

required to produce the desired effect. Rarely is it possible to etch a surface in less than 15 minutes and sometimes 45 minutes will be needed.

When the operator thinks that the etching is deep enough, the etchant is washed off with alcohol and the application of alcohol repeated a second time. This washing is followed by two or three minutes of washing in a stream of running water with continued brushing. The etched face is then rewashed with alcohol at least twice to remove the water, and then dried before an electric fan.

It occasionally happens that a spot will appear which has a slight tarnish. Sometimes this can be effectively removed with a clean rubber eraser, but if the spot does not yield to light rubbing it will be necessary to reetch the meteorite with a freshly prepared etching solution made up to contain one half the quantity of nitric acid used in the first solution.

This method gives an etched surface on a meteorite which is more lustrous than can be obtained by using nitric acid or nital (5% nitric acid and alcohol). If the meteorite is free from lawrencite, the etched surface will remain bright and in perfect condition as long as it is not touched with the fingers. This surface does not require protection of lacquers. Prior to the development of this method by Mr. B. O. Reberholt, the meteorites in the display cases in this Museum required refinishing every year or so. The present display of iron meteorites was installed nearly 8 years ago and none have required any refinishing.

BODENBENDERITE, A DISCREDITED SPECIES*

CHARLES MILTON AND ALFRED TENNYSON MYERS,
U. S. Geological Survey, Washington, D. C.

In 1928 Eberhard Rimann (1) proposed the name bodenbenderite for a supposed new compound of composition given as $(\text{Mn,Ca,Fe,Mg})_4\text{Al}[(\text{Al,Y})\text{O}] [(\text{Si,Ti,U})\text{O}_4]_3$. The proposed new species was received with some reserve; thus, J. F. Schairer (2) in 1929 commented that the data were unsatisfactory; in 1932 Dana-Ford (3) listed bodenbenderite in small capitals, signifying a species of doubtful validity; in 1934 Larsen-Berman (4) suggested a possible relationship to beckelite, notwithstanding considerable differences in the formulas ascribed to the two substances. In 1941 Strunz (5) listed it, as probably a variety of garnet, with a question mark as denoting an inadequately defined "mineral."

Recently, Dr. Michael Fleischer of the Geological Survey brought to our attention the unsatisfactory status of bodenbenderite. Through the kindness of Dr. William F. Foshag, of the United States National Museum, a specimen of the original material (U.S.N.M. 95804) was made

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available for study. This had been obtained from Rimann shortly after his two papers were published.

The two papers by Rimann, one in German, the other a Spanish translation, to which latter is added a spectrographic study, give in much detail the chemical analytical work, from which the composition of the supposed mineral was determined. However, a casual glance at a thin section of the material would have shown the hopelessness of interpreting even a good analysis of such a mixture. The microphotograph (Fig. 1) shows the complex intergrowth of the material.

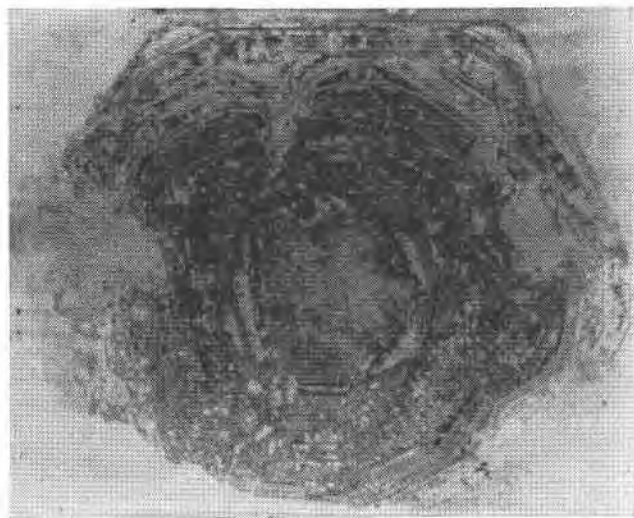


FIG. 1. "Bodenbenderite" = spessartite, fluorite, etc.

× 9 thin section. The opaque layers may be mixtures of spessartite with manganese oxide; the spessartite forms thin shells interlayered with much fluorite, chlorite, albitic plagioclase, etc.

Carefully selected crushed fragments of the cleanest possible material gave good x -ray patterns, which our co-worker Joseph Axelrod found to consist solely of the lines of garnet and fluorite. Spectrographic study gave the following data, which are presented along with Rimann's analysis (by E. Gruner).

The major discrepancies are in TiO_2 , CaO , and Y_2O_3 (yttria earths).

The analysis by Gruner is that of "selected as pure as possible material" with "admixture of fluorspar, penninite, and CO_2 (sic)." Furthermore, the percentages given are an average of two analyses, with no data listed as to their divergence. It is supplemented by two others, both also the average of two analyses. One is that of the portion dissolved in eight

	A. T. MYERS (SPECTROGRAPHIC)	E. GRUNER
SiO ₂	XO.	20.2
TiO ₂	.X	7.4
MnO	XO.	34.3
FeO	X.O (Total Fe)	.3
CaO	XO.	5.5
MgO	.X	.3
Al ₂ O ₃	XO.	10.7
Fe ₂ O ₃		1.2
Y ₂ O ₃	.OX	}13.2
Er ₂ O ₃		
K ₂ O		.2
Na ₂ O		.3
H ₂ O		1.3
CO ₂		3.8
U ₃ O ₈		.4
F		2.3

hours in hot 4*n* HCl; the other, that of the insoluble residue. After deductions for CaF₂, gaseous (!) CO₂, muscovite, hematite, and moisture, totaling 16.7 per cent of the first analysis, the residue is computed to the formula ascribed to bodenbenderite.

It is hardly worth while to discuss in detail the methods of an obviously bad analysis; however, it seems likely that the major errors were (1) failure to remove fluorine completely, evaporation of the sodium-carbonate melt with HCl at 110° C. being insufficient, and, as is well known, fluorine affects adversely the determination of many if not most elements; (2) it is likely that Gruner precipitated calcium or manganese, or both, as oxalates, mistaking the precipitate for rare-earth oxalates. The oxides weighed as yttrium earths were therefore in all likelihood calcium, probably with some manganese.

It may be noted here that spessartite garnets do carry small but detectable quantities, usually on the order of hundredths of a per cent, of yttrium earths. An investigation of this by Howard Jaffe and Charles Milton is in progress and will appear in this journal.

In the spectrographic discussion forming part of his paper in Spanish, Rimann mentions that in the visible spectrum, in order of intensity, there were recognized: Ca, Mn, Al, Mg, Na, K, Si, Fe, Ti, Y, Er, Nd, Pr, which is not the order of abundance given by his analysis with respect to Mg, Na, K, Ti, and the rare earths, but does agree with our spectrographic data in the ultra-violet.

In summary, the name bodenbenderite for a mineral species has no justification and should be dropped.

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- (2) SCHAIRER, J. F., *Am. Mineral.*, **14**, 388 (1929).
- (3) DANA, E. S., Textbook of Mineralogy, 4th ed. by W. E. Ford, page 634.
- (4) LARSEN, ESPER S., AND BERMAN, HARRY, Microscopic Determination of the Non-opaque Minerals, *U.S.G.S. Bull.*, **848**, page 58.
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CORRECTIONS TO RECENT PAPERS ON
PROBERTITE AND LINDGRENITE

WILLIAM H. BARNES, *National Research Council, Ottawa, Ontario.*

In a recent paper on "The Unit Cell and Space Group of Probertite" (*Am. Mineral.*, **34**, 19-25 (1949)), at the bottom of p. 23 and the top of p. 24, Fl_c^* and Fl_a^* are shown equal to Fd_c^* and Fd_a^* , respectively. Since probertite is monoclinic, this is, of course, not true (see bottom of p. 22) when l^* and d^* have their usual significance. The manuscript of this paper was completed in March 1948 and, at the present date, I am unable to offer any explanation for this error except the possibility of an automatic but irrational reflex in making the *b Axis, Zero Level* data symmetrical in appearance with those for the *a Axis, Zero Level*. The aberration does not appear in my original notes. At the bottom of p. 23, c^* translation (t_c^*) and spacing (d_c^*) should read c^* spacing (d_c^*) and, at the top of columns 2 and 4, Fl_c^* should be deleted. Similarly, at the top of p. 24, a^* translation (t_a^*) and spacing (d_a^*) should read a^* spacing (d_a^*) and, at the top of columns 2 and 4, Fl_a^* should be deleted.

For the data presented in "The Unit Cell and Space Group of Lindgrenite" (*Am. Mineral.*, **34**, 163-172 (1949)), photographs obtained with copper radiation were used. Subsequently other crystals were examined with molybdenum radiation. Since diffraction photographs of the latter, of course, show many more reciprocal lattice points, they were selected for reproduction. Due to the small difference between d_c^* and d_a^* the identities of the c^* and a^* axes have been assigned incorrectly in Figs. 7, 8, 9, 10, pp. 168, 169. Thus under Figs. 7 and 8, *new a axis* should read *new c axis* and under Figs. 7, 8, 9, 10, (*new c* horizontal*) should read (*new a* horizontal*). In this connection measurement of the original negatives of Figs. 7 and 9 to check this point has given values for c^* and a^* within 0.3% of those obtained previously using a different crystal, a different radiation and a different Buerger precession film measuring device,