the existence of γ-rays shows that the observed curves must be superpositions of at least two simple spectra, whereas their shapes are not such as could be represented as sums of two K.U. curves with end-points differing by the energy of the γ-rays.

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A New Form of the Baryteron Equation and Some Related Questions

IT is known that the 2-component *spinors* introduced by Van der Waerden must be completed to 4-component quantities if linear transformation of their components by the complete Lorentz group including reflections is required. These quantities, often called 'Dirac wave-functions', will be called here 'four-spinors' or '*undors** of the first rank'. Defining the reflection in the right way[1], it is possible to join to every four-spinor ψ another four-spinor[2] $\psi^{\pounds}$, the components of which are linear combinations of those of ψ^*. This $\psi^{\pounds}$ is called the *charge-conjugated*[3] of ψ. For if ψ is a solution of the Dirac equation for a positive particle,

$$mc\psi = \beta\{\varepsilon - (\vec{\alpha}.\vec{\pi})\}\psi,$$

$$c\varepsilon = i\hbar(\delta/\delta t) - e\varphi,\ \vec{\pi} = -i\hbar\vec{\nabla} - (e/c)\vec{A},$$

then $\psi^{\pounds}$ is a solution of the Dirac equation for a negative particle:

$$mc\psi^{\pounds} = \beta\{\varepsilon^L - (\vec{\alpha}.\vec{\pi}^L)\}\psi^{\pounds},$$

$$c\varepsilon^L = i\hbar(\delta/\delta t) + e\varphi,\ \vec{\pi}^L = -i\hbar\vec{\nabla} + (e/c)\vec{A}\ ;$$

vice versa ($\psi^{\pounds\pounds} = \psi$). Four-spinors, which are equal to their own charge-conjugated, we may call *neutrinors*. These quantities, which are equivalent to a two-spinor together with its complex conjugated, are not only useful in the so-called neutrino theory of light, but also Majorana's theory of *neutrons*[4] may be summarized by stating that the quantized four-spinor of a neutral particle is a neutrinor.

An *undor-calculus* analogous to tensor-calculus and Van der Waerden's spinor-calculus can be developed. An undor of the second rank $\Psi_{k,k'}$ (k,k' = 1, 2, 3, 4), that is, a quantity transforming like the product of two four-spinors, may be regarded then as consisting of a scalar, a pseudo-scalar and a pseudo-4-vector (the antisymmetrical part of $\Psi_{k,k'}$) and a regular 4-vector with an antisymmetrical tensor (its symmetrical part). So Kemmer's baryteron* field[5] can be represented[6] by one single symmetrical undor ($\Psi_{k,k'} = \Psi_{k',k}$). Denoting by ψ_P and ψ_N the wave-functions of protons and neutrons and by $\vec{\alpha}$, β and $\vec{\alpha}'$, β' the Dirac matrices operating on k and k', the baryteron equation[5,7,8] is given in the following simple form:

$$2m_0c\{\Psi_{k,k'} + 2if_{\text{op}}(\psi^{\pounds}_{Nk}\psi_{Pk'} + \psi^{\pounds}_{Nk'}\psi_{Pk})\} = \beta\{\varepsilon - (\vec{\alpha}.\vec{\pi})\}\Psi_{k,k'} + \beta'\{\varepsilon - (\vec{\alpha}'.\vec{\pi})\}\Psi_{k,k'}. \quad (1)$$

The operator f_{op}, which operates on the arguments k and k', becomes a constant c-number (f) only if the two constants f and g, occurring in Kemmer's equations[5], would happen to be equal. As experiment seems to indicate[9] that these constants do not differ very much, this formal argument for the advantage of equality of f and g seems to be interesting.

The electric charge-density and electric current are given by[6]

$$\rho = (e/8\hbar)\ .\ \Psi^*(\beta + \beta')\Psi,$$

$$\vec{j} = (e/8\hbar)\ .\ \Psi^*(\beta\vec{\alpha}' + \beta'\vec{\alpha})\Psi.$$

The wave-function of *free* baryterons can be interpreted to some extent as the Dirac wave-function in the hole-theory of electrons. In both cases the same kinds of difficulty arise.

As for the complications occurring in baryteron theory[7,8], as well as in the quantum theory of the Maxwellian field[10,11], which are caused by the fact that some of the canonical equations of the field do not contain time derivatives, it is possible to develop a theory of quantization of mixed fields of Fermi-Dirac particles and Einstein-Bose quanta, in which the question of dealing with such complications is answered in a rather general way.

Details will be published elsewhere.

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* *Unda* = Wave.

* Βαρυτερος = heavier.

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Exploration of the Sun's Disk and its Astrophysical Results

IN NATURE recently (Dec. 10, p. 1035), I took the opportunity, in connexion with the recent researches on practical relativity by H. E. Ives and G. R. Stilwell, to place on record that on principles scarcely anywhere denied now, a radiating atom, or system of atoms, falling free into the sun or describing a free orbit close around it should not experience any internal influence on the periods of its radiation, the