number than bismuth were involved, but both these alternatives were difficult to accept at that time. Then, however, came Hahn and Strassmann's discovery of fission processes, and the problem became easier, at least in principle.

From this point of view we have been working on the chemical identification of elements for several months, but have not come yet to final conclusions. In the meantime, results on similar work were published by Bretscher and Cook[4] and by Meitner[5], but exact identification of elements was not given. Although our experiments are still in a very preliminary stage, we should like to give here the results so far obtained, since we are obliged to interrupt our work for some time.

Thorium nitrate, carefully freed from mesothorium as well as from other disintegration products except radiothorium, was exposed to fast neutrons which were produced by bombarding lithium with 3 Mv. deuterons of several microamperes from our cyclotron. The exposure ranged from one to five hours, after which the sample was subjected to chemical separations. Examination of radioactivity showed the production of the following active substances: Bi, Hg, Sb, Sn and Ag. Besides these elements, the following fractions were found to be radioactive: alkali fraction, halogen fraction, Mo-fraction, Se + Au-fraction, Cu + Cd-fraction. Identification of elements in these fractions requires further investigation.

We tested for radioactive lead and arsenic and proved their definite absence. Our chemical separations, however, took at least two or three hours and all radioactivities of short periods must have escaped our detection.

We tried similar experiments also with uranium, and so far have obtained the following radioactive precipitates: Bi, Hg, Ag, Sb + Sn, and Cu + Cd-fraction.

More thorough identification of radioactive elements both from thorium and uranium, and determination of their periods will be made in the future. Chemical procedures and details of the experiments will be given elsewhere.

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[1] Nishina, Y., Yasaki, T., Kimura, K., and Ikawa, M., NATURE, **142**, 874 (1938).

[2] Meitner, L., Strassmann, F., and Hahn, O., *Z. Phys.*, **109**, 538 (1938).

[3] Hahn, O., and Strassmann, F., *Naturwiss.*, **26**, 756 (1938); **27**, 11 (1939); **27**, 89 (1939).

[4] Bretscher, E., and Cook, L. G., NATURE, **143**, 559 (1939).

[5] Meitner, L., NATURE, **143**, 637 (1939).

The Meson and Cosmology

THE mean life τ_0 ($\tau_0 \sim 2{\cdot}5 \times 10^{-6}$ sec.) of a meson at rest gives us a new fundamental constant of the dimension of time which lies intermediate between the 'atomic constant' τ_a (say, $\tau_a = \frac{R_0}{c} \sim 5{\cdot}5 \times 10^{-26}$ sec.) and the 'cosmological constant' t_0 ($t_0 \sim 2 \times 10^9$ years). R_0 denotes the 'classical radius' of the meson, $R_0 = \frac{e^2}{\mu c^2}$, where the symbols have their usual meaning. We shall take $\mu = 170\,m$, where m is the mass of an electron. We can construct from these basic time units (τ_a, τ_0, t_0) three dimensionless 'large numbers',

$$\frac{t_0}{\tau_a} \sim 1{\cdot}1 \times 10^{42},\ \frac{t_0}{\tau_0} \sim 2{\cdot}5 \times 10^{22},\ \frac{\tau_0}{\tau_a} \sim 4{\cdot}6 \times 10^{19},$$

and if, following Dirac and others, we make the hypothesis that 'large numbers' are interrelated, we have

$$\frac{t_0}{\tau_0} = \frac{\tau_0}{\tau_a} = \left(\frac{t_0}{\tau_a}\right)^{1/2}, \text{ or } \tau_0 = (\tau_a \,.\, t_0)^{1/2}. \qquad (1)$$

In comparing such large numbers any differences by factors of about 10^3 are to be ignored, as these could be easily taken account of by introducing the dimensionless numbers such as the fine-structure constant $\hbar c/e^2$, μ/m and H/m, H being the mass of a proton. Further, on this hypothesis we can connect the above large numbers with the (familiar) large number $e^2/G\mu^2 \sim 1{\cdot}4 \times 10^{38}$ formed from the gravitational constant G and the atomic constants e, μ. We have:

$$\frac{t_0}{\tau_a} = \frac{e^2}{G\mu^2}, \qquad (2)$$

$$\frac{\tau_0}{\tau_a} = \left(\frac{e^2}{G\mu^2}\right)^{1/2}, \qquad (3a)$$

$$\frac{t_0}{\tau_a} = \left(\frac{e^2}{G\mu^2}\right)^{1/2}. \qquad (3b)$$

Equation (3a) in the form

$$L_0 \equiv c\tau_0 = R_0 \left(\frac{e^2}{G\mu^2}\right)^{1/2} \qquad (4)$$

has already been given by Blackett[1].

It is of interest to note, as equation (1) shows, that in a system of measurement in which the atomic units remain constant the mean life of the meson is proportional to the square root of the epoch t_0, and as the mean life of the meson is intimately connected with β-decay, the mean life of a radioactive substance (β-activity) would vary as $t_0^{1/2}$.

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[1] NATURE, **144**, 30 (1939). This has suggested the present communication. It may be noted that if in (4) μ be replaced by the electron mass, L_0 becomes the maximum radius possible for a body composed of *degenerate* matter.

The Diode as a Frequency-Changer for Measurements at Ultra-High Frequencies

THE increasing use of ultra-short wave radio communication has created a need for the measurement of oscillating electric currents, potential differences, and field strengths, at very high frequencies, up to at least 300 megacycles per second. The difficulty of measuring these quantities can be greatly reduced by converting the original frequency to a much lower 'intermediate' frequency by the well-known heterodyne process, provided that the law is known which connects the amplitudes of oscillation at the two frequencies. Theory suggests that the diode frequency-changing circuit as described,