The iron is penetrated by numerous irregular fissures, most of which are filled with corrosion products. Indications of plastic deformation are present – both in the ruptured phosphides and sulfides and in the slight distortion of the Widmanstätten grid. Except for a few hammered places on the surface, the deformation is of preatmospheric origin.

Twin City is an unusual, polycrystalline ataxite. In its structure it resembles Santa Catharina except for its significant content of α-spindles. It is much less weathered than Santa Catharina, preserving the heat-affected rim zones over considerable areas. Its chemical composition resembles Santa Catharina, except for its lower nickel content.

Specimens in the U.S. National Museum in Washington:

109 g slice (no. 1770, 8 x 5 x 0.4 cm)
38 g slice (no. 1770, 6 x 3.5 x 0.3 cm)
35 g fragment (no. 1770, 3.5 x 2.5 x 1.5 cm)

Udei Station, Benue River, Nigeria
7°57'N, 8°5'E

Medium octahedrite, Om, with silicate inclusions. Neumann bands. Group I – Anomalous. About 8.9% Ni, 0.12% P, 62 ppm Ga, 204 ppm Ge, 0.51 ppm Ir.

HISTORY

A meteorite was said to have fallen sometime between January and March 1927, north of the Benue River near Makurdi. The Geological Survey of Nigeria did not learn about the event until 1935, when a mass of 226 pounds (103 kg) was located six miles west of the railway station at Udei and 23 miles north of Makurdi. Residents of the area, and those as far away as 15 miles east of Makurdi, reported seeing and hearing the descent, which took place in the daytime. It was compared to the passage of an express train and was followed by a thud that shook the nearby houses. The meteorite was recovered from a shallow hole, scarcely deeper than its own thickness. Unconfirmed reports exist that a second fragment also fell. The material was classified as a mesosiderite (Macleod & Walls 1958).

Mason (1967a) examined the silicates and concluded that Udei Station was more closely related to the irons with silicate inclusions than to the mesosiderites. A similar conclusion was reached by Powell (1969), who presented the results of a thorough examination of the metal, with a photomicrograph and with microprobe examinations. While nine mesosiderites were estimated to have had an average cooling rate of 0.1° C/10^6 year, Udei Station cooled much more rapidly – 10° C/10^6 year – a rate which is similar to that of typical iron meteorites.

COLLECTIONS

Geological Survey, Kaduna, Nigeria (about 100 kg main mass), London (1 kg), Washington (202 g).

DESCRIPTION

According to Macleod & Walls (1958) who described the main mass and gave photographs of the exterior and of etched sections, the meteorite is roughly a parallelepiped and measures 42 x 35 x 22 cm. Although the surface was dull gray to rusty brown, the authors identified mammillated and striated fusion crusts in the depressions, particularly over the silicates. They noted that the silicates were just below the level of the surrounding iron, suggesting that they had been more readily removed during the meteorite's passage through the atmosphere.

An examination of the samples in Washington confirms the general fresh appearance of the material. Black fusion crust with tiny protuberances and roughly parallel flow lines are preserved, damaged, however, by rough hammering and chiseling during an attempt to detach specimens. Beneath the fusion crusts, 1.5-2.5 mm wide heat-affected α_2 zones are preserved. This information makes it plausible that the actual date of fall was in 1927 near the Benue River as maintained by the local residents.

Etched sections are of an anomalous and very heterogeneous appearance, displaying a mixture of metal, troilite and silicates. The ratio between the components varies in different sections, but the metallic portion always prevails, constituting more than 50% by volume. It appears that the metal was originally a polycrystalline aggregate of taenite grains, about 1 cm in size, and very imperfectly developed because of the numerous silicate and troilite inclusions. During the primary cooling, the taenite decomposed around these nuclei first and thereby formed 0.2-1 mm wide rims of swathing kamacite. Later, a Widmanstätten mechanism transformed the taenite squeezed between the swathing kamacite and produced a medium octahedrite pattern with straight, short ($\frac{L}{W} \sim 6$) kamacite lamellae with a width of 0.6±0.2 mm. The kamacite displays subboundaries, and Neumann bands from a cosmic shock event are common.

UDEI STATION – SELECTED CHEMICAL ANALYSES

	percentage			ppm								
References	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Macleod & Walls 1958	8.6											
Hey 1966: 495	9.4											
Wasson 1970a	8.83								61.6	204	0.51	

The range in the nickel analyses is probably due to sampling problems of the heterogeneous material.

Taenite and plessite cover perhaps 20% by area, mainly as rather massive, up to 200 μ wide taenite lamellae and wedges. The interiors of the wedges display martensitic and duplex unresolvable $\alpha + \gamma$ mixtures. Schreibersite occurs as 10-25 μ wide grain boundary veinlets but is uncommon. Rhabdites were not seen. The bulk phosphorus content is estimated to be 0.12±0.03%.

The silicates form rounded and angular fragments that range in size from single grains, 100 μ across, to angular, often brecciated composites, up to 8 x 3 cm in size. Enstatite (Fs_6), olivine (Fa_5), oligoclase (An_{16}) and diopside (Fe_5) are the major silicates and occur in that order of abundance (Mason 1967a). Troilite occurs as veins in the silicates or as irregular grains – at least up to 6 x 5 mm in size – in both silicate and metal. The brecciation must be of remote date since all silicate fragments are cemented by metal and troilite. It appears that the brecciation is primary, as if granulated silicates and metal were compressed, brecciated and sintered to a massive composite during a mixing process on the parent body.

Udei Station has been classified as a mesosiderite by Macleod & Walls (1958) and Hey (1966: 495). However, the silicate data by Mason (1967a), the cooling rate data by Powell (1969), and the trace-element data by Wasson (1970a) all indicate that Udei Station is quite different from typical mesosiderites, such as Estherville and Vaca Muerta. From the present examination, it may be concluded that Udei Station is closely related to Mertzon, Mazapil and Toluca and also displays similarities to Campo del Cielo (El Taco), Woodbine and Four Corners, all of group I.

However, Udei Station is still somewhat anomalous since it falls well below the group I band on a graph where bandwidths are plotted against nickel contents.

Specimens in the U.S. National Museum in Washington:
193 g endpiece (no. 2577, 5 x 5 x 2.5 cm)
Polished sections

Uegit, Lugh Ferrandi, Somali
3°49′N, 43°20′E

Medium octahedrite, Om. Bandwidth 0.95±0.15 mm. HV 260±15.

Group IIIA. 7.5±0.2% Ni and 0.08±0.02% P, judging from the structure.

HISTORY

A mass of 252 kg was found in 1921 by Michele Dall'Olio at Dersa, somewhat east of Uegit near the road from Uegit to Oddur. Uegit has the coordinates given above. The large mass was transported to Mogadishu and deposited at the Colonial Office of Engineering. It was divided into two almost equal parts to facilitate handling and was then donated to the Italian National Museum in Rome. It appears that the meteorite, when discovered, already had a very deep fissure and that this had been entirely opened by dynamite during the transactions in Somali. The mass was described by Millosevich (1924) who gave an analysis and three excellent photographs of the beautiful exterior. Another photomacrograph showed a deep-etched near-surface section. It was classified as a medium octahedrite, but a less appropriate comparison was unfortunately made to Toluca and Gibeon (Lion's River) with which it has little in common.

COLLECTIONS

Rome (main mass of 251.8 kg), Paris (172 g), Milano (10 g), Parma (fragment).

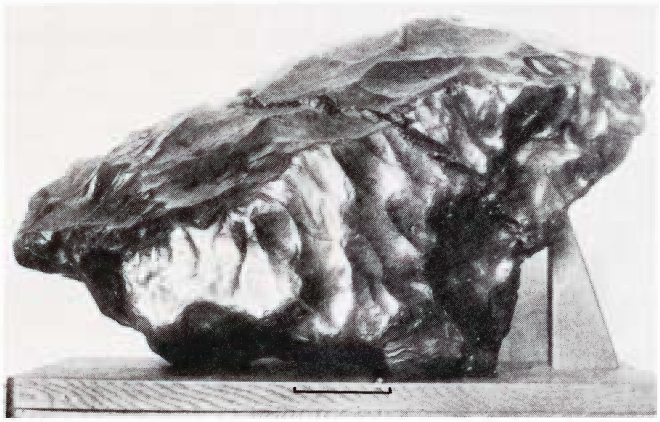

Figure 1826. Uegit (Rome). The well-preserved meteorite weighs 252 kg. It was cut to facilitate handling, but it is shown here restored to its original shape. Scale bar approximately 10 cm. (From Millosevich 1924.)

Figure 1827. Uegit (Rome). A medium octahedrite that probably belongs to group IIIA. Deep-etched. Scale bar approximately 2 cm. (From Millosevich 1924.)

ANALYSIS

Millosevich (1924) reported 7.11% Ni, 0.55% Co, 0.11% P and 0.21% S. The nickel content is more likely to be 7.3-7.8%, but otherwise the analysis appears good.

DESCRIPTION

The eminently preserved mass is roughly shield-shaped or compressed hemispherical in shape with the dimensions of 68 x 35 x 30 cm in three perpendicular directions. The convex surfaces are covered by distinct regmaglypts, 3-6 cm in diameter, and 0.5-1 cm deep. Some of them are aligned as subparallel furrows, e.g., 7 x 3.5 cm in size. The opposite, almost plane surface is covered by much shallower and wider regmaglypts, typically 7-9 cm in diameter. In its sculpture it resembles Hraschina, Cabin Creek and Oakley. The convex-pyramidal surface was probably the anterior face, while the plane surface was the posterior face during an oriented, stabilized flight through the atmosphere. All surfaces are covered by well-preserved fusion crusts with warts and microridges. Locally, there are small pits from the selective ablation of low-melting troilite. In one larger pit, measuring 45 x 20 mm across, the remnants of the troilite nodule may still be distinguished. Under the fusion crust there is a 2-3 mm wide zone of heat-affected α_2. It is evident that the loss from this iron by terrestrial weathering has been almost negligible.

Etched sections display a medium Widmanstätten structure of long ($\frac{L}{W} \sim 30$) straight kamacite lamellae with a width of 0.95±0.15 mm. The kamacite displays prominent subboundaries which sometimes form dense subparallel tangles. Neumann bands occur in profusion and almost as closely spaced as in Kodaikanal. The microhardness is 260±15, but it drops to 205±15 in the heat-affected α_2 zone. The annealed transition zone is as soft as 160±5 (hardness curve type I).

Taenite and plessite cover about 30% by area, mostly as very degenerated comb and net plessite fields; to a minor degree, duplex almost unresolvable $\alpha + \gamma$ fields occur. The taenite is shock-deformed to a hardness level of 380±20.

Schreibersite is not present as large crystals, but does occur as grain boundary veinlets, 3-10 μ wide. Troilite is present in all sizes from 0.5 mm to 40 mm across. Many nodules have nucleated discontinuous rims of schreibersite and 1.0-1.5 mm wide rims of swathing kamacite. The troilite is monocrystalline, but displays multiple twinning, and it contains parallel bars of daubreelite, 10-300 μ wide. Carlsbergite is well-developed as oriented platelets, 20 x 1 μ in size, in the kamacite. Chromite crystals, 0.1-1 mm across, occur in association with troilite.

Millosevich (1924) reported graphite, but this could not be verified in the present study.

Several fissures penetrate the mass (as far as the minute sections allow examination). They follow the phosphide filled Widmanstätten α - γ boundaries and may have formed during the violent deceleration in the atmosphere. They are now partly filled with terrestrial corrosion products.

Uegit is an extremely well-preserved iron which structurally is closely related to Henbury, Kenton County, Madoc and Cape York. Chemically it will probably turn out to be a normal member of group IIIA.

Union. See North Chile (Union)

Union County, Georgia, U.S.A.

Approximately 34°45′N, 84°W

Coarsest octahedrite, Ogg. 1-2.5 mm wide lamellae and 0.5-3 cm almost equiaxial grains. Distorted Neumann bands. HV 200-300.

Anomalous. 6.12% Ni, about 0.20% P, 55 ppm Ga, 245 ppm Ge, 2.1 ppm Ir.

HISTORY

A mass, said to weigh about 15 pounds (i.e., about 7 kg), was discovered by a Mr. Freeman in the Appalachian Mountains, in Union County. The finder evidently split the mass, and one fragment of 500 g passed through several hands before it was acquired by Shepard who briefly described it (1854a). Other fragments must also have been saved since the cumulative weight of known specimens, as listed below, is about 1.6 kg. The date of find is not known exactly, but Shepard (1883a and elsewhere), who was the

Figure 1828. Union County (Amherst). One of the largest preserved fragments, weighing 225 g. Coarse kamacite grains alternate with lamellar parts, and the whole structure is cold-worked and deformed. Deep-etched. Scale in centimeters.

best-informed on this meteorite, normally listed Union County as having been found in 1853, although in one place (1872a) he gave 1850 as the date of discovery.

The meteorite, which could easily be broken into small fragments, was rapidly distributed to all major collections; consequently brief notes appeared by Reichenbach (1859-62), Rose (1863), Brezina (1885; 1896) and others. Wülfing (1897: 371) and Farrington (1915) reviewed the literature.

COLLECTIONS

Tempe (239 g and 37 g fragments), Amherst (225 g fragment and 63 g sawings), Yale (216 g, No. P 154), London (194 g), Strasbourg (141 g), Washington (82 g), Paris (72 g), Chicago (67 g), Tübingen (67 g, now apparently lost), New York (59 g), Berlin (47 g), Harvard (35 g), Calcutta (33 g), Leningrad (25 g), Vienna (16 g), Göttingen (14 g), Bonn (11 g), Tartu (7 g), Ottawa (5 g), Budapest (3 g), Vatican (2 g). Farrington (1915: 468) stated that Amherst College owned 2½ pounds (about 1,140 g); although still believed to be true (Hey 1966), this is no longer the case. Only 288 g remain, the rest possibly having been exchanged.

DESCRIPTION

The original shape and dimensions of the meteorite are only known inaccurately. Shepard (1854a) assumed that it was a tabular mass of 15 pounds with a thickness of about 5 cm. To be found in collections now are fragments, detached along the weathered grain boundaries, making it rather difficult to identify the original exterior surface. In this study, no fusion crust and no heat-affected α_2 zone were detected. On the contrary, all surfaces were covered by terrestrial oxidation products, and several samples were deteriorating further by exfoliation along the Widmanstätten grain boundaries.

One of the largest samples extant is a 225 g fragment in Amherst that measures 6 x 4 x 2 cm. The cut and etched surface of 6 x 3.5 cm clearly shows the two major structural elements of Union County. About 40% is a relatively normal Widmanstätten structure displaying slightly bent kamacite lamellae ($\frac{L}{W} \sim 6$) with a width ranging from 1 to 2.5 mm. The remaining surface is made up of a few large kamacite grains, each 30 x 12 mm in cross section. In other samples the kamacite grains which may approach equiaxial shapes, attain sizes of 10-30 mm. Evidently, the meteorite is an unusual aggregate of almost equal parts of large equiaxial grains and of Widmanstätten structure. Thus, the meteorite cannot be unambiguously classified within the system. It is here decided to label it a coarsest octahedrite to stress the fact that octahedral structural elements are important and that a considerable grain growth has taken place. The same classification was applied by Hey (1966: 498).

The kamacite is irregularly cold-worked as the result of a cosmic event. In some parts normal Neumann bands occur (HV 220±15), in other parts the bands are severely distorted and bent, and the hardness consequently increases to 245±15. The maximum hardness of 300±10 is found in the shear zones, which may be 200 μ wide and 2-5 cm long. A good example is the Tempe specimen No. 326.1x of 239 g, in which four subparallel narrow shear zones cross the entire polished section.

Plessite fields were not observed, but taenite occurs in modest quantities (less than 0.1% by volume), e.g., as 100 x 20 μ lamellae associated with a little schreibersite. The taenite seems to be the last unresorbed remnants of previous comb plessite.

Schreibersite is present as 10-40 μ wide veinlets that are mainly located in the grain boundaries of the Widmanstätten parts. Rhabdites are common as slender prisms, 2-10 μ thick. The bulk phosphorus content is estimated to be 0.20±0.05%.

Troilite was observed by Shepard (1854a) who reported "cylindrical or almond-shaped masses of meteoritic pyrites, some of which are above an inch in length and one-third of an inch in diameter." On the preserved fragments troilite is rather rare, perhaps because the brittle and weathered mineral was destroyed during the later subdivision of the fragments. On the Tempe specimen a part of a troilite nodule, 8 mm in diameter, is preserved near the surface. On other specimens, small nodules ranging from 50 μ to 2.5 mm in diameter occur. The troilite is monocrystalline, but shear-deformed. It contains numerous parallel daubreelite bars, ranging from 0.5 μ to 0.5 mm in width. A typical small nodule, 100 μ in size, was composed of alternating parallel lamellae of 0.5-5 μ wide daubreelite (70%) and troilite (30%). The whole aggregate was twisted by shear-deformation. Several of the sulfides have nucleated narrow (25-50 μ) rims of schreibersite. These are also brecciated by shear.

Carlsbergite, the chromium nitride CrN, occurs in the kamacite as oriented platelets, 10 x 2 μ in size.

Cohenite, graphite and silicates are not present.

Union County is an anomalous iron which has Mount Dooling as its nearest relative, structurally and chemically. However, this iron is considerably altered by a secondary reheating that was probably the result of a cosmic shock event. Union County is shock-hardened only, without significant annealing effects. In this respect it resembles Nelson County closely; the comparison is, however, only valid for the structure, since the chemical composition of

UNION COUNTY – SELECTED CHEMICAL ANALYSES

	percentage			ppm								
Reference	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Wasson 1970a	6.12								54.8	245	2.1	

Nelson County differs appreciably. Union County appears to be remotely related to various irons on the 6-6.5% Ni level, such as Saint Francois County, Bendego and Arispe, but the detailed structures and compositions indicate that the relationship is only a very loose one.

Specimen in the U.S. National Museum in Washington:
82 g part slice (no. 1170, 3 x 3 x 2 cm)

Unter-Mässing, Bavaria, Germany
49°5′25″N, 11°20′0″E; 540 m

Plessitic octahedrite, Opl. Kamacite spindles 0.06±0.02 mm wide. Neumann bands.

Group IIC. 9.9% Ni, about 0.4% P, 37 ppm Ga, 101 ppm Ge, 4.4 ppm Ir.

HISTORY

A mass of 80 kg – not 8 kg as believed by Hey (1966: 498) – was found in 1920 a few kilometers east of Unter-Mässing. The spot was on a forested slope near the junction of the roads to Röckenhofen and Oesterberg, corresponding to the coordinates above. The meteorite was found by Franz Kerl, a forest worker, while he was clearing the ground after removing a 120-year-old spruce. The mass was firmly embedded between the roots of the tree at a depth of 150 cm. It was acquired by *Die Naturhistorische Gesellschaft* in Nuremberg and thoroughly described, with an analysis and photomacrographs, by Hess (1920).

COLLECTIONS

Natural History Society, Nuremberg (78.3 kg main mass), Tempe (54 g).

DESCRIPTION

According to Hess (1920) the 80 kg mass measured 45 x 32 x 25 cm in its extreme dimensions. From his figures of the exterior, it appears that the mass is only slightly weathered, having preserved numerous regmaglypts as 3-5 cm angular depressions.

This was confirmed by an examination of the sample in Tempe, a part slice with surface, measuring 40 x 40 x 5 mm. The heat-affected α_2 zone is preserved as a 1-2 mm thick rim, and micromelted schreibersite pools are present in the outer half of this zone. The fusion crust has weathered away, but the average loss of metal is estimated to be less than 0.5 mm. The meteorite has thus lost very little by weathering during terrestrial exposure that must amount to at least 120 years and is probably much more.

Etched sections display a plessitic Widmanstätten structure, where uniformly oriented kamacite spindles occur in varying abundance across the surface. Neumann bands are common in the kamacite. The prominent spindles are 0.15±0.05 mm in width and 5-10 times as long as they are wide. A large number – or perhaps all – the major spindles are developed around schreibersite nuclei that are typically 20-60 μ across. Schreibersite also occurs as minute particles, 1-5 μ across, in the plessitic matrix between the kamacite platelets.

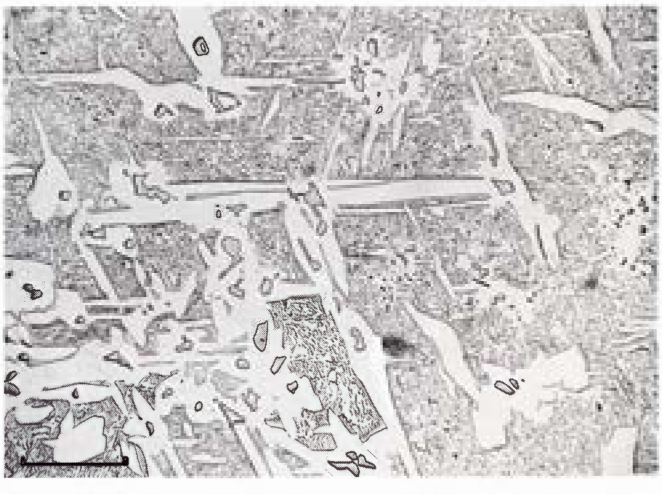

Figure 1829. Unter Mässing (Tempe no. 593.1). A plessitic octahedrite of group IIC. Schreibersite particles are very common, both in the kamacite spindles and in the plessitic matrix, where they stand in high relief. Etched. Scale bar 400 μ.

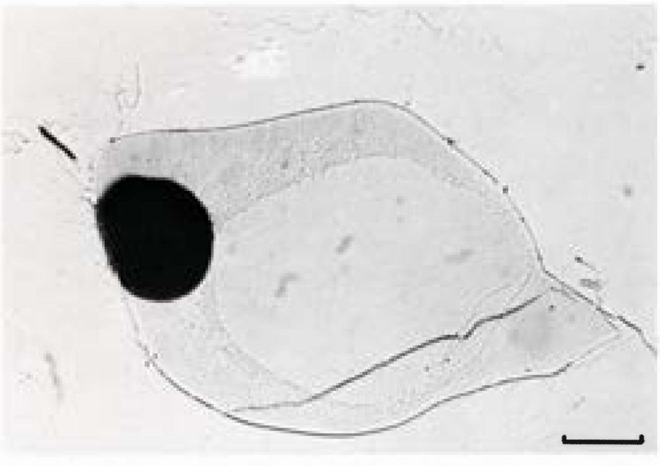

Figure 1830. Unter Mässing (Tempe no. 593.1). A schreibersite crystal in the heat-affected α_2 zone. As heat penetrated from the surface (left) the phosphide started to melt, but immediate and rapid cooling caused it to resolidify to a fine-grained structure, with a large gashole. Etched. Scale bar 20 μ.

UNTER-MÄSSING – SELECTED CHEMICAL ANALYSES

	percentage			ppm								
References	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Hess 1920	9.98			2000								
Wasson 1969	9.80								37.1	101	4.4	

The carbon value is high and appears doubtful.

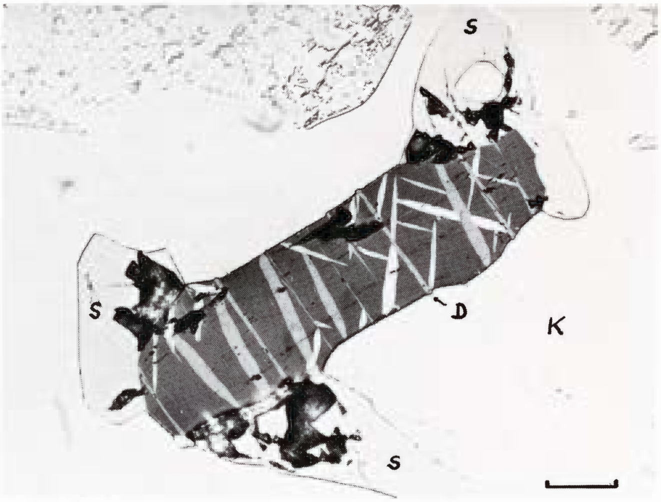

Figure 1831. Unter Mässing (Tempe no. 593.1). A troilite crystal showing multiple twinning due to mechanical deformation. Parallel daubreelite lamellae are seen as narrow gray streaks, one of them marked D. Schreibersite crystals have precipitated at both ends. Swathing kamacite (K) envelops the aggregate. Etched. Crossed polars. Scale bar 50 μ.

In addition, schreibersite is common as large lamellae that reach dimensions of 20 x 0.1 mm. These lamellae are enveloped by somewhat asymmetrical 0.2 mm wide rims of swathing kamacite. It appears that these are typical Brezina lamellae, parallel to {110} of the parent austenite crystal. The bulk phosphorus content is estimated to be 0.4±0.1%.

The kamacite associated with the schreibersite lamellae was no doubt nucleated by early schreibersite that was the first to precipitate from the supersaturated taenite during the primary cooling period. The widths of these kamacite lamellae are not representative of the kamacite lamellae produced later by homogeneous nucleation and growth. The Widmanstätten lamellae proper occur in profusion in the interstices between the schreibersite-kamacite lamellae, have a width of 0.06±0.02 mm and are nearly phosphide-free. Troilite occurs as a few scattered bars or blebs, 50-300 μ across. It contains parallel daubreelite lamellae, 1-50 μ thick and displays multiple twinning as the result of slight shear deformations.

Unter-Mässing is a plessitic octahedrite, related to Ballinoo and Salt River as already noted by Hess (1920). Chemically, it is a member of the resolved chemical group IIC.

Ur. See the Supplement

Ute Pass. See Mount Ouray and the Supplement

Uwet, Biafra, Nigeria
5°17′N, 8°15′E

Hexahedrite, H. Decorated Neumann bands and partially recrystallized. HV 162±10.

Group IIA. 5.66% Ni, 0.47% Co, 0.25% P, 62 ppm Ga, 182 ppm Ge, 2.7 ppm Ir.

HISTORY

A 9 kg fragment of a mass estimated to weigh 120 pounds (about 55 kg) was acquired for the British Museum in 1908 and was described by Prior (1914). The meteorite was held in great veneration by the natives of Uwet, a town on the Calabar River, about 23 miles northwest of Calabar. According to a report quoted by Dr. Prior two meteorites fell at Uwet about 1825. One

"fell causing considerable consternation. A large hole was noticed but was not probed. The same day a second fell which is the one in question. In this case it was dug up and preserved. . . . The stone is bound up in the general welfare of the town. In 1903 it was removed

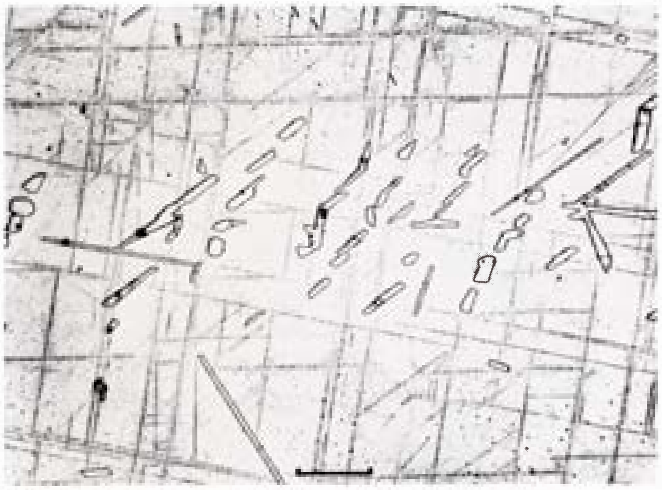

Figure 1832. Uwet (Heidelberg). A cluster of branching rhabdite crystals in an annealed matrix with indistinct Neumann bands. Etched. Scale bar 500 μ. See also Figure 155.

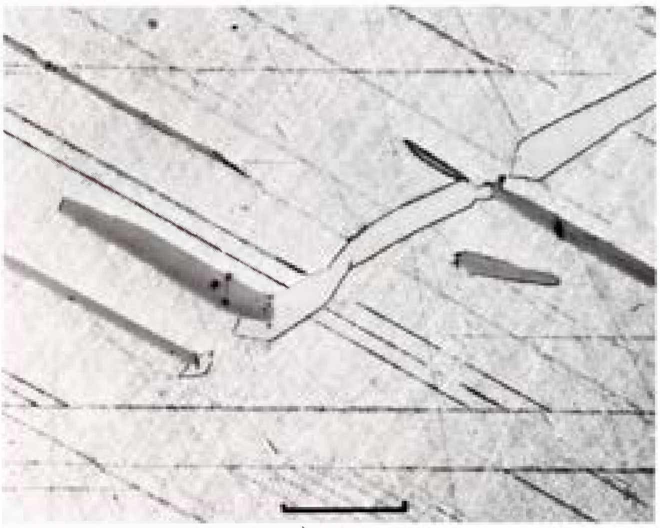

Figure 1833. Uwet (Heidelberg). The branching rhabdite crystals are composed of several units, as clearly seen under crossed polars. Etched. Scale bar 200 μ.

from Uwet. Smallpox, however, broke out and devastated the town, which was attributed to its absence. The stone was returned to Uwet, since when, I am informed, the town has been entirely prosperous."

It is interesting to note that a similar story is associated with an iron from a different culture. The Iron Creek meteorite was intimately tied to the destiny of the Crees and Blackfoot Indians in Canada.

The present report is unique inasmuch as it specifies two independent falls on the same day. Whether any meteorite at all fell at Uwet on that June day is impossible to decide today. As will be shown below, the degree of terrestrial weathering on the recovered mass excludes the possibility that it was an observed and rapidly retrieved fall from the year 1825. Most authorities, including Hey (1966: 500), presumably agree that Uwet is not a dated fall.

Prior (1914) presented an analysis and two photographs of the exterior shape. Gentner (1966) gave another photograph. Hintenberger et al. (1967) determined helium and neon isotopes and pointed out that Uwet showed a significant ^{3}He deficiency. This was interpreted as being due to loss of tritium during some slight reheating in its interplanetary orbit. These observations were further discussed, and several photomicrographs were presented, by Buchwald (1971d).

COLLECTIONS

The village of Uwet, Eastern Nigeria (half mass of about 25 kg), Heidelberg Max-Planck-Institute (22.4 kg), London (5.0 kg), Washington (1.1 kg), Moscow (730 g), Chicago (348 g), Calcutta (254 g), Harvard (152 g), Tempe (17 g), Denver, Rio de Janeiro (10 g).

DESCRIPTION

From the text and the photographs in Prior (1914), Uwet may be described as having the shape of a bicycle saddle with the maximum dimensions 37 x 22 x 15 cm. Its surface is smooth and rounded but covered with terrestrial oxides. These oxides only form thin deposits (0.05-0.2 mm), so at first glance the meteorite appears almost unweathered. However, sections perpendicular to the surface failed to reveal any fusion crust, heat-affected α_2 zone or hardness gradients. This indicates that at least 3 and possibly, on the average, 5 mm of the surface has been lost by terrestrial weathering. The oxides have continuously spalled off or they have been removed by the natives who kept the mass. Since the removal of several millimeters of iron possibly requires centuries in the Nigerian climate, it is out of the question that Uwet was observed to fall in about 1825.

Etched sections show that Uwet is a hexahedrite; i.e., a monocrystalline kamacite-unit where Neumann bands extend without directional change across the full sections. The Neumann bands are, however, rather unusual in their detailed morphology. They are partially annealed out, and partially decorated along both sides with phosphides, less than 1 μ across. The kamacite is penetrated by subboundaries, decorated by 1-2 μ phosphides. But, in addition, there

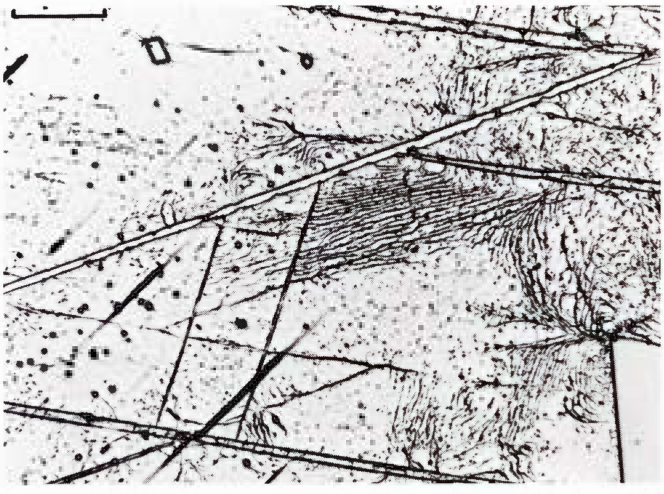

Figure 1834. Uwet (Heidelberg). The Neumann bands are annealed and broken up in cells. The kamacite matrix is polygonized, but rarely shows recrystallized grains. The edge of a large rhabdite is in lower right corner. Etched. Scale bar 40 μ.

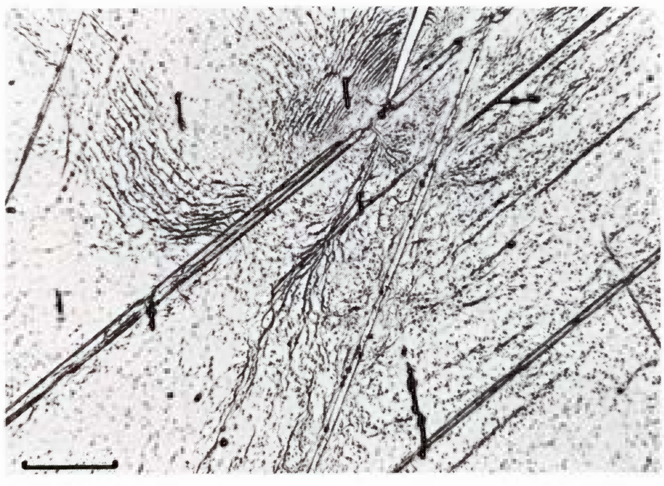

Figure 1835. Uwet (Heidelberg). Another view of the annealed Neumann bands and the polygonized matrix. The black, almost vertical streaks are carlsbergite platelets. Etched. Scale bar 40 μ.

UWET – SELECTED CHEMICAL ANALYSES

	percentage			ppm								
References	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Prior 1914			0.25	300								
Lovering et al. 1957	5.70	0.47				28	134		43	164		
Smales et al. 1967						28	127	<1	52	175		
Wasson 1969	5.61								62.3	182	2.7	

is a uniquely, much more densely spaced network of subparallel cells. The distance between successive cell walls is 2-5 μ, and most cells are distinctly elongated and arranged in subparallel units, partially conditioned by the previous Neumann bands. In the nickel- and phosphorus-depleted zones near phosphides the cells become equiaxial, 5-10 μ in diameter. The development somewhat resembles what is present in the kamacite of Providence, except that Uwet's kamacite is significantly softer, HV 162±10.

It appears that Uwet is under recovery and on the verge of recrystallization. In a few places, notably at intersections of Neumann bands and rhabdites, recrystallized grains, elongated after the Neumanns, may, in fact, be identified. Such recrystallized units, 75 x 15 μ in size, are rare and mainly occur where nickel and phosphorus were low and the deformation was intense. The recrystallized grains show several successive generations of growth lines, suggesting periodic growth. The lines may have developed as the meteorite regularly passed the perihelion in its orbit. The rhabdites inside the recrystallized grains have lost their sharp crystallographic facets; compare Indian Valley.

Taenite and plessite and silicates were not observed. Carlsbergite is common as oriented, tiny (20 x 1 μ) platelets in the kamacite.

Schreibersite occurs as irregular, monocrystalline, rosette-shaped crystals locally. They may be 1.5 x 0.5 or 2 x 0.4 mm in size, and they have served as nucleation sites for cohenite. Cohenite previously covered the schreibersite as a discontinuous rim 20-200 μ thick. At some late reheating, probably the same that recovered the kamacite, the cohenite decomposed to graphite and ferrite, very low (1%) in nickel. The ferrite forms a cellular aggregate with a very low hardness, 98±5. The graphite forms feathery veins, typically 30 x 100 μ in size. From the detailed morphology it may be inferred that the schreibersite plus cohenite aggregates were first brecciated and somewhat shear-displaced; later the decomposition of cohenite followed, starting from the cracks in the cohenite. The brecciation thus belongs to the shock event, while the decomposition belongs to some later cosmic (cyclic) reheating.

Uwet is conspicuous by its quantity of rhabdites arranged in macroscopically visible parallel planes, spaced 5-10 mm apart and following one of the Neumann band directions. The rhabdites are plates, typically 1 x 1 x 0.05 mm in size, but larger crystals also occur. Many are branched, but if so, each branch is an independently oriented crystal. In the kamacite between the parallel rows, a large number of prismatic rhabdites, 5-15 μ in thickness occur. Finally, small rhabdites less than 1 μ across are common in certain zones. The phosphides are often broken and shear-displaced their own thickness. They are all sharply outlined and not rounded, except for the few situated inside a recrystallized kamacite grain.

Troilite is present as nodules with serrated outlines, 1-12 mm across. They are partially sheathed with 0.1-0.4 mm thick rims of schreibersite. All troilite is

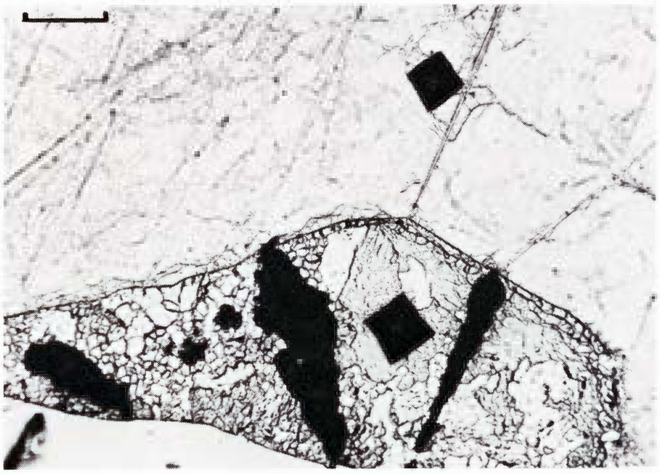

Figure 1837. Uwet (Heidelberg). A schreibersite crystal (below) upon which cohenite was once precipitated. Cosmic annealing decomposed the cohenite to granular kamacite and lamellar graphite. The hardness of the nickel-poor kamacite, formed from cohenite, is much lower than that of average kamacite. Etched. Scale bar 50 μ.

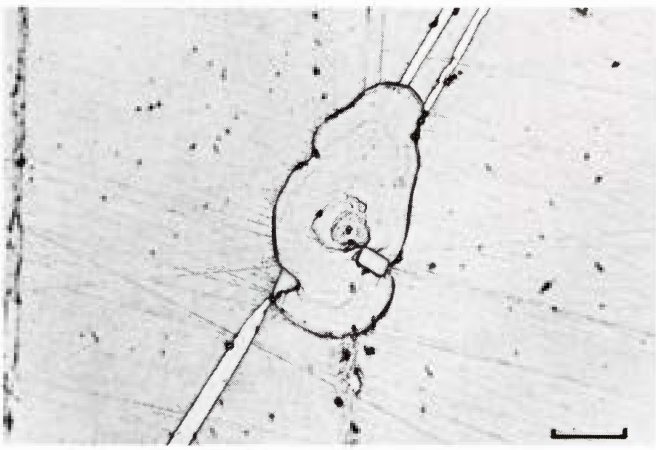

Figure 1836. Uwet (Heidelberg). Occasionally a recrystallized kamacite grain is found such as this one with concentric growth rings and a smoothly rounded rhabdite crystal. Etched. Scale bar 20 μ.

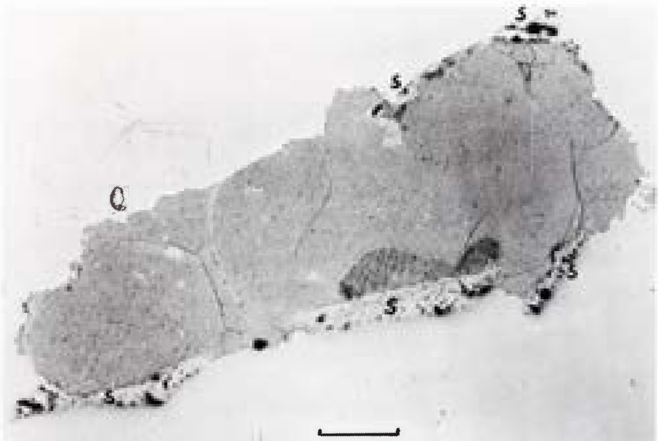

Figure 1838. Uwet (Heidelberg). A typical shock-melted troilite nodule. The interface with kamacite is serrated and fringed, and the schreibersite crystals (S) are brecciated and partially dispersed in the melt. Polished. Scale bar 500 μ.

shock-melted and has reacted with the adjacent metal so that the outlines are jagged. The eutectic has solidified rapidly to a fine-grained iron plus sulfide aggregate (HV 265±15) in which there are numerous dispersed, subangular fragments of daubreelite, 5-10 μ across. The troilite melt has invaded the shattered schreibersite rims

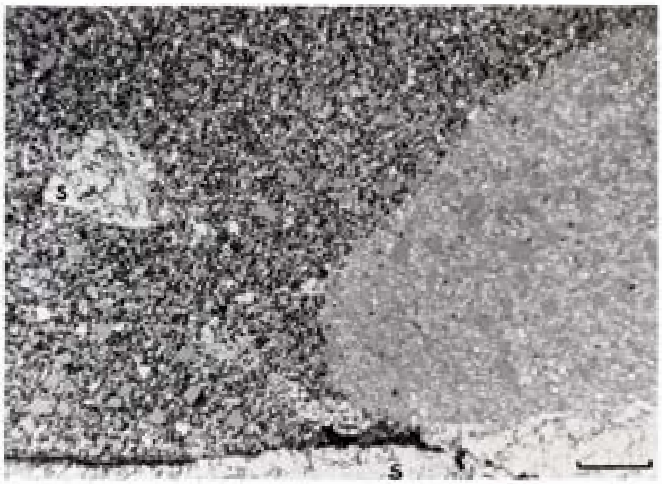

Figure 1839. Uwet. Detail of Figure 1838 near center. In the shock-melt light and dark shaded areas occur, and this is rather typical. The reason for this is not clear. Brecciated schreibersite is marked S. Lightly etched. Scale bar 50 μ.

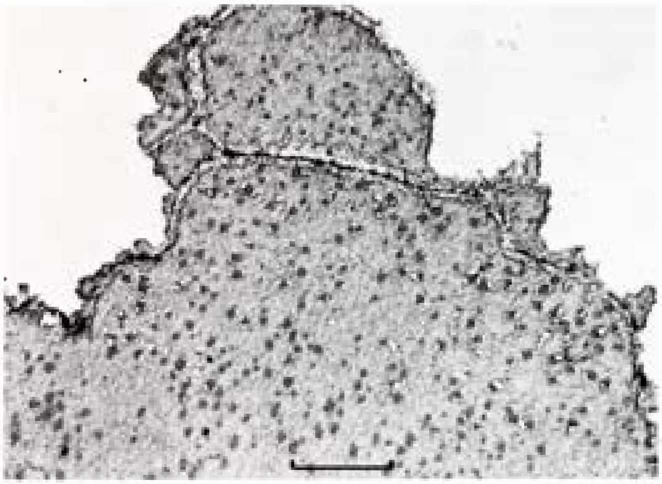

Figure 1840. Uwet (Heidelberg). The edge of a shock-melted troilite nodule. The curvilinear boundaries are visible. The subangular daubreelite fragments are also well developed in this picture. Polished. Scale bar 100 μ.

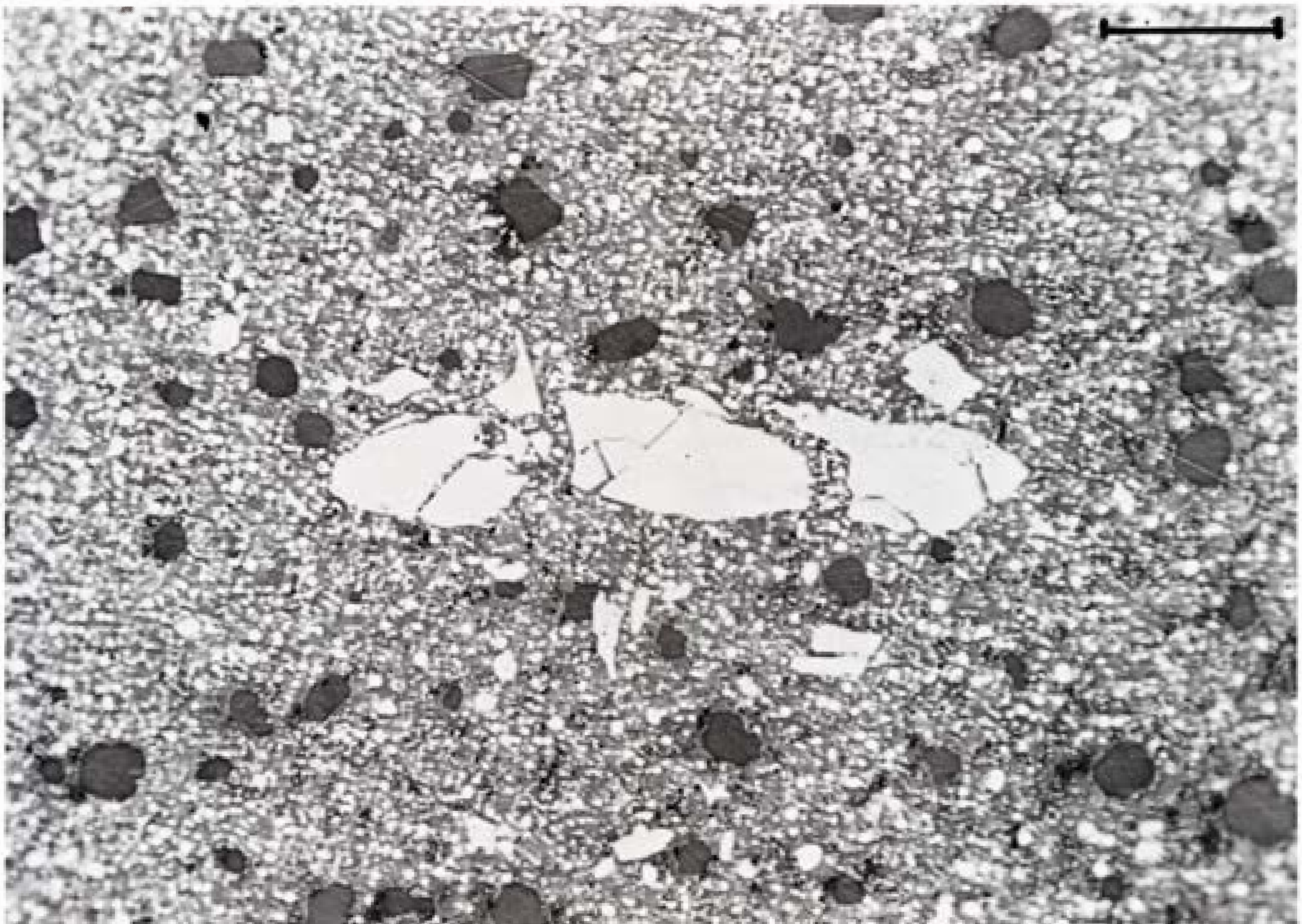

Figure 1841. Uwet (U.S.N.M. no. 601). Detail of shock-melted troilite nodule. Centrally a shattered schreibersite fragment torn loose from the troilite-kamacite interface. Daubreelite fragments (black) are dispersed in the sulfide (gray)-iron (white) eutectic. Polished. Scale bar 30 μ.

and partially dispersed them also. The aggregates are clearly subdivided in millimeter-sized segments by softly curved lines, rich in iron. This subdivision is typical of shock-melted troilite, but rarely seen to perfection, because terrestrial corrosion rapidly attacks along the boundaries and converts them to "limonite." The subdivision must somehow be informative as to the specific physical conditions when the shock wave passed the meteorite.

The observations discussed in the foregoing may be summarized thus. First, Uwet slowly cooled on its parent body and developed kamacite of large grain sizes (> 20 cm). In this, schreibersite with cohenite and rhabdites of various shapes precipitated. The monocrystalline troilite exsolved parallel daubreelite lamellae. A violent shock event released the mass from its parent body, whereby Neumann bands with shock hardening occurred. Simultaneously the troilite melted and solidified rapidly, while all brittle minerals became somewhat brecciated and shear-displaced. Finally, the meteorite was repeatedly reheated so that recovery with a hardness drop occurred. The cohenite decomposed to graphite, the Neumann bands became decorated and recrystallization started.

Uwet is chemically and structurally very closely related to Hex River. It is also distantly related to Bingera, Lombard and Gressk, all of which show rhabdite plates precipitated in parallel planes. It is interesting to note that the idea of a tritium deficit implied by Hintenberger et al. (1967) can be supported by the metallographical examination which indicates a late cosmic, cyclic reheating to temperatures of 300-400° C (Buchwald 1971d).

Specimens in the U.S. National Museum in Washington:

630 g part slice (no. 601)
470 g part slice (no. 4834)

Uwharrie, North Carolina, U.S.A.

35°31'N, 79°58'W; 150 m

Medium octahedrite, Om. Bandwidth 1.15±0.15 mm. Annealed ϵ. HV 188±10.

Probably group IIIA. About 7.9% Ni and 0.15% P.

Guilford County may be a fragment of Uwharrie.

HISTORY

A mass of 73 kg was mentioned by Nininger (1933c: 160) as coming from Uwharrie in 1930. Upon a visit to the North Carolina State Museum, in Raleigh, where the main mass is preserved, the curator, Harry T. Davis, kindly provided me with the following particulars. The mass was plowed up in May 1922 on the Len Cranford Plantation which lies half a mile east of the Uwharrie River just inside Randolph County. It was found in heavy soil at a depth of about 40 cm. From 1922 to 1930 it was used as a barnyard anvil, but in 1930 it was donated to the Museum by T.L. Russell of Denton, N.C. It weighed exactly 160 pounds (72.5 kg) before an endpiece was cut from it at the Smithsonian Institution in 1931.

COLLECTIONS

North Carolina State Museum, Raleigh (about 71 kg), Washington (1,287 g).

ANALYSES

No analyses are known. From the structure I would estimate the composition to be 7.7-8.1% Ni and 0.13-0.17% P, with trace elements placing it in group IIIA.

DESCRIPTION

The somewhat rounded mass has the average dimensions of 32 x 30 x 20 cm and exhibits a 20 x 15 cm polished face at one end where an endpiece of about 1.5 kg has been removed. A cylindrical hole, 10 mm in diameter and 15 mm deep, was probably drilled while the meteorite served as an anvil, but otherwise the mass has suffered little damage from this use. It has, however, suffered considerably from terrestrial weathering, and it continues to corrode under normal, dry museum conditions. The fusion crust and the heat-affected α_2 zone have been lost by corrosion and, in their place, the Widmanstätten structure is indistinctly developed as a grid on the surface. The kamacite lamellae have corroded a bit more rapidly than the interstitial taenite ribbons, thus giving rise to the slight structural relief. Oxides, 1-5 mm thick, cover other parts of the surface and some exfoliation along Widmanstätten planes is also present. On the average, 2-4 mm may have been lost by weathering.

Etched sections display a medium Widmanstätten structure of long ($\frac{L}{W} \sim 30$), straight kamacite lamellae with a width of 1.15±0.15 mm. At low magnification the kamacite shows an acicular, crosshatched ϵ-structure indicating a cosmic shock event above 130 k bar magnitude. High magnification reveals, however, that the hatched structure is duplex on a fine scale, evidently due to annealing after the shock. The kamacite has precipitated an

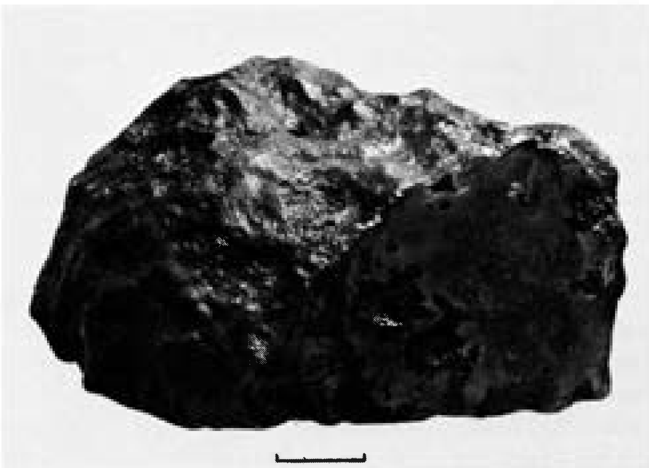

Figure 1842. Uwharrie (Raleigh). A weathered mass of 73 kg, which for a while was in use as an anvil. Scale bar approximately 5 cm.

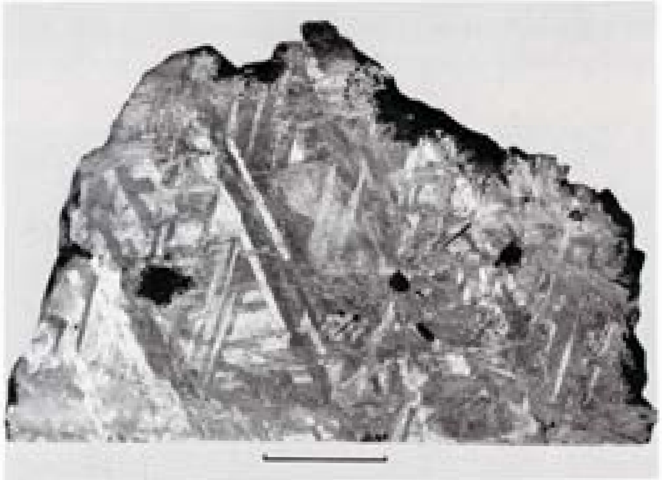

Figure 1843. Uwharrie (U.S.N.M. no. 850). A medium octahedrite of group IIIA, related to Cape York and Casas Grandes. Shock-melted troilite nodules appear black. Corrosion (also black) along the exterior surface. Deep-etched. Scale bar 20 mm. S.I. neg. 41839A.

abundance of fine beads, less than 1 μ across, that are located mainly along the straight, microshear planes of the ε-structure, thus enhancing the contrast. While the hardness of an unaltered ε-structure is usually about 300, the hardness of the annealed, duplex structure in Uwharrie is only 188±10. Similar examples are mentioned under Dalton and Guilford County.

Taenite and plessite cover about 30% by area, mainly as open-meshed, degenerated comb and net plessite and as duplex fields. The taenite ribbons and the taenite rims around the fields etch yellow and exhibit an oriented grid of densely spaced dark lines. The taenite has a hardness of 225±15. The grid and the low hardness are indications of cosmic annealing. The taenite frames duplex fields which are usually uniformly decomposed to $\alpha + \gamma$ on the micron scale; the hardness is rather uniform, too: 275±15. Martensitic and acicular areas are apparently wholly absent.

Schreibersite is common as 10-60 μ wide grain boundary precipitates and as 5-40 μ irregular blebs inside plessite. Rhabdites, 1-5 μ across, are numerous, even inside some of the open plessite fields. The nickel- and phosphorus-depleted zones around the schreibersite crystals are relatively poor in fine γ-precipitates. Instead the kamacite has recrystallized here to 10-20 μ equiaxial units.

Troilite is common as nodules, 1-12 mm in diameter, and as elongated bodies, typically 10 x 1 mm in size. They are enveloped in 20-40 μ thick schreibersite rims, which in turn have nucleated 0.5-1 mm wide rims of swathing kamacite. The troilite is shock-melted and the 15% daubreelite, previously located as parallel lamellae in the troilite, is shattered and dispersed through the troilite as 5-10 μ fragments. Also, the schreibersite rims are shattered and partially dispersed. The troilite has dissolved some of the confining metal and upon solidification formed a fine-grained, iron-sulfide eutectic, with a spongy border against the metallic matrix. The troilite-daubreelite-iron shock melt has a hardness of 220±10.

In the kamacite there are several hard oriented platelets of carlsbergite, typically 10 x 1 μ in size.

Some preterrestrial plastic deformation has brecciated and sheared the schreibersite, often along subparallel shear planes each of which has provided a relative displacement of 2-5 μ. Several fissures extend from the troilite nodules and along phosphide-filled Widmanstätten planes.

Uwharrie is a shocked and annealed medium octahedrite which, chemically, is related to Augusta County, Cumpas, Casas Grandes and Cape York. In its annealed structure it resembles Dalton, Owens Valley and Guilford County. The last mentioned may have been another fragment of Uwharrie, found a hundred years earlier, and later almost lost due to the activities of a blacksmith. [J.T. Wasson, personal communication 1974: Group IIIA with 7.83% Ni, 20.6 ppm Ga, 39.0 ppm Ge and 3.6 ppm Ir].

Specimens in the U.S. National Museum in Washington:

945 g half endpiece (no. 850, 10 x 7 x 2 cm, completely embedded in plastic)
342 g half endpiece (no. 850, 8 x 8 x 2 cm)

Vaalbult, Cape Province, South Africa

Approximately 30°S, 22½E

Coarse octahedrite, Og. Bandwidth 2.0±0.3 mm. Distorted Neumann bands. HV 190-240.

Group I. 6.98% Ni, 0.45% Co, 0.20% P, 84 ppm Ga, 323 ppm Ge, 1.7 ppm Ir.

HISTORY

A mass of 26 pounds (11.8 kg) was found in 1918 on the farm of Mr. Japie Greeff near Vaalbult in the Prieska Division of the Cape Province. It was acquired by the South African Museum in Cape Town the same year, and a sample was sent to London for description (Prior 1926). Comerford et al. (1968), when describing Deelfontein, discussed the relationship between it and other South African meteorites; they particularly examined the case of Deelfontein and Vaalbult, but found too many structural differences for them to belong together. In the present study, I find the two irons present a favorable case for pairing.

COLLECTIONS

Cape Town (about 11 kg main mass), London (157 g).

DESCRIPTION

The mass, a cast of which is in the British Museum, is deeply and broadly pitted. It resembles the upper half of a human skull, covered by a beret. The two "eye" depressions are roughly spherical and 25-30 mm across; the smaller one is deeply undercut. They evidently formed by ablational removal of troilite, augmented by subsequent corrosion. In other places there are shallow depressions, e.g. 10 x 5 and 8 x 7 cm in size and up to 3 cm deep, again caused by ablation plus some corrosion.

For the detailed examination I was loaned the same sample that Prior described so well in 1926 (Brit. Mus.

No. 1921, 274). A corner was removed for a polished section of high quality.

Vaalbult is a coarse octahedrite with straight, bulky ($\frac{L}{W} \sim 8$) kamacite lamellae with a width of 2.0±0.3 mm. Local grain growth has led to almost equiaxial kamacite grains 5-10 mm in diameter. Subboundaries in the kamacite are common and are usually decorated by 1-5 μ angular phosphides. Undecorated Neumann bands occur in profusion, sometimes in distorted and bent varieties. The kamacite displays numerous cubic cleavage cracks, typically 0.5 mm long and 0.01 mm wide; there are also many intercrystalline cracks. All cracks are oxidized by terrestrial corrosion. The microhardness ranges from about 195 to about 240. The hardness variation and the numerous cracks are perhaps due to the inhomogeneous strain deformation which occurred during a breakup in our atmosphere. This makes it possible that additional specimens might be recovered from the area – or perhaps already have been: Deelfontein.

Taenite and plessite cover about 5% by area, mostly as comb plessite and as acicular varieties. The taenite lamellae are cloudy and may show high hardnesses locally (410±20), while other taenite lamellae and rims are somewhat softer (310±30). The acicular plessite contains a Widmanstätten felt of acute kamacite spindles or bayonets, typically 2-10 μ thick. Pearlitic and spheroidized plessite varieties were not present in the small section.

Schreibersite is common as cuneiform and flame-like skeleton crystals, typically 14 x 1.5 mm in size. They are surrounded by asymmetrical, 1-3 mm wide rims of swathing kamacite. It is monocrystalline, but severely brecciated and invaded by terrestrial corrosion products. Schreibersite also occurs as 15-100 μ wide grain boundary veinlets and as 5-30 μ blebs inside plessite, substituting for taenite particles of similar size. Rhabdites are very common and well developed, they are prismatic and range from 2 μ to 25 μ in cross section. Both schreibersite and rhabdites are broken and often shear-displaced 2-10 μ in successive steps.

Troilite occurs as 2-3 cm lenticular and spherical nodules. Graphite was not observed but will presumably be found in other sections. Silicates occur as scattered, 10-30 μ anisotropic gray blebs in the metal phase, often having served as a substrate for precipitating phosphides. Prior (1926) identified minute feldspar grains with twin lamellae in the insoluble residue from his analysis.

Cohenite occurs as continuous, 0.1-0.3 mm wide rims around the larger schreibersite crystals. It is hard and slightly brecciated but has not started the decomposition to graphite and ferrite. Carlsbergite occurs as minute platelets in the kamacite phase, typically 10 x 1 μ in size. Cohenite will undoubtedly be found as central skeleton crystals in the kamacite lamellae when additional samples are cut in the future.

Vaalbult is corroded and covered with 0.5-1 mm thick crusts of terrestrial oxides. Nevertheless, the heat-affected α_2 zone may be detected along limited parts of the periphery. It is 1-2 mm wide and contains micromelted phosphides in its exterior part. Its hardness is 190±15; in the recovered transition zone the hardness drops to 150±5 (hardness curve type IV). The partial presence of the α_2 zone indicates that Vaalbult on the average has only lost 2 mm by terrestrial weathering.

Vaalbult is an inclusion-rich coarse octahedrite which is closely related to Deelfontein, Canyon Diablo, Odessa and Seymour. Chemically, it is a typical member of group I. Its exact place of discovery is difficult to pinpoint on available maps, but it appears to be about 100 km northwest of Deelfontein where another very similar coarse octahedrite was found about 1932. It is recommended that future examinations include the consideration of the possibility that Deelfontein and Vaalbult belong to the same fall. The range of structures displayed by these two masses is certainly not larger than what is known to occur within one and the same body of the inclusion-rich coarse octahedrites. Compare, e.g., Magura, Canyon Diablo and Odessa.

Varas. See Serrania de Varas

Veliko-Nikolaevsky Priisk,
Irkutsk Oblast, USSR
53°50′N, 97°20′E

Medium octahedrite, Om. Bandwidth 1.15±0.10 mm. ε-structure. HV 295±15.

Group IIIAB. About 8.5% Ni, about 0.3% P.

HISTORY

A mass of 24.27 kg was found in the Veliko-Nikolaevsky mine in 1902. It was transferred to Leningrad where Y.A. Markov gave the following details (quoted by Kulik 1941a). The meteorite had been recovered from deposits being worked for gold. Although little definite

VAALBULT – SELECTED CHEMICAL ANALYSES

	percentage			ppm							
References	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Prior 1926	6.99	0.68	0.19		tr.							
Comerford et al. 1968	7.12	0.45	0.20									
Wasson 1974, pers. comm.	6.84								84.3	323	1.7	

information as to the exact circumstances had been collected, it appeared that the meteorite had been embedded in deposits accumulated at the end of the ice age, and it was concluded that the meteorite was of the same age. This conclusion was supported by the presence of a 2-3 mm thick crust of iron oxides. The gold mine was located on the Khorma stream, a tributary of the Great Birjusa River, and had the coordinates given above.

Kulik (1941a) gave a brief description with two photomacrographs and classified it, erroneously, as a coarse octahedrite. This classification was maintained by Zavaritskij & Kvasha (1952: 42), who examined the microstructure, and by Hey (1966).

COLLECTIONS

Moscow (22.65 kg main mass and 539 g slice), Leningrad (about 250 g).

DESCRIPTION

The mass is of a flat lenticular shape with the extreme dimensions of 33 x 21 x 10 cm. It is corroded and covered with 2-3 mm thick iron oxide crusts; nevertheless, Kulik (1941a) and Zavaritskij & Kvasha (1952) saw indications of regmaglypts. My examination of the specimen did not support this conclusion. The fused crust and the heat-affected α_2 zone have disappeared; and, moreover, there is no hardness decrease from the interior to the edge. These facts – together with the oxidized crust – strongly indicate that, on the average, at least five, and most likely 10, mm has been lost by terrestrial corrosion. The resulting corrosion pits somewhat resemble regmaglypts.

Etched sections reveal a medium Widmanstätten structure of long ($\frac{L}{W} \sim 15$), somewhat distorted α-lamellae with a width of 1.15±0.10 mm. There are numerous subboundaries decorated with 0.5-2 μ angular phosphides. The kamacite is of the crosshatched martensitic type (ϵ), with some Neumann bands; it is hard, HV 295±15, suggesting a shock hardening event with an intensity above 130 k bar. In addition, the ϵ-structure is macroscopically sheared and faulted, and the included schreibersite bodies are brecciated while the ductile taenite is bent and sometimes displaced as much as 100 μ. The hardness of the kamacite increases to a maximum of about 360 in the shear zones.

Taenite and plessite occupy about 30% by area. The taenite ribbons are tarnished in yellow-brown-black hues and display a hardness of 360±25. In numerous places microscopic slip in octahedral directions is visible, particularly when examining deep-etched sections (1 minute with 2% Nital) with oil immersion objectives. The slip lines are especially well developed upon faces of taenite ribbons that cut the section obliquely (Figure 1849). Such faces may be profoundly divided into minute terraces revealing the internal cubic face-centered structure. The distance between successive parallel slip planes is less than 1 μ.

Plessite occurs in a variety of forms, from comb and net plessite to unresolvable, black, duplex $\alpha + \gamma$ mixtures.

Figure 1844. Veliko-Nikolaevsky Priisk (Moscow). The meteorite which weighs 24.3 kg is of a flat lenticular shape as shown in this composite photograph where the mass is seen from two sides. Scale bar 5 cm. (Courtesy E.L. Krinov.)

Figure 1845. Veliko-Nikolaevsky Priisk (Leningrad no. 237). A shocked medium octahedrite which probably belongs to group IIIA. Several distorted Reichenbach lamellae are seen (black streaks). Deep-etched. Scale bar 20 mm.

VELIKO-NIKOLAEVSKY PRIISK – SELECTED CHEMICAL ANALYSES

The phosphorus value indicates that the examined specimen was unusually rich in phosphides. Planimetry of sections suggests a bulk value of 0.30±0.05% P.

	percentage			ppm								
Reference	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Dyakonova & Charitonova 1960	8.47	0.56	0.60				300					

Textures with martensite developed parallel to the bulk Widmanstätten structure are very common; they range in hardness from 380 to 420 and are the hardest of the metallic phases. Around some black taenite wedges the kamacite has been severely distorted; the densely crowded slipplanes in the kamacite have become visible because of a late precipitation of submicroscopic phosphides, and the hardness has decreased to 250±15. Compare Thule.

Schreibersite is common as 20-80 μ wide grain boundary precipitates. It is also present as 0.1-0.4 mm wide blocks, arranged centrally in some kamacite lamellae. Locally these blocks are accumulated in a tight row and may, in fact, be interconnected above or below the plane of section. They apparently form imperfect Brezina lamellae. Rhabdites are very few; locally they attain sizes of 1 μ.

Troilite occurs as narrow, distorted Reichenbach lamellae, typically 20 x 0.1 mm in size. They have nucleated discontinuous rims of 0.1 mm wide schreibersite precipitates. The troilite-schreibersite aggregates are enveloped in asymmetric, 0.4-0.8 mm wide kamacite ribbons. The troilite lamellae were probably originally straight but became bent by the plastic deformation that distorted the meteorite.

Veliko-Nikolaevsky Priisk is a shock-hardened medium octahedrite related to Aggie Creek, Joe Wright Mountain, Welland and Cleveland. Although no trace-element analysis has been performed, the structural evidence strongly indicates that the meteorite belongs to group III, particularly to the transitional subgroup between IIIA and IIIB. It is interesting because of its considerable terrestrial age, the circumstances of finding and its involved cosmic deformations.

Thanks are due to Director Kolomenski, Leningrad, and Dr. Krinov, Moscow, for permission to examine their specimens. [J.T. Wasson, personal communication 1974: Group IIIA-IIIB with 8.75% Ni, 21.5 ppm Ga, 47.4 ppm Ge and 0.62 ppm Ir].

Ventura. See Supplement

Verkhne Dnieprovsk. See Augustinovka

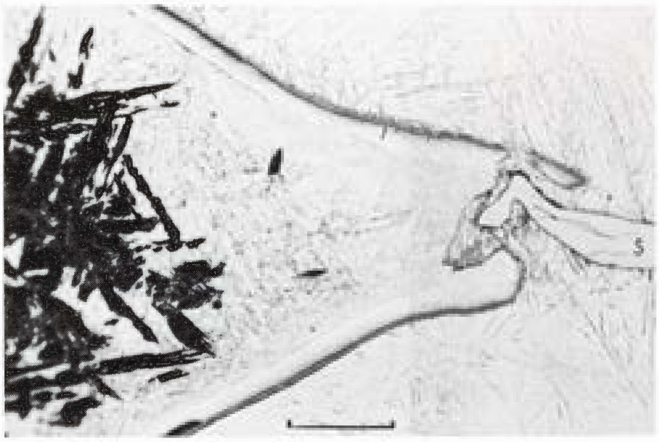

Figure 1846. Veliko-Nikolaevsky Priisk (Moscow no. 761). Shock-hatched kamacite and schreibersite in a grain boundary. Typical plessite field with martensite developed parallel to the bulk Widmanstätten pattern. Etched. Scale bar 50 μ.

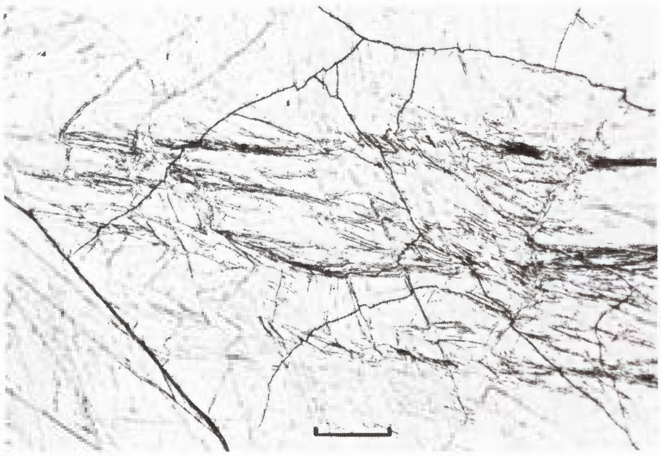

Figure 1847. Veliko-Nikolaevsky Priisk (Moscow no. 761). Shock-hatched kamacite which is furthermore thoroughly cold-worked. Faulted subboundaries. Etched. Scale bar 100 μ.

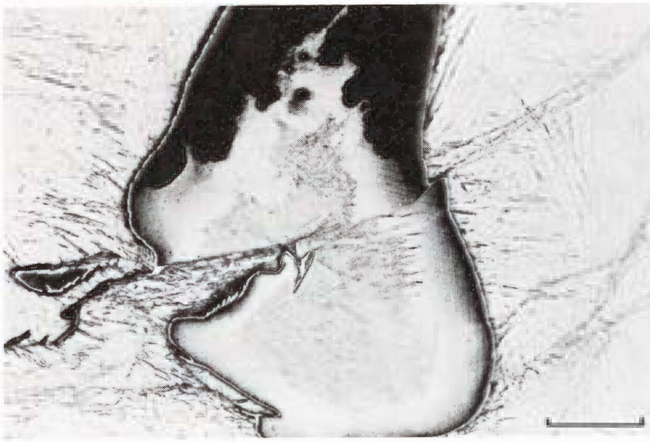

Figure 1848. Veliko-Nikolaevsky Priisk (Moscow no. 761). A plessite field which has been sheared and slightly displaced. A dense grid of slipplanes is visible in the taenite. Compare Figures 110 and 1849. Etched. Scale bar 30 μ.

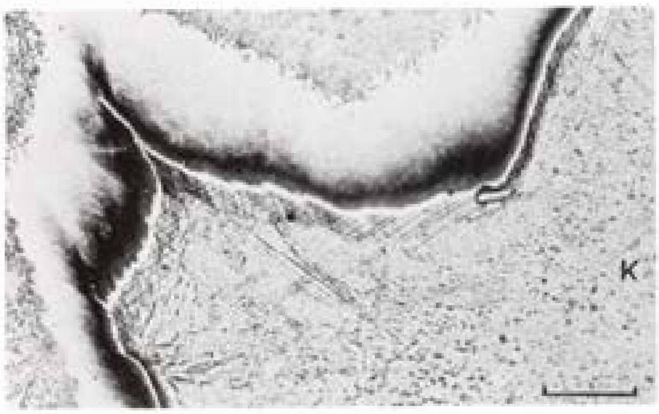

Figure 1849. Veliko-Nikolaevsky Priisk (Moscow no. 761). Detail of a taenite-kamacite (K) interface. The deformation grid in the taenite is particularly well observed on the tapering interface that has become exposed after the kamacite was partly etched away. Scale bar 30 μ.

Verkhne Udinsk,
Buriat-Mongolian Autonomous SSR
54°46'N, 113°59'E

Medium octahedrite, Om. Bandwidth 1.15±0.15 mm. Recrystallized. HV 165-205.

Group IIIA. 7.64% Ni, 0.14% P, 19.0 ppm Ga, 39.8 ppm Ge, 3.3 ppm Ir. The whole mass was artificially reheated to 500-850° C.

HISTORY

A mass of about 18.5 kg (45.1 Russian Funt, each of 408 g) was found in 1854 near the Niro River, a left tributary of the Vitim east of Lake Baikal. According to Krinov (1947: 37) who, like other Russian workers, calls the meteorite Niro, the locality has the coordinates given above. Widely different coordinate sets were previously given by Brezina (1896: 368) and Ward (1904a: 27). The meteorite was brought to Leningrad, and a 560 g specimen was acquired by Rose who briefly described it and compared it to Schwetz (1864a: 65; 1864b: 355). About 1865 the main mass was purchased by Krantz in Bonn who cut it up and distributed it. Laspeyres (1895: 188) and Laspeyres & Kaiser (1895: 493) examined the material in Bonn and believed they had identified heat-affected rim zones. Berwerth (1914: 1080) and Buchwald & Munck (1965: 65) saw, however, indications of artificial reheating. Further examinations of various specimens, reported below, led to the conclusion that the whole mass was artificially reheated to 500-850° C and somewhat hammered, although no report to this effect has been preserved. Wülfing (1897: 382) reviewed the literature. Trofimov (1950) examined the isotopic composition of the carbon isotopes. Zavaritskij & Kvasha (1952) examined the material in Moscow and gave two drawings of the structure.

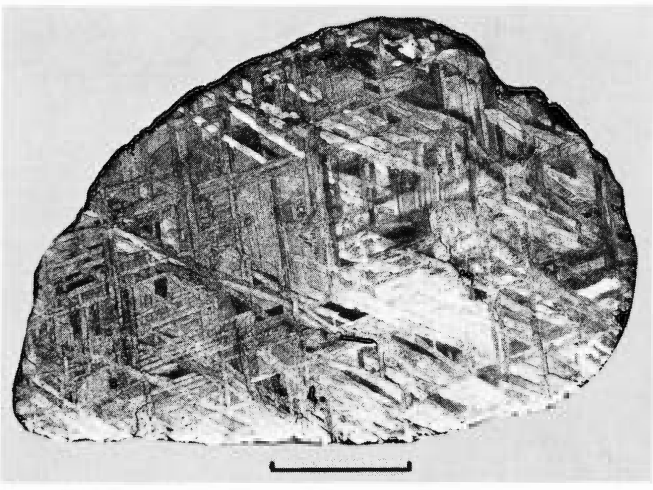

Figure 1850. Verkhne-Udinsk (Prague no. 191). A medium octahedrite of group IIIA (related to Cape York) which has been artificially reheated. It appears that a thermal gradient developed along the mass, with the pointed end (left) attaining the highest temperature. Here the kamacite transformed to unequilibrated α_2 grains. Deep-etched. Scale bar 30 mm.

COLLECTIONS

London (2.90 kg), Moscow (2.06 kg), Stockholm (1.60 kg), Bonn (670 g), Berlin (569 g), Budapest (553 g; lost according to 1969 catalog), Vienna (423 g), Amherst (383 g), Calcutta (242 g), Leningrad (234 g), New York (208 g), Paris (183 g), Tübingen (133 g), Prague (122 g), Copenhagen (116 g), Dorpat (115 g), Rome (110 g), Dresden (54 g), Vatican (50 g), Harvard (46 g), Oslo (44 g), Washington (36 g), Yale (22 g), Göttingen (15 g), Ottawa (15 g), Strasbourg (14 g), Tempe (12 g). Three samples in Chicago (No. 1138 of 220 g, No. 1139 of 75 g and No. 1140 of 432 g), are apparently mislabeled. Close inspection revealed that one was a deeply-etched "Toluca." From a structural examination it is suggested that all three, in fact, represent Toluca material.

DESCRIPTION

The original form and dimensions are unknown. However, from the larger slices and endpieces extant in London, Moscow, Stockholm and Prague it appears that the mass was loaf-like and ellipsoidal with the average dimensions of 24 x 15 x 12 cm. The mass had a rough surface and was somewhat weathered before the reheating took place. No fusion crust and no heat-affected zones from the atmospheric flight have been identified, but some specimens with a crust show a particular oxidation resembling hammer scale.

Etched sections display a medium Widmanstätten structure of long ($\frac{L}{W} \sim 20$), straight kamacite lamellae with a width of 1.15±0.15 mm. The kamacite previously had Neumann bands and, in some specimens – in Moscow for example – they are still rather well-preserved. In others they are recrystallized or even show incipient α_2 formation, as in the Washington specimen. This has a hardness range of 165-205.

Taenite and plessite cover about 30% by area, mainly as taenite ribbons, open-meshed comb and net plessite with discontinuous taenite borders. Black, unresolvable taenite and fine-grained duplex $\alpha + \gamma$ mixtures are also common. The taenite ribbons have a low hardness of 240±20.

VERKHNE UDINSK – SELECTED CHEMICAL ANALYSES

	percentage			ppm								
References	Ni	Co	P	C	S	Cr	Cu	Zn	Ga	Ge	Ir	Pt
Trofimov 1950				260								
Dyakonova & Charitonova 1963	7.81	0.40	0.14				200					
Scott et al. 1973	7.46								19.0	39.8	3.3	

Schreibersite is present as 10-50 μ wide grain boundary precipitates and as 5-50 μ irregular blebs inside the plessite. Rhabdites occur as 1-4 μ thick tetragonal prisms.

Hard oriented platelets of the chromium nitride, carlsbergite, mentioned under Schwetz and Cape York, are quite common and 10 x 1 μ in size.

Troilite occurs as 0.5-15 mm nodules and as lenticular bodies, typically 5 x 4 x 0.8 mm in size. Daubreelite constitutes 10-20% of the inclusions; and 10-20 μ thick, discontinuous schreibersite precipitates may also be found. The troilite is monocrystalline with a few lenticular twins from slight plastic deformation.

In the following I shall point out the facts from which it is possible to conclude that the mass has been artificially reheated.

The metallic matrix shows both by its hardness range and its optical appearance that an incomplete homogenization has occurred. The rhabdites are dissolved to varying degrees, and recrystallization and α_2 formation have occurred in various specimens. The taenite has lost its high hardness (~ 350), a loss which will occur during reheating for as brief a period as 15 minutes at 550° C; compare page 94. The specimen No. 191 in Prague is rather informative in this connection. It is a full slice of 13 x 10 x 0.15 cm through the mass, and it shows a thermal gradient. It exhibits recrystallized material at one end – but Neumann bands at the other end – in a fashion much related to Kingston.

A close examination of polished sections reveals that the hydrated corrosion products have reacted with the meteoritic minerals. Laceworks, 5-50 μ wide, are present along the interface between limonite and kamacite, and in the limonite itself there are numerous metallic beads, 0.5-1 μ across. The interface between schreibersite and limonite now forms a 2-5 μ wide, creamcolored zone, but the phosphides are unmelted. The troilite is partially recrystallized to angular blocks, 10-100 μ across, that follow the previous corrosion fissures. A similar structure was shown in Rodeo, Figure 1455.

It is impossible to escape the conclusion that the mass was reheated – perhaps in a primitive fireplace – and attained a thermal gradient from perhaps 850-500° C across the mass. Equilibrium conditions were not reached before the mass was again cooled.

Verkhne Udinsk is a medium octahedrite which, except for its reheating, is closely related to Cape York, Casas Grandes, Schwetz and Augusta County, and, as these, belongs to the chemical group IIIA.

Specimen in the U.S. National Museum in Washington:
36 g part slice (no. 1179, 4.5 x 2.5 x 0.7 cm)

Vicenice, South Moravia, Czechoslovakia
49°13′N, 15°48′E

A mass of 4.37 kg, buried 0.8 m deep in clay, was found in 1911 near the village of Vicenice (Meteoritical Bulletin 1964, No. 31). A preliminary examination indicated that it was a medium octahedrite. The material is apparently in the University in Brno.

Victoria West, Cape Province, South Africa
31°42′S, 23°45′E

Fine octahedrite, Of. Bandwidth 0.22±0.05 mm. Decorated Neumann bands. HV 170±10.

Anomalous. 12.0% Ni, about 0.6% P, 15.3 ppm Ga, 31.4 ppm Ge, 0.02 ppm Ir.

The whole mass has been artificially reheated to about 900° C.

HISTORY

A small mass of 6-7 pounds was briefly mentioned by Gregory (1868). It was said to have fallen in 1862 at Victoria West and had later been acquired by the South African Museum in Cape Town. According to a letter in the British Museum (Hey 1966: 507), the mass was allegedly observed to fall in 1860 by a Hottentot on a farm 30 miles southwest of Victoria West. Similar information was obtained by Smith (1873) and Cohen (1905: 293) who gave the locality as Treurfontein. Numerous sets of different coordinates have been presented by Cohen (ibid.), Ward (1904a) and Brezina (1896). The coordinates above are those of Hey (1966), but I have not been able to confirm them on available maps.

As will be shown below, the meteorite is so corroded that it is out of the question that it could have fallen in 1860 or 1862. A similar conclusion was already reached by Brezina (1893: 164). However, most authors, e.g. Hey (1966), Frondel (1965) and Horback & Olsen (1965) still accept that the meteorite was an observed fall.

Tschermak (1871) and Smith (1873) gave brief descriptions, and Cohen (1905) gave further details. Brezina & Cohen (1886-1906, plates 12-14) presented eight photomacrographs of the specimen in Vienna; in their description

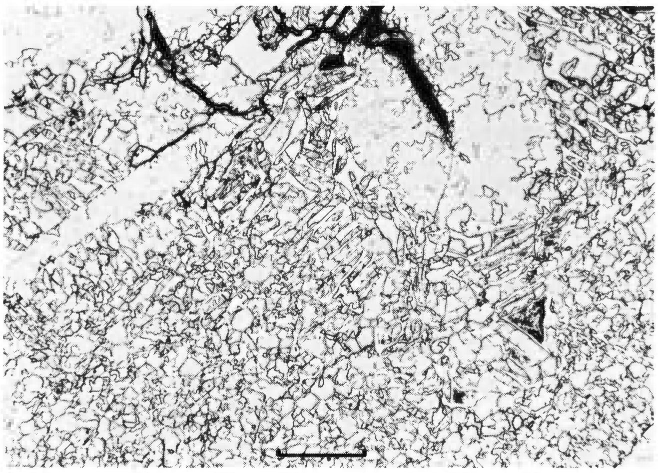

Figure 1851. Victoria West (Copenhagen no. 1905, 1731). An anomalous fine octahedrite. Artificial reheating has granulated all kamacite. Etched. Scale bar 400 μ.