The President then introduced the first speaker of the evening, Professor Laurie Lawrence who was to speak on:-

'Galena under stress'

Professor Lawrence commenced his talk by referring to people being under stress when they may experience strain and may even suffer collapse. In a sense the same process may happen to minerals and the speaker intended to use the particular example of galena to illustrate this. He apologised for reading out his talk from prepared notes which are reproduced as follows.

Minerals are deposited under a certain pressure-temperature regime but may be subjected to a renewed pressure-temperature elevation aeons of time later. Faulting, folding or metamorphic events may impose renewed pressure at elevated temperatures on a mineral deposit long after its formation. Such force may be compressive, tensional or shear, leading to stress in the mineral grains. This stress increases the free-energy of the grains and may distort the crystal lattice leading to strain, (stress gives rise to strain). The excess free energy can be utilized in restoring grain equilibrium; the processes by which this is done are broadly known as annealing.

The crystal lattice of a mineral will accommodate an imposed force, up to a point, providing the mineral's strain-rate is not exceeded whereupon fragmentation ensues.

Dissipation of free-energy takes place in a number of ways commencing with pressure twinning or, with the case of galena, slippage along the {100} or cube direction. If this is insufficient to restore equilibrium galena will undergo kinking or crenulation usually diagonal to the cube direction {111}; this is manifest as a folded or rippled surface.

The crystal lattice, here, develops a host of minute dislocations from which new sub-grains develop. The pattern shown by sub-grains resembles that of a jig-saw puzzle and is seen in polished section after etching with hydrogen bromide and lightly re-polishing.

In more advanced cases surface free-energy facilitates the growth of new strain-free grains. The ideal situation of minimal surface free-energy is possessed by spheres, (minimum surface area), but recrystallization cannot convert mineral grains into spheres; the pentagonal dodecahedron, as seen in garnet crystals, is the closest approximation. In polished sections this is seen as an array of six-sided grains with boundaries meeting in groups of three, (triple junctions), with angles mostly of 120^{o} between them. Strain is then eliminated and the mineral fully annealed or recrystallized.

The processes may be repeated if further force, at elevated temperature, is later applied. Some Broken Hill galena shows evidence of multiple deformation and annealing corresponding to different periods of tectonic movement, e.g. new re-crystallized grains overprinted by later sub-grains.

Laurie Lawrence November 2003

To illustrate his talk Professor Lawrence passed around a number of specimens of galena showing examples of the various stress, strain, crenullation and deformation features that he had been describing. He finally referred to a selection of slides further showing further examples of these features.