

made upon the machine during induction and maintenance, the vaporisation of 15 fl. oz. of ether per hour has been provided for. The vaporisation of this amount of ether requires 28,000 calories. If we decide that the hot-water chamber is to be refilled once every sixty minutes, then we must be able to add 28,000 calories each time we refill, and this amount of heat will be furnished by 400 c.c.m. of boiling water as it cools from 100 C. to 30 C., the melting-point of the reservoir substance. The capacity of the hot-water container is thus determined at 400 c.c.m. Hydrated calcium chloride ( $\text{CaCl}_2 \cdot 6\text{H}_2\text{O}$ ) was chosen as a suitable reservoir substance. . . . The minimum amount of calcium chloride which can be used is that amount which will just be melted completely by the addition of 28,000 calories. . . . By calculation, this minimum amount of calcium chloride is 700 grammes. In practice, however, it is desirable to use considerably more than this minimum amount. . . . In order to provide a considerable margin of safety we have therefore incorporated a calcium-chloride container with a capacity of 1300 g. Good heat transfer must be provided between the hot water and the calcium chloride, and between the calcium chloride and the ether; on the other hand, direct transfer of heat between the hot water and the ether must be prevented. These conditions are achieved by arranging the containers concentrically. . . . Since the ether container is maintained at about 30 C., heat loss from the apparatus is small because the temperature difference between its outside wall and the surrounding air is slight. Heat exchange between the containers is increased by making them of an alloy of good heat conductivity, and by equipping the walls with radial fins. . . .

"In the Oxford Vaporiser No. 1, a liquid anaesthetic, such as ether, is maintained at a constant temperature

below its boiling-point, thus making available a constant supply of vapour. The concentration of anaesthetic vapour in the inspired air is controlled by a calibrated mixing tap which determines how much of the inspired air passes through the vaporiser, and how much by-passes it. . . . To maintain the vaporiser in operation it is necessary only to fill at intervals with ether, and with sufficient hot water to re-melt the crystals; cylinders of compressed gas are not required. Since the machine delivers vapour only during inspiration it is economical in use. Artificial ventilation, with or without anaesthetic vapour, can be administered by a spring-loaded bag."

J. C. M. C.

COWAN, S. L.; SCOTT, R. D., AND SUFFOLK, S. F.: *The Oxford Vaporiser No. 2*. *Lancet* 2: 64-66 (July 19) 1941.

"The Oxford Vaporiser No. 2 has been developed to maintain a quantity of liquid anaesthetic at a temperature at which its vapour pressure exceeds atmospheric pressure—i.e., above its boiling-point. . . . The outflow of undiluted vapour from the vessel is controlled by a valve, and is measured by a flowmeter which is maintained at a constant temperature approximately the same as that of the liquid. The vapour is afterwards mixed in a mixing chamber, also at approximately the same temperature as the liquid, with a measured flow of oxygen, together with any other gas if desired. In this way condensation of vapour is avoided and mixtures containing any desired concentration can be prepared; moreover, condensation will not occur during passage of the mixture from the apparatus to the patient so long as the saturation concentration at the temperature of the coolest part of the connecting tubing is not exceeded. When ether is used at usual room temperatures, con-

densation will not take place unless the concentration of vapour exceeds 50 per cent; in clinical anaesthesia percentages above 20 are rarely necessary.

"The principle of the apparatus is that the anaesthetic liquid, the flowmeter and the mixing chamber are maintained at constant temperature by drawing upon the latent heat of crystallisation of a thermal reservoir substance previously melted by hot water."

J. C. M. C.

EPSTEIN, H. G., AND PASK, E. A.: *The Performances of the Oxford Vaporisers with Ether*. *Lancet*. 2: 66-67 (July 19) 1941.

"Clinical performance of vaporiser No. 1. . . . Though not recommended if the more usual methods are available, induction with ether vapour is perfectly practicable. The spring reservoir bag is put into circuit, and with the mask held a short distance from the patient's face a gentle current of air containing gradually increasing concentrations of ether vapour is blown over by rhythmic pressure on the bag. The mask is gradually lowered on the face and as soon as the patient becomes unconscious it is applied firmly; the ether concentration is thereafter increased as rapidly as the patient will tolerate it. Surgical anaesthesia is produced usually in about ten minutes. In a short series of experimental inductions using ether alone on an open mask, and comparable in comfort and smoothness with those obtained with this vaporiser, it was found that about thirty minutes was needed to reach surgical anaesthesia. The extra speed and smoothness of induction with this vaporiser may in part be due to the steady gradual increase in ether concentration which is possible, and it is also probable that the ether vapour at room temperature delivered by the vaporiser is less irritant than the cold vapour from an open mask. . . .

"Induction with ether . . . ethyl chloride or di-vinyl ether . . . is carried out as usual until automatic respiration denotes the onset of surgical anaesthesia. The mask of the vaporiser is then applied and the mixture control set to 15 per cent. A concentration of this order is now readily accepted and after some minutes the mixture can be enriched or weakened as the requirements of the patient indicate. . . . For induction with pentothal, evipan, etc., the 'induction dose' varies between 0.2 and 1 g. according to the robustness of the patient. This dose is given rather quickly, and during the transient respiratory depression which follows the mask of the vaporiser is applied to the face, the spring reservoir bag put into circuit, and an attempt made rhythmically to inflate the lungs with air containing 15 per cent of ether vapour. At first the inspiration of this mixture may be resisted, but if the attempt is continued the patient will shortly accept the vapour and breathe normally. In this way he is rapidly brought under the influence of ether as the effect of the barbiturate wears off. There is, of course, considerable individual variation between patients, but it is found in the majority of cases that percentages of ether vapour greater than 15, used in this way, excite troublesome laryngeal spasm, while percentages below 15 allow the patient to recover from the barbiturate narcosis more rapidly than he is depressed by the ether. . . .

"When the required plane of anaesthesia is reached the mixture control is brought back to a low percentage, usually between 4 and 6, and the selected plane is then readily maintained with great constancy. Provided the mask is firmly applied, and the airway is maintained clear, the patient inspires the percentage of ether vapour indicated by the control lever. If de-