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THE PLANTERSVILLE METEORITE, GRIMES COUNTY, TEXAS

JOHN T. LONSDALE,
Iowa State College, Ames, Iowa.

INTRODUCTION

The Plantersville meteorite fell September 4, 1930, at about 4:00 P.M. at a point near the southeast corner of the A. W. Greenwood 1900 acre tract in the Joel Greenwood Survey, about 3½ miles southwest of Plantersville, Grimes County, Texas, longitude 95° 52′ W., latitude 30° 20′ N. This locality is forested and only the fact that six men (John Caraway, Ernest Caraway, Wilbur Caraway, Henry Bodkins, Ben Kirk, and Jerry Parrish) were cutting timber within a few hundred yards of the point of fall permitted the finding and recovery of the meteorite. Mr. John Caraway secured the specimen and retained possession of it until June 1935. The specimen now is in the collections of the U. S. National Museum.

The details of the phenomena of fall of this meteorite have been secured from two of the observers, John Caraway and Ernest Caraway. Their first impression of an unusual occurrence was that of hearing a distant explosive rumbling at a high angle in the sky. They estimated that this lasted about two minutes. The rumbling noise was succeeded by a noise like an airplane which lasted several minutes and which seemed to come from the southwest and pass the observers before stopping. As this noise stopped some of the men heard a noise like that of a "chunk falling from a tree." At this time the observers thought an airplane had fallen nearby and they moved in the direction from which they heard the last sound. As they moved through the woods in a line with several yards interval, Mr. John Caraway observed two freshly broken tree limbs, 2½ inches in diameter, in an area where no timber cutting had been carried on. As the men searched in this area the meteorite was found protruding slightly above the surface of the ground, which here was composed of compact hard, dry, clay soil. The observers estimated that not more than five minutes elapsed from the start of the search until the discovery, and that the meteorite was picked up within a few minutes of the time of discovery. It was reported to be "milk-warm," and that the hard soil at the place of impact was pulverized for several inches around the pit made by the impact.

The explosive rumbling which was the first evidence of the fall, apparently, was heard over a considerable area since others than the six men previously mentioned remember this phenomenon. However, as far as can be learned, notices of this or of the fall and recovery of the meteorite did not appear in newspapers of the region.

External Features of the Meteorite

The meteorite is a very perfect specimen which as received has been marred by the removal of two small flakes of the crust. The specimen as received weighed 2084.9 grams. A small portion has been cut from one corner to provide material for study and to permit polishing of a fresh surface. Before cutting, the dimensions were $5\frac{3}{4}'' \times 4'' \times 3\frac{3}{4}''$, measured in the three principal directions. The specific gravity determined from a bulk sample, evacuated of air, is 3.71.

The specimen is prominently faceted with ten bounding faces some of which are concave, others convex. In addition, it is subconoid in shape due to rounding of the apex of a prominent octahedral solid angle. It is evident from the shape and character of surface markings that the meteorite was oriented in flight. The four faces bounding the cones were the exposed forward portion (*brustseite*), the remaining faces occupied a lee position less exposed to the air stream. On the forward faces fine thread lines are well developed radiating from the apex of the cone and disappearing or becoming faint at the intersections with the rear faces (Fig. 1).

The surface is covered with a dense black glassy crust. On the rear face this is much rougher than on the exposed faces. There are a few coarse thread lines, but the general appearance is pitted (Fig. 2). The crust is generally less than 0.5 mm. in thickness with the greatest thickness over the rear pitted face.

Megascopically the meteorite, on a fresh surface, is light gray in color but soon assumes a brownish tint due to oxidation of grains of metallic iron. This distribution of the metallic constituents is shown in Fig. 3(1). The surface shown in this figure is traversed by fine cracks filled with metal so that there is an appreciable amount of brecciation. This polished surface also shows the specimen to contain many chondrules, many of which are angular or fragmented, set in a crystalline base of grains of a brownish gray mineral. The chondrules are light gray (pyroxene) and colorless (chrysolite) in appearance. The bulk material of the meteorite is friable but is sufficiently coherent to take a polish and permit the cutting of sections without fracturing.

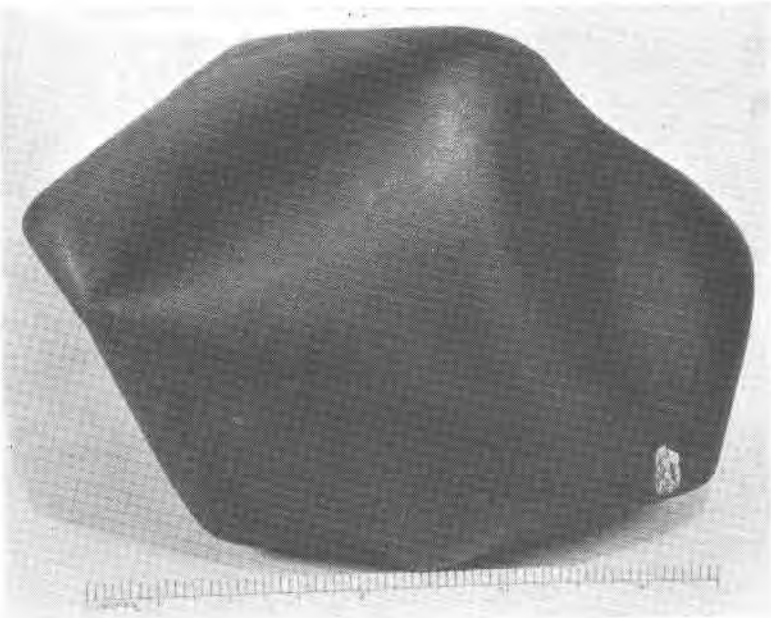

FIG. 1.
Front view of the meteorite showing the subconoid development and fine thread lines radiating from the cone apex.

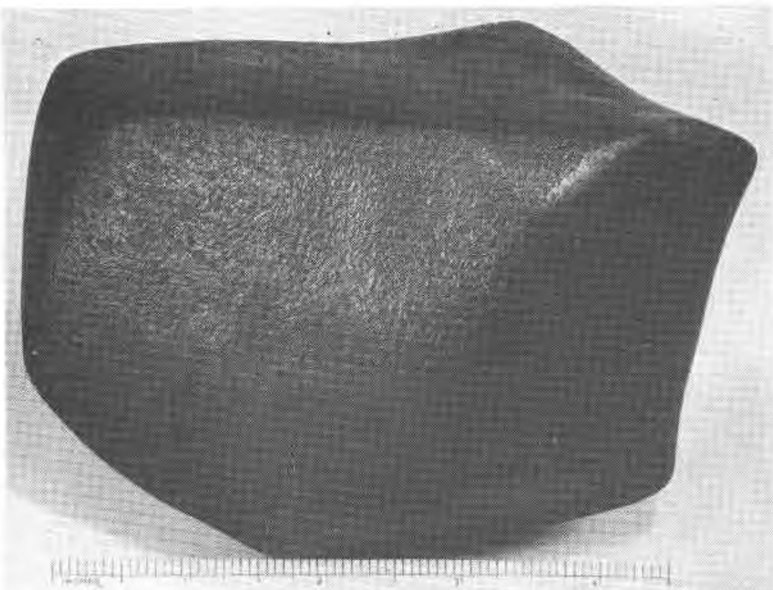

FIG. 2.
Rear view of the meteorite showing the thicker and coarser crust.

Structure

Thin sections confirm the general structural features observed on a polished surface. Nearly all of the specimen is crystalline, but there is a small amount of glass, largely interstitial. The structure typically consists of many chondrules in a ground mass of grains of silicate minerals, metal, and troilite, with approximately the same range in size as that of the chondrules. Relatively few of the chondrules are perfect, most of them exhibit irregularities in shape or are actually fragments of chondrules. A considerable number of the chondrules are of the porphyritic or fragmental type and are of comparatively large size so that they appear to blend into the general field of silicate grains. Low magnifications reveal such structures and show that a surprisingly large part of the complete specimen is composed of chondrule material.

Individual chondrules vary considerably in composition and structure, more so perhaps than is usually the case in a single meteorite. Figures 3 and 4 show some of the more striking types. It is to be noted that all of the chondrules are crystalline though interstitial glass is not uncommonly present in them. Pyroxene and chrysolite are the main mineral constituents, but do not appear in the same chondrules.

The chrysolite chondrules include the common barred monosomatic type, twinned barred forms with a large amount of glass, porphyritic types with a few subhedral crystals, and fragmental types consisting of angular and rounded fragments of the mineral in a glass matrix (Figures 5(2) and 6(5)). The pyroxene chondrules include radiate twinned or untwinned forms and monosomatic types, some of which are concentrically zoned. Grains of metal are common in all types of chondrules and many of the relatively perfect chondrules are partly rimmed by this material. The size range of all chondrules is 0.1 mm. to 2 mm., but some of the fragments of chondrules must have been from much larger structures.

Some of the fragments of large chondrules and certain areas of grained mass are minutely granular. These consist of an aggregate of very fine grains of pyroxene, chrysolite and metal. The texture resembles closely the cataclastic texture of metamorphic rocks. In classification the meteorite is intermediate between white chondrite, veined (Cwa), and intermediate chondrite (Cia). The prefix hypersthene might well be added to the appropriate name.

Mineralogy

The mineral constituents of the meteorite include hypersthene and a monoclinic pyroxene 40 per cent, chrysolite 30 per cent, metal 19 per cent, troilite 5 per cent, glass 5 per cent, brown spinel, a trace; and chromite (?), a trace. A series of sections show considerable variation in the

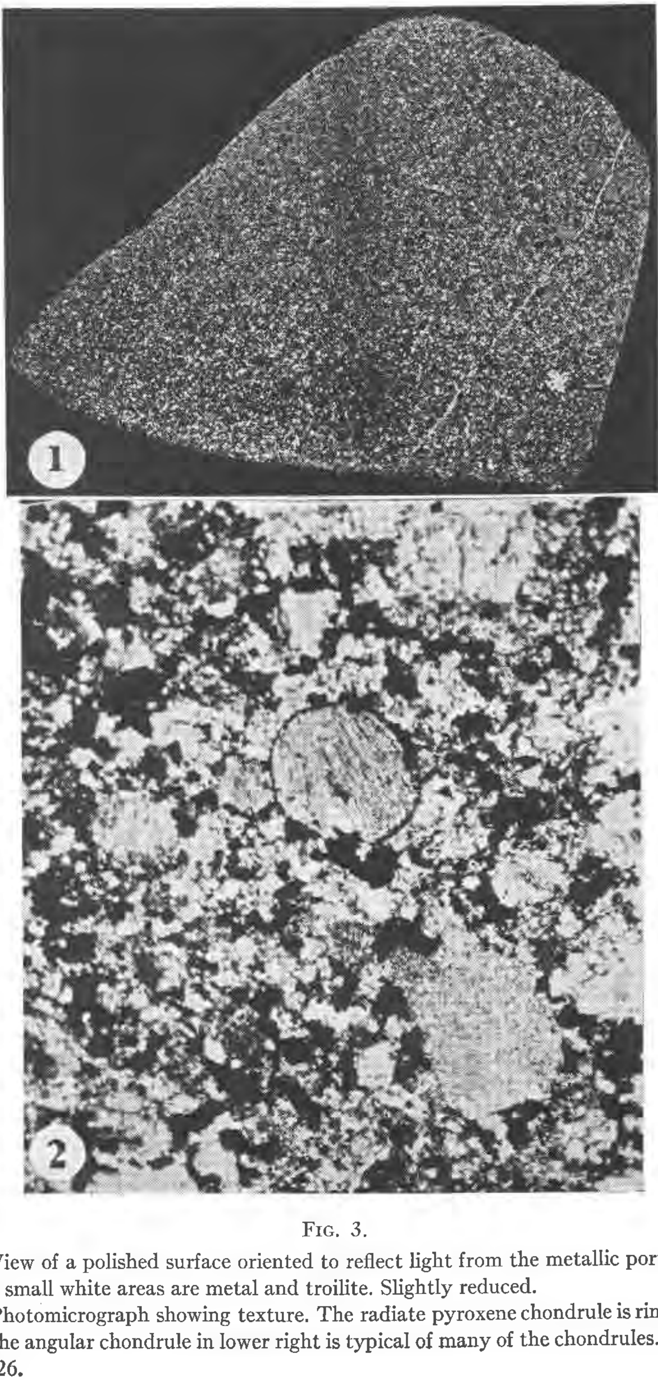

FIG. 3.

(1) View of a polished surface oriented to reflect light from the metallic portions. The vein and small white areas are metal and troilite. Slightly reduced.

(2) Photomicrograph showing texture. The radiate pyroxene chondrule is rimmed with metal. The angular chondrule in lower right is typical of many of the chondrules. Polarized light. ×26.

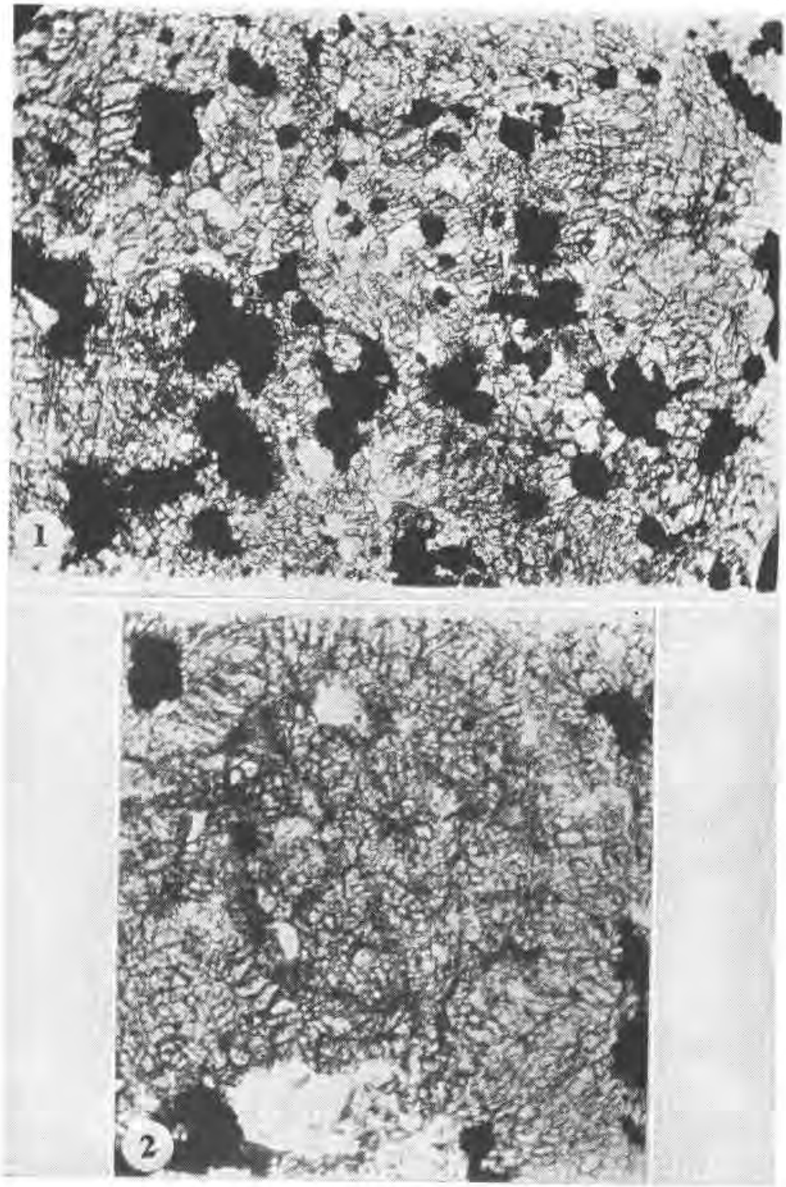

FIG. 4.

(1) Photomicrograph ×100 showing colorless glass, pyroxene with prominent cleavages and black metal.

(2) Monosomatic pyroxene chondrule with outer concentric zone in optical continuity with inner part. ×100.

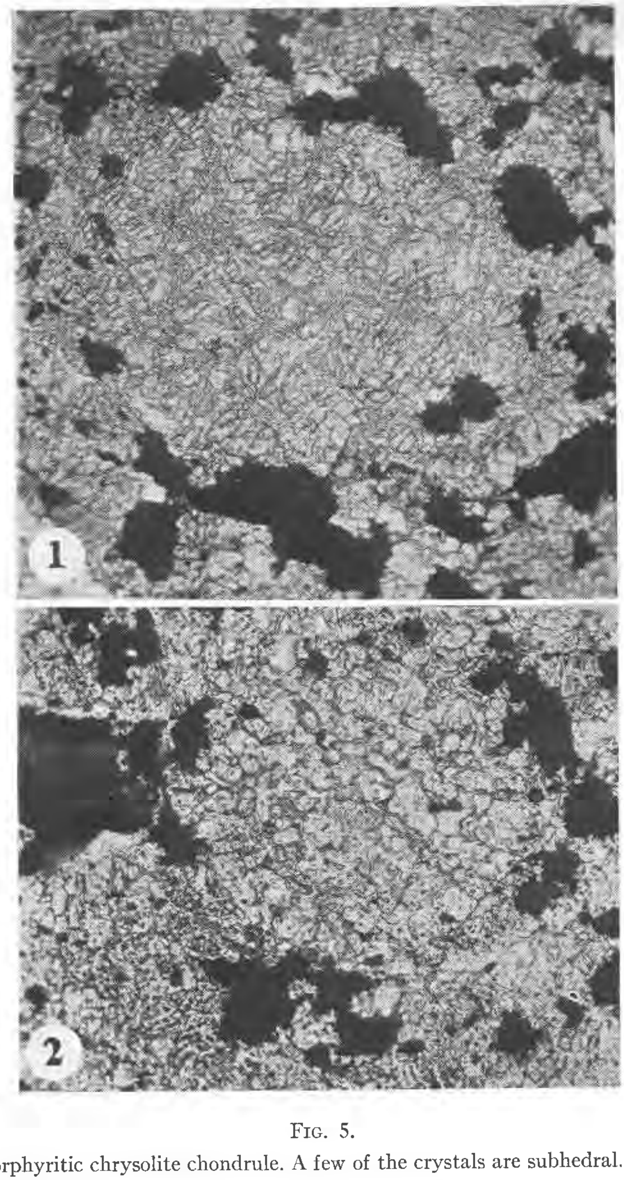

Fig. 5.

(1) Porphyritic chrysolite chondrule. A few of the crystals are subhedral. Glass forms the matrix. ×100.

(2) Fragmented chrysolite chondrule with glass matrix. Black area at left is dark glass surrounded by colorless glass. ×100.

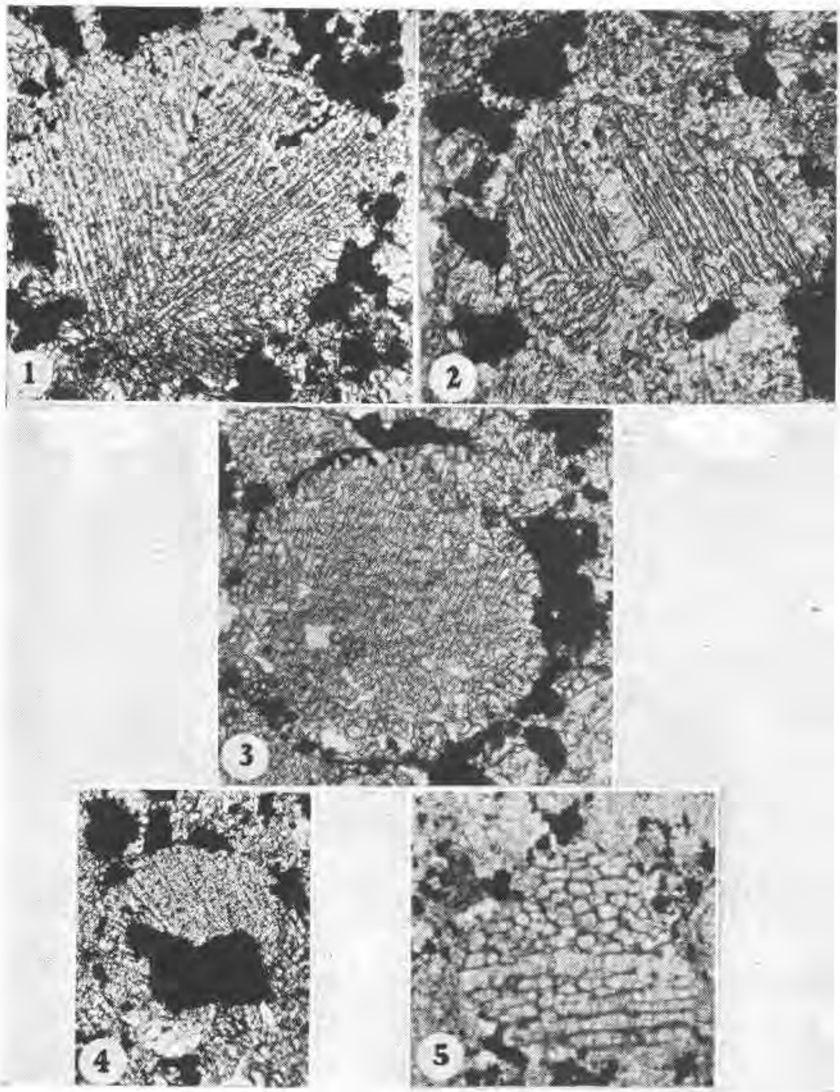

Fig. 6.

(1) Twinned radiate pyroxene chondrule. ×100.

(2) Barred chrysolite chondrule with glass occupying areas of low relief. ×100.

(3) Monosomatic pyroxene chondrule with metal rim. Some of the small white areas are glass. ×100.

(4) Radiate pyroxene chondrule with metal inclusion. ×100.

(5) Barred monosomatic chrysolite chondrule. ×100.

amounts of the minerals, and the mode stated is therefore approximate.

Pyroxenes. Pyroxenes either in chondrules or separate grains are the most abundant minerals of the meteorite. Two varieties, hypersthene and a monoclinic pyroxene, are present, but the latter is present in very small amounts. The two minerals could not be separated in heavy liquids because there is so much glass included in both in variable amounts that a continuous rather than fractional separation results. In thin sections, only rarely are grains observed exhibiting inclined extinction, but in the heavy concentrate consisting of both minerals, one out of ten grains oriented to show the emergence of an optic axis gave a positive optical character. Figures 4 and 6 (3, 4) show occurrences of the pyroxene minerals. The hypersthene is grayish in thin section, very slightly pleochroic and occasionally shows multiple twinning. Grains with observable prismatic cleavage show straight extinction, $\gamma=1.678$, $\gamma-\alpha=.013$, large optic axial angle, and negative optical character.

The monoclinic pyroxene resembles the hypersthene. In the few grains identified a maximum extinction angle of 28° was observed. The mineral is optically positive and has a moderate optic axial angle. The indices of refraction have not been measured except that they are within the limits of those given for hypersthene. These facts, together with the rather large amount of lime shown in the chemical analysis of the insoluble part of the specimen, lead to a tentative identification of the mineral as pigeonitic pyroxene.

Chrysolite. The chrysolite, like the pyroxene minerals, occurs both in the chondrules and in separate grains. A few subhedral crystals are present in both occurrences. Figure 6 (2, 5) shows the mineral in chondrules. The chrysolite is optically negative, with a large optic axial angle, $\gamma=1.707$, and $\gamma-\alpha=.038$. The iron rich character indicated by these optical data is confirmed by the chemical analysis of the soluble part of the meteorite.

Metal. The metal is disseminated throughout the specimen in grains, veinlets, and as rims surrounding chondrules. The grains are irregular in outline and reach 0.7 mm. in greatest dimension. Certain grains show troilite continuous with the metal. The veinlets apparently are contemporaneous with the grains of metal since they, in many cases, lead from the grains and in no case appear to occupy fractures in grains of the metal. The veinlets characteristically consist of numerous irregular grains of metal connected by thin threads of the same material.

Troilite. Troilite is much less abundant than metal and occurs generally in smaller grains. It is present to a limited extent in the veinlets and generally shows a tendency toward association with the metal.

Glass. An isotropic substance, presumably glass rather than a crystalline material occurs as interstitial grains in the general mass of the specimen, in several types of chondrules, and in fine grained aggregates with silicate minerals. The glass has an index refraction of 1.510 and hence probably is not *maskelynite*, the glass of many meteorites.

The interstitial glass is colorless and is present in grains of very irregular shape. These appear to occupy space left between mineral grains and chondrules. At times such grains contain inclusions of the silicate minerals. Interstitial glass is shown in Fig. 4 (1).

Many of the chondrules contain glass. Figure 6 (2) shows a chrysolite chondrule with a large amount of glass which appears to be one connected body in which the bars of the chrysolite are supported. Glass is present in the chondrules of Fig. 4 (2), Fig. 5 (2), and Fig. 6 (2), but in these cases it is not so abundant or easy to distinguish.

Sections of the meteorite show many irregular fragmental aggregates of minerals and also irregularly shaped chondrules composed of fragmental mineral grains. These invariably contain glass and the relation between the constituents suggests a cataclastic texture.

Chromite (?). Associated with the troilite and metal of the specimen is a very small amount of a black opaque mineral. Since the chemical analysis shows a small amount of chromium oxide, this mineral is tentatively identified as chromite.

Brown Spinel. A brown isotropic mineral with high index of refraction occurs as minute inclusions in the silicate minerals. These are globular to roughly octahedral in shape, and the mineral is tentatively identified as spinel.

Chemistry

A chemical analysis of the specimen was made by F. A. Gonyer and is given below:

Metallic portion:	19.03%
Soluble silicates and sulphides:	39.04
Insoluble silicates:	41.93

	Insoluble Silicates	Soluble Silicates Sulphides	Metallic Portion	Composite
SiO_2	55.55	32.23		35.87
Al_2O_3	4.37	0.86		2.18
FeO	11.17	19.01		12.10
MgO	22.01	36.74		23.57
CaO	3.61	1.19		1.97
Na_2O	2.52	—		1.05
K_2O	0.31	—		0.12
P_2O_5	None	0.15		0.05
Cr_2O_3	0.08	—		0.03

MnO	032	0.13		0.18
TiO_2	None	None		None
NiO	None	0.04		0.01
CoO	None	None		None
S	—	*3.73		1.45
Fe	—	*6.48	89.28	16.99
		*Iron and sulphur in troilite		
Ni	—	—	10.12	1.92
Co	—	—	0.36	0.06
Cu	—	—	0.04	Trace
P	—	—	0.02	Trace
Sum	99.94	100.56	99.82	97.55

The insoluble silicate portion corresponds to the pyroxene of the specimen except that most of the alumina, lime, soda and potash, possibly, are present in the glass. If all of the soda and potash are allotted to alumina, and excess alumina to lime, the normative plagioclase *ab 89, an 11* results. The low index of refraction of the glass (1.510) indicates that it corresponds to an alkali feldspar. The iron to magnesium ratio indicates a pyroxene of the hypersthene type. The soluble silicate portion is essentially the chrysolite of the specimen. The iron to magnesium ratio suggests a chrysolite corresponding fairly well with the observed mineral.

A norm calculated for the analysis is as follows:

Orthoclase	0.56
Albite	8.91
Anorthite	1.11
Diopside	6.70
Olivine	47.93
Hypersthene	12.30
Fe_nNi_m	18.99
Troilite	3.98

A spectographic analysis of the three portions of the meteorite, made by Dr. H. C. Wilhelm, revealed the presence of germanium and titanium in addition to the constituents reported in the chemical analysis. The complete spectographic analysis is given.

	Na	Mg	Ca	Al	Ti	Si	Ge	Co	Cr	Mn	Ni	Fe	K
Metallic portion	2	2	4	4	5	2	4	3	2	4	2	1	
Soluble silicate	2	2	4	4	0	2			3	5	3	3	
Insoluble silicate	2	2	4	4	5	2			2	5	5	3	4

Intensities: 1 strong, 2 present, 3 weak, 4 trace, 5 very faint trace.

Acknowledgments

The writer wishes to acknowledge his indebtedness to a number of people who have aided in the securing and description of the Plantersville Meteorite. Dr. Lamar Jones of Bryan, Texas, first learned of the specimen and was instrumental in obtaining it from Mr. Caraway. Dr. W. F. Foshag of the United States National Museum, arranged for the cutting of the specimen and preparation of thin sections. Dr. H. A. Wilhelm very kindly made the spectographic analysis quoted, and Dr. Louis Lykken determined the specific gravity. The chemical analysis was made possible by a grant from the Industrial Science Research Funds, Iowa State College.