the transport integrals become scalars but are functions of $\mathbf{H}$, making a convenient and simple calculation possible. These results and all the following are valid for all $|\mathbf{H}|$.

$L(\phi)$ has been calculated from (2) by using the mass tensors for the three simplest cubic solutions (see, e.g., Shibuya[5]): 100-type spheroids (case A), 111-type spheroids (case B), and 110-type spheroids (case C). In the principal axis system $E=\frac{1}{2}\hbar^2[(k_x^2+k_y^2)/b+k_z^2/a]$. We show here only the results for $L_{11}^A(\phi)$ and $L_{11}^B(\phi)$:

$$-\frac{6\pi^3}{e^2}L_{11}^A=\frac{1}{b}\int(\partial f_0/\partial E)\tau E d\Omega\left\{\left(\frac{b}{a}\right)\left(\frac{1}{1+(\omega\tau)^2}\right)+\frac{2+(\omega\tau)^2(1+a/b)}{1+(\omega\tau)^2(1+a/b)+(\omega\tau)^4[(a/b)+\frac{1}{4}(1-a/b)^2(\sin 2\phi)^2]}\right\}$$

$$-\frac{6\pi^3}{e^2}L_{11}^B=\frac{2}{3}\left(\frac{1}{b}\right)\left(2+\frac{b}{a}\right)\int(\partial f_0/\partial E)\tau E d\Omega\left\{\frac{2+(\omega\tau)^2\times\frac{2}{3}(2+a/b)}{1+(\omega\tau)^2\times\frac{2}{3}(2+a/b)+(\omega\tau)^4\times\frac{1}{9}[(2+a/b)^2-(1-a/b)^2(\sin 2\phi)^2]}\right\};$$

L_{11}^C is of the form $C_1L_{11}^A+C_2L_{11}^B$, $\omega=(eH)/(ab)^{\frac{1}{2}}c$.

Figures 2 and 3 show the experimental $L_{11}(\phi)$ for n-type Ge and Si. Comparison of theory and experiment shows directly that the spheroidal assumption is the correct one and that case A must hold for Si and case B for Ge, in agreement with other work. Within experimental error, the angular dependence of the integrands exactly matches the experimental curves; thus τ probably does not vary strongly with energy.

Further application of the theory has resulted in the following relations for $K\equiv a/b$ for cases A and B, respectively:

$$\left[\frac{L_{11}^{H=0}-(L_{22}+L_{23})_{45^\circ}}{K(L_{11}^{H=0}-L_{11}^{45^\circ})-2L_{23}}\right]^A=\frac{1}{2}\left(\frac{K+(1/K)-2}{K(1+K)-2}\right),$$

$$\left[\frac{L_{22}-L_{11}}{L_{11}^{H=0}-L_{11}}\right]^B_{90^\circ}=\frac{9}{(2+K)(2+1/K)}$$

$$=\frac{\rho_0}{\rho_L}\left(\frac{\rho_T^2+(RH)^2-\rho_L\rho_T}{\rho_T^2+(RH)^2-\rho_0\rho_T}\right).$$

These expressions hold independently of any assumption on τ except that it be constant on a surface of constant energy. Comparison with experiment gives

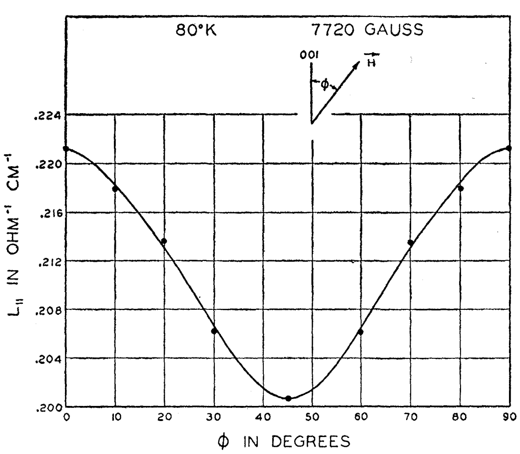

FIG. 3. Transverse magnetoconductivity for n-type silicon.

$K=15.5\pm0.5$ for Ge and $K=5.2\pm0.5$ for Si. The accuracy can be improved by working at higher $|\mathbf{H}|$ and lower temperature. Comparison of various components of $L(\phi)$ shows that $K>1$ in both cases. The latter relation indicates a simple method for finding K for case B from ρ_L, ρ_T, and ρ_0 (longitudinal, transverse, and zero-field resistivity) and R (Hall constant in the appropriate units). In addition, having found the effects of the band structure on the transport integrals, one is at liberty to make more exact investigations on the behavior of τ. Further and more complete details will be subsequently reported.

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Acceptors Quenched into Germanium

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RECENTLY Logan[1] and Hopkins and Clarke[2] have presented evidence which seems to be contradictory to my earlier experiments[3] and which appears to be mutually contradictory. The purpose of this Letter is to point out that the differences among us can be rationalized by noting the effects of dislocations on the annealing process which Logan has found.

Logan claims that my data on the number of acceptors quenched into Ge are larger by a factor of 5 than his. However, if my data are plotted along with Logan's, they are extremely close to the curve which Logan has drawn through his n-type data. My sample was 30 ohm-cm n-type, and therefore, it may be argued that the number of acceptors I observed should be compared with Logan's data taken on p-type Ge. If this be the basis of comparison, Logan's data and mine differ by a factor of at most 2.2. This factor includes the correction for the fact that my acceptor concentrations

were measured at dry ice temperatures while Logan's were measured at room temperature. Furthermore, Logan's points scatter as much as 100% from the line drawn through them, while my data when plotted yielded a rather good straight line. It therefore seems to me that, within the possible experimental errors inherent in this kind of experiment, Logan's and my results agree for the number of acceptors quenched into Ge. Furthermore, we both find the same activation energy of 2 ev.

Logan's method of quenching is to drop his samples into an oil bath. His quench time is clearly faster than the quench time used in my experiments where the sample cools by its own radiation. On the other hand, this is not to say that one can conclude from Logan's data that I could not possibly have quenched fast enough to trap these defects. Logan's shortest annealing time is of the order of one minute; in order to conduct annealing experiments to determine whether a given quench is fast enough, he would need to control anneals for periods of only a few seconds. My quenching rate was 100°C/sec initially and 5 seconds were required for the sample to cool to 500°C.

Logan has provided an interesting new fact on the quenching problem when he studied the effect of dislocations on the annealing rate. Logan found that in a sample with a dislocation density of 10^6/cm^2 (measured by etch pits) he could not quench in any acceptors. Clearly, this is an indication that dislocations influence the speed of annealing of the defects produced by the heat treatment. In the process of dropping samples into the oil bath, it would be quite likely that some dislocations were introduced through plastic flow during the thermal shock associated with the quench. Possibly for this reason Logan's samples anneal much faster than my sample. On the other hand, the nature of his annealing curves is very similar to the annealing I observed.

Because of the obvious importance of dislocations on the annealing rate which Logan has shown, I have had the dislocation density measured in the sample which I used for my annealing experiments. We[4] found a dislocation density of 10^4/cm^2 by counting CP4 etch pits on the (111) surface. This density is typical of the dislocation density for crystals pulled from the melt, indicating no noticeable production of dislocations during my heat treatment. I, therefore, would like to suggest that the apparent differences between the annealing rates in Logan's experiments and in mine arises from different dislocation densities.

As far as the experiments of Hopkins and Clarke are concerned, it is conceivable that no quenched defects were observed because the dislocation density in their samples might have been too high for their quench rate. It seems clear from the importance of the dislocations on the annealing process that any future experiments in this field should include measurements of dislocation density.

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Λ^0-Nucleon Forces*

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An analysis of the binding of Λ^0 hyperons in nuclei by Dalitz[1] has produced some definite information on the Λ-nucleon force. In particular the forces are strong and highly spin-dependent. It is the purpose of this note to show how this result may be predicted by a simple field-theoretic model, assuming the forces are due only to exchange of pions.[2] We assume spin $\frac{1}{2}$ for the Λ and Σ and give them the same parity. The form of the fixed-source Hamiltonian is then prescribed for processes

$$\Lambda \rightleftarrows \Sigma + \pi. \qquad (1)$$

Instead of writing this directly, the interaction is more conveniently expressed in terms of a model of some intrinsic interest,[3] i.e., consider the Λ and Σ as corresponding singlet and triplet isotopic spin states of a bound nucleon and some other isotopic spin $\frac{1}{2}$ particle (such as the $\bar{\theta}$ meson). This picture, coupled with the assumption that the $\bar{\theta}$, say, does not interact with pions and so plays only a geometrical role, is equivalent to the assumption above. Now the Λ-nucleon potential is expressed in terms of the usual fixed-source pion-nucleon Hamiltonian

$$H = \sum\nolimits_{k,\alpha} (a_{k\alpha} V_{k\alpha} + a_{k\alpha}^* V_{k\alpha}^*),$$
$$V_{k\alpha} = (ih/\mu)[\boldsymbol{\sigma}\cdot\mathbf{k}/(2\omega_k)^{\frac{1}{2}}]\tau_\alpha. \qquad (2)$$

We must, of course, consider that the coupling constant h may be different from the usual constant f. We shall consider only fourth order diagrams. All crossed diagrams plus diagram (b) of Fig. 1, are those usually

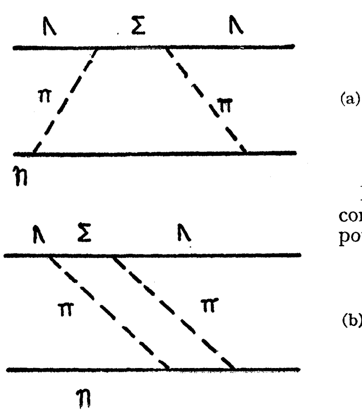

Fig 1. Some processes considered in the Λ-nucleon potential.