LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

The Hylleraas Method Applied to Lithium

It has been shown by the work of Hylleraas[1] on He and of the authors[2] on H_2 that two-electron problems can be satisfactorily solved by the variation method with wave functions which provide for the expression of polarization effects (the instantaneous distortion which each electron produces upon the orbit of the other). A series of terms is prepared, starting with a leading term of approximately the form which would be a solution of the problem if the effects of electronic repulsions could really be replaced by those of static screening charges. Other terms are derived from this by multiplying it with simple combinations of powers of the coordinates of the individual electrons, and of their mutual separation. The final wave function is a linear combination of these terms, with coefficients determined by the variation process.

We have extended this method to a three-electron problem, the ground state of Li. Unfortunately, the pressure of other work will force us to delay the presentation of a full analysis and report upon the problem; we wish here to communicate the bare results obtained. We give below the total energy as computed in atomic units ($e^2/a_0 = 27.08$ volts). Using a wave function constructed from the same series, after removing one electron, we have also computed the energy of the ion; we give here the difference between these two quantities, as the ionization energy. For comparison, we include the results of Wilson[3] (the best previous calculation), and the observed values.[4]

Energy of Lithium Atom

	Total	Ionization	
	e^2/a_0	e^2/a_0	volts
Experimental	7.4783	0.1981	5.364
Wilson	7.4192	0.1965	5.320
James and Coolidge	7.4757	0.1975	5.347

These results were obtained with a series of 15 terms, of which 5 involved distances between electrons of the K-shell and that of the L-shell. Although the mutual polarization of the K electrons is undoubtedly greater, we contented ourselves with two terms, taking account of this, because our chief interest lay in the ionization energy, and it soon became clear that this would not be affected if the wave function contained small errors referring exclusively to the inner-shell electrons. Such errors raise the energies of the atom and of the ion by practically the same amounts. There is no reason to doubt that it would be easy to get a considerable improvement in the result for the total energy by putting in two or three additional simple terms involving mutual polarization of the K electrons. The residual error in the ionization energy seems much more obstinate. A survey of the probable improvement obtainable from certain untried terms whose effect can be predicted with some assurance does not promise more than 0.007 volt. The success of the method is therefore comparable to the case of the first excited level of parhelium,[5] where also there is involved the reaction between 1*s* and 2*s* electrons of the same spin.

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April 4, 1935.

[1] E. A. Hylleraas, Zeits. f. Physik **54**, 347 (1929).
[2] H. M. James and A. S. Coolidge, J. Chem. Phys. **1**, 825 (1933).
[3] E. B. Wilson, Jr., J. Chem. Phys. **1**, 210 (1933).
[4] A. Ericson and B. Edlén, Zeits. f. Physik **59**, 656 (1930).
[5] E. A. Hylleraas and B. Undheim, Zeits. f. Physik **65**, 759 (1930).

Analysis of Data on Radioactivity Induced by Neutron Bombardment

Though 47 elements are reported to be activated by neutron bombardment the literature gives the isotope involved and the type of transmutation for only 27. These 27 are classified in Table I. Group I of this table contains those activated by simple capture of a neutron; group II, those activated by capture of a neutron with emission of a proton; and group III, those activated by capture of a neutron with alpha-emission. Z (the atomic number), M (the mass number), and M–Z are also recorded for each parent isotope. The following facts are apparent:

TABLE I. *Elements activated to radioactivity by neutron bombardment* Classified according to type of transmutation.

I. SIMPLE CAPTURE				II. PROTON EMISSION				III. ALPHA-EMISSION			
	Z	M	M–Z		Z	M	M–Z		Z	M	M–Z
Na	11	23	12	Mg	12	24	12	F	9	19	10
K	19	41	22	Al	13	27	14	Al	13	27	14
V	23	51	28	Si	14	28	14	P	15	31	16
Mn	25	55	30	P	15	31	16	Cl	17	35	18
Cu	29	63	34	S	16	32	16	Sc	21	45	24
Cu	29	65	36	Ca(?)	20	40	20	Mn	25	55	30
As(?)	33	75	42	Cr	24	52	28	Co	27	59	32
Br	35	79	44	Fe	26	56	30	All Z's and M's odd.			
Br	35	81	46	Zn	30	64	34	In every one of the 27 cases, M–Z is even.			
I	53	127	74	Zn	30	66	36				
All Z's and M's *odd*.				8 of the 10 Z's and M's even.							

(?) The two cases indicated with this mark in this table, Table II and Fig. 1 are somewhat doubtful.