

*Weathering of sulphide minerals in coal:
production of ferrous sulphate heptahydrate.*

MICROSCOPIC examination of subsection B in a pillar sample of Greta seam coal revealed greenish-white fibres up to $\frac{1}{2}$ in. long, which tended to occur radially in small spherical nests and appeared to be produced by weathering of sulphide minerals. The fibrous mineral was readily soluble in water and ferrous iron was the major cation present. The upper inch of the subsection was composed of felted crystals of the greenish-white, fibrous mineral with a ground mass of clay, coal, and pyrite nodules. From its optical properties the greenish-white fibrous mineral appeared to be melanterite ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$), and examination with a polarizing microscope showed that the samples were probably monoclinic.

To settle doubts as to the constitution of the samples their X-ray diffraction patterns were taken and proved to resemble that of melanterite on the A.S.T.M. card; but agreement was not complete. In an attempt to resolve the difficulty an investigation of pure ferrous sulphate was carried out. Three samples were examined: blue-green crystals and white powder separated from a sample of ferrous sulphate that had become partially dehydrated, and freshly recrystallized ferrous sulphate.

	Fe.	SO ₄ .	H ₂ O.
Blue-green crystals . . .	20.1%	34.3%	45.6%
White powder . . .	24.6	44.6	30.8
Recrystallized $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$. . .	19.8	35.0	45.2

Chemical analyses indicate that the white powder is the tetrahydrate, the other two samples being the heptahydrate. Metals other than iron were present only in small quantities; a spectrochemical analysis shows about 0.1% Mg, between 0.01 and 0.1% Al and Mn, about 0.01% Si, and traces of Cu, Ni, Co, Ga, Ti, and Y.

The X-ray diffraction patterns of the two hydrates were determined (table I) and found to differ from those listed in the relevant A.S.T.M. cards (0560/d/1-0253). These determinations were made under standard conditions (Co- $K\alpha$, 42 kV, 15 mA, Fe filter) and the diffraction photographs were photometered with an automatic double-beam microdensitometer. The samples were prepared by grinding the repeatedly recrystallized heptahydrate and the tetrahydrate to pass a 200 British Standard mesh screen and subjecting them to gentle extrusion.¹

The X-ray diffraction pattern given by the sample of greenish-white

TABLE I. X-ray diffraction data recorded by the authors.

Ferrous sulphate heptahydrate				Ferrous sulphate tetrahydrate			
<i>d</i> , Å.	<i>I</i> .	<i>d</i> , Å.	<i>I</i> .	<i>d</i> , Å.	<i>I</i> .	<i>d</i> , Å.	<i>I</i> .
6.60	4	1.95	27	6.60	19	1.64	13
5.92	7	1.90	10	5.72	6	1.62	17
5.26	42	1.86	22	5.31	67	1.59	9
4.69	100	1.84	28	4.73	43	1.56	11
4.42	19	1.74	9	4.37	100	1.48	13
3.95	29	1.68	10	3.90	52	1.43	33
3.70	54	1.65	5	3.35	56	1.38	20
3.53	2	1.61	9	3.20	45	1.30	29
3.35	13	1.59	3	2.93	72	1.26	9
3.20	42	1.54	11	2.71	30	1.24	9
3.06	23	1.52	11	2.56	48	1.16	11
2.95	14	1.49	12	2.40	39	1.13	11
2.71	46	1.45	6	2.34	48	1.23	9
2.61	45	1.39	7	2.24	44	1.22	7
2.45	20	1.35	9	2.10	15	1.09	7
2.40	18	1.32	5	1.95	39		
2.29	13	1.30	5	1.88	35		
2.25	7	1.24	6	1.78	22		
2.18	5	1.21	4	1.74	17		
2.06	12	1.19	5	1.71	15		
2.00	24	1.17	6	1.66	13		

fibres was the same as that given by the ferrous sulphate heptahydrate. This confirms the identity of the sample as melanterite.

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¹ M. Kossenber, Journ. Sci. Instr., 1955, vol. 32, p. 117.

BOOK REVIEWS

BRUHNS (W.) and RAMDOHR (P.) *Petrographie*. Sammlung Göschel, vol. 173. Berlin, 1960. 141 pp., 21 figs. 3.60 DM.

This small book gives a condensed and well-rounded survey of the whole field of petrology and is extremely good value. The descriptive aspects predominate and make it especially valuable for those geologists