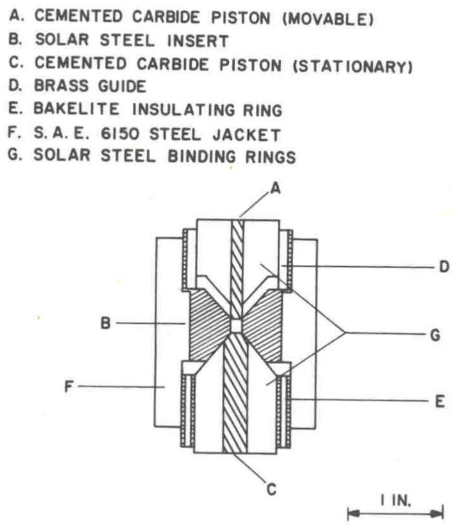

Fig. 2 Cross-section of high-pressure cell

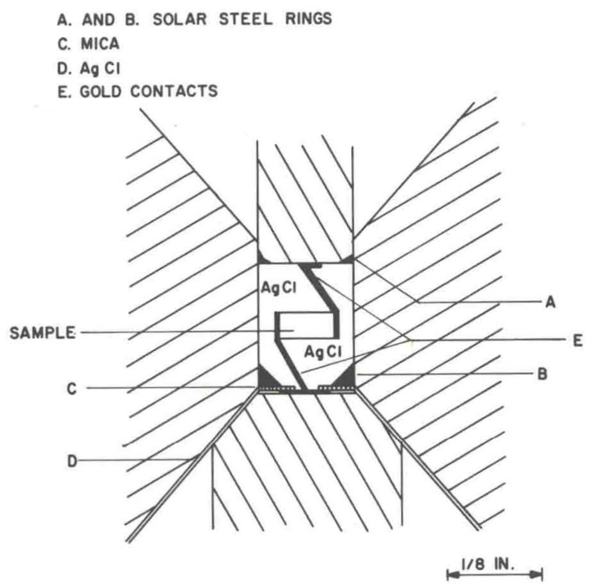

Fig. 3 Detailed drawing of sample chamber

The method of measurement is quite straightforward. An X-Y recorder is used, with pressure plotted on the X-axis and resistance on the Y-axis. The pressure is converted to an electrical signal by a strain-gage transducer mounted in the oil reservoir supplying the ram. In a typical run, the change of resistance at some fixed temperature is plotted as the pressure is first increased to a point above the bismuth I - II - III transitions, and then decreased until the transitions reappear in reverse order. The resulting curve is thus a loop, and the assumption is made that the transition pressures observed on the "up" and "down" curves may be averaged to yield the true transition pressure. At room temperature

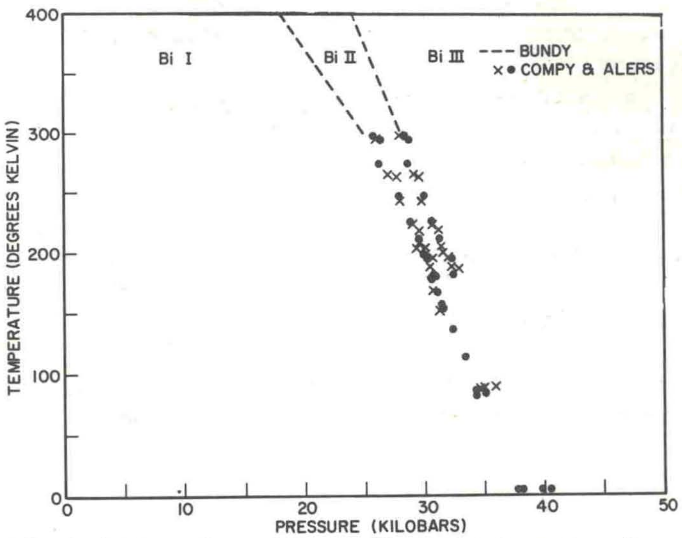

Fig. 4 Data on phase changes of bismuth taking place from zero to 40 kilobars in the 4.2 K to 300 K temperature range

such a procedure yields a Bi I - II transition which runs 2 - 5 percent high, and a Bi II - III transition about 6 - 8 percent high, when compared with the results of Kennedy and La Mori (7). A thermocouple, attached to the tension member as near as possible to the pressure cell, is used to monitor temperatures down to the boiling point of liquid nitrogen, and a carbon resistor is used to measure temperature in the liquid-helium range.

Because of the massive construction of the cell, some 15 liters of liquid helium are required to cool the apparatus from 77 to 4.2K, but the rate of helium boiloff is quite moderate: about 500 cc of liquid per hr.

PRELIMINARY RESULTS

To demonstrate the operation of this equipment, we have accumulated data on the bismuth transitions below room temperature. We are thus in a position to suggest the form of the phase diagram of bismuth from 300 to 4.2K and zero to 40 kilobars, complementing the work of Bundy (8) at higher temperatures and pressures. The data are shown in Fig. 4. The point at which Bi II disappears seems to be in the neighborhood of 180K, but our measurements are not refined enough to show the shape of the phase boundaries at this point.

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