

happened to be roughly normal to the *c*-axis, a number of isolated growth cones first form, which are then covered by vicinal *r* or *z* faces or both, and finally the surface is covered with a drusy aggregate of parallel pyramids (fig. 4).

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REFERENCE

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Analyses of altered struvite from Skipton, Victoria

SPECIMENS of Skipton Cave guano minerals, held in the mineral collection of the Government Chemical Laboratories, Perth, Western Australia, showed on examination subaqueous and subaerial replacement of struvite by newberyite. The phosphate minerals occurring in this cave have been only partially studied since their discovery by McIvor (1887, 1902). The description by Cohen and Ribbe (1966) of a subaqueous alteration of struvite to newberyite at Mono Lake, California, prompted further investigation.

The Skipton Cave, described by Ollier (1963), occurs on the north slope of Mt. Widderin, 25 miles south-west of Ballarat. The bats responsible for the guano were last seen live in 1866 and their species is in doubt; however, Simpson and Smith (1964) reported the discovery of a mineralized mandible of *Miniopterus schreibersi*. Collection material was supplemented by further specimens collected in 1966 from the Skipton Cave by the author.

Specimen S2216, newberyite after struvite, is of a similar form to that described by Ribbe (1969) and the crystals have been partially altered to a white opaque compact newberyite powder. The alteration is definitely subaerial in origin as the sample was kept in a closed box for over thirty years.

Specimen MDC 2888A, newberyite collected in January 1966 is of two types: MDC 2888A(a) large crystals of tabular and pyramidal forms, which are common in the cave; and MDC 2888A(b) replacing struvite of a similar form to S2216, but coarsely crystalline, white, zoned, and with remnants of clear struvite, which could have originated in either subaqueous or, less likely, subaerial conditions.

Specimen MDC 2887B, fresh clear struvite crystals of the same form as S2216 was also collected and kept in damp guano until examined. The samples were handpicked,

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crushed, and purified by magnetic and heavy liquid separations to a purity of better than 99 %.

Whitaker (1968) appears to consider that all the Skipton Cave newberyite was derived from struvite. The different crystal form is a strong indication that this is not so except in the case described above. Most newberyite formed directly from solutions in the guano.

The analyses in table I show the residual ammonia in the completely altered struvite MDC 2888A(b) to be lower than the more recently altered S2216 from the collections, and the manganese figures are slightly higher than those reported by McIvor (1887), and by Cohen and Ribbe (1966).

TABLE I. *Chemical analyses of newberyite and struvite from Victoria*

	1	2	3	4	5	6
MgO	23.1	23.0	22.7	22.5	16.4	16.4
P ₂ O ₅	40.7	39.9	39.7	39.2	28.7	28.9
(NH ₄) ₂ O	—	trace	0.12	1.05	10.5	10.6
H ₂ O	36.1	36.1	36.2	35.2	43.6	44.0
MnO	—	0.58	0.57	0.64	0.21	—
FeO	—	0.03	0.12	0.02	0.02	—
	100.0	99.6	99.4	98.6	99.4	100.0

1. MgHPO₄·3H₂O. 2. MDC 2888A(a) Newberyite. 3. MDC 2888A(b) Newberyite after struvite. 4. S2216 Newberyite after struvite. 5. MDC 2887B Struvite. 6. NH₄MgPO₄·6H₂O.

Analysts: 2, R. J. Everett; 3, 4, 5, P. E. Hewson.

Method: A single determination was done on each sample; MgO and P₂O₅ gravimetrically as Mg₂P₂O₇, (NH₄)₂O by distillation, H₂O by absorption on 2 and 3 and by difference of ignition loss and (NH₄)₂O on 4 and 5. MnO colorimetric on Mg₂P₂O₇ residues and FeO by atomic absorption.

X-ray powder diffraction studies of the newberyite using a Guinier focusing camera with internal standard showed no significant differences from earlier published data.

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