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SOME INTERESTING OBSERVATIONS OF HIGH LEVEL WIND MAXIMA IN THE ATMOSPHERE

The analysis of the wind data of the high level cosmic ray balloon flights, conducted at Hyderabad (India) during March 1960, yielded certain interesting results. Each of the six flights, for which the data are available, showed the presence of two wind speed maxima. The composite diagram in Fig. 1 depicts the wind speed against height in respect of all the six flights and shows the nature of variation of wind speed.

The first maximum wind speed, hereafter designated as $(U_{max})_I$, was found to be between 28-66 knots and occurred at an altitude between 9-12 km above ground. The figures for the six individual flights are shown in Table 1. The average wind speed, $(U_{mean})_I$, between the ground level and the level of the first maximum wind speed, was calculated and the values are given in col. 4 of

TABLE 1

Place : Hyderabad (India)
(Lat. 17° 26′ N, Long. 78° 27′E)

Time of launching of each flight : About 0800 IST

Date March 1960	First maximum				Second maximum				Height of the calm region (km)
	Height (km)	$(U_{max})_I$ (knots)	$(U_{mean})_I$ (knots)	Ratio $\frac{(U_{max})_I}{(U_{mean})_I}$	Height (km)	$(U_{max})_{II}$ (knots)	$(U_{mean})_{II}$ (knots)	Ratio $\frac{(U_{max})_{II}}{(U_{mean})_{II}}$	
1	2	3	4	5	6	7	8	9	10
3	9	66	23	2·9	31	35	24	1·5	21·5
12	12	55	19	2·9	27	47	24	2·0	18·0
14	12	66	25	2·6	27	52	23	2·3	16·5
19	12	38	23	1·7	25	35	23	1·5	21·0
24	9	41	20	2·0	29	29	15	1·9	18·5
29	12	28	17	1·6	27	35	14	2·5	17·0
Average ratio				2·3				1·9	

Table 1. The ratio between the maximum speed and the average speed, *i.e.*, $(U_{max})_I/(U_{mean})_I$ was also worked out for each flight and is given in col. 5 of the table.

These flights also showed the presence of another wind speed maximum with a shallow region of almost calm wind in between the two wind maxima. It was in this shallow layer that the change of wind direction took place from westerly to easterly. The height, above ground, of this calm region for each flight is shown in col. 10 of Table 1.

The upper maximum always occurred at an altitude much higher than that of the lower (or the first) maximum. The wind speed at the second maximum, *i.e.*, $(U_{max})_{II}$, was found to be less than that of the first maximum in all cases except in one. $(U_{max})_{II}$ was found to vary between 35-52 knots and occurred at altitudes between 25-31 km above ground. The figures for the second maxima for the six individual flights are given in cols. 6 and 7 of the table.

As in the case of the first maximum, the average wind speed $(U_{mean})_{II}$, between the calm region and the level of the second maximum, was calculated and these values for the six flights are shown in col. 8 of the table. The ratio $(U_{max})_{II}/(U_{mean})_{II}$ was calculated and the figures are shown in col. 9 of the table.

It will be seen from the above table that the ratio $(U_{max})_I/(U_{mean})_I$ varies from 1·6 to 2·9 for the various flights and averages to 2·3. Thus we can safely conclude that a ratio of the order of 2·5 exists between the speed of the first wind maximum or jet and the average speed below this level.

Similarly for the second maximum, we observe that the ratio $(U_{max})_{II}/(U_{mean})_{II}$ varies between 1·5 and 2·5 for the various flights and averages to 1·9. Thus a ratio of the order of 2·0 is found to exist between the speed of the second (or upper)maximum and the average speed between this layer and the layer of calm wind in between the two maxima.

Here it may perhaps not be entirely out of place to mention that Long (1959) has found a similar relationship existing in the case of flow of fluids with density stratification in a gravity field. According to him, a velocity concentration or jet is expected to form in the

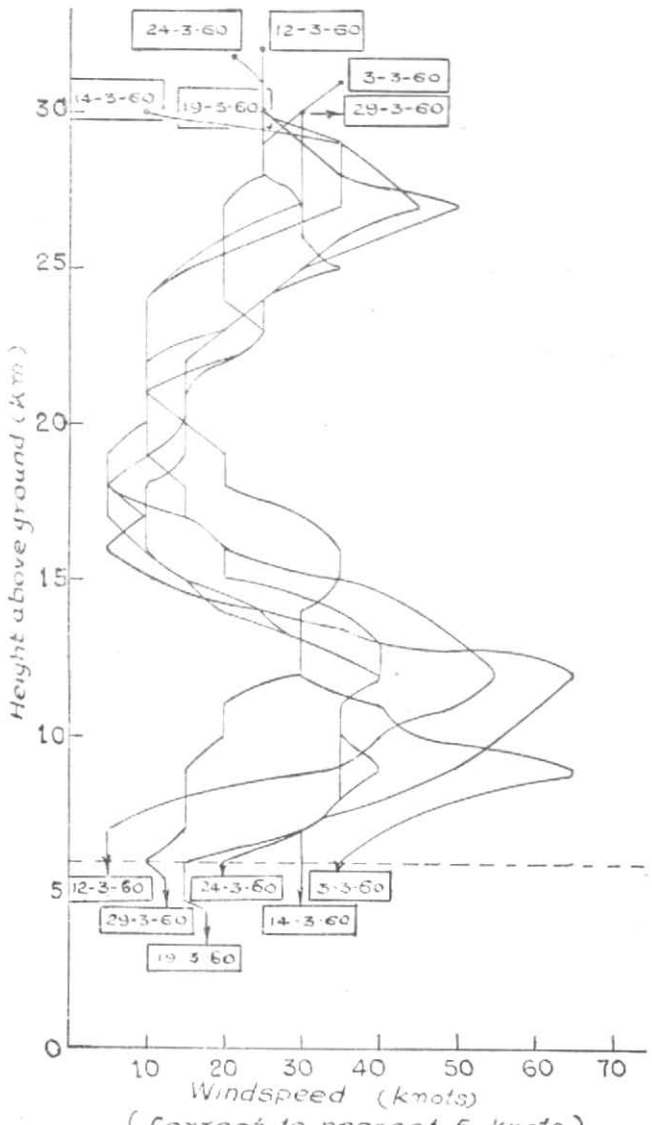

Fig. 1. Nature of variation of wind speed with height

middle of the channel through which the fluid is flowing. He has further shown the velocity concenration or jet to have a maximum speed of $3U$, where U is the horizontal velocity. His theory also predicts the simultaneous occurrence of a number of velocity maxima.

It will be seen that Long's figure of 3 for the ratio U_{max}/U_{mean} compares favourably with the figure of 2·5 for $(U_{max})_I/(U_{mean})_I$ existing in the case of tropospheric flow as shown by the above analysis of the Hyderabad flights. Although Long's treatment deals with phenomena observed in broad deep channels of barotropic fluid flow, not subjected to any coriolis force and where Navier-Stokes frictional forces balance the impelling forces along the flow, yet the observed similarity between the figures for the ratio U_{max}/U_{mean}, in the two different types of fluid flow, is interesting and intriguing.

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REFERENCE

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