ONE POSSIBILITY OF BARYON CLASSIFICATION

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FROM the baryon wave equation[1] one finds as the general expression for the baryon's electric charge*

$$q = -\varepsilon (t_3 + v_3). \tag{1}$$

Here t_3 stands for the eigenvalue of the operator T_3, and v_3 is a certain number which changes in going from one multiplet to another. In our treatment v_3 replaces the Gell-Mann number; it could be called the eigenvalue of the third component of the isotopic momentum operator V_3.

The requirement that all elementary particles should have charge $+\epsilon, -\epsilon$ or 0 leads to the following rules:

(a) t_3 and v_3 are simultaneously integral or half-integral.

(b) $|t_3 + v_3|$ may not exceed unity. From these rules one obtains quantum numbers determining the baryon type (see table). For the Λ^0 particle the values $v_3 = \pm 1$ are also possible; however these should apparently be excluded.

Baryon Type	t_3	v_3
P	$-1/2$	$-1/2$
n	$+1/2$	
Λ^0	0	0
Ξ^0	$-1/2$	$+1/2$
	$+1/2$	
Σ^-	1	0
Σ^0	0	
Σ^+	-1	

The values $v_3 = \pm \frac{1}{2}$ indicate that the nucleon and Ξ-hyperon doublets are components of a doublet in the v_3-space. Indeed, it is easy to write a general equation for the nucleon and Ξ-hyperon:

$$[\Gamma^\nu (\partial/\partial x_\nu) - k_0 I \exp(aT_3 + bV_3)]\psi = 0, \tag{2}$$

where Γ^ν, I, T_k and V_k are 16 × 16 matrices

$$\Gamma^\nu = 1^{IV} \times \gamma^\nu, \quad V_k = (1^{II} \times \sigma_k) \times \gamma^5,$$

$$T_k = (\sigma_k \times 1^{II}) \times \gamma^5, \quad I = \left[\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \times \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}\right] \times 1^{IV}. \tag{3}$$

For the constants a, b, $m_0 = \kappa_0 \hbar / c$ the following values should be taken:

$$m_0 = 2181\, m_e, \quad a = 3\alpha/10\pi, \quad b = 0.1714.$$

It is interesting to note that the value of m_0 coincides with the mass of the Λ^0 particle. This makes it possible to describe the Λ^0 particle as a nucleon in the special singlet state $t_3 = 0$, $v_3 = 0$.

The constant a, characteristic of mass differences within a t_3 multiplet, is of the order of magnitude α/π. The constant b, characteristic of mass differences between nucleon, Ξ hyperons and the Λ^0 particle, is of the order of magnitude g/π, where g is the strong coupling constant. This shows that mass differences within a multiplet are caused by electro-magnetic interactions, whereas mass differences between nucleons, Ξ hyperons, Σ hyperons and the Λ^0 particle are due to strong interactions.

It follows from the above considerations that nucleons, Ξ hyperons, and the Λ^0 particle are closely related to each other, whereas the Σ hyperons form a separate group. One may suppose that besides nucleons, Ξ hyperons also are present inside nuclei (the existence of the Λ^0 particle in nuclei has been proven).

In conclusion I consider it my pleasant duty to express sincere gratitude to P. Kard for criticism of this work.

Note added in proof (November 21, 1957). The main results, following from our equations, are in full agreement with the Peaslee scheme with which the author only became familiar after the present work was submitted to press.

*This result coincides with the expression for the charge given by Salam and others.[2]

[1]H. Oiglane, J. Exptl. Theoret. Phys. this issue, p. 1511 (Russian), p. 1167 (transl.).
[2]A. Salam and J. C. Polkinghorne, Nuovo cimento 2, 685 (1955).
[3]D. C. Peaslee, Nuovo cimento 6, 1 (1957).

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319

ERRATA TO VOLUME 6

Page	Line	Reads	Should Read
643	16 from bottom	where $\kappa = \pi a^2 \Omega - \ldots$	where $\kappa = \pi a^2 \Omega \varphi - \ldots$
690	8 from bottom	$\ldots \sin [- \ldots$	$\ldots \sin \vartheta [- \ldots$
	5 from bottom	$\ldots \sin 2\vartheta \sqrt{\frac{1}{3}} \ldots$	$\ldots \sin 2\vartheta \left[\sqrt{\frac{1}{3}} \ldots \right.$
809	9 from top	$\ldots \left(\frac{1}{2 \sinh u} + \ldots \right.$	$\ldots \left(\frac{1}{\sinh u} + \ldots \right.$
973	unnumbered equation	$\ldots C_{n\mu - \mu'}^{S' - \mu'; S\mu} T_{\mu' - \mu'}^{(n)}.$	$\ldots C_{n\mu - \mu'}^{S' - \mu'; S\mu} < S' \Vert T^{(n)} \Vert S^{-1} >$ $\times T_{\mu' - \mu}^{(n)}.$
975	5 from bottom	...of a particle by a nucleus ...	...of a particle in state a by a nucleus ...
992	Eq. (18)	$\ldots \tau_1 \tau_2^{-2} / 2\hbar^1 \ldots$	$\ldots \tau_1 \tau_2^{-1} / 2\hbar^2 \ldots$