THENARDITE CRYSTALS FROM RHODES MARSH, NEVADA

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The specimens which furnished the basis of this paper were collected from Rhodes Marsh, Mineral County, Nevada, by Dwight Lemmon and were assigned to the writer for detailed study by Professor A. F. Rogers, who also directed the study and made many valuable suggestions. Grateful acknowledgment is hereby expressed to each of them.

Rhodes Marsh, nine miles south of Mina, Nevada, is described by P. C. Rich[1] as having a mineralized section of 200 acres, the northern part of which consists of three to five feet of thenardite (Na_2SO_4) underlain by fifteen feet of mirabilite ($Na_2SO_4 \cdot 10H_2O$), and overlain by about one

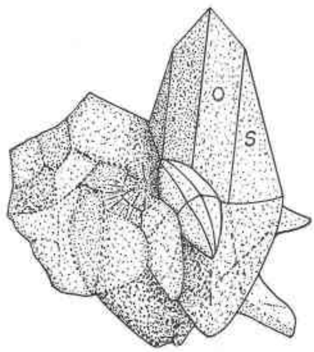

FIG. 1. Sketch of Thenardite from Rhodes Marsh
(About ½ natural size)

foot of fine silt and halite. Rich believes that brines filled the old borax workings in this locality, and during the evaporation that deposited the NaCl, enough heat was transmitted into the bed of salts to cause the conversion of mirabilite to thenardite.

The mineral, unidentified by the writer when assigned to him, was determined to be thenardite by microchemical tests for sodium and the sulfate radical, and the absence of water in a closed tube. The identification was confirmed by optical tests, n_α (1.46+) and n_γ (1.48+). Biaxial positive interference figures with very large axial angles were found without difficulty.

From Rhodes Marsh have come many thenardite crystals, ranging in size to some slightly larger than the one described here. This crystal, shown in the accompanying figure, which is not a regulation clinographic

[1] Rich, P. C., Sodium sulfate from Nevada finds ready market: *Eng. and Min. Jour.*, vol. **134,** pp. 252–253, 1933.

drawing but a sketch in about the conventional position, protrudes from a mass of subhedral and anhedral fragments. The bottom half is rough and broken and shows rounded faces, but the top is almost perfectly developed, consisting of two rhombic dipyramids. The faces have a few pits and elevations, but are generally smooth and their edges sharp. The crystal is icy-white in color, and its dimensions in the directions of the *a*-, *b*-, and *c*-axes are respectively: 4.8 cm, 3.8 cm, and (assuming the crystal to be complete) 10.6 cm.

The interfacial and interzonal angles were measured with a contact goniometer, and a comparison of the values listed in Dana's *System* indicated the two forms to be *o*{111} and *s*{131}.

LIST OF INTERFACIAL ANGLES

Angle	*Measured* (10 readings)	*Recorded*
oo‴ (111:1$\bar{1}$1)	56°23′	56°41′
oo′ (111:$\bar{1}$11)	108 00	105 11
ss‴ (131:1$\bar{3}$1)	118 42	116 34
ss′ (131:$\bar{1}$31)	56 30	56 39
os (111:131)	31 24	29 57½

LIST OF INTERZONAL ANGLES

Angle	*Measured* (10 readings)	*Recorded*
[0$\bar{1}$1]:[0$\bar{1}$3]	25°36′	23°43′
[001]:[0$\bar{1}$1]	103 30	102 47
[101]:[10$\bar{1}$]	131 00	128 59

The discrepancies could easily be due to the slight curvature of several faces and to irregularities.

The interzonal angles were found by measurement of the appropriate edges. The ability to measure the angles between edges of a crystal is one of the few advantages of using a contact goniometer.

Thenardite crystallizes in the rhombic dipyramidal class with an axial ratio of $a:b:c=0.5976:1:1.2524$. The most persistent form is *o*{111}. The other known forms include *m*{110}, *t*{106}, *r*{101}, *c*{001}, *b*{010}, *e*{011}, which also acts as the twinning plane for cruciform twins, *v*{113}, *u*{130}, and *s*{131}, which is not nearly so common as *o*{111}, but which has been described from several localities.

The crystal described here is a combination of forms not given in Goldschmidt's *Atlas*. The crystal development makes this a very attractive specimen of a mineral not usually found in good crystals.