# AN UNUSUAL FORM OF THAUMASITE FROM THE DUCKTOWN DISTRICT, TENNESSEE*

WALDEMAR T. SCHALLER,
*U. S. Geological Survey, Washington, D. C.*

## OCCURRENCE

An unusual occurrence of thaumasite, $CaSiO_3 \cdot CaSO_4 \cdot CaCO_3 \cdot 15H_2O$, was found by Mr. V. L. Kegler[1] in the Isabella mine, Isabella, Ducktown district, Tenn. The mineral was first noted as small tuffs of radiating crystals on the iron sulphides and was identified as thaumasite by Dr. C. S. Ross of the U. S. Geological Survey. It occurs in seams or vug-like cavities in the sulphides, 200 feet below the zone of secondary enrichment and seems to be associated with small surface-water channels which penetrate the primary ores, dominantly pyrrhotite with minor quantities of pyrite, chalcopyrite, sphalerite, and magnetite. Most of the thausmasite forms small patches of white needle-like crystals but one specimen (presented by Mr. Kegler to the U. S. National Museum),

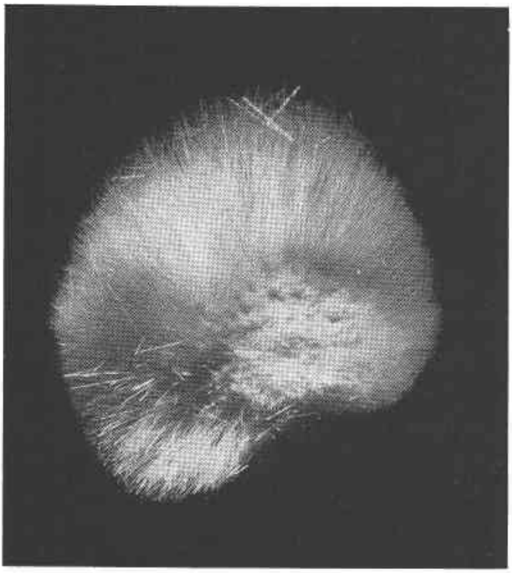

FIG. 1. Spherulitic group of thaumasite crystals from Ducktown, Tenn. Enlarged two diameters.

---

* Published by permission of the Director, U. S. Geological Survey.

[1] Until recently mine superintendent of the Ducktown Chemical and Iron Company, Isabella, Tenn.

shown enlarged two diameters in figure 1, consists of a spherulitic group of very thin crystals radiating from a center of more massive material. The specimen resembles a zeolitic mineral much more than it does the thaumasite from Paterson, N. J., which is either compact massive, or in stubby crystals, usually only a few times as long as thick.

The individual crystals of the specimen shown in figure 1 are about a centimeter long and have an average thickness of only 0.04 (varying from 0.03 to 0.045) millimeters, a little thinner than a human hair. The ratio of length to thickness is about 250:1.

## CRYSTALLOGRAPHY

Many of the crystals are terminated by the base $c\{0001\}$ and the pyramid of the first order $e\{10\bar{1}2\}$. The prism $m\{10\bar{1}0\}$ is the only other form identified. The terminal forms are about of equal size with the base slightly predominating.

The measurements for $e\{10\bar{1}2\}$ are as follows:

| *Measured* | | *Calculated* | |
|---|---|---|---|
| $\phi$ | $\rho$ | $\phi$ | $\rho$ |
| 0°52′ | 29°42′ | 0°00′ | 28°16′ |
| 1 52 | 28 47 | | |
| 0 02 | 28 47 | | |
| 1 30 | 28 31 | | |

The form $e\{10\bar{1}2\}$ was first identified on crystals from West Paterson, N. J., by Wherry.[2] The terminated crystals from the same locality earlier described by the writer[3] also had minute faces of a form whose $\rho$ angle varied between 31° and 32°. No indices were assigned to this form but on the basis of Wherry's measurements the form is $e\{10\bar{1}2\}$. Wherry lists the forms $c$, $m$, $a$, $e$, $p$, $f\{20\bar{2}3\}$, and $q\{30\bar{3}2\}$. Crystals from Sweden and from Crestmore, Calif., showed only the three forms $c$, $m$, and $p$.

The best crystallographic data are those of Wherry who gives $(0001) \wedge (10\bar{1}1) = 47°05'$, $c = 0.931$, determined on thaumasite crystals from West Paterson, N. J. Flink[4] obtained a similar value, namely 47°35′, whence $c = 0.9479$, on thaumasite from Långbanshyttan, Sweden.

## OPTICAL PROPERTIES

The indices of refraction of the thaumasite from Ducktown were determined as $\epsilon = 1.468$, $\omega = 1.506$. Determinations of the indices of

---

[2] Wherry, E. T., Notes on mimetite, thaumasite, and wavellite: *U. S. Nat. Museum Proceed.*, vol. **54**, p. 377, 1919.

[3] Schaller, W. T., The crystallography of thaumasite: *U. S. Geol. Survey, Bull.* **610**, pp. 131–132, 1916.

[4] Flink, Gustave, Einige Neuigkeiten in schwedischer Mineralogie. 4. Thaumasit: *Geol. Fören. Förh.*, vol. **39**, pp. 447–452, 1917.

refraction of this mineral from different localities show a constant value, as is to be expected from the remarkable constancy of chemical composition of thaumasite, as evidenced by the several chemical analyses in the literature.

INDICES OF REFRACTION OF THAUMASITE[5]

| | $\epsilon$ | $\omega$ | $B$ |
|---|---|---|---|
| Sweden (Bertrand) | 1.467 | 1.503 | .036 |
| Sweden (Lévy & Lacroix) | 1.468 | 1.507 | .039 |
| Utah (Butler) | 1.464+ | 1.500+ | .036 |
| New Jersey (Brown) | 1.468 | 1.505 | .037 |
| New Mexico | 1.47 | 1.51 | .04 |
| Virginia | — | 1.505 | — |
| Ducktown | 1.468 | 1.506 | .038 |
| Av. | 1.468 | 1.506 | .038 |

In its constancy of chemical composition, notwithstanding the presence of three acid radicles, thaumasite differs from the varying composition of the similar more complex wilkeite group in which $P_2O_5$ is a fourth acid radicle.[6]

## LOCALITIES AND ORIGIN

A mineral of such an unusual composition as thaumasite might be expected to form only under very unusual conditions and hence to be of extremely rare occurrence. Although it is known only from Sweden and the United States, there are 12 localities where it has been found. Four localities are known in Sweden; the Bjelkes mine near Åreskutan; Kjoland in Kalls Kirchspiel, Jemtland; Skottvång in Södermanland; and Långbanshyttan.

It has been found in six States in the United States, as follows:

New Jersey—West Paterson and Great Notch
Virginia—Leesburg

---

[5] Thaumasite (easily available from Paterson, N. J.) is excellent material for student practice. Four student determinations gave:

| $\epsilon$ | $\omega$ |
|---|---|
| 1.468 | 1.508 |
| 1.465 | 1.508 |
| 1.462 | 1.506 |
| 1.468 | 1.506 |

Thaumasite has no basal cleavage and hence it is difficult (and good practice) for a student to obtain a fragment nearly parallel to the base which will show the uniaxial interference figure.

[6] McConnell, Duncan, The substitution of $SiO_4-$ and $SO_4-$ groups for $PO_4-$ groups in the structure of apatite; ellestadite, the end-member: *Am. Mineral.*, vol. **22**, pp. 977–986, 1937.

Tennessee—Ducktown
New Mexico—Magdalena
Utah—Beaver County
California—Riverside and San Bernardino counties

When the origin of the thaumasite from West Paterson, N. J., became known through the discovery of anhydrite[7] and gypsum as its source material, Wherry[8] was justifiedly led to regard thaumasite, systematically, as a sulphate rather than as a silicate, a conclusion with which Holden concurred.[9] Later discoveries of thaumasite at other localities and under different geological environments, raise doubts as to whether it should be so considered.

At three of the American localities it occurs with limestone or dolomite in which no sulphate mineral other than thaumasite is reported. In Utah, thaumasite forms a network of small veins in the contact-altered limestone on the first level, about 80 feet below the surface in the Old Hickory mine in Beaver County.[10] In San Bernardino County, California, thaumasite forms narrow veins in metamorphosed dolomite.[11] Thaumasite forms a felted crust of silky fibers on some of the metamorphosed limestone northeast of Oak Spring, Magdalena district, Socorro County, New Mexico.[12]

At Leesburg, Virginia, thaumasite was found[13] in xonotlite which forms thin seams in relatively unaltered limestone. At Crestmore, Riverside County, California, thaumasite[14] was derived from spurrite, a carbonate-silicate of calcium, by the action of sulphated waters. Later examination showed[15] that merwinite, gehlenite, diopside, and wollastonite—all silicates—are intimately associated with the spurrite.

---

[7] Allen, F. I., The origin of thaumasite: *Am. Jour. Sci.*, 4th ser., vol. **39**, p. 134, 1915. See also Schaller, W. T., The crystal cavities of the New Jersey zeolite region: *U. S. Geol Survey, Bull.* **832**, pp. 35–36, 38–40, (pls. 12, B; 15, and 16), 1932.

[8] Wherry, *op. cit.*, pp. 378–379.

[9] Holden, E. F., A study of the constitution of thaumasite: *Am. Mineral.*, vol. **7**, p. 14, 1922.

[10] Butler, B. S., and Schaller, W. T., Thausmasite from Beaver County, Utah: *Am. Jour. Sci.*, 4th ser., vol. **31**, pp. 131–134, 1911.

[11] Schaller, W. T., Monticellite from San Bernardino County, California, and the monticellite series: *Am. Mineral.*, vol. **20**, p. 816, 1935.

[12] Statement taken by permission of G. F. Loughlin from manuscript of unpublished report: Geology and ore deposits of Magdalena district, N. Mex., by G. F. Loughlin and A. H. Koschmann.

[13] Shannon, E. V., Mineralogy and petrography of Triassic limestone conglomerate metamorphosed by intrusive diabase at Leesburg, Virginia: *U. S. Nat. Museum Proceed.*, vol. **66**, Article 28, p. 13, 1925.

[14] Foshag, W. F., Thaumasite and spurrite from Crestmore, California: *Am. Mineral.*, vol. **5**, pp. 80–81, 1920.

[15] Larsen, E. S., and Foshag, W. F., Merwinite, a new calcium magnesium orthosilicate from Crestmore, California: *Am. Mineral.*, vol. **6**, p. 147, 1921.

The two localities in New Jersey are the only American localities in which it can be shown that the thaumasite was derived from a sulphate mineral. As it evidently can be derived from either a carbonate, carbonate-silicate, or silicate mineral, its placement as a sulphate rather than a silicate, on the basis of its origin in New Jersey, seems questionable. The Ducktown occurrence gives no direct clue to any parent mineral and its deposit on iron sulphide suggests that it formed from commingling waters containing the necessary constituents, rather than directly from some pre-exsiting calcium mineral.

NOTE. An occurrence of 1–5 mm. wide veins of thaumasite ($\omega = 1.507$, $\epsilon = 1.468$) in a metamorphosed inclusion of marl in basalt from Hungary has recently been described by Mauritz.[16] This is an additional occurrence of thaumasite not derived from a pre-existing sulphate mineral.

---

[16] Mauritz, B., Die Mineralien in den Hohlraümen der Basalte von Haláp und Gulács im Plattenseegebiete (Ungarn): *Mineral. Petrogr. Mitteil.* (*Zeits. Krist., Mineral., Petrogr., Abt. B*), vol. **50,** (heft 2), pp. 94–95, 1938.