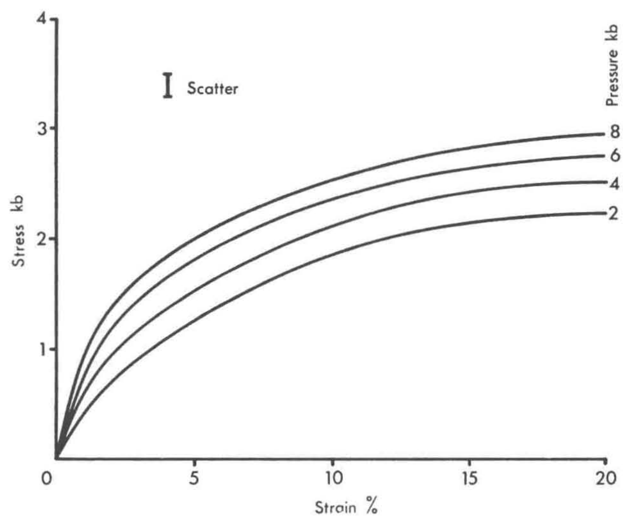

Fig. 9. Stress-strain curves for boron nitride at room temperature and confining pressures shown

5. Boron Nitride

Here also the specimens deformed uniformly and the stress-strain curves (Fig. 9) showed marked work hardening at all pressures from 2 to 8 kb. Compared to talc, the boron nitride is weaker at strains below 5 percent but of similar strength at larger strains. In other orientations, however, somewhat different strength may be expected because of the preferred orientation of the grains.

6. Graphite

The stress-strain properties of graphite under pressure show a number of peculiarities (Fig. 10). There is no obvious elastic range or yield point in the stress-strain curves at any confining pressure from 1 to 8 kb. Also, an extraordinary degree of reversibility appears in the strain, the specimens returning approximately to their original dimensions upon release of both differential stress and confining pressure even though strains of 20 percent shortening had been reached at high pressure. Thus, length measurements using the technique of Paterson (1963) on a specimen of similar graphite showed the following sequence of length changes: applying the confining pressure of 4 kb caused an initial shortening of 3.5 percent; after 20 percent further shortening at 4 kb as a result of applying differential load, removal of the differential load was accompanied by a length recovery of 7.5 percent; finally, the length recovered a further 14 percent during release of the confining pressure, resulting in the final specimen length being only slightly less than the initial. Other specimens deformed 20 percent at 2 to 8 kb confining pressure gave similar recoveries on release of pressure. Similar changes occur in the volume; these and their interpretation are discussed elsewhere (Edmond and Paterson, 1971 a and 1971 b).

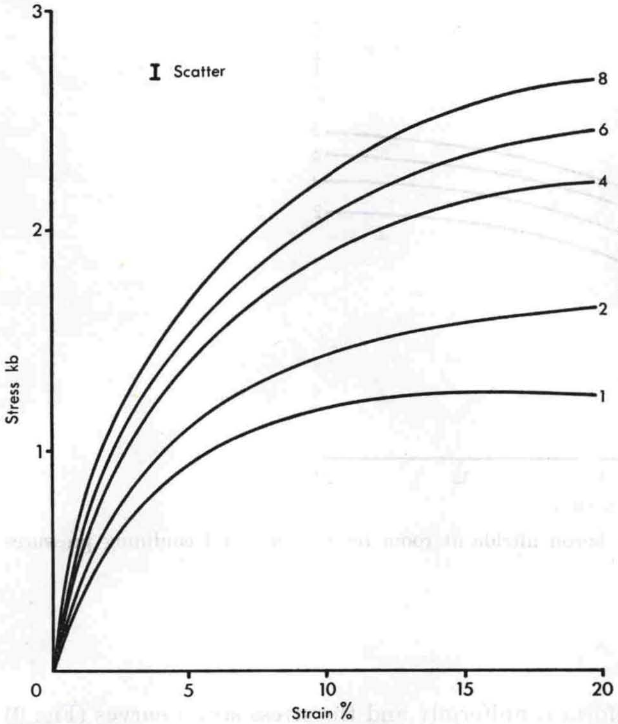

Fig. 10. Stress-strain curves for graphite at room temperature and confining pressures shown

Discussion

It is seen that, even at room temperature, all the materials tested can undergo substantial permanent deformation when subjected to differential stress under moderate confining pressures. However, there are considerable differences in the amount of stress needed and in the influence of confining pressure on it. Thus, at 8 kb confining pressure, the strongest material, pyrophyllite, will support differential stresses an order of magnitude higher than will silver chloride, and the effect of pressure on the flow stress is also an order of magnitude gigher.

The differences in pressure sensitivity of the flow stress probably reflect differences in deformation mechanism. For a polycrystalline body to deform uniformly by crystallographic slip in its grains, five independent slip systems are required (von Mises, 1928; Groves and Kelly, 1963; Paterson, 1969). This condition is satisfied in silver chloride which deforms by pencil glide in the [110] direction (Nye, 1949) and it is probably satisfied by sodium chloride through activity of (100) as well as the usual (110) slip planes under the constraint of the confining pressure. Then, the absence of a strong effect of pressure on the stress-strain curve in these materials can be attributed to their deforming entirely by slip in the grains, a process which is known normally to be only slightly affected by pressure.

On the other hand, talc, pyrophyllite, boron nitride and graphite have layer structures with strong bonding within the layers and slip can only be expected