On Granite containing Andalusite from the Cheesewring, Cornwall.

By J. J. H. Teall, M.A., F.G.S.

[Read May 10th, 1887.]

THE granite of the Cheesewring Quarry is coarse grained and grey in colour. It is essentially composed of white felspar, quartz and two micas. Tourmaline occurs sparingly. The dominant felspar is orthoclase, frequently twinned on the Carlsbad plan. Crystalline form is not well developed. Under the microscope the individual grains do not, as a rule, give definite extinction. Different portions extinguish at slightly different angles. The arrangement of the different portions is often very irregular; sometimes, however, it gives rise to a striped structure, under crossed nicols, suggestive of micro-perthite; but in no case has a perfectly definite intergrowth of plagioclase and orthoclase been observed. Examined by Szabo's method the orthoclase is seen to be fairly rich in soda. A well striated plagioclase occurs in the rock, but is present in very small quantity. When it does occur it is often seen to be idiomorphic with respect to quartz.

Quartz occurs abundantly in the form of large grains and also as a fine-grained aggregate of irregular individuals. It occasionally shows traces of crystalline outline. The two micas occur in thin plates without any great regularity of form. The dark mica is very strongly dichroic. Sections at right-angles to the basal plane change from a pale brown, when the cleavage cracks lie at right-angles to the short axis of the polariser, to a deep reddish brown (almost black) when the cracks lie parallel to the short axis. This mica is distinctly biaxial, but with a small optic axial angle. It contains inclusions of apatite and zircon. The zircon inclusions are in all cases surrounded by a border in which the colouring matter of the mica has been heaped up as it were. The apatite inclusions, on the other hand, are not surrounded by such a border. It is quite clear that the zircon inclusions have exerted an influence on the distribution of colouring matter in the mica, which the apatite inclusions have not.

The light coloured mica is not, at any rate as a rule, absolutely colourless; at the same time the colour is so slight as to escape notice in thin sections. It is biaxial, with a much larger axial angle than the dark mica. Where zircon inclusions occur in the white mica they are surrounded

by a pleochroic border of about the same width as the corresponding border in the black micas, but not nearly so dense. In the black micas the border is often quite opaque; in the white micas it is faint, but distinct.

Brown tourmaline occurs sparingly and presents no features of special interest. Minute crystals and grains of zircon are fairly abundant. Apatite occurs sparingly. In two or three of the slides examined there occurs another mineral of considerable interest. It possesses a higher refractive power than quartz, but about the same double refractive power. It occurs in more or less elongated crystals which often show a decided approach to crystalline form. Longitudinal sections are more or less lath-shaped, and generally without definite terminations. Cleavage cracks run parallel with the length of the sections. The major axis of the ellipse of elasticity invariably lies parallel with the length of the section. Hence we may infer that the direction in which the crystals are elongated is coincident with the a axis of elasticity—in other words, with the negative bisectrix. The lath-shaped or longitudinal sections often show a marked pleochroism; α *red*, β and γ *colourless* in thin sections. This pleochroism is never distributed uniformly throughout any one individual, but is developed in an irregular or patchy manner. Sections more or less at right angles to the direction of elongation show that the crystals are bounded by two pairs of parallel faces. Cleavages parallel with these faces may sometimes be detected, and the extinction-positions bisect the angles formed by the faces.

All the characters above described point to the conclusion that we are here dealing with somewhat ill-developed crystals of andalusite. The faces in the prismatic zone are those of the form $\{110\}$. In one slide a section cut almost at right angles to an optic axis was observed. The form of the section was that of a somewhat imperfect lozenge, the acute angle of which measured 69°. Assuming the mineral to be andalusite, having an optic axial angle of 84° (true), then the acute angle made by the traces of the prism-faces on a plane at right angles to an optic axis would be 74°2′. The difference between the observed and calculated results may be accounted for by the fact that the section is not exactly at right angles to the optic axis.[1]

The andalusite appears to have as good a claim to be regarded as an original constituent as any other mineral occurring in the rock. It may

[1] The optic axial angle of andalusite varies from 83° to 85° according to Rosenbusch. In Brooke and Miller (New Edition, 1852, p. 285) the half-angle is given as 46° 13′. If we assume that the above section is exactly at right angles to an optic axis, then it follows that the half angle must be 47° 22′, a result which agrees very closely with the statement in Brooke and Miller.

be seen in contact with unaltered felspar, and small crystals occur also as inclusions in white mica. In two of the slides examined there are nests exceptionally rich in dark mica and tourmaline. They contain also andalusite, quartz and a colourless mineral occurring in minute acicular prisms. The prisms are aggregated in bundles and sheaves, and occur as inclusions in a mineral having the refractive and double-refractive power of quartz.[1] They give straight extinction, and the γ axis is coincident with the length. They are cross-jointed at irregular intervals, and give chromatic polarisation between crossed nicols. These characters point to sillimanite. It is somewhat curious that two forms of SiO_2 Al_2O_3 should be present in the same rock. The andalusite gives rise by alteration to aggregates of white mica. This secondary mica, developed at the expense of the andalusite, is readily distinguishable from the normal white mica of the rock. I am indebted to Mr. Butler for the specimens on which the observations contained in this paper are based.

[1] It is possible that cordierite may be present.