On the Ionisation of Metallic Vapours in Flames.

By Prof. J. C. McLennan, F.R.S., and David A. Keys, M.A., University of
Toronto.

1. *Introduction.*

It has been shown by Frank and Hertz[*] and also later by McLennan and
Henderson[†] that when electrons possessing kinetic energy corresponding to a
fall of potential of approximately 4·9 volts are allowed to impinge upon
heated mercury vapour in a vacuum, the vapour emits a monochromatic
radiation of wave-length $\lambda = 2536 \cdot 72$ A.U. R. W. Wood[‡] has also shown
that if light of this wave-length be projected in a given direction into heated
mercury vapour in a vacuum, the phenomenon of resonance comes into play
and a radiation of wave-length $\lambda = 2536 \cdot 72$ A.U. is re-emitted by the
vapour in directions making all angles with that of the impinging light.
Quite recently too it has been shown by McLennan and Thomson[§] that if
mercury vapour be introduced into the flame of a Bunsen burner there issues
from the flame in addition to the ordinary well-known light of the Bunsen
flame the monochromatic radiation of wave-length $\lambda = 2536 \cdot 72$ A.U. These
illustrations serve to show then that there are at least three distinct agencies
by means of which the vapour of mercury may be brought into a state
in which it is capable of emitting the characteristic monochromatic radiation
of wave-length $\lambda = 2536 \cdot 72$ A.U. Frank and Hertz[||] have also shown—and
it has later been confirmed by Newman[¶]—that mercury vapour is ionised
when electrons are projected into it with a velocity equal to or greater than
that acquired in a fall of potential of 4·9 volts. This result would therefore
suggest that whenever mercury vapour is brought into a condition to emit
the monochromatic radiation $\lambda = 2536 \cdot 72$ A.U., it is also ionised and should
be capable of exhibiting electrical conductivity. Some experiments made by
Steubing[**] also seem to support this suggestion, for he found that mercury
vapour could be made conducting by simply passing through it light of wave-
length $\lambda = 2536 \cdot 72$ A.U. It would seem, therefore, if this suggestion should

* Frank and Hertz, 'Verh. d. Deutsch. Phys. Ges.,' vol. 11, p. 512 (1914).
† McLennan and Henderson, 'Roy. Soc. Proc.,' A, vol. 91, p. 485 (1915).
‡ R. W. Wood, 'Phys. Zeit.,' Jahrgang 10, No. 13, p. 425.
§ McLennan and Thomson, *supra*, p. 584.
|| Frank and Hertz, 'Verh. d. Deutsch. Phys. Ges.,' vol. 10, pp. 457–467 (1914).
¶ Newman, 'Phil. Mag.,' vol. 28, pp. 753–756 (Nov., 1914).
** Steubing, 'Phys. Zeit.,' Jahrgang 10, No. 22, p. 787.