point the c/a ratio is lowered below that value which β quartz[6] exhibits at 1000°C. Thermal and electrical evidence supports this view. Crystals bombarded by 5×10^{19} neutrons/cm^2 fail to exhibit the latent heat at the $\alpha\rightleftharpoons\beta$ inversion point and piezoelectric crystals no longer resonate after this irradiation.

Heavy dosages of fast neutron flux reduce all four of these solids to a common phase. This highly disordered material has an x-ray diffraction pattern of a glass, is optically isotropic, and has a density of 2.26. This material was recrystallized by annealing at 930°C for 16 hours and resulted in the formation of polycrystalline α quartz. Debye-Scherrer diffraction patterns taken using monochromatic radiation from a Cu target gave x-ray reflections at angles up to $2\theta=90°$. The fact that x-ray reflections were not observed at larger Bragg angles may be due to incomplete recrystallization, particle-size broadening, or strain. The contributions of each of these factors are being determined.

It appears that the bombardment of any of the above-mentioned phases produces a silica glass, with a density and average refractive index near that of normal low tridymite, which can then be transformed into α quartz in a solid-state reaction. Further annealing studies are necessary to confirm this view unambiguously. Such behavior would be of major interest since investigators[6] have been unsuccessful in their attempts to transform any of the complex silica phases into α quartz by means of a solid-state transformation in the absence of chemical aids.

A detailed report on the results of this investigation will be submitted for publication at an early date.

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Experimental Evidence Concerning Degeneracy in Germanium

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IN a recent note by Adams[1] it has been suggested that agreement of theory and experiment for germanium is such as to provide weak but definite evidence that the predicted degeneracy in the band structure[2] does not occur. It is the purpose of this note to point out that more recent measurements have modified substantially the stated points of agreement.

Measurements of lattice mobility taken on purer and presumably more prefect germanium samples show a variation with temperature as $T^{-1.6}$ for electrons,[3] $T^{-2.3}$ for holes,[4] instead of the $T^{-1.5}$ predicted by the deformation-potential theory[5] and other theoretical derivations. Along with other experimental results such as those for magnetoresistance and the anomalous ratio of Hall to drift mobility for holes,[3] this would seem to be explainable only on the basis of a more complicated picture of the band structure,[6] such as that predicted by Herman and Callaway. Such a band structure would result in shifts of the band edges with shear strains as well as dilatation.[5] In the light of these facts, the quantitative agreement found between the value of E_{1G} (the shift of the energy gap per unit dilatation) obtained from pressure experiments and that predicted by the deformation-potential theory for germanium would seem largely fortuitous. For silicon, it is worth noting, agreement was considerably poorer.

Agreement also apparently existed between values of β, the change in energy gap per degree change in temperature, determined from a few different types of experiment. The significance of this agreement is also open to question. One value of β was calculated from the experimental E_{1G} under the assumption that the change in energy gap with temperature was due entirely to thermal expansion. Another value of β is obtained from comparison of the theoretical formula

$$n_i^2=np=4\left(\frac{2\pi m_n^{\frac{1}{2}}m_p^{\frac{1}{2}}kT}{h^2}\right)^3 e^{-E_G/kT} \tag{1}$$

with n_i^2 calculated from measurements of intrinsic conductivity. With a $T^{-\frac{3}{2}}$ dependence for the lattice mobility and effective masses equal to the free electron mass, this led to a value of 1×10^{-4} ev/°K for β, in good agreement with the value calculated from E_{1G}.[5] Incorporating the changed temperature dependences of the lattice mobilities will change this value and worsen the agreement unless, of course, the effective masses used in (1) are changed. There is, however, a fundamental question as to whether or not these two values of β should agree; it has been shown by Fan[7] that the shift in the energy gap with temperature arises in part from the changing interaction of the electrons with the lattice vibrations.

If the band structure is not the simple kind usually assumed, Eq. (1) must be modified. It may well be that for some particular band structure the modification consists of the insertion of statistical weight factors for the conduction and valence bands as suggested by Adams.[1] The effective masses in the formula for n_i^2 should then represent suitable averages of effective masses over different bands or different directions. Unfortunately, however, the effective mass in other formulas may not be represented by the same average. Thus it appears that, in general, detailed knowledge of the band structure may be required for the determination of β from n_i^2.

A different value of β, 4×10^{-4} ev/°K, is obtained from measurements of infrared absorption.[7] If the band structure of germanium is that calculated by Herman and Callaway, it is not to be expected that this value of β agree with that obtained from thermal transitions.

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"Closed" Fountain Effect in Liquid Helium II*†

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THE rise in the liquid level of a closed system of helium II through which a heat current is passing has been observed. The rise is attributed to a stress which is the difference between

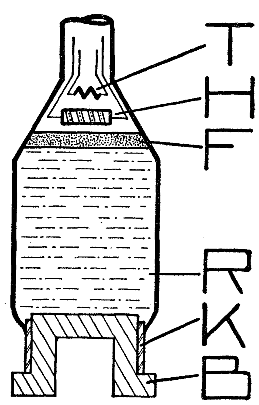

FIG. 1. Diagram of the closed, rouge-packed, glass-metal system.

the thermomechanical tension given by H. London's equation, $\Delta p=\rho S\Delta T$,[1] and a Hooke's law type stress.

Figure 1 is a diagram of the apparatus used. It consists of a glass tube which was packed with rouge powder (R) and which