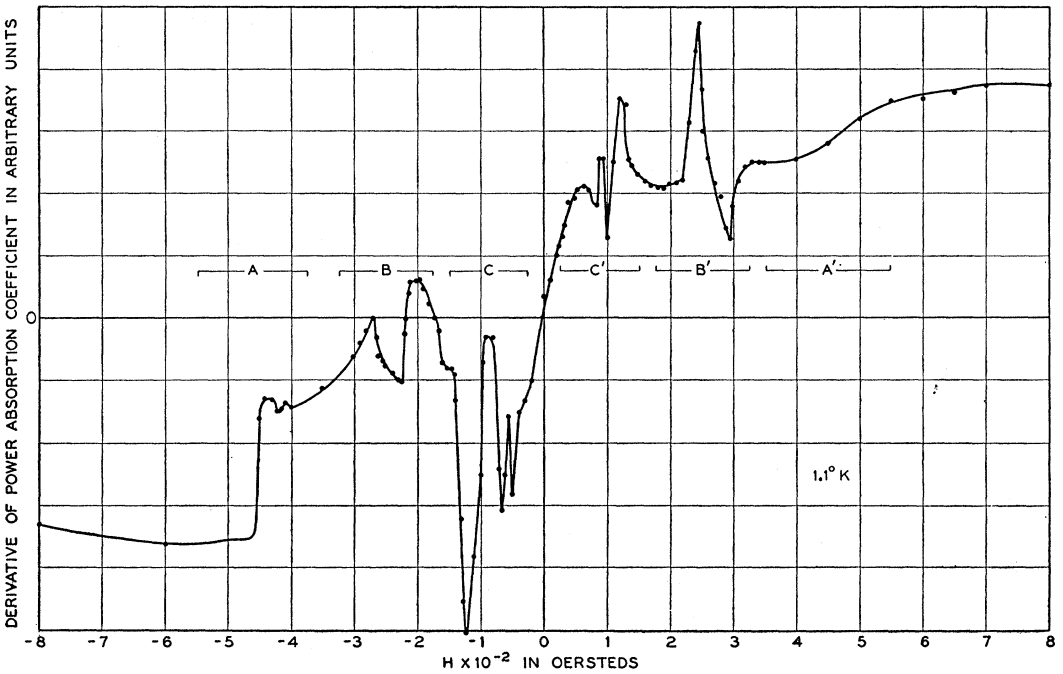

FIG. 2. Expanded plot of the low-field data in Fig. 1(b). The points are taken from the original data, which were taken as a continuous plot.

θ is the angle between H and the normal to the plane of the disk.

We do not feel qualified to make a definitive interpretation of the data in Fig. 2. We do suggest, however, that the structure in these data consists essentially of singularities which arise from the resonance behavior of minority carriers as suggested by Anderson.[5] We associate one of these singularities with each of the field ranges labeled A, A', B, B', C, C'. The two singularities labeled with the same letter occur in each case at roughly the same magnetic field but on opposite sides of $H=0$. As a result, we cannot say with confidence whether each pair corresponds to a hole and an electron or to one type of carrier for which the constant energy surfaces are highly eccentric.[7,8] The fields at which singularities occur lead from the cyclotron resonance condition to a mass of about 0.05 m_0 for those marked A and A', about 0.03 m_0 for those marked B and B', and to a mass of less than 0.02 m_0 for those marked C and C'. These numbers are very approximate, of course.

We do not exclude the possibility that there are other carriers which are not resolved at our frequency, but our data lead us to expect a minimum of four and a maximum of eight types of charge carriers.

One other effect, not shown in Figs. 1 and 2, became apparent at fields above about $H=2500$ oersteds. This is an oscillation in the absorption coefficient *vs* H curve with period proportional to $1/H$. Anderson[7] has suggested that the carrier mean free path and, therefore, the conductivity should show oscillatory behavior under the conditions of our experiment, as energy levels emerge from the Fermi sea, and this may be the reason for these oscillations. More work will be necessary, however, to show conclusively that this effect does not arise simply because at higher fields our skin depth may be comparable to the thickness of our samples.

We wish to express our gratitude to G. R. Hennig for our samples and for useful discussions, S. Geller for x-ray observations, P. Nozieres for useful discussions, and B. B. Cetlin for technical assistance.

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Structure of Neutron-Disordered Silica*

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IT is known[1–3] that under prolonged irradiation by fast neutrons crystalline quartz and vitreous silica become converted to a new amorphous modification.

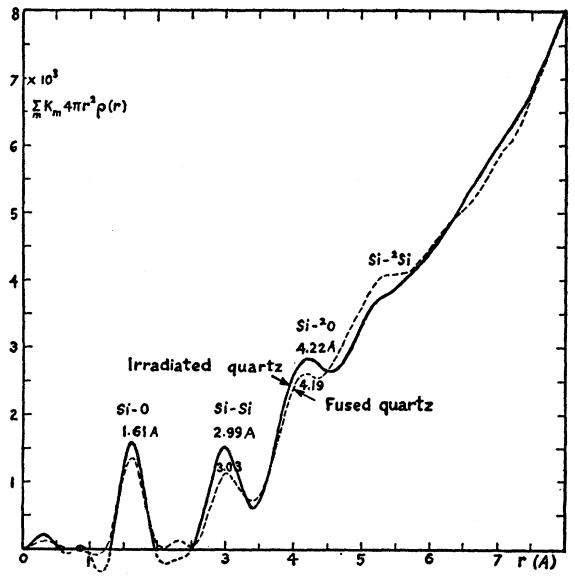

FIG. 1. Distribution of electron density as a function of radial distance from a silicon atom in quartz discovered by fast neutrons of a total integrated flux of 1.4×20^{20} neutrons/cm^2. Dashed line is a radial electron density distribution curve obtained on a sample of fused quartz (unirradiated).

We have investigated by means of x-ray diffraction the structure of natural single-crystal quartz plates and of vitreous silica plates that have been irradiated by fast neutrons (at 38°C) in the Materials Testing Reactor to a total integrated flux of 1.4×10^{20} neutrons/cm^2. Upon irradiation, the density of quartz decreased from 2.650 to 2.306 g cm^{-3} while the density of vitreous silica increased from 2.222 to 2.303 g cm^{-3}.

The x-ray diffraction patterns of solid plates were obtained by means of a recording, Geiger-counter goniometer, using the method of balanced filters. Irradiated quartz and irradiated vitreous silica gave patterns that were identical within the limits of experimental error; however, they were perceptibly different from that of the thermally fused, unirradiated vitreous silica.

The electron radial distribution functions were obtained from the diffraction patterns using the theory developed by Warren and co-workers[4] for glass. In the numerical solution of the scattering integral equation, we used a direct approach rather than performing the Fourier inversion by the usual harmonic analysis.[5] This was made possible by using the Datatron high-speed digital computer for the numerical integrations. The direct method eliminates the errors inherent to the harmonic analysis but it does not avoid the errors resulting from the excessive weighting of fluctuations at large scattering angles. For this reason an appropriate artificial temperature factor was applied.

From the results shown in Fig. 1, we may make the following conclusions. (1) The silicon-oxygen distance in the neutron-disordered quartz is the same (1.61 A) as in vitreous silica. (2) The distance from the silicon atom to the next nearest silicon atom is somewhat smaller in the disordered quartz than in vitreous silica. This indicates that the angles of the Si—O—Si bond is slightly smaller (138°) in the disordered quartz than in the vitreous silica (142°). (3) The radial distances of the oxygen atoms (O—O and the Si—second O) and of the more distant neighbor atoms show a wider distribution in the disordered quartz than in the vitreous silica.

A complete report on this work will be published.

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[5] The author wishes to thank Dr. L. Peck for this suggestion and Mr. C. Block for programing the problem for the computer.

Interference Effects in the Electron Microscopy of Thin Crystal Foils*

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ELECTRON microscopic studies of metals thinned by electrolytic polishing and other means to a degree that they become transparent for electrons, were started by Heidenreich[1] and continued by Castaing.[2] These authors studied aluminum and aluminum-copper alloys.

The present paper concerns face-centered cubic chrome (18%)—nickel (8%) steel, which was thinned by electropolishing. The specimen, a circular disk (2 cm. diam; 0.2 mm thick; insulated with a varnish on the edge; connected as anode) was attacked from both sides by pointed cathodes of which the point only was not insulated. At first the cathodes were placed 2 mm from the specimen until a central hole was formed in the specimen; afterwards, the distance was increased to 1 cm, so that preferentially the region near the edge was attacked and a new hole opened. The treatment was continued up to the very moment when the two holes joined. In that region, the specimen showed relatively large areas which could be cut out and observed in transmission in the electron microscope. The cleaning was done by rising in hot water, dissolving all salts in hot sequestrol solution, and rinsing anew in hot distilled water. The electrolytic bath was a mixture of

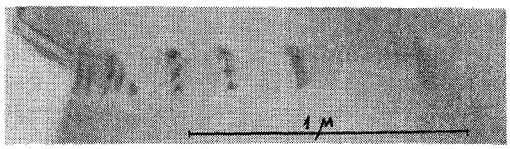

FIG. 1. Sections of dislocation lines crossing a steel foil.