$$e^4 (Z_1^{2/3} + Z_2^{2/3}) / v^2. \qquad (11)$$

These results are connected with the absence of collisions with small impact parameters for the channeled particles.

It should be emphasized that expressions (7) - (9) were obtained under the assumption that the velocity of the incoming particles should be much larger than the velocity of the atomic electrons.

3. The obtained distribution function of the energy loss (4) and (7) is in satisfactory agreement with experiment [3]. In [3] there is given an experimental plot of the energy losses for incident protons with energy E_{kin} = 4.84 MeV, passing through a single crystal of Si with L = 2 mm, parallel to the [111] direction. This curve is characterized by two maxima, one of which coincides with the position of the maximum in complete absence of symmetry. This maximum is well described by the second term in (4).

The height of the second maximum in [3] exceeds by 9.1 times the height of the first maximum. The increase of the height of the second maximum is connected also with the decrease of the dispersion of the second maximum (11) and with the fact that the number of channeled particles is larger than that of the unchanneled ones. Therefore, using for α the experimental value 1.9, the distribution function of the energy losses (4) and (7) leads to an intensity ratio of the second maximum to the first equal to 10 (the experimental value is 9.1).

It was observed in experiment that the loss of the channeled particles is 0.45 of the loss of the unchanneled ones. In the considered approximation it follows from (10) that the decrease of the energy loss is 0.5. This is connected with the suppression of the "close" collisions, in which, according to Lindhard [1], there is lost approximately half of the total energy losses.

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[2] L.D. Landau, J. Phys. USSR 8, 201 (1944); L.D. Landau, Collected Works, Vol. 1, Nauka, 1969.
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TEMPERATURE STABILITY OF THE METALLIC MODIFICATION OF HYDROGEN

E.I. Estrin
Institute of Metallurgy and Metal Physics, Central Research Institute for Ferrous Metallurgy

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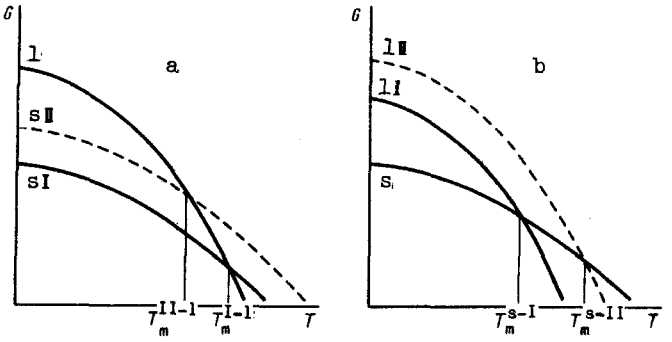
There have been lively discussions lately on the question of obtaining a metallic modification of hydrogen at high pressure. This modification, it is assumed, can have a high temperature T_c of transition to the superconducting state. For the practical utilization of the high T_c of the metallic hydrogen it is important to be able to maintain it at normal pressure at sufficiently high temperatures (on the order of or higher than T_c). In this connection, interest attaches to an estimate of the interval of stability of the metastable metallic hydrogen at normal pressure.



Temperature dependence of the thermodynamic potential (G) of solid (s) and liquid (l) phases of the same substance: a - case of two solid phases (stable I and metastable II); b - case of two liquid phases (stable I and metastable II).

According to thermodynamics, the melting temperature of the metastable modification of any substance is always lower than the melting temperature of its stable modification (Fig. a). In the presence of two liquid phases (stable and metastable), the temperature of melting of the solid phase into a stable liquid phase is always lower than the temperature of melting into a metastable liquid (Fig. b). In the general case of two solid (stable and metastable) and two liquid (stable and metastable) phases, the lowest melting temperature is the temperature of melting of the metastable solid phase into a stable liquid phase.

In transformations in the solid state, one frequently observes during crystallization, by virtue of the kinetic factors, the metastable existence of one of the phases in the region of stability of the other phase. To the contrary, the experience accumulated to date shows that it is impossible to superheat a solid (at any rate by heating from the surface) above its melting temperature (possibly because the formation of the liquid layer on the surface of a melting body does not involve the loss of energy to the formation of the new surface).

As applied to hydrogen, the foregoing means, first, that the lowest melting temperature at normal pressure is the melting temperature of the metastable (metallic) modification into a stable (molecular) liquid (and this temperature consequently lies below the melting temperature of the stable (molecular) modification into a stable liquid) and second, that superheat of the metallic modification above the melting temperature is hardly possible.

Thus, the upper limiting temperature for the existence of the metallic modification of hydrogen at normal pressure obviously does not exceed the melting temperature of its usual modification (14°K). In fact, with decreasing pressure the phase transition from the metallic into the ordinary modification will apparently occur at a still lower temperature.

SURFACE SECOND SOUND IN LIQUID HELIUM

A.F. Andreev and D.A. Kompaneets
Institute of Physics Problems, USSR Academy of Sciences
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Capillary waves can propagate over the surface of liquid helium, and in the superfluid solution He^3 in He^4 there exists also surface impurity levels [1, 2]. Both can be regarded as surface elementary excitations. Their motion is accompanied by transport of mass, energy, entropy, etc., and it can be regarded as a motion of a surface normal component.