157, 158 and 160. Faint effects at 152, 154 are probably due to the presence of samarium in the sample used.

Terbium (65) shows only one line, 159. Search was made for a possible heavier constituent suggested by its atomic weight, 159·2, but none could be detected.

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Catalysed Reaction of Hydrogen with Water and the Nature of Over-voltage

IN the electrolytic formation of hydrogen from water an inertia is present, which has to be overcome by a certain amount of over-voltage. The nature of this inertia is still under discussion. It may either be ascribed to the process of the transition of the hydrogen ions from the water into the state of atoms adsorbed on the electrode, or to the process of formation of hydrogen molecules from the adsorbed atoms.

Our observations on the spontaneous transition of hydrogen from platinum into water[1] seem to settle this question for the case of a platinum electrode. It appears that the rate at which the hydrogen is ionised strongly depends on the composition of the aqueous solution with which the platinum is in contact. This influence can scarcely be explained if one attributes the inertia of the process to the reaction of hydrogen with platinum, whereas its presence is easily understood if the inertia is attributed to the transition of the hydrogen atoms into the solution.

The rate of ionisation of hydrogen on platinum black was found to be highest in pure water. Taking the rate in pure water as unity, the approximate rates in different solutions are as follows: in $N/1$ HCl 0·7; in $N/1$ H_2SO_4 0·2; in $N/4$ KOH 0·4; in ethyl alcohol + 2 per cent water 0·4; in ethyl alcohol + 2 per cent water + $N/4$ KOH $<0{\cdot}02$.

From the last figure we see that the interchange of hydrogen atoms adsorbed on platinum with the hydrogen atoms of undissociated ethyl alcohol molecules is an imperceptibly slow process.

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[1] NATURE, 132, 819, Nov. 25, 1933.

Theory of Supraconductivity

IN a recent paper[1] I discussed the transition of a metal in an external magnetic field to the supraconductive state on the usual thermodynamical methods. The chief results of that paper may be summarised as follows:

(1) Simple phenomena and sharp transitions can only be expected if we have to do with a long-shaped or very flat body, orientated parallel to the field.

(2) The experimental data permit us to consider only the transitions between the normal state and those supraconductive states where the induction B equals 0 (B has been called G).

(3) A relation has been derived in analogy to Clapeyron's equation, which was verified for tin[2] in low external fields (Rutgers' equation).

(4) From the validity of Rutgers' equation the conclusion may be drawn that, within the limits of accuracy, $dQ/T = dS$, is true for the transition.

(5) If the body has not the shape of a very oblong or very flat body parallel to the field, supra-conductivity will vanish gradually[3], when the field or the temperature is raised. Supraconductivity will then be disturbed in some parts of the body, while it can persist in other parts, the persisting parts being long-shaped or very flat regions ('needles' or 'razor blades') parallel to the field.

A few weeks ago, Meissner and Ochsenfeld[4] published a series of very interesting observations on the establishment of supraconductivity in a constant external field. Their results seem to indicate that in a supraconductor B always equals 0.

This last assumption throws new light upon my results (2) and (4). It appears that the condition $B = 0$, made in the thermodynamical treatment, does not cause loss of generality, since supraconductive states with $B \neq 0$ do not exist. If hysteresis may be neglected for a moment, the transition to the supraconductive state and back again is literally reversible (in spite of the 'persisting currents') so that it is obvious that $dQ/T = dS$.

One further remark must be made about the (usually small) magnetic and thermal hysteresis, which has been observed. This hysteresis can perhaps be attributed to the fact that a transition (in an external field or if the measuring current is not switched off) will cause a sudden change in the distribution of the magnetic field, and so will be accompanied by eddy currents in other conductors in the neighbourhood and in non-supraconductive parts of the body itself. These currents represent a certain amount of energy, which will be wasted, when the currents will die out in course of time; this energy might be identified with the hysteresis loss ($\int H d\sigma$ or $\int T dS$ in a magnetic or in a thermal cyclical process). It may be expected that the transition *to* the supraconductive state especially will be retarded by the necessity of starting the eddy currents.

The remarkable fact, that the condition $B = 0$ does not seem to be fulfilled in Meissner's experiments inside a hollow leaden tube may be brought into relation with my result (5). It seems highly probable that parts of the tube were not supraconductive; this allowed the lines of induction to pass (it may be remembered that at first only supraconductive 'needles' or 'blades' parallel to the field will be formed).

So it seems quite possible to complete, on the basis of Meissner's new results, my previous considerations, with the assumption that in the supraconductive state not only $E = 0$, but also $B = 0$. Though general agreement with the observed facts seems to exist, perhaps new difficulties may arise when theory and experiment are considered together more closely (especially if bodies of complicated shapes are considered). Perhaps the formation of supraconductive rings in the body might account for such complications.

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[1] *Archives du Musée Teyler*, 7, 378: 1933.
[2] Making use of Keesom and Kok's results on the discontinuity in the specific heat. *Comm. Leiden*, 221e: 1932.
[3] For example, W. J. de Haas and J. Voogd, *Comm. Leiden*, 212c and 214c; 1931. W. J. de Haas, *Leiziger Vorträge*, 59; 1933.
[4] *Naturwiss.*, 21, 787; 1933.