Calcite crystals from Holywell, North Wales.

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In September 1923 a visit to the lead-mining district of Holywell, Flintshire, so closely associated with the name of Thomas Pennant,[1] was organized by Mr. Campbell Smith in order to examine the abandoned workings with a view to collecting specimens. The occurrence of the ores has been described in detail by Sir Aubrey Strahan[2] and Mr. Bernard Smith,[3] and reference to many mineral localities, mentioned by Pennant, is made by Mr. Campbell Smith (loc. cit.).

The commoner specimens collected consist of ruby-blende (Talargoch mine), botryoidal and pseudomorphous calamine $ZnCO_3$ (Milwr mine), orange and reddish-mauve fluor with bitumen and blende (Bryn-gwiog mine).

Calcite also occurs abundantly in veins and cavities throughout the limestone, the crystals usually consisting of large modified obtuse rhombohedra. At the Bryn-gwiog mine, however, a specimen of massive yellowish calcite, bearing crystals of calcite of unusual development, was found by the mine-manager Mr. J. Francis, of Halkyn, who kindly conducted us over the waste-dumps. These crystals are of two distinct habits, as shown in figs. 1 and 2, but they cannot be ascribed to successive crystal-generations.

One of these two types, which we shall call the pyramidal habit, is

[1] W. Campbell Smith, Min. Mag, 1913, vol. 16, p. 331.

[2] 'Geology of the neighbourhoods of Flint, Mold, and Ruthin.' Mem. Geol. Survey, 1890, p. 159.

[3] 'Lead and zinc ores in the Carboniferous rocks of North Wales.' Special Reports on the Mineral Resources of Great Britain, Mem. Geol. Survey, 1921, vol. 19.

shown in fig. 1. It consists essentially of the hexagonal bipyramid $L(91\bar{7}) = (8.8.\bar{16}.3)$ with the basal plane and a curved rhombohedron

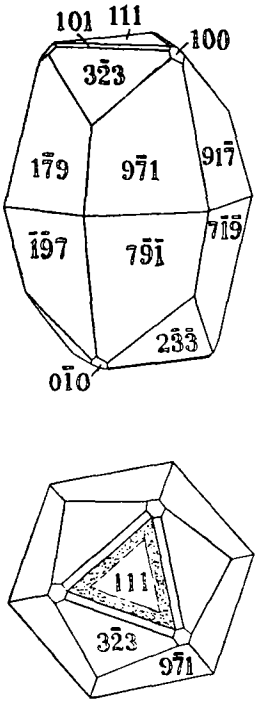

Fig. 1. Calcite from Holywell. Pyramidal crystal.

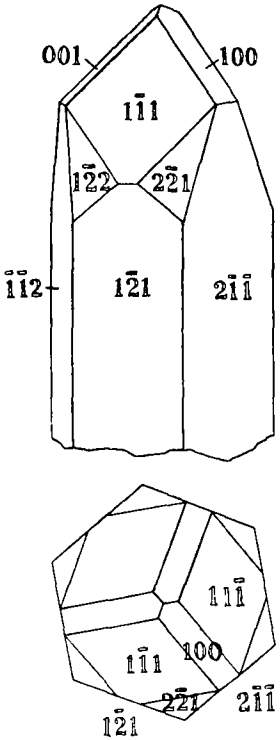

Fig. 2. Calcite from Holywell. Ideal prismatic crystal.

varying in position between $\phi(33\bar{2}) = (05\bar{5}4)$ and $h(55\bar{4}) = (03\bar{3}2)$, and modified by small faces of e (110) and r (100). Measurements were made on a three-circle goniometer, the orientation being determined by the cleavage, and three faces of the pyramid gave fairly good single-images, giving the following readings:

$c \wedge L$	77° 37′		Average.	Calculated.
$c \wedge L_2$	77° 40′	...	77° 37′	... 77° 37′
$c \wedge L_3$	77° 35′			

Faces of the other forms all gave bad images, the readings only being possible to the nearest degree. The basal plane reflected almost entirely

from a triangular central portion, the marginal portion (stippled in the plan of fig. 1) giving images in positions corresponding to faces of the form (411) = $\frac{1}{2}R$; this latter part consists then of a number of pits with surfaces of this form. The largest crystal of this type is 1·2 cm. long and 8 mm. broad.

The chief interest attaching to these crystals is the unusual bipyramidal habit, which has hitherto been described from the following localities (apart from its occurrence as a subsidiary form):

Locality.	Author.	Reference.
Andreasberg, Harz	G. vom Rath	Ann. Chem. Phys. (Pogg.), 1867, vol. 132, p. 521.
Rhisnes, Belgium	G. Cesàro	Mém. Acad. Roy. Belg., 1886, vol. 38, p. 8.
Seilles, Belgium	,,	Ann. Soc. Géol. Belg., 1892, vol. 19, p. 270.
Wisby, Gotland, Sweden	A. Hamberg	Geol. För. Förh., 1894, vol. 16, p. 709.
Bad Lands, S. Dakota	S. L. Penfield and W. E. Ford	Amer. Journ. Sci., 1900, vol. 9, p. 352.
Union Springs, N.Y.	,,	Amer. Journ. Sci., 1900, vol. 10, p. 238.
Shullsburg, Wisconsin	A. F. Rogers	Amer. Journ. Sci., 1901, vol. 12, p. 42.
Raith, Fifeshire	M. F. Heddle	Min. of Scotland, 1901, vol. 1, pl. 30, fig. 85.
Lyon Mount, N.Y.	H. P. Whitlock	Zeits. Kryst. Min., 1907, vol. 43, pl. 4, fig. 4, etc.
Unknown locality	W. J. Lewis	Min. Mag., 1908, vol. 15, p. 72.
Kelley's I., Ohio	W. E. Ford and J. L. Pogue	Amer. Journ. Sci., 1909, vol. 28, p. 186.
Dannemora, Sweden	G. Flink	Arkiv Kemi Min. Geol., 1910, vol. 3, no. 35, p. 110.

The form falls in the normal series 2 of Goldschmidt and according to his theory should be a common form. H. P. Whitlock[1] remarks that the series of pyramids on calcite 'regarded as rare up to a comparatively recent date, is considerably more common than has been hitherto recognized'.

Considerable confusion has been caused by the unnecessary inconsistency in the symbols employed in the representation of this form, as is shown by the following table:

[1] H. P. Whitlock, Proc. Amer. Acad. Arts Sci., 1915, vol. 50, p. 352. [Min. Abstr., vol. 1, p. 348.]

	523 = (35$\bar{8}$4).	917 = (8.8.$\bar{1}$6.3).	553 = (08$\bar{8}$7).
Haüy, 1823	γ ...	— ...	—
Miller, 1852	γ ...	— ...	—
Des Cloizeaux, 1874	γ ...	*L* ...	$e\frac{2}{3}$
Goldschmidt, 1886	$\mathfrak{d}$ ...	γ ...	λ
Dana, 1892	Γ ...	γ ...	*L*
Heddle, 1901	γ ...	*L* ...	—
Flink, 1910	— ...	γ ...	λ

while Flink also uses the letter *L* to denote the rare form (17.9.2$\bar{6}$.8).

The second type, which we shall call prismatic, usually shows an ill-defined development. Except in rare cases and in the prism-zone, attempts to measure these crystals gave angles approximate only to the nearest degree. A perfect crystal of this type is shown in fig. 2 and the usual development depicted in fig. 3. The combination consists of the

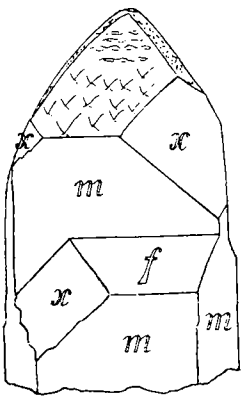

FIG. 3. Calcite from Holywell. Pyramidal crystal, normal development.

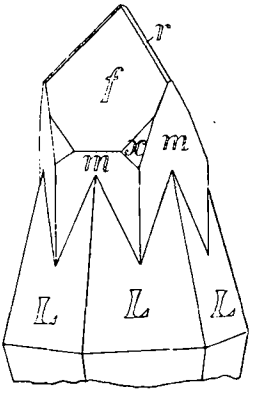

FIG. 4. Calcite from Holywell. Combination of prismatic and pyramidal types.

prism *m* (2$\bar{1}$1) and a curved rhombohedron varying from *f* (11$\bar{1}$) = (02$\bar{2}$1) to *h* (55$\bar{4}$) = (0332), modified by *r* (100) and a scalenohedron *x* (21$\bar{2}$) = (13$\bar{4}$1). Alternate *m* faces are usually repressed almost completely, resulting in a triangular prism, while the scalenohedral faces are also very unequally developed. The curved rhombohedra, which again belong to the inverse series, bear small pyramids, consisting approximately of the forms *f*, *m*, and *x*, and wavy lenticular markings.

A crystal-combination occurring several times on this same specimen consists of a pyramidal crystal capped by a prismatic crystal, as shown in fig. 4, and somewhat resembling a crystal of sceptre-quartz.

Specimens of calcite crystals from the Holywell district previously represented in the Museum Collection mostly possess a rhombohedral habit. Large yellow rhombohedra with curved faces belonging to forms varying between f and ϕ [Dana's symbols] are characteristic of Trelogan mine and are sometimes twinned on the basal plane. Crystals with similar curved forms and the scalenohedron v are found at the Halkyn mine, and a specimen showing x, e, r, and a pyramid comes from Rhosesmor mine.