Simon

1: Helium at about 100 atm
high-pressure valve, *G*. *E* con-
was used to transmit to the
essure pump, *F*. Details of the
n a recent paper (Holland *et al.*

the helium was transmitted to
apillary tube of 18/8 austenitic

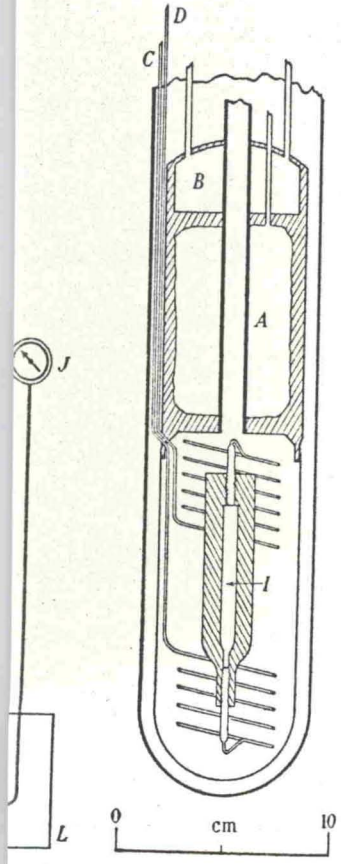

FIGURE 2. The calorimeter and cryostat.

a second high-pressure valve
ty, could be isolated from the

her end of the calorimeter to
n the pump, *K*, could be used
o the calorimeter. The gauge,
vas very small.
figure 2. *A* is the expansion
mber. The calorimeter *I* is

suspended in a vacuum chamber attached to *A*, while outside this and enclosing both *A* and *B* is a second vacuum space. Exchange gas could be introduced into either vacuum space.

The calorimeter was made from a solid cylinder of 'Vibrac' steel (diameter 2·1 cm and length 12 cm) in which was drilled an axial hole of 0·7 cm diameter to within 1·8 cm of the end. The open end was then swaged down for a length of about 2 cm until the inner diameter of this part was reduced to less than 1·5 mm. Both ends were then drilled and tapped to receive the capillary tubes. The volume of the calorimeter at room temperature, after having been tested to 4000 atm pressure was 2·69 cm^3 as determined by filling with mercury. Over the greater part of their length the dimensions of the capillaries leading to the calorimeter were: outer diameter 1 mm and inner diameter approximately 0·1 mm. At about 2 cm from the calorimeter the outer diameter increased to 2·5 mm and the inner to about 0·5 mm. The wider part of the capillary could then be threaded and hard-soldered into the calorimeter. (These 'pipette' type tubes were originally developed for the experiments on the melting curve of helium of Holland *et al.* 1951.)

Although this is not shown in the figure, the capillaries *C* and *D* were soldered in half-loops to the sides of the expansion chamber. The length of each capillary touching the walls of the chamber was about 15 cm, and good thermal contact was thus assured. This was essential not only for the purpose of reducing heat flow along the capillaries to the calorimeter from the external hydrogen bath but also because these half-loops in the capillaries were used to 'freeze off' the helium in the calorimeter and had therefore to attain the temperature of the helium chamber to be effective. Provided that the pressure in the helium was always maintained at a value higher than the freezing pressure corresponding to the temperature of the chamber, solid helium remained in the capillaries and held the helium in the calorimeter accurately at constant volume.

Around the calorimeter a jacket of 0·25 mm copper foil was soldered in order to reduce the time of reaching temperature equilibrium after an application of heat during an experiment. On top of this were wound the resistance thermometer and the heater.

The resistance thermometer was of 47 s.w.g. constantan (490 ohms at the hydrogen boiling-point) fastened around the outside of the calorimeter in a zigzag path parallel to the axis to avoid any strain on the wire due to pressure inside the calorimeter. The thermometer was calibrated against the vapour pressure of hydrogen in the range of temperatures between 14 and 27° K. In the helium region it was calibrated against the vapour pressure of helium, and the calibration in the intervening region was obtained by interpolation on the basis of the known behaviour of samples of the same constantan wire.

The heater (approximately 800 ohms) was also of constantan. It was fitted with extra leads so that the potential could be measured directly. The time of each heating period was determined by a stop-watch (calibrated against a crystal-controlled clock) which was automatically operated in synchronism with the current switch.