

other reactions of iodine in aqueous solution have led to the conclusion that the rate-determining reaction is  $\text{Fe}^{++} + \text{HIO} \longrightarrow \text{FeO}^{++} + \text{H}^+ + \text{I}^-$ .

Additional experiments have been planned which, it is hoped, will furnish further information about the properties of ferryl ion.

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RECEIVED MARCH 28, 1932  
PUBLISHED MAY 7, 1932

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### THE EXISTENCE OF NEUTRONS IN THE ATOMIC NUCLEUS

*Sir:*

In my article on the Arrangement of Protons and Electrons in the Atomic Nucleus [THIS JOURNAL, 53, 981 (1931)] the discussion was limited to nuclei in which the numbers of protons and electrons are multiples of four and two, respectively. These atoms are by far the most abundant and in terms of the proposed coupling pattern represent the highest symmetry attainable. Although it is not yet possible to make a definite extension to the other nuclear series, it is of interest to discuss the problem briefly in reference to recent investigations.

It appears significant that the next most abundant nuclear type is that which resembles the symmetrical or  $4n$  proton type most closely and may be derived from it by the removal of a single proton. This series, *i. e.*, with  $4n-1$  protons, follows very closely the  $4n$  series: the first and second "extra electron pair" enter at the corresponding atomic numbers. All other nuclei, *i. e.*, those with  $4n-2$  and  $4n-3$  protons and those with uneven numbers of electrons constitute but a fraction of one per cent. of the atoms of the earth's crust and appear in general to owe their instability to the presence of incomplete or unsaturated groups. More information about nuclear spins and a knowledge of the coupling rules in these cases are necessary before definite conclusions can be drawn regarding these structures. At present we can only discuss certain possibilities.

As an illustration we may consider carbon 13. In the accompanying figure, this nucleus is pictured in the same symbols formerly employed, a proton, or the direction of the proton spin vector, by a bar and an electron pair by a ball. The structure is the same as that of carbon 12 plus one proton and one electron (half ball). Of course we do not know where the extra proton is coupled but we do know that such a bond of two protons and one electron as suggested in the figure (two bars and the half ball) is stable from the existence of the hydrogen isotope [Urey, Brickwedde and Murphy, *Phys. Rev.*, 39, 154 (1932)] of mass 2. Beryllium 9 must also contain such a group and when it captures a high speed alpha particle to form carbon 13 it is not difficult to imagine that occasionally the loosely bound

proton and electron are detached and emitted as a neutron leaving carbon 12, as postulated by Chadwick [*Nature*, **129**, 312 (1932)].

The essential point may be stated in this way. In the proposed structure alpha particles and neutrons do not exist as such in any nucleus, merely protons and electrons coupled in a certain definite pattern. When these couplings are broken, alpha particles and electrons in pairs are normally formed as in the radioactive series. However, it should also be possible to break the bonds in such a way as to give neutrons, mass one or two, hydrogen, mass one or two, helium mass 5, etc., and it is to be expected that such particles would be formed more readily from nuclei containing unsymmetrical or unsaturated groups.

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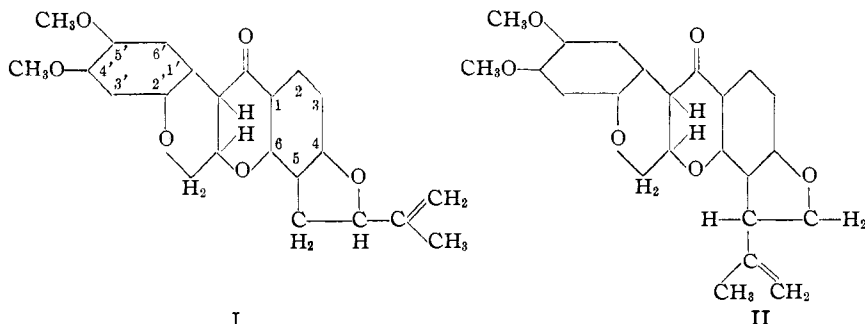
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RECEIVED APRIL 4, 1932  
PUBLISHED MAY 7, 1932

ROTENONE. XXI. THE STRUCTURE OF ISOROTENONE,  
 $\beta$ -DIHYDROROTENONE AND DEHYDROROTENOL

Sir:

In a recent publication [S. Takei, S. Miyajima and M. Ōno, *Bul. Inst. Phys. and Chem. Research* (Tokyo), **11**, 1-4, Feb. 1932] Takei and his associates proposed a formula for rotenone which differs from the one (I) proposed by us [F. B. LaForge and H. L. Haller, *THIS JOURNAL*, **54**, 810 (1932)] only in the point of attachment of the isopropenyl side chain on the substituted dihydrocoumarone ring as indicated in formula II.



The formula of Takei takes no account of the loss of optical activity by cleavage of the oxygen bridge with the resultant formation of the phenolic hydroxyl in position 4 by hydrogenation of tubaic acid and the analogous formation of tetrahydro derivatives from other rotenone derivatives. Moreover, the mechanism suggested by us is strongly supported by analogy with that of certain codeine derivatives, which is referred to in a previous article [H. L. Haller and F. B. LaForge, *THIS JOURNAL*, **54**, 1988 (1932)].