PETROGRAPHY OF THE ROY, HARDING COUNTY, NEW MEXICO, METEORITE[1]

ROBERT E. S. HEINEMAN.[2]

The discovery of the Roy aerolite has been described by H. H. Nininger[3] in a recent article. A fragment of the stone, weighing 192.4 grams, and having a specific gravity of 3.39 was received from Mr. Nininger for the petrographic study. A small portion was broken from this piece and a polished surface examined. This polished surface fragment was then made into a thin-section, which, when completed, was 15 by 20 mm. in size.

The interior of the aerolite is generally chocolate-brown in color due to the presence of a relatively high amount of sesquioxide of iron. A few scattered spots are lighter tinted where the silicate minerals are not as highly stained with the oxidized material. The stone is fairly compact and, while it has a rough fracture, it breaks across both chondrules and matrix. It would be classified as a crystalline chondrite, but only after a microscopic examination as the chondrules cannot be easily distinguished in the hand-specimen.

The polished surface shows scattered, irregularly-shaped grains of a nickel-iron alloy, ranging from microscopic particles up to pieces approximately 2 mm. in diameter. The boundaries of the grains show alteration to and replacement by oxidation products. On etching the nickel-iron fragments with nitol[4] no octahedral Widmanstätten structure was obtained, but, instead, a roughly five- and six-sided, rather coarse granularity was noted. The alloy appeared to be constant in composition and the trias could not be distinguished. A few very fine Neumann lines were observed. In direction they bore no relation to the granularity of the alloy.

Considerable troilite is present in rather thin, irregularly shaped, elongated patches, seemingly a post-silicate fissure filling or replacement. In reflected light the troilite is brass-yellow in color and between crossed-nicols showed marked anisotropism. The matrix shows a number of thread-like, irregularly intersecting, dark veinlets. They are probably composed chiefly of ferric oxide.

[1] Published with the permission of the Director, Arizona Bureau of Mines.

[2] Mineralogist, Arizona Bureau of Mines, Tucson, Arizona.

[3] Nininger, H. H., The Roy Aerolite: *Popular Astronomy*, **XLIII**, 10, pp. 599–600, 1934.

[4] 5% solution of nitric acid in alcohol.

The thin section proved the aerolite to be a crystalline chondrite. The chondrules are very numerous and varied in character. They are scattered throughout a crystalline ground-mass which is composed largely of fragmental silicate grains, although a few euhedral

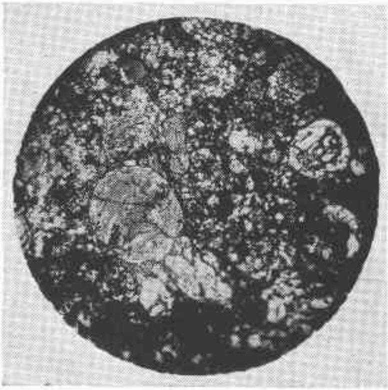


FIG. 1. General view. Note large enstatite chondrule. ×7.

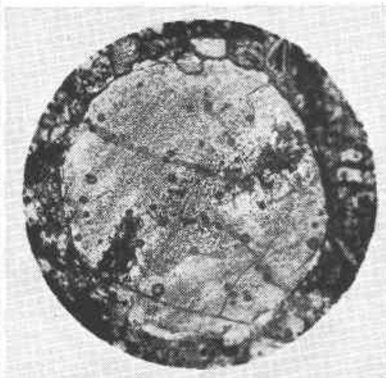


FIG. 2. Enstatite chondrule. ×20.

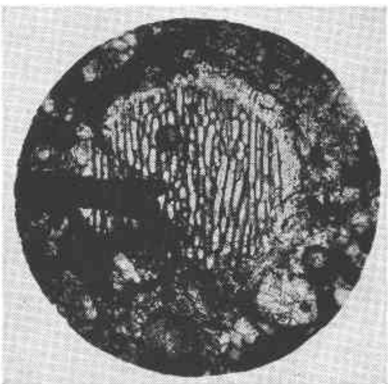


FIG. 3. Barred chrysolite chondrule. ×37.

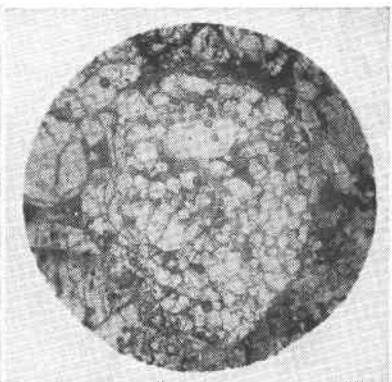
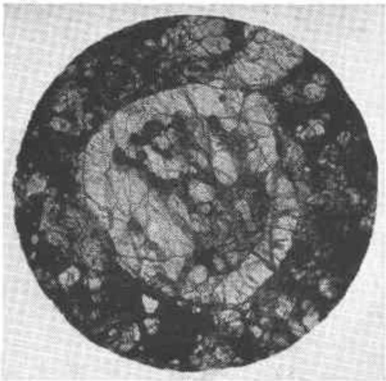


FIG. 4. Porphyritic chondrule. ×23

crystals of chrysolite and one of enstatite were seen. The ground-mass is heavily stained brown with ferric oxide between the grain boundaries and along fractures and cleavages. The ground-mass silicate is chiefly chrysolite.

The chondrules vary in size up to 2 mm. The largest one observed is a spherical enstatite chondrule and is shown in figure 2. There are no particularly unusual features in the stone, but it is of interest because of the variety of types of chondrules present. There are are the barred chrysolite type, the radiating enstatite (bronzite)



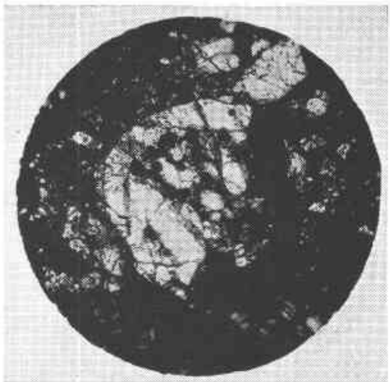


FIG. 5. Bordered, twinned chrysolite chondrule. ×27.

FIG. 6. Same chondrule as Fig. 5, showing twinning. Crossed nicols. ×27.

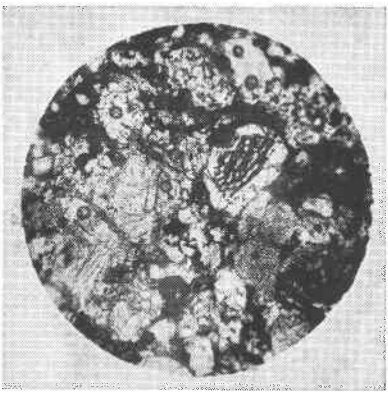


FIG. 7. Group of chrysolite chondrules with inclusions and several fragmental enstatite chondrules. ×20.

type, and the porphyritic type. Many of the chondrules are almost perfect spheres, but some are ellipsoidal in shape and many are fragmental. It is difficult to give a clear description of the structure of a stony meteorite and a better idea may be obtained by referring to the photomicrographs of the thin-section. Figure 1 is a general view at relatively low magnification. The enstatite chondrule mentioned previously may be seen in figure 2. Figure 3 shows a barred chrysolite chondrule, and a porphyritic chondrule enlarged is shown in figure 4. The particles composing this chondrule are chiefly chrysolite. A bordered twinned chrysolite chondrule is shown in figures 5 and 6. In figure 7, a chrysolite chondrule with inclusions and several fragmental enstatite chondrules may be seen. This same figure shows a number of small incipient chondrules within large chondrules and crystal grains.

A chemical analysis of the stone was made by F. G. Hawley[5] and is as follows:

Metallic portion:	0.04 grams.	
Non-metallic portion:	50.00 grams.	
Silicate analysis:		
SiO_2		36.95%
Al_2O_3		2.92
Fe_2O_3		13.29
Cr_2O_3		0.43
FeO		12.57
MnO		0.16
NiO		1.27
CoO		0.14
CuO		0.10
MgO		23.10
CaO		2.50
Na_2O		0.26
K_2O		0.06
TiO_2		0.12
P_2O_5		0.31
FeS		3.58
SO_3		0.69
Loss on ignition		1.88
TOTAL		100.33%

Using this analysis as a base, the mineralogical composition of the silicate portion of the aerolite was calculated by the standard method of norm calculation as applied to stony meteorites by Farrington.[6] This method was, however, changed a little as merrillite ($3\ CaO.Na_2O.P_2O_5$) was calculated instead of apatite, and the orthoclase, albite, and anorthite molecules were combined after calculating to form maskelynite. No crystalline plagioclase could be seen in the slide and neither could any apatite. As the nickel,

[5] Chief Chemist, International Smelting Company, Miami, Arizona.

[6] Farrington, O. C., Analyses of Stone Meteorites Compiled and Classified: *Field Col. Mus. Pub.* **151**, *Geol. Ser.*, vol. 3, pp. 197–208, 1911.

cobalt and copper were reported as "ous" oxides they had to be combined with FeO and MnO in the calculations, but the amounts are so small as to be negative in influencing the silicate molecule ratios. The results of the calculations follow:

Maskelynite	8.56%
Diopside	2.91
Enstatite	31.20
Chrysolite	36.19
Chromite	0.67
Ilmenite	0.15
Merrillite	0.74
Troilite	3.58
Oxidation products, Fe_2O_3+SO_3+Loss on ignition	15.86
TOTAL	99.86%

The ratio FeO:MgO in the silicates is approximately 1:3 which would make the enstatite the variety bronzite. The relatively large amount of oxidized material, of course, changes the percentage composition of the stone as it now is considerably from its composition at the time of fall, before the oxidation took place. The 13.29 per cent of ferric oxide would be derived chiefly from the oxidation of metallic iron. The SO_3 probably came from the oxidation of troilite.