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CORRIGENDUM

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Correction and addendum to Oka 2000: introductory remarks

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My earlier assignment of the H_3^+ signal in J. J. Thomson's plate is corrected. The double nature of the $m/e=3$ signal, one due to H_3^+ and the other to HD^+, which puzzled Thomson for over 20 years, is discussed.

Keywords: J. J. Thomson; H_3^+; HD^+; historical

The assignment of the H_3^+ signal in J. J. Thomson's plate (Fig. 1 of Oka 2000), which was copied from my earlier review (Oka 1983), was incorrect. The assignment was based on Fig. 21a of Thomson (1912), which is reproduced here as figure 1. Thomson's remark on page 241 'the line is the one marked *a*; above it are the lines due to the hydrogen atom and molecule,' led me to assign the weak parabola pointing towards *a* as H_3^+, although it was puzzling that it is so far away from the parabolas of H^+ and H_2^+. Further reading of Thomson's papers and books has revealed that the mark *a* is misplaced and that the H_3^+ signal is the faint dot just below the strongest H_2^+ parabola (shown by an arrow in figure 1).

The H_3^+ signals observed in hydrogen plasmas were often not reproducible and Thomson later called it 'capricious', 'fugitive' or 'evanescent' (Thomson 1934*a*–*c*, 1937). Thomson's quest to obtain a more 'permanent' $m/e=3$ signal led him to a different method of producing the '3' line by bombarding solids with cathode rays and using the evaporated gas for discharges. An example of the more permanent '3' line produced by this method is given in Fig. 50 of Thomson (1913*a*) which is reproduced here as figure 2: the '3' line is sandwiched between the H_2^+ and He^+ lines. Thomson spent 8 pages of his 20 page Bakerian Lecture (1931*b*) on how this permanent '3' line was produced by bombarding a great many metals, salts,

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One contribution of 26 to a Discussion Meeting Issue 'Physics, chemistry and astronomy of H_3^+'.

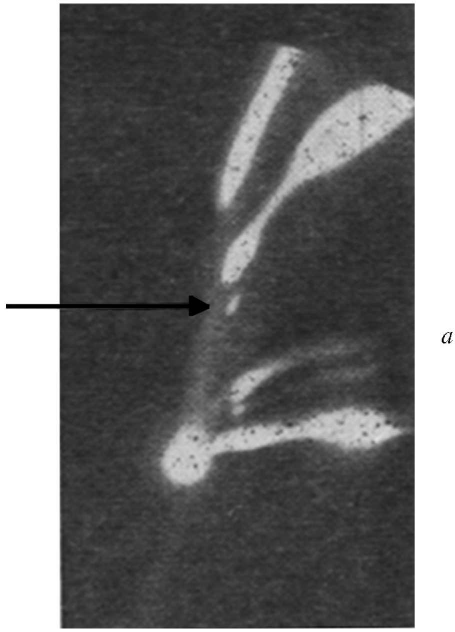

Figure 1. The ‘capricious’ H_3^+ signal. From Thomson (1912).

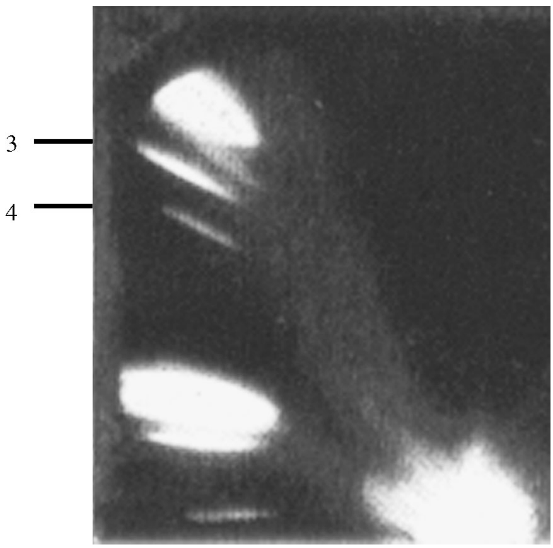

Figure 2. The ‘permanent’ signal later found to be due to HD^+. From Thomson (1913*a*).

meteorites, etc. (26 solids were used!) The existence of the two different kinds of the ‘3’ line puzzled Thomson so much that after the initial two papers (Thomson 1911, 1912), he refrained from using H_3^+ and used X_3 instead, in his papers and books.

After 20 years, Thomson’s quandary was finally resolved when the deuterium was discovered by Urey, Brickwedde and Murphy in 1932. After repeating the experiment using ‘samples of 80 per cent concentration of heavy hydrogen’ obtained ‘through the kindness of Lord Rutherford’, Thomson understood that the capricious, fugitive and evanescent signal of figure 1 was indeed due to H_3^+, but the permanent signal in figure 2 was HD^+ due to HD desorbed from the solids. This led to his somewhat misleading remark (Thomson 1934*a*), 'The evidence seems to me to leave little doubt that the gas I called H_3 more than 20 years ago is the same as that which is now called heavy hydrogen'. The properties of the dot signal due to H_3^+ were discussed in Thomson (1935), although some explanations are cryptic.

Thomson's last remark on H_3^+ appeared in his autobiography (Thomson 1937) where he convincingly writes 'one of the first things discovered by the photographic method was the existence of H_3^+'. However, his later remark in the same book, 'though H_3^+ is so evanescent, H_3 itself is much more durable, for when H_3 has once been observed in a tube, then though the tube has not been sparked for several days, H_3^+ will at once appear when sparking is resumed', indicates that Thomson had not understood the chemistry of H_3^+. The secondary nature of the H_3^+ production, i.e. ionization of H_2 to H_2^+ followed by the reaction $H_2^+ + H_2 \rightarrow H_3^+ + H$, was left to younger generation of American scientists, Dempster, Hogness and Smyth, to figure out (Oka 1983, 2000).

I am indebted to B. J. McCall for initiating discussions leading to this clarification.

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