Calcites from the Neighbourhood of Egremont, Cumberland.

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A REMARKABLE series of crystallised calcites from Cumberland which have been found during the present year deserve description, both on account of their size and beauty, and also by reason of their peculiar form.

The crystals, although obtained from a small area, exhibit great variety of habit and appearance, and fall naturally into the seven groups which are described below. Of these the most remarkable consists of a series of magnificent heart-shaped twins, somewhat similar to the rare but well-known "butterfly twins" of Eyam, in Derbyshire; they result from the same mode of twinning as the latter, but are far larger and more beautiful than any of the Derbyshire twins, frequently measuring four inches in breadth. There are also crystals which exactly resemble the true butterfly twins of Eyam, and others which are very similar to the rectangular twinned prisms of Wheal Wrey in Cornwall. A second and very rare twin law is also represented among these specimens, in which the rhombohedron, whose edges are truncated by the cleavage planes, acts as twin-plane. The majority of the specimens, however, consist of perfectly limpid and colourless prisms, terminated by brilliant rhombohedron faces, which in their transparency and symmetry of form rival the calcite from any other known locality.

All these varieties have a matrix of earthy hæmatite from which they are easily separated, and most of the crystals are slightly stained with earthy oxide of iron of a red, yellow, or brown colour. In the simple crystals the staining is rarely more than superficial, but some of the twins (4) are rendered almost opaque by the dark brown earthy matter with which they are impregnated.

The heart-shaped twins owe their beauty largely to the fact that they are attached to the matrix merely by the apex, so that they are completely and symmetrically developed in every direction. One variety alone (2) is associated also with pale blue barytes of later growth than the calcite.

In all the varieties the predominant forms are those which are characteristic of the calcites from the North of England, namely $\{2\bar{1}\bar{1}\}\ \infty R$, $\{20\bar{1}\}\ R3$, $\{100\}\ R$, $\{10\bar{1}\}\ \infty R2$, $\{3\bar{1}\bar{1}\}\ 4R$, and planes in the zone

[100, 010] forming a rounded and striated surface which replaces the rhombohedron $\{110\} -\frac{1}{2}R$.

The physical characters of the faces are as follows: $\{100\}$ and $\{3\bar{1}\bar{1}\}$ are perfectly lustrous and smooth; $\{20\bar{1}\}$ is striated with curved lines nearly parallel to $\{100\}$; $\{2\bar{1}\bar{1}\}$ is uneven and dull, covered with curved triangular elevations of which the apex is turned toward the adjacent face of $\{100\}$; $\{10\bar{1}\}$ is striated parallel to $\{20\bar{1}\}$.

There is also a new scalenohedron described under (2); and several scalenohedron faces lying in the principal zone occur between $\{20\bar{1}\}$ and $\{10\bar{1}\}$. The crystals are sometimes corroded, as by the action of some solvent, in which case $\{2\bar{1}\bar{1}\}$ has a drusy surface entirely formed by the triangular elevations mentioned above, and numerous etched planes appear in the neighbourhood of the prism edges.

Varieties. (*A*.) Simple crystals.

(1.) Prismatic habit.

Clear, transparent prisms $\{2\bar{1}\bar{1}\}$, sometimes having their edges truncated by small faces of the prism $\{10\bar{1}\}$, terminated by brilliant rhombohedron planes $\{100\}$, which have the appearance of cleavage surfaces, but are true planes of growth. The edges of the rhombohedron are replaced by the curved and striated faces $\{110\}$. The primary rhombohedron not unfrequently disappears, so that $\{110\}$ constitutes the sole termination. All the crystals of this variety have also below the rhombohedron $\{100\}$ small faces of the forms $\{20\bar{1}\}$ and $\{3\bar{1}\bar{1}\}$.

On one crystal curved faces were found truncating the edges between $\{11\bar{2}\}$ and $\{3\bar{1}\bar{1}\}$, and inclined at an angle of about 28° to the latter.

Some of the prisms attain a length of about 100 mm. and a breadth of 35 mm.

(2.) Pyramidal habit.

Prisms $\{2\bar{1}\bar{1}\}$ and $\{10\bar{1}\}$, terminated by brilliant faces of the rhombohedron $\{100\}$ without any trace of the usual striated truncations upon its edges, also $\{20\bar{1}\}$; the predominating faces, however, belong to a new form which very nearly coincides with the prism $\{10\bar{1}\}$ and gives the crystals the aspect of very acute hexagonal pyramids. The scalenohedron $\{20\bar{1}\}$, though generally large, sometimes disappears entirely, in which case the predominating forms are the acute scalenohedron and the prism $\{10\bar{1}\}$.

The new faces are capable of accurate measurement, since, though always dull, they give very definite images on the goniometer, and the measurements establish beyond doubt that the form is a negative scaleno-

hedron having indices near $\{161 . 10 . \overline{144}\}$ $-\frac{1}{9}R\ ^{3}\frac{9}{5}$, and not a hexagonal pyramid.

The following measurements were made upon one very perfect crystal, and are fully confirmed by others.

	Observed.	Limits.	Number.	Calculated.
Acute edge ...	60°19′	60°18′ — 60°22′	3	60°17′
Obtuse edge ...	58°59′	58°58′ — 59°0′	3	59°0′

The reflections yielded by these faces are accompanied by faint but definite reflections belonging to a scalenohedron with the dihedral angles 60° 0′ and 59° 16′.

The prism $\{10\bar{1}\}$, though bright, is striated not only, as mentioned above, parallel to $\{20\bar{1}\}$ but also horizontally by oscillatory combination with the new scalenohedron.

This variety has the usual matrix of earthy hæmatite, but is associated with pale blue tabular crystals of barytes ($\{001\}$ $\{110\}$ $\{100\}$) which are penetrated by the calcite; other specimens of the same barytes have also quartz and limpid crystals of scalenohedral calcite of the form common in the north of England.

Crystals of this habit are extremely rare. They are mostly small, but sometimes attain a length of about 50 mm., when the terminal rhombohedron faces generally disappear.

(3.) Trigonal habit.

A very acute negative rhombohedron, terminated by striated faces of $\{110\}$ and characterised by the almost total absence of $\{100\}$. They are generally rendered nearly opaque by inclusions. The acute rhombohedron is inclined at an angle of 61° 30′ to the faces of $\{100\}$ as determined approximately by the hand goniometer. These crystals attain the same dimensions as (1).

(B.) Twin crystals.

(4.) Rectangular habit. Twin-plane (100).

These are formed by a pair of prisms intersecting nearly at right angles; the individuals are either transparent and belonging to habit (1) or opaque and belonging to habit (3). The latter are precisely similar to the well-known specimens from Wheal Wrey, Cornwall, with the exception that they have not the basal plane which is common upon Wheal Wrey crystals.

(5.) Butterfly habit. Twin-plane (100).

These crystals are identical in form with the well-known twins from Eyam in Derbyshire, but are transparent and attain larger dimensions than

the latter. The predominant forms are $\{10\bar{1}\}$ $\{2\bar{1}\bar{1}\}$, and uneven striated faces of the scalenohedron $\{20\bar{1}\}$; the peculiar form is produced by the exaggerated development of a pair of scalenohedron faces near the line of junction. Small faces of the forms $\{100\}$ $\{3\bar{1}\bar{1}\}$ are also found at the extremities of the twin. Sometimes one of the individuals is doubly terminated, in which case the portion which projects from the apex of the twin has the usual scalenohedral habit of the North of England calcites.

These twins sometimes attain a breadth of 80 mm.

(6.) Heart-shaped habit. Twin-plane (100).

These remarkable crystals owe their form to precisely the same mode of growth as those of the last habit; they differ from the latter in having a thickness along the twin-plane equal to more than half their breadth perpendicular to the same, and in their termination, which is formed by large striated faces of the rhombohedron $\{110\}$. Two adjacent faces of the usual scalenohedron $\{20\bar{1}\}$ are enlarged, but not nearly to the same extent as in habit (5); and more rarely the pair of prism faces $\{10\bar{1}\}$ which are perpendicular to the twin-plane are developed so as to give the twin a tabular appearance; in all cases the pair of rhombohedral surfaces $\{110\}$ which are adjacent in the two individuals are greatly enlarged in comparison with the remaining faces of the same form.

It is possible that union takes place in the interior of the twin along the plane of twinning, but on the surface the crystals overlap in an irregular manner; they are always developed on both sides of the twin-plane, *i.e.* so that the latter divides the twin symmetrically, but the individuals are sometimes doubly terminated and project to form a second heart-shaped twin at the other extremity.

The largest twin hitherto found is 135 mm. in breadth, 110 mm. in height, and has a thickness of 55 mm.; but the most perfect and limpid are the small crystals, which are sometimes not more than 20 mm. in breadth; the latter are identical in appearance with small twin-crystals formerly found in Derbyshire, which are accompanied by blende, galena, and nearly colourless fluor. In one specimen muddy brown inclusions are arranged in bands parallel to the prism face which is common to the two individuals and perpendicular to the twin-plane.

(7.) Heart-shaped habit. Twin-plane $(11\bar{1})$.

This is well known to be an extremely rare mode of twinning, and only two crystals twinned according to this law have been found among the Egremont calcites. The one which I have examined is a clear crystal, 40 mm. in length and 30 mm. in breadth, consisting of two prisms $\{2\bar{1}\bar{1}\}$ of

the usual habit, terminated by the striated faces {110}; there are also present faces of the usual forms $\{31\bar{1}\}$, $\{20\bar{1}\}$, $\{10\bar{1}\}$; the crystal is therefore precisely similar to those described under (6) with the exception that the principal axes of the two individuals are inclined at an angle of 53° 46′ instead of 90° 46′, while the pair of faces {110} which are perpendicular to the plane of the axes are opposite and not adjacent to one another. The angle between these faces can be accurately determined in spite of their nature, since the measurement is made along and not across the striations. The angle is

106° 17′ measured.
106° 16′ calculated.

Composition appears to take place parallel to the twin-plane in the interior, but on the surface the crystals overlap and have a zig-zag junction parallel to prism faces belonging alternately to the two individuals.

Here, as is the case with twins of habit (6), the crystal has been attached by its apex and is completely developed upon every side.

Crystals twinned (probably) according to this law have been described from Alten in Norway, and from Traversella, and there are also specimens in the British Museum from Alston, and from the Himalaya Mountains. In all these, however, the habit of the crystals is scalenohedral and not prismatic.

In Haidinger's Memoir on twin-crystals (*Edinburgh Journal of Science*, 1825, ii. plate iii.) are figures which have been copied into most text-books. Fig. 7 represents the butterfly habit No. (5), and Fig. 6 the heart-shaped habit No. (6), so accurately that it is unnecessary to repeat figures of this twin-law.