

BREAKS IN INDIAN SOUTHWEST MONSOON AND TYPHOONS IN SOUTHWEST PACIFIC

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ONE of the important features of the Indian southwest monsoon is the trough of low pressure which extends from northwest India to Orissa. The axis of this trough runs on the average from Hissar in the Punjab through Agra and Allahabad to the head of the Bay of Bengal in the mid-monsoon month of July. The winds are westerly to the south of the axis, while to the north, they are easterlies. This axis does not remain stationary, but it moves north or south of the normal position and affects the rainfall distribution over the country as it moves. Sometimes, the axis of the trough shifts north and lies possibly over the Himalayas. When this happens westerlies sweep across the Gangetic Plain and the easterly flow is totally absent. This is called by the Indian Meteorologists as a 'break' in the monsoon'. In such situations the rainfall is mostly confined to the foot of the Himalayas and is also heavy. There is a general decrease of rain over the rest of the country.

Malurkar² has concluded that the shift of the axis of the monsoon trough northwards may be taking place at a time when one of the stationary low pressure areas in West China or Chinese Turkestan gets accentuated. This accentuation may be partly due to the more southerly travel of extra-tropical disturbances than usual. He has also said that the travel of a low pressure area or 'pulse' south of the equator into the southwest Arabian Sea may give rise to a 'break' in the monsoon in the Indian area. Koteswaram³ has mentioned that the westward movement of an upper 'low' at low latitudes across the Indian area is often associated with a 'break' in the south-west monsoon. Parthasarathi⁴ has recently discussed some aspects of breaks in the monsoon during 1954.

In this note, an attempt has been made to trace the relationship between the 'breaks' in the southwest monsoon in India and the movement of depressions or typhoons in the southwest Pacific. The typhoon tracks published by the Royal Hongkong Observatory in their 'Meteorological Results—Part I', have been used in this study. The positions of depressions and typhoons mentioned in the note hereafter refer to 00 GMT. The axis of the monsoon trough

in India has been traced from the daily wind distribution at 3,000' at 0200 GMT. The study covers the months of July and August in the six years, 1947-52.

A close correlation has been found to exist between the position of the axis of the monsoon trough and the position of typhoons in the China Seas. As depressions or typhoons in the southwest Pacific located between longitudes 110° E and 140° E. crossed over to the north of Lat. 30° N., the axis of the monsoon trough over India moved into the Himalayas. Six specific instances in support of the above are given in Table I. It was seen that in five of these cases the axis of the monsoon trough moved to the foot of the Himalayas within a day of the depression or typhoon in the China Seas crossing to the north of Lat. 30° N.

TABLE I

No.	Date on which depression or typhoon in S.W. Pacific crossed to the north of Lat. 30° N. with position of the centre on that date	Date on which the axis of the monsoon trough over India at 3,000 ft. shifted close to the foot of the Himalayas
1	9-7-1947 (31.4° N., 130.3° E.)	9-7-1947
2	7-8-1947 (33.3° N., 138.2° E.)	7-8-1947
3	17-7-1949 (31.2° N., 129.8° E.)	18-7-1949
4	16-8-1949 (32.7° N., 130.0° E.)	20-8-1949
5	5-7-1951 (32.8° N., 136.9° E.)	6-7-1951
6	22-8-1951 (32.6° N., 124.3° E.)	23-8-1951

Only in the August 1949 instance (16th-20th), did the eastern end of the trough begin to shift northwards after the typhoon moved to the north of 33° N. After the typhoon moved to 36° N. the trough shifted into the Himalayas. The instance of July 1949 is very striking in that the trough on the 16th was occupying an unusually southerly position between 21° N. and 22° N. Within two days this trough moved into the Himalayas coinciding with the movement of a typhoon from 27.8° N. to 34.1° N. The break that set in on 23rd August 1951 lasted practically till the end of the month.

Two more instances of the axis of the trough having shifted to the Himalayas with the depression/typhoon heading towards Lat. 30° N. occurred during the periods 27th-30th July 1947 and 10th-15th August 1950. In these two instances full information regarding the typhoon tracks is not available.

There have been six cases when the axis of the monsoon trough did not shift to the hills even though depressions or typhoons in the China Seas have crossed to the north of Lat. 30° N. These instances occurred during the periods 5th-9th July 1948, 27th-29th July 1949, 18th-21st July 1950, 26th-29th July 1950, 18th-20th July 1952 and 16th-19th August 1952. It was, however, noticed that at about that time, conditions have either been unsettled in the North Bay of Bengal or depressions have been present in the Indian area.

Even with no depressions in the Indian area, a few instances have been observed when the axis did not shift to the Himalayas in spite of the depression/typhoon in the China Seas having crossed to the north of Lat. 30° N. The noteworthy feature in these cases is that at the same time there were other typhoons or depressions in the southwest Pacific itself at more southern latitudes than the ones that had crossed 30° N. Two such instances occurred during the periods 23rd-25th July 1949 and 13th-15th July 1952.

Besides the cases mentioned above, there have been only two other occasions of break in monsoon in the months of July and August in these six years which it has not been possible to associate with published typhoon tracks available to the author. It is not known whether there were any typhoons to the east of Long. 140° E during the period which have had any association with these two cases of breaks. It may be mentioned that all the typhoons which have crossed 30° N. to the west of 140° E. during these six years have been considered in this note.

From the above evidence the following correlations would appear to exist between the 'break in the monsoon' over India and movement of depressions or typhoons in the southwest Pacific (i) When a depression or typhoon in the China Seas crosses to the north of 30° latitude the axis of the monsoon trough shifts into the Himalayas; (ii) This break does not

occur if simultaneously there is another depression or typhoon in the China Seas itself to the south of latitude 30° N. (iii) Unsettled conditions in the Bay of Bengal or a depression in the Indian area prevents the movement of the monsoon trough into the Himalayas even if a depression or typhoon in the China Seas has crossed 30° N. latitude.

The general circulation gives an easterly flow over the sub-Himalayan area above 4 km. during the months of July and August. Typhoons of the China Seas are intense systems which may affect the general circulation over a very wide belt. Hence it is probable that a typhoon near Long. 120° E, when it crosses to the north of Lat. 30° N. may affect the circulation westwards as far west as 80° E. and replace the prevailing easterlies by westerlies over the Indian area which lies to the south of the typhoon centre.

However, when there is a tropical cyclonic system in the Indian area itself, it is natural to assume that the far eastern typhoon is unable to replace the prevailing easterlies above 4 km. along the foot of the Himalayas by westerlies. Again, when there are two typhoons, one to the north of Lat. 30° N. and the other to the south of Lat. 30° N., their effect at the distant Indian latitudes may cancel out and under such a situation the prevailing easterlies over India may continue and the axis of the monsoon trough may not shift to the hills.

It is not contended that the typhoons in the China Seas are the only factor controlling the breaks in the Indian monsoon. Factors such as the unusual southward movement of the troughs in the westerlies further to the north of India may also have an influence on the occurrence of 'breaks'. This aspect of the problem is under investigation.

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1. *India Meteorological Department Technical Note*, 1944, No. 1, 17.
2. Malurkar, S. I., *Memoirs of the India Met. Department*, 1950, 28, Part 4, 15.
3. Koteswaram, P., *Ind. J. Meteorology and Geophysics*, 1950, 1 (2), 162.
4. Parthasarathi, K., *Ibid.*, 1954, 5 (4), 328.