increase in refrigerator capacity inherent in the shift to plastic containers that save 83% of the space when unfilled and 50% when full of blood. Plastic bags with ACD weigh 16.7% of glass. Full of blood, they weigh but 50%. Plastic packs with integral donor tubes require no storage space or handling for the latter. The infusion of blood from blood packs is easy and reliable. Specially designed recipient sets provide an adequate channel for blood to reach the nylon filter. Slow-down and stoppage are eliminated. Positive pressure infusion is accomplished either by squeezing the blood pack or by hanging the recipient set over the edge of a chair and sitting on the pack or by sliding it into a pressure pouch and building pressure in a rubber bladder to squeeze the blood from the plastic container.

An Acceptable Pilot Tube

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The term pilot tube is used to indicate any receptacle accompanying a bottle of blood, holding a separate specimen of the blood within the bottle for use when matching against the potential recipients serum. It is generally accepted that sampling bottles to obtain specimens for matching, however carefully performed, will inevitably result in the introduction of some bacterial contamination. In Great Britain, for example, the Ministry of Health booklet Notes on Transfusion issued to hospital medical staff, states that bottles which have been opened, or punctured for sampling, if not given within 24 hours, should be labelled dangerous for patients and not used even if stored at 4°C since sampling. In such circumstances absence of a pilot tube must impose a considerable strain on the blood bank. Acknowledging the fears of those who object to pilot tubes on the grounds that they are not an integral part of the blood bottles, and that some change over may occur, we nevertheless believe that these difficulties can be overcome.

It is essential that any pilot tube provided must be filled at the time of the blood donation. The practice of preparing pilot tubes by subsequent sampling of the bottles is to be condemned for the possibilities of contamination and clerical error. We have not been able to develop a pilot tube actually moulded into the structure of the bottle for both financial and technical reasons. Apart from the cost of such bottles, the design offers great difficulties. The pilot tube must be so placed as to be readily accessible for sampling without disturbing the sedimented cells in the parent bottle. A tube placed in the base of the bottle, for example, is
impracticable, and the space available in the neck is so limited as to suggest an alternative site if possible (fig. 1).

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To overcome these difficulties, a pilot tube has been developed in the shape of a 4 ml capacity bottle a screw threaded neck, closed by a metal cap, having a central hole beneath which lies a self-sealing rubber closure. The rounded base of the bottle gives it strength, and as it will not stand on a flat surface, acts as a deterrent to removal. The attachment to the parent bottle consists of a flanged aluminium strip perforated by two holes of such diameter as to allow passage over the screw threads of both bottles, but no further. Screwing the caps home firmly unites both bottles. Anticoagulant is introduced and the apparatus assembled as shown here prior to sterilisation. Even if the screw cap of the pilot tube is removed it remains in place and cannot be withdrawn due to the shoulder of the parent bottle. A label for this pilot tube is superfluous and is deliberately omitted. After filling, the complete assembly is sealed with a hard-setting transparent viscose cap. Experience has proved that these steps are adequate to indicate to technologists (and even to our medical colleagues), that the pilot tube is to be left undisturbed. Its position in no way interferes with the subsequent administration of the blood. These precautions are pointless unless there is absolute certainty that the blood in the bottle and pilot tube issued to the hospital, and that in the sample vial tested by the Transfusion Service, is inevitably from the same donor, and that donor alone (fig. 2.)

Our current method of doing this was not developed until we had been collecting some hundreds of bottles of blood every week for more than ten years. Many more than 200,000 donations have since been taken by this technique without a known discrepancy between the blood in the bottle and pilot tube. It is surprising that it was not thought of before.

With the apparatus shown here blood is collected from the donor by gravity, aided by light cuff pressure round the upper arm. When the bottle is full the delivery tube is clipped about 4" above the bottle cap at the same time as the cuff pressure is released (fig. 3). The taking needle is removed from the donors arm and immediately inserted through the rubber wad sealing the sample vial which accompanies the bottle, and which has been labelled during donation with the same serial number and details as those shown on the bottle label (fig. 4). Immediately after this the needle which has delivered the blood is withdrawn from the self-sealing bottle closure and at once thrust through the closure on the pilot tube. From this moment on no cross-over or other sampling error is possible, the sample vial and pilot tube being filled in closed circuit with the blood from the tube. At this stage the blood bottle may safely be handed to another person or mixed with other freshly taken bottles. The pilot tube is vacuumised in the course
of preparation before sterilisation. It fills, upon releasing the clip on the tube, the residue of the blood in the tube then being drained into the sample vial for test by the Transfusion Service.

The operation is fool-proof and takes only a few seconds. The completed product is shown in this picture (fig. 5).

It remains to ensure that pilot tube blood samples are acceptable from the point of view of serological results.

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Our technical standards for pilot tubes demand:

2. That during the normal storage life of the blood, the serological reactions of the A, B and Rhesus antigens shall be comparable with those of the cells in the bottle.
3. That under normal conditions of storage the contents should not undergo appreciable haemolysis within 28 days of collection.
4. That random samples taken during the normal storage life shall be free from panagglutinability or pseudo-agglutination (rouleaux) due to the method of preparation of the pilot tube sample.

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It is understood that the pilot tubes are sampled by syringe and needle using an aseptic technique. With the double purpose of preservation and reproducing as closely as possible the conditions existing within the blood bottle, 1 ml of standard acid-citrate-dextrose anticoagulant is introduced into each pilot tube when assembling the apparatus before sterilisation. Time will not permit a full demonstration of the work which has been done, but we now have practical experience of some ten years working with an A.C.D. blood pilot tube mixture. Repeated investigations over the years by different workers have given consistent evidence that such samples satisfy our technical requirements. Serial testing of samples at 7-day intervals from the 1st to 29th day after collection by saline, albumin and antihuman globulin methods, using weak antisera designed to represent a potential recipients serum, have given comparable and reproducible results in our laboratory. The same tests have been applied
to the pilot tubes of unused and time expired blood which has been returned from hospital blood banks. Although in fact most of the 40 hospitals to which we routinely supply blood prefer to wash the pilot tube cells once before testing, this is really only necessary when using the antihuman globulin technique. We have not found it necessary to introduce any form of antiseptic into the pilot tube. Comparative studies with certain antiseptics added have been performed but no advantage from these could be demonstrated. There was even in fact a suggestion that, for example, sodium azide as a preservative not only discolours the sample but has some slight inhibitory effect on the agglutination potential of certain cells.

My colleagues at the Leeds Centre of the British National Service investigating this matter with us some years ago tested 2,961 time-expired blood A.C.D. pilot tube specimens returned to their laboratory. All gave satisfactory agglutination results. Culture for 5 days at room temperature and 37 C revealed 4 contaminated samples. Subsequent investigation revealed that all 4 had been improperly used in one particular hospital laboratory, the same contaminating staphylococcus albus being common to all.

On these grounds, we consider that a pilot tube containing a mixture of A.C.D. solution and blood, designed and filled as here described, forms a safe, reliable and therefore acceptable pilot tube.