Notes on the occurrence of zeolites in Cornwall and Devon.

By Arthur Russell.

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IN the present notes the writer has endeavoured to collect all the available facts concerning the occurrence of zeolites in both Cornwall and Devon. Specimens belonging to this group are rarely represented in collections of Cornish minerals, and as several new localities have recently come to light, the following observations will, he ventures to hope, be of some interest as adding to the already lengthy list of mineral species occurring in the West of England.

Heulandite.

Wheal Forest, Okehampton, Devon.—During the summer of 1906, while mineral-collecting in the neighbourhood of Okehampton, Devon, I visited some small abandoned mine-workings named Wheal Forest, situated in Meldon Gorge, on the right bank of the West Okement River, about half a mile up from the viaduct. On the old burrows, in addition to some large and excellent crystals of axinite and garnet, I obtained several specimens of an unrecognized crystallized mineral. On my submitting the specimens to Mr. L. J. Spencer, he very kindly measured a crystal and showed the mineral to be heulandite, this being the first record of its occurrence in England.

On five of the specimens, which were all broken from one large mass, the heulandite presents itself as a thin crust of somewhat confused pearly crystals upon a peculiar, pale yellowish-brown rock, sections of which were examined and found to consist almost entirely of a plagioclase-felspar near oligoclase, with here and there small colourless prisms of apatite. On another of the specimens the heulandite forms druses of sharp and brilliant crystals, occupying cavities in the above-mentioned rock, the largest crystal noted being about 2 mm. in length. On a third specimen the heulandite occurs in very minute crystals forming a drusy crust on small crystals of quartz and pink orthoclase, associated with some mispickel.

The crystals are flattened parallel to the face *b* (010) and possess the characteristic pearly lustre. The face *c* (001) is usually uppermost. The following forms were observed *b* {010}; *c* {001}; *m* {110}; *t* {201}; *s* {$\bar{2}$01} (fig. 1). The specific gravity = 2·16.

According to an old mining directory, Wheal Forest was worked for copper, tin, lead, and arsenical pyrites about the year 1870.[1] Judging, however, from the small size of the burrows, very little work can have been done there. The mine is situated practically on the line of contact between the great granite boss of Dartmoor and the shales of the Culm-measures, and as in all other mines in the Okehampton district, the occurrence of axinite and garnet is attributable to powerful metamorphic agencies, evidence of which is to be seen on all sides. The heulandite is evidently of secondary origin and possibly derived from the associated and more or less altered plagioclase-felspar.

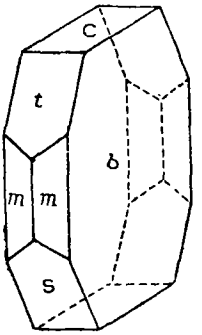

Fig. 1.—Crystal of Heulandite from Wheal Forest, Okehampton, Devon.

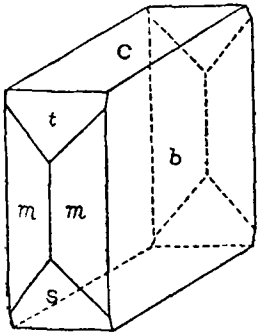

Fig. 2.—Crystal of Heulandite from Carrick Du mine, St. Ives, Cornwall.

Carrick Du mine, St. Ives, Cornwall.—During the summer of 1909 heulandite was found by the writer at the above locality. The mineral occurs in comparative abundance amongst the debris from an old shaft situated on the edge of the cliff, close to the footpath leading from St. Ives to Burthallan Cliff. The heulandite crystals form a crust, often covering considerable surfaces, on the joints of a greenish-grey, fine-grained, intrusive greenstone (diabase), a little foliated chlorite and also actinolite being present on some specimens. In one case the heulandite forms a coating on a mass consisting of quartz, pink orthoclase, chalybite, and chalcopyrite—evidently true lode-material.

The crystals possess a strong pearly lustre, owing to the prominence

[1] J. Williams, 'The Cornwall and Devon Mining Directory,' 1870, p. 85.

of the cleavage-face *b* (010), which face is perpendicular to the acute, positive bisectrix. They are mostly of a yellowish-brown colour, though sometimes quite colourless; they are well defined, and are occasionally 1 mm. in length, though usually much smaller. In habit they for the most part resemble the heulandite from Wheal Forest, Okehampton, and show the same forms *b* {010}; *c* {001}; *m* {110}; *t* {201}; *s* {201}. Some of the crystals, however, appear nearly square in outline (fig. 2), and thus resemble both in habit and colour the so-called beaumontite from Jones's Falls, Baltimore, Maryland, U.S.A. The specific gravity = 2·16.

Carrick Du mine was worked for copper and tin, but was abandoned about 1861.

Ramsley mine, South Tawton, Devon.—Heulandite was discovered at this locality by the writer during 1909. Only three specimens were found, all part of a single mass, which was obtained from the principal dump, and evidently derived from the deep workings of the mine. The crystals, which form a crust on a dark Culm-measures shale, are extremely small, barely 1 mm. in length, but are bright and fairly well defined. They are colourless, with the face *t* {201} prominent, and resemble in habit, and exhibit the same forms as the heulandite described from Wheal Forest and Carrick Du mines.

Stilbite.

The Cliffs between Wheal Cock and the Crowns Rock, Botallack, St. Just, Cornwall.—Joseph Carne in 1822 was the first to call attention to the occurrence of zeolites in the St. Just district. Stilbite is mentioned by him as occurring crystallized in flat four-sided prisms with wedge-like summits, associated with radiated mesotype and asbestos in prehnite veins.[1]

The area of cliff in which the prehnite veins occur is that lying between Wheal Cock on the north and the Crowns Rock, Botallack, on the south. The veins traverse a narrow strip of greenstone, which has intruded itself through the granite mass, and forms the precipitous cliffs between the two above-mentioned places. The writer has never seen a specimen of stilbite from this or other of the St. Just localities in any collection of Cornish minerals. It is, however, probable that the original locality might be re-found were a careful search made along the area of cliff in question.

[1] Joseph Carne, 'On the mineral productions and the geology of the parish of St. Just.' Trans. R. Geol. Soc. Cornwall, 1822, vol. ii, p. 310.

Hall in his 'Mineralogist's Directory' gives Botallack and Wheal Cock mines, St. Just, as a locality for stilbite.[1] There is, however, no evidence to show that stilbite occurred in the underground workings, the true locality probably being the cliffs between the two mines, as cited by Carne.

Colcerrow quarry, Luxulyan, Cornwall.—Mr. F. H. Butler was, I believe, the first to notice the occurrence of stilbite at this locality. Of this mineral only a few specimens have been found. In those that I have examined, the stilbite occurs as small, sheaf-like aggregates, or more rarely as distinct, colourless, glassy crystals reaching 6 mm. in length. It is associated with apatite, tourmaline, and quartz, and is implanted on small spheres of greenish-yellow gilbertite, which in turn coat large crystals of orthoclase, the whole occupying cavities in the coarse pegmatitic granite typical of the quarry.

The crystals are twinned in the manner common to stilbite, are flattened parallel to *b* (010), and are much elongated parallel to the zone [*c*, *b*], with a tendency to group themselves in parallel position. The following forms were observed *c* {001}, *m* {110}, *b* {010}, *f* {$\bar{1}$01}. Of the five associated minerals the stilbite appears to have been the last formed, and there can be little doubt as to its secondary origin from felspar.

Chabazite.

Colcerrow quarry, Luxulyan, Cornwall.—Quite recently, the writer and Mr. F. H. Butler, while looking over a series of specimens from the Colcerrow quarry, Luxulyan, that formerly belonged to Mr. Warburton, of Highbury, noticed one showing a mineral that on examination proved to be chabazite.

The chabazite crystals, the largest of which is 3 mm. along the side, are perfectly transparent and colourless, and consist of simple rhombohedra *r* {10$\bar{1}$1}, faintly striated parallel to their edges. The specific gravity = about 2·1. A qualitative test revealed the presence of silica, alumina, lime, and water. The chabazite is associated with some small quartz crystals and occupies a cavity in pegmatitic granite, the occurrence being very similar to that of the stilbite already described.

According to a label with the specimens, they were obtained during 1892 and 1893. The Colcerrow quarry is already well known to mineral collectors for the fine specimens of apatite, fluor, &c., that it

[1] Townshend M. Hall, 'The Mineralogist's Directory,' 1868, pp. 43-44.

has yielded, but so far as the writer is aware the mineral chabazite has not previously been recorded from Cornwall.

Ramsley mine, South Tawton, Devon.—While examining the burrows of this mine in 1906, I discovered a single specimen of chabazite, a mineral not previously recorded from Devon. In 1909 a further examination resulted in the discovery in situ of a considerable number of excellent specimens. The exact spot at which the mineral was found is amongst the débris derived from the excavation of a small reservoir situated on the 800-feet contour line (Six-inch Ordnance Map, LXXVII. N.E.) on the west side of Ramsley Hill.

The chabazite crystals, which are thickly scattered over the surfaces or joints of a greenish-grey rock composed of hornblende and felspar (uralite-diabase), are small, the largest being not more than $1\frac{1}{2}$ mm. along the side; they are, however, very sharp and bright, and consist of colourless, glassy, simple rhombohedra, r $\{10\bar{1}1\}$, most of them showing the characteristic interpenetration-twinning. Many of the crystals are of composite growth and show two or more interpenetrating individuals. The forms e $\{01\bar{1}2\}$ and s $\{02\bar{2}1\}$ were observed on a few crystals. Associated with the chabazite are a few long, prismatic crystals of calcite m $\{10\bar{1}0\}$, terminated by the scalenohedron v $\{2131\}$. Minute, silky tufts of an undetermined mineral were also observed on a few specimens.

The Ramsley or, as it was formerly called, the Emily or Fursdon mine has been, and is still, extensively worked for copper on lodes traversing the shales of the Culm-measures, close to their junction with the great granite boss of Dartmoor. The lodes contain in addition to chalcopyrite, mispickel, and pyrrhotite, much axinite, garnet, diallage, and calcite, minerals that are common to highly metamorphosed areas. It is owing to the kind facilities offered to me by the joint-owner Mr. M. E. Jobling, and by the manager Mr. C. E. Jobling, that I have been able on several occasions to examine the surface and underground workings of this most interesting mine.

Analcite.

Cliffs near Botallack, St. Just, Cornwall.—Mr. J. H. Collins, in his 'Mineralogy of Cornwall and Devon,' states that analcite is said to have been found in the cliffs near Botallack.[1] The authority, however, is not given, and the occurrence must therefore be looked upon as doubtful. No specimen so labelled is known to the writer.

[1] J. H. Collins, 'Mineralogy of Cornwall and Devon,' 1871, Part II, p. 5.

Natrolite.

Chynhalls Point, St. Keverne, Lizard, Cornwall.—Mr. Harford J. Lowe described the occurrence of natrolite at Chynhalls Point, St. Keverne, in a paper read before the Geological Society of Cornwall in 1899.[1] According to him 'the natrolite occurs in needle-like crystals radiating from many centres, and occupies a narrow fissure, varying in width from an inch and a half to a mere joint in the vertical face of serpentine'. The mineral was chemically determined as natrolite by Dr. G. T. Prior. The occurrence is of interest, and the writer is unaware of the mineral having been previously found in serpentine-rocks.

Parc Bean Cove, Mullion, Lizard, Cornwall.—As an associate of datolite, described by Mr. W. F. P. McLintock at the meeting on March 15, 1910, of this Society (this vol., p. 407).

Apophyllite.

Terrace Hill quarry, Lostwithiel, Cornwall.—Three specimens found by the writer at this locality during 1907 show a mineral which is apparently apophyllite. The mineral occurs in small, white, semi-transparent, lamellar masses possessed of a very strong pearly lustre, and is more or less completely embedded in a skeleton-like mass of a slightly less pearly, opaque material, which also contains numerous embedded, sharp crystals of violet-brown axinite. The other minerals present on the specimens are yellowish-brown garnet, massive and in small crystals, small masses of deeply-etched calcite, quartz, black blende, galena, and a few specks of iron-pyrites.

Before the blowpipe the apophyllite is easily fusible to a white, bubbly enamel, and yields water in a closed tube. It is decomposed by hydrochloric acid with the separation of silica, gives a slight precipitate with ammonia, and a copious precipitate with ammonium oxalate. The solution gives a micro-chemical reaction for potassium with platinum chloride. The specific gravity = 2·31. Cleavage fragments show a positive, uniaxial figure with weak double refraction.

Terrace Hill quarry is situated a little to the north of the town of Lostwithiel, and has long been known as one of the best localities in Cornwall for crystallized axinite. The rock is a very tough calc-flinta.

[1] H. J. Lowe, 'Natrolite from the Coverack district.' Trans. R. Geol. Soc. Cornwall, 1900, vol. xii, pp. 336–337.

The following is a list of so-called zeolites that have been mentioned by various writers on Cornish mineralogy. It includes many doubtful occurrences, and in nearly every case the description given is too vague to make it possible to assign the substances described to any recognized species.

In 'A Manual of Mineralogy', published at Truro in 1825,[1] two zeolites are mentioned under the headings of zeolite and mesotype as occurring in Stenna Gwyn mine, St. Stephen's. The writer has been unable to find any specimens from this locality in any Cornish collection, and it seems more than likely that the so-called zeolites were really the mineral wavellite, the occurrence of which has long been known at this mine. The Stenna Gwyn wavellite occurs in granite as delicate radiating tufts of acicular crystals which might easily have been mistaken for a zeolite. Townshend M. Hall, whose information was probably derived from the above source, gives Stenna Gwyn as a locality for both natrolite and mesolite.[2]

Greg and Lettsom cite 'Wheal Carn' as a locality for natrolite.[3] This, however, is most probably a confusion with 'Wheal Cock Carn', a name formerly used for an elevated portion of the cliff close above the prehnite vein, and given as a locality for apatite by Joseph Carne in his account of the St. Just minerals. There is an old tin mine in the granite, named Wheal Carne, about a mile inland east of Wheal Cock, where the mineral 'isopyre' was first noticed by Carne; of zeolites, however, he makes no mention. Hall falls into the same error as Greg and Lettsom, at the same time naming prehnite, stilbite, and axinite as occurring at Wheal Carne, St. Just.[4]

A mineral described as 'radiated mesotype', and which sometimes contained nodules of prehnite, also an earthy variety, possibly the 'mealy zeolite' of Jameson, are stated by Carne to have accompanied stilbite in the prehnite vein in the cliff between Wheal Cock and

[1] 'A Manual of Mineralogy; in wich [sic] is shown how much Cornwall contributes to the illustration of the science.' Truro, 1825, pp. 175–176. This admirable, but little-known work on Cornish mineralogy was published anonymously, likewise a later edition in London, 1828. A presentation copy is, however, known to the writer in which the name of the author is given as Thomas Hogg, Master of the Grammar School, Truro. This was also stated in some copies issued in 1826 with a fresh title-page (Truro, 1826). William Jory Henwood (Trans. R.Geol. Soc. Cornwall, 1871, vol. viii, part 1, p. 112) in quoting extracts, wrongly ascribed the book to Michell.

[2] Townshend M. Hall, 'The Mineralogist's Directory,' 1868, p. 33.

[3] R. P. Greg and W. G. Lettsom, 'Manual of the Mineralogy of Great Britain and Ireland,' 1858, p. 151.

[4] Townshend M. Hall, loc. cit., p. 44.

Botallack.[1] Carne also mentions 'needlestone' as having occurred at Botallack;[2] it is not, however, clear whether this refers actually to the mine or the cliff locality near by. Greg and Lettsom state that natrolite occurred occasionally with prehnite between Botallack and Wheal Cock.[3] Hall mentions mesolite from the same locality.[4]

[1] Joseph Carne, 'On the mineral productions and the geology of the parish of St. Just.' Trans. R. Geol. Soc. Cornwall, 1822, vol. ii, p. 310.

[2] Joseph Carne, 'Additional contributions to the mineralogy of the parish of St. Just.' Trans. R. Geol. Soc. Cornwall, 1846, vol. vi, p. 48.

[3] R. P. Greg and W. G. Lettsom, loc. cit., p. 151.

[4] Townshend M. Hall, loc. cit., p. 43.