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(With Four Plates)

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U. S. National Museum

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The iron meteorite here described by the name of Cedartown was obtained by the writer from Mrs. Elizabeth H. McCallie, of Atlanta, Ga., whose husband, the late S. W. McCallie, was State Geologist of Georgia from 1907 until his death in 1933. She recalls that it was plowed up on a farm between Cedartown and Cave Springs, Polk County, Ga. (lat. 34° N., long. 85° 16′ W.), and that it came into her husband's possession about the year 1898. No written data are available regarding the iron, as all of Mr. McCallie's papers were destroyed by the burning of his house in 1917. He sent it to the Field Museum of Natural History in 1904 where it remained for 10 years, but the negotiations for its purchase by that museum were not completed and it was returned to him.

The meteorite as received weighed 25½ pounds and was intact, except for the removal of a few grams for analysis. Its shape is lenticular, one side slightly more rounded than the other, its greatest dimensions being 9 by 11 inches. The greatest thickness of about 3 inches at the center diminishes to thin edges all around. A fissure, caused by partial disruption during its flight through the air, extends inward about 5 inches. The fissure, half an inch wide at the surface, is almost parallel with the flatter side of the mass. Though the specimen is obviously an old fall, its surface is not deeply rusted. It shows very shallow pittings, with no noticeable cavities.

An analysis by E. P. Henderson[1] showed: Fe, 94.02; Ni, 5.48; Co, 0.22; P, 0.30; S, 0.04; Cr, 0.02; total, 100.08 percent.

Several slices were removed which revealed a "normal" hexahedral structure, with two sets of Neumann lines crossing the entire surface of the slices. One set is conspicuous, the other scanty and less noticeable (pl. 1, upper and lower).

A peculiar feature of the macrostructure is a conspicuous banded effect, two systems of parallel but irregular bands crossing the surface, their directions differing by about 15 degrees. This appearance

[1] Amer. Mineral., vol. 26, pp. 546-550, 1941.

is due to elongated grains of more or less uniform width, suggesting the columnar pattern of grains produced by certain heat treatments in artificial irons (pl. 2, upper). These grains tend to group themselves in irregular bands which are conspicuous to the eye on an etched surface because their sheen is oriented differently from that of the adjoining grains. Such bands do not affect the general direction of the Neumann lines.

Elsewhere there is a normal microstructure of fine grains of varying size and shape, in some areas showing a profusion of Neumann lines diversely oriented (pl. 3, upper).

Several inclusions of troilite were observed, some reaching dimensions of a centimeter, one large one being partly surrounded by graphite.

Schreibersite is abundant, occurring as long oriented needles (lamellae, pl. 4), rhabdites, and irregular bodies. A number of parallel bands of rhabdites and short needles extend across the surfaces (pl. 3, lower), but few scattered rhabdites were observed.

There are numerous small inclusions of troilite associated with schreibersite, the latter usually more or less completely surrounding the former, and in such cases the troilite usually contains many minute white spots which apparently are kamacite, as they are not affected by either picral or sodium picrate etching (pl. 2, lower).

Trolite solidifies at about 980° as an Fe-FeS eutectic containing 16 percent of iron and 84 percent of sulphide. On further cooling the iron is almost all rejected, for the solubility of alpha iron (kamacite) in the sulphide is not more than 2 percent and with the proportion of nickel in this iron the alpha phase would be reached at about 550°. As schreibersite also solidifies at about the same temperature as troilite, the progressive rejection of iron from the troilite would proceed through a range of at least 400° after both components had become solid. Thus the solidified schreibersite surrounding the troilite body apparently prevented the migration of the rejected iron to the surrounding mass and forced it to segregate as droplets in the interior.

An interesting feature of this iron is the fact that it was subjected to strong artificial heating without producing any appreciable changes in its microstructure. The McCallie residence in Atlanta was burned while the meteorite was in a room on the second floor, and later it was recovered from the ashes. The house was of frame construction, eight rooms, with no basement, and it was practically destroyed within an hour.

It may fairly be assumed that the meteorite was heated to a red heat, and at the maximum perhaps to a blood-red heat, which would correspond with a temperature of about 560° centigrade. Such a maximum heating may have lasted a short time, then diminishing over a number of hours. Such would appear to have been the greatest probable heating; it may have been less because of the position of the iron, the direction of the wind, and other circumstances of the fire.

The normal microstructure shows no appreciable changes. Neumann lines everywhere remain unaltered, and phosphide bodies show no appreciable evidence of diffusion into the surrounding mass along grain boundaries, which in many irons produces an appearance of thornlike projections. These facts are consistent with the results of experiments by Kase,[2] which showed that the lines are obliterated only by prolonged heating at 550° or 560°, and those by Vogel,[3] which indicated that schreibersite needles were preserved but partly diffused after heating 13 hours at 700°. In this case the appearance of phosphide inclusions would indicate that the mass had not been heated for any considerable time higher than the temperature corresponding with a blood-red heat.

The main mass of the Cedartown meteorite was given to the United States National Museum, four slices having been removed which are in the American Museum of Natural History, the Chicago Natural History Museum, the Harvard University museum, and the writer's collection.

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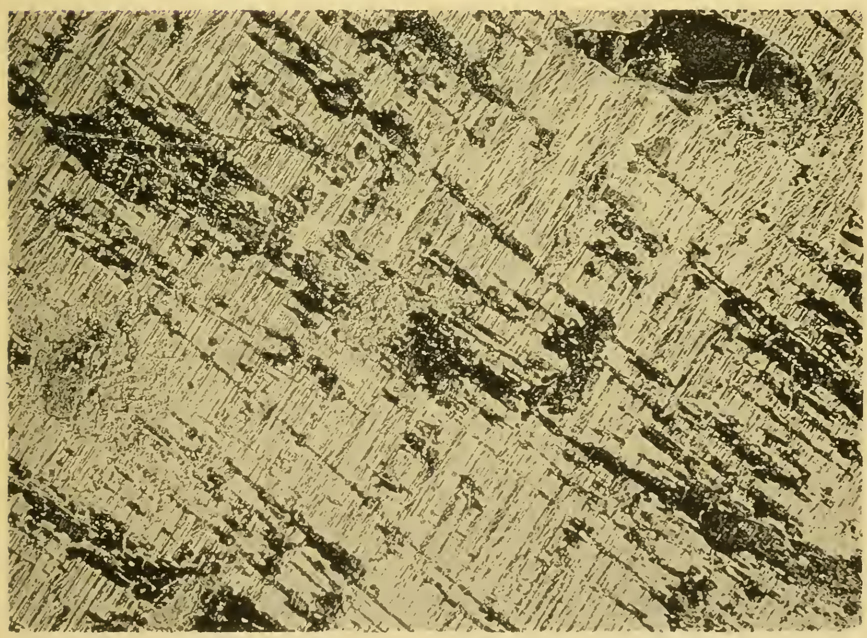
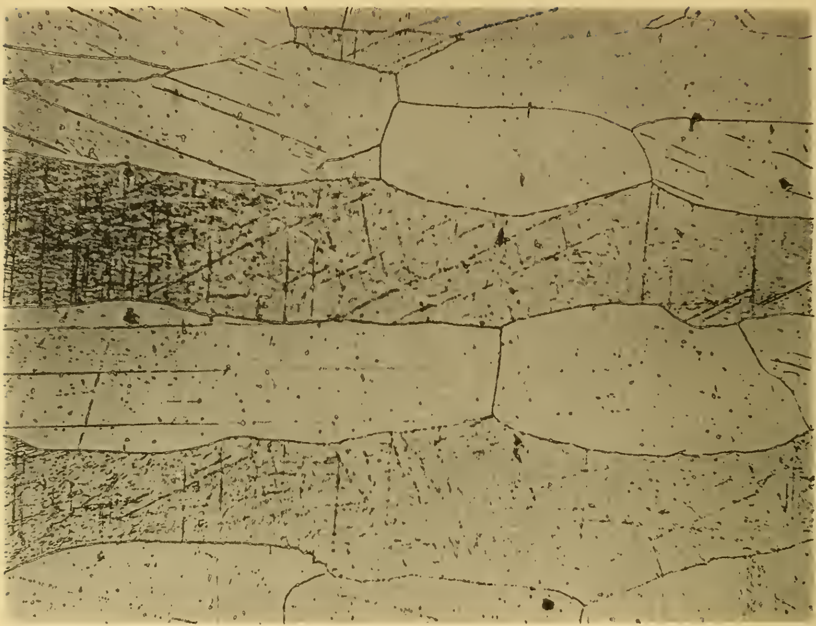
[2] Kase, Tutom. On the Widmanstätten structure in iron-carbon and iron-nickel alloys and in metorites. Sci. Rep. Imp. Tohoku Univ., vol. 14, No. 5, pp. 537-558, 1925.

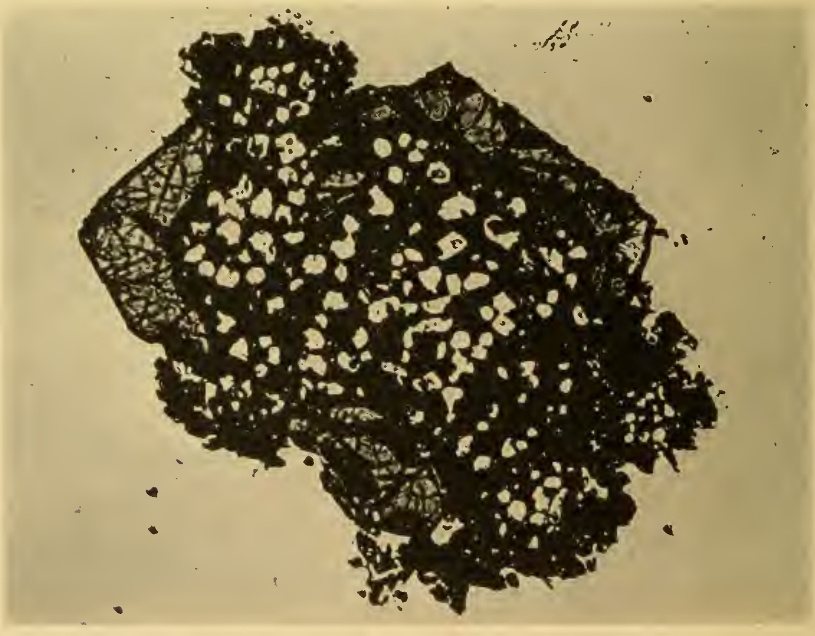
[3] Vogel, Rudolf. Über die Struktur des Meteoreisens und ihre spezielle Beeinflussung durch Umwandlung und beigemengten Phosphor. Abh. Ges. Wiss. Göttingen, math.-phys. Kl., n.s., vol. 12, p. 2, 1927.



UPPER, SLICE, LIGHT MICRO-ETCH, X 4/5. ONE SET OF NEUMANN LINES IS APPARENT, RUNNING CROSSWISE OF THE SURFACE. IRREGULAR DARK BANDS, RUNNING LENGTHWISE.

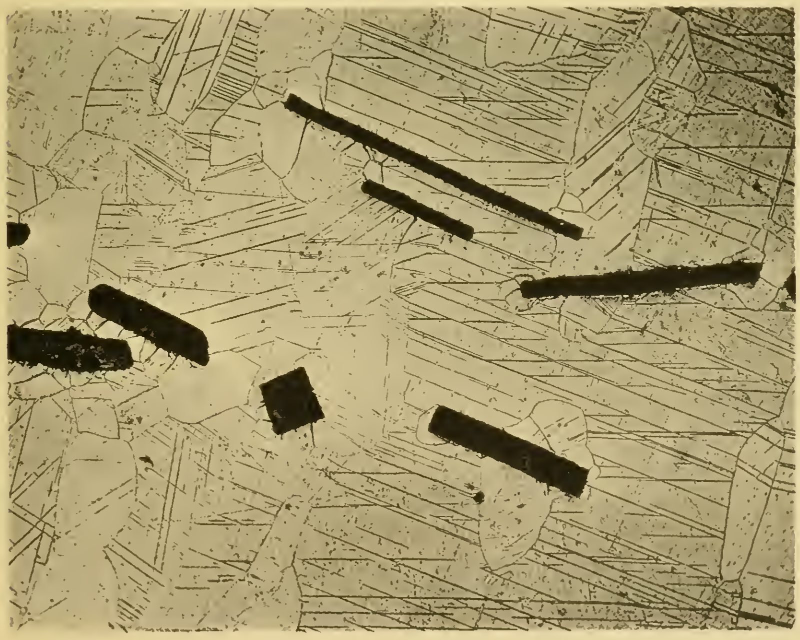
LOWER, THE STRUCTURE SHOWN IN UPPER FIGURE, X 10. THE NATURE OF THE BANDED APPEARANCE IS MORE APPARENT AND A SECOND SET OF FINER NEUMANN LINES CAN BE DISTINGUISHED.





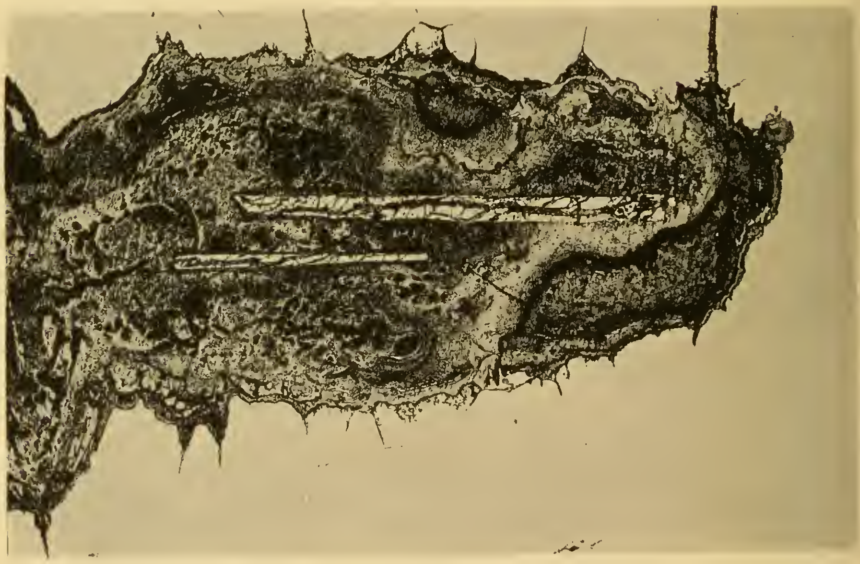
UPPER, AN AREA SHOWING ELONGATED GRAINS; LIGHT PICRAL, X 100. DIVERSE ORIENTATION OF CRYSTALLOGRAPHIC PLANES IN THE ELONGATED GRAINS GIVE THEM A DIFFERENT SHEEN FROM THAT OF ADJACENT GRAINS.

LOWER, INCLUSION OF TROILITE SURROUNDED BY SCHREIBERSITE. THE WHITE DROPLETS APPARENTLY ARE KAMACITE REJECTED FROM THE COOLING FE-FES SOLID SOLUTION. LIGHT NEUTRAL SODIUM PICRATE ONLY, X 250. THE PICRAL STAIN ON THE PHOSPHIDE AREAS SHOWS A RETICULATED PATTERN.



UPPER, AN AREA OF KAMACITE SHOWING FINE GRAINS OF VARYING SIZE AND SHAPE WITH NEUMANN LINES DIVERSELY ORIENTED. SOME AREAS SHOW SUCH GRAINS; IN OTHERS THE KAMACITE IS HOMOGENEOUS. LIGHT PICRAL, X 150.

LOWER, SCHREIBERSITE NEEDLES, PART OF ONE OF A NUMBER OF LONG PARALLEL BANDS OF SUCH BODIES RUNNING ACROSS THE SURFACE OF SLICES. PICRAL AND NEUTRAL SODIUM PICRATE, X 100.



UPPER, SCHREIBERSITE LAMELLA. AS THE Fe-Fe_3P SOLUTION COOLED, THE EXCESS OF IRON (KAMACITE) WAS REJECTED CHIEFLY IN THE FORM OF A CENTRAL LAMELLA INSTEAD OF THE MORE COMMON FORM OF DROPLETS. THIS APPARENTLY IS A PRIMARY STRUCTURE AND NOT THE RESULT OF REHEATING. X 666.

LOWER, TWO SCHREIBERSITE LAMELLAE SURROUNDED BY HYDROXIDE. X 50.