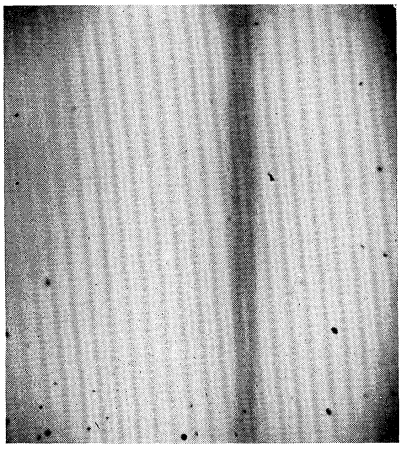

FIG. 3. Photograph of trace. Distance between center of split trace and direct trace is 2.15 mm.

The results of the various runs are given in Table I. The value of the deuton moment is found to be 0.77 ± 0.2. The effect of the protium correction is such that a 5 percent correction results in a moment change of 0.2 of a unit.

TABLE I.

$l_1^2+2l_1l_2=652$ cm^2						$d=0.07$ mm	
H Gauss	$\partial H/\partial y$ Gauss/cm	s_1 mm	s_2 mm	f_3	f_2	μ_d	Estimated H^1 content
98	796	0.03	0.147	0.536	0.802	0.77	5%
121	984	.05	.190	.656	.844	.77	5%
121	984	.045	.190	.683	.855	.73	10%
179	1455	.082	.295	.800	.898	.82	10%

The corrections we have made for H^1 are more likely to be too small than too great.

It should be emphasized that our measurement cannot distinguish the sign of the nuclear moment.[4] It is thus within the realm of possibility that the proton and deuton moments may both or either be negative. On this basis if we assume the deuton to consist of a proton and a neutron which retain their identities in the deuton, and if we further assume no rotational moment, then the magnetic moment of the neutron would be about ± 2.5 or ± 4.0 units.

[4] This is also true in the experiments of Stern, Estermann and Frisch.

The Emission of Ions and Electrons from Heated Sources

A. J. DEMPSTER, *University of Chicago*

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It is found that pin-hole photographs may be made of ions or electrons emitted by a heated source. The crossed paths of the charged particles is explained by the space charges in the immediate neighborhood of the emitting points on the source, which distort the lines of force and allow of accelerations in various directions. Part of the electron emission from an oxide coated filament and the positive ion emission from spodumene is thus found to be concentrated at definite points on the surface.

BY means of electric or magnetic fields the electrons emitted by a hot filament may be focused on a photographic plate.[1] These photographs often reveal a difference in the emissions from various parts of the surface. The experiments described in the present paper show that, in addition to the general emission, there are concentrated point sources where the emission is especially intense.

[1] E. Brüche and H. Johannson, Ann. d. Physik **15**, 145 (1932); E. F. Richter, Zeits. f. Physik **86**, 697 (1933); E. Ruska, Zeits. f. Physik **87**, 580 (1934); V. K. Zworykin, J. Frank. Inst. **215**, 535 (1933); C. J. Calbick and C. J. Davisson, Phys. Rev. **45**, 764 (1934).

The source of electrons was a heated Western Electric coated filament F, Fig. 1. The source of positive lithium ions was a strip of platinum on which a small crystal of spodumene had been melted. The source was placed 12 mm in front of the slit S_1, the second slit S_2 was 6 cm from S_1 and the photographic plate P was 22 cm from S_2. Constant accelerating potentials of 10,000 to 20,000 volts were applied between F and the slit system. With $S_1=0.5$ mm in width and $S_2=0.02$ mm it was noticed with the positive ions that the image on P was not a single line, as was to be expected, but consisted of four lines.

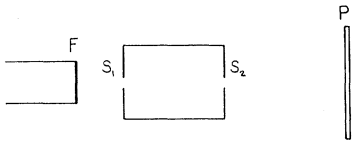

FIG. 1.

When S_1 was widened more lines appeared, and when the front of the metallic cylinder was left completely open, a complex pattern of as many as twenty-five lines appeared. This is illustrated in Fig. 2. With a total current from F of 2×10^{-6} amp. the exposure time with Schumann plates was 45 seconds. The slit S_2 was given a notch at one end, and it is seen that the lines are displaced sideways as well as up and down. The length of the lines agrees with the theory that there are many point sources on F which project images of S_2 on P. S_2 was then removed and a small, irregular hole was inserted between the positions of S_1 and S_2. A great many images of the hole (more than 25) were obtained, each of which showed the irregular form of the hole.

With an oxide coated filament it was found that the electrons gave similar photographs. With a small hole 0.01 mm in diameter in a piece of platinum foil placed 3 cm from F, a group of spots were obtained on P. These differ greatly in intensity and some of them are arranged in straight lines. Four photographs with lithium ions showed the same general arrangement of points is recorded by this method of observation. Around these points, the equipotential surfaces

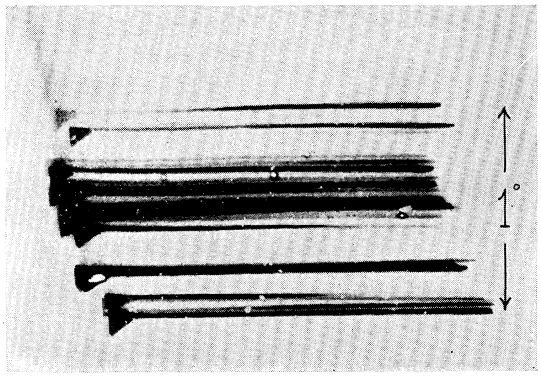

FIG. 2. Images of slit formed by lithium ions.

lines, indicating that the emission remains located at the same points over a considerable time. With 10,000 volts accelerating potential the effect was the same as with 20,000.

The interpretations of the lines and spots as due to point sources of ions or electrons on F seems at first to be untenable, since it would be necessary for the electrons or ions to describe paths that cross at S_2 or at the hole, and that make angles with other paths as large as 1°. We see, however, that this is possible, if we consider the effect of space charge in distorting the field in the immediate neighborhood of emitting points. Only the emission from such are distorted, Fig. 3, so that some of the electrons

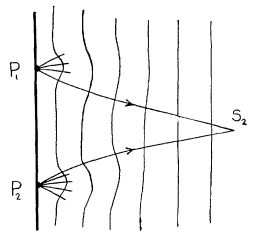

FIG. 3.

leaving P_1, may find their paths crossing the paths of some of the electrons from another point P_2.

We may conclude then that the emission of lithium ions from a heated spodumene crystal, and of electrons from an oxide coated cathode is to a considerable extent concentrated at points on the surface.

The experiments illustrate also a difficulty and possible source of error in dealing with narrow electron or ion bundles in reflection or diffraction experiments. Even with very narrow slits, we do not necessarily have a single beam of uniform intensity issuing from the slit system, but may have a group of several distinct beams making small angles with each other.

Note added in proof: Dr. C. J. Davisson has kindly called an article by H. Seemann to the attention of the author. (Zeits. f. Physik **79**, 742–752 (1932).) In this article tungsten filaments are also shown to emit electrons more strongly from some spots than others. Photographs of the focal spot on an anode first suggested the phenomenon which was later confirmed by direct pin-hole photographs of the cathode.

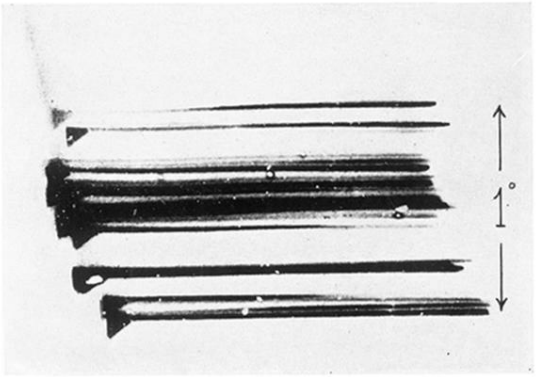

FIG. 2. Images of slit formed by lithium ions.