TABLE I

SUMMARY OF AVAILABLE OPTICAL HIGH-PRESSURE CELLS

Type of cell	Pressures (kbar)	Advantages	Disadvantages
Shock wave	1000	1. Highest obtainable pressures	1. Pressure exerted over short time
			2. Explosives needed to give shock wave
Piston and cylinder	200	1. Largest specimen volumes	1. Not enough optical clarity to permit optical observation or photography
		2. Considered to give hydrostatic pressures	2. Specimen may interact with salt matrix
			3. Must be calibrated with respect to pressures measured in a different type of cell
Opposed anvils (diamonds)	200	1. Only micro quantities of material necessary	1. Pressure gradient exists
		2. Compact—can be used with spectrophotometers	2. Absorption of diamonds from 4 to 6 μ

200-μ region, and involves the use of a Perkin-Elmer Model No. 301 double-beam grating spectrophotometer (used in double-beam operation), a $6\times$ beam condenser, and the high-pressure diamond cell manufactured by High Pressure Diamond Optics, Inc., McLean, Virginia. Certain modifications were necessary. The size of the ellipsoid mirrors on the beam condenser had to be reduced to accept the diamond cell. To allow for easy alignment of the cell, a machine lathe micrometer attachment was added to give movement in the x, y, z directions. To allow for more energy for operation below 100 μ, larger diamonds ($\sim$0.8-mm^2 area) were used, although above 100 μ, diamonds of 0.25 mm^2 can be used.* An expansion scale was also built into the No. 301 spectrophotometer to amplify weak vibrations. This allowed for less

* For operation to 200 μ with a grating spectrophotometer, the cost of a beam condenser and the diamond cell is about $7000 (price based on conditions existing in 1969).

TABLE II

HIGH-PRESSURE APPARATUS CURRENTLY USED FOR LOW-FREQUENCY STUDIES

Workers	Spectrophotometer or interferometer	Wavelength range (μ)	Optical cell[b]
Weir *et al.* (*3–5*)	Perkin-Elmer No. 621	2–35	Diamond anvil
Jacobsen and Brasch (*21, 22*)	Perkin-Elmer No. 521[a]	2–35	Diamond anvil
Ferraro *et al.* (*6, 7*)	Perkin-Elmer No. 301[a]	16–200	Diamond anvil
	Beckman IR-11[a]	16–200	Diamond anvil
	Beckman IR-12[a]	2–40	Diamond anvil
McDevitt *et al.* (*9*)	FS-520 interferometer	to 250	Diamond anvil
Bradley *et al.* (*8*)	Michelson interferometer	50–1000	Anvil, quartz window
Sherman (*11*)	University laboratory spectrophotometer	25	Piston–cylinder, sapphire, MgO, or fused silica window

[a] With 6× beam condenser.
[b] For a new cell using quartz windows see R. P. Lowndes, *Phys. Rev. B* **1**, 2754 (1970).

compensation in the reference beam and the use of narrower slits. A microscope is absolutely essential in all pressure work to determine whether one has a good solid load between the diamonds and if a phase transition is occurring.

In the interferometer tieup with the diamond cell, a brass cone light pipe is used (angle 9°37′) (*9*). Infrared radiation comes out of the instrument and enters this cone. The cone bends the radiation toward the small opening (0.060-in.) in the other end and is machined to accept the diamond cell piston. The energy then passes through the diamonds and enters the detector by means of another light pipe.

C. Calibration of Diamond Cell

It has already been indicated that a pressure gradient exists in the multiple-anvil diamond cell. Duecker and Lippincott (*23*) have demonstrated that in compressible solids the pressure gradient is parabolic across the diamond face, pressures in the center reaching 1.5 times those on the edges. Thus, any measure of pressure in the contact area of the diamond gives only an average pressure.

There are several ways to make a pressure calibration of the cell. These are as follows: