REFERENCES

DANA (E. S.), 1892. *The system of mineralogy*. 6th edn, New York (Wiley).
DEER (W. A.), HOWIE (R. A.), and ZUSSMAN (J.), 1962. *Rock-forming minerals*, **1**, *ortho- and ring silicates*. London (Longmans).
GUPTA (L. N.), 1973. *Min. Mag.* **39**, 253–5.
MASON (B.) and BERRY (L. G.), 1968. *Elements of mineralogy*. San Francisco (W. H. Freeman).
PHILLIPS (E. R.), 1968. *University of Queensland, Dept. of Geology Papers*, **6**, 159–206.
POLDERVAART (A.), 1956. *Amer. Journ. Sci.* **254**, 521–54.

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The unit-cell and twin of bayldonite

BAYLDONITE shows usually mamillary crusts often mixed with other secondary minerals (duftite, mimetite). Recently, rather well-shaped crystals were discovered at Tsumeb and a new crystallographic study was undertaken.

TABLE I. *Composition and unit cell data of bayldonite*

CuO	34·9 %	Cu	0·439	3·1
ZnO	1·1	Zn	0·013	
PbO	32·1	Pb	0·144	1
As_2O_5	29·0	As	0·252	1·8
H_2O	2·8	H_2O	0·155	1·1
Total	99·9			

	Tsumeb (present study)	La Rabasse, Hérault (Guillemin, 1956)
a	10·152±0·004 Å	5·03±0·02 Å
b	5·893±0·002	5·97±0·05
c	14·083±0·005	6·93±0·02
β =	106° 06′±05′	103°±1°
Space group	C 2/c or Cc	
V =	809·6 Å^3	202·8 Å^3
Z =	4	1

These crystals present two different facies, giving identical X-ray powder patterns: as micaceous stackings of grass-green flattened crystals or like sharp dark-green 'scalenohedra', built in fact from three crystals in twin position.

The first X-ray powder diagrams showed that these crystals were probably bayldonite; a new chemical analysis (Table I) gave results corroborating the earlier analysis by Guillemin (1956), and leads to the formula $(Cu, Zn)_3Pb(AsO_4)_2(OH)_2$. According to the differential thermal analysis curve, the loss of water does not begin before 500 °C: obviously water is present as hydroxyl groups, its loss being indicated by two endothermic peaks at 520 and 570 °C.

Analytical method: Cu by atomic absorption spectrophotometry and gravimetry

with salicyl-aldoxime; Pb and Zn by atomic absorption spectrophotometry; As by colorimetric determination with methylene blue; water by thermogravimetry.

Crystallography. The cell dimensions and symmetry of bayldonite were determined from Buerger precession photographs. The symmetry is monoclinic, in agreement with Guillemin (1956), and the space group is $C2/c$ or Cc. Refinement of the cell dimensions (Table I) by a least-squares method was carried out on 45 2θ values obtained

TABLE II. *X-ray powder data for bayldonite, Tsumeb*

d_{obs}	I	hkl	d_{calc}
5·043	7	110	5·044
4·965	36	11$\bar{1}$	4·965
4·873	18	200	4·877
4·607	38	20$\bar{2}$	4·609
4·516	65	111	4·519
4·352	7	11$\bar{2}$	4·354
3·383	22	004	3·383
3·231	72	20$\bar{4}$	3·231
3·148	100	113	3·145
3·018	1	11$\bar{4}$	3·017
2·946	39	020	2·947
2·932	78	31$\bar{1}$	2·933
2·881	1	021	2·879
2·723	60	31$\bar{3}$	2·724
2·702	49	022	2·701
2·658	55	311	2·659
2·641	2	114	2·640
2·542	46	11$\bar{5}$	2·541
2·528	9	40$\bar{2}$	2·529
2·522	10	220	2·522
2·483	50	22$\bar{2}$	2·483
2·476	24	204	2·476
2·438	32	400	2·439
2·417	7	221	2·418
2·304	26	40$\bar{4}$	2·304
2·260	54	222	2·259
2·179	13	313	2·180
		11$\bar{6}$	2·178
2·114	7	402	2·115

d_{obs}	I	hkl	d_{calc}
1·994	1	025	1·993
		22$\bar{5}$	1·993
1·958	1	116	1·957
		314	1·957
1·922	5	13$\bar{1}$	1·921
1·919	9	51$\bar{2}$	1·920
		42$\bar{2}$	1·919
1·903	9	51$\bar{1}$	1·903
1·899	21	11$\bar{7}$	1·898
		51$\bar{3}$	1·898
1·892	9	131	1·892
1·879	14	13$\bar{2}$	1·879
		420	1·879
1·861	9	206	1·860
1·852	1	510	1·852
1·816	26	31$\bar{7}$	1·817
		22$\bar{6}$	1·815
		42$\bar{4}$	1·815
1·791	5	026	1·791
1·759	31	315	1·760
		404	1·760
		51$\bar{5}$	1·759
1·737	19	133	1·737
1·718	26	422	1·718
1·699	9	33$\bar{1}$	1·699
1·691	19	008	1·691
		60$\bar{2}$	1·691

from an X-ray powder diagram made with a focusing Guinier-de Wolff camera (Nonius) using Cu-$K\alpha_1$ radiation and quartz as internal standard. The a and c parameters determined in this study are double those of Guillemin (1956). Probably the faint reflections indicating the $C2/c$ space group were not observed by this author because only poor crystals were available.

X-ray powder data of this bayldonite are given in Table II and agree well with those published by Claringbull (1951) and Guillemin (1956), but many extra lines are observed, owing to the use of a larger diameter camera. X-ray powder diagrams obtained with this camera on a bayldonite from St. Day United mine, Cornwall (B.M. 40633) and on another one from Les Ardillats, Rhône, France (specimen no. 52 *in*

Guillemin) showed all these minerals to be perfectly identical, although the latter specimen was not pure, the two stronger lines of mimetite being present on the photograph.

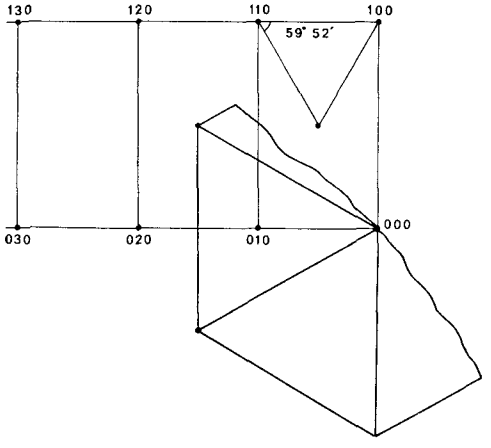

FIG. 1. Trilling of bayldonite, in relation to the reciprocal lattice.

The dark-green 'scalenohedra' are in fact trillings with a common pseudo-hexagonal lattice. As a matter of fact, in the (001) plane [010] and 1/2[110] are respectively equal to 5·89 and 5·87 Å, with an angle of 59° 52′ between them; in addition [103] is pseudo-orthogonal to this plane with a 92° 12′ angle between [103] and [100].

Examination of the reciprocal lattice of this trilling indicated that the composition plane was $(\bar{3}11)$, thus two side-by-side crystals have [130] in common in the (001) plane (1/2[130], 10·193 Å ≈ [100], 10·152 Å).

The crystals present sector twinning in thin sections perpendicular to the pseudo-threefold axis; the orientation of one of these sectors in the (001) plane is shown in fig. 1.

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REFERENCES

CLARINGBULL (G. F.), 1951. *Min. Mag.* **29**, 609–14.
GUILLEMIN (C.), 1956. *Bull. Soc. franç Min. Crist.* **79**, 7–95.

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Nickel hydroxides from Unst, Shetland

THE first natural occurrence of nickel hydroxide $Ni(OH)_2$, blue-green in colour, was reported by Williams (1960). Jambor and Boyle (1964) demonstrated that natural