the Mineralogical Record

Volume Twenty-five, Number One
January–February 1994
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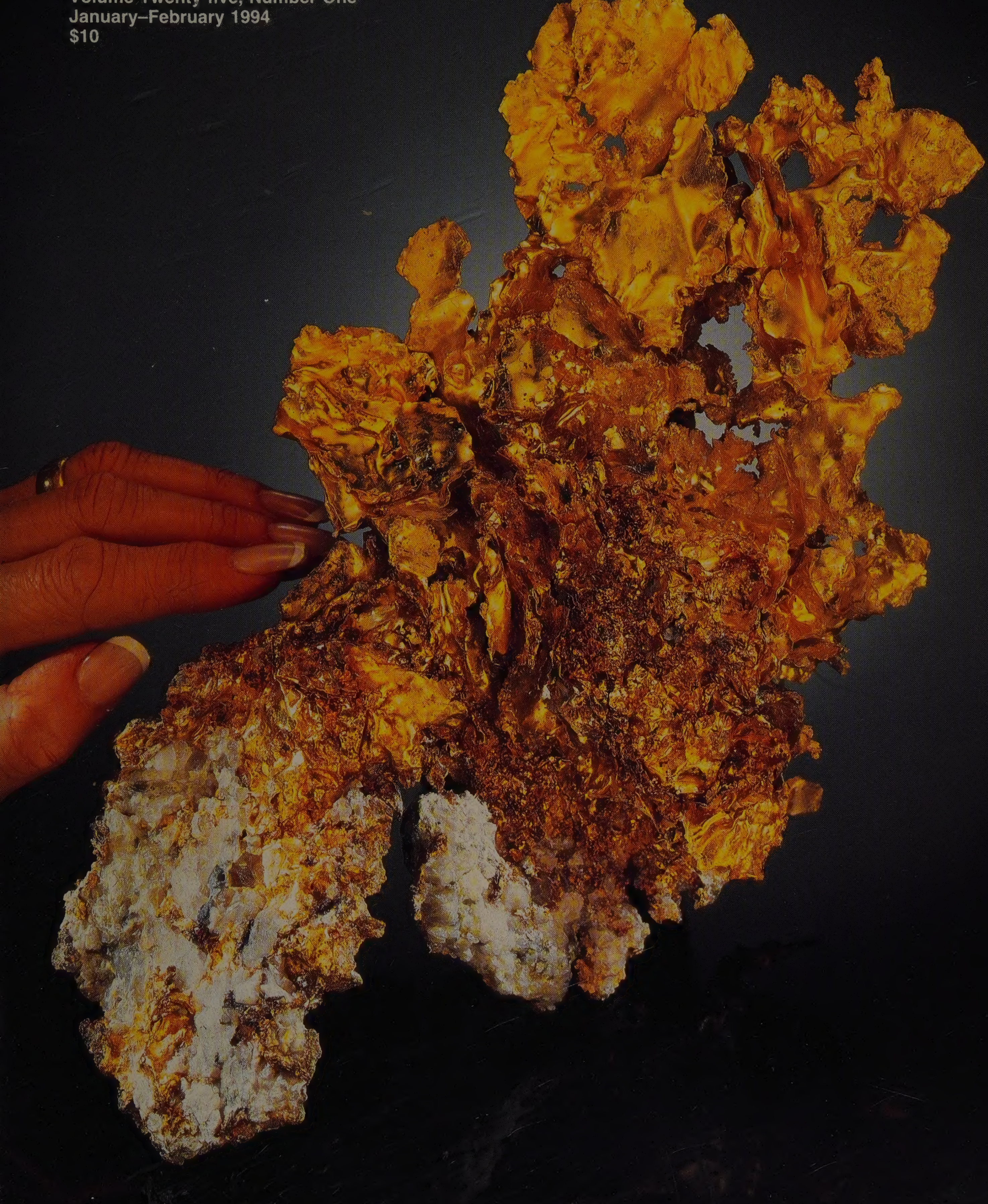

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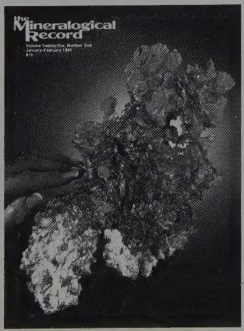
Articles

Columns

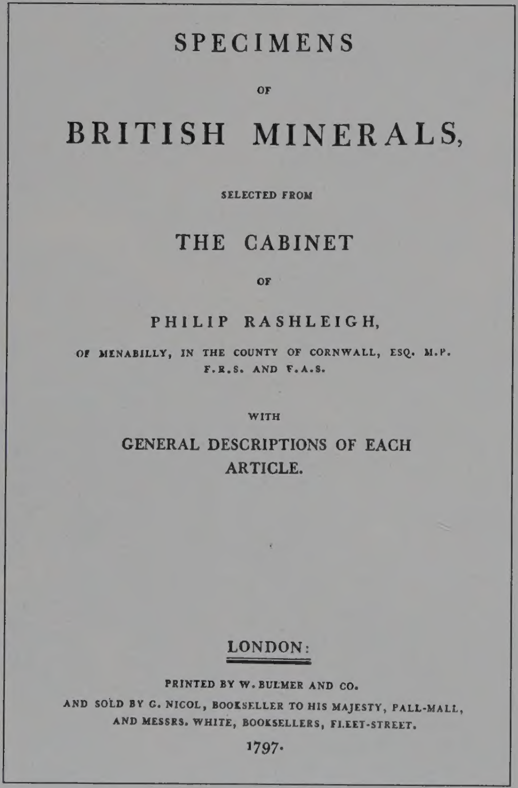


COVER: GOLD from the Jamestown mine, Tuolumne County, California, collected December 26, 1992. Wayne and Dona Leicht specimen; photo by Harold and Erica Van Pelt. See the article on this discovery in this issue beginning on page 7.

notes from the EDITOR

BLANCHARD CLOSES

Mineral collectors interested in visiting the Blanchard mine or other mines in the Hansonburg mining district near Bingham, New Mexico, should be advised that the Bureau of Land Management has temporarily closed access to this area by anyone except claim owners and local ranchers. This action was prompted by the recent death of a collector in one of the tunnels. The collector was part of a group that had signed in at Bingham for entry to the Blanchard mine area for surface collecting. Underground collecting at the Blanchard is strictly prohibited due to the hazardous nature of the mine workings, and visitors are required to acknowledge this prohibition as part of the agreement to collect in the area. The Blanchard mine will be closed to the general public until further notice. For further information, contact Ramon S. De Mark at 530 E. Arch Street, Marquette, Michigan 49855.



SPECIMENS
OF
BRITISH MINERALS,
SELECTED FROM
THE CABINET
OF
PHILIP RASHLEIGH,
OF MENABILLY, IN THE COUNTY OF CORNWALL, ESQ. M.P.
F.R.S. AND F.A.S.
WITH
GENERAL DESCRIPTIONS OF EACH
ARTICLE.

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AND MESSRS. WHITE, BOOKSELLERS, FLEET-STREET.
1797.

ANTIQUARIAN REPRINTS

We recently completed our seventh Antiquarian Reprint: volume 2 of Sowerby's *Exotic Mineralogy.* A nice touch is the inclusion of a portrait of Sowerby himself as a new frontispiece. After having been put in contact with members of the Sowerby family through the courtesy of the British Museum, we commissioned a transparency of the portrait (never before published in color), and reproduced it with the family's permission.

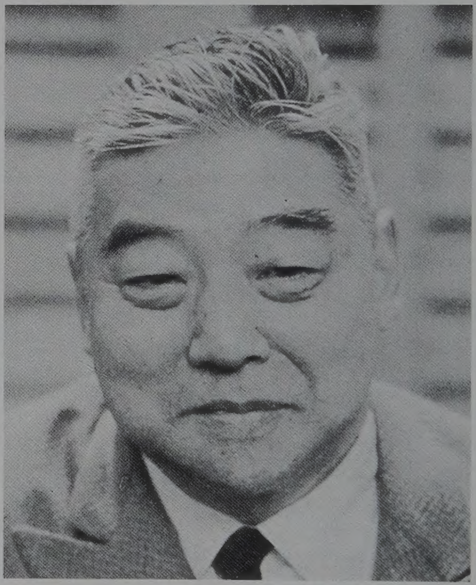
There was little point in notifying the readership of the completion of this entry in the series, since all copies were naturally spoken for by buyers of volume 1 (number six in our series). However, I might point out that occasional books and even complete sets of the series do come up for resale now and then. People interested in obtaining back numbers should let me know, as I keep a list which is made available to sellers. So far, no copies have sold below the original purchase price (as far as I know, and I try to keep close track of them), and some have sold at a substantial mark-up.

The next entry in the series (no. 8) will be Rashleigh's famous *British Mineralogy* of 1797 and 1802. To avoid disappointment, please notify us *early* if you would be interested in obtaining one of these.

EXCALIBUR PURCHASES CURETON CO.

Forrest and Barbara Cureton, long-time advertisers in the *Mineralogical Record,* have announced the sale of their business to Anthony Nikischer of Excalibur Mineral Company. The Cureton company was founded in 1950, operated for many years in Stockton, California, and was relocated to Tucson, Arizona in 1982. Over the years the Curetons have become widely known as one of the most prominent rare-species dealers in the world.

Excalibur Mineral Company has operated as a supplier of rare species by mail order and at shows since 1974. The merging of the extensive inventories of these two firms may well create the largest commercially held stock of rare minerals in existence. A new warehouse facility is planned to open sometime this year. Inquiries should be directed to the Excalibur-Cureton Mineral Company, 5 Louis Lane, Crugers, NY 10521.



K. Sakurai (1912–1993)

NOTICE

Died, Sakurai Kinichi, 80, of heart failure, in Tokyo. The prominent Japanese amateur mineralogist, Sakurai Kinichi, was born on December 11, 1912. He was the first son of a noted Tokyo restauranteur in whose footsteps he followed. He was awarded a doctorate (D.Sc.) from Tokyo University in 1955 in recognition of his contributions to the science of mineralogy. Dr. Sakurai maintained a separate facility in Tokyo to house his extensive collection of minerals and shells, and the attendant research facilities, and to serve as the meeting place of the "No Name Club," a collectors' group which he established. An illustrated catalog (in Japanese) of part of his collection was published on the occasion of his sixtieth birthday. The focus of his collection was on scientific documentation, and it boasted a thorough representation of Japanese mineralogy; the catalog lists 1,380 Japanese occurrences encompassing some 670 species. He was active as a teacher and publisher in mineralogy, and his contributions have been recognized in the naming of *sakuraiite,* $(Cu,Zn,Fe)_3(In,Sn)S_4$. He died October 6, 1993.

A. Rosenzweig

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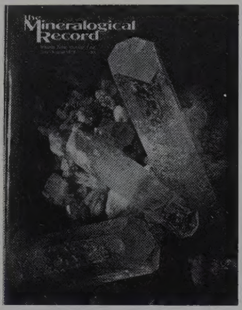
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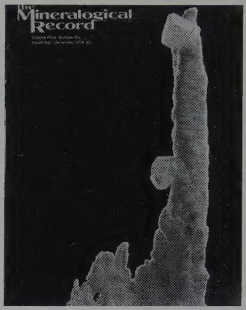
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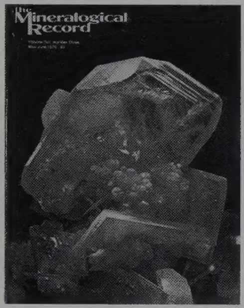
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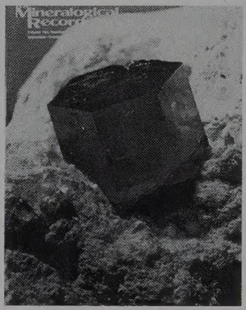
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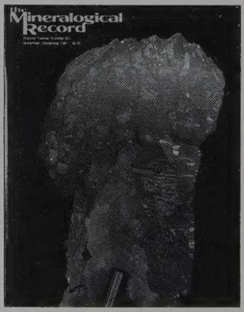
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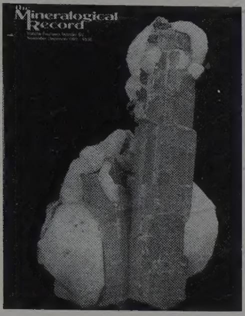

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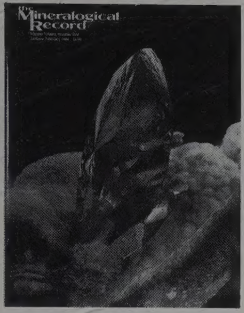

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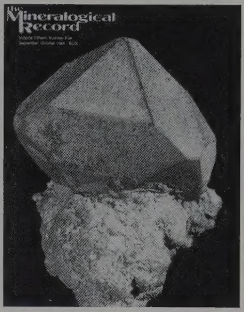

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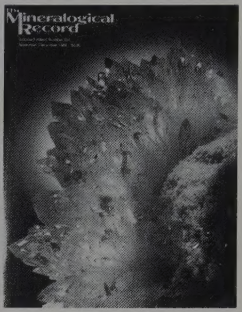

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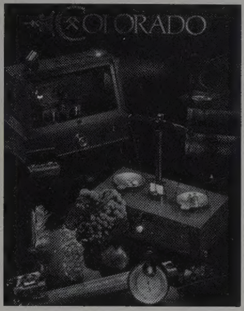

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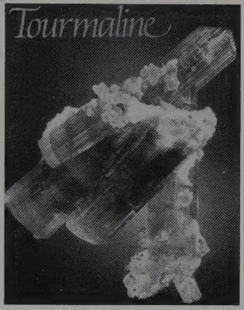

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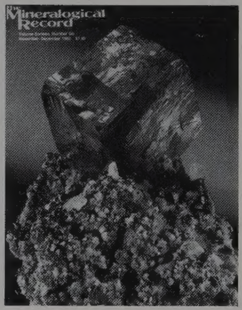

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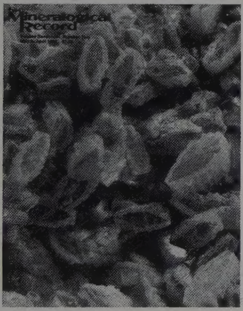

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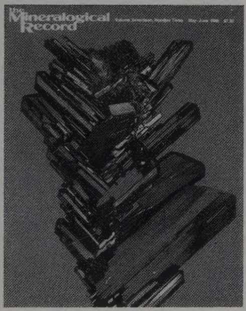

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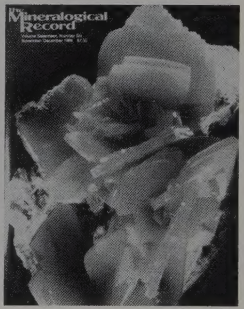

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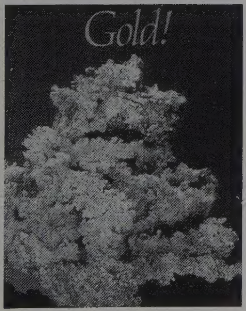

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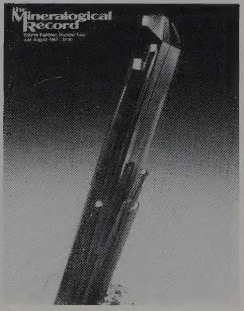

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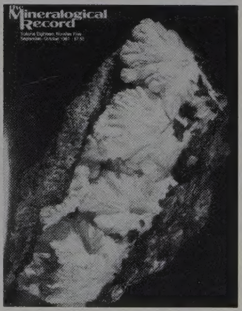

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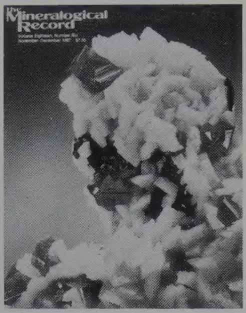

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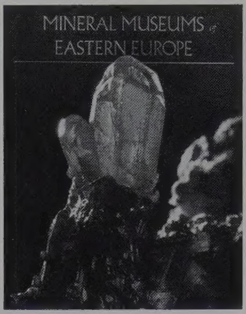

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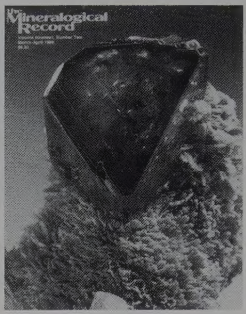

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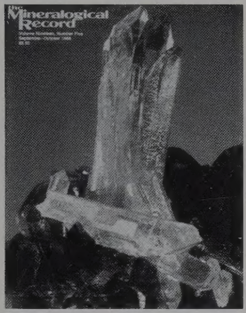

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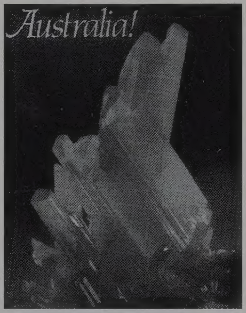

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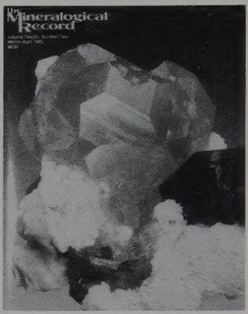

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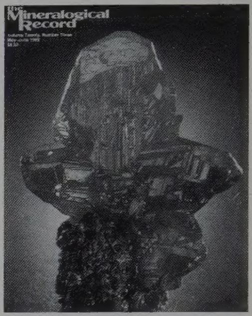

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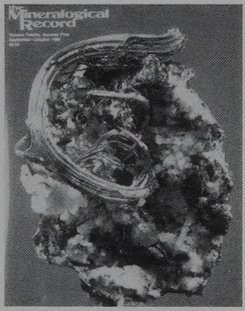

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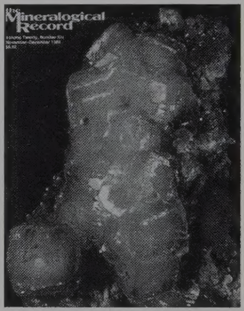

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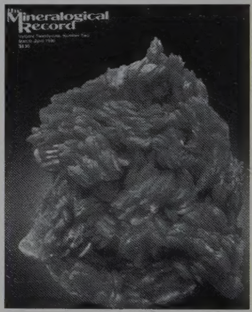

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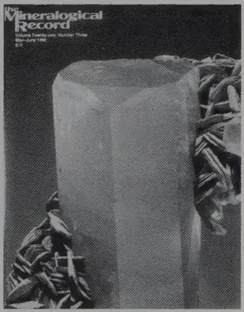

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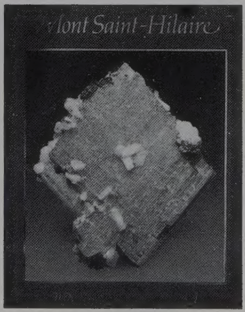

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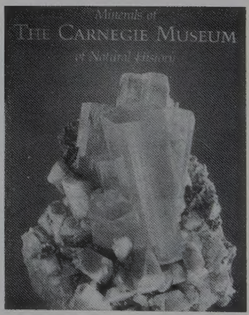

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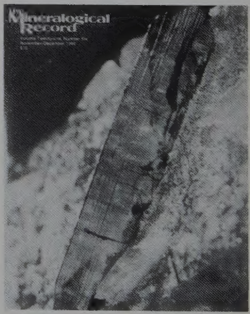

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NATIVE GOLD

FROM THE JAMESTOWN MINE, TUOLUMNE COUNTY, CALIFORNIA

Genne Myers Nelson
Sonora Mining Corporation
P.O. Box 1368
Jamestown, California 95327

Wayne Leicht
Kristalle
332 Forest Avenue, No. 8
Laguna Beach, California 92651

On December 26, 1992, owners of the Jamestown mine in Tuolumne County, California, received an unexpected Christmas present. Excavation in the company's Crystalline pit revealed a "pocket" of crystalline leaf gold. Approximately 1,568 ounces of specimen gold were collected in all. The largest piece, weighing in at 25.79 kg (69 troy pounds), ranks as one of the largest specimens of gold ever found in California, or the nation.

LOCATION

The Sonora Mining Corporation's Jamestown mine, consisting of the Crystalline deposit, the Harvard pit, the Dutch-App-Nyman deposit, the Jumper deposit and supporting facilities are located just west and south of the town of Jamestown, Tuolumne County, California. The Crystalline pit is the northernmost of these, situated about a mile due west of Jamestown and directly adjacent to the Harvard pit, which abuts Route 49 and 108 on its south side. It is an operating mine, and can be visited only with the approval and supervision of mining company personnel.

HISTORY

Tuolumne County has been the discovery site of many large gold specimens. More than a dozen alluvial and colluvial nuggets in excess of 9 kg (25 troy pounds*) have been uncovered, the Sonora and Columbia workings being primary sources (Allgood *et al.*, 1987). These nuggets varied from well-rounded, stream-worn nuggets to gold-filled fractures in vein quartz. The largest mass of gold discovered in California came from the Carson Hill mine, located just across the river in Calaveras County. All of these discoveries took place in the 1850's; none of the nugget descriptions specify whether any had crystalline form. All were eventually melted down for their precious metal and none survive today.

Nevertheless, Tuolumne County has definitely produced crystalline gold in the past. Notably, the pocket belt in the Sonora-Columbia area has produced some superb specimens, which survive today in major mineral museums. Unfortunately, printed references to "specimen" gold far outnumber the surviving specimens. Few crystalline examples exist today as evidence of the large number of mines, or the ten million ounces of historical gold production attributed to Tuolumne County prior to 1980 (Julihn and Horton, 1940).

The California Gold Rush—never before in the history of mankind had so many people from all over the world converged on one geographic region for such an event. It changed the course of a nation, financed the prosecution of a bloody Civil War and indirectly led to the discovery of the Australian gold fields. The lure of gold drew like a magnet people of every station and walk of life. Those early gold seekers characterized their journey as "going to see the elephant." Discouraged souls who turned back before reaching the gold fields claimed that they had seen the "elephant's tracks," or his "tail." But, successful or not, the search for California gold, like the exotic ele-

---

*Historical references quantify gold in troy ounces and troy pounds. A troy ounce equals 31.1 grams and a troy pound equals 373 grams.

Figure 1. **Headframe of the Crystalline mine, 1890's.**

phant, provided the immigrants with mystery, excitement and enough adventure to last a lifetime (Levy, 1992).

Gold was discovered in Tuolumne County, California, in 1848 by a prospecting party led by Benjamin Wood. The site, later called Wood's Creek, contained gold in such abundance that the prospectors could pry 30 to 50 ounces of coarse nuggets and grains from the creek bottom daily (DeFerrari, 1982). Wood's Creek was also the site of a spectacular nugget discovered in 1848. The 150-pound gold-laced quartz boulder yielded 75 troy pounds of gold (Clark, 1980).*

Wood's Creek runs in a westerly direction through Jamestown, but at Wood's diggings it swings sharply south, parallel to a ridge backboned by bold quartz outcrops. It was no coincidence that this rich placer deposit lay directly adjacent to the quartz vein which would become known as the world famous Mother Lode.

The first gold quartz lode in the area was staked as a placer claim

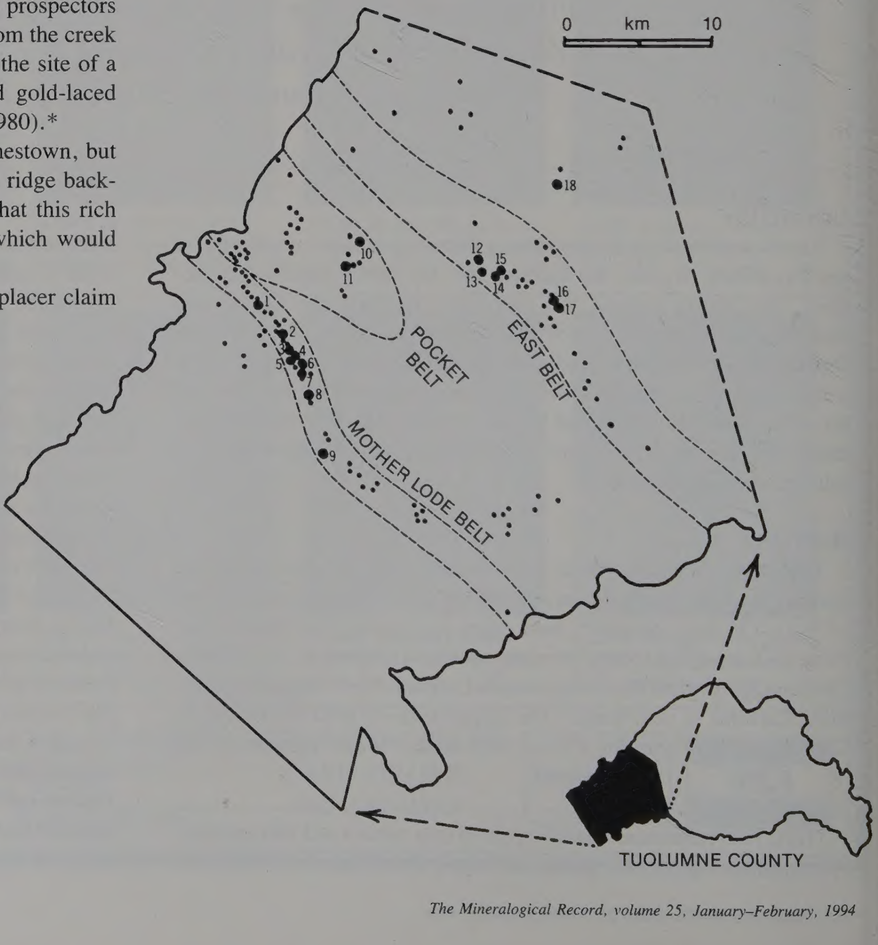

Figure 2. **Gold belts in western Tuolumne County. Small dots = minor gold mines; large dots (numbered) = major gold mines (production > 50,000 ounces). 1. Rawhide mine. 2. Harvard mine. 3. Sweeney mine. 4. Dutch mine. 5. App mine. 6. Heslep mine. 7. Santa Ysabel mine. 8. Jumper mine. 9. Eagle-Shawmut mine. 10. Sugarman-Nigger mine. 11. Bonanza mine at Sonora. 12. Draper mine. 13. Black Oak mine. 14. Gilson mine. 15. Soulsby mine. 16. Grizzly mine. 17. South United mine. 18. Confidence mine. The current "Jamestown" mine is an agglomeration including the Rawhide (1), Alabama-Crystalline, Harvard (2), Dutch (4), App (5), Nyman, Golden Rule, and Jumper (8) mines.**

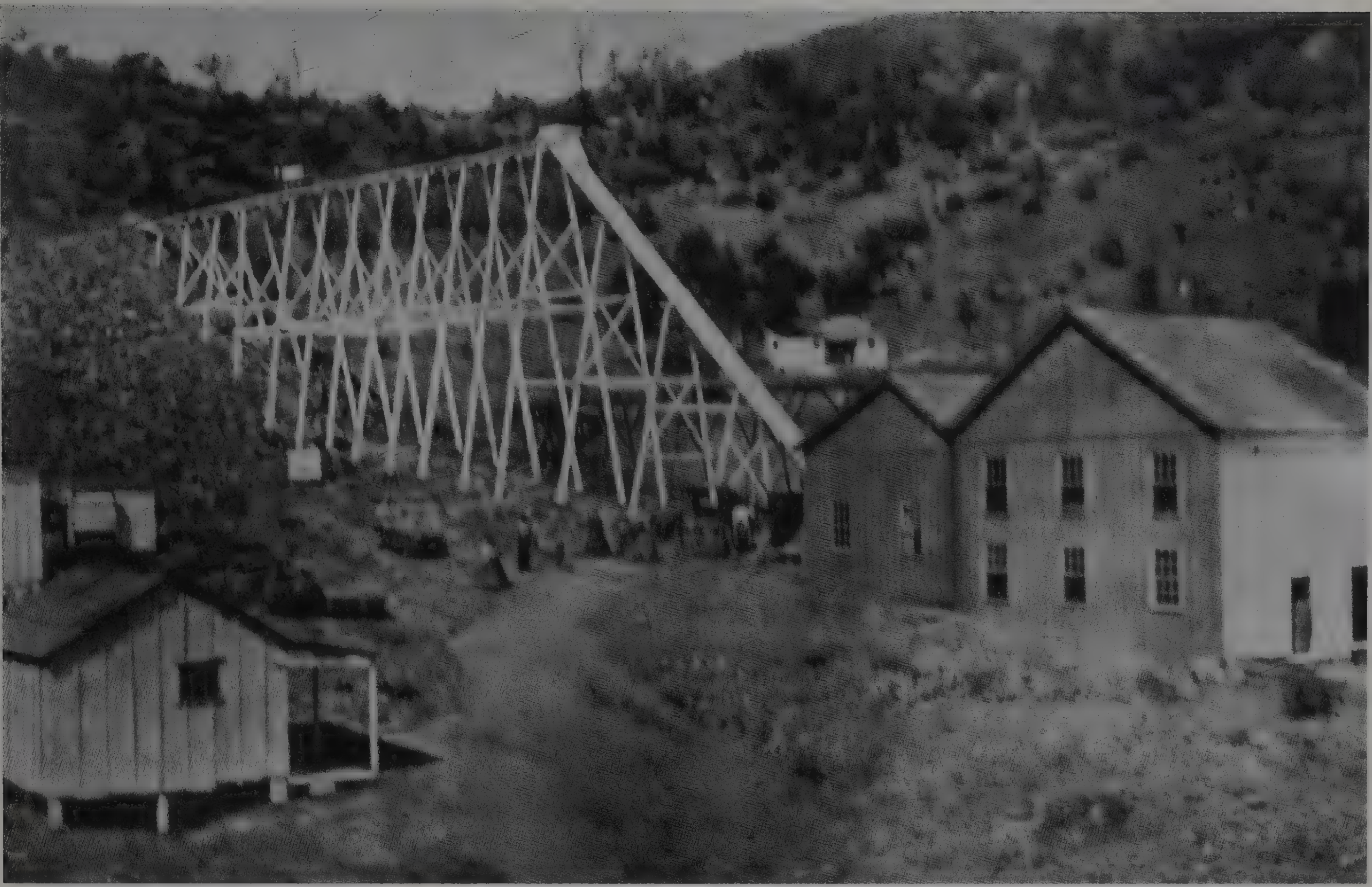

Figure 3. **The Alabama mill, 1880's.**

in 1852 by John Carey. Carey carted dirt down from the quartz-ridged hillside to the creek where he washed the gold free. He recovered an average of 10 ounces per load. When Carey finally uncovered the bedrock he found a quartz vein equally rich in gold. To commemorate his great good fortune, Carey laid in a generous supply of liquid refreshment and invited his miner friends to help him celebrate. The jubilation continued unabated for several days, after which time the area was covered with empty whiskey bottles. From then on the site was known as Whiskey Hill (DeFerrari, 1982).

Whiskey Hill was actually two separate hills lying north of Wood's Creek and south of Table Mountain, a prominent topographic feature created by an old lava-filled river channel. Several small claims were staked across the Whiskey Hills; development consisted primarily of surface prospects and shallow tunnel workings. A few far-sighted miners realized that efficient, profitable mine development was impossible on the small patches of ground each miner held. Henry Williams was one such man who set out to remedy the situation, but his scheme ultimately ended in his death.

Henry Williams and his brothers owned two claims on North Whiskey Hill in 1864. They were mining a small vein via a tunnel, and were paying expenses with gold recovered by hand mortar. Occasionally they would uncover some spectacular specimen ore. But Williams realized they needed more mining property to justify the expense of a mill to process the ore. He approached neighboring claim owner William Harris with a plan to consolidate land holdings for a share of the profits. Harris flatly opposed the plan. In spite of this, Williams continued to consolidate other claims and to stake new ones. In time, he controlled all of North Whiskey Hill except for the Alabama claim to the north and Harris's two claims. Harris's property had become an island within Williams's property, and he angrily accused Williams of overstaking one of his claims. But Williams, secure in his land position, headed East to look for investors. He was successful, and in 1865 the Crystalline Mining Company was incorporated in New York (DeFerrari, 1982).

Harris caught Williams soon after his return from New York prospecting on the disputed ground which he had overstaked during his land consolidation. The ensuing argument ended in gunplay which fatally wounded Williams and permanently crippled Harris's left arm. Harris was taken to trial for the shooting, but the testimony of the only eye witness, an employee of Williams, was not heard. Harris was released on the basis of his own testimony.

Williams's brother Samuel assumed management of the Crystalline mine. Development work on a tunnel continued on a small scale, but without adequate production to fund the enterprise, operations ceased on the early 1870's. All the while William Harris watched and waited for the chance to avenge himself on the remaining Williams brother for his bad arm.

In 1880 Harris became convinced that the required diligence work had not been performed at the Crystalline mine. Working through his twin stepsons, Harris had the Crystalline mine restaked as an abandoned claim, and then applied for a patent for the claim from the U.S. Government. Williams saw the posted patent notice and immediately filed a protest to the action. The ensuing litigation continued until October of 1881 when the judge awarded the claim to the Crystalline Mining Company. Harris was beaten, but it was a hollow victory for Williams, as the mine had to be mortgaged to pay the lawyer's fees.

The other mine on North Whiskey Hill, the Alabama claim situated against the south side of Table Mountain, was discovered by four men from the southern U.S. in 1858. While sinking a shaft in 1859, the miners encountered four small veins which were so rich in gold, they immediately bought a 4-stamp mill. Instead of making them wealthy, the debt accrued to pay for daily operations of the mill ultimately caused the forfeiture of the mine and the mill in 1860 (DeFerrari, 1982).

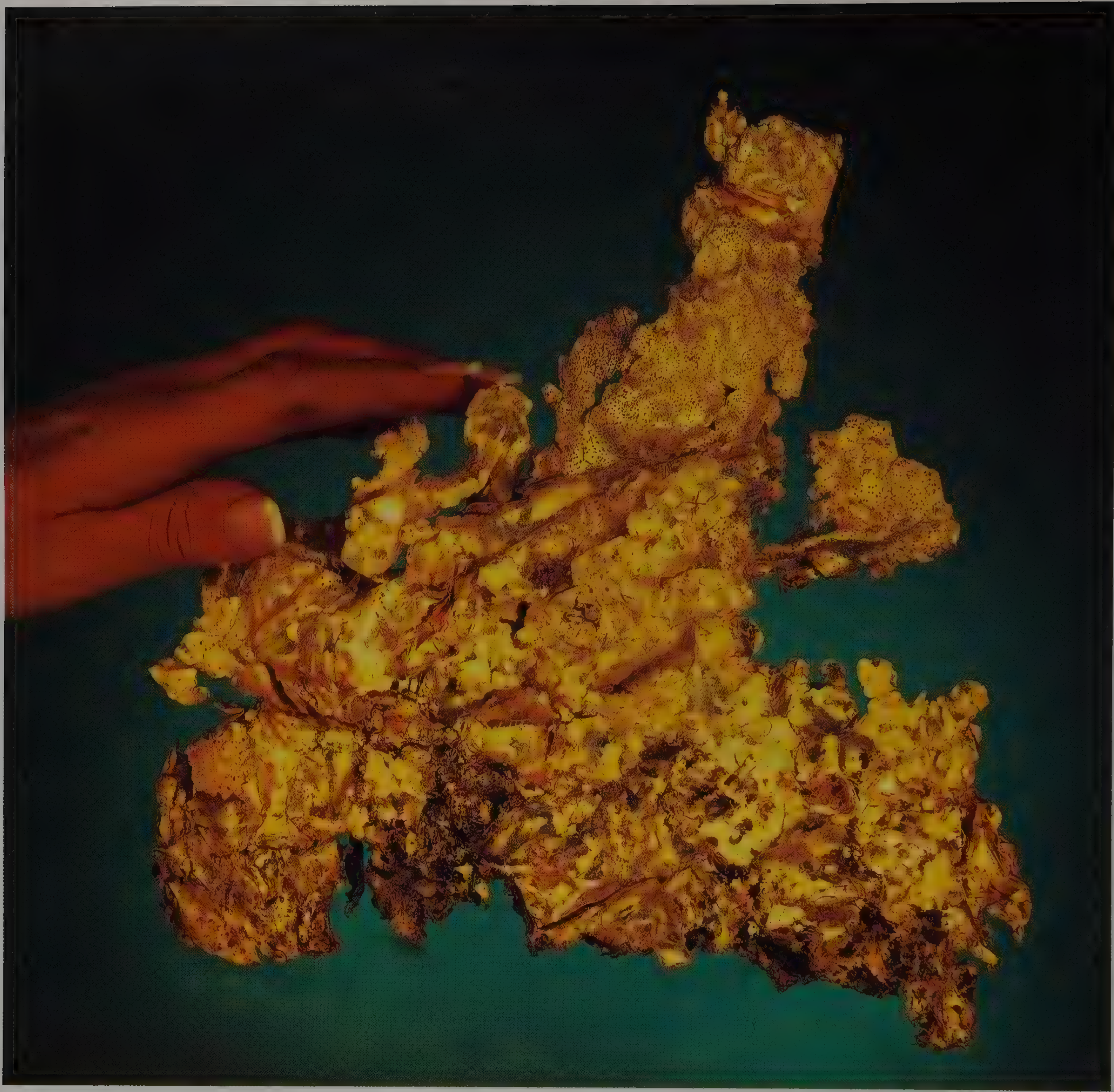

Figure 4. **One of the best gold specimens from the 1992 find. Photo by Harold and Erica Van Pelt.**

In 1862 possession of the property passed to the owner of a local trading post, Christian Reist. He was no more successful at mine operation than his predecessors, and in 1866 he lost mine, mill and trading post to Daniel Williams (possibly a brother of Henry and Samuel Williams). Reist remained at the Alabama mine, working as a miner, and in 1870 he was killed in a cave-in. For the remainder of the sixties and seventies a succession of owners tried and failed to profitably operate the mine (DeFerrari, 1982).

Even as Harris was trying to wrest the Crystalline mine from Williams, he was also eyeing the Alabama mine for purchase. Confident in his own management abilities over the follies of his predecessors, Harris, in partnership with David Hunt, bought the Alabama mine in June of 1880 for $6,000. The partners immediately set out to construct a new mill, and they hired James Tulloch, who was well-known for his milling expertise. The forty-stamp mill was completed in late 1880, had a production capacity of 80 tons per day, and was acknowledged by all who came to see it as one of the finest mills in the Mother Lode. Unfortunately, it did not work very well. The Alabama had high silver values in its ore, and this may have complicated the metallurgical recovery. Later an accident involving the rock crusher claimed the life of one of Harris's stepsons. Hunt sold his interest to Harris, and in 1891 Harris lost the property to creditors (DeFerrari, 1982).

Historically the Alabama had produced gold primarily from a glory hole. Ore was trammed from the open cut through a tunnel to the mill. In 1896 a 300-foot shaft was sunk in the bottom of the glory hole, looking for a continuation of the ore shoot. A crosscut was started on the 300 level, but litigation between investors again halted operations. The mill was dismantled and sold in 1904. Lessees operated for a short time on the 100 level during the late 1940's.

The Alabama mine was never productive on a large scale. Although early records are incomplete, it has been credited with $150,000 of gold production (Logan, 1934). The Crystalline mine operated on a fairly steady basis around the turn of the century, and total production has been estimated at $100,000 (Logan, 1928). The two properties came under the common ownership of Charles Shafer in the early part of this century and have been prospected repeatedly over the years. However, the mines did not become productive again until recently.

Figure 5. **Some of the leaf-gold specimens recovered from the "Christmas pocket" in the Crystalline pit in December of 1992. The largest piece weighs about 35 ounces. Photo by Harold and Erica Van Pelt.**

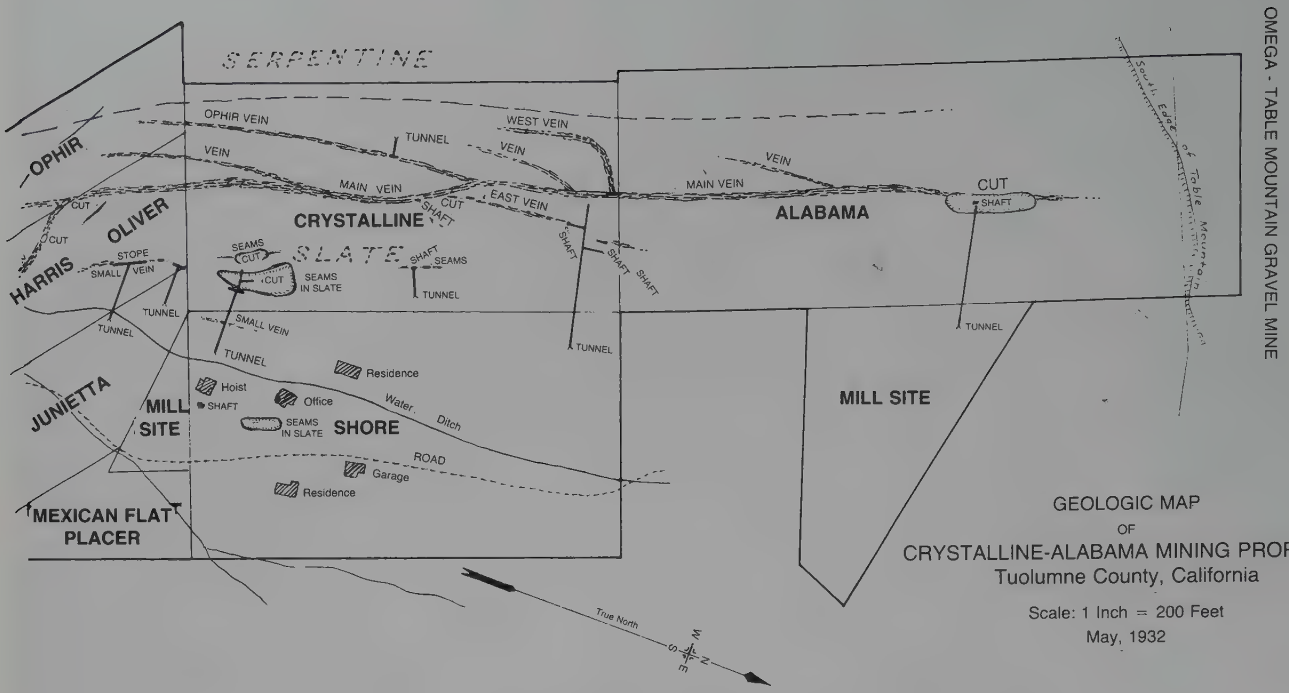

***Figure 6.* Geologic and claim map of the Crystalline-Alabama mine.**

MODERN OPERATIONS

High gold prices in the late 1970's renewed interest in the California Mother Lode. From 1978 to 1982 exploration geologists working for Gulf and Western Corporation conducted a surface geochemical sampling program, followed by exploratory drilling in the old Jamestown district. Their efforts concentrated on historic mining operations along a five-mile stretch of the Mother Lode. Results were promising, and they outlined 25 million tons of low-grade ore recoverable by open-pit mining methods. However, the company decided to sell the ore deposits rather than to develop them.

In 1983 a group of Canadian geophysicists examined the Jamestown property. Convinced of the potential of the deposits, they capitalized and incorporated Sonora Mining Corporation with the sole purpose of purchasing and developing the Jamestown mine. The purchase was consummated in late 1983, and the company began environmental study and permit acquisition for the project.

The Jamestown mine consisted of five historical mine groups which were, from north to south, the Rawhide mine, the Alabama-Crystalline mines, the Harvard mine, the Dutch-App-Nyman mines and the Golden Rule-Jumper mines. The mine plans called for development of the Harvard pit first, followed by the Crystalline pit. Pre-stripping on the Harvard deposit began in the summer of 1986. Mining of the Crystalline pit, begun in September 1990, was interrupted in May of 1991 and resumed in January of 1992.

A 7,000-ton-per-day gold processing facility was erected adjacent to the Harvard pit during 1986, and the first ore was processed in February of 1987. The majority of the gold occurs as microscopic particles attached to the surfaces of pyrite, the average gold particle ranging from 30–150 microns in size. The gold is recovered using flotation technology which preferentially selects the auriferous pyrite from barren sulfides and matrix materials. The sulfide concentrate is then shipped to a cyanide treatment facility in Nevada. Overall recovery averages 77%. Coarse gold particles, which are not amenable to the flotation process, are captured and treated using gravity separation techniques. This process accounts for 15–20% of the total recovered gold.

Before the spectacular gold discovery in December of 1992, Sonora Mining Corporation had moved almost 59 million tons of rock, 13 million tons of which was ore. Ore processing at that time had yielded a total production of 18,879 kg (607,000 ounces) of gold. The pocket of leaf gold was found in the north end of the Crystalline pit on the 1510 bench. The site lay slightly north of, and approximately 50 feet below the old Alabama glory hole. Old mine timbers in the area of the find indicate that the miners of yesterday came within 24 meters of the big pocket!

The first specimens from the Jamestown pocket were exhibited at the Tucson Gem and Mineral Show in February of 1993. No more specimen material has been found to date in the Crystalline pit. Mine operations are scheduled to be completed in early 1994.

GEOLOGY

The Jamestown mine lies along the historic California Mother Lode. In this area the Mother Lode vein system is coincident with the Melones fault system, a high-angle reverse fault zone generated by compressional stresses which accreted volcanic/sedimentary sequences to the North American continental margin (Duffield and Sharp, 1975). Potassium-argon dating indicates that gold-bearing hydrothermal solutions percolated up the fracture system 127 million years ago, reacting with the surrounding rocks and depositing gold (Kistler *et al.*, 1983).

The wall rocks consist of greenschist-grade metamorphosed sedimentary and volcaniclastic rocks. These rocks include graphitic slate, phyllite and greenschist. Ultramafic oceanic crust was plastically intruded along the fault suture, resulting in serpentinite, some of which retains its gabbroic texture. Hydrothermal alteration adjacent to the fault structures has resulted in ankeritic schists, talc schists, and quartz-ankerite-mariposite schists. "Mariposite" is characteristic of the Mother Lode gold system. It was first defined in 1867 from a locality in Mariposa County, California (Silliman, 1867), and is today recognized as a high-silica chromian muscovite.

The Mother Lode vein strikes approximately N25°W (335° azimuth) and dips steeply eastward about 70°. The hangingwall slates and greenstones are isoclinally folded and dip eastward about 80°. Smaller quartz veins roughly parallelling the Mother Lode structure occur in the wall rocks, sometime developing their own alteration/minerali-

Figure 7. **Schistose area in the Crystalline pit, riddled with white quartz veins, where the "Christmas pocket" (center of photo) was found.**

zation selvage. Another set of veinlets are developed in the hanging-wall rocks dipping gently westward, 30°–45° into the Mother Lode structure. These represent vein fillings of tensional joints developed during lateral compressional deformation. These structures seem to be the favorable depositional sites for free visible gold. In fact, visible gold has always been found within quartz-bearing structures at the Jamestown mine.

The Jamestown crystalline leaf-gold pocket was not found in the Mother Lode vein. A fault trending due North which intersects the vein at an acute angle brought black graphitic slate into contact with mariposite-quartz-talc schist. A well-developed gouge zone 10 to 15 cm wide formed along the structure. The soft gougey material allowed the gold to crystallize euhedrally. The largest gold specimen apparently spanned the full width of the fault, as it had sooty graphitic matrix on one side and talcy-quartzose matrix on its other side.

MINERALOGY

The mineralogy of the Jamestown deposits is fairly simple. The gangue minerals consist of quartz, feldspar, ferromagnesian silicates, and calcium, magnesium and iron carbonates. Occasionally barite and plagioclase join quartz and carbonate minerals as vein fillings. Typical trace metamorphic minerals also occur: apatite, ilmenite, rutile, titanite, zircon and, in the serpentinite, chromite and magnetite.

Pyrite is by far the dominant sulfide, but chalcopyrite, galena, sphalerite and tetrahedrite are also seen. Polished section analysis reveals some of the rarer minerals present. As expected with the presence of ultramalic rocks, "bravoite" (= nickeloan pyrite), cobaltite, gersdorffite, millerite and siegenite have been identified. Rare grains of telluride minerals have also been identified: coloradoite, hessite, melonite, petzite and native tellurium.

The specimens found in the pocket were generally bright gold leaf on one side, with occasional octahedral pits or points showing on the surfaces. The other side was sparsely to densely covered with dark to silvery gray crystals of hessite up to 3 mm across. Some of the smaller specimens were completely encrusted in fine gray hessite so that they did not look like gold at all. Although the specimens were not found in place, it is reasonable to expect that the hessite side of all the gold specimens faced the same direction. This could indicate a direction of fluid movement, or a change in fluid chemistry over time. Historically the Alabama had a higher silver content in its ore than other Mother Lode deposits, and may reflect a variant fluid chemistry. Distinctive tetrahedrite ore shoots with high silver values have been observed in the Harvard and Crystalline pits. These shoots average 10–15 meters in strike length and 50 meters or more in dip continuity.

The hessite was identified by electron microprobe analysis. Some of the crystals contain intergrowths of gersdorffite crystals. Gold fineness varies from 730–780 fine. Some of the gold has a distinctive red, or iridescent coating less than 0.1 micron in thickness. Scanning electron microscopy revealed that the coating is either fluorite plus a magnesium fluoride, or some other mineral containing Ca, Mg and F. Sellaite (MgF_2) is known from some hydrothermal cassiterite veins in volcanogenic settings, but it is a colorless mineral. Fluoborite ($Ca_3Mg_3F_8O_2$), is another possibility, known from contact-metamorphic limestones (Palache *et al.,* 1951). Unfortunately, the Jamestown material is too sparse to allow X-ray diffraction analysis, and even under 30,000X magnification does not show any recognizable crystal morphology.

Of historical interest is a paper by Benjamin Silliman dated 1867 which describes an occurrence of hessite found at the Reist mine on the northeasterly end of Whiskey Hill. The source of the hessite was the auriferous slates east of the main vein, but the workings were flooded at that time. A Mr. Williams, owner of the mine, shared a specimen with Silliman for positive identification. It was reported that masses of the mineral "half an ounce in weight" had been obtained in the past (Silliman, 1867). Christian Reist's ownership of the Alabama mine from 1862 to 1866, followed by Daniel Williams, and the general description of the mine's location all suggest that the Reist mine and the Alabama mine are one and the same. A reference in an

Table 1. **Minerals identified from the Jamestown mine.**

Native Elements		***Oxides***	***Carbonates***
Gold	Au, Ag	Chromite	Ankerite
Graphite	C	Ilmenite	Calcite
Tellurium	Te	Mangetite	Siderite
		Rutile	
Sulfides and Sulfosalts			
Chalcopyrite	$CuFeS_2$	***Phosphates***	
Cobaltite	CoAsS	Fluorapatite	
Galena	PbS		
Gersdoffite	NiAsS	***Silicates***	
Millerite	NiS	Amphibole group	
Pyrite	FeS_2	Feldspar group	
Siegenite	$(Ni,Co)_3S_4$	Muscovite (chromian)	
Sphalerite	(Zn,Fe)S	Pyroxene group	
Tetrahedrite	$(Cu,Fe)_{12}Sb_4S_{13}$	Quartz	
		Serpentine group	
Tellurides		Talc	
Coloradoite	HgTe	Titanite	
Hessite	Ag_2Te		
Melonite	$NiTe_2$		
Petzite	Ag_3AuTe_2		

Figure 8. **The Crystalline pit, Jamestown mine, Tuolumne County, California, in 1992.**

1874 issue of *Mining and Scientific Press* describes "the Reist or Alabama quartz claim near Jamestown."

ACKNOWLEDGMENTS

We wish to express appreciation to the management of Sonora Mining Corporation for allowing the publication of this report. We also wish to commend Carlo DeFerrari for his informative and detailed historical research of mining activities in the area, upon which we relied heavily.

Finally, we wish to dedicate this paper to the men and women of Sonora Mining Corporation, without whose hard work and commitment the Jamestown mine would never have become the third largest gold producer in California. In the words of the forty-niners, they not only "saw the elephant," they dug up one of the jumbo elephants of all time.

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"Paleontologist on the point of a discovery" *W. E. Wilson*

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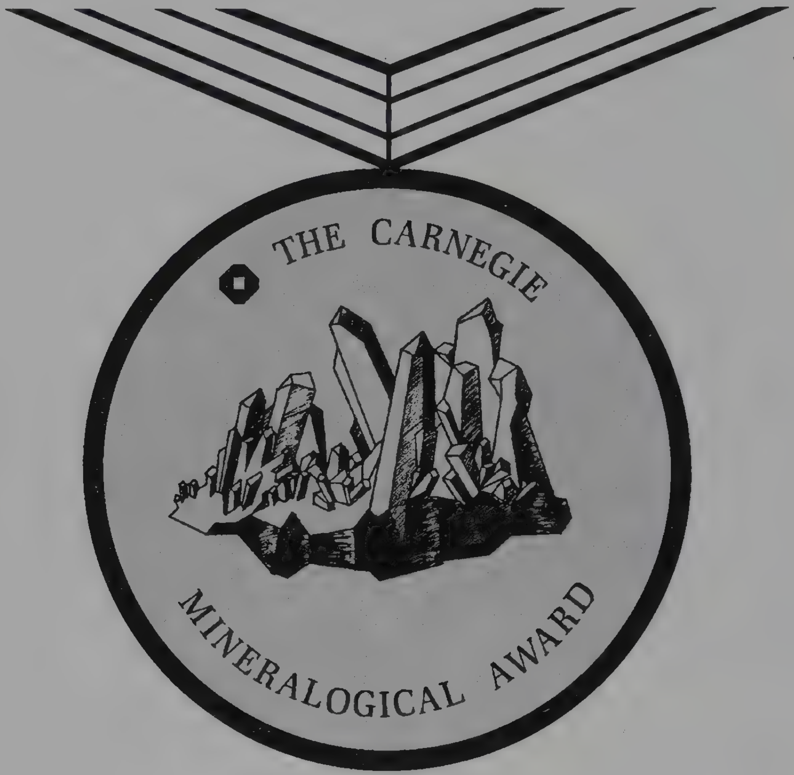

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THE HORCAJO MINES

CIUDAD REAL PROVINCE, SPAIN

Borja Sainz de Baranda
Avenida de America, 28, 3°A
28028 Madrid, Spain

By the beginning of this century the Horcajo mines had produced some of the world's fine pyromorphite specimens. Despite this fact, no specimens of any significance had been found in recent times until 1990, when works connected with the High Velocity Train exposed many occurrences of outstanding pyromorphite crystals.

INTRODUCTION

The Horcajo mines are located at the southern limit of Ciudad Real Province, Spain, approximately 35 km south of the village of Brazatortas, in the heart of the Sierra Morena Mountains. Access is by means of country road 420 Ciudad Real-Córdoba. The mines can be reached by taking a narrow trail for 2 km to the south of the Puerto de Valderrepisa.

The mines were worked for argentiferous galena and, to a lesser extent, native silver, cerussite and pyromorphite. The quantity and quality of pyromorphite crystals have made this locality famous among European collectors. Large crystals in magnificent groups to several tens of centimeters across, with fine color and luster, were found at the beginning of this century. The variety of forms and colors has made Horcajo pyromorphite popular among some of the best public and private collections worldwide.

Until 1990, the possibility of collecting any good crystals on the dumps was very limited. However the modern route of the High Velocity Train from Madrid to Sevilla cut across the old minesites and dumps, and has exposed many occurrences of pyromorphite as well as several other phosphate minerals, none of them previously reported from this locality.

Unfortunately the dumps are now being smoothed over and planted with trees to forestall erosion, thus cutting off collector accessibility for the foreseeable future.

HISTORY

Evidence exists that Romans first worked the deposit during ancient times, along with many other Sierra Morena lead-silver deposits. However, the earliest work in modern times took place in 1859, when a small operation for the production of lead and silver began. During the first four years, production reached 1,227 "quintales" (about 28 metric tons) of ore. During the following two years the production increased to 6,975 quintales, with a lead content of 60 to 62%, and 5 ounces of silver per ton (Piquet, 1876).

Later, new veins were found and the production increased substantially. Only the San Alberto (or Nuevo Perú) vein was mined until 1871, whereas two years later six of the more important veins were being worked, including the Ana María, Paralelo and San Germán veins, in addition to others of minor significance. The chief vein was 70 cm wide at that time, although it widened to 4.5 meters in some places, principally to the west of the Argentino shaft. A rise in the

Figure 1. **View of the Horcajo mines, looking north, with the H.V.T. bridge in the foreground; spring of 1990. Photo by J. M. Gordillo.**

Figure 2. **Beraunite crystal group (3 cm) with dufrenite (?) from El Horcajo, collected in November of 1991. The crystals are up to 5 mm in longest dimension. Author's specimen and photo.**

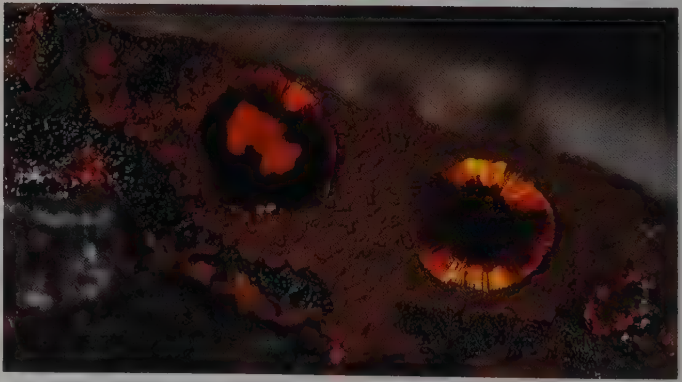

Figure 3. **Cacoxenite rosettes, each 5 mm across. This is the best cacoxenite specimen thus far recovered from the Horcajo dumps. Collected in November, 1991. S. Maturana collection; photo by the author.**

silver content appeared at 80 meters depth, then decreased again until 105 meters, when it started to increase once more.

Production between 1866 and 1874 was maintained between 2.11 and 4.05 quintales per square meter of lode mined per year, and silver content reached a maximum of 6.69 ounces per ton in this time period. This was the period of greatest production in the Horcajo mines, when the number of village inhabitants reached more than 2,000. Production continued until 1911; since then, only the upper adits have been mined because of heavy water flow at depth. The mining operations were carried out intermittently by the Sociedad Minero-Metalúrgica Peñarrolla until the district closed in the 1960's.

At present, all shafts and mining installations are abandoned, and collecting in the area is only possible on the old dumps. No permission is necessary to work at the surface collecting sites.

GEOLOGY

The Horcajo deposits lie within the southern limit of the Zona Centro-Ibérica (central part of the Iberian massif) described by Julivert *et al.* (1972). This zone is distinguished by the existence of large

Figure 4. Pyromorphite crystal group, 15 cm, from Horcajo. Sorbonne collection; photo by Nelly Bariand.

Figure 5. Pyromorphite crystals to 5 mm on goethite, showing color zoning. Collected in the Horcajo dumps in September of 1989. Author's specimen and photo.

Figure 6. Pyromorphite crystals to 3 mm showing hourglass zonation, from the Horcajo dumps. Collected in 1990. J. M. Gordillo collection; photo by G. García.

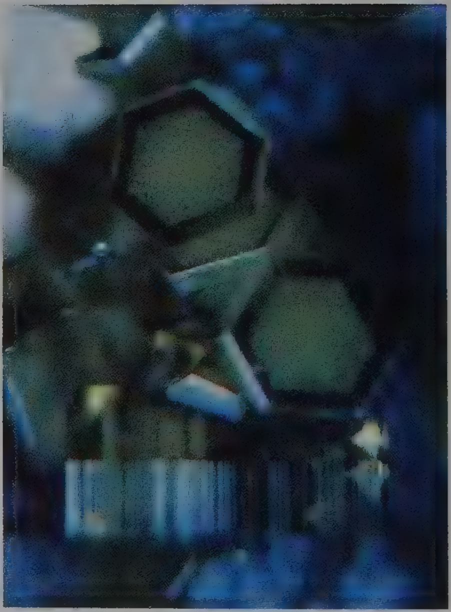

Figure 7. Pyromorphite crystals to 2 mm showing zonation and striation. Collected on the Horcajo dumps in 1990. J. M. Gordillo specimen; photo by G. García.

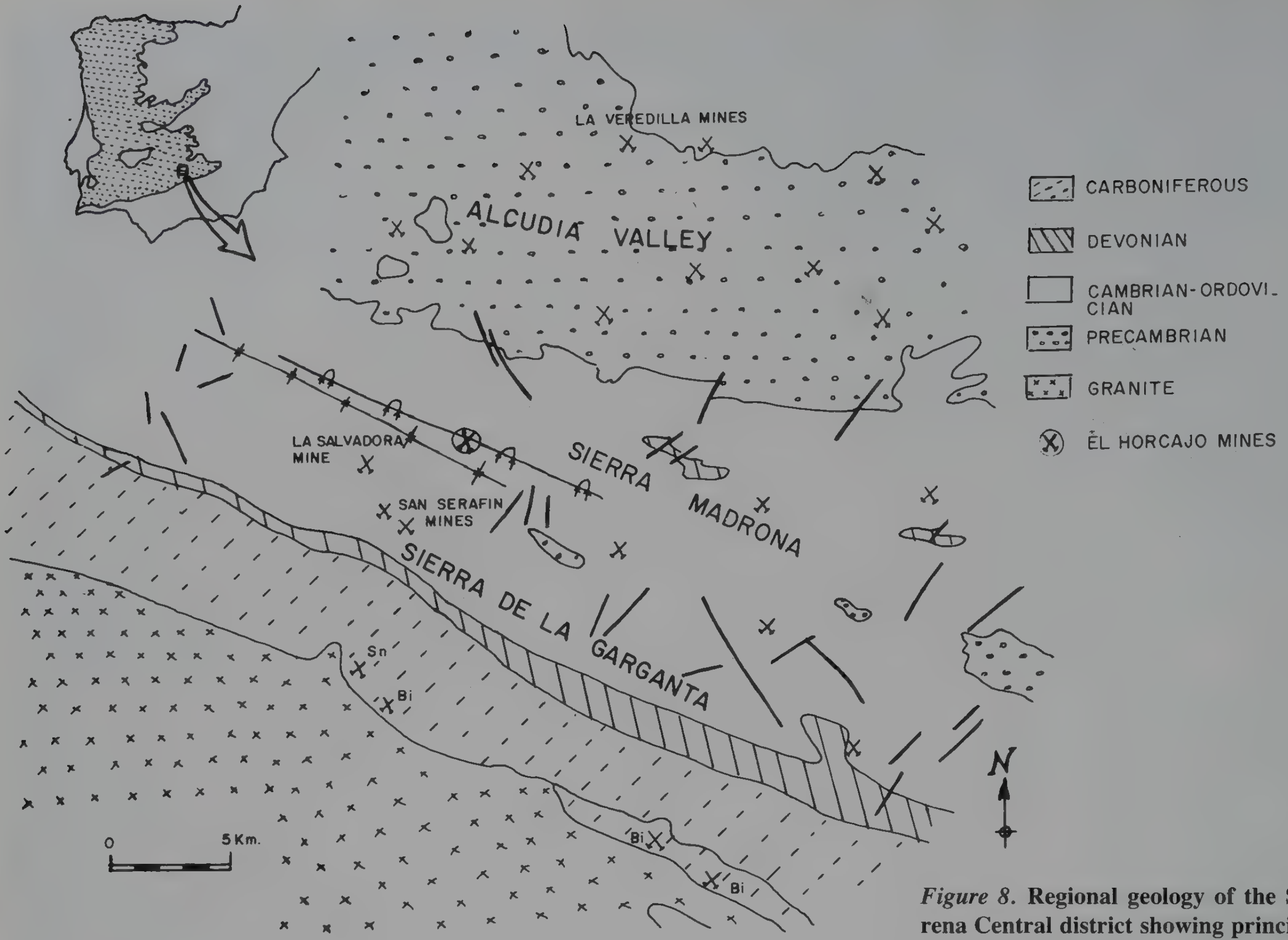

Figure 8. **Regional geology of the Sierra Morena Central district showing principal mines.**

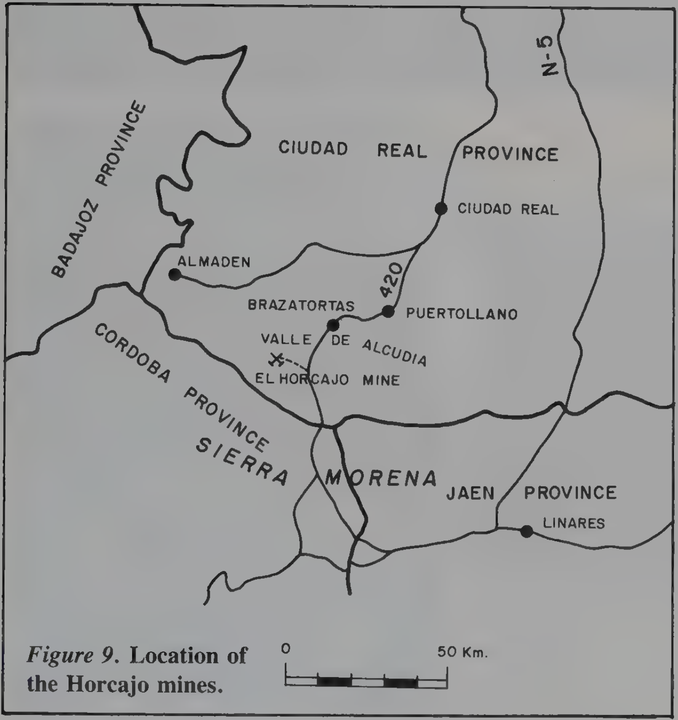

Figure 9. **Location of the Horcajo mines.**

northwest-trending folds: the synclines of Almadén and Guadalmez, and the Alcudia antiform in whose south flank the Horcajo deposits are situated.

Precambrian sediments, graywackes, sandstones and slates, are exposed in the Alcudia antiform; two different units have been distinguished: the Lower Alcudiense (graywackes, conglomerates, slates) and the Upper Alcudiense (graywackes, shales and mudstones). These units are separated by an unconformity (Crespo and Tamain, 1971).

In the Paleozoic, a long period of sedimentation began with a coastal formation, the basal conglomerate. This period continued until the Carboniferous, concluding with the Dinantian flysch (Almela *et al.*, 1962). Discontinuous alkaline volcanic activity (Sainz de Baranda and Lunar, 1989) took place throughout this period, mostly in the Almadén syncline.

Three main periods of deformation occurred during the Hercynian Orogeny, accompanied by low-grade regional metamorphism (Julivert *et al.*, 1983). The last period of distension created a system of conjugate faults with two trends; these were of great important in the formation of the vein deposits of the area.

The Horcajo deposits are hosted by Ordovician shales and sandstones. They are low-temperature hydrothermal veins with a dominant east-west trend. The deposits are of the peribatholithic type, related to the Pedroches Batholith (Crespo and Tamain, 1971). Dominant gangue minerals are quartz and ankerite. Weathering led to the development of an important gossan consisting principally of goethite and pyromorphite. The origin of the phosphate minerals is related to the action of solutions on the phosphatic country rocks.

MINERALS

I and my colleagues have been collecting in the area regularly since 1980, and have recovered a large number of rare species, most of them previously unreported from this locality, and some of them under study at present. Where appropriate, X-ray powder diffraction and microprobe analyses have been performed. Only the minerals of primary interest to the mineral collector are described below. A complete list of species from the Horcajo deposits is given in Table 1.

Anglesite $PbSO_4$

Anglesite has been found in very fine, white to pale brown and pink crystals up to 4 mm in the San Germán mine.

Beraunite $Fe^{2+}Fe^{3+}_5(PO_4)_4(OH)_5 \cdot 4H_2O$

Beraunite forms vertically striated, prismatic, orange to red crystals, commonly associated with small gray-green spherules and rosettes of dufrenite (?). Beraunite appears in single crystals or, more frequently, in rosettes up to 2 cm in diameter, having a radial structure.

Cacoxenite $(Fe^{3+},Al)_{25}(PO_4)_{17}O_8(OH)_{12} \cdot 75H_2O$

Very fine specimens of cacoxenite, as well as other well crystallized iron phosphates, have been found on the dumps from the Horcajo mines. The phosphate minerals appear in joints in the Ordovician sandstone. Cacoxenite appears in large crystals to 1 cm, as golden and yellow-amber needles and sprays with high luster. This is the second find of cacoxenite in Spain, and perhaps one of the best in Europe, because of the size, quality and beauty of the specimens.

Cacoxenite is usually associated with goethite and the other iron phosphates, appearing in the last stage of the paragenetic sequence.

Cerussite $PbCO_3$

Cerussite was one of the main ore minerals mined in the Horcajo deposits. According to Calderón (1910), cerussite content sometimes reached between 2 and 4 quintales per square meter of lode worked.

I have seen very fine crystals throughout the Horcajo dumps, commonly with a thin oxidation coating. The crystals are colorless, white or ochre and translucent, of prismatic to tabular habit, and vertically striated. Twinned crystals are common, associated with quartz, pyromorphite and linarite.

Cerussite also appears in large masses of several kg which are gray or almost black because of very tiny inclusions of galena. They are associated with small crystals of linarite and pyromorphite in cavities.

Chalcocite Cu_2S

Chalcocite is a common mineral in the San Germán mine, as formless blue masses several centimeters across, associated with native copper, silver, goethite, cuprite and pale brown pyromorphite. No chalcocite crystals have been reported from the mines.

Chalcopyrite $CuFeS_2$

Chalcopyrite is a common mineral throughout the Horcajo deposits, where it is the dominant primary copper mineral. Fine crystals are uncommon, appearing on ankerite and quartz and reaching 5 mm in size. The crystals usually show a darkened oxidized surface.

Copper Cu

Calderón (1910) reported that "the lead veins from Horcajo usually have small masses of pyrite with native copper crystals." I have seen this mineral in the gossan of the San Germán mine, where copper appears as sheets, plates, arborescent groups and small, copper-red, octahedral crystals, sometimes associated with native silver. The best crystals are embedded in chalcocite masses. The crystals reach 2 or 3 mm across, although large masses of several kg have also been found.

Cuprite Cu_2O

Small cuboctahedral crystals of cuprite have been found in the Horcajo deposits, mostly in the San Germán mine. The red translucent to opaque crystals are commonly coated with malachite or a thin film of native copper. Crystals to 3 mm are relatively common in the goethite cavities.

Freibergite $(Ag,Cu,Fe)_{12}(Sb,As)_4S_{13}$

Freibergite is a very scarce mineral in the dumps, appearing in small tetrahedral crystals to 2 mm on quartz. Crystals are very lustrous in broken sections, but usually show an altered and dull surface. Associations include galena and chalcopyrite.

Galena PbS

Galena was the main ore mineral in the deposits, mostly because of its silver content. According to Calderón (1910), galena from Horcajo also has an elevated antimony content, and commonly appears altered, sulfated and coated with wires and plates of silver.

Cubic and octahedral crystals of galena to 6 or 7 mm are uncommon in the dumps. They are associated with chalcopyrite and freibergite in quartz geodes. Dense masses are found in ankerite veins.

Goethite FeO(OH)

Goethite forms attractive, iridescent, botryoidal masses with radial structure. It is a very abundant mineral throughout the mines, and is found associated with almost all the other secondary minerals. In the San Germán mine, botryoidal groups with radial structure have developed around native copper grains.

Linarite $PbCu^{2+}(SO)_4(OH)_2$

Linarite occurs frequently on cerussite and galena in the dumps from the Horcajo deposits. Crystals are small, to 2 or 3 mm, forming radial groups in very attractive microscopic specimens. It is commonly associated with tiny green crystals of caledonite (?).

Plumbogummite $PbAl_3(PO_4)_2(OH)_5 \cdot H_2O$

Small, yellow, rhombohedral plumbogummite crystals to 1 mm and botryoidal masses associated with pyromorphite have been identified. In some specimens the plumbogummite occurs as white epimorphs after pyromorphite crystals to 2 mm on quartz.

Pyromorphite $Pb_5(PO_4)_3Cl$

According to Calderón (1910), pyromorphite crystals from Horcajo were the best known from Spain up to that time. Pardillo and Gil (1916) described four types of habits: (1) Thick, equant crystals with parallel structure; (2) very thin, acicular crystals; (3) small, tabular crystals, and (4) small, equant, bipyramidal crystals, similar to those of quartz.

The principal forms observed are $c\{0001\}$ and $a\{10\bar{1}0\}$, the latter being the largest and usually striated. Pardillo and Gil (1916) also considered $b\{11\bar{2}0\}$, $h\{21\bar{3}0)$, sometimes very large $x\{10\bar{1}1\}$, and narrow $x\{20\bar{2}1\}$ to be common. Pardillo and Gil observed 13 other forms, less common and poorly developed. The prism $\{11\bar{2}0\}$ faces usually are poorly developed, whereas the prism faces $\{10\bar{1}0\}$ are large and striated. The basal pinacoid is typically smooth, sometimes with hexagonal surface features, visible only under intense reflected light because of a very low relief. Pyramidal $\{10\bar{1}1\}$ faces are common, sometimes truncated by pinacoids. Second-order pyramidal faces are uncommon.

The classic specimens from this locality (like the Sorbonne specimen illustrated here in Fig. 4) are large aggregates of thin or acicular

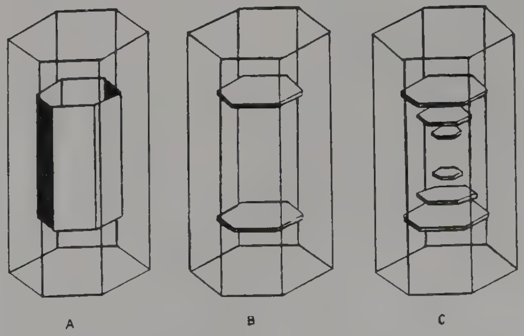

Figure 10. **Sketches showing the common types of zoning in Horcajo pyromorphite. Sketches by J. M. Gordillo.**

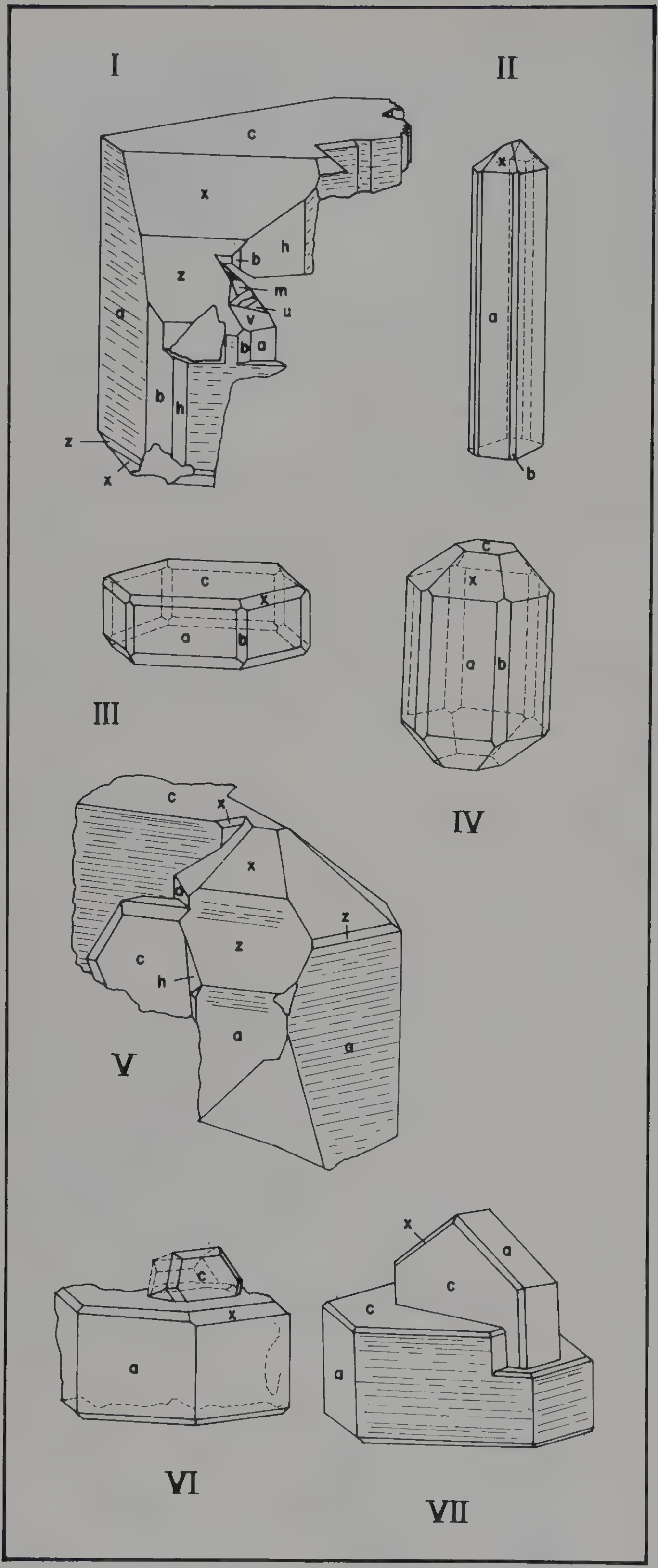

Figure 11. **Crystal drawings of Horcajo pyromorphite (VI and VII: twinned crystals). Redrawn from Pardillo and Gil (1916).**

crystals, commonly in parallel groups. Nevertheless, we have been able to find single crystals of exceptional quality. Although the average length is only 3 or 4 mm, some crystals exceed 1 cm.

Pyromorphite occurs in quartz breccia, filling the interstices between quartz fragments. It is also found in very fine, gemmy, emerald-green crystals in quartz pockets and with goethite.

Table 1. **Minerals from the Horcajo mines.**

Mineral	References				
Native Elements					
Copper	1	2	3	4	x
Silver	1	2		4	x
Sulfides					
Arsenopyrite			3		
Bornite			3		
Chalcocite					**x**
Chalcopyrite	1	2		4	x
Covellite			3		x
Freibergite			3		x
Galena	1	2	3	4	x
Marcasite			3		
Pyrite			3	4	x
Halides					
Iodargyrite	1	2		4	
Oxides and Hydroxides					
Cuprite					**x**
Goethite				4	x
Massicot					**x**
Carbonates					
Ankerite			3		x
Cerussite	1	2	3	4	x
Malachite					**x**
Sulfates					
Anglesite					**x**
Barite			3		
Caledonite (?)					**x**
Linarite					**x**
Phosphates					
Beraunite					**x**
Cacoxenite					**x**
Dufrenite (?)					**x**
Kidwellite (?)					**x**
Plumbogummite					**x**
Pyromorphite	1	2	3	4	x
Strengite					x
Silicates					
Quartz			3	4	x

(?) Species requiring confirmation; (1) Calderón, 1910; (2) Galán and Mirete, 1979; (3) Crespo, 1972; (4) Piquet, 1876; (x) observed in the present study; (**x**) reported here for the first time at Horcajo.

A range of habits have been found: tabular, prismatic, equant, acicular, barrel-shaped, and in concave habits. Sometimes, the unequal growth velocity of the prism faces with respect to the basal pinacoid results in cavernous crystals where the prism faces enclose a nearly empty space, with hardly any development of the pinacoids. Also common is the superposition of several generations of pyromorphite crystals. Acicular, parallel crystals growing from the pinacoid of a first-generation crystal is one example.

Pyromorphite occurs at Horcajo in a variety of colors: colorless, white, gray, yellow, brown, black and all shades of green. Crystals are transparent to opaque. One single crystal can show a range of color and transparency. Color zoning is a common feature of Horcajo pyromorphite crystals, parallel or perpendicular to the *c* axis. A "Hourglass" zonation is common.

Silver Ag

According to Calderón (1910), silver is found on wires on galena and plates on quartz, mostly in deep zones of the Ana María mine. Old miners have told me that native silver ("plata en rama," or branched silver) was very abundant in the Argentino shaft, sometimes in large veins. I myself have collected small wires, scales and arborescent groups to 2 or 3 mm, on goethite and quartz, in the San Germán mine. A common association is native copper, in very fine specimens, but silver is very rare on chalcocite in this mine. Very beautiful wires and arborescent groups of silver have recently been found on the Horcajo main dumps, associated with gray-white pyromorphite and quartz.

Strengite $Fe^{3+}PO_4\cdot 2H_2O$

Strengite is a very scarce mineral on the dumps. I have collected only one specimen, consisting of outstanding, transparent, colorless to pink crystals and rosettes to 2 mm, associated with beraunite, cacoxenite and kidwellite (?).

COLLECTING STATUS and CONCLUSIONS

Horcajo is a classic mineral locality because of the quality and abundance of pyromorphite crystals. Although large crystals are scarce at the moment, collectors of micromounts and miniature-size specimens will find very good samples in the dumps, as well as an interesting suite of associated minerals. Furthermore, additional mineral species will probably be reported as investigations progress and collecting continues.

The mines are located in a private range, so visitors must check in at the entrance. Permission is necessary to camp.

ACKNOWLEDGMENTS

I would like to thank the members of the Grupo Mineralogista de Madrid for their help in preparing this paper, especially Jose Manuel Gordillo, Salvador Maturana and Gonzalo García. I would also like to thank the people from the Instituto Tecnológico y Geominero de España for permission to photograph several specimens from the Museum. My thanks to Dr. Wendell E. Wilson for providing helpful suggestions, and to Nelly Bariand for specimen photography.

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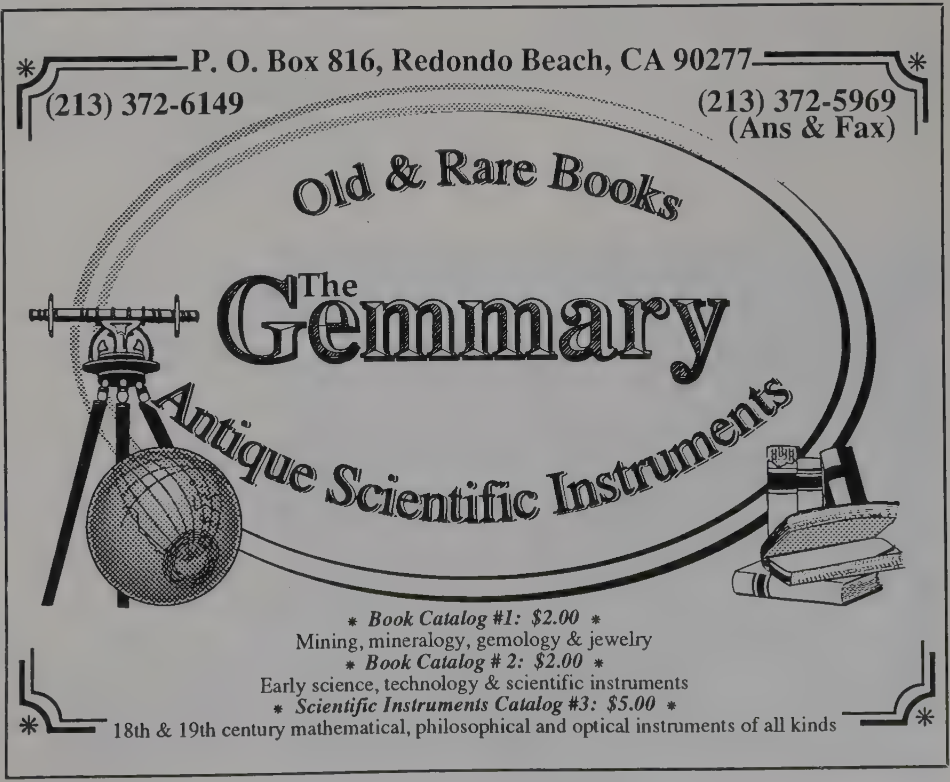

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SOME PEGMATITE MINERALS FROM THE ZOMBA DISTRICT, MALAWI

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Excellent crystals of lustrous greenish black aegirine, black arfvedsonite, smoky quartz and gray orthoclase-microcline have been found in a Narssârssuk-like pegmatite deposit in Malawi. Rare associated minerals include parisite-(Ce), bastnäsite-(Ce), fergusonite-(Y), hingganite-(Y) and mangan-neptunite, among others.

INTRODUCTION

The first of the recently discovered specimens from the Zomba pegmatites appeared at the Tucson Gem and Mineral Show in 1991, where a limited number of exceptionally lustrous, very attractive single crystals and groups of aegirine were offered for sale by Dry Creek Minerals, Rancho Cordova, California. The find was mentioned by Wilson (1991), who noted that the aegirine was associated with grayish white microcline, smoky quartz, beryl and pinkish microcrystals of a mildly radioactive, unknown mineral. Subsequently Robinson and King (1991) reported it as well; their mention of the find ends with the words: "What other uncommon alkalic species might also be present?"

Partly because of the beauty of these specimens, but even more because of a suspicion that such well-developed crystals of aegirine (obviously grown in pockets and/or in open veins) could very well be associated with a number of other interesting minerals, the senior author, familiar with minerals of this type of paragenesis from his many years of work in South Greenland, bought two of the specimens for study. Both proved, however, to contain nothing but aegirine with minor smoky quartz.

At the Münchner Frühjahrsbörse (Munich spring show) of the same

Figure 1. **The Malosa Plateau seen from the town of Domasi; photo by R. Cullmann.**

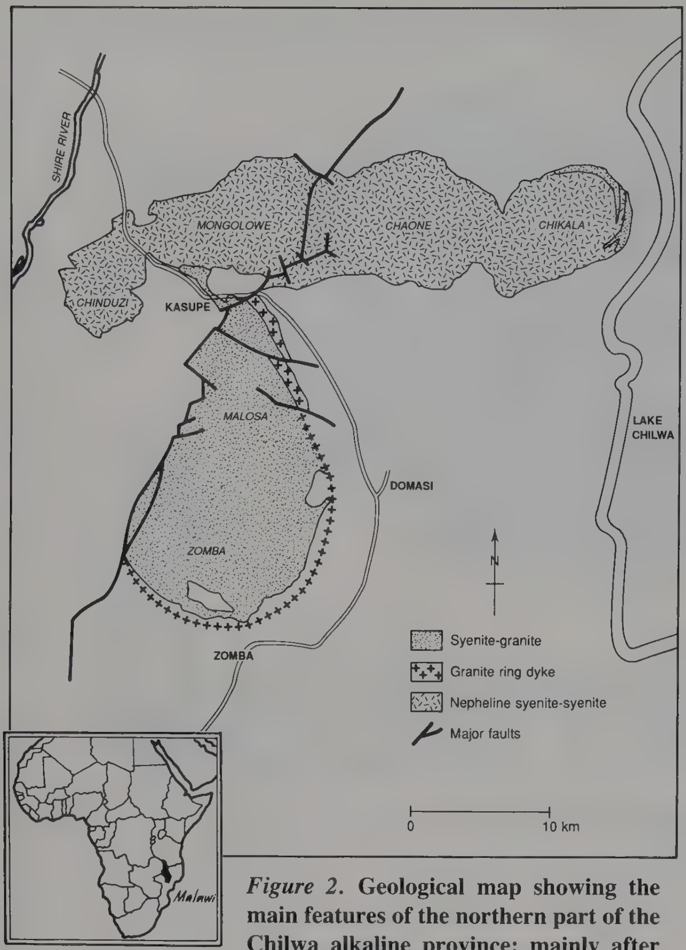


Figure 2. **Geological map showing the main features of the northern part of the Chilwa alkaline province; mainly after Woolley and Jones (1987).**

year, the junior author offered a small selection of similar aegirine crystals for sale. Zircon and such exotic minerals as pyrochlore, epididymite and parisite were identified on four of these specimens by the senior author, proving the original suspicion that such aegirine was likely to be associated with a number of interesting minerals, and demonstrating the need for a closer investigation of additional material.

Since then a limited but reasonably large amount of material has shown up on both the European and American markets, prompting the authors to publish this report.

LOCATION

Little is known as to the exact locality of these specimens. According to a local contact, they are from Mount Malosa on the Zomba Plateau, Malawi, in southeast Africa. The veins are allegedly found more or less accidentally, while looking for gem corundum (?) and smoky quartz, at locations where the ground sounds hollow under the feet. That the veins must be near the surface is further supported by the fact that many of the specimens contain plant roots. While knowledge of the exact locality is limited, the available detailed descriptions of the general geology and mineralogy of the area (Bloomfield 1965; Woolley and Platt 1986; Woolley and Jones 1987; Woolley 1991) provide a reasonably good basis for its attribution to the Malosa part of the Zomba-Malosa complex of the Chilwa alkaline province, Zomba district, Malawi.

GEOLOGY

The Chilwa alkaline province is the southernmost manifestation of the alkaline vulcanism associated with the East African rift, which can be traced almost continuously from the Red Sea to just south of Lake Malawi. The major intrusions of this province comprise plutons of peralkaline granite and syenite and somewhat smaller complexes of nepheline syenite and syenite, as well as several carbonatite centers.

The largest intrusion of the northern part of the province is the Zomba-Malosa complex (just north of the town of Zomba), which consists of syenite, quartz-syenite and granite. Of the predominantly nepheline syenite complexes north of Zomba-Malosa, only Mongolowe makes contact with the northern margin of Zomba-Malosa.

The Zomba part of the complex has a central syenite plug, an inner syenite ring and an outer alkaline granite ring separated from the main complex by a screen of basement gneiss. The Malosa part is a much more heterogenous mixture of syenite and granite, and on the northeastern side of Malosa there is a marginal strip of true alkaline granite. The outer alkaline granite ring, north of the Domasi River, intruded along the syenite/gneiss contact, is represented to the northwest by a lenticular dike of alkali granite intruded along the contact between the Malosa granite and the gneisses.

Differentiation at Zomba-Malosa was from syenite to granite; half the granites are chemically peralkaline. Quite recent mineralogical evidence—two series of pyroxenes both leading, though along different trends, to aegirine and two series of amphiboles—suggests that a single but heterogenous magma body with two discrete magma systems evolved. The Zomba system, in the lower part of a vertical magma column, differentiated from syenite to quartz syenite and the Malosa system, in the upper part of the column, differentiated from syenite to granite with a concomitant increase in peralkalinity (Woolley and Jones 1992).

In the Zomba part pegmatites are rather rare; north of the Domasi River they are much more common. Granite pegmatites are especially abundant in the western part of the Malosa complex and at the northern end near Kasupe.

The alkaline microgranites intruded into the Malosa part of the complex show an abundance of Nb, Ti and Zr in the trace elements and an enrichment in Be, Li, Pb, Mn and Y.

Minerals previously reported from the pegmatites include quartz, feldspar (microperthite or microcline, albite), aegirine, riebeckite, zircon, xenotime, pyrochlore, monazite, thorite, epidote, hematite and yttrian wad.

In 1955, a radioactive anomaly was detected just southeast of Kasupe. Subsequent detailed investigations showed this was caused by transgressive granitic and pegmatitic veins within the basement gneisses just east of the northern tip of the Malosa part of the Zomba-Malosa complex. Besides the minerals mentioned above, kaolin, calcite, galena and epidote were identified from the pegmatites within the complex. It is specifically noted that the quartz is of the smoky variety.

Geological and mineralogical evidence thus strongly suggests that the minerals dealt with in this article originated from quite large, agpaitic granite pegmatites representing very late differentiates in the alkaline granites, somewhere in the northern tip of the Malosa part of the Zomba-Malosa complex, probably not too far from the town of Kasupe.

MINERALOGY

Based on relative size and shape of the crystals and associated species, the material examined so far can be divided into three types, probably originating from three different veins or systems of veins or three different parts of the same vein. The *first type* is characterized by relatively large, often twinned, feldspar crystals overgrown with smaller rosettes of slender aegirine crystals. In the *second type* (probably the most interesting), relatively small but highly lustrous feldspar crystals are associated with partly very large, very well-developed prismatic crystals of aegirine with brilliantly lustrous faces and fairly large, lustrous smoky quartz crystals. Crystals of zircon and of the two Be-minerals epididymite and eudidymite are particularly common in this type of material. The *third type* is characterized by relatively large feldspar crystals, for the major part slightly weathered, and (in contrast to the feldspar of the first type) only very rarely twinned.

Associated with the feldspar are lustrous, equally large, very well-developed crystals of arfvedsonite and a large number of fairly large pyrochlore crystals. Only rarely is smoky quartz found with this type of material.

Aegirine $NaFe^{3+}Si_2O_6$

The aegirine crystals are among the most spectacular found anywhere. Aegirine is one of the most common minerals on the specimens; it forms single crystals or groups of crystals from a few millimeters to 20 cm! The smaller crystals are slender, prismatic or acicular, and the larger ones are stout prismatic. All the crystals show the prism {110}; most of the crystals show no other forms. In addition to {110}, some of the best developed crystals have the {100} pinacoid, $\{\bar{h}01\}$ and/or very steep prisms, possibly {461} and $\{\bar{6}61\}$. Crystals of the latter type are often split into several individuals at the distal end. Only very rarely are the crystals doubly terminated. All crystals are black to greenish black, have very sharp edges and brilliant prism faces; even the faces of the forms {100} and $\{\bar{h}01\}$ are more lustrous than normal for aegirine.

Albite $NaAlSi_3O_8$

Albite occurs exclusively as parallel overgrowths on potassium feldspar, but only on faces of the zone [001] and preferably on the faces of the forms {110} and $\{1\bar{3}0\}$ of the potassium feldspar. The crystals have lustrous faces with sharp edges, are colorless and completely transparent.

Arfvedsonite $Na_2(Fe^{2+},Mg)_4Fe^{3+}Si_8O_{22}(OH)_2$

Arfvedsonite forms very well-developed crystals, most of which are between 1.5 and 3 cm, though perfect crystals as large as 8 cm have been found. The generally short prismatic crystals all show the prism {110}, which is often strongly striated. In addition to the prism, most of the crystals show the pinacoid {001} and the prism $\{\bar{1}11\}$. The crystals are black and generally not as lustrous as the aegirine crystals. Many crystals show incipient to advanced alteration to asbestiform riebeckite.

Bastnäsite-(Ce) $(Ce,La)(CO_3)F$

So far bastnäsite has only been identified on two specimens of strongly weathered aegirine. The nearly 1-cm crystals are very poorly developed and strongly corroded. They are brownish yellow, at least partially transparent, with a typical glassy to greasy luster, and may be difficult to distinguish from parisite. (No chemical analysis of this bastnäsite is available.)

Epididymite $NaBeSi_3O_7(OH)$

Epididymite, the orthorhombic form of $NaBeSi_3O_7(OH)$, is quite common in this paragenesis. It occurs for the most part intergrown with or overgrown on smoky quartz, but also forms free crystals and crystal groups. The crystals directly associated with quartz reach fully 6 cm, and form groups of parallel, extremely platy, prismatic to acicular, colorless transparent crystals. Such inclusions of epididymite in smoky quartz are particularly common in crystals of the second type of material. Almost every smoky quartz crystal in the newest material available has some inclusions of epididymite. Individual crystals and crystal groups rarely reach 1.5 cm; they are slender, prismatic to ruler-shaped, whitish to colorless and translucent or transparent. The epididymite forms delicate interpenetration trillings, well-known in specimens from elsewhere. One such flattened trilling is 5 x 5 cm across and 1.5 cm thick, but generally they are much smaller.

Eudidymite $NaBeSi_3O_7(OH)$

Eudidymite is a relatively rare mineral in this paragenesis. Most of the crystals are between 3 and 12 mm, but the very latest shipment received contained a single specimen with crystals up to 5 cm! The crystals are thin, flat (parallel to {001}) tablets with rhombic outline; nearly all the crystals are composite and consist of plates grown together in fan-like aggregates. They are white, rarely colorless, translucent or transparent, with glassy to occasionally pearly luster. Like the epididymite, the eudidymite is often found grown on smoky quartz crystals as well as on slender prismatic aegirine crystals.

Fergusonite-(Y) $YNbO_4$

Fergusonite has so far only been found in the third type of material, always associated with arfvedsonite. Large numbers of small crystals (<3 mm) can be found on most of the arfvedsonite crystals, but are easily overlooked; larger crystals less than about 2 cm are rare. The crystals are not particularly well-developed, and have rough edges and uneven faces. Nevertheless, the tetragonal symmetry of the steep, bipyramidal, occasionally doubly terminated crystals is quite conspicuous. The crystals are strongly corroded. The color varies from ocher-yellow on weathered surfaces to dark brown-red in the central unaltered portion where the luster is vitreous to submetallic.

The fergusonite-(Y) was first identified on the basis of a very complete microprobe analysis kindly provided by R. A. Gault of the Canadian Museum of Nature, Ottawa, Canada (see Table 1). The analysis corresponds to the empirical formula $(Y,REE)_{\Sigma 0.999}(Nb,Ti,Ta,Si)_{\Sigma 1.002}O_4$. This identification has been confirmed by X-ray diffraction. X-ray powder diffraction diagrams of untreated material show it to be amorphous, but after heating to above 1,200° C for 24 hours

***Table 1.* Microprobe analysis of fergusonite-(Y), Zomba-Malosa complex, Malawi. Left part of the table gives oxide weight % values, and the right part the cation contents calculated on the basis of four anions.**

Y_2O_3	20.74	Y^{3+}	.507
Nb_2O_5	48.89	Nb^{5+}	.975
La_2O_3	.87	La^{3+}	.015
Ce_2O_3	5.37	Ce^{3+}	.090
Pr_2O_3	1.19	Pr^{3+}	.020
Nd_2O_3	5.52	Nd^{3+}	.091
Sm_2O_3	1.92	Sm^{3+}	.030
Gd_2O_3	2.52	Gd^{3+}	.038
Tb_2O_3	.36	Tb^{3+}	.005
Dy_2O_3	3.53	Dy^{3+}	.052
Er_2O_3	1.93	Er^{3+}	.028
Tm_2O_3	.36	Tm^{3+}	.005
Yb_2O_3	1.26	Yb^{3+}	.018
CaO	.85	Ca^{2+}	.042
ThO_2	4.45	Th^{4+}	.047
UO_2	1.08	U^{4+}	.011
Ta_2O_5	.60	Ta^{5+}	.008
SiO_2	.12	Si^{4+}	.006
TiO_2	.37	Ti^{4+}	.013
Total	99.93	Cation sum	2.001

***Table 2.* γ-spectroscope analysis of fergusonite-(Y), Zomba-Malosa complex, Malawi**

Isotope	Bequerel per sample (x ± s.d.)	Bequerel/g
Pb^{214}	11.93 ± 0.77	22.64
Bi^{214}	9.33 ± 0.61	17.70
Pb^{212}	0.57 ± 0.05	1.08
Bi^{212}	<0.42	<0.80
Ac^{228}	0.33 ± 0.05	0.63
Ra^{226}	90.77 ± 5.86	172.24
U^{234}	145.07 ± 3.44	275.28
Pa^{234}	0.41 ± 0.10	0.78
Th^{234}	4.50 ± 0.36	8.54
Th^{228}	<2.91	<5.25
K^{40}	8.74 ± 0.55	16.58

Figure 3. A particularly well-developed aegirine crystal, 3.5 cm. Collection of M. Grossmann; photo by R. Bode.

Figure 4. Typical 3.5-cm aegirine crystal terminated by {110} and steep prisms, and split into several individuals at the distal end. Collection of the Geological Museum, Copenhagen; photo by R. Bode.

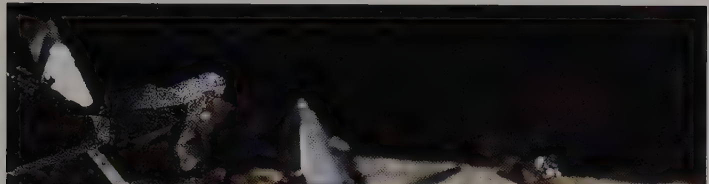


Figure 5. Group of ruler-shaped epididymite crystals on quartz with aegirine. The largest epididymite crystal is 1.5 cm. Collection of the Geological Museum, Copenhagen; photo by R. Bode.

Figure 6. A typical 5-mm aggregate of tabular eudidymite crystals on smoky quartz with aegirine. Collection of the Geological Museum, Copenhagen; photo by R. Bode.

Figure 7. A 7.5-cm arfvedsonite crystal overgrown with aegirine on feldspar. Collection and photo, R. Dallinger.

Figure 8. Metamict crystal of fergusonite, almost 2 cm long, with feldspar and arfvedsonite. Collection of the Geological Museum, Copenhagen; photo by R. Bode.

Figure 9. Corroded ocher-yellow parisite crystal, 1.4 cm long, showing typical swelling at one end. Collection of M. Grossmann; photo by M. Hansen.

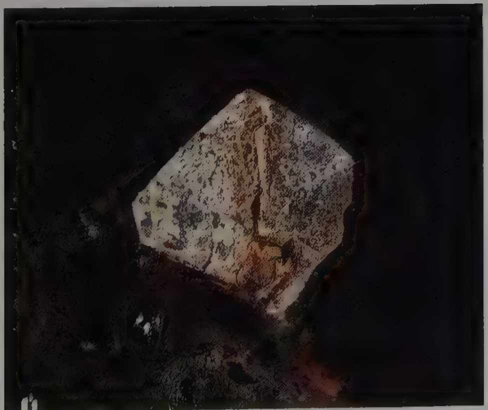


Figure 10. Octahedral pyrochlore crystal, 3 mm, partly covered by a white unidentified powdery mineral. Collection of the Geological Museum, Copenhagen; photo by R. Bode.

Figure 11. Smoky quartz covered with well-developed crystals of zircon. The specimen is 3 cm tall. Collection of M. Grossmann; photo by R. Bode.

a pattern comparable to that of JCPDS-card 09-0443 (fergusonite-(Y) / heated) was obtained. The fergusonite-(Y) from Malawi is, like fergusonite from so many other places, a paramorphosis of an isotropized substance after tetragonally crystallizing fergusonite material. The fergusonite-(Y) crystals are weakly radioactive. A γ-spectroscopical analysis, carried out at the University of Innsbruck, and kindly made available to the authors by R. Dallinger, is presented in Table 2. The analysis shows the presence of Th^{234}, Pa^{234}, U^{234}, Ra^{226}, Pb^{214} and Bi^{214} (of the U^{238} decay series) and Ac^{228}, Th^{228}, Pb^{212} and Bi^{212} (of the Th^{232} decay series). From $Ra^{226} = 90.77$ Beq $\rightarrow U^{238} = 90.77$ Beq and from $Ac^{228} = 0.33$ Beq $\rightarrow Th^{232} = 0.33$ Beq. Whereas the former corresponds well with the $\approx 1\%$ UO_2 obtained by the microprobe analysis, the latter, for unknown reasons, does not at all correspond to the $\approx 4.5\%$ ThO_2 obtained by the microprobe analysis.

Goethite $Fe^{3+}O(OH)$

Goethite has only been positively identified on one specimen, where it occurs as microcrystalline-to-powdery, reddish aggregates in sharp, rhombohedral pseudomorphs after ankerite-siderite (?) crystals partially imbedded in quartz.

Hematite Fe_2O_3

So far hematite has only been found on a limited number of specimens, as black acicular crystals replacing pyrite. The pseudomorphs are plentiful on the few specimens on which they have been found, and always occur on the tips of aegirine crystals. The pseudomorphs never exceed 1.5 mm; they show surprisingly sharp edges and {100} cube faces with minor octahedron {111} faces.

Hingganite-(Y) $(Y,Yb,Er)BeSiO_4(OH)$

By far the rarest mineral yet identified in this paragenesis is hingganite-(Y), having been confirmed on only one specimen, and visually identified on one other. The hingganite occurs as individual crystals, rarely larger than 1 mm, and fanlike to sheaf-shaped aggregates to nearly 2 mm, scattered on slender prismatic smoky quartz crystals. The only associated minerals are aegirine and zircon. The larger individual crystals are dominated by the prisms {110} and {111}, with only minor {001} pinacoid, while simpler crystals show only the forms {110} and {001}; the indices and the form names refer to the crystal class $\frac{2}{m}$, and the orientation that was originally suggested by Ding Xiaoshi *et al.* (1981). The crystals are pale blue and transparent, with a vitreous luster. Preliminary microprobe analysis has confirmed that the hingganite from Malawi is indeed hingganite-(Y).

Ilmenite $Fe^{2+}TiO_3$

Ilmenite has only been found on a few specimens, where it forms thin, tabular crystals arranged in rosettes ("iron roses"), 5–15 mm in size, mainly on potassium feldspar. The crystals are steel-gray and opaque, with a dull metallic luster.

Mangan-neptunite $KNa_2Li(Mn^{2+},Fe^{2+})_2Ti_2Si_8O_{24}$

Mangan-neptunite has only been found on a single specimen, as a more or less coherent layer of minute crystals on a peculiar pale green fibrous aegirine crystal. The mangan-neptunite crystals are small, from 0.1 to 0.3 mm, have sharp edges and brilliant faces. The habit is dominated by nearly equally large {110} prism and {001} pinacoid faces. The crystals are black, but show the characteristic blood-red color in small splinters. No chemical analysis is available, but the X-ray powder pattern seems to suggest that it is mangan-neptunite.

Orthoclase-microcline $KAlSi_3O_8$

No petrographic or X-ray examination of the feldspar of this paragenesis has been carried out; therefore both morphologically monoclinic orthoclase and microcline formed by Si-Al ordering after its crystallization (microclinization) are described here together. The latter probably constitutes the major part of the potassium feldspar, but only occasionally shows twin lamellae recognizable with the naked eye. Potassium feldspar is probably the most common mineral in the veins, the size of the crystals varying from less than 1 cm to 20 cm! The generally well-developed crystals are blocky to short prismatic. The blocky crystals show combinations of pinacoids {010}, {001}, prisms {110}, {$\bar{1}$11} and occasionally small faces of the form {$\bar{1}$01}; all indices given refer to the crystal class $\frac{2}{m}$. The short prismatic crystals show combinations of pinacoids {010}, {001}, prisms {110} and {$\bar{2}$01}, sometimes with additional (then rather dominating) faces of the {130} prism. The potassium feldspar crystals are often twinned; a particularly well-developed and large Manebach twin, showing the forms {010}, {130}, {$\bar{1}$01}, {$\bar{2}$01} and {$\bar{1}$11}, is shown in Figure 12 with the corresponding drawing of an idealized such twin. Quite often both {110} and {130} prism faces of the potassium feldspar are expitaxially overgrown with well-developed, colorless and completely transparent crystals of albite. The color of the potassium feldspar varies from whitish to gray with a reddish or, more rarely, greenish hue. White or colorless, transparent,

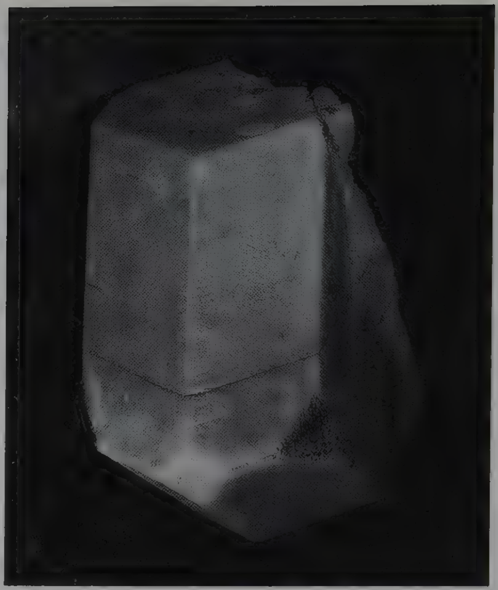


Figure 12. **A particularly well-developed 8-cm Manebach twin of potassium feldspar, with albite overgrowths on the {130} faces of the potassium feldspar. Collection of the Geological Museum, Copenhagen; photo by O. Johnsen.**

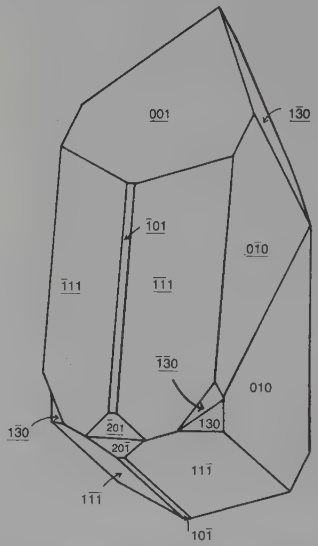


Figure 13. **Drawing of an idealized Manebach twin of potassium feldspar (corresponding to Fig. 12). The lower half of the twin is shown in standard orientation (clinographic projection).**

Figure 14. **This 35-cm smoky quartz crystal is the largest found in these veins so far. Collection of M. Grossmann; photo by R. Bode.**

short-prismatic discrete crystals of ideal, maximum triclinic microcline up to 1 mm are found in limited amount, growing on potassium feldspar, quartz and aegirine.

Parisite-(Ce) $Ca(Ce,La)_2(CO_3)_3F_2$

Of the two REE-carbonates identified in the paragenesis, bastnäsite and parisite, parisite is by far the more common. The trigonal (crystal class 3) mineral forms apparently hexagonal crystals, the habit of which is dominated by at least two prisms and several pyramids. Many of the crystals show the familiar pagoda-like shapes characteristic of several of the minerals of this group. Crystals up to 3.5 cm long have been found, and are usually strongly corroded, but occasionally crystals with lustrous faces have been observed. The color of the crystals varies with the degree of alteration, from darker brown with an orange tint for the fresh material to pale ocher-yellow for the most altered. (No chemical analysis of this parisite is available.)

Polylithionite $KLi_2AlSi_4O_{10}(F,OH)_2$

So far polylithionite has only been identified on two specimens. The colorless, transparent crystals are small (to 3 mm) and form typical, micaceous aggregates on aegirine.

Pyrochlore $(Ca,Na)Nb_2O_6(OH,F)$

Pyrochlore is quite a common mineral in this paragenesis, particularly in the third type of material, and always occurs as fairly well-developed crystals, most often associated with potassium feldspar. The crystals generally are small, 0.5 mm, but crystals as large as 6 mm have been observed. The only form developed is the octahedron {111}, the faces of which often show growth trigons. The color varies from dark reddish-brown to pale ocher-yellow. Most of the crystals have a brilliant luster; only occasionally are the crystals covered by a white powder of an unknown mineral.

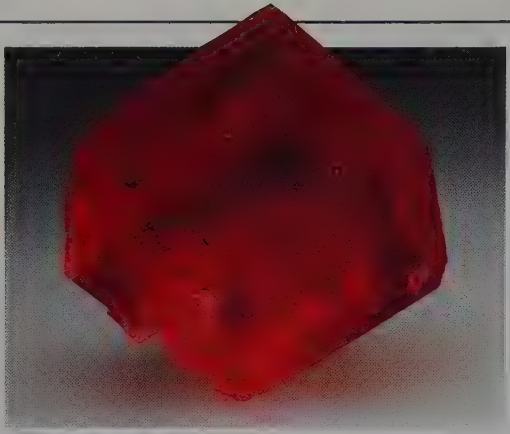
Quartz SiO_2

Quartz forms well-developed crystals and is probably the second most common mineral in the veins. The size of the crystals varies from a few millimeters to 35 cm! (See above photo.) The simplest crystals show combinations of the prisms $\{10\bar{1}0\}$ and both rhombohedrons $\{10\bar{1}1\}$ and $\{01\bar{1}1\}$, with $\{10\bar{1}1\}$ usually being the predominant form. More complex crystals may show additional faces of one or more of the following forms: rhombohedrons $\{h0\bar{h}1\}$ and $\{0h\bar{h}1\}$ with $h > 1$, the bipyramid $\{11\bar{2}1\}$, and the trapezohedron. All the crystals are prismatic, and several are doubly terminated; most are elongated and many are tapered by the oscillatory combination of successive rhombohedrons with the prism. Many crystals are flattened parallel to $(10\bar{1}0)$ and show horizontal striations on the prism faces. Etching and various kinds of skeletal growth are quite common. The color varies from colorless, through pale smoky to deep black. The crystals are either translucent or transparent, and may contain a number of inclusions. But only epididymite and aegirine—the latter being the by far most common—have been identified with certainty (by X-ray and microprobe respectively), though rutile and ankerite/siderite (?) have been identified visually.

Riebeckite $Na_2(Fe^{2+},Mg)_3Fe^{3+}_2Si_8O_{22}(OH)_2$

Some of the arfvedsonite crystals may be lightly (rarely strongly) altered to blue asbestiform riebeckite; X-ray powder diffraction patterns of such crystals constantly show the presence of riebeckite.

(continued on p. 38)



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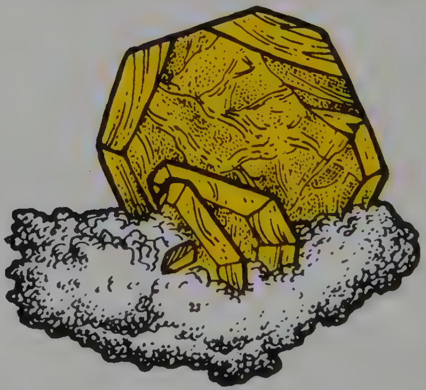

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Rutile TiO_2

Judging from the visual appearance of the sometimes very large amount of golden yellowish acicular crystals found in several of the quartz crystals, rutile is likely to occur in this paragenesis. However, its identification has not yet been confirmed.

Zircon $ZrSiO_4$

Zircon is quite a common mineral in this paragenesis. Crystals vary in size from 0.5 mm to about 10 mm, and show considerable variation in crystal forms and habits. The major part of the crystals show only the prism and bipyramid forms {100} and {101} respectively, but vary in habit from short-prismatic with minor {100} faces to long-prismatic crystals with sharp edges and smooth faces. A smaller percentage of the crystals are extremely flat, bipyramidal individuals, most of which show only a very flat bipyramid, possibly {104}. In addition, a few show the pinacoid(s) {100} and/or {001}. Most of the latter type form composite "rounded" crystals with growth triangles on the pyramidal faces, and/or clusters of crystals with their *c*-axes parallel. The color varies considerably from brown to brown-gray, brown-orange, orange-yellow and pale yellow, as does the degree of transparency, from opaque to translucent to completely transparent. The luster is vitreous. None of these zircons shows any fluorescence under ultraviolet light.

DISCUSSION

This entire mineral paragenesis from the Zomba-Malosa complex, Malawi, shows a remarkable resemblance to the assemblage from the famous pegmatites at Narssârssuk, Greenland (Petersen and Secher, 1993).

Not only do the specimens and the individual minerals from Malawi visually resemble those from Narssârssuk, but more importantly most of the minerals identified so far (aegirine, albite, arfvedsonite, bastnäsite-(Ce), epididymite, eudidymite, microcline, neptunite, potassium feldspar, goethite, hematite, polylithionite, pyrochlore, quartz, riebeckite and zircon) occur at Narssârssuk. Of the Malawi minerals only hingganite-(Y), ilmenite, parisite-(Ce) and rutile are not known to occur at Narssârssuk. Furthermore, not only are the minerals (such as aegirine, potassium feldspar, albite, quartz, zircon, epididymite and eudidymite) characteristic of the main phase of the pegmatite stage at Narssârssuk also characteristic of this assemblage; but the last phase of the pegmatite stage (the REE-carbonates) that makes Narssârssuk unique—ancylite, bastnäsite, cordylite, röntgenite and synchysite—is also represented in the assemblage from Malawi by bastnäsite and parisite. Chemically both assemblages are characterized by their richness in such elements as O, Si, Na, the presence of Zr-bearing and Be-bearing minerals, and especially by the presence of REE-bearing carbonates.

ACKNOWLEDGMENTS

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FURTHER NOTES ON THE HISTORY OF PHOSGENITE AND MATLOCKITE FROM MATLOCK, ENGLAND

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Since my first article on this subject was published in the *Mineralogical Record* (Burr, 1992), a large amount of additional information has come to light which ties up many of the loose ends. Much of this information has very kindly been supplied to me by Roger Flindall of Long Eaton, England, who produced a large, unpublished report on the Bage mine in 1986 with the title: "The History of the Bage and Venture Mines."

Thomas Pearson

Unfortunately, there seem to have been rather a lot of Thomas Pearsons in the Matlock region, and it is not always easy to distinguish between them in old records. However, the "Tom Pearson of Matlock" who "got the muriate of lead for Mr. Greville" was probably Thomas Pearson of Matlock Bath. A pedigree of the family to which he belonged was compiled by T. N. Ince, a solicitor at Wirksworth, in 1833, but it should be noted that such pedigrees are not always reliable. His father is given as Thomas Pearson of Matlock, a miner. Thomas Pearson of Matlock Bath (ca. 1760–ca. 1830) is given as a "petrifactioner" (dealer in geological specimens etc.). One of his brothers is given as Benjamin Pearson of Wirksworth. This was probably the Benjamin Pearson who was agent for the Gang mine just to the north of the Bage mine (and also drained by the Cromford level) during the mid 1780's. Benjamin Pearson of Wirksworth had a son, Thomas Pearson of Wirksworth, who died at an advanced age in 1831.

In 1913, a well-known local mining historian, David Palmer Pearson (died 1932), described Thomas Pearson (of Matlock?) as his great grandfather, and recorded that he was given the title to various veins at Upperwood, Matlock Bath, on October 1, 1774 (Pearson, 1913).

Local newspapers indicate that Thomas Pearson of Matlock Bath was a member of the Matlock area association for prosecuting felons during the 1790's, which suggests that he must have been a reasonably well-established tradesman. Local newspapers also record the marriage in 1833 of a William Pearson of Matlock, who was also a "petrifactioner."

It would seem that Thomas Pearson of Matlock Bath was also a miner, for the Matlock Barmaster's (Mining Commissioner's) books have an entry for January 3, 1810, stating that: "Thomas Pearson of Matlock Bath to have permission to go up the sough on Nestus to his mines in zigzag wood." The sough (drainage level) in question was the Wragg Sough, the mines were the Nestus mines, and the "zigzag" wood was the wooded hillside above Matlock Bath, now known as the "Heights of Abraham" (Flindall and Hayes, 1976). There are several other entries to "Thomas Pearson" in the Barmaster's books, but it is difficult to be certain which Thomas Pearson they refer to.

According to Charles Konig (1774–1851), Thomas Pearson of Matlock Bath was also a "guide" in 1819. This probably indicated that he was one of a number of local people who earned an (additional) income showing visiting members of the gentry around the locality. However, it might also have indicated that he was a guide for one of the local show mines. The first of the local mines to open as a show mine/cave was the Cumberland Cavern at Matlock Bath which opened in 1800. It was followed by the Rutland Cavern at Matlock Bath in 1810. Thomas Pearson of Matlock Bath may have acted as a guide for the Rutland Cavern, but it should be noted that he was in dispute with the owners of the mine between about 1810 (see above) and shortly after 1812 (when the miners sold out to the owners) because the owners were trying to stop mining occurring in, and adjacent to, their show mine (Flindall and Hayes, 1976). A more likely candidate would be the Tear Breeches mine at Matlock Bath, which was also intimately connected with mine workings undertaken by members of the Pearson family. Thomas Pearson (of Matlock?) was given the title to Tear Breeches vein and Hopping Pipe vein in 1774, James Pearson was given the title to part of Hopping Pipe vein in 1805, and Joseph Pearson was given the title to part of Hopping Pipe vein in 1812, and extended the title in 1817. The Tear Breeches mine was opened as the "Fluorspar Cavern Show Cave" sometime before 1818 (probably by 1814), so that Thomas Pearson of Matlock Bath could have been a guide for this mine in 1819 (Flindall and Hayes, 1976, vol. 2).

The fact that Thomas Pearson of Matlock Bath was a "petrifactioner," and his brother Benjamin was probably agent for the Gang mine in the 1780's, make it highly likely that he did indeed supply Charles Greville (1749–1809) with his phosgenite specimens about 1785.

John Mawe and Thomas Pearson

The mineral dealer John Mawe (1766–1829) owned the Royal Museum spar shop at Matlock Bath in the period about 1800. The fact that he was in direct competition with Thomas Pearson of Matlock Bath as a "petrifactioner" may explain why Mawe was able to give so little information on phosgenite in his *Mineralogy of Derbyshire*, published in 1802. Mawe left England in 1804 on an adventurous trip to South America. He did not return until late in 1810 (Torrens, 1992). Acting through his agent, John Vallance, Mawe was one of the people involved in the dispute with Thomas Pearson of Matlock Bath and his fellow miners with respect to the Nestus mines and the (proposed) Rutland Cavern show mine (Flindall and Hayes, 1976).

Dr. J. Cantrill (Cantrell)

It is of interest to note that Dr. William Cantrell (1801–1876) was one of the most active directors of the Meerbrook Sough Company during the period when the Bolehill branch was under construction (1854–1866). He died on February 7, 1876 (Derby and Chesterfield Reporter, February 18, 1876).

The "Arkwright" mine

In my previous article, I indicated that the "Arkwright" mine probably referred to workings associated with the Cromford level. While this is probably correct, there are several other possibilities, including the mine called "Sir Richard Arkwright's Title" in documents dating from about 1840. This mine lay at the eastern end of the Moletrap vein, about 3 km to the north-northeast of the Bage mine. The area was worked on a large scale during the mid and late nineteenth century as the Bullestree mine, and it is not impossible that matlockite (and phosgenite) could have been found there at that time, when the workings reached depths similar to those of the Bage mine (90 to 130 meters) (Rieuwerts, 1987). Alternatively, the "Arkwright" mine may have referred to a mine in which the Arkwright family had a majority interest. Such mines included the Side mine worked by Peter Arkwright on the Hard Rake vein near Matlock in the period about 1848–1868, and various mines in the Bage mine area, including the Gang mine, the Thistley Wallclose mine, and the Calver Penny or Blue Bell mine.

The Wall Close mine

In the 1700's there was a mine being worked on Cromford Moor called Wallclose Bank mine, and in the 1750's there was a Wall Founder mine on Cromford Moor. Both of these were in the Cromford Liberty (mining administration region), and distinct from the Wall Close mine in Wirksworth Liberty, which was associated with the Bage mine.

Workings on the Wall Close vein

(1849–1851, 1880–1885)

In 1851 the proprietors of the Bage mine were working two *new* areas off the Wall Close vein: Land's scrin (minor vein) which ranges north about 150 meters east of the Butler vein, and Mitchell's scrin which ranges northeast from the extreme eastern end of the Wall Close vein about 300 meters east of the Butler vein. In addition, they may have been *re*working other parts of the Wall Close vein.

A fair number of matlockite specimens seem to have been obtained in the period 1880–1885. This was a period of great mining activity in the Bage mine, during which many new areas were worked, including several associated with the Wall Close vein to the east of the Butler vein.

Closure of the Bage mine

Although Bryce Wright Sr. (1814–1874) stated sometime between 1851 and 1858 that the Bage mine had ceased to work, it would seem that this was not correct. Production was low (between 30 and 131 "loads," 7.50 to 32.75 tonnes of dressed ore, per year) between 1854 and 1866 (inclusive), when the Bolehill branch of the Meerbrook Sough was under construction, but it never ceased.

Deep mining at the Bage mine ceased in 1907, but later attempts were made to work the mine at shallow depths.

Brooke's phosgenite

As mentioned in my previous article, the collection of William Phillips (1775–1828) was destroyed by bombing (fire) at Liverpool in 1941. However, the annotated sale catalog of the collection survived, and is now kept at Liverpool Museum (Phillips, 1829).

The catalog lists the following entries:

1232 Murio-carbonate of lead, in detached transparent crystals. Huel Confidence Mine *[sic]*, near New Quay, Cornwall. Accompanied by drawings and measurements.

1233 Muriate of lead. Horhausen on the Rhine. Also, a small tray containing minute detached crystals, with drawing and measurements.

1232 and 1233 removed to No. 2425.

(2425) 2431* Sulphate of lead, Scotland.

2431** Phosgenite (chloro-carbonate of lead). Cornwall (very rare). Removed from No. 1232.

2431 Detached crystals of sulphato-tri-carbonate of lead.

The phosgenite specimens were described by Arthur Russell (1878–1964) in a paper published in 1927:

> The habit is nearly the same as that of the two specimens already described, the forms present being also the same. One of the aggregates shows a little attached limonite and chalcopyrite. It was probably from this source that the Brooke specimen had ascribed to it the locality Huel Confidence.

The two specimens mentioned above were one that Arthur Russell had purchased in 1905 from the collection of John Hawkins (1758–1841), and the specimen in the collection of Henry James Brooke (1771–1857). Arthur Russell was convinced that both specimens had come from the region near to Wheal Rose, Sithney, Cornwall; he had found almost identical specimens (which have very characteristic matrixes) on one of the old dumps of Wheal Rose, and the Hawkin's collection also contained specimens of cerussite from Wheal Pool which is situated nearby.

Russell described Brooke's specimen as follows:

> It likewise consists of a portion of a small geode of velvety black limonite, in which are several very well-defined crystals of phosgenite exactly similar in habit and presenting the same forms as those on the specimen from the Hawkins collection. In addition . . . there are platy crystals of a mineral which Professor Hutchinson . . . has proved to be the rare species paralaurionite . . . There is no laurionite upon this specimen, the only other mineral present being a little pyromorphite on the outside of the geode.

Brooke's specimen has now been relocated in the Sedgwick Museum, Cambridge (*Min. Rec.*, **24**, 401). It is a small specimen, 3 by 5 cm in size, consisting of a "limonite" shell with a central cavity. The cavity contains three crystals of phosgenite, and the marks where an additional three crystals have been extracted (for Brooke's goniometric measurements?). At one end there is a spray of fine plates, which are described in the catalog as "pseudolaurionite." These crystals would seem to be Brooke's "native muriate of lead," and to consist of paralaurionite.

With respect to the locality "Huel Confidence," Russell wrote the following:

> Several small lead mines were formerly worked on loades outcropping in the cliffs near New Quay and one of these may once have been known as Wheal Confidence. A search of old mining records has only established that there was a Wheal Confidence at work in Cornwall during the years 1830–1, but whether a lead mine and where situated is not stated.

Additional references

An account of the workings of the Bage mine, based on a visit he made in about 1876, was published by Leon Lecornu in 1879.

An interesting account of the area just to the west of the Bage mine, and of the Cromford level, is given by Flindall (1982). Flindall records that the Rantor branch of Cromford Sough on Fletcher's vein in fact collapsed in 1786. This fits in very well with the comments of Charles Greville who stated that he purchased specimens of phosgenite (evidently from Thomas Pearson of Matlock Bath) about 1785, but was unable to obtain any more afterwards because the mines had become flooded.

A survey of the Bage mine and additional information are given by Warriner (1982). It should be noted that the presently accessible workings, and the surveys of them, only represent a small part of the whole of the Bage mine.

Additional photographs may be found in the *UK Journal of Mines and Minerals* (Cooper, 1992), and in the 20th anniversary edition of the *Mineralogical Record* (1990).

An account of the animosity which existed between R. P. Greg and W. G. Lettsom as a result of their conflicting efforts to acquire specimens of phosgenite (apparently through the services of Bryce Wright), and as a result of Greg's (preemptive) publication of the discovery of matlockite, is described in a letter by Michael Cooper published in the *Mineralogical Record* (vol. 24, May-June 1993, p. 245–246). The letter was based on information contained in letters preserved in the Natural History Museum, London.

ACKNOWLEDGMENTS

I would like to thank the following institutions and individual persons for the additional information given above: The Liverpool Museum for information on the William Phillips collection; The Sedgwick Museum, Cambridge, and Mr. G. A. Chinner, for finding Brooke's specimen, and for bringing Russell's description of it to my attention; Mr. T. D. Ford for general comments; Mr. R. Flindall for information on almost everything.

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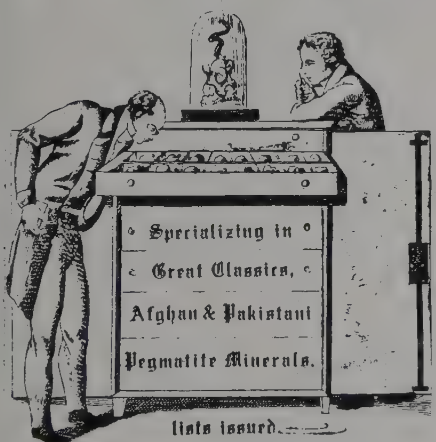

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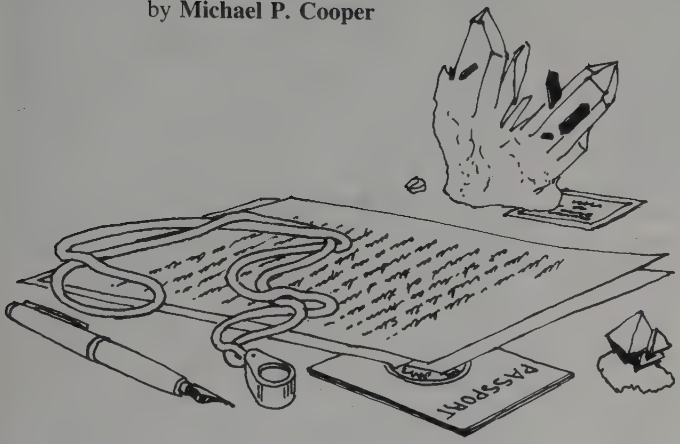

The British Scene

Looking back through my run of the *Mineralogical Record* (now almost complete following a large exchange of minerals for magazines) it seems that there has been little reporting on the collecting scene in the United Kingdom. Even *my* promise to do something about it, made in my inaugural *Letter,* came to naught at the time. So I feel a few words on (relatively) recent events are in order.

The stereotypical British collector is renowned as a systematist, fiercely proud of the minerals of the United Kingdom, unimpressed by specimens acquired with the "silver pick," and indifferent to minerals from foreign parts (sound familiar?). Outside of this elite, the majority of British collectors venture both into the field and into the mineral shows as opportunity arises or mood dictates, using whatever means necessary (governed, of course, by propriety and the bank balance) to obtain specimens that take their fancy. And the extremist remainder, here as everywhere else, wheels and deals, wheedles, barters, risks their lives in old mines, their reputations in shady deals, and their freedom in dubiously legal enterprises to acquire specimens. The collector's instinct is a powerful force, and no names will be mentioned in this column.

As you would expect, the British mineral show seasons are mainly in the autumn and spring, and the field collector's seasons take place in the spring and summer. Finding anything notable in many of Great Britain's classic localities is now largely a matter of luck or perseverance, but the prospective visitor is advised that some serious literature research in advance of a trip can pay dividends by pointing to places somewhat off the beaten (and well hammered) track.

For several years now the indoor collector's principal haunts have been the several shows round the country run by the *British Lapidary and Mineral Dealers Association* (BLMDA). The biggest is in London around Easter, a position once held by the "British Mineral Show," a now vanished enterprise that was run "by collectors for collectors," concentrating more on collector minerals and less on lapidary. The BLMDA shows are coordinated by John Turner (recently moved to 3 Water Lane, Middlestown, Wakefield), who is happy to supply dates and details to visitors and potential exhibitors. Runner-up for size is the BLMDA show at Harrogate over the August Bank Holiday weekend. A one-time spa, Harrogate is a fine and prosperous town, and, importantly, home to one of the finest coffee shops in the country.

Prize for the most easy going show goes to the independent "Annual Rock Exchange" held in Bakewell, Derbyshire, at the beginning of October. Many part-time dealers are attracted to its school-house venue, and it has a more informal holiday atmosphere than its larger hotel-based rivals, despite the often inclement autumn weather of this Peak District town. Another small but enthusiastic event, the one-day "Sussex Mineral Show," is held every year in Hayward's Heath, south of London on the road to Brighton. This is a relatively obscure part of the country for those of us from up north—door-to-door I can get to the Paris show in about the same time—but the show has a great reputation and is one of the few, possibly the only, British show to regularly feature mineral displays and lectures in addition to its commercial side. In recent years these displays have derived from a variety of sources: private British collectors and societies; home institutions such as the Oxford University Museum and the Natural History Museum (London); and foreign collections from as far afield as Irkutsk and Hungary. This is an idea that many would like to see extended to other shows here.

Newcomers on the scene are the one-day minerals-only shows put on by Cornwall-based dealer (and British *Mineralogical Record* representative) Paul Lowe. The Exeter Show began last year and, as I write this, the first Oxford show has just closed, its ticket price including a free shuttle bus to the Oxford University Museum and admittance to its excellent mineral displays. The museum was specially opened for the day, and mineral curators Brian Atkin and Monica Price generously gave up their weekend to be on hand to talk about their interesting collections. The show was a success, and the Oxford venue will be repeated next year.

In addition to these shows there are many more small, local events, mainly run by regional mineralogical or geological societies. Some are commercial shows, others intend to promote knowledge, discussion or mineralogical awareness among their visitors. Events staged by the two major national mineralogical societies here, the *British Micromount Society* (BMS) and the *Russell Society,* fall into the latter categories. The reputation of the BMS probably owes more to its annual symposium than to anything else. This is principally held for members, but there are occasional overseas visitors. The Russell Society was named after that quintessentially British collector, Sir Arthur Russell (1878–1964), whose remarkable collection is one of the few additions to our national collection important enough to have retained its integrity and to be stored in its original cabinets in an upper floor of the Natural History Museum in London. Society membership is open to all. Last year's annual meeting of the society saw a novel one-day symposium on collecting, and it is to be hoped that this stimulating event will become a continuing tradition.

Shortly before the Russell Society meeting last year there was another important initiative: a symposium at Manchester University entitled "Conserving our mineralogical heritage." Speakers and spectators gathered from all parts of the country to discuss the various pressures on mineralogical sites. Delegates included mineral collectors, research mineralogists and geologists, botanists, lichenologists, industrial historians and archeologists, and a researcher of slime molds whose enthusiastic descriptions of the huge masses of these intriguing organisms found in some underground workings put many off their lunch. Importantly, the meeting also attracted delegates and speakers from the heritage "industry" including powerful national bodies such as the *National Trust,* and *English Nature*. Perhaps an appreciation of the continuing value of old mine sites across such a wide range of disciplines will help to save some of them (or at least material from them) currently under threat from developers and environmentalists. Unfortunately, the symposium notes and conclusions have yet to be published, and the only description currently in print of this innovative event is that by Roy Starkey in the *Journal of the Russell Society,* **4**, 71–74 (1992).

But on to actual specimens. The heyday of field collecting in the

United Kingdom is long past: much luck and hard work is necessary now to find anything remotely like the treasured classics of the nineteenth century, raised when mining was at its height and gentler mineral winning techniques left more specimen material undamaged. But, although display-quality material is scarce, it is still possible in several localities (for the collector with a good microscope) to find rare or exotic species in acceptable specimens overlooked by previous generations of naked-eye cabinet-specimen collectors. Cornwall and Cumbria are the most renowned areas in this respect.

Most new ground is now broken by quarrying and, since quarry owners want pure rock free from extraneous mineralization, most such localities yield little for the mineral collector. And when they do there is no guarantee anyone will hear of it. There have been a few instances in recent years when quite remarkable material was discovered, only to be hushed up and buried by quarry owners hostile to the desires of scientists and collectors for proper conservation and recording. Descriptions of some of these occurrences eventually found their way into print, and specimens into institutional collections at least, but so much must have been lost. More enlightened management prevails in other localities, and regular visits by collectors, usually under the aegis of a responsible body like the Russell society, have led to a steady accumulation of knowledge and specimen material.

In recent decades there have been occasional local revivals of mining, subject to the fluctuating prices of commodities such as tin, fluorspar and tungsten. In almost all cases, these revivals have also lead to a renewal of cabinet-specimen production. So, although the short-term production has been small, viewed over a longer time span production of fine quality specimens from the British Isles has been reasonably good in recent years.

Results of these modern mining activities have included some modern classics and several species new to the country or to science. The last (and now past) tin mining revival in Cornwall produced many of these: at St. Just, the Geevor mine and its extension into the old Levant mine workings continued its long-held tradition of producing excellent **chalcocite** crystals (Bancroft featured a Levant chalcocite in his *World's Finest Minerals and Crystals* (1973) though modern pieces are better!) and also **calcite** in several forms, the most characteristic being "paper" or "Angel wing" calcite in thin, white to peach-colored lamellar crystals. Very recently the now-abandoned workings of Geevor have yielded specimens of the rare uranium minerals **becquerelite, schröckingerite** and **andersonite**, found as efflorescences on mine walls in the Peeth Lode. The other major specimen producer in the county was the late Wheal Jane, an ancient tin mine at Kea. This rich polymetallic deposit is the type locality for **ludlamite** (described in 1877) and many superb specimens of the species were raised from the recent workings. The best specimens came from a particular zone in the deposit, and each time this was cut a fresh batch of crystals hit the market. The workings were just heading back into this zone when the mine closed for the last time. The largest of these crystals reaches 3 cm or so, and the best specimens are those with crystals scattered on quartz or siderite, away from the notoriously unstable Wheal Jane pyrite which has caused the decay of many a fine old-time specimen, including, sadly, several of those in the collection of the eponymous Henry Ludlam and now in the care of the Natural History Museum.

The underground exploration of long-closed Cornish mines has also paid off on occasion. For instance the fine **bayldonite** and associates from Penberthy Croft, St. Hilary, and **cerussite** from Pentire Glaze, St. Minver.

In the north of England, veins of **fluorite** have been worked on and off (under increasingly heavy pressure from imports of cheap "spar" from China) and have produced an irregular stream of fine specimens . . . not the glories of the past but very collectible nonetheless. In Weardale, Frazer's Hush yielded good purple to dark sea-green or indigo-blue crystals, some with galena. Each fresh batch produced offered different colors, the best being a highly fluorescent limpid purple. Following a management buy-out, Fraser's Hush is still working, but with a much reduced workforce, and, despite a positive attitude toward collecting, no specimen material of note has been produced for over two years.

The Cambockeels mine has been noted for pale **fluorite** with attractive lenticular **calcite** crystals. In the last years of "Cambo" an increasingly aware workforce began to preserve remarkable **pyrrhotite** specimens (mostly as loose, characteristically curved and etched crystals, some up to 6 cm), and some interesting **calcite** with certain faces preferentially dusted with minute iridescent pyrite crystals. But just as the range of specimens was on the increase the mine was closed down. Rumor has it that some fine material remains stashed away, but no proof has emerged yet.

Fluorite is also being produced at a small mine in Rogerley quarry at Frosterley. This enterprise, run by dealer and collector Lindsay Greenbank of Kendal, is Britain's only specimen mine, run solely for collector material. According to Lindsay, the trials (pun intended) and tribulations of working a specimen mine would fill a book. But the effort has been worth it: the best pieces from here are sharp, glassy, deep bottle-green cubes and twins to 2 cm or so encrusting matrixes to 15 cm. The fluorite is fiercely fluorescent and the color defies any daylight film to reproduce it. The finest specimens give the classic green fluorite from the Heights mine a run for their money. The latter mine has been a closed and desperately dangerous place for many a year, but veins in the nearby Heights quarry still produce some good fluorites of various colors, from milky purple to gray, blue-green and green. However, despite many wild claims, these pieces are not a serious match for the old timers. Problems with access remain at Heights, the management's attitude not being helped by collectors working without permission.

Elsewhere in the North, intrepid collectors have negotiated many old mine workings in search of classic species, but have generally found insufficient material to make an impact on the collector market. Exceptions include some of the barium-bearing species for which northern England is so famous: alstonite, barytocalcite and witherite. Some good **calcite after alstonite** pseudomorphs to 1 cm with barite were obtained from the Admiralty Flats, Nentsberry Haggs mine, Nenthead in Cumbria, a locality that also yielded some worthy **barytocalcite** as dull gray-white bladed crystals coated with barite. Some quite large **witherite** crystals also found their way onto dealers tables, although again these are superficially altered or dulled.

A little further south the large potash mine at Boulby, Yorkshire, has been producing very fine **boracite** specimens for a number of years. The species occurs as nodules covered with colorless, glassy, complex crystals to a few millimeters across. A common associate is salmon-pink **hilgardite**, either massive or as small, complex, etched crystals. The nodular form and the attractive colors of these specimens—the underlying matrix varies in shade from pale pink to pale sky blue—make them handsome cabinet material in addition to their mineralogical significance. They are commonly fist-sized but can be much bigger, and occur embedded in sylvite and halite from which they are extracted using hot water. (See What's new in minerals? in this issue, p. 61 and 63. Ed.)

There was much excited talk last year of a new find of **cuprite** and **copper** which, according to the first person to offer any around, came from a site somewhere in Derbyshire. Associated minerals include some very rare supergene copper species. This news was met with much surprise and conjecture by collectors. Just where in Derbyshire, a county hardly renowned for copper mineralization, could it have come from? After some time it slowly leaked out that the material had originated from a quarry in Leicestershire, copper mineralization being widespread in small quantities in that county. Unfortunately this very significant find was not regarded with enthusiasm by the quarry management, who ordered the removal and burial of all potential specimen material and would not countenance any action by collectors wishing to preserve or document it. All requests for permission to


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Figure 1. **Silver dendrite, 5 mm, from the Alva Silver mine near Stirling, Clackmananshire, Scotland. Stephen Moreton collection.**

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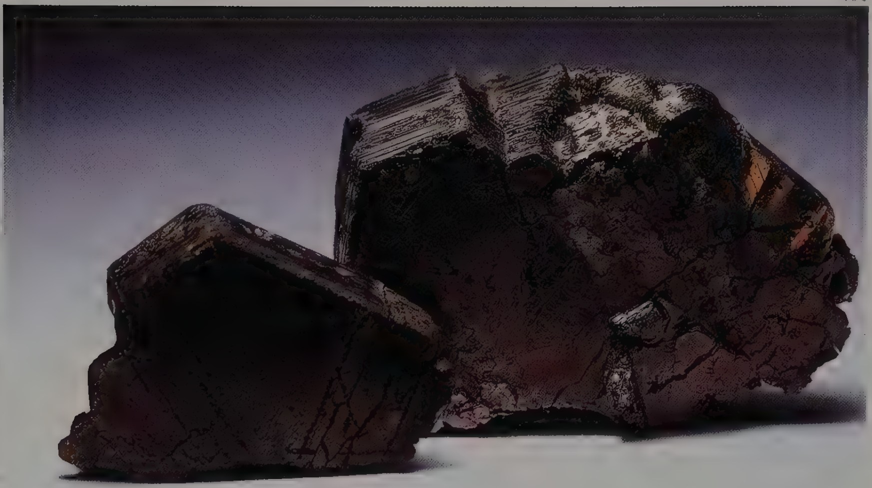

Figure 2. **Pyrrhotite crystals, to 5.5 cm, from the Cambockeels mine, Weardale, Durham, England. Lindsay Greenbank collection.**

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Figure 3. **Ludlamite crystal, 5 mm, on quartz from the type locality, Wheal Jane, Kea, Cornwall. Nick Carruth collection.**

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Figure 4. **Fluorite crystals, to 1.5 cm, from Frosterley, Weardale, Durham, England. The highly fluorescent crystals are a deep green in daylight. Lindsay Greenback collection.**

collect were ignored or turned down. Some irresponsible collectors then took matters into their own hands and entered the quarry without authority. On being caught they are reputed to have claimed to be members of the Russell Society—a foolish and irrelevant claim the repercussions of which are still being felt. The Russell Society has spent many years building rapport with quarry owners and managers and establishing a reputation as a responsible and concerned body; actions like this can wipe out years of good relations overnight. The

Society is still seeking the culprits, but no one is owning up yet . . . .

In Scotland some exceptional **silver** specimens have been found on the weathered dumps of the ancient Alva silver mine, near Stirling. A fortune was wrested from this interesting silver-cobalt deposit in the eighteenth century. The dumps were reworked at a later date, but a small portion appears to have been left untouched, and it was here that Scottish collector Stephen Moreton discovered a handful of fine pieces in which gorgeous dendrites of bright silver were revealed by dissolving away the carbonate matrix. The site has since attracted the attention of the Royal Museum of Scotland, which is planning to survey the site and dig the dumps for a full mineralogical investigation. Collectors are warned not to trespass on the site.

Also in Scotland some superb **agate** has also been reported recently from a new locality near Dundee. It has been known for some years but little word was allowed to leak out. The agates are the best found in Scotland this century. A full description of the occurrence is being prepared. Looking back a little further, there was a surprising find of some excellent **veszelyite** a few years ago. Members of the British Micromount Society on an annual society field trip came across some beautiful specimens featuring transparent blue crystals to 5 mm or so on hemimorphite on a long-neglected dump at Wanlockhead. This was the first record of the species in the United Kingdom and, although not a match for the recent specimens from Philipsburg, Montana, are nevertheless very desirable pieces. The dump was afterwards investigated by the Royal Scottish Museum, but it turns out that the BMS collectors had been very lucky and had hit upon the one section of the dump to contain the species. It's assumed that the material came from just one dumping of waste from the workings.

Many of these finds have been, or will be, described in Great Britain's two main collector journals: the *UK Journal of Mines & Minerals* and the *Journal of the Russell Society*. The former is aimed squarely at the collector, the latter adopts a more academic stance and is distributed free to society members.

Paris Show

[March, 1993]

I missed the Pullman St. Jacques show last autumn and decided instead to attend the spring show in the Hilton Hotel. It's run by the same man (Roger Pelloux, 9 Square Roget de Lisle, 95140 Garges-les-Gonesse, France), but is a smaller event. It does, however, have the distinct advantage (especially for tall, thin people like me) of being in a warmer season. The Hilton is in the shadow of the Eifel Tower (when the sun is in the right direction), a stone's throw from the Seine, and was within walking distance, past some wonderful *patisseries*, of our hotel. On one such walk my attention was caught by a small knot of people in the *Champs du Mars* in front of the Military Academy. It was general election weekend in France, and the presence of a camera crew nearby suggested it might be some politician's walkabout. However, soon after striking out in their general direction I decided that I wasn't really that interested: the group was surrounded by a selection of the largest meanest men I had seen in many a year, their grim demeanors alone sufficient to make one turn aside if the machine guns they were carrying hadn't put you off already. No, it wasn't Mitterand, or Le Pen—it was Salman Rushdie.

Another big news story of the weekend was the discovery in Grenoble of a stash of explosives in a city center flat. "Terrorists," said the police; "Mineral collectors," said those arrested. They were mineral collectors according to dealers in the show too. We all felt guilty.

The show held few surprises for the serious collector, though there was plenty of interesting stuff on offer. Some of the nicest things I saw were those in a select bunch of specimens belonging to Spanish dealer Jordi Fabre: some highly lustrous **calcite** in groups of large gray-brown crystals from the Denton mine, Ozark County, Illinois; an attractive green **beryl** 10 cm long, sharp, clean and unetched from the Altai pegmatite, Sinjiang, China (also noted for excellent **elbaite** and **tantalite** crystals, apparently); and some new **gold** from the Mystery Wind mine in El Dorado County, California, in crystalline plates on quartz similar to, but cheaper than, material from Eagle's Nest. Jordi also told me that the best of the **barite** specimens from Spain reported in my last *Letter* had been bought by the Smithsonian, so those of you within striking distance of that institution can see for yourselves what the fuss was about.

My traveling companion, Monica Price of the Oxford University Museum, bought an excellent display specimen of **sphalerite** from Dalnegorsk for the collections (Dalnegorsk is the best source of sphalerite crystals seen for a long time), despite my praises of a **scheelite and cassiterite** on the same table (that of Stanislaus Horsky, *Geoprieskum,* Garanova 1, 040 00 Kosice, Slovakia). This specimen is a wolframite blade some 10 cm long encrusted with orange scheelite crystals to 5 cm in parallel growth, with later 1–2 cm black cassiterite. The locality is Tchukotka, Russia. Material from this same fine (under different spellings!) was to turn up later at Ste-Marie-aux-Mines. There was also some good **stellerite** from Klick, Russia, forming lustrous gray globular masses about 8 cm across.

Stalactitic minerals always interest me, but **malachite** examples usually come a little down the excitement scale nowadays, there having been so many fine ones available in recent years. But Gilbert Gauthier had some such pieces the like of which neither I nor he had ever seen before: *tabular* stalactites, each with a minute tube down the middle that you could still blow air through! These pieces had been found on the dumps of the abandoned Lukuni mine, Zaire, a locality renowned for "normal" stalactites up to 60 cm long. The tabular pieces are small by that standard (10 cm or so), and apparently formed in clusters, flat sides in close proximity. Local collectors or dealers had given them a light polish to bring out the rich color.

Another long-time interest of mine is pseudomorphs, so I was intrigued to find some fine **"ikaite"** specimens on the stand of Pierre and Martine Clavel. These Russian specimens from Bielo More on the Kola Peninsula show tapering brown "crystals" apparently piercing nodules of a fine-grained gray mudstone. Ikaite (a hydrated calcium carbonate) is the parent mineral of those long-enigmatic pseudomorphs called variously "jarrowite," "glendonite," "thinolite" etc. All are calcite pseudomorphs, as indeed these Russian specimens must be (despite their labels), since ikaite itself is extremely unstable at anything above a few degrees Celsius.

But the most memorable things I saw that weekend were in the museums. Monica and I had decided to make a long weekend of visits to all three of the city's major collections in addition to the *bourse*: the Natural History Museum in the Botanical Gardens ("the Museum"); the University of Paris at Jussieu ("the Sorbonne collection"), just down the road; and the School of Mines on the Boulevard St. Michel. At the Museum, curator Henri-Jean Schubnel kindly invited us to view the year's new acquisitions—a cabinet filled with exquisite things. The Museum is very lucky to have its acquisitions funded by a grant from the Elf-Aquitaine petrol company, a generous move which we can all be grateful for. Schubnel had certainly spent the money well, there were fine specimens from many modern finds in China, Russia, Pakistan and the United States, both display pieces and rarities. For my money, though, the best was an incredible **orpiment and calcite** from China, a large radiating mass of glittering ivory-colored scalenohedra with finger-thick brilliant orpiment prisms protruding between them. The specimen was doubly remarkable for being almost completely undamaged. By coincidence I saw this piece's larger brother the same weekend, recently imported by Frederick Escaut (whose first imports of this material were reported in these columns last year), a stunning piece over 30 cm across! It is now in the Keith Hammond collection in London. The museum's other acquisitions included realgar, axinite, ferrotantalite, rhodochrosite, beryllonite, tremolite, lazurite, powellite and many more that my scribbled notes don't do justice to.

At the School of Mines my principal intent was to research their purchase records for specimens from British dealers, but it is impossible to enter this fine collection, through its imposing wooden doors under the carved legend "Collections," without taking a look around. Monica had never seen it so we walked it from end to end. It's a very rich collection, mainly systematically displayed but with some topographical cases. The display of specimens from the Niari Basin in Zaire—source of some fine **dioptase** in recent times—is an eye-opener: gorgeous blue botryoidal hemimorphite, quartz-coated wulfenite crystals over 5 cm in groups about 60 cm across (2 feet!), cerussite crystals to 15 cm, and many more. There's some excellent British material too: Cumbrian barite, calcite and aragonite, matlockite from Derbyshire—old pieces supplied by the long-dead dealers I'd come to research.

The School is planning a celebratory exhibit this year to mark the 250th anniversary of the birth of pioneer crystallographer, mineralogist and gemmologist René Just Haüy (1743–1822). He became a *Professeur* of all the three great institutions whose collections we visited, and was an influential teacher of mineralogy. His ideas were carried to the United States by some of his pupils, including Adam Seybert, Benjamin Silliman, Archibald Bruce and George Gibbs. Haüy's contributions to the development of mineralogical science and the Parisian mineral collections cannot be overestimated. The exhibition will run from December 1993 to March 1994.

We also managed to squeeze in a trip to the darkened vault of the Sorbonne collection, now easy to find off the street through its new entrance. It seemed to take forever for my eyes to adjust to the restrained lighting, but the wait was worth it. My list of favorite pieces ran to several pages by the time we'd walked round the whole display, but despite all these goodies most people on learning you've just been to the Sorbonne ask if you saw "the cumengéite." You could hardly fail to do so since it's a six-rayed boleite overgrowth 3.5 cm across!

And lastly from Paris a little trivia quiz: how many of the 72 names of eminent French scientists and others molded into the skirts of the Eifel Tower had minerals named after them?

Saint-Marie-aux-Mines Show

[July, 1993]

I always look forward to the St.-Marie *bourse* with greater anticipation than any other show I visit. Not that I don't enjoy the rest, or that they're intrinsically inferior, there's just an indefinable atmosphere here. Is it because it's French, or summertime, or because there are so many dealers, and so many great specimens? No, I think it's because so much of it is outdoors. Simply that. It gives the show a relaxed feel that just can't be had indoors. And this year there was even more of it outside. Michael Schwab had expanded it into another street, added at least one more large marquee and fitted in over 400 officially registered dealers.

Pieces from Russia, the Commonwealth of Independent States and China were plentiful at the show, but prices are rising fast. Russian mineral prices especially have leapt up. This is hardly surprising, I'm told, considering the number of Western dealers now making regular trips there to buy material. Some of these people told me of great problems obtaining specimens, followed by even greater problems in getting them out of the country, or even hanging onto them long enough to get as far as customs. In some cases specimens were confiscated by the local police shortly after purchase from the miners!

Though new finds from Russia and the CIS were thin on the ground there was plenty of material from now familiar sources, including, I was glad to see, Dalnegorsk where the Nicolai mine is rumored to be closing soon. Among others, particularly fine selections were available from András Lelkes (Hercegprimás u. 11, H-1051 Budapest, Hungary), and *Mingeo* (Pardubická 734, 500 02 Hradec Králové). The simple suite of minerals from this area is probably well-known to all by now, but a couple of types deserve mention. A superb **galena** spinel-law twin (a flat plate studded with triangular faces with a **pyrrhotite** crystal embedded in it) on its way to the "shop collection" at Mike Bergman's *Galena Rock Shop* in Galena, Illinois, struck me as one of the nicest examples of this habit I'd seed for a long time. And an excellent, curved, pink **calcite** perched on a long quartz prism, belonging to Bordeaux collector Francis Benjamin, was the best of these delicately hued calcites I'd come across. Of the many **fluorite** specimens on offer, I particularly liked a colorless glassy cube with a veiled phantom in the center on the stand of András Lelkes. But I handed over my remaining money to *Mingeo* for an almost perfect **pyrrhotite** rosette with a cuboctahedral galena crystal embedded in it.

On to some new things. A notable recent CIS find (first pictured in the September-October issue) is some interesting deep purple (almost black) **fluorite** in sharp octahedral crystals from Akschatau, Kazakhstan. These average about 1.5 cm, but reach 8 cm on edge, forming groups and individuals on quartz. By themselves these are striking enough, but in combination with pale aqua-blue **apatite** prisms, small colorless **bertrandite** plates, and a second generation of fluorite as a thin, bright purple encrustation, they're lovely. A nice cabinet specimen would set you back about $100–$200, with a premium for the bertrandite, but some pieces reach 30 cm across and cost a lot more. Eric Schmidt and Thomas Pusch (Martin Luther Strasse 19, 10777 Berlin, Germany) had some good ones. I assume the locality is the same one known for fine creedite as reported in the *Mineralogical Record* some time ago.

Eric's display of Russian and CIS minerals took quite a while to look over. Among other things he had **emerald** crystals from a new find at the old occurrence at Malischevo, Urals, forming typical, dull, deep green prisms 2 to 10 cm embedded in schist. From Saranpaul, a district well known for **axinite**, there was some well-formed **titanite** (still usually labeled as sphene here) in clove-brown crystals up to 2 cm long with lenticular calcite. These groups reach 10 to 15 cm across and were priced to about 430 DM. And from the Tenkergin tin and tungsten deposit at Tschukotka come large, brilliantly lustrous **cassiterite** bipyramids to 11 cm across.

Growth in Chinese minerals is also noticeable. Christian Gobin, long-known as a specialist in central African minerals, was offering the fruits of a recent trip: **scheelite**, **wolframite**, **fluorite** and others in nice cabinet pieces. He feels that China is a safer place to collect minerals these days and, considering the comments on the violent events surrounding his African acquisitions described in my last *Letter,* I tend to agree. But despite the overall increase in availability there is little startlingly new material as yet. One exception was the tail end of a small lot of **stannite** specimens, belonging to Frédérick Escaut (the remainder had been sold before the show and those on display were spoken for already). These specimens consist of striated **arsenopyrite** crystals about 2 cm long with stannite crystals averaging 1 cm perched on top of them. In some specimens the stannite crystals are bright and lustrous, others are less brilliant in appearance (though still lustrous) because of complex oscillatory growth or etching. Although smaller than the well-known Bolivian stannites, the Chinese crystals from the Zinyhanj mine, Hunan, are much superior to their dull black South American competitors, and a stark contrast to the massive material familiar to Cornish collectors.

Along with the growth of interest in Chinese minerals comes the inevitable rise in the faking of specimens. Buyers should be aware that there are increasing numbers of carefully bent stibnites, glued cinnabars and orpiments, and oiled azurites on the market. Buy from reputable dealers and take along a hand-lens to look for those telltale signs!

When did you last see a truly aesthetic cabinet specimen of **arfvedsonite**? If you've not seen material from Marcus Grossmann's prospect on Mt. Malosa, Zomba Plateau, Malawi, probably never. Marcus (*MGM,* Windwart 3, D-83739 Wörnsmühl, Germany) had a small display of remarkable minerals from this locality on the stage of the


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Figure 5. **Beryl crystal, 10 cm, from the Altai pegmatite, Sinjiang, China. Jordi Fabre specimen.**


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Figure 6. **Fluorite crystals, to 2 cm, from La Cabaña, Berbes, Asturias Spain. Jordi Fabre specimen, now in the Francis Benjamin collection.**


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Figure 7. **Wolframite crystal, 5 cm, with fluorite, from China. Christian Gobin specimen.**


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Figure 8. **Cosalite crystals, to 2 cm, with pyrite from Kara Oba, Kazakhstan. Jordi Fabre specimen.**

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Figure 9. Stannite crystal, 1 cm, on arsenopyrite from the Zinyhanj mine, Hunan, China. Frédérick Escaut specimen, now in the Keith Hammond collection.

Figure 10. Gypsum sprays, to 2 cm across, from the Gonguel iron mine, Murcia, Spain. Jordi Fabre specimen.

Figure 11. Galena crystal plate, 9 cm, tabular due to spinel-law twinning, with pyrrhotite, from Dalnegorsk, Primorsky Kraj, Russia. Mike Bergman specimen.

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Figure 12. Calcite crystal (5 cm) perched on a quartz prism, from Dalnegorsk, Primorsky Kraj, Russia. Francis Benjamin collection.

main hall at St.-Marie. The arfvedsonite, which occurs as crystals to 8 cm on pale feldspar, is found in association with doubly terminated **aegirine** crystals to 22 cm, **pyrochlore**, smoky **quartz** with inclusions of **epididymite**, **zircon**, **fergusonite-(Y)**, orange **parisite** crystals to 1.5 cm, **bastnaesite** and **hingganite-(Y)**. A good list of rarities! Marcus promises more material at the Munich show.

Indicolite (blue elbaite) from Brazil is hardly new, but an outstanding specimen on display by Ennio Prato (Via Aurelia, 53, 16031 Bogliasco, Italy) deserves a mention. Terminated, 26 cm long, and deep blue, it had a lot of admirers. The locality is Pederneira, Goveneur Valadares, Minas Gerais. Ennio also had a good selection of Russian material, obtained at a show in Moscow earlier this year. It included some of the Russian **cassiterite** mentioned above, this time labelled Tenkerchin mine, Chukota, Magadan Oblast (another addition to my list of spelling variants—does anybody know of a handy standard list of these site names?); tabular **corundum** crystals, zoned in shades of blue from the Ilmen Mountains, Urals; and groups of pale brown **topaz** (3–4 cm) with **smoky quartz** from Sherlova Gora, Chita Region.

Spain had produced yet more variants on two of its most well known species: **gypsum** and **fluorite**. The latter was from Berbes, in Asturias, where an avalanche at La Cabaña dropped a huge (80 tonnes) vuggy block containing sharp, zoned purple fluorite cubes to 2 cm. Several hundred specimens were recovered. The gypsum find was much larger: a cavity "the size of a truck," according to Jordi Fabre who had bought the whole lot. It had taken 4 months, laboring in a temperature of 23°C and 92% humidity, to extract the specimens from an ancient iron mine at Gorguel, Murcia. Jordi's pieces are all perfect and carefully mounted in custom-made perspex boxes to protect their fragile beauty. The crystals are delicate, colorless blades only a few centimeters long but form exquisite sprays on a dark iron-rich matrix. The best are quite beautiful . . . and so are the worst.

Jordi was also excited over a small **cosalite** specimen from Kara Oba, Kazakhstan. It consists of a group of pyrite crystals sprouting cosalite needles to 2 cm. Fine and delicate, these needles were impossible to free from pieces of protecting cotton wool. The stuff should be outlawed, along with the often equally intractable *Blu-Tak!* Free-grown cosalite needles from this site can reach over 3 cm.

Two lots of good **prehnite** were available at St.-Marie. The most interesting to the European market was that from the classic locality at Bourg d'Oisans, France: dark green, rounded crystals of old-time quality, a centimeter or more across, in small groups and singles. There was also a small selection from the recent find at Copper Valley, near Brandberg, Namibia. These are quite different from the French material, being aggregates of distinct apple-green crystals to 4.5 cm or so. They had been partially etched out of a calcite matrix.

Brand-new was a recent find of **azurite** from Touissit, Morocco. The best specimen I saw belonging to French collector Gilles Emrhinger, two crossed prisms with a scattering of crude **cerussite** crystals; others show shorter crystals partially altered to **malachite** or forming encrustations of small brilliant crystals in geodes. The strike was reputedly only 4 days old. Masses of material were available from the Moroccan dealers on the streets of St.-Marie, but never lived up to the claimed quality. Good for micromounts though. Also from Morocco was a second find of superb **hematite** crystals from Nador—no *not* the eponymous locality for nadorite in *Algeria,* as had previously been assumed (and erroneously reported by me in my last *Letter*). These mirror-bright crystals differed from the first vug by being skeletal and elongated (up to 2 x 7 cm) rather than the tabular "petals" figured in my *Letter*. The best has a perfect, equant hematite crystal perched on a long blade, and is very sculptural. This, and others, had been obtained by Christian Lallemont (7 rue Nungesser et Coli, 37000 Tours, France). It constitutes a significant find for the species.

A word to the wise—well, several words—to save buyers possible disappointment. If you are told, upon asking about a piece at a show reported upon by me, that "This specimen is going to appear in the *Mineralogical Record,*" you can usually assume that this means little more than "The European Correspondent of the *Mineralogical Record* borrowed it for photography." There's a long road between my ad hoc studio at a mineral show and the printed page. Maybe the specimen just isn't photogenic, maybe the photo won't come out, maybe it will but the color will be wrong (typical of fluorite for instance), maybe (as happened once) my roof will leak during a violent storm and soak the photographs beneath in gritty water. Even if the picture is satisfactory and gets selected by me when the report is written, it still has to satisfy the editor, and fit within the allotted pages. Collectors might want to bear this in mind, but I don't expect that these words will make any difference. Let's face it, a specimen that *might* be figured is more interesting than one that hasn't been photographed at all, but at least now I won't feel guilty the next time I hear it!

That's all the news fit to print at the moment. Now I must get down to learning more about computer networking (our museum is about to have one installed) and give minerals a bit of a rest until it's time for the Harrogate show, the British Micromount Society's Symposium, and Munich.

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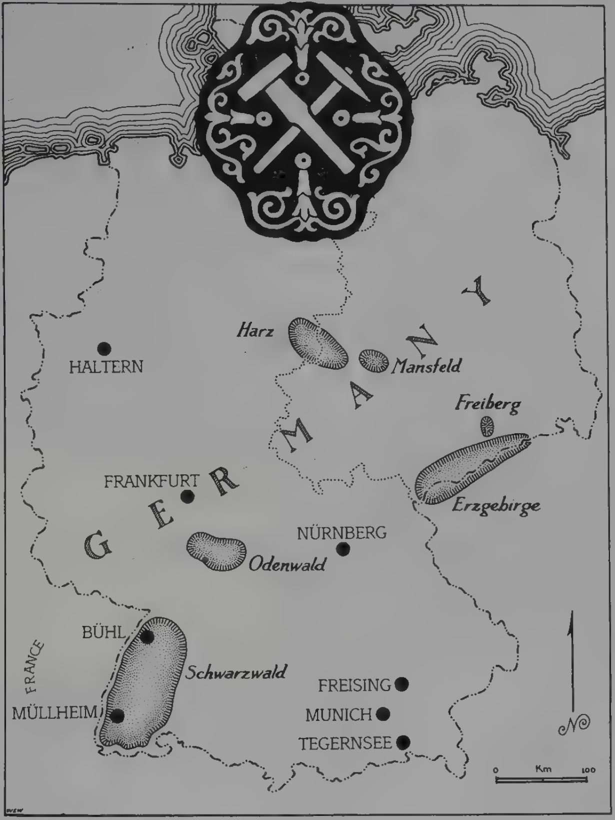

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ADULARIA FROM THE HOWARD-MONTGOMERY QUARRY, HOWARD COUNTY, MARYLAND

John S. White
370 Bens Road
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Numerous quarries throughout Maryland, and some even in northern Virginia, never enjoyed great fame as specimen producers until George Brewer's keen mind and eye coaxed from them specimens no one ever dreamed existed there. Examples include goosecreekite and loudounite from the Goose Creek quarry, Loudoun County, Virginia, and loudounite from the Fairfax quarry, near Centreville, Fairfax County, Virginia. These two new species discovered by Brewer are among the thousands of specimens that he collected, most of which came to the Smithsonian following his tragic death in 1983, at the early age of 34 years. If Brewer (who was a resident of Ellicott City, Maryland) had lived, the number of his discoveries by this time would no doubt have been extraordinary. He was easily the best field collector I have ever known.

One of the localities in Maryland that few believed had much potential is the Howard-Montgomery quarry in the Cockeysville Marble, located in Howard County about 10 miles northeast of Clarksville, and probably not more than 30 miles from Washington, D.C. It once was known as the Brighton quarry (Bernstein, 1980). The age of the Cockeysville Marble is still debated, but most would agree that it is either late Precambrian or early Paleozoic.

Brewer found specimens of the adularia variety of orthoclase ($KAlSi_3O_8$) at this quarry, the best one of which he brought into the museum for identification and subsequently donated (NMNH #135824). It is quite remarkable for an American occurrence because it closely mimics the appearance of some adularia from Switzerland, especially from the St. Gotthard massif. On this specimen, five milky white adularia crystals stand upon a surface of coarsely crystallized calcite marble (Fig. 1). They are up to 2 cm long and about 1 cm wide, and are multiply twinned so that in cross-section they appear square, with re-entrants on most of the terminal faces. A light sprinkling of tiny pyrite crystals covers both the adularia and the crystalline calcite matrix.

In thin-section normal to the elongation direction [100], the *quadrille* structure of adularia is very evident and quite beautiful (Fig. 2). Inclusions of a finely divided material (clay?) appear to have been incorporated at the corners of the crystal during growth, producing a striking Maltese cross pattern. Tiny unidentified micaceous crystals are seen as inclusions in the adularia.

The sectioned crystal was analyzed by Joseph A. Nelen using the ARL electron microprobe and the results are shown in Table 1, where

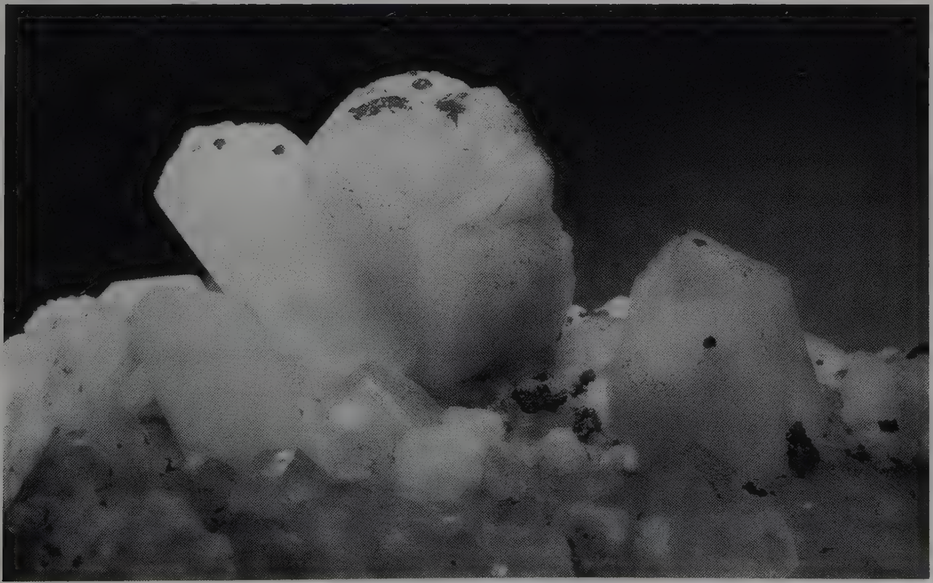

***Figure 1.* Adularia with tiny pyrite crystals, on calcite matrix. Dane Penland photo; Smithsonian specimen.**

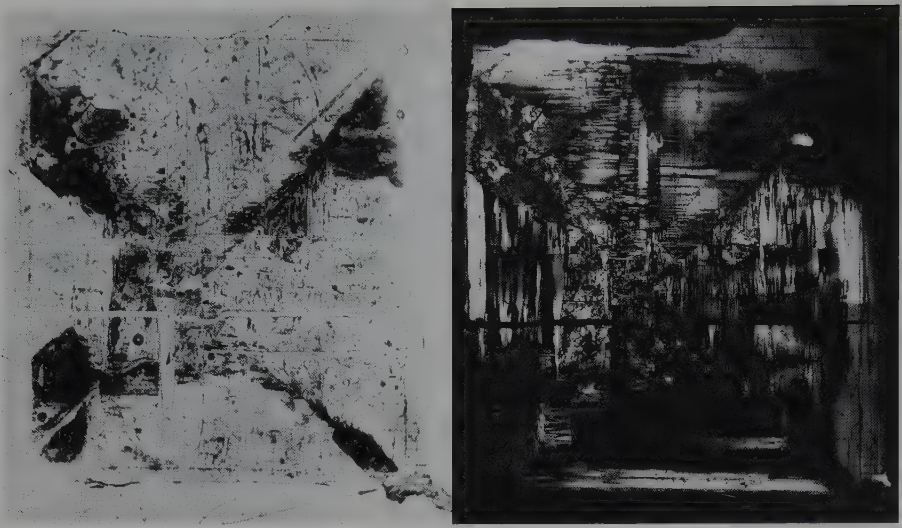

Figure 2. **Section of adularia crystal from the Howard-Montgomery quarry. Victor E. Krantz photo; Smithsonian specimen. (Right: crossed nichols)**

Table 1. **Analyses of adularia from the Howard-Montgomery quarry and elsewhere.**

	Maryland (NMNH #135824)			*1.*	*2.*	*3.*
	Edge	*Core*	*Average*			
SiO_2	64.15	65.11	65.0	64.60	63.95	64.28
Al_2O_3	18.69	18.48	18.4	18.33	19.66	19.19
K_2O	16.90	15.35	16.3	16.28	14.43	15.30
Na_2O	0.14	1.09	0.6	0.42	1.17	0.92
Fe_2O_3	n.d.	n.d.	n.d.	—	0.05	0.09
MgO	0.01	0.00	0.01	—	0.04	0.10
BaO	n.d.	n.d.	n.d.	—	0.08	0.11
CaO	0.04	0.03	0.02	—	0.04	0.11
H_2O+	n.d.	n.d.	n.d.	—	0.56	0.36
H_2O-	n.d.	n.d.	n.d.	—	0.16	—
Sum	99.93	100.06	100.33	99.63	100.14	100.46

1. Piz Lucendro, Switzerland, NMNH #121938. Smithsonian microprobe analysis.
2. St. Gotthard, Switzerland, NMNH #R2817. Kracek and Neuvonen (1952).
3. St. Gotthard, Switzerland. Spencer (1937).

they are compared with analyses of other adularia specimens. The Howard-Montgomery quarry adularia is similar to the others. Of particular interest is the near absence of calcium in spite of the mineral having crystallized upon calcite. The sodium content decreases measurably from core to rim, with a corresponding proportional increase in potassium.

Adularia is not considered a mineral species in its own right, yet it has a quite distinctive crystal habit and it twins in a very characteristic manner, unlike other varieties of orthoclase.

Other minerals of interest to collectors that Brewer found at the Howard-Montgomery quarry include:

Calcite $CaCO_3$

Calcite is found as colorless to light gray, equant microcrystals which have the form of rounded rhombs, often heavily included with fine pyrrhotite crystals in the near-surface zones. Larger scalenohedral crystals up to 2 cm, associated with muscovite, are also found, these sometimes having minute pyrite crystals on their surface.

Pyrite FeS_2

Pyrite is found in very tiny, unmodified cubes on calcite and adularia.

Pyrrhotite $Fe_{1-x}S$

Pyrrhotite occurs as very thin, platy crystals, commonly appearing bent. They are found on and in calcite crystals, both of which grew upon quartz and muscovite crystals. The pyrrhotite crystals are virtually identical in appearance to the more familiar pyrrhotite from the Morro Velho gold mine, near Nova Lima, Minas Gerais, Brazil. They reach several millimeters in size.

Rutile TiO_2

Rutile occurs in simple prismatic crystals in calcite, with pyrrhotite. The crystals are so dark, even under the microscope, that they appear to be truly black. They reach 2–3 mm in length.

The present level of activity at this quarry and its accessibility by collectors is not known, but one may reasonably assume that access is severely restricted.

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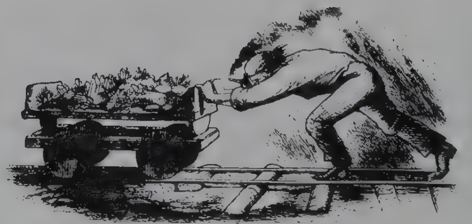

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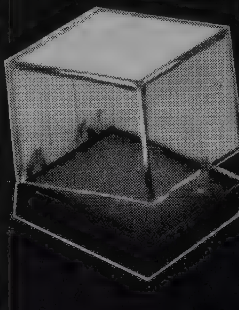

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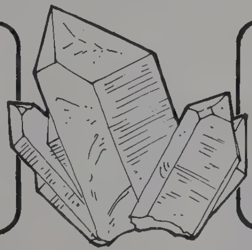

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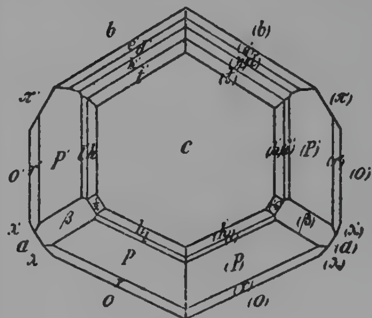

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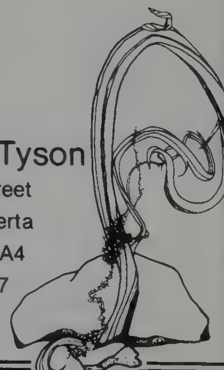

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What's New in Minerals?

Springfield Show

by Thomas Moore

[August 13–15, 1993]

For much too much of the summer of 1993 the weather in southern New England has featured downright hydrothermal conditions of heat and humidity, making us residents perhaps empathize more with the lobsters we like to boil alive. And so the most immediately *nice* thing about the hall which was the new site of the '93 Springfield, Massachusetts, show is that it was air-conditioned. And cooling off the inside of the Eastern States Exposition Center in West Springfield must be no small or inexpensive feat, either, as there is enough space in there to create an easy feeling of elbow-room such as is rare at major mineral shows. The 99 dealers were not in any way crowded by the special exhibits, the mineral stamps, the snack bar, the wholesale and swap sections, or the gold-panning-for-kids concession. And the parking lot outside was both roomy and free, and there was a lecture room for the eight lectures by four lecturers, and a nice little studio into which Jeff Scovil could abduct specimens for photography (see some results here). So, generally, this show was a claustrophobe's heaven. Sales were said to be off this year, but let us hope that Marty Zinn will still be able to keep scheduling "Springfield"—i.e., the East Coast Gem and Mineral Show—in this building for years to come.

The show's "theme" this year, in the loose fashion of show themes, was the gem pegmatites of Pakistan and Afghanistan, and many special exhibits featured beautiful, large, transparent, pastel-colored crystals on hunks of white felsic rock. Especially impressive were Herb Obodda's casefull of fine green, pink and purple cuboctahedral fluorites from Pakistan; the miscellaneous Himalayan pieces shown by Stuart and Donna Wilensky in their case and by Andreas and Rebecca Weerth in theirs; and the show's most curious "curiosity," all by itself in a case: Obodda's rough, milky white trapezohedron of **pollucite** measuring about 2 *feet* across, with some gemmy bicolored elbaites on one side. Herb bought this—assuming (as who wouldn't) that it is the world's biggest pollucite crystal—chiefly to save it from the destruction planned for the sake of getting out the tourmalines. The locality is the Paprok prospect, Kamdesh, Nuristan, Kunar Province, Afghanistan.

Among the displays were some highly educational spreads of old-time beryls from New England (Harvard Mineralogical Museum), and beryls from Connecticut (Peabody Museum, Yale); an intelligent if humble display of various styles of quartz specimens, put in by the Springfield Science Museum, is also worthy of note and of thanks. A small selection of uniformly excellent worldwide pieces from his private collection was put in by Kenneth Hollman of Center Rutland, Vermont. And the star-of-the-show case (I'd say), proudly chaperoned by Joel Bartsch, displayed the Houston Museum of Natural History's ten superpieces including two enormous Russian axinites on matrix, and a 3-cm, sharp, deepest green gem Colombian emerald sticking vertically up from a 5-cm matrix.

Of the various Himalayan materials available, the most diverse were being offered by Dudley Blauwet of *Mountain Minerals International* (Louisville, Colorado). Dudley's regular trips to these pegmatite Shangri-Las have yielded him (besides notes for his lecture on "A Mineral Buying Trip to Pakistan") nice stocks of **elbaites**, **aquamarines**, **spessartines**, **epidotes**, etc., as well as less predictable items such as (to mention just two) fine butterscotch-orange **titanite** crystals from Alchuri Village, Shigar Valley, Baltistan, Pakistan; and a most tantalizing blue-white sparkling cavity filled with crystals to 5 mm of something which looks a great deal like **euclase** (species-confirmation is pending, but euclase from these regions would, of course, not be too surprising, so stay tuned). Dudley also garners regular surprises (if this is no oxymoron) from Sri Lanka's gem gravels—and here were a few more of the very pale blue loose prisms of **sillimanite** I reported on from Tucson; some fine alluvial **sapphires** of typical form which look hardly at all waterworn (from Galbkka, near Vallivaya, Uva Province, Sri Lanka); and some similarly sharp, small, loose, tetragonal prisms of glassy brown **zircon** (from Ambilipitiya, near Kataragama, Sri Lanka).

But the Himalayan Blue Ribbon this time must go to the only European dealership in attendance at Springfield: Andreas and Rebecca Weerth (Hochfeldstr. 27, D-83684 Tegernsee, Germany), whose ads in German magazines, I remember fondly, advertised goodies "vom Dach der Welt" (from the "roof of the world") with a full-page color spread surrealistically showing a gemmy brown topaz crystal towering, higher than Everest, up from a stark mountainscape of snowpeaks and sinuous montane glaciers. From the same place in Pakistan as Herb Obodda's giant pollucite (which place name Andreas rendered as "Pavrok") a major strike in June of 1993 yielded about 150 very fine **elbaites**, all of which the Weerths obtained, and many of which they were offering at Springfield. The less dramatic of the two general types shows thick, short, very pale, milky pink translucent crystals with flat basal terminations; the other type shows much longer crystals, with much parallel-growth aggregation, the best of the prisms very effectively watermelon-banded dark green and dark red, gemmy in liberal areas, and with fairly steep trigonal terminations. For both types there are sparse, aesthetically uninteresting associations of smoky quartz, microcline and muscovite. The large bicolored crystals range up to about 4 x 20 cm; a dozen or so are between 10 and 15 cm tall. This Pavrok (or Paprok, or Paprock) prospect, it seems, is a small one which has been intermittently worked for about the past

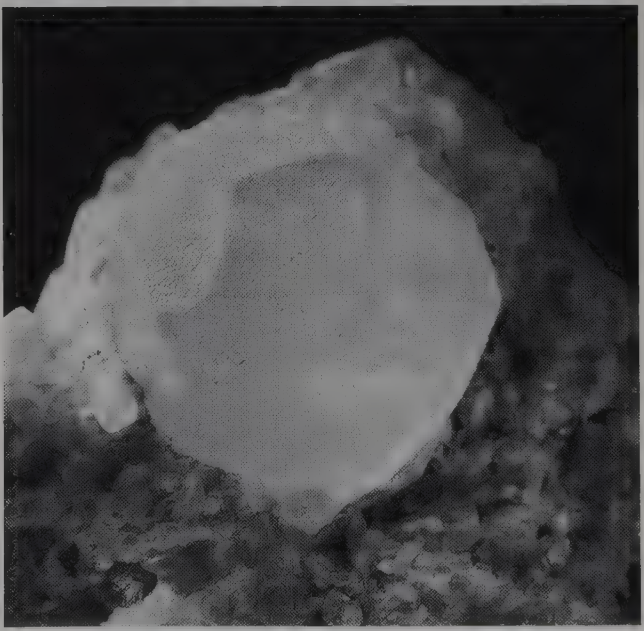

Figure 1. **Pollucite crystal, 2.2 cm, from Shingus, Gilgit, Pakistan. Herb Obodda specimen, now in the Bill and Carol Smith collection; photo by Jeff Scovil.**

Figure 2. **Elbaite crystal, 15.2 cm, from Paprok, Afghanistan. Andreas Weerth specimen; photo by Jeff Scovil.**

three years, and has, as we'd expect, a highly uncertain specimen-production future. Some of the world's biggest milky white beryllonite crystals have also come from here, although none were in evidence at the Weerths' or elsewhere in Springfield.

People have learned by now to keep their antennas out for new and/or already-familiar-but-fine things from the former Soviet Union. And, yes, there were at Springfield a fair number of the latter things, although if there also were any dramatic debuts, I missed them. Doug Wallace (2800 Routh St., Suite 107, "the Quadrangle," Dallas, Texas 75201) had the nicest assortment of specimens of **datolite** from Dalnegorsk, Russian Far East, that I have yet seen. This is, as you probably know, an utterly gorgeous datolite, with brilliant glassy luster, total transparency even in many of the larger of the complex tabular crystals, and a delicate bluish green hue unmatched as far as I know by any datolite from elsewhere. Doug had about 100 specimens of all sizes, with the gemmy crystals, which could reach 5 cm across, sprinkled on groups of milky quartz whose own prisms sometimes reach 1 cm. The best of the thumbnails on hand cost $30 (as I should know, since I bought it myself).

Except for a mildly intriguing scatter of loose octahedrons of franklinite from Franklin, there wasn't much in evidence from classic eastern U.S. (or European) localities. But a new dealership, *Rockyfellas Minerals* of Downingtown, Pennsylvania, deserves honorable mention, chiefly for offering some interesting, nicely translucent, pale yellow to orange groups of scalenohedral **calcite** crystals from the (presently productive) Delta Carbonate quarry, York County, Pennsylvania. Individuals can reach 20 cm and groups can reach 50 cm. These calcites need to work on their luster and transparency, but I'd say the locality still stands a fair change of rivaling the nearby and better known occurrence at Thomasville, in York County, and even perhaps to join the list of sources of truly world-class crystallized calcite.

Over in the wholesale section, I learned something new and exciting about the "rock crystal" quartz which had been dug for decades (chiefly to the delight, in latter years, of the mystically inclined) from various small mines in Montgomery County, Arkansas. One of the most experienced among the diggers, Don Burrow of *Crystal City, Inc.* (H.C. 63, Box 135C, Mt. Ida, Arkansas 71957) had, to my surprise, about 30 miniatures and cabinet-sized specimens showing large (to 6 cm across the wingtips), well-individualized **Japan-law twins of colorless quartz**, these either standing up proudly or hiding shyly among the tall tumbled grass of the groups of conventional prismatic crystals. The exact locality, Don said, is the Collier Creek mine near Mt. Ida, in southern Montgomery County, from which source, he went on, only about 50 Japan-law twins have been found since 1980. They tend to be somewhat thicker than usual, have fairly deep re-entrant angles and light striations, and (sometimes) show rhombohedral calcite-cast cavities on the bases of clusters. Don's largest specimen is a 20-cm group with a 6-cm Japan-law twin; prices range from about $300 for an excellent miniature to around $2,000 for a spectacular cabinet piece. The best of all that I saw, however, had already joined the proud family of the Houston Museum collection, in whose case it starred.

One unambiguously "What's New" item from this show is the new lot of amazingly lustrous, large, indeed altogether stunning **pyrargyrite** crystals from a new Mexican source, discovered just this past June: level 320, Cueva Santa vein, San Luis shaft, Fresnillo, Zacatecas. The crystal groups are mostly thumbnail and small miniature size, with individual prisms, extremely sharp and brilliantly lustrous, to 3 cm long; they show a good ruby-red interior color with the right lighting, but what's most impressive is the luster. Sometimes the flat prism faces are nicely contrasted in their mirror-flash brilliance by areas of sparkliness from later drusy growths of microcrystals. Several dealers had small stocks of these outstanding pyrargyrites, but the best belonged to Dave Bunk (9240 W. 49th Ave., #317, Wheat Ridge, Colorado 80033), and to his stand-neighbor Dennis Beals (*XTAL*, Colorado Springs, Colorado, tel. 719-632-6091).

Further, both of these gentlemen from Colorado had some very good thumbnails of **acanthite** (paramorph after argentite), in arborescent growths, stacked-cube clusters, and as bright simple cubes on matrix, from the familiar Reyes mine, Guanajuato, Mexico. From the same place they had handsome thumbnail groups of sharp, stacked, hexagonal plates of metallic black **polybasite**. To complete the Reyes silver suite, Beals had what are probably the best-so-far-from-anywhere specimens of the rare species **pearceite**: $Ag_{16}As_2S_{11}$, the arsenic analog of polybasite. In these, the bright, metallic-black, platy pearceite subhedra form flat-lying rosettes on a whitish matrix; for such a rare mineral they are outstanding specimens, priced for the most part in the low hundreds.

That's all, then, from New England, but read on now for more mineral news from the famous Denver Show.

Denver Show

by Thomas Moore

[September 14–19, 1993]

As I write this, my maiden visit to the enormous Denver show has been crystallizing quite well; indeed, it has been going euhedrally, thanks. And when I get tired of looking at minerals here at the Holiday Inn and at the main show at the Denver Merchandise Mart, I can always foray out into the surrounding territory and . . . look at minerals (in the Denver Museum of Natural History or the Colorado School of Mines collections), with glimpses enroute reminding me dimly that, yes, there is an Outside World.

Marty Zinn has organized a successful motel show once again: the Holiday Inn rooms are happily humming with commerce, and the barbeque area by the pool (now with dealers' tents) is busy each day and evening. The Main Show is running smoothly as well, with predictably fine exhibits, though I'll probably lack time and space to offer descriptions of these. Sad but true, however: some dealers and visitors are mumbling petulently that this show has not produced any *really* new, *really* dramatic mineral thrills, on the order, say, of the last Tucson show's Rhodochrosite Experience—but really now, and in view of that very full plate last winter, how vastly productive of wonders can surprise-junkies expect our poor planet to be between Tucson Spring and Denver Autumn? And it *is* still true that, as Wendell Wilson observed in the " 'What's New' issue," this *is* a golden age of mineral collecting. And from Denver there actually is plenty to report about, as we'll see.

Steve Allred of *Utah Mineral and Fossil Company* (3888 Marshall Rd., Erda, Utah 84074) filled a whole room with small specimens (ranging across the quality spectrum) of lovely products of the Thomas Range, Juab County, Utah: gemmy orange topaz crystals, loose or on rhyolite; fine, dark red spessartines; perfectly sharp, cubic, bright black **bixbyites**; metallic black, gas-sublimation crystals of hematite; and varying combinations of these. Indeed it's the combinatorial permutations that are the most fun to watch: any of these species may occur alone, or the bixbyites may be jauntily perched on white altered rhyolite matrixes, or the bixbyite cubes may even decorate the topaz crystals. What's really new here, however, are several hundred mostly small-thumbnail specimens showing bixbyites scattered over **garnet** (presumably spessartine) crystals rounded almost to spheres through replacement by a fine-grained gray hematite. These are more attractive than they may sound (black on gray, true, but the peppery little bixbyite cubes are perfect and razor-edged). And in a very few specimens the garnet trapezohedron form is also sharply visible. These garnet/bixbyites have recently been taken from what's called Maynard's Locale, on the east side of the Thomas Range.

Also from Utah—specifically, from the Deer Trail mine, Marysvale—has come more of the beautiful pale apple-green to very pale watery greenish translucent dodecahedral **fluorite**, with finely stepped, frosted crystals to 3 cm on matrixes of gray-white sandstone with drusy quartz. This material has long been known, but there was a most impressive spread of specimens in all sizes being offered at the main show by Diversified Minerals (2866 Floribunda Drive, Salt Lake City, Utah 84117). The star piece was a 45-cm plate blanketed with the more deeply colored fluorites. On the other hand, lovely, winsome small thumbnails with single crystals of palest green tint, loose or on matrix, could be had for around $12.

The already fabled, world-class **rhodochrosites** from Colorado's Sweet Home mine, dug by Bryan Lees' team in the summer of 1992 and extensively gushed over in my last Tucson report, are still rather abundant around the market, although apparently no new bonanzas have been forthcoming. Bryan and Kathryn's *Collector's Edge* dealership (P.O. Box 1169, Golden, Colorado 80402) offered a hundred or so luminous cabinet specimens and miniatures at Denver, plus hundreds of smaller ones, in addition to which, of course, hundreds more had come to grace many other dealers' stocks. And I here retract in part my earlier, hasty generalization that none of the associated species from this great strike occur on their own in noteworthy specimens: at the Lees' stand and elsewhere one could occasionally see beautiful, delicate specimens of needle quartz with small, dark purple **fluorite** cubes pleasingly nestled among, or hoisted in air by, the colorless transparent prisms. These seem all to have come from the "tetrahedrite stope" of the Sweet Home, and thumbnails for around $50 are a good buy, not just for the fame and charisma of the occurrence

Figure 3. **Cerussite twins, about 2 cm across, from the Bunker Hill mine, Kellogg, Idaho. Wayne Thompson specimen; photo by Jeff Scovil.**

Figure 4. **Pyromorphite crystal croup, 5 cm across, recently recovered by Bob Hopper at the Bunker Hill mine, Kellogg, Idaho. Photo by Jeff Scovil.**

but also for their intrinsic quality as fluorite specimens.

Remaining for one more paragraph in Colorado, we greet Dave Bunk's new honey-orange **barites** from the 121 stope, 1250 level of the Black Cloud mine, Leadville. These are tabular, complexly edge-modified crystals, often showing dark phantoms, on sulfide matrixes, sometimes with bluish quartz; they were mined earlier this year, and come in all sizes. We'll hear again in a couple of further connections from Dave (9240 W. 49th Ave., Wheat Ridge, Colorado 80033), as he always seems to have something interesting and/or new.

For example, in this room also were some groups of nailhead **calcite**, very attractive in a low-key way, mined a few years ago from the 24 stope, 4200 level of the Sunshine mine, Kellogg, Idaho. The grayish white, somewhat frosty, glistening, flattened rhombs are uniformly about 2 cm across, and they form in dense clusters over another of those quartz/sulfide matrixes.

Speaking of Idaho, there's very recently been a large litter born (borne onto the market) of very nice, small **cerussite** specimens from the Bunker Hill mine, Kellogg. This, of course, is the famous locality for bright yellow-green and mammillary orange pyromorphite; the cerussites were reportedly found just tens of meters away from the most pyromorphite-productive area of the mine. Wayne Thompson (1723 E. Winter Drive, Phoenix, Arizona 85020) was offering around a hundred fair-to-excellent thumbnails and small miniatures, the best of which are glassy and quite transparent, well-terminated V-twins. Others are matrix pieces with bright, individual, equant cerussites to 1 cm, and flattened, densely reticulate Tsumeb-style or Broken Hill–style pieces. The new owner of the Bunker Hill mine is Robert Hopper, who has reopened the workings to produce ore, but is also sympathetic to the preservation of mineral specimens. While mucking out a stope on the 9th level he recently encountered the first of several pockets lined with green **pyromorphite** crystals and orange botryoidal pyromorphite, so this famous material is now reaching the market once again as well.

Enroute to South America, I'll stop in Mexico just long enough to observe that Dave Bunk and Dennis Beals (*XTAL*, 20 North Iowa St., Colorado Springs, Colorado 80909) still have a few each of the dazzling thumbnails of silver minerals that I described from Springfield. Specifically, brilliant thumbnails of the new **pyrargyrite** from the Cueva Santa vein, Fresnillo, might still be had for $200 to $300; there is a very small number of marvelous **stephanites** from the (older) Santo Nino vein, Fresnillo; and special honors go to a few glistening, metallic gray thumbnails whose surprisingly light weight betrays them as something odd—hollow **polybasite/pearceite** casts after what were once 2-cm euhedral pyrargyrites, these from the Reyes mine, Guanajuato. The more familiar stacked-cube and branching arborescent **acanthites** from the Reyes were also available in excellent thumbnails from these two dealers, and more generally around the show.

Steve Green (*Rough and Ready Gems*, P.O. Box 10404, Denver, Colorado 80210), who is normally best known for his stocks of amethyst and green andradite from Veracruz, Mexico, has recently been getting some interesting **vesuvianite** crystal groups from a nearby locality. The crystals are modified pseudo-cubes to a little more than 1 cm across. Most are opaque pale green with little luster, but a few have dark green translucent areas and a nice vitreous luster.

Gary Nagin of *Crystal Springs Mining* (P.O. Box 40, Royal, Arkansas 71968) had yet more of the outstanding large **vivianites** from Morococala, Bolivia, which appeared at the last two Tucson shows, though he says that none comparable have been found in the past six months or so. More interesting, for being "newer," are his fine **cassiterite** groups on quartz matrixes from Viloco, Bolivia, with highly lustrous, bright brown-black (some showing transparent interior yellow-brown areas) cyclic-twin crystals to 1.5 cm. There are some large cabinet pieces with smallish crystals, but the best-cassiterite prize goes to the dozen or so miniature-sized, heavy clusters with gleaming large twins tightly packed on the matrix.

Brazil's most dramatic instance, in my opinion, of an old occurrence surpassing itself at this show was the lot of eleven outstanding **childrenites** from Linopolis, Minas Gerais, being offered at the main show by Ernesto Ossola (8 rue du Luxembourg, 30140 Anduze, France). Collected, according to Ernesto, about seven years ago, and stashed away until now, the loose, yellowish brown, translucent striated prisms with good terminations can reach 15 cm long; some are in groups with two to five crystals, but the best of the lot is a doubly terminated sharp single 12 cm long.

Intermittent quarrying in basalt flows near Irai, Rio Grande do Sul, Brazil, has long yielded great quantities of pale **amethyst** in large rosettes, and sprays of pearly lustered, sharp-pointed, translucent white **calcite** scalenohedrons in all sizes. But steady abundance of supply can lead to specimens being taken for granted; there is a tendency to look past fine specimens of common species, despite their beauty. I have not seen these Irai calcites and amethysts mentioned much in show reports, and the roomfull of them at *Valadares Minerals* (Rua Capote Valente No. 513, Apt. 133, São Paulo, Brazil) inspires me to make amends. Large gas pockets in the basalt, when broken into, are found to be thickly lined with a dense, dark green chlorite. When the pockets are dry, matrix pieces with calcite crystals resting on the chlorite layer on the basalt may be carved out; and when the pockets are wet, calcite sprays may simply be picked off the chlorite like flowers—this winning metaphor being part of the enthusiastic account given by Edson Endrigo of *Valadares*. The great amethyst-rosette plates, Edson goes on, result from the decision to acid-sacrifice the overlying calcite and scrape off or ultrasound-clean the chlorite; the exposed, bright, roseate quartz arrangements can exceed 30 cm across, with pale purple and colorless areas showing in the same specimen. Calcite clusters on matrix may also reach such a size, but I prefer the quietly pearly-beautiful thumbnail sprays—"flowers," indeed. Of course, many other dealers offer this Irai material also, but Edson's supply was the largest, best, and most lovingly offered up to the world at Denver.

In the Valadares room were also 20 or so miniatures from a new find (February 1993) of **siderite** in an aquamarine mine in a pegmatite at Fundão City, Espirito Santo, Minas Gerais, Brazil. The clean, simple rhombs are dull to vitreous brown, much resembling those from Mont Saint-Hilaire, but the matrixes feature large, euhedral, gray-white feldspar crystals, micas, quartz and sparse tiny aquamarines. The siderite crystals reach 3.5 cm on edge, and a good 7-cm piece may be had for around $50.

We now board a boat of the Gondwana Line and drift on across the South Atlantic to Namibia, where nothing seems new from dying Tsumeb, but where, on a brighter note, the Otjua mine near Karibib continues to distinguish itself as a major locality for giant matrix clusters, loose parallel groups, and single prisms of partially gemmy, dark red and green **elbaite**. Several dealers had these, but the best were with Bryan and Kathryn Lees in their *Collector's Edge* booth at the main show. Also here, and also from the Otjua, but much less familiar, were some excellent large lepidolite specimens: cabinet-sized hunks showing dense packings of edge-on books or, more commonly, columnar crystals in aggregates, over platy white albite. These pieces, ranging from 6 to 30 cm across, can be very pretty, with good silvery-purple color and bright luster on the rounded tops of the bunched-up columns; the best large cabinet specimen sold for $200. Certainly this mine bears watching for further pegmatite species surprises.

Alain Carion (92 rue Ste.-Louis-en-l'Isle, 75004 Paris, France) had a modest surprise from a place called Ambatofinandrahana, Madagascar—referred to hereinafter as "there." Two years ago, some dozens of **quartz** crystal groups with conventional prisms to 4 cm long were collected *there*, the groups reaching 15 cm across—but with unconventional, ghostly dark green phantoms created by chlorite (?) inclusions. The sharp outlines of the earlier quartz terminations remain strikingly salient, in this crisp green, visible through the transparent side faces to about halfway up the prisms. Miniatures sold for around $75, and a 15-cm plate for $250. A couple of other French dealers had limited numbers of these as well.

The new pale blue-green **boracites** from England (a few of which did appear, I'm told, at the Costa Mesa show, and were briefly noted in the annual "What's New" survey in vol. 24, no. 5) were among the most intriguing and truly new-seeming of recent discoveries at Denver. Specimens by the dozens were being offered by Scott Williams (P.O. Box 48, Oberlin, Kansas 67749) and by James and Mary Walker of *IKON* (P.O. Box 2620, Fallbrook, California 92088), both of which dealerships had nice, pretty specimens, mostly miniatures, at prices remarkably low for such fine representatives of a rare species. As an example, some 8-cm pieces covered with sparkling green crusts of boracite crystals to 2 mm on edge could be had for around $80. The locality is the Boulby mine near Cleveland, Yorkshire, England—a potash mine whose bedded sylvite is normally easy enough for the machines to chew through; but when the first boracite lens was hit, the mineral's great hardness (7–7.5 Mohs) destroyed a drill bit. In these lenses, the earliest mineral seems to be a white unknown species occurring in tiny, dense, radial groups, around which the boracite later grew; a paramorph of the very rare borate hilgardite (in tiny orange ferrous crystals) and at least three more unknowns occur in the lenses too. The cubic to tetrahedral boracites line open seams in apple-green massive boracite. In other cases, spheres of sparkling microcrystals are grouped around the cores of the white unknown. Smaller boracites are cubic but the largest, up to 5 mm on edge, are sharp tetrahedrons. The lovely color is much like that of the classic German boracites from near Hanover, usually found as isolated cuboctahedons in matrix. These new English specimens deserve to be considered classics as well. It is rumored that this economically shaky mine will close down in a year or so. (See also p. 44. Ed.)

Elsewhere in Europe, the Madan orefield in the Rhodope Mountains, Bulgaria, continues to be prolific, and Ernesto Ossola (again) had a few really excellent gemmy green **sphalerites** from this locality (as he did at Tucson). The very bright, complex, transparent crystals reach 1.5 cm, and are implanted on and in honeycomb quartz matrixes, with galena crystals. Backlit, they are gorgeous, and a fine thumbnail can be had for $100.

Only a couple of thousand kilometers east, good gemmy green **sphalerite** is also coming from the copper mine at Dzhezkazgan, Kazakhstan. According to Don Edwards of *Tideswell Dale Rock Shop* (Commercial Road, Tideswell, Derbyshire, U.K.), transparent green and transparent orange sphalerites have been found here for awhile now, but those at Denver were the first I'd seen. The slightly modified, resinous tetrahedrons reach 1 cm, and occur in tight groups or as isolated crystals on quartz matrix—they are handsome enough, and at their best when backlit, of course, although most specimens I saw unfortunately have some damage, presumably from the inexpert collecting. The precise locality as given by Don (who should know, having just returned from a trip to these exotic parts) is Mine 57, Dzhezkazgan. Here again, the best thumbnails hover around $100 in price.

The Pljaskov–Van Scriver dealership (best mailing address these days: Star Van Scriver, Dobraticka 521, 199 00 Praha 9-Letnany, Czech Republic) once again had very fine (verging sometimes on stupendous) things from the ex-Soviet vastnesses. For instance, Brad and Star Van Scriver showed me two monumental, Swiss-surpassing **smoky quartz gwindels**—the larger one measuring 25 cm—found in 1974 at the Dodo mine, 75 km from Saranpaul (village), Polar Urals, Tyumen Oblast, Russia. From the same mine come excellent part-gemmy yellow-brown titanites, both as loose V-twins and as large matrix groups up into the mid-cabinet sizes. The now-revered deep brown gemmy *ferroaxinites* from the "Polar Urals" are found, according to the Van Scrivers, in a different mine, the Pouyva, a few kilometers away from the Dodo mine. Superlative specimens of this axinite, by the way, continue to be available from many dealers. (See especially the cover photo on the previous issue.)

Ferberite (often labeled wolframite) continues to come in magnificent large groups from Akschatau, east Kazakhstan; a 7-cm group handled by the Van Scrivers has sharp black blades to 3 cm across the top edges. And there has been a new find of **magnetite** from the Sarbay silver mine near Rudni (village), Kusteni Oblast, north Kazakhstan; I saw a heart-stopping specimen, with brilliant black simple octahedrons (averaging 1 cm along the edges) aesthetically grouped over massive magnetite with small white fluorite crystals, the whole piece measures 6.5 cm. But bad news from Russia: the "Cherry Mountain" niobium mine, the very recently acclaimed source of the world's best **pyrochlore** and some of the world's best zircon crystals, officially closed just a week before the show.

Finally (for Russia), in Dave Bunk's room I was quite amazed to find about ten miniature and cabinet specimens of beautiful, pale greenish blue, gemmy **topaz** crystals to 3 cm across, in copious clusters with green fluorite and smoky quartz. Except for the tinge of green and except for the fluorite, these resemble the classic blue topazes from Mursinka in the Urals, although in fact they come from the other pegmatite shore of the vast Russian land-ocean—from Scherlowaja Mountain, Adun-Tschilon, Transbaikalia. The best of these recently mined specimens is a stately 17 cm with sharp topaz crystals and good green fluorite dodecahedrons.

At the main show, *The Rocksmiths* (Tombstone, Arizona) turned heads with a small outward-facing case crammed richly with large, extraordinarily vivid, bright red, transparent **realgars** from the Shimen mine, Hunan Province, China. Although all of these and most of the others inside the booth were devoid of the associations of fine calcite crystals and dusty orpiment that we've come to expect, they are quite spectacular for their color, their gemmy transparency, and their sizes, which range up to 12 cm. There is some damage on most of them, perhaps inevitably, but crystal forms are sharp.

Old China hand Doug Parsons (1119 S. Mission Rd., Suite 243, Fallbrook, California 92028) had a few intricate, pert little thumbnails of **scheelite** from Hengyang, southern Hunan Province: clean, sharp pseudo-octahedrons to 1 cm, light yellow-orange, on matrixes of muscovite, quartz and bright, sharp 2-mm pyrite cubes; these sold for only $20 to $40. Doug would also like to pass on a correction of my (parroted) assertion in the last Tucson report that the fine orange scheelites with aquamarine come from Hunan Province; in fact, he says, they are from Sichuan. At any rate, he had one 17-cm flat plate with about 20 very bright orange, sharp, 2-cm scheelites partly embedded in it.

And the trusty, industrious, always well-mineralized François Lietard of *Minerive* (Au Bourg, 42800 Tartaras, France) had some Afghani treasures, most remarkably some huge, loose, pale lavender **kunzites** from Mawi, Afghanistan. One crystal is a thick 15 x 15 x 7 cm and has an unusually complex set of terminal faces. Another, whose simpler termination is like the wedge-shaped one on the kunzite on the cover of vol. 24, no. 5, is limpidly gemmy and over 20 cm tall. And as previously, M. Lietard also had some enormous **beryllonites** from Paprock, Afghanistan: flattened cyclical aggregates somewhat like cerussite in form, to 12 cm, and dull milky white in color.

Finally, another true What's New: loose, very lustrous, medium-green, equant trigonal crystals of what seems to be a **chromian uvite**, from "near Mogok, Burma." Although several dealers offered these, Cal and Kerith Graeber (P.O. Box 47, Fallbrook, CA 92028) had the largest selection and highest quality. These crystals, almost always in thumbnail sizes, sold at prices around $50 for a crystal with a broken backside to around $300 for the (scarce) complete or nearly complete euhedra. Though none are in matrix, informed speculation is that they occur in the regionally metamorphosed marbles around the ruby-producing gem fields "near Mogok"; some say that the uvite site is about 15 km from the Thai border. All specimens are of the same pleasing bright green color, though with enough internal fracturing to preclude cutting all but the tiniest faceted stones (one theory being, of course, that the real gem-grade crystals, if any there are, are all going under the cutter's blade). Anyway, this already fine uvite occurrence certainly shows promise.

Figure 5. **Smoky quartz gwindel group, 18.5 cm across, from Saranpaul, Polar Urals, Russia. Van Scriver/Pljaskov specimen; photo by Jeff Scovil.**

Figure 6. **Realgar crystal, 6.8 cm, from Shimen, Hunan, China. John White specimen; photo by Jeff Scovil.**

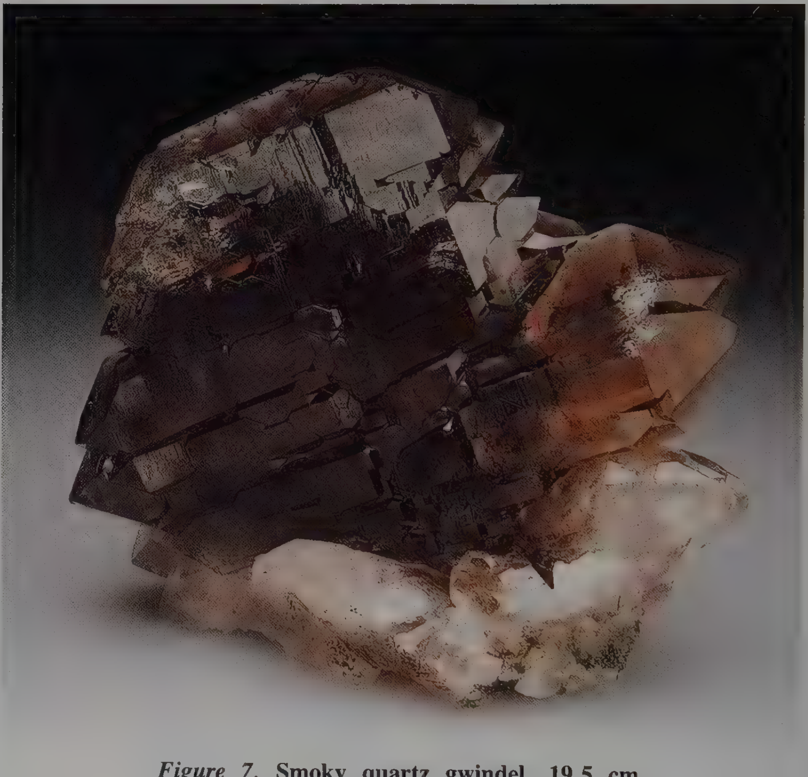

Figure 7. **Smoky quartz gwindel, 19.5 cm across, from Saranpaul, Polar Urals, Russia. Van Scriver/Pljaskov specimen; photo by Jeff Scovil.**

Before I conclude, a late flash—out of geographical sequence, all right, but who cares when such fine native **sulfur** specimens as these are involved? In January and March of this year, wholesalers Mike New and Mark Kielbaso went digging in the fumarolic area near San Felipe, Baja California Norte, Mexico, and extracted 40 flats of fine sulfur specimens, plus many, many more flats of less-than-fine ones; the best of the best went to the dealership of Ken Roberts (Twain Harte, California), who had them at the main show. Matrix specimens come in all sizes, with bright, sharp, gemmy sulfur crystals in blanketing druses and as larger, lightly perched singles, some standing alertly straight up, on a powdery white matrix. This matrix looks like rhyolite but is, according to Mike, a granite altered by fumarolic activity. We are talking dry-cooked rock here, with its exquisite garnishing of the gas-sublimate yellow crystals. These can reach 2 cm while still remaining solid and gemmy; skeletal crystals even larger are known.

With my customary apologies (which in fact I've never thought to render before) to all dealers whose noteworthy mineral wonders I've

Figure 8. **Sulfur crystals on matrix, 10.5 cm, from near San Felipe, Baja California, Mexico. Roberts Minerals specimen; photo by Jeff Scovil.**

Figure 9. **Fluorite crystals to 3.1 cm, from Dalnegorsk, Russia. Syntaxis specimen; photo by Jeff Scovil.**

Figure 10. **Boracite crystal group, 6 cm across, from the Boulby mine near Cleveland, Yorkshire, England. IKON specimen; photo by Jeff Scovil.**

missed or omitted, here's saying good-by from Denver. Time now to look forward to Tucson, which should be just on the verge of heating up by the time you read this. See you there!

Tom Moore
15 Lakeview Drive
Niantic, Connecticut 06357

Thank You & Goodbye

from

Cureton Mineral Company

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AGAIN, GOODBYE, AND THANK YOU.

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WEW

Letters

CORNWALL

It is high time that an article on the geology and mineralogy of Cornwall appeared in *The Mineralogical Record*, and I am delighted to see the splendidly illustrated contribution by Peter Bancroft and Sam Weller in the issue for July-August 1993. Some of the illustrations are credited to the "Royal County Museum of Truro." This should read the "Royal Cornwall Museum," until a few years ago known as the County Museum & Art Gallery, a private museum administered by the Royal Institution (not Institute) of Cornwall. The "Medieval deer antler mining Pick" (Fig. 2) is far more likely to be Bronze Age and is one of several implements in our museum which merit carbon-14 dating.

The three lions of England (leopards in heraldic terms) which embellish the opening page of the article are clearly smiling. No doubt this is because they were chosen in preference to the Arms of Cornwall, a county where "Cornish loyalists," as the authors state, regard England as beginning at the Devon border. Cornwall uses on its shield the Arms of the Duchy of Cornwall, fifteen bezants (golden roundels) on a sable or black background.

In Table 1, page 282, I should like to add the name of **James Wickett** (23 Nov. 1841–12 Nov. 1921), whose extensive collection of Cornish and other minerals was presented to the Royal Institution of Cornwall in 1922. Wickett was on the board of directors of the Tincroft mine, confidential agent to Messrs. Williams, Foster & Co., copper smelters, and in 1880 joint founder of Abbott & Wickett, mining stock and shares brokers at Redruth. He was largely responsible for opening up mines in the Malay Straits and at his death was Chairman of seven Straits properties. For that reason his mineral collection is very rich in cassiterite from many parts of the world, but particularly from the Malay Straits. From the point of view of size and quality, his collection is eclipsed only by that of Philip Rashleigh (1729–1811) in whose honor the Rashleigh Gallery has been named.

Of necessity the treatment of Cornish mining history by Bancroft and Weller had to be very short, but I must expand on a few points they make which I feel are wrong or misleading. It is not true to say that "tin ores are not found in Egypt." Cassiterite deposits, including placers, were found at Igla and Abu Dabbab in economic quantities in the early 1940's (A. H. Sabet, V. Chabanence and V. Tsogoev, 1973, "Tin-tungsten and rare-metal mineralization in the central eastern desert of Egypt," *Annals of the Geological Survey of Egypt*, **3**, 75–86). It is true, however, that they were unlikely to have been known in antiquity.

The source of tin used in Near Eastern civilizations, including Pharaonic Egypt, remains a mystery. In my *Tin in Antiquity* (1986, Institute of Metals) I stuck my neck out in favor of Uzbekistan, where there is historical and archeological evidence for tin production and mining by the 10th century A.D., with the possibility of prehistoric working here and elsewhere in known deposits in central Asia. The area is huge and remote, but no more remote than Badakhshan in Afghanistan from where lapis lazuli reached Neolithic Egypt ca.

4000 B.C. A central Asian source would also account for the rare tin-bronze found in the Indus civilization.

So far as Cornwall is concerned, there can be no doubt at all that cassiterite was exploited from the beginning of the Bronze Age in Britain, ca. 2000 B.C. A good number of bronze artifacts have been recovered from alluvial deposits in the county, including flat axes of the Early Bronze Age, as well as cassiterite pebbles from Bronze Age settlements, notably at Trevisker in St. Eval parish. The most impressive find was a Middle Bronze Age pin with amber setting (now in the Bristol City Museum) dug up from a depth of 10 fathoms (60 feet) in about 1795 "at the bottom of a mine near the River Fowey . . . where a new work was begun for searching after tin ore" (Philip Rashleigh, 1796, *Archaeologia,* **12**, Plate LI, Fig. 8). Rashleigh did not give the precise locality of the find, but only one tin stream in Cornwall was that deep: Middleway, St. Blazey, near the south coast about a mile inland from the present Par harbor. A Middle Bronze Age rapier was dug up by tin streamers from a depth of 40 feet in the same area in 1796.

Even allowing for the silting up of coastal valleys in recent centuries, the above finds emphasize the great depth to which prehistoric tinners would go to reach "the tin ground," as it was called. It is not correct to imply that alluvial tin in workable quantities occurred "at grass roots and in stream beds." Surface or near-surface tin there was. Such "shoad tin" is not known to have been worked for its own sake. Rather, as Norden wrote ca. 1584, it was a "means to direct to the place of profite [i.e. to tin lodes], as the smoake directeth where the fire lurketh."

I have found no evidence that alluvial tin occurred "in stream beds," a misconception which arose because of the vast amount of fine cassiterite which escaped the dressing floors of the lode mines in the 19th century and was carried downstream. This was recovered by a different kind of tin streaming operation along the lengths of valleys and even from washing beach sands. Tin streaming in the traditional sense, as carried out throughout prehistory and later history including the Second World War, was opencast mining. The alluvial tin deposits were always covered by barren sediments. In moorland depressions the tin ground commonly lay at a depth of 10 to 15 feet, but up to 30 feet in Roche parish. In valley bottoms near the sea it lay at 15 to 30 feet, sometimes more as indicated above. At Pentewan in 1852 in the Wheal Virgin tin streamworks (about 2 miles from the south coast) a wooden shaft was discovered about 15 feet deep, its top being about 10 feet below the present surface. At its bottom was a Bronze Age spearhead (now in the Penzance Museum) and a "chisel" (probably part of a now-lost rapier blade). The shaft was filled with sand, clearly abandoned after an inundation of the sea in Bronze Age times, an occurrence which even happened on more than one occasion in Cornish tin streamworks in the late 18th and early 19th centuries A.D.

As for the possibility that "as early as the third millennium B.C. Phoenicians or other explorers discovered and worked alluvial tin deposits," there is no evidence whatsoever. All archeological evidence indicates that tin working lay in the hands of the native inhabitants, as indeed it did throughout the Romano-British period when there is only scant evidence to show that the Roman authorities displayed more than a passing interest in how the locals conducted their business.

What evidence exists for Mediterranean contacts shows that tin was transported during the pre-Roman Iron Age from Cornwall via the Bordeaux area to Massalia (Marseilles), a Greek colony founded ca. 600 B.C. Nothing Phoenician has ever been found in Cornwall (despite many claims to the contrary), nor elsewhere in northern Europe. The Phoenicians did not colonize southern Iberia until ca. 700 B.C., and since their colonies were close to the southern end of the Iberian tin-belt, there was no point in their trekking so far as Cornwall. For this and other reasons, Chapter 21 of my *Tin in Antiquity* is titled "The Phoenician Myth." The time for the Phoenician ghost to be laid to rest has long since passed.

A more youthful ghost which refuses to be exorcized is that the arsenic industry in Cornwall and Devon thrived in combatting the Mexican boll weevil. As Bancroft and Weller point out, the boll weevil did not reach the United States until 1892. What is not generally realized is that experiments using arsenic to combat the pest did not begin in earnest until 1915–17, and the use of arsenic only increased rapidly after the huge infestation of cotton crops in 1920. British arsenic exports to the United States stopped in 1917. It was the rapid spread of the Colorado beetle across the United States which brought about the most important use of arsenic compounds as an insecticide from the late 1860's down to the First World War. For further reading on this chapter of Cornish mining see Roger Burt (1988), "Arsenic—its significance for the survival of south western metal mining in the late nineteenth and early twentieth centuries," *Journal of the Trevithick Society,* no. 15, p. 5–26.

Roger D. Penhallurick
Royal Cornwall Museum
Truro, Cornwall

ANTIQUE BOXED SPECIMEN SETS

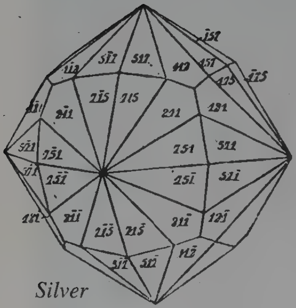
In response to Renato and Adriana Pagano's request for information (*Mineralogical Record,* **24**, 319) on a boxed set of minerals, I can give some information on the origins of that supplied by Thomas Russell and also on that supplied by Russell and Shaw now in the Rand Afrikaans University collection previously queried by Bruce Cairncross (*Mineralogical Record,* **23**, 445). But before I offer the information at hand on Russell may I make a plea for more? I have been researching early British mineral dealers for many years now ("early" covering the 200-year period 1750–1950, before which there were almost none and after which one encounters laws of libel . . .), with the intention of publishing a full catalog of names and potted biographies, and would be *very* interested to receive any information—or knowledge of the whereabouts of such information—however apparently trivial, on any of these men (and the occasional woman). I am particularly anxious to acquire copies or originals of labels (especially *dated* labels, so that a chronology can be built from label style to label style for the same dealer), copies or transcripts of correspondence to and from dealers, advertising matter or catalogs, and details of significant specimens acquired from British dealers by exchange or sale to foreign collectors or institutions. But, on to Mr. Russell:

Thomas Douton Russell established a dealership in natural history items in 1848. He was not a specialist mineral dealer, although minerals were undoubtedly an important part of his trade, but described his shop as "The Natural History Stores," and sold from it (according to an advertisement in *Nature* in 1869) "Geology and conchology . . . [and] British Natural History collections." In later ads more detail was given, e.g. in 1874: "Shells, Corals, Zoophytes, Annelids, Crustacea, Echinoderms, Minerals, Fossils, Rock Specimens, Microscope objects &c." In different ads the proprietor described himself variously as a "Geologist and Microscopist" or "Mineralogist &c." He occasionally addressed his ads "To Mineralogists" and went on to offer "select Minerals," but the species offered were relatively common and usually available priced by the dozen specimens. The impression thus is given more of a supplier of a wide range of good quality educational material, and of collector's and researcher's equipment rather than fine "cabinet quality" collector's specimen material, although some may have been stocked.

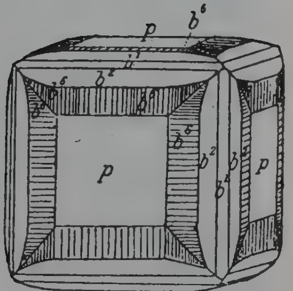
In 1884, Russell exhibited at the International Health and Education Exhibition held in London's Royal Albert Hall. He was awarded a medal for his collections of geological specimens, which presumably were varieties of the boxed sets mentioned by your correspondents. (Further details of the dealers involved in this exhibition may exist in the original main exhibition catalog and reports of the competition juries, but it has so far proven impossible to track down copies through the Inter-Library Loan service in British libraries. Anybody have one or both??)

Russell operated from a series of addresses in and around what has been described as London's "Natural History District"—i.e. the area around Covent Garden from Bloomsbury (home to the British Museum) to the Strand.

(Continued on p. 77)



Silver



Argentite

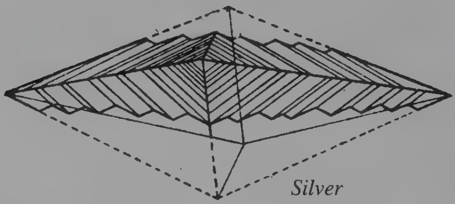
15TH ANNUAL FM-TGMS-MSA MINERALOGICAL SYMPOSIUM

SILVER

15th ANNUAL MINERALOGICAL SYMPOSIUM

10:15 A.M. – 3:00 P.M.
Saturday, February 12, 1994
Copper Ballroom
Tucson Convention Center

10:15-10:20	Introductory remarks—Symposium Chairman Richard W. Graeme
10:20-10:45	Geology of Silver Minerals Mark D. Barton, Terry C. Wallace & Frank Mazdab
10:45-11:10	Silver-Bearing Minerals of the High-Temperature Carbonate-Hosted Pb-Zn-Ag-Cu-(Au) Deposits of Northern Mexico Peter K. M. Megaw
11:10-11:35	Silver Minerals of Las Chispas Mine, Arizpe, Sonora Terry C. Wallace
11:35-12:00	Arizona Silver Les Presmyk
12:00-1:00	Lunch break
1:00-1:25	The Tetrahedrite Zoo and the Tetrahedrite Bestiary: Possible, Impossible, and Improbable Endmembers Mary L. Johnson
1:25-1:45	Silver Minerals from the F. John Barlow Collection Bill Smith
1:45-2:10	Szenicsite, a new mineral from Tierra Amarillo, Chile Carl E. Francis, Lawrence C. Pitman, and David E. Lange
2:10-2:35	The Silver Mines of Yankee Boy Basin, Ouray, Colorado Tom Rosemeyer
2:35-3:00	The Mineralization Pattern of Clear Creek and Gilpin Counties, Colorado Ed Raines



Silver

INTRODUCTION

On Saturday, February 12, 1994 the 15th Annual Tucson Mineralogical Symposium will be held in conjunction with the 40th Annual Tucson Gem and Mineral Show. This event is jointly sponsored by the Friends of Mineralogy, The Tucson Gem and Mineral Society and The Mineralogical Society of America. Native silver and silver-bearing minerals are the featured minerals for the 1994 show and, as is traditional, the theme of the symposium. Departures from the theme, while uncommon, are permitted when an individual is willing to present a paper on a current, important topic such as the paper on the new mineral szenicsite to be given at this function.

Silver-bearing minerals are widely distributed, particularly in base metal deposits throughout the world. In spite of this wide distribution, only a small number of the more than 100 such species can be considered common. The intent of this symposium is to look at the mineralogy of the silver-containing species, the controlling geologic environment in general, detailed characteristics of several important silver-producing provinces or deposits. Minerals of interest to the collector are also to be discussed. In all, this program will present a cross-section of technical aspects of these popular minerals, as well as a look at the silver minerals in one of the more important private collections.

Figure 1. Proustite crystal group, 6 cm across, from the Hartenstein mine, near Aue, Erzgebirge, Germany. Ben de Wit specimen.

Figure 2. Tetrahedrite crystals to 2 cm from the Daly-Judge mine, Park City, Utah. Chuck Turley specimens.

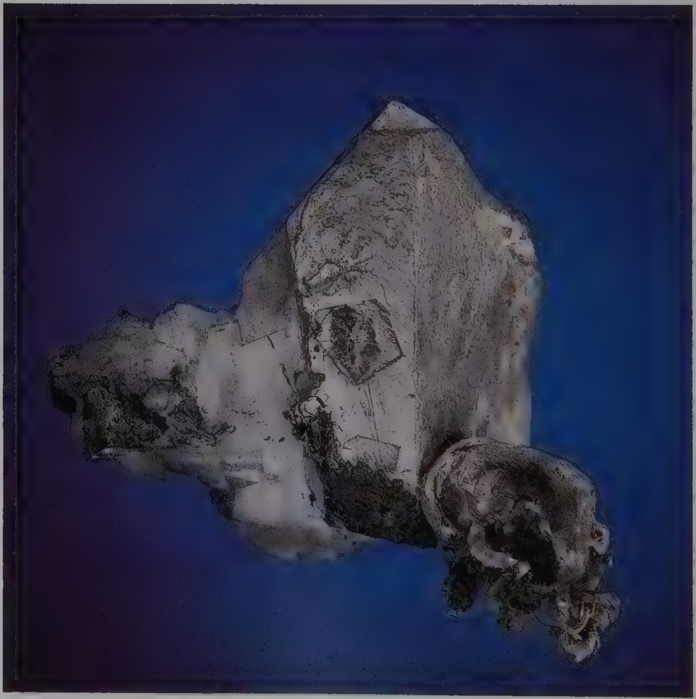
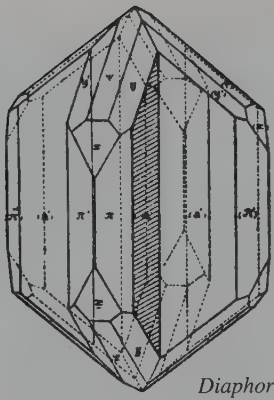


Figure 3. The famous Kongsberg silver twin, 3.5 cm, collected in 1884. Norwegian Mining Museum, Kongsberg, Norway. Photo by Harold and Erica Van Pelt.

Figure 4. Silver crystal group, 9 cm across, from the Wolverine mine, Michigan. Collection of the late Don Pearce.

Figure 5. Pyrargyrite crystal group, about 9 cm across, from Johanngeorgenstadt, Germany. Collection of the State Museum for Mineralogy and Geology, Dresden. Photo by Harold and Erica Van Pelt.

Figure 6. Pyrargyrite crystal, 5 cm, from Fresnillo, Zacatecas, Mexico. Although backlit only at the top in this photo, the crystal is equally gemmy throughout. Gene Schlepp specimen.



Diaphorite

Geology of Silver Minerals

Mark D. Barton, Terry C. Wallace, and **Frank K. Mazdab**
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Tucson, Arizona 85721

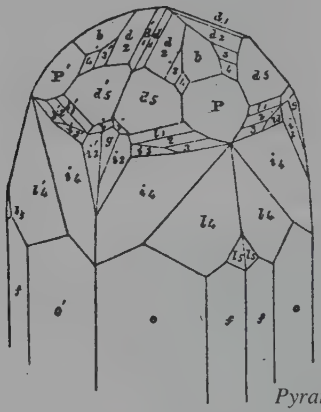
Silver is widely distributed in nature, occurring in the crust of the earth at concentrations of about 80 parts per billion. Discrete silver minerals are restricted to a few types of deposits, generally those formed by hydrothermal processes. Silver minerals form by both secondary (weathering or supergene) and primary (hydrothermal or hypogene) processes. In supergene processes, descending groundwaters cause the oxidation of primary silver-bearing minerals commonly leading to the formation of silver minerals such as native silver and chlorargyrite (and other silver halides). Much wire silver forms by this process. In hypogene processes, silver is concentrated in hydrothermal fluids which can form several distinct types of deposits. Most silver minerals, particularly the better crystallized examples, form by hydrothermal processes.

Although there are over 100 mineral species that contain silver as a necessary constituent, most are rather restricted in their distribution. To understand the distribution of silver minerals it is convenient to divide them into several classes: (1) native metals and alloys, (2) simple sulfides and tellurides (e.g., acanthite group), (3) lead-poor sulfosalts (e.g. stephanite, proustite, pyrargyrite, miargyrite, polybasite), and (4) lead-bearing sulfosalts (e.g., andorite, diaphorite, freieslebenite).

Silver is a minor constituent in many base-metal deposits. For example, much silver is produced as a byproduct of porphyry copper deposits, where it is present as a minor constituent in chalcopyrite. Extensive silver production from many kinds of Pb-Zn deposits (sedimentary and volcanic massive sulfides, Mississippi Valley type, high-temperature veins and carbonate replacements) comes from the recovery of trace amounts of silver that are incorporated in minerals such as tetrahedrite, galena and sphalerite. Minor acanthite and silver sulfosalts are present in only a few deposits, whereas native silver and chlorargyrite can be prominent in supergene ores (as at Broken Hill, Australia).

Silver-mineral-rich deposits can be broadly classed into volcanic-related "epithermal" deposits (the classic deposits of the American Cordillera, such as Guanajuato, Comstock Lode, Potosi) and native silver-rich ores of the Cobalt-Kongsberg type. The epithermal deposits occur primarily in regions of Cenozoic magmatism and are commonly mined primarily for their silver (and gold) contents. Andesitic to rhyolitic volcanic rocks host quartz-carbonate-rich veins in which silver generally occurs in acanthite and the lead-poor sulfosalts. Associated sulfides typically are pyrite and sparse base-metal sulfides, rarely tin minerals as in the famous Bolivian occurrences. The base-metal-rich examples of these deposits contain more complex Ag-Pb-Cu-Sn sulfosalt minerals. Geological and geochemical data indicate that these deposits form as the result of circulation of groundwaters driven by magmatic heat near volcanic centers with minor contributions from the magmas themselves. Cobalt-Kongsberg type deposits tend to be associated with mafic or carbonaceous rocks and have a very different mineralogy—native silver is the most common mineral; associated minerals are nickel and cobalt arsenides and sulfides, pyrrhotite and pyrite. The origin of these deposits is enigmatic, although it is clear that they too are hydrothermal.

The contrast in silver mineralogy among the deposit types reflects difference in the availability of sulfur, semi-metals, and base-metals. Where base-metals (and sulfur) predominate, silver is dispersed in other minerals. Where sulfur and semi-metals are present, but base-metals are sparse (as in the epithermal systems) silver forms sulfides and "simple" sulfosalts (proustite, etc.). Where sulfur is sparse, even in the presence of semi-metals, native silver predominates, locally along with alloys such as dyscrasite. Likewise, during weathering of all types of silver-rich deposits, sulfur is removed and base-metals are sequestered in supergene minerals, freeing silver in its native state or making it available for incorporation into halides such as chlorargyrite.



Pyrargyrite

Silver-Bearing Minerals of the High-Temperature Carbonate-Hosted Pb-Zn-Ag-Cu-(Au) Deposits of Northern Mexico

Peter K. M. Megaw
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P.O. Box 65538
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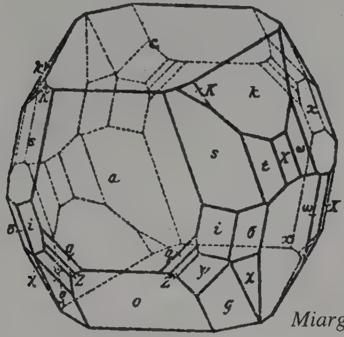
Northern Mexico contains a large number of high-temperature, carbonate-hosted Ag-Pb-Zn-Cu-(Au) deposits, including the famous "replacement" deposits of Santa Eulalia, Mapimi, and Los Lamentos, the major skarn deposits of Naica, San Carlos, Concepcion del Oro, and San Martin, and the carbonate-hosted veins of Fresnillo. These districts collectively account for a significant percentage of Mexico's overall silver production. All have produced suites of minerals of interest to collectors, but with notable exceptions, only a few aesthetic silver species. Most of the silver species occur as poorly crystallized intergrowths in massive oxide or sulfide ores, and many have only been found in polished petrographic sections.

Before 1925, most of these mines, and many of the less economically important deposits, produced oxidized ores dominantly consisting of argentiferous cerussite with subordinate chlorargyrite, bromargyrite and iodargyrite. Native silver and secondary acanthite was locally common in these ores. Argentojarosite has been identified only at Santa Eulalia, but was probably also common in the other deposits.

Microcrystals of all of these were probably once plentiful, but thorough extraction over the last 400 years has left little high-grade material for the collector.

Significant sulfide production began in about 1925, and since then primary ores, dominantly composed of argentiferous galena, sphalerite, arsenopyrite, chalcopyrite, pyrite and/or pyrrhotite with minor sulfosalts have dominated. Acanthite pseudomorphs after argentite are common as are native silver, pyrargyrite and proustite. Polybasite and stephanite are known from several districts whereas argentopyrite, pearceite, matildite, bohdanowiczite and miargyrite are known from single localities. Good macrocrystalline and microcrystalline specimens of many of these minerals are available, as well as associated sulfides and sulfosalts including: bournonite, boulangerite, enargite, freieslebenite, jamesonite and tetrahedrite-tennantite.


Miargyrite

Silver Minerals of the Las Chispas Mine, Arizpe, Sonora

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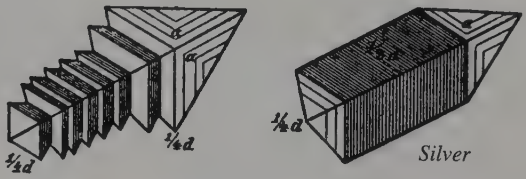
In 1640, soldiers under the command of Pedro de Perra discovered a system of veins rich in silver in the Valley of the Rio Sonora, near the future town of Arizpe. One of these veins, the Las Chispas, was extensively mined between 1880 and 1930, and produced what are arguably the world's finest stephanite and polybasite specimens. Polybasite crystal groups in excess of 65 pounds, and individual stephanite crystals 7 cm wide, were collected. The Las Chispas mine also produced some exceptional acanthite crystals.

The Las Chispas vein is hosted by a felsic porphyry and overlying rhyolite. The vein is primarily quartz and the mineralization consists of pyrite, silver sulfides and sulfosalts, and occasionally chalcopyrite. Silver mineralization within the vein shows strong secondary enrichment; ore minerals grade from chlorargyrite and silver at the top of the vein to pyrargyrite at depth. Although the vein had an average width of 4 feet, it occasionally widened to 20 or more feet; in these wide sections open vugs were common, and this is where the large crystals were found. The silver mineralization is concentrated in these *mantos*, and much of the rest of the vein is totally barren. The system is very antimony-rich, and arsenic appears to be largely absent. Pearceite is reported from the Las Chispas mine, but every specimen labeled pearceite which has been X-rayed by the author is polybasite (one sample was antimonpearceite). It is very common for acanthite and silver specimens to have a matrix of polybasite. The only other mineral of interest to collectors is fluorite. Many of the polybasite specimens have an outgrowth of pale colored fluorite, which is very distinctive and diagnostic for the locality.

The stephanite crystals from the Las Chispas mine are invariably of two habits. Most crystals are short, thick, pseudo-hexagonal prisms formed by a combination of the basal plane, *c*{001}, with the prism, *m*{110} and the pinacoid *b*{010}. This habit shows radial striations corresponding to twinning. The second, less common habit consists of elongated pseudo-hexagonal prisms, occasionally reaching 5 cm in length. The polybasite also is found as short pseudo-hexagonal prisms. Occasionally these prisms reach 12 cm across.

The production history of the Las Chispas mine is mixed; it was interrupted by revolution, strikes and seizure. The total silver produced probably did not exceed 20 million ounces of silver, but it must be considered one of the "classic" localities owing to its production of fine mineral specimens.



Silver

Arizona Silver

Les Presmyk
610 S. Bay Drive
Gilbert, AZ 85234

Although Arizona's mining history is synonymous with copper, the metal that first supported mining in Arizona was silver. Arizona has produced 525,000,000 ounces of silver, mostly as a by-product of copper mining. In 1991, for example, Arizona ranked fourth in the United States for silver production and there was not one operating silver mine. The mines of interest to the collector are the high-grade, bonanza type deposits with limited production. Most of these were mined from 1875 to 1920 and did not have the benefit of geologic and mineralogic examinations. There are two notable exceptions, those being the Silver King mine, near Superior, and the mines of Tombstone. This presentation will deal with the general history and importance silver mining has played in Arizona, as well as a cursory glance at some of the more notable specimen occurrences.

The exploration of Arizona began with tales of riches of silver and gold. Like the believers in the Peralta gold and Lost Dutchman today, the Spanish followed the legends of the Seven Cities of Cibola into Arizona and New Mexico some 400 years ago. As the Spanish influence diminished, and without finding any of the legendary riches, very little mining took place until the mid-1800's. At that time, most of the attention was focused on California with the gold rush of 1849. Only after miners, prospectors, and explorers realized their fortunes lay elsewhere, did they begin to examine the Arizona territory in earnest.

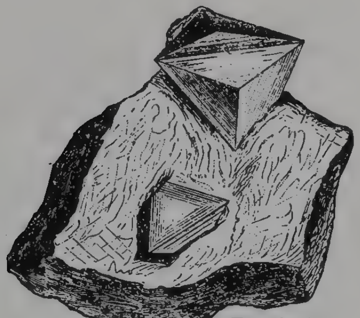
The territory was pretty much the domain of the various Indian tribes, including the Apache, Papago and Pima. As settlers moved into Arizona and New Mexico, conflicts and transgressions were inevitable. It was not until after the Civil War that the United States could send manpower and resources into the Arizona–New Mexico territory to subdue the Indians.

Ajo has the distinction of being the earliest exploited mineral deposit in Arizona. The rich outcrop was certainly inviting, but what the prospectors mistook for *silver glance* (acanthite) turned out to be *copper glance* (chalcocite). Once they became better educated, they moved on to deposits that actually contained silver. The first area of real silver mining activity, in about 1855, was south of Patagonia in Santa Cruz County at the Mowry mine. Colonel Sylvester Mowry, discoverer and owner of the mine, was suspected of being a Southern sympathizer and the rich silver mine was confiscated by Union troops.

By 1875 the various Indian tribes had been subdued, thus allowing miners and prospectors to begin diligent work. The rich, near-surface deposits they discovered include the Silver King and Silver Queen (Magma) mines in Pinal County, Richmond Basin north of Globe and McMillanville, both in Gila County, the Tip Top mine in Yavapai County, the Cerbat Mountains in Mohave County, and the Santa Rita Mountains in Pima County. Each of these mining districts had their heyday but none lasted for much more than 15 years as a silver producer.

One additional area that deserves mention is the Silver district in Yuma County. Even though this is some of the harshest and most inhospitable terrain in Arizona, a water supply and the ability to ship supplies and concentrates was assured by its close proximity to the Colorado River. Today these mines are much more famous for other secondary minerals, such as wulfenite, vanadinite and cerussite.

Due to the richness of the ores, there was certainly a multitude of fine specimens produced. Unfortunately, the remote nature of most of the mines did not allow for access by persons interested and very few pieces have survived. Some of the more notable localities for native silver are the Silver King mine, the Stonewall Jackson mine at McMillanville, and Mineral Park. While silver sulfides and sulfosalts have been reported from a number of mines, only one crystallized acanthite specimen is known. Stromeyerite was an important, massive ore mineral at the Silver King and Magma mines. The most noteworthy oxidation minerals are wulfenite and vanadinite from the Red Cloud and Melissa mines.



Tetrahedrite

The Tetrahedrite Zoo and the Tetrahedrite Bestiary: Possible, Impossible, and Improbable Endmembers

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Pasadena, CA 91104

There are seven known endmembers in the tetrahedrite group of sulfosalt minerals, including the silver-rich species *freibergite,* $(Ag,Cu,Fe)_{12}(Sb,As)_4S_{13}$, and *argentotennantite,* $(Ag,Cu)_{10}(Fe,Zn)_2(As,Sb)_4S_{13}$. This mineral group is notable for the wide variety of elements which are stable in its structure, and has the potential to become an important geothermometer/geobarometer. However, because the tetrahedrite structure contains five different sites, all with variable compositions, the possible number of endmembers in the tetrahedrite group is far greater than the number of tetrahedrite species already named; and some candidates for new species may already have been described.

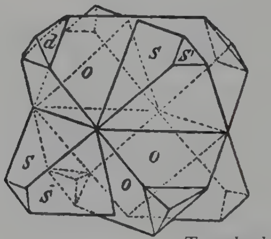
The formula for tetrahedrite-group minerals may be written as $M_{12}P_4X_{13}$, where M is a metal (cation), P is a semimetal in pyramidal coordination, and X is an anion (sulfur or selenium). The formula is sometimes also written $A_{10}B_2P_4X_{13}$, where A is a monovalent and B is a divalent cation. If sites are distinguished, the formula becomes $M_6^{IV}M_6^{III}P_4^{IIIp}X_{12}^{IV}X^{VI}$. There are six cations each in two distinct cation sites, and two distinct anion sites have multiplicities 12 and 1. None of the anions are clustered, and the charge on the cations and semimetals exactly balances that on the anions. A Brillouin-Zone model leads to the same charge balance for natural tetrahedrites as the ionic model.

Species designations are currently based on the elements which constitute the plurality of occupation in the combined M, the P, and the combined X sites. (*Tetrahedrite:* Cu,Sb,S; *tennantite:* Cu,As,S; *argentotennantite:* Ag,As,S; *freibergite:* Ag,Sb,S; *giraudite:* Cu,As,Se; *goldfieldite:* Cu,Te,S; *hakite:* Cu,Sb,Se.) Any hypothetical speciation scheme based on the plurality of monovalent or divalent atoms (greater than 5 Cu or Ag, greater than 1 Fe or Zn) is incorrect, as monovalent and divalent atoms correspond to no particular M site. However, implicit in the present speciation scheme is the assumption that atoms do not partition preferentially into one cation site relative to another, or into one X site relative to the other.

In the case of Ag versus Cu in the M^{III} and M^{IV} sites, this assumption is known to be false. Strictly speaking, the dividing line between tetrahedrite and freibergite should come at an occupation of 3 Ag in the M^{III} site, which Ag prefers; and another, more silver-rich species can exist at the point when the occupancy of Ag in the M^{IV} site exceeds that of Cu. The name *argentotetrahedrite* has been suggested for (Sb,S) tetrahedrites with extremely high silver contents.

Similarly, the X^{IV} and X^{VI} sites are quite distinct in number and variety of nearest neighbors; but I know of no study of partitioning of Se versus S in these two sites. Data on the unit cell sizes of intermediate (S,Se) tetrahedrites may be enough to distinguish between the $M_{12}P_4S_{12}Se$ and $M_{12}P_4Se_{12}S$ cases; in either case, intermediate species designations may be warranted.

Possible tetrahedrites proliferate when one considers the elements known to be found in the two different M sites, the P site, and the two distinct X sites. Looking only at the known plurality elements, 48 tetrahedrites are possible (Cu, Ag in the M sites; Sb, As, Te in the P site; S, Se in the X sites). More exotic possibilities exist: also present in the M sites are Fe, Zn, Hg, Tl, Cd, Mn, and □ (vacancy); the P site can contain Bi; the X^{VI} site could potentially contain halides or □, in analogy with synthetic compounds with the tetrahedrite structure. Charge considerations limit some possibilities for substitutions, especially for Te-bearing tetrahedrites, and consideration of atomic sizes makes certain other possibilities unlikely; but we can expect many more tetrahedrite-group minerals to be described in the future.



Tetrahedrite

Silver Minerals from the F. John Barlow Collection

Bill Smith
1731 Daphne Street
Broomfield, CO 80020

The mineral collection of F. John Barlow in Appleton, Wisconsin, includes a specialized sub-collection or suite of native silver and silver-

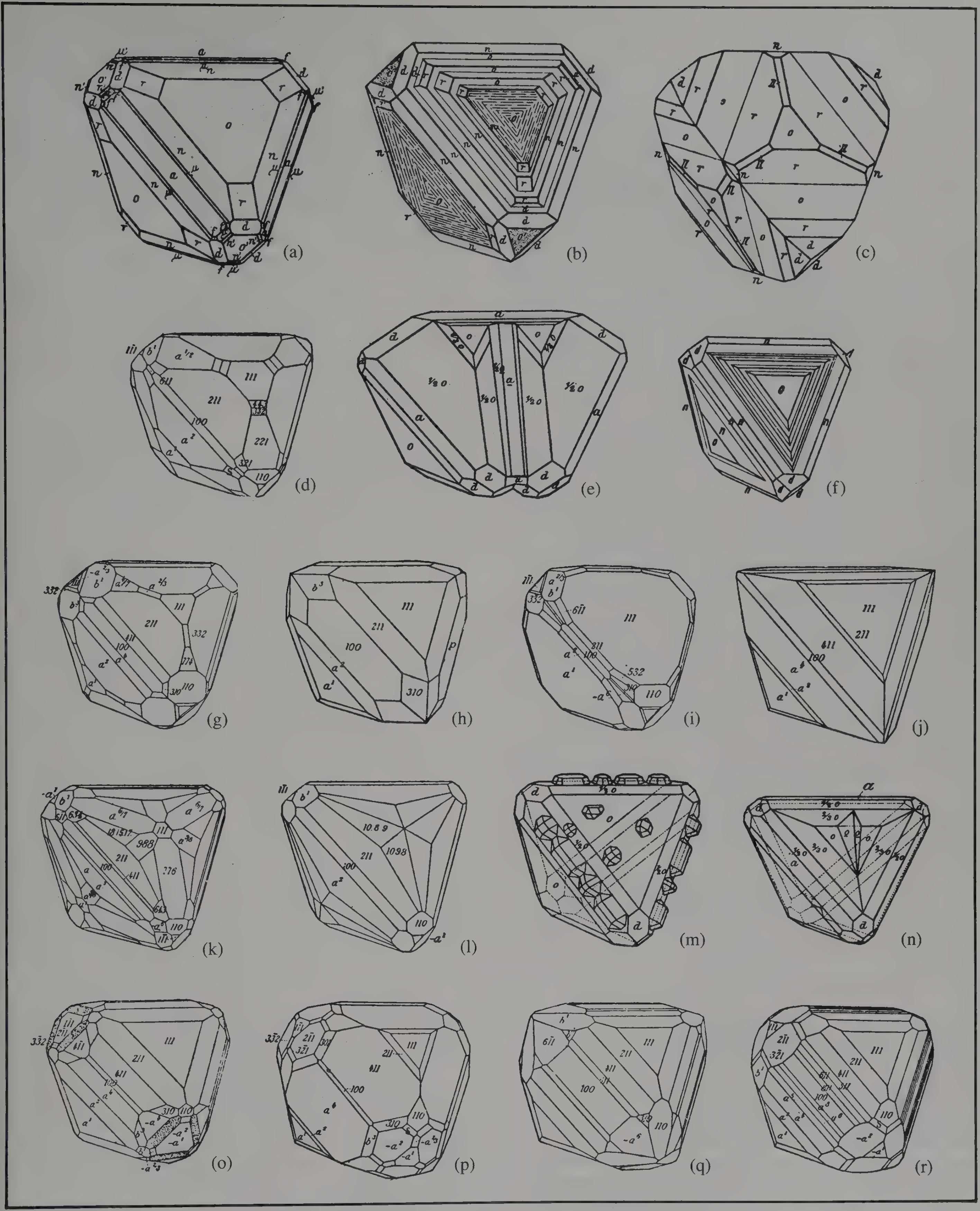


Figure 7. **Tetrahedrite-tennantite crystals from Botes, Romania (a, b, c); Urbeis, Alsace, France (d, g-l, o-r); Zilla near Clausthal, Germany (e, m, n); and Ruzsnyo, Hungary (f). From Goldschmidt's *Atlas der Krystallformen* (1916).**

containing minerals. This suite comes very close to representing all known silver species, many of them in very high-quality examples. Photographs of a number of notable specimens will be presented and discussed.

Szenicsite, a new mineral from Tierra Amarilla, Chile

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Szenicsite is a new copper hydroxyl molybdate from a mine near Tierra Amarilla, Atacama, Chile. Electron microprobe analyses of twenty points on two grains yielded CuO 56.25, MoO$_3$ 34.00, and H$_2$O 8.99 for a total of 99.24 weight %. H$_2$O was also separately determined by TGA. Normalizing to a single molybdate anion gives $Cu_{2.99}(MoO_4)(OH)_{4.11}$, which is in excellent agreement with the ideal formula, $Cu_3(MoO_4)(OH)_4$.

Szenicsite is orthorhombic, with unit cell parameters of a = 8.449(3) Å, b = 12.527(6) Å, and c = 6.067(1) Å; Z = 4, and space group *Pnnm*. The strongest X-ray powder (diffractometer) lines are [d in Å, (I)(hkl)] 3.759(100)(130), 2.591(67)(320), 2.773(57)(310), 5.057(48)(120), and 2.132(31)(400).

Szenicsite, a secondary mineral derived from the oxidation of primary bornite and molybdenite-2H, is associated with abundant green powellite and with chrysocolla, brochantite, hematite and quartz. The mineral occurs as dark green bladed crystals, lamellar on {100} and elongated parallel to [001], which are intergrown as radial aggregates about [001] resulting in lustrous, curved {010} faces. The dominant form is {100} with {010} common. Crystals are typically less than 1 cm, but the largest reach 3 x 1 x 0.1 cm. They occur both freestanding in cavities and as fracture fillings. The luster is adamantine; Mohs hardness is 3.5–4. The density is 4.26 g/cm^3 (meas), 4.30 g/cm^3 (calc). Optically, the mineral is biaxial positive with α = 1.886(2), β = 1.892(2), and γ = 1.903(2) and 2V (meas) = 74(3) deg, and 2V (calc) = 73 deg. X = b, Y = a, and Z = c. Dispersion is strong, with $r > v$. There is no significant pleochroism.

The mineral is named for its finders, Terry and Marissa Szenics. The mineral and name have been approved by the IMA Commission on New Minerals and Mineral Names.

The Silver Mines of Yankee Boy Basin, Ouray County, Colorado

Tom Rosemeyer
P.O. Box 586
Ouray, Colorado 81427

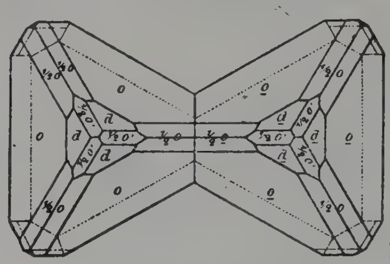
Yankee Boy Basin, situated at an elevation of 11,000 feet, is located 8 miles southwest of Ouray, Colorado, in the Mt. Sneffels mining district.

In the 1870's and 1880's, the basin was the scene of intense mining activity and promotions, with both miners and promoters hoping to make a small fortune on the newly discovered silver veins. Mines named the Minnie B, Circassian, Eldorado, Ruby Trust, Yankee Boy, and Black Diamond sprang to life. Most of the mines were short-lived, lasting only a few years, but a few lingered on until the silver panic of 1893 which shut the remaining mines down.

Sporadic activity was again resumed by leasors in the 1920's and 1930's but production was small. In 1986, a Utah mining group leased the Eldorado group of claims and an exploration drift was driven on the Eldorado vein. The drifting encountered two small silver-bearing orebodies which were mined and produced a variety of fine crystallized minerals.

The silver-bearing veins of the basin occur in Tertiary San Juan tuff and the Stony Mountain gabbro-granodiorite intrusion. The steeply dipping veins average about 60 cm in width and most have a general northwest trend.

Of interest to the mineral collector is the number of mineral species found that occur as well crystallized microcrystals. Ore minerals found to date include native gold, native silver, polybasite, acanthite, pyrargyrite, tetrahedrite, galena, sphalerite and chalcopyrite. The gangue minerals found in the veins are pyrite, marcasite, arsenopyrite, quartz, barite, rhodochrosite, kutnohorite, dolomite, siderite and calcite. Of special interest are the globular inclusions of pyrargyrite and tetrahedrite that occur in transparent crystals of quartz and barite.



Tetrahedrite

The Mineralization Pattern of Clear Creek and Gilpin Counties, Colorado

Ed Raines
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Patterns of hypogene mineral zonation in the precious metal deposits of Clear Creek and Gilpin Counties have been recognized since 1904 and have been successively refined since then. Each mining district exhibits certain similarities in the zonal pattern, although there are some striking dissimilarities from east to west across the two counties.

All of these deposits developed as part of the Front Range portion of the Colorado Mineral Belt. The minerals were emplaced as vein fillings in faults concommitant with several pulses of igneous activity 65 to 57 million years ago in the eastern area and 39 to 35 million years ago in the western districts.

In the eastern area the mineralized veins are zonally arranged. In the core areas the veins contain pyrite and quartz with little gold and no silver. Encircling the core zones are zones of pyritic copper veins (chalcopyrite and/or tennantite or arsenian tetrahedrite) with high gold content. Outside of these zones lie peripheral lead-zinc veins (galena and sphalerite with subordinate pyrite, chalcopyrite and tennantite-tetrahedrite). The silver minerals pyrargyrite and acanthite are locally common. Quartz and carbonates (mostly siderite and dolomite with minor rhodochrosite) form the gangue of the lead-zinc veins. In the outermost areas is a zone barren of metallic ores. Some of the veins in the eastern area are composite veins with their own internal zonation; the wall zone is distinctly pyritic whereas the central zone is either auriferous pyritic copper or argentiferous lead-zinc.

All of the veins in both counties show a sequence involving initial fracturing, followed by wallrock alteration, pyrite crystallization, and finally base and precious metal mineralization. In the western districts, however, the lead-zinc zone is better developed and silver was therefore the more economically important metal. Silver mineral species identified include silver, acanthite, jalpaite, polybasite/pearceite, proustite/pyrargyrite and pyrostilpnite.

Ed. Note: The crystal drawings accompanying these abstracts are taken from Goldschmidt's *Atlas der Krystallformen* for the purpose of illustrating general morphology. They do not represent specimens from the specific localities discussed here.

Many, probably most, of the important London dealers in mineralogy, geology, conchology, entomology and other natural history subjects operated in this district at one time or another, drawn here partly, perhaps, by the presence of the natural history departments of the British Museum (before their removal to South Kensington), partly by the social milieu.

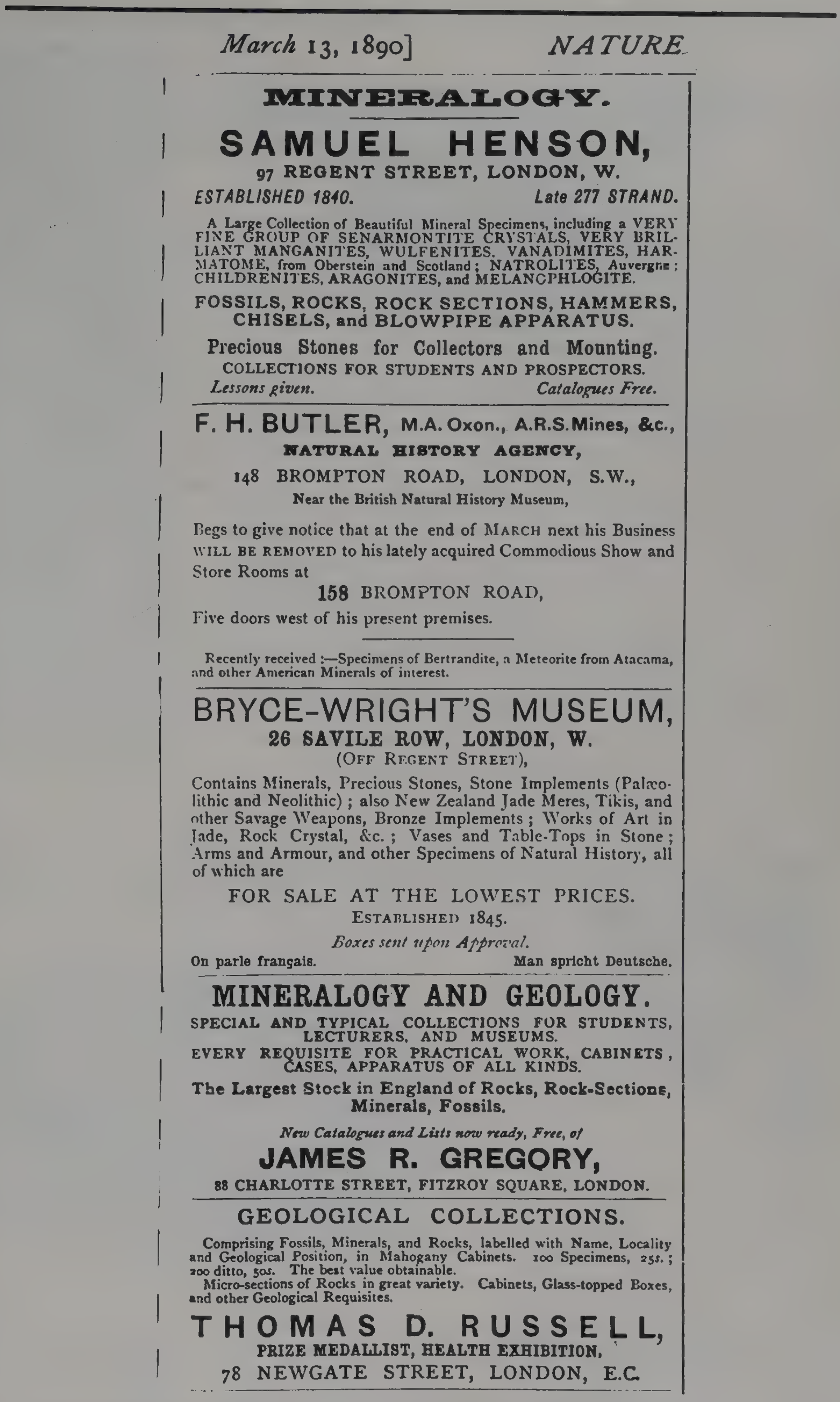
Russell moved east to 78 Newgate Street in 1884 and the business was still there in 1902 when Russell's name is replaced in that year's London Trade Directory (LTD) by that of **William James Shaw** at the same address. When the business became Russell & Shaw is unclear at the moment—Shaw may have been a manager rather than a partner at first, but this is just conjecture at present. Shaw removed to 11 John St., Bedford Row about 1907; he first appears in the LTD at this address in 1908. The entries in the LTDs for this period still give only Shaw's name, but specimen labels seen from this address are printed *Russell & Shaw*. However, there exist address labels on boxed sets of minerals printed *Thomas D. Russell* alone with the new 11 John Street address pasted over the old label. In the 1913 LTD the address changes again (to 38 Great James Street) and the entry is for Russell & Shaw. The last entry is in the 1924 directory.

Russell & Shaw was taken over by the old established firm of J. R. Gregory and Co. This was a continuation of one founded by **James Reynolds Gregory** in 1858. On his death it was carried on (becoming J. R. Gregory & Co.) by his son Albert L. F. Gregory. In 1932, E. Percy Bottley became a partner in this company and carried it on as Gregory, Bottley & Co. until 1981 when, on his death, it was bought by Brian Lloyd (once manager of mineral auctions at Sotheby's) and continues to operate as the well known Gregory, Bottley and Lloyd.

The Rand Afrikaans University box can therefore be dated, from the addresses on the labels, to the period 1907–1913 and the Pagano's to 1884–1902. And to round off this note, I enclose a copy of an advertisement for Russell's boxed sets taken from *Nature* and would like to take this opportunity to thank Mary Sheehan of *Nature* for generously allowing me to search through their back copies—the only set of which I know with the vital (to me!) ads bound in with the editorial matter.

Of the other, German (?) sets in the Pagano's collection I can only suggest that the stag beetle incongruously present in the mine in the illustration on the box lids is actually the manufacturer's trade mark. A search through German or Austrian trade mark catalogs may turn something up.

Michael P. Cooper
Nottingham, England



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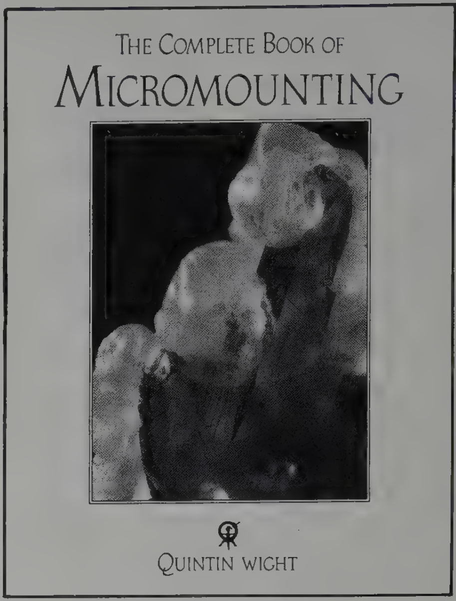
Regarding Lawrence Conklin's request for information on unfamiliar names of purchasers recorded in the bid book for the Dohrmann Collection auction in 1886 (vol. 23, no. 1, p. 10): "Beadle" immediately rang a bell. My collection of old geology textbooks contains a copy of Dana's *Manual of Geology* (1869) inscribed by dinosaur hunter Prof. O. C. Marsh to "the Rev. H. H. Beadle." According to Canfield (vol. 21, no. 1, p. 41–46), his father, E. R. Beadle of Philadelphia, had "a large collection. The specimens were said to weigh 15 tons"; the younger Beadle inherited the collection and presented it to Yale in 1916. So we may speculate that the purchaser at the auction (which took place in Philadelphia) in 1886 was E. R. Beadle. Another possible match on Canfield's list (for the buyer named "Lowe") is Leontina A. Lowe of Pasadena, California. Thank you for the opportunity to "play detective."

Prof. Michael Anthony Velbel
East Lansing, Michigan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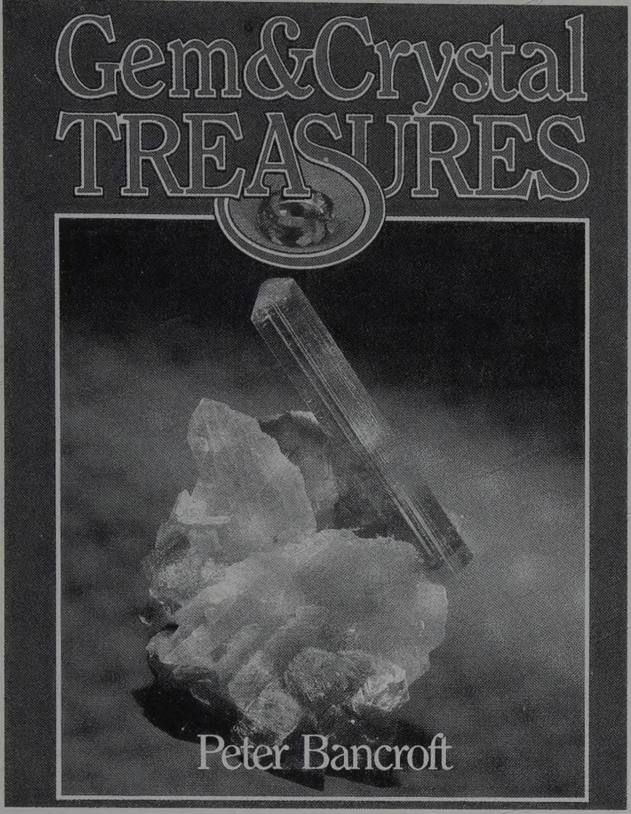

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