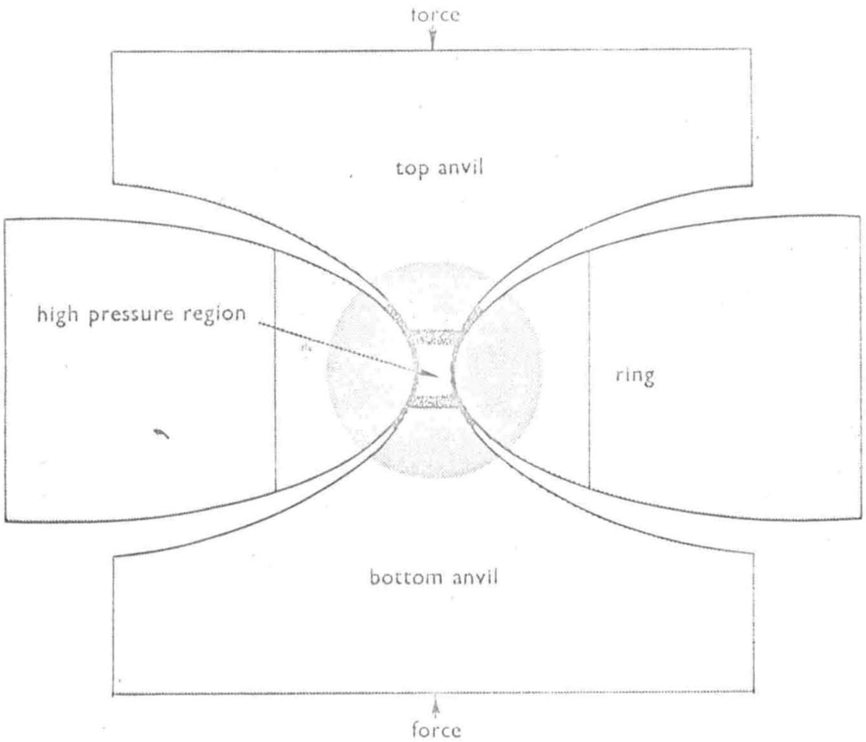

Fig 3 Hybrid apparatus is an advanced type of piston and cylinder. Pistons have become blunt cones or anvils which push into a contoured ring. Working volume is contained by a seal of pyrophyllite. Tensile forces are largely confined to outer parts of apparatus and pressures of 120,000 atmospheres can be reached

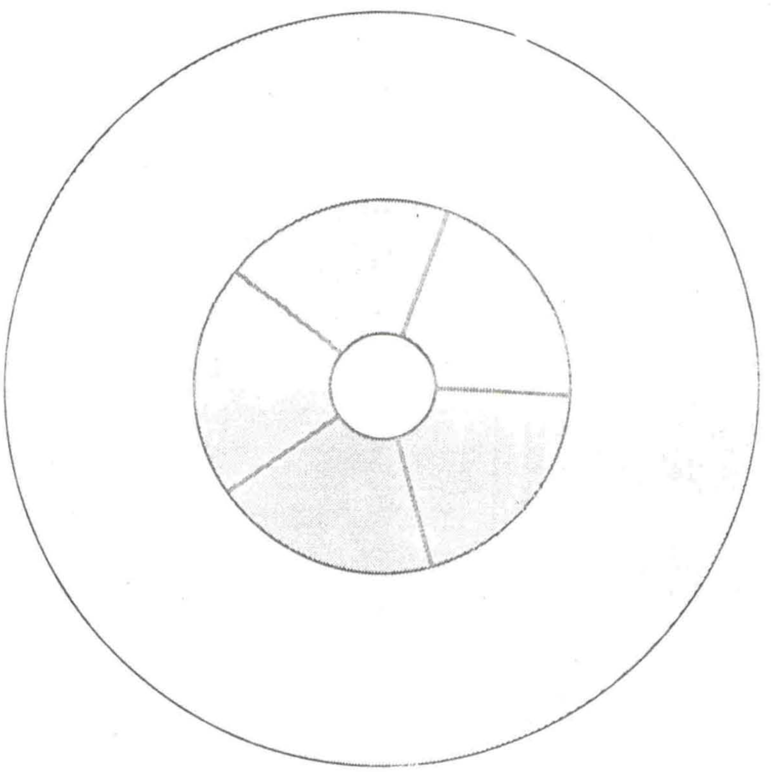

Fig 4 Cylinder apparatus consists essentially of two components: an inner ring which is split into several pieces, and an outer ring. Pressure in the bore results in compressive forces mainly in the inner ring, tensile forces in outer

specimen contained within the tetrahedron in much the same way as would a liquid. Here again forces in the anvil faces are primarily compressive, and large stress differences are transferred to the thicker sections behind. The practical pressure limit is just under 100,000 atmospheres, but this apparatus is simple and cheap to build.

The tetrahedral apparatus is essentially a high-pressure sphere with radial cuts in it to reduce hoop stresses near the high-pressure chamber. A cylinder can be constructed on the same principle with two basic components, an inner ring which is split into several pieces and an outer ring (*see Fig. 4*). Pressure in the bore results in mainly compressive stress in the inner ring and the outer ring carries the extra tensile hoop stress resulting from this arrangement. Designs of this type are being investigated in several laboratories, including our own.

Producing high temperatures

The generation of high temperatures is, by contrast, a relatively simple matter. The specimen is heated by passing a large electrical current through a tube of graphite or metal which surrounds it, and temperatures in the range of 2,000 to 3,000°C are easily reached. However, an excessive rise in anvil or ring temperature will produce a loss of mechanical strength. To avoid this, part of the working volume must be sacrificed to provide thermal insulation. Fortunately relatively thin insulation usually suffices since the massive mechanical support in the high-pressure chamber provides an excellent means of escape for the heat. This is just as well, since high-pressure apparatus tends to have rather small working volumes. The heated specimens in one tetrahedral apparatus we use are only about a tenth of an inch in diameter and a quarter of an inch long.

Future trends

So far most research in high-pressure chemistry has attempted to explain either the formation of natural minerals or the behaviour of materials deep beneath the Earth's crust. As very high-pressure apparatus becomes more readily available, interest will undoubtedly shift into other fields of chemistry.

Rumours of diamond synthesis in 'quart-size' high-pressure chambers probably herald future trends. Such