

path may become neutralised or decomposed and then as neutral hydrogen particles, send out the Balmer lines. Batho and Dempster⁵ obtained sharp displaced lines of the Balmer series indicating homogeneous velocities, the displacements agreeing with those calculated from the potential for the H^+ , H_2^+ and H_3^+ particles. At lower pressures the displaced line due to H_2^+ was found to become the strongest. Hogness suggested that the double absorption lines observed in some novæ might be of similar origin. Rough measurements of spectra of two novæ gave pairs of velocities approximately as $\sqrt{2}:1$ in each case. Anna McPherson⁶ observed an apparent minimum velocity for excitation of radiation in the neutral hydrogen atom at about 40 volts. In the helium-hydrogen mixture the hydrogen Doppler lines due to H_2^+ and H^+ alone were perceptible, that due to H_3^+ not appearing.

Positive Rays of Neon, Argon and Helium.—Romig⁷ found that the neon canal ray stream exhibited Doppler effect among the stronger lines in the first and the second spark spectra of neon, the arc spectra almost exhibiting no Doppler shift. The stream consists of rapidly moving neon atoms which radiate only when in the ionised state; hence the radiation from the

canal rays is almost entirely from atoms in the ionised condition. Anna McPherson⁸ showed that with the exception of λ 3418 of neon, the arc lines of neon and argon have no Doppler shift, while the lines of the first spark spectrum are accompanied by sharp displaced lines only slightly less intense than the rest lines whose separation corresponds accurately to the speeds acquired by singly charged ions in the accelerating field. Experimentally, the ions of hydrogen, argon, neon and helium, formed in a low voltage arc, were accelerated to high speeds in an electric field of high potential gradient forming beams of positive ions which had the same energy. The spectra of the beams of such positive rays observed in the direction of motion showed the characteristic Doppler effect, with the displaced lines fully as sharp as the rest lines. Satisfactory observations were made at a pressure of about 5×10^{-3} mm., the intensity and the sharpness of the displaced lines diminishing with increasing pressure. In helium the arc lines showed relatively faint displaced lines corresponding to singly charged ions; one spark line λ 4686 was accompanied by a relatively intense displaced line, while the only other spark line observed λ 4541 showed no Doppler effect. Further investigation alone can reveal the true nature of these divergent results.

⁵ Batho and Dempster, *Astrophys. J.*, 1932, **75**, 34.

⁶ Anna McPherson, *Phys. Rev.*, 1934, **45**, 485.

⁷ Romig, *ibid.*, 1931, **38**, 1709.

⁸ Anna McPherson, *Phys. Rev.*, 1933, **44**, 711.

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