THE IONIZATION OF Kr AND Xe BY POSITIVE ALKALI IONS AND THE IONIZATION POTENTIALS OF Ne, A, Kr, AND Xe

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THE previous work on the ionization of the noble gases by positive alkali ions[1,2,3,4,5] has been extended to krypton and xenon using velocities up to 600 volts, and the existence of a definite threshold at which ionization sets in has been studied for neon, argon, krypton, and xenon. The original apparatus described by Beeck[4] was used. With respect to the ionization chamber this method is similar to that of Sutton[1] and of Sutton and Mouzon,[2] but the mass spectrograph for ion separation and the use of electrometers instead of galvanometers, which makes the use of lower gas pressures possible, are new refinements. It is, however, noteworthy that the results of both methods are in very good agreement.

Previous work on helium, neon, and argon has given the unexpected result that the alkali ion nearest the noble gas in the periodic system is the most efficient ionizer. In the present work Cs^+ proves to ionize xenon most efficiently. In the case of krypton, however, K^+ seems to ionize equally as well as Rb^+. Also K^+ ionizes xenon more efficiently than Rb^+, while Rb^+ ionizes argon only slightly less than does K^+. These facts indicate that these collision phenomena are even more complicated than was formerly expected. The results show further that the maximum efficiency of ionization for a given accelerating potential increases with the atomic number of the gas. For example, the efficiency (the number of electrons liberated per initial positive ion per cm path per mm pressure) of caesium in xenon at 500 volts is 7.2 while that of potassium in argon is 3.4.

A second new and significant result, which is contrary to expectations based upon previous theories, is that there appears to be a definite threshold at which ionization begins. This was studied in neon, argon, krypton, and xenon. As the accelerating potential is increased from zero the ionization remains zero up to a certain point. Above this point the ionization increases almost linearly showing no indication that it approaches zero asymptotically at the lower voltages. In all cases except that of potassium in krypton it was definitely shown that the ion nearest the noble gas in the periodic system begins to ionize at the smallest voltage. This is in close correspondence with the

[1] Richard M. Sutton, Phys. Rev. **33**, 364 (1929).
[2] R. M. Sutton and J. C. Mouzon, Phys. Rev. **35**, 694 (1930).
[3] Otto Beeck, Naturwissenschaften **18**, 719 (1930).
[4] Otto Beeck, Ann. d. Physik **6**, 1001 (1930).
[5] R. M. Sutton and J. C. Mouzon, Phys. Rev. **37**, 379 (1931).

maximum efficiency of this combination. The observed ionization potentials in volts are given in the table.

	Li^+	Na^+	K^+	Rb^+	Cs^+
Ne	307	175	320	420	437
A	100	105	95	180	(365)
Kr	(420)	(400)	80	100	143
Xe	250	(360)	120	145	105

( ) probable error ± 10 volts.

A detailed account of this work will appear in the "Annalen der Physik" in the near future.