formerly obtained by substitution of air by argon. The usefulness of krypton for Geiger-Müller counters in cosmic ray research is also obvious.

Part of the expense for this investigation was covered by a grant from the Ministry of Education.

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Ionization Energy of Li+ and He

As a disagreement was found by Robinson[1] between measured and calculated values for the ionization potential of Li^+, I have made a direct calculation by the method described by Hylleraas[2]. The ionization potential in the 13th approximation is found to be 610,058 cm.⁻¹. This result is in good agreement with the value 610,054 cm.⁻¹ obtained from the Hylleraas' extrapolation formula for $Z = 3$.

To this value the following corrections are to be applied[3]: ε_3 (mass polarization correction—the elementary mass correction is contained in R_z and therefore already taken into account), H_1 (relativistic change of mass with velocity), H_2 (magnetic interaction between the orbits), H_4 (spin correction, arising from a characteristic term in the Dirac theory), H_i (relativistic correction for the remaining ion with one electron).

I have calculated the most important of these corrections, H_1 and H_4, using the best wave function with four terms. Bethe has made the same calculation using a less accurate wave function.

TABLE 1. RELATIVITY CORRECTIONS.

Correction unit	H_1 $\alpha^2 R$	H_4 $\alpha^2 R$	H_i $\alpha^2 R$	Total $\alpha^2 R$	Total (cm.⁻¹)
New value	153·8	− 125·1	− 20·3	+ 8·4	+ 49
Bethe's ,,	130·4	− 111·6	− 20·3	− 1·5	− 8

H_2 is found to be very little ($= -2$ cm.⁻¹). Other corrections seem to vanish in our approximation.

TABLE 2.

Unperturbed ioniz. pot. (cm.⁻¹)	Total corrections H (cm.⁻¹)	Mass pol. corr.[4] (cm.⁻¹)	Total calculated (cm.⁻¹)	Experimental value[1] (cm.⁻¹)
610,058	47	− 5	610,100	610,079 ± 25

For He the agreement is not so good: the calculated value is 198,325 cm.⁻¹ (the unperturbed value is calculated by Hylleraas) and the experimental result is 198,305 ± 15 cm.⁻¹ (measured by Paschen). It seems that the theoretical values (even for heavier elements) lie somewhat higher than the experimental values, so the disagreement cannot depend upon the use of the variational method.

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The O-H Raman Frequency in Inorganic Acids

THE band characteristic of the OH group has been recorded in the Raman spectra of many hydroxides and alcohols. It has not so far been observed, however, in the case of the stronger acids. Using the improved technique of complementary filters recently developed by Ananthakrishnan[1], and giving long exposures varying from six to twelve days, I have succeeded in obtaining spectra with sulphuric acid and crystals of iodic, selenious and telluric acids, in which the band is clearly seen in the 4046 A. excitation. Table 1 gives the frequency shifts. The value for boric acid is taken from Ananthakrishnan's paper[2].

TABLE 1.

Substance	Raman frequencies of the OH band (cm.⁻¹)		
	Beginning	Middle	End
H_2SO_4 (100%) liquid	2794	2985	3172
HIO_3 crystals	2834	2979	3125
H_2SeO_3 ,,	2973	3057	3141
H_6TeO_6 ,,	2985	3121	3257
H_3BO_3 ,,	—	3172, 3256	

The following points may be noted: (1) The OH frequency in these acids is represented by a band which is weak, broad and diffuse as compared with the other vibration frequencies. (2) The OH group, which gives a sharp line at 3608 in potassium hydroxide and a broad band at about 3660 in ethyl and methyl alcohols, gives a much lower frequency in the inorganic acids. (3) There is a progressive fall in the characteristic frequency shift and a diminished intensity of the band with increasing strength of the acid. (4) In the case of sulphuric acid, the band appears to be resolved into two components.

The fact that the OH band has not hitherto been recorded in the Raman spectra of acids has been regarded by some investigators[3] as supporting the hypothesis of the existence of the so-called hydrogen bond[4] in oxy-acids and their salts. Now that the OH band has actually been recorded, this view evidently requires some modification. We have in fact to postulate the existence of the OH bond in acids as well, but considerably weakened as compared with the strength of the bond in alkalis and in weak acids. It may be mentioned in this connexion that Badger and Bauer[5] have recently observed an infrared absorption band in the region of 3μ in sulphuric acid, and they ascribe it to the presence of the OH group. These authors have drawn the inference that the so-called hydrogen bond and the hydroxyl bond postulated by Bernal and Megaw[6] are only extreme cases of one and the same phenomenon. This view appears to be supported by the investigation reported above.

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