

An occurrence of harmotome in north-west Ross-shire.

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THE minerals to be described were found by Dr. Duncan M. Morison, of Edinburgh, and the writer in a small quarry having a national grid reference of 29/076184, which is at present being excavated for road surfacing material. The quarry is situated on the east side of the coast road between Lochinver and Ullapool at a point $\frac{1}{4}$ mile south-west of the southern margin of Loch an Arhair (called Loch a' Choin on early editions of the Ordnance Survey sheet 101) and $\frac{3}{4}$ mile south-west of the bridge carrying the Lochinver-Ullapool road over the river Kirkaig, the course of which here marks the boundary between the counties of Sutherland and Ross.

The quarry has been excavated along the outcrop of a fault, having a NE.-SW. strike, within the Lewisian of the foreland area which is here made up of felspathic and hornblendic gneisses. Within the quarry gneiss, undisturbed by faulting, is exposed, but the principal rock type is a slickensided and mineralized fault breccia. The rock outcropping at the north-eastern margin of the brecciated zone might be termed a concussion breccia, the angular and broken fragments having moved so little in relation to one another that the position which they must have occupied in the country-rock before it was fragmented may still be easily discerned. Towards the centre of the breccia, where mineralization is heaviest, movement has taken place, and fragments of several rock types may be found in a single hand-specimen. The outcrop of the fault breccia appears to be limited to the confines of the quarry.

The most abundant mineral forming the binding material of the breccia is haematite, which is largely earthy and amorphous; in cavities and fissures, however, it has developed characteristic mamillated surfaces. Calcite is fairly abundant as a vein-stuff and in cavities has developed prismatic crystals of 'nail-head' variety. Crystalline baryte occurs in veins through the breccia, and in cracks and cavities assumes the cockscomb habit. It is commonly reddish in colour, due probably to iron staining, and minute haematite crystals developed on the cockscomb surfaces may mask the true form and colour.

Small and unweathered harmotome crystals are found coating the vein-stuff in cracks and cavities throughout the breccia, although these occurrences are not abundant. The crystals (S.M.C. 442/36-43)¹ which are found emplaced on the vein-stuff are unweathered, water-clear, colourless, and lustrous, the largest examples being some 6 millimetres in length, although most of the crystals are little more than half that size.

All the harmotome crystals exhibit characteristic cruciform penetration twinning. Crystal faces observed are (100), (110), (010), and (001). The appearance of the crystals varies slightly depending on the relative development of the faces; typically, however, the (100) face is much better developed than (110) which is usually small, and the re-entrant angle (001) is poorly developed. Striations were seen on the (100) faces parallel to the edge between (100) and (010) and that between (100) and (001); and on the (010) face parallel to the edges between the (010) face and the bounding (110) faces, the striae meeting on the central line and so forming a herring-bone pattern.

Specific gravity 2.44. Refractive indices: α 1.508, γ 1.514, $\gamma - \alpha$ 0.006 (Na).

In 1888 A. M. Lévy and A. Lacroix² determined the refractive indices of a harmotome crystal from Strontian, Argyllshire, as α 1.503, β 1.506(?), γ 1.508; values which appear to have been accepted by most later workers. Since the indices determined for the Ross-shire specimens were at variance with the findings of Lévy and Lacroix it was thought desirable to redetermine the refractive indices of crystals from the better known Scottish localities. Specimens were therefore examined from the Strontian area (Corrantee, Middleshope, Whitesmith, Bells-grove, and Fee Donald or Feith Dhomhail) and from Bowling, Dumbartonshire, and it was found that, with little variation, the indices were in agreement with those of the Ross-shire specimens α 1.508, γ 1.514. It is of interest to recall here, however, that the refractive indices determined for harmotome from Glen Riddle, Delaware Co., Pennsylvania, were³ α 1.506, β 1.509, γ 1.514.

X-ray powder photographs obtained from small fragments of the Ross-shire specimens, and examples from Whitesmith, Strontian (S.M.C. 442/16); Bowling, Dumbartonshire (S.M.C. 442/10); and Glen Arbuck, Dumbartonshire (S.M.C. 442/18) are identical and appear to be in fair

¹ Numbers in parentheses refer to registered numbers in the Scottish Mineral Collection of the Royal Scottish Museum.

² A. M. Lévy and A. Lacroix, *Les minéraux des roches*. Paris, 1888. p. 309.

³ A. E. Meier, *Amer. Min.*, 1939, vol. 24, p. 555. [M.A. 8-298.]

agreement with the spacings in Ångström units for harmotome from Uganda published by Bannister and Hey (table I).

TABLE I. X-ray powder data for harmotome from Ross-shire and Uganda.

Ross-shire. ¹		Bannister and Hey. ²		Ross-shire. ¹		Bannister and Hey. ²	
<i>d.</i>	Int.	<i>d.</i>	Int.	<i>d.</i>	Int.	<i>d.</i>	Int.
8.24 Å.	s	8.11 Å.	s	2.13 Å.	m	2.16 Å.	m
7.17	s	7.16	s	2.04	m	2.03	w
6.26	s	6.25	s	1.94	s	1.95	m
4.94	m	4.96	m	1.88	vw	1.91	vw
4.26	w	—	—	1.82)	b w	1.84	w
4.03	s	4.07	s	1.80)		1.80	w
3.87	mw	3.50	m	1.75	mw	1.74	w
3.20	s	3.18	s	1.72)	b ms	1.72	ms
3.06	s	—	—	1.69)		1.68	w
2.88	mw	2.93	w	1.52	m	1.54	m
2.71	s	2.69	s	1.47	w	1.48	m
2.62	s	—	—	1.43	vw	—	—
2.51	m	2.52	m	1.36	w	1.37	w
2.45	vw	—	—	1.32	w	1.33	w
2.35	m	2.34	m	—	—	1.26	w
2.29	m	—	—	—	—	1.17	vw
2.23	w	2.25	w	—	—	—	—

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¹ University of Leeds, Department of Geology, Film number P.2988.

² F. A. Bannister and M. H. Hey, *Min. Mag.*, 1942, vol. 26, p. 224.