to convection. I have obtained similar experimental refutation as in the case of the Bénard cells, again using a floating layer. The importance of considering the role of surface tension in this phenomenon is illustrated by the failure of Heintz to obtain the effect he describes in water. However, whenever sufficient care was used so as not to contaminate the water surface, we obtained the effect.

MYRON J. BLOCK

Baird Associates, Inc.,
Cambridge,
Massachusetts.
April 18.

[1] Bénard, H., *J. de Phys.*, **9**, 513 (1900).
[2] Rayleigh, Lord, *Phil. Mag.*, **32**, 529 (1916).
[3] Schmidt, R. J., and Milverton, S. W., *Proc. Roy. Soc.*, A, **152**, 586 (1935).
[4] Hershey, A. V., *Phys. Rev.*, **56**, 204 (1939).
[5] Jeffreys, H., *Quart. J. Mech. App. Math.*, **4**, 283 (1951).
[6] Heintz, E., *J. Phys. et Radium*, **7**, 293 (1946).

A New Uncertainty Relation

ONE of the consequences of the introduction of a geometry of four dimensions as a basis of physical theory has been to reveal relations between certain quantities which had previously appeared to differ fundamentally in character, the simplest being the relation between space and time. In geometries which introduce new parameters or new dimensions, a similar unexpected unification may appear. This is particularly the case in the theory based upon the use of projective geometry associated with the names of Veblen and Hoffmann, and with the five-dimensional theory introduced by Kaluza. It is necessary to express any results obtained in this way in a form which satisfies the requirements of relativistic invariance; but the development of both these theories has proceeded in such a way as to make this possible.

In this framework the principles of conservation of energy and momentum are seen to be parts of a wider principle which embraces that of electric charge also. It was suggested also that an additional condition should be added to the relations $\int pdq = nh$ of the old quantum theory, and this was interpreted as expressing the quantization of electric charge[1]. In the light of a recent discussion[2] concerning the four-dimensional interpretation of such results, a new uncertainty relation is suggested. To the four familiar conditions it seems natural to add $\Delta m_0 \Delta\tau \sim \hbar/c^2$. The interpretation would be that in order to measure a rest-mass m_0 to the accuracy Δm_0, an interval of proper time $\Delta\tau$ must elapse, the two quantities Δm_0 and $\Delta\tau$ satisfying the above inequality.

This condition is also suggested by a work by K. H. Tzou[3] on the relativistic form of Heisenberg's quantum equation, in which the quantities $m_0 c$ and $c\tau$ occur in such a way as to suggest a pair of conjugate quantities.

An application of it would be to cases of the transformation of nuclear particles in which the time of decay, being the time available for observation, would limit the observable change of rest mass.

At first sight the relation appears to be a special case of the energy relation:

$$\Delta E \, \Delta t \sim \hbar$$

which for a particle of mass m in the absence of a field of force becomes,

$$\Delta m \, \Delta t \sim \hbar/c^2$$

This is usually applied to cases where the rest mass does not change. If it be assumed that it applies to the case of a particle which changes its rest mass while at rest, Δm is a change of rest mass and Δt a change of proper time.

The two conditions are the same in this case. Prof. P. Caldirola[4] has applied the energy relation in this way. Adopting the view that a μ-meson is an electron in a higher energy state, he points out that

$$(\mu_0 - m_0) \, \Delta t \sim \hbar/c^2$$

μ_0 and m_0 being the respective rest masses, and discusses the significance of the relation on the assumption that a minimum interval of time Δt exists. But the relation proposed here is not essentially an energy relation, and its application is not restricted to cases where the particle under consideration is at rest. When no restriction is placed upon the motion of the particle, the two conditions do not coincide. It is suggested that the rest mass condition is an independent one.

H. T. FLINT

Bedford College,
University of London,
London, N.W.1.

E. MARJORIE WILLIAMSON

St. Mary's College,
University of Durham.
July 19.

[1] Klein, O., *Nature*, **118**, 516 (1926). Flint, H. T., and Wilson, W., *Proc. Phys. Soc.*, **50**, 340 (1938).
[2] Flint, H. T., and Williamson, E. M., *Il Nuovo Cimento*, **3**, 551 (1956).
[3] Tzou, K. H., *Phil. Mag.*, **39** (7), 790 (1948).
[4] Caldirola, P., "A New Model of the Classical Electron", N. 86, 12 (Pubb. d. sezione de Milano, dell'Istituto Nazionale di Fisica Nucleare, 1956).

Fixation of Carbon Dioxide into the Carboxyl Carbon of Glycine

IT has been observed that carbon dioxide is a precursor to the carboxyl carbon of glycine in incubations with a hen-oviduct mince. Carbon 2 of the glycine is completely unlabelled when determined as the formaldehyde dimedone complex obtained after ninhydrin degradation. Carboxyl-labelled acetate is also formed in this system from carbon dioxide[1]. Acetate 1,2-^{14}C, however, was found to be a poor precursor to glycine, although it was converted to glutamic acid much more efficiently than carbon dioxide.

These observations appear to diminish the likelihood that carbon dioxide is entering glycine through acetyl coenzyme A or acetate directly. There appear two possible explanations. Glycine may be formed directly from an activated acetyl compound arising from the carbon dioxide fixation previous to acetyl coenzyme A, or carbon dioxide may be fixed independently to two distinct acceptors, one of which yields acetate and the other glycine.

RICHARD W. HENDLER

Laboratory of Cellular Physiology and Metabolism,
National Heart Institute,
National Institutes of Health,
Bethesda, Maryland.

[1] Hendler, R. W., and Anfinsen, C. B., *J. Biol. Chem.*, **209**, 55 (1955).