for $R \sim 5$ cm. Before such experiments are performed with a positive result we think it is more probable that if (1) is not merely accidental, it may be due to a common origin of $\vec{P}$ and $\vec{U}$, since it is possible that their values are determined already by the creation process of the earth and the sun.

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[1] Blackett, *Nature*, 159, 658 (1947).
[2] Cf. also the theory of Pauli, *Ann. Phys.*, 18, 337 (1933), especially p. 372 where $G^{1/2}/c$ occurs in connexion with h.
[3] See, for example, Barnett, *Rev. Mod. Phys.*, 7, 129 (1935).

IN his paper on the magnetic field of rotating bodies, P. M. S. Blackett has shown[1] that the relation $(P/U)_1$ between magnetic moment P and angular moment U of a rotating body seems to be independent of its size and constitution (about 0.95×10^{-15} E.M.U.); he also tried to explain the physical significance of this constant. He based his considerations on the well-known equation for the Bohr magneton, which is written

$$\left(\frac{P}{U}\right)_2 = \frac{e}{2mc} = 0.88 \times 10^7 \; [\text{cm.}^{1/2} \text{ gm.}^{-1/2}]. \quad (1)$$

Blackett points out that the empirically determined relation

$$\frac{(P/U)_1}{(P/U)_2} = 1.08 \times 10^{-22}$$

corresponds in order of magnitude with the well-known non-dimensional equation

$$G^{1/2} \frac{m}{e} = 4.90 \times 10^{-22} \; [\text{E.S.U.}] \quad (2)$$

(G is gravitational constant). For this reason, the new relationship

$$\left(\frac{P}{U}\right)_1 = G^{1/2} \frac{m}{e} \left(\frac{P}{U}\right)_2 \quad (3)$$

was introduced. By putting (1) in (3) he was able to show that

$$\frac{P}{U} = \frac{G^{1/2}}{2c} \quad (4)$$

represents the magnetic moment of a rotating body as a function on one hand of the angular moment, and on the other of the gravitational constant and the velocity of light.

In its present form, however, equation 4 is, from the physical point of view, not complete. The term c in that equation, for example, should not be identified with the velocity of light. This value is taken from equation 1, where it is only used to transform the value of e, quoted in electrostatic units, into electromagnetic units. Therefore equation 1 should be written in a more general manner, independent of any system of units, as

$$\left(\frac{P}{U/2}\right)_2 = \frac{2P}{h/2\pi} = \mu \frac{e}{m} \quad (1a)$$

(where μ is permeability of a vacuum, h is Planck's constant; the number 2 originates from the definition of the angular momentum and belongs therefore to U). Only in this form is equation 1 correct with reference to any system of dimensions.

Equation 2 also does not contain all the necessary physical quantities to make it correct dimensionally. The equation should be completed and then read as

$$\frac{\varepsilon^{1/2} G^{1/2} m}{e} = 4.90 \times 10^{-22} \quad (2a)$$

(where ε is the dielectric constant of the vacuum).

It becomes obvious that the above equation is now a non-dimensional one if the reciprocal value of G, namely, $1/G = \gamma$, is introduced; the result is the symmetrical equation

$$\frac{\varepsilon^{1/2}}{\gamma^{1/2}} \frac{m}{e} = 4.90 \times 10^{-22}. \quad (2b)$$

Blackett's equation 3 must then be written as

$$\left(\frac{P}{U}\right)_1 = \frac{m}{e} \sqrt{\frac{\varepsilon}{\gamma}} \left(\frac{P}{U}\right)_2. \quad (3a)$$

If (1a) is put in (3a), then finally equation 4 will be replaced by

$$\frac{P}{U/2} = \mu \sqrt{\frac{\varepsilon}{\gamma}}. \quad (4a)$$

This equation is numerically correct not only in the usual non-rational electrostatic system but also in the non-rational electromagnetic system of units, where the following relations are valid:

	E.S.U.	E.M.U.
$\varepsilon =$	1	$\frac{1}{9} \times 10^{-20}$
$\mu =$	$\frac{1}{9} \times 10^{-20}$	1
$\gamma =$		1.5×10^7

The removal of the factor c from equation 4 has led now to equation 4a, which is correct in any system of units and dimensions and shows that the new relation ε/γ (of the dielectric constant to the gravitational constant) may be one of the decisive relations concerned in this matter.

It is furthermore easy to understand that the permeability μ must play an important part in (4a), as we are dealing here with fundamental *magnetic* questions; indeed, it would be surprising if this physical quantity were not involved when dealing with such a matter.

In any event, the fact that the general electric properties of matter are decisive for the formation of the steady magnetic field of rotating massive bodies is best shown by equations 4a and 1a in the form

$$P = \frac{U}{2} \mu \sqrt{\frac{\varepsilon}{\gamma}} = \frac{U}{2} \mu \frac{e}{m}. \quad (5)$$

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[1] Blackett, *Nature*, 159, 658 (1947).

Spontaneous Waves in Discharge Tubes and in the Solar Atmosphere

A THEORETICAL study has been made of the plane electromagnetic waves which can exist in a strongly ionized gas when a constant electric field $\mathbf{E}_0$ and a constant magnetic field $\mathbf{H}_0$ are both present. As the results of this work appear to be of general interest, a brief account of them is given here.

It is found that in general for waves of a given frequency the medium is octuply refracting and that under certain conditions the absorption of the medium is negative, that is, the medium acts as an amplifier