

**Tennantite****(Cu, Ag, Zn, Fe)<sub>12</sub>As<sub>4</sub>S<sub>13</sub>**

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**Crystal Data:** Cubic. *Point Group:*  $\bar{4}3m$ . Crystals are tetrahedral, as large as 20 cm; may be as groups of parallel crystals; commonly massive, coarse or fine granular to compact. *Twinning:* Twin axis [111], twin plane {111}, as contact and penetration twins, commonly repeated.

**Physical Properties:** *Fracture:* Subconchoidal to uneven. *Tenacity:* Somewhat brittle. Hardness = 3–4.5 VHN = 294–380 (100 g load). D(meas.) = 4.62 D(calc.) = 4.61

**Optical Properties:** Opaque, except in very thin fragments. *Color:* Flint-gray to iron-black, cherry-red in transmitted light; in polished section, gray inclining to black to brown to cherry-red (high As and low Fe). *Luster:* Metallic, commonly splendent. *Optical Class:* Isotropic.  $n = > 2.72$  (Li).

R: (400) 31.5, (420) 31.4, (440) 31.4, (460) 31.2, (480) 31.0, (500) 30.8, (520) 30.6, (540) 30.2, (560) 29.7, (580) 29.0, (600) 28.3, (620) 27.7, (640) 27.1, (660) 26.6, (680) 26.2, (700) 25.9

**Cell Data:** *Space Group:*  $I\bar{4}3m$ .  $a = 10.19$   $Z = 2$

**X-ray Powder Pattern:** Binntal, Switzerland.

2.94 (100), 1.801 (80), 1.535 (50), 2.55 (30), 1.169 (30), 1.041 (30), 2.40 (20)

<b>Chemistry:</b>	(1)	(2)	(3)		(1)	(2)	(3)
Cu	35.72	42.05	51.56	As	17.18	12.57	20.26
Ag	13.65	0.04		Sb	0.13	10.87	
Zn	6.90	6.09		S	25.04	27.12	28.18
Pb	0.86			<b>Total</b>	<b>99.90</b>	<b>100.22</b>	<b>100.00</b>
Fe	0.42	1.48					

(1) Molly Gibson mine, Colorado, USA; corresponds to  $(\text{Cu}_{9.36}\text{Ag}_{2.11}\text{Zn}_{1.75}\text{Fe}_{0.12}\text{Pb}_{0.07})_{\Sigma=13.41}(\text{As}_{3.82}\text{Sb}_{0.02})_{\Sigma=3.84}\text{S}_{13.00}$ . (2) San Lorenzo mine, Santiago, Chile; corresponds to  $(\text{Cu}_{10.17}\text{Zn}_{1.43}\text{Fe}_{0.41}\text{Ag}_{0.01})_{\Sigma=12.02}(\text{As}_{2.58}\text{Sb}_{1.37})_{\Sigma=3.95}\text{S}_{13.00}$ . (3)  $\text{Cu}_{12}\text{As}_4\text{S}_{13}$ .

**Polymorphism & Series:** Forms a series with tetrahedrite.

**Mineral Group:** Tetrahedrite group.

**Occurrence:** In hydrothermal veins and contact metamorphic deposits.

**Association:** Cu–Pb–Zn–Ag sulfides and sulfosalts, pyrite, calcite, dolomite, siderite, barite, fluorite, quartz.

**Distribution:** From numerous localities; rarer than tetrahedrite. In England, in Cornwall [TL], from a number of mines in Gwennap, Gwinear, Illogan, St. Just, and elsewhere. An ore mineral in the Gortdrum mine, near Tipperary, Co. Tipperary, Ireland. In Germany, from Freiberg, Saxony. In Poland, at Kupferberg-Rudelstadt, Silesia. In Switzerland, from the Lengenbach quarry, Binntal, Valais. At Dzhezkazgan, Kazakhstan. In the USA, in Colorado, from many localities, including the Freeland mine, Idaho Springs, Clear Creek Co.; in the Central City district, Gilpin Co.; at the Molly Gibson and other mines, Aspen, Pitkin Co.; in the Red Mountain district, San Juan Co.; from the Champion Lode, Geneva, Georgetown district, Clear Creek Co.; at Butte, Silver Bow Co., Montana. From Concepción del Oro, Zacatecas, Mexico. At Morococha and Quiruvilca, Peru. From the El Teniente mine, 67 km west of Rancagua, O'Higgins Province, Chile. At Yaogonxian, Hunan Province, China. From Tsumeb, Namibia, remarkable large crystals. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise without the prior written permission of Mineral Data Publishing.

**Name:** In honor of Professor Smithson Tennant (1761–1815), English chemist of Oxford University, Oxford, England.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 374–384. (2) Weunsch, B.J., Y. Takéuchi, and W. Nowacki (1966) Refinement of the crystal structure of binnite,  $\text{Cu}_{12}\text{As}_4\text{S}_{13}$ . *Zeits. Krist.*, 123, 1–20. (3) Berry, L.G. and R.M. Thompson (1962) X-ray powder data for the ore minerals. *Geol. Soc. Amer. Mem.* 85, 55–56. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 557.