high vacua, and that these ions can travel towards the screen, causing bad damage with attendant loss of fluorescence. This effect should be especially noticeable in cathode ray tube systems employing mixed electrostatic and magnetic scanning, where a line will appear across the screen after some use, owing to the fact that the ion beam is not appreciably deflected by the magnetic field.

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Surface Structures of Possibly Atomic Dimensions using Autelectronic or 'Field' Emission from Fine Metal Points

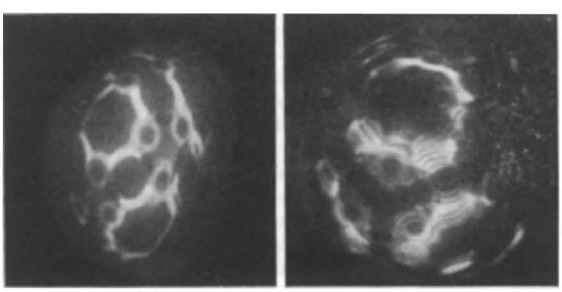
WE have set out to study the contamination of metal surfaces, using the field emission from fine points to give large-scale patterns representing the angular distribution of electron emission.

The general technique adopted is similar to that described by Müller[1,2], but we have found that with the wide-angle beams obtained a spherical bulb is desirable. The patterns which we have obtained from clean tungsten are so well defined that we feel it may be of general interest to describe the results so far obtained.

A fine tungsten point is mounted on a thick filament in the centre of a spherical bulb, one half of which is coated with fluorescent material. The anode consists of a carbon film on the other half of the bulb.

After suitable exhaust treatment, the filament is dimmed to room temperature or a little above, and a voltage of the order of 10 kv. is applied to the anode. An electron pattern of the emitting point is then obtained on the screen.

In our experiments the points have been different from those of Müller, being formed by electrolytic etching of fine wires of diameter 0·05 mm. The solid angle subtended by the pattern on the screen is considerably wider than Müller shows, and contains more pattern elements.



(a) (b)

Fig. 1.
PATTERN FROM CLEAN TUNGSTEN

In Fig. 1(a) is shown a photograph of a typical pattern on the screen. The symmetry of the pattern will be at once apparent, and the dark spaces can be identified, as Müller has done, as corresponding to the directions of the normals to the main lattice planes in the crystal. It is noteworthy that, except when the surface is heavily contaminated, there appears to be no luminosity in these areas.

In the case under consideration, the crystal has a cubic structure, and the centres of the large octagons correspond to the (100) planes. The small well-defined circles forming triangles are the (211) planes, and the centre of the main rectangle corresponds to the (110) plane. The fainter ones either side of the (110) are the (221) planes. The centres of the triangles corresponding to the (111) planes are not fully dark.

From the emission-voltage characteristics, the radius of the point and the size of the emitting area can be approximately estimated, using the Fowler-Nordheim formula[3,4]. For the point shown in Fig. 1 (a) the radius is $1\cdot5 \times 10^{-4}$ cm., and the emitting area is $2\cdot5 \times 10^{-11}$ cm.^{2}. Optical measurement indicated that the point radius was 5×10^{-5} cm.

In Fig. 1 (b), we show the pattern obtained with a somewhat larger point. (A rough measure of the size is given by the voltage necessary to obtain the pattern.) It will be observed that the pattern is basically the same as in Fig. 1 (a), but that the dark spaces are surrounded by multiple lines. The bright parts of the pattern are made up of small twinkling spots in rows forming the multiple lines, shown in Fig. 1 (b). From the number of spots present, and the emitting area, these spots must correspond with areas of atomic dimensions. Their agitation is quite clearly a function of temperature.

Using thoriated tungsten points, we have found that the basic tungsten pattern can be obtained. The surface can then be covered with a monatomic layer of thorium. The patterns obtained give some idea of the way the surface becomes covered.

It seems to us that the technique described offers an extremely simple method for the study of metallic surfaces and the contamination of such surfaces. For example, the arrival and removal of gas ions can be clearly observed.

We hope to publish our detailed results in the near future.

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Magnetic Evidence regarding the State of Manganese in Glasses

MUCH controversy centres around the role of manganese as a colorant of glass. Mellor[1] states that manganese colours alkaline glasses pink to violet under oxidizing conditions. According to Thorpe[2], the full colour is only developed when manganese is in a fully oxidized condition (Mn^{iv}). In Fuwa's[3] opinion, the manganic oxide is responsible for the pink colour, and colourless manganese in glasses is bivalent.

Notable contributions on the subject have been made by Bancroft and Nugent[4], Solomin[5], Childs and co-workers[6], Turner and Weyl[7], Springer[8], Hoffman[9] and others. According to Sir Herbert Jackson[10], none of the evidence is conclusive. An attempt has been made by us to clarify the issues by the aid of