Crystal Data: Cubic. *Point Group:* $4/m\ \bar{3}\ 2/m$. Typically octahedral, less commonly dodecahedral, striated ‖ $[0\bar{1}1]$ on {011}, to 25 cm, very rarely cubic; skeletal, granular, massive. *Twinning:* On {111} as both twin and composition plane, the spinel law, as contact twins, flattened, lamellar.

Physical Properties: *Cleavage:* Parting on {111}, very good. *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 5.5–6.5 VHN = 681–792 (100 g load). D(meas.) = 5.175 D(calc.) = 5.20 Strongly magnetic.

Optical Properties: Opaque, translucent through very thin edges. *Color:* Black; gray with brownish tint in reflected light. *Streak:* Black. *Luster:* Metallic to submetallic, may be dull. *Optical Class:* Isotropic. $n = 2.42$
R: (400) 22.3, (420) 21.8, (440) 21.3, (460) 20.8, (480) 20.5, (500) 20.3, (520) 20.3, (540) 20.4. (560) 20.5, (580) 20.6, (600) 20.6, (620) 20.7, (640) 20.8, (660) 20.9, (680) 21.0, (700) 21.2

Cell Data: *Space Group: Fd3m* (synthetic). $a = 8.3970(1)$ Z = 8

X-ray Powder Pattern: Synthetic.
2.532 (100), 1.485 (40), 2.967 (30), 1.616 (30), 2.099 (20), 1.093 (12), 1.715 (10)

Chemistry:

	(1)	(2)	(3)
SiO_2	0.27	0.11	
TiO_2	trace	0.29	
Al_2O_3	0.21	0.44	
Fe_2O_3	68.85	67.16	68.97
Cr_2O_3		0.08	
FeO	30.78	31.21	31.03
MnO		0.09	
MgO	trace	0.02	
CaO	trace		
Total	100.11	99.40	100.00

(1) Lovers Pit, Mineville, Essex Co., New York, USA. (2) Meier's Find, Western Australia; by electron microprobe, Fe^{2+}:Fe^{3+} calculated from stoichiometry. (3) $Fe^{2+}Fe_2^{3+}O_4$.

Polymorphism & Series: Forms two series, with jacobsite, and with magnesioferrite.

Mineral Group: Spinel group.

Occurrence: A common accessory mineral in igneous and metamorphic rocks, in which magmatic segregation or contact metamorphism may produce economic deposits. Extensive deposits in sedimentary banded iron formations; a biogenic product; important detrital deposits.

Association: Chromite, ilmenite, ulvöspinel, rutile, apatite, silicates (igneous); pyrrhotite, pyrite, chalcopyrite, pentlandite, sphalerite, hematite, silicates (hydrothermal, metamorphic); hematite, quartz (sedimentary).

Distribution: Many localities, even for fine crystals. In Sweden, at Falun, Kiruna, Västanfors. and elsewhere. At Arendal, Norway. From Zlatoust and Magnetigorsk, Ural Mountains, Russia. In the Zillertal, Tirol, Austria. From Traversella, Piedmont, Italy. In Switzerland, at Binntal and Rimpfischwäng, Valais, and elsewhere. In the Gardiner complex, beyond the head of Kangerdlugssuaq Fjord, Greenland. From Bancroft, Ontario, Canada. In the USA, around Lake Sanford, Essex Co., and in the Tilly Foster mine, Brewster, Putnam Co., New York; at Magnet Cove, Hot Springs Co., Arkansas; in the Iron Springs district, Iron Co., Utah. From the Cerro del Mercado, Durango, Mexico. At Itabira, Minas Gerais, Brazil.

Name: An ancient term, possibly an allusion to the locality, *Magnesia*, Greece.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 698–707. (2) Deer, W.A., R.A. Howie, and J. Zussman (1962) Rock-forming minerals, v. 5, non-silicates, 56–88. (3) Gole, M.J. and C. Klein (1981) High-grade metamorphic Archean banded iron-formations, Western Australia: assemblages with coexisting pyroxenes ± fayalite. Amer. Mineral., 66, 87–99. (4) O'Neill, H.St.C. and W.A. Dollase (1994) Crystal structures and cation distributions in simple spinels from powder XRD structural refinements: $MgCr_2O_4$, $ZnCr_2O_4$, Fe_3O_4 and the temperature dependence of the cation distribution in $ZnAl_2O_4$. Phys. Chem. Minerals, 20, 541–555. (5) (1967) NBS Mono. 25, 5, 31.