LETTERS TO THE EDITORS

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A Simplified Chemical Notation

SOME twenty years ago and more I suggested an abbreviated notation to a few chemical friends, who told me that the old method was all they needed, and was too well established to be disturbed. But the thing has recurred to my mind, and I am encouraged to think there may be something in it after all.

Suppose a tetrahedral molecule, with C in the middle, and four H-atoms, not at the apices, but on the *facets* of the tetrahedron; and let us call it A. Lay one such molecule on another; two facets (or two H-atoms) are thereby obliterated. A was CH₄, A₂ is now C₂H₆, and A_n is the whole series of the paraffins. It is obvious, and at the root of the matter, that A, which began as CH₄, may signify CH₃, CH₂, or even C, according to its place in a larger molecule.

Suppose another tetrahedron, on one face of which the H-atom is replaced by —OH, and call it B; this is methyl alcohol, AB is ethyl alcohol, and A_nB is the series of monohydric alcohols. The isomers of these explain themselves; for propyl alcohol (A₂B) may be AAB or ABA, and so on. The primary alcohols are A_nB, the secondaries are A_nA_mB, and the tertiaries are A_nA_mA_pB. The polyhydric alcohols have the general formula B_n; glycol is B₂, glycerol is B₃, and so on.

A third tetrahedron (D) has two of the four H-atoms replaced by O; it is formaldehyde, and A_nD is its homologous series. Acetone is formaldehyde to which two methyl groups are added on; its formula is ADA, and that of the higher ketones is A_nDA_m. Formic acid (CHOH : O) becomes a fourth tetrahedron, E; acetic acid is AE, and A_nE is the series of the fatty acids.

To include the nitrogen compounds we use a letter (N) for the ammonia radical; methylamine is AN, dimethylamine A₂N, and so on; but we must distinguish ethylamine, AAN, from A₂N. It will be useful to have a single letter (K) for the benzene ring; but we may deal otherwise with the cyclic compounds. For as A_n represents a linear, or successive, series of methane groups, so let some such symbol as {A_n} represent the same in cyclic form. {A₆} will represent the single-bonded cyclic C₆H₁₂; and, by a further convention, {{A₆}} may represent the double-bonded cyclic C₆H₆, that is, the benzene ring itself. As an example of a cyclic formula, take menthol (the alcohol):

A·B

This we may now write as A·A A·A₃, or as

A·A

A{A₅B}A₃. But enough of examples.

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Life-time of the Neutral Meson

THE circumstance that neutral mesons have thus far escaped all attempts at experimental detection can, if one assumes these particles to exist at all, be accounted for by ascribing to them a very short life-time, τ_n , where τ_n refers to the rest system of the neutral meson. In fact, τ_n should be smaller by several orders of magnitude than the corresponding quantity for charged mesons, τ_{ch} .

It has been pointed out by Sakata and Tanikawa¹ that a neutral meson can decay into p photons, $p \geq 3$, a process which gives the desired connexion $\tau_n \ll \tau_{ch}$: for $p = 3$ they find $\tau_n \sim 10^{-16}$ sec. $\sim 10^{-10} \tau_{ch}$. However, the reasoning of these authors would not seem to be conclusive as it involves, contrary to other life-time calculations, the cutting off of a divergent integral, namely, that of the momenta of the protons occupying negative energy-levels. Thus so long as the mystery of the divergences in quantum field theory has not been solved, the above numerical result remains questionable. Therefore, it may be of some interest to inquire whether there is another way of accounting for the short life-time of neutral mesons which does not involve cut-off integrals.

Clearly such a possibility exists: we have merely to assume, first, that in close analogy to the decay of charged mesons, the neutral meson disintegrates according to (the notation will be obvious)

$$Y^0 \rightarrow e^+ + e^-, Y^0 \rightarrow n + n'; \quad \dots \quad (1)$$

secondly, that

$$\frac{g_{ch}^2}{\hbar c} \ll \frac{g_n^2}{\hbar c}, \quad \dots \quad (2)$$

where g_{ch} (g_n) denotes the strength of the coupling of charged (neutral) mesons with the electron-neutrino field.

In the customary treatments, one puts instead of (2)

$$\frac{g_{ch}^2}{\hbar c} = \frac{g_n^2}{\hbar c} \quad \dots \quad (3)$$

(which, together with (1), would yield $\tau_n = \tau_{ch}$). The only reason for using (3) is analogy. In fact, relations similar to (3) for couplings of mesons with nucleons are employed in symmetrical theories of nuclear forces, where they find their experimental justification in the charge independence of nuclear forces. But has this analogy any physical background?

The fact that there exists a coupling between the various meson fields and the electron-neutrino field means that there are forces between electron-neutrinos, of the exchange (ordinary) type due to charged (neutral) mesons which can, to a first approximation, be computed by the second-order perturbation formula

$$\sum_i \frac{H_{Ai} H_{iF}}{E_A - E_i}$$

In the nucleon case, the same formula can be used. But whereas it is there possible (to a first approximation with respect to v/c) to neglect the dependence of $E_A - E_i$ on the energy of the nucleons (neglect of recoil), this is impossible in the case of the electron-neutrino because the quanta (virtually) created by the electron-neutrino are heavy compared with the particles by which they are created: the electron-neutrino forces are from the outset relativistic.

This means: (1) there is a dissymmetry between electron-electron and neutrino-neutrino forces on account of the different rest masses entering into the