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A FROST-TOLERANT POROUS-POT EVAPORIMETER

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A severe limitation to the usefulness of porous-pot evaporimeters in the field has been their restriction to frost-free periods, since ice formation causes air locks and often breaks the pot.

In lowland areas with relatively long frost-free periods, measurements may be obtained for most of a year. In mountainous country, however, at least above about 4000 ft., severe frosts usually occur during all months. Thus, using improved, conventional-type evaporimeters (Baylis 1957), only occasional measurements of evaporation from December until March have been possible in the high altitude snow-tussock and alpine zones of the Old Man Range, Central Otago, during the past three years. One short period of sub-freezing temperature is usually sufficient to upset or to destroy the instrument.

Because of this need for frost-tolerant evaporimeters, various modifications to the original design have been attempted. Instruments were subjected to pilot testing in a cold chamber at about 1° F. The one design tested successfully continued to function during April 1961 at 4000 ft. on the Old Man Range when air temperatures fell to 25° F.

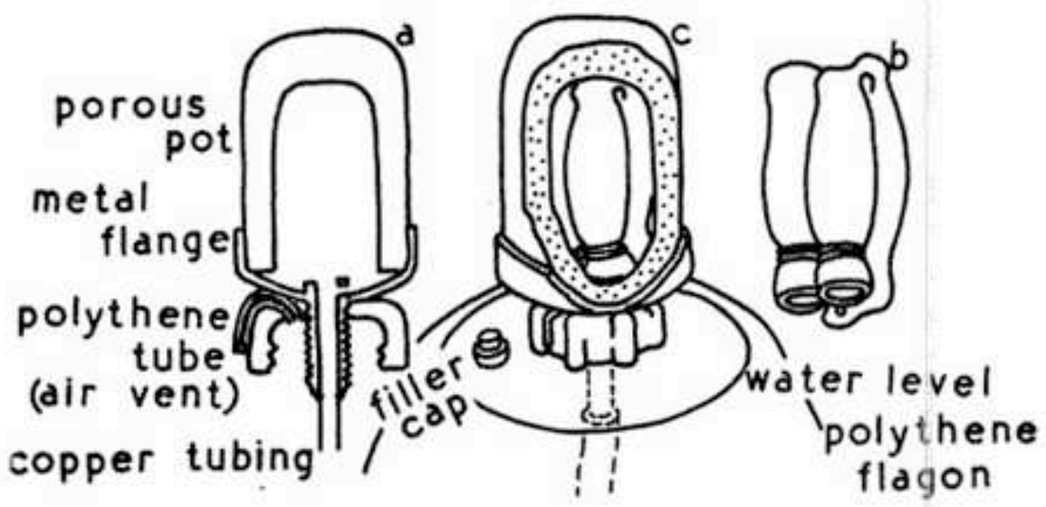

FIGURE 1. *A frost-tolerant porous-pot evaporimeter. "A" shows a conventional evaporimeter in cross section. The polythene air vent tube is shown inserted in the screw cap of the polythene flagon. A hole drilled in the stem of the metal flange to prevent an air lock in the interior of the pot is also shown. "B" shows the rubber surgical tubing ready for insertion into the porous pot. "C" shows the completed instrument, cut away to show the surgical tubing in place.*

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Construction of this model, shown in Figure 1, is as follows. The terminal four inches are cut from a five-inch Brownloe water filter candle. To prevent breakage, the hollow core of the filter candle is almost filled to capacity with a 20 cm. length of rubber surgical tubing (¼ inch internal diameter), sealed with rubber stoppers, and wired and cemented into place at both ends to retain its full volume of air. Partly filled cores did not prevent breakage of the filter candles. The metal flange from the base of the filter is then glued with "Araldite" resin glue to the base of the four inch section of candle. A one-inch length of ¼ in. copper pipe soldered to the outlet of the metal base serves as an attachment for the polythene supply tubing which leads into the reservoir.

The reservoir is a half-gallon polythene flagon. The filter candle is mounted upon its screw cap. Into a hole bored in the cap adjacent to the candle stem a short length of ⅛ in. diameter polythene tube is glued to serve as a vent equalising internal and external pressure. Glue also holds this tube deflexed against the side of the cap to prevent entry of rain. For filling, a short 1 inch length of ½ in. diameter polythene tubing is glued high on the shoulder of the flask and sealed with a rubber stopper. The bottom of this tube also serves as a referance mark for filling and measuring.

Twenty of these instruments have now been in use for 8 months up to an altitude of 5,350 ft. in Central Otago. Two small modifications proved necessary to ensure continued operation during periods with several freeze-thaw cycles. One was to mound earth around the reservoir to retard its freezing. If this was not done the porous-pots frequently became dry or partly dry presumably because they thawed and began to lose water before that in the reservoirs had melted. The second was to devise a different type of rain-proofing valve from the Livingston-Thone type in general use (Livingston & Thone 1920). This valve eventually collapsed because the pressure exerted by the water when freezing forced some mercury through the pad of cotton wool on which it was seated. A valve similar to that described by Wilson (1930) has overcome this problem. The modified valve consists of a loop about 3 inches high in the polythene supply tube, to which sufficient mercury is added to fill the lower third of the loop. This system, while acting as a rain-proofing valve, will also accommodate the expansion of freezing water, without any loss of mercury.

The approximate cost of parts for each instrument is £1. No attempt has been made to determine whether the spherical porous-pot evaporimeters in general use overseas can also be rendered frost-tolerant by this method.

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