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# *Studies on the zeolites. Part IV. Ashcroftine (kalithomsonite of S. G. Gordon).*[1]

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IN 1924 S. G. Gordon[2] described as a variety of thomsonite a pink zeolitic mineral occurring as a fine crystalline powder in cavities of augite-syenite at Narsarsuk, Greenland. The material was described as orthorhombic, with two good cleavages *a*(100) and *b*(010) and a less perfect one *c*(001); no other faces were observed on the minute prismatic crystals. The refractive indices Gordon measured as $\alpha$ 1·535, $\beta$ 1·537, $\gamma$ 1·545, with the optic orientation $\alpha = b$, $\beta = a$, $\gamma = c$, and optic sign positive. Analysis gave the figures under I (p. 307), and as these agree with the composition to be expected for a potassiferous thomsonite, apart from the high water content, Gordon regarded it as such, and gave it the varietal name kalithomsonite.

As will be seen from the figures under II (p. 307), the atomic ratios, per 80 oxygen atoms, do indeed suggest the thomsonite unit-cell formula $Na_{4+n}Ca_{8-n}Al_{20-n}Si_{20+n}O_{80}.24H_2O$, apart from the high water content; but the study of thomsonite by one of the

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[1] Part III. Natrolite and metanatrolite. Min. Mag., 1932, vol. 23, p. 243.

[2] S. G. Gordon (J. E. Whitfield, analyst), Proc. Acad. Nat. Sci., Philadelphia, 1924, vol. 76, p. 261. [Min. Abstr., vol. 2, p. 385.]

authors[1] had shown that artificial potassiferous thomsonites (produced by base-exchange reactions) only show a very small increase in refractive index over non-potassiferous material of the same Si/Al-ratio, and there is no tendency whatever to an increase of $\beta$ and $\alpha$, relatively to $\gamma$, which could lead to the changed optic orientation of Gordon's material. It therefore seemed very doubtful whether the substance really was a thomsonite at all.

Fortunately, a portion of the original material presented by Mr. Gordon to the British Museum in 1924 (B.M. 1924, 867), was available for examination. In view of J. E. Whitfield's analysis, a new chemical examination seemed superfluous, but one of us (F. A. B.) undertook an X-ray study of selected fibres, which had been found to show agreement with Gordon's optical data. Gordon's data were in general confirmed, except that no difference in facility of the two best cleavages (*a* and *b*) could be noticed, nor any difference in the refractive indices for vibrations perpendicular to these cleavages. The fibres are too thin for examination along their length, but observations on fibres lying on *a*(100) or *b*(010), with a high-aperture oil-immersion system, supported the idea that they may be uniaxial; certainly 2V cannot exceed 36°.

This conclusion was fully substantiated by the X-ray work, Laue-grams along the *c*-axis clearly showing that the symmetry is tetragonal, the principal axis being Gordon's *c*-axis, parallel to the elongation of the fibres. The unit cell is remarkably large, the dimensions being *c* 17·49, *a* 34·04 Å., both $\pm 0{\cdot}05$, giving an axial ratio *c*/*a* of 0·514. The rotation photographs are, in consequence, too complex to be completely indexed, but it could be observed that (*h0l*) is halved for $(h+l)$ odd; assuming holohedral symmetry this would lead to the space-group $D_{4h}^{14}$, but the evidence is insufficient to decide definitely.

The specific gravity was determined as 2·61, the accuracy not being very great (about $\pm 0{\cdot}05$) on account of the small size of the crystals. From this figure, Whitfield's analysis, and the measured cell-size, the atomic cell-contents given under III are calculated. The figures are so large that it is difficult to assign a definite unit-cell formula, but assuming that the minimum number of similar positions in the unit cell is four, they may be regarded as an approximation to

$$\mathrm{Na_{40}K_{40}(Ca,Mg,Mn)_{40}Al_{160}Si_{200}O_{720}.320H_2O}, \text{ or}$$
$$\mathrm{40[NaK(Ca,Mg,Mn)Al_4Si_5O_{18}.8H_2O]},$$

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[1] M. H. Hey, Min. Mag., 1932, vol. 23, p. 51.

by far the most complicated unit-cell formula yet found among inorganic compounds.

Ashcroftine ('kalithomsonite'), analysis by J. E. Whitfield:

| | $SiO_2$. | $Al_2O_3$. | CaO. | MgO. | MnO. | $Na_2O$. | $K_2O$. | $H_2O+$. | $H_2O-$. | Total. | O % |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I. | 38·09 | 26·61 | 5·72 | 0·87 | 0·79 | 3·62 | 5·65 | 12·00 | 6·40 | 99·75 | 36·97 |

Atoms per 80 atoms oxygen:

| | Si. | Al. | Ca. | Mg. | Mn. | Na. | K. | $H_2O$. | Si+Al. | Ca+Na+K. |
|---|---|---|---|---|---|---|---|---|---|---|
| II. | 22·01 | 18·13 | 3·54 | 0·75 | 0·39 | 4·06 | 4·16 | 35·46 | 40·14 | 12·90 |

Atoms per unit cell:

| | Si. | Al. | Ca. | Mg. | Mn. | Na. | K. | $H_2O$. | O. | $H_2O+$. |
|---|---|---|---|---|---|---|---|---|---|---|
| III. | 203·2 | 167·4 | 32·8 | 6·9 | 3·6 | 37·5 | 38·6 | 328·4 | 740·8 | 214·2 |

'Kalithomsonite' is, therefore, not a variety of thomsonite, but an independent species. Now names formed on the principle of kalithomsonite have been in use for some time for artificial base-exchange products prepared from the zeolites (e.g. silver-natrolite, ammonium-stilbite), for natural zeolites of abnormal composition (e.g. barium heulandite), and for end-members (actual or hypothetical) of isomorphous series (e.g. calciothomsonite, Natronthomsonit).[1] All these uses seem quite legitimate, and in each case the names cover varieties and not species.[2] It therefore seems undesirable to retain the name kalithomsonite for a mineral which is not simply related to thomsonite; such a name belongs properly to the artificial potassiferous thomsonites prepared by one of the authors.[3]

It is therefore proposed to replace the name kalithomsonite, for the material above described, by *Ashcroftine*, in honour of Mr. Frederick Noel Ashcroft, whose munificent gifts of zeolites to the British Museum have greatly enriched the collections and enabled this series of studies to be undertaken.

Ashcroftine, then, is a tetragonal mineral, with a unit cell measuring $c$ 17·49, $a$ 34·04 Å., and containing approximately

$$40[NaK(Ca,Mg,Mn)Al_4Si_5O_{18}.8H_2O].$$

Its refractive indices are $\epsilon$ 1·545, $\omega$ 1·536, and it occurs as small needles bounded by the cleavage forms $a(100)$, $c(001)$. Specific gravity 2·61 ± 0·05.

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[1] For other examples of all three uses, see the lists of new mineral names collected by Dr. L. J. Spencer, Min. Mag., vols. 11–22.

[2] Even Kali-Harmotom (= phillipsite) of L. Gmelin, 1825, belongs to the same isomorphous group as harmotome.

[3] M. H. Hey, Min. Mag., 1932, vol. 23, pp. 109–110.

The amount of material available was not sufficient to undertake vapour-pressure and base-exchange work. Experiments with a small quantity of material showed no appreciable change in optic properties after digestion in boiling NaCl solution for 700 hours, or fusion with $NaClO_3$ at 250° C. for 48 hours, followed by soaking with water, but it is not certain that any appreciable base-exchange was obtained. Whitfield's figure for $H_2O-$ shows that the water is not very firmly held.