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flame-tube pendulum as shown in fig. 3 and bent by tying the two ends at (a) together. The thread joining the two

Fig. 3.

ends at (a) is burnt, and the spring thus set in motion. If the band is geometrically and physically perfectly symmetrical, the flames remain at rest*.

Another case, where inertia plays a rôle, we have in the so-called centrifugal force. If the flame-tube lying on the table is turned about one end as centre, the flame at the other end becomes large through the centrifugal force causing an increase of the internal pressure at that end of the tube. This effect is shown even if the motion is very slow.

The experiments described above do not of course exhaust the uses of the flame-tube, but merely serve as examples.

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LIV. *The Decomposition of Water-Vapour in contact with Hot Platinum Wire.* By ALFRED HOLT, Junr.†

RATHER more than a year ago the author made several attempts to estimate the extent of the dissociation of water-vapour at high temperatures by heating a platinum wire (by means of an electric current) in contact with it at low pressures. The results were consistent among themselves, but at high temperatures were decidedly lower than those previously obtained by Nernst and Wartenberg (*Göttinger Nachr.* 1905, p. 35). The work was not published, owing to the circumstance that some doubt arose as to whether the numbers were a true measure of the dissociation of the vapour at the temperature of the wire.

* A cork pushed in between the prongs at (a) serves well enough for holding the axle for the disk used in the last experiment.

† Communicated by the Author.

Although it was recognized that a gas heated by contact with a fine platinum wire must be very rapidly cooled, yet it was feared that as the cooling took place there might be an appreciable amount of recombination in the immediate neighbourhood of the hot wire, owing to the catalytic action of the platinum vapour thrown off from the incandescent metal.

The amount of the dissociation would obviously be reduced by this source of error, and the magnitude of the discrepancy between it and the observed values would become greater as the temperature of the wire, and the consequent amount of metallic vapour thrown off it, increased.

It was not evident at the time when these determinations were made, that it could be independently ascertained whether the error in question influenced the results to an appreciable extent. More recently, however, while performing a series of experiments for a different purpose, the extreme rapidity with which the separation of oxygen and hydrogen took place in pure water-vapour at about 15 mm. pressure was noticed; and the idea occurred that, by taking cognizance of this fact, an experiment could be devised to test whether any combination of the electrolytic gas took place in the immediate neighbourhood of the wire.

The principle of the proposed experiment was that the water-vapour and electrolytic gas should be withdrawn both from the surface of the wire and at some distance away from it. If no recombination occurred during cooling, then the oxygen and hydrogen should be present in both samples in combining proportions; but in the event of a partial reunion, the sample of gas taken from the immediate neighbourhood of the wire should contain an excess of oxygen, whereas that taken simultaneously from another portion of the water-vapour should be correspondingly rich in hydrogen. For, when a wire is heated in water-vapour, electrolytic gas is produced at its surface. Diffusion would at once take place, and if no recombination occurred, the oxygen and hydrogen would become uniformly distributed in combining proportions throughout the vapour, since any diffusion back of the hydrogen from the cooler towards the hotter layers of vapour, would be exactly compensated by the direct outward diffusion from the hot wire.

If, however, recombination took place in a zone at some little distance from the surface of the wire, its effect would be to diminish the amount of electrolytic gas in the cooler and more distant portions of the water vapour; so that

outward diffusion would be continually going on, with the result that the gas which had the greater rate of diffusion would be found in excess outside the zone of recombination, while that with the slower rate would tend to concentrate round the wire.

Since these experiments on the dissociation of water-vapour were performed, Langmuir (Journ. Amer. Chem. Soc. 1906, p. 1357) has carried out a very similar investigation, and has obtained results in close agreement with those of Nernst and Wartenberg. He does not seem to have considered that any appreciable source of error arose from this recombination in the immediate neighbourhood of the wire, and this view is confirmed by the experiments described in this paper; but he is of opinion that the highest temperature is reached at which it is feasible to determine the amount of dissociation by this method when the wire begins to disintegrate, and deposits finely divided metal as a film on the inner surface of the glass vessel employed. Some amount of recombination of the electrolytic gas may take place in contact with this film, and so cause considerable errors in the determinations.

In his experiments, however, the apparatus employed was only 0.9 cm. diameter, and was heated during each experiment to at least 100° C. by the steam passing through it, whilst I used a vessel 20 cms. diameter, the walls of which hardly became heated during the short time occupied by each determination. Under these conditions it is less probable that there would be any large error from this cause, though it is possible that it may be an explanation of the lowness of the numbers at high temperatures. The catalytic action of this spray and deposit is being further examined, and it is impossible at present to say how far it really influences the results.

The values obtained for the amount of dissociation of water-vapour are slightly higher than those of Langmuir and Nernst and Wartenberg at low temperatures, but they steadily become smaller as the temperature rises, till at 2000° absolute they are only about $\frac{1}{7}$ of the quantities obtained by the other authors.

The cause of this marked discrepancy of results is being further investigated.

Experimental.

The apparatus employed for the determination of the amount of dissociation consisted of a large glass bulb of rather more than 4 litres capacity, in the centre of which a pure platinum wire about 5 cms. long was hung.

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The globe was completely evacuated, and then filled with water-vapour by opening a tap beneath it which communicated with a smaller bulb containing pure distilled water.

When the large globe was completely filled with vapour, the wire was heated to the required temperature, which was kept as constant as possible till equilibrium had been established. The current which heated the wire was then cut off, and the whole contents of the bulb pumped off through a freezing-mixture in order to condense the water-vapour. The electrolytic gas was collected, and estimated by explosion, when it was always found to contain a minute excess of hydrogen. This excess appeared to be due to the absorption of a trace of oxygen by the mercury in the fall-tube of the pump.

The temperature of the wire was determined from its resistance by the following formula:—

$$t - \theta = \delta \left\{ \left(\frac{t}{100} \right)^2 - \frac{t}{100} \right\},$$

$$\theta = \frac{R_t - R_0}{R_{100} - R_0} 100.$$

1.54 was the value adopted for δ .

Experiments were made with two different wires, in order to see whether they gave concordant results.

In the following tables the percentage decomposition of water-vapour at the various temperatures is given.

The values at the pressure of the water-vapour were determined experimentally, while those at 760 mms. pressure were calculated from them.

Wire No. I.

Temperature absolute.	Per cent. decomposition at the pressure of water-vapour.	Calculated per cent. decomposition at 760 mms. pressure.
1220° C.	0.0038	0.00108
1540 „	0.0573	0.015
1640 „	0.0884	0.0246
1700 „	0.118	0.0317
1760 „	0.153	0.04

Wire No. II.

Temperature absolute.	Per cent. decomposition at the pressure of water-vapour.	Calculated per cent. decomposition at 760 mms. pressure.
1350° C.	0.00644	0.00175
1500 „	0.034	0.00887
1560 „	0.0593	0.0158
1630 „	0.0704	0.01842
1770 „	0.148	0.0388
1890 „	0.203	0.053
2030 „	0.264	0.068

The values obtained with the two wires are very fairly concordant, and would undoubtedly seem to represent the amount of decomposition taking place under the conditions of the experiments.

The apparatus used for the experiments on the separation of the oxygen and hydrogen through partial recombination by the platinum spray, is shown in fig. 1.

A current of water-vapour entered at A and was decomposed by the hot platinum wire Pt (which had a small weight W attached to it) while passing up the narrow portion of the apparatus, so that a condition of equilibrium between the vapour and electrolytic gas was reached in the compartment D. The oxygen and hydrogen were withdrawn through B and C, and as the entrance into E from D was only about 2 mms. wide and had the hot wire passing through it, it was expected that the gas collected through B would largely consist of that which immediately surrounded the wire in D, while the portion pumped off through C would contain the gas from the cooler parts of D.

Fig. 1.

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As already pointed out, one would expect in the event of a partial reunion of the electrolytic gas by the platinum spray, to find an excess of oxygen in B and hydrogen in C.

The details of the experiments are given below, where it will be noticed that there is no separation of this kind ; on the contrary, there is a minute excess of oxygen in C and hydrogen in B. One is, therefore, bound to conclude that any recombination which takes place through this cause has no appreciable influence on the results.

Total volume of Gas collected in B.	Excess of Hydrogen in B.	Total volume of Gas collected in C.	Excess of Oxygen in C.
6.0 c.c.	0.25 c.c.	4.0 c.c.	0.12 c.c.
12.0 c.c.	0.37 c.c.	9.0 c.c.	0.195 c.c.
4.0 c.c.	trace	2.5 c.c.	trace

The University, Manchester.

LV. *On the Influence of Stress on the Electrical Conductivity of Metals.* By W. ELLIS WILLIAMS, B.Sc., Research Fellow of the University of Wales*.

THE effect of hydrostatic pressure in altering the electrical resistance of metals was discovered by Chwolson † in 1880, and his results were soon afterwards confirmed by Tomlinson ‡. In both cases, however, the range of pressure employed was too small to enable accurate measurements to be made. The question has, in recent years, been taken up by Lussana § and also by E. Lissell ||.

The results obtained by Lissell were :—That the resistance of all the pure metals investigated is diminished by hydrostatic pressure, and that the diminution is nearly but not quite proportional to the pressure. He found further that with alloys the decrease of resistance is much smaller than with the pure metals, and that with some alloys the resistance is increased by pressure. He paid special attention to the case of *manganin*, in which he found the increase to be, within the limits of his experiments, accurately proportional

* Communicated by Prof. E. Taylor Jones, D.Sc.

† Chwolson, *Bull. Petersburg*, 1880.

‡ Tomlinson, *Phil. Trans.* 1883.

§ Lussana, *Nuovo Cimento*, (4) x. p. 73, (3) v. p. 305, 1903.

|| Lissell, *Diss. Upsala*, 1902.