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Variation of Electrical Potential Gradient with height at Poona from 31 October to 2 November 1953

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In recent papers (Venkiteshwaran and others 1953, 1954) have described the techniques developed by them to measure the distribution of electrical potential gradient in the upper air by radiosonde. They have employed the HL23 valves as an electrometer as devised by Koenigsfeld (1951) and adapted it for use with the audio frequency modulated type of radiosonde used in the U.S.A. Polonium collectors were used with the valve electrometer.

In the American type radiosonde, the meteorological elements are measured from the audio frequency modulation of a carrier wave on about 4 metres by varying the resistance in the meteorological control circuit. To measure the potential gradient, the meteorological elements are replaced by the valve electrometer. The balloon ascent will therefore consist of the above assembly which gives values of the potential gradient, and an F-type radiosonde (Venkiteshwaran and others 1948) to determine the corresponding heights. One can get from this flight, in addition to values of potential gradient, values of pressure, temperature and humidity distribution also. The ground equipment will consist of two independent units, one being the American radiosonde recorder for the potential gradient and the other, the F-type radiosonde recorder for pressure, temperature and humidity.

A number of observations of potential gradient have been made at Poona with balloons carrying the above assembly. In clear weather, they generally indicate a rapid decrease in the field with increasing height above the ground, attaining almost a steady value of about 20 to 30 volts per metre at levels above about 15,000 feet. There are, appreciable variations, both diurnal and seasonal, in lower layers of the atmosphere up to about 10,000 to 15,000 feet even in clear weather. These are obviously due to local changes in the space-charge and the conductivity of the air. They are due to the amount and distribution of smoke or dust pollutions which are controlled appreciably by the variations in the stability of the atmosphere, *i.e.*, in the mixing action and general turbulence of the air layers. During the winter season, strong ground inversions prevail, particularly during the night and in the early morning and as a result, there is an increase in the condensation nuclei, in the lower layers of the atmosphere, resulting in mist or even fog, which decrease the conductivity of the air by raising the proportion of the slow ions, causing a corresponding increase in the potential gradient.

In the following paragraphs, the variation of potential gradient with height at Poona during a few consecutive days in October-November 1953 (from 30 October to 2 November) are described. On two days during this period there was fog in the morning. As actual observations showing the variation of potential gradient with height published so far is meagre, it is presumed that the data described in this paper will be useful. The balloon flights were made on all the days at about 2000 IST.

Figs. 1–4 show the distribution of potential gradient and the corresponding tephigrams from the radiosonde flights. Fig. 5 shows the nature of the original record of potential

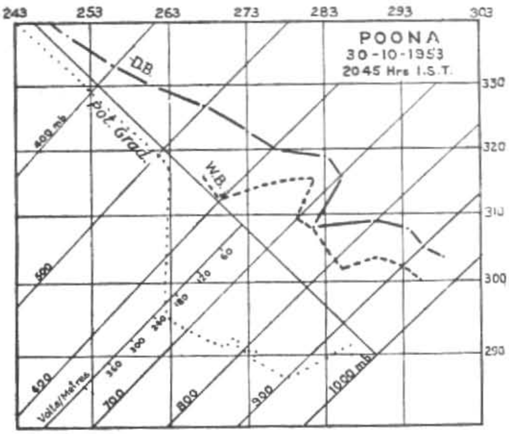

Fig. 1

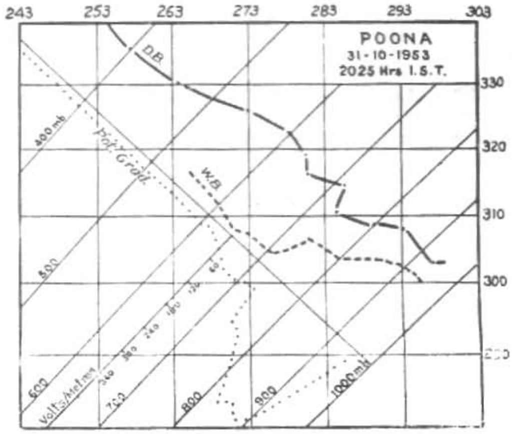

Fig. 2

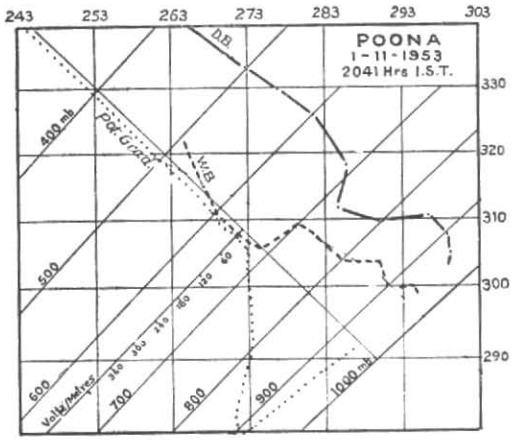

Fig. 3

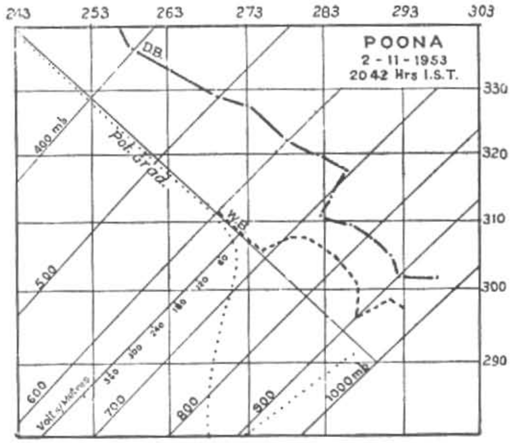

Fig. 4

gradient obtained on 31 October 1953 with the ground equipment used with the American audio frequency modulated type of radiosonde.

At the time of the balloon flight, the weather was clear on all the days. But there was dense fog on the morning of 31 October and 1 November. On 31 October, the fog commenced at about 0545 IST and the whole town including the Parvati Hill which is nearly 350 feet above ground was also covered. The fog cleared by 1000 IST

On 1 November, the fog commenced at about 0500 IST. Its thickness and distribution was lesser than that on the previous day. There was no fog on the Parvati Hill, and observations at 0700 IST from the hill, showed that it was thin and was covering the town. The fog lifted by 0815 IST in the form of stratus cloud and finally cleared by 0835 IST. There was fair weather cumulus during the day and this also cleared up by 1800 IST.

There was no fog on other days, but there was morning mist. There was fair weather cumulus on the 2nd after 1000 IST which cleared by the evening. On 3 November, the sky was mainly clear except for traces of *Ci.*

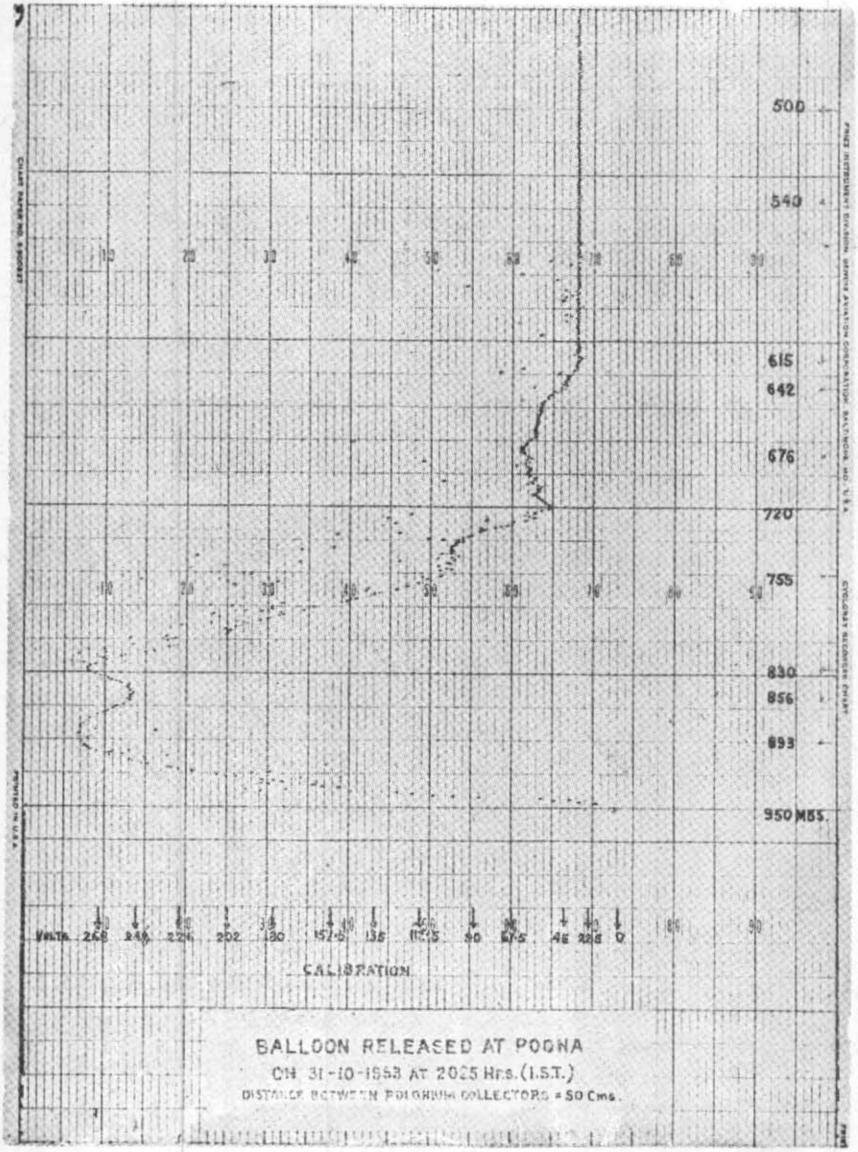
500
540
615
642
676
720
755
830
856
893
950 MBS.
VOLTS 268 246 224 202 180 157·5 135 112·5 90 67·5 45 22·5 0
CALIBRATION
BALLOON RELEASED AT POONA
ON 31-10-1953 AT 2025 Hrs. (I.S.T.)
DISTANCE BETWEEN POLONIUM COLLECTORS = 50 Cms.

Fig. 5

Excepting for the record of 31-10-53, the tephigrams and the potential gradient records are almost similar on all the other days.

On most days, the potential gradient increased sharply just above the ground to nearly 600 volts per metre and this value rapidly decreased above approximately 850 mb (4760 feet above ground). It will be observed from the tephigrams that this level corresponds to the level above which there is an increase in the lapse rate of temperature. However, the ascent of 30 October 1953 was an exception. On this day, the high values of potential gradient extended up to about 660 mb (11,200 feet above ground). The potential gradient was greater than 440 volts per metre up to about the 650-mb level. The actual values attained on this day were not recorded as it exceeded the maximum of the scale. The occurrence of large potential gradients up to higher levels (nearly 650 mb) on this day is presumably related to special features shown in the tephigram and the thick fog which occurred the next morning. On this day, the humidity was appreciably greater at higher levels, reaching almost saturation at about 730 mb (9200 feet above ground). On other days, there was a sharp discontinuity indicating the presence of drier air above approximately between 750 and 700-mb levels.

The potential gradient distribution and the tephigrams also show that although the level at which the fall in the potential gradient approximately corresponds to the region of increasing lapse rate (about 850 mb), the lowest value of the potential gradient is reached at 750-700 mb, where there is a sharp inversion associated with the drier air mass above. The potential gradient record of 31 October 1953 even shows a small hump in the region between approximately 720 to 660 mb corresponding to the changes in the lapse rate at these levels.

The value of the potential gradient in the upper drier air mass is low, being of the order of about 30–50 volts per metre, and there appears to be no change in this value at all heights above, extending even up to 100 mb.

Even these few ascents when examined with the corresponding tephigrams bring out some features about the variations in the potential gradient in clear weather in relation to the limit of convection level. The tentative conclusions pointed out in this note will be tested by an examination of regular observations which are being planned to be recorded.

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