

Methodological Notes*DEMONSTRATIONS OF THE PROPERTIES OF SATURATED VAPORS*

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IN the ordinary demonstration of the properties of saturated vapors, a mercury-filled glass tube is used, beneath which a vacuum is created by the method of Torricelli. Ether is introduced in this space by means of a U-tube until saturated vapors are formed; the pressure is set by lowering the mercury level. The tube is then tilted or submerged in a mercury bath. The lack of a change in the height of the mercury column in this case shows the independence of the saturated vapor pressure of the volume. Heating the vapors with a flame lowers the mercury level, which demonstrates the increase of pressure with temperature.¹

In the demonstration apparatus room of the Moscow University, I. A. Yakovlev and V. S. Egorov prepared an apparatus for the demonstration of the temperature dependence of saturated vapor pressure. It consisted of a glass flask with two branches. One tube is connected to a vacuum gauge, the other to a pump. By heating the ether contained in the flask, one observes the increase in the saturated vapor pressure by readings a vacuum gauge. We at Tomsk University have constructed apparatus with which one can demonstrate both the temperature dependence of the saturated vapor pressure and its independence of the volume. The apparatus consists of a spherical glass vessel with a branch sealed off below, three tubes along the "equator" of the flask, and a fourth tube with two stopcocks above.

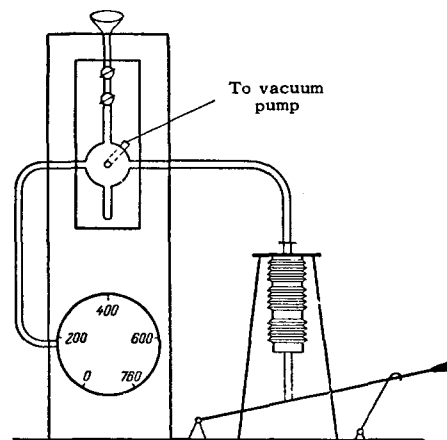
The upper tube is used for introducing liquid into the vessel. For this purpose, the upper stopcock is opened and the tube is filled with liquid up to the lower stopcock. Then the upper cock is closed and the lower opened, and the liquid flows into the flask. By this arrangement, the path to the air is always completely sealed off.

The rear tube is used for connecting the vacuum pump (for example, a BN461), the left-hand tube connects to the vacuum gauge, and the right hand one to a sylvon bellows. Three soldered sylvons of 3 cm diameter are used in the apparatus. The sylvons are fastened from above to a tripod. Below, they are attached to a disk which connects with a short lever hinged on the end.

The demonstration is carried out in the following way. Air is removed from the apparatus by the pump. The sylvon is compressed here by the atmospheric pressure and the lever rises to a position which is fixed by the hook attached to it. Then, by operating

the stopcocks, enough liquid is poured into the branch of the tube so that liquid remains in the tube after boiling. The sylvon is extended by manipulation of the lever and the volume of the saturated vapor is increased. The volume of the vapor can be decreased by lowering the lever. The vapor pressure remains unchanged in this case. We then heat the flask with hot cotton wadding dipped in alcohol, and an increase is noticed in the saturated vapor pressure. At the start of the demonstration, it is advantageous to carry out a similar experiment with unsaturated vapor. The choice of liquid is of great importance for the success of the experiment. Liquid ether, which is usually used, is unsuited here since an exact method of measurement of the pressure change (instead of the semi-qualitative used in an earlier version of the experiment) immediately shows its inadequacies. These are due to sharp adiabatic cooling upon increase in volume and to the presence of air in the vapor. The pressure of this air increases under compression, and the total pressure is changed. This effect is highly noticeable in the setup with a vacuum gauge for exact determination of the pressure, and distorts the observed phenomenon.

The acetone used in our apparatus makes it possible to avoid this difficulty. The pressure of the saturated acetone vapor amounts to about 200 mm Hg at room temperature, and its boiling point is 56°, which allows us to demonstrate conclusively the fundamental properties of saturated vapors. A schematic of the apparatus is shown in the diagram. The apparatus is mounted on a wooden stand, the vertical part of which has a height of 75 cm, while the horizontal part is 70 cm in width. The diameter of the spherical part of the flask is 8 cm, the length of the tube with the funnel



and two stopcocks is 22 cm. The dimensions of the lever arms are 10 and 60 cm, respectively. The total length of these slyphons is 16 cm.

fizike (Demonstration Lectures in Physics), vol. 1, Molecular Physics and Thermodynamics (Gostekhi-zdat, Moscow, 1948).

¹A. B. Mlodzeevskii, *Lektsionnye demonstratsii po*

Translated by R. T. Beyer
