[Papers On Surface Phenomena On Mercury]

by

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C O N T E N T S

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PREFACE (v. Regulation 2).

The first paper gives a summary of the results of an investigation of the causes of false reconstructions of objects when the stereoscopic method of radiography was used. The work was done under the direction of Professor T.H. Laby at a time when there was a tendency to abandon the stereoscopic method owing to the frequency of errors in reconstruction. It was soon evident that much of the trouble was due to the failure to realize that the perception of distance and relief depends on factors much more complicated than the simple convergence of the lines of sight of the two eyes. Moreover transparent plates allow of no less than 8 different reconstructions of the object whereas with ordinary stereoscopic pictures the worst that can happen is the interchange of 'left' and 'right' pictures and this gives an inversion of perspective that is at once detected. The predictions from the theory of binocular vision were experimentally tested and a simple technique described that would make error impossible and would allow the position of any point to be determined from measurements on the plate. Once the sources of error and their effects are completely known however it is a simple matter to devise a technique for any given conditions.

The other papers describe work which originated with Professor Kerr Grant's suggestion to the author that it would be of interest to experiment with films on the surface of mercury since experiments with water had yielded useful results in the hands of Langmuir and others. The first of these papers describes a number of previously unrecorded phenomena, chiefly those presented by aqueous solutions spreading over mercury and gives a quantitative account of some of the factors involved. This paper was the subject of special demonstrations before the Physical Society by Professor C.R. Darling and the late Professor Edser, and the latter used the photograph of a film spreading over water to illustrate his theory of spreading in the new edition of his "General Physics". The ascending ridge observed on a vertical glass plate from which water is draining was the subject of a number of papers by Professor Satterley (Proc. Roy. Soc. Canada, 1929 p. 95 -; 1930, p. 87 -; 1931, p. 205 - etc.)

The next paper was written at the invitation of the Faraday Society to contribute to the General Discussion on 'Phenomena at Interfaces'. It includes some further data on the spreading of solutions on mercury, including the quantitative agreement between data from the spreading of acids and the electrically forced spreading of water. The paper however was written as a contribution to a discussion and deals mainly with the position revealed by an attempt to find from

the literature the value of the surface tension of mercury in air and in vacuum. For this it was accorded a special reference in the International Critical Tables but as matter of fact not much more than a preliminary survey of the subject had been made at the time of the Faraday Society Discussion. The results of some observations by the drop-weight method are included and also some observations by Oliphant using a 'large drop' apparatus and observing the phenomena of spreading in controlled atmospheres and in vacuum.

Henceforth the work was chiefly concerned with the surface tension of mercury and the action of gases on its surface. Oliphant's success in establishing the adsorption of gases on a shower of mercury drops was communicated in a joint note (Nature, 1927 p. 584). The position with regard to the surface tension was that workers each claiming a high degree of accuracy (occasionally of better than 1 in 1000) yet differed by 20% from each other; while data regarding the effects of gases were even more discordant. In Vol. IV of the International Critical Tables published shortly after this time the compilers were driven to ignore all determinations of the surface tension of mercury by the 'big drop' method though its users claimed a higher order of accuracy than was attained in any other method. Values for the surface tension in vacuum were given by the drop weight method only; yet the data quoted for the effect of exposure of the surface to air were taken from a 'big drop' determination. In the work carried out here on the 'big drop' method, (described Nature, 1931 p. 456, and

Trans. Far. Soc. 1932 p. 866) every effort was made to avoid merely producing another value for the surface tension of mercury in vacuum. The chief results were that most of the discrepancies between this and other methods no longer appeared, and especially that there is little difference between the value for vacuum and the initial value in dry air, thus enabling the surface tension in vacuum to be stated with confidence. Incidental to the work a determination of the temperature coefficient up to 230°C of the surface tension in vacuum was made. This represents apparently the only observations that have been made over any appreciable range of temperature by any method (for vacuum conditions). The coefficient obtained agreed with that obtained by Harkins using the drop-weight method, over a small temperature range. The 'big drop' method no longer produced results that were mysterious and inexplicable.

The paper on Adsorption of Gases on Mercury, (Proc. Phys. Soc. London, May 1935) was the result of an attempt to find whether gas adsorbed on a mercury surface was retained when the space above the mercury was evacuated. This gave a positive result and a direct and imambiguous measurement of the gas liberated on collapsing the mercury surface could then be made.

Under the title 'Phenomena of Spreading and their Interpretation' are presented some unpublished notes on observations made over a number of years. The present position of

theories of spreading is discussed and it is shown that the value of the spreading coefficient determines the spreading or otherwise of aqueous solutions on mercury. Finally the bearing of these observations on determinations of the interfacial tension for mercury against water is discussed and particularly the fact that ionic adsorption makes it unsafe to regard the interface as that between two pure liquids.
