THE ZENDA METEORITE

William F. Read

The Allyn Palmer family operates a 174-acre farm located half a mile west of Zenda in Walworth County, Wisconsin. In the spring of 1955, Mr. Palmer, while plowing, noticed an unusual-looking dark, heavy rock and brought it back to the house. Some time later his eldest son Jon took the rock to school and gave it to some boys who were members of the local astronomy club. The boys showed it to Dr. G. P. Kuiper at Yerkes Observatory. Suspecting that it might be a meteorite, Dr. Kuiper bought the specimen and forwarded it for positive identification to Dr. H. H. Nininger of the American Meteorite Museum at Sedona, Arizona. Dr. Nininger cut a small slice from one end, determined that this was in fact an iron meteorite, and returned the main mass to Dr. Kuiper. The writer purchased the main mass from Dr. Kuiper in March, 1960.

The original total weight was near 3.7 kg. As received by the writer, the main mass weighed 3623 g. It has since been cut into two pieces weighing 2791 g and 770 g. Dr. Nininger retained the slice which he had cut off and later sold it, along with the bulk of his collection, to Arizona State University. This slice weighs 60 g.

**Figure 1.** South half of Sect. 28, T 1 N, R 17 E. Stippled line is the Palmer farm boundary. The meteorite is believed to have been found in the east half of the area explored with a metal detector.
Mr. Palmer does not recall exactly where on his property he found the meteorite. Figure 1 shows the farm boundaries. Certainly the specimen came from north of the railroad tracks, and probably from east of the stream in the area which the writer later explored (unsuccessfully) with a metal detector. If so, the coordinates of the fall are Lat. 42° 30' 48"; Long. 88° 29' 22". This is gently rolling farm country on the south slope of the Darien moraine of the Delavan ice lobe.

EXTERNAL FORM

The Zenda meteorite evidently fell many years ago. A brilliant fireball is reported to have burst over Zenda the evening of February 5, 1917, (Frost, 1917) but is it doubtful that this was the source of the present meteorite. Rusting has destroyed the original fusion crust with its ablational detail. How much rust had accumulated we cannot tell since much was doubtless dislodged by farm machinery. The thickest remaining accumulation (Fig. 3) is about ¼ inch.

The overall form at present is roughly wedge-shaped. The narrow end (Fig. 2) tapers between fairly flat surfaces; the broad end is more irregular. Shallow depressions, circular to irregular in plan and up to 2 inches in diameter, occur equally on all sides. The conspicuous notch which appears on the upper left margin of the upper photograph in Figure 2 is caused by an unusually deep depression which has cut into the edge between two surfaces. Probably these depressions are ablational in origin though they have doubtless been modified by weathering.

A narrow, deep cleft may be seen parallel to the lower right margin of the upper photograph, Figure 2. This marks the former position of a thin, flat sheet of troilite, remnants of which are still visible. The black spot in the upper right corner of the lower photograph is a hole leading into the cleft.

Some evidences of human tampering are present. The squarish projection shown on the upper right margin of the lower photograph, Figure 2, has been flattened off with a file. One inch, and again four inches, to the left of the projection, shallow notches cut with a hacksaw may be seen.

COMPOSITION AND STRUCTURE

Two etched sections through the Zenda meteorite are shown in Figure 3. Octahedral structure is immediately evident. The narrower kamacite bands have a width of about .6 mm., making this a “medium” octahedrite.
On the larger surface, the right one third shows a different pattern of bands from the left two thirds. This is attributed to twinning, the boundary between the two contrasting parts being a composition surface. Since one set of kamacite bands (i.e., one of the octahedral directions) is common to both parts, the twin is assumed to be of the "spinel" type.
The kamacite bands are somewhat swollen between intersections. Many of them shown conspicuous Neumann lines. Also, many are divided into rounded or polygonal grains separated by fine furrows.

**Figure 3.** Etched sections through the Zenda meteorite. Left hand section cut by H. H. Nininger. Light area at the top is a curved surface. Note limonite "worms" due to presence of lawrencite. Right hand section cut by W. F. Read.

**Figure 4.** Tracings from photographs of etched surfaces shown in Figure 3—black: oxidation, white enclosed areas: schreibersite, dotted: troilite. Dashed line indicates composition surface between two parts of twin. Radiant diagrams show angles between kamacite bands limited to one part of twin and those shared in common (longer line).
on the etched surface. Neumann lines cross these furrows without deflection. Minute euhedral schreibersite crystals (rhabdites) are abundant as inclusions. “Swathing” kamacite surrounds the more conspicuous patches of schreibersite and troilite (Fig. 4).

Taenite lamellae are fairly uniformly developed around the kamacite plates. For some reason, they etched to a golden color on the surface cut by the writer—hence appear dark in the photograph, Figure 3. They have the usual silvery appearance on the surface cut by Dr. Nininger. Variations in width are pronounced. In some places, the taenite is about one fifth as wide as adjoining kamacite bands. Elsewhere it narrows down to a hair line or may be entirely lacking. Some sections of the taenite lamellae are replaced locally by schreibersite.

Plessite fields occupy perhaps 20 percent of the total area of a cut surface. Most show a grilled structure, with pronounced variation in the coarseness of the grill. Some are apparently structureless. Small, irregular inclusions of schreibersite may be present. A few plessite fields show partial replacement by a brittle, brownishmetallic mineral which resembles troilite but leaves no mark on a sulfur print.

The conspicuous included patches of schreibersite and troilite shown in Figure 4 are of considerable interest. Dark speckles which appear within and near them in the photographs, Figure 3, are crystals of pyroxene (black), olivine (pale brown to greenish), and graphite (grey) in approximately equal proportions. These crystals tend to be clustered together, leaving certain portions of the inclusion—most commonly the extremities—relatively clear. From the fact that the silicates and graphite occur outside the inclusions, though never very far outside, one gets the impression that nickel-iron has encroached on (replaced) the schreibersite and troilite, leaving less digestible silicates and graphite stranded beyond their original matrix. Replacement is also suggested by the presence of small spongy masses of kamacite inside the phosphide and sulfide.

No crystals of silicate or graphite are seen in the wedge-shaped mass of troilite which cuts into the upper edge of the smaller surface as shown in Figure 4. This is in line with the prominent cleft mentioned in the description of external form; hence, the troilite here belongs to a flat sheet, not an irregular patch. Unlike the troilite of the patches it fractures along parallel planes (possibly the 0001 parting) and may be a single crystal. The curved margin adjoining to the right (Fig. 4) was apparently one wall of a second mass of “sheet” troilite running at right angles to the first. The edge of the specimen is here formed by a strip of swathing kamacite.
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REFERENCES CITED