# ON THE SPARTIAL DISTRIBUTION OF THE ELECTRIC FIELD IN A CONDUCTING ELECTROLYTE

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### ABSTRACT

The difference of potential between the cathode and each of various points in a 0.0024 normal solution of copper sulphate were measured, and, from this distribution of potential, the space-charges at various points in the solution were calculated.

The electrolyte was contained in a porcelain trough having a length of 30cm and a square cross section of 25cm$^2$. Copper electrodes of the same area, placed near the ends of the trough, were maintained at a constant difference of potential of 9,000 volts. A fine copper wire, sealed into a drawn-out glass tube and cut off so that only the end was exposed, served as the movable electrode. The difference of potential between the cathode and this electrode was measured with a potentiometer in which a quadrant electrometer served to indicate the balance.

For any given point in the electrolyte, difference of potential readings were made every minute for at least fifteen minutes, by which time the potential of the point had become nearly constant. From a series of such sets of data taken at various points between the electrodes, the potential distribution was determined for various times of flow of the electrolytic current; these data were plotted. The slope of the resulting curve (for any one time) was then determined graphically at various points, and a second curve showing the field-intensity as a function of the distance from the cathode was drawn. The slope of this second curve was measured graphically at 0.01 cm, 2cm, 15cm, and 27cm from the cathode, and from these data the space-charge at each point was calculated.

The space-charges found at the end of fiften minutes were:
40.8 e. s. u./cm$^3$ at 0.01 cm. from cathode,
$1.5\times10^{-6}$ e. s. u./cm$^3$ at cm from cathode,
$1.3\times10^{-6}$ e. s. u./cm$^3$ at 15 cm from cathode,
and $9.3\times10^{-5}$ e. s. u./cm$^3$ at 27 cm from cathode,

In every case the charge was positive, i.e., consisted of an excess of $Cu^{++}$ ions, at all pointsin the solution except very near the anode. The results may be presented as the fractional excess of the positive ions at each of the four points. At 0.01 cm, the excess was one for each 18,000,000 $Cu^{++}$ ions normally present in the 0.0024 normal cooper sulphate solution; at 2 cm, the excess was one in every $4.8 \times 10^{14}$; at 15 cm, one in $5.7 \times 10^{13}$; and at 27 cm, one in $7.8 \times 10^{12}$.

Great accuracy cannot be claimed for these figures, but it is believed that they are of the right order of magnitude.

Work on this problem was begun in 1924 by D. E. Roller and continued during the following years by J. N. Cameron, L. D. Huff (one summer), J. T. Mitchell, and Charles A. Reed. Mr. Reed worked during 1928-1929, and it is his data which are given in this paper.