the Mineralogical Record

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January–February 1992
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HOUSTON
MUSEUM SUPPLEMENT INSIDE


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POPULAR MINERALOGY

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John Sampson White

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Mamaroneck, NY

Editing, advertising
Wendell E. Wilson
4631 Paseo Tubutama
Tucson, AZ 85715
602-299-5274
FAX: 602-299-5702

Circulation Manager
Mary Lynn Michela
(Subscriptions, back issues, reprints, book sales, shows)
P.O. Box 35565
Tucson, Arizona 85740
602-297-6709

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Columns

COVER: ACANTHITE after argentite, 10 cm tall, from the Las Chispas mine, Arizpe, Sonora, Mexico. Houston Museum of Natural Science collection; photo by Harold and Erica Van Pelt. See the special supplement in this issue devoted to the Houston Collection.

Guest Editorial:

NEW MINERALS: WHAT COLLECTORS CAN DO TO HELP

Collectors can advance the science of mineralogy in numerous ways. One of these is the finding of new mineral species. Every year a number of new species are described which were first noted by members of the collector community; these are among their many important contributions. Because collectors are in the field more often than research mineralogists, and because they collect and study rare-mineral assemblages, they can play a significant role in the advancement of mineral knowledge. New species, once characterized, in turn enhance collector activities . . . by expanding the universe of mineral species, providing new insight into relationships among the collectible species, generating more understanding, and usually adding a few interesting stories to the verbal *mineralculture*. Thus, the description of new mineral species is stimulating to all concerned. I have already discussed the descriptive process (*Mineralogical Record,* **8**, 341–349) and have addressed the topic of what collectors who think they have found a new mineral might do (*Mineralogical Record,* **6**, 220–221). Now, 15 years later and after having made a few mistakes, I would like to ask collectors to consider some of the problems associated with their finding new minerals.

The interaction between researchers and collectors sometimes carries a bit of tension. In general, scientists want to discover knowledge and get credit for their efforts, publish information for all to have, and put good specimens away in public institutions for posterity; most collectors want to collect and own specimens for personal enjoyment, exhibition, education, and/or investment, among other reasons. The research mineralogist and the collector both seek preservation of samples, albeit in many cases for different reasons. These distinctions, although useful for discussion and generally true, present a restricted and forced dichotomy which has many exceptions; there are some collectors who have scientists' interests foremost, and *vice-versa*.

Sometimes the interests of the research mineralogist and the collector come into conflict and our science suffers. The collector community loses as well. Such loss is often not recognized because it is never seen; what is lost is more published knowledge and/or more species that could have been formally established, along with the other benefits noted in the first paragraph.

Providing Material

It is natural for a collector to want to retain his best specimen and submit other, lesser-quality specimens for identification. If, however, investigation shows that the mineral is unknown and undescribed, and a full investigation is both feasible and warranted, then a good, rich specimen is essential for study. Assuming the full characterization can be completed on the second-best or third-best specimens, the researcher should still be provided an opportunity at least to visually examine the best specimen before publishing the description; in that way, the description will not be short-changed. The analyzed sample(s), however, must be donated to science, to be deposited in a large public museum as the *type* specimen(s). In turn, the collector should receive published recognition for his contributions.

Sometimes, an inferior sample is provided for description, and then, a few weeks following publication, plenty of fine material suddenly becomes available for sale. Such held-back samples may contain significant paragenetic information, and sometimes crystals which would have permitted a better description. The science has lost in a number of ways and, indirectly, the collector community has also. Often, the better quality material would have provided not only a better description, but a more efficient one. When a mineralogist has invested many excess months in very difficult work necessitated by inferior crystals (flawless, near-perfect ones are best for X-ray work), only to find out he was held blind to the best material, his attitude toward collectors in general may suffer. The researcher may be less likely to cooperate with collectors in the future. So, provide the best material you can; you will be a friend of mineralogy.

The Locality

If the locality is known, and if the material is self-collected, the collector should try to show the mineralogist the site of the occurrence in person. Such a visit should be undertaken as soon after the discovery as possible; site relations and special features, to which a geologist may be more sensitive than a collector, may be altered either by nature, by construction, by further mining, or by subsequent collecting. If there is the slightest doubt about the exact locality, or precise site at the locality, the collector should communicate this information fully to the investigator, in writing, with such qualification as he deems appropriate.

If the collector is unwilling to disclose the locality, then he should state this frankly before the material is even examined. Responsible scientists must publish correct and site-specific mineral locality information. If the locality is known simply from specimen labels or word-of-mouth, then that qualifying factor, too, should be communicated.

The Mineral Name

The naming of a new mineral is the responsibility, and privilege, of the senior author of the description. Many minerals have been named in honor of mineral collectors, and *many more* collectors would no doubt be pleased to be honored with a species name. Sometimes, however, it is forgotten that honors of this sort are bestowed, not negotiated, sought, or bought (yes, some try). Unfortunately, the unseemly behavior of a few aggressive members of the collector community has caused some distaste among some mineralogists for the further creation of collector-derived mineral names. Some mineralogists consider the request or even a hint (without perspective) to be in poor taste. The finding of an undescribed new mineral by a collector is not instant justification for naming the mineral for its finder. There are far too many scientists, collectors and others, living and dead, of great accomplishment and repute, who have yet to be so honored.

Most collectors who have had species named in their honor have been surprised; they generally also have long track records of being friends of mineralogy. It is unfortunate that more collectors cannot take basic pleasure in the collective honor that is bestowed on all when one is honored. However, this might be an inevitable condition considering the very personal nature of the honor; it usually employs only *one* person's name.

If a collector wants a possible new species described, he should put it in the hands of a responsible *descriptive* mineralogist without any strings attached (explicit, implicit, hinted or otherwise). If one looks at those in the more responsible, contributory parts of the collector community, one will observe that, *with time,* the real contributors frequently are recognized as such. The collector is assuredly due proper recognition for his contributions and, in general, most mineralogists are generous with such recognition. So, each collector should try to contribute altruistically to science. If rewards or honors happen to come back to him someday, they are best considered an unexpected bonus.

The Mineralogist

Having discussed some areas of interaction where tensions can cause or exacerbate problems, I would be remiss if I did not admit that some of the interactive hassles arise from the mineralogists as well. Part of the problem is that there are many more mineralogists willing to take on an exciting possible new mineral than there are who will see it through and *finish* the task. The excuses and reasons are varied; some are good, some are not. They don't matter much because, for a possible new species, the bottom line is a successful *completion*; "almost" doesn't count. *A species is, or is not.* Assuming suitable and sufficient material is available, all the good intentions in the world don't make a species; only hard work does. A mineralogist might decide not to continue an investigation; this is his right. However, that decision should be promptly communicated to the collector who supplied the material. Those mineralogists who sit roosting on inactive investigations impede science and deserve strong criticism.

So, if a collector is in a situation where a possible new species is sitting dormant with a mineralogist, he shouldn't be too shy about suggesting that he might want to take it to another scientist (this is not a solicitation). The suggestion alone might prompt activity; or taking it to another researcher might give a fresh start to the effort. The science can benefit either way. The problem of stale, non-performing investigations is another where the interests of the collector (in completion) and the sciences (in increased knowledge) can both benefit from a gentle shove. Several precautions are in order. First, new minerals are not described overnight. Some take much time, and so it is important to ascertain whether or not an investigation is truly proceeding. Secondly, one should *never* take a mineral to a new investigator without telling the first one, and the collector should also be sure to tell the new investigator of the prior efforts. Communicate and hold no one blind.

For those who are starting out fresh, I strongly suggest reading "So you think you have found a new mineral" (*Mineralogical Record,* **6**, 220–221). Then pick an investigator carefully after consulting with the more experienced and sophisticated collectors who know professional mineralogists. One might choose to send a zeolite to a mineralogist who specializes in zeolites, or a sulfide to an ore mineralogist, but one should first ascertain that the scientist is a bonafide *descriptive* mineralogist willing to see it through, not just a mineralogist interested in only one or two exciting parts of the process, such as the crystal structure. Lastly, pick one with a track-record for *publishing full descriptive papers,* not just abstracts.

It is sad to say, but some mineralogists just don't finish such tasks; others are skilled at it. Also, the collector might consider picking an energetic researcher who hasn't described too many new minerals; he might be more eager than one who has done a great many, and it spreads the fun around!

The contributions of the collector to this aspect of mineralogy have always been significant, and now they are even more important. Thanks for what you have done, and please continue to help your science grow!

Pete J. Dunn
Department of Mineral Sciences
Smithsonian Institution
Washington, D.C. 20560

notes from the EDITOR

HOUSTON MUSEUM CATALOG

A little over a year ago we published a museum catalog supplement devoted to the mineral collection of the Carnegie Museum of Natural History in Pittsburgh. Now we are pleased to include in this issue a similar bonus showcasing the extraordinary mineral collection of the Houston Museum of Natural Science.

I want to thank curator Joel Bartsch, museum president Truett Latimer, and the rest of the Houston Museum staff and its benefactors for making this gift to our subscribers possible. Many people cannot travel to visit all of the mineral museums they might like, and catalogs such as these help to bring remarkable collections right into the reader's own living room.

The Carnegie and Houston catalogs are quite similar in concept and approach because the two museums have similar philosophies and exhibit goals. These museums focus primarily on aesthetic, high-quality display specimens, presented to the public more or less as naturally formed art objects. At both museums some exhibits are devoted to instruction in the basic scientific concepts in mineralogy, but these are presented as technical background in support of the principal thrust, which is to demonstrate the awe-inspiring beauty of the Mineral Kingdom.

Of course, only a fraction of the total number of specimens on exhibit can be featured in a catalog. I can vouch for the fact that the Houston Museum (and the Carnegie) have a wealth of other exquisite specimens that will make a personal visit highly rewarding.

The arrangement for the publication of these catalogs is quite simple. In exchange for our technical expertise and services as publisher (creating the concept and graphic design, editing and/or writing text, overseeing production, and so on), we ask only for the donation of 9,000 copies to give to our subscribers. The sponsoring institution pays for the actual production expenses (typesetting, paste-up, photography, color separations and printing), and orders a substantial number of additional, separate copies for distribution and sale through the museum. If a large enough overrun is ordered and is ultimately sold at a reasonable mark-up, the entire project can conceivably prove self-supporting for the museum in the long run. More importantly, however, it will have yielded a massive amount of high-quality publicity precisely targeted at the mineral community. The catalog can also serve museum administrators as a "pride piece" to give away to friends and potential benefactors.

The services of the Mineralogical Record are available to other museums as well, and I'm certain that our readers would enjoy receiving additional museum supplements in the future. Catalogs do not necessarily need to follow the format of the Carnegie and Houston supplements. They can be specifically tailored to each museum's strengths and goals; they can be made larger or smaller, can be individually designed for uniqueness, and can be sized to conform with larger or smaller budgets. Interested curators and administrators are invited to contact the editorial office for price estimates and further details.

CURATORIAL NOTICE

Jeffrey E. Post has been appointed Curator of the National Gem and Mineral Collection of the National Museum of Natural History, Smithsonian Institution. He succeeds Mr. John S. White, who retired in July of this year. Dr. Post joined the Department of Mineral Sciences as a research geologist in 1984 and has served as Chairman of that department since 1989. A native of Wisconsin, he received B.S. degrees in geology and chemistry from the University of Wisconsin–Platteville and a Ph.D. in geochemistry from Arizona State University. He also served as a postdoctoral research fellow in the Department of Geological Sciences at Harvard University from 1982 to 1984. His research interests include X-ray diffraction and electron microscope studies of oxide and clay minerals. He has been an avid mineral collector and is strongly committed to the increased development of public programs about minerals and geology.

COLLECTING REGULATIONS

Field collectors need to be aware of the legal restrictions that apply to collecting on state lands. Because regulations vary from state to state, it can be difficult for travelers to know where they stand. However, the American Museum of Natural History has recently published an up-to-date survey of state collecting regulations based on existing legislation, current reports issued by regulatory agencies, and upcoming legislation liable to be enacted soon. The 1991 report, written by Robert M. West (Director of the Cranbrook Institute of Science), describes the regulations state-by-state, giving the names and mailing addresses of the various state agencies. Permits required, areas open to collecting, tools allowed, discovery disclosures required, and restrictions on the use and transport of collected material are all covered. The report is available for $5 from Special Publications, American Museum of Natural History, Central Park West at 79th Street, New York, NY 10024.

McGUINNESS MEMORIAL

The *A. L. McGuinness Memorial Fund* has been established for the purpose of purchasing mineral specimens to be donated in his name to the California Academy of Sciences in San Francisco. Friends and admirers of Al who would like to help perpetuate his memory in this way are invited to send their contributions to Cliff Krueger (attorney and mineral collector, who has agreed to serve as comptroller of the fund), 625 Market Street, Suite 802, San Francisco, CA 94105. Checks should be made payable to *Clifford Krueger*; contributions are tax-deductible, and all will be acknowledged. Correspondence and questions regarding the fund may be addressed to Charles I. Trantham, 324 W. 41st Avenue, San Mateo, CA 94403 (415-345-6228).

HARDING PEGMATITE CATALOG

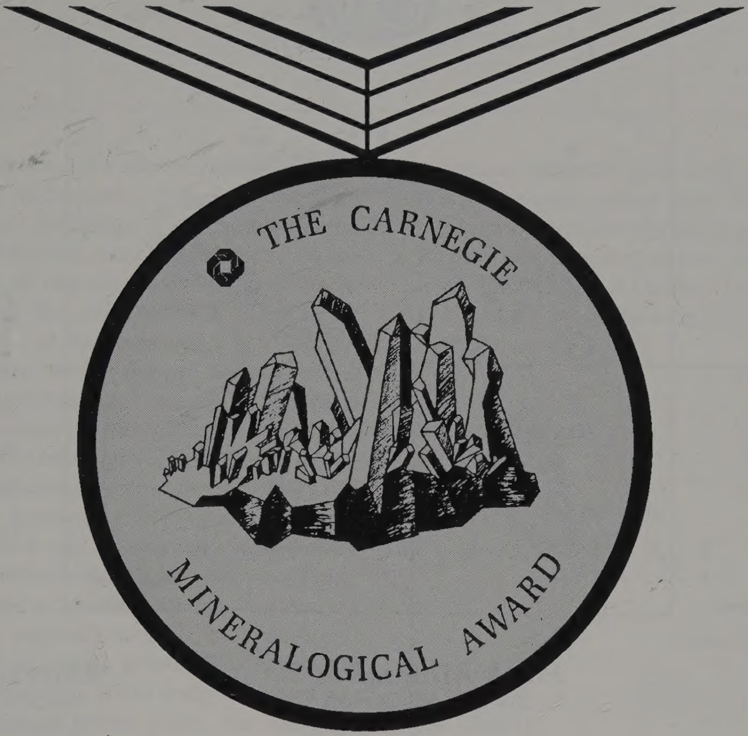
The University of New Mexico Geology Museum is preparing a *catalog of specimens and archival material* related to the Harding pegmatite in north-central New Mexico. This well-known collecting locality was donated to the university by Arthur Montgomery in 1978. The museum's collections include suites of samples from specific zones within the pegmatite; a variety of analytical data have been obtained for many of the specimens. The catalog will also contain listings of available archival material including geological maps, claim documents, core logs, historic photographs and slides, and a bibliography of published papers and unpublished theses. Short articles will describe the history, geologic setting and mineralogy of the mine site. The Harding mine catalog will provide researchers and collectors with a unique guide to the geological and historical record that has been preserved by the University of New Mexico.

To make the book as complete as possible the museum is soliciting bibliographic citations on the Harding mine and information about other collections of Harding mine specimens. The museum will also welcome the opportunity to acquire high-quality, precisely located specimens from the mine. Interested persons should send helpful information and/or inquiries to: Dr. Gary A. Smith, Senior Research Associate and Curator, Department of Geology, University of New Mexico, Albuquerque, NM 87131; (505) 277-2348.

ERRATA

The footnote to last issue's *Guest Editorial* by Bill Smith erroneously attributed the remark (about FM having failed in its mission) to Bill; the statement was actually made by Arthur Montgomery as part of his letter.

Honoring the late *Paul E. Desautels* recipient of the **1990 Carnegie Mineralogical Award!**



The Carnegie Mineralogical Award was established in 1987 to recognize outstanding contributions which "promote mineralogical preservation, conservation and education, ideals embodied in the Carnegie Museum's *Hillman Hall of Gems and Minerals*. The Award is open to individuals, groups, organizations, or institutions—thus private mineral enthusiasts, collectors, educators, curators, mineral groups or societies, as well as museums and universities, are eligible." The Award carries with it a $1500 cash prize, a certificate of award and a cast bronze medallion that will be awarded each year during the main Tucson Show. The *Mineral Museums Advisory Council* administers the Award and oversees the selection process.

Please plan to attend the presentation of the **1991 Carnegie Mineralogical Award** during the *T.G.M.S. Awards Ceremony,* 9:00 p.m. Saturday evening, February 15th, 1992, at the Tucson Convention Center.

Nominations for the **1992 Carnegie Mineralogical Award** will be accepted until December 31, 1992. If you have a candidate for the Award, please send your nomination to the address below. An official form will be sent to you by return mail. Thank You!

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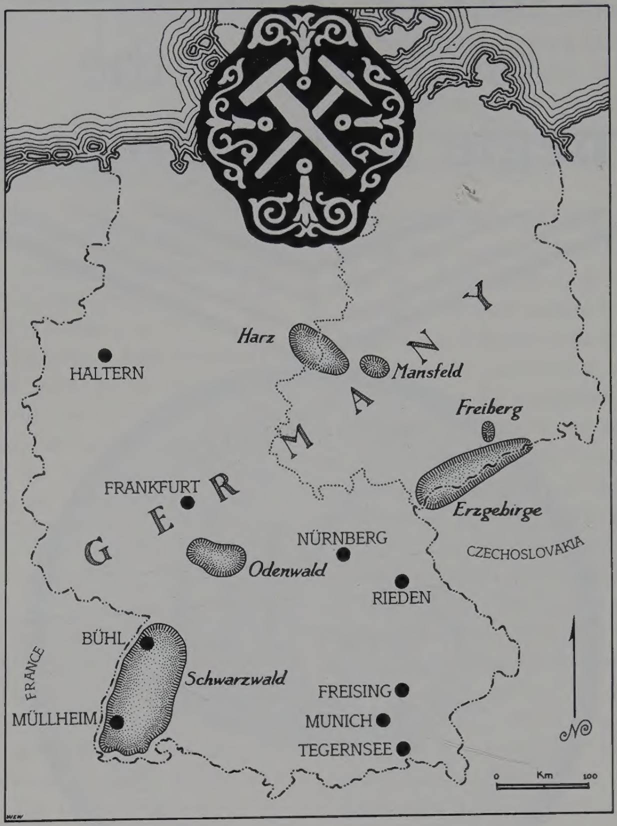

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ANATOMY OF A MINERAL SALE: THE DOHRMANN COLLECTION

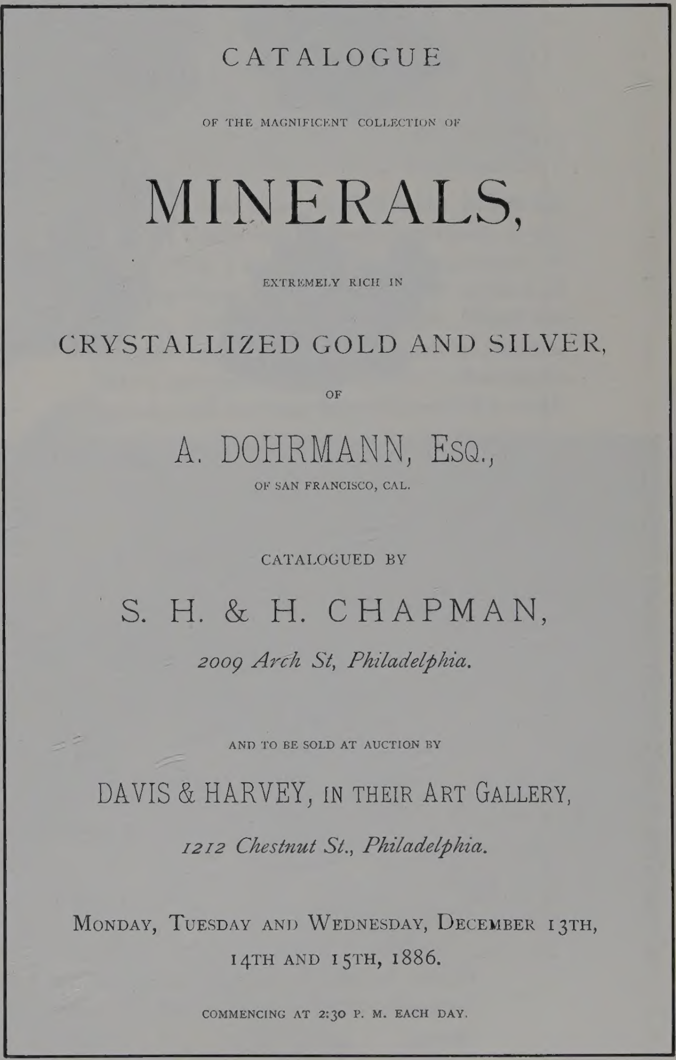
Lawrence H. Conklin
2 West 46th Street
New York, New York 10036

One of the few significant auction sales of mineral specimens to take place in America occurred on December 13th, 14th and 15th, 1886, at the Davis & Harvey Art Gallery at 1212 Chestnut Street, Philadelphia, Pennsylvania. It was catalogued and conducted by the prestigious and venerable firm of rare coin auctioneers, S. & H. Chapman,[1] also of Philadelphia. The collection was listed as the property of "A. Dohrmann, Esq., of San Francisco, Cal.," and for the time being, at least, except for the fact that an "Important Coin Collection," the property of "A. Dohrmann," was sold at auction in New York City by W. Elliot Woodward, from March 6th through the 11th, 1882, nothing has been uncovered about Mr. Dohrmann himself.

I had long known of this Dohrmann sale, and over the years two copies of the sale catalogue had passed through my hands. But what made me consider writing about it was my learning, several years ago, from George Kolbe[2] of the existence of the *bid book* of this sale, a very rare survival. For those not acquainted with the term, the bid book is that copy of the catalogue used and retained by the auctioneers, and which has inscribed within its pages, among other things, the bids that are left by absentee bidders, the prices realized by each lot, the auctioneer's estimates, the reserve prices, if any, and, most importantly, *the names of the successful bidders*. The thought of all this early mineral collecting information in one place was very exciting indeed. George had already sold the book when I heard about it, but he did promise that he would ask the new owner to consider my request for access to the information it contained. Happily, the present owner of this treasure, Armand Champa of Louisville, Kentucky (owner of the finest library on American numismatics ever assembled), telephoned me several months ago and then later, most generously, sent me a complete photocopy of it, the high points of which I share with you here.

Many well known mineral collectors and dealers of the period are included in the list of purchasers, such as *Foote* (Albert E. Foote, M.D., 1846–1915), *Jefferis* (William Walter Jefferis, 1820–1906), *Roebling* (Washington A. Roebling, 1837–1926), *English* (George Letchworth English, 1864–1944), *Kunz* (George Frederick Kunz, 1856–1932), *Vaux* (George Vaux, Jr., 1863–1927) and the German dealer B. Sturtz of Bonn.

Conspicuous by his absence, considering the fact that this sale was held in his home town, was the greatest of all mineral collectors, Clarence S. Bement, whose magnificient collection was given to the American Museum of Natural History by J. Pierpont Morgan in 1900. It is all the more curious when one remembers that the Bement collection was particularly weak in golds, especially those of American origin. Louis Pope Gratacap, in the chapter on the Bement Collection in his book *A Popular Guide to Minerals* (New York, 1912), in which he discusses the outstanding individual specimens in the collection,



CATALOGUE

OF THE MAGNIFICENT COLLECTION OF

MINERALS,

EXTREMELY RICH IN

CRYSTALLIZED GOLD AND SILVER,

OF

A. DOHRMANN, ESQ.,

OF SAN FRANCISCO, CAL.

CATALOGUED BY

S. H. & H. CHAPMAN,

2009 Arch St, Philadelphia.

AND TO BE SOLD AT AUCTION BY

DAVIS & HARVEY, IN THEIR ART GALLERY,

1212 Chestnut St., Philadelphia.

MONDAY, TUESDAY AND WEDNESDAY, DECEMBER 13TH,
14TH AND 15TH, 1886.

COMMENCING AT 2:30 P. M. EACH DAY.

***Figure 1*. Title page of the Dohrmann auction catalogue (1886). (Mineralogical Record Library)**

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[1] It was the Chapman Brothers who auctioned Clarence Bement's superb coin collections early in the twentieth century.

[2] George Frederick Kolbe, P.O. Drawer 3100, Crestline, California 92325, is the preeminent purveyor of antiquarian numismatic literature, and has the writer's thanks for information on Mr. Dohrmann.

Figure 2. **Plate I from the Dohrmann auction catalogue (1886), showing California gold specimens:**

- **(35) Tuolumne County; 3.18 cm**
- **(36) Tuolumne County; 2.54 cm, 1.9 cm**
- **(39) Seaton mine, Amador County; 12.07 cm**
- **(45) (no locality given); 2.54 cm**
- **(49) near Placerville, El Dorado County; 1.5 cm**
- **(55) Grit mine, El Dorado County; 8.26 cm**
- **(60) Grit mine, El Dorado County; 4.76 cm**
- **(61) Grit mine, El Dorado County; 4.29 cm**
- **(62) Grit mine, El Dorado County; 2.22 cm**
- **(63) Grit mine, El Dorado County; 2.54 cm**


WEW

Figure 3. Gold from the Grit mine, El Dorado County, California: shown on the facing page as no. 60 on Plate I of the Dohrmann catalogue. Originally purchased by the American Museum of Natural History, it was traded a century later to William Larson.


WEW

Figure 4. Gold from the Grit mine, El Dorado County, California: the same specimen as no. 61 on Plate I of the Dohrmann catalogue. It was purchased at the Dohrmann auction in 1886 by Georges de la Bouglise. When the Bouglise collection was auctioned in Paris in 1911 it was purchased by Albert C. Burrage of Boston, and was later bequeathed to Harvard.

WEW

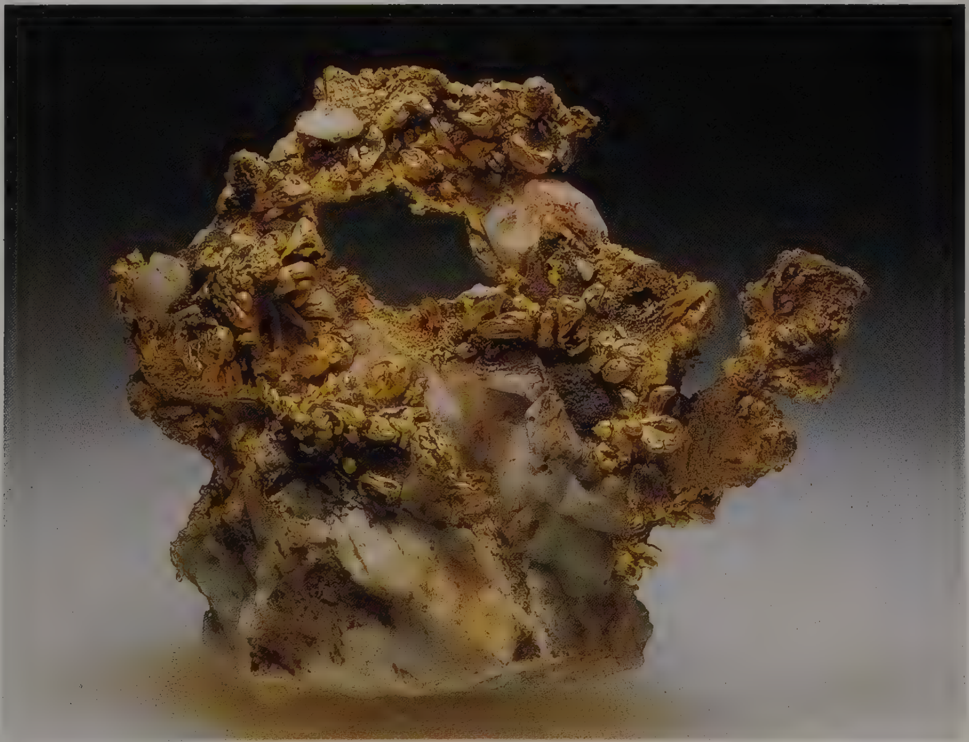

Figure 5. The Grit mine gold specimen, 8.26 cm, shown as no. 55 on Plate I of the Dohrmann catalogue, and also shown on the cover of the Bouglise auction catalogue (1911). It was purchased by Albert C. Burrage and bequeathed to Harvard in 1948.

did not mention even a single noteworthy specimen of gold!

Many unfamiliar names are also recorded in the bid book, sometimes in abbreviated form, as purchasers of mineral specimens, and they are listed here in the hope that some reader can shed further light on them. They are: Beadle, Becket, Bruce, Chapman (one of the Chapman brothers?), Day, Decker, Drowne, Esser, Frick, Gee, Hall, Harvey, Laws, Lowe, McCole, McFeb., Magee, Morton, Noble, Osborn, Pastor, and Sheldon.

Surprisingly, George Kunz bought very little for Tiffany & Co., most notably a specimen of turquoise for one dollar and a piece of coal for fifteen cents. Perhaps it was considered poor form, in those days, to bid against one's clients. The American Museum of Natural History, on the other hand, acquitted itself most respectably through the efforts of its Chairman of the Department of Geology, Robert Parr Whitfield (1828–1910), whose tenure at the museum lasted from 1877 to 1909. Whitfield purchased "Lot 11. Gold. Thick sheet with small crystals on large surface of Quartz crystals. 40 x 72 [sixteenths of an inch for a total of 6.35 x 11.43 cm]. Exceedingly fine, rare and beautiful. Near Byrd's Valley, Placer Co. [California.] See Plate II." Whitfield got it for the sum of $25 against an estimate of $90 to $100 so, presumably, it was a bargain. He also purchased other golds—Lot 38 from the Grit mine [Spanish Dry Diggins] for $23 against an estimate of $50–$75; Lot 59 for $18, estimate $35–50; Lot 60, also from the Grit mine for $162.50 against an estimate of $100–150; Lot 62, same mine, for $18 against an estimate of $25–40 and finally, a gold nugget of 627 grains (approximately 1.25 oz. Troy) from the Gravel mine in Oregon for $30 against an estimate of $35–50. He also purchased five silver specimens for a total of $160. The grand total spent, $469.50, was a considerable sum for the year 1886.[3]

Dohrmann's suite of gold specimens was by far the best part of his collection, and the single largest purchaser of these golds is listed simply as "Bouglise." This refers to Georges de La Bouglise, a French mining engineer, after whom the mineral "bouglisite" was named in 1892 by his associate, Edouard Cumengé (1828–1902), who himself had been previously honored with the naming of "cumengeite." Bouglisite was found at Boleo in Baja California, Mexico (the same locality that produced the cumengeite), but was discredited by the mineral-chemist Frederick A. Genth only one year later, in 1893, as being merely a mixture of anglesite and gypsum.

After his death, Bouglise's considerable collection of gold specimens was offered for sale at public auction on December 14, 1911, by the Parisian mineral dealer Alexandre Stuer, and it was purchased *in toto* by Albert C. Burrage of Boston, Massachusetts. The collection subsequently found its way into the Harvard Mineralogical Museum in 1948 as a bequest of Burrage, who was a member of the Harvard class of 1883. The treasure remains there to this day.

One lovely specimen whose history can be traced quite accurately, is number 60 of Plate I of the Dohrmann catalogue. It was bought by Whitfield for the American Museum of Natural History and was exchanged out of the collection approximately 100 years later. It is in a private collection today. Harvard, of course, can identify several Dohrmann specimens within its vast collection of golds. Number 61 on Plate I of Dohrmann especially stands out. Other gold specimens now in Harvard's collection are Dohrmann numbers 29, 49, 54 and 55, with number 55 occupying the place of honor on the cover of the Bouglise auction catalogue.

In this "bid book," inscribed at the rear, is some very interesting information, presumably written by one of the Chapmans, that relates to the economics of the sale. The gross receipts were $2870. The Chapmans charged a flat 25% for handling the sale, printing the catalogue, mailing it, etc., which amounted to $717.50. *Their* expenses (which included a fee of 5% of the gross or $143.50 to the auctioneer) amounted to $418.33. The largest single expense, $219.83, was for the production of the catalogue, and the Chapman's net profits amounted to $299.27. There is an entry on the plus side of this accounting of $20 for sales of the catalogue, and if the listed price of the catalogue of $1 is correct, then only 20 catalogues were sold and their rarity today is easy to understand; but it should be remembered that auctioneers distribute free catalogues (sometimes without plates) to regular customers and to those whom they believe

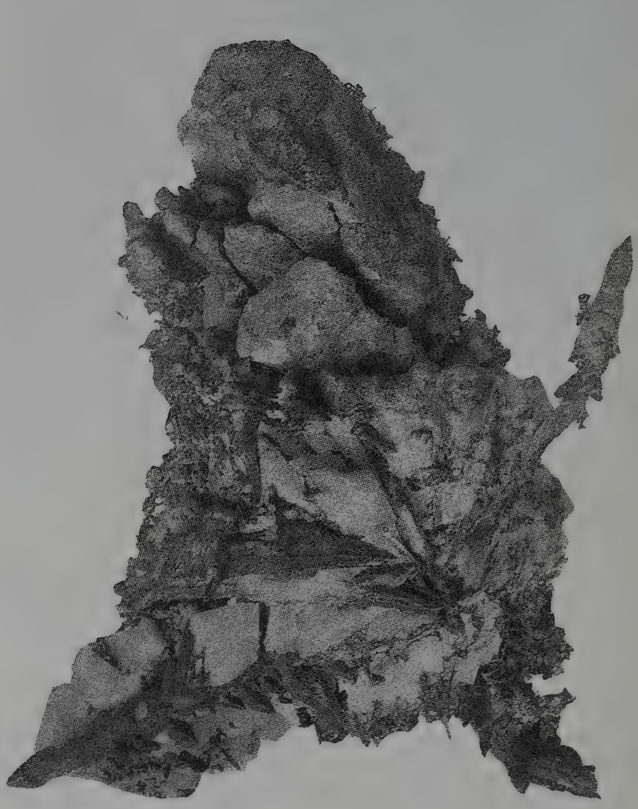

Figure 6. **Silver crystals in calcite, 9.5 cm, from Batopilas, Mexico. The Dohrmann catalogue describes it as "One of the gems of the collection."**

Figure 7. **Wire silver, 4.29 cm, one of 16 silver specimens from Mineral Park, Arizona.**

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[3] According to American Museum of Natural History records, Whitfield took advantage of this trip to Philadelphia to visit the shop of Dr. Albert E. Foote on December 14th, to spend $64.80 on five mineral specimens.

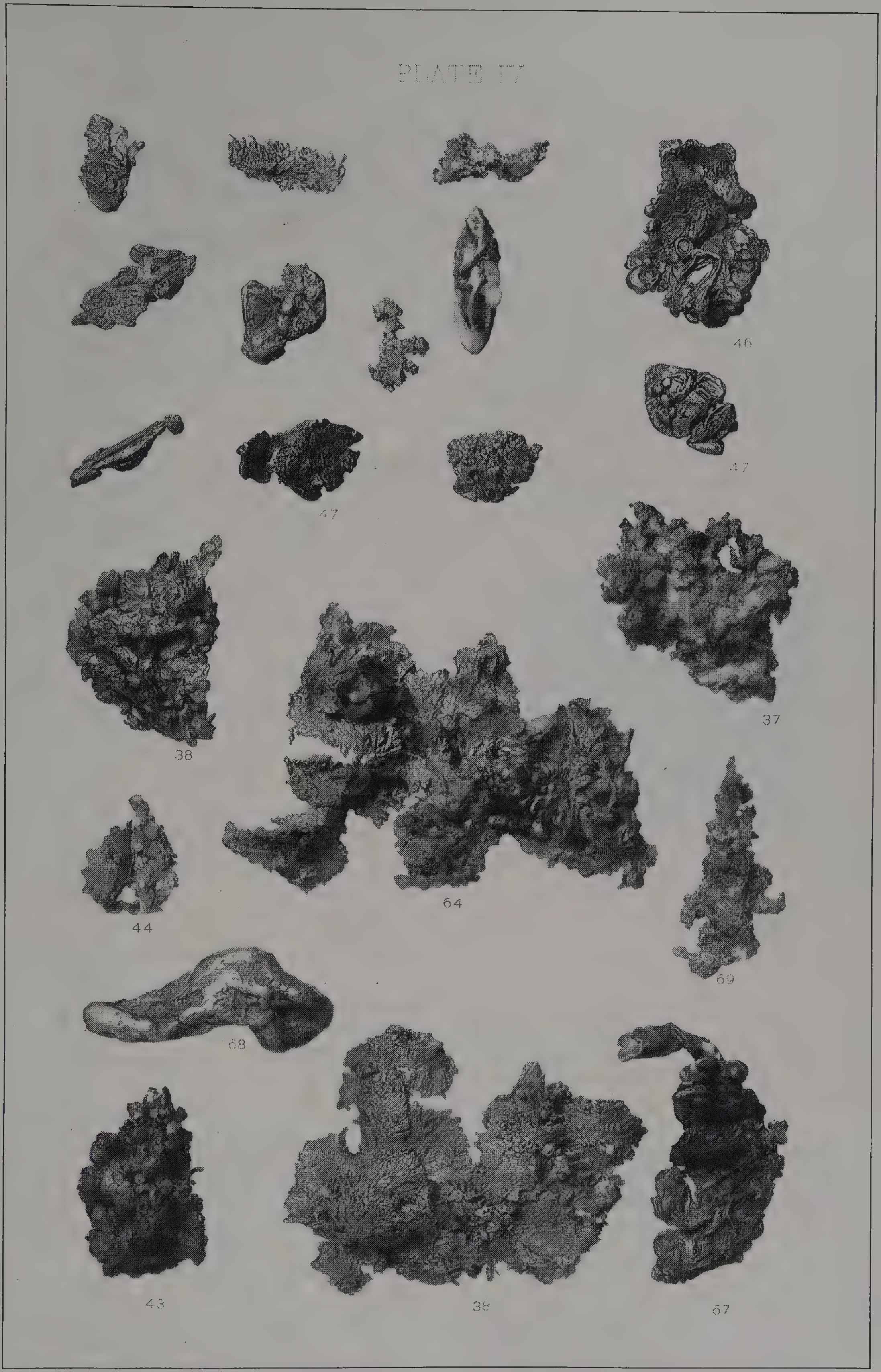
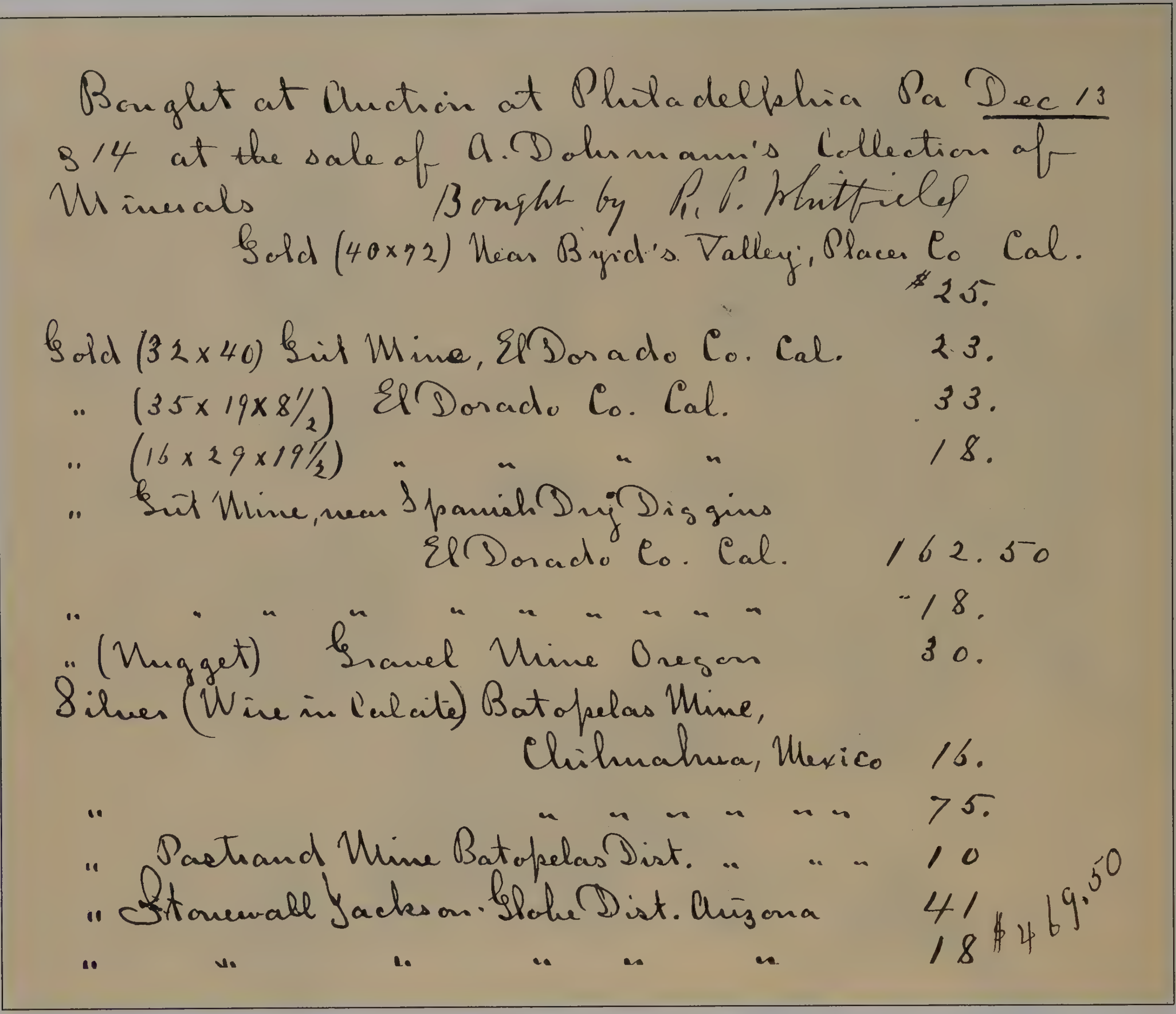


Figure 8. **Plate IV from the Dohrmann auction catalogue (1886) showing mostly California gold specimens:**

- **(37) Grit mine, El Dorado County; 3.18 cm**
- **(38) Grit mine, El Dorado County; 6.35 cm**
- **(43) El Dorado County; 3.18 cm**
- **(44) El Dorado County; 2.86 cm**
- **(46) Byrd's Valley, Placer County; 3.81 cm**
- **(47) near Forrest Hill, Placer County; 2.54 cm**
- **(64) Grit mine, El Dorado County; 7.62 cm**
- **(67) Butte County; 4.45 cm**
- **(68) Gravel mine, Oregon; 4.45 cm**
- **(69) Colorado; 3.81 cm**



Bought at Auction at Philadelphia Pa Dec 13
8/4 at the sale of A. Dohrmann's Collection of
Minerals Bought by R. P. Whitfield

Gold (40×72) Near Byrd's Valley, Placer Co Cal.	$25.
Gold (32×40) Gut Mine, El Dorado Co. Cal.	23.
" (35×19×8½) El Dorado Co. Cal.	33.
" (16×29×19½) " " " "	18.
" Gut Mine, near Spanish Dry Diggins El Dorado Co. Cal.	162.50
" " " " " " " " " " "	18.
" (Nugget) Gravel Mine Oregon	30.
Silver (Wire in Calcite) Batopelas Mine, Chihuahua, Mexico	16.
" " " " " " " "	75.
" Pastrand Mine Batopelas Dist. " " "	10
" Stonewall Jackson. Globe Dist. Arizona	41
" " " " " "	18
	$469.50

Figure 9. **A page from the American Museum of Natural History accession ledger for 1886 showing Dohrmann specimens purchased (courtesy of Joseph Peters).**

this 56-page catalog is more in line with the statement in the preface that 100 copies had been prepared and offered for sale "at cost," implying that the total production cost for the catalog was about $100. One hundred is therefore the maximum number of copies that could have been distributed; the actual number is probably less, the remainders having been discarded. There is also one entry for an advertisement in the Min.(ing) J.(ournal) of $6.

The Dohrmann collection consisted of 1,687 mineral specimens, including 372 golds and 212 silvers. There were also 105 gemstones, 98 fossils and nine Indian stone implements.

As mentioned, nothing certain is known about Dohrmann himself although he must have been a long-time resident of the American West, because his collection was largely composed of Western minerals. His gold specimens were almost entirely Californian, from many different mines and prospects (see Table 1). His silvers included over a hundred specimens from the Batopilas district, Chihuahua, Mexico, 73 of which were specifically identified as having come from the Pastrana mine. Other silver localities represented include the Stonewall Jackson, McCracken, Mineral Park and Silver King mines in Arizona (56 specimens), Silver Islet in Canada (5 specimens), the Bell mine in the Butte district, Montana (1 specimen), and the Gould & Curry mine in Virginia City, Nevada (2 specimens).

Other specimens of note include a 656-gram slab of the Shingle Springs, California, iron meteorite, discovered in 1870; hessite crystals, native antimony and tellurium specimens from Hungary; fine polybasite crystals, silver and octahedral crystals of argentite from Mineral Park, Arizona; cinnabar crystals from the New Almaden mine, California; crystalline proustite, pyrargyrite and miargyrite from Batopilas; miargyrite, stephanite, pyrargyrite and silver from the Tuscarora mine, Elko County, Nevada; many polybasite crystal specimens from Virginia City, Nevada; no less than 174 specimens of chlorargyrite from various Arizona, California and Nevada mines; and a number of wulfenite specimens from the Red Cloud mine (listed as "Yuma County") in Arizona.

Table 1. **Specific gold localities represented in the Dohrmann collection (number of specimens shown in parentheses).**

Arizona Territory
- Dos Cabezas (5)
- Black Warrior mine (1)

California
- Empire mine, Grass Valley, Nevada Co. (4)
- Massachusetts Hill quartz mine, Grass Valley, Nevada Co. (6)
- Mamaluke Hill quartz mine, nr. Georgetown, El Dorado Co. (1)
- Byrd's Valley, Placer Co. (3)
- Cedarbury mine, nr. Spanish Dry Diggins, El Dorado Co. (2)
- Cornish mine, nr. New City (1)
- Amador mine, Amador Co. (3)
- Oaks and Reese quartz mine, Mariposa Co. (4)
- U.S. Grant mine, Calaveras Co. (2)
- Blue Ledge mine, nr. Placerville, El Dorado Co. (1)
- Jackass Gulch, Calaveras Co. (1)
- Williams quartz mine, Mariposa Co. (2)
- Cedarburg mine, El Dorado Co. (2)
- Grit mine, El Dorado Co. (8)
- Seaton mine, Amador Co. (1)
- Diamond Creek, Nevada Co. (1)
- Ford and McDonald mine, Grass Valley (2)
- Forrest Hill, Placer Co. (2)
- Placerville, El Dorado Co. (21)
- IXL mine, Calaveras Co. (1)
- Coloma, El Dorado Co. (3)
- Ophir, Place Co. (7)
- Sutter, Amador Co. (10)
- Black's mine nr. Coulterville, Mariposa Co. (2)
- Enterprise mine, nr. Meadow Lake, Nevada Co. (6)
- Bodie, Mono Co. (4)
- Mormon Bar, El Dorado Co. (1)
- Ramon quartz mine, Calaveras Co. (1)
- Mosquito Gulch, Calaveras Co. (1)
- St. P. mine, Placer Co. (3)
- Empire Flat, Colorado River (1)
- Gold Run, Placer Co. (12)
- Scott River, Siskiyou Co. (1)
- Pilot Hill, El Dorado Co. (3)
- Dry Town, Amador Co. (4)

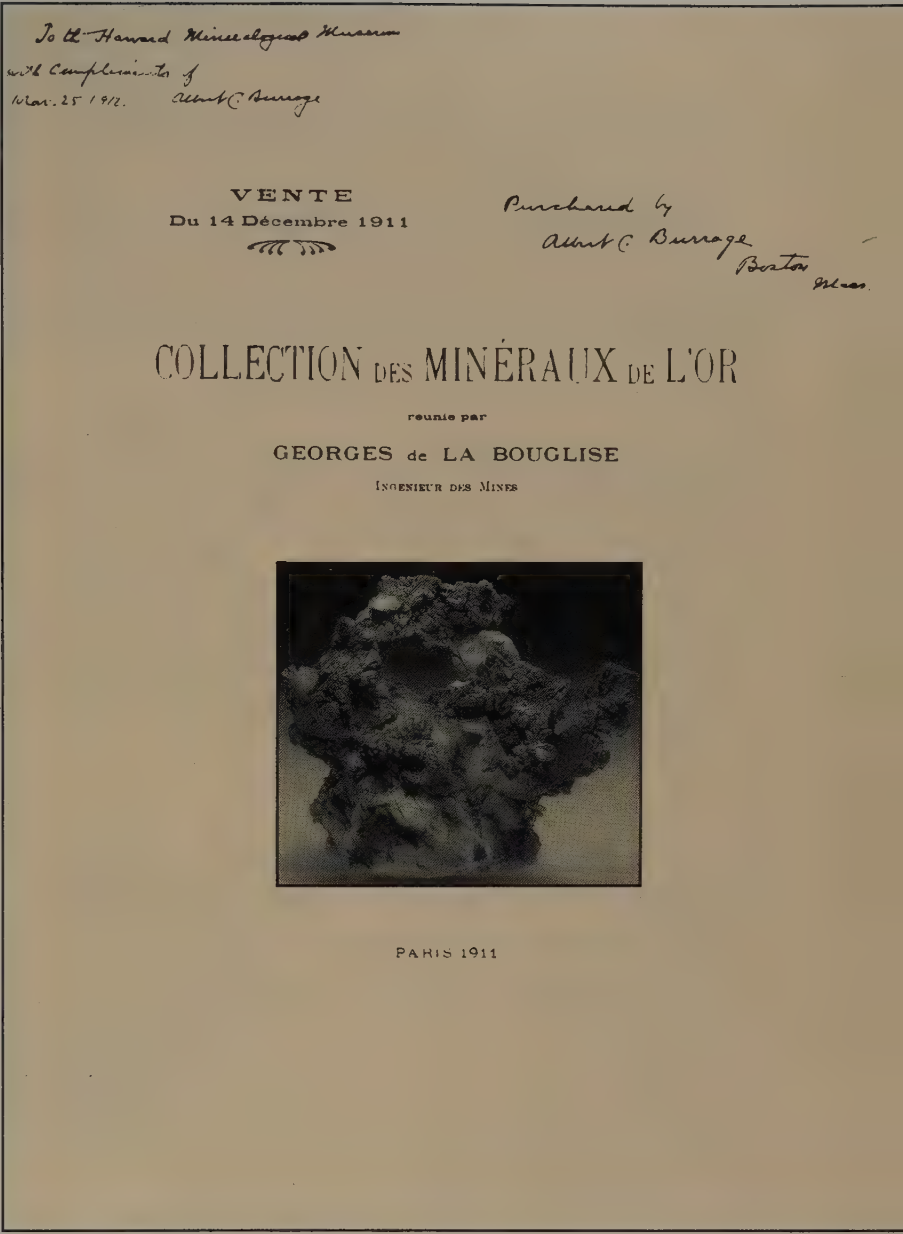
Colorado
- Bassic mine (1)
- Central City, Gilpin Co. (1)
- Leadville (1)

Nevada
- Herbert & Sheald mine, nr. Silver City (1)
- Pratt's mine, 46 miles S.E. of Carson City (1)
- Grand Prize mine, Tuscarora, Elko Co. (1)
- Virginia City (1)
- Comstock Lode (1)
- Silver City (1)

Oregon
- Gravel mine (1)

Wyoming Territory
- Prospect mine (7)
- Cock Robin mine, Saline group (10)

Also specimens from Alaska, British Columbia, Idaho, the Black Hills in South Dakota, and Mexico (exact localities unspecified).



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Albert C Burrage
Boston
Mass.

COLLECTION DES MINÉRAUX DE L'OR
reunie par
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INGENIEUR DES MINES

PARIS 1911

***Figure 10.* Cover of the Bouglise auction catalogue (1911), showing the Grit mine gold pictured as no. 55 on Plate I of the Dohrmann catalogue. (Courtesy of the Harvard Mineralogical Museum)**

With the mineral specimen market and dealerships as limited in development as they were in 1880's California, Nevada and Arizona Territory, one can speculate that Dohrmann may have been a mining engineer or consultant. Only by actually visiting a great many mines in those states could he have acquired such a large number of gold, silver and silver-containing specimens. The specimens in his collection from other states and around the world are comparatively limited in number and were probably acquired through some of the very dealers who attended his auction. We may never know all of the details. But we may be certain that Mr. A. Dohrmann, Esq., of San Francisco was a man who knew and appreciated minerals. ⛝

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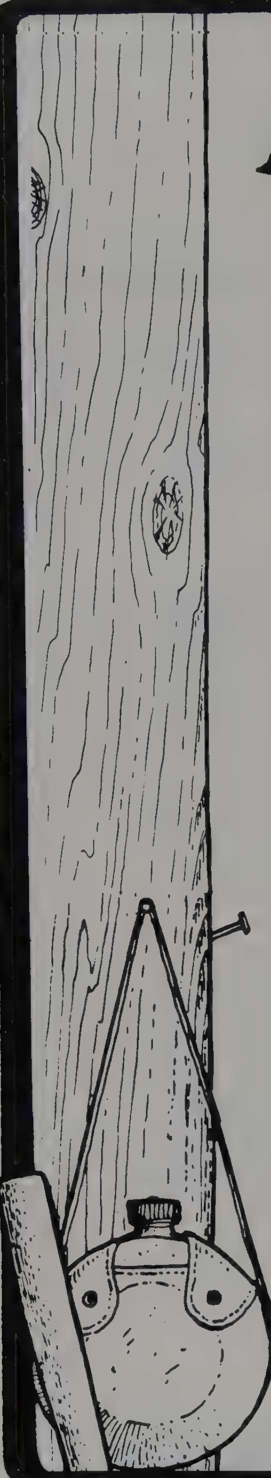

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The Gillette quarry is one of a number of complex zoned lithium-rich pegmatites in the well-known Middletown, Connecticut, pegmatite district. It has long been a favorite locality for field collectors, yielding fine specimens of elbaite, beryl, quartz and lepidolite.

INTRODUCTION

Specimens from the Gillette quarry grace many personal and public collections. Foremost among the latter is the American Museum of Natural History in New York City. Suites from the Gillette quarry can also be seen in the collections of Yale University, the Harvard Mineralogical Museum, Wesleyan University and The Natural History Museum (London). Such notables as George F. Kunz, J. Pierpont Morgan, and Clarence S. Bement have owned Gillette specimens or been instrumental in obtaining them for public collections.

In 1922, W. G. Foye referred to Gillette as one of the best known localities in the United States. However, the prolific production of specimens and gem rough from the pegmatites of southern California and the magnificent material from Minas Gerais, Brazil, ultimately diverted all but local attention from Connecticut's pegmatites.

The locality is noted in greater or lesser detail in numerous field guides and regional mineralogies including that of the Boston Mineral Club (ca. 1950), Brown (1951), Foye (1922), Jones (1961) and Schooner (1958).

The Gillette quarry is located on the northeast shore of the Connecticut River off Injun Hollow Road near the village of Haddam Neck in Easthampton, Middlesex County, Connecticut. It is situated at an elevation of about 17 meters, and is shown as an unnamed quarry on the USGS 7.5-minute topographic map of *Haddam, Connecticut* (1961), northeast of Haddam Island State Park. The quarry dumps actually run right down into the river, making them a pleasant spot for a break after a day's hard work in the quarry.

HISTORY

The quarry was evidently named after its owner, M. P. Gillette. It was originally opened in 1896 for gem tourmaline, mineral specimens and feldspar, and quickly produced a fair amount of tourmaline. Kunz was reporting on Gillette in 1896, Ernest Schernikow was selling elbaites to the American Museum of Natural History in 1896 or 1897, and George L. English and Company was selling Gillette tourmaline in 1896. This suggests that numerous pockets were encountered soon after the quarrying operation began.

According to Sterling C. Gillette (Vitali, 1979), M. P. Gillette had prior quarrying experience. He had been in charge of operations at the Roebling quarry (no connection to Col. Washington Roebling) in Upper Merryall, Connecticut. The Roebling pegmatite was operated for fine, gem quality aquamarine and golden beryl.

The Gillette quarry was operated under a lease arrangement by Ernest Schernikow and J. C. Wilkes. Joseph Peters of the American Museum of Natural History notes that many Gillette tourmalines in the Clarence S. Bement collection were sold to the museum by Schernikow in 1896 or 1897 (personal communication, 1986). Schernikow was an early officer of the New York Mineral Club along with George F. Kunz, who was the Club's first president.

Brown (1961) writes that Schernikow sent a suite of specimens in 1896 to the Oxford Museum in Oxford, England. These specimens became the subject of a detailed paper in 1902 by H. L. Bowman, Demonstrator in Mineralogy at the Oxford University Mineralogical Laboratory.

Kunz wrote regularly for the USGS Annual Reports on United States precious stone production. In these reports he often mentioned the latest tourmaline finds from Gillette. In the 17th Annual Report, he names the "Flint and Spar Company" as the operator of Gillette quarry (Kunz, 1896). In another USGS Annual Report (1897), Kunz notes the discovery of a 2.5 by 25-cm elbaite, partially transparent and a rich green. It is interesting to note that a 30-cm green elbaite from Gillette (AMNH 48362) is included in the first color illustration to be used in a USGS publication (20th Annual Report, 1899). In the same report, Kunz mentions the use of a green Gillette tourmaline by Professor Samuel L. Penfield and H. W. Foote to help determine the

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[1] Ellis Rudy collection of Kunz correspondence in the American Museum of Natural History library.

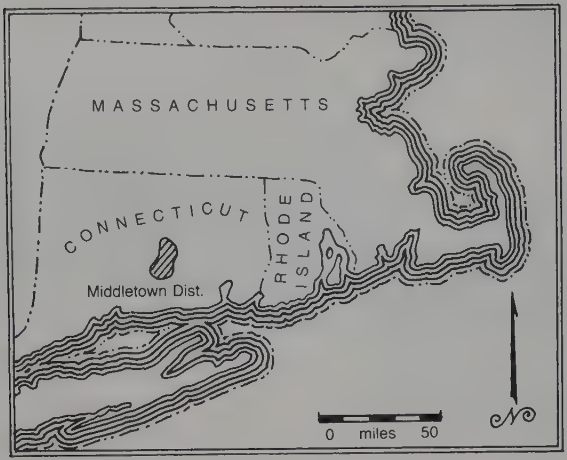


Figure 1. **Location map.**

formula of tourmaline. Davis (1901) describes numerous fine, large elbaites removed from the quarry.

In a letter[1] dated June 4, 1904, M. P. Gillette offered Kunz the lease of the quarry for tourmaline and feldspar production:

> Hartford, Conn., June 4, 1904
>
> Dear Sir
>
> I have expected up to within a few days, that the American Gem Co. of your city would lease the mineral section of our quarry, but they say that they cannot get to it at present.
>
> I am anxious to have something done this summer and if you know of anyone that would like to lease it or go in company with me and work it I am ready to do so on easy terms. I have been at the expense of $25 to get it in shape to mine and it would take but little to get it a going. The Spar that we would get out will bring a better price than when it was worked last.
>
> If you know of any one or perhaps you would like to go in yourself, if so I would like to see you or anyone up here or I would come to N.Y. if you think anything can be done. I sent you this from Hartford, so it will get to N.Y. Monday. How about the book you were to get out in the spring.
>
> Shall be pleased to hear from you soon.
>
> Yours Truly
> M. P. Gillette

The nature and ownership of the American Gem Company is unknown. It has been suggested that the company was owned by Schernikow. At any rate, during an unspecified four-year period around the turn of the century, 105 elbaite crystals were collected from the quarry by an unnamed New York jewelry firm. This collection was later donated to the American Museum of Natural History by J. P. Morgan, who obtained them from Kunz when he worked for Tiffany and Company in New York City. In light of this, it may be that Tiffany's was the firm that operated the Gillette quarry for those four years. Morgan as the source of the 105 tourmalines is confirmed by a letter[1] from G. F. Kunz dated Oct. 31, 1901, to then-president of the American Museum, Morris K. Jesup:

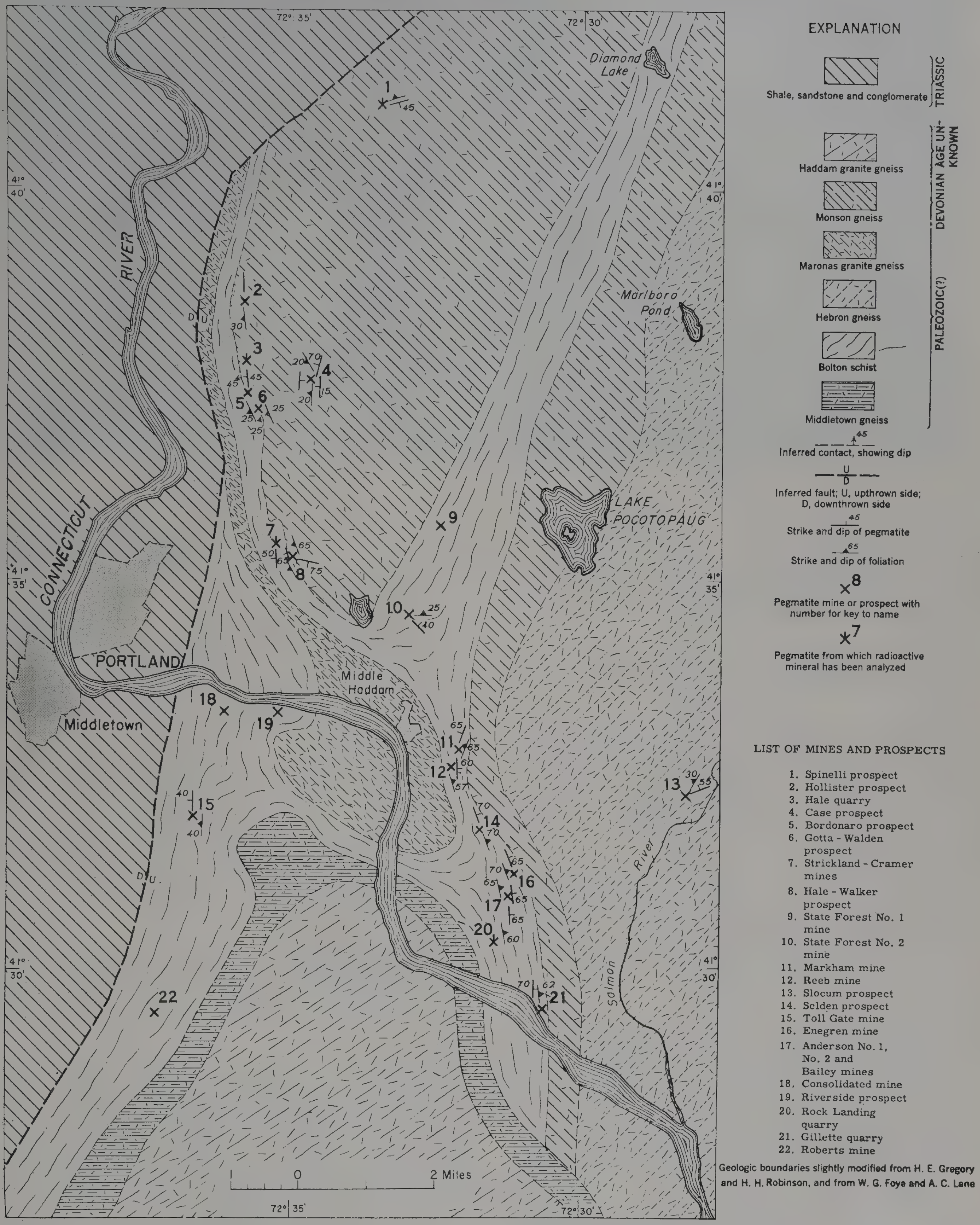
> October 31st, 1901
>
> Dear Sir:
>
> We send you by today's express a case containing 105 Tourmalines from Haddam Neck, Conn. that has been entered at the Pan-American Exposition in the name of the American Museum of Natural History and has been awarded an honorable mention, and a nugget of gold weighing 1158 pennyweights from Trinity Co. Cal.
>
> These we send you at the request of J. Pierpont Morgan Esq., of New York as an addition to the Morgan Hall Collection. Kindly acknowledge these to us and also to the donor.
>
> Respectfully yours,
> Tiffany & Co.
> George F. Kunz

Figure 2. **Gillette quarry, east cut; early 1940's. Harvard Mineralogical Museum photo.**

There is a great deal of confusion as to who actually operated and disposed of the specimens collected at the Gillette quarry. Gratacap (1912) says that the specimens in his collection from Gillette are a result of the mutual efforts of Bement, Schernikow and English.

George L. English and Company, a well known mineral dealership at the time, sold Gillette quarry specimens at an early date. An advertisement in an 1896 edition of *The Mineral Collector* (vol. 3, no. 9) lists "Multi-colored Gem Tourmalines, Conn., small terminated xls., specially selected for their beauty and no two alike. 3 for 25¢, 7 for 50¢ and 18 for $1.00."

Cameron *et al.* (1954) report that the quarry was in operation as of 1907, but had closed down by 1914. For three months in 1934 B. E. Johnson of Haddam, Connecticut, worked the quarry for feldspar. B. E. Johnson and E. H. Johnson of Middletown worked Gillette



LIST OF MINES AND PROSPECTS

1. Spinelli prospect
2. Hollister prospect
3. Hale quarry
4. Case prospect
5. Bordonaro prospect
6. Gotta - Walden prospect
7. Strickland - Cramer mines
8. Hale - Walker prospect
9. State Forest No. 1 mine
10. State Forest No. 2 mine
11. Markham mine
12. Reeb mine
13. Slocum prospect
14. Selden prospect
15. Toll Gate mine
16. Enegren mine
17. Anderson No. 1, No. 2 and Bailey mines
18. Consolidated mine
19. Riverside prospect
20. Rock Landing quarry
21. Gillette quarry
22. Roberts mine

Geologic boundaries slightly modified from H. E. Gregory and H. H. Robinson, and from W. G. Foye and A. C. Lane

***Figure 3*. Generalized geologic map of the Middletown district, Connecticut, showing distribution of pegmatite mines and prospects (from Cameron *et al.*, 1954).**

Figure 4. **Gillette quarry, east cut; early 1940's. Harvard Mineralogical Museum photo.**

from November 1942 to November 1944 for feldspar, at which time it was called the J-J mine (Brown, 1961). Most of the feldspar was shipped down the Connecticut River on barges, down Long Island Sound, to Chesapeake Bay, then up to the ceramics factories in Trenton, New Jersey. Since 1944, the quarry has been commercially inactive.

In 1942 Cameron *et al.* mapped the quarry. A revised map by Shainen, Main and Digman was made in June of 1945 (Cameron *et al.*, 1954).

The quarry passed on to M. P. Gillette's son, Sterling C. Gillette, Sr. Upon the latter's death on April 25, 1956 (*Rocks & Minerals,* vol. 32, p. 46), ownership passed jointly to his three children. Shortly thereafter, his daughter Ella Clarke Gillette (Mrs. George Hindle) bought out the interests of the other two children. The property is now owned jointly by Mrs. Hindle and her son and daughter-in-law, Robert and Diane Hindle.

Sterling C. Gillette, Sr. was well known to collectors and very cooperative in allowing collecting. The quarry has been open intermittently since his death. It is presently closed due to insurance considerations and the constant annoyance of collectors who must walk through the property and are within earshot of the owners' homes.

GEOLOGY

The Gillette quarry is located in Connecticut's Eastern Highlands in the Middletown District. The district covers an area of about 15 x 23 km and consists of heavily wooded upland with a general elevation of about 125 meters in the area of the Gillette quarry. A fault line escarpment separates the highlands from the Central Connecticut Lowlands just to the west, which consist of Triassic/Jurassic clastic sediments, diabase intrusions and basaltic extrusive rocks (Cameron *et al.*, 1954).

Various igneous and metamorphic rocks underlie the Middletown District. The area has over 400 pegmatites, some 300 of which occur in the Bolton schist, 75 in the Glastonbury (Monson) Gneiss, and 50 in the mafic gneisses (Stugard, 1958).

The Bolton Schist is made up of quartz-mica schists, mica gneiss, lenses of amphibole schist and beds of marble and quartzite. Most pegmatites are non-foliated and discordant. Though the physical properties of the host rocks likely influenced pegmatite size and shape, there is little evidence that they had a significant effect on pegmatite composition. Most pegmatites show very little chemical interaction with host rocks (London, 1985).

The granitic Glastonbury (Monson) Gneiss has intruded the Bolton Schist. The gneiss is variable in composition, containing medium grained microcline, orthoclase, quartz, oligoclase, biotite and muscovite. Accessory minerals include epidote, titanite, apatite, zircon, garnet and magnetite (Cameron *et al.*, 1954).

Potassium-rich pegmatites are more numerous in the south, whereas sodium rich pegmatites are more common in the north. The plagioclase-rich pegmatites are not as common, but contain most of the rare minerals. In these pegmatites, all the plagioclase is albite, sometimes of the platy cleavelandite variety (Stugard, 1958).

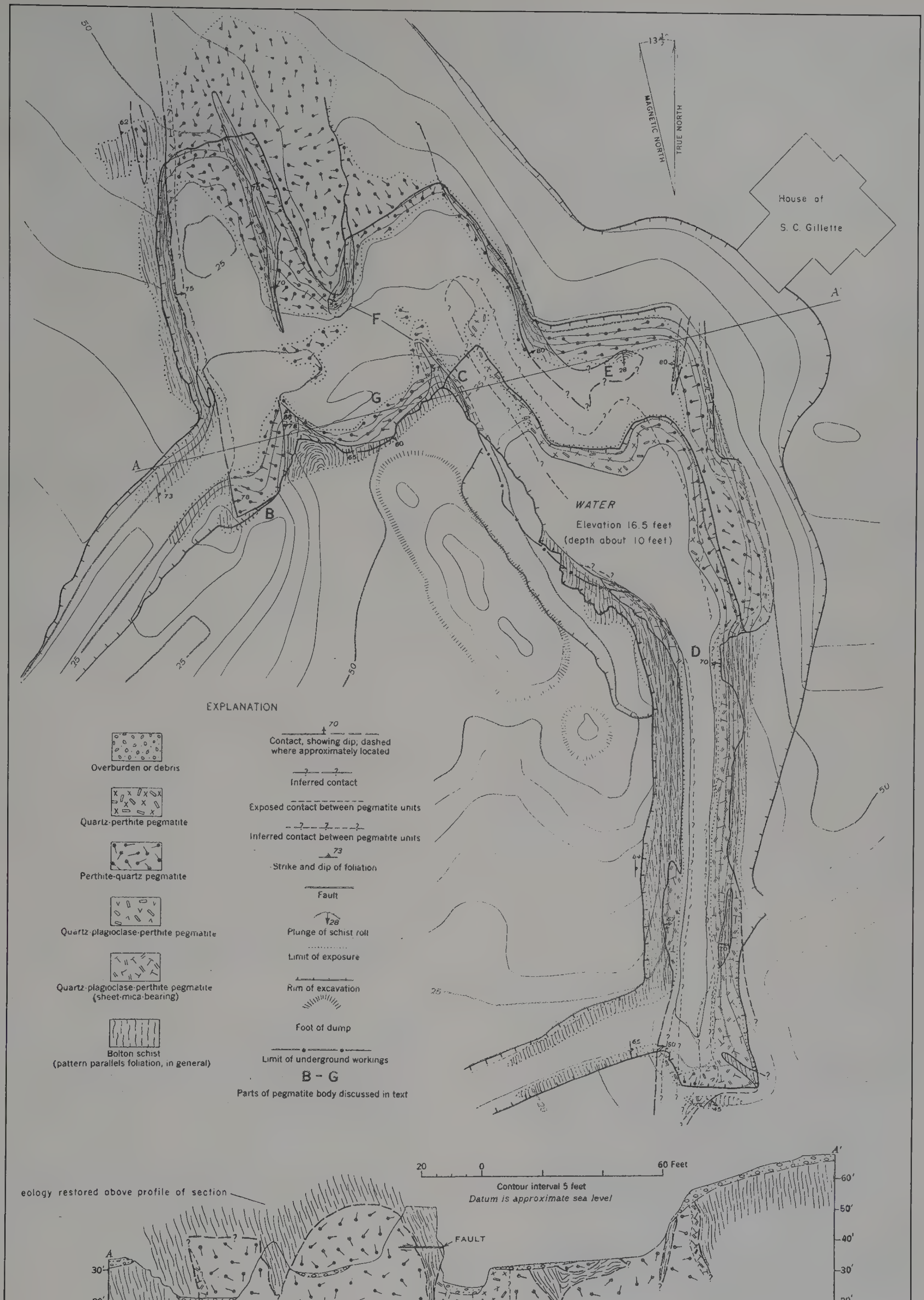
The origin of the pegmatites is unknown. A long-standing hypothesis proposes the source as being the Glastonbury (Monson) Gneiss. More recently, it has been suggested that the pegmatites are a product of differential anatexis. This is a high-temperature process whereby pre-existing rock is partially melted to generate a magma (Stugard, 1958).

Armstrong *et al.* (1970) conducted various isotopic dating analyses on a number of pegmatites from the area using U/Th, K/Ar and Rb/Sr. Results indicate that pegmatite crystallization began approximately 270 million years ago, and ended approximately 250 million years ago.

The workings consist of two open crosscuts leading to a very irregular open cut 108 meters long. These cuts expose a complex pegmatite consisting primarily of steeply dipping, interconnecting lenses that strike N 35° W. The pegmatite is exposed along its strike for about 100 meters, and varies in thickness from 5 to 25 meters. The walls of the pegmatite are characterized by irregular rolls or ridges most of which plunge gently north, and by sharp bends that are related to joints.

The wall rock is concordant Bolton Schist. There are, however, places where it is sharply discordant.

The pegmatite and schist are cut by many joints and one reverse fault showing minor displacement. The joints and faults generally strike a few degrees west of north. Some of the joints are horizontal and dip as much as 10° west.



Mapped by V. E. Shainin, F. H. Main, and R. E. Digman, June 1945

Figure 5. **Geologic map and section of the Gillette quarry (from Cameron *et al.*, 1954).**

Zoning

According to Cameron *et al.* (1954) the western and eastern parts of the pegmatite exhibit slightly different zoning and mineralization, which can be described as follows:

Western part

(1) Border zone (1.3 to 46 cm thick)
(2) Wall zone, sheet mica bearing (1.3 to 15 cm thick)
(3) Perthite-quartz zone (3.3 to 15 meters thick) frequently containing crystal-bearing cavities.

Eastern part

(1) Border zone (1.3 to 3.3 cm thick)
(2) Quartz-plagioclase-perthite zone (1.3 to 2 meters thick)
(3) Intermediate zone, sheet mica bearing (60 cm to 2 meters thick)
(4) Quartz-plagioclase-perthite intermediate zone (1 to 1.7 meters thick)
(5) Perthite-quartz intermediate zone (1.3 to 6.7 meters thick)
(6) Quartz-perthite core (11 meters maximum thickness), 35% quartz (Cameron *et al.,* 1954).

Cavity formation appears to have been controlled by replacement bodies produced by late-stage residual fluids. Such fluids are rich in water and other volatile compounds which react with the already-formed pegmatite minerals. A typical result is the alteration of microcline to albite through the replacement of potassium by sodium (a process called albitization). The liberated potassium then becomes available for the growth of muscovite and lepidolite. Lithium from spodumene also becomes available for the formation of lepidolite (Jahns, 1953). These residual or "post magmatitic" fluids crystallized as random localized concentrations in the Gillette pegmatite. The pegmatite bodies are characterized by quartz, cleavelandite, muscovite, lepidolite and rare minerals.

Jahns (1953) hypothesizes the possible development of a vapor phase from the residual fluid. This vapor phase would be more mobile, with its movement controlled by fractures. This may explain another mode of pocket occurrence at Gillette. In the north end of the east cut, numerous pockets were located using the joints as clues. In one level area, wherever two vertical joints were found, they were followed downward about 1 meter to a horizontal joint. At the junction of the three joints a pocket was usually found.

MINERALS

Besides the elbaite for which Gillette is famous, a whole suite of other species has come from the pegmatite. These other minerals often occur well crystallized in pockets. A typical pocket may include elbaite, quartz, lepidolite, perthite, beryl, albite, cookeite and muscovite. Bastin (1910) describes pockets from the east cut as being 20–25 cm in diameter, though many are smaller. Vitali (1979) describes a pocket he exposed, measuring 61 cm in diameter. The author has seen another nearly 2 meters long. Pockets are distributed irregularly through the pegmatite, with the exception of the border zone and core, and are commonly associated with fine granular lepidolite, pale green albite and small green tourmalines. Most crystals lay in the pocket bottoms, imbedded in a sandy mass of decomposed minerals, quartz fragments and cookeite.

In many old collections, specimens from the Gillette quarry are labeled simply as "Haddam Neck." Some are also erroneously labeled "Haddam," which is a town to the west across the Connecticut River. It is probable that the vast majority of specimens (from complexly zoned pegmatites) which bear such labels are from the Gillette quarry. There is only one other complex pegmatite in the area: the Swanson quarry, which was known for large quantities of lepidolite, abundant beryl, multicolored tourmaline, manganapatite, garnet, cassiterite, microlite and triplite. The workings are not extensive and few specimens are to be found in collections.

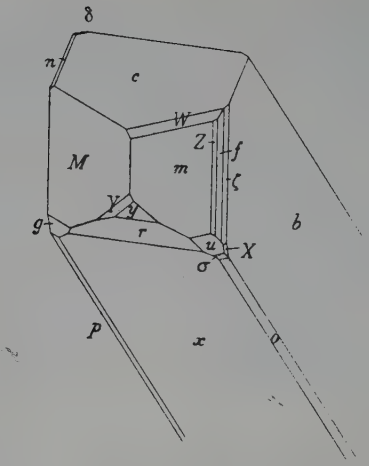


Figure 6. **Albite crystal drawing, "Haddam Neck" (Bowman, 1902).**

Albite $NaAlSi_3O_8$

Albite is found as clear, colorless, well-developed crystals to 2.5 cm in diameter, sometimes displaying a beautiful opalescence.

Almandine $Fe_3^{+2}Al_2(SiO_4)_3$

Almandine is a fairly common mineral found as poorly formed crystals to 1 cm, and occasionally as gemmy, flattened crystals in muscovite books. A loose 4-mm crystal from the William and Cecil Hoisington collection (Randolph, Vermont) consists of a gemmy, flattened trapezohedron with minor dodecahedron modifications.

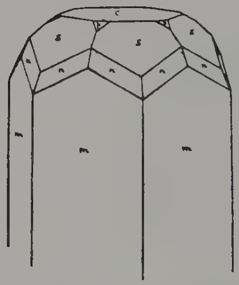


Figure 7. **Beryl crystal drawing, "Haddam Neck" (Bowman, 1902).**

Beryl $Be_3Al_2Si_6O_{18}$

Gillette beryl exhibits a number of interesting habits and associations. Beryl has been found as fine crystals in shades of golden yellow, aqua, pink, and colorless. Crystals in cavities are usually morganite of a fine peach-pink color, occasionally exhibiting a pale green core. The Boston Mineral Club (ca. 1950) notes several broken beryl crystals with microlites near their centers, and morganite prisms capped with larger tabular crystals resembling mushrooms. Crystals to 15 cm across and up to 20 cm long have been found. Vitali (1979) pictures a fine, pale green beryl of complex form measuring about 5 x 5 cm. Cameron *et al.* (1954) report that beryl makes up 0.2% of the pegmatite.

Gems known definitely to have been fashioned from Gillette quarry beryl are hard to come by. In the Bruce Jarnot collection there is a fancy cut, 3.35-carat pale yellow beryl.

Jones (1961) reports that morganite from Gillette fluoresces blue-white under shortwave ultraviolet light. One crystal in the author's collection fluoresces a pale greenish blue.

Biotite $K(Mg,Fe^{+2})_3(Al,Fe^{+3})Si_3O_{10}(OH,F)_2$

Biotite has been reported as an accessory mineral from the pegmatite (Brown, 1961).

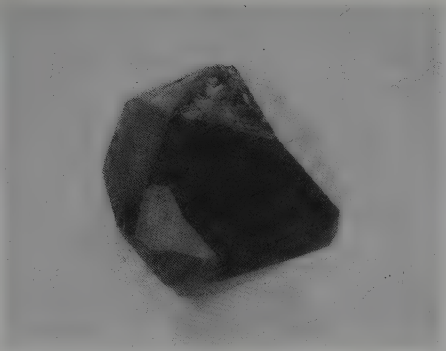


Figure 8. **Cassiterite crystal, 2 mm, on albite, from the Gillette quarry. Scovil collection and photo.**

Cassiterite SnO_2

Schooner (1961) and the Boston Mineral Club (ca. 1950) report that good crystals to 1 cm have been found. One specimen in the author's collection is a highly modified, lustrous, dark brownish black microcrystal in cleavelandite.

Calcite $CaCO_3$

Fluorescent calcite is reported by Jones (1961).

Chrysoberyl $BeAl_2O_4$

The Brush collection at Yale University contains a twinned yellow-green crystal 2.5 cm long on a matrix of feldspar, quartz, muscovite and garnet (C768), labeled "Haddam Neck."

Cookeite $LiAl_4(Si_3Al)O_{10}(OH)_8$

Cookeite occurs as pinkish globular encrustations coating crystals which line pockets.

Elbaite $Na(Li,Al)_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$

Elbaite is found in pockets as crystals up to 30 cm in length. Crystals are frequently bicolored and tricolored, in shades of green, pink, golden yellow and blue. Davis (1901) describes individual crystals showing as many as five colors. Zoning is usually longitudinal; concentric "watermelon" zoning is not common. Flawless crystals are rare; Gillette elbaites are usually fractured. Kunz (1898) notes that fine cats-eye tourmalines from the Gillette quarry are as good as any of the cats-eye chrysoberyls from Ceylon. Pockets at Gillette were generally not large, but Sinkankas (1959) refers to one that produced 600 crystals.

Of 74 crystals examined in the American Museum of Natural History collections, the majority are green with pink terminations formed by the trigonal pyramid. Only three have golden yellow terminations. Blue is also relatively uncommon. Pedion terminations are usually associated with dark colors such as green and blue. Occasionally there is a narrow pale colored zone immediately beneath and parallel to the pedion. These relationships are repeated in many Gillette elbaites found in other collections. Though Gillette has produced thousands of elbaite crystals, very few identifiable cut stones exist in collections today. The collection of Bruce Jarnot contains three, and the Smithsonian collection contains two (NMNH #G6175, a green, 6.14-carat step cut; and NMNH #G6176, a green, 5.14-carat step cut).

Ferrocolumbite $Fe^{+2}Nb_2O_6$

Ferrocolumbite is found as well-formed iridescent crystals to 2 cm long, usually enclosed in microcline. The identification was made by Petr Cerny at the University of Manitoba, using microprobe analysis (Carl Francis, personal communication, 1989).

Fluorapatite $Ca_5(PO_4)_3F$

Fluorapatite from Gillette is well known for its brilliant yellow fluorescence under shortwave ultraviolet radiation. Most fluorapatites are found encased in feldspar. More rarely, crystals to 3.2 cm across have been found in pockets. It is interesting to note that these crystals do not fluoresce as intensely as the imbedded crystals. Fluorapatite crystals range in color from pale green to pale purple, sometimes with both colors in a single crystal. The Yale collection contains a very fine specimen with four fluorapatites up to 3.2 cm on a matrix of quartz and cleavelandite crystals with a 1-cm ferrocolumbite crystal (C2802, Brush collection).

Bowman (1902) observed that the green fluorapatites are richer in crystal forms than the pink/purple crystals. He counted fifteen on the former, and nine on the latter.

Fluorite CaF_2

Fluorite as red, massive or crude crystals to 4 cm, associated with fluorapatite, and lithian muscovite, was frequently found in the eastern quartz-plagioclase-perthite zone. It is reported that the fluorite fluoresces a dull green (Boston Mineral Club, ca. 1950).

Graphite C

Graphite occurs rarely as poorly developed crystals and thin irregular fracture fillings (Boston Mineral Club, ca. 1950). Graphite also occurs as millimeter-sized blebs with a radiating structure on a matrix of feldspar and quartz.

Hematite Fe_2O_3

Hematite is found as brown pseudo-hexagonal inclusions in muscovite, often producing fascinating patterns.

Lepidolite $K(Li,Al)_3(Si,Al)_4O_{10}(F,OH)_2$

Lepidolite is a common pocket mineral, and its presence in the pegmatite usually indicates the proximity of pockets. Crystals to 10 cm in diameter have been found.

Magnetite $Fe^{+2}Fe_2^{+3}O_4$

Magnetite is found as flattened inclusions in muscovite and as sharp octahedra to 1.5 cm (Yale, Brush Collection C763).

Microcline $KAlSi_3O_8$

Microcline is usually intimately intergrown with plagioclase in the form of perthite at Gillette. Crystals in cavities reach 20 cm or more across, and up to 120 cm across as crude crystals in the core. Perthite makes up the majority of the pegmatite outside the core. Davis (1901) reports the occurrence of pale green microcline (amazonite).

The American Museum of Natural History collection contains a pale blue-green microcline crystal 20 cm across, and a fine buff colored crystal 25 cm across (AMNH 18797). Microcline from Gillette is reported to fluoresce a bluish white (Boston Mineral Club, ca. 1950).

Figure 9. **Microlite crystal, 3 mm, with albite and quartz. Scovil collection and photo.**

Microlite $(Na,Ca)_2Ta_2O_6(O,OH,F)$

Microlite is an uncommon mineral found as modified octahedra up to 1.1 cm (Hoisington collection) with a resinous brown color. The

Figure 10. Beryl, 7.5 cm, from the Gillette quarry. Harvard specimen 86393; Scovil photo.

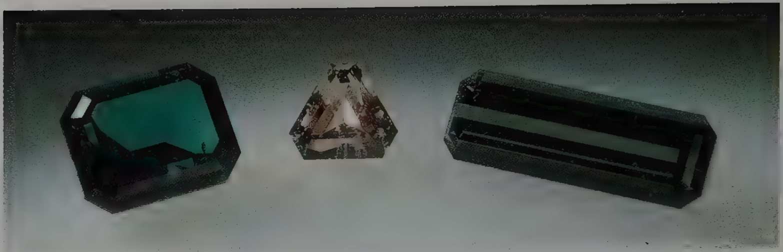


Figure 11. Faceted elbaites, 3.32 ct., 0.89 ct., and 4.28 ct., from the Gillette quarry. Bruce Jarnot collection; Scovil photo.

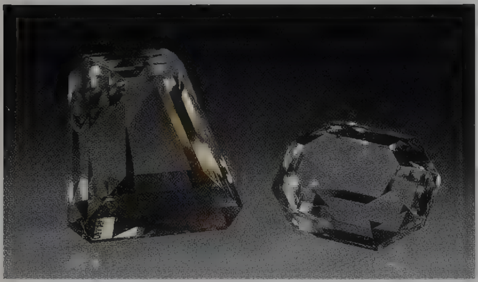


Figure 12. Beryl, 3.35 carats, and topaz, 2 carats, from the Gillette quarry. Bruce Jarnot collection; Scovil photo.

Figure 13. Elbaite, 6.8 cm, from the Gillette quarry. Harvard specimen; Scovil photo.

Figure 14. Elbaite, 5.6 cm, from the Gillette quarry. Harvard specimen; Scovil photo.

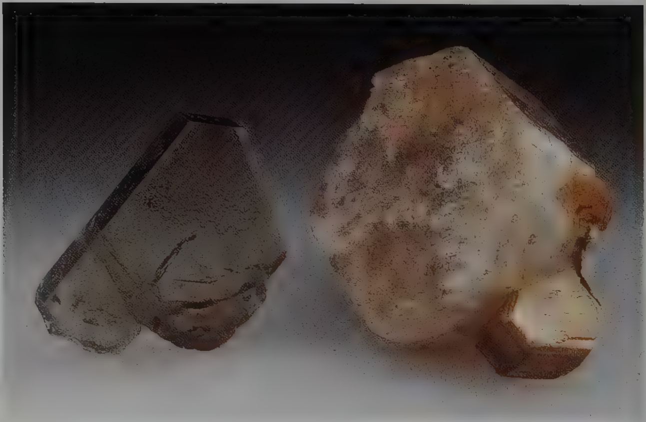


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Figure 15. Fluorapatite crystals, 2.5 cm and 3 cm, from the Gillette quarry. Harvard specimens 58438 and 165.

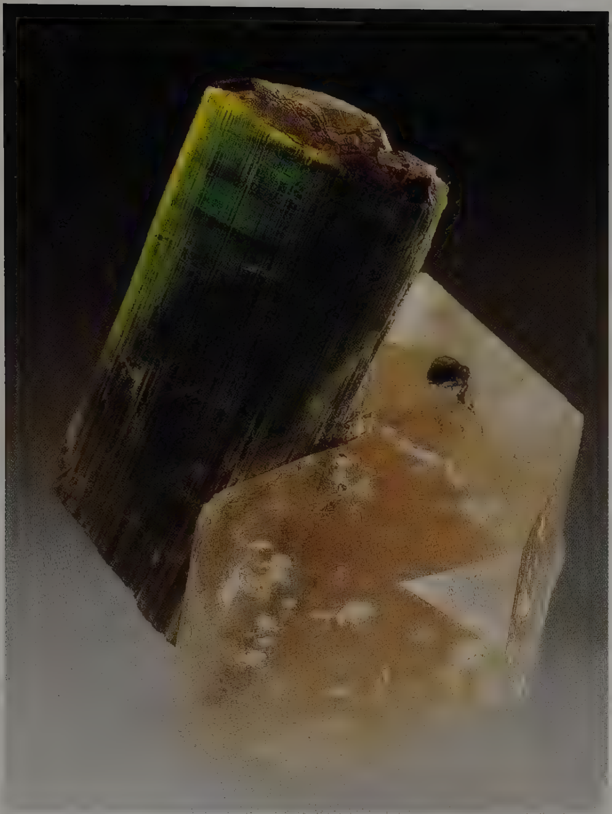

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Figure 16. **Elbaite crystal, 3.4 cm, on quartz from the Gillette quarry. Harvard specimen 917.**

WEW

Figure 17. **Orange topaz crystal, 5.7 cm, partially altered to muscovite, from the Gillette quarry. Harvard specimen 119419.**

WEW

Figure 18. **Lepidolite with muscovite and cookeite, 7.4 cm, from the Gillette quarry. Harvard specimen 121873.**

WEW

Figure 19. **Lepidolite with muscovite, cookeite and quartz, 4.6 cm, from the Gillette quarry. Harvard specimen 86952.**

Figure 20. **Microcline crystal, 7.2 cm, from the Gillette quarry. B. and C. Hoisington collection; Scovil photo.**

Boston Mineral Club (ca. 1950) reports that the microlite is radioactive.

Muscovite $KAl_2(Si_3Al)O_{10}(OH,F)_2$

Muscovite occurs in books up to 45 cm in diameter and 20 cm thick. Books often contain beautiful inclusions of green elbaite and black schorl, as well as hexagonal hematite platelets and flattened magnetite octahedra.

Bowman (1902) goes into great detail in his analysis of muscovite and lepidolite from Gillette. The two form interesting overgrowths, with pale green muscovite at the center. This core is surrounded by a sharply defined zone of pink lepidolite. The lepidolite was subsequently overgrown by pink fibrous muscovite. The fibers are rhombic in cross section and are in parallel or twin-position so that the mass can be cleaved as if a single crystal. These muscovite/lepidolite intergrowths have been referred to in the old literature (e.g., Martin, 1912) as the variety "schernikite."

The fibrous muscovite also occurs as inclusions in quartz crystals. The muscovite starts at a pin point in the quartz crystals interior and becomes a divergent sub-parallel bundle of fibers as it reaches the surface where it is often the preferred site for a cookeite hemisphere.

These muscovite/lepidolite intergrowths closely resemble the fine lepidolite crystals that came out of Virgem de Lapa, Minas Gerais, Brazil, several years ago. It would be interesting to test the latter and see if they might be a similar intergrowth.

Orthoclase (?) $KAlSi_3O_8$

The Yale collection contains a specimen, labeled "orthoclase," of off-white crystals to 3.8 cm on quartz (C762, Brush Collection).

Pyrite FeS_2

Pyrite is found rarely as small crystals and masses often altered to "limonite" (Boston Mineral Club, ca. 1950).

Pyrolusite (?) MnO_2

Boston Mineral Club (ca. 1950) reports that pyrolusite is found as thin steel-gray coatings on some minerals, particularly cleavelandite. This was probably only a visual identification; X-ray diffraction analysis would be necessary to positively identify the species.

Quartz SiO_2

Quartz has been found as many fine crystals, from pale to dark smoky in color, sometimes showing phantoms and inclusions of lepidolite, muscovite and elbaite. One 1.8-meter pocket contained nothing but jet-black smoky quartz crystals up to 14 cm in length. Massive rose quartz has also been found at Gillette (Yale, Brush Collection C797).

An interesting occurrence of quartz crystals is noted by the Boston Mineral Club (ca. 1950): several vugs were found to contain etched pseudocubic crystals, and the balance of one vug was filled with red fluorite.

Sterling Gillette used to carry as a watch charm a doubly terminated, flattened quartz crystal with enclosed tourmalines that came from the quarry (Davis, 1901).

Schorl $NaFe_3^{+2}Al_6(BO_3)_3Si_6O_{18}(OH)_4$

Schorl is found in minor amounts throughout the pegmatite and in the vicinity of pockets. It commonly grades into elbaite.

Scheelite $CaWO_4$

Scheelite is one of the rarest minerals from Gillette. It is found as minute grains in quartz-tourmaline matrix.

Spodumene $LiAlSi_2O_6$

Spodumene has been reported from Gillette (Schooner, 1961). The Boston Mineral Club (ca. 1950) reports a waxy butterscotch colored crystal measuring 1.5 x 2.0 x 5.0 cm altered to "pinite" (mica).

Topaz $Al_2SiO_4(F,OH)_2$

Topaz occurs rarely as equant colorless crystals up to 1 cm in cavities and as pale orange crystals to 5.6 cm embedded in quartz-muscovite matrix. Such crystals are often partially or wholly altered to muscovite. The Bruce Jarnot collection contains a fine, colorless, 2-carat faceted topaz.

Uraninite UO_2

Uraninite was reported by Stobbe (1949), but no details are given.

Uranophane $(H_3O)_2Ca(UO_2)_2(SiO_4)_2\cdot 3H_2O$

Uranophane is found rarely as small (to 1 mm) lemon-yellow acicular crystals (The Boston Mineral Club, ca. 1950).

CONCLUSION

The Gillette quarry is a long-famous tourmaline locality whose specimens, usually found in older collections, are highly prized. Limited collecting has been allowed very sporadically in the past, but prospects for future collecting are quite dim. Fine Gillette quarry specimens are hard to come by, but are today treasured by mineral collectors as New England classics.

ACKNOWLEDGMENTS

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(continued on page 80)

THE MACHOW MINE, TARNOBRZEG, POLAND

Janusz Gradowski
Earth Science Fellowship Society of Poland
ul. Czarnowiejska 41-43/73
30-049 Krakow, Poland

Wladyslaw W. Kubiak
Institute of Materials Science
Academy of Mining and Metallurgy
al. Mickiewicza 30
30-059 Krakow, Poland

Sulfur has been mined at the Machow mine only since 1970. Despite this short history, the deposit has yielded thousands of beautifully crystallized specimens of celestine, sulfur and barite which have found their way into collections all over the world.

INTRODUCTION

The Machow mine (pronounced "Mahŏov") is the largest sulfur-mining operation in Europe. It is located in southeastern Poland near the town of Tarnobrzeg, on the south side of the Vistula River, about 95 km south of Warsaw. The western portion of the orebody is being mined by the Frash process, in which superheated water is pumped underground, and melted sulfur is pumped out. Obviously this process leaves no possibility for specimen recovery. However, in the eastern part of the deposit mining is opencast, and thousands of fine specimens have been taken out. Many of these have been sold on the international mineral market by different dealers, at the Tucson Show, Munich Show and elsewhere, for at least the last eight or ten years (Wilson, 1983, 1989).

Visitors to the mine are generally forbidden from collecting. A Museum of Sulfur Mining is located nearby at Baranow Sandomierski, situated in a beautiful Renaissance palace. But, strangely enough, it contains no mineral specimen exhibits.

HISTORY

Reports and legends of sulfur mining in the Polish principality of Vistula are known to have originated as far back as the 9th century. The oldest surviving document pertaining to sulfur exploration and mining is a grant from King Wladyslaw Jagiello dated 1415, permitting exploration for sulfur near what was then the village of Swoszowice. Eventually many mines sprang up, and for five centuries Poland's sulfur mining industry was the most active in Europe.

Beginning in the late 19th century, changing economic conditions and competition from the Sicilian sulfur mines put severe pressure on the Polish mines. The famous Swoszowice mine closed in 1884, and the others followed in succession. The Posadza mine, the last to remain operating, closed in 1921.

In the 1930's, Jan Czarnocki and Karol Bogdanowicz suggested that important sulfur deposits might be found in a geological area called the Carpathian Foredeep, especially near Grzybow and Tarnobrzeg. A similar suggestion had earlier been made by Teisseyre in 1921, and before that by Staszic in 1815. This hypothesis remained untested for many years. Finally, in 1952, a group under the direction

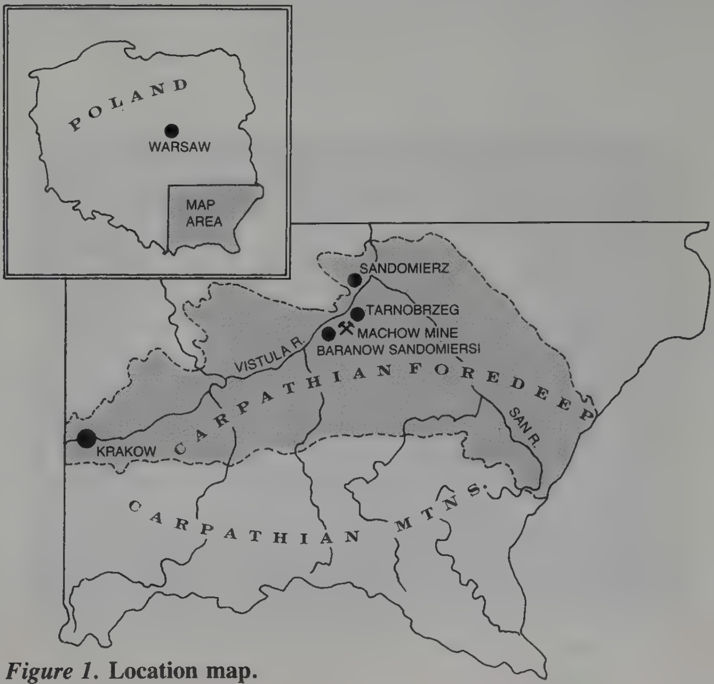

Figure 1. **Location map.**

Figure 2. **Sulfur-bearing limestone. Machow open pit.**

of Stanislaw Pawlowski discovered rich sulfur deposits during the course of exploratory drilling in the Carpathian Foredeep near Tarnobrzeg and Staszów. Development of the open pit operation at Machow was initiated in 1963, and sufficient overburden had been removed by 1970 for sulfur production to commence.

The open pit is very large, over 2 km long and 1 km wide. A layer of overburden approximately 100 meters thick must be stripped to reach the sulfur-bearing layer, which is about 20 meters thick. Waste rock is carried by conveyor belt and dumped as backfill in disused parts of the pit (De Wit, 1988).

GEOLOGY

Deposits of native sulfur in Poland proved to occur only within the Carpathian Foredeep, a marginal trough filled by Miocene molasse to a depth of several kilometers. Sandstones comprise the lowest layers, followed upward by limestone, a distinct layer of gypsum and anhydrite 20–45 meters thick, followed by vuggy limestone and halite beds. Above these are clayey rocks which in places reach a thickness of 2,500 meters. Pawlowski (1970) distinguished elongated zones (1 km across and tens of kilometers long) in which the post-gypsum limestone beds are somewhat elevated. These zones proved to be the focus of sulfur deposition. They extend from Krakow through Pinczów, Tarnobrzeg, Stalowa Wola and Haryniec.

The sulfur deposits formed post-depositionally in the vuggy limestone layer above the gypsum and anhydrite bed. This unit is capped by relatively impermeable clay-rich rocks and is underlain by more permeable rock types which permitted the restricted circulation of groundwater. Gypsum, in response to hydrogen-rich metasomatic fluids, reacted to form elemental sulfur, calcite and water. This process

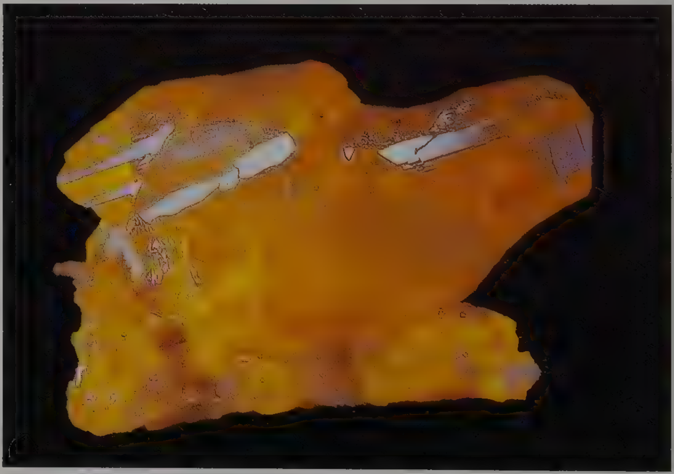

Figure 3. **Large sulfur crystals, 8 cm across. Jacek Wachowiak collection.**

Figure 4. **Barite with sulfur, 6 cm across. Author's collection.**

WEW

Figure 5. **Dark blue celestine crystal, 10 cm tall. Rod and Helen Tyson specimen.**

Figure 6. **Color-zoned golden brown celestine, 6 cm. Terry Huizing collection and photo.**

Figure 7. **Colorless celestine crystals to 4 cm. Author's collection.**

Figure 8. **Amber-colored celestine crystals, 9 cm across. Author's collection.**

took place with the help of reducing bacteria, and huge quantities of natural gas (Pawlowski, 1970). Sulfur was deposited in voids, vugs, karst caverns and fissures in the limestone, mostly as powder but also as coarsely crystalline masses and as free-growing crystals. In the richest areas of the limestone bed, sulfur accounts for 35% of the rock mass.

Other materials present in the sulfur-bearing horizon include calcite, gypsum, quartz, aluminum oxides, and traces of bismuth (Osika, 1986). Hauerite (MnS_2) has also been identified (De Wit, 1988). Strontium and barium mobilized by the metasomatism crystallized as celestine and barite (Parafiniuk, 1989). Geochemical studies (Osmolski, 1986) have shown that as the strontium content of the rock decreases gradually toward the east, there is a corresponding increase in the abundance of well-formed celestine crystals.

MINERALOGY

Barite $BaSO_4$

Barite occurs in two general habits at the Machow mine: tabular to lamellar, and columnar to acicular. The columnar specimens are typically very transparent, and are colored yellow to golden brown or pale brown by inclusions of organic bitumens. The crystals form druses, radiating acicular aggregates and fine crystal groups, with individuals measuring up to at least 4 cm in length. These have been found predominantly in the uppermost levels of the orebody. The best discovery to date took place in 1988, when dozens of fine cabinet specimens to about 30 cm across were found covered with dense groups and sprays of gemmy, golden brown crystals (Wilson, 1989).

Tabular habits are represented by large groups of spherical and radiating aggregates. Typically opaque, the crystals are usually white to gray or pale brown, in sizes up to 2 cm. Stalactitic growths (a hollow central tube surrounded by crystals) are common. Rare but quite attractive are the "roses" and dendritic aggregates up to 10 kg and more in weight. Color zoning is present in some crystals.

Calcite $CaCO_3$

Calcite is common at the Machow mine, in trigonal, white to gray-brown and honey-yellow crystals and groups. It typically occurs in crystals up to 2 cm, associated with celestine, barite and sulfur.

Celestine $SrSO_4$

Celestine occurs as druses and single crystals up to 10 cm or more, individually and in attractive groups lining cavities in limestone. The color ranges from white to cream, honey-yellow, amber-yellow, brown, pale blue-gray and deep blue-gray. Crystals are transparent to translucent, and are sometimes color-zoned. Sulfur and calcite are typically associated, and strontianite has been reported recently as well (Parafiniuk, 1989).

Machow mine celestine is typically columnar in habit, and usually exhibits only a few crystal forms. However, some crystals are rich in forms, one example reportedly showing 35 faces (Laszkiewicz, 1956). Groups with sulfur and calcite have been recovered in sizes up to 40 cm, and make very attractive display pieces.

Gypsum $CaSO_4 \cdot 2H_2O$

Large masses and lenses of gypsum have been encountered in and adjacent to the ore horizon. Most of the gypsum is massive, but larger, embedded, commonly twinned crystals up to 4 meters long have been found in the lower part of the gypsum and anhydrite bed (Osika, 1986).

Hauerite MnS_2

Amorphous masses, spherical aggregates, and well-formed octahedral crystals with corners flattened by cube faces have been reported by De Wit (1988), and identified as hauerite. It occurs not in the orebody itself but in the overburden.

Strontianite $SrCO_3$

Strontianite is relatively rare at the Machow mine, occurring as acicular microcrystals with rhomboidal cross-sections. In some cases strontianite appears to have been replaced by celestine (Kowalski *et al.*, 1980). Dolomite and witherite have been reported as well.

Sulfur S

Sulfur occurs disseminated throughout the post-gypsum limestone layer, as fissure-filling masses, cavern fill, stalactites and crystal aggregates. Fine crystals to 3 cm are relatively common, but larger examples (up to 8 cm) are rare and difficult to remove intact. The habit ranges from bipyramidal to blocky to tabular, in colors ranging from bright yellow to deep yellow and orange-yellow, in some cases also with a sea-green tint (Laszkiewicz, 1956). It is usually associated with calcite, celestine and barite. Good crystals are common; rounded masses typically form the matrix for attractive crystals of celestine and barite.

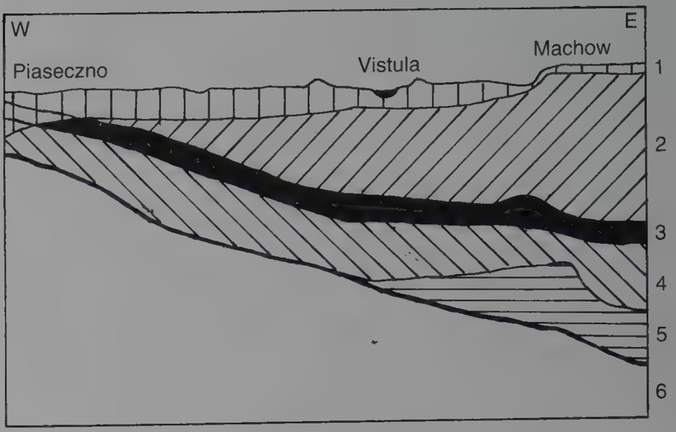

***Figure 9.* General geologic cross section through the Piaseczno and Machow mines (after Pawlowski *et al.*, 1970) (1) Holocene and Pleistocene deposits, (2) Sarmatian clays, (3) limestone with sulfur and gypsum, (4) sands, (5) brown coal clays, (6) Cambrian siltstones and claystones.**

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Minerals of the
HOUSTON MUSEUM
of
NATURAL SCIENCE

Front Cover: Rhodochrosite crystal group (10 cm) on a matrix of quartz, pyrite and tetrahedrite crystals; from the Home Sweet Home mine near Alma, Colorado. Found in 1965, it is considered by many to be the finest rhodochrosite in the world.

Above: Spodumene crystal (30 cm), the lilac-colored variety known as *kunzite*; from the Pala Chief mine, San Diego County, California. Found shortly after the turn of the century, it is among the finest North American kunzite crystals ever recovered.

Minerals of the HOUSTON MUSEUM *of* NATURAL SCIENCE

by
Wendell E. Wilson
Editor, Mineralogical Record Magazine
Joel A. Bartsch
Curator of Gems & Minerals
Houston Museum of Natural Science

Photography by
Harold and Erica Van Pelt

Dedicated to the memory of
Paul E. Desautels (1920–1991)

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The great repositories of minerals today are the major public museums and institutions around the world, which, through the centuries, have gathered together and preserved over 5 million mineral specimens. Many of these museums were founded on the pre-existing collections of private individuals, and over the years have been significantly enlarged through the assimilation of many more such personal accumulations. Private collections have historically proven to be the necessary precursors on which the major institutional collections have been built.

Throughout the Dark Ages and much of Antiquity, minerals were described unscientifically, in terms of their supposed supernatural powers. The notion of experimentation to verify physical or medicinal properties was unheard of, and writers were content to copy from and embellish upon earlier writers without ever examining real specimens. Consequently mineral collections as we know them today did not begin to develop until the Renaissance, when a fresh interest in nature combined with a more objective outlook. A class of scholars evolved, achieving fame by their collecting activities alone and not by birth. They needed a proper environment to carry out their studies, and thus was born the "modern" notion of a museum.

The first mineral collector of record was Georg Bauer, better known by his Latinized name, Georgius Agricola. Born in Saxony in 1494, he became a prominent physician in the famous mining towns of St. Joachimstal and Chemnitz. His interest in minerals apparently began with the accumulation of samples of a sort of pharmaceutical stockpile, though he eventually collected them for their own sake and published several important books on minerals and mining from 1530 to 1556.

Agricola's circle included two friends who drew inspiration from him and began mineral collections of their own. Johannes Mathesius (1504–1565), a Saxon clergyman, and Johannes Kentmann (1518–1574), a Saxon physician. Kentmann's collection of over 1,600 specimens was described in a catalog published in 1565. Conrad Gesner (1516–1565), a Swiss naturalist and collector, also inspired Kentmann and assisted in the publication of his catalog.

A French naturalist and potter named Bernard Palissy (1510–1590) independently originated mineral collecting around 1540, not as pharmaceuticals but as raw materials for the experimental compounding of ceramics and glazes. His collection, ultimately used as examples in his lectures on natural history in Paris, was quite famous in its time.

Unfortunately, little remains of these earliest accumulations. The collections of Agricola, Mathesius, Kentmann and Palissy were dispersed and lost before the end of the sixteenth century and, although Conrad Gesner's collection ultimately went to the Natural History Museum in Basel centuries later, no specimens can be positively identified there today. Because these men were the first to collect minerals, there were as yet no public institutional museums to preserve their specimens following their deaths.

By the 17th century, collecting fever had spread throughout Europe. Emperor Rudolph II (1552–1612) build a massive "cabinet" (as the collections were called) of minerals and other objects of nature at Hradschin Castle in Prague. The collection of Austrian Prince Klemenz von Metternich (1773–1859), which itself had absorbed many earlier collections, became the basis for the National Museum in Prague. Emperor Franz Stephen von Lothringen (1708–1768) was also a connoisseur of minerals, and it was his collection which later formed the nucleus of the Natural History Museum in Vienna.

Private collections were also built by middle-class scholars, physicians and amateur naturalists. In England, physicians such as William Harvey (1578–1657) were prominent collectors, but it was the Royal Gardener, John Tradescant (1587–1638), whose collection later formed the basis of the Ashmolean Museum at Oxford. Sir Hans Sloane (1660–1753), one of the greatest private collectors of all time, donated his immense collection to establish the British Museum of Natural History in London. Naturally, mineralogists also built major mineral collections, as much to support their studies as to indulge their personal tastes. René Just Haüy (1734–1822), the founder of modern crystallography, and Abraham Gottlob Werner (1749–1817), the father of modern mineralogy, left their collections to the French National Museum and the Freiberg Mining Academy, respectively.

In our century, several major museums have benefitted greatly from the acquisition of important private collections. Clarence S. Bement (1843–1923) assembled one of the greatest private mineral collections in history; it was purchased in 1900 by J. P. Morgan and given to the American Museum of Natural History. The extensive collections of Washington A. Roebling (1837–1926)—builder of the Brooklyn Bridge—and Frederick Canfield (1849–1926) greatly enriched the holdings of the Smithsonian Institution. Sir Arthur Russell (1878–1964) built an enormous collection of British minerals which he donated to the British Museum of Natural History. And recently, the collection of Albert Chapman, perhaps the best ever assembled in Australia, was purchased by the Geology Museum of the New South Wales Department of Mines in Sydney.

Today there are more private collections being built, some of which will eventually be absorbed by other museums. But there are also tens of thousands of small collections owned by people who do not aspire to greatness, but rather to personal satisfaction and enjoyment. This may be the single factor which distinguishes 20th century collecting from previous centuries: its relatively wide spread popularity. There has probably never been a time in history when so many people were so involved with collecting minerals. The Houston Museum of Natural Science, built on significant private collections and donations, is a continuation of this legacy.

The Houston Museum and Scientific Society, Inc. was formed in 1909 with the objective of "establishing a natural history museum in the city of Houston." The first home for this new museum was downtown in the City Auditorium, but by 1930, the Houston Museum of Natural History, as it was known, had moved to a more permanent structure near the zoo in Hermann Park where it would remain until 1964. In 1960 the name of the museum was officially changed to the Houston Museum of Natural Science, and in 1964 the first phase of the present facility, the Burke Baker Planetarium, opened to the public. The central portion of the present museum complex was completed in 1969, adding more than 18,000 square feet of gallery and office space.

Since the early 1980's, a renewed commitment from the Board of Trustees to expand the facility, increase the scope and quality of the collections, and increase public participation has revitalized the museum. During the past decade the museum increased its annual attendance from just over 400,000 visitors to just under 2,000,000—a significant increase, underscored by the fact that during that same period the museum began charging an admission fee for the first time in its 83-year history.

A major factor in this surge in attendance has been the continued expansion of the museum's facilities. Following the appointment of Truett Latimer as President in 1986, and under his direction, the Museum took a bold step forward; buoyed by the success of past campaigns and with a strong eye toward the future, a $12-million capital campaign was launched to expand the museum by almost 36,000 square feet. New areas include the Cullen Grand Entry Hall, the Wortham IMAX Theatre, and the George Observatory in Brazos Bend State Park, which features a 36-inch telescope that is available for public viewing. Completed in 1989, the new facilities more than doubled the museum's size.

Further growth is scheduled for the future. In the fall of 1991 a $17.5-million capital campaign was announced to build an additional 90,000 square feet of collection storage and gallery space featuring a 12,000-square-foot butterfly center, new anthropology, chemistry and paleontology halls, and a state-of-the-art Petroleum Hall. Upon completion of this phase in 1994, the museum complex will comprise more than 140,000 square feet of gallery, storage and office space. These new facilities will allow the Houston Museum of Natural Science to continue to preserve and advance the general knowledge of the natural sciences, while educating and delighting its visitors with the wonders of the natural world.

As mentioned, most museum collections worldwide have, as their nucleus, one or more major collections originally assembled by prominent private collectors. So also does the mineral collection of the Houston Museum of Natural Science. In recent decades the museum has acquired several collections which contained modest accumulations of worldwide mineral specimens. Major John Milsap built one such collection acquired in 1927 which, along with other collections and donations, formed the core of the Museum's gem and mineral collection. The best, however, was yet to come.

During the mid-1970's there arrived on the mineral collecting scene a determined Texas oilman and his wife; they set out to assemble one of the world's finest mineral collections. Perkins and Ann Sams were able to accomplish this goal by teaming up with Paul Desautels, former Curator of Gems and Minerals at the U.S. National Museum of Natural History (Smithsonian Institution). The latter part of the 1970's and the first half of the 1980's saw frenzied activity in the mineral market, due, in large part, to the collecting activities of this illustrious trio.

An integral part of their collecting strategy was to acquire entire collections from other major collectors, thereby ensuring that they would acquire a significant number of the finest pieces available in as short a time as possible. Several important collections were absorbed, including the collection of San Diego County, California, minerals assembled by David P. Wilber; Miriam and Julius Zweibel's superb worldwide collection featuring some of the finest pieces ever recovered from the Tsumeb mine in Namibia; the worldwide tourmaline collection of Charles Key; the collection of Paul Obeniche of France; and some superb specimens from the collection of Ed Swoboda to name just a few.

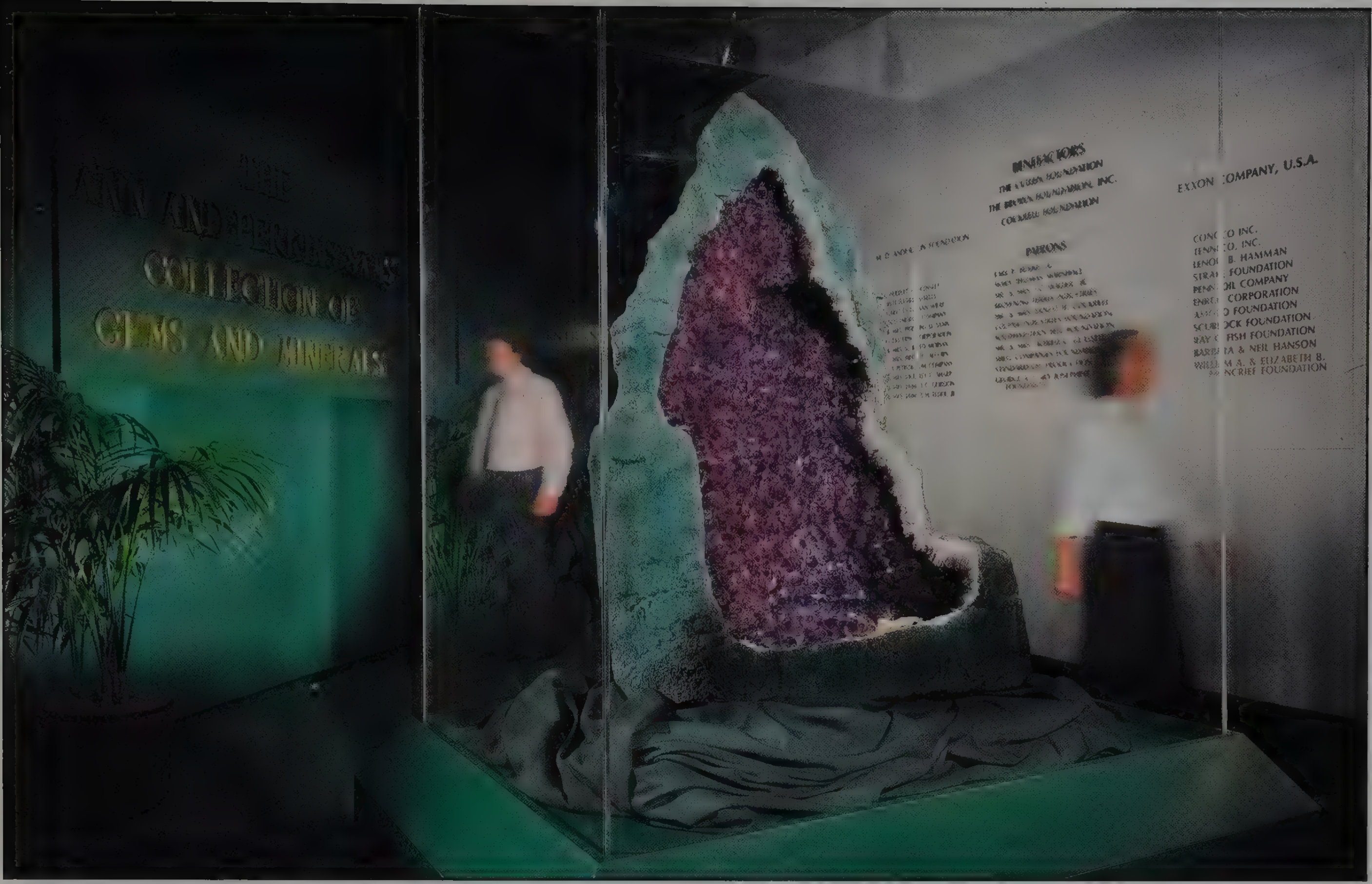
As the collection grew it became apparent that their approach to collecting was anything but subtle. For example, rather than selecting one or two specimens of azurite from a major find at the Tsumeb mine in Namibia, Desautels and Sams bought the entire pocket! Determined to assemble a major suite of tourmalines, they purchased several hundred over the course of just a few months. As a result of this aggressive collecting style they were able to capture some of the finest known specimens of numerous minerals. A cursory review of the collection reveals beautiful, "world-class" specimens of rhodochrosite, azurite, elbaite, beryl (aquamarine, emerald and morganite), corundum (ruby and sapphire), topaz, gold, silver and dozens of other minerals. Complementing these stunning pieces are some of the world's finest crystals of some exceedingly rare minerals, most notably: superb specimens of phosphophyllite, ludlockite, alamosite, pyrosmalite, leadhillite, stottite, jeremejevite, sperrylite, cuprosklodowskite and spangolite. This combination, pieces of unrivaled beauty complemented by specimens of extreme rarity, broadens the appeal of the collection to the layman and connoisseur alike.

In a few short years Ann and Perkins Sams assembled one of the finest private mineral collections in the world. In 1983 they began looking for a home for this magnificent collection, with the hope that it would remain in Texas.

In 1984, Ernest Cockrell, President of the Board of Trustees of the Houston Museum of Natural Science, became aware that the Sams Collection might be available. Cockrell, a collector of fine gems and minerals, was able to appreciate the importance of the collection. He recognized an unusual opportunity for the museum to acquire a collection which, in fact, consisted of several of the world's most important private collections, constituting a cornerstone around which future acquisitions could be built. With Cockrell's guidance, and the very generous support of the citizens of Houston, especially the Cullen and Brown foundations, the Board of Trustees made the commitment to acquire the collection, thereby establishing the Houston Museum of Natural Science as one of the world's major repositories for fine mineral specimens.

With a grand opening gala entitled "Be Dazzled!," the collection went on public display in the Lillie and Roy Cullen Gallery of Earth Science in May of 1986. Dominating the entrance to the Cullen Gallery, by way of introduction to the breathtaking mineral displays, is a reconstructed crystal pocket containing honey-colored calcites, metallic black sphalerites, purple cubes of fluorite and white mounds of barite in every conceivable combination, all from the famous Elmwood mine at Carthage, Tennessee. Tucked away in the crevices of a cave-like setting are numerous exhibits devoted to structural geology (faulting, volcanoes, plate tectonics, etc.), as well as rock and mineral formation. A separate gallery, the Eby Hall of Mineral Science, which opened in September 1990, relates the physical properties of minerals to the history and development of mineralogy as a science. At the far end of the geological exhibits, in the foyer which separates the introductory area from the Sams collection, is a giant, 660-pound amethyst geode from Minas Gerais, Brazil. Unearthed in December of 1990, it was acquired for the museum through the generosity of the Museum Guild in June of 1991.

Just beyond this striking specimen lies the portal which leads into five, interconnected, darkened galleries containing more than 60 brightly lit, recessed display cases featuring some of the finest specimens the mineral kingdom has to offer. Each of the five galleries contains hallmarks of its own. The George R. Brown Hall of Minerals boasts fine suites of tourmaline and azurite, a superb spray of mesolite crystals on a matrix of apophyllite crystals, major specimens of crocoite, phosphophyllite and spangolite, as well as three fine, gem-quality crystals of topaz. The Dr. & Mrs. John McGovern Hall of Minerals features several excellent cerussites from Namibia, a beautiful opal from Australia (weighing more than ten pounds), and what is arguably the world's finest pyromorphite, a magnificent 30-cm cluster of lustrous orange and green crystals to 3 cm, on matrix, from the Bunker Hill mine near Kellogg, Idaho. The centerpiece of the Virginia & Ernest Cockrell Hall of Minerals is also one of the finest mineral specimens in existence: an awesome, intergrown, bright red, 10-cm rhodochrosite crystal on a matrix of quartz and pyrite crystals from the Home Sweet Home mine, near Alma, Park County, Colorado. Rounding out the gallery are superb gem crystals of beryl (aquamarine, morganite and emerald), gem-quality diamond crystals and superb specimens of crystallized gold from California and Brazil. The Exxon Hall of Minerals highlights recent acquisitions as well as superbly crystallized rarities like ludlockite, milarite and scorodite. Also on display in this gallery is a near-perfect, internally flawless, 12-cm crystal of cerussite from Tsumeb, Namibia, and a very fine specimen of crystallized native

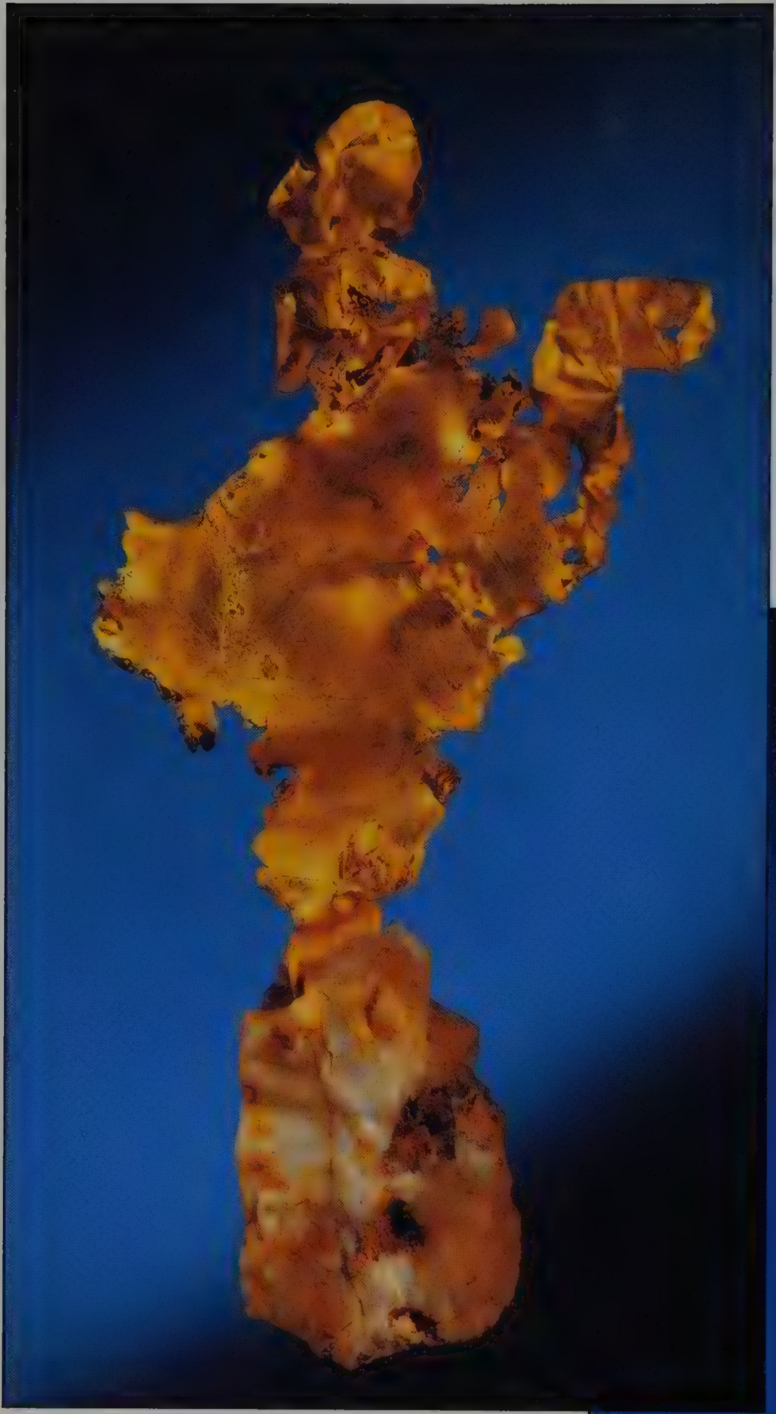


bismuth from Schneeberg, Saxony, Germany. A fifth gallery situated between the mineral halls and the Eby Hall of Mineral Science is devoted to special exhibits, usually focusing on gems and jewelry. Recent exhibits have included selections from the National Gem Collection at the Smithsonian Institution and a major exhibit of native gold featuring important pieces from the Harvard Mineralogical Museum.

It is certainly fair to say that the mineral collection at the Houston Museum of Natural Science represents considerable expenditures of time and money. But more importantly, as a collection of collections it ultimately reflects decades, if not centuries, of connoisseurship in minerals. For while some specimens are indeed "contemporary classics" (mined within the last two decades), others, such as the wire-silver from Kongsberg, Norway, were originally extracted from the earth more than 200 years ago, and have survived the centuries to be enjoyed by present and future generations.

Following is a selection of photographs showing 60 of the 550 mineral specimens currently on public view, and one (the proustite) which is not on continuous exhibit because of its sensitivity to light. The choice of specimens to feature in this catalog was a difficult one because so many are not only extraordinarily beautiful and significant but also photogenic. Those of us involved frequently arrived at different preferences, testifying to the great wealth of specimen material in the collection. Visitors to the museum are invited to decide upon their own favorites, bearing in mind that only half the collection is currently on exhibit, and that an active acquisitions program is adding regularly to this remarkable and unique archive of natural beauty.

The Houston Museum of Natural Science is open 9 a.m. to 6 p.m. Monday through Friday and noon to 6 p.m. Saturday.



Gold

In 1848 gold was discovered in the stream beds of northern California. Miners panned the rivers and sand bars for gold dust and waterworn nuggets, working their way up-stream in search of the "Mother Lodes" where fresh gold veins were being weathered from the hard rock. There they found beautiful crystallized gold specimens such as the three shown here (*left:* 16 cm, from the Shore mine, Tuolumne County; *below:* 17 cm; *facing page bottom:* 3 cm).

Gold

The Morro Velho gold deposit was discovered in the Brazilian jungles of Minas Gerais in 1834. Mining there eventually reached a depth of nearly 2,500 meters before high rock temperatures made deeper workings impractical. The mine continues in operation today, however, and occasionally yields small gold specimens. The extraordinary 14-cm piece shown here *(right)* may well be the finest ever found in South America.

Silver

The silver mines at Kongsberg, Norway, have been famous since 1623 for the beautiful specimens of ropy, curled wire silver found there. The 13-cm example shown at left is especially interesting because of the lustrous black sphalerite crystals attached near the top, and the white calcite crystals farther down. The last of the Kongsberg mines closed in 1957.

Copper

The Michigan copper mines on the Keweenaw Peninsula have been worked since prehistoric times. During the last 150 years, thousands of fine copper specimens have been recovered, but the 6-cm specimen shown here has particularly sharp, well-formed crystals.

Bismuth

Native bismuth rarely occurs crystallized, and when it does the habit is commonly rather confused and intergrown or reticulated. The extraordinary 7-cm crystal group at right may well be the best in existence. It was found at Schneeberg, Saxony, in the late 19th century.

Sulfur

The sulfur deposits of Sicily have been famous for centuries because of the well-formed sulfur crystals found there. The large crystal shown at left (5.5 cm) is from Agrigento. All of the mines on the island are now closed and, although a few small specimens emerge now and then, no more major pieces are likely to be recovered.

Diamond

Excellent specimens of natural diamond crystals in their original rock matrix have occasionally reached the market from the Soviet Union, especially during the last 20 years. The 2-cm gem-grade crystal shown at right is from the Mir pipe ("mir" means "peace") near Yakutia in Siberia.

Proustite

The deep ruby-red silver-arsenic sulfide, proustite, is among the most treasured of all species when well crystallized. The richly transparent 7-cm group shown at right is from the Dolores mine, Chañarcillo, Chile. The Chañarcillo silver deposits were discovered in 1832 by a mule driver named Juan Godoy, who became very wealthy but squandered his riches and was reduced to beggary. Some of the world's finest proustites have come from Chañarcillo.

Acanthite

The Las Chispas silver mine in Arizpe, Sonora, Mexico, opened in 1907 on an extremely rich series of veins. It produced world-class specimens of acanthite, polybasite and stephanite from ore containing over 500 ounces of silver per ton. The acanthite (silver sulfide) pictured at left, 10 cm tall, shows some of the best crystals to have survived.

Bournonite

The Herodsfoot mine near Liskeard in Cornwall, England, is the most famous occurrence of the lead-copper-antimony sulfide, bournonite. During the years 1850 to 1875, sporadic cavities in the upper levels yielded superb specimens with "cogwheel" crystals on white quartz, like the 12-cm example shown at right.

Fluorite

Until recently the only source for fine, pink octahedral fluorite has been the Swiss and French Alps. However, in November of 1980 a zone of vugs in sulfide ore at the Huanzala mine, Huanuco, Peru, yielded a trove of spectacular specimens. The example pictured above is among the best from that discovery.

Ruby

The Mogok stone tract in northern Burma has been mined for rubies since well before its annexation by King Nuha-Thura Maha Dhama-Yaza in 1597. It remains among the world's principal sources, although large specimen crystals like the one shown at right (5 cm) are very rare.

Sapphire

Like ruby, sapphire is a colored variety of corundum (aluminum tri-oxide). Most gem-grade crystals come from Ceylon and Burma, but many (including the 5-cm crystal shown at left) have been found along the Umba River in Tanga province, Tanzania. The Houston Museum collection also includes a large sapphire-blue zoisite (tanzanite) crystal from near Arusha, in the same region.

Cassiterite

Cassiterite, tin oxide, occurs in good crystals at only a few places in the world. The 5-cm specimen shown at right is from the prolific mines at Llallagua ("Ya-ya-gwa"), Bolivia, which, for a time, produced one-tenth of the world's total output of tin.

Cerussite

Cerussite, lead carbonate, is a common ore of lead found in arid to semi-arid mining districts around the world. At only a few locations does it form large and beautiful crystals, however, and the famous Tsumeb mine in Namibia is a classic example. The specimen shown at right, 9 cm tall, has white rhombs of dolomite attached.

Cerussite

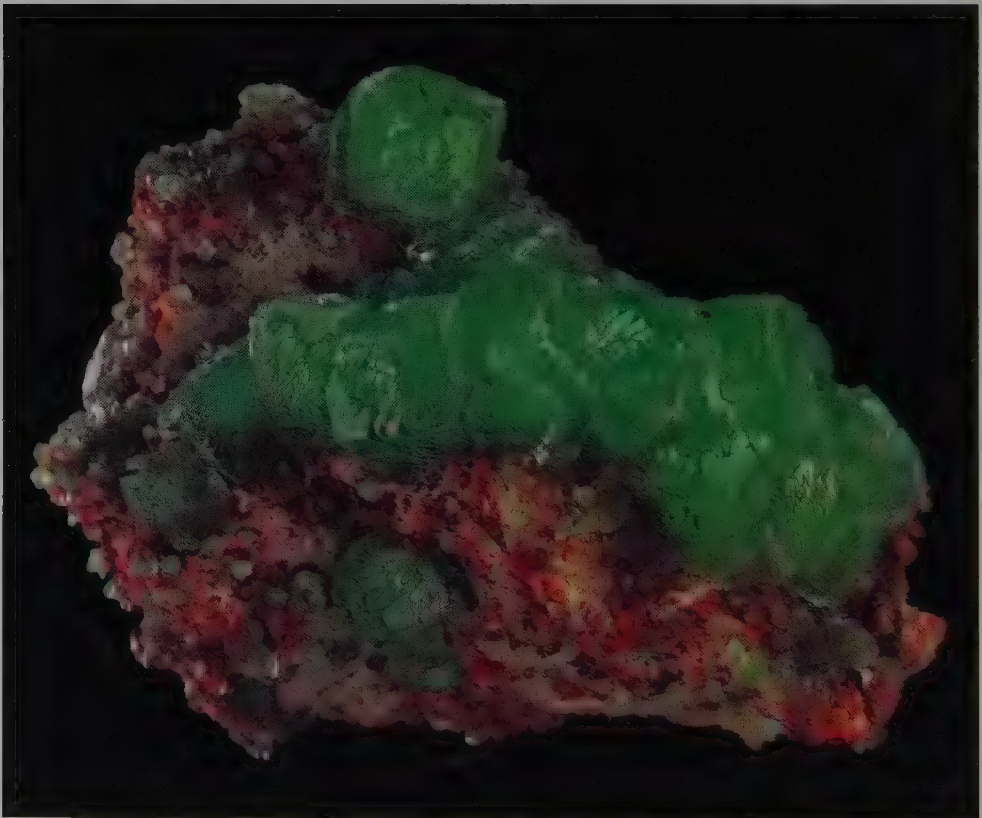
The Kombat mine in Namibia, located not far from the Tsumeb mine, is another source of extraordinary cerussite specimens. The gemmy twin shown at left measures 6.5 cm tall. Mining at Kombat was temporarily suspended in 1988 when a high-pressure aquifer was encountered which quickly flooded the lower levels, killing a number of miners.

Rhodochrosite

Vying with the Home Sweet Home mine as the source of the world's best rhodochrosite (see cover photo) is the Kalahari Manganese Field in northern Cape Province, South Africa. The ruby-red crystal group shown at left is from the N'Chwaning mine, and measures 9.5 cm. Although the crystal size of Kalahari specimens rarely exceeds 3 cm, the crystals have unsurpassed color, luster and clarity.

Smithsonite

The Tsumeb mine in Namibia is virtually the world's only source for apple-green cuprian smithsonite. The 8.5-cm specimen at right, which is remarkable for its deep color, fine luster and transparency, is probably the finest known example of this variety. A similar and even rarer Tsumeb specimen, turquoise-blue in color, is also in the Houston Museum collection.



Azurite

In 1979 a new locality began producing world-class azurite specimens: the Touissit mine near Oujda, Morocco. The 7.3-cm specimen shown at left exhibits the rare "electric blue" color and also some alteration to green malachite. The doubly terminated crystal crossing the larger crystal at its base also contributes to the unusual aesthetics of this piece.

Azurite

The Tsumeb mine in Namibia has produced world-class specimens of many species, particularly azurite. Examples, like the 8-cm crystals shown at right, tend to be lustrous, sharp and blue-black in color. The best specimens were recovered in the 1930's and again in the years following 1957 when a second oxide zone was encountered at a depth of 900 meters.

Quartz

Quartz, in well crystallized specimens, is common at many localities around the world. Consequently, for a specimen to be considered world-class it must have truly spectacular aesthetics. The unusual platy crystals shown above, measuring 10 cm across, fulfill that requirement. In addition, the source of this piece is the Jonas mine near Itatiaia in Minas Gerais, Brazil, renowned for the largest and finest tourmaline crystals ever found.

Rose Quartz

Rose-colored quartz is relatively common as shapeless masses in pegmatite deposits. But fine crystal specimens were virtually unknown until around 1960, when a remarkable pocket of large and beautiful crystal groups was discovered at the Sapucaia mine in Minas Gerais, Brazil. The example shown at right measures 12 cm.

Amethyst

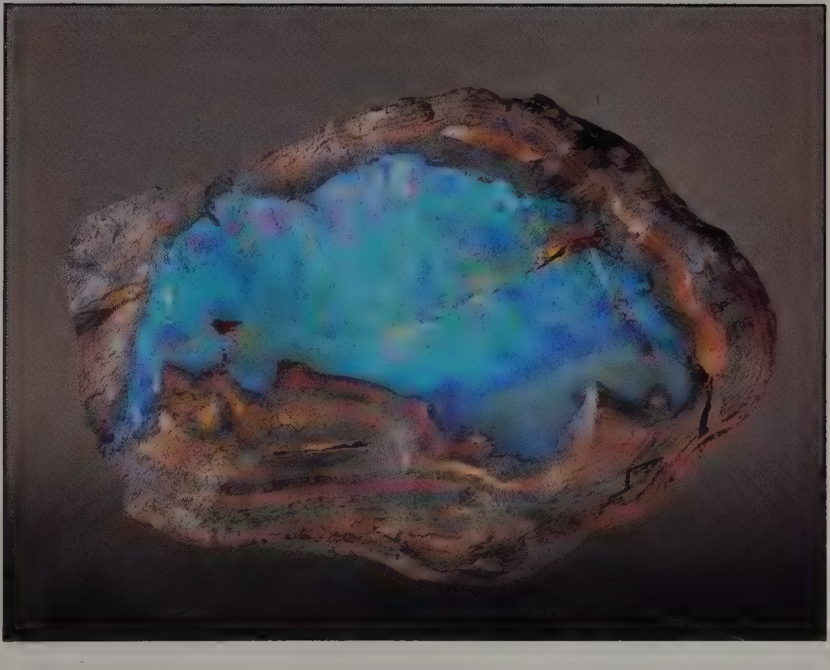
Artigas, Uruguay, has produced some of the largest and finest groups of amethyst (violet quartz) crystals ever found. Nevertheless, most specimens are relatively flat plates covered with stubby crystals; the 15-cm group shown at right is exceptional.

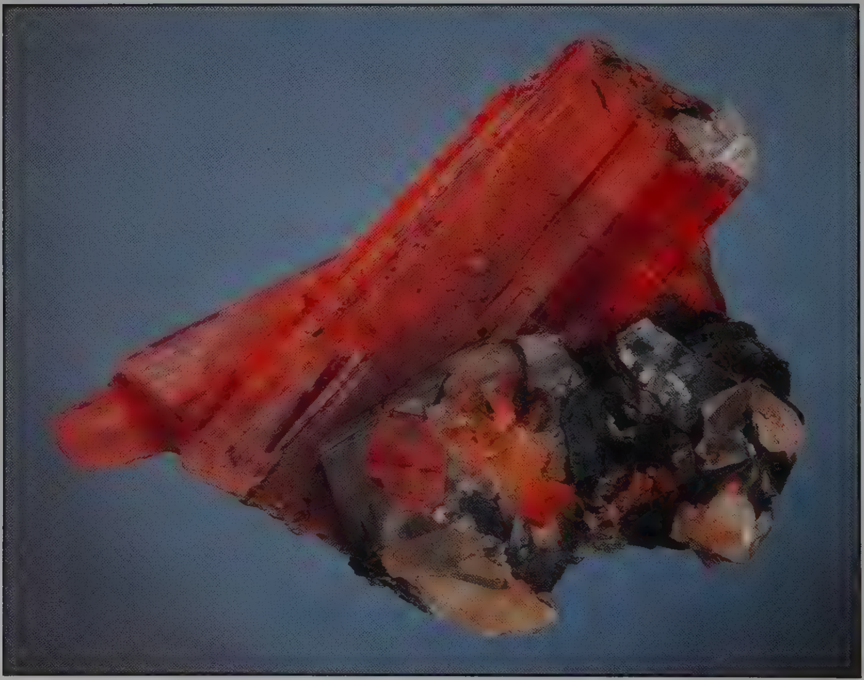
Rutilated Quartz

Quartz crystals shot through with golden needles of rutile (titanium oxide) are among Brazil's most attractive and interesting products, popular as specimens and as gem material. The 16-cm crystal shown above is from Curvello, Minas Gerais.

Opal

The Australian opal fields have yielded large numbers of beautiful gems from many individual occurrences. A unique deposit near the Yowah Homestead in Queensland produces opal nodules in ironstone (called "yowah nuts"), like the 5-cm specimen shown at right.



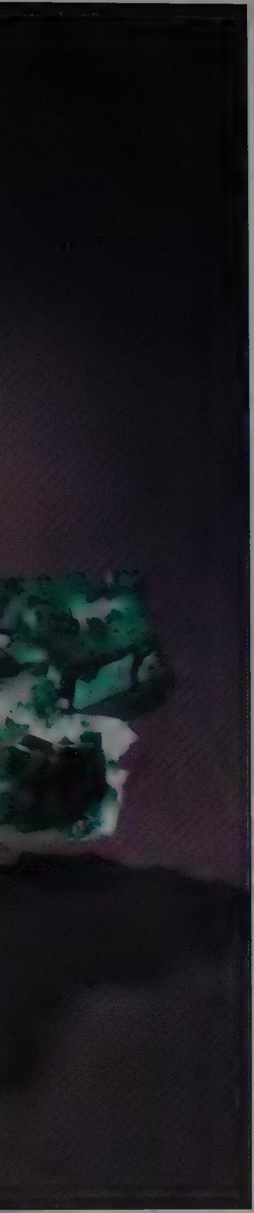


Dioptase

Dioptase and white cerussite, two of the most famous minerals from the Tsumeb mine in Namibia, occur together on the extraordinary 16-cm specimen shown above.

Rhodonite

Bright red rhodonite, a manganese silicate, is among the most treasured minerals from Australia's famous Broken Hill deposit in New South Wales. The terminated, 7-cm crystal shown at left is among the largest and best known.

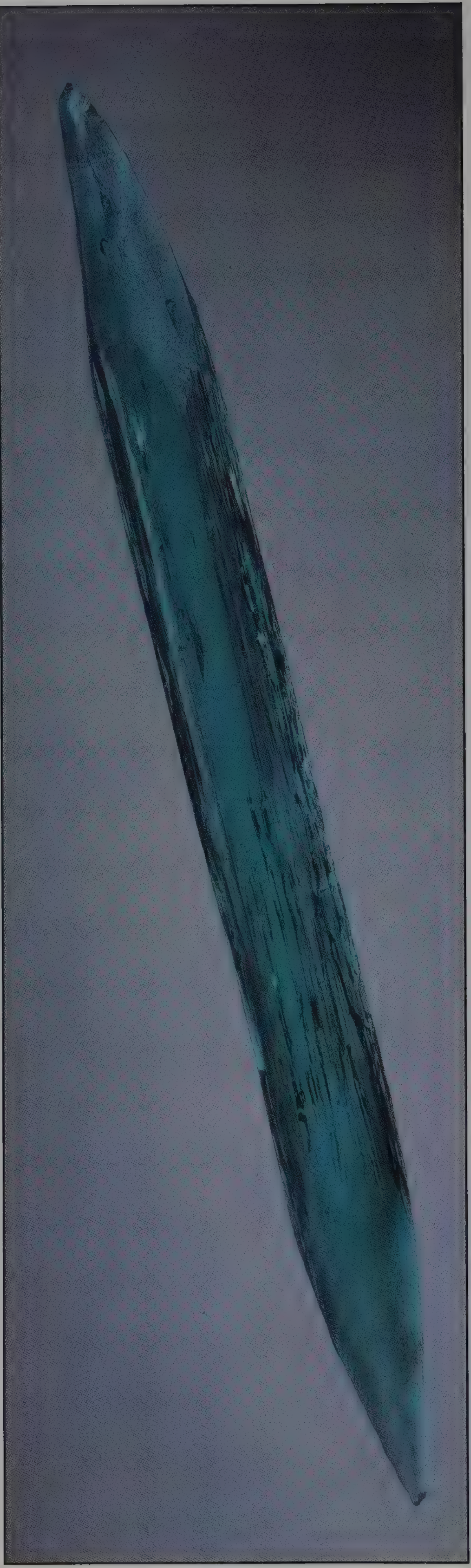


Chrysoberyl

Interpenetrating "sixling" twins of greenish yellow chrysoberyl were found for only a short time around 1939–1941, in the remote Brazilian village of Itaguaçu, Espirito Santo. The example above measures 6.5 cm.

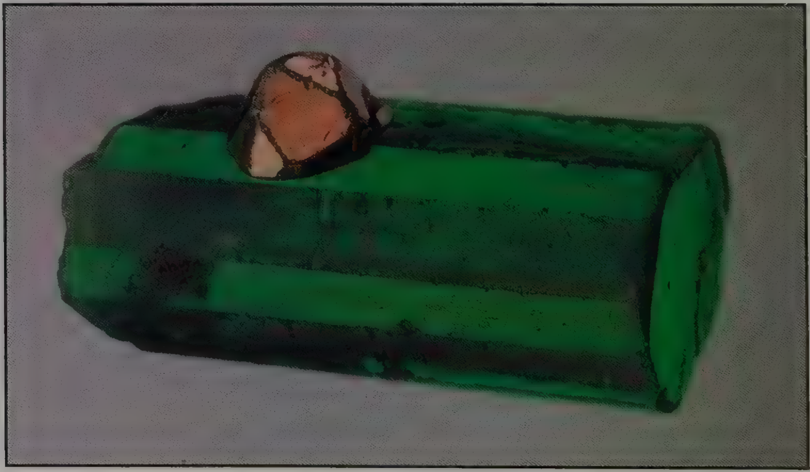
Epidote

The Knappenwand occurrence in Untersulzbachtal, Austria, discovered by a shoemaker in 1865, has produced some of the world's finest epidote. The crystal group at right measures 12 cm.



Beryl

Beryl in its various colors is among the most popular gemstones. The 22-cm blue (aquamarine) crystal at left is from Minas Gerais, Brazil. The 6.5-cm pink (morganite) crystal on cleavelandite, shown above, is from the White Queen mine near Pala, California. And the 2.7-cm chromium-green (emerald) crystal with pyrite, shown below, is from the famous Chivor mine in Colombia.



Topaz

The "Imperial topaz" mines around Ouro Preto in Minas Gerais, Brazil, have produced the world's most beautiful golden to reddish orange topaz. The first specimens, found in 1751, were called "Brazilian rubies" and caused great excitement at the Royal Court in Lisbon, Portugal. The two large, gem-grade crystals shown at left, measuring 12 and 13 cm, are both from the Saramenha mine.

Topaz

Blue topaz also reaches its finest development in Brazil. The huge, 18-cm crystal shown at right was taken from the Xanda mine at Virgem da Lapa, Minas Gerais, in the mid-1970's. The world's finest hydroxyl-herderite, in large lavender-colored crystals, came from the same area; the Houston Museum has two fine examples of these as well.

Spessartine

During the 1960's the Hercules mine near Ramona, California, was worked for orange spessartine garnet, and yielded a number of fine specimens. The 7-cm piece shown at right, with albite and black schorl, contains one of the best surviving crystals.

Tourmaline

The pegmatite deposits of San Diego County, California, have yielded many tons of the finest tourmaline ever found in North America. The Himalaya mine in the Mesa Grande district has been the leading producer. Most of the output from 1904 to 1912 was sold to the Chinese government as carving rough, and relatively little mining took place for many years thereafter. But in 1977 the mine was reopened and for the last ten years has yielded a fabulous wealth of specimens. The example at left, 12.5 cm tall, is an old specimen from the early period of mining.

The Tourmaline Queen mine has also been a significant producer, but a single, large pocket found in 1972 stands out from all the rest because of the deep blue caps on the large pink crystals. The 20-cm group shown at right is among the finest recovered from the pocket.

Tourmaline

Brazil (with California) is the other leading producer of fine tourmaline. The 17-cm crystal shown above was found at the Santa Rosa mine. First discovered in 1938 and worked intermittently for years, Santa Rosa's big discovery took place in 1968 when hundreds of pounds of green and pink tourmaline were removed from a single pocket. The example pictured here is unusual because of its yellow termination.

The color-zoned, 10-cm crystal shown at right is from the Araçuai area, a district rich in gem pegmatites. The complex, well-formed termination is relatively unusual.

Mesolite

The massive basalt flows which cover 200,000 square miles in west-central India have yielded countless thousands of fine zeolite specimens. Large gas bubbles frozen in the once-molten lava rock make ideal locations for extraordinary specimens like the 23-cm mesolite spray (shown above) to form. This specimen was collected near Poona in Maharashtra state.

Pyromorphite

In 1980 a huge walk-in pocket was discovered at the Bunker Hill mine near Kellogg, Idaho. Fabulous groups of up to 3-cm orange, yellow and green pyromorphite crystals were removed, the largest (30 cm) and best of which is pictured above. It is probably the finest known example of the species.

Phosphophyllite

The Potosi mines in Bolivia have been famous for silver since the 16th century. Their riches financed the Spanish Armada which sailed against England in 1588. The Potosi mint was kept busy striking pure silver coins which became accepted currency throughout the world. It is surprising, therefore, that Potosi's fame as a specimen locality should rest on a beautiful, green, silver-free mineral called phosphophyllite, not found there until the 1950's. The twinned crystal at left measures 7 cm, and was removed from the Unificada mine; it is probably the second best in existence.

Brazilianite

The first occurrence in Minas Gerais, Brazil, for the new species brazilianite was discovered in 1942 and mined out in 1943–1944. Called Córrego Frio ("Cold Stream"), it yielded what are still considered to be the finest examples of the species, despite the fact that many other occurrences have since been discovered within a radius of a few miles. The 4-cm crystal on muscovite shown at right is among the finest small specimens from that initial find.

Legrandite

Fine specimens of the zinc arsenate, legrandite, have been found at only one occurrence: the Ojuela mine near Mapimi, Durango, Mexico. Mining for silver in the district began in 1598 and has continued intermittently until modern times. Fine specimens of many species have been recovered there for decades, most notably adamite (see page 28), mimetite, hemimorphite, wulfenite, aurichalcite, paradamite and legrandite. The world's finest legrandite specimens were discovered at the Ojuela mine in the mid-1970's, of which the 11-cm crystal group pictured at left is an excellent example.

Adamite

The Ojuela mine near Mapimi, Mexico, has been famous since at least the 1940's for the beautiful yellow to yellow-green adamite found there. Scattered specimens with a lilac tint were encountered periodically, but it was not until 1981 that a major pocket of bright purple adamite was found. Specimens from that one discovery immediately ranked as the world's best, and the example shown above is perhaps the finest of the lot.

Mimetite

The Tsumeb mine in Namibia has produced the world's best specimens of a number of attractive species, including mimetite. The best mimetites are generally considered to be the pale yellow, water-clear crystals to 5 cm found in 1971, and the Houston Museum does indeed have a fine example from the two dozen or so specimens that comprised that find. The 7-cm specimen shown at left, however, is from a different pocket characterized by beautifully formed crystals with less transparency but with inclusions of a red mineral. Had the gemmy crystals not been found, this specimen might well have ranked as the finest known for the species.

Ludlockite

Ludlockite occurs only at Tsumeb, Namibia, but no one is sure exactly where, because all known specimens were taken from a boulder of ore after it had been dumped on the surface. The spray shown at left measures 3 cm.

Vanadinite

Although the lead mines near Mibladen in Morocco have been worked for at least a century, it was not until the late 1960's that significant quantities of fine vanadinite specimens began to reach the market. These crystals immediately set the standard for the species because of their size, luster, color and sharpness. The specimen at right measures 4 cm across.

Scorodite

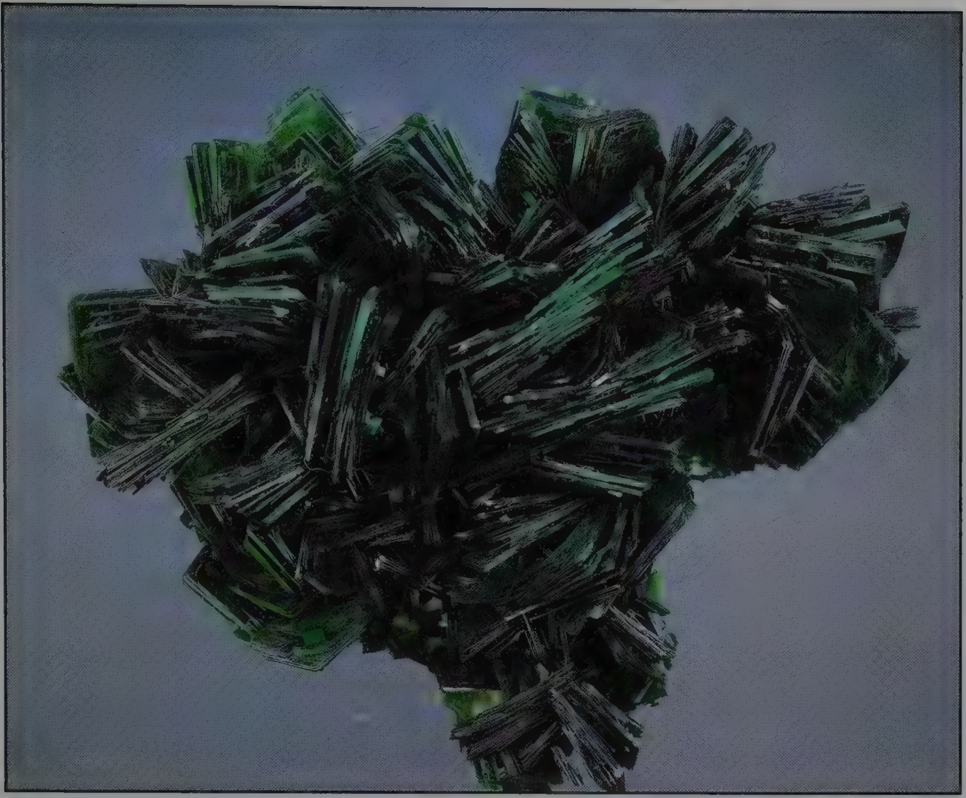
A single pocket of superb, blue-green scorodite crystals to 3 cm was found at the El Cobre mine, Zacatecas, Mexico, in 1968. Only about eight or ten good cabinet specimens were recovered, but they are the best for the species. The specimen shown at left is from that find.

Jeremejevite

The rare mineral jeremejevite, an aluminum borate, occurs in Germany and Siberia, but reaches its best development in the Cape Cross pegmatite near Swakopmund, Namibia. The 5.5-cm specimen shown at left is remarkable for being a crystal group on matrix (most crystals were recovered loose) and may be the best known example of the species.

Cuprosklodowskite

The Musonoi mine near Kolwezi in the Shaba region of Zaire was originally opened as a copper and cobalt mine, but in the 1950's a uranium-bearing zone was found. This 50 x 100-meter zone has yielded the world's finest specimens of cuprosklodowskite, a copper uranate-silicate. The 12-cm pocket shown below is among the best known examples.



Metatorbernite

The Musonoi mine near Kolwezi in Zaire (see facing page) has also yielded the world's finest specimens of metatorbernite, a copper uranyl-phosphate. The 9-cm specimen at left is typical of the emerald-green color and platy habit shown by the best pieces.

Anglesite

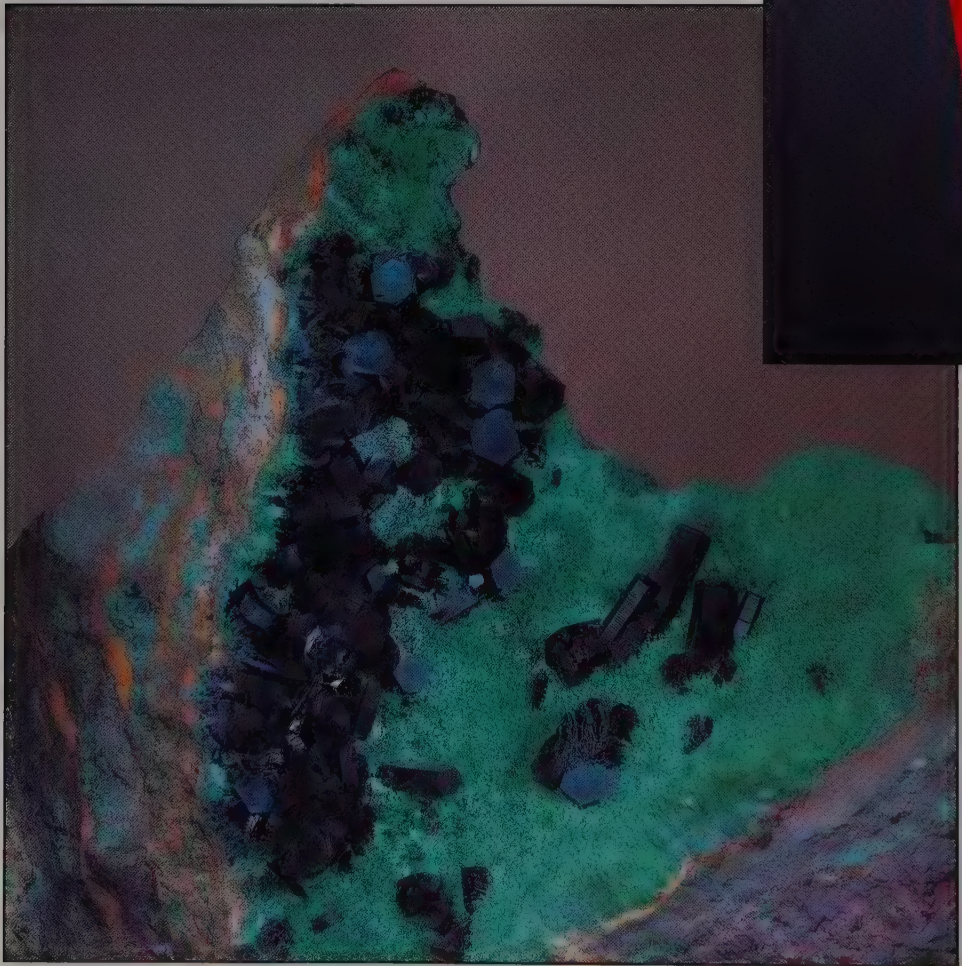
The Touissit mine in Morocco has produced some of the world's finest specimens of anglesite during the last ten years. The crystals, like the 7-cm example at right, are notable for their pleasing yellow color, sharpness and transparency.

Leadhillite

Fine specimens of leadhillite have been found at Leadhills in Scotland and at the Mammoth–St. Anthony mine in Arizona, among others, but the largest sharp crystals come from the Tsumeb mine in Namibia. The 7-cm group shown at left is among the best known specimens of the species.

Crocoite

Brilliant red prisms of crocoite from Tasmania have been sought after by collectors since before the turn of the century. Thousands of fine crystals and groups have been mined but, of all these, the 11-cm pair of crystals shown at right, found at the Adelaide mine in the 1920's, is considered to be the best. All of the mines around the district capitol of Dundas are now closed, caved, worked out or flooded.



Spangolite

Spangolite, a rare copper-aluminum sulfate, has been found at a number of copper mines in Cornwall, Sardinia, and the American West. The best example by far is the 13-cm specimen shown at left, which carries individual crystals up to 1.6 cm in size. It was found in the famous Copper Queen mine at Bisbee, Arizona.

Wulfenite

The Los Lamentos district near Villa Ahumada, Chihuahua, Mexico, has been a prolific producer of beautiful wulfenite specimens since the 1930's. The best crystals, like those shown above, are 5 cm or more in size and very lustrous, with sharp edges and a rich orange color.

Scheelite

Fine scheelite specimens have been found at a number of localities worldwide. Although the relatively small, red-orange crystals from Brazil, Arizona and Siberia are very sharp and attractive, the enormous 16-cm crystal shown at right should probably be considered the best for the species. It was found in the Taewha mine in central South Korea.

FLUORITE AND ASSOCIATED MINERALS FROM ASTURIAS, SPAIN

Carles Curto Milà
Museu de Geologia de Barcelona
Parc de la Ciutadella, s/n.
08003 Barcelona, Spain

Jordi Fabre Fornaguera
c/ Arc de Sant Martí 79 (Local)
08032 Barcelona, Spain

Over the last few decades and especially in the 1980's, localities in Spain have become famous internationally for beautiful specimens of crystallized fluorite. These occurrences, particularly Berbes and La Collada, rank among the world's best for the production of aesthetic specimens.

INTRODUCTION

In recent years, fine specimens of Spanish fluorite have appeared regularly on the international mineral market (see, for example, Wilson, 1981, 1989; Curto and Fabre, 1987; Green, 1990; and Green *et al.*, 1991. These have generally been labeled as coming from Asturias or Oviedo. In fact, a number of different mines and zones of similar geological origin have been responsible for the output, each producing specimens of characteristic habit, color and associations.

In this article we will describe the three most important occurrences for Asturian fluorite, giving an overview of the mining areas, and a discussion of the characteristic features and associated species typical of each area. The three specimen-producing districts are Caravia-Berbes, La Collada and Arlós-Villabona.

Asturias is an ancient kingdom in northwestern Spain; since 1823, it has been officially known as the province of Oviedo, although usage of the old name still predominates. It has been an "Autonomous Community" since 1982. The area is among the richest mining regions in the country. The economic importance of fluorite in Spain has developed only recently, Asturias being among the most productive regions in Europe (Ferrand and Thibiéroz, 1978). Official estimates (I.G.M.E., 1986) indicate that 331 people were employed in 1986, producing approximately 250,000 metric tons of 97%-pure fluorite per year (Vázquez Guzman, 1989). The principal companies involved are Minerales y Productos Asociados S.A. (MINERSA), Minas de Villabona S.A., and Fluoruros S.A. (Vázquez Guzman, 1989).

GEOLOGY

The economic fluorite mineralization in Spain occurs at the base of the Asturian Permo-Triassic Basin, and is clearly related to Carboniferous, and in places Devonian, horizons (Vázquez Guzman, 1983, 1989). The faulted block comprising the basin is bounded on the south by the Cantabrian Range, deformed during the Hercynian orogeny.

Fluorite is found in sandstones and conglomerates deposited over a horizon now dipping gently to the north at 10°–15°. This layer is related to an angular unconformity between Paleozoic rocks and red Permo-Triassic sediments. Volcanic rocks are intercalated in the upper parts of the Triassic strata (reddish shales of Keuper age).

The ore bed is composed of a brecciated post-Paleozoic unit, with fluorite filling karstic channels and cavities. The breccia and associated deposition of fluorite are thought to be related to a peneplain subjected to repeated subsidence and in-filling.

Some authors have proposed a syngenetic origin for the mineralization. However, subsequent studies of fluid inclusions and temperatures of formation suggest that the fluorite may be epigenetic, the calcium and fluorine having been derived from Devonian or Carboniferous schists and clayey limestones, or older sediments reworked during the Permian period (Forster, 1974).

More detailed reviews of the geology of the various Asturian fluorite mining districts may be found in Tejerina and Zorrilla (1980), Tejerina and Vargas Alonso (1980), Endlicher (1976), Ferrand and Thibiéroz (1978), and Ferrand *et al.* (1978).

FLUORITE MINING DISTRICTS

Caravia-Berbes District

The Caravia-Berbes deposits are situated on the northeastern coast. Historically the most productive occurrences were the Ana and San Lino mines, but these are now closed.

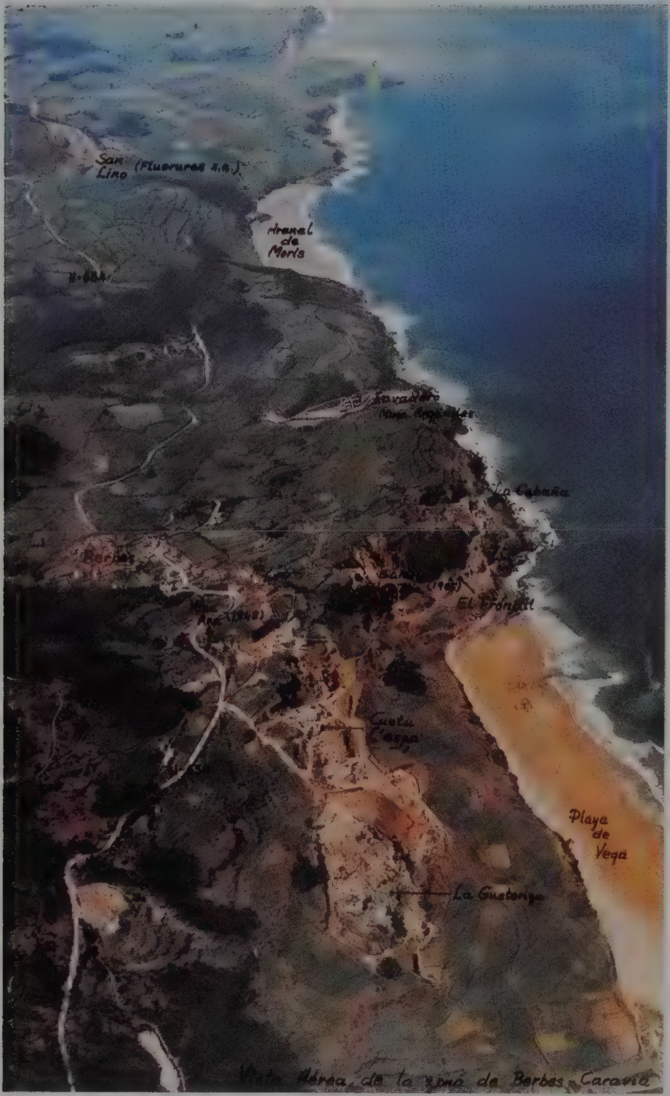


Figure 1. **An aerial view showing the Caravia-Berbes district (1982). Photo by José Ramón García Alvarez.**

Between the Ana mine and the seacoast at Vega beach are some mineralized zones known collectively as "Berbes," after the local village. The Berbes area has been intensively exploited by prospectors and mineral collectors, especially following the closure of the Ana mine in 1986. In addition to the usual manual methods, power shovels and explosives were used at Berbes to such an extent that the occurrence is now practically exhausted. Only minor, sporadic finds are being made today, generally by private collectors visiting the site on holidays.

The most beautiful fluorites found in the Caravia-Berbes district have all come from the occurrences known as "La Cabaña" and "Cuetu L'Aspra." The best crystallization, transparency, luster and color are all characteristic of these two places. The crystal pockets, when first opened, are generally full of mud which obscures the crystals and makes on-site specimen evaluation difficult; a thorough cleaning is necessary.

In May of 1985 a new mine called the "Emilio" opened a few kilometers away from Berbes village, between the villages of Caravia and Colunga. The first good fluorite specimens were removed in 1988, from a depth of 80 meters.

In the 1960's a few fluorite specimens similar in habit to those from the Emilio mine were reported to have come from Colunga. They can still be seen in some museums and private collections.

La Collada District

The La Collada district, located 10 to 15 km inland in the north-central part of Asturias, consists of a series of mines and quarries surrounding the small village of La Collada. Quarries were opened there in 1936–1939, and active mining took place in the 1940's. However, in 1943 or 1944 thieves stole the payroll money from the mining company office, a loss which forced the mines to close for many years.

The La Collada mines operated intermittently during the 1970's, but closed permanently in 1986. Today, due to lingering legal problems and the nature of the deposits, there is virtually no possibility for additional specimen discoveries to be made. The only fluorites coming out are those that have been saved by miners and collectors from the time of active mining.

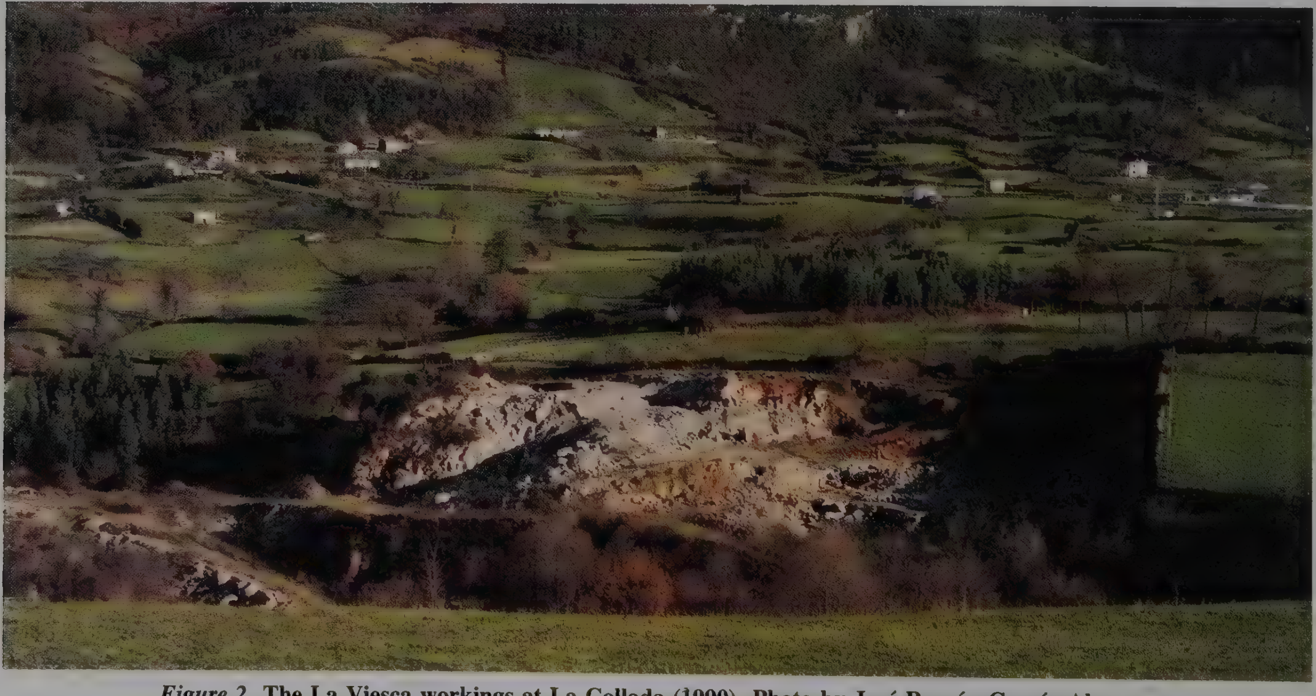


Figure 2. **The La Viesca workings at La Collada (1990). Photo by José Ramón García Alvarez.**

Figure 3. **Fluorite with barite, collected at La Cabaña, Berbes, in 1986; 30 cm. It was removed from a large geode which yielded many excellent specimens, some of them truly exceptional. Sorbonne collection; Nelly Bariand photo.**

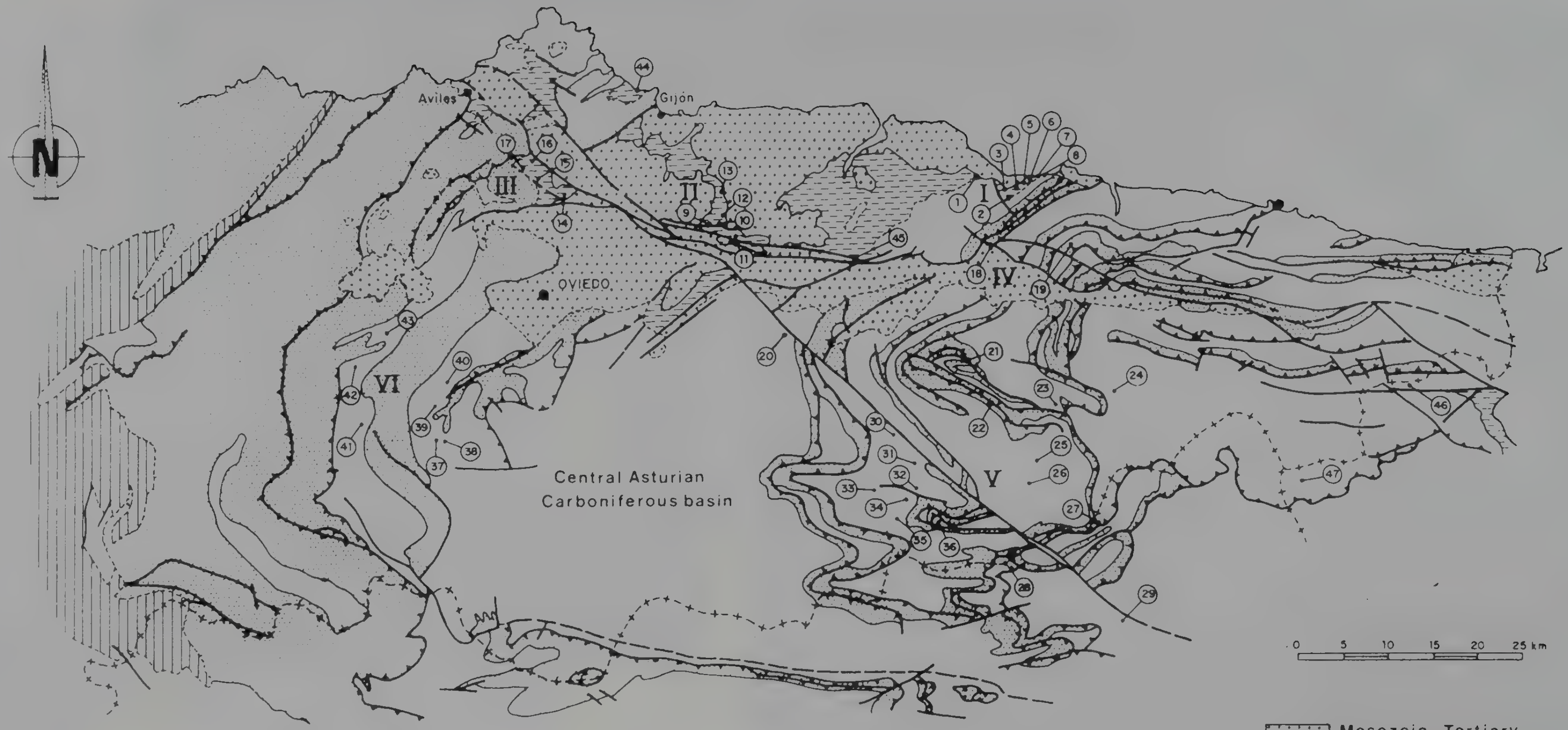
Figure 4. **Fluorite, 8.5 cm, found at the Moscona mine, Villabona, in 1987. Note inclusions of globular pyrite-marcasite forming zones. Fabre collection; Curto Milà photo.**

The best fluorite specimens at La Collada came from level 75 between the Veneros Norte and Pozo Collada shafts, in crystal-lined cavities measuring up to 4 x 10 meters.

Arlós-Villabona District

The Arlós-Villabona district is located about 20 km west of La Collada, halfway between the coast and the capital city of Oviedo. The dumps and shafts of the Villabona and Cucona mines are visible from the village of Villabona.

The Villabona mine was the first opened in the district; activity shifted to the Cucona mine in 1975. Fluorite veins there average 3 meters in thickness, dipping gently at 10° to 20°. In 1979 the Moscona mine, with veins 4 to 8 meters in thickness, began operation. The Moscona mine is located 1 km from the village of Solis, which is



I CARAVIA-BERBES	II LA COLLADA	III. VILLABONA-ARLOS	IV S. DEL SUEVE	V. BELEÑO-C. DE CASO	VI. ARAMO	INDICIOS VARIOS
1 ROZADA 2 OBDULIA CHU VALNEGRO CANELLO 3 EDUARDO 4 DUYOS-EL CORONEL EL VALLIN FILON I 5 AURORA Mª DE LAS NIEVES 6 SAN LINO LAS PIEDRAS 7 ANA LA CABAÑA FRONDIL 8 CUETO LASPRA	9 F COLLADA ROMANI PERUYERA CASA DE LA LUZ 10 J VENEROS COROÑA F. EQUIS VENEROS-EL CANTU ZOREINA VALLE de la ESTACION 11 SARIEGO 12 LA VIESCA 13 BALDORNON	14 VILLABONA CUCONA 15 FERROÑES CASA DEL CURA 16 MOSCONA M. GLORIA TAUJO ROSARIO 17 ARLÓS	18 FIOS COFIÑO	19 MARGOLLES 20 PEÑA-MAYOR 21 C. MERANDI 22 SELLAÑO 23 LLAMPRA 24 P. PRIMIELLO 25 BELEÑO 26 SOBREFOZ 27 C. LLAETE 28 TARNA 29 BURÓN 30 GOBEZANES 31 VENEROS 32 P CASAL 33 CALEAO 34 SANTA FE 35 LA FELGUERINA 36 BIAIZ	37 M. CAROLINA 38 PEÑA TENE 39 VILLAMEJIN 40 LAS XANAS 41 CADUPO 42 VENDILLES 43 PANDO	44 XIVARES 45 PIEDRAVELLA 46 TREVISO 47 ALIVA

Figure 5. **Fluorite deposits in Asturias-Leon (after Vázquez Guzmán, 1989).**

situated a short distance northwest of Villabona.

Mining continues today in the Arlós-Villabona district, albeit somewhat intermittently, so there is currently a better chance for specimen recovery there. The miners generally have specimens.

MINERALS

Barite $BaSO_4$

In the Berbes area barite occurs in book-like clusters of thin, white, translucent to opaque, platy crystals with poorly defined faces and rounded edges. Some specimens have limonite inclusions.

In the Caravia area, white, laminar, pearly and opaque, 1-cm book-like clusters have been found at the San Lino and Emilio mines.

In the Arlós-Villabona area barite occurs as laminar to tabular crystals having well-formed faces. A pinacoid, two prisms of the same crystallographic zone and one at right angles to them are the predominant forms, but other small forms exist which may correspond to higher order prisms or even bipyramids.

The color of barite from the Arlós-Villabona area ranges from translucent milky white (most common) to gray-blue and pale sky-blue (transparent to translucent) and yellowish white to golden yellow (found in 1990). These latter specimens are strongly reminiscent in shape and color to the larger classic examples from Cumberland, England. The crystal size ranges up to 15 cm, but most crystals are closer to 6 cm.

Some collectors and dealers have been exposing milky white Arlós-Villabona specimens to the sun, causing them to turn a rather dirty, pale blue color. However, the effect cannot duplicate the naturally colored specimens, which show a bright, clean blue color.

Recently (late 1990, early 1991) some small, pearly pink barite crystals coating fluorite cubes and calcite crystals were found at Arlós-Villabona.

Calcite $CaCO_3$

Calcite is very rare in the Berbes area, where it occurs as small white scalenohedrons coating fluorite cubes.

In the Caravia area scalenohedral crystals were encountered periodically in the San Lino mine. These crystals are white or yellowish in color, sometimes with a brown (limonitic?) crust. White to yellowish scalenohedral crystals have also been found at the Emilio mine.

At La Collada, calcite was found in the Josefa vein, in groups of large, white, translucent to opaque scalenohedons and penetration twins. In rare cases these crystals show predominant rhombohedral and minor ditrigonal prism faces.

In 1978, in the Pozo Coroña mine at La Collada, white to yellow calcite scalenohedra to 15 cm were found on matrix. Nearly all are twinned.

Calcite is widespread in the Arlós-Villabona district, where it occurs in a variety of habits. The most common consists of a rather flat, low-angle rhombohedron, sometimes modified by small ditrigonal prism faces and other rhombohedra of varying development. These crystals commonly occur stacked in columnar, co-axial aggregates capped by a larger crystal so as to present a scepter-like aspect. Scalenohedral phantoms inside rhombohedral/prismatic crystals are also found. Scalenohedra to 10 cm (more typically 1 to 6 cm), usually twinned, are common as well. The color varies from translucent milky white to golden yellow, with a very bright luster. Ferruginous red inclusions along zones near the terminations of scalenohedra may also be present in some crystals.

Chalcopyrite $CuFeS_2$

In the Emilio mine chalcopyrite occurs in small, well-formed, unaltered tetragonal disphenoids, some having curved edges and some showing twinning. Fluorite is always present in association.

At La Collada, chalcopyrite crystals occur on dolomite and as inclusions in fluorite crystals.

Dolomite $CaMg(CO_3)_2$

Dolomite occurs with chalcopyrite at La Collada. It has also been found as small, white to pale pink rhombohedra of the typical, distorted saddle shape at Arlós-Villabona. These saddle-shaped crystals commonly line vugs and fissures, forming the substrate for the later growth of barite and calcite crystals.

Fluorite CaF_2

Fluorite from Berbes is typically cubic in habit, sometimes showing dodecahedron faces as narrow bevels along the cube edges. The color ranges from lilac to deep violet or purple and, more rarely, to pale blue and deep blue, with pronounced color zoning. The crystal faces are typically mirror-smooth and lustrous, but in other cases a cobblestone effect is produced as a result of surface growth features. Dendritic inclusions are relatively common, as are fluid inclusions (Garcia Iglésias and Touray, 1976, 1977), the latter showing a pale yellow fluorescence. Although vugs at Berbes tend to be rather small, exceptional crystal groups up to 80 cm have been found there with barite.

In the San Lino and Jaimina mines at Caravia similar specimens have been found, although these more commonly have tetrahexahedral faces, alone or modifying the edges of cubes. The tetrahexahedral modifications are sometimes gently curved. The color ranges from lilac and violet to sky-blue, making an attractive contrast with the white barite or calcite crystals and groups serving as matrix. But the luster of Caravia fluorites is not as bright nor the faces as smooth as on the Berbes specimens.

In the Emilio mine, fluorite occurs in groups of cubic crystals, some with minor dodecahedral modifications. The crystals are water-clear and colorless to pale blue, often with a high luster. Parallel-growth aggregates and color zoning are common features. White, translucent crystals have been found with calcite, chalcopyrite and (more rarely) sphalerite. The Emilio mine crystals do not fluoresce noticeably.

A few fluorite specimens came from the Colunga area in the 1960's, but their precise source is unknown. They are similar in appearance to the Emilio mine specimens.

Fluorite crystals from mines and quarries around La Collada are easily recognized by their distinctive habit. A dominant cube is combined with a minor dodecahedron, the cube faces being smooth and the beveling dodecahedron faces very rough in texture. The fluorite crystals, isolated or in groups, are typically imbedded to some extent in white calcite scalenohedra. The crystals are sky-blue to deep violet and purple, and transparent to translucent, often with strong color zoning. The darkest color is typically concentrated along the dodecahedron faces.

Crystals from the La Viesca open pit at La Collada show some variation in that the beveling dodecahedron faces are more smooth rather than rough, and the dominant color is blue to lilac and less intense. Color zoning is common, and fluorescence is absent. A peculiarly lustrous bubbly texture on the cube faces is another distinguishing aspect of some specimens, as is the association with quartz rather than calcite.

Fluorite at Arlós-Villabona occurs as groups of unmodified cubic crystals with smooth, brilliant, well-formed faces, high transparency and a pale yellow to honey-yellow color. Some crystals are zoned parallel to the cube faces, a feature particularly noticeable under longwave ultraviolet light: the surface zones appear pale yellow and the cores violet.

Pyrite FeS_2

Pyrite occurs as microcrystals coating fluorite aggregates at the Emilio mine and at Caravia. At Arlós-Villabona it is found as very small, somewhat deformed cubic crystals with an iridescent patina. These crystals partially or completely coat fluorite, calcite, barite and other species, sometimes preferentially concentrated along crystal edges, striations, terminations, etc. Globular and reniform growths,

Figure 6. Fluorite on calcite, 6.5 cm, found at an unidentified location at La Collada in 1974. Note rough-surfaced and darker colored dodecahedron faces. Sorbonne collection; photo by Nelly Bariand.

Figure 7. Fluorite on barite, 7 cm, from the same pocket at La Cabaña as the specimen in Figure 3. Fabre collection; Curto Milà photo.

Figure 8. Fluorite on matrix with quartz, the large crystal measuring 7.5 cm on edge, from La Viesca at La Collada. Fabre collection; Curto Milà photo.

Figure 9. Calcite on fluorite, 6.5 cm, found at Veneros Norte, La Collada, in 1984. Fabre collection; Curto Milà photo.

Figure 10. Barite with calcite and fluorite, 11.5 cm, found at the Moscona mine, Villabona, in 1985. Fabre collection; Curto Milà photo.

Figure 11. Barite with calcite, 24 cm, found at the Moscona mine, Villabona, in 1987. Museu de Geologia de Barcelona specimen no. 14,424; photo by Jordi Calafell.

Figure 12. Calcite on fluorite, 5.5 cm, found at the Moscona mine, Villabona, in 1990. Fabre collection; Curto Milà photo.

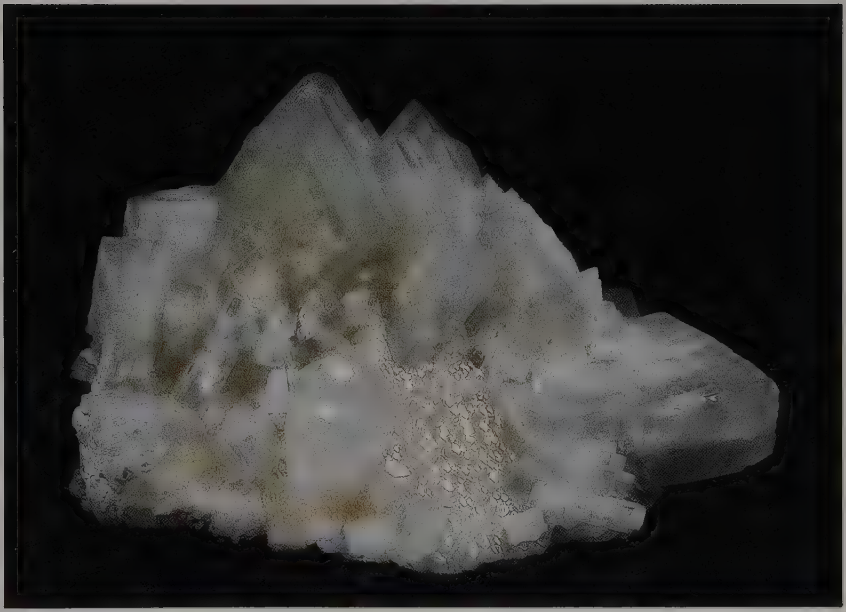


Figure 13. Botryoidal pyrite coating fluorite, 7.7 cm, found at the Moscona mine, Villabona, in 1988. Fabre collection; Curto Milà photo.

Figure 14. **The Pozo Coroña workings at La Collada (1990). Photo by José Ramón García Alvarez.**

possibly consisting partially of marcasite, occur covering or accompanying the other minerals from the area.

Quartz SiO_2

Quartz occurs at Caravia-Berbes as typical hexagonal prisms with six-faced terminations. These are often found as doubly terminated "floaters," individually and sometimes in groups, and very rarely in association with fluorite crystals. The quartz is colorless and transparent, with many fluid hydrocarbon inclusions and moveable bubbles (Garcia Iglésias and Touray, 1976, 1977). These inclusions fluoresce pale yellow under longwave ultraviolet light. Quartz druses have also been found coating fluorite and barite crystals.

At La Collada, quartz has been found as closely grouped layers or druses of rhombohedral points covering matrix rock and underlying fluorite crystals.

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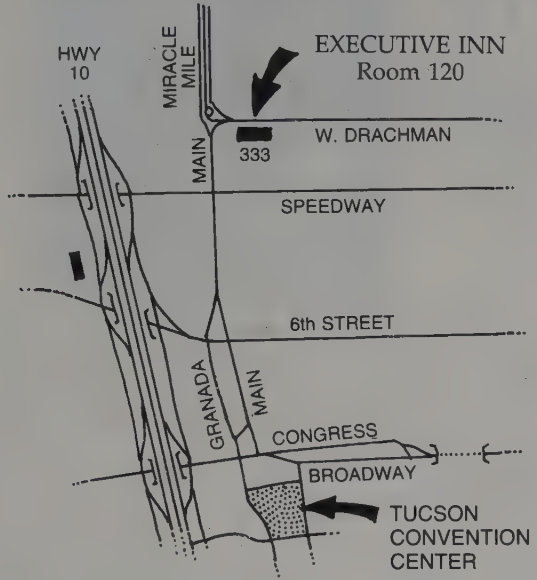
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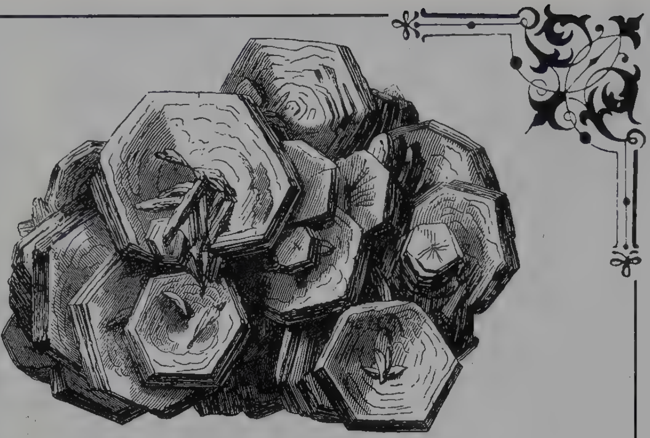

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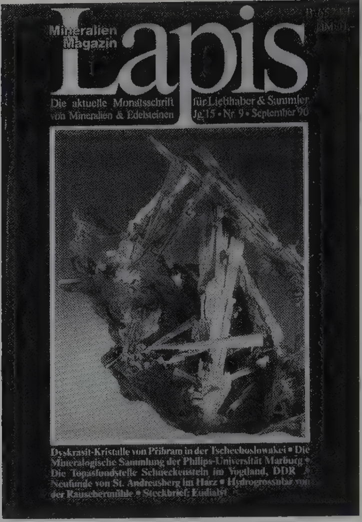

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Symposia

The 13th Mineralogical Symposium sponsored jointly by FM, the Tucson Gem and Mineral Society and the Mineralogical Society of America, will be held at the 38th Tucson Gem and Mineral Show on Saturday, February 12, 1992. Pyromorphite is the show's theme mineral and papers on pyromorphite, secondary lead minerals, and selected compatible subjects will be presented. Carl Francis, Curator, Harvard Mineralogical Museum, is serving as Chairman. (The abstracts, which were not ready by press time, will appear in a future issue.)

To have reached the "13th" indicates a long history of such events. Since the mid-1970's, the Friends of Mineralogy and the Mineralogical Society of America have been sponsoring a symposium during the Tucson Gem and Mineral Show. The events were intended to be social as well as scientific. The first symposium was sponsored jointly by FM, MMAC (Mineral Museums Advisory Council), Tucson Gem and Mineral Society, the University of Arizona at Tucson, and MSA. It was written at that time that "this meeting culminates a major goal of FM, namely to help fill a gap that has existed for many years—promotion of mineralogical interest on an intermediate level." It was held on Sunday and Monday, February 10 and 11, 1974, at the Tucson Community Center, overlapping the last day of the Tucson Show. Two major themes were discussed: (1) mineral nomenclature, terminology and systematics; and (2) mineralogy and paragenesis of porphyry copper deposits, with additional time for a session containing general papers. Joel E. Arem received the papers.

Thereafter, two day programs were held in Tucson every other year; a dinner with a speaker was a part of the first day's schedule. A field trip was sometimes scheduled for the third day. Themes were many and varied. The list of speakers reads like a "Who's Who" of authors, professionals and amateurs.

The 2nd Biennial MSA-FM Meeting was held February 14–15, 1976. Papers were presented on "Crystal Chemistry and Paragenesis of the Gem Minerals." Paul B. Moore, University of Chicago, was the Technical Sessions Chairman. There were two keynote speakers: Richard H. Jahns, "Gem-bearing Pegmatites," and Rustam Kothavala, "Mineralogy of the Deccan Traps." Twenty-four titles were solicited, 12 on gem mineralogy and 12 on general topics. Each paper was limited to approximately 30 minutes plus ten minutes for discussion. William Panczner served as General Program Chairman. A field trip to the Mammoth–St. Anthony mine, Tiger, Arizona, was scheduled for Tuesday, February 17, limited to 70. Transportation and box lunches were available. It was decided at that time that biennial meetings would be continued.

The Third Joint MSA-FM Meeting and Symposium was scheduled for Feb. 13–14, 1977. Again, there was a registration fee and advance registration. The topic was "Crystal Growth and Habit." Dr. Kurt Nassau of Bell Laboratories presented the keynote address on the subject: "Gems; Science, Beauty and Deception." Twelve papers were solicited on crystal growth, morphology and compositional variations of minerals and synthetic compounds, and 12 papers on general topics. Dr. Arthur Roe was the General Chairman.

The 4th Annual FM-MSA Symposium was held Feb. 15–16, 1981, at the Tucson Community Center. Over 100 registrants heard 23 speakers on "Pegmatites," and Clifford Frondel was the banquet speaker on "Mineralogy and Mining of Early American Pegmatites." Gordon E. Brown, Jr., of Stanford University, arranged an outstanding technical program. Two buses were needed to transport field trip attendees to Washington Camp, Arizona, on Monday.

The 5th Annual program, held on Feb. 13 and 14, 1983, covered "Oxidation Mineralogy of Base Metal Deposits." John Anthony was General Chairman; Dick Bideaux was Business Manager; and Carl Francis was Technical Chairman.

The every-other-year, two-day symposium schedule was changed as of 1984; the 6th was held on Sunday, Feb. 12, 1984. "Mexican Minerals" papers were presented under the direction of Bill Panczner.

The 7th was held on Sunday, Feb. 10, 1985, and offered 12 talks on "Classic Mineral Localities." The 8th was scheduled for Feb. 15, 1987, on "Quartz and associated minerals." It was sponsored by FM and TGMS. Henry Trube was Chairman. One intriguing title of a talk by Alvin Cohen was "In throes of death stately cairngorm brings forth bacchannalian amethyst."

Henry was also the Chairman of the 9th and 10th symposia, February 14, 1988, and February 12, 1989. In 1988, the symposium became a "mini," starting at 10:30 a.m. and closing at noon. "Beryl-Paragenesis and descriptive mineralogy" was covered in detail; a booklet of the abstracts was available at a minimal cost. In 1989, the sponsors were FM, TGMS and MSA, and the show theme mineral, galena, provided the subject matter.

Karen Wenrich conducted the 1990 program on Saturday, February 16, using the show theme mineral, azurite; she also conducted the 1991 symposium, also on Saturday, on wulfenite. The abstracts for both these meetings appeared in the *Mineralogical Record*.

Successful symposia have been conducted by the Colorado Chapter, the Pacific Northwest Chapter and the Pennsylvania Chapter. The March-April 1975 issue of the *Mineralogical Record* has an article, "Try a mineral symposium," by David E. Jensen.

A Creative Field Trip

The April 1990 *Pacific Northwest Chapter Newsletter* reported that their meeting included a discussion of the bad image mineral collectors are developing. At Hanson Creek in Washington, the U.S. Forest Service was forced to gate the upper road because collectors digging for amethyst had undermined the roadway. In December, someone had shot the lock off. Unauthorized blasting had taken place in Walker Valley, and parts of Washington Pass had been trashed by collectors.

It was suggested that collectors have to do a better job of policing their own activities, including those of commercial collectors, and promoting responsible collecting practices. Thus, the idea of a late summer collecting/clean-up field trip to Washington Pass was born.

In their September 1990 newsletter Ray Lasmanis reported that, at the suggestion of president Becky Harris, a field trip was organized by Cheryl Stewart, "to create good will between the U.S. Forest Service and collectors by policing for trash along the scenic highway and to have the experience of collecting minerals from the Golden Horn Batholith." Okanogan National Forest resource assistant Ardis Bynum set aside five camp sites for FM members at the Klipchuck campground west of Mazama, Washington. In spite of the heavy rain, by midnight 15 members and 3 children had checked in and set up camp.

On Saturday morning, Ardis Bynum provided garbage bags and maps to clean up areas for every team of workers. FM members filled their yellow sacks at Cutthroat Creek, Silver Star view point, the big Switchback below Early Winter Spires, Washington Pass, Blue Lake trailhead, and the Rainy Pass area. At noon, they met at Cutthroat Creek to unload into a U.S. Forest Service truck (among the cans, bottles, paper, plastic and discards there was even a Mercedes hubcap). For the rest of the afternoon and on Sunday, members searched the cuts and talus slopes along State Highway 29 from Washington Pass down to Cutthroat Creek. They found the cut at Silver Star view point especially productive. In the arfvedsonite granite, they found smoky quartz crystals up to 9 cm, and crystals of albite, microcline, arfvedsonite, astrophyllite, acmite and zircons (as inclusions in smoky quartz), elpidite, zektzerite, hematite microcrystals and siderite.

Locality Lost

As desirable as locality preservation may be, it is not always possible. The dumps of the Strickland quarry, Portland, Connecticut, often referred to as a "mineralogist's paradise," will soon be a thing of the past. A nine-hole golf course is being built on Collins Hill, and the dumps will be supplying fill. The quarry itself and shafts have been fenced in. This locality will be preserved only as a water-filled hole in the ground, in literature, and in collections. (The quarry will be used as a reservoir for needed water . . . what a water hazard!)

GILLETTE QUARRY continued from page 28

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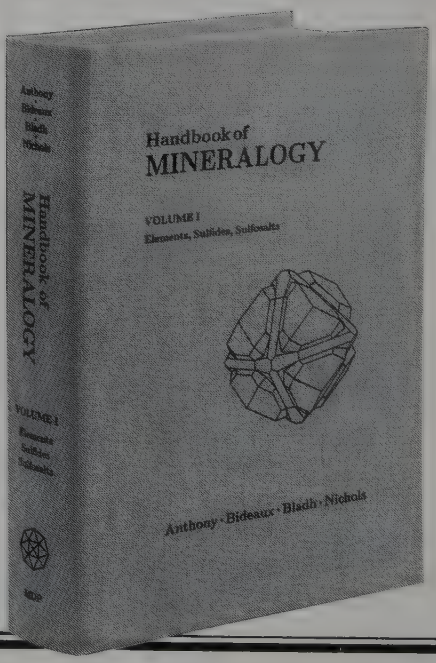

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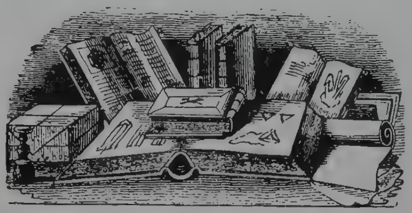

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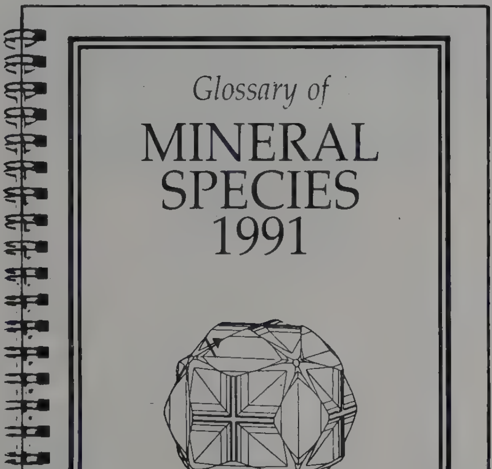

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Notes from Europe

Munich Show 1991

Two weeks time in the German autumn make a difference in the weather, and now that the Munich Show is being held during the first week of November instead of mid-October, it's quite chilly. But the show itself is as exciting as ever, and the crowds were substantial, even on Friday when admittance is supposedly restricted to "the trade."

This year, show organizer Johannes Keilmann again had interesting exhibits for the public to enjoy, but he is tending away from major themes now. In the past he was justifiably lauded for his complex and beautifully staged presentations on particular topics such as gold (1983), Alpine minerals (1984), tourmaline (1985), the history of mineral collecting (1988), calcite (1990), and so on. But these each required several *years* of advance work to arrange, and Keilmann has decided to cut back a bit on such extravaganzas. I don't blame him a bit, but it's too bad nonetheless. In any case, there was still plenty to see this year. One large area was converted to a desert, with tons of sand hauled in, and large vertebrate fossils poking out. The centerpiece was Kirby Sieber's two 8-meter whale skeletons, plucked not long ago from the Peruvian desert. Another area featured exhibits on the historic Habachtal emerald locality in Austria, and a series of bibliophilic cases on the history of systematic mineralogies honoring the 50th anniversary of Hugo Strunz's *Mineralogische Tabellen*.

Complementing those exhibits was the work of a new (at least to me) mineral artist, Hilde Könighofer, born (1954) and still residing in Rettenegg, in eastern Steiermark, Austria. Her original paintings of specimens from the Natural History Museum in Vienna, the Joanneum, and other collections lined one wall. At first glance they resemble the style of the late Claus Caspari, who painted his specimens "floating" on a white field. But a closer inspection reveals stunning and unprecedented detail and accuracy virtually down to the microscopic level. She must have extremely good eyes and a *very* small brush. The paintings were for sale and, judging by the "reserved" labels affixed, were moving well at prices around $500–$900.

As in 1990, the show was spread through four interconnecting exhibit halls: Halle 1 (for the special exhibits and the gem dealers), Halle 2 (for the leading mineral dealers), Halle 3, and Halle 5 (for the collector-dealers) where the miscellaneous showcases of private collectors and a few dealers were also arranged. This year Keilmann produced a handy *Sammler-Notizbuch* ("Collector's Notebook") listing all of the show dealers by stand number, and giving coded information for each on country of origin, whether they do exchanges or mail order, and what their specialties are. Book collectors, for example, could easily scan down the "specialties" column and circle all of the "L" codes (for "Literature"), then speedily check them out in order of their location. This is an excellent innovation, especially useful at such a large show.

Now to a brief summary of the newer mineral finds:

Erich Schmidt (Friedhofstrasse 3, D-8591 Tröstau, Germany) had many Russian specimens including some beautiful pale green octahedral fluorites on matrix from Kara-Oba, Kazakhstan. The individual crystals reach 3 or 4 cm on an edge, and are associated with quartz crystals and cubic pyrites on specimens generally 5 to 10 cm in size. Russian specimens were prominent in several other dealers' booths as well. François Lietard, for example, had 20 very nice wire silvers from Kazakhstan, mostly black and thumbnail-size but a few larger and some less heavily tarnished. And Bill Larson had some very large and fine axinite crystals to 6 or 7 cm on adularia crystals from Puiva, northern Ural Mountains in Russia.

Franz Fritsche (Eichhornseckerstr. 17, D-8342 Tann) had many new specimens from the Machow mine in Tarnobrzeg, Poland, including big groups of gemmy golden-brown barite spears in clusters on pale yellow sulfur matrix, and tan-colored to white celestine crystal groups.

Eric Asselborn had many specimens of pyromorphite in a range of colors (green to brown) from the Les Farges mine, France, and also some beautiful axinite groups from Rocher de Armentiers, Iseré, France.

Jordi Fabre had the results of a recent discovery at the Emilio mine near Berbes, Spain: beautiful cabinet groups and miniatures of colorless, water-clear and mirror-smooth cubic fluorite. The specimens are extremely temperature sensitive, and will crack if washed in water that varies by more than 3° C from room temperature.

Fabre also had some extraordinary specimens recently collected at Trimouns, Luzenac, France: 5-mm hexagonal parisite crystals; hexagonal, orange-brown, 1-cm bastnaesite-(Ce) crystals; and dark brown allanite blades to 1 cm, all on white dolomite and talc.

Hans-Jürgen Henn (Mainzer Strasse 60, D-6580 Idar-Oberstein 2) had a marvelous lot of "emerald" crystals from Jos, Nigeria (for an example of the find see Bill Larsen's crystal on the cover of the September-October issue). The crystals offered are up to about 15 cm long, including some real beauties in the 4 to 5-cm range. They are gemmy, lustrous and well-terminated by a rather steep hexagonal bipyramid. The color is decidedly more blue than the conventional "emerald-green" of Colombian beryls, and thus does not command the same price. But, according to Henn, the crystals have been analyzed and chromium is indeed the chromophor. I asked whether any other species had been found in association, and Henn replied that he had not seen any. The "emerald" crystals reportedly *do* occur on some sort of matrix but, as is typical of remote third-world areas unfamiliar with the priorities of mineral collecting, the Nigerian miners routinely break the crystals off the matrix for easier packing and shipment. Blue aquamarine crystals have been found at a pegmatite nearby, on the same mountain, and were also being offered for sale by Henn.

Stefan Stolte had a large number of new, brilliant red-orange crocoite specimens from the famous old Red Lead mine in Tasmania. A few of the miniatures are particularly nice, with excellent glassy luster and terminated crystals.

Jürgen Kastning (Holsteiner Strasse 4, D-2057 Reinbek) laid out a large number of interesting silver specimens from the Pohla mine in (former East) Germany, the same locality that has become famous for large, gemmy, golden yellow barite groups. The silver is in arborescent growths, like little 2-cm pine trees, densely imbedded in sooty black native arsenic. Miniatures to sizeable cabinet specimens were available.

Giovanni Zingo (34, rue de Voux, 54610 Mailly sur Seille, France) had dozens of freieslebenite crystals, a few up to 1 cm in size, from Oruro, Bolivia. Some are on miniature-size matrix and others are loose thumbnails.

Olivier Szentessy (BP 445, Petit-Lancy, 1213 Geneva, Switzerland) had some very interesting erythrite from a recent find in "Carcoara," New South Wales, Australia. What makes these specimens unusual is the somewhat muted color, not as bright as the Saxon and Mexican specimens (a chemical analysis might be worthwhile), and furry-textured, much thinner crystal size than the typical acicular habit from elsewhere. The furry tufts appear to be quite thick, 5–10 mm, and they densely cover the matrix. Excellent miniature to cabinet specimens were available. *However,* it is the opinion of Dr. Bill Birch, of the Museum of Victoria, Australia, that these specimens are instead probably from the well-known occurrence at Mt. Cobalt in Queensland. Carcoar (the correct spelling) is an old mining area near Bathurst, New South Wales. Erythrite was first found there in 1888, but the


WEW

Figure 1. **Liddicoatite crystals to 2.6 cm from the Anjanabonoina pegmatite, Madagascar. Uwe Geyer specimens.**


WEW

Figure 3. **German miner's "frog" lamp, dated 1673; Hans-Joachim Glapa collection.**

WEW

Figure 2. **Liddicoatite slab, about 12 cm across, from the Anjanabonoina pegmatite, Madagascar.**

modest specimen in the Museum of Victoria is quite unlike the new ones, and specimens have always been scarce. The new specimens are comparable in appearance to Mt. Cobalt material; mineral dealers within Australia have made no attempt to attribute it to any other locality.

The Anjanabonoina pegmatite in Madagascar must be producing again, because I saw eight or nine dealers selling beautiful polished liddicoatite slabs showing the typical color zonings in a Mercedes Benz emblem pattern. Of these, only a few dealers had uncut crystals. Uwe Geyer (Richard-Wagner-Strasse 11, D-7448 Wolfschlungen) had a large number of uncut crystals, including some superb singles in the 1 to 3-cm range, with good luster, transparency, color, and nice three-faced (rhombohedron) terminations. Geyer specializes in Madagascar minerals, and had other specimens of hamburgite, garnet, epidote, microcline and so on from Madagascar pegmatites. Boulet-Fuchs-Steinbrecher (Wendalinusstr. 45, 6690 St. Wendel) also had a few.

Several dealers carried antique miners' lamps, particularly Siegbert Zecha (Windecker Pfad 1, D-6369 Schöneck 2) and Hans-Joachim Glapa (Bussardweg 12, D-4352 Herten). Glapa also had several very rare *Barten,* or ceremonial German miners' axes (1000 to 9000 DM), prime collectibles for the European lover of mining artifacts.

Vic Yount had an unusual 22-cm cabinet specimen of fluorite from Berche, Mongolia. The rough-surfaced octahedral crystals (1 to 2 cm in size) are virtually black in the outermost layer but are purple inside, and rest on a matrix of very pale pink octahedral fluorite.

Edson Endrigo (*Valadares Minerals*) had five large specimens of elbaite from Morro Redondo, Coronel Murta, Minas Gerais, Brazil. The crystals are 15 cm tall and around 6 or 7 cm in diameter, with a peculiar pinkish brown color. What makes them interesting is a partial coating of white cookeite in 2 to 3 mm hexagonal crystals with a bright pearly luster.

In the "scuttlebut" category, I heard from a company official that the N'Chwaning I mine near Kuruman in the Kalahari Manganese Field, South Africa, is flooded and essentially abandoned. The Tsumeb mine in Namibia is said to have about two more years of productive life before it will finally be closed down. And specimen productivity throughout Brazil is said to be very low at the present time.

Next year's show is scheduled for October 30 through November 1, 1992. By that time, Munich's new airport, scheduled to open in the spring of 1992, should be in full operation. W.E.W.

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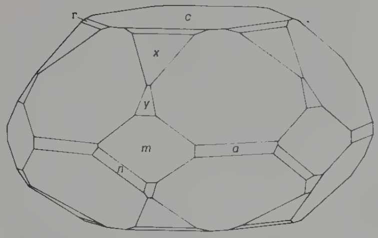

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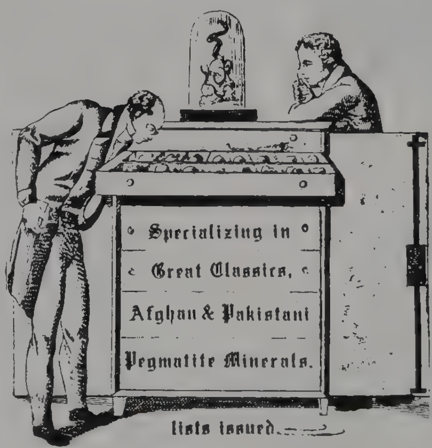

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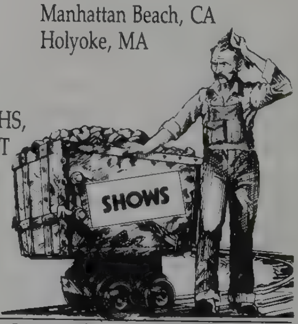

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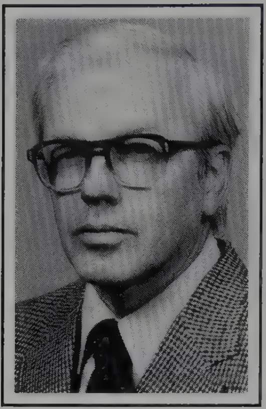

Microminerals

by Bill Henderson

Anatases I Have Known

Recently, and for the third time, I received some very interesting anatase crystals from Diamantina, Brazil. I will have more to say about them later. That, taken together with the fact that anatase is among the micromounter's favorite minerals, inspired this column. The specimens shown and described are drawn from the wide variety of anatases in my collection.

The anatase from Watertown, Connecticut, shown in Figure 1 is almost jet-black in color, but with a faint hint of midnight-blue when strongly backlit. The striations visible are formed by alternation between a steep and a shallow dipyramid. The small, brighter area at the top of the crystal is not another dypyramid, but rather the spot where the shallower one becomes predominant.

In Figure 2 is shown a distinctly bi-colored anatase with sharp color zoning. Most of the crystal is a pale tan, but the widest part of the crystal shows zones of bright blue. It is from Thomaston Dam, Thomaston, Connecticut, and is associated with pyrite and quartz. A few of the other hundred or so such crystals collected there by the author show similar zoning.

The next few crystals shown are all from Switzerland, a well-known source for fine anatase. The deep blue crystal in Figure 3 was obtained by exchange, the locality given as Eggishden, Wallis (Valais), Switzerland. I have not been able to find the locality in any book I have on Swiss minerals or any map or atlas. [Ed. note: possibly Mt. Eggishorn, 14 km northeast of Brig, Valais.]

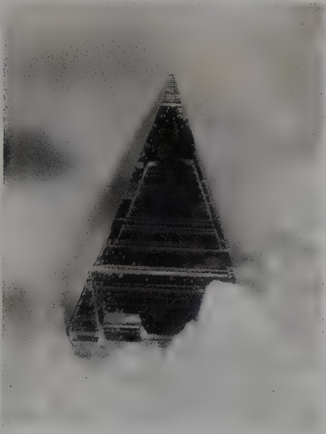

Figure 1. **Jet-black crystal of anatase from Watertown, Litchfield County, Connecticut. Size of crystal, 0.4 mm. (All photos except Fig. 10 are by the author.)**

Figure 2. **Bi-colored, zoned, pale tan and deep blue, 0.3-mm anatase crystal from Thomaston Dam, Thomaston, Litchfield County, Connecticut.**

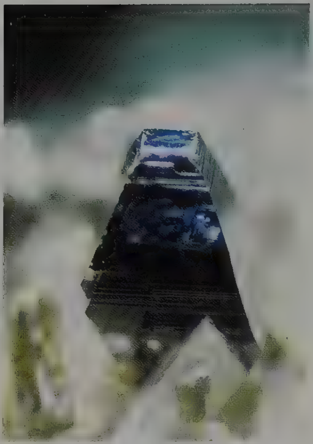

Figure 3. **Deep blue anatase crystal, 1.3 mm high, from Eggishden [Mt. Eggishorn?], Valais, Switzerland.**

Figure 4. **An hourglass-shaped anatase crystal, 1.4 mm long, from Lodrino, Ticino, Switzerland.**

The anatase shown in Figure 4 is from a better known locality; Lodrino, in the canton of Ticino. I like it because, as close inspection of the bottom of the crystal will show, it has an hourglass figure, formed by alternation between the dipyramid faces with the indices ($hh1$) and those with the indices ($hh\bar{1}$), i.e., the upper and lower halves of the dipyramid(s).

Figure 5. **A jet-black anatase crystal showing interference colors (iridescence). The crystal is 0.8 mm high, and is from Lodrino, Ticino, Switzerland.**

Figure 6. **Anatase on brookite (with chlorite?); the field of view is 1.5 mm. From Lodrino, Ticino, Switzerland.**

The second Lodrino crystal shown (Fig. 5) was chosen for its marked iridescence. It displays most of the colors of the rainbow, and the colors vary as the angle to the light source is varied. The body color of the crystal is jet-black.

A final specimen from Ticino is shown in Figure 6. This one is interesting because it shows two polymorphs of TiO_2, anatase and brookite, in the same specimen. In fact, the former is perched on the latter. Because the conditions under which they form and are stable are quite different, many other polymorphs (tridymite and quartz,

Figure 7. Dipyramidal anatase on rutile, from the Bockstein quarry, Bad Gastein, Salzburg, Austria. The field of view is 6 mm.

Figure 10. A group of anatase crystals associated with xenotime-(Y); field of view 6.6 mm. From the Hendre quarry, Glyn-Ceiriog, Clewd, Wales, Great Britain. Photo by Dan Behnke.

Figure 8. Gemmy, orange anatase crystal, 0.7 mm in size, from Rauris, Austria.

Figure 9. A skeletal anatase crystal with half the back side missing, from Grieswies, near Rauris, Austria. Height of crystal is 3.2 mm.

Figure 11. Waterworn, tabular anatase crystal with liquid and solid (rutile?) inclusions, from Diamantina, Minas Gerais, Brazil. Width of crystal is 3.2 mm.

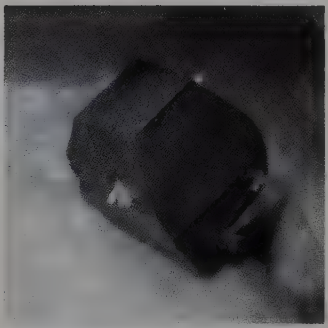

Figure 12. Jet-black anatase crystal (*c* face pitted) with white tetranatrolite crystals on the dipyramid faces. The crystal, 1.8 mm high, is from the Poudrette quarry, Mont Saint-Hilaire, Quebec, Canada.

graphite and diamond, etc.) are seldom found together. However, two of the three polymorphs of TiO_2 (anatase, brookite and rutile) are frequently found in the same specimen, and very rarely, all three.

Swiss anatase is most commonly found in schistose, metamorphic rocks, in alpine veins. Similar specimens are found in the Austrian

(continued overleaf)

Alps, and three are shown here. The first (Fig. 7) shows dipyramidal anatase in contact with its other polymorph, rutile. The specimen is from the Bockstein quarry, Bad Gastein, Salzburg, Austria. Next, included for its warm orange color, is the crystal in Figure 8 from Rauris, Austria. The crystal is remarkably transparent, and was obtained from a very old source, old enough so that it was labeled "octahedrite," a discredited name for anatase. The anatase crystal in Figure 9 is from Grieswies, near Rauris. It has a large gap on the reverse side. Whether it was formed during growth or by corrosion after growth is not known.

Great Britain is not noted for its anatase crystals, but the superb group shown in Figure 10 is from the Hendre quarry, Glyn-Ceiriog, Clewd, Wales. I love those locality names! This and another superb anatase were obtained recently from Neil Hubbard. Neil (122 Cordery Road, Evington, Leicester, LE5 6DF, England) is a dealer/collector, and the package of 15 specimens he sent was of the finest quality I have received in a long time. (Perhaps, after giving such a glowing recommendation, I should mention that I do not accept gifts or favors of any kind from dealers mentioned in this column.)

I mentioned earlier several anatase specimens received over a period of time from Diamantina, Minas Gerais, Brazil. The last such was sent by Carlos Barbosa. All the crystals have a slight pitting on their faces; they appear to be waterworn, and are perhaps from a placer deposit. As the crystal in Figure 11 shows, the crystals have a deep blue color. The photo was taken looking down the c-axis of the distinctly tabular crystal. Most interesting are the liquid and solid inclusions in these crystals. Large liquid inclusions are clearly visible in the corners of this crystal, and close inspection will reveal the presence of acicular solid inclusions. These are most probably rutile.

Last are two specimens from the Poudrette quarry, Mont Saint-Hilaire, Quebec, Canada. The two are jet-black, and both show the *c* face to be deeply pitted yielding a matte effect. The first (Fig. 12) shows a single dipyramid in addition to the *c* face. The white crystals on its faces are tetranatrolite. The second specimen, shown in Figure 13, has two features of interest. Again, two polymorphs of TiO_2 are present. The largest crystal, the pseudo-octahedron, is actually a brookite. The rest of the crystals are anatase, but with a rare habit. The crystals show no dipyramid faces, but only those of the tetragonal prism and the base. Without the matte finish on the *c* faces, the crystals could easily be mistaken for cubes.

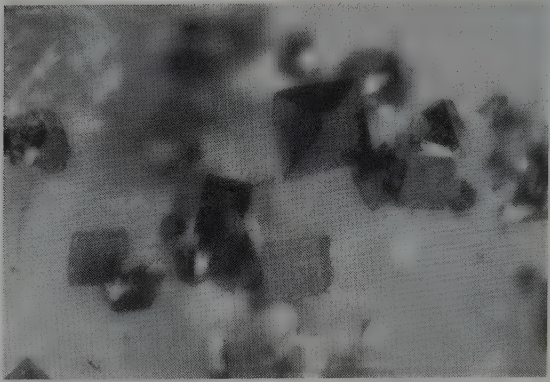

Figure 13. **Pseudocubic anatase crystals with matte *c* faces, and pseudo-octahedral brookite crystals; the field of view 2.0 mm. From the Poudrette quarry, Mont Saint-Hilaire, Quebec. Marcelle Weber specimen.**

The above by no means exhausts the extreme variability of anatase crystal forms and color. No really complex crystals are shown. However, it may provoke readers to go over their anatase micromounts again, or to try to obtain some new types from new locales.

William A. Henderson, Jr.
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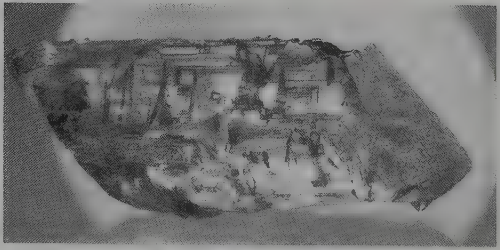

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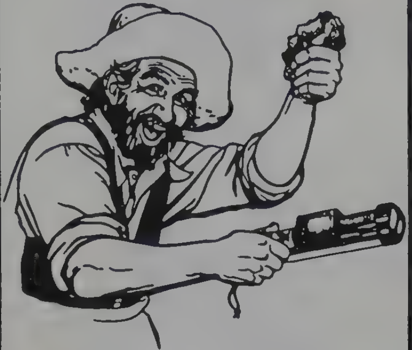

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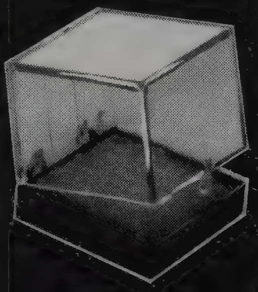

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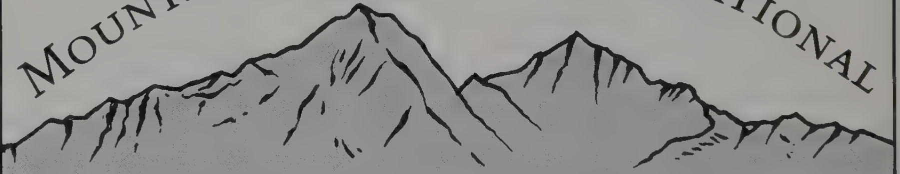

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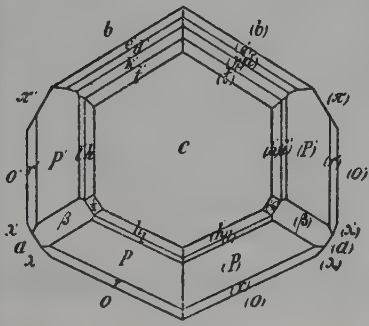

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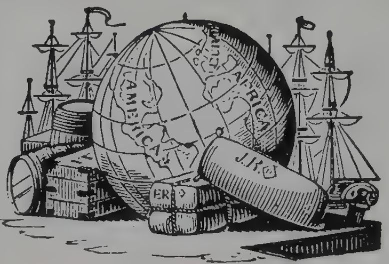

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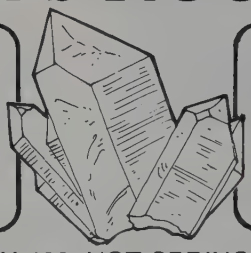

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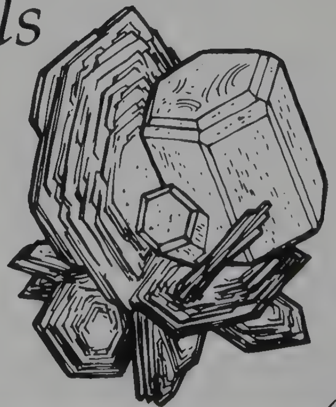

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