APPENDIX

APPENDIX A

ETCHING OF FLUORITE

Fluorite or Fluorspar is the only common fluoride occuring in nature. Chemically it is Calcium fluoride, having the formula CaF_2 (F = 48.9 per cent). Because it melts readily and is also used as a flux, Agricola in 1546 gave the mineral the name fluorite. It crystallizes in isometric system (hexoctahedral class), With structure as shown in fig. (i). The habit is practically always cubic, the other forms are subordinate. It is distinguished by the cubic crystals, the perfect octahedral cleavage and specific gravity which is a little higher than the average non-metallic minerals. On a cube the octahedral cleavage is shown as triangular faces at the vertices or at least as cracks in this direction (figure ii). The lines in the figure show cleavage directions. Optically it is isotropic.

Fluorite has various industrial uses. It is utilized in enameling iron for baths etc., in the manufacture of opaque and opalescent glasses, in the construction of lenses, for the production of hydrofluoric acid and as a flux in steel makings and for foundary work.

Fractographic stüdy of fluorspar is made by Zapffe (1947). The present author has done some work on cleavage surfaces from the point of view of matching. The crystals were cleaved along the (111) plane and after depositing silver film over the cleaved pair, they were studied for matching. When low powers are used there appears to be reasonable degree of correspondence on the matched regions. Figure (iii) x12 shows a photomicrograph of the crystal cleaved and etched by sulphuric acid. Between the major cleavage lines starting from an edge and turning on to a second edge of the crystal, there are very small secondary cleavages. On a closure inspection some differences on the cleaved counterparts are disclosed and the matching in some areas is not perfect. This inequality may be due to the possibility of small fragments falling out in the process of cleaving.

Etch figures on fluorite have been observed by many workers. Etch pits principally bounded by hll and hhe are obtained with the acid solvents and o k^1 from alkaline solvents. For literature, see Becke (1890); Bauhans and Goldschmidt (1918); Himmel (1930); Kleber (1932, 1934); Himmel & Kleber (1934, 1935).

Recently Bontinck and Amelinckx (1957) observed helical dislocations in fluorite crystals. Formation and properties of these dislocations are discussed by Amelincks et al (1957a). Bontinck (1957) studied the etch structure of cleavage (111) plane and helical dislocations in synthetic fluorite crystals. Calcium fluoride crystals annealed at high temperature were cleaved and etched by concentrated sulphuric acid. Double-rows of etch pits were observed. They were identified with the emergence points of the parts of helical dislocations obtained by cleaving through the halices. Peculiarities of helical dislocations, observations concerning rows of closed loops and special features were also discussed. Some more evidence in this connection is also gathered (Amelinckx 1957b).

Investigation on the etch phenomena on the natural fluorspar crystals by studying the etch figures produced by hydrochloric, sulphuric and nitric acids is undertaken in the present work. Report is already made on the preliminary study Pandya and Pandya (1958) of the etching of fluorite. Etching by these acids gives rise to scattered triangular pits which go on increasing in size with etching. No new pits were observed on the surface up to a particular etching time. Figures (iv a, b) x 360 show the matched regions on the fluorite crystal. The triangular etch figures are oriented

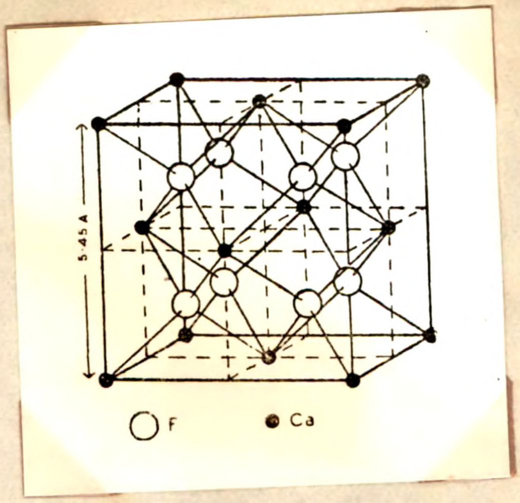


Fig (i)

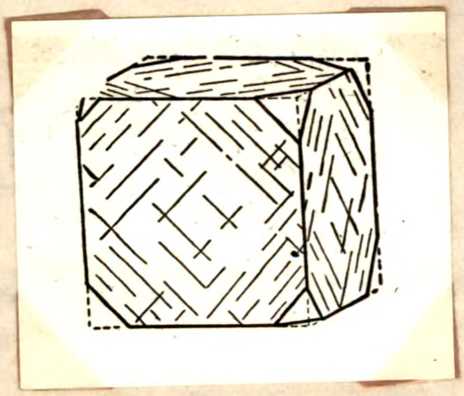
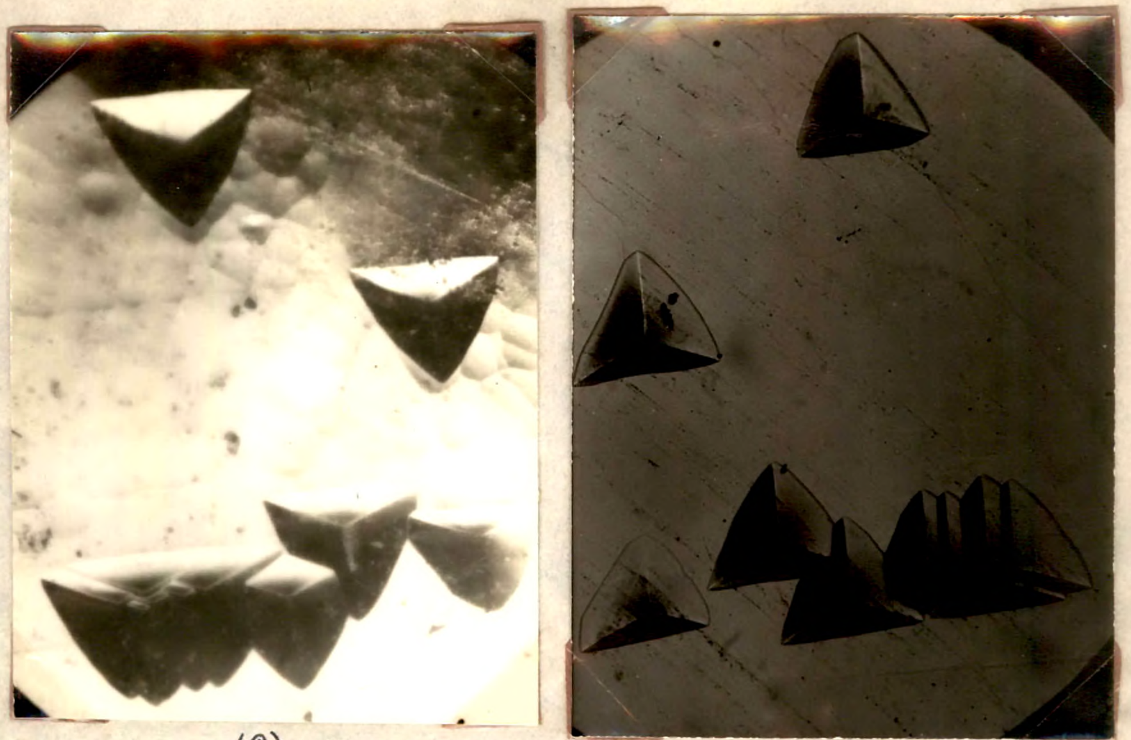


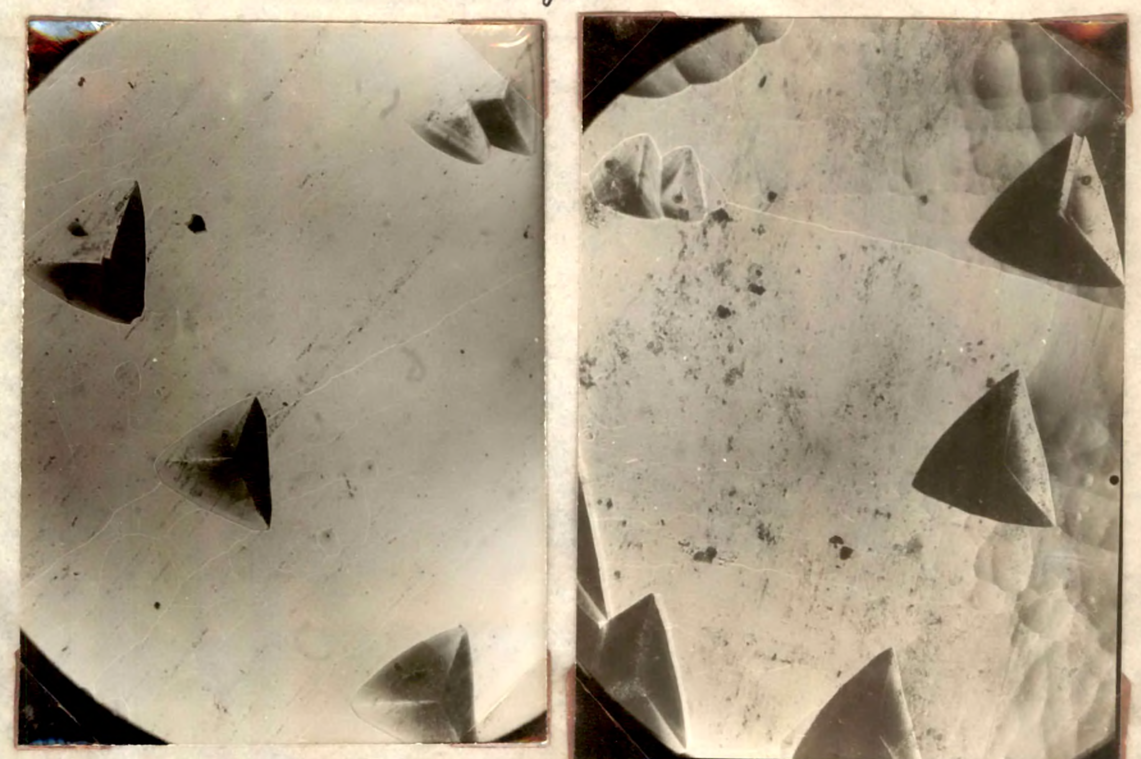
Fig (ii)

Fig (iii) x12



(a) (b)

Fig(IV) × 360



(a) (b)

Fig(V) × 360

(a) (b)

Fig(vi) x 360

(a) (b)

Fig(vii) x 360

differently and the beginning of the formation of block patterns and unequal sizes of etch pits due to unequal etching are also evident. Figures (v a,b) x 360 is another matched region of the cleaved crystal. The cleavage line which runs on a pit a in figure (va) is displaced considerably as shown in figure (vb) in which the same line passes on two small pits. This is expected as the cleavage lines on etching are known to move, as reported earlier on mica and calcite cleavages.

With the increasing etching, the pits begin to Coalesce and form the familiar block patterns figures (vi a,b) x 360 similar to these on diamond (Pandya and Tolansky 1954), and calcite crystals reported earlier in the present work.

Bending experiments were carried out to ascertain the origin of pits. In this experiment, one crystal was etched directly for a definite time (2 hours) and the counterpart was bent and then etched for the same period (2 hours). The counterparts were compared. The result is shown in the photomicrographs, figures (vii a,b) x 360. It shows the complete matching of the pits. From one such experiment no definite conclusion could be drawn.

The work was started on two small crystals of the form $\{001\}$ and $\{111\}$ with the expectation that few more crystals would be made available in future for the detailed study. As no more crystals could be secured, further work in this direction was left half way.