A Rapid Mercury Still. By R. J. CLARK, Lecturer in Physics and Carnegie Teaching Fellow in the University of Edinburgh. (Communicated by Prof. Sir E. RUTHERFORD.)

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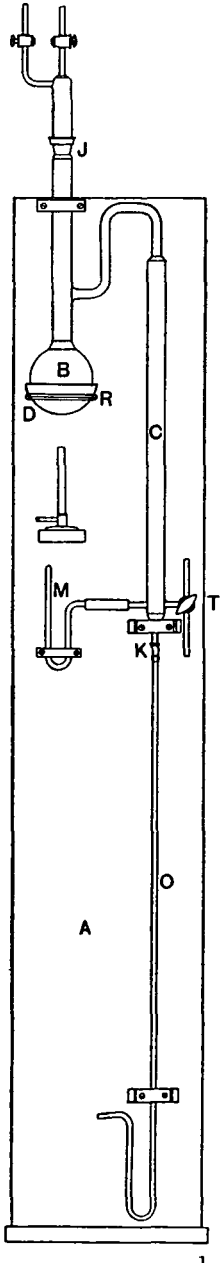
This still is a modification of Hulett's pattern* in which mercury is distilled in a current of air at greatly reduced pressure. The current of air has two uses; first it prevents bumping and so is led in beneath the surface of the boiling mercury, and secondly, it oxidizes most of the zinc, cadmium and lead which go over. The oxides float on the distillate and are easily removed by straining it. A still made according to Hulett's directions and having a boiler of half a litre capacity will distil satisfactorily about 750 grams per hour. If the rate of distillation is increased much, some of the other metals go over, and if more air is admitted to prevent this, the boiling mercury is thrown about very violently in the boiler, which breaks sooner or later.

By one change in design, the use of two inlets for air instead of one, the capacity of the still can be doubled for a given size of boiler. One of the two inlets is near the bottom of the boiler beneath the mercury, and the other is at the top above the surface. Only enough air to stop bumping is led in through the first, the rest goes through the other. A boiler of half a litre capacity can be used to distil 1500 grams per hour in this way.

A pattern of still, one of which has been in use for some years, is shown in the accompanying diagram, which is to scale and indicates sufficiently the way in which the still is made. The boiler *B*, a round-bottomed flask (soda-glass) of half a litre capacity rests on some fine brass filings in a hemispherical iron dish *D*, of 6 cm. radius, in its turn supported on an iron ring *R* fixed to the wooden support *A*. The neck of the flask is 2·5 cm. in diameter and 30 cm. long so that the mercury sealed ground joint *J* remains cool. Through this joint pass two concentric tubes, the larger extending 2 cm. into the boiler when in position, the smaller ending in a fine capillary 1 or 2 mm. only from the bottom of the boiler. This is shown in the detailed diagram of the boiler in Fig. 3. Taps are provided to regulate the amount of air admitted through each tube. The eduction tube to the condenser is 15 mm. in diameter, and is sealed in the neck 7 cm. above the bulb, and to avoid priming it is bent at right angles, and carried up 20 cm.; then it is bent through 180° on a radius of 4 cm. and joins the condenser *C*. This is a vertical tube 3 cm. in diameter, 60 cm.

* Hulett, *Physical Review*, vol. 21, p. 288, 1905.

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Scale $\frac{1}{12{\cdot}5}$ natural size.

Fig. 1.

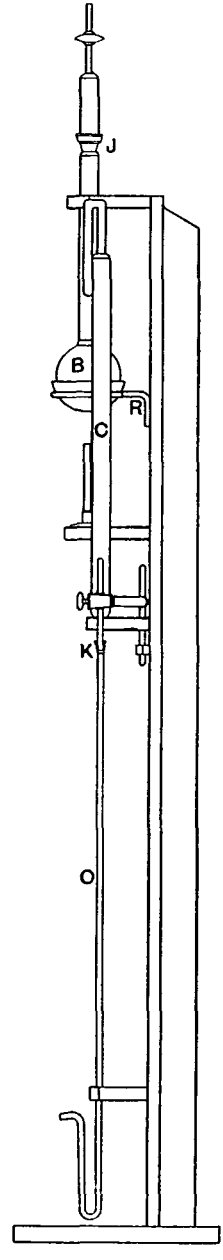
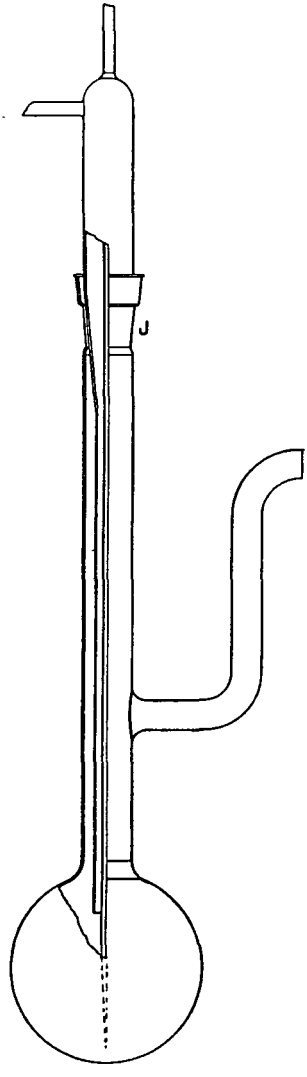


Fig. 2.



Scale $\frac{1}{4}$ (approx.) natural size.

Fig. 3.

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long and with a wall ·75 mm. thick ; it is supported on a wooden arm at its lower end, and through a hole in this arm passes a 7 mm. tube ending in the male part of a ground joint *K*. A three-way tap *T* is sealed on 2 cm. above the bottom of the condenser, and so the still can be evacuated or filled with air. The other part of this ground joint is at the upper end of the barometric overflow *O*, which is a heavy wall capillary tubing about 1 mm. in bore. A small manometer is connected to the lower end of the condenser by a piece of pressure tubing. The whole apparatus is mounted on a board stiffened by ribs, and occupies a floor space 30 cm. square, and is 150 cm. high.

To work the still the upper part of the head is taken off, and 4500 grams of mercury are poured into the boiler through a funnel with a stem long enough to reach nearly to the bottom. The joint *J* is rubbed over with graphite and put in place, and a little mercury is put in the cup to seal it. A *good* water suction pump is next connected to the tap *T* by some wide tubing. It is important that there should be no leaks and that the passage of gas to the pump should be entirely unobstructed. The end of the over-flow tube is now dipped into a dish of mercury, and the tap *T* is turned to connect the still with the pump. When the manometer shows a pressure of 25 mm. the amount of air admitted by the submerged inlet is adjusted so that one or two bubbles per second rise through the mercury. The other inlet is then adjusted until the pressure stays constant at about 21 mm. The burner is then lighted ; when the distillation begins the air supply will probably want further adjustment. Once started it can be let alone until there is 400 grams or so left in the boiler when the connection with the pump is cut off and the still allowed to cool. The distillate is then strained once or twice through a perforated filter-paper.

A still like this works as a pump, the pressure of oxygen being many times greater in the cold part of the condenser than in the boiler. Calculation shows that when 1500 grams of mercury are distilled per hour, 1 c.c. of air is admitted per second and the manometer shows a pressure of 20 mm., the pressure of oxygen in the boiler is less than 0·1 mm. Plenty of air must therefore be admitted and pumped out again by an efficient pump.

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