LETTERS TO THE EDITOR

Prompt publication of brief reports of important discoveries in physics may be secured by addressing them to this department. Closing dates for this department are, for the first issue of the month, the twentieth of the preceding month; for the second issue, the fifth of the month. The Board of Editors does not hold itself responsible for the opinions expressed by the correspondents.

Concerning W. T. Sproull's Article on "Diffraction of Low Speed Electrons by a Tungsten Single Crystal"

Sproull[1] reports intense sharp beams in the AA' azimuth (perpendicular to the cube diagonals) of the (112) plane for normal incidence. They obey a volume equation after allowing for refraction, and not the surface equation. All other beams are weak and broad. A simple interpretation of the intense beams is at hand if we make the logical assumption that due to evaporation during heat treatment of the crystal etching occurs parallel to the more densely populated (011) sets of planes which contain the atoms used for the volume equation. On this view the lines which Sproull has plotted in Fig. 2 as the volume condition (curved lines) now become the surface condition (straight lines) and *vice versa*, and θ is to be replaced by the angle of emergence measured from the normal to the (011) planes. Thus the beams in the AA' azimuth are really following the surface grating and are little affected by the depth grating. Also, the surface layer of atoms will appear more effective than for normal incidence, and the beams should continue over greater ranges in voltage and angle. This interpretation vitiates Sproull's values of the inner potential W_a, and his conclusion regarding constancy of the values, since his method does not apply when the angle of incidence is other than normal. Theoretically the observations should fall on the line representing the surface grating condition regardless of the value of W_a. That they are slightly displaced may be attributed to some other cause.[2]

Two other considerations require comment. First, Sproull concludes that the higher outgassing temperatures which could be used with tungsten compared with those which could be used by the writer with copper account for the "more consistent values" of W_a. We have previously emphasized that during the final observations on copper, the surface gas layer was reduced to such a thickness that it had no observable effect on the *intensity* of the beams due to copper, and further that even when the gas layer was thick enough to reduce appreciably the intensity of these beams, the *voltages* at which the beams attained their maximum values were not noticeably altered.

Second, Sproull states that contact potentials of over 7 volts exist in his electron gun and that their large fluctuation of 2 or 3 volts from day to day "may account for the irregular variations of W_a reported by some observers" using an oxide electron source. Since the writer has reported values of inner potential obtained when using such a source it is in order to state here that precautions have been taken and observations made which eliminate errors of the type mentioned due to spurious causes. For every type of electron gun used by the writer, preliminary investigations have been made to test the homogeneity of the electron stream and the contact potentials in the gun by an arrangement equivalent to that given in *J.O.S.A. and R.S.I.*[3] In addition, a check as to the constancy of the conditions from day to day during the course of a long series of observations has always been made by checking the voltage, colatitude angle, and intensity of a low voltage (below 100 volts) diffraction beam once or twice each day. The voltages have always checked to within the order of 0.1 volt after sufficient outgassing. We believe that these tests are sufficient to eliminate the possibility of any fluctuations as observed by Sproull, and conclude that some condition peculiar to his arrangement is responsible for his observed fluctuations.

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Providence, R. I.,
April 19, 1933.

[1] Sproull, Phys. Rev. **43**, 516 (1933); R.S.I. **4**, 193 (1933).

[2] Space is not available here for a discussion of this.

[3] H. E. Farnsworth, J.O.S.A. and R.S.I. **15**, 290 (1927).

Comments on W. T. Sproull's Article "Diffraction of Low Speed Electrons by a Tungsten Single Crystal"

I should like to suggest an alternative explanation of the very interesting effects in electron diffraction described by W. T. Sproull in a recent number of your journal.[1] He finds that sharp beams are obtained from a single crystal of tungsten cut to a (1–1–2) plane which do not follow the law to be expected for surface effects, but another[2] which he interprets as a condition for volume interference. This equation is, however, the condition that wavelets from atoms in a (1–0–1) plane should be in phase,

[1] W. T. Sproull, Phys. Rev. **43**, 516 (1933).

[2] Reference 1, p. 519, Eq. (2).