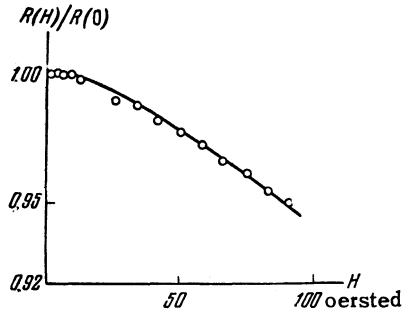

field up to 10 oersted, i.e., $dR/dH \to 0$ as $H \to 0$. In fields with $H > 10$ oersted there is a monotonic reduction of the surface resistance with increasing field, in agreement with the results of the earlier work.[2,3]

It is interesting to note that the dependence of the surface resistance of metals on the magnitude of the magnetic field should be taken into account in measuring the temperature dependence of R_S/R_n for superconductors (R_S and R_n are the surface resistances of the metal in the superconducting and normal state) if as R_n we take the surface resistance of the metal under conditions in which the superconductivity is destroyed by the field. Neglecting this effect may lead to values of R_S/R_n which are too high.

[1] M. Ia. Azbel' and E. A. Kaner, J. Exptl. Theoret. Phys. (U.S.S.R.) **30**, 811 (1956), Soviet Phys. JETP **3**, 772 (1956); J. Exptl. Theoret. Phys. (U.S.S.R.) **32**, 896 (1957), Soviet Phys. JETP **5**, 730 (1957).

[2] E. Fawcett, Phys. Rev. **103**, 1582 (1956).

[3] P. A. Bezuglyi and A. A. Galkin, J. Exptl. Theoret. Phys. (U.S.S.R.) **33**, 1076 (1957), Soviet Phys. JETP **6**, 831 (1958).

Translated by H. Lashinsky
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THE PHASE DIAGRAM OF THE HYDROGEN-DEUTERIUM SYSTEM

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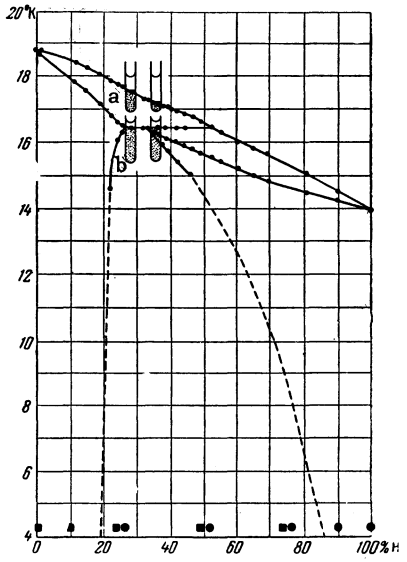
In a previous letter[1] we reported some preliminary results of x-ray studies of hydrogen and deuterium at liquid helium temperatures. In it we showed that the previous determinations of the crystal structure of hydrogen at Leyden[2] had been done incorrectly.

At the Symposium on Low Temperature Physics in Leningrad in June, 1956, we also reported some results of crystal structure studies on mixtures of the hydrogen isotopes, in which it was shown that there was only a limited range of concentrations for which a solid solution could exist in this system.

In the present report we shall present more detailed data for the system, obtained from the thermal analysis of hydrogen-deuterium mixtures. The mixtures were prepared from the pure isotopes, condensed into a calorimeter cooled with liquid hydrogen kept at reduced pressure by a vacuum pump, and then frozen. After the pump was stopped, the mixture was allowed to warm up slowly over the temperature interval from 14° to 19° K.

Thermal analysis revealed a horizontal portion in the solidus curve at a temperature of 16.4° K. Comparison of the thermal analysis data with the results of x-ray patterns at 4.2° K enabled us to determine the approximate limits of the two-phase region, to connect this low-temperature portion with the solidus line, and outline the general shape of the phase diagram for the hydrogen-deuterium system (see the figure).

During the crystallization of mixtures in the concentration range 26 — 52% of hydrogen by volume, the presence of peritectic regions was established visually. We made use of the fact that in the vapor over liquid helium a stable tempera-



○ — results of thermal analysis, ■, ● — results of x-ray analysis (■ — D_2 lattice; ● — H_2 lattice)

ture gradient can be set up which will persist for some time. A set of two glass test tubes, containing condensed mixtures whose composition lay within the concentration limits given above, were placed in a Dewar flask over liquid helium. The test tubes were so placed that the level corresponding to the temperature of onset of crystallization passed through them. The boundary between the solid and liquid phases established itself at different levels in mixtures of different composition, being at a lower level in mixtures richer in hydrogen (see a in the phase diagram, which is a schematic representation of the test tubes). The boundary could be caused to shift by moving the test tubes to a region of lower temperature. As the amount of the solid phase increased, the liquid phase became increasingly richer in hydrogen, and the boundary in tubes with hydrogen-rich mixtures overtook the boundary in tubes containing more deuterium, corresponding to the equalization of liquid-phase concentrations when the peritectic region is reached. After the solid-liquid boundary had reached the same level in both tubes (see b in the diagram), further crystallization proceeded at the same temperatures in both tubes.

In addition to the thermal analysis, an x-ray study of the hydrogen-deuterium mixtures, and of the pure isotopes, was made. Some improvements in the method of taking the photographs made it possible to eliminate the parasitic lines which were present in the patterns of previous work, as has been explained. As a result, two lines were found to be present due to the hydrogen lattice, corresponding to spacings d = 3.15 A and d = 2.79 A; but from the deuterium lattice there was only one, corresponding to d = 2.84 A. No lines were found at wide angles, because of the rapid falling off of the scattered intensity. The x-ray patterns from mixtures with hydrogen concentrations lying in the interval 20 to 80% contained lines from both the hydrogen and the deuterium lattices, with parameters only slightly altered. This confirms the conclusion we have expressed already, that the structure of hydrogen was incorrectly determined by the workers at Leyden, and that there is a region of concentration in which hydrogen and deuterium exist as a mixture of two solid phases. As to the accurate determination of the structures of hydrogen and deuterium, the question must remain open for the time being, because of the difficulty of assigning definite indices to x-ray patterns which contain so few lines. It is, however, possible to state unequivocally that they do have different lattices.

The results which we have obtained, indicating a separation of the solid mixture of hydrogen isotopes into two phases, agree with the conclusions of Prigogine et al.[3] that there is a crticial temperature below which a solid solution of isotopes must separate. For the hydrogen isotopes, however, these authors estimated a critical temperature below 1° K; I. Lifshitz and Stepanova[4] have shown that the critical temperature for separation is equal to $T = \epsilon^2\Theta_D$ ($\epsilon = \Delta m/m$ and Θ_D is the Debye temperature); i.e., for hydrogen isotopes it is of the same order as their melting point. This agrees completely with the shape of the phase diagram for the hydrogen-deuterium system, as reported in this letter.

[1] Kogan, Lazarev, and Bulatova, J. Exptl. Theoret. Phys. (U.S.S.R.) **31**, 541 (1956), Soviet Phys. JETP **4**, 593 (1957).

[2] Keesom, De Smedt, and Mooy, Comm. Phys. Univ. Leyden **209d** (1930).

[3] Prigogine, Bingham, and Jeener, Physica 20, 383 (1954).

[4] I. M. Lifshitz and G. I. Stepanova, J. Exptl. Theoret. Phys. (U.S.S.R.) **31**, 156 (1956), Soviet Phys. JETP **4**, 151 (1957).

Translated by D. C. West
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CORRECTION TO THE ARTICLE "ON THE STRUCTURE OF THE ELECTRON SPECTRUM IN LATTICES OF THE TELLURIUM TYPE"

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In this paper[1] the conclusion was drawn, from the relations (22) and the fact that Λ_2 and Λ_3 are complex conjugate quantities, that the terms E_2 and E_3 are in contact along the entire k_z axis. It is, however, easy to convince oneself that for the "rotating" elements $U_2^{(j)}$ the equation

$$\sum_{j=1}^{3} \chi_j [(U_2^{(j)})^2] = 3, \qquad (1)$$

holds. According to Herring[2] this indicates the absence of supplementary contact of the zones be-