4. Na was present as an impurity. Because of the slight chance that the ion at 40 might be $(NaOH)^+$ a search was made at 56 and 58 for $(KOH)^+$. No trace was found.

5. If the peak at 40 were due to $K^{39}H$ a corresponding one at 42 due to $K^{41}H$ should have been present in abundance 1/14 as great. None was present in abundance greater than 1/150,000 of K^{39}. Neither $(H_2O)^+$ nor H_2^+ could be detected in the tube.

6. At the higher pressures peaks were found at masses 78 and 80 corresponding to $(K^{39}K^{39})^+$ and $(K^{39}K^{41})^+$. The peak at 40 could not, however, be due to $(K^{39}K^{41})^{++}$ because at the lower pressures the peak at 80 disappeared completely, as it should, while that at 40 remained.

It is estimated that the apparatus had sufficient sensitivity and resolving power to detect a peak at 40 of magnitude 1/45,000 compared to K^{39}. In the region of masses 42 and 43 there is less background than at 40. One can safely say that K^{42} and K^{43}, if present, were each present in abundance less than 1/150,000 relative to K^{39}.

I wish to express my appreciation to Professor John T. Tate for his valuable suggestions and interest in this work.

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particle: $\epsilon_{23} = i\alpha_2\alpha_3\alpha_4 \cdots$, $\epsilon_{01} = i\alpha_1\alpha_4 \cdots$. γ is a matrix introduced in our previous paper in such a manner that the potentials A_k do not appear in the equations for a neutron. H' represents the interaction between the heavy particle and the electrons and neutrinos. It must be written so that the conservation laws of the energy and of the spin are respected; that is, every transition of a neutron into a proton must be accompanied by the emission of an electron and a neutrino (as by Fermi[3]). In the present paper we remark that the values of the magnetic moment of the proton $(3e\hbar/2Mc)$ and of the neutron $(2e\hbar/2Mc)$, which we obtain from (2) by introducing only one numerical factor $e\hbar/Mc$ (as a coefficient of ϵ_{kl}), are both in a satisfactory agreement with the values recently deduced by G. Kruger (2.7 and 1.75 nuclear magnetons) and with the measurements of the magnetic moment of the proton.

It seems also noteworthy that the interaction of the heavy particles with the electrons (represented, for instance, by the Dirac "density matrix") and neutrinos makes it possible to understand the oriign of the exchange forces between the proton and the neutron (considered by Heisenberg and E. Majorona).

A more detailed account of this question will be published shortly.

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Remarks on the Theory of Protons and Neutrons

In a recent paper[1] the author attempted to write the equations of the proton and the neutron (considered as two quantum states of one heavy particle) in close analogy with Dirac's equations for the electron and Pauli's equations for the neutron.[2] Eight values of the spin-variable were used and two additional terms in the Hamilton-operator were introduced. These latter represented (1) the interaction of the tensor of the electromagnetic field with the electric and magnetic moment of the particle and (2) the interaction of the heavy particle with the quantized field of electrons and neutrinos. (This second interaction is analogous to that introduced by Fermi[3] in his theory of β-rays.)

We write:

$$(p_0 - H/c)\psi = 0,$$

where

$$H = H_{PN} + H' \qquad (1)$$

and H_{PN} is the Hamilton-operator of the heavy particle:

$$\frac{1}{c}H_{PN} = \frac{e}{c}A_0\gamma - \alpha_4 Mc - \Sigma\alpha_k\left(p_k - \frac{e}{c}A_k\gamma\right) - \frac{e\hbar}{Mc}\Sigma\epsilon_{kl}\frac{\partial A_e}{\partial x_k}. \qquad (2)$$

Here ϵ_{kl} represents the components of the antisymmetrical tensor of the magnetic and electric moment of the heavy

The Relation Between Internuclear Distances and the Force Constants of Diatomic Molecules

Some time ago the writer called attention to the close relation, in diatomic molecules, between the internuclear distance, r_e, and the "bond force constant," k_e (defined as d^2V/dr^2 at the equilibrium separation) and proposed an equation expressing this relation,[1] which may be written as follows:

$$r_e = (C/k_e)^{\frac{1}{3}} + d_{ij}. \qquad \text{Relation I.}$$

This equation gives satisfactory agreement with experimental data if C is taken as a universal constant and d_{ij} is constant for all molecules made up of two atoms found in the ith and jth rows of the periodic table, respectively.

The writer has recently observed another relationship which may be expressed in an equation of just the same form:

$$r_e = (C_{mn}/k_e)^{\frac{1}{3}} + d_{mn}. \qquad \text{Relation II.}$$

In this case d_{mn} and C_{mn} are constant for the analogous electronic states of all molecules made up of two atoms found in the mth and nth groups of the periodic system, respectively. In other words a given pair of constants will fit the ground states, for example, of all molecules in such a set as Cl_2, Br_2, IBr, ICl and I_2; or CO, SiO, CS, TiO and PbO. Relation II gives even more satisfactory agreement

TABLE 1. *Test of Relation II.*

MOLCULE	r_e (obs.)	r_e (calc.)	CONSTANTS OBTAINED FROM DATA ON
ICl	2.310A	2.31A	Cl_2 and I_2
Pr$_2$	2.28	2.28	" " "
PN	1.487	1.50	N_2 and P_2
SO	1.489	1.47	O_2 and S_2
HCl	1.272	1.26	HF and HBr
HI	1.600	1.60	" " "
SiO	1.505	1.48	CO and TiO
CS	1.53	1.52	" " "
PbO	1.918	1.91	" " "

with experiment than Relation I, as may be seen from Table I in which, for the ground states of several molecules, the observed r_e is compared with the value calculated from k_e (obtained from vibrational data) with the use of constants determined from the data on two other similar molecules.

Because of lack of data Relation II can at present only be well tested for the ground states of molecules, but there is an indication that it also applies, but with different values of the constants, to analogous excited states of molecules within sets of the type described, and may possibly be a test as to whether excited states of two molecules are similar or not.

It is interesting to note that in case the constants d_{ij}, d_{mn} and C_{mn} can be determined from other molecules, it is possible by means of the two relations together to predict both r_e and k_e for molecules for which no data at all exist.

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