section of the molecules for electron impact, and that there was a volume loss term specified similarly by the total inelastic cross-section. That is, an elastic collision was assumed to leave an electron in the group and an inelastic collision to remove it. The boundary conditions, chosen to approximate to those in the tube, were that the concentration had a constant maximum over the face of the cathode, was zero over the rest of the cathode plane and was zero, apart from the usual free path correction, over the whole anode plane and intermediate wall. The solution was obtained as an exponential-Bessel series with coefficients determined by tube dimensions, cathode concentration and the ratio of loss and diffusion coefficients. Sixteen terms, evaluated using a digital computer, were found to give adequate convergence. The ratio was varied until one giving the best fit to the experimental data was obtained. This value proved to be in substantial agreement with published values for the relative cross-sections, the chief source of uncertainty being lack of exact knowledge of the gas temperature.

Two other results which have emerged are:

(1) The distribution of electrons in a plane perpendicular to the axis follows a bell-shaped curve, illustrated by graph *a* in Fig. 1. It is interesting that a curve of this shape can occur in a plasma and does not necessarily indicate that conditions are subnormal[4,5].

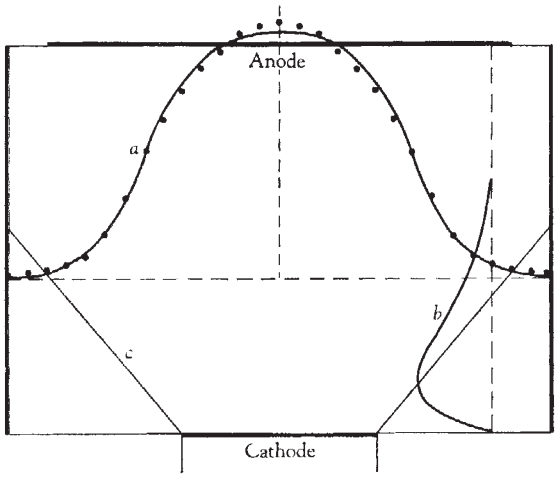

Fig. 1. Diagram of tube and calculated fast electron concentration profiles. *a*, Radial distribution, 2 cm from cathode, ● experimental values at 600 m.amp, 700 μm mercury; *b*, distribution parallel to axis, 1·5 cm from cathode edge; *c*, locus of maxima in *b* (wings). (Graph *a* electron concentration axis vertical; graph *b* electron concentration axis horizontal)

(2) As a consequence of the boundary conditions, the concentration has a maximum (graph *b*) between the planes of cathode and anode along lines perpendicular to these outside the cathode radius. A typical locus of maxima for a given discharge is shown by line *c* in Fig. 1. Since the luminosity of the plasma is largely due to the fast electrons, this effect may contribute to the winging sometimes seen to start at a cathode edge, or even to that associated with plasma-electron oscillations[6].

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Gyromagnetic Ratio of the Proton

The gyromagnetic ratio of the proton was determined two years ago[1] in terms of the unit of current maintained at the National Physical Laboratory by means of standard resistors and standard cells.

A determination of the unit of electric current by the balance of the Laboratory now enables the values of the gyromagnetic ratio of the proton to be referred to the ampere as defined in terms of the metre, kilogramme and second.

The interquartile range of 70 independent measurements of current was 8 in 10^6, which corresponds to a quite small probable error of the mean; but an analysis of possible systematic errors suggests that the probable error may be as large as 4 in 10^6. The results indicate that the unit of current maintained at the Laboratory by material standards exceeds the ampere by 15 in 10^6. When this difference is taken into account, we find for the gyromagnetic ratio of the proton in water, uncorrected for diamagnetism, $2{\cdot}675\ 13 \times 10^8$ $Wb^{-1}m^2s^{-1}$ with a total probable error of 5 in 10^6. The same figure was also quoted as a preliminary value by Driscoll and Bender[2] and has been provisionally recommended by the Association of Geomagnetism and Aeronomy[3].

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GEOPHYSICS

Self-reversal of Remanent Magnetization of Magnetite at Low Temperatures

The intensity of isothermal remanent magnetization of a ferromagnetic body usually increases with its cooling in non-magnetic space, owing to increase in spontaneous magnetization. We have found, however, that the direction of isothermal remanent magnetization of a single crystal of magnetite produced at room temperature is reversed at about $-143°$ C in a cooling process in non-magnetic space. The sample examined by us was a single crystal of magnetite collected from Mituisi, Japan. The chemical composition (less than 0·3 per cent titanium dioxide content) and the X-ray data ($a = 8{\cdot}391$ Å) of this sample indicate that it is nearly stoichiometric magnetite.

A disk of single crystal magnetite (diameter = 1·3 cm, thickness = 0·3 cm) was magnetized in a magnetic field of $H = 5{,}000$ œ at the room temperature and then was cooled to $-196°$ C in non-magnetic space. Fig. 1*a* shows the change of the remanent magnetization with temperature. In this figure the remanent magnetization vanishes at about $-143°$ C and then re-appears into the opposite direction on further cooling. When the magnetite is reheated to room temperature in non-magnetic space, the direction of the remanent magnetization is again reversed to the original one at the same critical temperature (Type 1 curve in Fig. 1*a*).

In order to explain this self-reversal of remanent magnetization at $-143°$ C, it may be assumed that there are two different kinds of magnetic domains which are coupled with each other by magneto-static force. The following two experiments seem to justify this assumption.

(*A*) *Field cooling experiment.* The isothermal remanent magnetization was produced on the sample at room temperature and afterwards the sample was cooled to $-196°$ C in a magnetic field of which direction was parallel to that of the original isothermal remanent magnetization. It is found that the magnetic field of 0·5 œ is sufficient to suppress the self-reversal phenomenon. The experiment