Note on garnet crystals from Cairnie, Aberdeenshire.

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IN 1938 large crystals of almandine garnet were collected by the writer from a cutting excavated during road-widening operations, on the main Huntly–Keith road, near Cairnie church, about 4½ miles from Huntly. In view of their exceptional size and excellent crystal form, it is felt that the occurrence is worth recording. Garnet crystals of comparable size have been recorded by Heddle[1] from several localities. The Cairnie crystals, considering their size and excellent form, must rank with the finest recorded from Scotland.

The rocks at this cutting are coarsely banded garnet-biotite-sillimanite-gneisses with abundant quartz, oligoclase, orthoclase, and biotite, subordinate muscovite, and accessory magnetite, apatite, and zircon. Sillimanite is sporadic in occurrence, forming elongated colourless prisms up to 2 mm. across. The biotite-rich bands generally contain only small garnets, if any, but garnet is very abundant in bands rich in quartz and felspars, and often forms a large part of the rock.

The garnets are wine-red to purplish-red in colour, and show the forms (110) and (211). The dodecahedron is usually the dominant form, and shows oscillatory combination with (211), giving a series of stepped faces. Where the two forms are nearly equally developed, the crystals appear almost spherical, due to this oscillatory combination. A great many of the crystals are about ½ inch across, but several exceptionally large crystals, up to 2 inches across, of almost perfect proportions, have been found. For example, one dodecahedron found by the writer measures 1·88 inches along all three axial directions. Larger crystals have been found, but are more irregular, and are generally made up of various units in parallel growth.

A chemical analysis of a purplish garnet from this locality was made by the writer and is given below. The analysed material was carefully purified by hand-picking and centrifuging with heavy liquids.

[1] M. F. Heddle, Trans. Roy. Soc. Edinburgh, 1878, vol. 28, pp. 299–319. The mineralogy of Scotland, Edinburgh, 1901, vol. 2, p. 48. [Min. Mag. **2**–230, **13**–194.]

	Weight %.	Molecular ratios.		No. of metal atoms to 12 oxygens.	
SiO_2	36·59	0·6092	Si ...	2·888	2·987
TiO_2	1·68	0·0210	Ti ...	0·099	
Al_2O_3	22·42	0·2199	Al ...	2·084	2·087
Fe_2O_3	0·04	0·0003	Fe''' ...	0·003	
FeO	32·11	0·4470	Fe'' ...	2·119	2·896
MnO	1·42	0·0200	Mn ...	0·095	
MgO	5·41	0·1342	Mg ...	0·636	
CaO	0·54	0·0096	Ca ...	0·046	
	100·21		O ...	12·000	

Sp. gr. 4·09. n 1·804±0·002. Almandine 76·47, pyrope 18·58, spessartine 3·42, grossular 1·35, andradite 0·18.

The crystals are usually covered with a thin sheath of chlorite, and are sometimes crowded with inclusions of quartz, felspar, and magnetite, which show no definite arrangement. They generally show a conspicuous parting, along which films of chlorite are often developed, and they break along this parting with curved and somewhat irregular surfaces. The parting does not appear to be parallel to any constant crystallographic direction, but rather to be related to some structural direction in the rock. In groups of crystals embedded in different orientations in the rock, the partings are approximately parallel to each other. Harker[1] has commented on similar partings in garnets of regionally metamorphosed rocks, and states that they are developed at right angles to the direction of maximum relative tension. At Cairnie they cut the planes of schistosity and gneissic banding at fairly low angles (about 15–30°). The sheaths of chlorite surrounding the crystals and the films of chlorite along the parting planes were probably formed by retrograde changes during the decline of the regional metamorphism of these rocks. The garnet partings were presumably formed before the chlorite or at about the same time, when the temperature had become sufficiently low to prevent their healing by recrystallization. One would expect the parting planes to cut the plane of schistosity at angles of 45° or greater, if the direction of maximum pressure were normal to the schistosity. As in this case they cut the planes of schistosity at low angles, it is possible that they are due to renewal of stresses at a relatively low temperature, in rather different directions to the stresses responsible for the main regional metamorphism. The fissuring of the garnets might bear a definite relationship to the new directions of stress, while the matrix might yield by rearrangement along its original planes of schistosity and not show any obvious effects of the change in stress directions.

[1] A. Harker, Metamorphism. London, 1939, pp. 356, 195.