This remained true when the time of exposure for the saturated solution was increased to 15 hours. This line agrees with that found by Carrelli, Pringsheim and Rosen, (Zeits. f. Physik **51,** 511 (1928)) and is attributed to the NO_3 ion, since they found it in solutions of different salts containing this ion. The present experiment confirms this and shows no indication of $NaNO_3$ molecules, although from conductivity measurements the partial dissociation theory would have said that nearly two-thirds of the salt was nondissociated in the saturated solution.

The water band was also found excited by the mercury lines 4358, 4077, 4046, and 3650. The water was redistilled. The ordinary laboratory distilled water spectrum showed many lines, a number appearing like absorption lines although a photograph of the absorption in the region showed nothing. These lines could not be attributed to Raman scattering. The redistilled water spectrum showed only the water band in the region of wave-lengths shorter than 5460A except once a faint suggestion of an absorption line at 4859A, several lines still appeared at wave-lengths greater than 5790A.

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June 14, 1930.

The Calculation of Energy Values

A number of modifications of the Ritz method of calculating characteristic numbers have recently been applied to the quantum dynamical problem. I have tried another of these methods, which seems to possess several advantages.

The characteristic functions of an atomic system of N electrons whose coordinates are $(r_1, r_2 \cdots)$ are approximated by polynomials of the requisite symmetry,[1] whose separate terms are of the type

$$u(\alpha, r_1)\, v(\beta, r_2) \cdots .$$

Taking a hint from the empirical formulae for energy levels, I assume that each of these functions, say v, is a characteristic function of a one-electron system whose nuclear charge is, say, β. These various "effective" charges $\alpha, \beta, \cdots$, are then determined so that the variation integral is a minimum, subject to the condition that the wave function is of the form just described. The justification for this choice of wave function is purely empirical at present, but it is believed that some theoretical justification for it may be found.

TABLE I

Z	Level	$T/(Z-1)^2$			$\alpha(1s)$	$\beta(2p)$
		Present method	Perturb. theory	Observ.		
2	He I, 2^1P	0.245	-0.039	0.2475	2.003	0.965
2	He I, 2^3P	0.262	$+0.097$	0.2657	1.99	1.09
3	Li I, 2^1P	0.245	0.173	0.250	3.007	1.94
3	Li I, 2^3P	0.261	0.224	0.263	2.98	2.16

The rule has several advantages: (1) the approximate wave function involves at most N parameters. Others have often used more without obtaining results that are much more accurate than those given by the present choice. (2) It leads to a definite result for the approximate wave function, no matter what the atomic system under consideration may be. (3) Many of the integrals whose numerical values are needed have a simple form. (4) The same functions $u, v \cdots$, recur in many different problems, so that when the numerical work required for one has been finished, much of the work for several others is also completed. This will be particularly true in the later parts of the periodic system.

The method has already been applied to the particular case of the normal states of atoms of two electrons,[2] the result being

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[1] This has also been suggested by V. Guillemin and C. Zener, Zeits. f. Physik **61,** 199 (1930).

[2] J. Frenkel, Einführung in die Wellenmechanik, p. 291 ff. Berlin, J. Springer (1930).

that their term values are $2(Z-5/16)^2$, Z being the true nuclear charge. I have extended the calculations to the $2P$ and $3D$ states with the following results.

In Table I, T is the term value in units of Rh cm^{-1}; the third column contains the result of a calculation based on the foregoing rule; the fourth, the first-order result of perturbation theory; the fifth, the observed value. The quantities α and β are the effective nuclear charges for the $1s$ and $2p$ electrons, respectively. In the case of the $3D$ states, the screening constant $z-\beta$ proves to be so nearly unity that the Balmer formula may be used to calculate the absolute magnitude of the term value. The difference 3^3D-3^1D may be calculated, however, and is compared with the results of perturbation theory and observation in Table II.

TABLE II. 3^3D-3^1D

	Present method	Perturb. method	Observation
He I	5.14×10^{-5}	$198.\times10^{-5}$	3.68×10^{-5}
Li II	3.80×10^{-5}	$30.\times10^{-5}$	2.68×10^{-5}

TABLE III. $2P$ levels.

	$T/(Z-2)^2$		$Z-\alpha$*	$Z-\beta$ (calc.)	$Z-\beta$ (observ.)
	Present Method	Observation			
Li I	0.255	0.2605	0.31	1.98	2.019
Be II	0.258	0.2620	0.32	1.95	1.937
B III	0.258	0.2609	0.32	1.93	1.884
C IV	0.257	0.2595	0.32_6	1.91	1.858
N V	0.257		0.33	1.89	1.838
O VI	0.256		0.33	1.88	1.816

* Cf. Guillemin and Zener, reference 1.

Having performed the calculations required for the foregoing cases, it was less than two hours' work to compute the following data for the sequence of three-electron systems. A graphical method of interpolation was used, which is believed to have been sufficiently accurate. Although there are systematic deviations of the calculated from the observed values of $T/(Z-2)^2$, it is interesting to note that both sequences show a flat maximum near Be II. The calculated values of the screening constants $Z-\beta$ are not strictly comparable with those deduced from the observed doublet separation, but both sequences decrease monotonically.

Theory indicates that the method should be applicable to the 2^3S state of atoms with two electrons, but requires a slight modification for the 2^1S. A rough calculation verifies this. As soon as the calculations for these states have been made, it will be possible to calculate the normal states of the Li I sequence with very little additional labor. A more detailed account of this investigation will be published later.

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June 12, 1930.

Some Pecularities of the Spectrum of the Tungsten Mercury Arc

In the course of an investigation of sources of ultraviolet radiation, it was found that the new General Electric Sunlamp in a quartz bulb gives a very intense continuous spectrum in the region from 4000A to 2100A. The source of the ultraviolet radiation is a 300 watt alternating current mercury arc between hot tungsten electrodes with the bulb containing about 100 mm pressure of argon. With a Hilger E2 quartz spectrograph, an exposure of 10 to 15 seconds is sufficient to give an intense continuous background. The intensity of the continuous spectrum relative to the line spectrum can be increased by