slower ion is approximately 0.07 seconds. It is the normal ion in hydrogen and has an absolute mobility of 8.25 cm/sec. per volt/cm. The hump on the high mobility side of the

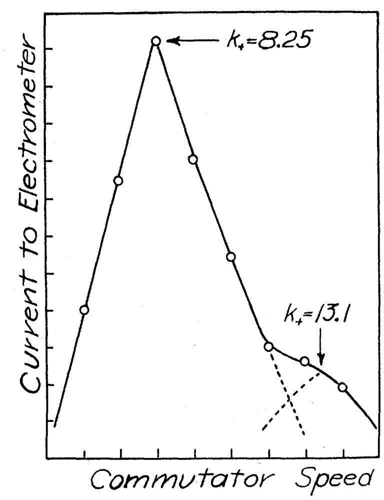

Fig. 1.

curve is definite evidence of the presence of an ion of age equal to 0.04 seconds and mobility 13.1 cm/sec. per volt/cm. While this latter value is not exact owing to the lack of resolving power of the method under such conditions, particularly with the low current intensity obtained in hydrogen ionized by x-rays, the agreement with the value obtained by Loeb is extremely good in view of the uncertain temperature correction in his calculations. These experiments thus obtain a slightly more accurate absolute value for the mobility of the normal ion in hydrogen, and entirely substantiate the existence of one ion of much higher mobility as observed by Loeb. The detection of the 17.5 mobility ion is beyond the limits of this method.

The experiments are being continued for ions in other gases.

Norris Bradbury

Department of Physics,
University of California,
Berkeley, California,
October 19, 1931.

The Nuclear Moments of Indium and Gallium

The nuclear moment of indium was reported about a year ago by Jackson (Proc. Roy. Soc. **128,** 508, 1930) to be 1 from a study of the hyperfine structure of the resonance lines. Almost simultaneously McLennan and Allin (Proc. Roy. Soc. **129,** 208, 1930) reported it to be $\frac{1}{2}$ by studying practically the same lines. A more recent communication by Jackson (Nature **127,** 924, 1931) pointed out that the difference between his results and those of McLennan and Allin is just what one would expect from the difference in the resolving powers of their analyzing apparatus. A still more recent paper by McLennan, Allin, and Hall (Proc. Roy. Soc. **133,** 333, 1931) which continues their former investigation, again arrives at the conclusion that the nuclear moment is $\frac{1}{2}$. We have studied the resonance lines of indium using a Fabry-Perot interferometer and find indeed that λ4101 ($5p\ ^2P_{\frac{1}{2}} - 6s\ ^2S_{\frac{1}{2}}$) has four distinct components as reported by Jackson, which, while it does not determine the nuclear moment, requires that it be greater than $\frac{1}{2}$. Microphotometer curves of this line show that the outside components are of equal intensity (which would be expected for any value of the nuclear moment) and that the inner components are both of smaller intensity. From the intensity rules this latter would be expected only if the nuclear moment were greater than $1\frac{1}{2}$. The line λ4511 ($5p\ ^2P_{1\frac{1}{2}} - 6s\ ^2S_{\frac{1}{2}}$) was reported by Jackson to have four components but as the lines could not be fitted to a level scheme where both initial and final states were split into two, he concluded that he did not have the complete pattern and that one more line existed which he did not resolve. We have found a fifth component which is present very weakly and furthermore a strong indication of broadening in one of the more intense components, showing that the pattern consists of six lines, again in agreement with only those values for the nuclear moment which are greater than 1. The measured intervals are somewhat different from those reported by Jackson and these also point to the higher nuclear moment, the value $2\frac{1}{2}$ giving good agreement with the interval rule. The hyperfine-structure components of this line fall into two groups of three each and it must be that McLennan, Allin and Hall in observing only two lines have not separated the members of the groups. While it does not seem possible to say with certainty at present what the value of the nuclear moment for indium is, it seems quite certain that it is greater than $1\frac{1}{2}$.

The resonance lines of gallium were examined with the same apparatus and the line $\lambda 4032$ ($4p\,^2P_{\frac{1}{2}} - 5s\,^2S_{\frac{1}{2}}$) was found to consist of three components at -0.083, 0, $+0.098$ cm^{-1}. In order to make certain that the central component was single the interferometer plates were separated 3.6 cm, causing the outside, components of adjacent orders to overlap, but the central component showed no signs of broadening, and one may conclude that the gallium nucleus has a spin moment $\frac{1}{2}$ as this is the only value which would give three components. The intensities as estimated visually are also in good agreement with the expected ratio of 2 to 1 for the central component with respect to either of the outer ones. The other resonance line is more difficult to resolve and we have succeeded in obtaining only partial resolution. There does not seem to be any doubt, however, that the same difficulty exists for gallium that also exists for thallium and indium regarding the relative hyperfine structure separations of the two members of the doublet arising from a single p electron. Here again the separation of the state with $J=\frac{1}{2}$ is comparable to the S state with which it combines but the state with $J=1\frac{1}{2}$ has a much smaller separation than that to be expected theoretically.

J. S. Campbell
R. F. Bacher

National Research Fellows,
California Institute,
October 15, 1931.

Current-Intensity Relation of the λ600 Band of Helium

Sommer (Nat. Acad. Sci. Proc. **13**, 213, 1927) identified as a helium band a diffuse line occurring at λ600 on some of Lyman's plates. This identification has been confirmed by subsequent investigators but its relation to the rest of the helium molecular spectrum has remained undetermined. An investigation has been carried on at Princeton University in an attempt to determine the origin of the band. The extreme ultraviolet spectra of low voltage arc, Schuler cathode, and uncondensed capillary discharged have been obtained with a vacuum spectrograph. The band at λ600 appeared strongly only under such conditions of pressure and purity of the helium as permitted the appearance of the visible bands of helium. It has a distinctly sharp edge at the short wave-length side and shades away to the red. By using an approximate method of photometry it was found that in the uncondensed capillary discharge the intensity of λ600 varied directly with the current, whereas Weizel (Zeits. f. Physik **95**, 320, 1930) has observed that the visible bands of helium vary in intensity as the square of the current. An intensity varying as the first power of the current has generally been interpreted as signifying a primary, or one-stage process, while an intensity varying as the square of the current has been interpreted as a secondary, or two stage process, such as excitation by an electron of an atom which has been excited by a preceding electron. This suggests the possibility of a difference in the mechanism of excitation between the λ600 band and the visible bands. A more detailed discussion will be published later. Grateful acknowledgement is made to the Carnegie Institution of Washington for financial assistance.

John L. Nickerson

Mount Allison University,
Sackville, New Brunswick, Canada,
October 17, 1931.

Production of Second and Third Spark Spectra in a Hollow Cathode Lamp

The normal operation of a hollow cathode discharge tube with argon gas usually excites only the arc and a portion of the first spark spectra of the cathode material, while its operation with helium gas gives the arc and first spark spectra, and usually no more, the limit being approximately the energy available from the singly ionized gas. The introduction of a spark gap in series with the lamp removes this limitation and lines from higher stages of ionization are obtained. Lines of doubly ionized carbon and copper and of doubly and triply ionized germanium have been identified in spectrograms thus produced. Pulsating direct current was supplied to the Schuler Lamp by a full-wave rectifier consisting of two hot cathode mercury rectifier tubes, a filter choke and a 3 mfd condenser shunting the output. The lamp was normally operated at 0.4 to 1.2 amperes and at 500 to 2000 volts.

In normal operation with helium as the circulating gas the Ge II spectrum was strongly