independent of the impurity concentration and were equal respectively to +1.85 and +2.0 mm/sec, followed by a sharp drop and again a region where the shift stayed constant with varying tin concentration.

According to the theory of Blandin and Daniel [1], the change of the charge density around the impurity nuclei and the matrix nuclei in dilute solid solutions should be proportional to the concentration and should have the same sign. As shown by data on the Knight shift, this rule is satisfied in the main for impurity concentrations up to several per cent [2-4]. However, in the case of small impurity concentrations in Ag (< 1 at.%) the values of the Knight shift for Ag^{109} nuclei did not fit the linear dependence on the concentration, and the line shape was asymmetrical. It may be that the anomalous behavior of the isomer shift of the Sn^{119} impurity nuclei and of the Knight shift of the Ag matrix nuclei have a common cause. A possible cause of such a jumplike behavior of the isomer shift may be a transition from bound states to band states, or in other words, a change in the structure of the alloy (for example, a transition from a fully disordered alloy to an ordered one). The latter is quite possible, since the valence difference ΔZ between the impurity and the matrix is positive, thus contributing to ordering of the impurity, and the same data on the Knight shift of the nuclei Sn^{119} and Ag^{107} in dilute alloys with Ag base indicate that the Sn atoms have a tendency to become ordered.

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PHONON DRAGGING IN BISMUTH

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The interaction between electrons and phonons in a crystal causes not only mutual scattering, but also dragging, an effect that becomes manifest in a strong increase of the thermal emf and of the Nernst effect.* The conditions become particularly favorable for dragging in nondegenerate semiconductors, where the phonon components of these kinetic phenomena can exceed the diffusion ones by hundreds or even thousands of times [1,2].

A. L. Natadze and A. L. Efros [3] and L. E. Gurevich and I. Ya. Korenblit [4] have pointed out in their theoretical papers that favorable conditions for the appearance of dragging exist at low temperatures in such a semimetal as bismuth. According to the theoretical estimates, dragging should cause vanishing of the small factors $k_0T/\zeta \ll 1$ in the formulas for the differential thermal emf α and the Nernst coefficient Q of a degenerate electron gas

$$\alpha \approx \frac{k_0}{e}\frac{k_0T}{\zeta}, \tag{1}$$

$$Q \approx \frac{k_0}{e}\frac{u}{c}\frac{k_0T}{\zeta} \tag{2}$$

(k_0 is Boltzmann's constant, e the electron charge, ζ the chemical potential, and u the mobility), so that these kinetic coefficients can reach values typical of nondegenerate semiconductors. The experimental data reported in this letter confirm this theoretical prediction.

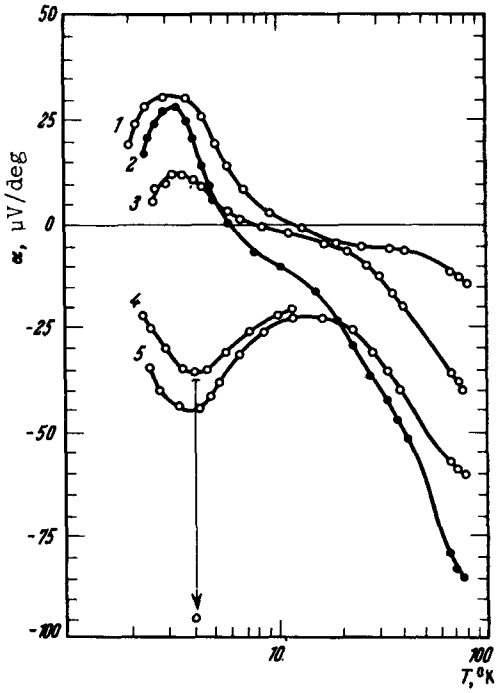

Fig. 1. Experimental temperature dependences of the thermal emf for pure ($R_{300°K}/R_{4.2°K}$ = 300) single crystals of bismuth (3 - $\nabla T \perp C_3$, 2 - $\nabla T \parallel C_3$) and bismuth ($\nabla T \perp C_3$) doped with tellurium (4 and 5) and with tin (1).

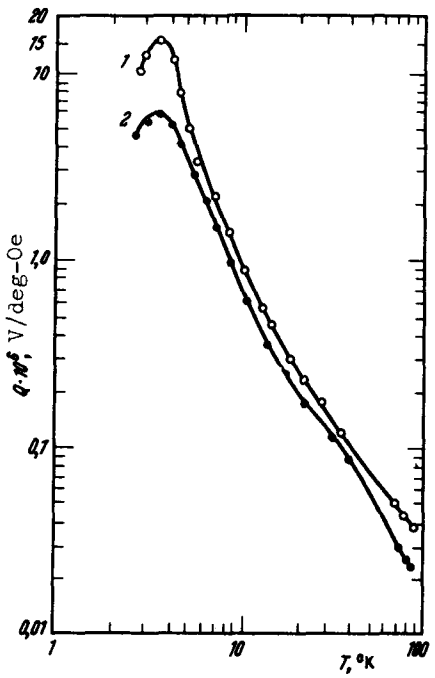

Fig. 2. Experimental temperature dependences of the Nernst coefficient for pure bismuth single crystals (see Fig. 1) with two orientations: 1 - $H \parallel C_3 \perp \nabla T$; 2 - $\nabla T \parallel C_3 \perp H$.

Figure 1 shows the thermal emf measured in pure and alloyed bismuth single crystals for two orientations, $\nabla T \parallel C_3$ and $\nabla T \perp C_3$. In view of the fact that pure bismuth contains equal numbers of holes and electrons, which can cancel each other in the thermoelectric effect, we investigated bismuth single crystals doped with tellurium and tin, which produce in the bismuth donor and acceptor levels, respectively. Such impurities make it possible to exclude either the electrons or the holes from the transport phenomena in the bismuth. By investigating a whole batch of samples with different tellurium contents, we determined the optimal concentration (2.5×10^{-3} at.%) needed to ensure maximum thermal emf in the dragging region. The corresponding optimal concentration for the tin impurity has not yet been determined. The arrow in Fig. 1 shows the increase of the thermal emf in a magnetic field H = 10 kOe ($H \parallel C_3 \perp \nabla T$), which reaches its theoretical value $\alpha = k_0/e = 86$ μV/deg. In the absence of dragging, the diffusion thermal emf at T = 4°K would not exceed several microvolts per degree.

Figure 2 shows the results of an investigation of the Nernst effect in pure bismuth single crystals for two orientations, $H \parallel C_3 \perp \nabla T$ and $\nabla T \parallel C_3 \perp H$. In this case the electrons

and holes do not compensate each other and the Nernst coefficient reaches in the dragging region its theoretical vale $Q \approx (k_0/e)/(u/c)$, which is unusual even if nondegenerate semiconductors are considered.

The authors are grateful to I. Ya. Korenblit for a discussion of the theoretical questions.

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* In an unevenly heated **conductor, the magnetic** field produces an electric field perpendicular to the temperature gradient and to the magnetic field.

VANISHING OF THE SHUBNIKOV - DE HAAS EFFECT IN A BISMUTH-ANTIMONY ALLOY UNDER PRESSURE

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As shown in [1-3], the areas of the extremal hole and electronic parts of the Fermi surface of bismuth decrease under pressure. From data obtained by extrapolation towards higher pressures, we can expect the energy-band overlap ϵ_{ov} to vanish at a pressure $P_{cr} = 25$ kbar, and consequently the carrier density also vanishes. It would be of interest to investigate the character of the variation of the frequency and of the amplitude of the quantum oscillations of the electric resistance under pressure near the possible point where the overlap is removed, i.e., to observe the 2.5-order phase transition by oscillation methods. However, the pressures necessary to investigate the oscillation phenomena are as yet unattainable.

At the same time, it was noted in [4-6] that in bismuth-antimony alloys the areas of the extremal sections of the electronic Fermi surface and the carrier density decrease with increasing antimony content in the alloy. At an antimony concentration near 5 at.% the band overlap disappears, and at higher densities the alloy has semiconductor properties in a wide range of temperatures [7]. Thus, in $Bi_{100-n}Sb_n$ alloys with $n < 5$ at.% the carrier density at atmospheric pressure is lower than in pure bismuth, and we can expect an electronic transition to take place in these alloys at pressures below 25 kbar. We have therefore measured the quantum oscillations of the electric resistance in a bismuth-antimony alloy at antimony concentration 3 at.% under hydrostatic pressure.

The single-crystal $Bi_{97}Sb_3$ samples were obtained by zone growing with preliminary equalization in the Semimetal Laboratory of the Leningrad State Pedagogical Institute. The samples for the measurements were cut by the electric-erosion method from the single-crystal ingot and measured 12 x 3 x 1 mm. The sample orientation was checked by x-ray diffraction. The magnetic-field direction could be varied in the plane of the binary and trigonal axes (C_2, C_3).

Figure 1 shows typical plots of the quantum oscillations of the electric resistance