

determine adsorption *per se* was made; nevertheless, the general results led strongly to the view (for which confirmation was forthcoming in contemporary literature²) that adsorption of water vapour is negligible provided that both the metal surface and the atmosphere are free from contamination. Iron was found to be particularly susceptible to the presence of disperse solid particles (for example, traces of ammonium sulphate³), while nickel provided an extreme case of susceptibility to gaseous pollution (for example, traces of sulphur dioxide⁴).

Experiments carried out about the same time but hitherto unpublished appear to bear upon Bowden and Throssell's observations. Polished and degreased nickel surfaces were submitted to two-stage exposures, (a) to purified air saturated with water vapour, (b) to purified and dried air to which had been added a trace of sulphur dioxide. No visible change was produced at the end of either the first or the second periods of exposure. The experiment was then reversed, the specimens (polished and cleaned as before) being first exposed to the dry air containing a trace of sulphur dioxide and, secondly, to air saturated with water vapour; between the two exposures the specimens were placed in a vacuum desiccator which was evacuated to remove sulphur dioxide other than any held by adsorption on the metal surface. No visible change resulted from the first exposure; on transference to the saturated atmosphere, however, the specimens became rapidly covered with a visible film (spontaneous 'fogging'). The published work showed the presence of free sulphuric acid in such films, arising no doubt from the catalytic activity of the metal. Although entirely qualitative, the results appear to be significant as showing that adsorption of sulphur dioxide must precede any adsorption of water vapour; they may, indeed, provide a clue to the nature of the impurity responsible for the adsorption observed in Bowden and Throssell's experiments.

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¹ *Nature*, **167**, 601 (1951).

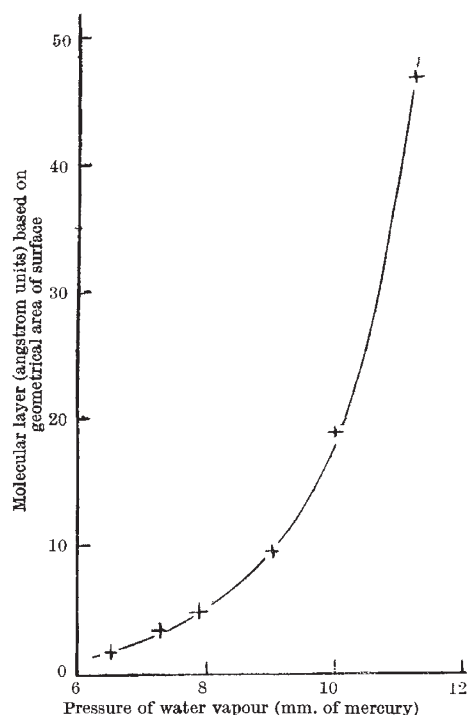
² McBain, J. W., "The Sorption of Gases and Vapours by Solids", 316 (1932).

³ Vernon, W. H. J., *Trans. Farad. Soc.*, **23**, 159 (1927); **31**, 1692 (1935).

⁴ Vernon, W. H. J., *J. Inst. Metals*, **48**, 121 (1932).

It is interesting to note that the measurements (by weighing) of water vapour on metal surfaces reported by Dr. F. P. Bowden and W. R. Throssell¹ are in agreement with measurements (by insulation resistance determination) published twenty-one years ago² for the adsorption of water vapour on clean and contaminated mica surfaces. The accompanying graph has been plotted from these measurements by assuming a sodium chloride 'contamination' which would give a measurable insulation resistance for a thickness of electrolyte of the order of molecular dimensions (10^{-8} cm.)—a concentration of as low as 10^{-8} gram-equivalent per c.c. suffices.

In our paper we find: "These observations mean that a fresh, clean mica surface, in an atmosphere of clean, unsaturated water vapour, takes on a measurable layer of moisture only with the greatest difficulty; indeed, they seem to indicate that if perfect cleanli-



Adsorption of water vapour on a mica surface freshly formed in air. Temperature, 20.5°C .; saturation pressure, 18 mm. of mercury

ness were attainable, no measurable layer would form until saturation pressure was reached".

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Glasgow, C.I. May 10.

¹ Bowden, F. P., and Throssell, W. R., *Nature*, **167**, 601 (1951).

² Macaulay, J. M., and Carson, D., *J. Roy. Tech. Coll., Glasgow*, **2**, 161 (1930).

It is clear from Dr. Vernon's and from Dr. Macaulay's observations that a variety of surface contaminants can give rise to an apparently heavy 'adsorption' of water vapour. We should expect this to be so since any hygroscopic substance will take up water in this way, and the results quoted are in harmony with our experiments. We find, for example, that if clean metal surfaces are washed with tap water and then dried, there is a large increase in weight when they are exposed to water vapour well below its saturation pressure.

With pure water vapour and with surfaces which have been cleaned by heating *in vacuo*, this is not observed. Nevertheless, the adsorption is appreciable and is measurable: in our experiments (both by direct weighing and by the use of polarized light) it corresponded to about one molecular layer when the relative pressure of water vapour was c. 0.7 and about two molecular layers when it was c. 0.95. The fact that the adsorption of water on clean surfaces is small is of general interest, since experiments which appear to show heavy adsorption are often quoted as evidence for long-range surface effects.

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