Meteorites ✦ Adventures ✦ People ✦ Tektites

# Meteorite Times

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## Caring For Meteorite Collections

2021 1 September

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# Meteorite Times Magazine

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Paul Harris

## Featured Articles



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Meteorite Times Magazine

# Turbid Glass from a King: The Ipiranga Brazil Meteorite

Martin Horejsi

Two days after Christmas back in 1972, a meteor headed west across the sky over southwest Paraná State in Brazil. Described as an “airplane on fire” and a “flying torch” the bright light broke up and left a trail of smoke that floated in the cloudless morning sky for more than 15 minutes.

Machine guns came to mind to those who heard the meteor, and nearby homes shook with the concussions rattling the windows. When the dust settled, a strewn field stretching 40km yielded seven kilograms of H6 regolith breccia, the largest of which was 2.65kg.


In 1999, meteorite collector extraordinaire Jim Schwade acquired a small piece of what is now called the Ipiranga meteorite fall from the estate of Dr. Elbert A. King, Jr. who had died one year earlier. Dr. King was famous in NASA circles as a trainer of astronauts, published author, and the first curator of the Lunar Samples Laboratory Facility at Johnson Space Center in Houston, Texas. King's book *Moon Trip: A Personal Account of the Apollo Program and its Science* is available free online on the Lunar & Planetary Institute website.

Less than a decade later, the sample of Ipiranga again changed hands and landed in my collection. The seven gram specimen is a crust covered corner fragment with two internal faces, one fractured and one ground and polished.

The light colored and heavily shocked matrix is similar in appearance to the Peekskill meteorite, another H6 breccia that fell 20 years after Ipiranga. Although the distribution of Ipiranga is somewhat limited with a majority of the material in two locations, research has been done on the stone. In a Meteoritics article (Vol. 10, p.380, December 1975) titled The chondritic shower of Lajeado Ipiranga, Paraná, Brazil, the authors concluded that “Its most interesting feature is the presence of several turbid glass chondrules with evident shock effects.”

Ipiranga is one of many meteorites from Brazil. One of many falls, in fact. But as a regolith breccia, I believe that it has more to tell us beyond containing turbid glass.

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I'll wrap this up with some words from Dr. Elbert A. King, Jr. regarding the human exploration of Mars:

***"The excitement of the Apollo program was that it accomplished a bold leap from the surface of the Earth to the Moon. The deed challenged our technology and engineering skill. Deliberate preparations are being made now for another and even more daring leap. When it comes, I dearly hope the United States will lead in the endeavor. We must!"***

I sure hope he is right.

Until next time….

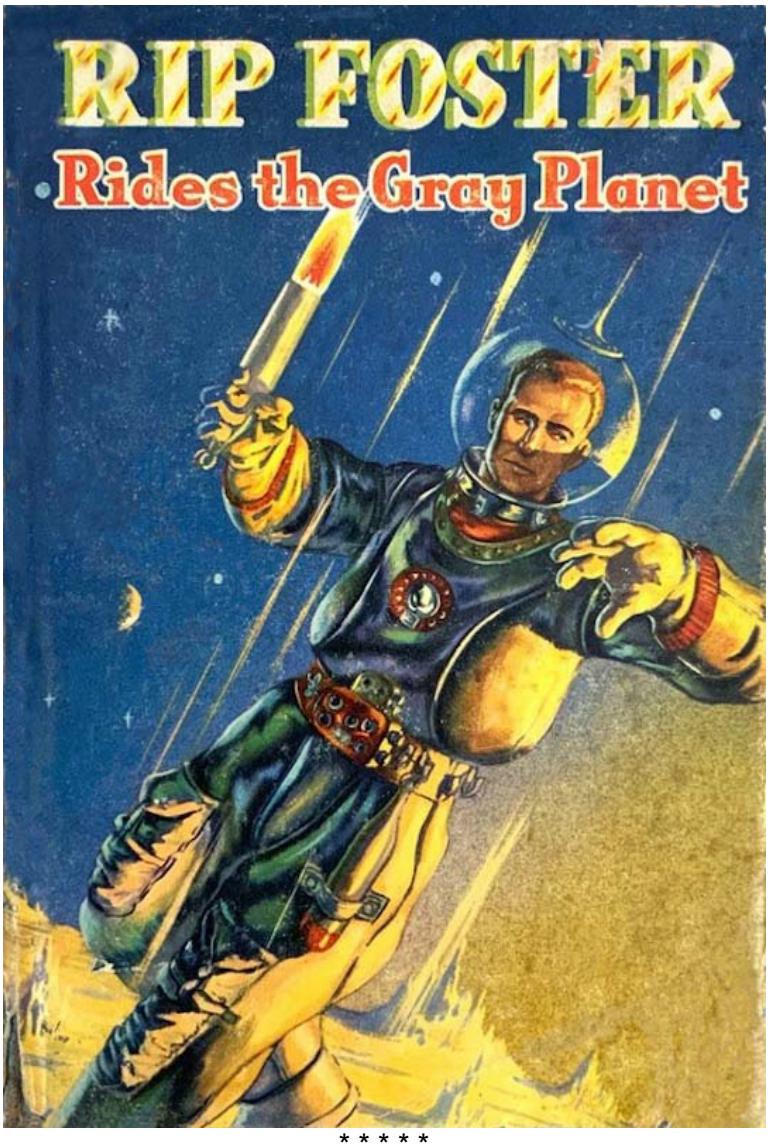
# Meteorite Times Magazine

## Caring for a Meteorite Collection

James Tobin

Before my article begins I want to share a little victory. Over the years I have thought about the first sci-fi novel I ever read. I could not remember the title or the author's name but I remembered the story. It has been 60 years since I borrowed the book from the library. I read it when I was about 10 years old. During the last several years it has been cropping up in my mind every couple of months. So one evening this August I decided to see if I could find anything out about the novel on the internet. I put in this series of keywords into the browser search "science fiction novel 1960 spacemen asteroid thorium" and what do you know, my mystery novel was number two in the results. It is titled "Rip Foster Rides the Gray Planet." It was written by Harold L. Goodwin under the pseudonym Blake Savage. The novel was originally published in 1952 to be one in a series of space adventures. But to my knowledge no more episodes were written about Lt. Rip Foster spaceman hero of free people everywhere. It is still available, listed now as public domain, and is even in audiobook form. I ordered a copy for just $4.50. I am excited to read again this book that began my love of Science Fiction, astronomy, meteorites, and asteroids. It was the book that first sparked the idea of mining in space for me.

Final note: The book arrived and I read it cover to cover in one long sitting. The reprint copy had many OCR errors and tiny print. I had a headache much of the following day from straining to see the words. It was always a book for young people but I enjoyed reading it again at 70. I was surprised by the forward-thinking of the author. Many of the ideas and inventions described by the author in the book exist today.

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## Caring for a Meteorite Collection

We hear a great deal about the potential dangers of meteorite and asteroid impacts. But over the years I have written little about the dangers the Earth poses to meteorites. For most of my life, I lived within two or three miles of the Pacific Ocean. The moist salty air kept me from displaying many meteorites. Some were able to stay successfully in Riker cases but I was forced to keep many in sealed containers. It was not a lot of work protecting them but it was a routine that had to be done for each new acquisition.

This is an ordinary Riker case with some of the Stewart Valley finds from a one day hunt. Many meteorites need no more care than a Riker case provides.

There was a navy surplus sale on Saturdays when I was a kid and I always went to see all the cool stuff that was there. I never had much money till I got older and had a paper route. One Saturday there was a scintillator and a civil defense proportional counter for a couple of dollars each. They only needed batteries for me to start playing with them. They were my first introduction to detecting radioactivity. There was always something there that caught my eye and curiosity. It was sort of like what still happens at gem shows. I see a million rocks but only buy the ones that speak to me. Another Saturday there were some cans labeled “INDICATOR, HUMIDITY” the price was only fifty cents for a can that held 125 cards. I knew what they were, but did not have a use at the time for them, still, I bought three cans. Little did I know that they would be part of a lifetime supply of humidity indicator cards for a meteorite collection. I still have some of those and later I found some more at the famous TRW swap meet. One of those later cans I photographed and placed below. Living near the ocean it was really important to know how dry the meteorites were in their containers. It is a bit different now that I live in the mountains on the edge of the Mojave Desert. I have more NWA stones laying around. I would never have just left them out and about by the ocean.


Humidity cards are available with different ranges of indicator dots. The 50%, 40%, 30% version has been fine for my use. As can be seen in the picture I do not worry about keeping the cards in the can dry. I let them turn pink which would be bad in use. But when the card is placed with desiccant it will turn blue again and that will be a good indication that the bottle has gotten dry enough to change the card.

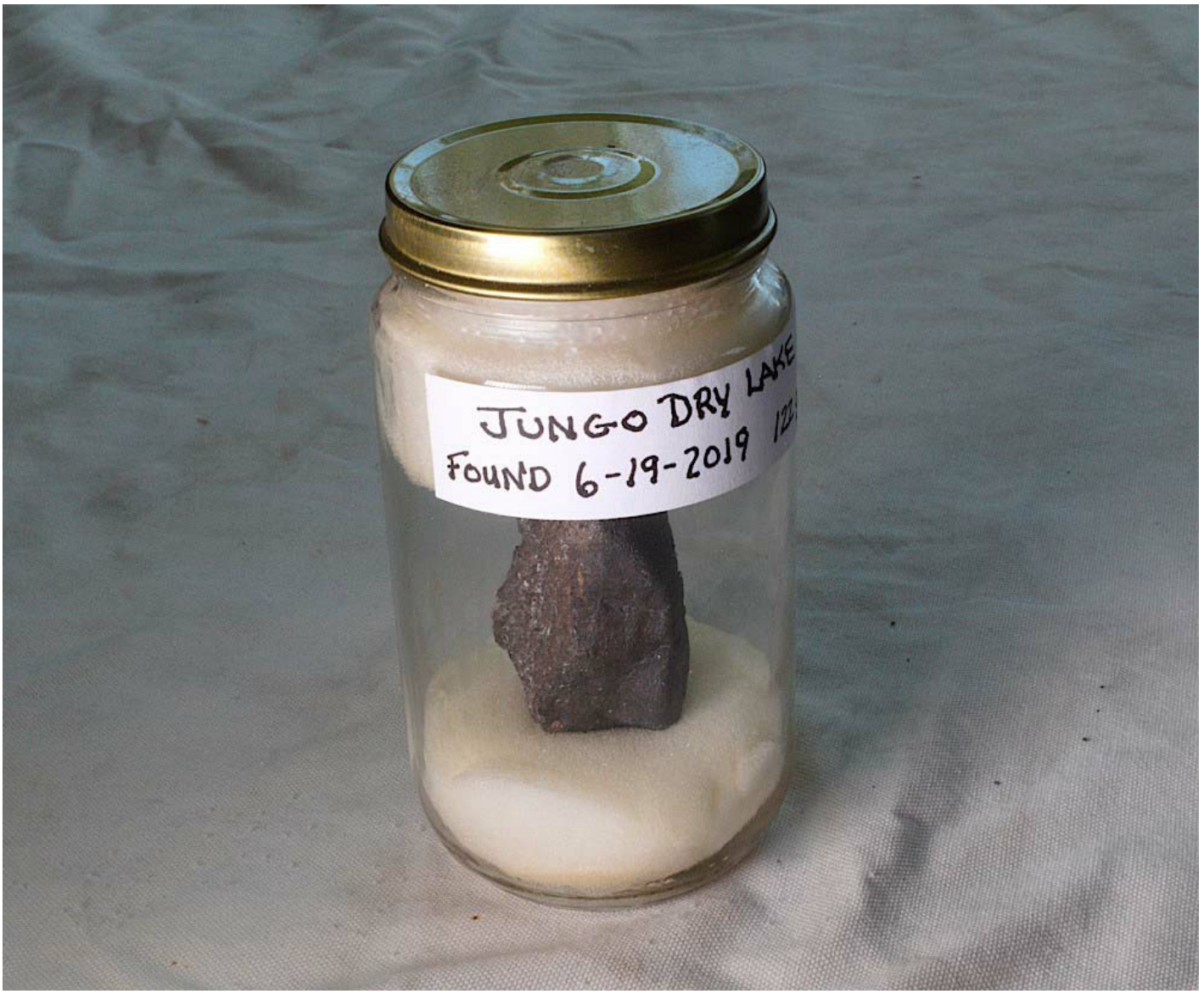
As the years went by I started putting more meteorites into bottles and used fewer Riker and plastic cases. You could see me after everyone was gone from the Thanksgiving dinner table washing up the glass bottles that items like gravy or jelly came in so I could use them on meteorites. There are always Ball Jars and Mason Jars in the closet waiting for a meteorite to take up residence like some extraterrestrial hermit crab. And one of those long-held indicator cards is usually included as part of displaying the meteorite. It goes something like this. First, I put some padding in the bottom of the jar, (a circle of foam rubber) and sometimes a healthy amount of silica gel under the padding then the meteorite is positioned on top of the foam. More foam is put on top with an indicator card slid down the side of the jar. The airtight lid is screwed on and that meteorite is done forever, usually. I have meteorites that I did this process on that have stayed perfect with all blue indicator spots for twenty years. I don’t think I have returned to a jar to change desiccant in at least ten years on any bottle. Polished iron faces look just as shiny as the day they came off the lapping disc and polishing wheel. Fragile stones are gently supported and centered in the glass jars and never get banged around or chipped ever again.


Some Canyon Diablo graphite nodules are prone to rust. This slice which was for a long time the only specimen of graphite nodule that I had has been in the old mustard bottle for about 15 years. The foam rubber padding is starting to turn a bit yellow.

I have a few meteorites that are stubborn stinkers and do not stay rust-free no matter what I do. These I put into 3D printed holders under glass sealed with O-ring gaskets. This has been successful for about half the trouble makers in the collection. The others I keep immersed in silica gel and rework as needed. I have soaked them for months in alcohol and neutralized them and they are just unstable. It is only about five or six out of all the meteorites. Since these troublesome ones are all rather small it is not worth sending them out for some modern electrochemical process to stabilize them.

I guess at this point in telling about my meteorite storage I can admit that one and only one meteorite ever disintegrated. Long ago I bought a roughly 700-gram Nantan for a few dollars. That was the price back then. But I should have turned up my volume and listened closely for the popping and snapping sounds of its self-destruction. Within a year it was a pile of angular bits in the metal can I had stored it in. I knew I needed to be careful with Nantans but I failed to keep a close enough eye on that one.

I have not done much meteorite hunting in the last year. But I have hopes that will change. I enjoy protecting and displaying the space rocks I find. Some are in Riker cases and others are in the bottle displays. I am more interested in showing these personal finds now than in displaying other meteorites.


JUNGO DRY LAKE
FOUND 6-19-2019


I put the date on the label when meteorites are found and as these show they have been in their jars for several years or more with no worries for me.

Any meteorite stone larger than about half an inch thick needs to go into something other than a Riker case. The cases are not thick enough to hold them. Riker cases work well for slices and fragments but often not for whole specimens. I used to put silica gel under the filler in Riker-type cases. But it was a lot of work to monitor, change and recharge the desiccant. Bottles are maintenance-free, come in all sizes and the specimens generally have good visibility.

For the tiny specimens, I have used small bottles with corks and vials with screw tops. I make wooden racks to hold the bottles. The only real drawback to these is that the bottles are so small labels often cover too much of the glass surface. This makes seeing the meteorite a little difficult. Many of these small bottles contain rarer meteorites not ever available in larger sizes. Having protection is more important than visibility. Some of the meteorites in the tiny bottles are just fragments and I occasionally place the fragments into capsules and then put the capsules into the bottles. This has the added value of preventing me from losing the specimens if I drop them on the carpet. The capsules are easy to find.


Not all meteorites need moisture protection. The Lunar and martian meteorites have almost no metal to rust, I cut them thin and they work fine just protected from breakage in Riker type cases. The same thing goes for many of the achondrites which also have little nickel-iron metal. They do well in plastic or Riker cases. I have specimens in membrane boxes too. Some thought goes into deciding which are appropriate for putting in membrane-type boxes. Irons, pallasites, mesosiderites, and even some chondrites with large amounts of metal may not be safe in membrane boxes. The metal surface stays permanently in contact with the plastic membrane and even the tiniest amount of moisture can cause rust to form between the metal and the membrane. I try to use membrane boxes for small stones and stone slices and not for meteorites with larger areas of metal. The same metal to plastic contact with trapped moisture can happen with plastic bags. I try to always wrap meteorites in a paper towel or tissue before putting them in plastic bags, I usually pour some silica gel into the bag. If I am not going to get the meteorites out for a long time then I will throw in one of the indicator cards so I can see if they are remaining dry. Zipper-type plastic bags are notorious for not staying airtight for months at a time. On the meteorites that I cut a bit off of and then store again I often double bag them with some desiccant in the inner bag.

I know a lot of this is common sense but it is good to repeat since meteorites are the only truly foreign material on Earth. They are the real aliens. Before they landed here they spent their time in a vacuum without water (for most of them). Rusting and weathering as it happens on Earth was not possible. Compared to the millions of years they could remain unchanged in space, meteorites can decompose to unrecognizable blobs of goo in a geologically short time on Earth. Especially, if they fall into a harsh wet environment. Some meteorites that have fallen in jungles or water are never the same again, permanently unstable. Some can be fixed by the new methods created in the last few years that's true. I have pieces of Bondoc that came from the jungle and were then reportedly cleaned by putting the material in acid. This double whammy has given me headaches for years. I left some Bondoc chunks immersed in isopropyl alcohol for a year in an attempt to soak out some of the contaminants. The alcohol discolored greatly. But overall I would say I had little success. My Bondoc meteorite pieces stay in solitary confinement with desiccant. They are only viewed on rare occasions. Not a great way to enjoy meteorites. I have ground and polished hundreds of grams of Bondoc making beautiful specimens. I held my breath with every piece fearing it would rust in a few days. Many did haze over in a short time. It is a tough meteorite for me to keep beautiful. It may be that I bought large masses that were more unstable than pieces others have purchased. I don't know.

Once contaminated some meteorites can become a problem forever. It is exceedingly important when doing etching or other treatments that care be taken to neutralize and remove the chemicals. Once chemicals get down into cracks they sit there working away, damaging the meteorites. I bought an endpiece of Toluca from a famous meteorite dealer decades ago at the Tucson Gem and Mineral Show. It was a great-looking piece with a nice etch. I packed it away in my luggage. Four or five days later I got home to find the whole etched face covered with rust spots and the natural divisions between crystal grains deeply eroded as a spiderweb of brown lines. This wonderful specimen was never properly neutralized after etching, I suspect it was a rush job to get material prepared to sell at the gem show. I had to grind down the surface at a great loss of meteorite. I repolished the piece without an etch. I have over the thirty years since had to rework this endpiece two more times because of contaminants still down in the metal. It will never have an etch again or be a specimen I can put on permanent display. It was a real disappointment but an important lesson was learned. I am very selective now about who I buy etched iron meteorites from. I have gone so far as to buy whole iron-rich meteorites and cut or grind them myself to have a surface to etch.


The Sericho pallasite pieces in this jar were placed there within days of the Tucson Gem and Mineral Show in 2019. Some of the pieces were gound and polished and two in this jar were also etched. They are all fine and hopefully will remain so.

I suppose this would be a great time to discuss coatings that are sometimes on meteorites. I have bought etched irons with coatings and I have even coated slices of iron-rich meteorites. I have etched irons in my collection that are uncoated and perfect after thirty years. I don't think the problem or the protection is in the coating. It is all about the preparation and care of the meteorite. A properly prepared meteorite will survive well with just a little care, uncoated. A properly prepared and cared for meteorite with a coating will also survive well. But a meteorite that has been prepared poorly will go bad and show rust quickly, whether it is

coated or not. The problem will not be stopped by a coating. It will fester under the coating. In my experience, a coating on badly prepared meteorites is far more damaging. The corrosion will eat down into the meteorite rather than being mostly on the surface. The corrosive agent cannot dry out and slow its work when a coating on the meteorite. When I do rarely coat an iron, pallasite, or mesosiderite I use lacquer. I like that it dries by evaporation, is not water-based, and cures hard very fast. But I should write here that I rarely coat a meteorite. I have maybe applied a coating five times in forty years.

A meteorite collection can be a major project or problem to maintain. Or it can be safely static and just enjoyed. It is sort of like weeds in your yard. You should never turn your back on weeds. If you don't keep up with weeding they will take over the yard. Rust and deterioration of meteorites are the same way. The best thing I have found is to protect the meteorites permanently from the dangers on Earth when I first acquire them. Then I never have to worry about them anymore. It is a few minutes of labor on each one but after that nothing is required of me again. Yes, I sacrifice the handling of some of my space rocks. It is a price I am willing to pay to preserve them for generations of collectors after me. I have plenty of other meteorites to photograph, handle, cut, and enjoy in different ways. The vulnerable ones I keep safely enclosed in glass.

NWA 12692 LL3.00 S3 W2
By John Kashuba

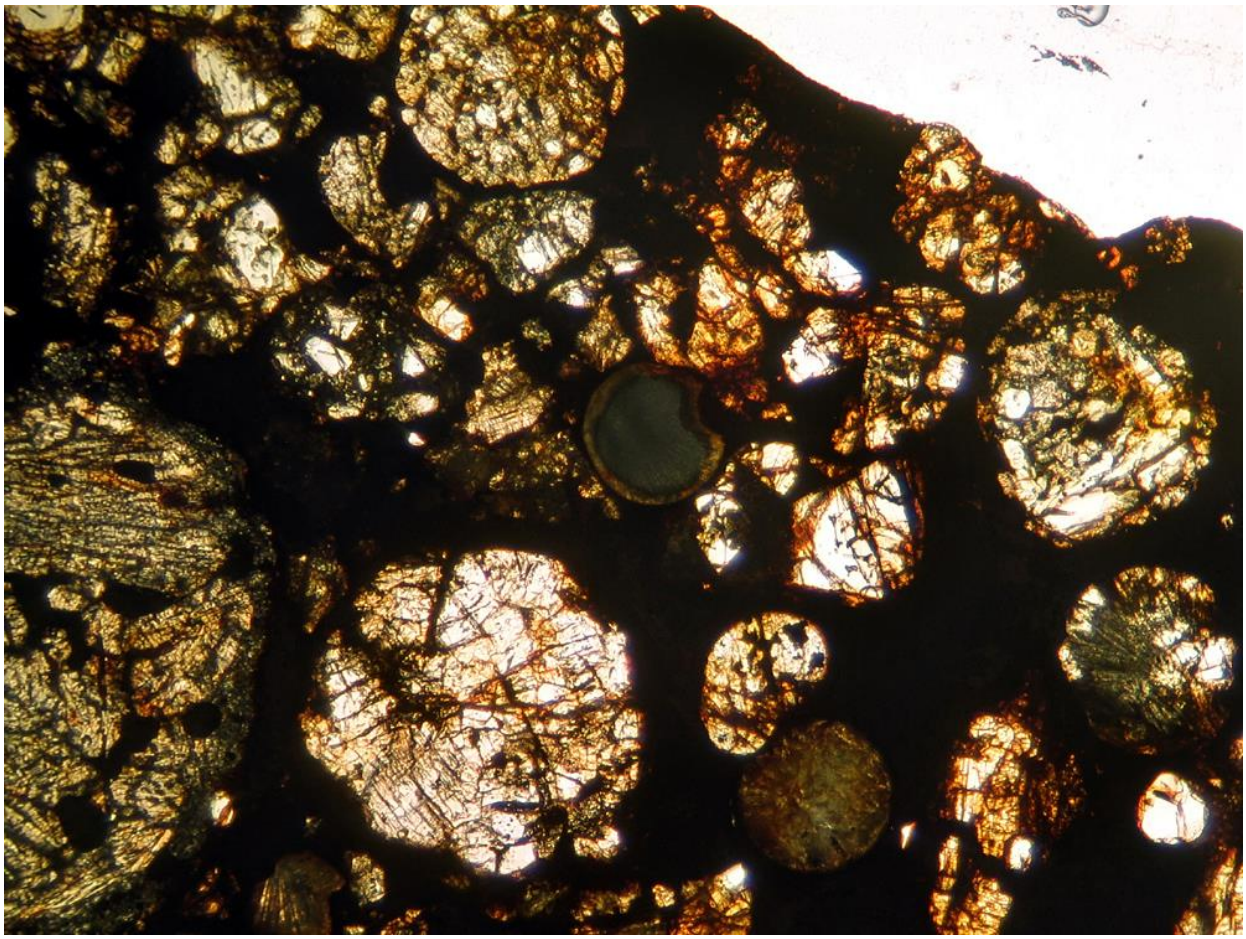
The 3.00 designation is assigned to chondrites that have experienced the least amount of metamorphism. Few are recognized. In September 2021 there are ten. The two L3.00 are possibly paired.

| | | |
|---|---|---|
| NWA 8576 | LL3.00 | 59.5 g |
| NWA 10061 | LL3.00 | 53.8 g |
| NWA 12692 | LL3.00 | 373 g |
| Semarkona | LL3.00 | 691 g |
| | | |
| NWA 7731 | L3.00 | 81 g |
| NWA 8276 | L3.00 | 789 g |
| | | |
| Chwichiya 002 | C3.00-ung | 779 g |
| NWA 11750 | C3.00-ung | 8.5 g |
| NWA 12957 | C3.00-ung | 43 g |
| NWA 13689 | C3.00-ung | 165 g |

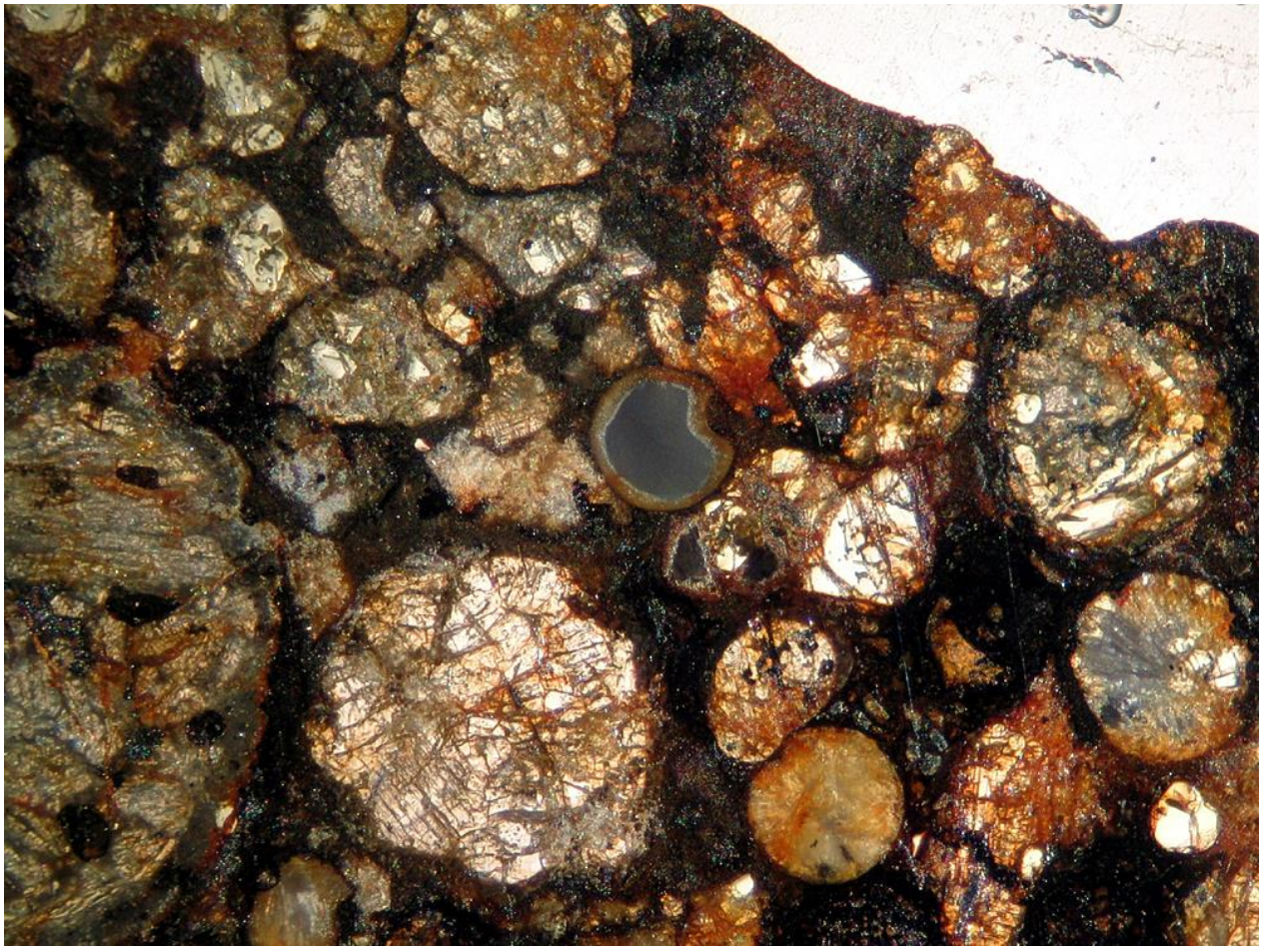
NWA 12692 was found in Mali in 2012. They were sixteen stones having no fusion crust and weighing 2 grams to 157 grams. Classification was done by C. Agee at University of New Mexico Albuquerque in 2019. Material is on deposit there and at the Research Center for Astronomy and Earth Sciences, Budapest, Hungary.


The main mass is held by Z. Kereszty and it is from him that I bought the beautiful slice which I had thin sectioned. Z. Kereszty photo.

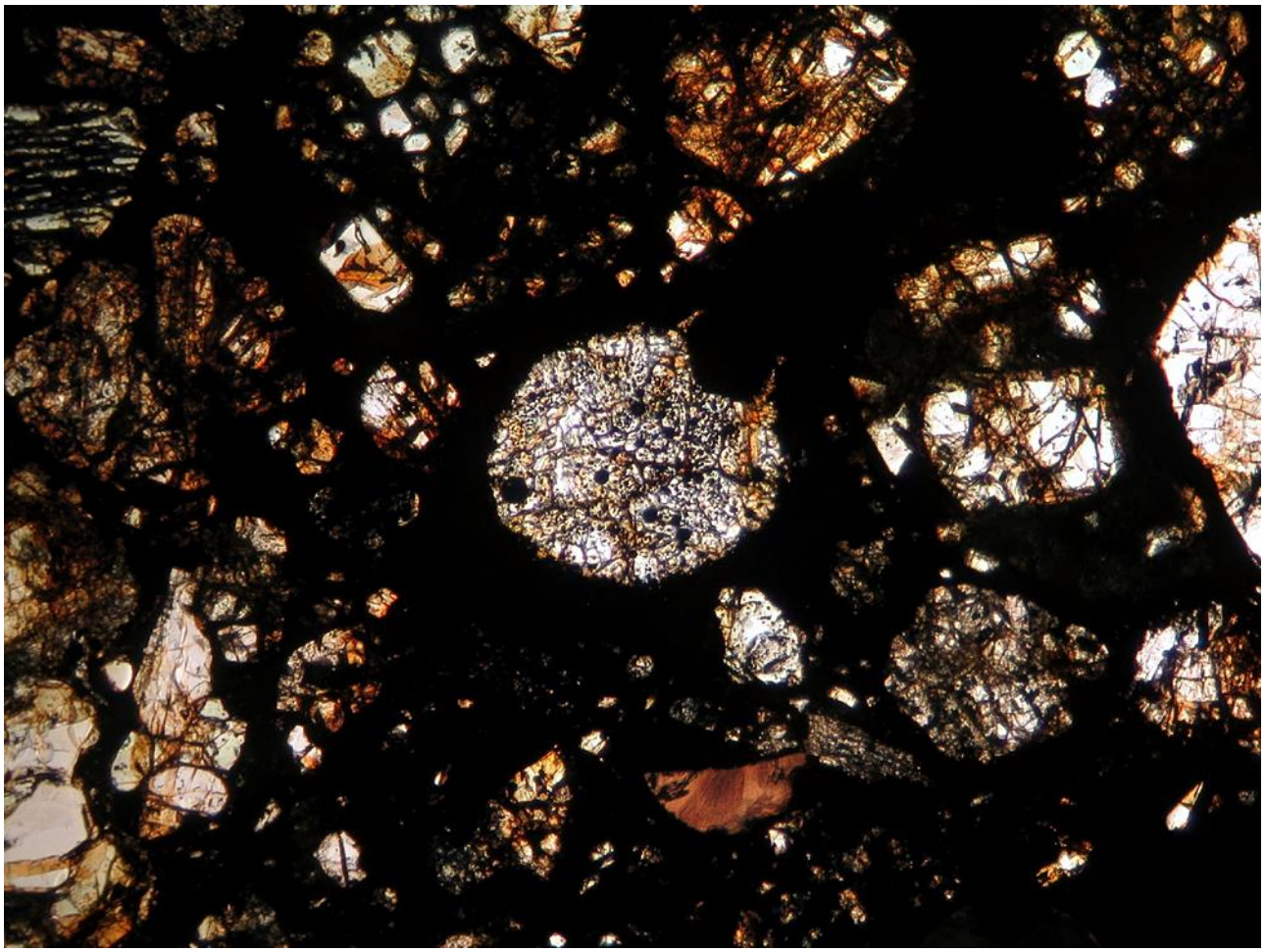

Chondrules are somewhat irregular and are densely packed. The matrix is black. The largest chondrule in this section is 3 mm across. Weathering grade is 2. A small crack extends from near the center bottom of the sample upwardly. It contains terrestrial weathering deposits. Thin section in transmitted light.



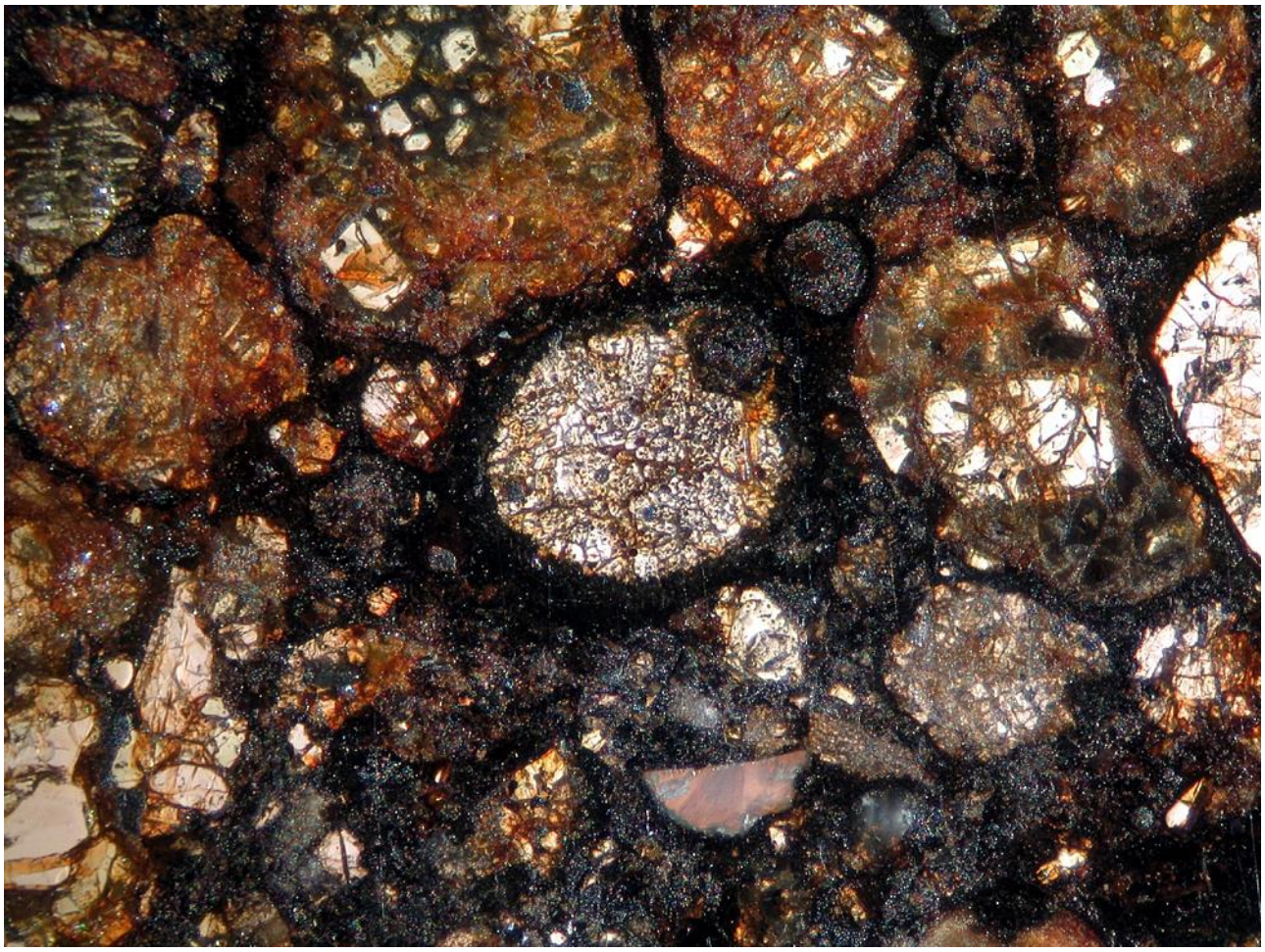
The rim on the fine grained radial pyroxene chondrule in the center is the result of hydrous alteration on the parent body. Field of view (FOV) is 3 mm. Plane polarized light (PPL)



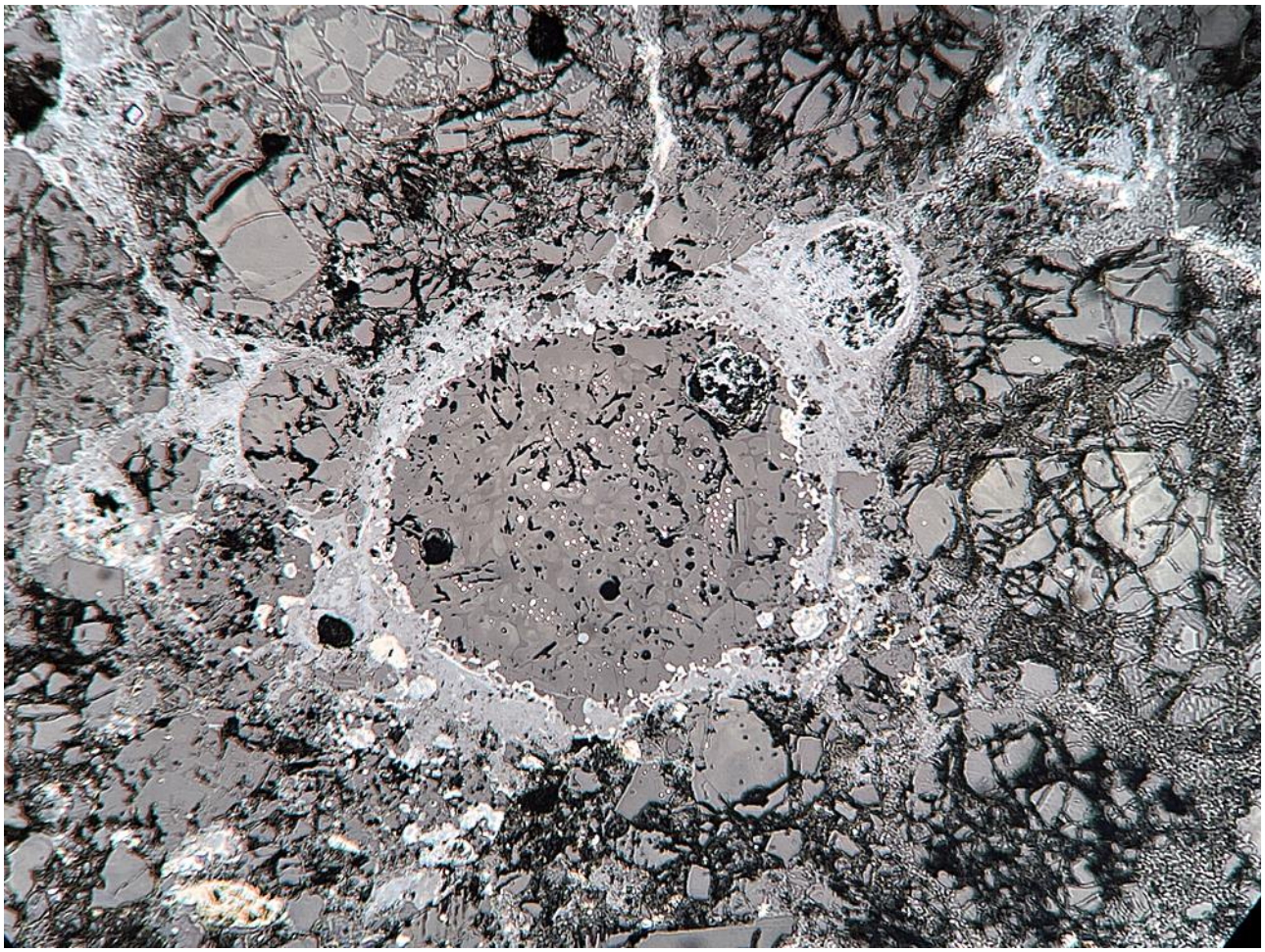
Chondrules and mineral grains throughout have been stained by terrestrial weathering. PPL and oblique incident light.



Center chondrule appears to be embracing something. FOV=3 mm, PPL

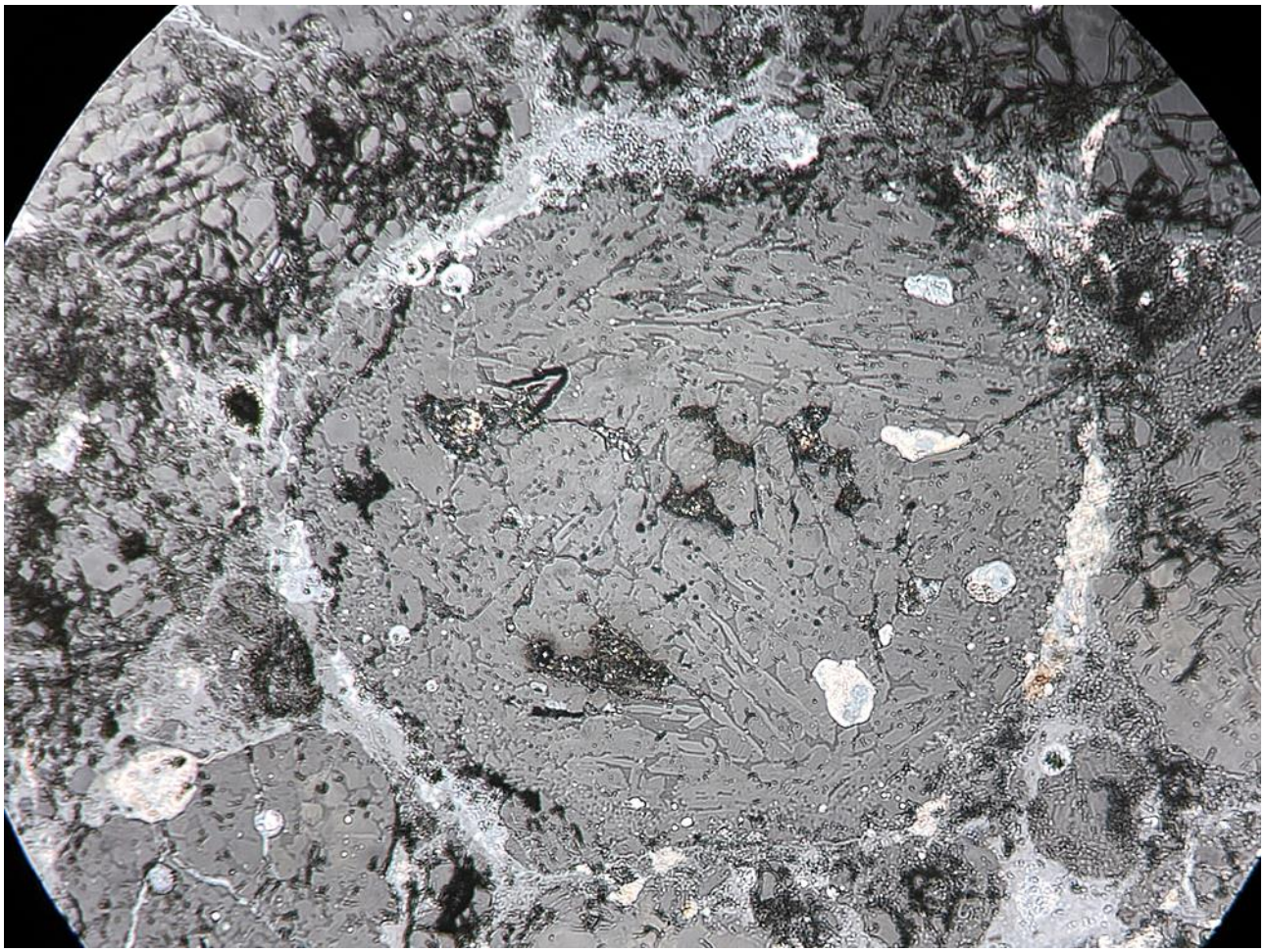


Something granular.  PPL and oblique incident light.

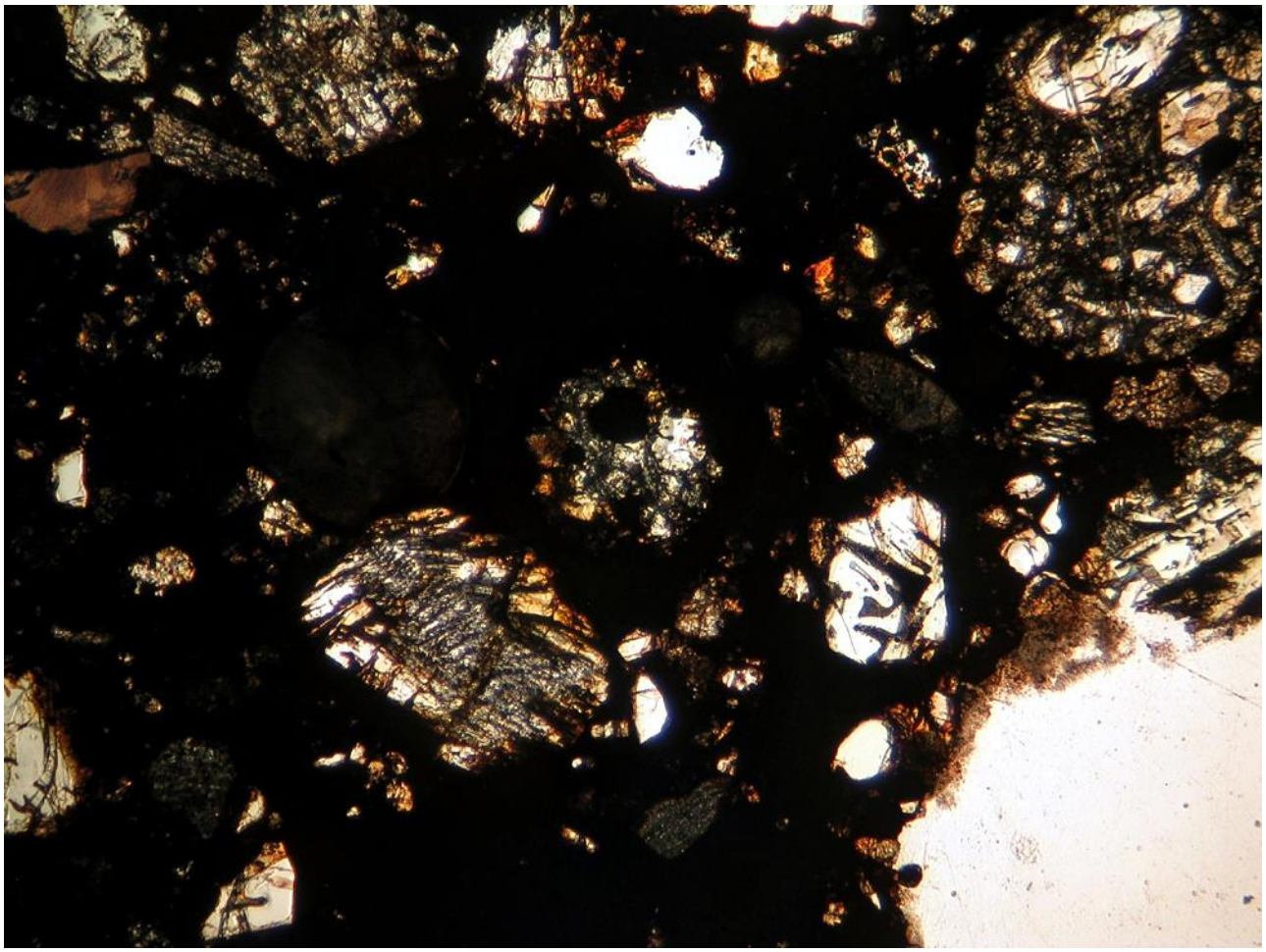


But not bright enough to be metal.  Much more detail shows in otherwise opaque areas.  Reflected light.

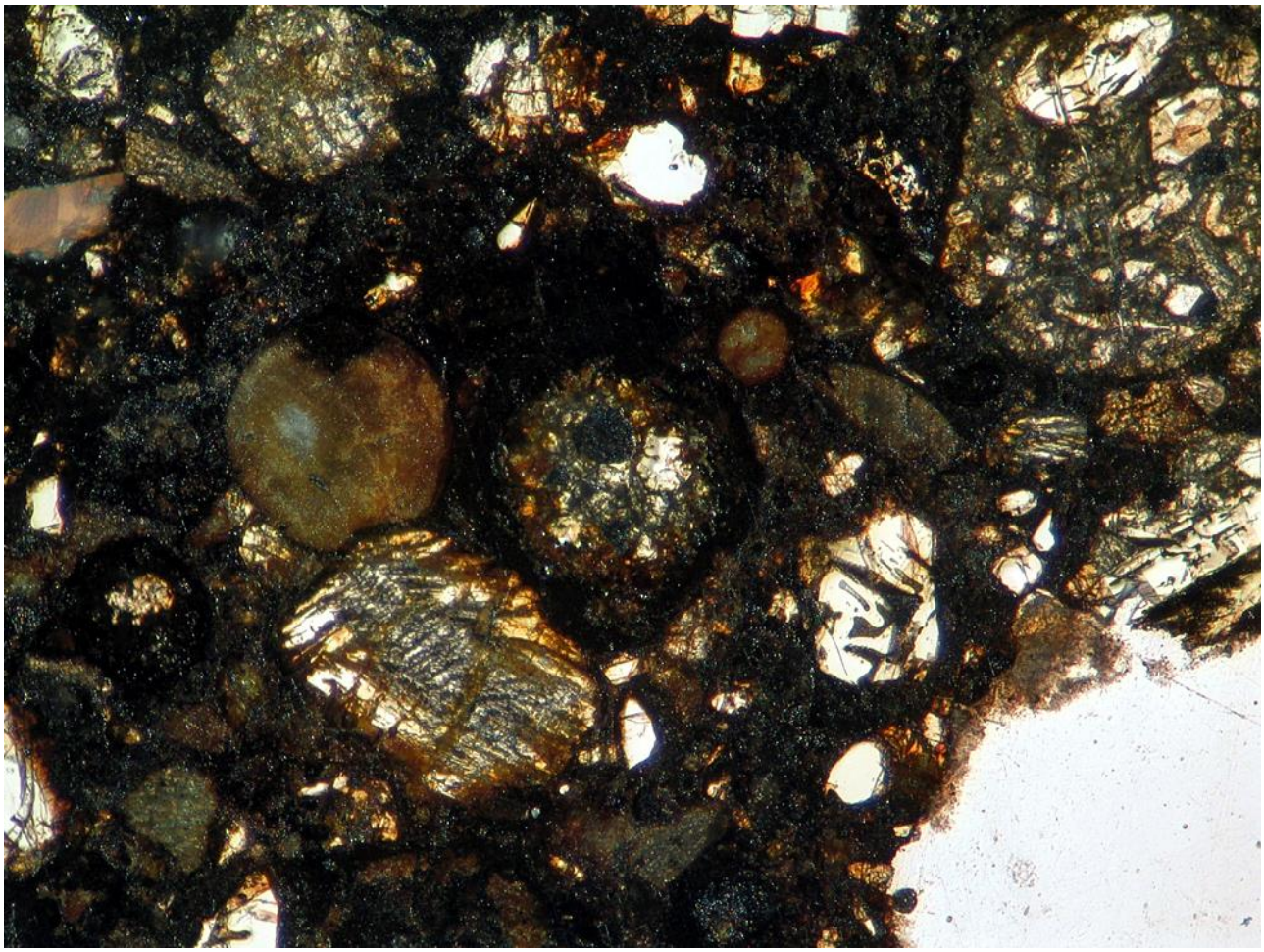
Larger chondrule with granular and dark appearing inclusions.  FOV=3 mm, PPL and oblique incident light.



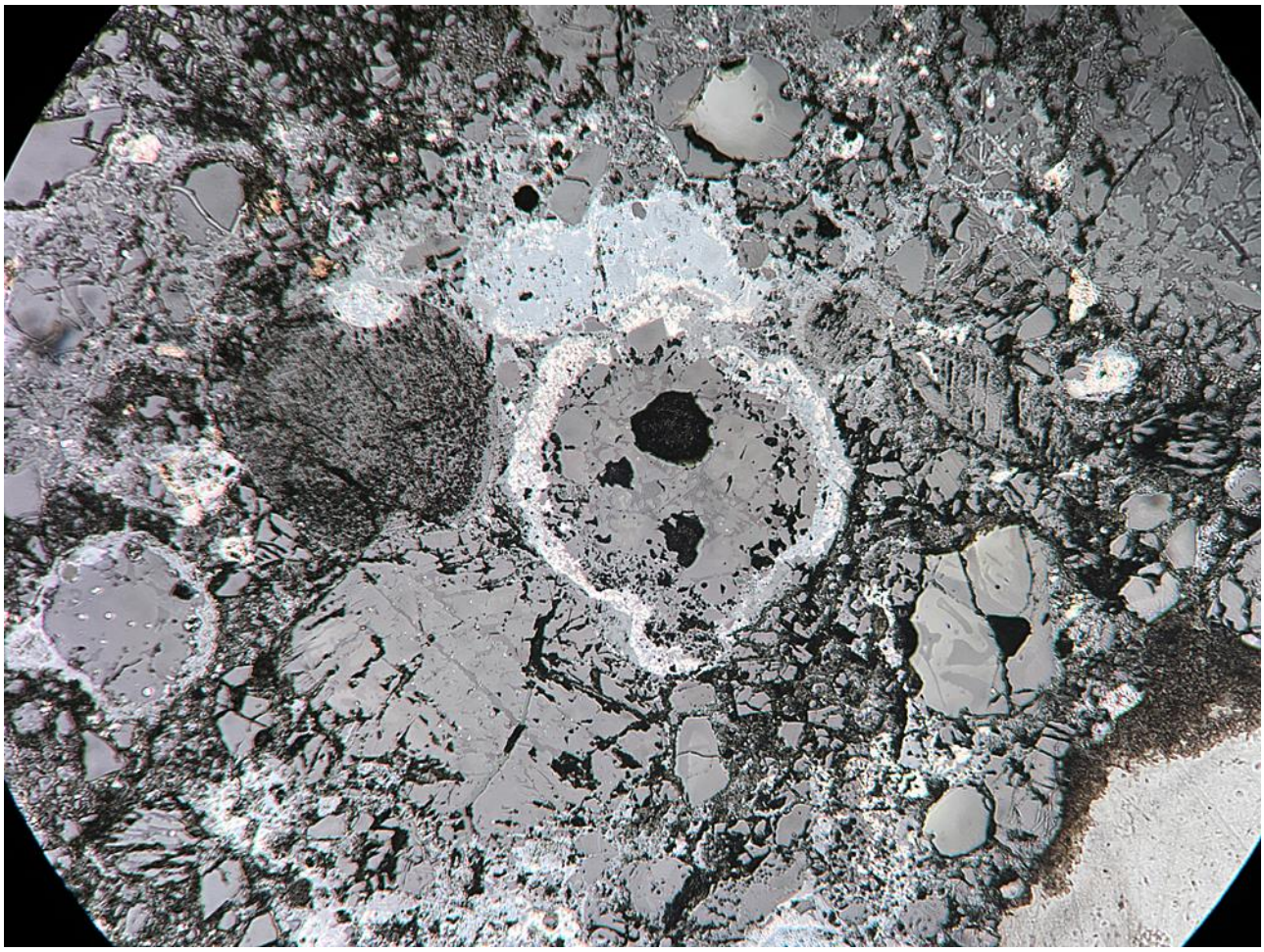
The otherwise dark inclusions appear bright like metal.  Reflected light.



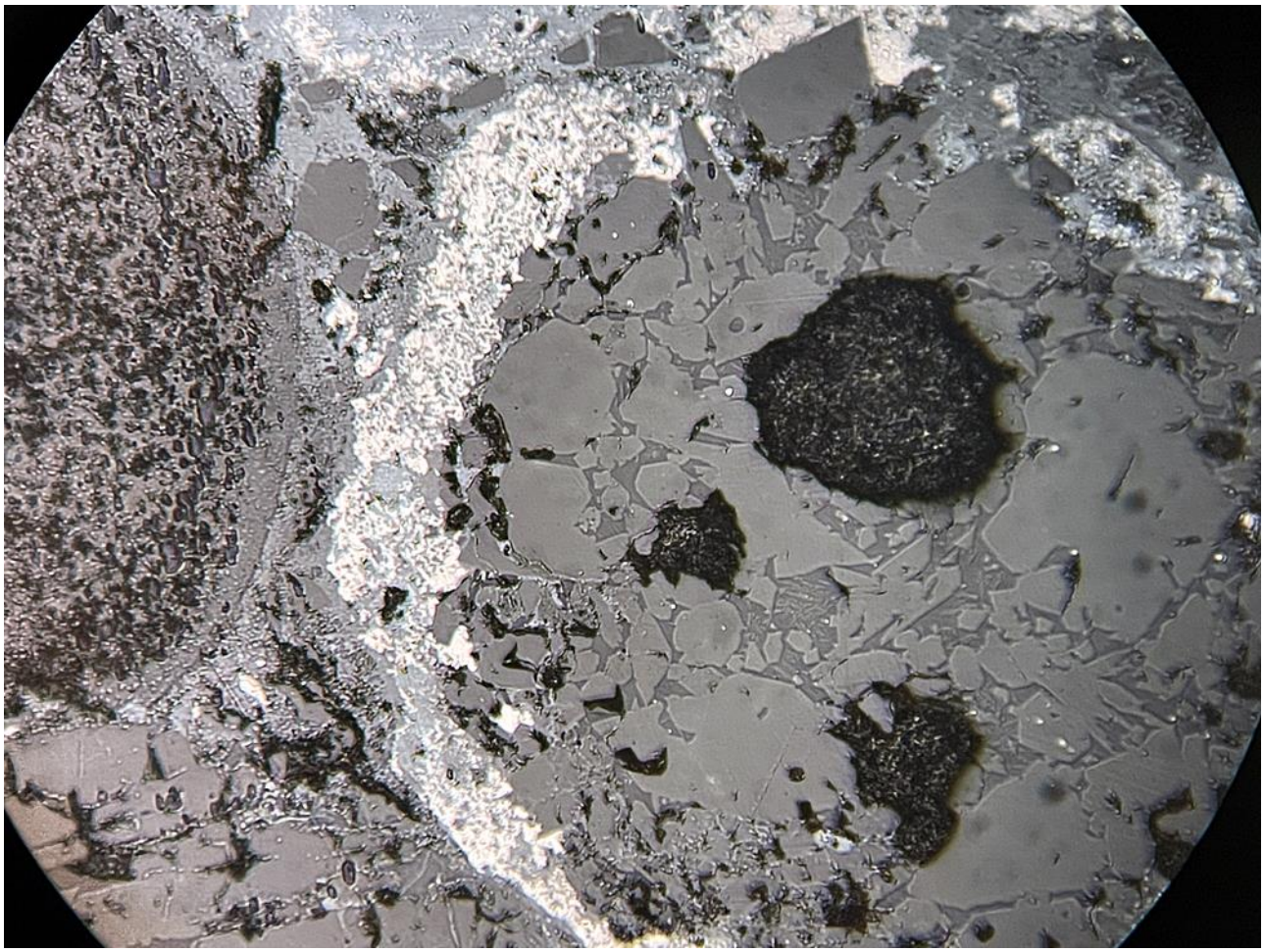
Chondrule with dark spot surrounded by opaque material.  FOV=3 mm, PPL.



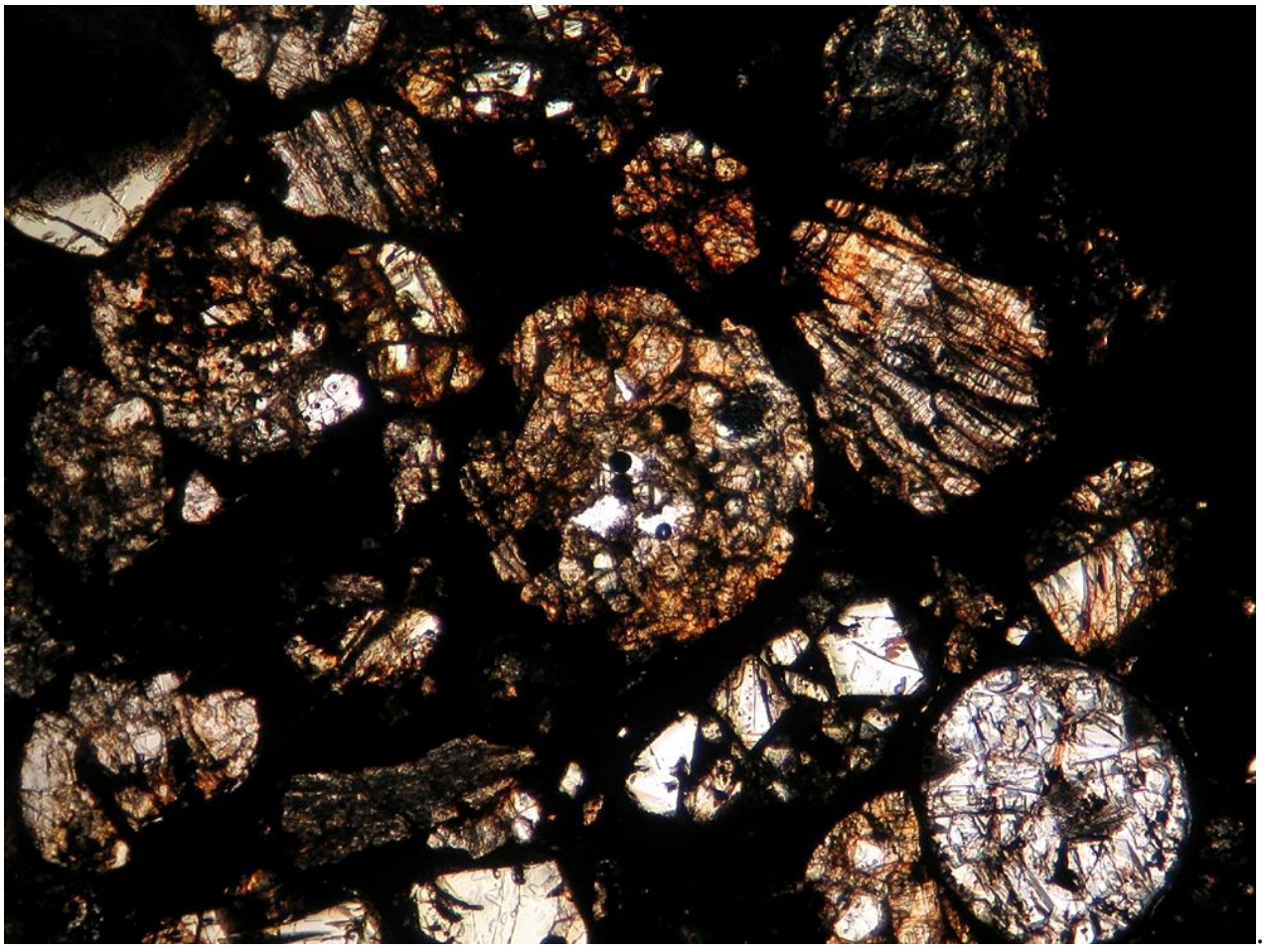
PPL and oblique incident light.



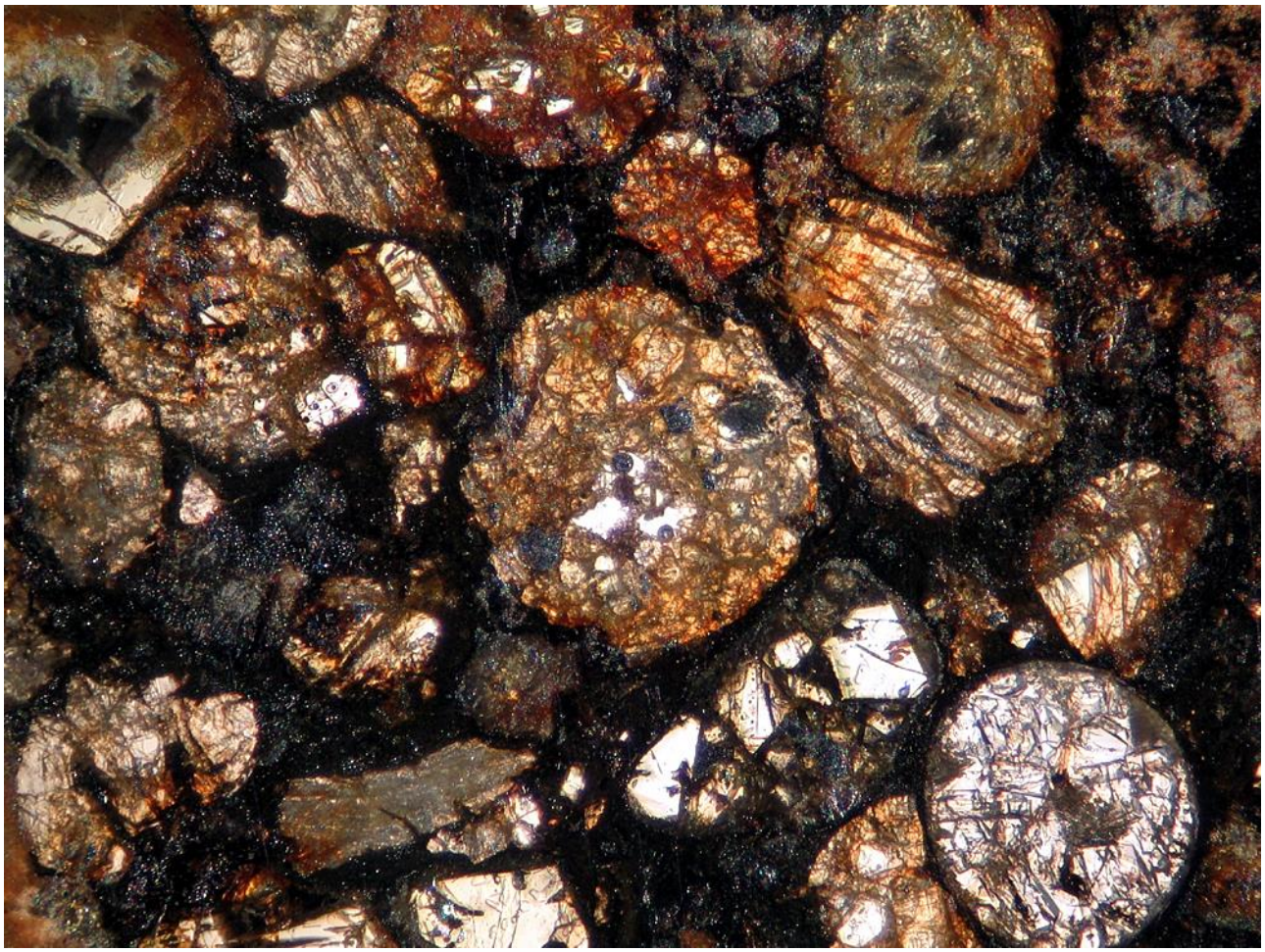
Chondrule appears to be surrounded by metal - armored.  Reflected light.



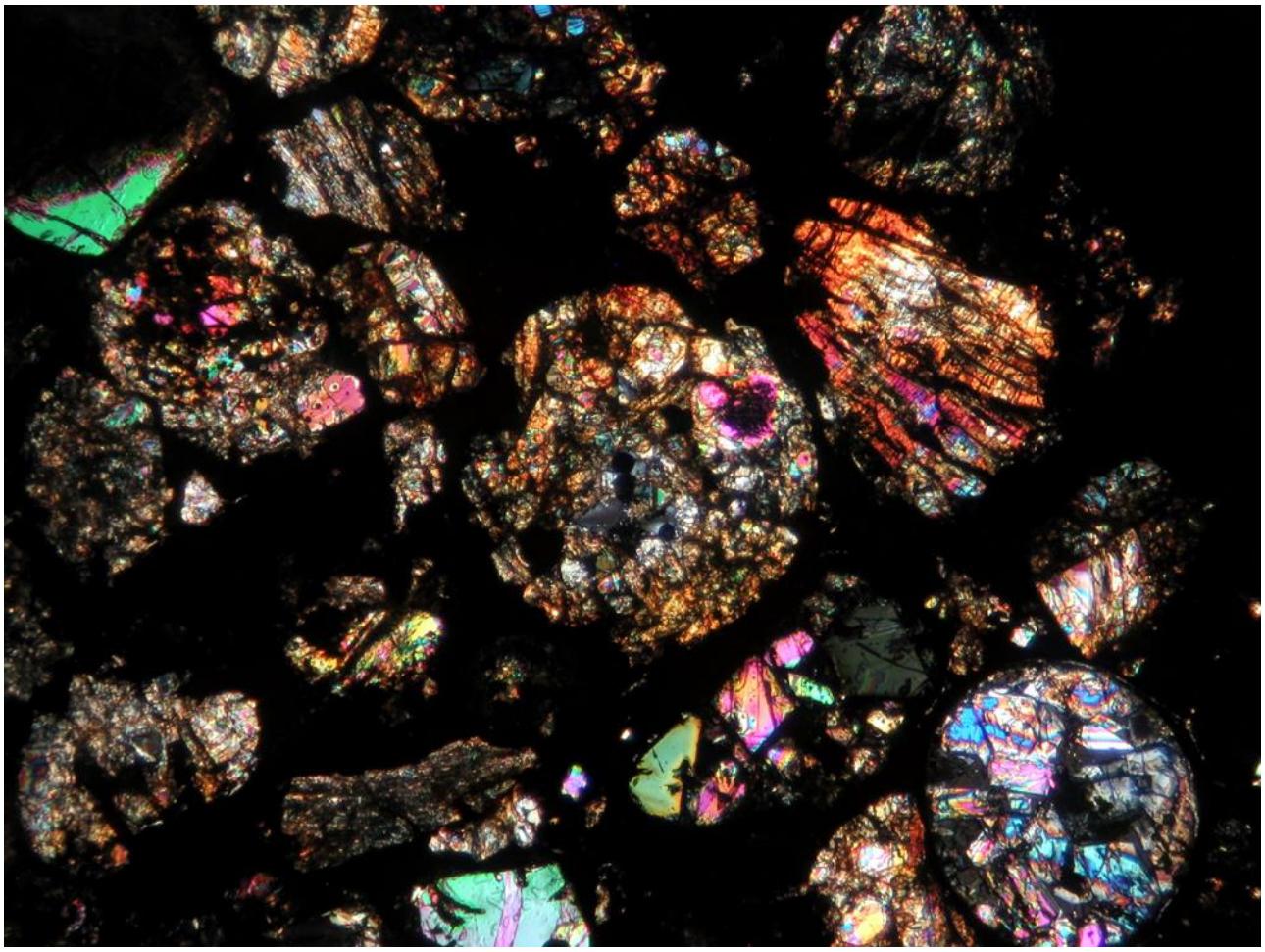
Textured metal.



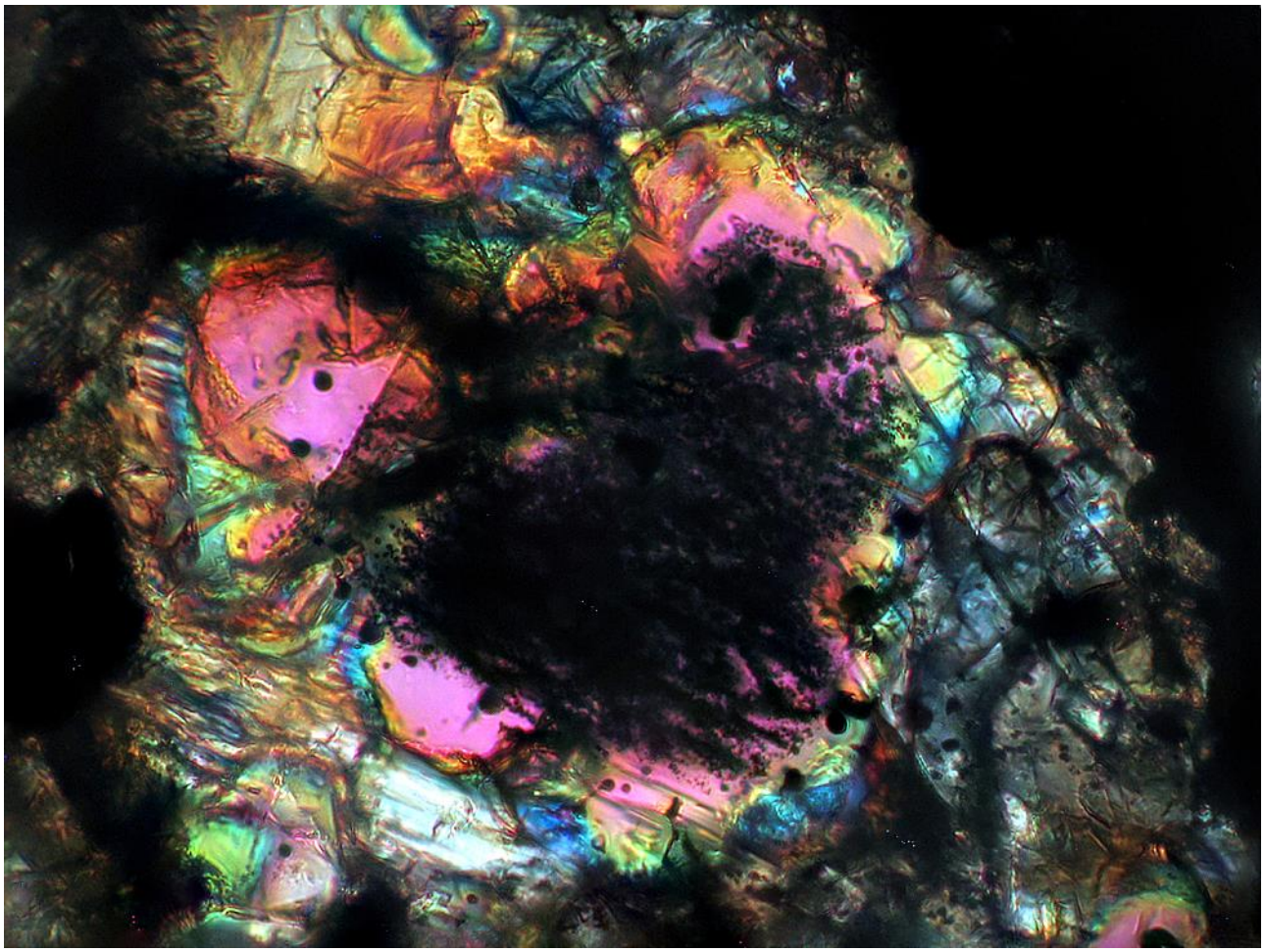
Chondrule with a few dark spots and white areas where material that was lost during the thin section making process - "plucked grains."  FOV=3 mm, PPL.



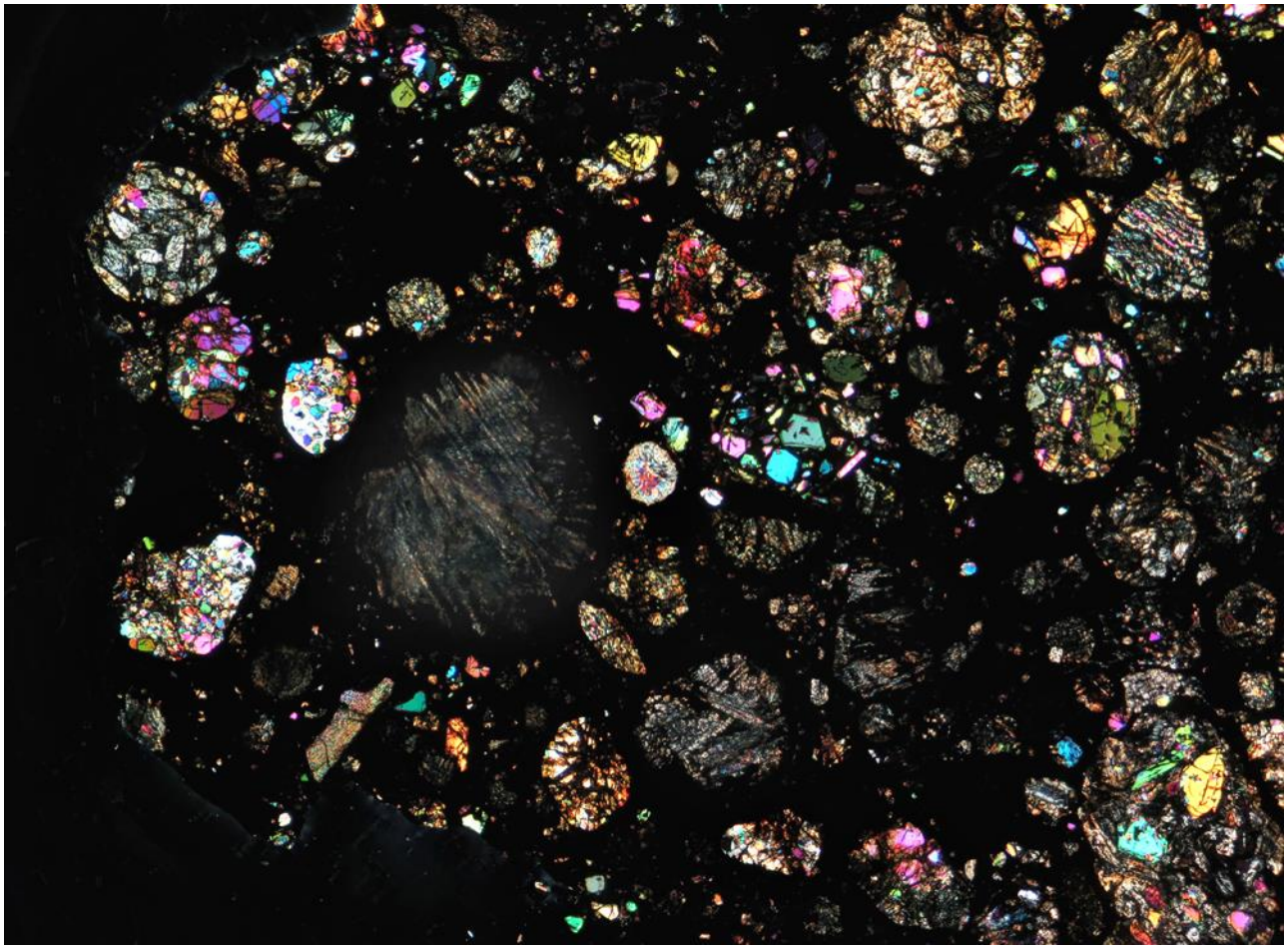
Dark spot at 2 o'clock looks fuzzy.  PPL and oblique incident light.



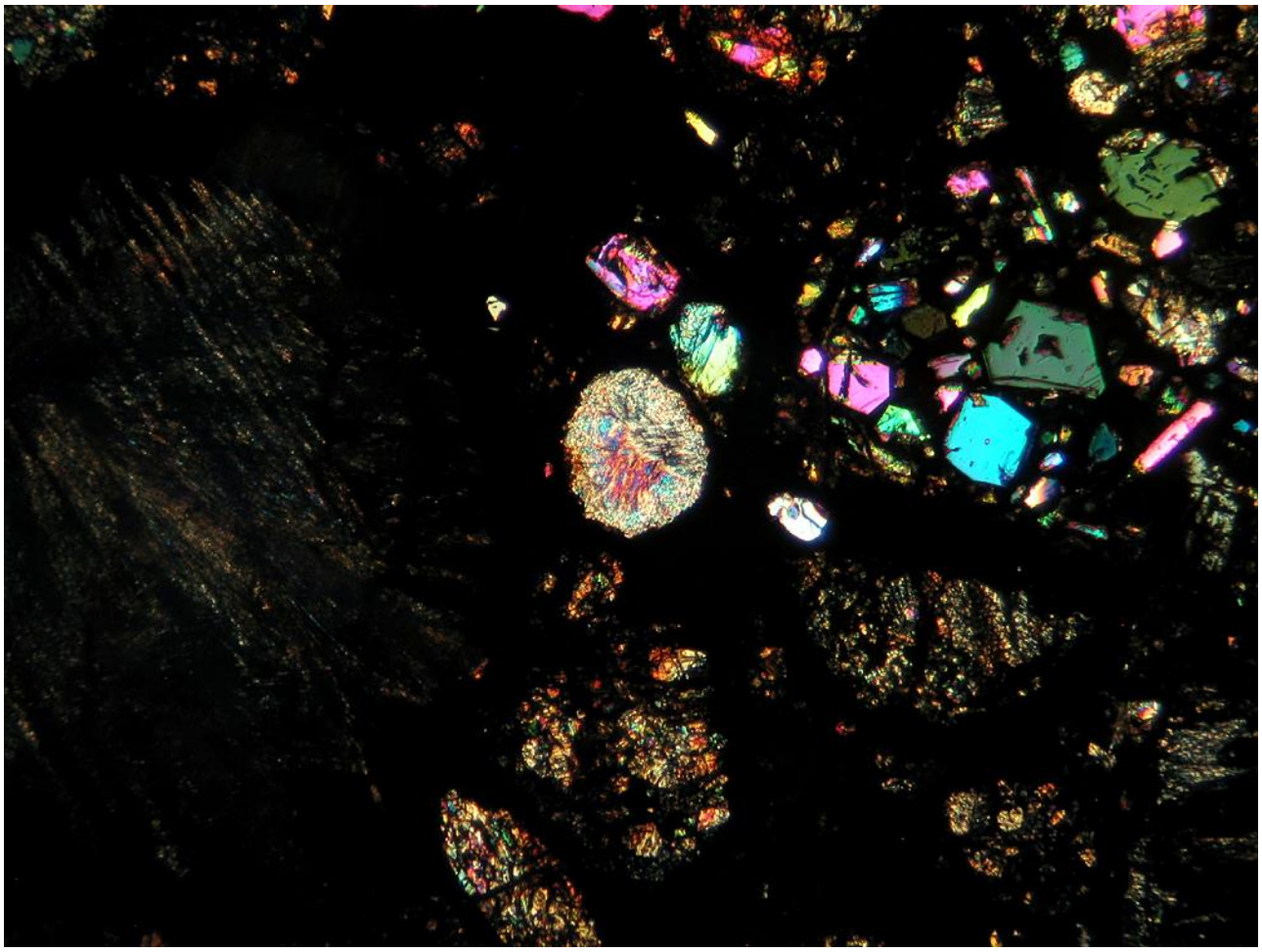
In cross-polarized light (PPL) that spot looks like it might be a relict grain.



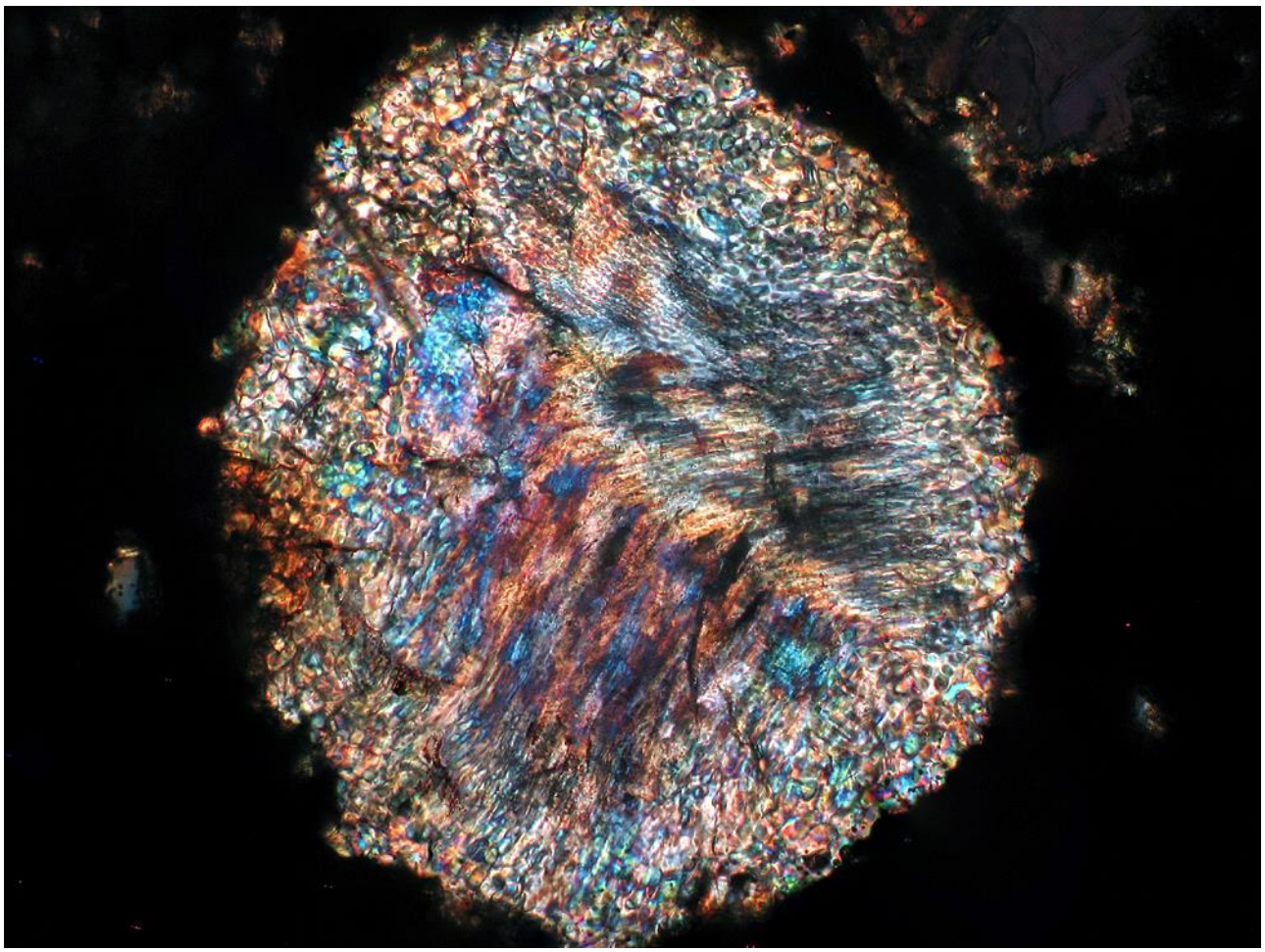
A closer view finds that it has the typical "dusty" appearance of a relict grain.



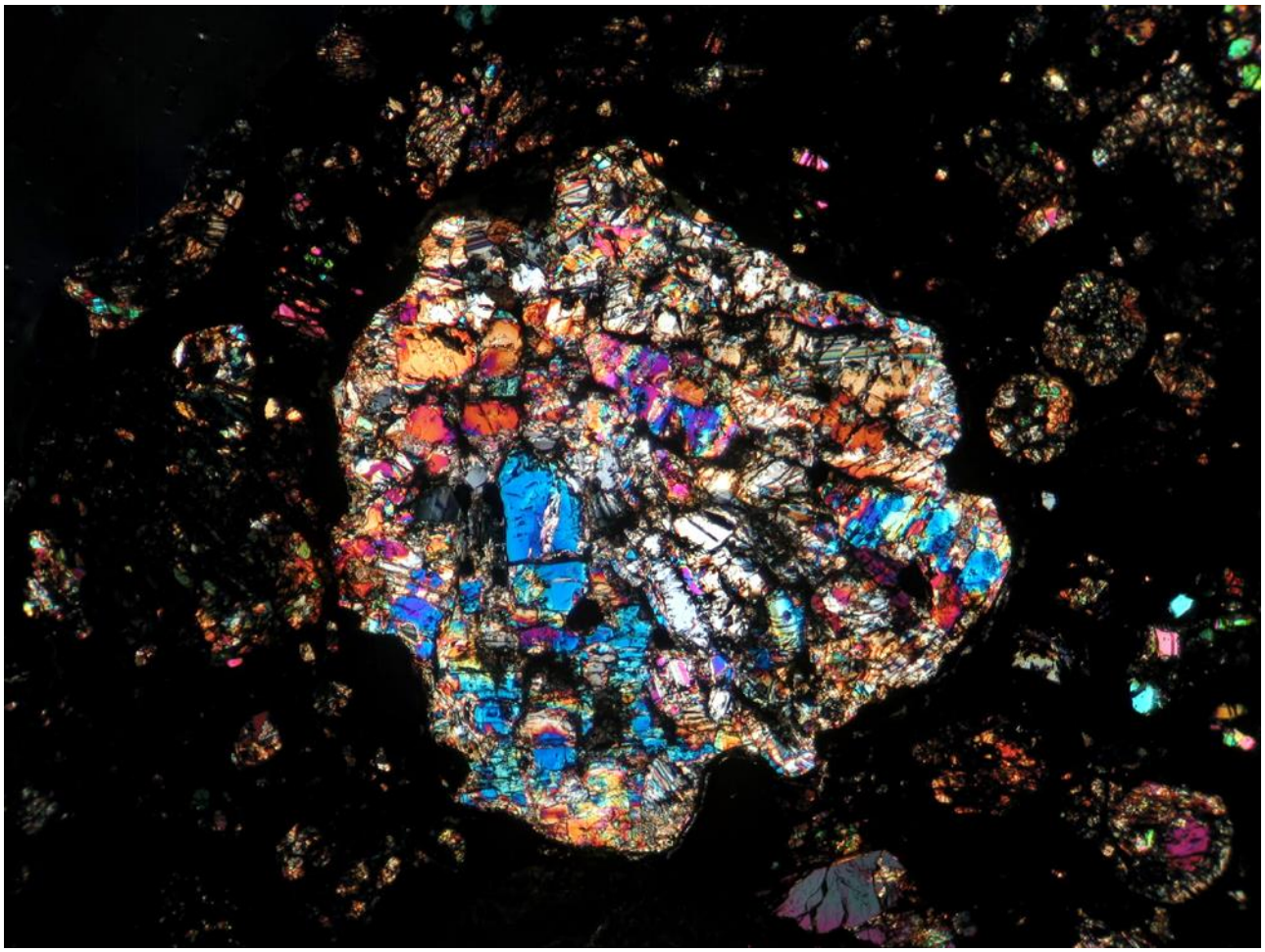
An 8 mm wide field hinting at the variety of chondrule types and sizes. The bright one in the center looks interesting. XPL.



Same chondrule in center of a 3 mm wide view.  XPL.



Chondrule has a fine grained texture.  It is 0.4 mm long.  XPL.



The largest chondrule in this thin section is an irregular 3 mm in diameter.  The vaguely radiating appearance is reinforced by sequential optical extinction between rotating crossed polarizing filters.

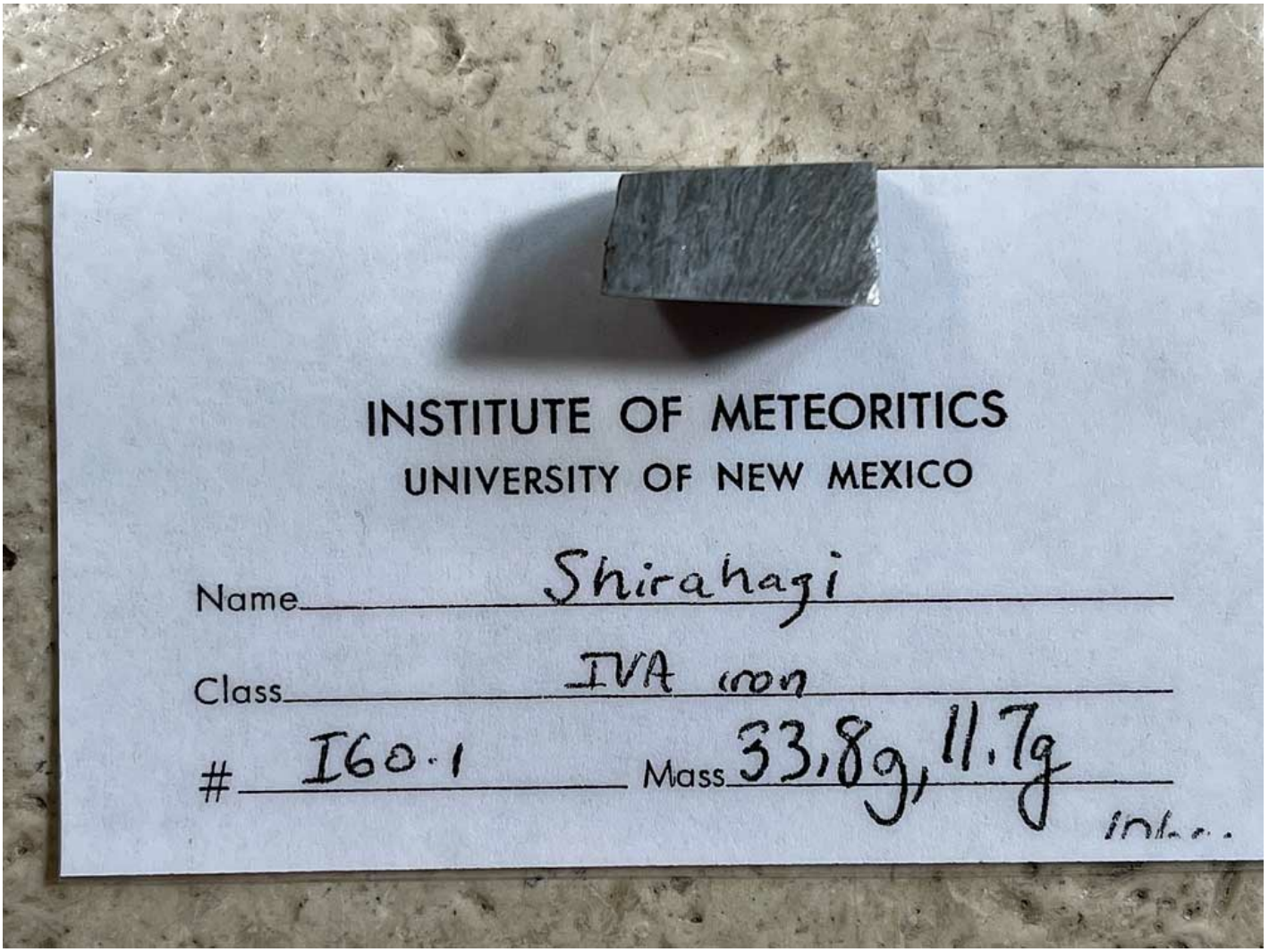
## Fit for Royalty: Shirahagi

Mitch Noda

Like many cultures, the Japanese revere its meteorites. Japan is home to the Nogata meteorite which is the oldest recorded witness fall that occurred over a millennium ago. Nogata, a stony L6, is over six centuries older than Ensisheim. Nogata was witnessed on 19 May 861 A.D. and recovered the following morning by villagers from a hole in the ground. The meteorite has been preserved since its fall in a Shinto shrine at Suga Jinja where the meteorite had fallen. It is publicly seen every five years at the grand shrine festival, when it is carried in a decorated ornate cart at the head of the parade.

Japan is home to another all world hall of fame meteorite – the Shirahagi meteorite. It is my favorite meteorite in my collection due to my Japanese ancestry, and its historic and remarkable story.

The Shirahagi is a fine octahedrite of group IVA iron and is the second largest meteoric iron ever found in Japan. The iron is folded or curled like an ocean wave or the letter “C.” Dr. Sadao Murayama of the National Science Museum in Tokyo thought the Shirahagi iron was probably distorted during its flight thru the atmosphere although Dr. Vagn Buckwald thought it was due to a cosmic shock event. It is a peculiar and interesting meteorite with an extremely distorted Widmanstatten pattern, evidence of a violent cosmic collision.




Etched face of 11.7 gram Shirahagi

Polished face of Shirahagi

There are two versions of where and who found the Shirahagi meteorite. One version is that it was found in April 1890 in the stream of the Kamiichi-gawa river in Shirahai-mura, Toyama prefecture, by a mine worker, Sadajiro Nakamura, and preserved by Issei Kobayashi, a mining engineer, who employed Nakamura. Initially, they did not know what they had, and in 1895, it was discovered to be a meteorite by Kwaijiro Kondo of the Geological Survey of Japan.

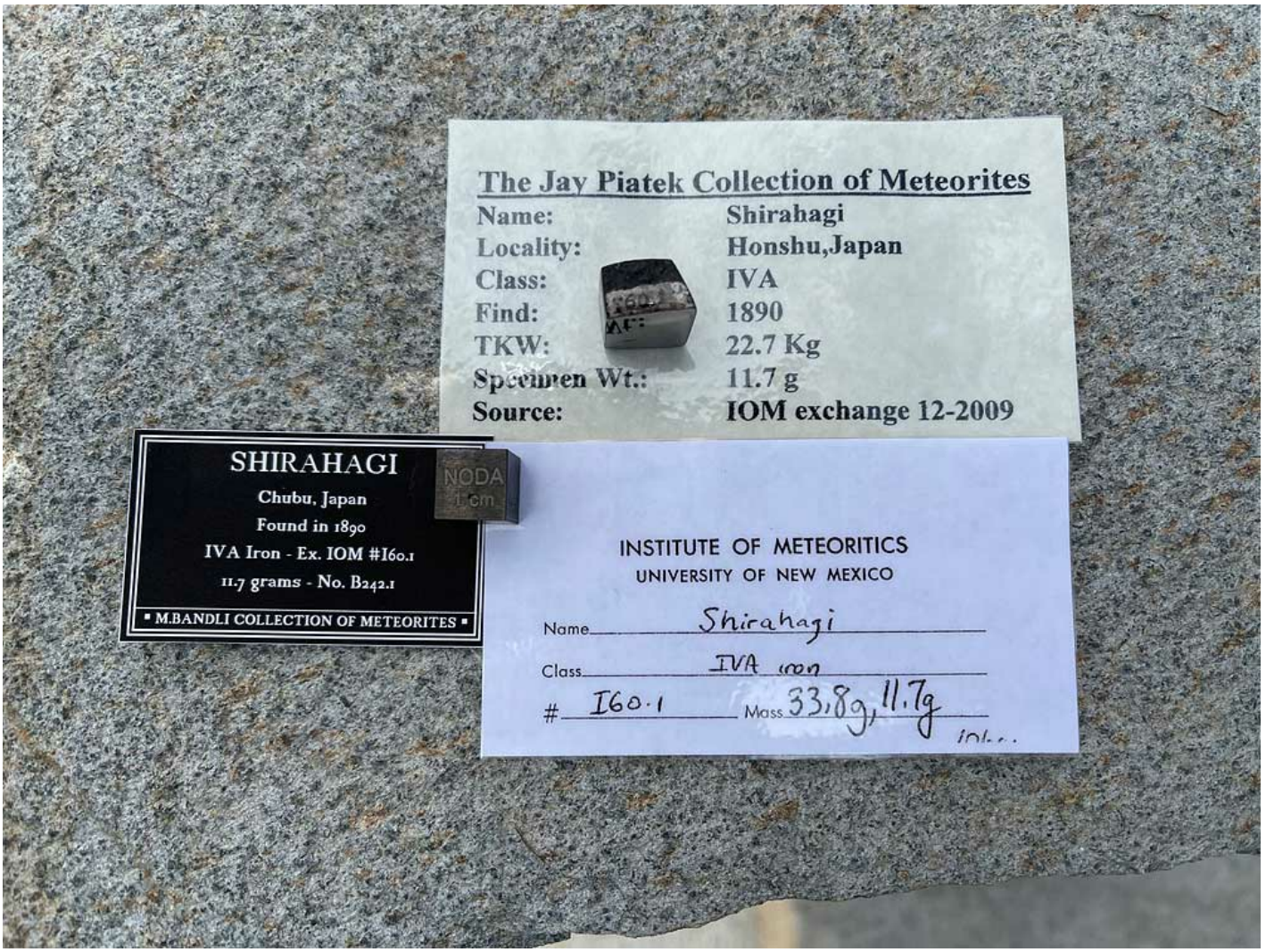
The other version of the story is that in 1890, a farmer was digging for potatoes and came across the unusual iron specimen. Curious as to what it was, the farmer presented it to a few appraisers. Not even the Osaka mint knew what it was. It spent the next several years being used as a weight in the pickling process of vegetables. In 1895, geologists from the Ministry of Agriculture and Commerce determined that it was a meteorite.

The two versions of the story then merge. The 22.7 kg (50 pounds) Shirahagi meteorite was purchased in March 1895, by Enomoto Takeaki, a Samurai, who would go on to play a key role in the creation of Japan's first modern navy and serve as Minister of various departments. Takeaki stayed in Russia as a special envoy, where he was fascinated by the Russian "meteor sword" – James Sowerby's sword made from the meteorite Cape of Good Hope for the Czar Alexander I.

Since Takeaki was a Samurai, he must have been inspired by the "meteor sword." According to the Samurai code or "Bushido" literally "way of the warrior," a Samurai's main sword represented his soul. "Bushido" was an ethical system, rather than a religion. The principles of Bushido emphasized honor, courage, skill in the martial arts, and loyalty to a warrior's master ("Daimyo") above all else. The Samurai usually carried two swords. The "Katana" or long sword (blade length about 100 cm or 40 inches) was mainly used in battle. The second companion sword was either a "Wakisazhi" or short sword (2/3 – 1/2 the length of the "Katana") which was the Samurai's back up sword used for close quarter combat, or a "Tanto" (blade about 8 inches or 21 cm) which was more like a long dagger. The "Katana" was a two handed sword while the "Wakisazhi" and "Tanto" were one handed swords. The scared swords were handed down from

one generation to the next.

Takeaki enlisted the services of master swordsmith, Okayoshi Kunimune, and commissioned the creation of five blades collectively known as “Ryuseito” literally “Comet swords.” Two “Katana” or long swords and three “Tanto” or short swords, were forged from the Shirahagi Meteorite. About four kilograms (8.8 pounds) of Shirahagi iron meteorite was used to create the five blades. The swords were difficult to work with due to higher nickel content, less carbon, more impurities, such as, schreibersite which required higher temperatures during forging, and the blades were comparatively resistant to hardening during quenching. It took three years to create the swords, and they were finally finished in 1898. The blades were made with 70% Shirahagi meteoric iron and 30% “Tamahagane” or iron sand-rich metal used for regular “Katanas.” The blades have a beautiful, and unusual dark swirling similar to a combination of tiger stripes and leopard spots “Hamon” or tempering pattern to them due to the meteoric content. The inner hilt of the swords had been engraved with solid gold inlay reading “Seitetsu,” or “Star Iron.” The remaining main mass (18.2 kg or 40.12 lbs.) was presented to the National Science Museum in Tokyo. The higher quality “Katana” was donated by Enomoto to the crown prince of Japan, who later became Emperor Taisho, who was the 125$^{th}$ Emperor and reigned from 1912 to 1926. The remaining four swords were handed down to Takeaki’s heirs. The other Katana or long Samurai sword is owned by Tokyo University of Agriculture which grew out of an institution Enomoto founded. As for the three “Tanto,” one is housed at the Toyama Science Museum in Toyama city, another was donated by Enomoto’s great-grandson and is in the Ryugu Shrine as a “shrine treasure” in Otaru, on the island of Hokkaido, and the last space sword’s whereabouts are unknown.




Shirahagi with painted University of New Mexico number and UNM, Jay Piatek and Mike Bandli labels

Shirahagi is a historic meteorite with a royal connection and wonderful story. The swords created from the Shirahagi meteorite can also be called “Tentetsutou” or “Sword of Heaven.” I would like to think that I obtained my specimen due to “Kami unmei” or “Devine destiny.”

My special cosmic specimen comes to me from my friends, Mike Bandli and Jay Piatek and has a University of New Mexico pedigree with accompanying UNM label with matching number on the meteorite.

A big thanks to Mike and Jay! Mike's write-up on the Shirahagi meteorite is outstanding and can be found at The Shirahagi Meteorite, Japan (historicmeteorites.com) Many years ago, reading Mike's article introduced me to the historic extraordinary Shirahagi meteorite. I also have a big thank you my friend, Craig Zlimen, who did an outstanding expert job of etching and polishing this rare Shirahagi iron. I want to acknowledge my brother from another mother, Jesse D. Piper who also shares in my love of Japanese meteorites, culture and all things Japanese.


Shirahagi with UNM, Jay Piatek and Mike Bandli labels

**References:**

Wikepedia: Nogata meteorite

The Meteoritical Society – Meteoritical Bulletin Database – Nogata and Shirahagi

Highlights of Astronomy, Volume 16 XXVIIIth IAU General Assembly, August 2012: "The quinquennial grand shrine festival with the Nogata meteorite" Hitoshi Yamaoka

SAO/NASA Astrophysics Data System (ADS) – "The Peculiar Structure of the Shirahagi, Jpana, Siderite" Sadao Murayama, The Tokyo Science Museum, Uyeno Park, Tokyo, Japan, Journal: Meteoritics and Planetary Science, Vol. 1, p. 99-102 (1953)

Japantoday.com – Lifestyle: "An up-close look at one of Japan's five Ryuseito Swords, forged from meteorites" September 26, 2019 by Casey Baseel, SoraNews24.

82nd Annual Meeting of The Meteoritical Society 2019 (LPI Contrib. No. 2157) – RYUSEITO: THE JAPANESE SWORDS MADE FROM SHIRAHAGI IRON METEORITE. M. Komatsu, A. Yamaguchi, M. Ito,

S. Yoneda, T. Saito, T. Ohgane, T. Hayashi, M. Sakamoto, T. Mikouchi, M. Kimura.

Facebook – Samurai history & Culture Japan (July 12, 2017)

The Royal Society Publishing | Notes and Records 2013 Dec. 29 published online 2013 Sep 4 – James Sowerby: meteorites and his meteoritic sword made for the Emperor of Russia, Alexander I, in 1814.

www.Swordsofnorthshire.com/wakizashi-vs-tanto

ThoughtCo. “Bushido: The Ancient Code of the Samurai Warrior” Kallie Szczepanski updated September 6, 2019

Buchwald, Vagn F. (1975) Handbook of Iron Meteorites. University of California Press, Shirahagi, volume 3, p 1115

Meteorite Times Magazine

## Canyon Diablo 373 Grams

Paul Harris

Our Meteorite of the Month is kindly provided by Tucson Meteorites who hosts The Meteorite Picture of the Day.

Canyon Diablo 373 Grams contributed by Paul Swartz, IMCA 5204

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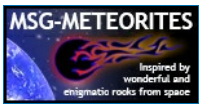

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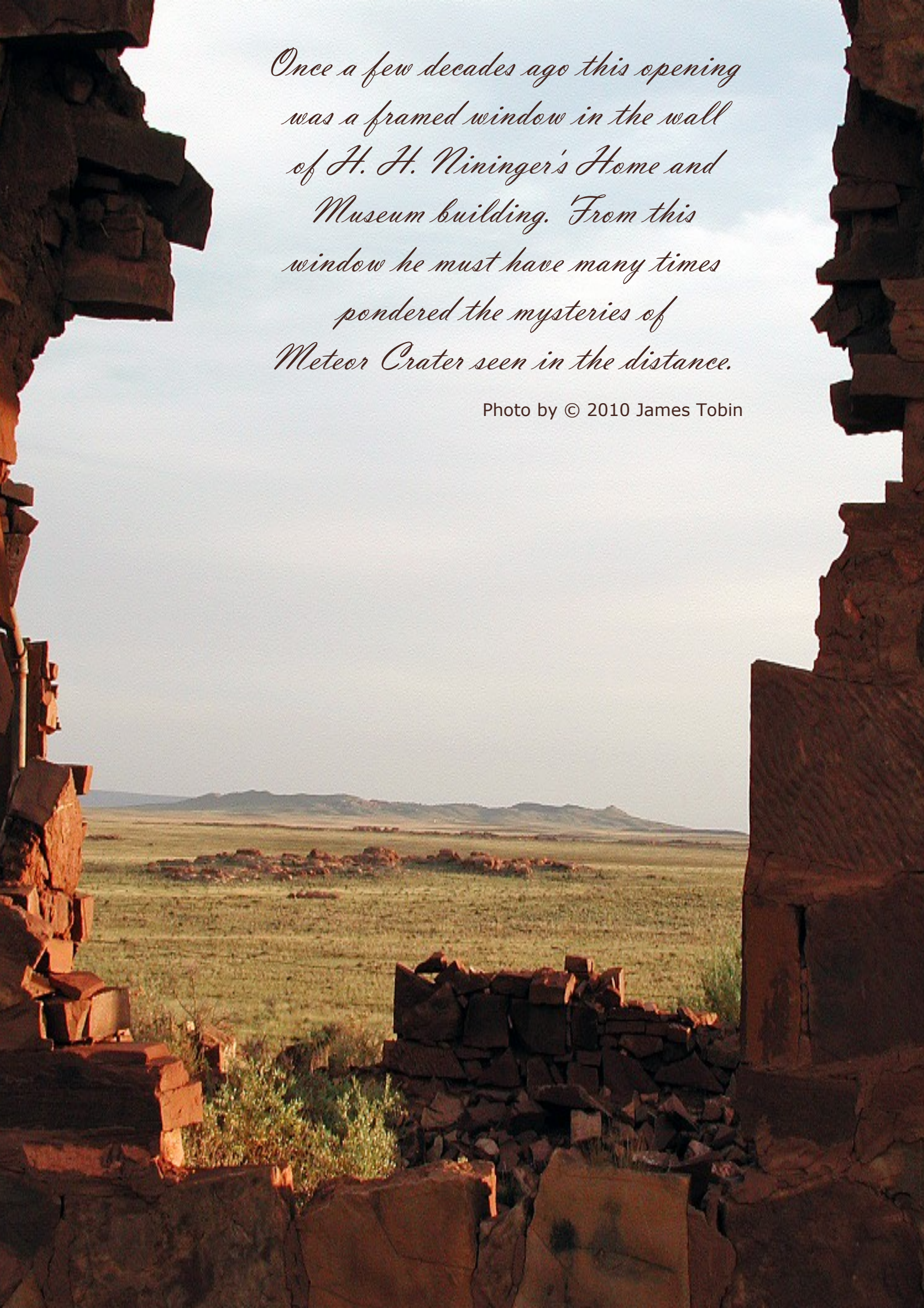

*Once a few decades ago this opening was a framed window in the wall of H. H. Nininger's Home and Museum building. From this window he must have many times pondered the mysteries of Meteor Crater seen in the distance.*