about the validity of such simple considerations as those used here, he is nevertheless gratified to find how well they do explain phenomena that must really be based on very complex systems of chemical forces.

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INDEXED POWDER DIFFRACTION DATA FOR SCAPOLITE

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During a study of the similarities between natural scapolites and fibrous potassium lead silicates synthesized by Shell (1957), no indexed powder diffraction data for scapolite for comparison could be found in the literature nor in the *x*-ray powder data file. Recently, Eugster and Prostka (1960, p. 1859) published data on seven indexed peaks for two synthetic scapolites. However, it is felt that additional indexed data, particularly for natural scapolites, might be a desirable addition to the literature since future comparisons might be desired. This note thus presents indexed data for some 40 peaks for scapolites from Arendal, Norway and from Grenville, Quebec.

TABLE 1. *X*-RAY POWDER DIFFRACTION DATA FOR SCAPOLITE

Arendal

hkl	d_{obs}	I/I_0	d_{calc}
110	8.556	5	8.553
101	6.439	5	6.419
200	6.040	20	6.048
211	4.397	5	4.402
220	4.282	10	4.276
310	3.824	60	3.826
301	3.558	20	3.560
112	3.464	100	3.463
321	3.069	70	3.067
400	3.027	55	3.024
222	2.833	10	2.835
411	2.734	15	2.736
420	2.703	25	2.705
312	2.693	30	2.691
510	2.370	<5	2.372
431	2.306	15	2.304
332	2.278	5	2.277
422	2.204	5	2.201
521	2.152	10	2.153
303	2.141	20	2.140
530	2.074	5	2.073
611	1.932	15	1.923
620	1.912	30	1.912
004	1.892	10	1.893
541	1.832	5	1.833
532	1.820	5	1.819
631	1.753	10	1.754
710	1.712	15	1.711
640	1.677	5	1.677
721	1.622	5	1.623
613	1.562	5	1.562
712	1.558	5	1.559
543	1.512	5	1.512
732	1.464	10	1.465
325	1.381	<5	1.381
624	1.346	15	1.345
910	1.335	<5	1.336
653	1.319	<5	1.320
921, 761	1.293	<5	1.293
435, 505	1.284	<5	1.284

Grenville

hkl	d_{obs}	I/I_0	d_{calc}
110	8.600	5	8.605
200	6.087	20	6.085
211	4.422	<5	4.419
220	4.306	5	4.303
310	3.846	45	3.849
301	3.577	10	3.577
112	3.465	95	3.465
202	3.210	10	3.214
321	3.085	75	3.083
400	3.043	55	3.043
330	2.869	<5	2.869
222	2.843	<5	2.842
411	2.750	5	2.750
420	2.721	5	2.722
312	2.700	100	2.699
510	2.387	<5	2.387
431	2.317	15	2.317
332	2.287	15	2.286
422	2.209	<5	2.209
521	1.164	15	2.165
303	2.142	20	2.143
530	2.086	5	2.087
512	2.091	10	2.019
611	1.933	15	1.935
620	1.923	30	1.925
413	1.918	15	1.918
004	1.893	15	1.893
541	1.843	10	1.844
532	1.827	<5	1.828
631	1.764	10	1.765
503, 433	1.752	<5	1.752
710	1.721	5	1.721
640	1.687	<5	1.688
721	1.632	<5	1.633
404	1.607	<5	1.607
613	1.567	15	1.568
543	1.518	<5	1.518
811, 741	1.514	5	1.514
732	1.472	10	1.472
505	1.459	5	1.459
325	1.381	<5	1.381
822	1.376	15	1.375
624	1.349	5	1.349
910	1.344	<5	1.344
653	1.325	<5	1.326
921, 761	1.301	<5	1.301
505, 435	1.286	5	1.286

The Arendal scapolite was white in color and non-fluorescent whereas the Grenville scapolite was yellow and fluoresced a brilliant canary yellow under long wave ultraviolet radiation. Each scapolite was mottled with less transparent areas which, when examined as grains under the polarizing microscope, appeared to contain a finely dispersed alteration product. Thus it was necessary to coarse-crush each scapolite and isolate the clear grains, then crush these clear grains to -400 mesh for the x-ray and chemical analysis. Smear mounts of the -400 mesh crushed fragments of each scapolite were scanned at $\frac{1}{4}$ degree per minute with a Norelco high-angle diffractometer operated in conjunction with an automatic strip chart recorder. Instrumental settings were: divergence and scatter slits, 1 degree; receiving slits, 0.006 inches; strip chart scale, $\frac{1}{2}$ degree per inch; time constant, 4; multiplier, 1; scale factor, 8 and 16; filtered Cu$K\alpha$ radiation.

The 2θ values for resolved $K\alpha_1$ peaks on the strip charts were read at the midpoints at $\frac{2}{3}$ the height of the peak (Donnay and Donnay, 1951); the 2θ values for unresolved or partly resolved peaks were read at the midpoints at $\frac{1}{2}$ the height of the peak (Smith and Sahama, 1954). These

TABLE 2. CHEMICAL ANALYSIS AND CALCULATION OF THE UNIT CELL CONTENT OF THE ARENDAL SCAPOLITE

(Analyst R. E. Hooper) U. S. Bureau of Mines, Norris, Tenn.

	Analysis wt. %	Mass units per unit cell (atomic-wt. units)	Gram-molecular wt. of oxide, or constituent of column 1	No. of oxides, etc. per unit cell	No. of metal ions per unit cell	No. of anions per unit cell
SiO_2	50.38	894.48	60.06	14.89	14.89	29.78
Al_2O_3	24.18	429.31	101.94	4.21	8.42	12.63
Fe_2O_3	0.29	5.15	159.70	0.03	0.06	0.09
TiO_2	0	—	—	—	—	—
CaO	13.06	231.88	56.08	4.13	4.13	4.13
MgO	0	—	—	—	—	—
Na_2O	7.09	125.88	61.97	2.03	4.06	2.03
K_2O	0.51	9.06	94.20	0.10	0.20	0.10
CO_2	0.94	16.69	44.01	0.38	0.38	0.76
Cl	4.32	76.70	35.46	2.16	—	2.16
F^-	0.31	5.50	19.00	0.29	—	0.29
SO_3	0	—	—	—	—	—
H_2O	n.d.					
	101.07					
Less O equivalent to F and Cl, resp.	.13 .95					
	99.99[1]					

[1] The total reported by the analyst, *i.e.* 100.25%, has been readjusted to 100.00%.

peak readings were then corrected to an internal standard—a synthetic spinel ($MgAl_2O_4$) with cell dimensions that had been carefully determined with respect to transistor grade silicon.

The data of Table 1 for the Arendal specimen were indexed on the basis of a tetragonal, body-centered cell: a 12.095, c 7.571A$\pm$0.05%; for the Grenville on a similar cell: a 12.163, c 7.569A$\pm$0.05%. In the case of the former precession photographs were taken to confirm the diffraction indices assigned to the peaks of the powder diffraction record. These photographs exhibited the symmetry $4/m$ and a systematic absence of reflections with $h+k+l$ odd. The space groups consistent with these diffraction data are $I4$, $I\bar{4}$ and $I4/m$. Piezoelectric tests were made on the Arendal scapolite as a possible means of discerning whether scapolite possesses space group symmetry $I4$, $I\bar{4}$ (noncentric), or $I4/m$

TABLE 3. CHEMICAL ANALYSIS AND CALCULATION OF THE UNIT CELL CONTENT OF THE GRENVILLE SCAPOLITE

(Analyst R. E. Hooper)

	Analysis wt. %	Mass units per unit cell (atomic wt. units)	Gram-molecular wt of oxide, or constituent of column 1	No. of oxides, etc. per unit cell	No. of metal ions per unit cell	No. of anions per unit cell
SiO_2	44.46	806.74	60.06	13.43	13.43	26.85
Al_2O_3	29.14	528.75	101.94	5.19	10.38	15.57
Fe_2O_3	0.23	4.17	159.70	0.03	0.06	0.09
TiO_2	0	—	—	—	—	—
CaO	16.36	296.87	56.08	5.29	5.29	5.29
MgO	0	—	—	—	—	—
Na_2O	2.43	44.09	61.97	0.71	1.42	0.71
K_2O	2.23	40.46	94.20	0.43	0.86	0.43
CO_2	0.95	17.24	44.01	0.39	0.39	0.78
Cl	0.35	6.35	35.46	0.18	—	0.18
F^-	0.15	2.72	19.00	0.14	—	0.14
SO_3	1.07	19.42	80.07	0.24	0.24	0.72
H_2O^-	0.11	—	—	—	—	—
H_2O^+	2.66	48.27	18.02	2.68	5.36	2.68
	100.14					
Less O equivalent to F and Cl	.06 .08					
	100.00[1]					

[1] The total reported by the analyst, *i.e.* 100.16%, has been readjusted to 100.00%.

(centric).* The test was made at 50° intervals between 20° C. and the boiling temperature of liquid nitrogen with the piezoelectric detector at the Pennsylvania State Crystallographic Laboratory, University Park, Pennsylvania. The results of the tests gave no indication of non-centrosymmetry, although it is realized that a negative result is not conclusive. However, Professor Pepinsky is of the opinion that the piezoelectric detector used for the test is very sensitive and that a negative result is a good indication of centrosymmetry. Thus, it appears probable that scapolite belongs to the centrosymmetric space group $I4/m$ which is in agreement with Pauling's (1930) postulated structure for scapolite. However, definite confirmation of this conclusion will have to await a detailed structural analysis of scapolite.

Other physical constants measured for these scapolites were, for the Arendal scapolite: $\omega_D 1.566$, $\epsilon_D 1.544$, $\rho 2.66$ and for the Grenville scapolite: $\omega_D 1.588$, $\epsilon_D 1.559$, and $\rho 2.69$.

The unit cell content of the two scapolites was found by calculating the atomic-weight units in the unit cell from the relation $\rho V/1.66$ and allocating these units to the various oxides, etc., on the basis of their respective weight percentages reported in the chemical analysis (Tables 2 and 3). The notation ρ and V refer to the measured density and unit cell volume, respectively, of the scapolites. No determination of H_2O was made in the chemical analysis of the Arendal scapolite because the 1.89 gm sample available for the analysis was expended in the analytical determination of the other chemical constituents.

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* While this article was in press, "Studies on Scapolite" by B. J. Burley, E. B. Freeman and D. M. Shaw appeared in *Canad. Mineral.* **6,** part 5, 670–679, with powder photograph data and a discussion of symmetry.