THE ABSORPTION OF MERCURY VAPOR BY TIN-CADMIUM ALLOY.

BY L. A. WELO.

THE writer has been engaged during the past year in a spectroscopic study of the gases occluded in certain metals, and has had occasion to keep the vapors from the mercury pump out of the evacuated tubes by cooling the intervening connections in liquid air. An accident to the liquid-air plant threatened to delay the work, as no gold leaf was at hand to be used as a substitute, until it was suggested by Dr. L. T. Jones that a portion of the connecting tubing be packed with some of his supply of chips of a tin-cadmium alloy which is known to form an amalgam with great ease. The alloy, commonly known as dentist's amalgam, consists of two parts of tin to one of cadmium and was used in the form of chips cut from a bar of the alloy with a milling machine. They have a thickness of the order 0.05 mm., are 12 mm. in length and vary in width from 1 to 3 mm.

A special test of the material has since been made to establish upper and lower limits for the length of tubing to be packed. The apparatus is shown in the figure. Eight branches are blown on centimeter tubing

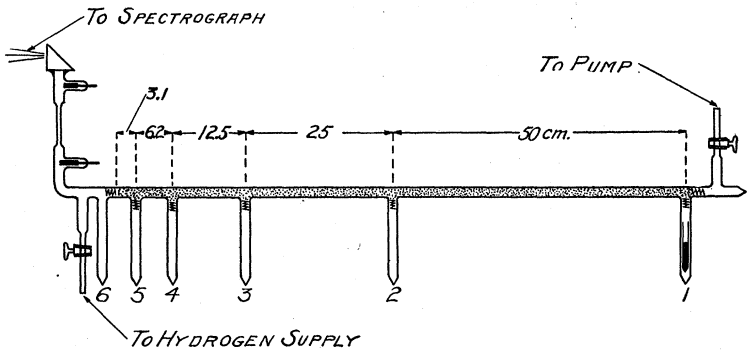

Fig. 1.

somewhat more than a meter in length and a Plücker tube is attached at the end. One branch leads to the pump and a second to the hydrogen supply, this gas being chosen because its low atomic weight makes its

spectrum extremely sensitive to traces of mercury vapor.[1] The remaining six branches are spaced as shown, rather than uniformly, in order that fewer branches with fewer trials will determine the lower limit of length in case it should be small. The Plücker tube is equipped with aluminum electrodes sealed in with platinum wire and is closed with a small right-angled quartz prism instead of plate, that it may be placed between the spectrograph slit and the end of another tube already lined up and which it was desired should not be disturbed.

The chips are closely packed, without jamming, for a length of 96.8 cm. and the test consists in leaving mercury in successive branches, beginning at the pump end, for certain lengths of time and noting from which branch mercury first appears as an impurity in the spectrum. After the vapor had penetrated from the third branch the remaining

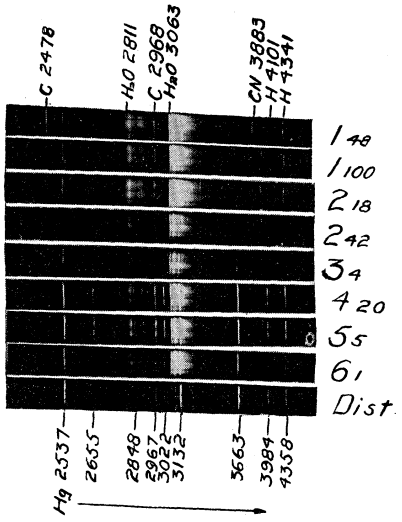

Fig. 2.

branches were also used to see if there were any further increase in strength of the mercury spectrum with time and with decrease of length of packing. To make the test more severe the mercury is kept at a temperature of 120–130 degrees with a small heating coil slipped over the branch, giving vapor pressures of 0.78–1.24 mm.[2]

Electrolytically prepared hydrogen dried with calcium chloride was admitted from time to time and, after adjustment to a suitable pressure indicated by the number of striations between the end of the capillary

[1] Lewis, Astrophysical Journal, 10, 137, 1899, and Nutting, same, 19, 105, 1904.

[2] Hertz, Wied. Ann., 17, 199, 1882.

and one of the electrodes, its spectrum was examined both visually and photographically. The voltage on the exciting transformer, capacity, length of spark gap and time of exposure were all constant. Nine of the spectrograms appear in Fig. 2, where the numbers at the right refer to the branch containing the mercury and the subscripts to the number of hours it had been there. The two stronger hydrogen lines H_α and H_β could always be seen in the direct vision spectroscope, but the line H_γ is seen only in the first four spectrograms. After that it is suppressed by the mercury which begins to enter from branch 3. The repeated filling with hydrogen is seen to remove all of the carbon and cyanogen and a part of the water vapor present as impurities before spectrogram 1–100 is taken. It is seen that the very persistent line Hg 2537 is present from the start, but that it also is removed on several fillings with hydrogen until in spectrogram 2–42 it is all but visible. In the next, 3–4, where the length of intervening packing is only 21.8 cm. the line again appears, showing that the vapor is able to penetrate from the third branch. The next three exposures show no progressive increase in intensity of the many mercury lines with time. The last spectrogram was taken after mercury had been distilled from the last branch to the vicinity of the electrode.

The results may be summed up in the statement: A column of chips of tin-cadmium alloy, which need not be more than 50 cm. in length, is an effective bar to the passage of mercury vapor from the pump to the vessel to be exhausted.

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June 9, 1917.

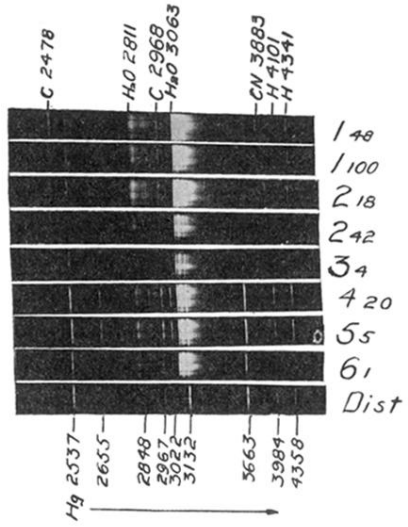
C 2478
H₂O 2811
C 2968
H₂O 3063
CN 3883
H 4101
H 4341
1 48
1 100
2 18
2 42
3 4
4 20
5 5
6 1
Dist
Hg 2537
2655
2848
2967
3022
3132
5663
3984
4358

Fig. 2.