

**Crystal Data:** Cubic. *Point Group:*  $4/m\bar{3}2/m$ . Dominantly octahedral crystals, to 5 mm; commonly massive, granular and compact. *Twining:* On {111}.

**Physical Properties:** *Cleavage:* Imperfect on {001}. *Fracture:* Uneven to subconchoidal. Hardness = 4.5–5.5 VHN = 435–558, average 492 (50 g load). D(meas.) = 4.5–4.8 D(calc.) = 4.85

**Optical Properties:** Opaque. *Color:* Pale gray to steel-gray. *Luster:* Metallic, easily tarnished.

R: (400) 41.5, (420) 41.8, (440) 42.2, (460) 43.0, (480) 44.0, (500) 45.0, (520) 46.0, (540) 47.0, (560) 48.0, (580) 49.0, (600) 49.9, (620) 50.7, (640) 51.6, (660) 52.4, (680) 53.1, (700) 53.7

**Cell Data:** *Space Group:*  $Fd\bar{3}m$ .  $a = 9.43$   $Z = 8$

**X-ray Powder Pattern:** Müsen, Germany.

2.83 (100), 1.670 (80), 2.36 (70), 1.815 (60), 0.988 (50), 3.34 (40), 1.090 (40)

**Chemistry:**

	(1)	(2)	(3)
Co	40.71	48.70	57.96
Ni	7.35	4.75	
Cu	8.79	2.40	
Fe	1.30	2.36	
S	41.43	41.70	42.04
insol.	0.14	0.40	
Total	99.72	100.31	100.00

(1) Gladhammar, Sweden; corresponds to  $(\text{Co}_{2.14}\text{Cu}_{0.43}\text{Ni}_{0.39}\text{Fe}_{0.07})_{\Sigma=3.03}\text{S}_{4.00}$ . (2) Carroll Co., Maryland, USA; corresponds to  $(\text{Co}_{2.54}\text{Ni}_{0.25}\text{Fe}_{0.13}\text{Cu}_{0.12})_{\Sigma=3.04}\text{S}_{4.00}$ . (3)  $\text{Co}^{2+}\text{Co}_2^{3+}\text{S}_4$ .

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

**Mineral Group:** Linnaeite group.

**Occurrence:** In hydrothermal veins with other cobalt and nickel sulfides.

**Association:** Chalcopyrite, pyrrhotite, millerite, bismuthinite, gersdorffite, carrollite, cattierite, ullmannite, marcasite, pyrite, galena, sphalerite.

**Distribution:** In Sweden, from the Bastnäs mine, near Ridrarhyttan, Västmanland [TL], and at Gladhammar, Kalmar. At Outokumpu, Finland. In Germany, from Müsen, North Rhine-Westphalia; at Altenberg, Saxony; in the Grube Georg, near Horhausen, Westerwald. At Kladno, Czech Republic. In the USA, from the Springfield and Mineral Hill mines, Carroll Co., Maryland; and at the Mine La Motte, Madison Co., Missouri. In Congo (Zaire), in the Musonoi mine, near Kolwezi, Katanga (Shaba) Province. At the N'Kana mine, Kitwe, from the Chambishi Southeast prospect, and in the Rhokana mine, Zambia. In the Wonderland and Selukwe Peak mines, Selukwe, Zimbabwe. From Tsumeb, Namibia. Known from a number of other minor occurrences.

**Name:** In honor of Carl von Linné [Carolus Linnaeus] (1707–1778), Swedish taxonomist.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 262–265. (2) De Jong, W.F. and H.W.V. Williams (1927) Die Verbindungen  $\text{Fe}_3\text{S}_4$ ,  $\text{Co}_3\text{S}_4$ ,  $\text{Ni}_3\text{S}_4$  und ihre Struktur. Z. Anorg. Allg. Chem. 161, 311–315 (in German). (3) Berry, L.G. and R.M. Thompson (1962) X-ray powder data for the ore minerals. Geol. Soc. Amer. Mem. 85, 103. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 323.

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