as a hydrothermally reworked product of eudialyte in nepheline syenites. Indeed, ashcroftine was found in vugs in augite-syenite at Narsarsuk, Greenland and for this reason the presence of yttria is not surprising. Finally, we have computed wt % for the proposed ashcroftine formula (table II) and these values are in fair agreement with the Whitfield analysis. The Gladstone–Dale calculation in table II yielded $d = (n-1)/k = 2{\cdot}51$ g/cm³ which, with the earlier discussion, suggests that the observed specific gravity of 2·61 reported by Hey and Bannister is too high.

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Rankinite and kilchoanite from Tokatoka, New Zealand

Two polymorphs of tricalcium disilicate, rankinite and kilchoanite, have been discovered near Tokatoka, New Zealand.

The first record of high-temperature calc-silicates in the Tokatoka district was by Mason (1957) who described larnite, gehlenite, spurrite, and scawtite from a contact zone adjacent to a small dyke near Rehia, 2 miles SE. of Tokatoka. During a later survey the writer discovered several more localities of high-temperature calc-silicates; a study of the mineralogy and petrology of these occurrences is in progress.

Examination of one locality, a limestone/basalt contact, 1 mile NNW. of Tokatoka revealed the presence of rankinite and kilchoanite. Neither of these minerals has been recorded previously in the district.

Rankinite and kilchoanite occur with other high-temperature calc-silicates in a band, approximately 1 m wide, of dark-grey flinty rocks. These rocks are separated from the basalt by a narrow zone a few millimetres wide of wollastonite and grossular and from the unmetamorphosed country rocks by white coarsely crystalline wollastonite-, scawtite-, tobermorite-, and hydrogrossular-bearing limestones.

Thin section and X-ray diffraction study of the dark calc-silicate rocks show that they consist of essentially monomineralic lenses and bands of larnite, spurrite, and rankinite. The dark colour is due to finely disseminated iron ores; the only other

TABLE I. *X-ray diffraction data for rankinite and kilchoanite. Norelco diffractometer, Ni-filtered* Cu-$K\alpha$ *radiation, internal silicon standard*

Tokatoka				Agrell and Gay, 1961		Roy, 1958 'Phase Z'		Calc. for kilchoanite	
Rankinite		Kilchoanite		Kilchoanite					
d_{obs}	*I*	d_{obs}	*I*	d_{obs}	*I*	d_{obs}	*I*	d_{calc}	*hkl*
5·43 Å	2	5·07 Å	2	5·17 Å	m	5·10 Å	2	5·07 Å	202
5·18	2	4·79	1	—	—	4·76	1	—	—
4·48	7	4·27	1	4·26	w	—	—	4·28	112
4·09	2	4·18	1	—	—	4·18	1	4·18	013
4·01	1	3·97	2	4·00	w	3·97	2	3·97	204
3·84	7	—	—	—	—	3·76	1	3·74	211
3·785	3	—	—	—	—	3·67	1	3·66	006
3·723	1	3·56	4	3·56	ms	3·56	4	3·54	114
3·547	1	3·38	3	3·39	vw	—	—	3·37	213
3·382	2	3·05*b*	10	3·07	s_3	3·06	7·5	3·08	206
3·197	5	—	—	—	—	—	—	3·05	310
3·176	8	2·88	8	2·89	s_1	2·88	10	2·88	116
3·027	6	2·86	2	—	—	2·84	3	2·87	215
2·981	4	—	—	—	—	—	—	2·86	400
2·940	1	2·76	2	2·77	vw	—	—	2·76	402
2·902	5	—	—	—	—	2·73	1	2·74	008
2·858	5	—	—	—	—	—	—	2·69	017
2·763	2	2·67	8	2·68	s_2	2·67	7·5	2·67	314
2·717	10	2·54	2	2·55	m	2·55	2	2·55	020
2·578	4	2·48	2	2·48	m	2·48	2	2·48	{121, 411}
2·521	3	2·43	2	2·42	m	2·42	3	2·43	217
2·362	1	2·35*b*	1	2·36	ms	2·35	1·5	2·36	118
2·274	1	—	—	—	—	—	—	2·35	123
2·166	2	—	—	—	—	—	—	2·34	316
2·137	1	2·255	1	2·26	vw	2·26	0·5	2·27	222
2·043	1	2·165	1	2·18	vw	—	—	—	—
2·001	1	2·050	—	2·06	w	—	—	—	—
1·963	2	—	—	1·996	w	—	—	—	—
1·861	3	1·963	4	1·964	ms	1·964	3	—	—
1·819	6	—	—	1·906	m	1·902	1·5	—	—
1·757	2	1·860	2	1·872	m	—	—	—	—
—	—	—	—	—	—	1·833	3	—	—
—	—	—	—	1·814	w	—	—	—	—
—	—	—	—	1·779	w	—	—	—	—
—	—	1·746	3	1·745	m	—	—	—	—

impurity detected was gehlenite. The larnite and spurrite rocks are fine-grained with anhedra rarely exceeding 0·03 mm. Rankinite, on the other hand, occurs as large plates up to 8 mm in length. Locally rankinite shows replacement by kilchoanite. Large crystals of rankinite are mottled and edges corroded and replaced by small irregular individual grains (0·2–0·4 mm in diameter) or by granular aggregates of kilchoanite. Kilchoanite has not been observed to completely replace rankinite.

Properties of the Tokatoka rankinite and kilchoanite are: rankinite α 1·640, β 1·644, γ 1·650 (all $\pm$0·002), $2V_\alpha$ 114°, $r > v$ weak, D 2·998$\pm$0·002; kilchoanite α 1·646, β 1·648, γ 1·650 (all $\pm$0·002), $2V_\alpha$ 46 to 54°, $r > v$ strong, D 2·992$\pm$0·002.

Both rankinite and kilchoanite are colourless in thin section and have no observable cleavages. Kilchoanite typically shows abnormal brown and blue interference colours.

Table I lists X-ray powder diffraction data for the Tokatoka rankinite and kilchoanite together with the data of Agrell and Gay (1961) and Roy (1958) for the natural and synthetic kilchoanite ('Phase Z') respectively. The Tokatoka kilchoanite is tbe third record of kilchoanite and the first outside Great Britain.

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Arthurite from Potrerillos, Atacama Province, Chile

THE felicitously named arsenate of copper and iron, arthurite (Davis and Hey, 1964), has been confirmed from a second locality, the Potrerillos porphyry copper deposit (26° 29′ S.; 69° 26′ W.), Atacama Province, northern Chile, in the course of an investigation of supergene sulphide and oxidate mineral assemblages in the copper deposits of the Copiapó region (Sillitoe, Mortimer, and Clark, 1968; Sillitoe, 1969).

The arthurite-bearing specimen was collected in 1966 from a small dump of high-grade ore recently taken from tributers' workings in the uppermost 60 m of the open-pit of the now-abandoned porphyry copper mine (March, 1935). The ore at this level consists of massive djurleïte, formed in the earlier of the two major episodes of supergene enrichment that affected the area in the Lower Eocene to Upper Miocene interval, and subsequently strongly oxidized to malachite, goethite, and minor cuprite.

The arthurite occurs as very thin (0·1–0·5 mm) and sporadic coatings, of a pale