On Zinc Oxide from a Blast-furnace.

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With a Crystallographic Examination of the same by

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A CRYSTALLISED substance from a blast-furnace at Mostyn, in N. Wales, having been brought under my notice by Mr. Heywood, of St. Mellons, it was thought worth while to subject it to a careful examination. The largest of the crystals was about 6 mm. long and 2 mm. in diameter. They were translucent, varying in colour from almost colourless to honey-yellow, and were arranged in tufts on what seemed to be altered firebrick. They yielded a pale yellow powder of which the specific gravity was found to be 5·605.

Two different portions were analysed, with the following results :—

		I.	II.
ZnO	...	97·96	98·79
Pb	...	1·02	0·95
S	...	·39	·10
SiO_2	...	·61	trace
FeO	...	·39	trace
		100·37	99·84

In both cases the powder was soluble in dilute hydrochloric acid, with the exception of some glittering grains of lead sulphide.

In I., however, excess of sulphur was present as sulphide decomposed by acids, but in II. the lead was in excess, and present in the metallic state in minute globules. The silica and iron were probably derived from imperfect separation from the matrix.

This substance, then, consists of almost pure zinc oxide, and is deposited in cavities in the wall of the furnace at about its widest part.

(The furnace was used for the preparation of "spiegeleisen" from an ore containing a considerable quantity of zinc.)

The zinc is apparently volatilised as such, and diffuses into these cavities, where in some cases it becomes oxidised, but in others, when access of oxygen is denied, metallic zinc is deposited.

Crystallographic Examination.—The crystals of zinc oxide sent me by Mr. Cundall as suitable for measurement are small, being about 3 mm. long and from 1-2 mm. in diameter.

They belong to the rhombohedral system, and some few of them are simple doubly-terminated hexagonal pyramids $\{51\bar{3}\}$; the greater number, however, exhibit the following combination of forms :—

a $\{10\bar{1}\}$, $o\{111\}$, $f\{2117, 13\}$, $k\{531\}$, $m\{210\}$, $x\{31\bar{1}\}$, and y $\{51\bar{3}\}$. Owing to the development of the crystals in tufts, no doubly-terminated specimen of this habit was to be found, and hemimorphism could not therefore be detected. On one crystal the rhombohedron $r\{100\}$ occurred in combination with a $\{10\bar{1}\}$, $o\{111\}$, and y $\{51\bar{3}\}$. The angle $o\,r$ was not, however, capable of very accurate measurement, and the element 111:100 was therefore calculated from the very good readings = 31°·40′ obtained for the angle ok; the resulting value of 111:100 is 58°·2′, while ox = 61°·37′ and xx' = 52°·12′. These crystals possess a fair cleavage parallel to the base $o\{111\}$, and a perfect one parallel to the faces of the prism a $\{10\bar{1}\}$. They are interesting as exhibiting the new faces r $\{100\}$ and $f\{21\ 17\ 13\}$, and for being much richer in forms than others hitherto described.

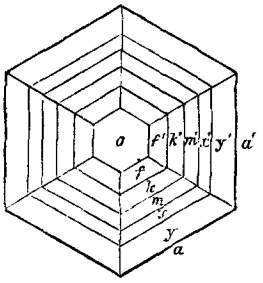
The somewhat high indices $\{21, 17, 13\}$ are not to be regarded as certain, for although they agree best with the observed value of the angle $o\,f$=12° 14′ (calculated=12° 17′) the faces of this form are rounded and give indefinite reflections; the simpler indices $\{543\}$ require $o\,f$=13° 1′.

Crystals similar to these have often been observed as furnace products, and in addition to the forms $a\ o\ r\ f\ k\ m\ x$ and y, the following have from time to time been described: b $\{2\bar{1}\bar{1}\}$, l $\{951\}$, w $\{73\bar{1}\}$, d $\{11,8,3\}$, e $\{11,\bar{2},\bar{2}\}$, s $\{911\}$, and its dirhombohedral form σ $\{\bar{3}75\}$.

I append a list of the observed angles, comparing them with those calculated from the element 58° 2′, together with a resumé of the literature.

Angle.	Calculated.	Measured.	
	° ′	° ′	
$o\,r$	58 2	58 10	
$o\,d$	37 1		
$o\,e$	71 25½	71 26	(Koch)
$o\,f$	12 17	12 14	
$o\,k$	—	*31 40	

Angle.	Calculated.	Measured.	
	° ′	° ′	
$o\,l$	36 31	36 58	(V. Rath)
$o\,m$	42 47	42 36	
$o\,w$	50 59	50 0	(Koch)
$o\,x$	61 37	61 37	
$c\,y$	74 53	74 50	
$o\,s$	58 30		
$s\,a$	36 19		
$s\,s'$	18 34	18 45	(V. Rath)
$s\,\sigma$	32 24	32 25	(,,)
$d\,a$	58 34	58 30	(Des Cloizeaux)
$d\,d'$	62 52	63 30	(,,)
$x\,x'$	52 12	51 48	
$z\,z'$	57 44	57 45	



The forms $o\,e\,w\,a$ were observed by Koch (*Beitr. z. Kenntniss Kryst. Hüttenprod. Göttingen*, 1822); see also Hausmann (*Handb. d. Mineralogie*, 1847, II. 198). Schabus (*Wien. Ak. Ber.*, 11, 8) and Lévy (*Ann. d. Mines* [4] 4, 516) both observed the combination $a\,o\,x$; the former takes for his element $xx' = 52° 17\frac{1}{2}'$, while Lévy selects $o\,x = 62° 20'$, whence $x\,x' = 52° 34'$.

The same combination has more recently been observed by Rinne (*N. Jahrb. f. Min.* 1888, II. 164-171): he finds $o\,x = 61° 54'$, whence $x\,x^1 = 52° 21'$, his crystals are moreover hemimorphic, as shown both by their development and their etched figures.

Vom Rath (*Pogg. Ann.* 1864, 122, 406; 1872, 144, 580) has described the combination $s\,\sigma\,o\,a$ and a twin exhibiting the forms $a\,b\,o\,l\,x$; he adopts as his element $o\,x = 62° 1'$, and finds that the crystal is twinned about a face of the hexagonal pyramid which makes an angle of 59° 8′ with $o\{111\}$, hence it has the indices $\{25,9,7\}$, and taking $ox = 61° 37'$ this angle becomes 58° 42′: the plane of combination is perpendicular to the twin plane.

The rhombohedron $d\{11,3,3\}$ was found by Des Cloizeaux (*Ann. d. Mines* [4] 1,488) on some crystals formed in cavities in roasted blende; see also Brooke and Miller (*Mineralogy*, 1852, 218).

A large series of crystals from various furnaces have recently been investigated by Greim (*Ber. d. Oberhess. Ges. f. Nat. u. Heilk*, 1886, 24, 29), who described for the first time the forms k, m and y, all of which are present on the crystals I have examined; our values for the angle $o\,k$

are identical; the form $w\{915\}$, described by Greim as new ($o\,w = 50°59'$), is probably the same as that already observed by Koch ($o\,w = 50°$).

Firket (*Ann. Soc. Géol., Belg.*, 1885, 12 Bull. 191) and Gorgeu (*Bull. Soc. Min. France*, 1887, 10, 36) have also observed the artificial formation of zinc oxide crystals.

The above measurements were made in the Cambridge Mineralogical Laboratory, and my best thanks are due to Prof. Lewis for much kind assistance and advice, and to Mr. Solly for the loan of his Fuess goniometer.