551·515·4(541)

A SEVERE THUNDERSQUALL AT GAUHATI ON 17 MARCH 1955

1. General

A severe thundersquall accompanied with heavy showers was experienced at Gauhati Airport and neighbourhood on the night of 17 March 1955. It was a northwesterly squall and hit the station at 1815 GMT. In the absence of a Dines anemograph, the maximum wind speed could not be ascertained accurately, but according to the observer's estimation the speed was of the order of 66 mph. A temporary motor transport shed at the airport was completely demolished, a portion of the roof of the C.A.D. quarters (asbestos sheet on an Assam-type Kutcha-Pucca structure) collapsed and a corrugated tin sheet of a private garage was blown off to a distance of about 200 yds towards ESE. This squall was one of considerable interest because of its severity.

2. Synoptic situation

The synoptic situation on the morning of 16 March was briefly as follows. A low pressure area lay over the Punjab-Kumaon hills and the adjoining Nepal-Himalayas while a feeble secondary developed over Chota Nagpur and adjoining West Bengal. The wind discontinuity at 5000 ft a.s.l. between *Tc* and *TmTc* air passed from Jamshedpur to Sibsagar through Bhagalpur. With the northeasterly movement of the cyclonic vortex over Chota Nagpur, thundery conditions developed over Bagdogra at 0600 GMT but Gauhati remained clear. At 1200 GMT, the low over Chota Nagpur was more or less stationary, but the low over the Nepal-Himalayas had moved slightly to the east. Bagdogra was overcast with *Cb*, and Gauhati recorded a thunderstorm with two oktas of *Cb*. Thundershowers with squall were reported at 1300 GMT with wind speed reaching about 36 mph.

The situation on the 17th was also somewhat similar to that of the 16th. A trough extended from Uttar Pradesh to Central Burma with two distinct cores; one lying over Sub-Himalayan Uttar Pradesh and adjoining Nepal-Himalayas, while the other was over the central part of Bengal. By 1200 GMT the low over Central Bengal had shown little movement as on the previous day, and the thunderstorm developed at Gauhati at about 1800 GMT.

3. Change in convergenee pattern

To estimate the change in convergence pattern associated with the squalls the following procedure was adopted. We have

$$\mathrm{div}_2\,\mathbf{V} = \frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}$$

where u, v are the wind components towards the east and the north respectively. Hence

$$\frac{\partial}{\partial t}(\mathrm{div}_2\,\mathbf{V}) = \frac{\partial}{\partial t}\left(\frac{\partial u}{\partial x}\right) + \frac{\partial}{\partial t}\left(\frac{\partial v}{\partial y}\right) = \frac{\partial}{\partial x}\left(\frac{\partial u}{\partial t}\right) + \frac{\partial}{\partial y}\left(\frac{\partial v}{\partial t}\right) \quad (1)$$

The values of u and v were computed for ten stations in northeast India from the 0200 and 0900 GMT ascents on 17 March 1955. From these two ascents separated by seven hours, the values of $\partial u/\partial t$ and $\partial v/\partial t$ were computed and were plotted on the W4 chart (1:10000000)—Figs. 1 (a) and 1(b). Then from the isolines of $\partial u/\partial t$ and $\partial v/\partial t$, the rate of change of divergence was estimated by using equation (1). The values thus obtained are shown in Fig. 2 in units of $10^{-3}\,\mathrm{hr}^{-1}$.

It will be seen that an area of increasing covergence or decrease in positive divergence, was well marked in the vicinity of Bagdogra and Dhubri, northwest of Gauhati. It is, of course, realised that this method of computation can only indicate the order of magnitude of the increase in convergence because of the instrumental errors in wind determinations; nevertheless, the indication provided by the area of increasing convergence is of interest in view of the subsequent development of the thundersquall that swept over Gauhati.

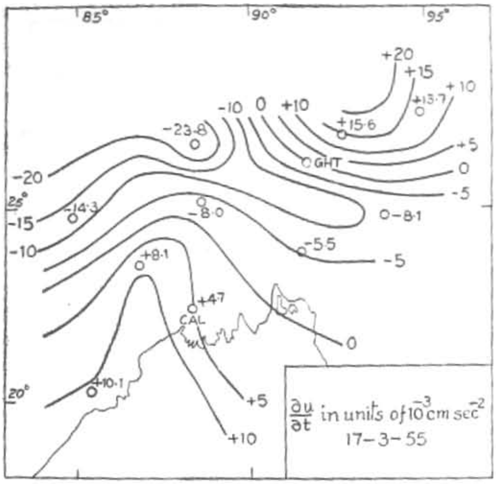

Fig. 1(a)

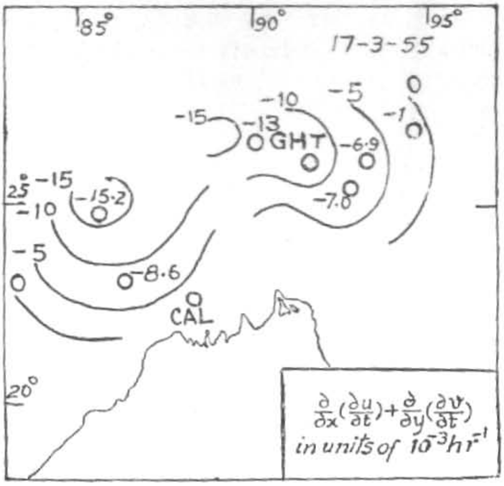

Fig. 2

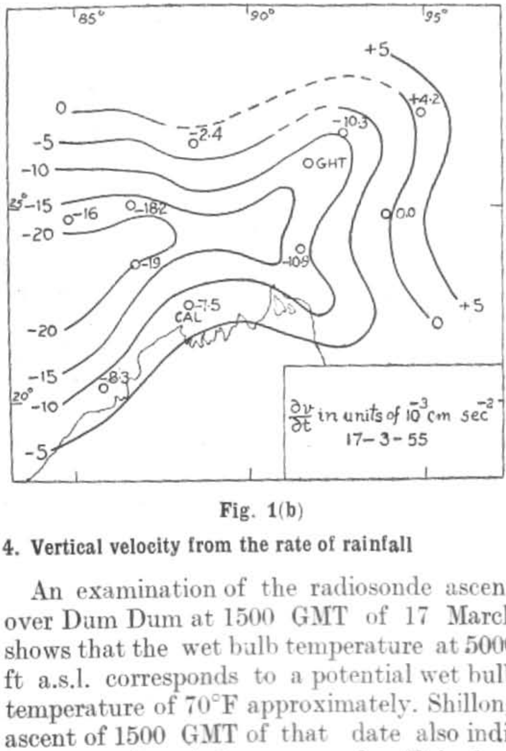

Fig. 1(b)

4. Vertical velocity from the rate of rainfall

An examination of the radiosonde ascent over Dum Dum at 1500 GMT of 17 March shows that the wet bulb temperature at 5000 ft a.s.l. corresponds to a potential wet bulb temperature of 70°F approximately. Shillong ascent of 1500 GMT of that date also indicates a value of the same order. This has, therefore, been assumed to be representative of the air mass over Gauhati.

Moreover, the rain forming processes in this case, *viz.*, widespread lifting due to instability, extended over quite a large area. The Shillong ascent for 17th shows that the air was nearly saturated up to about 600-mb level. Evaporation from falling rain was not likely, therefore, to cause appreciable error.

Now assuming air of potential wet bulb temperature 70° F being bodily lifted with vertical velocity $\bar{w}$ cm sec^{-1} above 1000-mb level, we can apply the following formula of Bannon's to solve for $\bar{w}$, *i.e.*,

$$\bar{w} = 2{\cdot}4\ P \text{ cm sec}^{-1}$$

where P is the rate of rainfall. The multiplying factor 2·4 is obtained by extrapolation.

Now from the records of the S.R. raingauge of 17 March 1955, it is seen that 73 cents of precipitation (thundershowers) occurred in 45 minutes during the period between 0015 and 0100 IST of 18 March.

Therefore the rate of rainfall

$$= 0{\cdot}73 \times 4/3 = 0{\cdot}97''$$
$$= 24{\cdot}6 \text{ mm hr}^{-1}$$

Now $\bar{w} = 2{\cdot}4 \times 24{\cdot}6 = 59$ cm sec^{-1} (approx.)

Upward velocities of 10 — 20 cm sec^{-1} are usual in the active depressions. Such an abnormally high value of the vertical velocity in association with the thundersquall under review clearly indicates tremendous lifting triggered by local instability and also possibly, by orography.

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REFERENCE

Bannon, J. K. 1948 *Quart. J. R. met. Soc.*, **74**, p. 57.