The Robert Haag COLLECTION of METEORITES

PRIVATE COLLECTION EDITION

OVER 280 ALL NEW PHOTOGRAPHS!

The Robert Haag COLLECTION of METEORITES

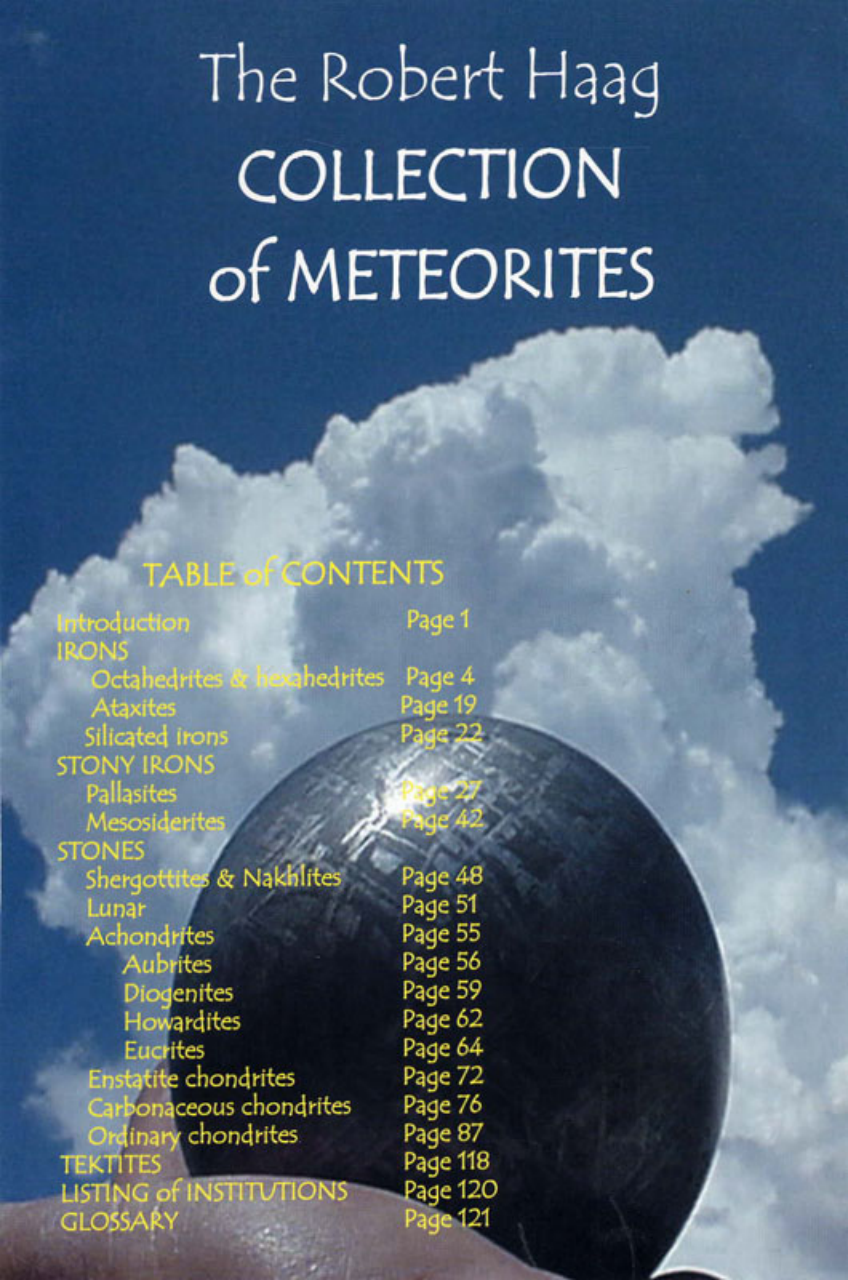
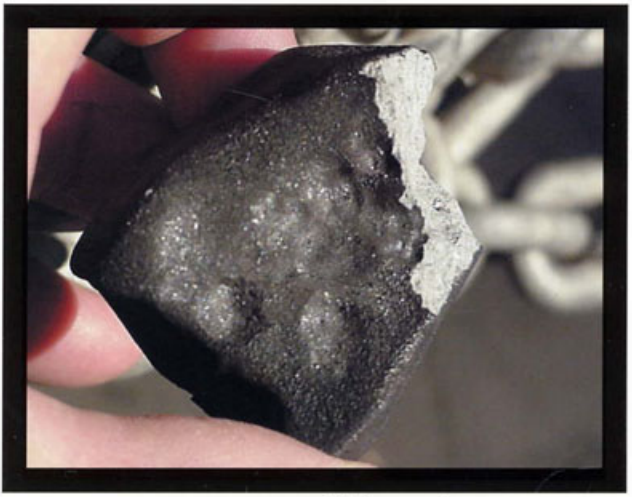


TABLE of CONTENTS



BEN SOUR. 146 grams. (LL6) New fall from Algerian - Moroccan border. Feb. 10, 2002. Note the fresh black fusion crust. This thin burnt skin is melted rock and a result of the friction produced heat generated by high speed entry through the Earths atmosphere. Fusion crust, whether fresh or weathered is the key to finding and recognizing meteorites. Nine-out-of-ten meteorite-dropping "shooting stars" will unload material that looks just like this typical stone meteorite.

Robert Haag Meteorites

P. O. Box 27527 Tucson, AZ 85726

Phone: 520-882-8804 Fax: 520-743-7225

Email: rhaag6@comcast.net
www.meteoriteman.com

Layout, typesetting and editing by Terri Haag / WordWorks
Published by Robert Haag Meteorites, Tucson Arizona

Cover: **ADAMANA, Arizona.** 1.78 kilos. Ordinary chondrite. This amazing stone meteorite is a perfectly aerodynamic "nose cone" shape that obviously remained stable during its passage through Earth's atmosphere.

PORTALES VALLEY.
New Mexico
Complete stone, top. 1.58 kilos. Etched slice, right. 128 grams. Unique H-6 with iron "ribs". This fell June 13, 1998 at 7:30 am. Witnesses described, "a spiraling dragon falling out of the sky". Several dozen metorites were quickly recovered. The specimen above was purchased from its finder the day after the fall.

Meteorites like this can be worth more than their weight in gold to collectors and scientists alike.

Thanks for "visiting" the Robert Haag Collection of Meteorites ...

You will find we have made several changes in the format and have added over 280 all new pictures and several new acquisitions. We're sure you'll enjoy it.

People always ask how I got started in meteorites. Like most boys, I had a pas sion for all things airborne, which was fueled by my father, an aviation electri cian, and an uncle who loved building airplanes. I got my pilot's license when I was 21.

While I'd always had an interest in high flying objects, the event that made the most impact (no pun intended), on me was the time I sat on a beach in Mexico with my family and watched a fireball scream directly overhead and apparently land in the hills just behind us. I didn't find that one, though, and it wasn't until many years later that I was able to actually handle my first meteorite.

As fate would have it, my mother's parents owned a rock shop and eventually persuaded my parents to get involved in the mineral business, too. Thus Al and Bernie Haag were among the first dealers at the then fledgling Tucson Gem and Mineral Show. In fact, the Smithsonian bought their entire collection of wulfen ite and those specimens are still on display in the nation's capital. (We spent a good deal of our childhood on mine sites and at mineral shows.)

In my early twenties I happened to see an advertisement in the back of a min eralogical magazine placed by someone who wanted to buy meteorites. Meteorites were valuable! (Who knew?) I contacted the person who placed the ad no less than Jim Dupont and the next thing I knew, I was in business. The following years took me all over the globe, searching for, collecting, buying, sell ing, trading and promoting meteorites. As a result, my life has been more excit ing, adventure filled and fulfilling than I ever imagined.

This book is my 13th publication. The previous editions were intended as a basic introduction to meteorites a way to educate, guide and inspire. My hope was to encourage people to go out and find their own meteorites, and I'd like to believe that I've been successful. In the last 20 years, meteorite awareness and the recovery of new meteorites has been nothing short of phenomenal. Literally thousands of new specimens have been found in recent years, to the delight of collectors and scientists, and ultimately to the benefit of everyone on the planet.

During the writing and preparation of this book, we relied heavily on information found in the excellent Cambridge Encyclopedia of Meteorites by O. Richard Norton, and the invaluable Catalogue of Meteorites, by Monica Grady and the Natural History Museum, London. If you love meteorites, you need these books.

By now you'll have noticed that this book is different. There are less anecdotes, less instruction, and lots more pictures. Whenever possible, these photos were taken in direct sunlight, to give a sense of how the specimens might appear in the field. We believe that when it comes to identifying meteorites, a picture is worth a thousand words and think you'll agree that for this purpose, this edition is better than ever.

As always, thanks to all meteorite enthusiasts everywhere for your support!

Robert Haag The Meteorite Man

Iron metorites are very heavy!
These metal rocks are basically dense crystals of iron alloys. Some contain stone inclusions. Irons have been chemically and structurally differentiated into 17 groups, based on the size of the kamacite crystal band-width in millimeters and the percentage of nickel by weight. Roman numerals I through IV refer to the crystal size in descending order (coarsest octahedrite through ataxite) and the alphabetical designations A through F refer to the percentage of nickel by weight.

Statistically, fewer irons fall to earth than stones, however more irons tend to be recovered, simply because they are more distinctive and they resist weathering longer. The largest meteorites known are irons, as they are stronger than stones and under the proper conditions, resist the forces of entry and impact better.

NATURAL WONDERS. Hard to get cooler than this... .
Meteorites may be the ultimate objet d' art. Gibeon. 300 kilos.

IRONS

SIKHOTE ALIN. Russia 117 kilos. A huge fall on Feb. 12, 1947. Coarsest octahedrite. 5.8% nickel. (IIAB) iron. Purchase from collector.

IRON METEORITES are the most easily recognized of all meteorites, even though they are actually rarer than stones.

Iron meteorites are primarily made up of an alloy of nickel and iron, although sulfur, silica, carbon and other trace elements are common inclusions. Iron meteorites almost certainly represent the center of asteroids and/or planets with enough mass to melt the inner core. As this molten metal cooled in zero-gravity, two different molecular arrangements formed. Kamacite, a low-nickel structure, and taenite, a nickel-rich structure, formed crystalline arrangements called a Widmanstatten pattern. This pattern is definitive of iron meteorites and can not be faked or duplicated within earth's gravity. When etched with a weak nitric acid solution, almost all iron meteorites will show an eight-sided crystalline structure called a Widmanstatten pattern.

Iron meteorites can be detected with a metal detector and obviously will attract a magnet. Iron meteorites also begin to rust once they encounter water and water vapor on Earth.

HENBURY
Australia. 30 kilos. 7.5% nickel, medium octahedrite. This classic, oriented and shield-shaped meteorite fell approximately 5000 years ago in central Australia. It left a large strewnfield and at least 13 known craters. ASU trade.

TAZA. Algeria. 6 kilos. Plessitic octahedrite. 16% nickel and rich in platinum and platinum-group elements. Considered an intermediate between octahedrites and ataxites. Moroccan find in 2000. Great surface features. Purchase from dealer.

MUNDRABILLA, Australia. 550 kilos. 7.7% nickel. Medium octahedrite. Anomalous. (IIICD) Sulfide and silicate inclusions weathered out leaving behind the distinctive coral-like texture of the nickel-iron. Purchase from finder.

Etched slice (right): 1.56 kilos

GIBEON, Namibia. 63 kilos. 7.7% nickel. Fine octahedrite. (IVA) The most popular iron meteorite. Extremely malleable largely because of the fine crystal structure. The strewnfield is the largest in Africa - nearly 400 kilometers long by 120 kilometers wide. Thousands of pieces have been recovered and this is the most esthetic one yet! Purchase from dealer.

Meteorite medallion 35 grams. This was a unique production to melt iron meteorite and cast it into these one of a kind coins. Canyon Diablo irons were melted down at over 3,400 degrees and poured into molds to produce this space medal. Honors Halleys Comet.

CANYON DIABLO, Arizona. 1.5 kilos. 7.1% nickel. Coarse octahedrite. (IAB) - the most common iron meteorite. This unique piece was found after some 50,000 years of burial. Collected by the author.

The REAL METEORITE MAN

Canyon Diablo. 7.7 kilos. This amazing meteorite with the natural face has traveled the globe with various owners and now is back home in Arizona.

BOXHOLE, Australia. 4 kilos. 7.6% nickel. Medium octahedrite. (IIIAB) Purchase from finder.

TOLUCA, Mexico. 3.2 kilos. 8% nickel. Coarse octahedrite. (IAB) Purchase from finder on location

NANTAN, China. 1.5 kilos. 6.8% nickel. Medium octahedrite. (IIICD) Possible witnessed fall from the late 15th Century. Most specimens are very weathered because of high humidity. Purchase from dealer.

CAMPO DEL CIELO, Argentina. 22 kilos. 6.6% nickel. Coarse octahedrite. (IAB) Huge, etched end-piece. (I had a bigger one once, but that's another story...) Purchase from finder on location

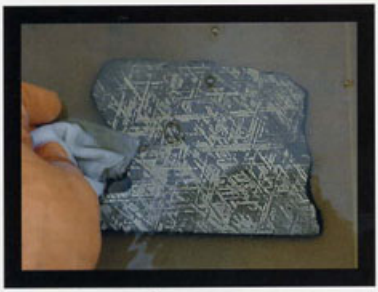
Back of polished end piece above.

Note the size of these iron crystals! This meteorite fell about 5,000 years ago, creating the largest strewnfield in South America. Collected by author on location.

RISPE, Mexico. 3.6 kilos. 6.6% nickel. Coarse octahedrite. (IC) Etch
d piece. Purchase / trade (metal detector!) from finder.

LDAMA, Mexico. 5.5 kilos. 7.6% nickel. Medium octahedrite. (IIIAB)
is specimen has been cut and polished but not etched. Found by a go

Cut Gibeon before acid etching.



Gibeon after 10% nitric acid etching.

8 kg Gibeon mirror with etched rim.

Etched Gibeon sword.

ALVORD, Iowa. 81 grams. 8.7% nickel. Fine octahedrite. (IVA.) Same as Gibeon. Purchase from finder at location.

KENTON COUNTY, Kentucky. 205 grams. 7.6% nickel. Medium Octahedrite. (IIAB) AMNH trade.

GLADSTONE, Australia. 1.17 kilos. 6.7% nickel. Coarse octahedrite. (IAB) ASU trade.

LORETO, Mexico. 1034 grams. 7.7% nickel. Medium octahedrite. (IIIAB) USNM trade.

LOUIS LOPEZ, Mexico 454 grams. Medium octahedrite. Undescribed. Purchase from dealer.

MAGURA, Slovakia. 748 grams. 6.7% nickel. Coarse octahedrite. (IAB) Dealer trade.

Cape York Greenland 37 kilo etched slice 7.58 nickel. Medium octahedrite (IIIAB). 3.5 ton mass was found by Inuit on a small peninsula later taken to Copenhagen were it was cut. Note large trolite nodules. Purchase.

SEYMORE, Missouri. 958 grams. 6.5% nickel. Coarse octahedrite. (IIICD) Shows large schreibersite crystals with cohenite rims. Dealer trade.

URUACHI, Mexico. 2.36 kilos. 8.3% nickel. Medium octahedrite. (IIIAB) Purchase from finder.

SACRAMENTO MTNS., New Mexico. 886 grams 8.1% niCKel. Medium. octahedrite. (IIIAB) Note large graphite nodule. MB-P trade.

FAIRVIEW , Texas. 296 grams. 7.6% nickel. Medium octahedrite. (IIIAB) Purchase from finder.

TOLUCA, Mexico. 2.92 kilos. 8% nickel. Coarse octahedrite. (IAB) Purchase from finder on location.

TRES CASTILLO, Mexico. 182 grams. 9.2% nickel. Medium octahedrite. (Ungrouped.) Dealer trade.

OCOTILLO, California. 738 grams. 7% nickel. Coarse octahedrite. (IAB) Private collector trade.

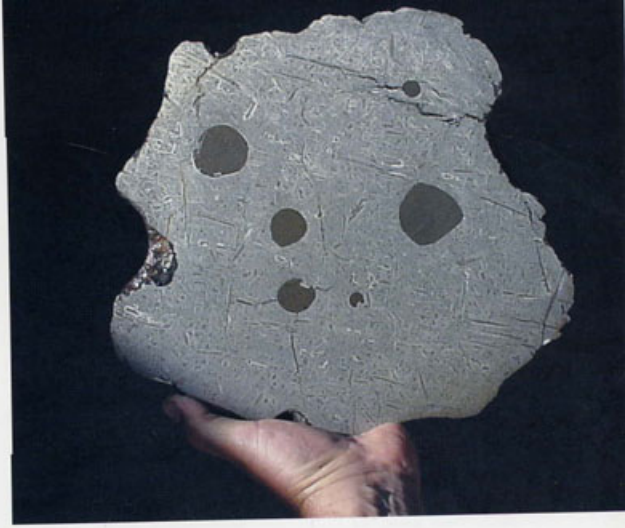
KALAMATH FALLS, Kentucky. 852 grams. Medium octahedrite. (IIIF) Note the long, slender schreibersite crystals. Dealer trade.

DJEBEL IN-AZZENE, Algeria. 184 grams. 10.3% nickel. Medium octahedrite. (IIIB) Beautiful! Private collector trade.

WOLSEY, South Dakota. 2.98 kilos. 6.6% nickel. Coarse octahedrite. (IAB) Etched. Shot through with tiny schreibersite crystals. Similar to Canyon Diablo. Dealer trade.

CANYON DIABLO, Arizona Graphite nodule. 1.17 kilos. Large graphite balls like this one were found around Barringer Crater. The interior reveals a web of shocked veins of nickel-iron in carbon. Impact-produced. Purchase from finder.

TAMBO QUEMADO, Peru. 3.85 kilos. 10.2% nickel. IIIAB. Medium octahedrite with troilite nodules. Dealer trade.



BEAR CREEK, Colorado. 754 grams. 9.8 nickel. Medium octahedrite. (IIIAB) This was found in a gulch in the Rocky Mountains. A 222 kilo mass was found 25 miles from Denver, Colorado. ASU trade.

TWANNBERG, Switzerland. 38 grams. 4.4% nickel. Hexahedrite to coarsest octahedrite. Anomalous. Note the unique, large schreibersite crystals, snaking through the matrix. MB-P trade.

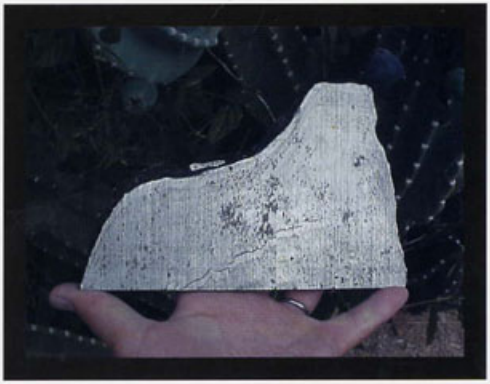
GUADALUPE Y CALDO, Mexico. (Left.) 1.47 kilos. 5.3% nickel. Hexahedrite. (IIAB) This etched piece shows beautiful Newman lines. It was found in a ditch and used as a dog bowl. Finally it was traded for a pickup truck.! Purchase from dealer.

NORTH CHILE, Chile. (Right) 1.9 kilos. 5.6% nickel. Hexahedrite. (IIAB) This meteorite was one giant kamacite crystal that disintegrated over the Andes. Purchase from finder on location.

WATSON, Australia. 1.83 kilos. Medium octahedrite. (IIE) Notice the large silicate inclusion. Private collector trade.

TINNIE, New Mexico. (Left.) 291 grams. 18.4% nickel. Plessitic ataxite. (IVB) Found by a grad student doing sheep research! Dealer trade.

SANTA CLARA, Mexico. (Right.) 1.1 kilos. 17.9% nickel. Ataxite. (IVB) Ataxites are almost pure taenite crystals with a nickel content greater than 16%. ASU trade.



SANTA CATHARINA, Brazil. 232 grams. 33.6% nickel. Ungrouped nickel-rich ataxite. Anomalous. The greenish tint is nickel oxide indicating a weathered, nickel-rich meteorite. Dealer trade.

1.6 kilos. 16.5% nickel. Ataxite. IVB. Gold hunters found this meteorite. This is said to be a beautiful place to search. Several dozen pieces have been found. Purchase from dealer.

HOBA, Namibia. 63 grams. 16.5% nickel. Ataxite. IVB. This is a piece from the world's largest KNOWN meteorite, a 60-ton monster that fell approximately 80,000 years ago. Less than 20 kilos is in collections. Dealer trade.

SHINGLE SPRINGS, California. 456 grams. 17%nickel. Ungrouped ataxite. High nickel makes these meteorites the most rust-resistant of the irons. Purchase from dealer.

TUCSON RING, Arizona. 199 grams. 9.5% nickel. Ataxite with a flow-pattern of tiny silicate inclusions throughout the matrix. This meteorite is almost devoid of both sulphur and troilite, making it highly unusual. At least 8% of this meteorite is silicate. Harvard University. (J. Lawrence Smith Collection.)

UDEI STATION, Nigeria. 851 grams. 8.8% nickel. (IAB) Medium octahedrite with silicate inclusions. Witnessed fall in 1927. KGS trade.

COPIAPO, Chile. 115 grams. 7% nickel. Coarse octahedrite. (IAB) Silicated anomalous iron.

GEORGETOWN, Australia. 570 grams. (IIICD) Anomalous. The dark material is troilite.

MOUNT DIEU, France. 560 grams. 7.5% nickel. Fine octahedrite. (IIE) The surface is rusty and highly friable.

LANDES, West Virginia. 337 grams. 6.3% nickel. Octahedrite. (IAB) Chemically anomalous. Polished face reveals pyroxenes.

STEINBACH, Germany. 45 grams. 9% nickel. (IVA) Silicate inclusions. Chemically anomalous. Etched slice.

TARAHUMARA, Mexico. 963 grams. 7.9% nickel. Anomalous silicated iron. (IIE) Etched face. Inclusions are olivine. Purchase from finder.

MALTAHOHE, Namibia. 293 grams. 10.7% nickel. Fine octahedrite with silicate inclusions. (IIICD) Found near the Gibeon strewnfield. Purchase from dealer.

MILES, Australia. 1.38 kilos. 8% nickel. (IIE) Iron with silicate inclusions. Etched. Dealer trade.

TOLUCA "B", Mexico. 943 grams. (IAB) Silicated iron. Classified as a separate entity, but this might actually be part of the Toluca mass. Etched surface. Purchase from finder on location.

WOODBINE, Illinois. 471 grams. 10.6% nickel. Fine octahedrite. Anomalous (IAB) Poly-crystalline with silicate-troilite inclusions. Etched surface. USNM trade.

CADDO COUNTY, Oklahoma. 4 kilos. 9% nickel. Octahedrite. (IAB) Widely separated silicate inclusions. Caddo County is virtually half pure iron meteorite and half primitive, lodranite-like achondrite. Purchase from finder.

ZAGORA, Morocco. 1.975 kilos. 9.8% nickel. Octahedrite. (IAB) Silicated with troilite inclusions. Purchase from dealer.

VERMILLION

Kansas. 794 grams. 7.5% nickel. Etched. Highly anomalous pyroxene pallasite. This was purchased as a Brenham pallasite but obviously wasn't! Dealer trade.

GLORIETTA, New Mexico. 127 grams. 12% nickel. Pallasite. Notice that fusion crust also covers the olivine crystals. Purchase from finder.

GLORIETTA, New Mexico. This perfect little iron button and cool "cigar" were found within 10 minutes of each other by the author, just outside of Santa Fe after 12 days of searching. Great hunting area!

Imilac, Photo 1

IMILAC, Chile. 9.1 kilos Pallasite. This is a complete speciman. Both sides of this meteorite clearly show the mix of olivine crystals and iron.

IMILAC, Chile. 598 grams. Pallasite. This is a complete slice from one of the world's most beautiful meteorites. Orange-yellow olivine crystals in Imilac tend to be more internally shattered than those in Esquel. Note the olivine density change at the mid-line. Purchase from finder on location.

IMILAC, Chile. 17 kilos. 9.9% nickel. Pallasite. This complete specimen was found half-buried in the dirt which preserved the superb black fusion crust. Purchase from finder. Below is a 2.8 kilo full slice. Dealer trade

ESQUEL, Argentina. 300 kilos. 8.5% nickel. Pallasite. Main mass. This has the best gem-quality peridot of any meteorite on Earth. Purchase from dealer. Discovered in 1951 by Argentine ranchers excavating for a new stock tank. It is the most beautiful pallasite ever found.

Thin slice (above) with back-lighting.
1.5 carat faceted peridot (left) from the
Esquel meteorite.

SANTA ROSALIA, Mexico. 56 grams. 10.1% nickel. Pallasite. Slice from the single 1.6 kilo specimen found. This is 75% olivine. ASU trade.

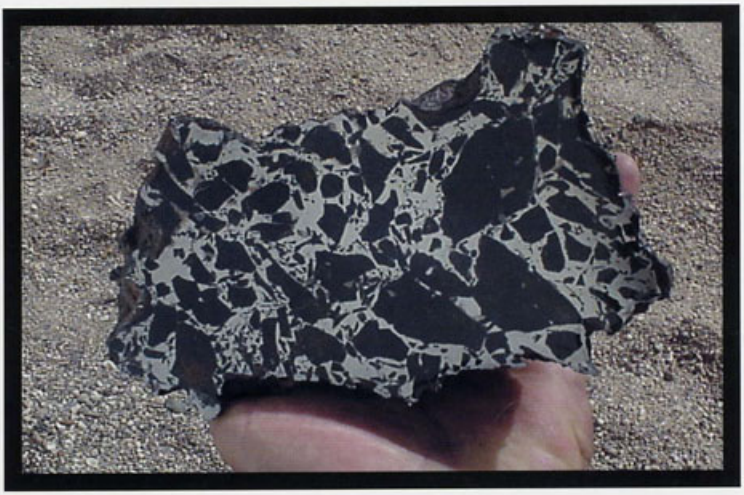
ACOMIDA, New Mexico. (Left.) 160 grams. 13% nickel. Pallasite. This rolled around in the back of a pickup truck for a long time before it was identified as a new pallasite. ASU trade.

AHUMADA, Mexico. (Right.) 295 grams. 8% nickel. Pallasite. Only one mass ever found. Note the large olivine crystals typical of Ahumada. ASU trade.

MOUNT VERNON Kentucky. 3.15 kilos. 11.5% nickel. Pallasite slice. At least 80% of this meteorite is composed of olivine. USNM trade.

DORA, New Mexico. 161 grams. 11.7% nickel. Pallasite. This sat by a fence for 11 years before it was recognized as a new pallasite. Very similar to Acomida but a distinct fall. IM trade.

QUIJINGUE, Brazil. 1.07 kilo. 7.5% nickel. Pallasite. This beautiful pallasite was found 1 meter underground by a farmer trying to plant a tree! Dealer trade.



OTINAPA, Mexico. 2.5 kilos. 10.6% nickel. Pallasite. Polished face (above) reveals large, angular olivine crystals. Back side of the specimen (below) shows slight weathering. Purchase from finder.

ADMIRE, Kansas. 400 grams. 10.7% nickel. Pallasite. Note the deformed and shattered olivine crystals. AML purchase.

ALBIN, Wyoming. 740 grams. 10.4% nickel. Pallasite. Also exhibits very shattered olivine crystals. ASU trade.

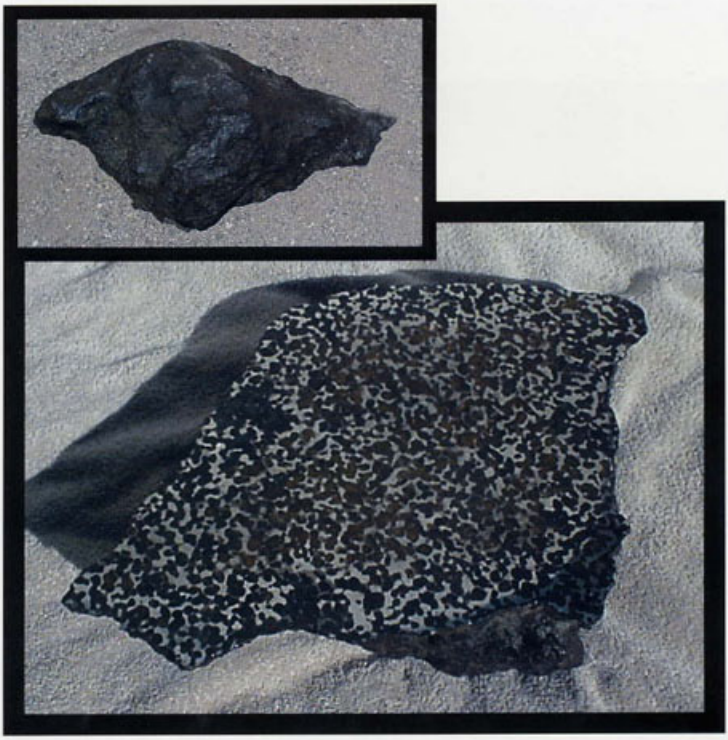
KRASNOJARSK, Russia. 40 grams. 8.9% nickel. This is the original pallasite discovered in 1749 and described by P. S. Pallas in 1772. This was the first meteorite to ever be etched, thus revealing Widmanstatten lines. RAS trade.

THIEL MOUNTAINS, Antarctica. (Left.) 310 grams. 10.1% nickel. Pallasite. This back-lit thin slice shows beautiful round peridot crystals. USNM trade.

SPRINGWATER, Canada. (Right.) 356 grams. 12.6% nickel. Pallasite. These olivine crystals are about 35% smaller than those in the Brenham pallasite. ASU trade.

BRAHIN, Russia. 8 kilos. 8.4% nickel. Pallasite. Some of the pockets of olivine crystals are surrounded with chromite. This is also found in some Brenham specimens. Over 1,000 kilos of this meteorite have been recovered.

Back of Brahin specimen above (right). Note the large olivine pocket at far right center. Purchase from dealer.



BRENHAM, Kansas. 25 kilos. 11.1% nickel. Pallasite. (Above and top) Round olivine crystals with chromite inclusions. Numerous masses have been found in this area of Kansas since the late 1800's. This end-piece specimen shows numerous gouges from being hit repeatedly by a plow. This meteorite has been well-distributed world-wide. Purchase from finder.

So much for classifications...This etched slice of Brenham (right) contains no olivine at all and is just a coarse iron octahedrite..

LOWICZ, Poland. 979 grams. 7.7% nickel. Mesosiderite fall. A shower of these stones fell in 1935. Notice the fine fusion crust on the back of this piece (right). This area was the site of a battle and meteorite hunters commonly find shrapnel fragments. MZW trade.

CRAB ORCHARD, Tennessee. 181 grams. 7% nickel. Mesosiderite. Found in 1887. AMNH trade.

224 grams. 7.2% nickel. Mesosiderite. Said to have fallen in 1857. Notice the interesting mixing of materials. NMW trade.

CHINGUETTI, Mauritania. 263 grams. 9.6% nickel. Mesosiderite. USNM trade.

CLOVER SPRINGS, Arizona. 88 grams. 6.1% nickel. Mesosiderite. A 7 kilo piece was found in 1954. U of A trade.

LAMONT, Kansas. 3.8 kilos. Mesosiderite. This was found along a fence in the 1940's. Purchase from finder.

DALGARANGA, Australia. (Left.) 640 grams. Mesosiderite. 8.8% nickel. Probably the largest Dalgaranga ever found. Purchase from finder.

MOUNT PADBURY, Australia. (Right.) 561 grams. 6.1% nickel. Old mesosiderite. Purchase from finder.

ESTERVILLE, Iowa. 3.3 kilos. 9% nickel. Mesosiderite. Witnessed fall. Purchase from dealer.

ESTERVILLE, Iowa. 818 grams. 9% nickel This has a natural hole through it where softer silicates melted out during entry. It was a spectacular witnessed fall on May 10, 1879 at 5:00 PM. So many small stones, called "Esterville pellets," rained down into a pond that the surface looked "alive" according to eye witnesses. Harvard University trade.

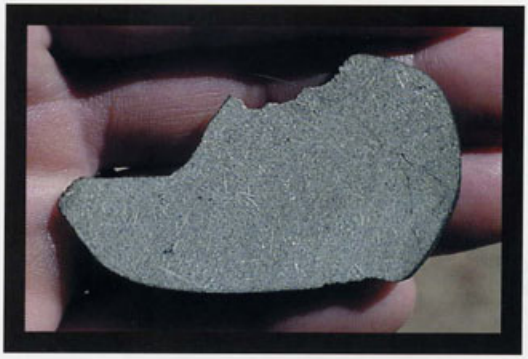
EMERY, South Dakota. 205 grams. 7% nickel. Mesosiderite. This was cleared from a farmer's field. Purchase from dealer.

BUDULAN, Russia. 1.9 kilos. 7.5% nickel. Mesosiderite. Purchase from dealer.

SAHARA 85001, North Africa. 99 grams. Found 1985. Mesosiderite. Dealer trade.

VACA MUERTA, Chile. 2.3 kilos. 7% nickel. Mesosiderite. Note the large, achondritic, like stony nugget. This is an extremely old, weathered meteorite from the Atacama Desert. The rusty exterior as seen on the back. (right). Purchase from finder on location.

BONDOC, Philippines. 1.45 kilos. 7.3% nickel. Mesosiderite. These iron 'baseballs' weathered out of a larger, stony mass. Dealer trade.



NWA, 856, North West Africa. 20 grams. Shergottite. Achondrite. Note the needle-like augite and pigeonite crystals. This meteorite is virtually identical to Zagami, but it fell nearly 4,000 kilometers away. Dealer trade.

LOS ANGELES, California. 37 grams. Shergottite. Achondrite. Two small, complete stones were found in the Mohave Desert. Dealer trade.

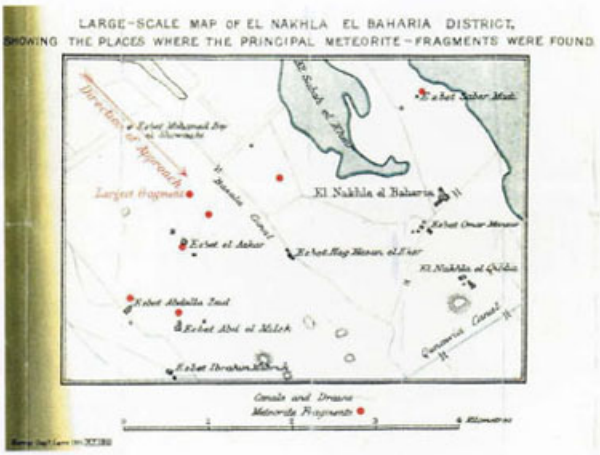
DAR al GANI 476 Libya. 33 grams. Shergottite. Achondrite. Basalt. This has a very old Earth-age and has been highly weathered. No fusion crust remains. Dealer trade..

STONES

ZAGAMI, Nigeria. 2.35 kilos. Shergottite (SNC); volcanic basalt. 13.7% iron. Pyroxene and plagioclase glass. Main mass. KGS trade.

On October 3, 1962, a bright fireball dropped a single 18 kilo stone near a man herding cows. Detonations were heard for miles and a smoke trail remained visible in the sky for several minutes. Chemical and isotopic analysis of Zagami matches material tested by the Viking probe on Mars. Recent analysis of cosmic ray data suggests that most Shergottites were ejected from Mars' surface by the same impact event 3 million years ago.

STONE METEORITES. Igneous, sedimentary and metamorphic rocks form in space in much the same manner as on Earth, but without water (with the noteable exception of some carbonaceous chondrites). Thus stone meteorites reflect a gamut of conditions of formation, chemistry, petrology and metamorphism and are classified accordingly.



NAKHLA, Egypt, Site of the Mars rock fall.(left). The strewnfield produced over 40 rare SNC-type stones. First described as a greenish colour, covered with something like shiny pitch. I have been here several times searching but no luck yet.....

NAKHLA, Egypt. 13 grams. 16.1% iron. Nakhlite. Achondrite. Nakhla is one of the three original type specimens in the SNC classification. Witnessed fall on June 28th, 1911 at 9:00 AM Humbolt University trade.

NAKHLITE NWA 998, Morocco. 13 grams. Nakhlite. Achondrite. So far less than a kilo has been found. Older and more weathered than the fresh Nakhla fall. Dealer trade.

CALCALONG CREEK, Australia. 7 carat slice. Lunar achondrite. 50% anorthosite, 20% KREEP (potassium rare-earth elements). This was a serendipitous discovery - it arrived as a stow-away in a shipment of Millbillillies, and was recognized by the author as being different by tiny bubbles in the fusion crust and the anorthosite inclusions on the inside. Anorthosite is diagnostic of lunar mare basaltic meteorites. We also know these are of lunar origin because they can be directly compared chemically and mineralogically to known lunar samples brought back by the wonderfully successful Apollo
space program.

Photo by Tim Fuller

the trajectory of material ejected from the Moon towards the Earth, page 614.

A lunar meteorite found outside the Antarctic

D. H. Hill*, W. V. Boynton*† & R. A. Haag‡

* Lunar & Planetary Laboratory, University of Arizona, Tucson, Arizona 85721, USA
† Department of Planetary Sciences, University of Arizona, Tucson, Arizona 85721, USA
‡ Robert A. Haag Meteorites, PO Box 27527, Tucson, Arizona 85726, USA

Our knowledge of the Moon's surface composition has come from samples returned by the Apollo and Luna missions, and from eleven lunar meteorites, all of which were discovered in Antarctica[1,2]. Here we report the discovery of a new lunar meteorite, Calcalong Creek, in a desert region of Australia which is analogous to Antarctica in its ability to preserve meteorites of different types[3]. On the basis of a diagnostic Fe/Mn ratio of 73–78, and other element abundances, we conclude that Calcalong Creek is a lunar breccia, containing both highland and mare materials. Whereas the Apollo and Luna missions selectively sampled only 5% of the lunar crust, lunar meteorites should provide a random sample[4]; nevertheless there has been some concern that the Antarctic meteorite population may be biased in some way[5]. Calcalong Creek will add to our understanding of lunar petrology, and as the first non-Antarctic lunar meteorite, may also shed new light on the transfer of impact ejecta from the Moon to the Earth.

Calcalong Creek is named after the Aborigine word 'Kalkallupilinguta', meaning 'seven sisters went up into the sky, chased by the Moon' (F. Wlotzka and A. Bevan, personal communication). It is a single stone, ~3 cm in diameter, weighing 19 g, with 100% fusion crust covering its exterior. The recovered sample has a caramel-coloured glassy fusion crust with an area containing small vesicles. Sawcuts of the sample reveal a microbreccia with submillimetre white clasts embedded in a dark-grey matrix (Fig. 1) resembling the first Antarctic lunar meteorite, ALHA81005, although the clasts are much smaller. Microscopic observation of bulk pieces reveals a variety of components: angular white clasts, 'sugary' clasts, white crystalline plagioclase,

Photo: Bill Greener

MOON MEN - Astronaut Alan Bean and Robert Haag swap stories. What a thrill meeting Alan Bean of the Apollo 12 moon mission! He was the 4th man to walk on the moon but I found my own piece of it right here on Earth!

CALCALONG CREEK, Australia. 7.5 grams. Lunar achondrite. Half stone.

DAR al GHANI, 400, Libya. 5.8 grams. Lunar achondrite. Anorthosite breccia. Dealer trade.

NWA 482, Morocco. 27.7 grams. Lunar achondrite. A new discovery from 2000. Note the dark glass veining secondary to shock. Dealer trade.

国立極地研究所
NATIONAL INSTITUTE OF POLAR RESEARCH
9-10, KAGA 1-CHOME, ITABASHI-KU
TOKYO 173, JAPAN.
Telephone: 03(3962)4711 - 47
Telegrams: POLARESEARCH TC
Telex: 2723515 POLRSC J
FAX: 03(3962)2529

June 29, 1994

Mr. & Mrs. Haag
Robert A. Haag Meteorites
P.O. Box 27527,
Tucson, AZ 85726,
U.S.A.

Dear Mr. and Mrs. Haag;

It was the great pleasure for me to meet you at our institute and also you looked our meteorite collections. I always feel that your activities on the worldwide meteorite search should be respectable. It had not been doing possible without support and cooperation of your wife.

...raphs taken at the NIPR and around

Sincerely yours,

Keizo Yanai

INTERNATIONAL COOPERATION...Had it not been for the National Institute of Polar Research and Drs. Keizo Yanai and Hideyasu Kojima, I would never have recognized the Calcalong Creek sample as lunar material. Their book, Photographic Catalogue of Antarctic Meteorites was inspirational.

From left: Heidi & Robert Haag with Dr. Yanai in Tokyo. Kampai!

D'ORBIGNY, Argentina. 88 grams. Angrite achondrite. Extremely rare. 95% fassaite (calcium-aluminum-titanium clino pyroxene), an ultramafic igneous rock. Note the large bubbles and single olivine crystal, center. Witnessed fall in 1979. One stone weighing 16 kilos was recovered but only recognized as meteoritic some 20 years later. Purchase from dealer.

SAHARA 98501, Morocco. 136 grams. Urelite achondrite. Pyroxene (pigeonite) and olivine set in a carbon-rich matrix. Complete stone with fusion crust and flow lines. Purchase from dealer.

Back of specimen (above) showing the odd "dried glue" appearance of the fusion crust. Purchase from finder.

PENA BLANCA SPRINGS, Texas. 11.5 kilos. Aubrite achondrite. Monomict breccia with coarse clasts of enstatite. Less than 2% iron. End piece. This was a witnessed fall on August 2, 1946. It plunged into a small pond in front of half a dozen men and was recovered immediately.

NORTON COUNTY, Kansas. 889 grams. 1.6% iron. Aubrite achondrite. Witnessed fall, February 18, 1948. Over a hundred stones were recovered with the largest single specimen weighing over a ton. Note the unusually light-colored fusion crust due to the low iron content. This is a delicate meteorite. Purchase from finder.

CUMBERLAND FALLS, Kentucky. 157 grams. 19% total iron clearly visible in the specimen. Aubrite achondrite. This witnessed fall on April 9, 1919, was accompanied by a fireball and detonations. AMNH trade.

MAYO BELWA, Nigeria. 82 grams. Aubrite achondrite. Witnesses reported a bright, evening fireball and thunderous noise on August 3, 1974. It dropped a single, 4.8 kilo stone almost completely devoid of fusion crust. This exhibits several unusual, pinpoint-sized cavities. Very coarse exterior surface. KGS trade.

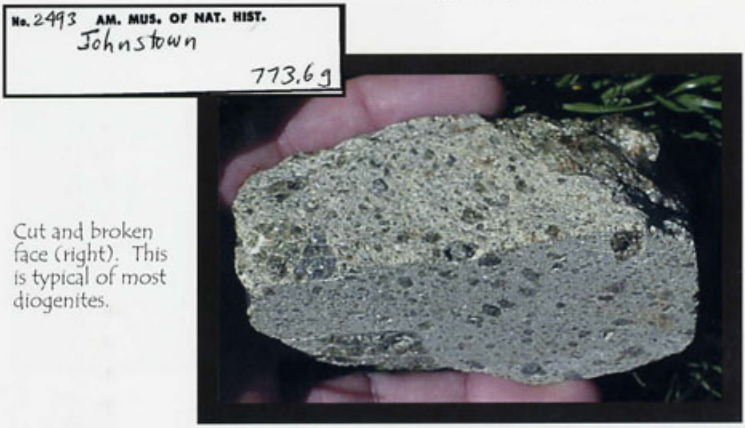
MOUNT EGERTON, Australia. 69 grams. Aubrite achondrite *or possibly mesosiderite.* Anomalous. Note the fragment of dark fusion crust on the smaller, fragment on right. Rusting nickel-iron grains and surrounding oxide staining of the enstatite crystal can be seen in the center of the larger specimen. Purchase from finders.

BILANGA. Burkina Faso 754 grams (top and middle). Notice the linear flow lines on the melted fusion crust surface. The shocked appearance of the interior has ribbons of both coarser and finer hypersthene crystals. Witnessed fall October 27, 1999.

Complete, 179 gram stone (left). This was recovered by villagers at the strewnfield. Diogenite falls are rare.

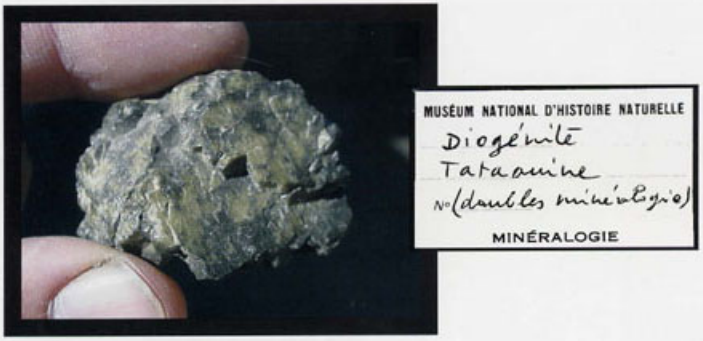
JOHNSTOWN, Colorado.

Back (above). Note fresh, matte-black fusion crust.

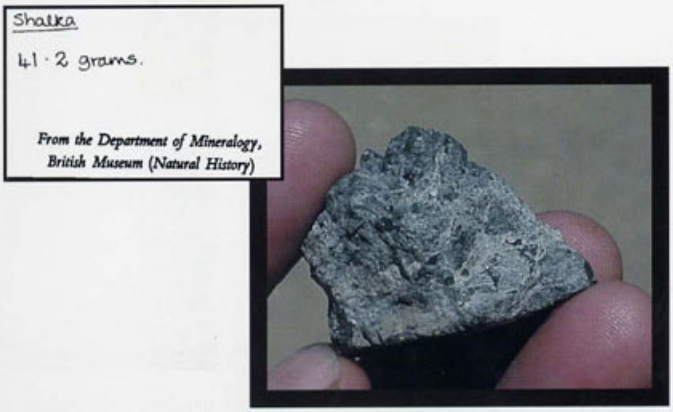


Cut and broken face (right). This is typical of most diogenites.

JOHNSTOWN, Colorado. 419 grams. Diogenite achondrite. Magnesium-rich, orthopyroxene cumulate (hypersthene) crystals. This witnessed fall on July 6, 1924, dropped some 27 stones in front of astonished mourners at a funeral. AMNH trade.



TATAHOUINE, Tunisia. 37 grams. Diogenite achondrite. Witnessed fall in the early morning of June 27, 1931. Over a dozen kilos of these very small, perfect hypersthene crystals rained out of the sky. None exhibited fusion crust, indicating a low speed, low altitude fragmentation. Complete fragment as found. MNHN trade.



SHALKA, India. 41.2 grams. 12.7% total iron. Diogenite achondrite. A witnessed fall from India on November 30, 1850. One stone nearly a meter across fell, but only 3.6 kilos were preserved. BMNH trade

GREAT SAND SEA 010, Egypt. 302 grams total. Howardite achondrite. These five stones were found in one lucky day by the author after a vivid dream the night before. Portions showing shiny, calcium-rich, black fusion crust were buried and thereby preserved from blowing sand.

KAPOETA, Sudan. 114 grams. Howardite. Note the CM2 carbonaceous chondrite fragment (upper right) within this achondrite meteorite. Kapoeta represents the well-churned 'soil' of an asteroid. This witnessed fall occurred April 22, 1942 during WWII when a single, 11.3 kilo stone fell in front of a column of armored vehicles. (They were well-prepared for incoming missiles!) Private collector trade.

HUGHES 005, Australia. 31 grams Howardite achondrite. This has remnants of a shiny, calcium-rich crust and nice flight markings. Purchase from dealer.

MUNDRABILLA 018, Australia. 24 grams. Howardite achondrite. Found by author.

Cut face of Mundrabilla 018 (left). In sunlight the tiny hypersthene (diogenite) grains look very green.

DAR al GHANI 779, Libya. 23 grams. Howardite achondrite. This is coarser-grained and more loosely "packed" than other howardites. Note the bright green diogenite crystals just left of center. This came from a basketball-sized stone that was almost buried in the desert sand. It is old and completely devoid of fusion crust. Trade with finder.

PASAMONTE, New Mexico. 41 grams. Eucrite achondrite. A huge, early morning fireball was witnessed by thousands on March 24, 1933. About 75 golf ball-sized stones were scattered over a 25 mile long strewnfield. The fragile fusion crust shows dozens of heat contraction cracks, and the interior of this meteorite has a soft, ash-like texture.. ASU trade.

MILLBILLILLIE, Australia. 946 grams. Eucrite achondrite. Witnessed fall, Autumn, 1960. This potato-sized stone was plowed up by locals dragging bedsprings behind a truck. The crust is so shiny it looks enameled. The rusty burial line shows the interface between surface and soil. Purchase from dealer.

MILLBILLILLIE, Australia. 1.71 kilos. Eucrite achondrite. Note the coarse and finer texture change in the plagioclase and pyroxene crystals. End piece purchase.

MILLBILLILLIE, Australia. 17 grams. Eucrite achondrite. Perfect example c bubbling on the trailing end of an ori ed meteorite.

Current research suggest most eucrites were ejected from their parent body ir inner asteroid belt some 23 million years ago. Typical eucrites contain 15% Fe

MILLBILLILLIE, Australia. 16 grams. Eucrite achondrite. This exquisite little meteorite shows fantastic flow lines.

MILLBILLILLIE, Australia. 16 grams. Eucrite achondrite. Superb example of flow lines and flawless orientation.

SERRA de MAGE, Brazil. 24 grams. Eucrite achondrite. Unbrecciated. Pyroxene and plagioclase with rare earth elements. Witnessed fall from 1923. Look at that glossy fusion crust! Purchase from dealer.

IBITIRA, Brazil. 143 grams. Eucrite achondrite. Anomalous. Witnessed fall from June, 1957. This unique meteorite is full of uniform, pin-sized "outgassing soda bubbles" that comprise 7% of the rock. Ibitira is the only vesicular achondrite known. This is from a partially vaporized eucrite parent body impact - possibly from the Vesta IV asteroid. Dealer trade.

JUVINAS, France. 366 grams. (Left.) Eucrite achondrite. Famous fall from June 15, 1821, when witnesses were treated to loud detonations and a daytime fireball that dropped a 91 kilo single stone near the village of Libonnes. MNHN trade.

STANNERN, Czech Republic. 394 grams. Eucrite achondrite. More than 60 stones were recovered from this fall on May 22nd 1808. The largest weighing 6 kilos. Texturally this is similar to Millbillillie. NMW trade.

BOUVANTE, France. 196 grams. (Right.) 15.1% total iron. Eucrite achondrite. This meteorite has a beautiful, coarse-grained texture. MNHN trade.

CAMEL DONGA, Australia. 1.13 kilos. Troilite-rich eucrite achondrite. Look at this "burnt-sugar" glossy crust indicating a very fresh find. About 100 stones were found. Purchase from finder.

SMARA, Morocco. 145 grams. Eucrite achondrite. This beautiful and highly unusual breccia was recently found in Morocco. Fragments of crust remain on the upper edge. Trade with finder.

Caldera - exterior.

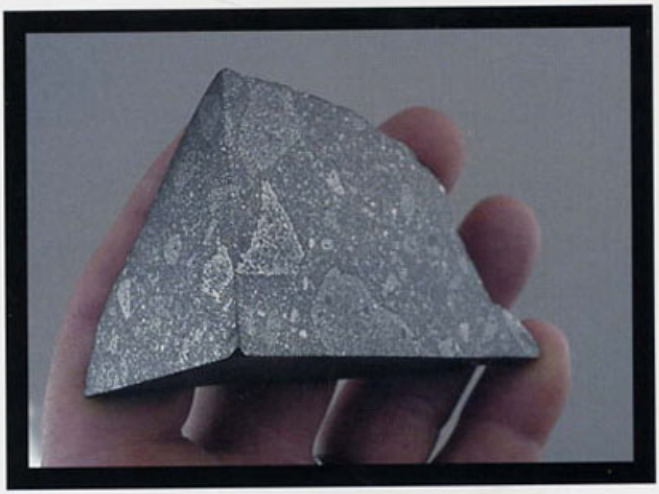
Caldera - interior.

CALDERA, Chile. 187 grams. 14.4% iron, 7.1% calcium. Eucrite achondrite. Non-cumulate, unbrecciated meteorite. This superb half-stone retains excellent flow lines and orientation. It was originally thought to be an SNC based on color and grain. Very well preserved. Purchase from finder

PALO BLANCO CREEK, New Mexico. 94 grams. Eucrite achondrite. From a 1954 find. Purchase from dealer.

Original telegram from 1983 offering 9 kilos of this terrific meteorite.

RANCHO BLANCO, Mexico. 69 grams. Eucrite achondrite. This was recovered from the Nuevo Mercurio strewnfield. Back of stone (above) shows tiny remnants of calcium-rich, shiny fusion crust. Serendipitous discovery by author among Nuevo Mercurios. Purchased from finder. (See page 108.)



ABEE, Canada. 155 grams. 32.5% total iron. Enstatite chondrite. (EH) This was a witnessed fall on June 9, 1953. A stone weighing 107 kilos was recovered from a hole 6 feet deep and a meter across. Purchase from private collection.

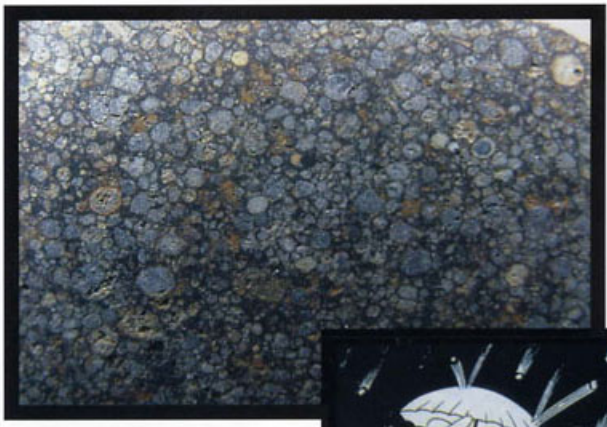
INDARCH, Azerbaijan. 11 grams. Enstatite chondrite. 33.1% total iron. High-metal content (EH4). Contains pre-solar diamonds, graphite and silicon carbide. Because both interior and exterior are black these are almost impossible to recognize. Purchase from dealer.

SAHARA 98044, Morocco. 135 grams. Enstatite chondrite . (EH3) This contains possibly the best chondrules I've ever seen, especially in thin-section. This was found with a metal detector. Extremely rare. Trade with finder.

HVITTIS, Finland. 565 grams. Enstatite achondrite. (EL6) 23.5% total iron with abundances of 13 trace elements. This was a witnessed fall at on October 21, 1901. Helsinki University trade.

EAGLE, Nebraska. 100 grams. Enstatite chondrite. (EL6) 23.3% total iron. Plowed up from a field in 1947. This would be a good place to look for more. Trade.

PILLISTFER, Estonia. 652 grams. Enstatite chondrite. (EL6) 27.8% total iron. Witnessed fall on August 8, 1868. Purchase from Estonian Museum.



RAGLAN, New Mexico. (Above.) (L3.5) Ordinary chondrite with extraordinary chondrules.
see Pg. 94

Thanks to cartoonist Marcel Vanek!

A WORD ABOUT CHONDRULES... Chondrules are one of the defining characteristics of chondritic meteorites and generally appear as tiny spheres of varying colors and sizes. Chondrules are thought to have formed from so-called "precursor particles" of condensing nebular gas and debris that at some point were melted in space. As these little drops cooled, they formed perfect spheres and bumped into each other in space and stuck together. As these masses accumulated more and more material, pressure, heat and impact events caused increased metamorphic changes.

...AND CHONDRITES... Current classification of ordinary chondrites ranges from Type 1 through Type 6. Types 1 through 3 have well-defined, intact chondrules, whereas types 4 through 5 contain more sparse, less distinct chondrules. In type 6, chondrules are nearly absent. .The letter designations H (bronzite), L (hypersthene) and LL (amphoterites) refer to chemical and petrological groupings. Carbonaceous chondrites are designated with the prefix "C"; enstatite chondrites with the prefix "E" and R-chondrites with the letter "R"..

ACHONDRITES have no discernable chondritic structure at all, secondary to complete shock-remelting and recrystallization.

Orgueil is the first meteorite found containing hydrated minerals and evidence of pre-terrestrial aqueous leaching. In other words... it's been exposed to water somewhere in space. Perhaps comets actually seeded the earth with both water and the building blocks of life. (Thanks!)

ORGUEIL, France. 11 grams. Carbonaceous chondrite. (C1) This is the most primitive carbon-rich cometary material ever seen. 19.5% total iron. Fell May 14, 1864 after a fireball and detonations. This meteorite contains interstellar water and is probably the most scientifically important of all meteorites. Note the remnant of fusion crust on the left side. Very soft and friable. MNHN trade.

Partial List of Organic Molecules Found in Space

Acetaldehyde	CH_3CHO
Acetonitrile	CH_3CN
Acetylene	$HC{=}CH$
Ammonia	NH_3
Carbon monosulfide	CS
Carbon monoxide	CO
Carbonyl sulfide	$O{=}C{=}S$
Cyanamide	NH_2CN
Cyanoacetylene	$HC{=}C\text{-}C\text{-}C\text{-}N$
Cyanotetra acetylene	HC_9N
*Dimethyl ether	$H_3C\text{-}0\text{-}CH_3$
*Ethanol	C_2H_5OH
Ethyl cyanide	CH_3CH_2CN
Formaldehyde	H_2CO

*Possible chemical candidates for the smell in Murchison

MURCHISON, Australia. 50 grams and 65 grams (right) 965 grams (below). Carbonaceous chondrite. (CM2) Cometary material. These meteorites are full of amino acids and organic compounds and smell strongly of alcohol and other volatiles. Note the fine flow lines below. Purchase from dealer.

COLD BOKKEVELD, South Africa. 20 grams. Carbonaceous chondrite. (CM2) 21% total iron. Witnessed fall on October 13, 1838. Notice the crustal remnant on the left side. Dealer trade.

MURRAY, Texas. 87 grams. Carbonaceous chondrite. (CM2) 21% total iron. This unpolished face shows beautiful little chondrules. Trade with private collector.

BUTHA QI, Mongolia. 203 grams. Ordinary chondrite with large, CM2 carbonaceous chondrite inclusion. (LL3?) Extremely rare. This may be the only piece. Purchase from dealer.

NOGOYA, Argentina. 112 grams. Carbonaceous chondrite. (CM2) 18.8% total iron. Fell June 30, 1879. This has a more silica-rich appearance than the other CM2's. La Plata Museum trade.

ALLENDE, Mexico. 17 kilo (above). 4.8 kilos (right).Carbonaceous chondrite. (CV3.2) 23.8% total iron. This is one of the most studied meteorites due to it's pre-solar age - approx.. 4.6 billion years. Fell February 8, 1969 at 1:05 AM. Several tons were recovered. Purchase from dealers and finders on location.

SAHARA 98044, Morocco. 155 grams. Carbonaceous chondrite. (CV) This has pristine chondrules and remnants of very old, weathered crust. Dealer trade.

LEOVILLE, Kansas. 20 grams. Carbonaceous chondrite. (CV3.0) 22% total iron. In this meteorite the normally spherical chondrules have been elongated by compression. Trade with private collector.

VIGARANO, Italy 61 grams. Carbonaceous chondrite. (CV3.3) 23% total iron. Fell on January 22, 1910. Museum trade.

KAINSAZ, Russia. 548 gram. Carbonaceous chondrite. (CO3.1) 25.5% total iron. This was a witnessed fall on September 13 or 14, 1937. Contains tiny chondrules. RAS trade.

ISNA, Egypt. 244 grams. Carbonaceous chondrite. (CO3.7) 25% total iron. Note the fusion crust on lower left. Found on the banks of the Nile River near Luxor. USNM trade.

COLONY, Oklahoma. 164 grams. Carbonaceous chondrite. (CO3.0) A single stone was caught in a cotton cultivator. Purchase from dealer.

DAR AL GHANI 749, Libya. 60 grams. Carbonaceous chondrite. (CO3) Found in a new strewnfield. Dealer trade.

GUIZBA, Nigeria. Very new - no information other than it is a unique Bencubbinite. Note the amazing round metallic chondrules. **THIS IS NOT CURRENTLY IN MY COLLECTION.** (But it's so cool I just had to show it to you...)

BENCUBBIN, Australia. 437 grams. Ungrouped chondrite with carbonaceous chondrite clasts. (!) Anomalous. In this exceedingly odd meteorite the matrix is arranged in pillow-like metal and carbonaceous chondrite clasts. Two specimens were found. WAM trade.

HAMADA al HAMRA 237, Libya. 54 grams. Carbonaceous chondrite. (CH) Anomalous. This is an extremely metal-rich carbonaceous chondrite. Trade with finder.

KAROONDA, Australia. 83 grams. Carbonaceous chondrite. (CK4) 25.5% total iron. This highly unusual carbonaceous chondrite was a witnessed fall on November 25, 1930. AMNH trade.

MARALINGA, Australia. 180 grams. Carbonaceous chondrite. (CK4) Anomalous. Contains highly unusual dark chondrules of varying sizes. No fusion crust. 3.3 kilo find in 1974. Dealer trade.

ACFER 059, Libya. 27 grams. Carbonaceous chondrite. (CR2) This weathered slice exhibits perfect, multi-colored chondrules in all sizes and shapes. Also shows metal traces on cut surfaces. On right side a new CR2 from near Zagora Morrocco.

RUMURUTI, Morocco. 61 grams. This is an R-type chondrite - one of the newest chondrite groups. R-chondrites contain almost no free iron metal. Dealer trade.

Cut face reveals two distinct textures - both achondritic (melt) and ordinary chondritic L5 materials.

CAT MOUNTAIN, Arizona. 905 grams. Ordinary chondrite. Impact melt breccia. This unusual meteorite is a breccia containing clasts of shocked L5 material in an igneous matrix. This specimen lacks a typical fusion crust although it probably fell within 24 hours of being recovered. Purchase from finder.

BJURBOLE, Finland. 3.02 kilos. Chondrite. (LL4) This highly unusual, creamy-white meteorite fell on sea ice in 1899. It is extremely friable and completely lacks any fusion crust. Helsinki University trade.

PARNALLEE, India. 260 grams. Ordinary chondrite. (LL3) 18.3% total iron. After loud detonations, two stones were seen to fall on February 28, 1857. ASU trade.

SAINT SEVERIN (large at top) 3.1 kilos, and **ENSISHEIM** (small, bottom) 85 grams. Amphoterite. chondrites. (LL6) 20% total iron. These meteorites are both historically and scientifically important - while they fell over 500 years apart, they landed within 100 miles of one another and are chemically and visually identical. In fact, when placed side by side, they appear to be from one contiguous piece. Saint Severin fell June 6, 1966 and Ensisheim fell November 16, 1492. Obviously they come from the same asteroid parent body. MNHN trades.

In June, 2000, Robert proudly accepted an award naming him one of the Guardians of the Ensisheim Meteorite. This annual event draws meteorite enthusiasts from around the world in a lively celebration of meteorites. It is a great honor.

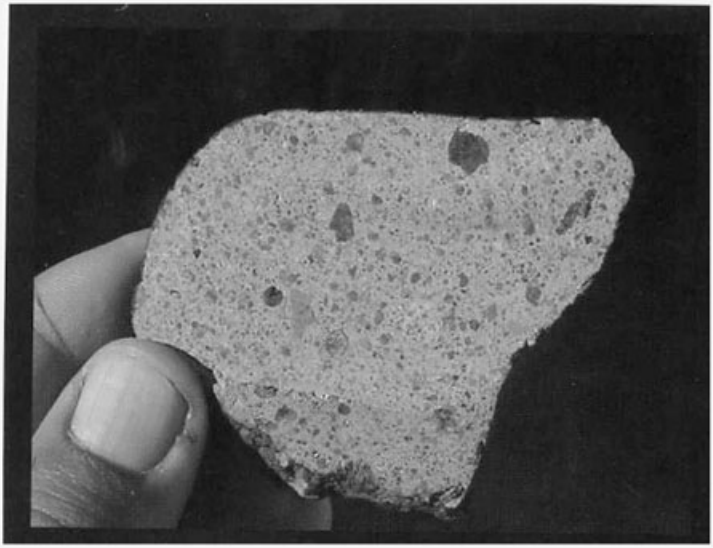
TUXTUAC, Mexico. 7 kilos. Ordinary chondrite. (LL5). 19.2% total iron. Fell October 16, 1975. Shows beautiful thumbprinting on surface (top). In 1989, a 25 kilo stone was found with grass growing up through the breaks and cracks. It was purchased by the author, grass included, at a mineral show in Tokyo.

BEELER, Kansas. 757 grams. Ordinary chondrite. (LL6) This heavily shocked, weathered find was plowed up from a field. BMNH trade.

BISON, Kansas. 314 grams. Ordinary chondrite. (LL6) Highly impact-shocked. Large, multi-colored, angular clasts. Purchase from dealer.

LAKE LABYRINTH, Australia. Ordinary chondrite. (LL6) 20.5% total iron. Highly shocked. This was probably a witnessed fall in 1924 but wasn't found until a few weeks later. ASU trade.

BANDONG, Indonesia. 95 grams. Ordinary chondrite. (LL
Witnessed fall from Java on September 10, 1871.



BOVEDY, Ireland. 83 grams. Ordinary chondrite. (L3) 22.5% total iron. This stone fell through a roof on April 25, 1969. Composed of glassy chondrules, anorthositic glass and bright metallic iron. Dealer trade.

RAGLAND, New Mexico. (Right.) 186 grams. Ordinary chondrite. (L3.5) 21.2% total iron. A Quay County wheat field yielded a 12 kilo, oriented stone that broke into 3 pieces on impact. NMW trade.

SARATOV, Russia. 233 grams. Ordinary chondrite. (L4) 21.7% total iron. Witnessed fall with fireball and detonations. Contains native, metallic copper! Purchase from dealer.

MOORABIE, Australia. (Above.) 4 kilos. Ordinary chondrite. (L3.6) 22.7% total iron. End piece. Beautiful round chondrules of all sizes make up this pristine meteorite. Purchase from finder.

BARRATTA, Australia. (left.) 949 grams. Ordinary chondrite. (L3.8) 21% total iron. Note the reddish remnants of old fusion crust. AMS trade.

BEAVER, Oklahoma.. 575 grams. Ordinary chondrite. (L5) This meteorite was used as a doorstop in the local county jail for over 40 years before it was recognized as a stone meteorite. Purchase from dealer.

IOKA, Utah. 136 grams. Ordinary chondrite. (L3) 20.7% total iron. Found in a plowed field in 1931. USNM trade.

TSAREV, Russia. 978 grams. Ordinary chondrite. (L5) 20.5% total iron. Over 1,000 kilos were recovered from fields after a probable fall on December 6, 1922. RAS trade.

KNYAHINYA, Ukraine. 434 grams. Ordinary chondrite. (L5) 20.15% total iron. This brecciated meteorite was a witnessed fall on June 9, 1866, when an estimated 1,000 stones showered the landscape. This has nice fusion crust with unusual, very small thumb-prints and indentations all over the surface. RAS trade.

HOMESTEAD, Iowa. 134 grams. Ordinary chondrite. (L5) 22.2% total iron. On February 12, 1875, after a brilliant fireball and detonations, an area of 18 square miles was showered with small stones. Over 100 were recovered. Note the contrast between crust and grainy interior. Purchase from dealer.

OHUMA, Nigeria. 433 grams. Ordinary chondrite. (L5) 23.4% total iron. This fell April 11, 1963. Only one stone was recovered. Note the contraction cracks in the fusion crust on the left side. KGS trade.

ETTER, Texas. 42 kilos. Ordinary chondrite. 20.6% total iron. This metal-veined end-piece has a weathered but well-defined fusion crust with nice thumb-prints. Purchase from dealer.

M'BALE, Uganda. 1.3 kilos. Ordinary chondrite. (L6) This fell on August 14, 1992 at lunchtime in the busy city of M'Bale. Hundreds of stones were recovered and there is an unconfirmed report of a child being hit. This meteorite contains big pockets of troilite crystals that when broken resemble vugs of iron pyrite. Dealer trade.

MOCS, Romania. 218 grams. Ordinary chondrite. (L6) 21.8% total iron. Thousands of stones were recovered from this area and there should be more. Purchase from dealer.

LA CRIOLLA, Argentina. 6.1 kilos. Ordinary chondrite. (L6) This spectacular sculptured specimen fell on January 6, 1985 after many detonations and a bright fireball and had the good grace to land in the Mayor's front yard. Purchase from finder on location.

BRUDERHEIM, Canada. 831 grams. Ordinary chondrite (L6) This nice specimen landed on fresh snow at 8:00 am on March 4, 1960. Because of the soft landing, few of the Bruderheim specimens were chipped or damaged. Purchase from finder on location.

ALFIANELLO, Italy. 1.42 kilos. Ordinary chondrite. (L6) 21.3% total iron. Fell February 16, 1883 after loud detonations. MNHU trade.

FORREST "B", Australia. 1.26 kilos. Ordinary chondrite. (L6) This broken and very weathered stone was found near the railway lines by rabbit hunters. They recognized it as a stone meteorite by its old fusion crust. Purchase from finder.

HARRISONVILLE, Missouri. 801 grams. Ordinary chondrite. (L6) This cut face shows abundant nickel-iron grains. Over a dozen stones were found in 1933 once farmers realized there was more than just corn in their fields. Purchase from dealer.

NEENACK, California. 427 grams. Ordinary chondrite. (L6) Single stone was plowed up from a field in 1948. UCLA trade.

SUNSITES, Arizona. 590 grams. Ordinary chondrite. (L5) Nice fusion crust. There's probably more to be found. Purchase from finder.

ANTARCTICA 76009. 202 grams. Ordinary chondrite. (L6) Antarctica has been a treasure trove of meteorites. This was spotted on blue ice by helicopter. FMNH trade.

RENFRO, Oklahoma. 2.23 kilos. Ordinary chondrite. (L6) A single 81 kilo stone was discovered in 1986 while terracing a hill for planting. Dealer trade.

BELLE PLAINE, Kansas. (Right.) 716 grams. Ordinary chondrite. (L6) Four stone averaging 20 kilos apiece were found within a couple miles of each other. Purchase from dealer.

SALLA, Finland. 618 grams. (L6) (Left.) Ordinary chondrite. 21.6% total iron. This was found in 1963. HV trade.

The Robert Haag COLLECTION of METEORITES

PRIVATE COLLECTION EDITION

OVER 280 ALL NEW PHOTOGRAPHS!

8 kilo stone (Right) Note thumb-prints.

3 kilos of small stones. (Left)

GAO-GUENIE, Burkina Faso. Ordinary chondrite. (H5) This famous fall occurred on March 5, 1960, at 5:00 PM. Scant attention was paid until the value of the stones was appreciated. Thousands of stones have now been recovered, primarily by women tending their gardens. Purchase from finders.

7 gram, oriented single stone with flow "lips" - created as material accumulated on the lower pressure area at the back.

EL HAMMAMI, Mauritania. 15 kilos. Ordinary chondrite. (H5) Listed as a find from 1997, this may have been a witnessed fall on January, 1995. This meteorite has also been known as Hamada du Draa and Mhamid. Purchase from dealer.

FOREST CITY, Iowa. 5 kilos. Ordinary chondrite. (H5) 27.2% total iron. Brecciated. This fell at 5:15 PM on May 2, 1890. Dealer trade.

NUEVO MERCURIO, Mexico. 2 kilos. Ordinary chondrite. (H5) Fell December 15, 1978. Several thousand stones rained down and were picked up by local ranchers. (Also see Rancho Blanco, pg. 65.) Purchase from finders on location.

JILIN, China. 10 kilos. Ordinary chondrite. (H5) 28.6% total iron. March 8, 1976 this meteorite screamed to earth and buried itself in the frozen ground. An estimated 4 tons has been recovered. Purchase from dealer.

CHIANG KHAN, Thailand. 619 grams. Ordinary chondrite. (H5) Fell on the Thailand - Laos border in 1981. This is the largest recovered stone. Note contraction cracks in the crust. Purchase from dealer.

DJERJ, NWA series. (Undescribed new find.) Ordinary chondrite. 417 grams. Based on the number and size of the metal grains this is probably another H5. Trade with private collector.

NADIABONDI, Burkina Faso. 263 grams. Ordinary chondrite. (H5) Note large, bright metal grains, typical of H5's, seen on this cut face. This fell July 27, 1956. MNHN trade.

PULTUSK, Poland. 223 grams. Ordinary chondrite. (H5) 27.2% total iron. This fell on January 30, 1868. Thousands of stones were reported to have been recovered. Trade with private collector.

MALVERN LAKE, Kansas. 4.5 kilos. Ordinary chondrite. (H5) While looking for more Norton County aubrite, some lucky folks discovered this big, completely new chondrite. Purchase from finder on location.

FAUCETT, Missouri. 4.6 kilos. Ordinary chondrite. (H4) 26.6% total iron. Over 100 kilos of this meteorite has been recovered since 1966. Good flight markings and fresh interior. Purchase from dealer.

FAITH, South Dakota. 7 kilos. Ordinary chondrite. (H5) A single specimen weighing 105 kilos was found in 1952. This intact fusion crust has weathered to a rich brown color. Purchase from dealer.

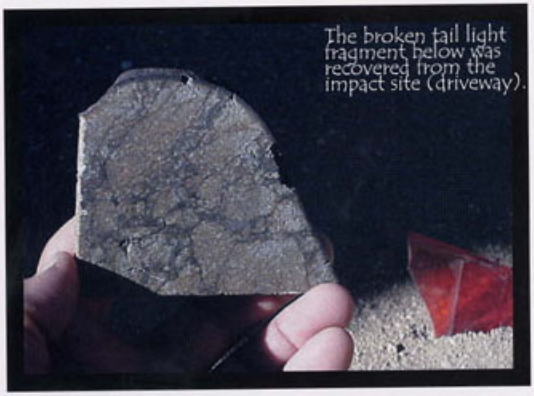
CORREO, New Mexico. 66 grams. Ordinary chondrite. (H4) Almost 100 complete stones have been found in this area just west of Albuquerque. This was the first stone meteorite ever found by the author. Note rough "pumpernickel-like" surface texture.

GREENLAND BLUE ICE, Greenland. 1.02 kilos. Ordinary chondrite. The fusion crust has been abraded by blowing ice crystals. Purchase from dealer.

TULIA "A", Texas. 232 grams. Ordinary chondrite. (H3-4) This slice clearly shows abundant metallic iron. Over 30 pieces have been recovered from this area of the Texas panhandle. Dealer trade.

GLADSTONE, New Mexico. 2.5 kilos. Ordinary chondrite. (H4) Three stones of this black-veined chondrite were found since 1936. Fairly weathered. Dealer trade.

BIG ROCK DONGA, Australia. 7 kilos. Ordinary chondrite. (H5) One stone was recovered by rabbit hunters. Thin fusion crust remains on this end piece, but there are few other surface features. Rusting has begun to occur on exposed edges. Purchase from finder.



PEEKSKILL, New York. 119 grams. Ordinary chondrite. (H6) Monomict breccia. This famous witnessed fall pierced Michelle Knapp's car at 7:50 PM, October 9, 1992, while she was watching Star Trek. Trade with private collector.

MARKOVKA, Russia. 336 grams. Ordinary chondrite. (H4) 25.5% total iron. RAS trade.

GRADY, New Mexico. 310 grams. Ordinary chondrite. (H3) 26.3% total iron. BMNH trade.

BEARDSLEY, Kansas. 422 grams. Ordinary chondrite. (H) 26.6% total iron. Fell October 15, 1929. Trade.

MUSLYUMOVO, Russia. 756 grams. Ordinary chondrite. (H) 27.17% total iron. RAS trade.

YBBSITZ, Austria. 287 grams. Ordinary chondrite. (H4) NMW trade.

RANSOM, Kansas. 314 grams. Ordinary chondrite. (H4) Dealer trade.

EGYPTIAN CHONDRITE, Egypt. (Near Libyan border.) 1.5 kilos. Ordinary chondrite. (H) All fusion crust has weathered away. Found by author on the very top of a sand dune, just before sunrise.

EGYPTIAN CHONDRITE, Egypt. 212 grams. Ordinary chondrite. (Undescribed.) This side was buried in the dirt and protected from weathering. Found by author just a few minutes after finding the specimen above. Thank those lucky stars!

Specimen (left) as found. Blowing sand abraded away the fusion crust.

STONE METEORITES (Undescribed)
These ancient little meteorites were found by the author on a small, dry lake bed, a few hours from the city of Farafra, Egypt, pretty much at the edge of the known universe. Almost all traces of crust have been scoured away by the blowing sand.

32 grams.

82 grams.

51 grams.

184 grams.

10 grams.

Finding meteorites like these is a thrill beyond describing. To go out looking for meteorites and actually *find* them makes it all seem worthwhile. *You* can do it, too.

LIBYAN DESERT GLASS 3.2 kilos of the ultimate night light. This superb piece of desert glass was found by the author on a hair-raising expedition to the Libyan Desert in 1995. It has been transformed into a spectacular lamp.

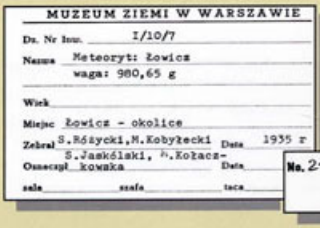
BUTTON TEKTITES, Australia. (Right.) Silicon dioxide. This beautiful little flanged button may be the most perfect example of aerospace ballistics ever seen. Purchase from dealer.

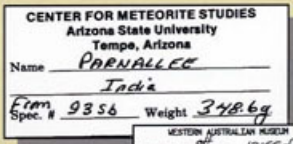
INDOCHINITE TEKTITE, Thailand. 61 grams. Silicon dioxide. Indochinites are known for their unusual shapes, such as this tear-drop. These are commonly found in rice paddies throughout southeast Asia. Purchase from dealer.

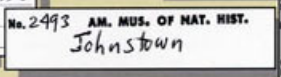
TEKTITES

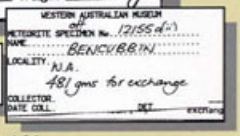
LIBYAN DESERT GLASS, Egypt. 148 grams. Silicon dioxide. Found by author. Note faceted cut gem at left.

TEKTITES like Libyan Desert Glass, indochinites and others raise almost as many questions as they answer. Some argue that tektites are impact produced phenomena. However most of the largest meteorite impacts produced no tektites. Some beleive Earth rock becomes superheated and ejected into the upper atmosphere when huge meteorites impact. During re-entry the molten glass assumes tear-drop and other aerodynamic shapes. Some, like Libyan Desert glass, are not associated with any known impact events and might in fact be actual silica meteorites. It is interesting to note that no tektite has ever been witnessed to fall and none have ever been recovered from antarctica. They are millions of years old.


MUZEUM ZIEMI W WARSZAWIE
Dz. Nr Inw. I/10/7
Nazwa Meteoryt: Żowica
waga: 980,65 g
Wiek
Miejsc Żowica - okolice
Zebrał S.Różycki, M.Kobyłecki Data 1935 r
S.Jaskólski, H.Kołacz-
Ozneczył kowska Data
sala szafa taca


CENTER FOR METEORITE STUDIES
Arizona State University
Tempe, Arizona
Name PARNALLEE
India
Item Spec. # 9356 Weight 348.6g


No. 2493 AM. MUS. OF NAT. HIST.
Johnstown


WESTERN AUSTRALIAN MUSEUM
off
METEORITE SPECIMEN No. 12155 d-1
NAME BENCUBBIN
LOCALITY N.A.
481 gms for exchange
COLLECTOR
DATE COLL. DET
exchange

LIST OF INSTITUTIONS AND MUSEUMS

AML	American Meteorite Laboratory; Denver, Colorado, USA.
AMNH	American Museum of Natural History; New York, NY, USA.
ASU	Center for Meteorite Studies, Arizona State University; Tempe, AZ, USA.
AMS	Australian Museum, Sydney; Sydney, Australia.
BMNH	British Museum of Natural History; London, England.
FMNH	Field Museum of Natural History; Chicago, IL USA.
HU	Helsinki University; Helsinki, Finland.
IM	Institute of Meteoritics, University of New Mexico; Albuquerque, NM, USA.
KGS	Kaduna Geological Survey; Kaduna, Nigeria.
LPM	La Plata Museum; La Plata, Argentina.
MB-P	Museum Bally-Prior; Swiss Meteorite Laboratory; Schoenenwerd, Switzerland.
MHN	Museum Historico National; Belo Horizonte, Brazil.
MNHN	Museum National d'Histoire Naturelle; Paris, France.
MNHU	Museum fur Naturkunde der Humbolt-Universitat zu Berlin; Berlin, Germany.
MZwW	Muzeum Ziemi w Warszawie; Warsaw, Poland.
NMW	Naturhistorisches Museum Wien; Vienna, Austria.
RAS	Russian Academy of Sciences (Committee of Meteorites); Moscow, Russia.
U of A	University of Arizona, Flandrau Planetarium; Tucson, AZ, USA.
UCLA	University of California at Los Angeles; Los Angeles, CA. USA.
USNM	United States National Museum (Smithsonian); Washington, D.C., USA
WAM	Western Australian Museum, Perth, Australia.


Visas
REPUBLIQUE DU
Visa temporaire valable du
janvier 1976 au 20 Fév
BAMAKO, le 24-0


Shoemaker 55

GLOSSARY

Achondrites	Stone meteorites that do not contain visible chondrules – magmatic origins.
Amino acid	Large organic molecule; building block of protein
Anomalous	Highly unusual, unique, uncategorized
Asteroid	An interplanetary body, of varying size not associated with a fixed orbit
Ataxite	High-nickel content iron meteorite showing no Widmanstatten lines when etched
Aubrite	Stone meteorite with very little elemental iron – of igneous origins. Also called an enstatite achondrite.
Basalt	Fine-grained volcanic rock primarily composed of plagioclase and pyroxene
Breccia	A coarse-grained conglomerate of angular clasts in a finer matrix that has been cemented together by heat or sediment
Carbonaceous	Chondritic meteorites with a high carbon content showing aqueous alteration and near solar composition
Carbonado	Carbon that has metamorphosed into its diamond phase but remains black
Chondrites	Stone meteorites that contain chondrules
Chondrules	Small spheres of silicaceous minerals of igneous origin associated with solar system formation
Cohenite	$((Fe, Ni, Co)_3C)$ A magnetic, nickel-iron carbide found in coarse octahedrites & ataxites
Crater	A hole or depression in the surface of a planet, or asteroid resulting from a meteorite impact
Enstatite	Silicate mineral with an associated iron content of 10% or less.
Diogenite	An achondritic meteorite mainly composed of magnesium-rich orthopyroxenes,
Eucrite	Class of stone meteorite consisting of Ca-pyroxene and plagioclase
Fall	Witnessed event of meteorite-dropping fireball
Find	A found piece without associated witnessing of event
Hematite	Oxidized iron ore
Hexahedrite	Six-sided crystal structure found in nickel-iron meteorites
Hypersthene	Silica mineral $(Mg,Fe)SiO_3$
Inclusions	Mineral grains that once existed separately but now form an aggregate
Kamacite	Nickel-iron alloy (7wt) phase with body-centered cubic structure
Matrix	Base material, surrounding material
Mesosiderite	A class of meteorite; partly stone, partly nickel iron in a melded mixture
Meteor	A meteoroid that has entered Earth's atmosphere
Meteorite	The remnants of a meteor after it has actually impacted the Earth
Meteoroid	An object in space; similar to but smaller than an asteroid
Newman lines	Fine striations seen in some high-nickel iron meteorites
Octahedrite	Eight-sided crystal structure found in nickel-iron meteorites
Olivine	A silicate mineral with the general formula $(Mg.Fe)SiO$
Pallasite	Class of stony-iron meteorite containing crystals of olivine
Plagioclase	A triclinic mineral with the general chemical composition of FAL,SL,Og
Pyroxene	One of a number of SiO silicate minerals common in meteorites
Schreibersite	$((Fe, Ni, Co)_3P)$ A non-magnetic nickel-iron phosphide.
Silicate	Glassy or stony component made up primarily of the element silicon
Strewnfield	The area over which a meteorite has fallen
Sulfide	Sulfur-containing, as in sulfur-oxide
Taenite	Iron alloy with a face-centered crystalline orientation
Troilite	(FeS) Stoichiometric iron sulphide, usually found in spherical nodules.
Ureilite	Carbon-rich achondrite meteorites with olivine and pigeonite
Widmanstatten	A crystalline pattern seen in iron meteorites after acid etching

HAND-FORGED GIBEON METEORITE KNIVES These beautiful, matching Damascus knives created by master knife-maker, Tai Goo, have hand-carved ebony handles and razor-sharp blades of folded Damascus-worked nickel-iron. Iron from the sky has been made into implements and adornments for millennia.

Toluca, Mexico etched iron meteorite full slice 2.9 Kg.
This meteorite has been worked by locals into tools for centuries.

ORIQUE, Portugal. 747 grams. Ordinary chondrite. (H4) Brecciated. This was a witnessed fall on December 28, 1998 a little after midnight.

CONQUISTA, Brazil. 387 grams. Ordinary chondrite. (H4)

Many thanks to my friend, cartoonist Marcel Vanek, and all the meteorite chasers! It's a true "space race."

ESQUEL, Argentina. 1.45 kilo slice. Pallasite.

Robert Haag has transformed the way the world looks at meteorites. His adventures have taken him from The Atacama Desert to Timbuktu in search of treasure from space. This meteorite collection is rated one of the top 10 most important and valuable treasures on earth.

Robert Haag - The Meteorite Man