**Drum Mountains, Utah, U.S.A.**
39°30'N, 112°54'W; 1500 m

Medium octahedrite, Om. Bandwidth 1.15±0.15 mm. Distorted Neumann bands HV 275±15.

Group IIIA. 8.47% Ni, about 0.25% P, 20.4 ppm Ga, 41.8 ppm Ge, 0.66 ppm Ir.

**HISTORY**

A mass of 529 kg was found in 1944 in Drum Mountains about 27 km northwest of Hinckley, Millard County. The mass was found on the surface between basaltic rocks in a sage brush desert, by Y. Nishimoto and A. Ujihara, two evacuees of Japanese ancestry, who were prospecting for chalcedony for lapidary work. In December 1944 the mass was sent to the Smithsonian Institution where about 10 kg was cut off in form of 10 slices, each 6-10 mm thick. Henderson & Perry (1948a) gave a thorough description with analysis and photographs of the exterior and of the microstructure. Brett & Henderson (1967) included Drum Mountains in their study of the Reichenbach lamellae and gave a photomacrogaph. Wasson & Kimberlin (1967) also gave a photomacrogaph.

**COLLECTIONS**

Washington (523 kg), Chicago (1,030 g), Moscow (695 g), Tempe (652 g), Ann Arbor (562 g), Calcutta (553 g), Madrid (281 g), Harvard (60 g).

**DESCRIPTION**

The meteorite has the overall dimensions of 65 x 60 x 40 cm and weighs 529 kg. When found, it rested upon a flattened side, about 50 x 30 cm in size and was, at the most, embedded 5-10 cm in loose gravel, while 30-40 cm projected above the ground. Drum Mountains provides a good example of differential corrosive attack in a desert environment. The uncovered surfaces have lost the fusion crust and an estimated 0.5-1 mm in thickness; and, since the ferrite phase has been dissolved a little more rapidly than the austenite, we now observe the Widmanstätten grid distinctly on all upturned surfaces. It is important to note that these surfaces have no scaly oxide crusts or, at the most, a 0.1-0.2 mm bright, shiny varnish, since periodic rains, some blowing sand and gravity have been able to keep the surfaces almost clean. The situation is a little different where the meteorite originally had a hole from a troilite nodule burned out in the atmosphere. (There are about 23 holes, ranging from 1-7 cm in diameter and from 1-8 cm in depth, on the 6,300 cm² surface accessible in the exhibit). The corrosion products could normally not peel off here and disappear, so the cavities slowly became more or less filled up with scales, whereby the corrosion rate increased because access of oxygen to the surface of the iron in the holes became impaired. The resulting, partly scale-filled cavities, therefore, are now larger than the troilite nodules which originally occupied the sites. Another important characteristic of the corrosion-enlarged holes is that they tend to be undercut and to have very sharp edges, in contrast to uncorroded troilite holes that are rarely undercut and have more smoothly rounded edges as a result of the atmospheric friction melting.

**Reference Table**

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*Figure 714. Drum Mountains (U.S.N.M. no. 1417). The meteorite as it was discovered in the Utah desert in 1944.*

*Figure 715. Drum Mountains (Tempe no. 567.1). Medium octahedrite of group IIIA with troilité and many Reienbach lamellae. Deep-etched. Scale in centimeters. (Courtesy of C.B. Moore.)*
The underside of the iron is corroded much more than the topside. No Widmanstätten structure is etched out, and the regmaglypts, which are still well preserved as 3-6 cm wide, shallow grooves on the topside, are removed on the underside. Instead, large shallow corrosion pits with 1.3 mm adhering, matte oxides cover the underside. The reason for the adhering oxides on the buried side appears to be the constraint from the surrounding earth. The heavier attack on the underside is caused by the lower accessibility of oxygen and, perhaps, a somewhat higher and more continuous moisture level than on the topside of the meteorite.

Etched sections display a somewhat distorted Widmanstätten structure of mostly straight, but locally bent, long (~ 25) lamellae with a width of 1.15±0.15 mm. There are numerous subgrain boundaries, decorated with 0.5-1 μm rhabdites, in the kamacite. Neumann bands are common, but they are often heavily distorted; in such areas, the kamacite shows numerous lenticular deformation bands. The hardness ranges from 250 to 290 depending upon the actual amount of cold work present. It is evident that the meteorite has suffered at least two shocks in a distant time, one producing the Neumann bands and a later, more gentle, one producing the plastic deformation of the Widmanstätten lamellae, Neumann bands and other linear, structural elements. Plessite covers about 30% by area, mostly in form of comb and net plessite fields, but also as duplex α + γ fields of varying fineness and as martensitic fields where the martensite plates repeat the overall Widmanstätten directions. As usual, all kinds of transition between these types are encountered.

Schreibersite is very common as 20-50 μm grain boundary precipitates but virtually nonexistent as larger crystals or rim zones around troilite. Rhabdites are rare in the matrix but do occur on the α-subgrain boundaries. The schreibersite is monocrystalline, but often violently sheared 5-50 μm by the same event that bent the Neumann bands. From the frequency of the phosphide inclusions the author would estimate the mass to contain about 0.25% P.

Troilite occurs as 1-10 mm nodules and irregular blebs into which the surrounding matrix may inject a finger. This is very nicely demonstrated at one spot on the ablated surface where an ellipsoidal hole, 6 x 3 cm in aperture and 3 cm deep, has a central 1 cm peak, indicating the place where a troilite nodule burned out, except for the intruding metal finger. Further, troilite is the main component of the numerous Reichenbach lamellae that crisscross the sections and may even be traced as grooves on the exterior surface of the main mass. The typical Reichenbach lamella is 25 x 8 x 0.05 mm and occurs with a frequency of about one per 10 cm². The lamellae represent at least eight different directions on the sections, of which one or two may

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Figure 716. Drum Mountains (U.S.N.M. no. 1417). Net plessite with cloudy taenite rims and black taenite wedges, Schreibersite crystals (S) in grain boundaries. Etched. Scale bar 500 μm. (From Henderson & Perry (1948a).)

Figure 717. Drum Mountains (U.S.N.M. no. 1417). Severely distorted structure. Bent taenite lamellae (black) and Neumann bands, and shear zones with deformation bands. Fissured schreibersite crystals (S). Etched. Scale bar 500 μm.

Figure 718. Drum Mountains (U.S.N.M. no. 1417). Cloudy taenite rim with shock-deformation grid. The interior displays tempered martensite, developed parallel to (111) γ. Etched. Scale bar 100 μm.
Drum Mountains - Duchesne

coincide with the Widmanstätten directions. The Reichenbach lamellae in several other irons, e.g., Duel Hill (1854), are fewer and represent cubic planes in the original austenite crystals, but this is not the case here. The Reichenbach lamellae are enveloped by irregular 0.2-1.5 mm wide rims of swathing kamacite and must, therefore, be of pre-Widmanstätten origin. Most of them are corroded or corrode easily during sectioning and polishing, but, in the better preserved specimens it is seen that they are composed of a 50 µ thick troilite foil upon which 20-100 µ thick, irregular schreibersite blebs have precipitated. The troilite is shock melted and has dissolved 10-30 µ of the surrounding kamacite. The melt has solidified into 1-5 µ fine-grained eutectics of which the iron part corrodes first and easily. The troilite did not remelt the schreibersite border, which, however, frequently was shattered and dispersed as tiny fragments in the troilite. The surrounding metallic matrix is often severely deformed, both compressed and sheared somewhat; a relative displacement of about 0.1 mm of the two sides of a Reichenbach lamellae does not appear unusual at all. The shock melting and the plastic shearing of the surroundings are probably coupled to the Neumann band production and the plastic-deformation event, respectively, as mentioned above.

The surface of the etched sections, from the topside of the meteorite, displays a 1.2-2 mm wide zone of heat-affected α₂. In the outer 0.4-0.6 mm of this zone micro-melted schreibersite bodies are numerous. These two observations help us to conclude that the corrosion has only removed 0.5-1 mm material on the average. It is also seen that corrosion attacks the 1 mm wide α-lamellae more rapidly than the intercalated γ-lamellae and plessite fields. The α-phase is covered with 0.1 mm thick, shallow oxides, which would not have been there if the attack was mainly an erosive attack. The hardness of the α₂ zone is 205±10; a minimum of 180±5 is met with at the transition to the untransformed kamacite. From here the hardness rapidly increases to 275±15 of the interior (hardness curve type I).

Drum Mountain is a medium octahedrite with distorted kamacite lamellae and with numerous, shock-melted Reichenbach lamellae. It is related to Franceville, Tamrapural and Thule, all of group IIIA.

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

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Duchesne, Utah, U.S.A.

Approximately 40°23'N, 110°52’W; 2500 m

Fine octahedrite, Of. Bandwidth 0.35±0.05 mm, Neumann bands. HV 225±25.

Group IVA. 9.37% Ni, 0.40% Co, 0.18% P, 2.23 ppm Ga, 0.126 ppm Ge, 0.42 ppm Ir.

Mount Tabby is a fragment of Duchesne. Altonah is a separate fall.

HISTORY

A mass of about 24.6 kg (54 lbs) was found 47 km northwest of Duchesne on the slopes of Mount Tabby by L.J. Coleman in 1906. Most of the mass was acquired by the University of Utah in the 1920s from where Nininger (1929c) borrowed it, sliced it partially and described it with an analysis and several photographs. No history was given. The foregoing is a summary of the tentative history given in the followiag, as based on the examination by Hardy.
(1958), and upon personal examination of various specimens of Duchesne, Altonah and Mount Tabby.

A mass of 54 pounds, later called Mount Tabby in some references, was found on Mount Tabby, near Hanna, according to Merrill, who had evidently received an inquiry to the effect that the Smithsonian Institution was interested in buying the meteorite (Merrill 1922b). He declined the offer, but sometime, about 1927, Harvard and Chicago each acquired about 1 kg, which had been chiseled and broken off from a larger mass, and labeled their specimens Mount Tabby. The main mass, now weighing just about 50 pounds, was acquired by the University of Utah, where the attached label states that the meteorite was found by L.J. Coleman of Heber, Utah (Hardy 1958). The locality is given as about 47 km northwest of Duchesne, or 1 km east of "the Elbow" in Red Creek, a place which coincides with Merrill's Hanna. When Nininger (1929c) described the mass, he coined the name "Duchesne" for it, evidently not knowing that two specimens had already been distributed under a different name. On Figure 2 in Nininger’s paper the places from which the fragments were detached may be seen. Nininger (1933a) gave the date of find as 1906.

Except for Nininger’s original description, no metallographic work has been done. Jaeger & Lipschutz (1967b) found by X-ray examination that the structure was typical of large, unshocked crystals. Several analyses have been carried out. Among these, two sets by Lovering et al. (1957) and by Nichiporuk & Brown (1965) on allegedly Mount Tabby material are apt to cause confusion. The material they analyzed must be from a coarse, Arispe-like octahedrite, completely different from the Duchesne-Mount Tabby specimens represented in Washington, Chicago, Tempe, University of Utah and Harvard. Lipschutz et al. (1965) examined the noble gas concentrations and estimated the exposure age to be 200 million years.

COLLECTIONS

Labeled Duchesne: Museum of Earth Science, University of Utah, Salt Lake City (8.6 kg “corner”), Washington (2,780 g), Tempe (2,613 g), Oslo (835 g), London (366 g), Paris (354 g), New York (245 g), Chicago (95 g), Los Angeles (33 g), Adelaide (29 g). According to a letter from Nininger to the Smithsonian Institution, at least four other slices of about 1 kg each were cut in 1928. They are now in private collections. Labeled Mount Tabby: Harvard (1,008 g), Chicago (888 g).

DESCRIPTION

Nininger (1929c) did not give the dimensions but, from his photographs and from preserved specimens, Duchesne can be reconstructed as a lenticular mass measuring about 28 x 22 x 11 cm. It is irregular, flattened on one side and with deep cavities, 2-5 cm in diameter, on other sides. In several places large troilite nodules may be seen as outcroppings on the surface. Terrestrial corrosion has removed the fusion crust and the heat-affected α2 zone and covered the surface with 0.2-2 mm thick oxides. As Nininger (1929c: figure 2) pointed out, a 2-3 cm high and 25 cm long escarpment extends along the flat side of the meteorite. There is a high concentration of troilite on the face which abuts against the escarpment. There is also a distinct cleavage fracture along octahedral planes, which is best explained as a very late fracture during atmospheric flight, facilitated by the burning out of large troilite nodules, whereby a 2 kg flattened fragment either tore off and landed a little distance from the main mass or almost broke off and was easily detached later by the finders. The fragment later became known as Mount Tabby as discussed.


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Duchesne is evidently one of the better examined iron meteorites. *The value given by Hawley (1939) includes all platinum metals.
above. That the fracture was late is evidenced by the octahedral cleavage marks which display no smoothing by atmospheric friction melting. Some plastic deformation and necking took place before the masses split or were finally split. Distorted Widmanstätten lamellae due to the separation are seen on, e.g., U.S.N.M. no. 2181.

Etched sections display a well developed fine structure of straight, long (\( \sim 40 \)) kamacite lamellae with a width of 0.35±0.05 mm. Subgrain boundaries, decorated with 0.5-1 \( \mu \) phosphides, are faintly visible. Neumann bands occur in profusion. The microhardness (100 g) is 225±25, exhibiting a rather high scatter within adjacent lamellae. Plessite occupies about 50% by area, mostly in the form of fine-grained, duplex \( \alpha + \gamma \) fields and cellular plessite, similar to that reported from Chinautla and others. Brown martensitic zones, 20-40 \( \mu \) wide, form the transition between the yellow taenite borders and the duplex interior of most fields.

No large schreibersite crystals are present, but 10-60 \( \mu \) grain boundary veinlets are common as are 1-10 \( \mu \) angular or vermicular substitutes for taenite in the duplex \( \alpha + \gamma \) fields. Around the troilite nodules are discontinuous, 10-50 \( \mu \) wide schreibersite rims.

Troilite is overly common as 0.5-40 mm nodules. They are monocristalline with an occasional deformation twin, and apparently daubreelite-free. Phosphate crystals (graftonite-sarcopside ?), 100-200 \( \mu \) in size, form nuclei of many of the troilite blebs. The near-surface troilite nodules are heavily attacked by corrosion, and creamcolored pentlandite veinlets are common. In one place the troilite and the enclosed phosphate are severely brecciated, and the surrounding metal is heavily faulted and fissured and later corroded. It appears that this is the result of preatmospheric deformation, followed by long-term terrestrial weathering.

Very characteristic of Duchesne are the Reichenbach lamellae which take the character of ultrathin, straight lamellae, precipitated in cubic planes of the original austenite crystal. They are typically 10 x 5 x 0.02 mm in size and occur with a frequency of about one per 8 cm². They are, as usual, the first to corrode, but chromite and troilite may still be identified as early lamellar phases upon which schreibersite has been deposited in irregular blebs. The complete lamella is surrounded by a 0.3-1 mm rim of swathing kamacite, and the Widmanstätten structure is discontinuous across the lamellae. The morphology and sizes of the Reichenbach lamellae closely resemble those of Duel Hill (1854).

Duchesne is a fine octahedrite related to Chinautla, Mart and Duel Hill (1854), and it is a typical group IVA member of the phosphide-containing high-nickel end. Duchesne structurally resembles Altonah, which was found about 30 km east of Duchesne, but small and real differences are observed in the bandwidth, amount of phosphides and amount of Reichenbach lamellae. Duchesne also appears to be of a significantly higher terrestrial age than Altonah. Since the analyses further show significant
differences in nickel, chromium and iridium, it must be concluded that the two masses represent different falls.

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

- 698 g slice (no. 825, 10 x 9 x 1.5 cm)
- 2,082 g part slice (no. 2181, 10 x 10 x 4 cm)

**Duel Hill (1854), North Carolina, U.S.A.**

\[35^\circ 51' N, 82^\circ 47' W\]

Fine octahedrite, Cf. Bandwidth \(0.35 \pm 0.05 \text{ mm}\). e-structure. HV 250±15.

Anomalous, but related to group IVA. Width \(0.35 \pm 0.05 \text{ mm}\). e-structure.

HV 250±15.

Anomalous, but related to group IVA. Width \(0.35 \pm 0.05 \text{ mm}\). e-structure.

Not to be confused with Duel Hill (1873), a coarse octahedrite related to Cosby's Creek.

**HISTORY**

A weathered mass of 4.0 kg (8 lbs 13 oz) was found on Jewel Hill, Madison County, in 1854 and was briefly described with an analysis by J.L. Smith (1860). According to Rand McNally's Indexed Atlas of the World, 1882 Edition, Jewel was located five miles northwest of Marshall with a population of 15. The corresponding coordinates are given above. Another mass of 18 kg (40 lbs) was allegedly found in 1856, and part of it came to Amherst (Venable, 1890a: 44). This report appears, however, to be based on hearsay and may be completely erroneous except for the fact that another mass was found in the same area; see Duel Hill (1873). Cohen (1905: 350) observed that two specimens of 1134 and 167 g in Amherst were fine octahedrites and different from the 10 kg coarse octahedrite found in the same area in 1873. This could be confirmed by a recent visit to Amherst by the author; the Amherst specimen is an endpiece of about double the weight mentioned. It was an entire mass, weathered and exuding droplets of deliquescent iron chloride. On the specimens in Amherst, U.S. National Museum and Tempe the original fusion crust is removed by corrosion, and 0.1-0.5 mm thick, terrestrial oxides cover the surface. Etched sections disclose, however, that 1.5-3.5 mm wide, heat-affected rim zones of \(\alpha_2\) are preserved, and micromelted pools of schreibersite are found to about half that depth. Selective corrosion particularly attacks the \(\alpha\)-phase of the duplex plessite fields and the Reichenbach lamellae, but the overall state of preservation is good, and the meteorite has, at the most, lost 1 mm by corrosion.

**COLLECTIONS**

This meteorite, Duel Hill (1854), was for several generations known as Jewell Hill, and many writers have confused it with Duel Hill (1873), the coarse octahedrite. In the following list only specimens known to the author as authentic Duel Hill (1854) are included; but more material is, no doubt, preserved. Amherst (1,200 g), Tempe (167 g, previously in Amherst), Washington (138 g), Harvard (137 g), London (131 g), Paris (104 g), Bedin (101 g), Prague (76 g; erroneously listed as Duel Hill (1873) by Tucek 1964: 29), New York (75 g), Bonn (74 g), Stockholm (50 g), Uppsala (49 g), Yale (45 g), Vienna (41 g), Chicago (40 g).

**DESCRIPTION**

The 4 kg mass of Smith (1860) had, before cutting, the dimensions of 17.5 x 15 x 7.5 cm, which must be the extreme dimensions since they correspond to a mass of about double the weight mentioned. It was an entire mass, weathered and exuding droplets of deliquescent iron chloride. On the specimens in Amherst, U.S. National Museum and Tempe the original fusion crust is removed by corrosion, and 0.1-0.5 mm thick, terrestrial oxides cover the surface. Etched sections disclose, however, that 1.5-3.5 mm wide, heat-affected rim zones of \(\alpha_2\) are preserved, and micromelted pools of schreibersite are found to about half that depth. Selective corrosion particularly attacks the \(\alpha\)-phase of the duplex plessite fields and the Reichenbach lamellae, but the overall state of preservation is good, and the meteorite has, at the most, lost 1 mm by corrosion.

![Figure 725. Duel Hill (1854). The 1.2 kg endpiece in Amherst. Although apparently weathered, the heat-affected \(\alpha_2\) zone is well-preserved, and the sample has not lost more than 1 mm on the average. Ruler in centimeters.](image)

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The Widmanstätten structure consists of straight, long (~30) kamacite lamellae with a width of 0.35±0.05 mm. The kamacite is shocked above 130 k bar and shows the typical acicular, shock-hardened ε-structure. The micro-hardness is 250±15. It decreases near the surface and reaches a minimum of 145 before it again increases to 175±10 in the heat-affected α₂ zone (hardness curve type I). Plessite fields occupy about 50% by area, normally in the form of fine-grained, duplex α+γ fields which frequently bear resemblance to myrmekitic intergrowths in quartz pegmatite. The duplex fields may be so fine-grained and dark-etching that they can not be resolved with a 45x objective.

Schreibersite is more frequent than in group IVA meteorites. It occurs as monocrystalline 50 x 150 μ angular blocks centrally in the α-lamellae and as 5-20 μ wide grain boundary veinlets; also as 1-5 μ vermicular bodies substituting for taenite in the duplex α+γ fields. Most of the schreibersite bodies are broken somewhat.

Troilite occurs as 1-5 mm irregular nodules with partial rims of 30 μ schreibersite. The troilite is monocrystalline but displays lenticular deformation twins. Daubreelite was not observed.

Large phosphate crystals (graftonite-sarcopside) occur in several clusters of skeleton crystals within the kamacite. They reach dimensions of 2 x 0.5 mm and are often associated with a little troilite. The phosphates apparently display multiple twinning, perhaps caused by the same shock event that twinned troilite.

The thin, nonmetallic plates which Tschermak (1872b) showed to be precipitated parallel to a cube face are very common. They occur with about 7 per 10 cm² section and are typically 7 x 5 x 0.005 mm. The Widmanstätten structure is normally discontinuous around them so they must be older than the α-precipitation. Since they now are corroded, the conspicuous part of the plates are oxides of various compositions, but it appears that they originally consisted of a backbone of a 1 μ thick lamella of an unidentified mineral (phosphate?), upon which chromite, troilite and schreibersite subsequently precipitated in irregular and varying thicknesses. The troilite is partly converted to pentlandite by corrosion. The complete plate is normally surrounded by an irregular 0.2 mm wide rim of swathing kamacite.

Duel Hill (1854) is a shocked, fine octahedrite with numerous, small phosphides and with characteristic Reichenbach lamellae. The meteorite is easy, on the basis of structure alone, to distinguish from Duel Hill (1873), which is a Cosby’s Creek type. Duel Hill (1854) is related to Chihautla, Boogaldí, Mart and other relatively phosphide-rich irons of group IVA. On the other hand, the detailed composition with respect to Ni, P, Ga, Ge and Ir indicates that it is sufficiently anomalous to be excluded from group IVA proper.

Specimens in the U.S. National Museum in Washington:
92 g part slice (no. 52, 6 x 3 x 0.6 cm)
32 g part slice (no. 1048, 2.7 x 2.7 x 0.5 cm, Shepard Collection no. 54)
14 g part slice (no. 2748, 2 x 2 x 0.4 cm)

Duel Hill (1873), North Carolina, U.S.A.
35°51'N, 82°47'W

Coarse octahedrite, Og. Bandwidth 2.4±0.7 mm. Neumann bands. HV 190±25.
Group I, judging from the structure. 6.51% Ni, 0.49% Co, about 0.2% P.
This meteorite is often mislabeled in collections. It is, however, easy to recognize since it resembles Canyon Diablo and Cosby's Creek, while Duel Hill (1854) resembles Chiraulta. Black Mountain appears to be a transported fragment of Duel Hill (1873).

**HISTORY**

A mass of about 25 pounds (11 kg) was found in 1873 on land of Robert Farnesworth, near Duel Hill, Madison County. Since the mass had been supporting a rail fence, now rotted away, it was inferred that it actually had been picked up long before but discarded. Two or three pounds had been chiseled off before the remaining 9.5 kg specimen was acquired by Professor Bradley. The mass was briefly described by Burton (1876) who presented an analysis and noted the presence of deliquescent iron chloride, probably the result of contamination with terrestrial chlorides from a long exposure to weathering. The mass, or essential parts of it, appears to have been purchased by Professor Dana for the Yale Collection; but, unfortunately, it was from the beginning erroneously listed together with the Duel Hill (1854) meteorite (Dana 1886; Washington 1897; Turekian 1966). On a visit in 1968 to the Yale Collection, the author discovered that No. P41a was, in fact, the missing 4.2 kg main mass of Duel Hill (1873). Dana exchanged material with Vienna (1.2 kg, Brezina 1896: 233, 286 and plate 8) described this material and proved Dana (1886) and Fletcher (1888: 60) to be wrong when they believed that all material from Duel Hill was identical. Apparently, then, we have a case here where, within about a mile, two different falls have occurred, the coarse octahedrites probably having fallen earlier than the fine one. As discussed under Duel Hill (1854), probably only two masses were ever found. The listing of an additional 18 kg mass found in 1856 or 1857 (Venable 1890a: 12) appears to be a distorted report of the first finding of the coarse octahedrite, which had since been mislaid for 17 years.

**COLLECTIONS**

Yale (4.2 kg main mass), New York (1,493 g), Vienna (1,202 g), Chicago (190 g), Budapest (29 g), Dorpat (17 g), London (12 g). Since mislabelings of the Duel Hill specimens are common, only those meteorites checked by the author are listed here.

**DESCRIPTION**

The overall dimensions were, according to Burton (1876), 22 x 16 x 9 cm, and his truncated specimen weighed 9.5 kg. The corner piece in Yale measures 12 x 15 x 5 cm and represents somewhat less than half of Burton's mass. The Yale specimen is corroded with 0.1-5 mm thick coatings of brown terrestrial oxides. There are several pits, typically with an aperture of 5 x 3 cm and a depth of 1-2 cm, and several smaller pits present. Sections through the surface show that a 0.5-1.5 mm heat-affected zone of \( \alpha_2 \) is preserved over long distances, and even the corroded remnants of the original fusion crust can be identified in sections. Therefore, the corrosion, which appears severe, after all has only removed minor amounts of material, and the intricate sculpture must primarily be due to ablation in the atmosphere and not to weathering.

Etched sections reveal a coarse Widmanstätten structure of irregular, short (\( \sim 10 \)) kamacite lamellae with a width of 2.4±0.7 mm. As usual for group I octahedrites, the narrowest lamellae are associated with the cohenite-rich parts of the meteorite. Grain growth has created more or less equiaxial kamacite grains locally, 10-20 mm across. The kamacite is rich in subgrain boundaries which look like barbed wire on account of the numerous rhabdite rods, 1-2 \( \mu \) thick, that have precipitated upon them. Neumann bands are common, and the microhardness is 190±25. The hardness decreases to a minimum of 155 at the transition to the \( \alpha_2 \) zone; increasing again to 190±15 in this zone. Taenite and plessite cover 2-3% by area but may be somewhat more common in the cohenite-rich areas. The small comb plessite fields are degenerated, the interior being free of taenite but rich in subgrain boundaries. The taenite wedges, 200-300 \( \mu \) thick, may have martensitic or

**DUEL HILL (1873) — SELECTED CHEMICAL ANALYSES**

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and varied in thickness from 1 to 1.8 mm. In the sections a branching crystal was measured to be 24 mm long and this variation is quite normal for the coarse octahedrites. Sheared as are the other minerals, individual branches were numerous taenite ribbons and plessite wedges, indicating a common origin with the cohenite. The cohenite is monocrystalline and heavily pearlitic interiors. The pearlite is very fine, with individual taenite lamellae less than 0.5 μ thick.

Schreibersite occurs as 1-10 mm skeleton crystals and as 50-100 μ wide grain boundary precipitates. It is monocristalline, but extremely brecciated and sheared. The primary skeleton crystals are partly covered with irregular, 0.5 mm thick deposits of cohenite. Two generations of rhodobites occur in the alpha matrix, one 5-15 μ across, another < 1 μ across. The latter cover large parts of the matrix as clouds of particles. The larger rhodobites are frequently sheared and displaced their own thickness.

Cohenite is the dominant mineral on most sections. It is typically 6 x 0.6 mm but may pinch and swell irregularly. A branching crystal was measured to be 24 mm long and 1 mm wide on the average. Intercalated between the individual branches were numerous taenite ribbons and plessite wedges, indicating a common origin with the cohenite. The cohenite is monocristalline and heavily sheared as are the other minerals. It frequently includes 50-100 μ blebs of schreibersite.

Breznina (1896: 286) reported parallel troilitue cylinders in the Vienna specimen. One such cylinder was 15 cm long and varied in thickness from 1 to 1.8 cm. In the sections studied here only minor amounts of troilitue were seen, but this variation is quite normal for the coarse octahedrites.

Of the accessory minerals, only a few chromite grains, 50 μ across, were observed in the kamacite. Duel Hill (1873) is a normal coarse octahedrite, related particularly to Cosby’s Creek and Gladstone. It appears to have suffered little, if any, reheating after its initial cooling period. Judging from the structure it is a typical group I iron.

Since there appeared to be a slight probability that Duel Hill (1873) could be a fragment of the Cosby’s Creek shower, the main mass of which was found 50 km farther west, a close inspection of the structures was carried out. No significant differences were found. It appears, however, that Cosby’s Creek is significantly more weathered, and that this alone is sufficient to establish the masses as separate falls.

A small amount of material, treated separately under the entry Black Mountain, appears to be a transported fragment of Duel Hill (1873).

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**Duketon, Western Australia**

27°30’S, 122°22’E

Medium octahedrite, Om. Bandwidth 1.0 mm.

Group IIIA. 7.5% Ni, about 0.2% P, 19.8 ppm Ga, 38.1 ppm Ge, 4 ppm Ir.

**HISTORY**

A mass of 119 kg (263 pounds) was briefly mentioned by Frost (1958) and by McCall & De Laeter (1965: 33). It had apparently been known to the aborigines in the Nuleri Land District for a long time before it was “discovered” in 1947 by V.R. Lloyd and H.W. Hill. After having been used for some years as a gate stop on Bandya Sheep Station, 10 miles north of Duketon, it was donated in 1957 to the Geology Department of the University of Western Australia, in Perth. The original locality of find was on the surface of a sandy spinifex plain near Mount Joanna and Bandya Station, about 80 miles north of Laverton, the coordinates of which are given above.

Frost (1958) presented two photographs of the exterior and one of an etched slice. Additional information and an analysis were given later (Frost 1965b), and another photograph of the very well preserved exterior was presented by McCall & De Laeter (1965: plate 5). Frost drew attention to the similarity between Duketon and previously reported small fragments, labeled Nuleri originating from the same general region. No conclusion as to the probability of the two being paired falls was reached.

**COLLECTIONS**

Geology Department, University of Western Australia, Perth (main mass of about 118 kg).

**ANALYSIS**

Frost (1965b) reported 7.25% Ni, 0.50% Co, 0.24% P and 0.03% S. The nickel content appears low and/or the phosphorus content high for the reported structure. The new data by Scott et al. (1973) show a satisfactory nickel determination: 7.52% Ni, 19.8 ppm Ga, 38.1 ppm Ge and 4 ppm Ir.

**DESCRIPTION**

The summary that follows is based largely on the three papers quoted above.

The mass weighed 119 kg and had the maximum dimensions 54 x 39 x 18 cm in three perpendicular directions. Although slightly rust colored from weathering, the fusion crust was well preserved over large areas. Regmaglypts of great beauty were distinctly developed; they were 2.5-5 cm across on the convex domed surface, and 5-10 cm across and considerably more shallow on the opposite flat surface. It appears that Duketon penetrated the atmosphere in an oriented, stabilized flight, presenting a parallel case to Cabin Creek, Hraschina and Mumpewie.

The only etched section prepared displayed a medium Widmanstätten structure of straight, long (~ 25) kamacite lamellae with a width of 1.0 mm. Comb plessite was common, and schreibersite was observed as grains and platelets up to 20 μ thick and 300 μ long. Cohenite was reported, but, under the circumstances, I believe it to be a misinterpretation of schreibersite. Troilitue was not present in the section but was identified on the ablated surface where a cavity indicated the place where a troilitue nodule about 2 cm across had burned out.

Duketon seems to be one of the best preserved medium octahedrites discovered and deserves a thorough examination. It appears to be a normal medium octahedrite related to Boxhole, Henbury and Cape York. Comparisons with the...
Nuleri fragments should be carried out in order to throw light on the possible relationship.

**Dungannon, Virginia, U.S.A.**

36°48'N, 82°26'W; 700 m

Coarse octahedrite, Og. Bandwidth 2.0±0.4 mm. Recrystallized. HV 180±10.

Group I. 7.0% Ni, 0.42% Co, 0.24% P, 0.5% C, 79 ppm Ga, 330 ppm Ge, 2.1 ppm Ir.

**HISTORY**

A mass of about 13 kg was plowed up on Copper Ridge in the Clinch Mountains about 5 km southeast of Dungannon, Scott County. The meteorite was somewhat oxidized and broke into two pieces of 2.3 and 10.5 kg, respectively, when hit by the plow. In 1922 the masses were forwarded by C.W. Castle of Nickelsville to the U.S. National Museum where they were described with an analysis and photomicrographs by Merrill (1923a). Perry (1944: plate 62) gave two photomicrographs and Nininger & Nininger (1950: plate 16) gave a photomacrograph.

**COLLECTIONS**

Chicago (6,540 g half mass, 760 g slices), Washington (1,009 g), New York (559 g), Tempe (152 g), London (75 g), Calcutta (47 g), Ann Arbor (38 g).

**DESCRIPTION**

The irregular, rounded mass had the overall dimensions of 17 x 16 x 12 cm, judging from an old photograph in the Smithsonian Institution. The two larger specimens preserved there and the samples in Chicago show that normal, shallow regmaglypts and grooves, 1-3 cm in diameter, from atmospheric flight, are present and much better retained than suggested by Merrill (1923a). On etched sections the heat-affected α zone may be seen as a 1-1.5 mm continuous rim in which micromelted phosphides are present in the outer 0.5 mm. Dungannon has probably not lost more than about 0.5 mm by corrosion. Corrosion penetrates a little into the interior, particularly along grain boundaries.

**Figure 729. Dungannon.** The mass was broken by a plow, but is restored here to its original shape. Scale bar 3 cm. S.I. neg. 28894A.

**Figure 730. Dungannon (U.S.N.M. no. 644).** An annealed coarse octahedrite with numerous decomposed cohenite crystals. Deep-etched. Scale bar 1 cm. S.I. neg. 24974B. See also Figure 147.

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*Sum of nickel and cobalt
but the state of preservation is better than in most earth-found group I meteorites. Corroded fusion crust can, in fact, be identified over many square centimeters in the regmaglypts.

Etched sections display an indistinct Widmanstätten structure of short (\( \approx 7 \)) kamacite lamellae with a width of 2.0±0.4 mm. Locally, early grain growth has led to almost equiaxial kamacite grains 10-15 mm in diameter. The overall structure immediately suggests a Canyon Diablo type which has been extensively altered. From Merrill’s original description, I concluded that the reason might be artificial reheating (Hey 1966: 143), but a reexamination of the specimens shows, unambiguously, that the reheating is preatmospheric since the heat-affected \( \alpha_g \) zone is preserved.

The kamacite originally had Neumann bands. They are still faintly visible because their traces are lined with rows of fine, 0.5-2 µ, rounded particles, consisting mostly of taenite. The original kamacite is recrystallized to 50-250 µ loped, elongated ferrite grains in which several concentric growth rings may be seen; compare Indian Valley. The recrystallized ferrite units are frequently subdivided in a lamellar network of 1-3 µ cells, and the microhardness is 180±10. In the recrystallized ferrite there are a few sharp Neumann bands, probably of very late date, having been formed when the meteorite fissured in the atmosphere.

Plessite is not prominent but occurs with one or two 1 mm fields per \( \text{cm}^2 \) adjacent to the former cohenite inclusions a little more frequently than elsewhere. Most fields are pearlitic with 0.5-1 µ wide taenite lamellae, some are well spheroidized with 0.2-2 µ taenite spherules. Original yellowish taenite now displays a grid of ultrafine lines or precipitates in a few directions. The plessite is not so strongly altered as the plessite of Oscuro Mountains.

Schreibersite occurs as 1-5 mm skeleton crystals and as 40-80 µ grain boundary precipitates; also as 20-50 µ wide veinlets and blebs in the original cohenite crystals. All

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**Figure 731.** Dungannon (U.S.N.M. no. 644). An annealed plessite field (above), recrystallized kamacite with new Neumann bands, and decomposed cohenite (below). Unaffected schreibersite (S). Etched. Scale bar 200 µ.

**Figure 732.** Dungannon (U.S.N.M. no. 644). Recrystallized kamacite with old (white) and new (black) Neumann bands. Fine phosphide particles in the grain interiors. Etched. Scale bar 100 µ.

**Figure 733.** Dungannon (U.S.N.M. no. 644). Recrystallized kamacite grains with indistinct, concentric growth rings. Graphite lamellae (black) from decomposed cohenite. Etched. Scale bar 40 µ.

**Figure 734.** Dungannon (U.S.N.M. no. 644). Recrystallized kamacite and annealed plessite. The taenite shows fine decomposition along (111) \( \gamma \) planes. See Figure 735. Etched. Scale bar 40 µ.
Schreibersite is monocrystalline and slightly broken; it does not show the creamcolored taenite rims which are otherwise seen in reheated irons. Rhabdites are common, partly as a "first generation" of 5-15 μ thick prisms, partly as a "second generation" of 0.5 μ thick microrhabdites everywhere in the ferrite. All crystal facets are rounded and smooth.

Characteristic for Dungannon is the cohenite decomposition. While Wichita County, Canyon Diablo and many other Group I irons display a partial, cosmic decomposition of cohenite to graphite, the transformation here is complete. The original cohenite crystals, typically 3 x 0.8 mm, occur in patches of many square centimeters and delineate the Widmanstätten structure better than anything else. However, no cohenite is left; it is converted to 5-30 μ wide and very long microcrystalline, cavernous, "arborescent" graphite lamellae in a matrix of nickel-poor ferrite. Judging from observations of incomplete decomposition in other irons, the graphite lamellae nucleated along cracks in the original cohenite, but there is now little evidence of these cracks. The microhardness of the ferrite formed from decomposing cohenite is 109±3, indicating a low amount of nickel (1.5%) and phosphorus in solid solution. The original kamacite windows stand out clearly as recrystallized ferrite with microrhabdites. This kamacite is intermediate in hardness between 109 and 180 of the lamellae, indicating an intermediate composition. The original taenite windows are now pearlitic, while the original schreibersite inclusions appear unaltered.

Troilite was not observed in the sections, but the impression of what was undoubtedly a 2 x 1.5 cm troilite-graphite nodule is seen in the fractured surface made by the plow.

Before the cosmic reheating Dungannon was a normal, carbon-rich, coarse octahedrite like Canyon Diablo. The present structure may be the result of a repeated reheating to about 500° or 550° C, whereby the recrystallization with growth rings of the ferrite, the precipitation of microrhabdites, the spheroidization of the plessite and the decomposition of the cohenite took place. The very few, sharp Neumann bands are late and may be due to cracking during atmospheric penetration. If the meteorite was already partly fissured in the atmosphere, it is also easier to understand how it could be broken by the plow.

Specimens in the U.S. National Museum in Washington:
655 g corner (no. 644, 7 x 5 x 4 cm)
249 g endpiece (no. 2749, 10 x 3 x 2 cm)
105 g fragments (no. 644)

Figure 735. Dungannon (U.S.N.M. no. 644). Annealed taenite. Numerous α-particles have precipitated upon (111) γ planes in the deformed taenite lamella. Spheroidized γ-particles are present in the adjacent kamacite. Etched. Scale bar 20 μ.

Figure 736. Dungannon (U.S.N.M. no. 644). Annealed taenite lamella and a cohenite crystal (above) which is entirely decomposed to granulated ferrite and lamellar graphite. Schreibersite (S). Scale bar 40 μ.

Figure 737. Dungannon (U.S.N.M. no. 644). Decomposed cohenite: graphite lamellae in granulated ferrite. The lamellae contain minute α-iron particles. Polished. Scale bar 40 μ.
Chupaderos is presently known as the State of in through secondhand reports before 1889, were discovered than it is today. His experiences in 1811, the State of Durango was larger than it is today. It extended far north and comprised what is presently known as the State of Chihuahua. The Chupaderos masses, which were only known to science through secondhand reports before 1889, were discovered in Chihuahua in a region which, when Humboldt worked, was known as Durango. It would, therefore, have been natural for Humboldt to refer to the large mass as Durango. Apparently he had only heard of one such mass, but much later it became clear that at least four masses over 3 ton existed in the region.

Thus, both historical and structural facts indicate that what Humboldt knew only vaguely as a 300-400 cwt. mass in Durango, was later to become known as Chupaderos. For further information, please examine the report of that name, on page 465.

B. The Karawinsky material

According to Partsch (1843: 113) and Buchner (1863: 150), about 1 kg fragments were acquired by von Karawinsky in 1834 and sold to the Vienna collection. It was said to have come from a large mass on the plains northeast of (the city of) Durango, but no particulars were ever published; and it appears that Karawinsky had not seen the main mass himself (Burkart 1856: 283). Small samples have been distributed from the Vienna material, e.g., to Berlin (35 g).

I have not had an opportunity to examine this material and have no opinion as to the origin of Karawinsky’s samples.

C. Cacaria, Durango

This is an independent fall, which is treated separately on page 362.

D. Rancho de la Pila, Durango

This is an independent fall, which is treated separately on page 1006.

E. Morito, Chihuahua

This is an independent fall, which is treated separately on page 838. Originally situated in the State of Durango, the locality has been a part of the State Chihuahua since 1823.

F. The Durango dyke

Probably the most remarkable attempt to explain away Humboldt’s observation is found in a note in “Nature” by Le Roy (1904). He reported that the Humboldt mass “proved to be a remarkable dyke, emerging from a rocky plain at the elevation of 6300 feet, rising from 400 feet to 650 feet in height itself, and forming a mass of iron ore a mile long and one third of a mile wide”, etc. Le Roy’s note could only add to the confusion.

G. pseudo Apoala

Nininger & Nininger (1950: 28, plate 5) listed a 417 g endpiece, no. 475.1, as Apoala. In 1959 this sample was divided; one half is now in Tempe (no. 475 of 195 g), the other half in London Brit. Mus. no. 1959, 969 of 208 g. I have examined the two samples and must conclude that they do not come from the Apoala mass, but from the 164 kg Durango mass; see below. The two masses are displayed in the same room in the Institute of Geology.
Mexico City, so it appears that Nininger, when he cut samples in 1929, unfortunately mislabeled one of them.

**H. Durango**

Under this entry the proper Durango meteorite is treated. It was apparently first mentioned by Haro (1931: 80) who stated that a mass of 164 kg was in the Institute of Geology, Mexico City, but unfortunately he gave no details whatsoever. The exact locality of the Durango mass proper is thus unknown. Perhaps the Archives in the Institute of Geology, Mexico City, preserve relevant information. On Plate 36, Haro presented a photograph of the exterior and labeled it Durango; however, this photo does not show the 164 kg Durango mass, but, due to a misunderstanding (retouche on the label of the photograph?) shows the 1,000 kg Santa Apolonia mass, also in Mexico City.

Nininger & Nininger (1950: 49) stated that Durango was first described in 1904. However, this seems to be a printer’s error for 1804, since no such meteorite description appeared in that year, while it is commonly assumed that 1804 was the year when “Durango”, i.e., Chupaderos was “discovered.”

**COLLECTIONS**

Authentic Durango material is preserved in Mexico City, Institute of Geology (main mass of about 164 kg), Chicago (no. 2138 of 296 g), London (no. 1959, 950 of 91 g), and Tempe (no. 38ax of 72 g). The London and Tempe samples are two halves of the same sample, originally no. 38a of 166 g in Nininger’s collection. Also, London (no. 1959, 969 of 208 g) and Tempe (no. 475.1x of 195 g) as noted under paragraph G above.

**DESCRIPTION**

The main mass in Mexico City is an irregular, somewhat shield-shaped mass, of which I attach a photograph for the sake of identification. Unfortunately, it is presently exhibited without a label. The mass measures 40 x 40 x 30 cm in three perpendicular directions, and weighs, according to Haro (1931: 80), 164 kg. At one end about 1 kg has been sawed off, leaving a 23 x 3 cm cut and ground surface. Part of the natural surface forms a rather smooth dome, approximately 35 x 25 cm in size, while the remainder is boldly carved with beautiful regmaglypts. The regmaglypts are 3-5 cm across and some of them form subparallel grooves. One part of the surface contains deep bowls, 10-15 cm across, subdivided by regmaglypts. Fusion crusts are preserved in many places, albeit in a slightly weathered form.

The following observations pertain to both authentic Durango specimens and to the specimen ‘G’ previously labeled Apoala (Tempe no. 475.1x); there are no differences at all.

Etched sections display a medium Widmanstätten structure of straight, long ($w \sim 25$) kamacite lamellae with a width of 1.15±0.15 mm. The kamacite is recrystallized to a uniform, equilibrated aggregate of 40-200 µgrains, which

Figure 738. Durango (Institute of Geology, Mexico City). This 164 kg mass is the genuine Durango meteorite. Only minor pieces have been removed. The meteorite is very well-preserved and its remarkable morphology is entirely due to ablative sculpturing in the atmosphere. Ruler above measures 15 cm.

**DURANGO – SELECTED CHEMICAL ANALYSES**

The first two analyses were performed on authentic Durango samples from the Tempe collection. The latter two analyses were performed on the material discussed above under G, which originally was assumed to be an Apoala specimen (Nininger & Nininger 1950: 28), then was listed as pseudo Apoala and assumed to be a Misteca sample (Wasson & Kimberlin 1967: 2089). A structural and historical examination shows, however, that No. 475.1 is a Durango sample. Lewis & Moore (1971) quoted an old analysis by Häpke (1884). Häpke’s work did not, however, concern Durango material, but, presumably, Humboldt’s material discussed above under A.

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<td>22.2</td>
<td>42.6</td>
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<td>Wasson &amp; Kimberlin, 1967</td>
<td>8.23</td>
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<td>Moore 1968, pers. comm.</td>
<td>7.92</td>
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are occasionally slightly elongated, presumably because they are extended along preexisting Neumann band directions; compare Indian Valley and Roebourne. While a major part of the recrystallized grains are devoid of Neumann bands, these do often occur in profusion in grains adjacent to the intercrystalline fissures, which are quite common. It appears that the fissures are of post-recrystallization date and formed during the violent deceleration in our atmosphere. Simultaneously, the Neumann bands formed in the strained zones along the fissures. The microhardness is 180±10.

Taenite and plessite cover about 35% by area. Comb and net plessite and varieties of the dense plessite fields are common, but it is characteristic that all are annealed. Martensitic, bainitic and unresolvable black taenite are thus absent, and the same is true of the stained taenite lamellae, otherwise so common. A typical field will display a yellow structureless rim zone (HV 192±6), followed by an easily resolved duplex $\alpha+\gamma$ mixture with 1-2 $\mu$ $\gamma$-beads (HV 195±6). While the taenite lamellae usually display straight interfaces with kamacite, Durango contains slightly jagged lamellae, due to incipient spheroidization. Likewise, otherwise massive taenite rims are under decomposition to $\alpha+\gamma$, displaying numerous tiny 0.5-2 $\mu$ windows of $\alpha$-phase, arranged in a network of 10-15 $\mu$ cells. Both the structure and the hardness of the taenite thus support the impression gained from the recrystallized kamacite: that Durango has suffered considerable cosmic annealing, presumably with reheating to 400-500°C for an extended period. The normal sharp M-curve, measured with the electron microprobe across a taenite-plessite field, would presumably be considerably smoother for Durango, since diffusion must have operated at the annealing temperatures in question.

Schreibersite is common as 20-80 $\mu$ wide grain boundary veinlets and as 5-50 $\mu$ irregular particles inside plessite,
substituting for γ-particles of similar size. No large cuneiform schreibersite crystals are present, and rhadbites are likewise absent. However, a large number of almost submicroscopic particles (<0.5 μ across) are to be found in the kamacite; they are apparently either microrhabdites or ultrafine γ-precipitates, perhaps dating from the annealing. The schreibersite crystals are enveloped in a discontinuous rim of 1-4 μ wide γ-particles; it appears that these γ-particles also formed during the above discussed annealing when the nickel-rich schreibersite had to decrease its nickel content according to the equilibrium diagram (Buchwald 1966: 10-12).

Troilite occurs as scattered 0.5-2 mm inclusions, but unfortunately none were present in any of the polished sections. When examined, they will probably be found to be shock-melted fine aggregates similar to those of Roebourne. Silicates are absent. A few 0.1-0.3 mm idiomorphic chromite crystals were noted in the kamacite.

Durango is well preserved and displays fusion crust on many sections. Moreover, it exhibits the same intricate whirlpools discussed under, e.g., Jamestown, Kalkaska, Sandtown, Seneca Township and Wood’s Mountain. The whirlpools — consisting of oxides and dendritic metal from the atmospheric flight — penetrate to a depth of 1-2 mm below the surface on one side but are absent on the opposite side. The primary Widmanstätten structure is often deformed around the intruding whirlpools, indicating that the metal was hot and plastic when hit with violent force by fused droplets which were swept from the adjacent parts of the meteorite. The metallic, dendritic part of the fusion crust and whirlpools normally display columnar, subparallel grains, 4-20 μ wide, with hardness of 320±20. Inclusions of 1-10 μ oxide globules and gas cavities are, however, common enough to make a hardness determination somewhat irrelevant.

Under the fusion crust is a 1-5 mm wide α₂ zone, with micromelted schreibersite crystals in the outer 50%. The α₂ zone is unusually hard, 230±25, possibly because phosphorus in solid solution yields a significant contribution (hardness curve type II). Indications are that the α₂ zone is wide, 3-5 mm, on the side of the whirlpools, but narrow, 1-2.5 mm, on the opposite side.

Chemically, Durango is a normal member of the resolved chemical group IIA, related to, for example, Sandtown, Kyancutta, Bagdad, Roebourne, Savannah, Thunda and Cumpas. It is also very closely related to another iron meteorite from the State of Durango, Rancho de la Pila; so closely, in fact, that even a full chemical analysis cannot distinguish between them. However, large structural differences are present due to secondary cosmic events.

Durango is particularly interesting because of its cosmically annealed structure which is related, in particular, to the structures of Roebourne and Withrow, but also shows similarities to Casimiro de Abreu, Willamette, Sandtown and Cachiyual. For Durango, the following elementary events may be deducted: (i) a primary homogeneous cooling period, whereby the precursor austenite crystal decomposed to a medium Widmanstätten structure; (ii) a shock event that produced Neumann bands, (iii) an annealing that erased almost all primary Neumann bands, recrystallized the kamacite, spheroidized and homogenized the taenite, and precipitated fine taenite particles around schreibersite — (The annealing may have been the result of the temperature increase, associated with a violent shock); (iv) another shock event, probably the deceleration in our atmosphere, whereby intercrystalline fissures developed, new Neumann bands formed, and α₂ zones and fusion crust covered the exterior; (v) a period of corrosion, which was insignificant; (vi) no artificial damage occurred, except for slight hammering and chiseling, visible on the main mass and upon some cut samples.

Figure 743. Durango (Tempe no. 475.1x). Whirlpool intrusion of melted iron-oxides. The comb plessite is plastically deformed. Metallic fusion crust (F) and heat-affected A-zone (A). Lightly etched. Scale bar 400 μ.

Figure 744. Durango (Tempe no. 475.1x). Six spherulitic, fused iron-oxide composites in the whirlpool-fusion crust. Terrestrial corrosion has altered the original structures somewhat. Etched. Scale bar 30 μ.