Note on some artificially-produced crystals of Gypsum.

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PROFESSOR H. LOUIS, of Armstrong College, handed over to me for examination some crystals of gypsum which had been sent to him by Mr. Frank E. Lott, A.R.S.M., F.I.C., of Burton-on-Trent. Mr. Lott has kindly furnished me with the following particulars.

The crystals were deposited in an apparatus employed for raising steam in the production of distilled water. This apparatus consists of a copper vessel enclosing steel steam pipes for heating the water. The crystals were deposited on the walls of the copper vessel and on the steel pipes, and had been formed within a period of twelve months. The water used in the vessel was the typical Burton shallow-well water,[1] derived from the red gypseous marls of the Keuper-beds; it contained:—

	Parts per 100,000.
Calcium sulphate	53·6
Calcium carbonate	19·0
Magnesium nitrate	19·9
Magnesium sulphate	18·7
Magnesium carbonate	1·9
Sodium sulphate	5·4
Potassium and sodium chlorides	14·7
Ferric oxide, alumina, silica, &c.	1·9
Total solids, dried at 180° C.	185·1

The specimens received consist of fairly large, distinctly-developed crystals standing out from a thin friable crust of more finely crystallized

[1] F. E. Lott and C. G. Matthews, 'The waters of Burton-on-Trent,' Journ. Soc. Chem. Industry, 1911, vol. xxx, pp. 69–70.

material. The crystals are transparent, and of a pale yellowish or creamy shade of colour, and they measure 1 to $1\frac{1}{2}$ cm. in length by about $\frac{1}{2}$ cm. in thickness. They are prismatic in habit, with a pyramidal termination of four striated faces, and they present quite the aspect of orthorhombic crystals. The crystals are freely developed at their upper ends, but at their lower ends they are somewhat intergrown, and this, together with a curvature of the faces, produces a tapering of the prismatic form.

A quantitative chemical analysis of the crystals, made by Mr. R. C. Burton, B.Sc., of this college, gave results agreeing with the gypsum formula $CaSO_4 . 2H_2O$. No magnesium is present. The specific gravity is 2·32.

Although the crystals show no re-entrant angles, the presence of twinning is at once betrayed by the herring-bone striations on the face $b(010)$ parallel to the highly perfect cleavage. The nature of this twinning is evident when a cleavage-flake taken from a crystal is examined between crossed nicols. The two portions extinguish symmetrically with respect to the central dividing line or twin-suture, the angle of extinction being 15° on either side of this line. The twin-plane is therefore $d(101)$.

On the Fuess goniometer only approximate measurements could be obtained, since the faces give bands of reflected images. The following readings were taken for the brighter portions of the bands. The faces of the prism $m\{110\}$ are deeply striated parallel to their intersection with those of $b\{010\}$; and $g\{230\}$ is present only as striae on m. The faces of $l\{111\}$ are much rounded, and the angles for these are only approximate.

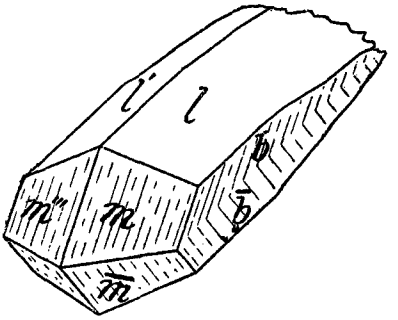
	Measured.	Calculated.[1]
$mm''' = (110):(1\bar{1}0)$ ...	68°—68½° ...	68° 30′
$bg = (010):(230)$ ...	42 —48 ...	45 36
$ll' = (111):(1\bar{1}1)$ ...	30 —33 ...	36 12
$m\bar{m} = (110):(\bar{1}\bar{1}0)$ ...	60 —60½ ...	60 32

That the twin-plane is $d(101)$ is proved by the parallelism (or approximate parallelism allowing for the curvature of the l faces) of the twin-suture with the edges of the zone $[bl]$, and also by the measured angle $m\bar{m}$. This is the rarer of the two twin-laws of gypsum, by far the more common law being that with $a(100)$ as twin-plane. Further, in the d-twins it is usually the free end of the crystals that shows the re-entrant

[1] Dana's 'System of Mineralogy,' 6th edit., 1892.

angles between the *m*-faces, but in the crystals here described the salient angles of the twin are at the free end.

The thin base, to which the larger crystals above described are attached, consists of an aggregate of much smaller crystals of gypsum, about 1–2 mm. across, which are of quite a different habit. These have the form of thin lenticles with a large development of the basal plane $c\{001\}$, $m\{110\}$ being small, and $b\{010\}$ apparently absent. These forms were determined under the microscope from the extinction-directions on the narrow cleavage-flakes. It is of interest to note that these smaller crystals are not twinned, whereas the larger crystals are invariably twinned as illustrated in the text-figure.



Twinned crystal of artificial Gypsum.

The formation of the smaller untwinned crystals of gypsum in the early stages of deposition and of the larger twinned crystals at a later stage, suggests that the production of the latter was influenced by the concentration of the solution, either of the calcium sulphate itself or of the associated salts. In this connexion it may be recalled that the artificial gypsum crystals recently described by Mr. C. J. Woodward[1] were also untwinned and in all probability deposited from a dilute solution, though under quite different conditions.

Of further interest is the presence of a later deposit of calcium carbonate on the larger twinned crystals of gypsum. This has the form of small cauliflower-like masses, which under the microscope are seen to consist of radial aggregates of minute needles a few hundredths of a millimetre in length. These were determined to be aragonite.

[1] C. J. Woodward, 'Note on gypsum crystals found lining a disused well at chemical works,' Mineralogical Magazine, 1907, vol. xiv, p. 211.