* Incidentally, several possible hyperon models exist, but there is no point in dwelling on them in this note.

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Peculiarities of the Temperature Dependence of the Electrical Resistance of Ferromagnetic Metals at Low Temperatures

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FROM general considerations it follows that for ferromagnetic metals we can expect the appearance of a peculiarity in the temperature dependence of the electrical resistance at low temperatures, brought about by the collisions of the conduction electrons withthe carriers of ferromagnetism. In order to make clear this peculiarity, measurements were carried out on polycrystalline samples of iron, nickel and platinum in the temperature interval from 4.2° to 1.23° K. Platinum was chosen for comparison of the ferromagnetic metals with a metal of the transition group that was nonferromagnetic.

The iron and nickel used in the investigation were from Hilger and were the purest at our disposal. From these we prepared specimens in the form of thin ribbons. The residual resistance of the iron specimen amounted to $R_{4.2°K}/R_{0°C} = 3.9328 \times 10^{-2}$, where $R_{0°C} = 0.5091$ ohm, and of the nickel, $R_{4.2°K} / R_{0°C} = 1.0148 \times 10^{-2}$, where $R_{0°C} = 0.8407$ ohm. The specimen of platinum was a resistance thermometer with residual resistance $R_{4.2°K} / R_{0°C} = 3.6805 \times 10^{-3}$ and $R_{0°C} = 59.79487$ ohms.

The measurements on platinum showed that the curve of the temperature dependence of the resistance of the platinum was accurately described by the expression

$$R_T / R_{0°C} = (R_{0°K} / R_{0°C}) + BT^2,$$

where

$$B \approx 1.8 \cdot 10^{-6}, \quad R_{0°K} / R_{0°C} = 3.6486 \cdot 10^{-3}.$$

The results of measurement on the iron and nickel are shown on the graphs of Fig. 1 and Fig. 2, where the magnitude of the relative resistance $R_T / R_{0°C}$ is plotted along the ordinate and the temperature in degrees Kelvin is plotted along the abscissa. The different symbols for the points correspond to different series of measurements on one and the same sample.

For iron, the resistance curve (Fig. 1) cannot be described simply by a quadratic function, as is the case for platinum. Its behavior is accurately expressed by a binomial in T^2 and an additional linear term:

$$R_T / R_{0°C} = (R_{0°K} / R_{0°C}) + AT + BT^2.$$

where $A = (4 \text{ to } 4.9) \times 10^{-6}$, $B = (1 \text{ to } 1.2) \times 10^{-6}$; $R_{0°K} / R_{0°C} = 3.9293 \times 10^{-2}$.

The temperature dependence of the resistance for nickel is plotted in Fig. 2 on the same coordinates which were used to describe iron. We obtain the formula

$$R_T/R_{0°C} = (R_{0°K}/R_{0°C}) + AT + BT^2,$$

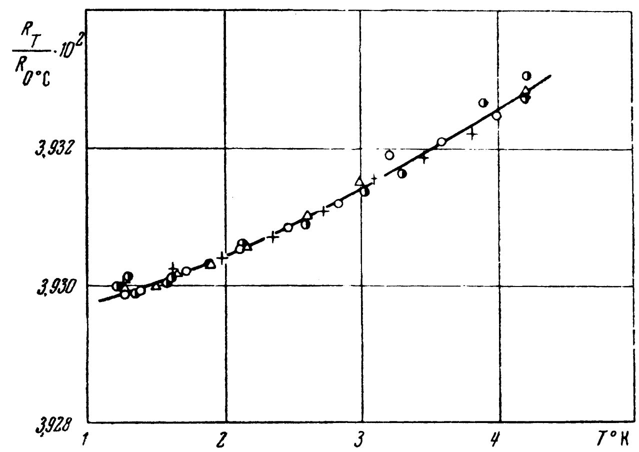

FIG. 1

in which $A = (0.8 \text{ to } 2.2) \times 10^{-6}$; $B \approx 2.7 \times 10^{-6}$; $R_{0°K} / R_{0°C} = 1.0086 \times 10^{-2}$.

For nickel, the linear component is smaller in magnitude and is determined less acuurately. Here it is necessary to separate a small value against a background of the much stronger quadratic dependence of the resistance. More accurate data on the values of the linear components of the electrical resistance in iron and nickel can be obtained with measurements on single crystals and at temperatures below 1° K.

In this fashion a peculiarity is observed in the temperature dependence of the electrical resistance

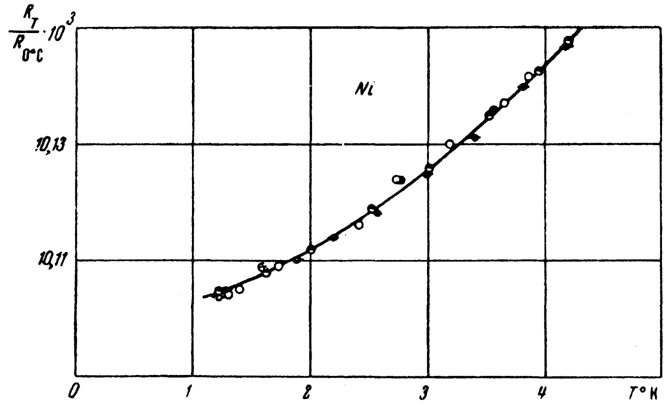

FIG. 2

of iron and nickel, which distinguishes them from other metals and which manifests itself in the presence of a linear term in the temperature dependence of the resistance.

It is interesting to note that the reults of the present research agree with the conclusions obtained in one of the works of Turov.[1]

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[1]E. A. Turov, Izv. Akad. Nauk SSSR, Ser. Fiz. 19, 474(1955).

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The Crystalline Structure of Hydrogen and Deuterium

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THE structure of solid hydrogen has been investigated by Keesom and his co-workers[1], who found it to possess a hexagonal close-packed lattice with parameter $a = 3.75$ A. The structure of deuterium was not studied, and it was to determnne this that the present work was undertaken. Specimens of solid deuterium were obtained by condensation of the gas onto a copper capillary filled with liquid helium. Use of the strong-focus method of x-ray crystallography made it possible to obtain x-ray patterns with sharp lines for deuterium with exposures of one to two hours. Unfortunately, as a result of the rapid decrease of the atomic form factor with angle, the deuterium lines were visible only at small angles; this made it difficult to obtain reliable measurements from the x-ray patterns or to determine accurately the parameters of the lattice. With as much confidence as these x-ray patterns seemed to warrant, we determined the structure of deuterium to be tetragonal, with a ratio of axes $c/a = 0.94$ and a paramter $a = 5.4$ A. This leads to a density of 0.18 gm/cm^2 for deuterium, which differs by only 10% from the value obtained by direct measurement (2). In view of these results, it appeared advisable to review the data on the structure of hydrogen, for it seemed surprising that the two isotopes should crystallize into lattices having different symmetry. In particular, such a difference might arise from the occurrence of polymorphism in the two isotopes, with transition points in the vicinity of 4.2° K, so that at this temperature they might be found in different phases. However, x-ray patterns for deuterium and hydrogen obtained at lower temperatures failed to confirm this supposition—neither hydrogen nor deuterium alters its structure in the temperature range from 1.5° to 4.1°K.

In the paper by Keesom, *et al.*,[1] the x-ray patterns themselves are not shown; it appears, however, that they consisted of discrete reflections, through which Debye curves were drawn. A direct computation of the line width to be expected from the conditions prevailing in the experiment shows this width to exceed the separation of certain of the more closely-spaced lines; i.e., the reflections which these authors have assigned to different lines could actually belong to a single line. This is the probable explanation for the fact that the five intense lines in the x-ray patterns obtained by Keesom, *et al.*, correspond to three lines in our patterns. Moreover, certain lines are erroneously ascribed by Keesom, *et al.*, to the β-spectrum. An exposure made through a filter passing only the