Letters to the Editor

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Electric Deflection of Cosmic Ultra-Radiation

FOR the purpose of an analysis of the cosmic ultra-radiation I have succeeded in deflecting the radiation by strong electric fields. This method is considerably more convenient for the investigation of cosmic ultra-radiation than the use of magnetic fields. The following gives the results obtained with fields of 700 volts and 70,000 volts per centimetre.

Four Geiger-Müller tube-counters of 35 cm. length and 2·7 cm. diameter are placed vertically one above the other, the axes in the east-west direction. The distances apart of their axes are: 6·0 cm. from the first to the second, 140·0 cm. from the second to the third, and 36·0 cm. from the third to the fourth. A plate condenser of 2·8 cm. plate distance, 40 cm. broad and 121 cm. long stands symmetrically between the second and the third tube. The counters are arranged to work in the usual coincidence method adopted for cosmic rays. The absorption in the whole apparatus is equivalent to 1·0 cm. of lead; over the apparatus there are also two covers of reinforced concrete and the roof of the building. The fourth and lowest tube-counter can be displaced to each side.

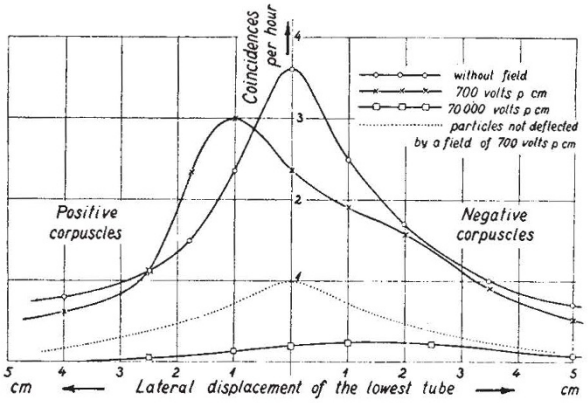


FIG. 1.

The uppermost curve in Fig. 1, giving the coincidences per hour, is then found without a field. At a field of 700 volts per centimetre in the condenser, 1 cm. deflection corresponds to particles of 1×10^7 electron volts. In this case we obtain more positive than negative corpuscles, if we take the difference between this curve and the curve indicating the non- or less-deflected particles. The latter form a similar curve to that without a field, with about 1·0 coincidence an hour in the centre. (Deflection $\leqslant 0{\cdot}5$ mm. corresponds to particles $\geqslant 5 \times 10^8$ e. volts, dotted curve in the figure.) At 70,000 volts per centimetre, there are more negative than positive corpuscles of 1–2 cm. deflection (1 cm. corresponds to $1{\cdot}0 \times 10^9$ e. volts). Without a field the mean statistical error of the measured points is 5 per cent, at 700 volts per centimetre it is 10 per cent and at 70,000 volts per centimetre it is 30 per cent; accidental coincidences have no effect.

I presume that the deflected particles observed with a field of 700 volts per centimetre correspond to the 'shower' particles, whilst the particles observed with a field of 70,000 volts per centimetre are chiefly primary corpuscles. The measurements are being continued with different fields in order to make an exact analysis of the radiation.

I wish to express my thanks to Prof. E. Regener for his kind help, and to the W. G. Kerckhoff Stiftung, Bad Nauheim, for providing funds for obtaining the condenser and the tube-counter in 1933, after preliminary work had been done since 1932.

ERNST LENZ.

Physikalisches Institut der
Technischen Hochschule,
Stuttgart.
Oct. 30.

Use of the Centrifuge in Determining the Density of Small Crystals

THE accurate measurement of crystal density has recently acquired increased importance, since it is necessary to know this quantity in order to use X-ray methods for determining the molecular weights of unknown chemical substances. But the usual crystallographic methods of density measurement, using the specific gravity bottle or flotation of the crystals under gravity in liquids of known density, cannot easily be made to give accurate results where only small quantities of very finely crystalline material are available. We have therefore recently applied the centrifuge in the second of these two methods to hasten the settling of floating crystals, just as the centrifuge is used by biologists in the measurement of the densities of living cells.

The density determination even of minute crystals can then be made a very rapid process. In our experiments a small quantity of the substance under examination (about 0·05 mgm. or less) was introduced into a suitable liquid in a small test tube and all air bubbles removed from the liquid and crystals by evacuation in a vacuum desiccator. The test tube was then placed in a centrifuge and spun for 1–2 min. at a speed of 2,000–4,000 rev. per min. According to whether the crystals sank or rose under the centrifugal force, heavier or lighter liquids were then added to the tube and the process repeated until finally a liquid was obtained in which no movement of the crystal could be observed. At this point the density of the liquid is that of the crystals. The limits of experimental accuracy could very easily be followed by slightly changing the density of the liquid on either side of the mean until the crystals began definitely to rise or sink.

So far we have used this method to determine the density of the following five crystals: vitamin B_1 hydrochloride, supplied by Prof. Peters, and the hydrocarbons '$C_{21}H_{16}$', '$C_{25}H_{24}$', '$C_{26}H_{26}$', '$C_{27}H_{28}$', obtained by selenium dehydrogenation of cholic acid, cholesterol, ergosterol and phytosterols respectively and given us by Prof. Ruzicka. The density of vitamin B_1 HCl, which is water soluble, was measured in a mixture of bromonaphthalene and xylene. The hydrocarbons were soluble in organic solvents and here aqueous sugar solutions proved most satisfactory. To overcome difficulties due to the high surface tension of water, the hydrocarbons were first introduced into a drop of sodium taurocholeate solution which was

then made up to the approximately correct density with the sugar solution. Owing to the high viscosity of the sugar solutions, it was found necessary to increase the centrifuge period to 5–7 minutes in the neighbourhood of the neutral point, but the high viscosity has also the advantage of lessening the danger of convection currents disturbing the equilibrium during the slowing down of the centrifuge.

The table below shows the values of the densities observed and the molecular weights deduced in certain cases from these and previously obtained X-ray measurements.

TABLE 1.

Substance	Density	Molecular Wt. Obs.	Molecular Wt. Calc.
Vitamin B_1 HCl	1·403 ± 0·003	351 ± 8	
$C_{21}H_{16}$	1·244 ± 0·002		
$C_{25}H_{24}$	1·195 ± 0·003	327 ± 7	324
$C_{26}H_{26}$	1·158 ± 0·003	341 ± 5	338
$C_{27}H_{28}$	1·135 ± 0·002		

Further work is in progress to increase the accuracy of the X-ray measurements of these compounds.

We have to thank Prof. R. C. Peters and Prof. R. Robinson for permitting one of us to use centrifuges in the Department of Biochemistry and Dyson Perrins Laboratory, Oxford.

J. D. BERNAL.

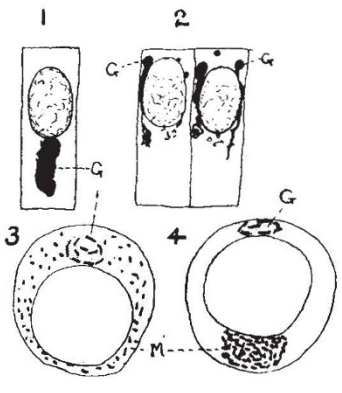
Department of Mineralogy, Cambridge.

D. CROWFOOT.

Department of Mineralogy, Oxford.

Use of the Ultra-Centrifuge for Studying the Golgi Apparatus

IN some recent work[1] it has been shown that the Golgi apparatus of the uterine gland cells of the guinea pig passes centripetally when pieces of uterus are centrifuged 400,000 times gravity by the ultra-centrifuge of J. W. Beams. This effect is shown in Figs. 1 and 2; in Fig. 1 the control Golgi apparatus lies as a dark mass towards the lumen of the gland. When centrifuged, the material of the Golgi apparatus passes up as streamers between the nucleus and the cell wall to the upper region, apparently being lighter than the surrounding cytoplasm.



Recently we have extended this work to the spermatocytes of *Helix*. These were studied intravitally by Platner[2] and others about the year 1885, and have been the subject of several monographs in recent years. As in many other types of cells, both Golgi apparatus and mitochondria are visible in the living cells. The control cell is shown in Fig. 3, the centrifuged cell in Fig. 4. In many cases complete separation of the two categories of cytoplasmic inclusions is effected.

H. W. BEAMS.
J. A. MULIYIL.
J. BRONTË GATENBY.

Zoology Department,
Trinity College, Dublin.
Oct. 27.

[1] Beams and King, *Anat. Record*, 1934.
[2] Platner, *Arch. mikr. Anat.*, **25**, 1885.

Aluminium Coating of Gratings

DR. SPENCER JONES, the Astronomer Royal, in a recent article[1] on the use of aluminium for coating glass reflecting mirrors, has dealt with its application to astronomy. We have recently carried out, at the Solar Physics Observatory, Cambridge, some tests on the behaviour of a speculum-metal grating which had been kindly coated for us with aluminium by the process of evaporation by Mr. C. H. Walker, of Metropolitan-Vickers Electrical Co., Ltd. The tests were made with a laboratory spectrograph with a calibrated wedge over the slit; photographic plates were cut into half and the two halves were exposed under identical conditions before and after the grating had been coated, and were developed in pairs together. The plates were examined with the observatory recording microphotometer.

In substantial agreement with Strong[2] we found a greater improvement in the shorter wave-lengths, and an average increase in the reflectivity of about 50 per cent. The process appears to transfer light from one order of the spectrum to another, for in this case all orders on one side of the central image gained considerably more than the corresponding orders on the other side, the first and third orders being improved more than the second. In one case, at 4870 A. in the second order, there was actually a loss of 30 per cent on one side, and a gain of 80 per cent on the other side of the central image. The greatest improvement at any point examined was at 3700 A. in the third order, where the improvement was 50 per cent on one side, and 120 per cent on the other. An improvement of 50 per cent and 100 per cent in the first order at 3800 A. was also obtained. The definition of the grating was unaffected by the coating.

C. P. BUTLER.
F. J. M. STRATTON.

Solar Physics Observatory,
Cambridge.
Oct. 31.

[1] NATURE, **134**, 522, Oct. 6, 1934.
[2] *Pub. Ast. Soc. Pac.*, **46**, 25; 1934.

Measurement of the Current Generated by a Rectifier Photoelectric Cell

CAMPBELL and Freeth[1] have described a method of measuring the current generated by a rectifier cell in such a way as to reduce greatly the disturbing effect of the internal leakage which occurs in these cells. This varies with temperature and intensity of illumination and may cause large curvature of the light-current characteristic in strong light. This method consists in the insertion of a variable external source of potential, obtained from a potentiometer