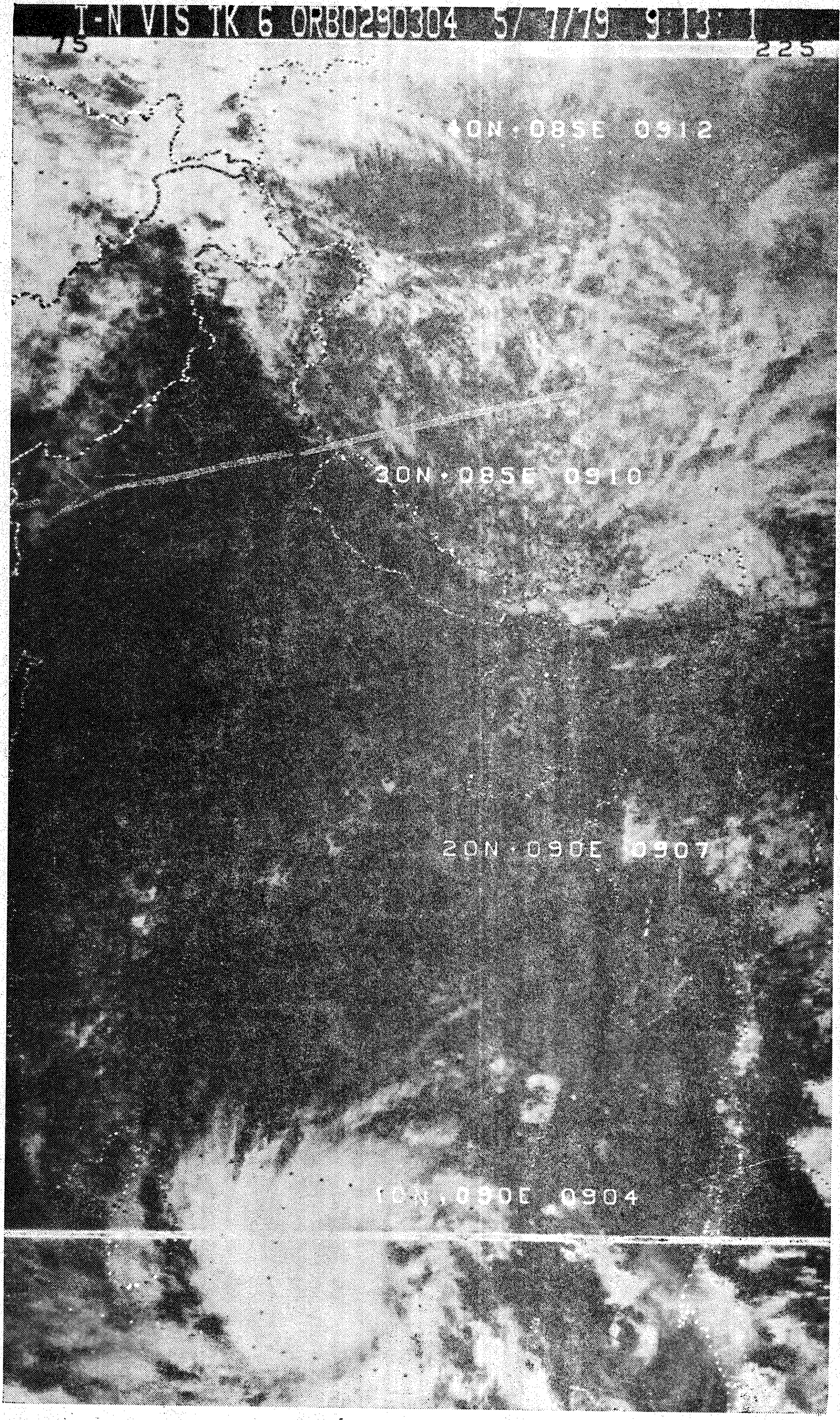

Fig. 5. TIROS-N visible image, 7 May 1979

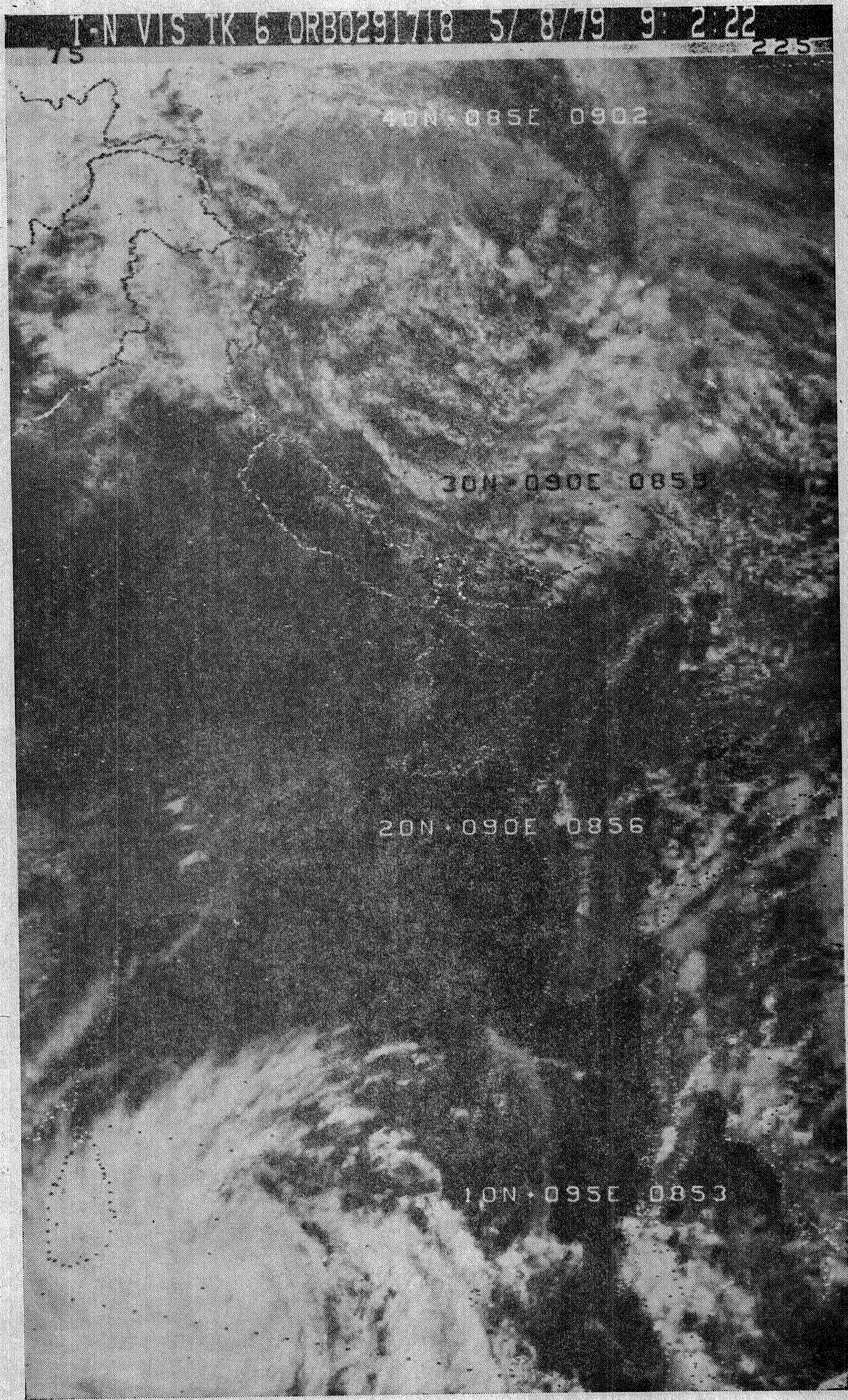

Fig. 6. TIROS-N visible image, 8 May 1979

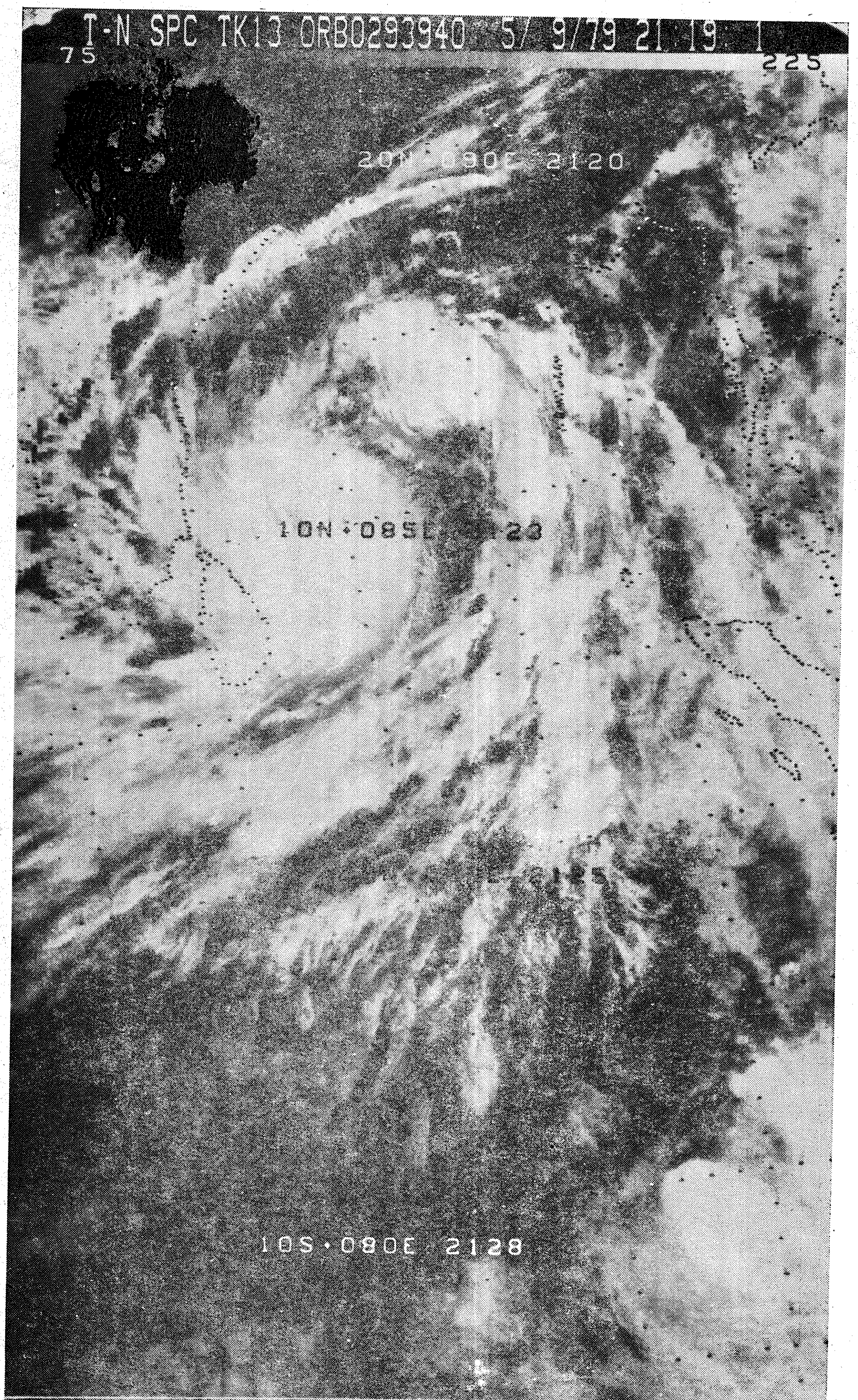

Fig. 7. TIROS-N visible image, 9 May 1979

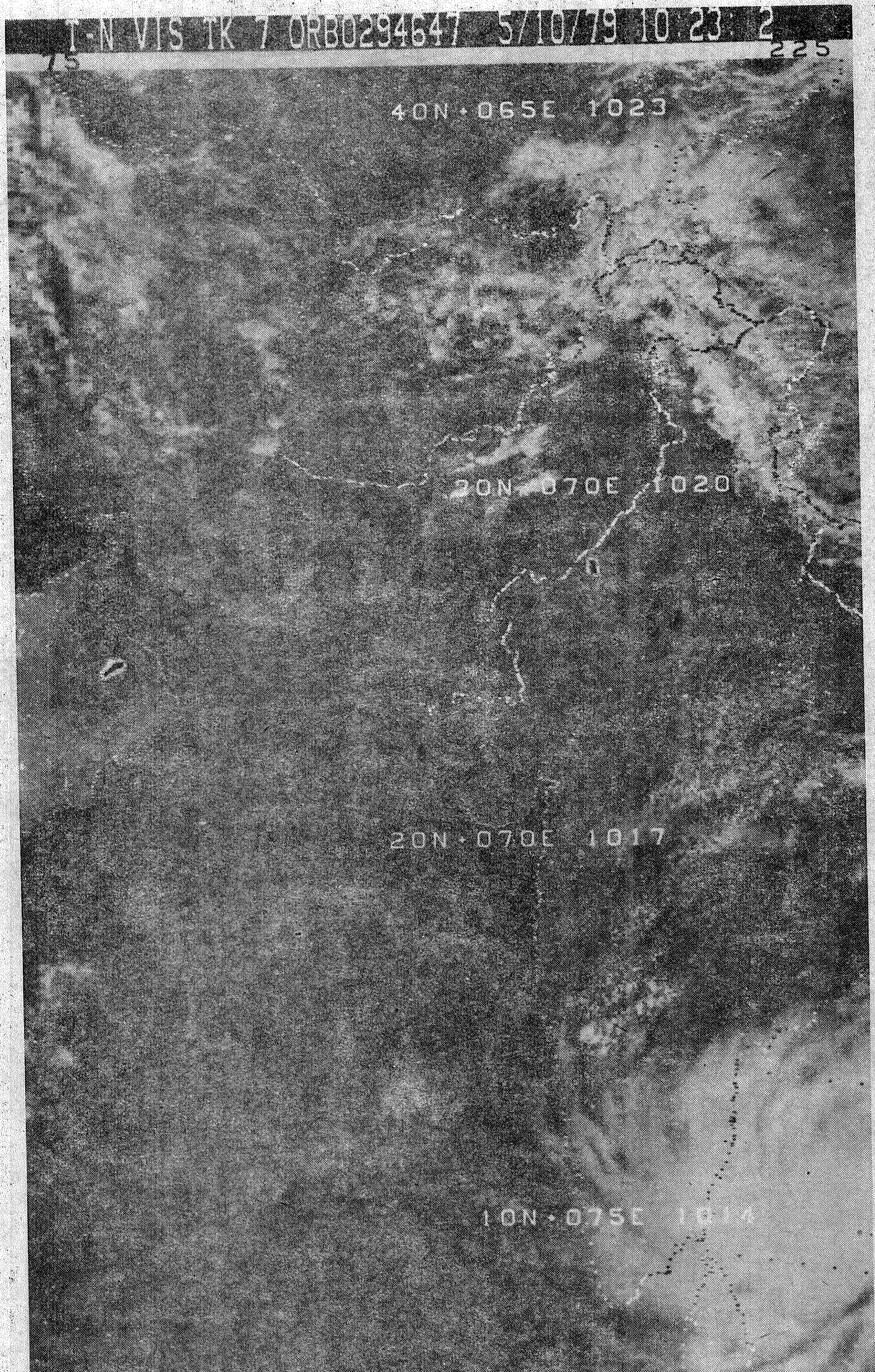

Fig. 8. TIROS-N visible image, 10 May 1979

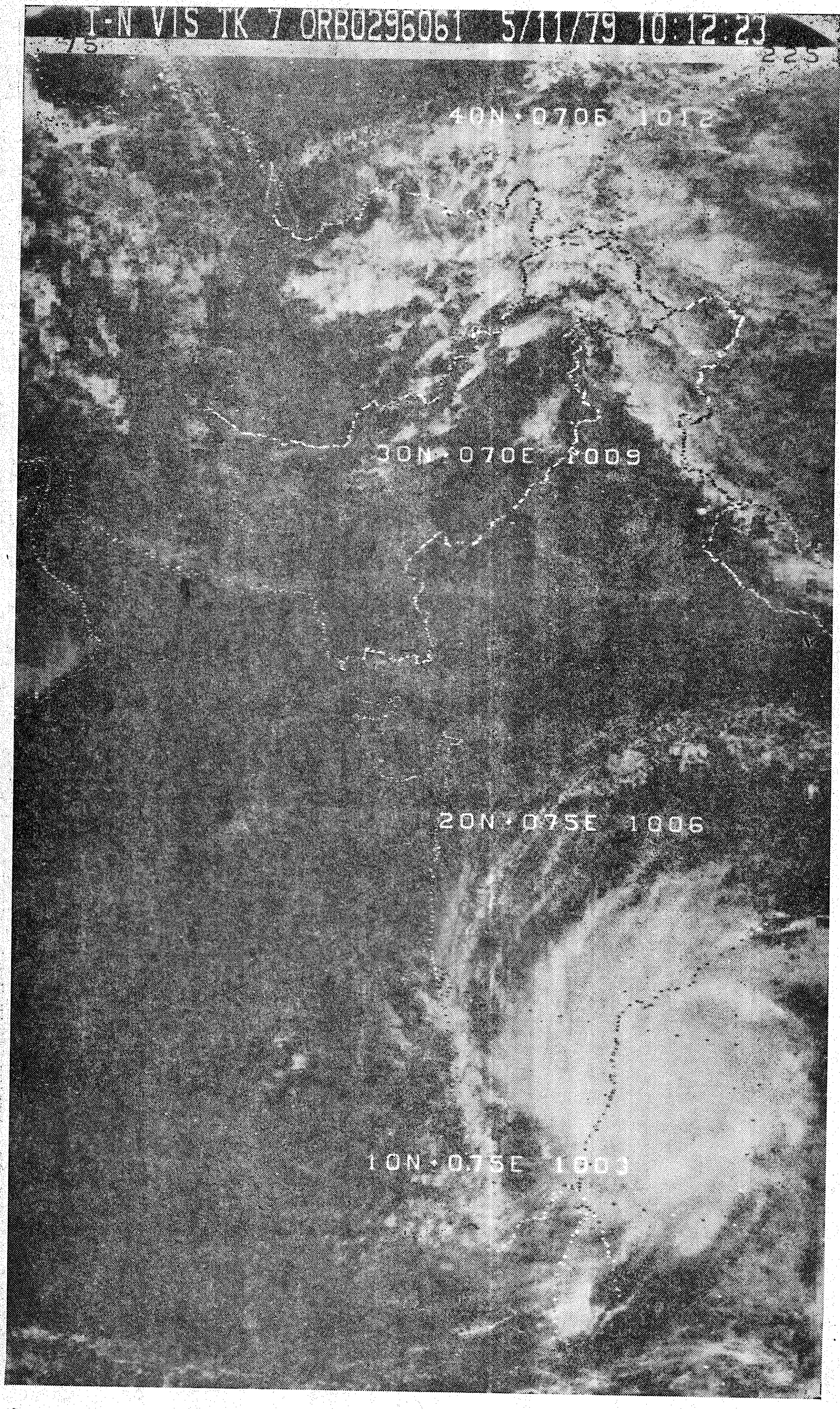

Fig. 9. TIROS-N visible image, 11 May 1979

Fig. 10. TIROS-N visible image, 12 May 1979

Fig, 11. TIROS-N visible image, 14 May 1979

TABLE 1

Date/Time	Location		Estimated	
	Lat. (°N)	Long. (°E)	Pressure (mb)	Wind (kt)
05/0925	7	89	1,003	30
06/0914	6.5	86.7	999	35
07/0904	6.9	87	988	55
08/0850	5.8	86	973	77
09/0842	8.6	85.9	973	77
10/1014	11.9	84	964	90
11/1004	13.9	82.3	954	102
12/0954	15.2	80.8	954	102

quantities were provided by the Satellite Applications Branch (Office of Operations), National Environmental Satellite Service and similar information was transmitted to the India Meteorological Department *via* the Global Telecommunication System. It should be pointed out that Dvorak used the storms over the Atlantic and the Pacific in his studies to estimate the central pressure and wind speed and in the present study over the Bay of Bengal, the nomograms developed for the Pacific storms were utilized. Since no aircraft or other data are available in the vicinity of this storm, it is difficult to compare the satellite estimates with other data.

On 3 May 1979, an organized cloud cluster (Fig. 1) was located east of Sri Lanka and on the following day (Fig. 2) it was relatively weak. However, low level spiralling cloud bands could be noticed indicating some organization taking place. Fig. 3 clearly shows an organized vortex on 5 May 1979 (at 7°N, 89°E) and the central pressure was estimated to be 1003 mb and wind speed 30 kt. On this day there was another vortex south of the equator at 5°S, 80°E. The intensity of the southern system was identical to the one in the north and the only difference was the one in the southern hemisphere dissipated the following day. On 6 May (Fig. 4), the tropical system was well organized with a noticeable centre and spiral bands and the location was at 6.5°N and 86° E with an estimated central pressure 999 mb and 35 kt winds. Within the next 24 hours the storm intensified and was located at 6.9°N and 87°E (Fig. 5). The central pressure and winds were estimated as 988 mb and 55 kt.

The tropical cyclone continued to intensify and move towards NW and on 8 May, it was located at 5.8° N and 86°E (Fig. 6) with an estimated central pressure 973 mb and winds 77 kt. The northwestward movement of the cyclone continued and Fig. 7 shows that on 9 May 1979, the system was located at 8.6°N, 85.9°E with an estimated central pressure of 973 mb and wind speed 77 kt. There seemed to be no change in the intensity of the cyclone between 8 May and 9 May. The cyclone continued to move NW and intensify during the next period and on 10 May (Fig. 8) it was located at 11.9°N and 84°E with a pressure of 964 mb and winds about 90 kt. Again, the eye of the cyclone could be noticed clearly in the image. Fig. 9 shows the position of the finally developed cyclone with a noticeable eye at 13.9°N and 82.3°E on 11 May 1979, and the central pressure was estimated as 954 mb and winds at 102 kt. There was relatively no change in the intensity of the cyclone on 12 May (Fig. 10), and it was located at 15.2°N and 80.8°E. One could conclude from this image that the cyclone had crossed the coast during this period and the central pressure was estimated to be 954 mb and winds 102 kt. The outflow at upper levels near the storm could be noticed from the spiralling clouds and covers a large areas of the Indian sub-continent.

No images were available over this area from Washington for 13 May 1979. Fig. 11 shows the remnant of the tropical storm on 14 May and located over the central part of south India. The intensity of the storm was relatively weak after the land-fill.

4. Summary

The sequence of TIROS-N images shown in Figs. 1-11 show the complete development and dissipation of the tropical cyclone over the Bay of Bengal during 3-16 May 1979. This short article shows the usefulness of good quality images in estimating the pressure and winds within these systems and the usefulness of this vital information for the synoptic analysis over the Bay of Bengal. As it has been pointed out by the India Meteorological Department, due to the timeliness of the information from TIROS-N satelite, adequate precautions were taken to minimize the loss of life, it is essential to have good quality images as shown in this article for adequate interpretation. Since no independent set of wind data were available near the storm it was not possible to compare the satellite estimates with actual information. It would be very useful if such comparisons could be made to ascertain the utility of Dvorak's technique for the Bay of Bengal area.

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