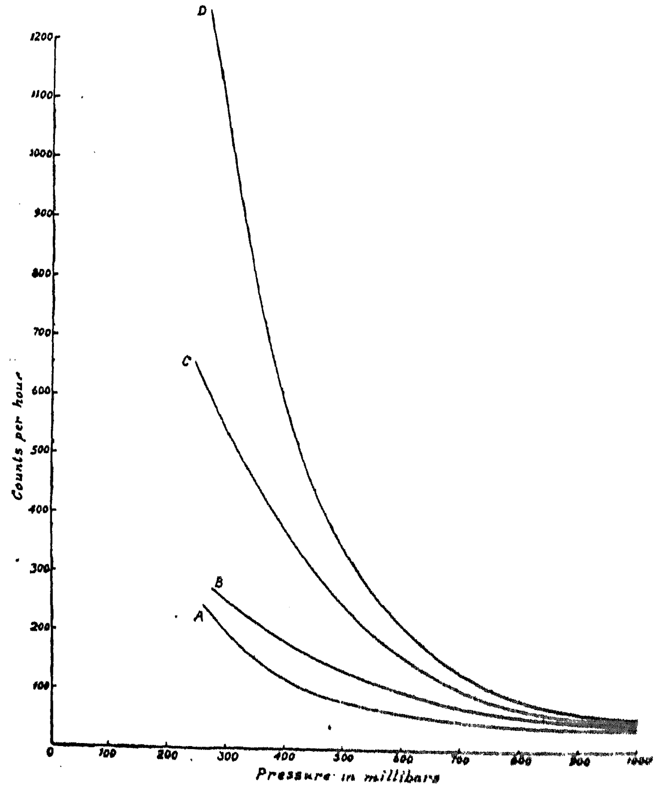
LETTERS TO THE EDITOR

LATITUDE EFFECT FOR MESONS

SCHEIN, Jesse and Wollan,[1,2] and Schein, Jesse and Grötzinger[3] have measured the variation with altitude of the vertical intensity of mesons penetrating 10 cms. of lead at Chicago, magnetic latitude 52·5° N. Similar measurements were made earlier by Dymond[4] at Edinburgh, magnetic latitude 59° N, but the work was interrupted by the war and only a preliminary note has been published. No such measurements have yet been made near the geomagnetic equator. We have, therefore, measured in an airplane the vertical intensity of mesons penetrating a 20 cms. block of lead absorber at Bangalore, magnetic latitude 3·3° N, up to a height corresponding to a pressure of 275 millibars 32,000 ft., with a quadruple coincidence counter telescope in which the extreme counters were 35 cms. apart. The counters were 15 cms. long and 3½ cms. in diameter. The geometry of the telescope was, therefore, such that a particle recorded at the maximum allowed angle of 22° would travel a thickness of the atmosphere and absorber only 8 per cent. greater than a particle arriving vertically.

In the figure we have plotted our results giving the intensity of mesons penetrating 20 cms. of lead at 3·3° N as curve A and, for comparison, the latest results of Schein, Jesse and Wollan[2] for the intensity of mesons at 52·5° N as curve B. The two curves have been fitted at sea-level to allow for the known latitude and longitude effect[5] of 12 per cent. In the same figure we have plotted the variation of the total vertical intensity with altitude at 3·3° N as given by Neher and Pickering[6] for a triple coincidence counter telescope as curve C, this curve being fitted to our curve so as to show a ratio of vertical meson intensity to total vertical intensity of 80 per cent. as observed at ground-level at Bangalore. Curve D gives the variation of the total vertical intensity with altitude as measured by Pfotzer[7] at a magnetic latitude of 49° N. The four curves together show at a glance the striking fact that whereas the latitude effect between 3·3° N and 49° N of the total intensity shows a pronounced increase with altitude, the



Curve A—Vertical meson intensity at 3·3° N (Bhabha, Aiya, Hoteko and Saxena). *Curve B*—Vertical meson intensity at 52·5° N (Schein, Jesse and Wollan 1941). *Curve C*—Vertical total intensity at 3·3° N (Neher and Pickering). *Curve D*—Vertical total intensity at 49° N (Pfotzer).

penetrating component shows practically no such increase of latitude effect even to heights corresponding to a pressure of 275 millibars. Our results give at least qualitative support to the theory of Hamilton, Heitler and Peng[8] according to which the penetrating component should show only a slightly greater latitude effect than at sea-level up to the heights corresponding to a pressure of 100 millibars. The difference in the geometry of the counter telescopes used by the different authors and the statistical accuracy of the results do not yet permit a quantitative comparison.

A detailed report of this work together with other results will be published shortly elsewhere.

It is with pleasure that we express our gratitude to Col. M. C. Robinson, Commanding Officer of the 84th Air Depot of the U.S.A. Air Force, for giving the permission for the flight, and also to Major G. Denis, Capt. J. Claunch, Lt. Mack, and Sgt. Beaver, under him, for their whole-hearted co-operation.

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EFFECT OF THE RATE OF TRICKLE ON THE MASS OF THE DROP

IN determining the surface tension of a liquid by the drop weight method it is necessary that the drops should be formed sufficiently slowly so that the conditions at the time of separation of each drop from the nozzle of the tube are truly static or very nearly so. The rate of formation of drops in Lord Rayleigh's[1] experiments was about a drop per minute, while Edser[2] and Worsnop and Flint[3] recommend a rate even as high as 60 drops per minute. An interesting point was revealed when actually an experiment was performed to bring out the effect of the rate of trickle on the mass of the drops formed. The results (Fig. 1) show that for small rates of trickle, the mass of the drop increases very slowly, but for larger rates it increases very rapidly to large values when the discrete drops are about to merge into a continuous jet.

A drop separates from the main bulk of the liquid at the nozzle when its weight just exceeds the pull due to Surface Tension. With increasing rate of trickle the liquid rushes out with an acceleration; this effectively reduces the weight of the drop and the drop grows to larger dimensions till the effective weight pulls it down. According to Lord Rayleigh for static conditions (*i.e.*, rate of trickle $n = 0$) $m_0 g = 3{\cdot}8\,r\mathrm{T}$ where m_0 is the weight of the drop when $n = 0$; r is the external radius of the capillary orifice and T is the surface tension of the liquid. If "a" represents the equivalent acceleration of the liquid when the rate of

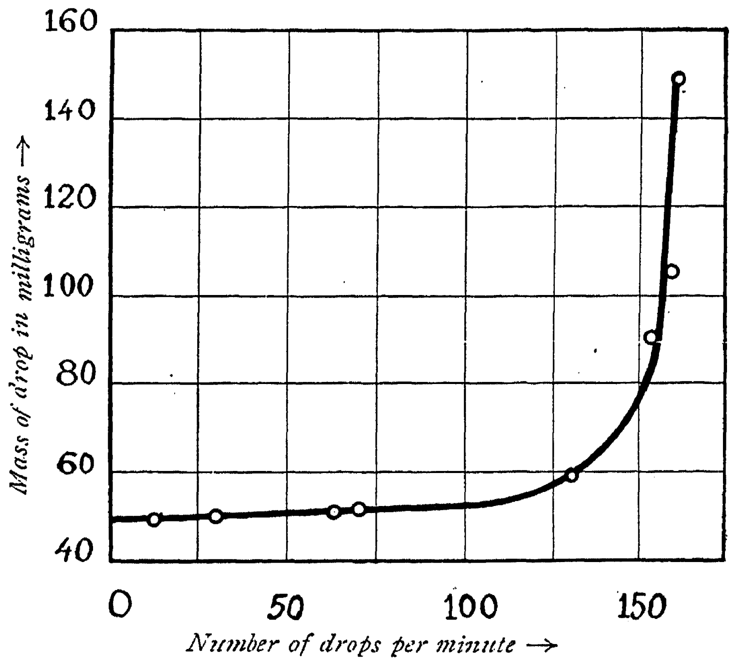

FIG. 1. Variation of the mass of drop with the rate of trickle

trickle is n drops per minute and m is the corresponding mass of the drop, we may write

$$m\,(g - a) = 3{\cdot}8\,r\mathrm{T} = m_0 g \quad \therefore m\left(1 - \frac{a}{g}\right) = m.$$

Now the acceleration "a" depends on "n" the rate of trickle. Therefore we write $m[1 - f(n)] - m_0$ where $f(n) = 0$, when $n = 0$. Since the experimental curve is nearly a rectangular hyperbola $f(n)$ probably has the form kn^x where k and x are constants.

In order to confirm the above explanation qualitatively experiments were carried out using strong electric fields to aid the acceleration of gravity. The drops actually separate out at an earlier stage of growth than when such an aiding force is absent.

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January 15, 1945.

1. Lord Rayleigh, "Investigations in Capillarity," *Phil. Mag.*, 1899, **48,** 321–37. 2. Edwin Edser, *General Physics for Students*, p. **319**. 3. Worsnop and Flint, *Advanced Practical Physics for Students*, 2nd Edition, p. 128.

OCCURRENCE OF FLUORSPAR NEAR MALHAN, JUBBALPUR DT., C.P.

THIS note reports the occurrence of a workable deposit of fluorite near Malhan (N. 80° 31′; E. 23° 40′), in the Jubbalpur District, C.P. The place is about 7 miles S.W. of Rupaund Railway Station on the Katni-Bilaspur branch of B.N.R. The country rock consists of dolomite with intercalations of slate and chlorite schists of Dharwar age. The strike varies from E.-W. to N.W.-S.E. and the dip is northwards varying from 30° to 90°. The dolomite is often found to be intruded by quartz veins which vary in width from 4′ to ½″. There are also basic dyke rocks intruded into the country rock.