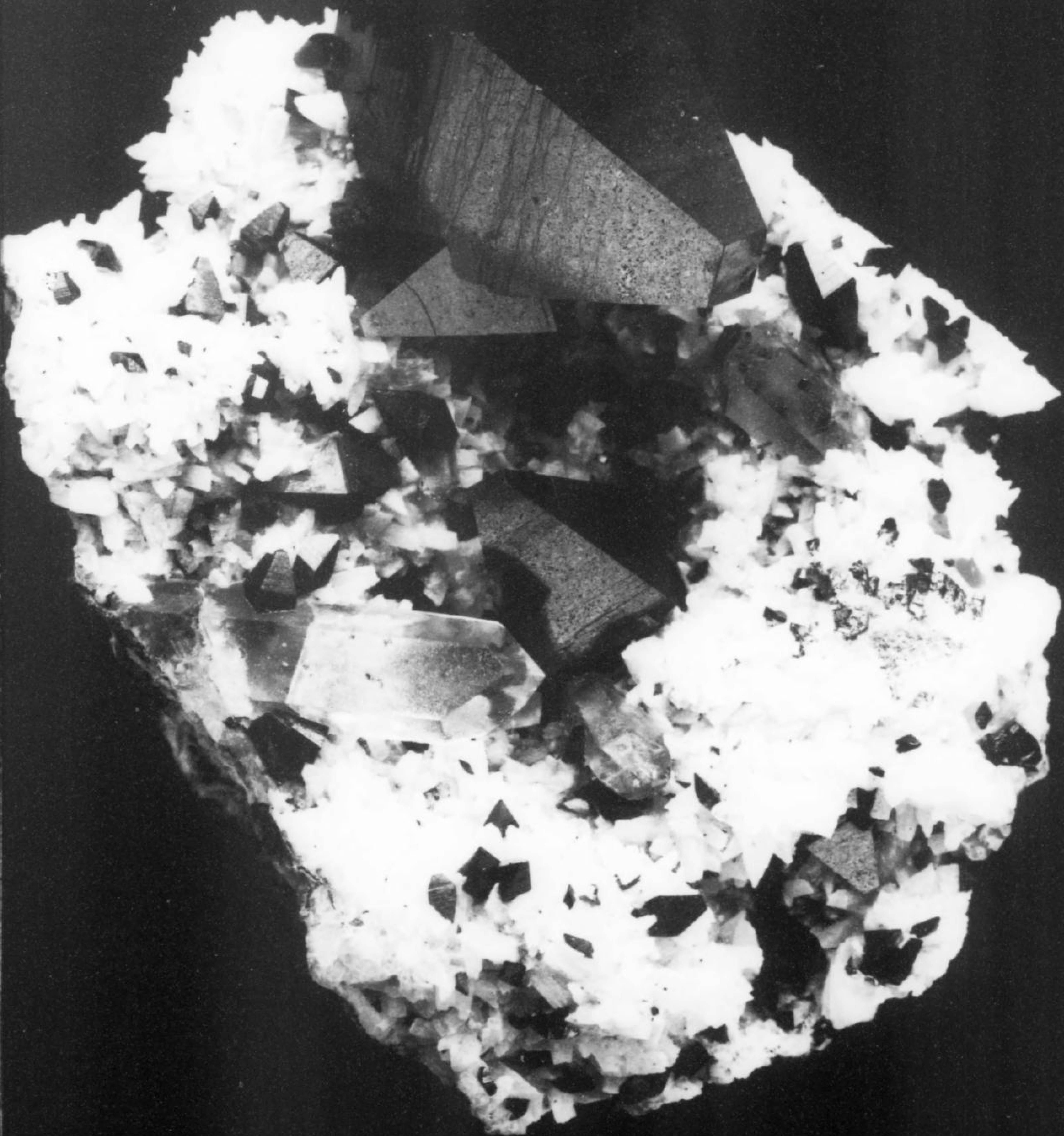
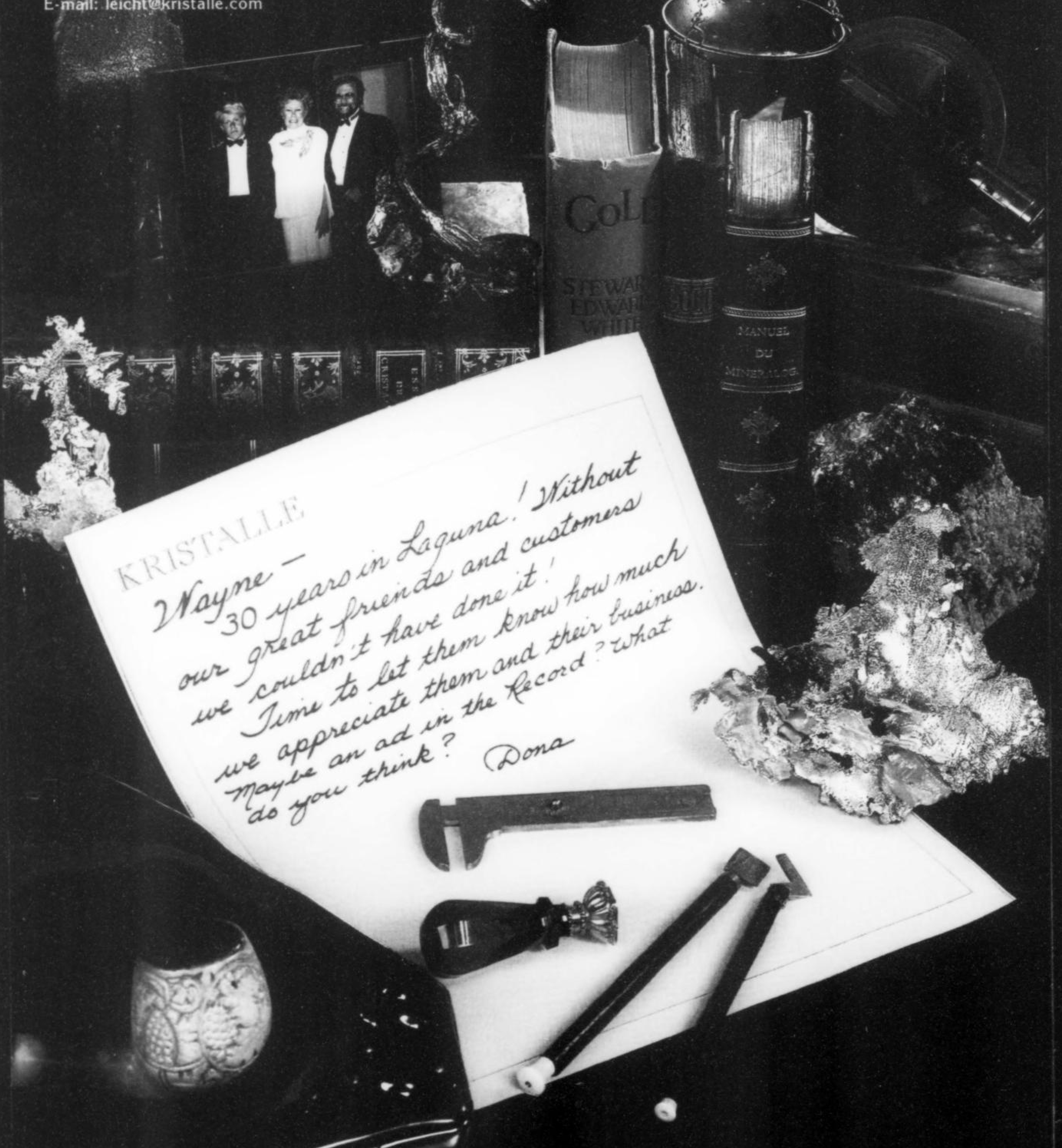
the Mineralogical Record

Volume Thirty-two, Number Four
July–August 2001
$12





GOLD
STEWART EDWARD WHITE
MANUEL DU MINERALOGIE

THE MINERALOGICAL RECORD

July–August 2001 Volume Thirty-two, Number Four

Articles

Columns

COVER: ANATASE with adularia, 4.2 cm, from the Valdres region, Norway. Steve Neely collection: Photo by Jeff Scovil.

Visit
our Website:
www.MINREC.org

The Mineralogical Record (ISSN 0026-4628) is published bi-monthly for $51 per year (U.S.) by Mineralogical Record, Inc., a non-profit organization, 7413 N. Mowry Place, Tucson, AZ 85741. Periodicals postage paid at Tucson, Arizona and additional mailing offices. POSTMASTER: Send address changes to: The Mineralogical Record, P.O. Box 35565, Tucson, AZ 85740.

Editing, advertising
4631 Paseo Tubutama
Tucson, AZ 85750
520-299-5274 • FAX: 520-299-5702
E-mail: minrec@earthlink.net

Subscriptions
(Subscriptions, back issues, reprints, book sales, shows)
P.O. Box 35565
Tucson, Arizona 85740
520-297-6709 • FAX: 520-544-0815
E-mail: minrec@aol.com

- **Individuals (U.S.):** $51 for one year; $96 for two years. (First-class mailing available; write to circulation manager for rates.)
- **Individuals (outside the U.S.):** $55 for one year, $99 for two years. (Airmail mailing available; write to circulation manager for rates.)
- **Libraries, Companies and Institutions (worldwide):** $150 for one year.

*Continued on p. 343

notes from the EDITORS

EDITORIAL: HELP FOR THE EDITOR

I'm told that in the Catholic faith there is a patron saint for just about every profession except politicians (they have no one to pray to, and it shows). Journalists, on the other hand, are blessed with *two* patron saints . . . because we need so much help.

Having been at my editorial post now for over a quarter of a century, I can testify that editors do need a great deal of help. I couldn't begin to count the number of times our associate editors have caught mistakes or provided keen insight when it was most needed. Our photographers, most frequently Jeff Scovil and Harold and Erica Van Pelt, have given their skill and time to beautify the magazine beyond measure. Our long-time typesetter, Carla Heath, is by now so knowledgeable about many aspects of mineralogy that she also serves often in providing editorial assistance, refinement and consistency. Our paste-up artist, Maggie Grabowski, maintains our huge storage files of color separations, advertisements, and typeset text while efficiently putting together complex layouts year after year. Our color-separation specialist, Lois Sorenson, has over 20 years of experience at meeting our particularly demanding color fidelity standards for minerals. Tony Kohn, our customer service representative for printing, always finds a way to give us high-quality printing of complex jobs, on time every time. And, of course, without my typist, Lynn Walsh, and our long-time Circulation Manager, Mary Lynn Michela (who has been with the Record even longer than I have!), our system would collapse into chaos. Without these hard-working people and the guidance of our excellent Board of Directors, the Record could not have survived in good health all these years.

Each year our faithful subscribers and advertisers, and our financial donors, most importantly Philip Rust and Randy Rothschild, provide us with the funds to produce approximately 500 pages (and sometimes more) of illustrated mineralogical reading written by a host of fine authors. Even with the invaluable cooperation of our editing and production team, it takes a tremendous amount of work to process those 500 pages to completion, to say nothing of our numerous other publications. Anyone who has tried to produce even a club newsletter at regular intervals will have an inkling of the challenges involved. Frankly, although your editor loves his job as much as ever, he's beginning to show a little wear around the edges after 25 years in harness. Bottom line: I could use some help in the editing department.

I am most delighted to announce that the long-needed help has finally arrived! Our show columnist for many years, Tom Moore, is joining the staff as a full-time editor (requiring that I inflate my own title to editor-in-chief). Furthermore, this addition to the staff will be accomplished without requiring any compensatory increase in the subscription price or the advertising rates.

Tom's talent for writing and editing is well known. He holds a Master of Fine Arts from Cornell University (in creative writing and contemporary fiction studies); he has taught college-level English courses for over 30 years, and has numerous publications to his credit (including a book on the novelist Thomas Pynchon which only fanatically serious literary critics can fathom). Still more to our purposes here, he holds a BS in geology from the University of Delaware, and his lifetime passion for mineral collecting has been expressed, not only by his work for the *Mineralogical Record*, but also by his eight years of teaching extension courses in mineralogy, and his assisting in curating the DuPont Collection at the University of Delaware. Finally, he has a working knowledge of German, which is going to prove very useful in researching information for articles in the extensive multi-language holdings of the Record Library.

Not only will Tom be assisting with most of the routine tasks involved in magazine and book production, he will also be helping to improve our service and our productivity to levels we could not previously aspire to. Ultimately it is our readers who will benefit most. I look forward very much to working with him.

W.E.W.

FROM THE NEW EDITOR

After such a fulsome introduction by the (new) Editor-in-Chief, I feel the need to say a few words as the (new) Editor.

For the past ten years now I have been coming regularly, at Wendell Wilson's request, to the Tucson and Denver shows to write those gabby show reports you've been reading. During those trips I have gained many valuable things—from dozens of first-rate specimens for my thumbnail collection, to timely relief from Connecticut winters, to the many, many new mineralogical friends and acquaintances I've made. Best of all, I've established a friendship with Wendell, one that feels good, being as it is firmly grounded in excellent personal chemistry as well as in many interlaced favors and kindnesses, all in the context of our mutual love of minerals and the *Mineralogical Record*. The way our respective interests and aptitudes dovetail will, I hope, yield practical benefits of many kinds for the magazine, now that we are to be two of its only three paid full-time staff members.

For me the association began in the mid-1980's, while I was encamped in the neighborhood of Kaiserslautern, Germany, teaching English courses for the European Division of the University of Maryland. When *Mineralogical Record* columnist Bob Sullivan gave up his "Letter from Europe," Wendell Wilson wondered in print who might be willing and able to replace him. More or less on a whim, I wrote a letter to Tucson. To my surprise, I soon received from Wendell a tentative marching order to "cover" the Ste.-Marie-aux-Mines show of 1986. The empurpled mineralogical and travel prose which followed for the next five years took readers to the Munich Show every year, to the Ste.-Marie and Bad Ems shows most years, on several one-time visits to other European shows, and on tours of Scandinavia and Czechoslovakia in 1990 and 1991 respectively. During these years of reportage it became necessary for me to expand my view, covering not just what interested me personally but what might be of interest to the *Record*'s diverse readership.

Then, as we know, certain thrilling things happened on the world political scene. Although I rejoiced, like everyone else, in the fall of the Iron Curtain, the end of Soviet Communism, the reunification of Germany, and the large-scale pullout of U.S. forces from Europe, I found also that these developments meant that my job was crumbling away. I and my family faced repatriation (and, for a while, unemployment) back in the U.S.: refugees from the end of the Cold War. It was an extraordinary boon to my spirits when, in these dark times, late in 1991, Wendell called me in Connecticut to invite me to Tucson, to see if I could write about the mineral world's show-of-shows. Since 1992 I have not missed a single Tucson show, and have missed Denver only once, and nearby Springfield only once—and *that* only because, in that August, I was in Colorado conducting research for my contribution to the

Sweet Home Mine Special Issue. Since living in Connecticut I have also done a piece about the Yale/Peabody Museum collection, and have returned to Europe to look into a mineral exhibition in Athens. On the side, Wendell meanwhile has been breaking me in, as it were, on copyediting, translation work, and book reviewing, and I have helped compile the 25-Year Index. Thus during these past ten years I've come to feel at home in, and welcomed by, the *Mineralogical Record* team and what Pete Dunn has called the "mineralculture" in general. Thank you all, for so kindly taking this refugee in.

Let me assure readers that I come to this job with no special agenda, no burning desire to change things that people have come to love about the *Mineralogical Record*. Nevertheless, like Wendell, I will always be interested to hear ideas, suggestions, compliments and complaints from readers; that is how a magazine stays in tune with its readership. Wendell will retain "final say" in overall editorial matters and will continue to handle business affairs and artistic duties (since I have *no* talents inclining me to such things as sketches, photography, layout, etc., although I'll struggle to learn such skills in good time). I for my part will do much editing and will handle much correspondence, will coordinate advertising, will frolic impressionistically in flowered meadows of Special Projects [I think he's looking forward to that part! W.E.W.], will travel, and will continue (of course!) to write major show reports. We anticipate a long and productive association turning out magazines.

By the time this appears, I will have completed my move to Tucson. Besides learning the job, my immediate and most interesting task, I image, will be to learn to handle the change of scene. I'll be switching from seascapes with sailboats, fish chowder, English Puritan remembrances, and sane air temperatures, to desert vistas with coyotes 'n' cacti, killer bees, red peppers and chimichangas, Spanish and southwest Indian imagery, and, yes, I'll be figuring out how to feel about that But-It's-A-Dry-Heat line I've so often heard about Tucson summers.

Looking forward to working with, and for, you all.

T.P.M.

MANDARINO ABSTRACTS

Joe Mandarino's abstracts of new mineral descriptions, published regularly in the *Mineralogical Record*, are growing into a valuable cumulative reference. For those who like to have them in a handy, collected format, we published five years-worth of abstracts a few years ago as a separate book, *New Minerals 1990–1994*. Recently, the Mineralogical Association of Canada expressed an interest in picking up the series from us, and we gave our permission. The result has just been published as *New Minerals 1995–1999*, 250 pages (Canadian Mineralogist Special Publication 4) ($20 plus $2 postage). **You can now order this book directly from the *Mineralogical Record***, and get a copy of the first volume (1990–1994, originally priced at $20) for **just $5** plus $1 shipping. Order from the Circulation Manager, P.O. Box 35565, Tucson, AZ 85750; VISA/MC Fax orders 520-544-0815, e-mail: minrec@aol.com.

MUSEUM FUND-RAISING

Here is a clever fund-raising technique being used by the Los Angeles County Museum of Natural History. It's called the "Adopt-a-mineral" program. Suppose you donate a specimen to a museum, and the staff finds it sufficiently significant to put on display (this alone is a tribute not only to your generosity but to your acumen in specimen selection). At most museums the label for the donated specimen will say "Donated by ________," giving your name to be immortalized forever in the hallowed halls of mineralogy (or, at least, for as long as the exhibit remains in place). Of course, there are always many fine specimens on display that were *not* received as donations. Now, instead of trying to find a specimen to donate that the museum really needs, you can pick one *already there* and retroactively become its donor. Just select a specimen on display* (which is not already associated with a donor), perhaps one that is especially meaningful for you, from a favorite locality or carrying a particularly rich history. The museum staff will then estimate its current market value. Then you can donate that amount in cash and, presto! You become the specimen's donor! The money is then used to buy more specimens, but your name remains associated with the one you picked. The better the specimen, the taller you stand in its reflected glory! This is a program that any mineral museum can easily adopt. The only requirement on the museum's part—and this is easily met—is to maintain accurate data on the specimen's original source as distinct from its later "donation," so as not to muddle the historical record for future researchers.

NOTICES

Died, Jessie May Hardman, 88. Many readers of the *Mineralogical Record* know of Jessie Hardman's passing on Sunday morning, June 25, 2000. The gem and mineral hobby lost a dear friend and dedicated participant when Jessie succumbed to pancreatic cancer. She had been diagnosed in the latter part of April and had been receiving hospice care at home. Jessie and her late husband, Harvey, became involved in minerals early in their marriage while on a trip to Mexico. They belonged to several gem and mineral clubs in Southern California including the Long Beach Mineral and Gem Society, Southern California Micro-Mineralogists, and Mineralogical Society of Southern California, and Jessie had held offices in each and every one of them. One of her fellow members recently said, "There wasn't a job that Jessie wouldn't accept."

Harvey and Jessie were avid mineral collectors. She was a frequent exhibitor at local, CFMS, and AFMS gem and mineral shows. Jessie loved trading thumbnail and micromineral specimens with folks around the world and traveled extensively during her lifetime. During her travels she visited many of the clubs overseas and made friends with their members. Jessie was one of the CFMS Podium People for many years, giving slide programs and presentations to member clubs based on her travels and extensive mineralogical knowledge.

Jessie worked as a Physical Education instructor in the Long Beach Unified School District, at Long Beach City College, and in the Long Beach Recreation Department for many years, teaching both women's and men's sports. She also was on staff at the Campfire Girls organization in Long Beach following her retirement. Jessie's involvement with teaching young people was a source of great gratification to her. Because of her love of teaching, her family feels it would be appropriate that donations in Jessie's memory be made to the CFMS Scholarship Fund.

In 1979, Jessie served as CFMS President. She received the Golden Bear Award in 1980. She was on the CFMS Museum Committee for several years, and was named CFMS Scholarship Honoree in the 1984–1985 year. Jessie was at one time Chairman of the CFMS Rules Committee and wrote the first CFMS Show Guidelines. Until the past couple of years, she served as a judge for CFMS and AFMS Shows. Jessie was the CFMS Honoree to the AFMS Scholarship Fund in 1993. Jessie served on the first AFMS Uniform Rules Committee and wrote the first *Exhibitor's Handbook*, along with many articles on judging and on Federation history.

---

*In the case of the LACM it must be a specimen that was initially purchased using funds supplied by their Gem & Mineral Council, sponsor of the fund-raising program. For more information visit the museum's website at http://nhm.org/~gmc/adopt.html

Jessie was inducted into the National Rockhound and Lapidary Hall of Fame in December of 1999.

Jessie's comprehensive collection has been given principally to the Los Angeles County Museum of Natural History Gem and Mineral Section, where she was a weekly volunteer for many years. Other friends and mineral groups, such as Southern California Micro-Mineralogists, also received some of her specimens. Recently the Museum dedicated their California Mineral Exhibit to her. She started volunteering at the Museum in the early 1960's. Jessie was a founding member of the Los Angeles County Museum's Gem and Mineral Council.

Beverly Moreau

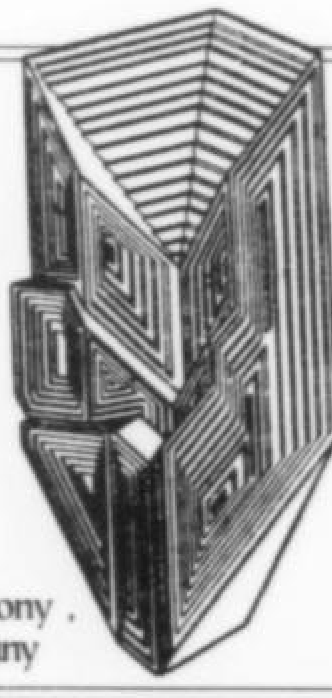
Died, Ingemar Johansson, 66, 24 March 2001 at Kopparberg, Sweden. He was born 8 September 1934 in Ramsberg and brought up in Kloten. His mineral interest took off from a chance find of chalcopyrite while on a family swimming trip in 1968. The rest is, as they say, history. He soon came into the circle of the Bergslagens Geologiska Sällskap (BGS), one of the first Swedish amateur clubs devoted to mineralogy and geology, where he has been active as chairman since 1972. In 1976, the BGS, under Ingemar's leadership, took the initiative to put on the Kopparberg show, the first mineral show in Sweden, an event which has become almost synonymous with Ingemar. The event is the number one Scandinavian mineral show, thanks in large part to Ingemar who, as the organizer and "chief ideologist," gave priority to mineral matters rather than peripheral fads and commercial bead-vendors. Via the show, but even more so as a private collector, Ingemar has had a great part in the "internationalization" of Swedish mineral collecting. Countless Scandinavian, European and other foreign collectors, mineral dealers and professional mineralogists have paid him a visit for advice, a swap or a friendly chat.

Above all, Ingemar was a hard-working Scandinavian field collector, combining the Swedish traditions of dump collecting and the Norwegian "off-road style" in his yearly 2 to 3-week summer collecting trips. The trips, prepared for by studying scientific geological/mineralogical publications and by following up new and old rumors, were often successful; the resulting material was used for exchange with fellow collectors inland and abroad. Eventually this led to the amassing of a systematic collection of 3,087 species, according to his last count in January.

For many of us young and eager "new-born" collectors, the door to Ingemar's home, especially *the* door to "the basement," was always generously opened to study his mineral collection and his ring-binders full of locality descriptions. If he wasn't off collecting or at a mineral show there was always a spare bed in his home and, especially during the field-collecting season, fellow collectors to team up with for visits to nearly classic localities such as Långban, Harstigen and Håkansboda. In this way, Ingemar's home has been a nursery/greenhouse for several of us in the Swedish mineral collecting community. The Kopparberg Show, "Kopparbergsmässan," taking place the last weekend before mid-summer, has for many of us become a yearly holiday much like Christmas or New Years. It is a weekend to indulge in minerals, escape everyday life, meet distant fellow collectors and—from now on—to remember one of the most important of all Swedish mineral collectors.

Johan Kjellman
Jörgen Langhof
Per Nysten

[For references see Moore, T. (1991) A mineral collector's Scandinavia 1990. *Mineralogical Record*, **22**, 43–52, and Thorin, L. (1999) Porträttet—Ingemar Johansson. *Stein Nordisk magasin for populær geologi*, **26**, 18–20.]



Mineralogical Record BACK ISSUES!

Pay us now . . . or pay a rare book dealer later!

v.1/#4 Columbian Emerald, Natrolite (OR), Benstonite (IL), Långban (Sweden) **$30**	**v.8/#5** Characterization of New Species, Twinning, Axinite (Brazil), Green River (WY) **$10**	**v.8/#6 California Issue** Benitoite, Gold L.A. County Museum, Himalaya mine **$10**	**v.9/#3** Kalahari rhodochrosite, Paterson (NJ), Brumado district (Brazil), Bosch Collection **$10**	**v.9/#4** Elmwood (TN), Chester (MA), Pyrite XL Forms **$10**
v.9/#5 Turkish Kämmererite, Afghan pegmatites, Chuquicamata (Chile) **$10**	**v.9/#6** Libethenite (Zambia), Quartz & Pyrite (WA), Hydroboracite (CA) **$10**	**v.10/#1** Hydroxylherderite (Brazil), Bookson U.S. minerals **$10**	**v.10/#2** Jeffrey mine (Quebec), Alpine Rodingites, Fluorite (Germany) **$10**	**v.10/#3** Taewha mine (Korea) Japan Twins (Quartz), Bancroft (Ont.), Franklin **$10**
v.10/#5 Thomas & Wah Wah Ranges (Utah) (famous for Topaz, Red Beryl, etc) **$10**	**v.11/#1** Toxic Minerals Barite from Hartsel (CO), Cassirer Memoirs (part II) **$10**	**v.11/#5** Los Lamentos (Mex.), Chromates (Iran), Nealite, Sperrylite, Mullica Hill **$10**	**v.11/#6** Broken Hill (Zambia), Cruziero mine (Brazil), Caplan Interview Rose Qtz. **$10**	**v.12/#1** Zeoli Zeolit SOLD OUT **$10**
v.12/#3 Pribram (Czecho.), Bald Knob (NC), Line Pit (PA-MD), Mcguinnessite **$10**	**v.12/#4** Mineral Fakes, Mineral Fraud, Leadhills-Wanlockhead (England) **$10**	**v.13/#4** Diamond (CO), Quartz (MT), Jeanbandyite, Bancroft (Ont.) **$10**	**v.14/#1** Celestite (IN), Derbyshire (England), Lotharmeyerite (Mapimi) **$10**	**v.14/#6** Chuquicamata (Chile), Univ. of Delaware Mineral Museum **$10**
v.15/#1 Darwin (CA), Pereta Mine (Italy), Cetine Mine (Italy) **$10**	**v.15/#5** Jacupiranga mine (Brazil), Jensen quarry (CA), Cunha Baixa mine, Paulkerrite **$10**	**v.15/#6** Bad Ems (Germany), Touissit Vanadinite, Hawleyite (IN), Fluorapatite (SD) **$10**	**v.16/#1** stoc oat, Maj Caps SOLD OUT **$10**	**v.16/#3** Colorado-III Issue! Leadville, Rico, Cresson Vug, Pikes Peak, CSM Museum **$10**
v.16/#4 Kingsgate mines (Australia), Mauldin Mountain Phosphates (AL) **$10**	**v.16/#5 Tourmaline Issue!** (112 p.) Elba, Maine, Pakistan, Nepal, California, etc. **$10**	**v.16/#6** Graves Mtn. (GA), Gardiner Complex (Greenland), Canaphite Hutchinsonite **$10**	**v.17/#2** J. C. Holmes claim (AZ), Austrian Minerals, Marsturite, Franklin (NJ) **$10**	**v.17/#3** Knappenwand (Austria), Laurium (Greece), Senaite (Brazil), Chalcophyllite (New Zealand) **$10**
v.17/#4 National Belle mine (CO), Tip Top mine (SD), Stoneham Barite (CO) **$10**	**v.17/#5** Black Hills type localities, Urucum (Brazil), Kalkar quarry (CA), Kremsmünster **$10**	**v.17/#6** Bleiberg (Austria), Brochantite (OK), Arsenopyrite (Ont.) Author's Guide **$10**	**v.18/#1 Gold-II Issue!** Australia, Calif., Breckenridge, Hopes Nose (England), etc. **$12**	**v.18/#2** Elk Creek (SD), Teyler's Museum, Ramsbeckite, Neotocite, Phosphosiderite **$10**
v.18/#3 Uranium minerals (Sardinia), Garnet Hill (NV), Photographer's Guide, Library Guide **$10**	**v.18/#4** Carrara Marble (Italy), Marburg Museum (Germany) **$10**	**v.18/#5** Hale Creek Inesite (CA), Vanadium Minerals Review, Peking Museum **$10**	**v.19/#1 Mineral Museums of Eastern Europe** Full-color 72-page book-issue **$10**	**v.19/#3** Table Mtn. Zeolites (CO), Tonopah-Belmont mine (AZ), Parker Cleaveland **$10**
v.19/#4 Ichinokawa mine (Japan), Bandora mine (CO), Chernikovite, Getchell arsenates (NV) **$10**	**v.19/#5** Almaden (Spain), IMA, J. Berzelius, Probertite, Osarizawaite **$10**	**v.19/#6 Australia Issue!** 152 pages and much color photography! **$12**	**v.20/#1 New Mexico Issue!** 96 pages and much color photography! **$10**	**v.20/#3** Ouro Preto (Brazil), Anjanabonoina (Madagascar), Port Radium Silver (Canada) **$10**
v.20/#4 Katanga Uranium Issue! Shaba (Zaire) deposits, much color photography! **$10**	**v.20/#5** Brazilian Diamonds, Leveäniemi mine Phosphates (Sweden), Phoenixville (PA) **$10**	**v.20/#6** Spanish Pyrite, Pint's quarry (IA), Beaverdell (Br. Col.), Hollister (CA), Blue Ball (AZ) **$10**	**v.21/#1 Special 20th Anniv. Issue!** Roebling, Canfield, Bement, Paris Exp., Transylvania **$10**	**v.21/#2** Thornberry Axinites (CA), El Dragón mine (Bolivia), Silver District (AZ), Goldschmidt **$10**
v.21/#3 American Amethyst Localities, Terlingua, Davis Hill, Edgarbaileyite, Faden Qtz. **$10**	**v.21/#4 Mont Saint-Hilaire Issue!** 112 pages and much color photography! **$12**	**v.21/#5** Rose qtz. (Brazil), green Apatite (Brazil), stereo photogr., Carnegie Museum Catalog **$12**	**Carnegie Museum Catalog** Magnificent 32-page, full-color catalog **free** in each v.21/#5.	**v.21/#6** Nanisivik mine (Canada), De Kalb (NY), Murfreesboro (AR) Australian Diamonds **$10**
v.22/#1 Mashamba mine (Zaire), Fat Jack mine (AZ), Monitor-Mogul (NV), azurite, Scandinavia **$10**	**v.22/#2** Mezica mine (Yugoslavia), Caldbeck Fells (England), SEM, Eugui quarries (Spain) **$10**	**v.22/#3** Messina mines (So. Afr.), Idria mines (Yugoslavia), Outlaw mine (NV), Pribram (Czech.) **$10**	**v.22/#4** Kalahari update (So. Afr.), Seriphos (Greece), Lake George mine (New Bruns), Wattersite **$10**	**v.22/#5** Smokey Bear qtz. (NM), Taaffeite, Sterling Hill (NJ), Grew's *Mus. Reg. Soc.* (1681) **$10**
v.22/#6 Wagholi cavansite (India), Kombat mine (Namibia), Madan mines (Bulg.),Beltana mine **$10**	**v.23/#1** Dohrmann Gold collection, Gillette quarry (CT), Spanish fluorite **$12**	**v.23/#2 Michigan Copper Country Issue!** Spectacular, 104-pg. book issue. One of our best! **$15**	**v.23/#3** African gold, IA calcite, Hiendelaencina (Spain), Freiberg Acad.; Tucson & Paris shows **$10**	**v.23/#4** Yukon Phosphates Issue! The only complete review of these famous occurrences **$10**
v.23/#5 Matlock (Eng.), Prenteg (Wales), Stephen Smale Collection, Mineral Stories **$10**	**v.23/#6** Black Pine mine (MT), Bixbyite (AZ), Pd-Pt (Brazil), Franklinphilite (NJ) **$10**	**v.24/#3** Majuba Hill mine (NV), Sawtooth Batholith (ID), Ashburton Downs (Australia) **$10**	**v.24/#4** Cornwall's Famous Mines, Rush Creek (AR), Clinomimetite, Inclusions in Microcrystals **$10**	**v.24/#5** The Geysers (CA), Sanford deposit (ME), Wessels mine (So. Af.), Parker mine (Que.) **$10**
v.25/#1 (CA), Hor dist. (Mal England) SOLD OUT **$10**	**v.25/#2** Quasicrystals, Sterling Hill (NJ), French Creek (PA), Burra Burra (Australia) **$10**	**v.25/#3** Jacupiranga mine (Brazil), Bennett quarry (ME), Rose mine (NM), Prospect Intrusion **$10**	**v.25/#4** Blowpipe Analysis, Arno Valley (Italy), Widgiemooltha (Australia), Laurium (Greece) **$10**	**v.25/#5** Orford nickel mine (Que.), Martin Ehrmann, Topeka-Kentucky Giant & Indiana veins (CO) **$10**
v.25/#6 The History of Mineral Collecting 1530–1799 Full-color 264-pages **$24**	**v.26/#1 Topaz Issue!** Gorgeous full-color issue, 80-pages, many illustr. **$10**	**v.26/#5** Finch mine (AZ), Gold Quarry mine (NV), World Review 1993–1994 discoveries **$10**	**v.26/#6** Guide to Soviet Mineral Localities, Morefield peg. (VA), Mineral Stories **$10**	**v.27/#1** Fluorescence in Minerals, Billie mine (CA), Seravezza Marble (Italy) **$10**
v.27/#2 Onganja mine (Namibia), Lac Nicolet mine (Quebec), Afghanite **$10**	**v.27/#3** Boulby mine (Engl.), Picos de Europa (Spain), Elmwood (TN), J.G. Lenz **$10**	**v.27/#4** Rio Tinto (Spain), Mendip Hills (England), Calcioaravaipaite **$10**	**v.27/#5** Hyalophane (Bosnia), Red Cloud mine wulfenite, N. Geronimo mine (AZ) **$10**	**v.27/#6** Alva mine (Scotland), Kruisrivier mine (So. Afr.), Silvana mine (Br. Col.) **$10**
v.28/#1 Illinois-Kentucky Fluorite District! Special Issue **$10**	**v.28/#2** Platinum (Russia), Otavi Mtn. Land (Namibia), Repair & Restoration **$10**	**v.28/#3** Western Union mine (AZ), Utahite, Pakistan Locality Guide! **$10**	**v.28/#4 Mines and Minerals of Peru.** Special 120-pg. issue **$15**	**LIMITED HARDBOUND EDITION** Mines and Minerals of Peru **$49**
v.28/#5 Hall's Gap (KY), Szenicsite (Chile), Glossary Additions **$10**	**v.28/#6** Kingsbridge Q. (NY), Ed Swoboda, Ernstite (Brazil, Emerald (Spain) **$10**	**v.29/#1 Mexico-I Issue** All about the Boléo District, Baja Calif. **$10**	**v.29/#2** Saint-Amable, Que.; Denver Show; Munich Show; Pomona Show **$10**	**v.29/#3** Annaberg, Type Locality for Wulfenite; Namibite; Philolithite; Boqueirãozinho**$10**
v.29/#4 The Sweet Home Mine! 192 pages, 180 color photos! Spectacular! **$20**	**v.29/#5** Castle Dome Dist. (AZ), Bushveld Complex, IDing micromounts, French Torbernite **$10**	**v.29/#6** Monograph on the Crystallographic Goniometer, 39 color illustrations **$10**	**v.30/#1** Potosí, Bolivia & phosphophyllite, Zeolite Group, mineral show reviews **$10**	**v.30/#2** Flambeau mine (WI), Silvermines Dist. (Ireland), Peabody Museum at Yale **$10**

Order From: Circulation Manager • Mineralogical Record • P.O. Box 35565 • Tucson, Arizona 85740

[Postage $1 per copy–Order 10 copies or more and **we pay all postage.**]

FAX YOUR **VISA** *or* **MasterCard** *CREDIT CARD ORDERS! 520-544-0815* Supplies are Limited

Order these great back issues:

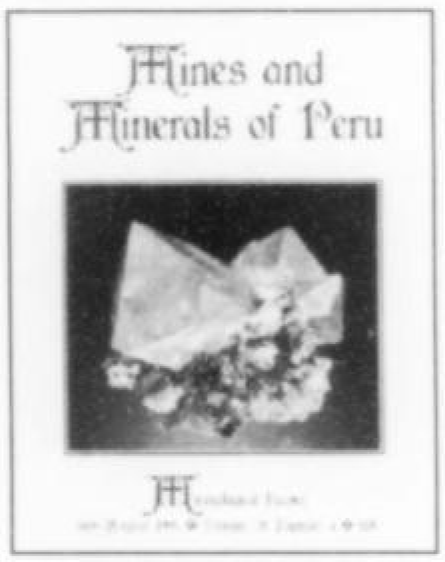
v.16/#3 Colorado-III Issue! Leadville, Rico, Cresson Vug, Pikes Peak, CSM Museum **$10**

v.16/#5 Tourmaline Issue! (112 p.) Elba, Maine, Pakistan, Nepal, California, etc. **$15**

v.18/#1 Gold-II Issue! Australia, Calif., Breckenridge, Hopes Nose (England), etc. **$15**

v.19/#6 Australia Issue! 152 pages and much color photography! **$15**

v.23/#2 Michigan Copper Country Issue! Spectacular, 104-pg book issue. One of our best! **$15**



v.28/#4 Mines & Minerals of Peru! 120 pages, full-color Special Issue! **$15**

Supplies
are
Limited

Circulation Manager
Mineralogical Record
P.O. Box 35565
Tucson, Arizona 85740

*FAX YOUR CREDIT
CARD ORDERS!
520-544-0815*

Add $1 postage per copy.

Mineralogical Record

Antiquarian Reprints

Since 1990 the Mineralogical Record has been producing hand-made limited-edition reprints of some of the rarest and most sought-after antiquarian color-plate mineral books. The current edition is:

No. 11 J. Baumeister's *Mineralreich* (1791), with color frontispiece and 24 plates of mineral specimens in colored and uncolored state. New English Introduction and biography, plus English translation of all figure captions. Calfskin spine. $290 ppd. WHILE SUPPLY LASTS.

**GET ON OUR
MAILING LIST!**

The Mineralogical Record
4631 Paseo Tubutama
Tucson, AZ 85715
Tel.: (520) 299-5274
FAX: (520) 299-5702

**GREGORY, BOTTLEY
& LLOYD**

Established by James Gregory in 1858

13 Seagrave Road, London SW6 1RP
Tel: 0207-381-5522 Fax 0207-381-5512

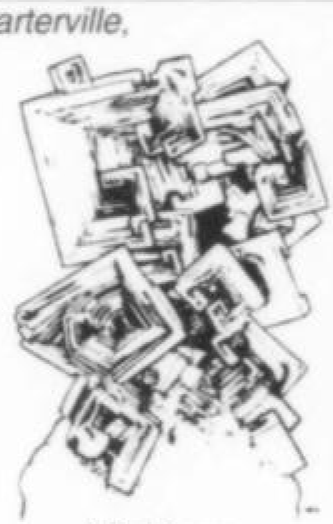
Brian Lloyd looks forward to seeing you when you are next in London. Our showrooms are open weekdays 9:30 to 5 pm—other times by appointment.

*Tucson, Executive Inn room 135, Jan. 27–Feb. 18 • Carterville, IL, March 17–18 • Cincinnati, OH, May • Springfield, Aug 10–12 • Carnegie, Aug. 24–26 • Denver Holiday Inn room 196, Sept. 11–16 • Detroit, October
Visit our website: www.northstarminerals.com*

NORTH STAR MINERALS

*SPECIALIZING IN THE MISSISSIPPI VALLEY-TYPE
DEPOSITS OF SOUTHERN ILLINOIS
New minerals direct from buying trips to Bulgaria and Eastern Europe*

Ross C. Lillie
7249 Woodlore Dr., W. Bloomfield, MI 48323
Tel./Fax: (248) 926-9929 • E-mail: Norstar@mich.com



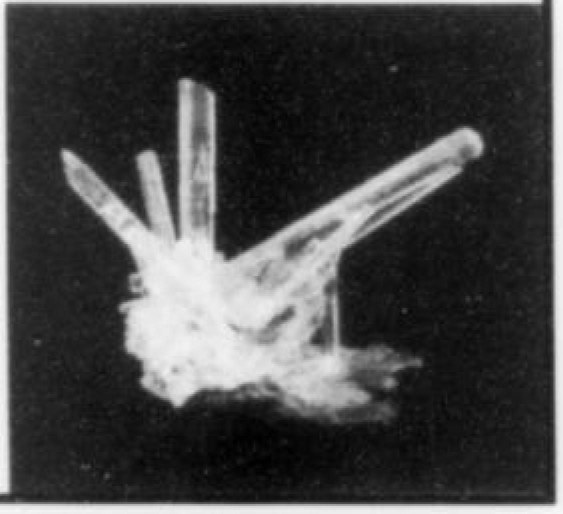
Michigan
Silver

Douglass Minerals

Quality, affordable, world-wide minerals
Miniature to large cabinet size

P.O. Box 69550
Tucson, AZ 85737

(520) 742-0294
douglassminerals@aol.com
www.douglassminerals.com



**UNUSUAL CRYSTALS
FROM
AROUND THE WORLD**

*CORUNDUM IS
OUR SPECIALTY!*

GEM-FARE

P.O. Box 213
Pittstown, N.J. 08867
Phone/Fax (908) 806-3339
REQUEST CRYSTAL LIST

EAST COAST **GEM, MINERAL & FOSSIL SHOW**

Better Living Center ★ EASTERN STATES EXPOSITION ★ 1305 Memorial Ave. ★ West Springfield, MA

AUG 10 - 11 - 12, 2001 Fri & Sat. 10 AM to 7 PM ★ Sun. 10 AM to 5 PM
Adults - $6.00 ★ Students & Seniors - $5.00

★ **AIR CONDITIONED HALL** ★ **FREE PARKING** ★
★ ***150 TOP Quality Dealers*** ★
★ Meteorites ★ Lapidary ★ Minerals ★ Fossils ★ Beads ★ Jewelry ★ Gems ★
★ Hourly Door Prizes ★ ***FREE*** Mineral Specimens for Kids (12 & under) ★
★ ***Great Dealers From All Over The World*** ★

Special Exhibit of . . . **ARIZONA MINERALS**
Collections of Evan Jones and Les & Paula Presmyk

DENVER - 2001

COLORADO MINERAL & FOSSIL SHOW

Holiday Inn - Denver North • 4849 Bannock Street • (where I-25 meets I-70)

SEPT. 12 - 16 Show Hours:
Wed. thru Sat. 10 - 7
Sun. 10 - 5

• Wholesale & Retail • Dealers on **3** floors of the Hotel • ***FREE*** Admission •
• Open to the Public • ***FREE*** shuttle bus to the Merchandise Mart Shows •
• *225 TOP Quality Dealers From All Over the World* •

FOSSILS ☆ METEORITES ☆ PETRIFIED WOOD

SEPT 14 - 16, 2001 Show Hours:
Fri. 9 - 6 ◆ Sat. 10 - 6
Sun. 10 -5

Outstanding Paleontological Specimens From All Over The World!
◆ **Park On the North Side of the Mart** ◆ ***MR. BONES IS BACK!!*** ◆
Held in conjunction with the Denver Gem & Mineral Show! (Admission of $4.00 includes both shows)

COLORADO FOSSIL EXPO

Denver Merchandise Mart ◆ Mart Plaza ◆ 52nd St. & Washington St. ◆ **(North side of Mart)**

Martin Zinn Expositions, L.L.C. • P.O. Box 999 • Evergreen, CO 80437-0999 • Fax (303) 674-2384
E-mail: mz0955@aol.com • website: http://mzexpo.com

CALIFORNIA DEALERS

Attard's Minerals
John & Kathy Attard
P.O. Box 17263
San Diego, CA 92177
Tel: (619) 275-2016
www.attminerals.com

The Arkenstone
Rob & Bailey Lavinsky
P.O. Box 12801
La Jolla, CA 92039
Tel: (858) 587-1141
www.thearkenstone.com

Coogan Gold Company
Ed and Kay Coogan
P.O. Box 1631
Turlock, CA 95381
Tel: (209) 634-5222
Micromounts, TN's, Min., Cab.

Si and Ann Frazier
Si and Ann Frazier
Suite 306, 6331 Fairmont Ave.
El Cerrito, California 94530
Fax: (510) 558-8486
e-mail: siannfraz@aol.com

Gemini Minerals
Joe & Susan Kielbaso
P.O. Box 70062
San Diego, CA 92167
Tel: (619) 223-0620
FAX: (619) 223-0385
E-mail: geminiminerals@home.com
We buy collections

Cal Graeber Minerals
Cal and Kerith Graeber
P.O. Box 2347
Fallbrook, California 92088
Tel: (760) 723-9292
By Appointment Only

Jewel Tunnel Imports
Rock H. Currier
13100 Spring Street
Baldwin Park, CA 91706-2283
Tel: (626) 814-2257
FAX: (626) 338-4617
Wholesale Only

Kristalle
875 North Pacific Coast Hwy.
Laguna Beach, California 92651
Tel: (949) 494-7695
E-mail: leicht@kristalle.com
WEB: http://www.kristalle.com

Debbie Meng's Minerals
Debbie Y. Meng
P.O. Box 8393
Monterey, CA 93943
Tel: (831) 484-7418, Fax: (831) 484-7419
E-mail: debbie.meng@usa.net
Specialty: Fine Chinese Minerals

Pala International & The Collector
912 So. Live Oak Park Road
Fallbrook, California 92028
Tel: (760) 728-9121
US Wats 1-(800)-854-1598

Steve Perry Minerals
P.O. Box 136
Davis, California 95617
Tel/Fax: (530) 753-7861
e-mail: steve@steveperrygems.com
website: steveperrygems.com

Bruce & Jo Runner Minerals
13526 South Avenue
Delhi, California 95315
Tel: (209) 634-6470
Micromount List $2
Showroom by Appt. only

Andy Seibel Minerals
Andy Seibel
P. O. Box 2091
Tehachapi, CA 93581
Tel: (661) 823-8091
www.andyseibel.com

Silverhorn
Mike Ridding
1155 Coast Village Road
Montecito, California 93108
Tel: (805) 969-0442

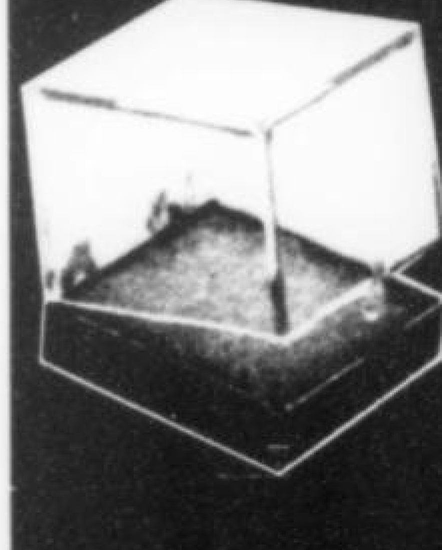
MOUNTAIN MINERALS INTERNATIONAL

Dudley has returned from Asia, see what's new:

New Carrollton, MD	(Ramada)	Aug. 3–5
W. Springfield, MA	(Eastern States Expo)	Aug. 10–12
Denver, CO	(Merchandise Mart)	Sept. 14–16

Mountain Minerals International
P.O. Box 302 • Louisville, Colorado 80027-0302
Tel: (303) 665-0672 • FAX: (303) 664-1009
www.mtnminitl.com

FREE CATALOG



Over 800 sizes of plastic boxes.
- Hinged
- Non-hinged
- Micromount
- Perky and magnifier boxes

ALTHOR PRODUCTS

2 Turnage Lane, P.O. Box 640, Bethel, CT 06801
Tel: (800) 688-2693 • FAX (203) 830-6064

Famous Mineral Localities:

ROSSIE, NEW YORK

George W. Robinson*
Department of Geological Engineering and Sciences
and A. E. Seaman Mineral Museum
Michigan Technological University
1400 Townsend Drive
Houghton, Michigan 49931

George R. Dix
Department of Earth Sciences, Carleton University
and Ottawa-Carleton Geoscience Centre
1125 Colonel By Drive
Ottawa, Ontario, Canada K1S 5B6

Steven C. Chamberlain*
Department of Bioengineering and Neuroscience
and Institute for Sensory Research
Syracuse University
Merrill Lane
Syracuse, New York 13244-5290

Chris Hall
Department of Geological Sciences
University of Michigan
2534 C. C. Little Building
425 E. University Street
Ann Arbor, Michigan 48109-1063

The Rossie lead mines are a famous early American mineral locality. While best known for large crystals of calcite and galena collected there in the 1830's–1860's, recent studies have revealed a number of previously unreported species and provided insight into the origin of these deposits.

INTRODUCTION

Rossie, New York, is a locality that pops up again and again on old mineral specimen labels in museums throughout the world. Minerals associated with these labels include fine examples of well-crystallized zircon, scapolite, fluorapatite, feldspars, amphiboles, pyroxenes, calcite, galena and a host of other species. "How can one locality produce such a diversity of specimens?", one asks.

---

*Research Associate, New York State Museum, Albany

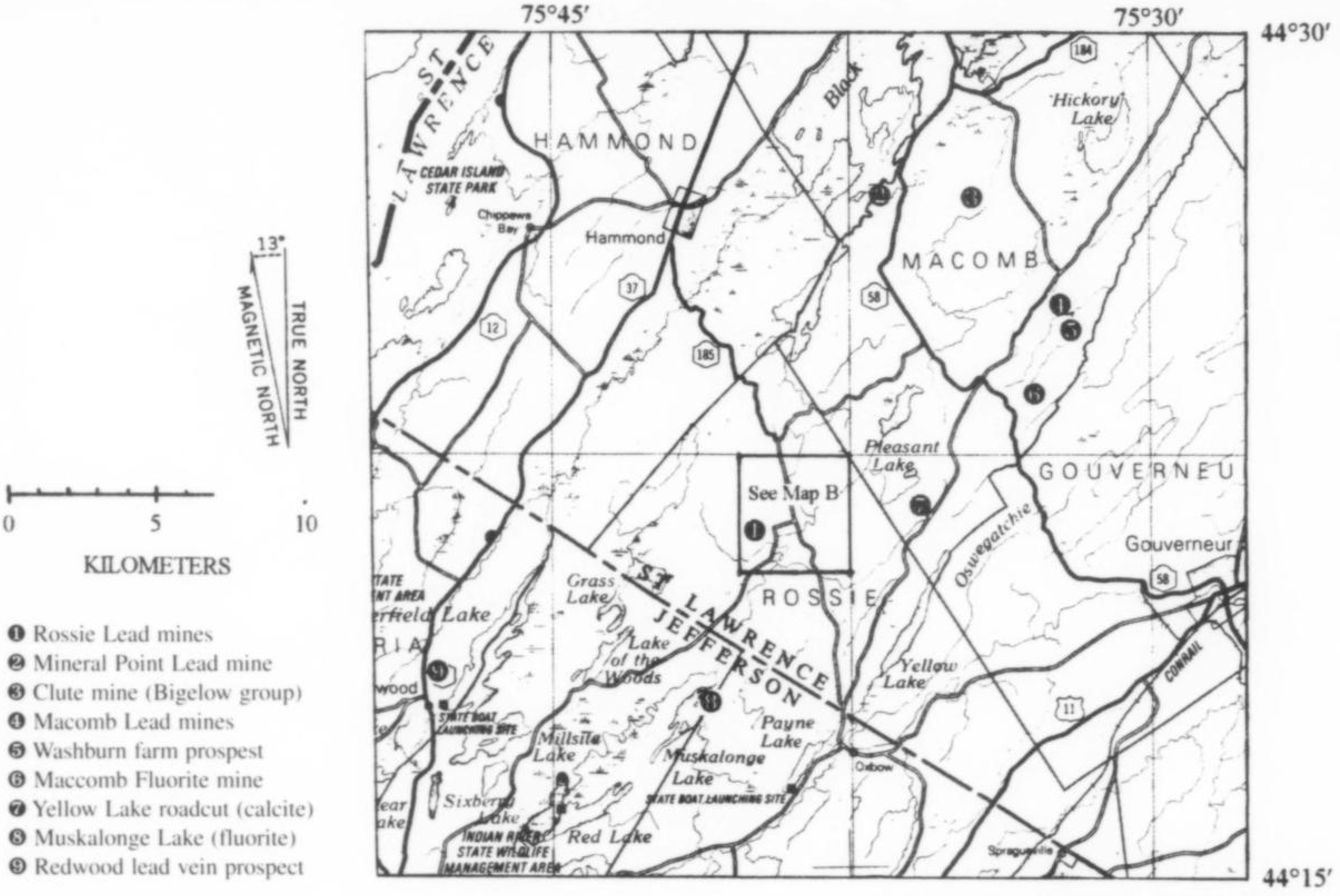
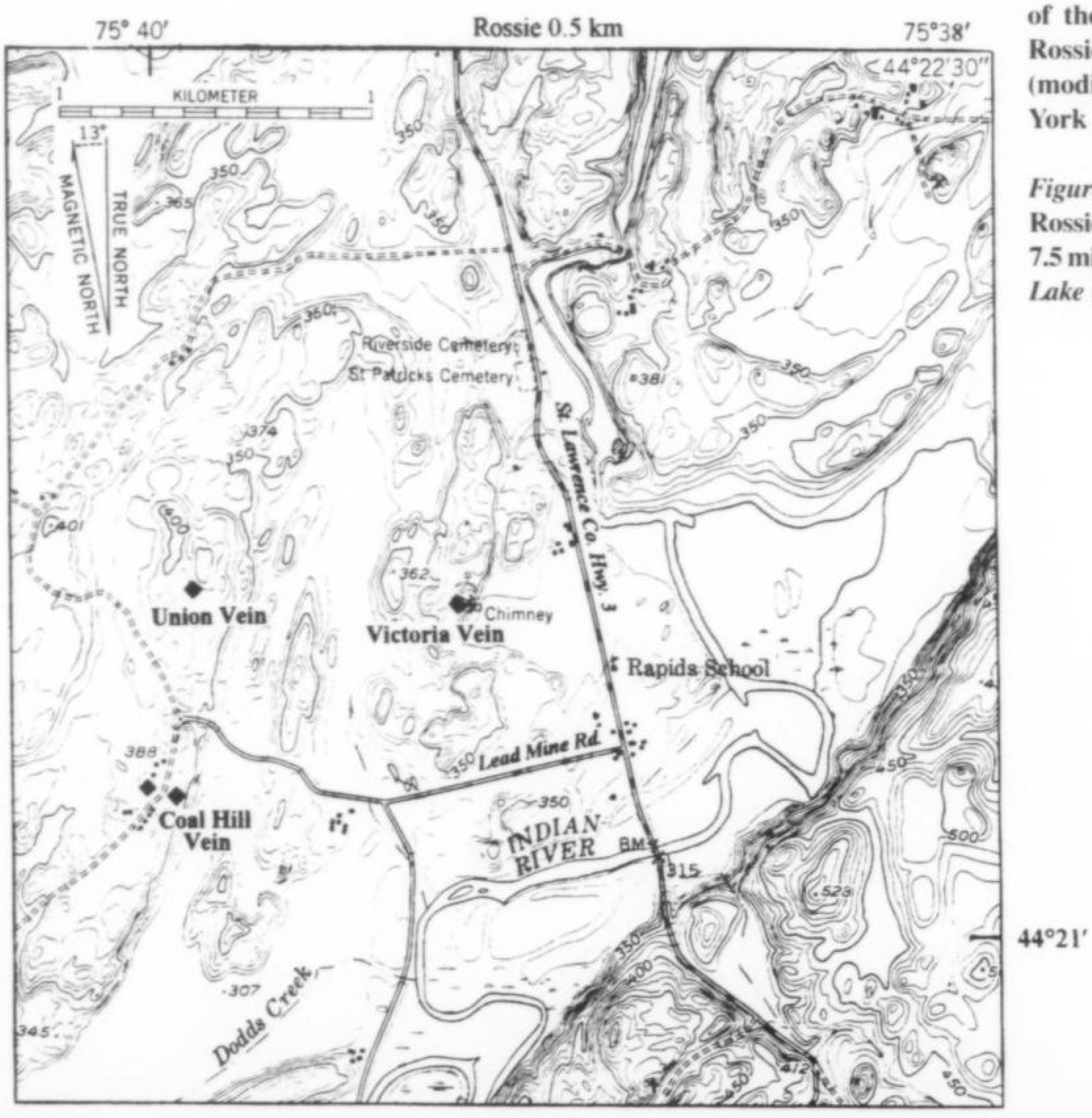


Figure 1. (above) **Map showing the location of the Rossie lead mines and other nearby Rossie-type and related gash vein occurrences (modified from** ***New York State Atlas,*** **New York State Dept. of Transportation, 1980).**

Figure 2. (left) **Detailed location map of the Rossie Lead Mines (modified from U.S.G.S. 7.5 minute series topographic map:** ***Muskalonge Lake Quadrangle,*** **New York, 1951).**



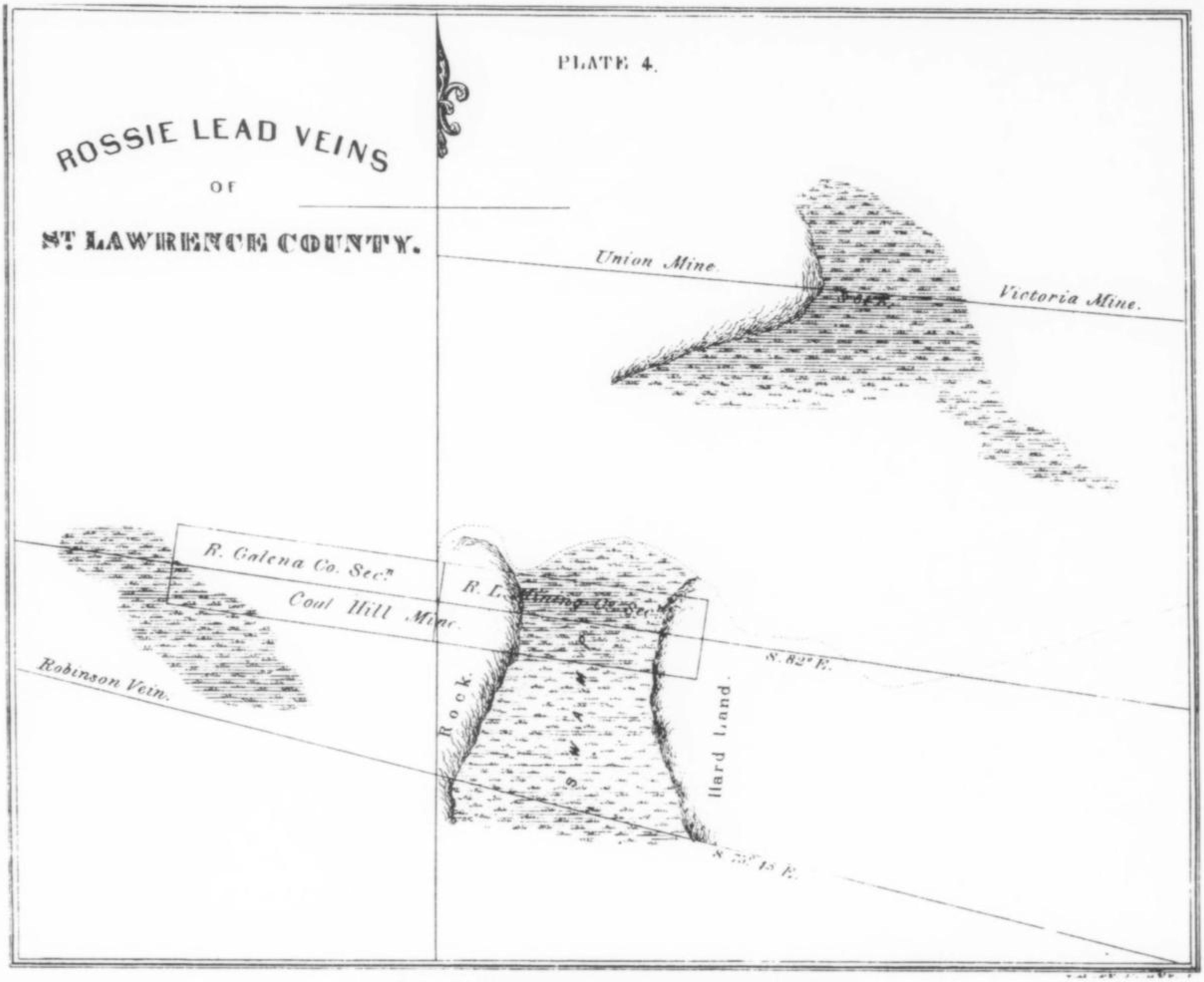


Figure 3. **Old map showing the principal lead veins near the village of Rossie (from Beck, 1842).**

The answer is simple, if one understands that the localities given on such old labels usually imply *township* rather than village names. Thus, a number of different localities with different geological environments are represented. Among the most famous of the localities in town of Rossie are the Rossie lead mines, renowned for their large, complex and often twinned crystals of calcite.

The Rossie lead mines are located on a hill approximately 2.5 km south-southwest of the village of Rossie, St. Lawrence County, New York. There, four roughly east-west-trending, nearly vertical calcite-galena veins cut Grenville-age granitic and dioritic gneiss; these are the *Nash* (Coal Hill), *Jepson* (Pardee, Victoria), *Ross* and *Robinson* (Indian River) veins. Three principal workings, the Coal Hill, Victoria and Union mines, were developed on the first three of these veins, respectively, and comprise the primary occurrences which supplied the majority of specimens preserved in museums today. However, a dozen or more smaller nearby occurrences are known, the most notable of these probably being the Mineral Point and Macomb lead mines, both in the town of Macomb (Fig. 1). All of the occurrences are geologically similar, consisting of nearly vertical calcite-galena veins cutting Precambrian Grenville-series crystalline rocks as well as locally overlying Paleozoic sediments (Smyth, 1903; Newland, 1921; Buddington, 1934; Neumann, 1952; Brown, 1983). Individual veins vary from a few centimeters to over a meter in width and have been exploited to various degrees by hand-dug trenches and shallow underground workings. Virtually all of these old mines are today on privately owned land, but most are still accessible to collectors who seek permission prior to visiting them.

HISTORY

Home to the Parish Iron Works, Rossie was a bustling industrial town long before its lead mines came into production. Coal Hill was so named for the production of charcoal there, which was used to fire the blast furnace in the village. In 1817, President James Monroe visited the Iron Works, and by the 1830's hematite ore was being smelted from a number of nearby mines, including the Sterling mine near Antwerp, famous for its millerite specimens (Robinson and Chamberlain, 1984).

Probably the first to discover lead in the Rossie area were the St. Regis Indians, who reportedly smelted the metal from galena ore in open fires. However, it is Arthur Bacon, an early resident of Rossie, who is credited with finding galena in the roots of an overturned tree on the Coal Hill (Nash) vein (Hough, 1853). In 1829, the Jepson (Victoria) vein was discovered by Eliza Jepson, the nine-year-old daughter of Joel Jepson. As a reward, George Parish,

Figure 4. **Old woodcut of the Coal Hill vein as it appeared in early 1836 (from Beck, 1842).**

owner of the Parish Iron Works, gave her a calico dress, and her father received 40 acres of land, a team of oxen and a barrel of salt pork (Simons, 1951; 1958).

By 1835, Parish had become interested in the prospect of mining lead, and in December of that year contracted with B. T. Nash to search for ore and develop a mine. Shortly thereafter, Nash sold his rights to J. C. Bush, and two companies with ten-year charters were incorporated in May, 1837 (Hough, 1853; Curtis, 1894). Each company had a working capital of $24,000 and was to work different sections of the Coal Hill vein: the eastern section by the Rossie Lead Mining Company, and the western section by the Rossie Galena Company. Preliminary work began on the western section late in 1836, and by January 1, 1837, serious work had commenced on both sections. Parish also worked the Victoria and adjacent Union (Ross) veins to the north, as well as the Robinson (Indian River) vein to the west. The New York State mineralogist, Lewis Beck, visited the mines in August of 1836, providing the following contemporary account (Beck, 1842):

> The vein of galena and decomposed ore was distinctly visible for some distance, passing down a precipitous ledge of primitive rock about fifty feet in height. The average width of the vein was two feet, and it cut the rock in a nearly perpendicular direction. . . . On ascending the ledge, the course and extent of the vein could be easily determined by the excavations which had been made . . . and its length, as exposed at that time, was about four hundred and fifty feet. . . . The galena found in this vein is often crystallized in large cubes, which are not infrequently modified by truncations upon the angles. . . . Throughout the whole extent of the vein, the ore is imbedded in a gangue of carbonate of lime, with druses of calcareous spar of great beauty, and presenting a great variety of crystalline forms.

Figure 5. **The Victoria lead mines, ca. 1838. A lithograph by Salathiel Ellis, printed by Cicéri, Paris. Courtesy of the New York Historical Society, New York City (from Shadwell, 1986, Plate 3.7).**

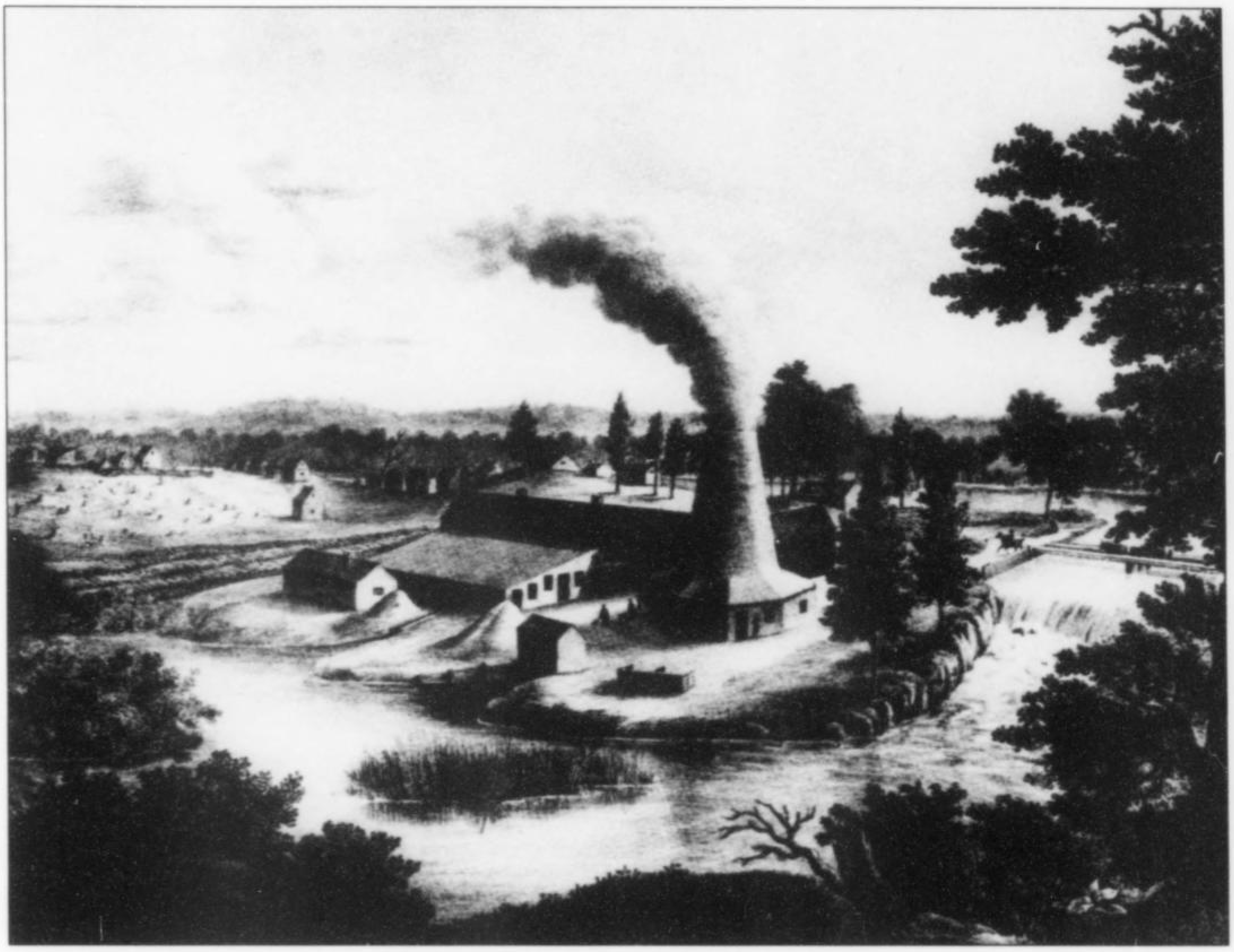


Figure 6. **Rossie furnace, ca. 1838. A lithograph by Salathiel Ellis, printed by Cicéri, Paris. Courtesy of the New York Historical Society, New York City (from Shadwell, 1986, Plate 3.4).**

> For three or four years, this mine was worked with great activity, and shafts were sunk to the depth of upwards of one hundred and fifty feet. At this depth the vein presented similar appearances to those observed nearer the surface, except perhaps that the proportion of ore to the gangue was somewhat less. Fine druses of crystallized galena and calcareous spar, together with variously modified crystals of iron pyrites and some copper pyrites, were from time to time laid open. A few beautiful specimens of crystallized sulphate of strontian [*sic*], of a bluish color, were also found.

In 1839 George Parish died, and operations ceased the following year, due largely to inefficient mining and financial mismanagement. In all, 1,625 tons of lead were produced. For over a decade the mines were idle, but in 1852 the Great Northern Lead Company was incorporated and the mines reopened with improved equipment and experienced miners from Cornwall, England. In spite of improved efficiency, the high cost of development precluded royalties promised to the Parish estate, and in 1854 the mines were leased to J. B. Morgan (Ontario Mining Company?) who worked them until 1868 (Curtis, 1894; Whitney, 1854). From this point forward the record becomes rather sketchy. French (1860) notes that the Rossie & Canada Lead Company worked the mines on a 20-year lease from 1856, though according to Smyth (1903) the "Rossie mines were worked during the Civil War by the Mineral Point Lead Mining Company." Which veins were exploited is not stated. Whitney (1854) implies that the Union vein was reworked circa 1854 by the Victoria Lead Company, and the St. Lawrence Mining Company worked the "Macomb mine," approximately 15 km to the northeast. An anonymous newspaper clipping (1885) notes that "work was discontinued in 1868, since which time the mines have filled up with water," though an 1874 newspaper article stated that "under the superintendence of John Webb, Jr., of New Jersey, a partial owner, work is to be vigorously prosecuted. Excavations have already begun in the mine known as No. 4; also in a place on the farm of George Webster."

Lead mining in Rossie ceased permanently in 1876 (Simons, 1958), having produced an estimated 6000 tons of lead (Neumann, 1952). In the summer of 1950, the Coal Hill and Union veins were diamond-drilled by the U.S. Bureau of Mines as part of a larger project to establish lead and zinc reserves of several Rossie-type deposits in the area (Neumann, 1952). What little reserves were found proved uneconomic to mine, and no follow-up work was done.

The Rossie lead mines may have been abandoned in 1876, but their fame spread to other famous mining towns as their miners moved west, bringing the name "Rossie Hill" to Park City, Utah, and many early Rossie family names to Butte, Montana (Simons, 1958; Gardner, ca. 1970). The words written by an anonymous newspaper reporter in 1885 are as fitting now as then:

> Rossie gradually sank into a state of slumberous quiescence, only broken once in a while by an itinerant drummer or a rambling specimen hunter. And yet it offers other attractions of many kinds to the searcher after health and pleasure during

Figure 7. **Lead ingot from the Rossie Lead Mining Company, in the collection of the Rossie Town Museum. The initials "H.P." probably stand for Herman Petrie, former owner. Photo by G. Robinson.**

the summer months. . . . To the student of geology, mineralogy and crystallography, this place offers, perhaps, greater variety and facility for obtaining interesting specimens, than any other in this state.

GEOLOGY

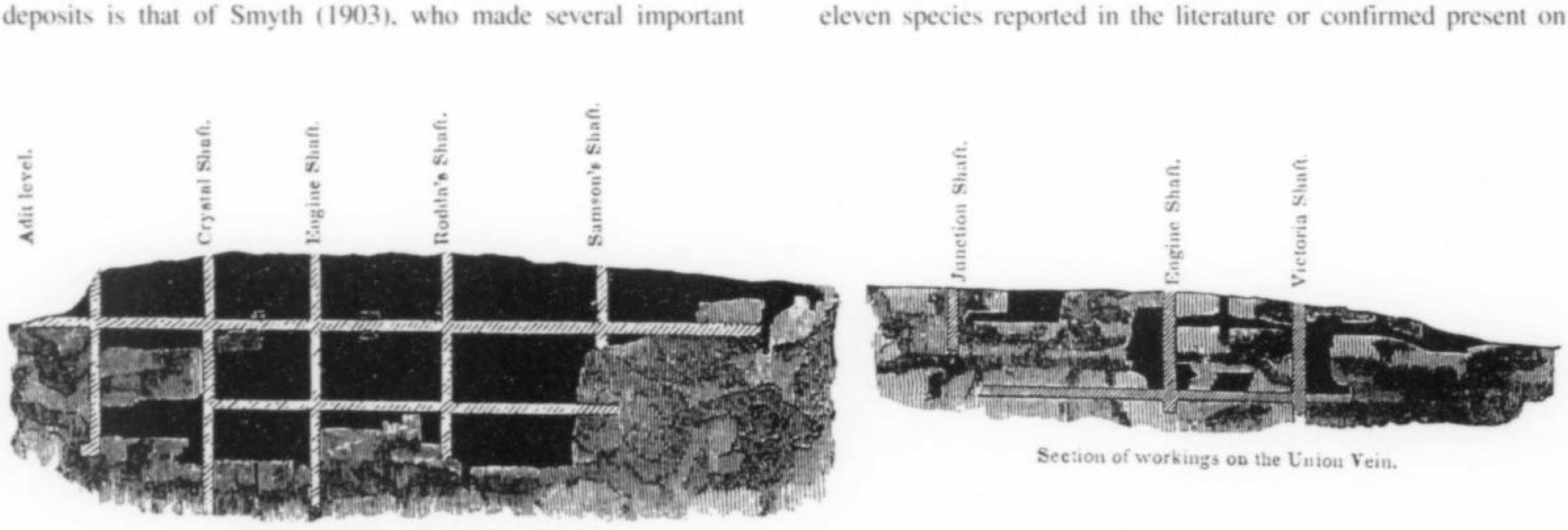
Most Rossie-type veins are relatively small, varying from a few centimeters to rarely more than a meter in width, and are comprised chiefly of coarse white to pale pink calcite with subordinate amounts of galena. They are not confined solely to the Rossie area, but form a genetically related group of hydrothermal deposits that extends south and west across southeastern Ontario, covering a 14,000 square kilometer area (Uglow, 1916; Alcock, 1930; Brown, 1983; Dix and Robinson, submitted). Similar veins also occur in the Charlevoix-Saguenay area of Québec (Carignan *et al.*, 1997). Bedrock in these areas consists principally of Precambrian metasediments and metavolcanics of the Grenville Central Metasedimentary Belt (Easton, 1992), overlain locally by Cambrian and Ordovician sandstones, dolostones and limestones. The consistently similar mineralogy and structure of Rossie-type veins over such wide areas with diverse host-rock lithologies suggests they share a common origin.

Most early studies concerning the Rossie lead mines focus on descriptions of the calcite crystals. Contemporary geological investigations are few in number, and largely descriptive in nature (Emmons, 1837, 1838; Beck, 1837, 1842; Hough, 1853). The first comprehensive work aimed at understanding the origin of these deposits is that of Smyth (1903), who made several important observations. The most significant of these is the fact that some veins cut the overlying Cambrian Potsdam Sandstone, and therefore are at least 500 million years (Ma) younger than the Precambrian Grenville series rocks that host most of the deposits. Smyth also noted the episodic fault-hosted nature of the veins, the limited extent of wall-rock alteration accompanying mineralization (Fig. 11), and the probable non-igneous origin of the deposits—observations and conclusions upheld by Brown (1983), Carignan (1997) and the present study.

Some recent investigators have shown that some veins cut middle Ordovician limestones, and they speculated such veins may even be as young as Cretaceous (Fletcher and Farquhar, 1982; Ayuso *et al.*, 1987). In a study of Paleozoic mineralization in the Ottawa Embayment, Dix and Robinson (submitted) show that mineralization of the Rossie-type and related veins is probably episodic from Acadian to early Mesozoic time. ^{40}Ar/^{39}Ar dating of late microcline (adularia) from the Coal Hill vein (this study) indicates that a late stage of mineralization occurred at 186.6 ± 1.8 (2σ) Ma, coincident with ultramafic dike intrusions to the northwest in southern Ontario (Barrett *et al.*, 1984), and likely linked to Atlantic Basin development.

MINERALS

The following descriptions are primarily of the minerals found at the Coal Hill and adjacent veins south of Rossie, but for completeness and geological comparison also include some species thus far observed only at other nearby Rossie-type deposits. An additional eleven species reported in the literature or confirmed present on



Section of workings on the Coal Hill Vein.

Section of workings on the Union Vein.

Figure 8. **Diagram of the Coal Hill and Union vein workings (from Whitney, 1854); (a) cross-section of the Coal Hill workings looking south; (b) cross-section of the Union workings, looking north.**

Figure 9. **Coal Hill vein, Rossie, New York. Excavation viewed looking west, as it appeared on 4 December, 1997. Photo by S. C. Chamberlain.**

single specimens during this study are listed in Table 1. Unless otherwise mentioned, all species have been verified by X-ray diffraction and/or electron microprobe analysis.

Albite $NaAlSi_3O_8$

Albite occurs abundantly in fractures and as drusy coatings on altered granitic xenoliths in the Coal Hill vein. The mineral forms colorless, glassy, tabular crystals 1–3 mm across and is associated with quartz, microcline, anatase and other species. Some crystals appear to be twinned according to the albite law. Electron microprobe analyses of these crystals show they are essentially pure albite ($\sim Ab_{98}An_{01}Or_{01}$), containing approximately 0.24 weight % SrO. Similar crystals have been found at the Mineral Point lead mine on Black Lake (Locality 2, Fig. 1).

Anatase TiO_2

Bright blue and (more rarely) lilac to pink, transparent crystals of anatase up to 0.5 mm across occur sparingly with albite, quartz and other minerals on some of the altered granitic xenoliths at the Coal Hill vein. The crystals are extremely tabular on {001}, and form rather equant wafers with a wulfenite-like habit. Tiny prism and pyramid faces sometimes may be seen with SEM magnification, but are too small to be measured optically.

Anglesite $PbSO_4$

Much of the galena at all the occurrences examined shows some degree of surface alteration. Beck (1842) states that powdery white "lead ashes" were "found in great abundance on that part of the Rossie vein which was exposed to the atmosphere, and . . . proved to be a mixture of the carbonate and sulphate of lead and carbonate of lime in variable proportions." While we have little reason to doubt this identification, neither have we been able to confirm it. X-ray powder-diffraction patterns for all galena alteration products examined during the present study showed cerussite and various clay minerals as the only species present. Likewise, cerussite has been identified by X-ray diffraction as coatings on galena speci-

Figure 10. **Stone chimney at the Coal Hill vein, Rossie, New York, as it appeared on 4 December, 1997, looking north from the eastern end of the mine excavation. Photo by S. C. Chamberlain.**

Figure 11. **Brecciated wall-rock cemented by pink vein calcite, Coal Hill vein, lower mine dumps. Photo by S. C. Chamberlain.**

mens from Rossie in the Harvard Mineralogical Museum (Carl A. Francis, personal communication, 1998).

Calcite $CaCO_3$

In its day, the discovery of fine calcite crystals in the Rossie lead mines must have caused a great deal of excitement in the mineralogical world. Beck (1842) writes:

> The finest crystals have heretofore been found at the Rossie lead mine. Their forms are exceedingly various, and require particular descriptions. Crystals of a delicate straw-yellow color, almost perfectly transparent, and from eight to ten inches in diameter, have occasionally been found in this vein; while smaller ones variously aggregated, have been obtained in vast quantities. They occur in water-filled cavities of the mine, and are associated with crystallized galena, iron and copper pyrites, and rarely crystallized celestine.

The world's contemporary crystallographers were fascinated by the complex morphology of Rossie calcite crystals, and their studies did indeed result in numerous "particular descriptions" (Phillips,

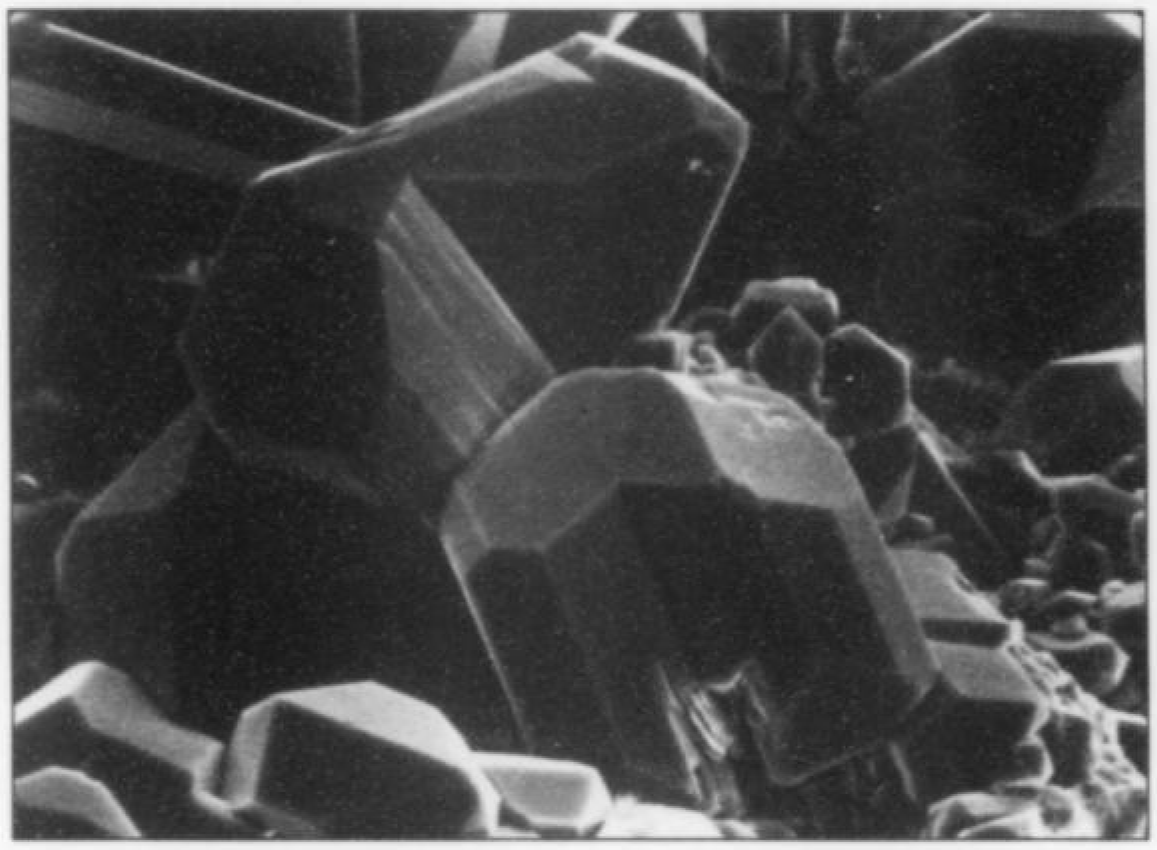


Figure 12. **SEM photomicrograph of albite on quartz from the Coal Hill vein; magnification 600X. Canadian Museum of Nature specimen; photo by G. Robinson.**

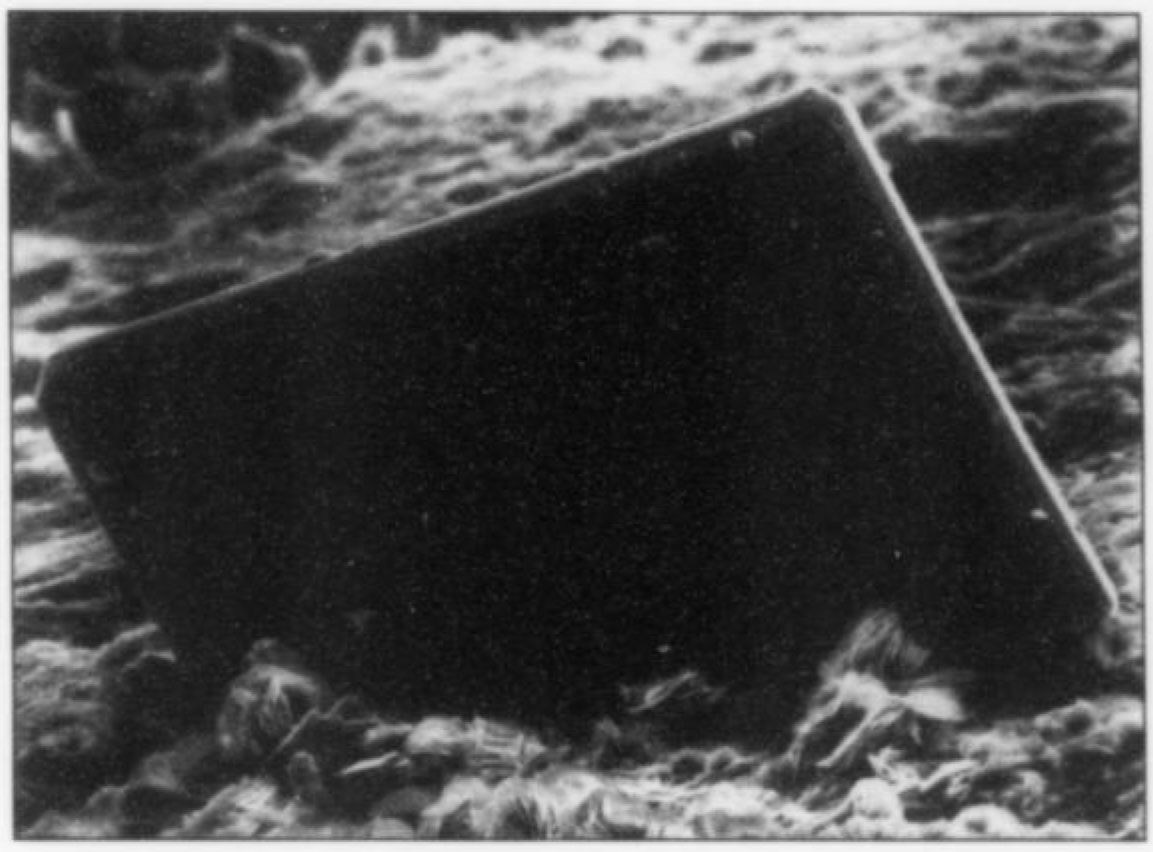


Figure 13. **SEM photomicrograph of anatase from the Coal Hill vein; magnification 500X. Canadian Museum of Nature specimen; photo by G. Robinson.**

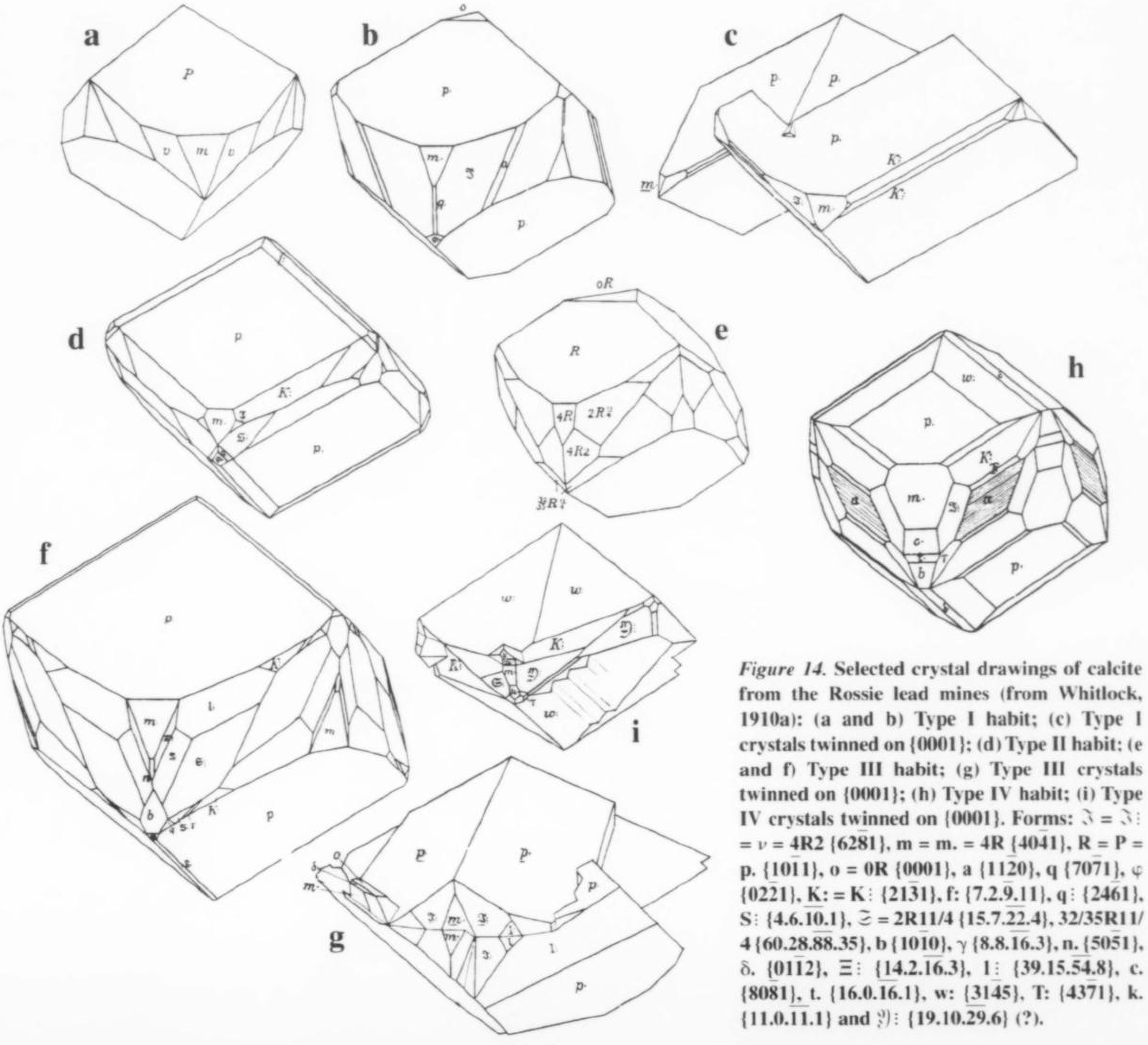


Figure 14. **Selected crystal drawings of calcite from the Rossie lead mines (from Whitlock, 1910a): (a and b) Type I habit; (c) Type I crystals twinned on {0001}; (d) Type II habit; (e and f) Type III habit; (g) Type III crystals twinned on {0001}; (h) Type IV habit; (i) Type IV crystals twinned on {0001}. Forms: ℑ = ℑ⁝ = ν = 4R2 {$62\bar{8}1$}, m = m. = 4R {$40\bar{4}1$}, R = P = p. {$10\bar{1}1$}, o = 0R {0001}, a {$11\bar{2}0$}, q {$70\bar{7}1$}, φ {$02\bar{2}1$}, K: = K⁝ {$21\bar{3}1$}, f: {$7.2.\bar{9}.11$}, q⁝ {$24\bar{6}1$}, S⁝ {$4.6.\bar{10}.1$}, ℨ = 2R11/4 {$15.7.\bar{22}.4$}, 32/35R11/4 {$60.28.\bar{88}.35$}, b {$10\bar{1}0$}, γ {$8.8.\bar{16}.3$}, n. {$50\bar{5}1$}, δ. {$01\bar{1}2$}, Ξ⁝ {$14.2.\bar{16}.3$}, 1⁝ {$39.15.\bar{54}.8$}, c. {$80\bar{8}1$}, t. {$16.0.\bar{16}.1$}, w: {$31\bar{4}5$}, T: {$43\bar{7}1$}, k. {$11.0.\bar{11}.1$} and 𝔜⁝ {$19.10.\bar{29}.6$} (?).**

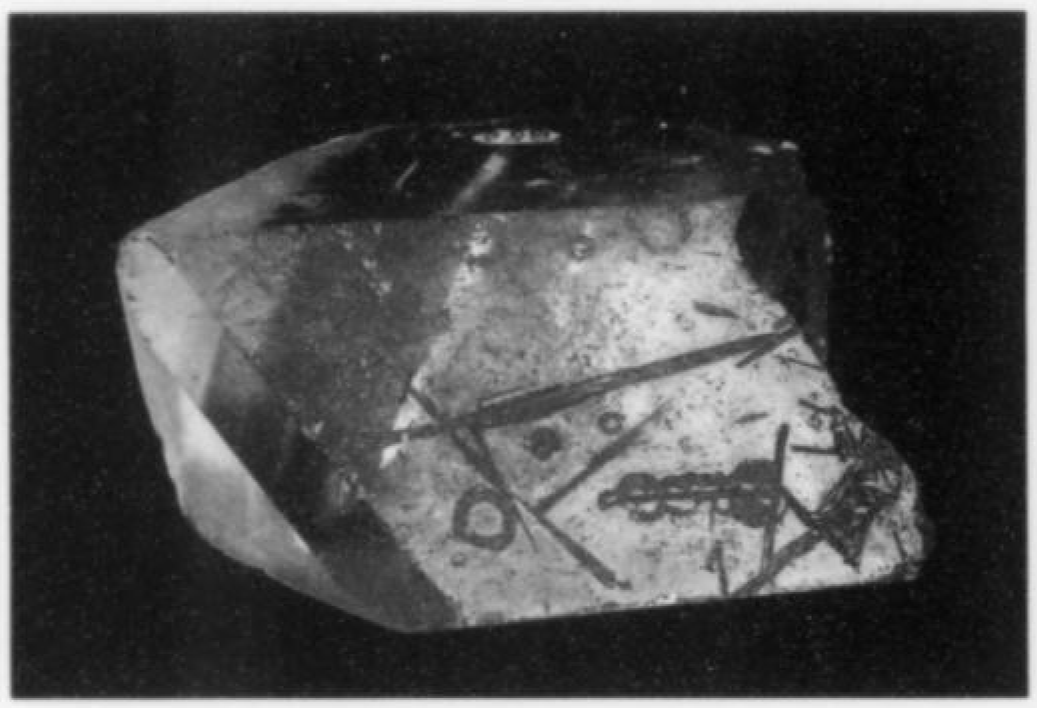


Figure 15. **Calcite from Rossie, New York. New York State Museum specimen (#656), 6 cm in maximum dimension. Photo by S. C. Chamberlain.**

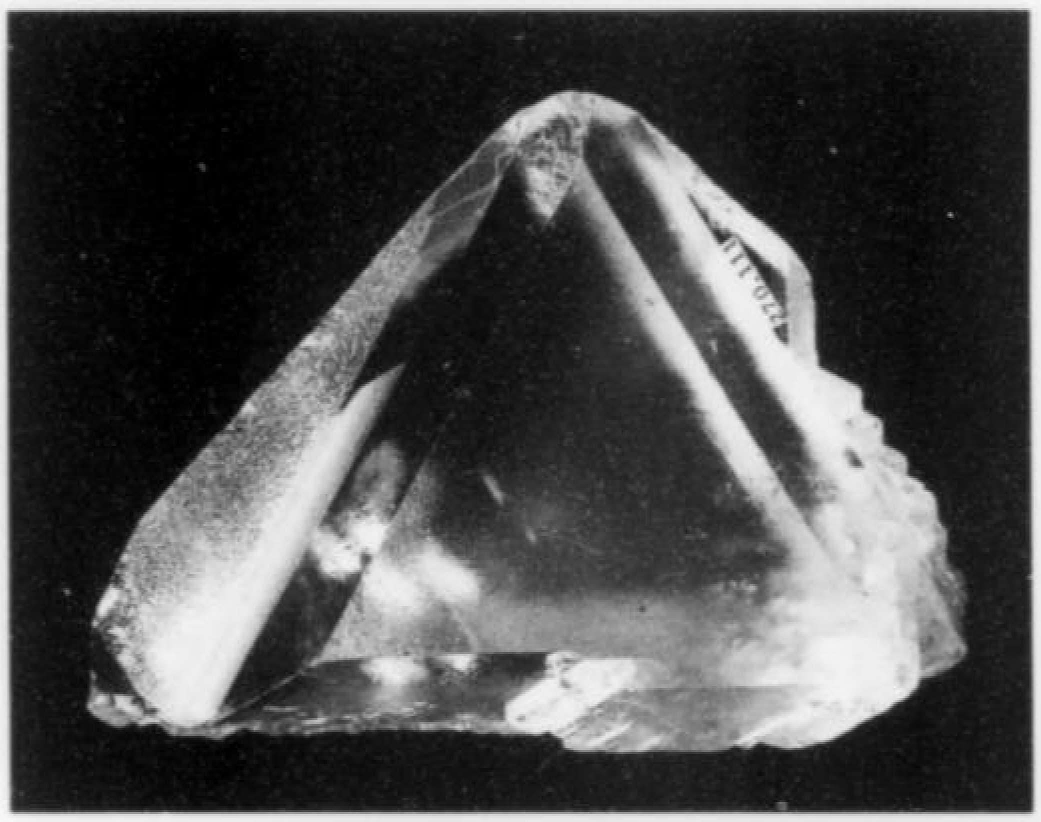


Figure 16. **Calcite from Rossie, New York. New York State Museum specimen (#270.111, Erastus Corning collection), 11.5 x 15 cm. Photo by S. C. Chamberlain.**

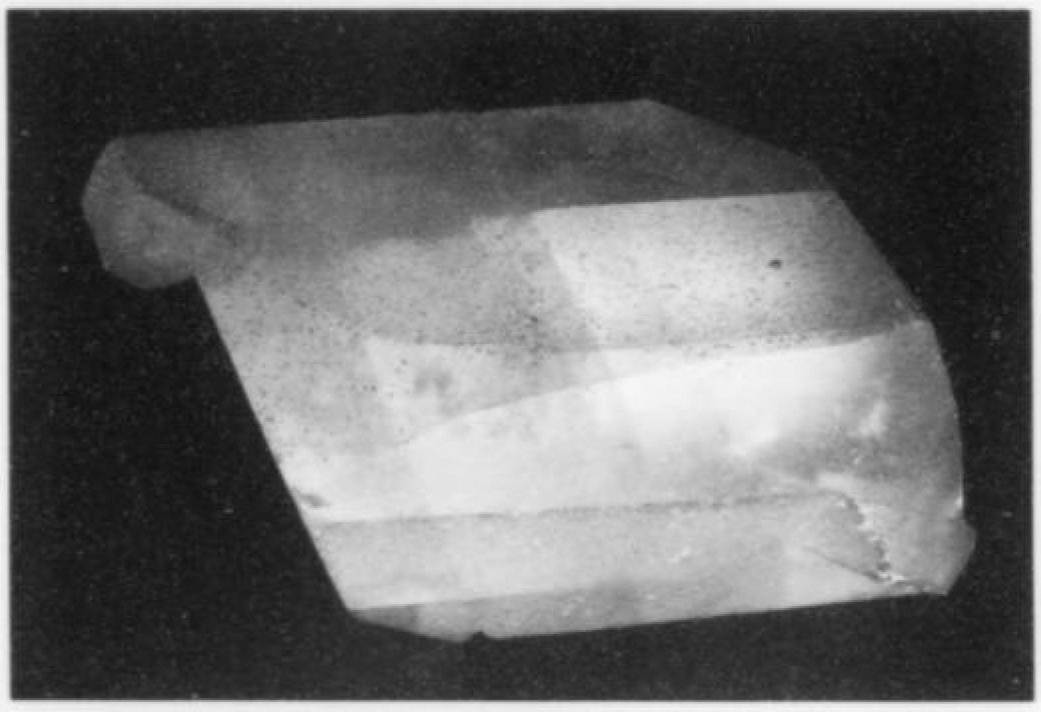


Figure 17. **Calcite from Rossie, New York. Hamilton College specimen (#H62, Oren Root collection), 19 cm in maximum dimension. Photo by S. C. Chamberlain.**

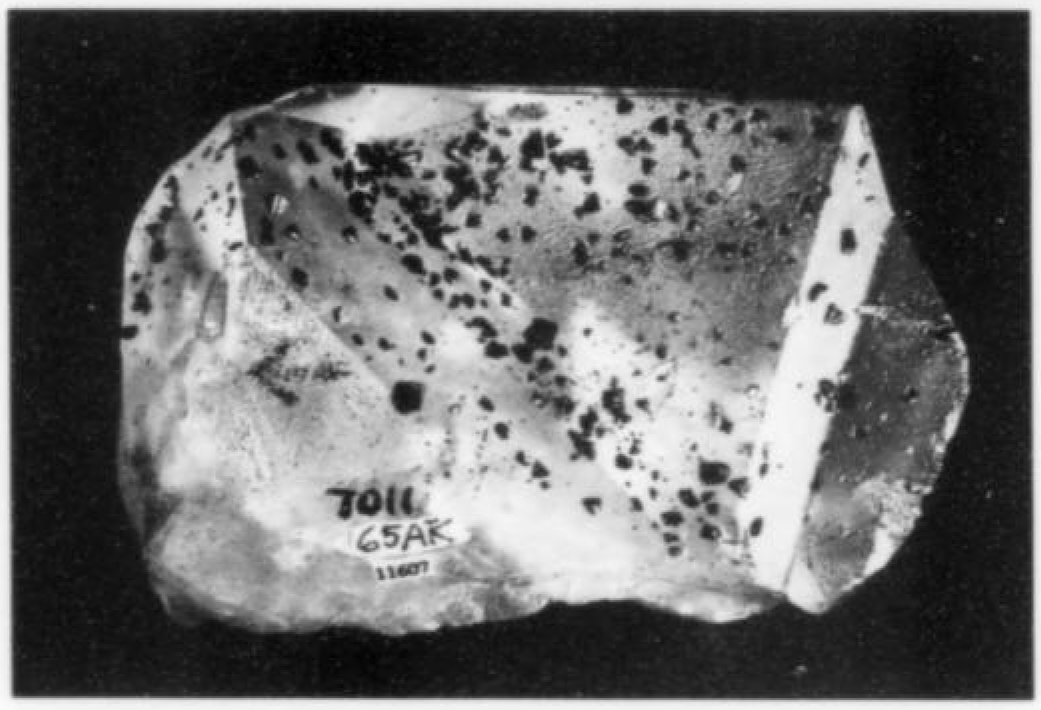


Figure 18. **Chalcopyrite on calcite from Rossie, New York; 9 cm in maximum dimension. Originally from the Clarence Bement collection (AMNH #7011), then the Edward E. David, Jr. Collection (#65AK) and currently in the Steven C. Chamberlain collection (#11607). Photo by S. C. Chamberlain.**

Table 1. **Other species from Rossie-type vein deposits.**

Species	*Occurrence*	*Reference*
Barite	General occurrence	Brown (1983), (unconfirmed)
Brochantite	Coal Hill vein; oxidation product on chalcopyrite	This study
Clinochlore	Coal Hill vein; gray-green microcrystals with microcline and pyrite	This study
Covellite	Locality 9, Redwood; microcrystals resembling iridescent hematite	This study
Dolomite	Macomb group mines; locality 5; 1–2 mm tan-white rhombohedra	Buddington (1934), this study
Fluorapatite	Coal Hill vein; colorless 0.3 mm microcrystal; alpine assemblage	This study
Kaolinite	Locality 5; cream-white micaceous crystal aggregates to 1 mm	This study
Malachite	Locality 9, Redwood; green film staining calcite	This study
Strontianite	General occurrence	Buddington (1934), (unconfirmed)
Sulfur	Locality 5; subhedral microcrystals to 0.5 mm on altered galena	This study
Titanite	Mineral Point mine, pinkish brown microcrystals; alpine assemblage	This study

Figure 19. **Pale blue celestine crystals to 2.5 cm on calcite from the Coal Hill vein. New York State Museum collection (#28.3.1.2-4), field of view 9 x 12 cm. Photo by G. Robinson.**

Figure 20. **A 1.2-cm octahedral crystal of green fluorite on calcite from Rossie, New York. New York State Museum specimen (Erastus Corning collection); photo by S. C. Chamberlain.**

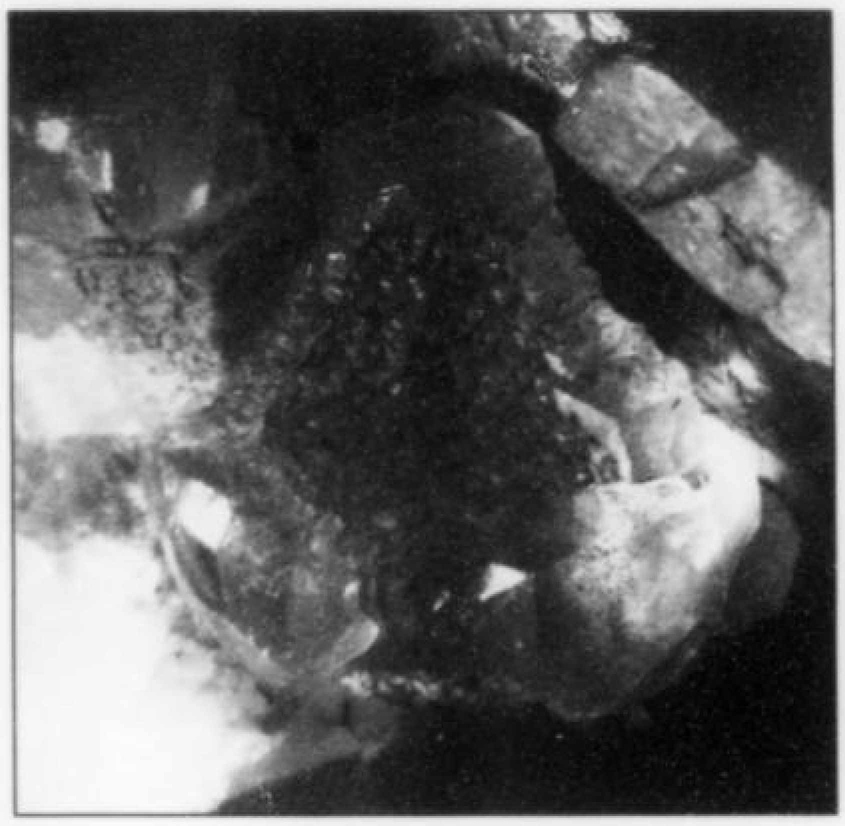


Figure 21. **A 1.2-cm octahedral crystal of pale green fluorite with hexoctahedral overgrowths from Rossie, New York. This is probably the specimen figured by Whitlock (1910b) from the Erastus Corning collection in the New York State Museum (#581). Photo by S. C. Chamberlain.**

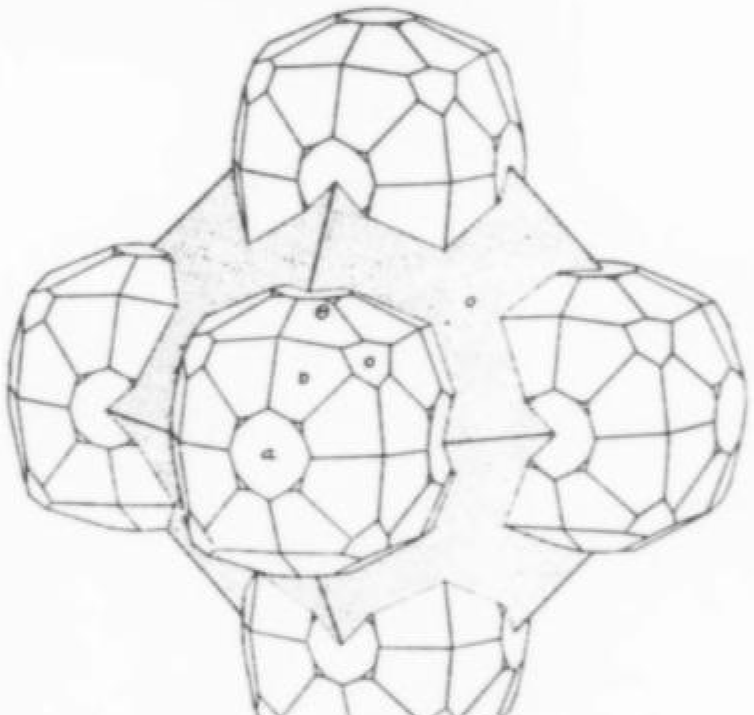


Figure 23. **Crystal drawing of fluorite illustrated in Figure 26 showing the forms *a* {100}, *o* {111}, *ν* {731} and Θ {19.1.1} (from Whitlock, 1910b).**

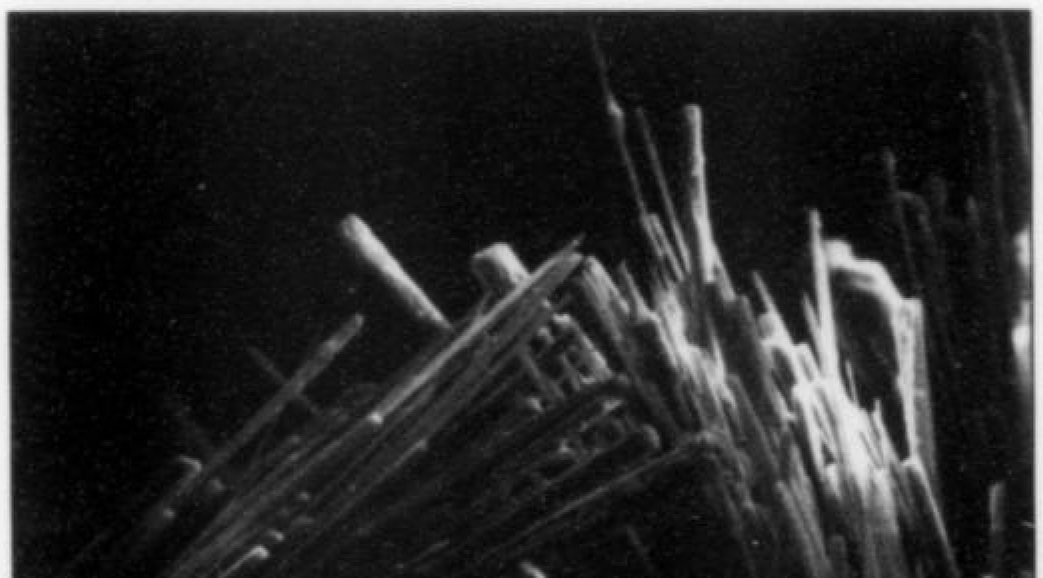


Figure 22. **SEM photomicrograph of cerian epidote from the Coal Hill vein; magnification 450X. Canadian Museum of Nature specimen; photo by G. Robinson.**

1844; Dana, 1844b; Zippe, 1852; Hessenberg, 1860; Nason, 1888; Goldschmidt, 1913). Remarkably, the first edition of Dana's *System of Mineralogy*, published in 1837—the same year the mines opened—illustrates a calcite crystal from Rossie! However, the most complete crystallographic study of calcite from Rossie is probably that of Whitlock (1910a), who categorized the crystals into four general types (hexagonal indices): (**1**) large, colorless to pale lavender, modified rhombohedral crystals showing the forms $\{0001\}$, $\{11\bar{2}0\}$, $\{62\bar{8}1\}$, $\{10\bar{1}1\}$, $\{40\bar{4}1\}$, $\{70\bar{7}1\}$ and $\{02\bar{2}1\}$; (**2**) smaller modified rhombohedral crystals with forms $\{40\bar{4}1\}$, $\{10\bar{1}1\}$, $\{02\bar{2}1\}$, $\{7.2.\bar{9}.11\}$, $\{21\bar{3}1\}$, $\{24\bar{6}1\}$, $\{4.6.\bar{10}.1\}$ and $\{62\bar{8}1\}$; (**3**) small, highly modified rhombohedrons with forms $\{10\bar{1}0\}$, $\{50\bar{5}1\}$, $\{40\bar{4}1\}$, $\{10\bar{1}1\}$, $\{01\bar{1}2\}$, $\{05\bar{5}4\}$, $\{04\bar{4}3\}$, $\{02\bar{2}1\}$, $\{21\bar{3}1\}$, $\{24\bar{6}1\}$, $\{4.6.\bar{10}.1\}$, $\{14.2.\bar{16}.3\}$, $\{62\bar{8}1\}$, $\{15.7.\bar{22}.2\}$ and $\{39.15.\bar{54}.8\}$; and (**4**) large, slightly more scalenohedral crystals exhibiting forms $\{10\bar{1}0\}$, $\{8.8.\bar{16}.3\}$, $\{16.0.\bar{16}.1\}$, $\{80\bar{8}1\}$, $\{40\bar{4}1\}$, $\{10\bar{1}1\}$, $\{01\bar{1}2\}$, $\{31\bar{4}5\}$ $\{21\bar{3}1\}$, $\{43\bar{7}1\}$, $\{4.16.\bar{20}.3\}$ and $\{62\bar{8}1\}$. Penetration twins on $\{0001\}$ are relatively common in all four types of crystals, particularly among the larger individuals.

Calcite is the most abundant mineral in all the Rossie-type veins, and as such may be in direct association with all other species present in a given vein. Whitney (1854) describes the calcite crystals from the Coal Hill vein as "some of the finest crystallizations of this mineral ever found . . . [with] one gigantic crystal, nearly transparent, in the cabinet of Yale College, [weighing] 165 pounds". Large twinned crystals and crystal groups with galena can be seen in most of the world's major mineral museums, though perhaps the finest and most complete suite of specimens is that in the Oren Root collection at the Geological Museum of Hamilton College, Clinton, New York. Examination of this suite of calcite specimens reveals five principal habits: (**1**) simple rhombohedral crystals, often twinned, and translucent gray to colorless, although occasionally opaque and white; (**2**) equant modified rhombohedra resembling "faceted spheres," usually gray to colorless; (**3**) sharp, lavender rhombohedral crystals with prominent saw-tooth development of the acute edges; (**4**) color-zoned scalenohedral crystals of transparent lavender and white or pale amber and white; and (**5**) pale amber crystals of a distorted nail-head habit, with abundant drusy crystals in parallel growth, often associated with celestine. There is, of course, extensive variation within each group.

Calcite specimens collected in the past several decades from the dumps seem to show a somewhat greater range of zoning, habits, surface features and tints than those previously preserved in museums. This probably reflects an abundance of excellent specimens that were preferentially saved from relatively large cavities which provided less overall variability than some of the lesser specimens from smaller cavities that ended up in the dumps.

Electron microprobe and $^{13}C - ^{18}O$ isotope analyses (this study) of calcites from several Rossie-type occurrences are given in Table 2 (trace element concentrations in ppm, $\delta\,^{13}C$ and $\delta\,^{18}O$ ‰ relative to PDB). All samples analyzed proved to be essentially pure calcite, with Mn, Mg, Fe and Sr as the most prevalent trace elements. Backscattered electron images of one white crystal from the Union vein showed minor chemical zoning with respect to Mg and Mn, but otherwise all samples examined appeared homogeneous.

Celestine $SrSO_4$

Pale blue, tabular crystals of celestine up to 3 cm have been found associated with calcite at the Coal Hill vein, but good specimens are uncommon. Electron microprobe analysis of one sample (NY State Museum #56) showed it to be essentially pure celestine: SrO 55.93, SO_3 43.31, sum 99.24 weight %, with 415 ppm Ca and 1145 ppm Fe (Ba, Mg, Mn, Na, K, Pb, Rb, Y and Cl were sought but not detected).

Cerussite $PbCO_3$

Cerussite is a common constituent of the powdery white alteration products found coating galena specimens from the Rossie-type vein occurrences (see discussion of anglesite, above). During the course of mining, the presence of an earthy white mixture of cerussite and calcite, called "putty" by the miners, was "considered as a sure indication of galena" (Emmons, 1837). Crystals of cerussite perched on relatively unaltered galena crystals are extremely rare, and seldom exceed 1 mm in maximum dimension.

Chalcopyrite $CuFeS_2$

Small crystals of chalcopyrite occur consistently but usually only in small quantities at most of the Rossie-type veins examined. Most crystals form simple disphenoids 2–5 mm across scattered on the surfaces of calcite crystals or included within them. An exceptional occurrence is on the Charles Washburn farm, a few hundred meters south of locality 5 (Fig 1), where crystals over 1 cm across have been found in a calcite vein known locally as "the copper mine" (Brown, 1983, locality 2).

Epidote Group $(Ca,Ce)_2(Al,Fe^{3+})_3(SiO_4)_3(OH)$

Rare-earth-bearing epidote-group minerals have been identified from a number of hydrothermal vein occurrences in the central metasedimentary belt of the Grenville geological province (Richards and Robinson, 1995; 2000). Most are cerian epidotes, but some are allanite-(Ce). At the Coal Hill vein, these minerals form microscopic radial aggregates of acicular gray-green crystals generally less than 0.5 mm across coating calcite crystals. Associated species include clinochlore, pyrite and microcline. Electron microprobe analyses of crystals from the Coal Hill vein show variations in total REE contents from 0.11 to 0.69 atoms pfu, with Ce > Nd > La > Sm. Calculating Fe^{2+}, Fe^{3+} and $(OH)^-$ by stoichiometry, and assuming preferential ordering of REE and Fe into the A(2) and M(3) sites, respectively (Dollase, 1971), the most REE-rich sample analyzed has the composition: $Ca(Ce_{.38},Ca_{.33},Nd_{.17},La_{.12},Sm_{.02})$-$Al_2(Fe^{2+}_{.65},Fe^{3+}_{.25},Al_{.07},Mg_{.02})Si_{2.99}O_{12}(OH)$, and is thus allanite-(Ce).

A mineral similar in appearance has been noted on a single specimen of calcite and fluorite from the Mineral Point lead mine, but has not been analyzed. Interestingly, colorless to pale pink acicular microscopic crystals associated with albite and titanite on a granodiorite xenolith from the main vein at Mineral Point give an X-ray powder-diffraction pattern similar to that of allanite.

Fluorite CaF_2

Like chalcopyrite, fluorite is found sporadically in many of the Rossie-type veins. It typically forms blue-green cleavage masses 1–2 cm across intergrown with calcite, though small octahedral crystals are occasionally encountered. Beck (1842) reports purple cuboctahedral crystals in calcite from "near Rossie," but the most interesting specimen of fluorite known from Rossie is probably that described by Whitlock (1910b), which consists of complex, pale green hexoctahedral overgrowths on octahedral crystals up to 1.5 cm across. The compound crystals are bounded by forms $\{100\}$, $\{111\}$, $\{731\}$ and $\{19.1.1\}$, and show violet cubic color zones along their *a* axes, similar to those from Old Chelsea, Québec (Grice, 1981). They occur together with chalcopyrite on a 9 x 5-cm specimen of rhombohedral calcite crystals collected by Ebenezer Emmons prior to 1870, and now part of the Erastus Corning collection at the New York State Museum. At least two similar but smaller fluorite specimens have been collected from the dumps at the Coal Hill vein by one of us (GWR) circa 1970, and Georgia Shaw, circa 1980. In the Peabody Museum collection at Yale University there are several large (10–20 cm) etched cubes of pale green fluorite labeled as coming from Rossie, New York. While these may have come from one of the lead mines, it is also possible that they are from either the Macomb or Muskalonge Lake

Table 2. **Trace element and stable-isotope analyses—Rossie-type vein calcites.**

Sample	*Mg*	*Fe*	*Mn*	*Sr*	*Other**	$\delta^{13}C$	$\delta^{18}O$
White crystal, zone 1 Union Vein, Rossie, NY Host: gneiss	440	968	1883	0	0	—	—
White crystal, zone 2 Union Vein, Rossie, NY Host: gneiss	1172	1124	3039	0	0	—	—
Purple crystal Coal Hill Vein, Rossie, NY Host: gneiss	272	543	1542	297	0	−1.45	−11.96
White crystal Clute mine, Gouverneur, NY Host: marble	136	484	694	226	Cl = 187	−2.71	−13.00
White crystal Mineral Point, Hammond, NY Host: marble + gneiss	2329	2050	2968	200	0	−2.66	−12.48
White cleavage Redwood, NY Host: sandstone	602	919	1957	0	Al = 85	−0.20	−13.28
White cleavage Frontenac mine Draper Lake, Ontario Host: marble + gneiss	478	818	2666	193	0	−1.01	−10.35
Purple crystal Kingdon mine Galetta, Ontario Host: marble + gneiss	314	358	1125	250	0	−3.39	−13.54
White cleavage Ramsay mine Carleton Place, Ontario Host: sandy dolostone	286	622	1360	184	0	+0.33	−12.98
White cleavage unnamed prospect Fermoy, Ontario Host: marble	339	909	2947	0	0	+0.61	−13.45

* sought elements: Pb, U, Zn, Co, Rb, Ni, Cu, Y, Al, Ce, Na, S, Cl, K & Ba
elemental concentrations reported as ppm; $\delta^{13}C$ and $\delta^{18}O$ reported as ‰ PDB

fluorite occurrences, neither of which is distant from Rossie (Kunz, 1889; Beck 1842).

Two samples of blue-green and purple fluorite collected from the dumps at the Coal Hill vein were analyzed by electron microprobe for trace Sr, Ba, K, Cl, Mg, Mn, Fe, Na and REE. The blue-green sample was found to contain 221 ppm Sr, and the purple sample, 1123 ppm Dy. Other than Ca and F, no other elements were detected in either sample.

Galena PbS

After calcite, galena is probably the best-known mineral from the Rossie veins. The most common crystal form is the simple cube, occasionally modified by octahedron faces, though predominantly octahedral crystals are sometimes found embedded in massive calcite. Dana (1869) illustrates more complex crystals, exhibiting the forms {100}, {110}, {111} and {322}, as well as spinel-law twinned crystals. Cubic crystals up to 15 cm are known, and Whitney (1854) states that "groups of crystals weighing over a hundred pounds" were obtained from near the surface of the Coal Hill vein. One specimen preserved in the Harvard University Mineralogical Museum measures 30 cm across, with cubic crystals to 12 cm. Although many of the galena specimens seen in museum collections show large gray cubes with dull surfaces, similar to those collected from the dumps today, specimens with splendent faces are present in the Oren Root collection at Hamilton College, The New York State Museum in Albany, the American Museum of Natural history, the Harvard University Mineralogical Museum, the Canadian Museum of Nature in Ottawa, and elsewhere. Calcite is often associated, and crystal aggregates of these two minerals are common.

Emmons (1842) described the occurrence of these specimens:

> Soon after the [Coal Hill] vein was opened, a large geode, or cavity termed a *water course* by miners, was struck. This

Figure 24. **Galena on calcite with minor sphalerite and pyrite from Rossie, New York. Canadian Museum of Nature specimen (#50932); field of view 6 x 8 cm. Photo by G. Robinson.**

Figure 25. **Galena from Rossie, New York. New York State Museum specimen (#2.6.1.1-27); largest crystal is 7.5 cm. Photo by S. C. Chamberlain.**

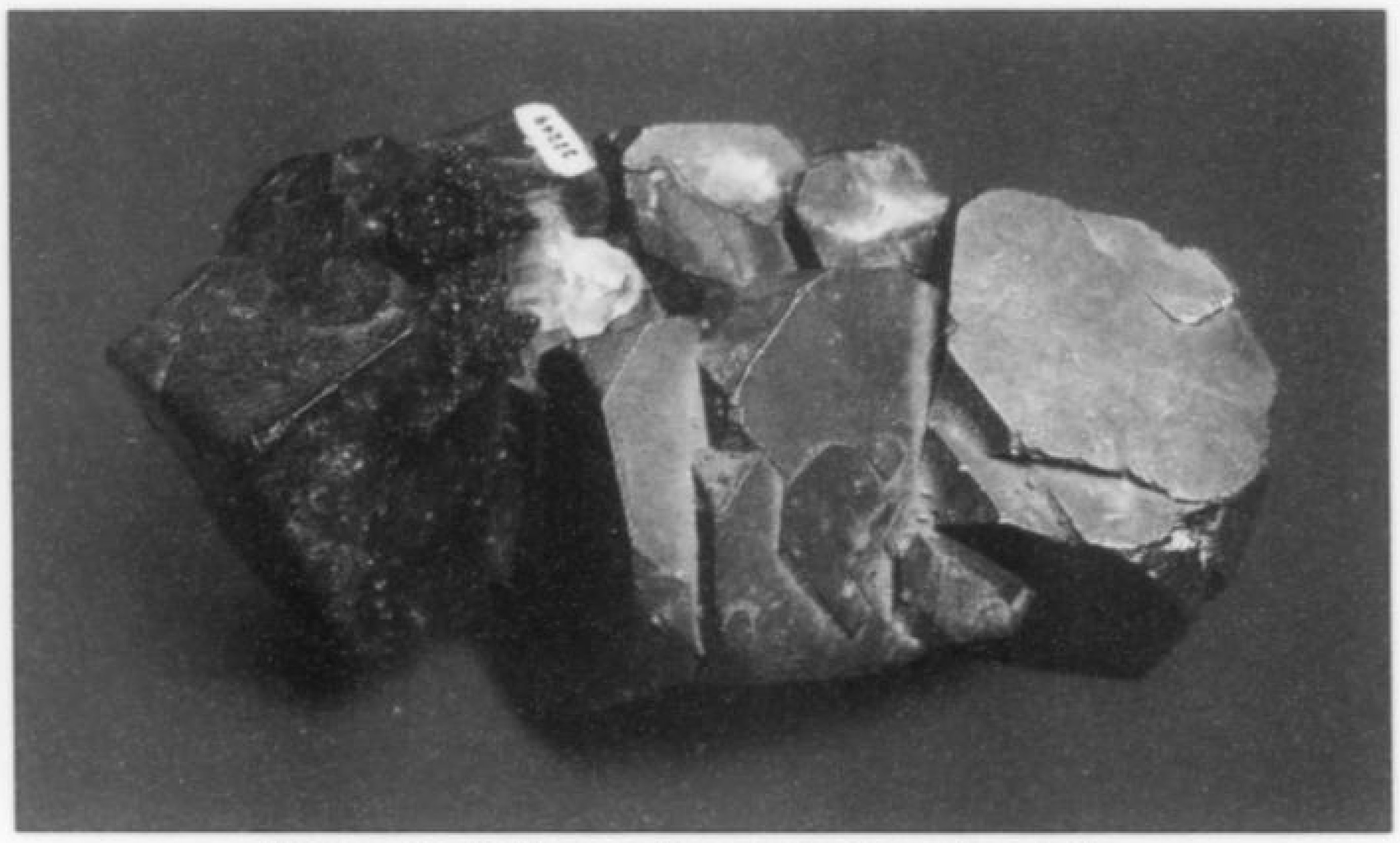


Figure 26. **Galena with sphalerite and calcite from Rossie, New York. Hamilton College specimen (#H5, Oren Root collection); 14 cm in maximum dimension. Photo by S. C. Chamberlain.**

> course was found lined with crystals of galena, whose edges bounding the faces were three inches in length. Some of the single crystals weighed thirty-five pounds; generally they came out in groups, whose aggregate weight exceeded one hundred pounds. . . .

Remnants of such a water course were still visible in a pillar between the "Crystal" and "Engine" shafts (Fig. 8) circa 1965, though no galena crystals remained.

Rossie-type vein galena is relatively pure PbS. Trace amounts of silver have been reported (Whitney, 1854), but electron microprobe trace element analyses (this study) for Bi, Ag, Cu, Fe, Zn, As, Sb, Cd, Se, Te and Mn failed to detect any of these elements in samples from seven different localities (estimated minimum detection limits for the method used varied from ~100–600 ppm for all elements except Bi, which is ~2000 ppm). However, ICP-MS analyses of two specimens in the New York State Museum collection showed up to 289 ppm Mn, 50 ppm Ni, 3,013 ppm Cu and 1 ppm Co (M. Hawkins, personal communication).

Figure 27. **Galena crystal cluster, 6.4 cm, from Rossie, New York. Joseph Polityka collection; Wendell Wilson photo.**

Figure 28. **Galena from Rossie, New York. Harvard University Mineralogical Museum (#95611); 6.5 x 10 cm. Photo by G. Robinson.**

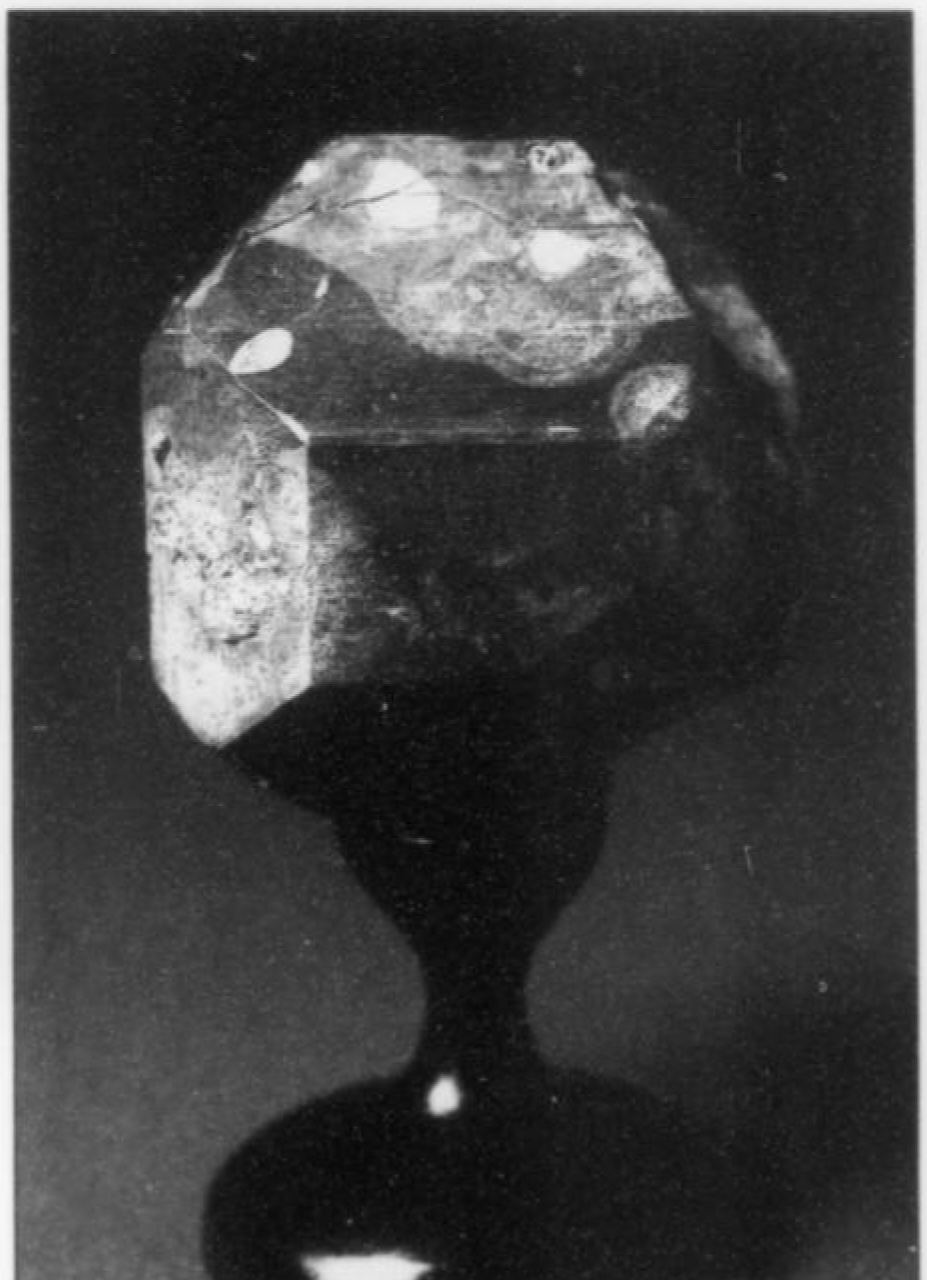


Figure 29. **A 3.5-cm crystal of pyrite from Rossie, New York. New York State Museum specimen (#208, Ebenezer Emmons collection); Photo by S. C. Chamberlain.**

Marcasite (FeS_2)

Whitlock (1910a) reported the presence of microscopic crystals of marcasite associated with chalcopyrite coating scalenohedral faces of a calcite specimen in the collection of the American Museum of Natural History. A second specimen in the collection of Richard and Elna Hauck of Franklin, New Jersey, consists of a 5-mm thick crust of botryoidal marcasite partially coating a calcite crystal.

Microcline $KAlSi_3O_8$

Microscopic pink to greenish tan colored crystals of microcline occur rather abundantly with quartz and albite on the surfaces of altered granitic xenoliths at the Coal Hill mine. This mineral was earlier misidentified by collectors as strontianite or stilbite. Microcline also has been observed as orange-pink adularia-habit crystals up to 5 mm in length growing on the surfaces of calcite crystals from pockets within the main vein. One such crystal was extracted

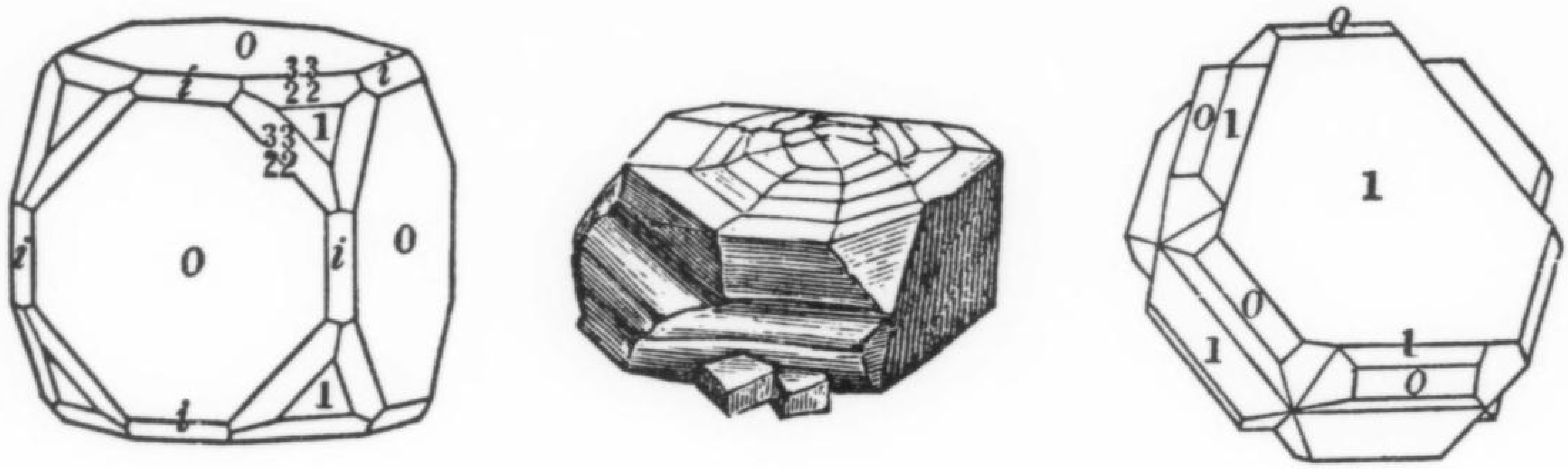


Figure 30. **Selected drawings of galena crystals from the Rossie lead mines showing forms: l {111}, O {100}, i {110} and 3/2,3/2 {322} (from Dana, 1869).**

and prepared for radiometric dating by the $^{40}Ar/^{39}Ar$ method. Procedures used were similar to those given in Hall and Farrell (1995). Mass spectrometry was performed using a VG1200S mass spectrometer equipped with a Daly detector operated in analog mode. Typical ^{40}Ar blanks consisted of $\sim 2 \times 10^{-16}$ moles and the blank at mass 36 was about 1×10^{-13} moles. Gas fractions were extracted using a Coherent Innova 5 W Ar-ion laser operated in multi-line mode. The results for the Coal Hill K-feldspar yielded a plateau segment over 80.4% of the ^{39}Ar released with an apparent age of 186.6 ± 1.8 (2σ) Ma and an indistinguishable total gas age of 186.2 ± 1.3 Ma (Fig. 38). We interpret the plateau age to be our best estimate for the K-feldspar's formation age. The age is calculated relative to an age of 520.4 Ma for standard hornblende MMHb-1 (Samson and Alexander, 1987).

Pyrite FeS_2

Pyrite is a minor constituent in most of the Rossie-type veins in the area, but large well-formed crystals are not common. Beck (1842) and Dana (1844a,b) describe perfect, lustrous, cubic crystals modified by various combinations of forms (Fig. 32), but few of these appear to have been preserved in collections.

Quartz SiO_2

Quartz occurs abundantly as colorless prismatic crystals up to 2 mm in length associated with albite, microcline and minor anatase forming drusy coatings on altered granitic xenoliths at the Coal Hill vein. Excellent micromounts of this assemblage are still collectable on the dumps.

Smithsonite $ZnCO_3$

Smithsonite is a major constituent of most of the gray-white alteration coatings present on sphalerite specimens from the Rossie veins. It is relatively abundant at Locality 9 (Fig. 1) near Redwood, where it forms pink, yellow and gray-white botryoidal crusts up to 1 mm thick on and in altered sphalerite. Collector-quality specimens are not known.

Sphalerite ZnS

Like pyrite, small amounts of sphalerite are common in virtually

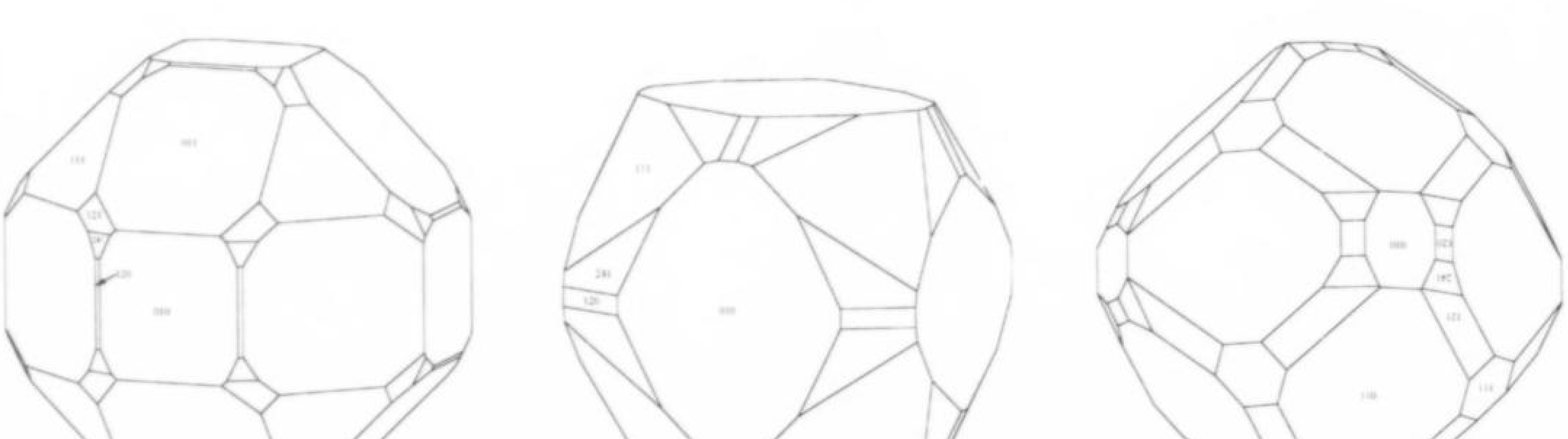


Figure 31. **Selected crystal drawings of pyrite from the Rossie lead mines showing forms: cube {010}, dodecahedron {011}, octahedron {111}, pyritohedron {120}, trapezohedron {121} and diploid {241}, from Goldschmidt (1913) and Dana (1837), redrawn with SHAPE computer program 4.0.**

Table 3. **Trace element and stable-isotope analyses—selected gash vein calcites.**

Sample	*Mg*	*Fe*	*Mn*	*Sr*	*Other**	$\delta^{13}C$	$\delta^{18}O$
White crystal Macomb fluorite mine Macomb, New York Host: marble	246	569	645	0	0	−5.43	−11.93
White crystal Muskalonge Lake fluorite vein Jefferson County, New York Host: marble	0	652	1286	211	0	−1.28	−11.61
White crystal Black Creek barite occurrence Westport, Ontario Host: marble	373	1125	1878	0	0	+0.23	−11.34
White crystal Galetta celestine occurrence Galetta, Ontario Host: marble	331	495	538	0	0	+1.39	−13.06
Pale yellow crystal Yellow Lake roadcut North of Oxbow, New York Host: marble	807	1601	1380	233	0	−0.72	−11.39
Pale lavender crystal Sterlingbush calcite cave Sterlingbush, New York Host: marble	235	558	2303	0	0	−0.87	−13.15
Colorless crystal Natural Bridge, New York Host: marble	846	1593	1883	307	0	−2.25	−13.22
Gray-white crystal Crawford barite mine Sharbot Lake, Ontario Host: marble	428	938	946	0	0	+1.74	−11.75
White crystal (pre-fluorite)	257	887	754	0	0	+1.31	−11.61
Gray crystal (post-fluorite) Madoc fluorite mines Madoc, Ontario Host: various	1182	1272	789	230	0	−2.22	−8.85

* sought elements: Pb, U, Zn, Co, Rb, Ni, Cu, Y, Al, Ce, Na, S, Cl, K & Ba
elemental concentrations reported as ppm; δ^{13}C and δ ^{18}O reported as ‰ PDB

all Rossie-type veins, but seldom in collector-quality crystals. Most sphalerite in these deposits forms disseminated massive brown clots or stringers in the calcite, though occasionally aggregates of euhedral, yellow-brown crystals up to 3 mm may be found in vugs with calcite and galena. An electron microprobe analysis of one sample from the Coal Hill vein gave Zn 63.43, Fe 3.12, Cd 0.21, Hg 0.36, Ga 0.04, S 33.11, sum 100.27 weight % (Mn, Cu, Ag, Sn, In, Se, Te and Tl were also sought but not detected).

Synchysite-(Ce) $Ca(Ce,La)(CO_3)_2F$

During the course of this investigation, REE-carbonate minerals were observed as rare microscopic inclusions in calcite from several Rossie-type and related veins in both northern New York and southeastern Ontario. However, at the Coal Hill vein, free-standing crystals of synchysite-(Ce) have been found in association with the albite-quartz-microcline-anatase assemblage, as well as with calcite in vugs in the primary vein. In both instances the crystals form colorless-to-pale pink tabular hexagonal individuals up to 0.5 mm in diameter. Whereas such crystals are not common, they easily may be overlooked due to their size and pale color. An electron microprobe analysis of one crystal yielded a composition of $Ca_{1.03}(Ce_{.37}Nd_{.21}La_{.15}Y_{.13}Pr_{.05}Sm_{.04}Gd_{.02}Dy_{.02})(CO_3)_2F$, based on 7 anions and assuming 2 C and 1 F atoms.

DISCUSSION

The origin of Rossie-type veins has long been a subject of debate. The deposits are distributed over a wide geographic area, yet are characterized by remarkably similar mineral assemblages, structural relationships and geochemical trends in spite of diverse host-rock lithologies. Stable-isotope and trace-element analyses of calcites from Rossie-type and related gash vein deposits (Brown, 1983; Dix and Robinson, submitted) are quite similar overall and show no apparent correlation with sample color, host rock lithol-

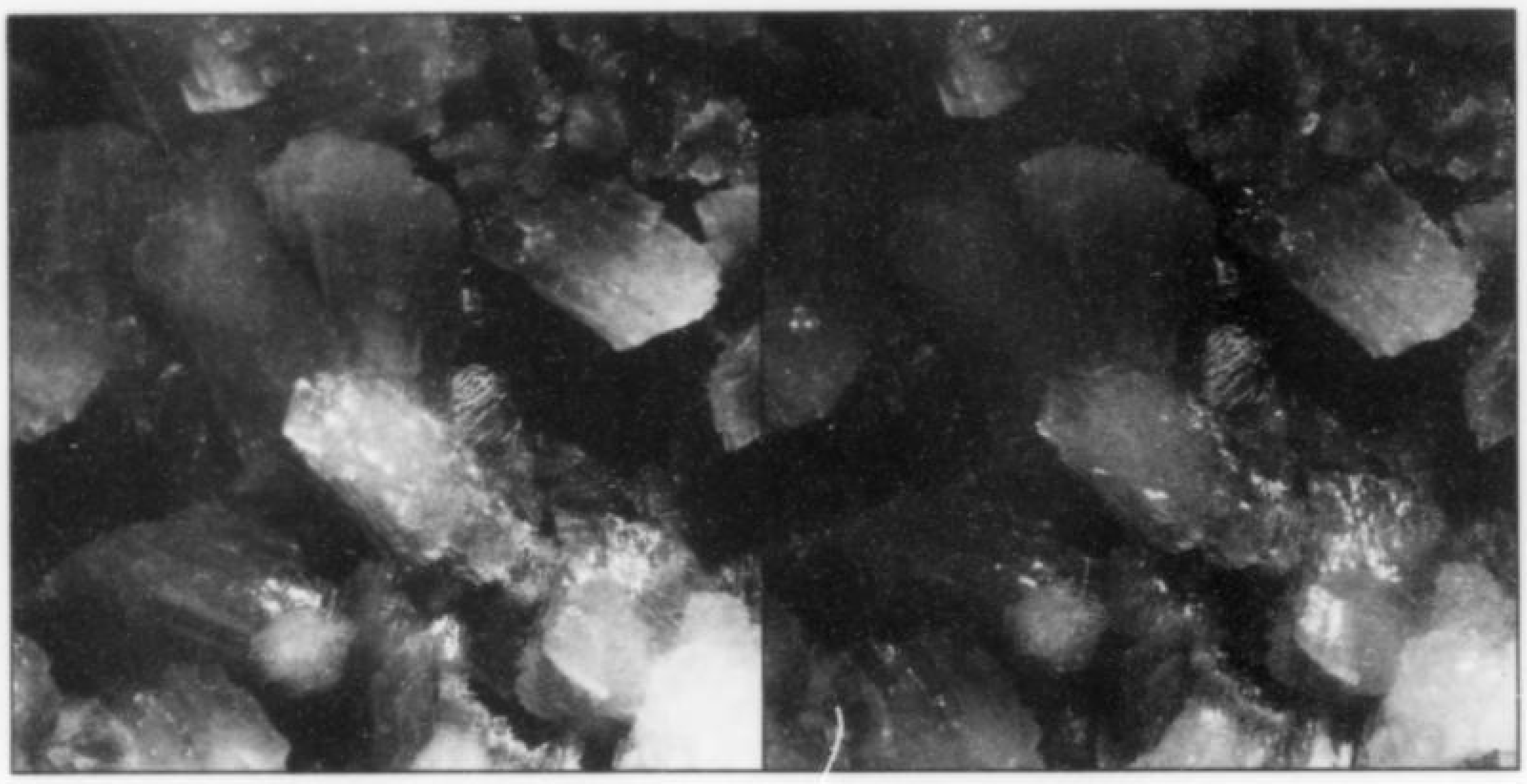
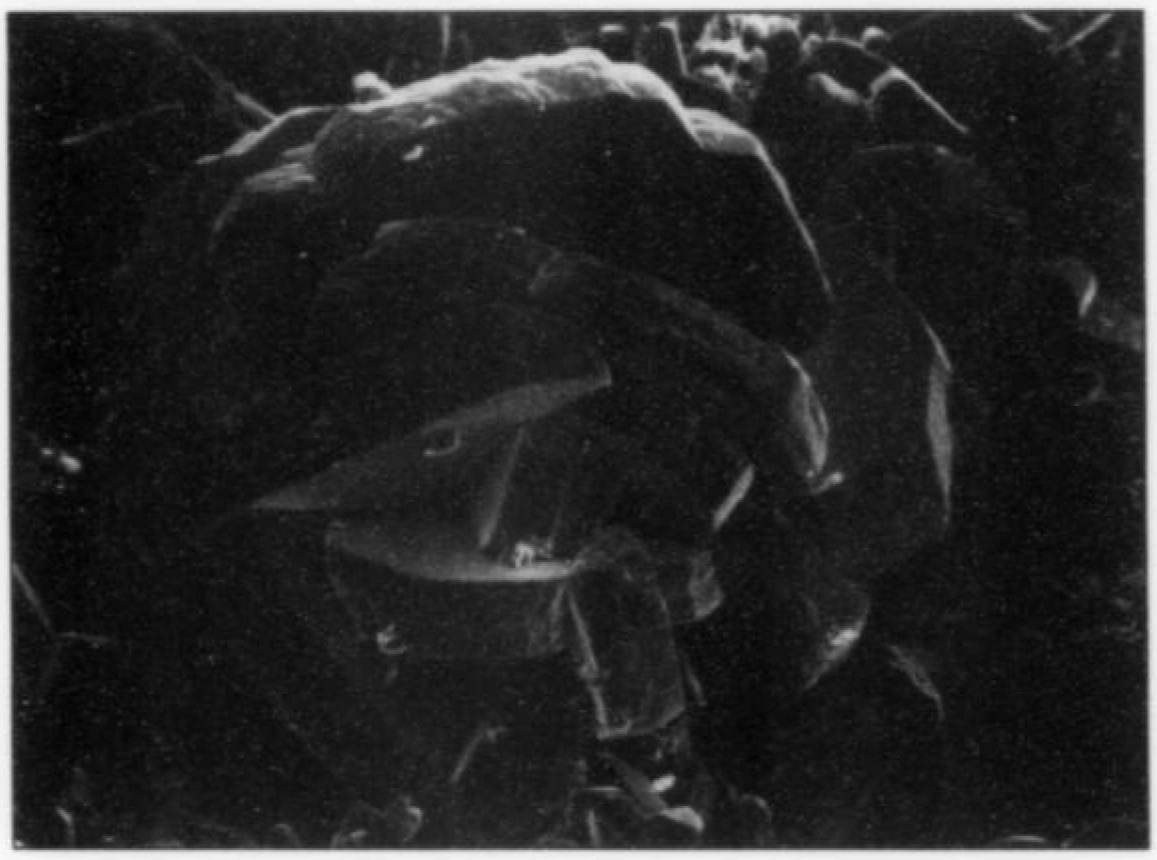


Figure 32. **Microcline (var. adularia) collected from the dumps at the Coal Hill vein, ca. 1970 (GWR). Canadian Museum of Nature collection (#48268); the crystals are ~2 mm thick. Stereopair photomicrograph by S. C. Chamberlain.**

Figure 33. **Pyrite on calcite, Rossie, New York; largest crystal is 6 mm on edge. New York State Museum specimen (#203, Ebenezer Emmons collection); Photo by S. C. Chamberlain.**

Figure 34. **SEM photomicrograph of synchysite-(Ce) on albite and quartz from the Coal Hill vein; magnification 250X. Canadian Museum of Nature specimen; SEM photomicrograph by G. Robinson.**



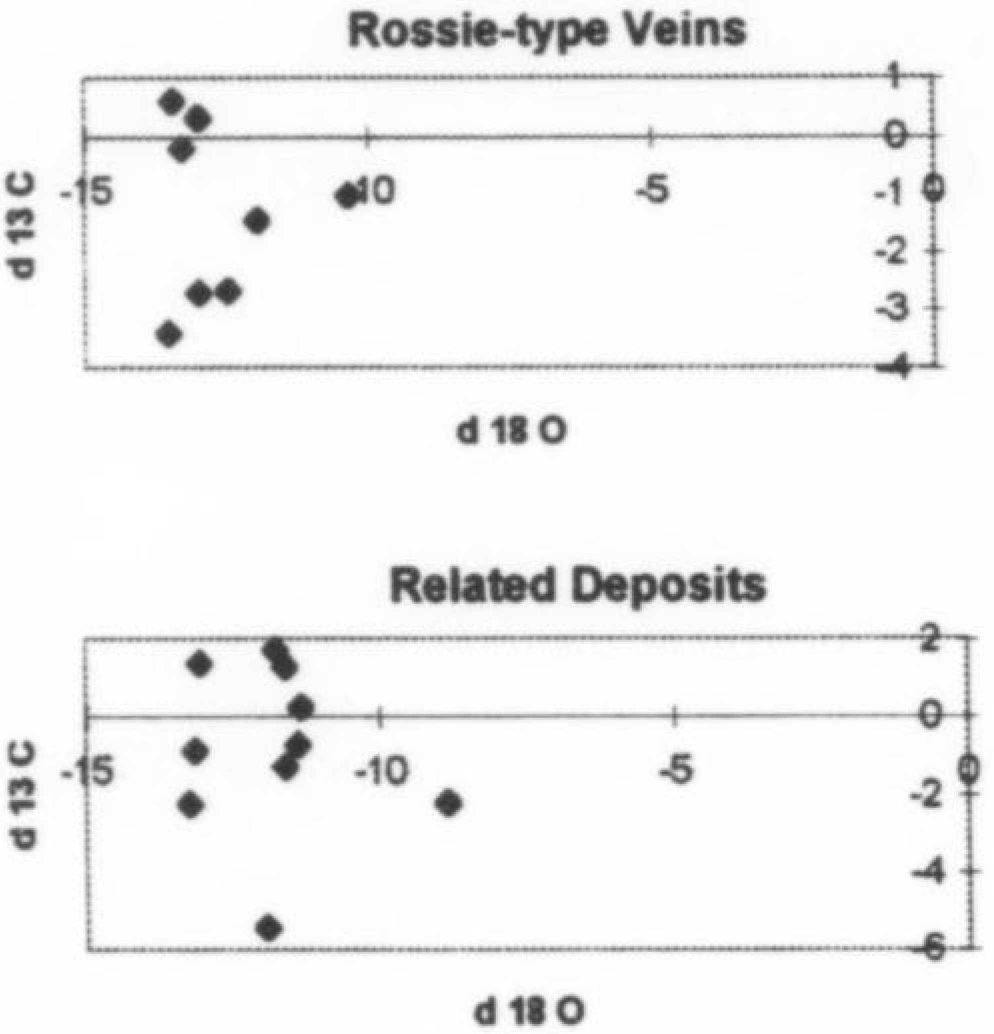


Figure 35. **Comparison of $\delta\ ^{18}O$ and $\delta\ ^{13}C$ ranges for calcites from Rossie-type veins and genetically related deposits.**

ogy or geographic distribution. Figure 35 compares $\delta\ ^{18}O$ and $\delta\ ^{13}C$ isotope data for calcites from the localities given in Table 2 to those from a number of nearby gash vein and other, probably related, deposits (Table 3). These observations suggest the deposits share a common origin (Uglow, 1916; Alcock, 1930; Fletcher and Farquhar, 1982; Brown, 1983; Ayuso *et al.*, 1987; Carignan *et al.*, 1997; Dix and Robinson, submitted).

The alpine-type albite-quartz-microcline assemblages associated with altered gneiss xenoliths at the Coal Hill and Mineral Point veins most likely resulted from minor reaction of the xenoliths with the mineralizing solutions that deposited the vein material. At the Coal Hill vein, the alpine assemblage is most prevalent in altered granitic gneiss, but is not confined to that lithology. Less frequently, the same minerals occur on the surfaces of altered dioritic gneiss xenoliths, and microcline, clinochlore, cerian epidote and synchysite-(Ce) have all been identified as rare accessory minerals in vugs within the calcite vein. In one instance microcrystals of synchysite-(Ce) and quartz were observed growing from the surface of an inclusion of bleached Potsdam (?) Sandstone.

Electron microprobe analyses of samples from the Coal Hill vein prove all the elements essential to form the observed alpine minerals are present in the host gneisses. Potassium feldspars in the host gneiss and unaltered xenoliths contain approximately 10 atomic percent Na, whereas those in altered blocks contain an order of magnitude less Na, suggesting Na was leached from them. Unaltered plagioclase in the same samples varies from 0.2–0.3 mole % anorthite, while altered plagioclase appears more sodic with 0.02–0.2 mole % anorthite. Fresh biotite in the host gneiss and unaltered xenoliths contains approximately 0.26–0.33 atoms pfu Ti, and alters to clinochlore. Similarly, fresh potassian ferropargasite in the dioritic gneiss contains approximately 0.3 atoms Ti pfu and trace amounts of Ce and Sr, and alters to a mixture of calcite and clinochlore similar in composition to that derived from biotite, but

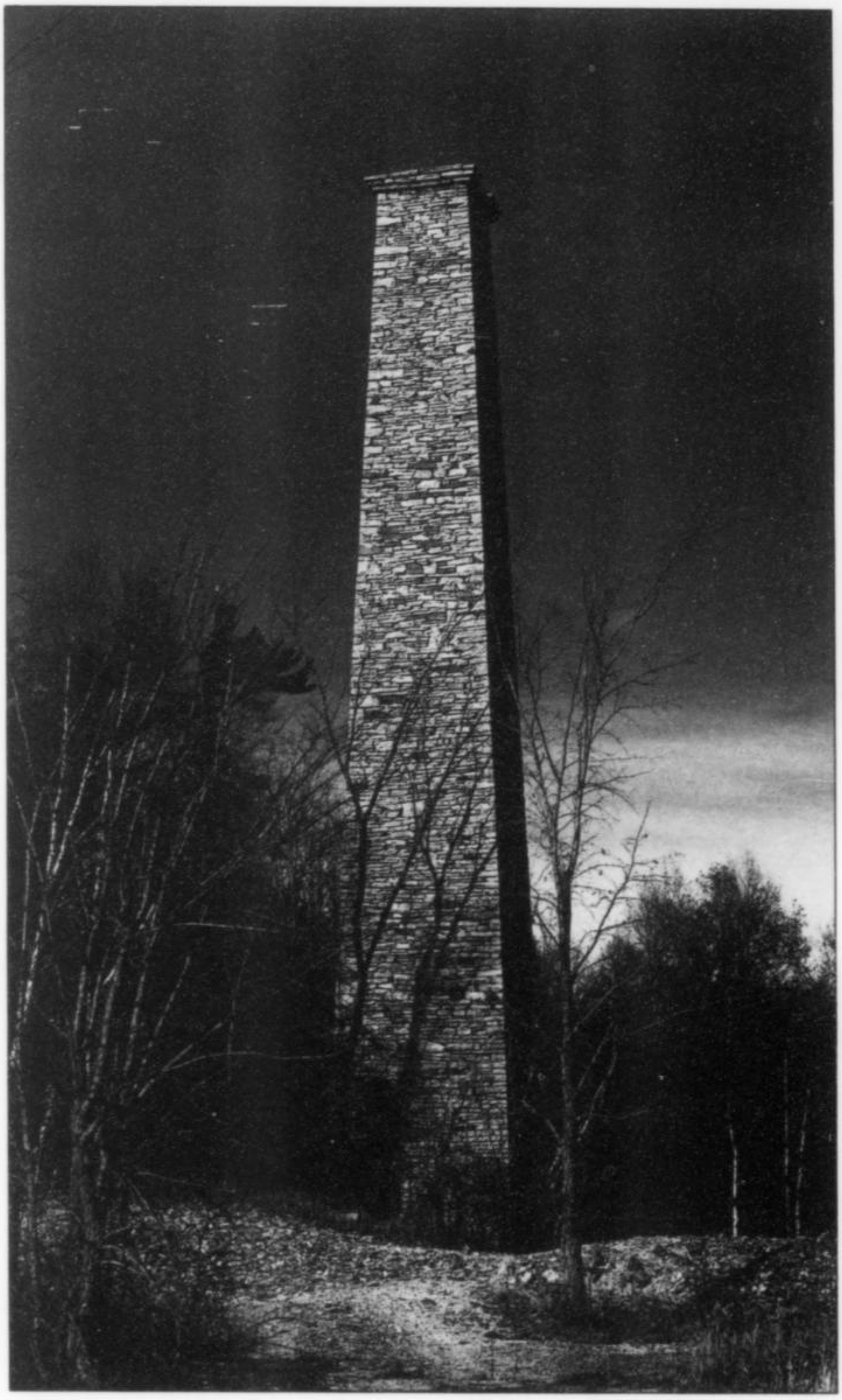


Figure 36. **Stone chimney at the Victoria vein, Rossie, New York, as it appeared in October, 1986, looking north from the eastern end of the mine excavation. Photo by G. Robinson.**

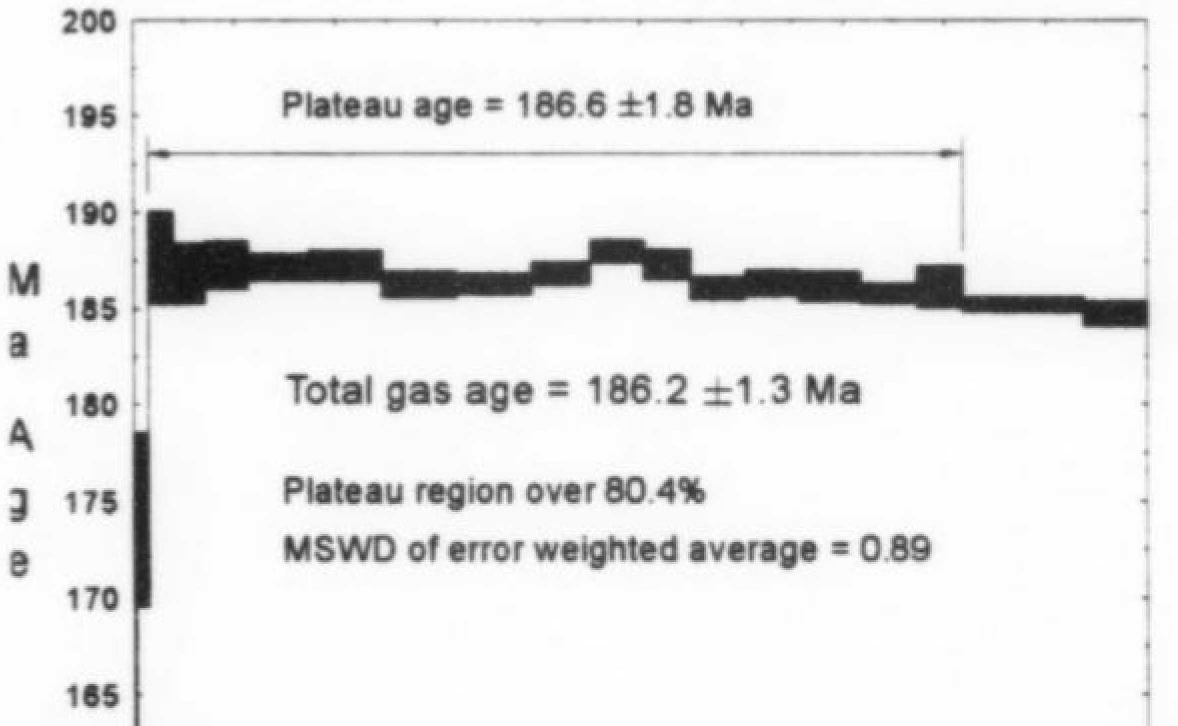


Figure 37. **Laser $^{40}Ar/^{39}Ar$ age spectrum for Coal Hill microcline.**

with a lower Mg/Fe ratio. Magnetite, pyrite, a TiO_2 polymorph (probably rutile), zircon, apatite and monazite-(Ce) are present as accessory minerals, but do not appear to be altered in the specimens examined.

It appears the alpine assemblage resulted from minor chemical leaching of the host gneisses during vein mineralization, given the analyses summarized above, the fact that the amount of alpine mineralization is proportional to the degree of alteration, and the general absence of such mineralization at Rossie-type veins hosted solely by Grenville marble or Paleozoic sediments. These observations as well as earlier petrographic studies (Smyth, 1903) show that the alteration is minimal, which essentially eliminates the immediate host-rocks as significant sources for the major constituent vein minerals.

Based on lead isotope studies, Fletcher and Farquhar (1982) have concluded that the Grenville basement is the most likely source of lead in the mineralizing solutions. These authors interpret isotopic variations in galena as reflecting a general uniformity of Th/Pb and variability of U/Pb in the Grenville gneisses. ^{207}Pb/^{204}Pb vs ^{206}Pb/^{204}Pb plots define a secondary isochron which, by extrapolation, passes through the Central Metasedimentary Belt data field, suggesting these rocks may have contributed lead to the system. Both of these authors and Ayuso *et al.* (1987) note that the secondary isochron probably represents a mixing line, and if so, a second, more radiogenic "end member" lead source was also involved.

The present study allows the above hypothesis to be tested, since it is the first time an absolute age has been determined for the Rossie-type veins. Using the relationship

$$m = \frac{1}{137.88} \cdot \frac{e^{\lambda 8t} - e^{\lambda 5t}}{e^{\lambda 8t1} - e^{\lambda 5t}}$$

where m is the slope of the secondary isochron, λ5 and λ8 are the decay constants of ^{235}U and ^{238}U, respectively, t_1 and t_2 are the production ages of the radiogenic leads, and a calculated slope of 0.0773628 from the data of Ayuso *et al.* (1987), our age date of 186 Ma for t_2 yields a corresponding value for t_1 of 1.04 Ga, confirming the Grenvillian sediments as the most probable source of lead.

Based on the available stable-isotope and fluid inclusion data, Ayuso *et al.* (1987) proposed that Paleozoic basinal brines migrated down faults, where they were heated and reacted with both Precambrian and Paleozoic wall-rocks as they convected upward. Metals leached from these rocks were deposited along fractures and faults upon cooling, forming the Rossie-type veins. Carignan *et al.* (1997) proposed a similar model, but argued that downward-moving meteoric water rather than basinal brines was responsible for the hydrothermal system based on ^{208}Pb/^{204}Pb data. Dix and Robinson (submitted) have identified at least four possible sources for mineralizing fluids in the Ottawa Embayment based on fluid inclusion and stable-isotope data: MVT-type basinal brines, Canadian Shield-like brines, brines dissolved from Ordovician evaporites, and meteoric water.

SUMMARY

The Rossie lead mines and related gash vein deposits such as the Macomb and Muskalonge Lake fluorite occurrences in northern New York State are among the most famous early American mineral localities. The classic calcite, galena and fluorite specimens they produced are preserved in museums around the world. The origin of these deposits is best explained by a model of downward-migrating fluids, which reacted both chemically and isotopically with Grenvillian gneisses and marbles. This reaction formed hydrothermal solutions that mineralized faults and gash veins which developed in response to westward-translated stress due to Acadian orogenesis. The mineralization may have been long-lived and episodic, and was active at least through early Mesozoic time.

ACKNOWLEDGMENTS

We are especially grateful to Richmond Rogers, Arthur Wilm, Helen Simons, Charles Washburn and other landowners who granted access to their properties. Elwood Simons, Rossie town historian, and the staff at the St. Lawrence County Historical Society provided a wealth of historical information. William Kelly and Michael Hawkins (New York State Museum), Carl Francis (Harvard University) and Ellen Faller (Peabody Museum, Yale University) furnished specimens for study and photography. Robert Gault (Canadian Museum of Nature) provided the microprobe analysis of synchysite-(Ce), and Ronald Conlon (Carelton University) provided the X-ray identification of covellite and allanite. We also thank Marcus Johnson for help in the laboratory, and use of the Phoenix-Ford Memorial Reactor for performing the neutron irradiation. Lastly, GWR gratefully acknowledges the Canadian Museum of Nature, and SCC, the Department of Bioengineering and Neuroscience at Syracuse University for their generous support of this research project.

REFERENCES

ALCOCK, F. J. (1930) Zinc and Lead Deposits of Canada. *Geological Survey of Canada, Economic Geology Series No.* **8**, 406 p.

AYUSO, R. A., FOLEY, N. K., and BROWN, C. E. (1987) Source of lead and mineralizing brines for Rossie-type Pb-Zn veins in the Frontenac Axis Area, New York. *Economic Geology,* **82**, 489–496.

BARNETT, R. L., ARIMA, M., BLACKWELL, J. D., and WINDER, C. G. (1984) The Picton and Varty Lake ultramafic dikes: Jurassic magmatism in the St. Lawrence Platform near Belleville, Ontario. *Canadian Journal of Earth Sciences,* **21**, 1460–1472.

BECK, L. C. (1837) Report of Dr. Lewis C. Beck on the Mineralogical and Chemical Department of the Survey. *New York State Assembly No.* **161**, 51–54.

BECK, L. C. (1842) *Mineralogy of New York.* Thurlow Weed, Printer to the State, 536 p.

BUDDINGTON, A. F. (1934) Geology and Mineral Resources of the Hammond, Antwerp and Lowville Quadrangles. *New York State Museum Bulletin No.* **296**, 202–227.

BROWN, C. E. (1983) Mineralization, Mining and Mineral Resources in the Beaver Creek Area of the Grenville Lowlands in St. Lawrence County, New York. *United States Geological Survey Professional Paper* **1279**, 21 p.

CARIGNAN, J., GARIÉPY, C., and HILLAIRE-MARCEL, C. (1997) Hydrothermal fluids during Mesozoic reactivation of the St. Lawrence rift system, Canada: C, O, Sr and Pb isotopic characterization. *Chemical Geology,* **137**, 1–21.

CURTIS, G. (1894) *Our County and Its People: A Memorial Record of St. Lawrence County, New York.* D. Nason & Co., Syracuse, New York, p. 590–592.

DANA, J. D. (1837) *System* of *Mineralogy.* First Edition. New Haven, p. 193.

DANA, J. D. (1844a) *System of Mineralogy.* Second Edition. New York, p. 478.

DANA, J. D. (1844b) Review of Beck's Mineralogy of New York. *American Journal of Science and Arts,* **46**, 25–37.

DANA, J. D. (1869) *System of Mineralogy.* Fifth Edition. John Wiley & Son, New York, p. 40.

DIX, G. R., and ROBINSON, G. W. (submitted) Phanerozoic stages of hydrothermal mineralization in the craton interior of Eastern North America, Ottawa Embayment. Submitted to *Canadian Journal of Earth Science.*

DOLLASE, W. A. (1971) Refinement of the crystal structures of epidote, allanite and hancockite. *American Mineralogist,* **56**, 447–464.

EASTON, R. M. (1992) The Grenville Province and the Proterozoic history of central and southern Ontario. *In:* Thurston, P. C.

et al. (Editors), Geology of Ontario. *Ontario Geological Survey Special Volume* **4**, 715–904.

EMMONS, E. (1837) First Annual Report of the Second Geological District of the State of New York. *New York Geological Survey Annual Report* **1**, 124–126.

EMMONS, E. (1838) Report of the Second Geological District of the State of New York. *New York Geological Survey Annual Report* **2**, 185–250.

EMMONS, E. (1842) *Geology of New York. Part II, comprising the survey of the second geological district.* White and Visscher, Albany, New York, pp. 354–360.

FLETCHER, I. R., and FARQUHAR, R. M. (1982) The protocontinental nature and variability of the Central Metasedimentary Belt of the Grenville Province: lead isotope evidence. *Canadian Journal of Earth Science*, **19**, 239–253.

FRENCH, J. H. (1860) *Gazetteer of the State of New York*. 8th Ed. R. P. Smith, Syracuse, New York, p. 582.

GARDNER, F. (ca. 1970) Unpublished notes, St. Lawrence Co. Historical Society Archives, Canton, New York.

GOLDSCHMIDT, V. (1913) *Atlas Der Krystallformen*. Carl Winters, Heidelberg.

GRICE, J. D. (1981) Hexoctahedral fluorite crystals from Old Chelsea, Québec. *Mineralogical Record*, **12**, 103–104.

HALL, C. M., and FARRELL, J. W. (1995) Laser ^{40}Ar/^{39}Ar ages of tephra from Indian Ocean deep-sea sediments: Tie points for the astronomical and geomagnetic polarity time scales. *Earth and Planetary Science Letters*, **133**, 327–338.

HESSENBERG, F. (1860) Kalkspath von Rossie, St. Lawrence Co., N.Y. *Mineralogische Notizen*, No. 3, 8.

HOUGH, F. B. (1853) A *History of St. Lawrence and Franklin Counties, New York*. Reprinted 1970, Regional Publishing Co., Baltimore, p. 455–467.

KUNZ, G. F. (1889) Mineralogical notes on fluorite, opal, amber and diamond. *American Journal of Science*, 3rd Series, **38**, 72–74.

NASON, F. L. (1888) Some New York Minerals and Their Localities. *New York State Museum Bulletin No.* **4**, p. 1.

NEUMANN, G. L. (1952) Lead-Zinc Deposits of Southwestern St. Lawrence County, N.Y. *United States Bureau of Mines Report of Investigations* **4907**, 25 p.

NEWLAND, D. H. (1921) The Mineral Resources of the State of New York. *New York State Museum Bulletin, No.* **223 and 224**, 140–143.

PHILLIPS, W. A. R., and ALGER, F. (1844) *Elementary Treatise on Mineralogy*. Fifth Edition. Boston, p. 265.

RICHARDS, R. P., and ROBINSON, G. W. (1995) A calcite-fluorite vein assemblage from Long Lake, New York (abstract). *Rocks and Minerals*, **71**, 199–200.

RICHARDS, R. P., and ROBINSON, G. W. (2000) Mineralogy of the calcite-fluorite veins near Long Lake, New York. *Mineralogical Record*, **31**, 413–422.

ROBINSON, G. W., and CHAMBERLAIN, S. C. (1984) Famous mineral localities: The Sterling mine, Antwerp, New York. *Mineralogical Record*, **15**, 199–216.

SAMSON, S. D., and ALEXANDER, E. C. (1987) Calibration of the interlaboratory ^{40}Ar–^{39}Ar dating standard, Mmhb-l. *Chemical Geology*, **66**, 27–34.

SHADWELL, W. (1986) St. Lawrence County, 1838, as seen through the eyes of Salathiel Ellis. *In: Prints and Printmakers of New York State, 1825–1940*, D. Tatham (Ed.), Syracuse University Press, Syracuse, New York, Plates 3.4 and 3.7.

SIMONS, V. B. (1951) Rossie. *In: Tribune-Press*, July 25 edition, Gouverneur, New York, p. 14.

SIMONS, V. B. (1958) Historical Calendar of Rossie. *In: Advance News*, Sept. 7 edition, Ogdensburg, New York, p. 11.

SMYTH, C. H., Jr. (1903) The Rossie Lead Veins. *School of Mines Quarterly: Journal of Applied Science, Columbia University*, **24**, 421–429.

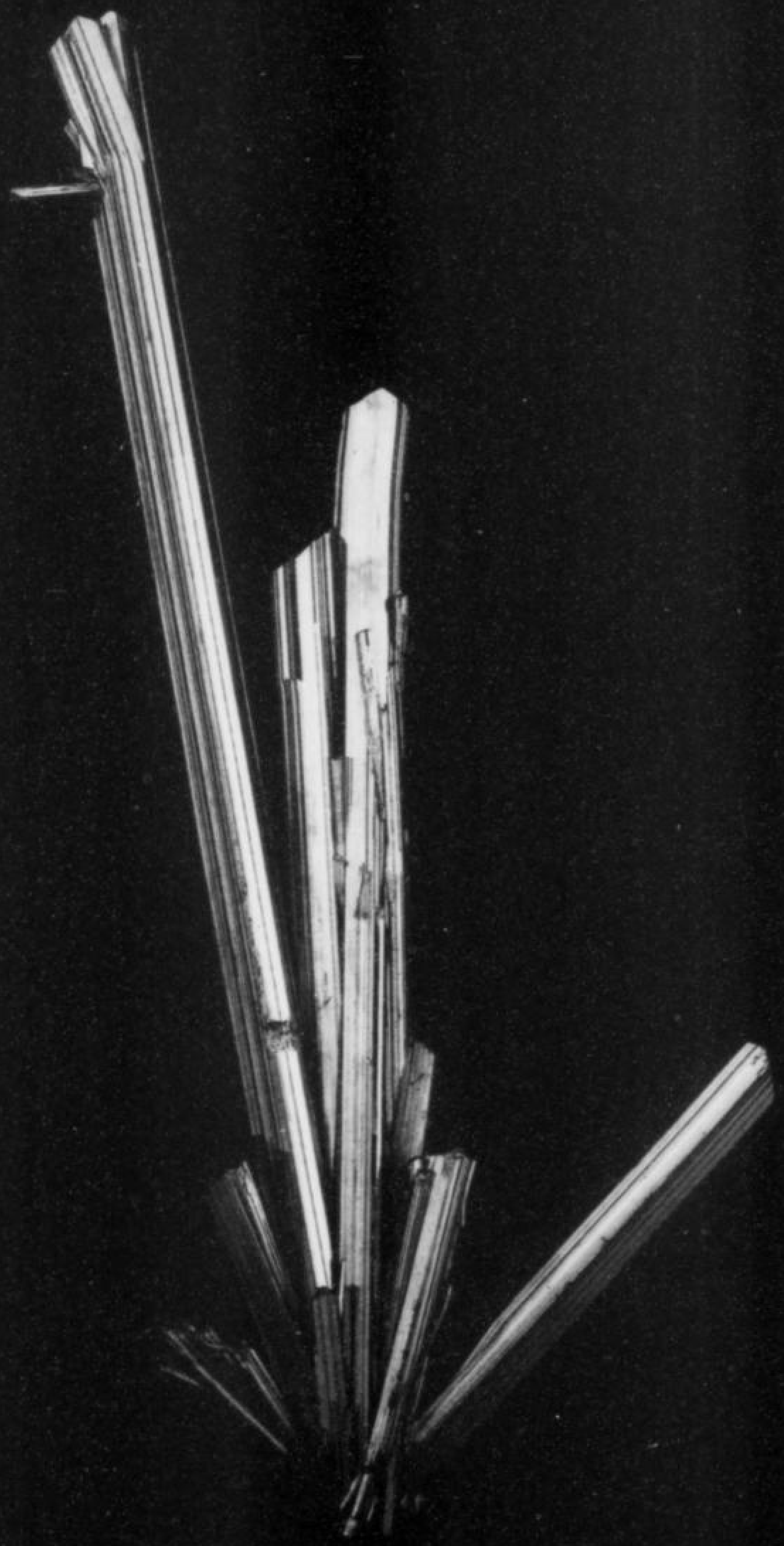
UGLOW, W. L. (1916) Lead and Zinc Deposits in Ontario and in Eastern Canada. *Ontario Bureau of Mines 25th Annual Report*, **20–25**, 56 p.

WHITLOCK, H. P. (1910a) Calcites of New York. *New York State Museum Memoir* **13**. University of the State of New York, Albany, 190 p.

WHITLOCK, H. P. (1910b) Fluorite, Rossie, St. Lawrence County. *Contributions to Mineralogy, New York State Museum Bulletin* **140**, 198–199.

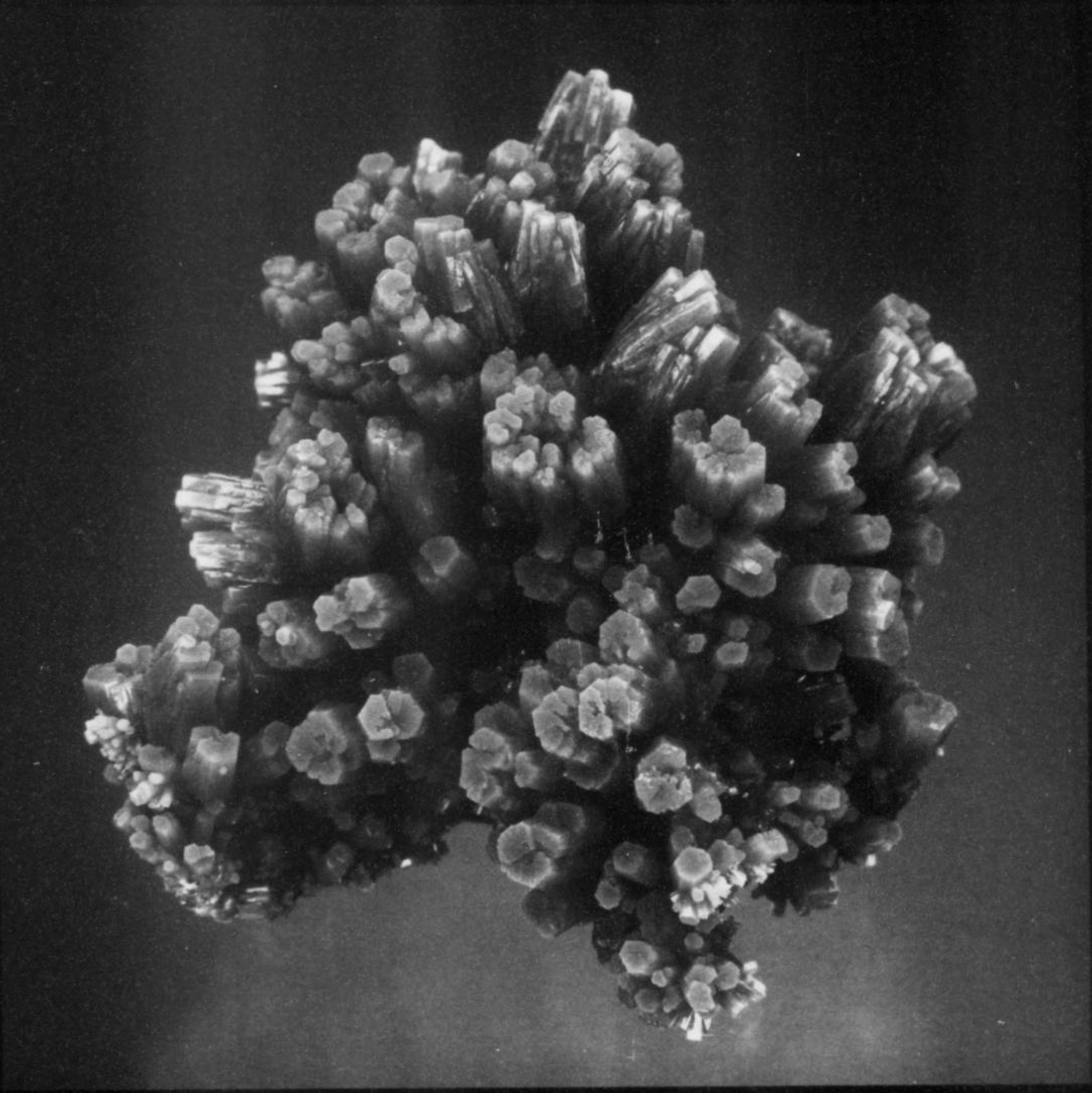
WHITNEY, J. D. (1854) *The Metallic Wealth of The United States, Described and Compared with That of Other Countries*. Lippincott, Grambo & Co., Philadelphia, p. 382–387.

ZIPPE, F. X. M. (1852) Besicht der Krystallgestalten des Rhombohedrischen Kalk-Haloids. *Denksch. der K. Akad. d. Wiss. Wien. Math.-Naturw.* Cl. III.



Stibnite; Wuling Antimony mine, Jiangxi Province, China, 19.9 cm, Acquired 2001

JEFF SCOVIL



The Friends of Mineralogy, Inc.

Who We Are:

Vol 1, No 1, Mineralogical Record, Spring 1970

The *Friends of Mineralogy* was founded in Tucson, Arizona, on February 13, 1970. Its objectives were to promote better mineral appreciation, education and preservation. The chief aims and activities of *FM* include:

- Compiling and publishing information on mineral localities, and important mineral collections.
- Encouraging improved educational use of mineral specimens, collections, and localities.
- Support a semi-professional journal of high excellence and interest designed to appeal to mineral amateurs and professionals, through which *FM* activities may be circulated.
- Operating informally in behalf of minerals, mineral collecting, and descriptive mineralogy, with voluntary support by members.

The Mineralogical Record has agreed to an affiliation with the Friends of Mineralogy whereby it will publish its written material and news of its activities. The *Friends of Mineralogy* will support the *Mineralogical Record*, since the aims of both are similarly educational and directed toward better coordination of the interest and efforts of amateurs and professionals.

Co-Sponsor, with the Tucson Gem & Mineral Society and the Mineralogical Society of America, of the Annual Tucson Mineralogical Symposia.

2000 Officers

President
Mike Howard, 3815 West Roosevelt Rd., Little Rock, AR 72204
(501) 296-1877 e-mail: JMichaelH@aol.com

Vice-President
Susan Eriksson, Geology Dept., Virginia Tech,
Blacksburg, VA 24061
(540) 231-5360 e-mail: Serikssn@vt.edu

Secretary
Charles Miller, 3320 Dawn Circle, Roanoke, VA 24018
(703) 983-0258 e-mail: cmiller1945@mciworld.com

Treasurer
Roland Bounds, 315 Stamford Dr., Newark, DE 19711-2723
(302) 731-8407 e-mail: 25628@udel.edu

For Membership Information Contact:

Membership Chair
Regina Aumente, 8075 West Freemont Dr.,
Littleton, CO 80123-4315
(303) 978-9926 e-mail: Raumente@aol.com

Treasurer
Roland Bounds, 315 Stamford Dr., Newark, DE 19711-2723
(302) 731-8407 e-mail: 25628@udel.edu

Newsletter Editor
Charles Miller, 3320 Dawn Circle, Roanoke, VA 24018
(703) 983-0258 e-mail: cmiller1945@mciworld.com

Chapter News:

Colorado Chapter
Order now!! *Minerals of Colorado*
Order from: Friends of Mineralogy—Colorado Chapter
P.O. Box 11005, Denver, CO 80211-0005
$150 + $3 p.&h. (Colo. residents add 7.3%)
For information on the Colorado Chapter Contact: Bill Chirnside,
2157 S. Cole Ct., Lakewood, CO 80228; Tel: (303) 989-8748;
e-mail: billdozer@megsinet.net

Midwest Chapter
Visit our website at www.indiana.edu/~minerals
For information about the Midwest Chapter contact: Dwaine Edington,
President, 217 W. Brown St., Knightstown, IN 46148;
Tel: (765) 345-5514

Mississippi Valley Chapter
For Chapter Information contact: Lawrence Nuelle, President, P.O. Box
1770, Rolla, MO 65402; Tel: (314) 244-8619; e-mail: brm@fidnet.com

Pacific Northwest Chapter
For Chapter information during 2000 and 2001, contact:
Sharleen K. Harvey, President
2309 S.W. 1st Ave., #2142, Portland, OR 97201
Home Phone: 503-248-4194 Work Phone: 503-647-2418
e-mail: bill-sharleenharvey@worldnet.att.net

Pennsylvania Chapter
Order now!! *Reminiscences of a Mineralogist* by Arthur Montgomery.
$20 plus $3 p.&h. Order from: Arnold Mogel, PA Treasurer,
15 Oak Rd., Schuykill, PA 17972
For Chapter Information contact: Roland Bounds, President,
315 Stamford Dr., Newark, DE 19711; Tel: (302) 731-8407;
e-mail: 25628@udel.edu

Southern California Chapter
For Chapter Information contact: Robert E. Reynolds, President,
220 South Buena Vista St., Redlands, CA 92373; Tel: (909) 792-3548;
e-mail: jreynold@empirenet.com
Visit our website at www.mineralsocal.org/scfm

Southeast Chapter
For Chapter Information contact: Chuck Miller, President,
3320 Dawn Circle, Roanoke, VA 24018; Tel: (540) 989-0861;
e-mail: cmiller1945@mciworld.com

National Friends of Mineralogy
Visit the national Friends of Mineralogy website at
www.indiana.edu/~minerals/fm.html

Chapter Symposia
Annual chapter symposia schedules are available through each chapter's contact person, listed on this page.

WAVELLITE, FLUELLITE AND MINYULITE FROM THE WILLARD MINE, PERSHING COUNTY, NEVADA

Martin Jensen
Earth Science Consultants Associated
1242 Glendale Avenue
Sparks, Nevada 89431

Joe Leising
4930 N. Cimarron
Las Vegas, Nevada 89149

A new occurrence for superb phosphate minerals has recently been discovered at the abandoned Willard open-pit mine complex near Lovelock, in Pershing County, Nevada. Locally abundant specimens of large and well-crystallized wavellite, fluellite and minyulite are present in quartz crystal-lined vugs, along with other minerals including native selenium, and a suite of associated phosphates.

INTRODUCTION

A carbonaceous and sulfide-bearing shale horizon just barely exposed at the bottom of the northernmost pit of the Willard mine contains excellent wavellite, fluellite and minyulite. Other minerals present in attractive, smaller crystals or coatings include cacoxenite, crandallite, dufrenite, gypsum, jarosite, native selenium and strengite/variscite. The deposit is an excellent mineralogical example of an economic, Carlin-type gold deposit with genetically associated supergene phosphate species.

A brief sketch of this occurrence was mentioned in Jensen (1999), discussing preliminary observations at the site. The current paper presents a comprehensive and more specific description of the locality, along with photos of selected attractive specimens.

The site of this new discovery is located in the Willard district, a former gold-producing region situated at the northern end of the West Humboldt Range. The nearest town, Lovelock, is a sleepy and peaceful ranching and farming community of about 2000 residents. Local physiography, typical of the Basin and Range high-desert, consists of flat, north-south-trending valleys and stark, intervening mountains. About 10 km north of Lovelock, the Willard district proper can easily be seen in the low foothills to the east of Interstate Highway 80, the main east-west route across Nevada. Fairly recent operations there for low-grade gold ore were conducted in the late 1980's. Two areas of mineralization were exploited by open-pit methods and later treated by conventional heap-leach techniques. All structures and evidence of mining have either been removed or reclaimed, and only the two open pits remain relatively undisturbed. No restrictive barriers, gates, signs, or diversions are present. Access to the mines is simple and straightforward, and it is surprising that the occurrence had not been visited earlier by collectors. At the Coal Canyon interchange

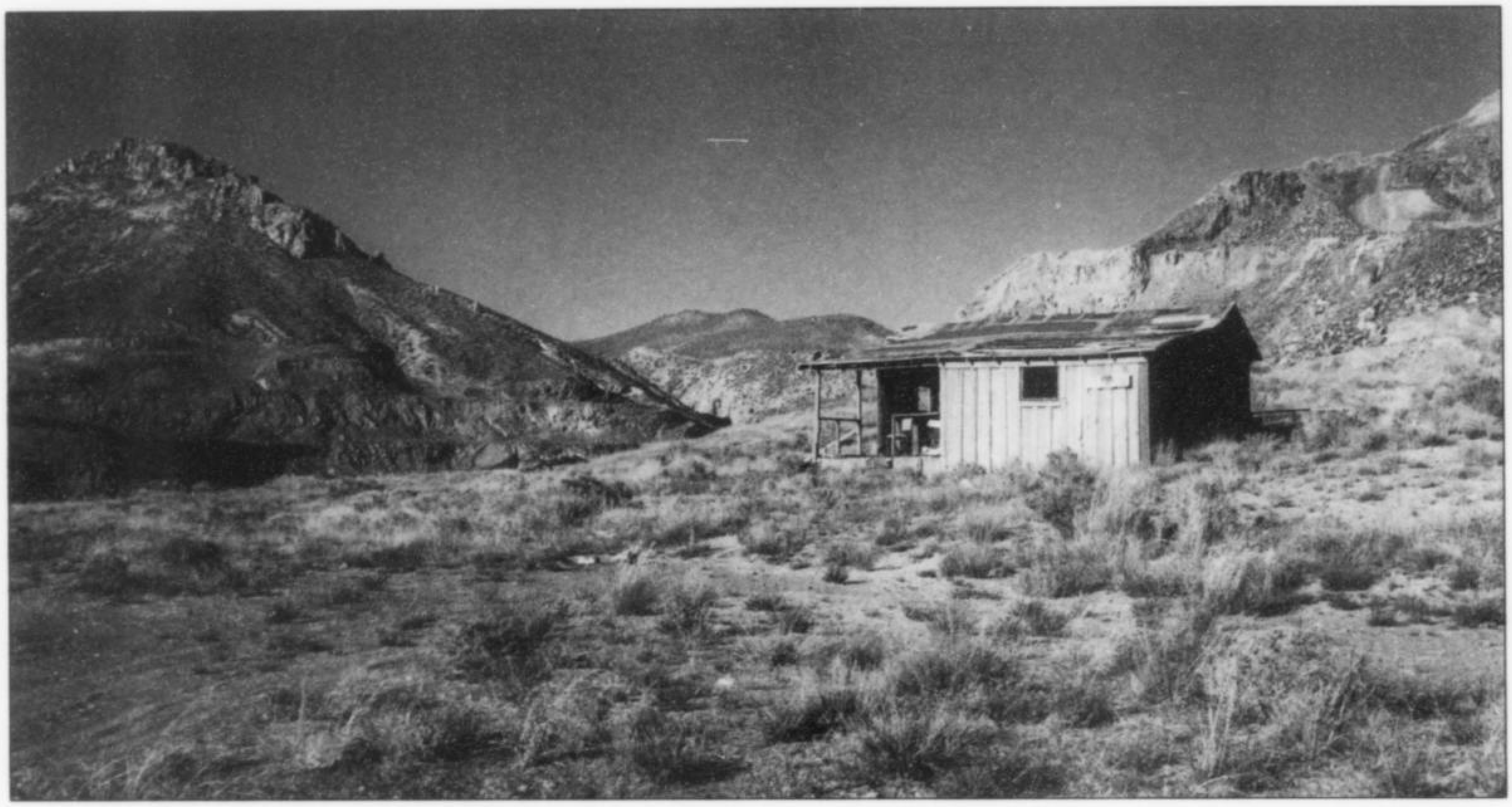


***Figure 1.* Willard mine area, view to the north; the upper benches of the north pit are visible at left-center. Photo by M. Jensen.**

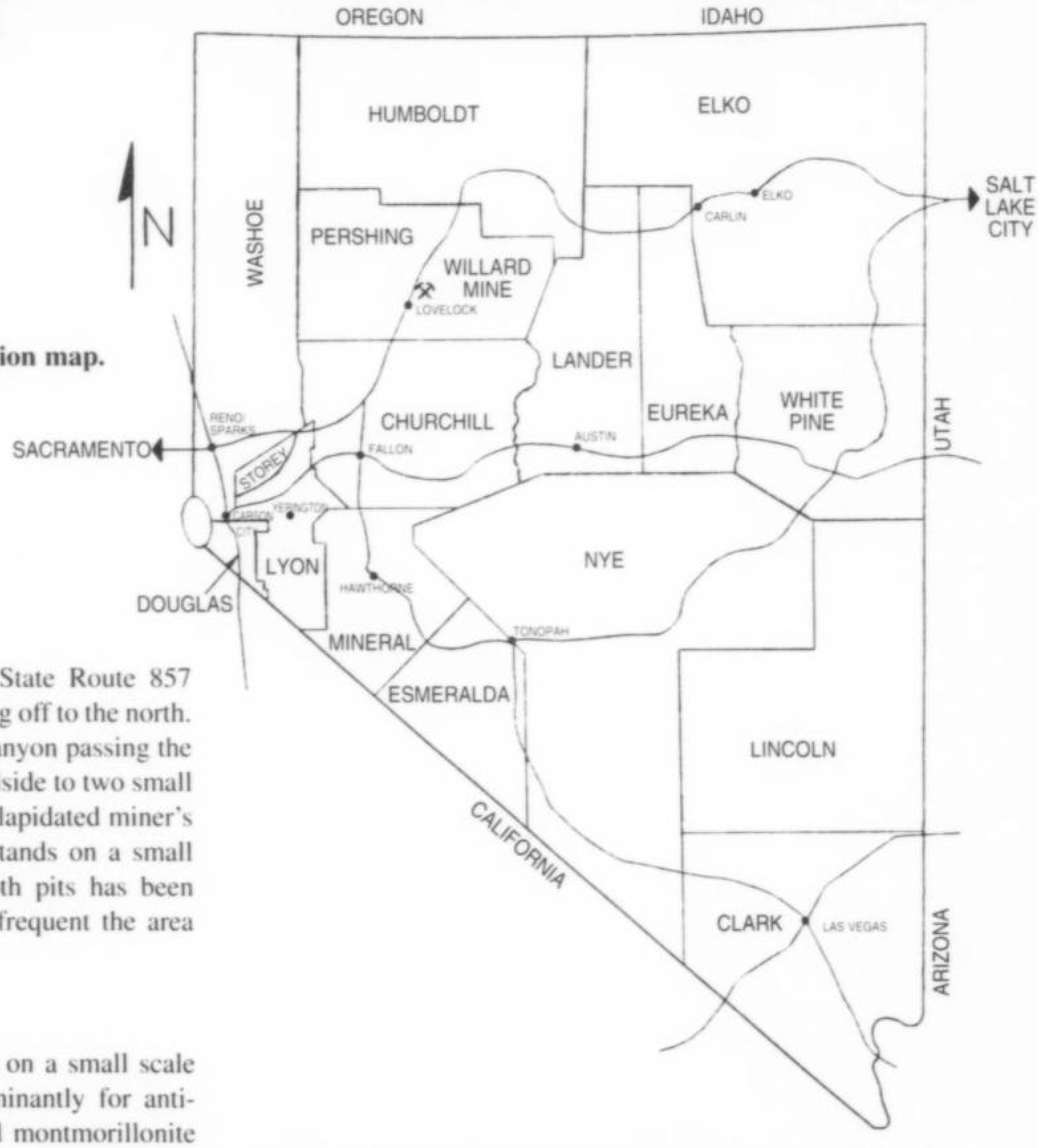


***Figure 2.* Location map.**

(mile marker 112), one travels east on paved State Route 857 exactly 2.5 km to a well-graded gravel road turning off to the north. This secondary road gently curves into a small canyon passing the recontoured heap-leach pads and follows up a hillside to two small open pits, a distance of 2.5 km. A solitary and dilapidated miner's cabin, probably dating from the early 1950's, stands on a small knoll between the pits. Vehicular access to both pits has been bermed off, although off-road enthusiasts who frequent the area have hand-dug bypass routes to gain entry.

HISTORY

Mining in the Willard district was conducted on a small scale beginning about 1905 (Johnson, 1977), predominantly for antimony, with lesser amounts of gold, copper, and montmorillonite clay recovered. The gold claims in the Willard group of mines at the western edge of the district were first discovered in 1915, but the veins were not of significant size, and Willard was "never known as a fighting camp" (Paher, 1970). Up through 1951, gold and silver were mined in small quantities from numerous adits and shafts, but, from the sparse information available, the total production was probably quite small. In the mid- to late-1980's, exploration efforts to delineate a possible low-grade, bulk-minable gold deposit were undertaken by Western States Minerals Company. The results of this work were apparently successful, because mining was initiated soon thereafter. Two open pits, each about 200 m in diameter and 100 m deep, were developed in mid-1989

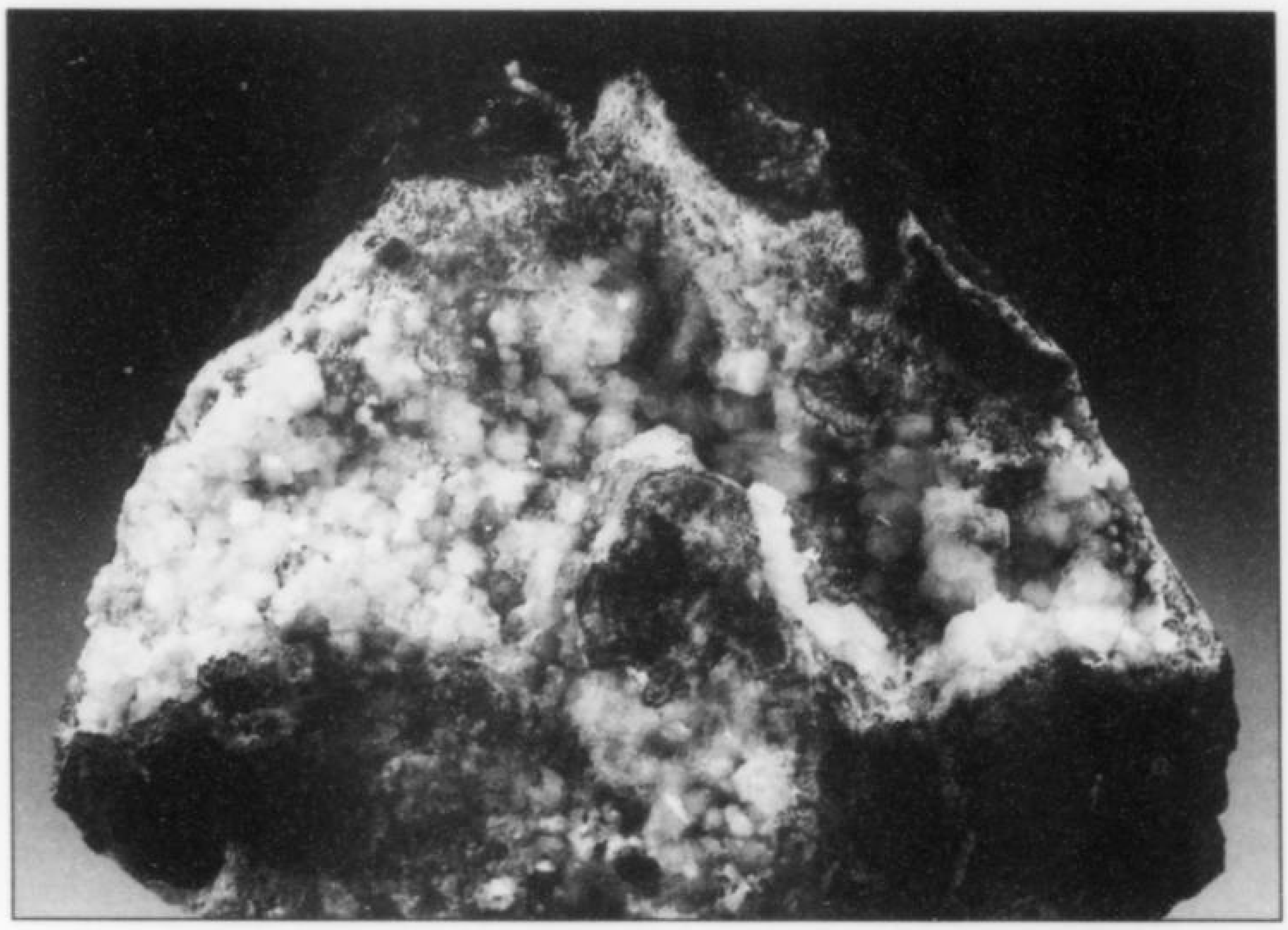


Figure 3. **Fluellite crystals to 5 mm in a vug, 12 cm across, associated with variscite and minor wavellite. M. Jensen collection; photo by Wendell Wilson.**

Figure 4. **Fluellite crystals to 5 mm. M. Jensen collection; photo by Wendell Wilson.**

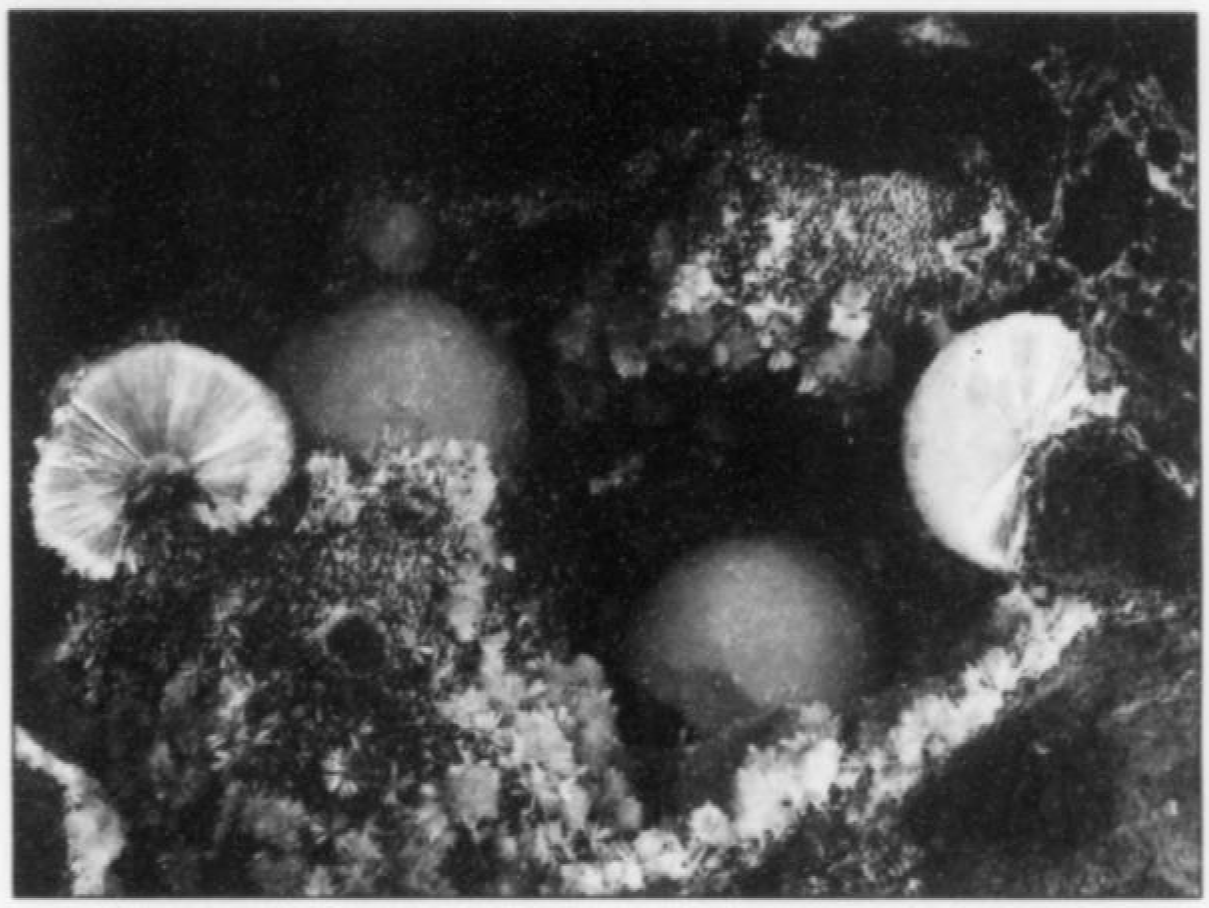


Figure 5. **Wavellite hemispheres to 1.4 cm, in a vug in jasperoid. M. Jensen collection; photo by Wendell Wilson.**

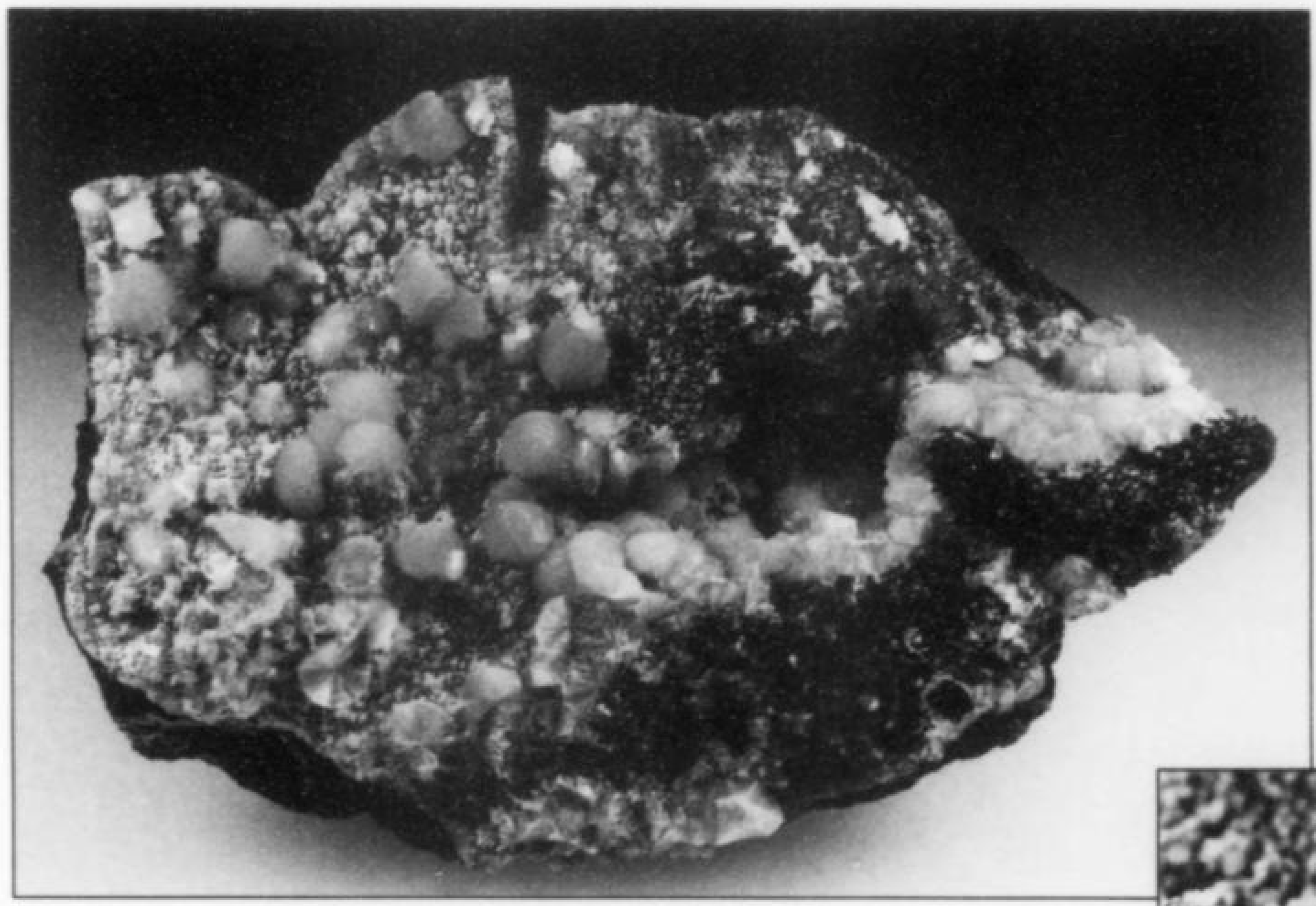


Figure 6. **Wavellite hemispheres (yellow) to 6 mm with white fluellite crystals to 6 mm and red, iron-stained drusy quartz. M. Jensen collection; photo by Wendell Wilson.**

Figure 7. **Minyulite tufts to 7 mm on clay-coated drusy quartz. M. Jensen collection; photo by Wendell Wilson.**

using standard drill-and-blast techniques, and ore was then treated on cyanide heap-leach pads for recovery of gold. Temporary facilities consisting of trailer-style offices and a sheet-metal truck shop were present on the site during the approximate two-year life of the mine. Government-mandated remediation of the site required another year or so.

GEOLOGY

The rocks exposed in the Willard district include very slightly metamorphosed sediments of Triassic and Jurassic age. The predominant lithologies include shale, sandstone and limestone units that, in general, strike northwest and dip southwest (Johnson, 1977). The sediments range in color from orange and pink-brown to gray and black, and have locally been tightly folded and contorted, providing magnificent examples of tectonic deformation. Tertiary ash-flow tuffs are found locally overlying the sediments.

At least two fault-controlled structures are present at the mine, and the ore deposits are clearly related to them. Broad, northeast-striking and northwest-striking zones of vertically dipping silicification are exposed in both of the open pits, and it is clear that these features are associated with the gold mineralization. The structural zones appear to be quite persistent and are comprised of brecciated and silicified sediments cemented by massive, white to drusy crystalline quartz. Old stopes along these quartz veins exposed locally in the pit walls are indicative of areas where earlier mining had taken place for high-grade ore. Mineralization was clearly not confined only to the veins, however, for the surrounding sediments are hydrothermally altered and contained low-grade gold. Near-surface rocks are heavily oxidized, containing abundant limonitic goethite and jarosite coatings, stains and impregnations. The oxidation terminates at a sharp contact with fresh sediments at the very bottom of the pit, and it is at this point that gold content dropped and mining ceased. It is here, however, that the abundant specimens of supergene phosphate minerals occur, and collectors should be thankful that mining stopped and exposed this zone.

MINERALOGY

The Willard mine is mineralogically noteworthy in a number of ways. It is the site of the first discovery of minyulite in Nevada; it has produced the world's largest crystals of fluellite and perhaps also minyulite; and it has furnished what are by far the finest quality specimens of wavellite, fluellite and minyulite ever discovered in the state. A total of 20 mineral species have been verified to date, all of which are discussed below in alphabetical order.

Barite $BaSO_4$

Druses of colorless, transparent, lustrous, tabular barite crystals to 1.2 cm, lightly coated with brick-red iron oxide, occur along a large fault plane exposed at the south end of the very bottom of the south pit. A thin veneer of calcite coats the barite in places.

Cacoxenite $(Fe,Al)_{25}(PO_4)_{17}O_6(OH)_{12}\cdot 75H_2O$

Within the wavellite-variscite-crandallite assemblage, thin crusts and individual spherules to 0.1 mm of bright yellow-orange to rust-brown cacoxenite occur sporadically. Viewed under the microscope, the typical velvety texture characteristic of the species can be seen, helping to differentiate it from other orange species such as jarosite and goethite. The Willard mine has produced the finest Nevada specimens of this species; totally covered surfaces 5 x 8 cm in size have been found. Cacoxenite is relatively late in the crystallization sequence, and may be found coating crandallite, variscite or wavellite.

Calcite $CaCO_3$

Fracture coatings and rare vug fillings of late-stage calcite occur chiefly in upper, oxidized regions of the orebodies. The species is present as typical "cave deposit" encrustations consisting of colorless to white, poorly crystallized crusts to 1.5 cm thickness.

Crandallite $CaAl_3(PO_4)_2(OH)_5\cdot H_2O$

The earliest phosphate species to precipitate during the crystallization sequence is crandallite, occurring in vugs directly upon lustrous, drusy quartz crystals. Crandallite, as at other Nevada hydrothermal occurrences (Candelaria mine, Esmeralda County, and Silver Coin mine, Humboldt County), is present predominantly as white to cream-white, flattened, hexagonal crystals to 0.1 mm. The mineral is commonly totally overgrown with variscite and other species, and is observed only infrequently.

Dufrenite $Fe^{+2}Fe^{+3}(PO_4)_3(OH)_5\cdot 2H_2O$

Thin fracture coatings and vug linings of botryoidal, dark green to black dufrenite have been observed very rarely, associated with radial sprays of strengite, minute cubic crystals of pharmacosiderite, and local sprays of meurigite.

Fluellite $Al_2(PO_4)F_2(OH)\cdot 7H_2O$

Magnificent, mirror-lustrous crystals of colorless to pale lavender fluellite have been found at the Willard mine. These are very likely the best and largest examples of the species found in the world. The first discovery of this mineral in the state was at the Gold Quarry mine in Eureka County (Jensen *et al.*, 1995). There, yellowish to pale lavender crystals to 3 mm were produced from a supergene phosphate zone at a very large Carlin-type gold deposit. It was believed at the time that specimens from that deposit were probably the finest crystals of fluellite ever found. At the Willard mine, much larger single crystals, some up to 1 cm and one partial crystal to 1.5 cm, have been recovered. Although somewhat isolated, several areas in the phosphate zone have been found containing euhedral, textbook-perfect fluellite crystals. Surfaces 7 x 12 cm liberally covered with sparkling crystals averaging 5 mm have been collected. Fluellite is paragenetically late and may occur directly upon lustrous quartz crystals, on botryoidal white to green strengite/variscite, or associated with white to yellow wavellite spherules. Incredibly beautiful micromount specimens, consisting of exquisitely perfect fluellite crystals balanced delicately upon individual wavellite needles, with associated orange cacoxenite and gray variscite spherules, have also been found locally. Examples of what appear to be cyclically twinned fluellite crystals to 1 mm, looking much like diamond gemstones when they have been faceted into the brilliant cut shape, have also been found. These are comprised of interpenetrating crystals which are slightly offset from one another in a circular stacking arrangement that is repeated around the orthorhombic *c*-axis.

Other United States localities for fluellite include a single specimen with crystals to 4 mm from the Carolina Pyrophyllite mine, Randolph County, North Carolina (Dunn, 1977), and dull white crystals to 1 mm from the Tuscarora mine, Rich County, Utah (Robinson, 1993).

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

Limonitic goethite is a widespread and very common alteration product occurring throughout all of the rocks exposed at both of the open pits. Rust-brown to brown-orange stains, coatings and thin fracture fillings occur predominantly in the oxidized rocks above the phosphate-bearing carbonaceous shale.

Gypsum $CaSO_4\cdot 2H_2O$

A surprising occurrence at the Willard mine is excellent gypsum crystals from the phosphate collecting area. With the exception of the historical gypsum crystals with brilliant cuprite inclusions found around the turn of the century at the deep copper mines of Ely, White Pine County, the specimens from Willard are currently the finest Nevada examples available. Selected specimens occur as floaters in a hydrothermal orange-brown clay, and consist of euhedral, doubly terminated, lustrous, colorless crystals to 5 cm. Gypsum also occurs quite commonly in many of the variscite and early wavellite vugs as platy, lustrous, flat-lying crystals forming glassy coatings over the underlying phosphate species.

Jarosite $KFe_3^{+3}(SO_4)_2(OH)_6$

Jarosite, like goethite, is also a very widespread acid-alteration mineral in the oxidized upper zone of both open-pits. Druses of typical rust-orange crystals to 1 mm coating fracture surfaces to several centimeters occur commonly in the upper benches of the northernmost pit. Peculiar yellow-green to orange-yellow stains on brecciated quartz vein material exposed along old stopes above the phosphate collecting area are also jarosite.

Kaolinite $Al_2Si_2O_5(OH)_4$

Orange-brown to white, non-swelling clay, presumably kaolinite, is locally present as vug and fracture fillings in brecciated rock at the phosphate occurrence.

Meurigite $KFe_7^{+3}(PO_4)_5(OH)_7 \cdot 8H_2O$

Very rare clusters to 0.2 mm of radiating, pale yellow meurigite crystals associated with strengite have been discovered on selected dufrenite specimens. This is the third occurrence of the species from the state (other than the Gold Quarry mine, Eureka County, and the Silver Coin mine, Humboldt County) and the identification has been confirmed by electron probe chemical microanalysis.

Minyulite $KAl_2(PO_4)_2(OH,F) \cdot 4H_2O$

The Willard mine is the source of the best minyulite found in Nevada; some truly remarkable pieces have been produced. Along the lower margin of the phosphate zone, quartz-lined vugs and large open fracture surfaces have been found that are partially to completely covered with delicate radiating clusters to 1.3 cm of superb minyulite crystals. The best specimens consist of numerous, isolated, silky-white to yellow "puffballs" perched attractively on a dark brown background of goethite-stained drusy quartz crystals. Undulating fracture surfaces 10 x 20 cm decorated in this manner have been preserved.

Minyulite, like fluellite, is a paragenetically late mineral, and may occur either alone, or with botryoidal strengite/variscite or finely crystallized wavellite spherules. Slightly larger clusters of minyulite, associated with sincosite, were discovered at the Ross Hannibal mine, South Dakota (Loomis, 1999), where about 150 flats of material were collected. The only other United States occurrences appear to be the Lucin Hill, Lucin County, Utah, variscite deposit, where crystal sprays to 1 mm have been verified (Gene Foord analysis, 1994), and the Van-Nav-San claims, Eureka County, Nevada, where rare and very small specimens were found (R. E. Walstrom, personal communication, 1999).

Pharmacosiderite $KFe_4^{+3}(AsO_4)_3(OH)_4 \cdot 6\text{–}7H_2O$

The only arsenic-bearing species yet observed at the Willard mine, pharmacosiderite, has been found very rarely as pale yellow-green, isolated cubic crystals no larger than 0.1 mm on a few dufrenite specimens. Associated minerals include crystallized strengite spherules and rare meurigite.

Pyrite FeS_2

Pyrite is a relatively common mineral at the mine, occurring predominantly as rounded, anhedral, brassy, metallic masses to 2 cm wholly enclosed in silicified carbonaceous shale breccias exposed at the phosphate collecting site. Distinct, small, poorly formed pyritohedral crystals have been seen locally. Sulfide-bearing rocks, when found, are exceptionally hard and fresh, and typically contain vugs of the crandallite-variscite-wavellite assemblage. No other sulfides typical of Carlin-type gold deposits, such as arsenopyrite or marcasite, have thus far been found at the mine.

Pyrolusite $Mn^{+4}O_2$

Typical black dendrites, presumably pyrolusite, are locally common on bedding surfaces of thin, pale brown, fissile shale exposed in the upper benches of the northern pit.

Quartz SiO_2

Quartz is a widespread mineral at the Willard mine , occurring for the most part along structurally prepared zones (faults) which served as channelways for mineralizing solutions. The species is present as a massive replacement (silica flooding) of limestone (jasperoid), as stockwork veinlets cementing breccia fragments, and as druses of euhedral hexagonal crystals to 4 mm. In the phosphate zone, selected quartz vugs have been found consisting of brilliant drusy crystals locally overgrown with botryoidal green variscite and/or lustrous wavellite hemispheres; these pieces typically comprise very attractive specimens.

Selenium Se

Another very surprising occurrence at Willard is the native selenium crystals found in the phosphate zone. This constitutes the third verified Nevada occurrence, including the Gold Quarry mine, Eureka County (Jensen *et al.*, 1995) and the mopungite occurrence, Churchill County (Williams, 1985). At the Willard mine, very rare specimens have been found consisting of isolated, radiating clusters to 0.1 mm of lustrous, black acicular crystals associated with various crystallized phosphate minerals. Incredibly beautiful panoramas under the binocular microscope are provided by radiating clusters of pale yellow wavellite crystals overgrown with spiky black selenium needles, which are, in turn, decorated with isolated spherules of orange cacoxenite and yellow-gray strengite/variscite.

Strengite $FePO_4 \cdot 2H_2O$

The iron end-member of the variscite-strengite series has been verified by electron probe chemical microanalysis techniques on selected specimens from the phosphate zone. Two particular examples were submitted for testing, one consisting of isolated white spherules to 1.5 mm in vugs in a peculiar dark brown host rock, and the other consisting of glassy, radiating crystallized groups to 2 mm associated with dufrenite, meurigite and pharmacosiderite. Undoubtedly, strengite, or iron-dominant examples of the series, occur more commonly, however, specific identification without microchemical data may be quite difficult. Visually, it is possible that the white to gray and colorless examples of variscite may actually have Fe>Al, but this hypothesis has not been thoroughly checked.

Variscite $AlPO_4 \cdot 2H_2O$

The finest specimens of variscite at the Willard mine consist of pleasing green botryoidal crusts to 2 mm thickness lining quartz vugs in samples of silicified, sulfide-bearing carbonaceous shale. Most druses are smooth although a few examples exhibiting coalescing crystal faces occur. Irregular, hummocky surfaces 20 x 20 cm totally covered with variscite have been found. At other locations in the phosphate zone, wide variations in color may be seen, ranging from pale green and pale blue, to gray-white and pale pink. The species generally formed early in the crystallization sequence, and underlies most of the other phosphate minerals, although a second generation deposited upon wavellite crystals has been seen rarely. Particularly attractive specimens, consisting of isolated, perfectly crystallized wavellite spherules perched upon drusy green variscite, are noteworthy.

Wavellite $Al_3(PO_4)_2(OH,F)_3 \cdot 5H_2O$

By far the most abundant and well-crystallized phosphate species at the Willard mine is wavellite. Specimens ranging from micromounts up to surfaces 30 x 30 cm totally covered with crystals have been found. The most common habit for wavellite, as spherules, is well represented at the mine, although single crystals, "bow-tie" groups, and "jackstraw" masses also occur. The largest complete hemispheres yet found are isolated, compact clusters 1.6 cm in diameter consisting of coarse, euhedral crystals resting in handsome quartz-lined vugs. These specimens will easily be ranked as the finest examples of wavellite ever found in Nevada. Even larger spherules, to 2.3 cm, have been seen, but these have unfortunately grown across the vugs and break in half when exposed. Although much smaller, the clusters of single and "jackstraw" crystals comprise similarly beautiful pieces, especially when viewed under the microscope. Some examples consist of brilliant, transparent, elongated crystals, commonly aesthetically associated with greenish variscite, orange cacoxenite, and/or white crandallite. Most wavellite is snow-white to nearly colorless, although straw-yellow and pale green variations also occur. It appears that two generations of crystallization have taken place, the first as rare, very large and coarse hemispheres and crystallized fracture fillings, followed later with smaller, but much more abundant hemispheres, "jackstraw" masses, and single crystals. Common specimens of the later generation of wavellite may be easily collected, the hemispheres typically ranging from 5 to 8 mm in diameter, either as isolated clusters or complete vug fillings. Paragenetically, wavellite occurs either on quartz, crandallite, and/or variscite, and/or may be overgrown with later variscite, cacoxenite, jarosite and/or goethite.

An extremely interesting occurrence of wavellite epimorphs after fluellite crystals was discovered in a large vug system about 20 x 20 x 10 cm in an intermediate region between the fluellite and wavellite zones. Here, milky-white, finely crystalline wavellite was found forming perfect hollow casts after euhedral fluellite crystals, some to 6 mm. Perched delicately inside a few of these epimorphs are brilliant radial sprays 1–2 mm across of colorless acicular wavellite crystals. A total of about one dozen specimens were collected.

DISCUSSION

The presence at the Willard mine of well-crystallized supergene phosphate minerals is not unique among sediment-hosted disseminated gold mines in Nevada. Assemblages of phosphate minerals have been noted at more and more of these important deposits across the northern half of the state, and it is very likely other occurrences have already been exposed but have been overlooked during mining. What makes the Willard mine significant is the wavellite/fluellite/minyulite mineralogical association, an assemblage noted at all the important Australian occurrences for these species (Henderson, 1981), but not previously found anywhere else in the world. With this new Nevada discovery, it would seem reasonable to hypothesize that there is a geochemical regime in which the formation of these three species is preferred, given what must be a relatively simple phosphorus and slightly fluorine-bearing hydrothermal fluid environment. Although wavellite is a somewhat widespread mineral found in many different geologic environments, the occurrence of fluellite together with wavellite is much more restricted. It may thus be suggested that where both wavellite and fluellite have been found, the third member of the association, minyulite, may also very likely be present. Careful examination in these cases is important because wavellite and minyulite often closely resemble one another.

Within the remnant shale bedding exposed in the phosphate collecting area at the Willard mine, there also appears to be a crude stratigraphic zonation with respect to the phosphate species and their abundance. At the top of the sequence of brecciated, carbonaceous, and silicified shale, in a zone about 1 meter in thickness, wavellite and green variscite have been found to predominate. Toward the middle of this section, white strengite/variscite, with fluellite and lesser wavellite, occur. Near the base of the sequence, minor white strengite/variscite and wavellite are present, associated with locally abundant minyulite. At the current time, it is not known if this apparent zonation is unique only to the Willard occurrence, or if a similar spatial distribution exists for these species at other localities.

A long-standing point of controversy exists among economic geologists as to the origin of gold in Carlin-type ore deposits. Some contend that the gold was contained in adjoining host rocks and has simply been mobilized by large, convective geothermal (hot springs) systems and reprecipitated along favorable structural zones in chemically permeable environments. Others contend that the gold has been brought in from external sources, such as intrusions. It is not the intention of this paper to resolve this controversy; however, based upon purely mineralogical observation, the evidence for a simple in-place geothermal mobilization and reprecipitation certainly seems the most reasonable. At the Willard mine phosphate minerals are confined to "dirty" shales which have been prepared by faulting and then invaded by geothermal fluids. During alteration, circulating solutions may have concentrated the trace phosphate (and lesser Se) present in these rocks and concomitantly produced leached textures and open-spaces for subsequent reprecipitation of the same elements in stable "micro-environments" (vugs). Gold may similarly have been concentrated. Comparing this process to a much larger paleogeothermal system, such as the Gold Quarry mine, Eureka County, Nevada (Jensen *et al.*, 1995), leaching of a much larger volume of very "dirty" sediments (containing Au, As, Hg, Sb, P, U, V, Mo, Se, Cd, Pb, Zn, Cu, etc.) led to the subsequent development of a very wide variety of secondary and supergene mineral species. It surely seems possible that this mechanism may indeed be responsible for the presence of the wonderful mineral specimens now being found in these types of deposits.

As a matter of speculation, if there is a genetic connection between the presence of supergene phosphates hosted in shaly sedimentary rock sequences and economic concentrations of gold, these minerals may possibly provide another tool to guide exploration efforts. (Has this concept been considered in regard to the well-known Australian phosphate occurrences?)

CONCLUSION

An interesting new locality for an assemblage of phosphate minerals has been identified at the Willard mine and now documented. In addition to producing a number of well-crystallized specimens of interest to collectors, both for display-quality pieces and micromounts, the locality is another occurrence of supergene phosphate minerals in a sediment-hosted, epithermal, Carlin-type gold deposit. Although most workers appear to believe that these types of deposits are relatively devoid of interesting minerals, it seems that the opposite may actually be more the case, and that these geologic systems warrant much closer attention by mineralogists. It can also be illustrated by the current example that, by conducting detailed examinations, combined with subsequent hard work moving rock and later careful studying of the field-collected specimens, surprising and often very satisfying rewards can come to the student of mineralogy.

ACKNOWLEDGMENTS

The authors wish to express their sincere gratitude to Joanne Newton of Reno, Nevada, for the excellent typing of the various versions of the manuscript. Excalibur Mineral Company, Peekskill, New York, kindly performed chemical microanalysis of selected specimens.

REFERENCES

DUNN, P. J. (1977) Fluellite from North Carolina. *Mineralogical Record*, **8**, 392–393.

HENDERSON, W. A. (1981) Microminerals. *Mineralogical Record*, **12**, 106–107.

JENSEN, M. C. (1999) Notes on selected hydrous aluminum phosphate occurrences in Nevada. *Mineral News*, **15**, 6, 1–8.

JENSEN, M. C., ROTA, J. C., and FOORD, E. E. (1995) The Gold Quarry mine, Eureka County, Nevada. *Mineralogical Record*, **26**, 449–469.

JOHNSON, M. G. (1977) Geology and mineral deposits of Pershing County, Nevada. *Nevada Bureau of Mines and Geology, Bulletin* **89**, 115 p.

LOOMIS, T. A. (1999) The Ross Hannibal mine, Lawrence County, South Dakota. *Mineralogical Record*, **30**, 199–206.

PAHER, S. W. (1970) *Nevada Ghost Towns and Mining Camps*. Howell-North Books, Berkeley, California, 492 p.

ROBINSON, G. W. (1993) What's New in Minerals. *Mineralogical Record*, **24**, 48.

WILLIAMS, S. A. (1985) Mopungite, a new mineral from Nevada. *Mineralogical Record*, **16**, 73–74.

Denver 2001

DENVER GEM & MINERAL SHOW

"The Main Show"

September 14 - 16

Fri. 9-6 • Sat. 10-6 • Sun. 10-5

DENVER MERCHANDISE MART

Expo Hall (I-25 & Exit 215)

•Wholesale and Retail Dealers•

•Museum & Competitive Exhibits•

•International Dealers • Lectures•

Featuring "Minerals of the Pikes Peak Region"

P.O. Box 621444, Littleton, CO 80162

(303) 233-2516

www.denvermineralshow.com

Free Shuttles Between Shows - Wednesday Through Sunday

Park at the Mart

One Ticket
For 2 Shows
$4 Adults
$3 Seniors/Teens

PARK IN BACK!

Of the Merchandise Mart

A TRUE PALEO EXPERIENCE!

COLORADO FOSSIL EXPO

SEPT. 14 - 15 - 16

Fri. 9-6 • Sat. 10-6 • Sun. 10-5

Mart Plaza Annex

(North side of Merchandise Mart)

Martin Zinn Expositions
P.O. Box 999 • Evergreen, CO 80437-0999
Fax (303) 674-2384
mz0955@aol.com

INTERNATIONAL GEM & JEWELRY WHOLESALE SHOW INC.®

September 13 - 16

DENVER MERCHANDISE MART
PAVILION BUILDING
I-25 & EXIT 215

Thurs., 12-8; Fri. & Sat., 10-7; Sun., 10-5

Wholesale Only - Registration Required

120 Derwood Circle
Rockville, MD 20850
(301) 294-1640 • FAX (301) 294-0034

the Great American-Best Western

Gem Show & Sale

September 12 - 16

Best Western - Denver Central

48th Ave. & I-25

Wed. - Sat. 10-7; Sun. 10-5

Under new management

120 Derwood Circle • Rockville, MD 20850
Phone: (301) 294-3360 • Fax: (301) 294-0034
Click on www.intergem.net

COLORADO MINERAL & FOSSIL SHOW

September 12 - 16

Wed. - Sat., 9-6, Sun., 9 - 5

HOLIDAY INN - DENVER NORTH
4849 Bannock St. (I-25 & I-70)

- *250 Top Quality Mineral & Fossil Dealers*
- *60 Dealers from foreign countries*

P.O. Box 999 • Evergreen, CO 80437-0999
Fax (303) 674-2384
mz0955@aol.com

GERMANIUM-RICH BEUDANTITE FROM TSUMEB, NAMIBIA

Jens Gutzmer and **Bruce Cairncross**
Department of Geology
Rand Afrikaans University
PO Box 524
Auckland Park 2006, South Africa

Several specimens of a germanium-rich beudantite crystals to 1.5 cm, which are regarded as the finest in the world, have been found in old collections of Tsumeb, Namibia, minerals.

INTRODUCTION

Beudantite ($PbFe_3^{3+}(AsO_4)(SO_4)(OH)_6$, Mandarino, 1999) is well-known from the Tsumeb mine in Namibia as euhedral pseudocubic and (more commonly) pseudo-octahedral crystals (Pinch and Wilson, 1977). The crystals can also exist as very thin pseudo-hexagonal platelets such as those described here by us. The crystals display a wide range of colors, from colorless to pale yellow, green, amber to dark red. Some of the finest examples were found associated with carminite; another associated species is lepidocrocite (Gebhard, 1999). Beudantite was fairly common in the second oxidation zone at Tsumeb and specimens, although not plentiful, were readily available during the mid to late 1970's. These beudantites are regarded as the finest in the world. The largest reported beudantite crystal is 1.5 cm and was reportedly misidentified and sold as siderite because of the brown color and large size.

GERMANIUM-RICH BEUDANTITE

Gebhard (1999) notes the presence of GeO_2 in one beudantite sample, proposing (without a full description or IMA approval) that it constitutes a new mineral to be named "germanium-beudantite." Elsewhere he refers to "Ge-beudantite" as merely a variety.

The germanium-rich beudantite he refers to was the only specimen known to exist until early in 1999 when an old (pre-1975) specimen in the Desmond Sacco collection was identified as being somewhat unusual and subject to the analyses that we report on here.

The specimen was acquired in the early 1970's. It is a 7 cm matrix specimen (Fig. 3) partially coated by dozens of extremely tabular, transparent pseudo-hexagonal golden/amber-colored crystals (Fig. 5). Associated minerals are quartz (Fig. 4) and wulfenite.

The beudantite was first identified using X-ray powder diffraction analyses and then subjected to scanning electron microscopy (including qualitative elemental analysis by EDS). Quantitative chemical analyses were obtained by electron microprobe analysis (WDS). All analyses were conducted at the Centralized Analytical

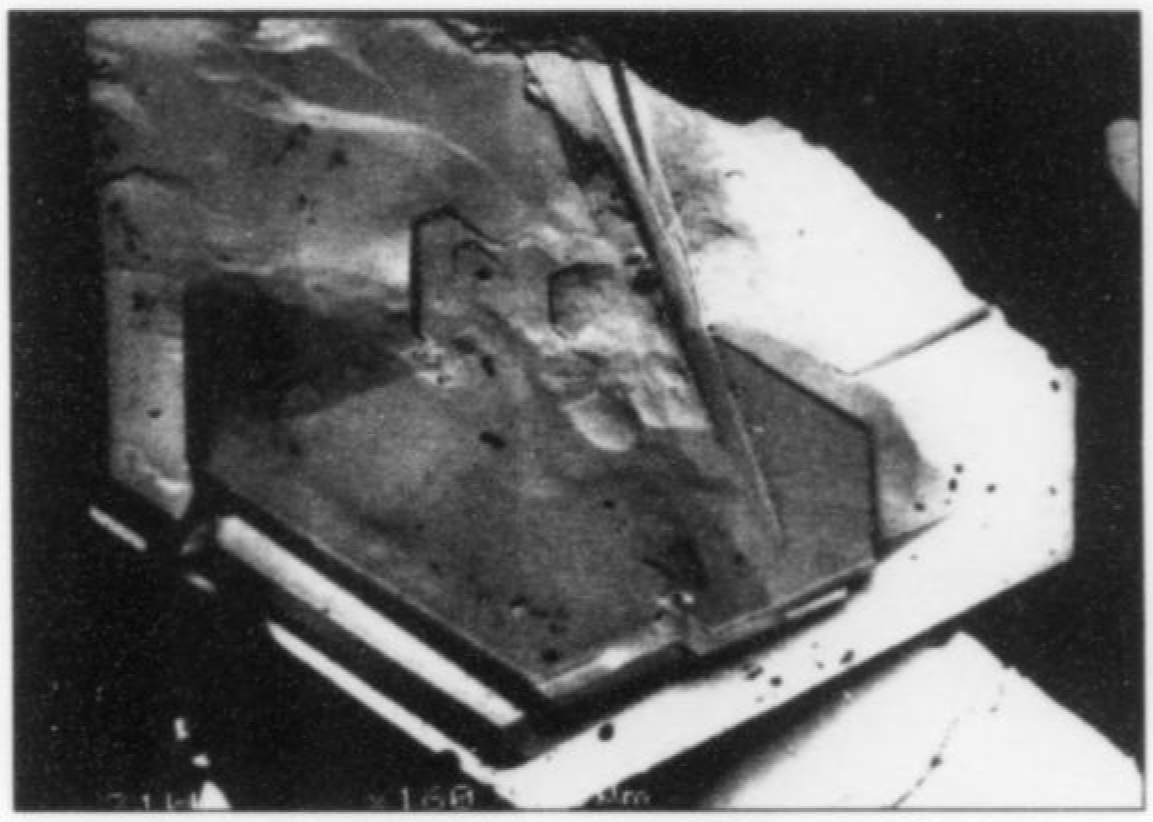


Figure 1. **SEM image of an 800µ germanium-rich beudantite crystal. Desmond Sacco collection; Jens Gutzmer photograph.**

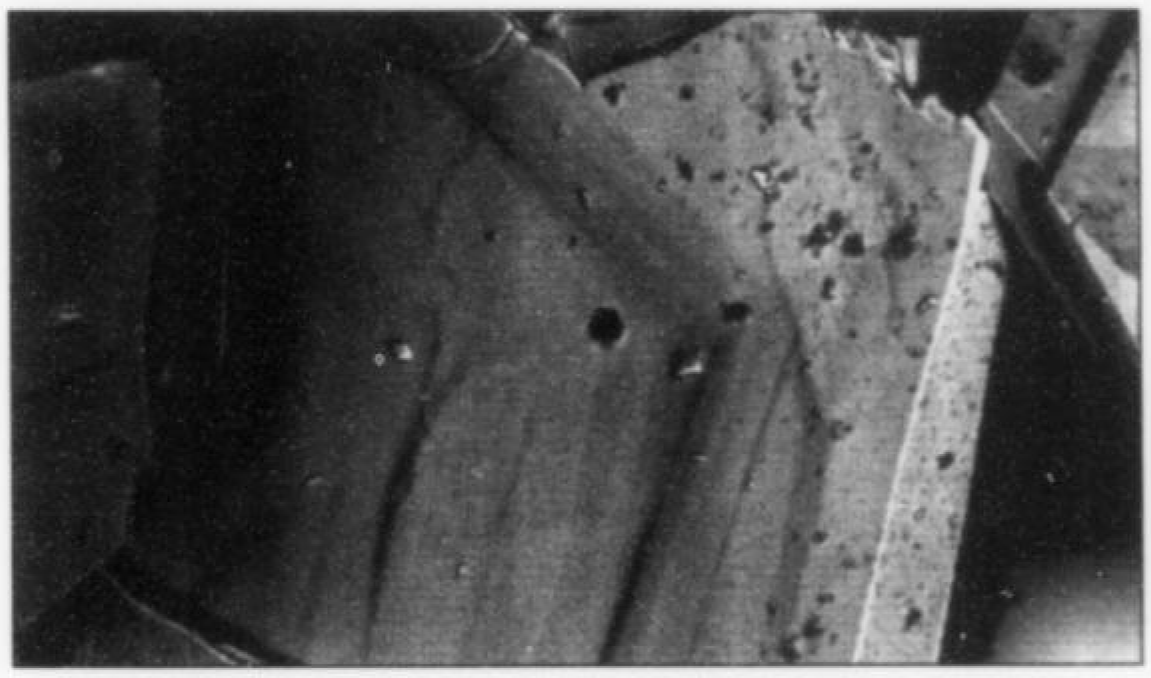


Figure 2. **Concentrically zoned growth patterns in a small crystal of germanium-rich beudantite. The bar scale represents 50µ. Desmond Sacco collection; Jens Gutzmer photograph.**

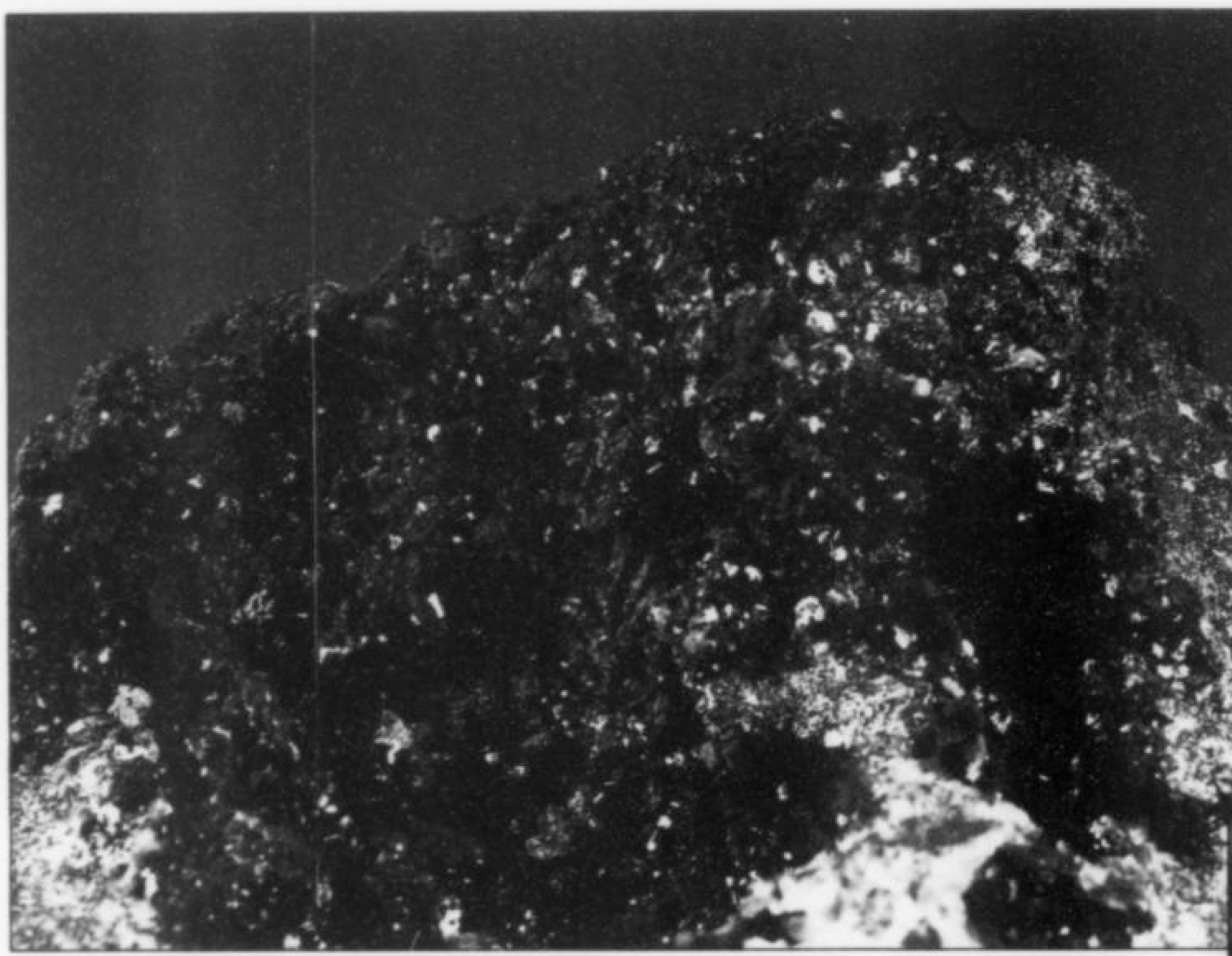


Figure 3. **Several dozen golden/amber crystals of germanium-rich beudantite partially coating a dark, oxidized ore matrix. The field of view is 6 cm. Desmond Sacco collection; Bruce Cairncross photograph.**

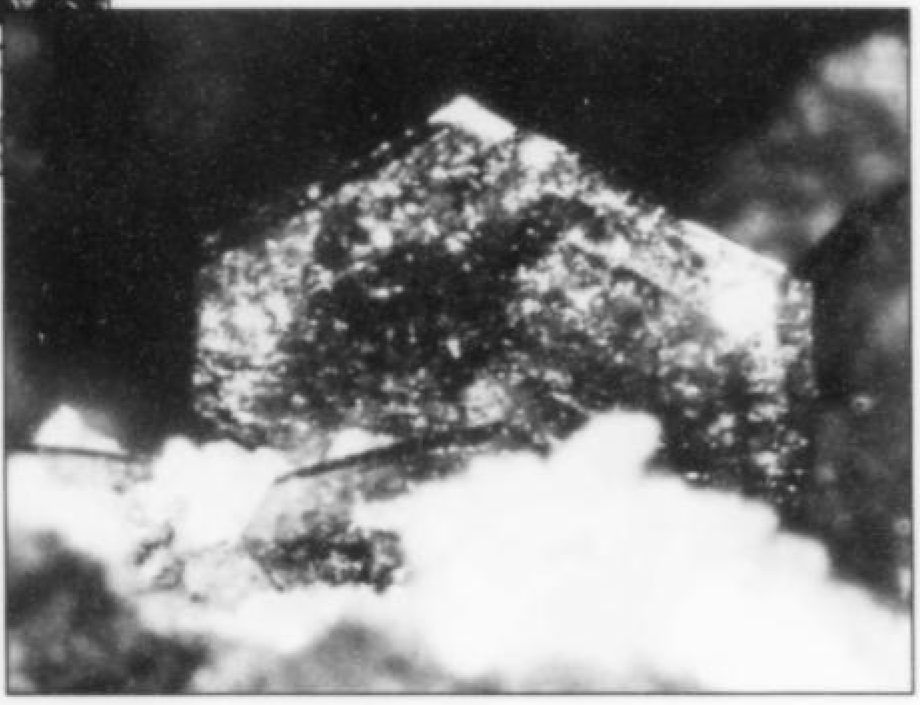


Figure 4. **Close-up photomicrograph of a single 3-mm crystal of germanium-rich beudantite. Desmond Sacco collection; Bruce Cairncross photograph.**

Figure 5. **Photomicrograph of quartz associated with a mass of intergrown, extremely tabular, pseudo-hexagonal germanium-rich beudantite crystals. The quartz is 6 mm. Desmond Sacco collection; Bruce Cairncross photograph.**

Facility at the Rand Afrikaans University in Johannesburg, South Africa.

Scanning electron microscopy revealed the pseudo-hexagonal platy shape of the crystals but an absence of basal cleavage (Fig. 1). At least some grains show fine concentric growth zoning (Fig. 2). Electron microprobe analyses of 10 single spots gave an average composition of 21.2 weight % Fe_2O_3, 33.4 weight % PbO, 5.2 weight % GeO_2, 2.1 weight % SO_4, and 21.1 weight % As_2O_5. Minor amounts of Cu and, interestingly, Sb were detected. Ge contents ranged between 3 and 4.5 weight %, similar to concentrations reported by Gebhard (1999), although somewhat less than the maximum of 6.5 weight % Ge reported from microcrystals of "Ge-beudantite" (Gebhard, 1999).

The best formula calculated from the available data is:

$$H_2PbFe_2[(OH)_6/(SO_4)_{0.2}/(GeO_4)_{0.4}/(AsO_4)_{1.4}].$$

This formula was calculated assuming that Ge substitutes as germanate anion for sulfate and arsenate as suggested by Gebhard (1999). This substitution mechanism is different from that found for gallobeudantite, $PbGa_3[(AsO_4),(SO_4)]_2(OH)_6$, where gallium substitutes for iron in the beudantite structure (Jambor *et al.*, 1996). Another interesting aspect of the chemistry is the very sulfate-poor composition and the apparent deficiency of iron in the germanium-rich beudantite structure. Since detailed microprobe work did not reveal the presence of any other element in substantial amounts, this deficiency was assumed to be due to the presence of H^+ or H_3O^+ cations, as also reported for the sulfate-free beudantite analog, segnitite.

Interestingly, a third matrix specimen of germanium-rich beudantite was discovered in September 1999 while this short report was being prepared. This specimen measures about 6 cm and is in the Karl Messner collection in Johannesburg. The crystals are identical in habit and color to those analyzed from the Sacco specimen. This third example was also obtained during the mid-1970's. It appears therefore that there may be more of these specimens in Tsumeb collections, hence the publication of this short note to aid in its identification.

ACKNOWLEDGMENTS

We thank Desmond Sacco for allowing us to photograph and sample his specimen of germanium-rich beudantite.

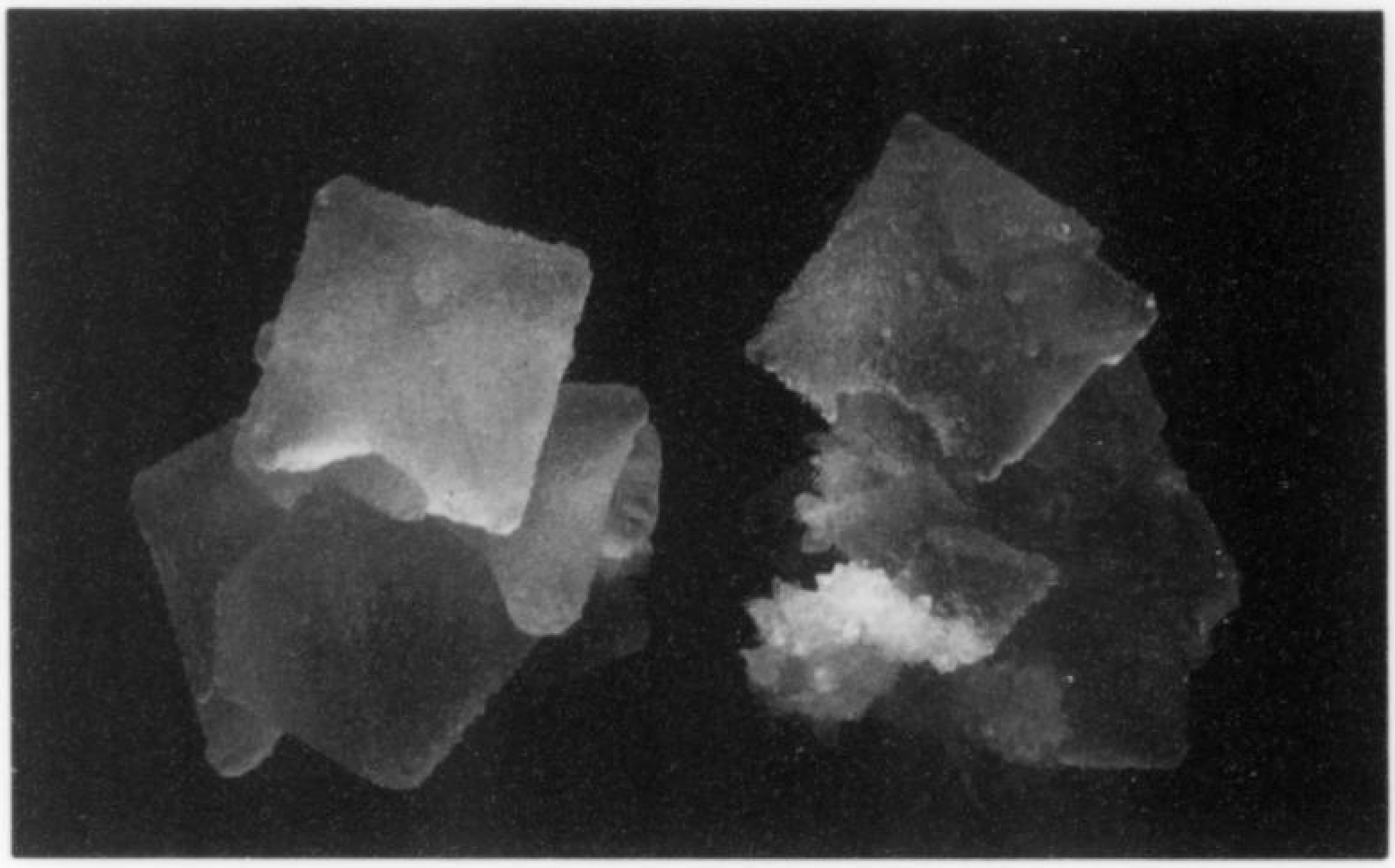
REFERENCES

GEBHARD, G. (1999) *Tsumeb II: A Unique Mineral Locality.* GG Publishing, Grossenseifen, Germany, 328 p.

JAMBOR, J. L., OWENS, D. R., GRICE, J. D., and FEINGLOS, M. N. (1996) Gallobeudantite, $PbGa_3[(AsO_4),(SO_4)]_2(OH)_6$, a new mineral species from Tsumeb, Namibia, and associated new gallium analogues of the alunite-jarosite family. *Canadian Mineralogist,* **34**, 1305–1315.

MADARINO, J. A. (1999) *Fleischer's Glossary of Mineral Species 1999.* The Mineralogical Record Inc., Tucson, 225 p.

PINCH, W. W., and WILSON, W. E. (1977) Minerals: a descriptive list. *In:* Tsumeb! The World's Greatest Mineral Locality. *Mineralogical Record,* **8**, 128 p.



Best of the Web

The Finest in Mineral Websites

Visit these websites for some of the finest in mineral specimens available on the worldwide web!

Don't wait for the next show—Great specimens are just a Click away!

Fabre Minerals
Jordi Fabre
www.Fabre-Minerals.com

IC Minerals
Isaias Casanova
www.ICMinerals.com

Key's Mineral Collection
Kiyoshi & Eriko Kiikuni
www.keysminerals.com

Sunnywood Collection
Bill & Elsie Stone
www.Sunnywood.com

Trinity Mineral Company
John Veevaert
www.TrinityMinerals.com
and www.RareMinerals.com

Weinrich Minerals
Dan & Jill Weinrich
www.DanWeinrich.com

The Arkenstone
Rob & Bailey Lavinsky
www.TheArkenstone.com
and www.iRocks.com

John Betts Minerals
John Betts
www.JohnBetts-FineMinerals.com

CK Minerals
Cyril Kovac
www.CKMinerals.com.au

Wright's Rock Shop
Chris Wright
www.WrightsRockShop.com

Best Information Sites

Mineralogy Database
http://webmineral.com

Athena Mineralogy
http://un2sg4.unige.ch/athena/mineral/mineral.html

Jolyon Ralph
http://www.mindat.org

The Virtual Show

If you can't make it to Tucson, Denver or Munich you can still see what's there!
Information, Specimens & Show Reports Available Online!

WWW.THE-VIRTUALSHOW.COM

INTERNET DIRECTORY

Bookmark these Great Websites and Check Them Regularly!

Alpine Mineral Company
Fine Alpine and Gem Pegmatite Minerals
www.alpineminerals.com
e-mail: kevin@alpineminerals.com

ARCH Minerals
Established Internet Mineral Pioneer
www.archminerals.com
e-mail: rhoek@archminerals.com

Argentum Auctions & Appraisers
Auctioneers of Minerals, Gems, Fossils & Mining Memorabilia
www.argentumauctions.com
e-mail: silver@argentumauctions.com

Attard's Minerals
Fine Worldwide Minerals, Equipmt., Services
www.attminerals.com
e-mail: attard@attminerals.com

Cyberocks
Worldwide Minerals, Fossils, Fluorescents
www.cyberocks.com
e-mail: steven@cyberocks.com

Dakota Matrix Minerals
Cab. To MM, Rare, Fine, Weekly Specials
www.dakotamatrix.com
e-mail: dakotamatrix@home.com

Douglass Minerals
Quality Worldwide Affordable Minerals
www.douglassminerals.com
e-mail: douglassminerals@aol.com

Element 51
Interesting Minerals, all Sizes & Prices
www.element51.com
e-mail: tjokela@execulink.com

Excalibur Mineral Company
Rare Minerals & Analytical Services
www.excaliburmineral.com
e-mail: info@excaliburmineral.com

Geoprime Minerals
Fine Minerals for Collectors
www.geoprime.com
e-mail: xlmine@geoprime.com

GeoSource Minerals
Fine Worldwide Minerals
www.georocks.com
e-mail: ryan@georocks.com

Great Basin Minerals, Ltd.
300+ Pics of Nevada & World Classics/Rarities
www.greatbasinminerals.com
e-mail: scottkleine@greatbasinminerals.com

H&P Minerals and Gems
Thumbnail and Miniature-size Minerals
www.hpminerals.com
e-mail: halprior@louisacomm.net

Jendon Minerals
Worldwide Localities and Thumbnails
www.jendonminerals.com
e-mail: Jendon6214@aol.com

Lawrence H. Conklin
For the Finest Specimens on the Internet
www.lhconklin.com
e-mail: lhc@lhconklin.com

Marin Minerals
Fine xls, great prices, freq. site updates
www.marinminerals.com
e-mail: mike@marinminerals.com

Martin Zinn Expositions
Tucson, Denver, Springfield and Costa Mesa Shows!
www.mzexpos.com
e-mail: mz0955@aol.com

The Mineralogical Record
Order Books & Back Issues Online!
www.mineralogicalrecord.com
e-mail: minrec@aol.com (Circulation)
e-mail: minrec@earthlock.net (Editing)

Mineralogical Research Co.
Minerals Meteorites Books MR-Back-Issues
www.minresco.com
e-mail: xtls@minresco.com

Mineralogy Database
On-line User-Frndly, Up-to-date Mineral Data
http://webmineral.com
e-mail: dbarthelmy@webmineral.com

The Mineral Vug
Minerals from the US and World Localities
www.themineralvug.com
e-mail: minerals@themineralvug.com

The Mineral Zone
It's All About the Minerals
www.mineralzone.com
e-mail: marcus@mineralzone.com

Mountain Minerals International
Direct Importers: Asia and East Africa
www.mtnminitl.com
e-mail: dudley@mtnminitl.com

Ososoft Mineral Connection
Worldwide Minerals at Reasonable Prices
www.osomin.com
e-mail: george@osomin.com

Penn Minerals
Classic Pennsylvania Minerals our Specialty
www.pennminerals.com
e-mail: SteveCarter@pennminerals.com

Pickens Minerals
Fine Worldwide Minerals, Acrylic Stands/Mounts
www.pickensminerals.com
e-mail: reo@pickensminerals.com

Spheres to You
More than 5,000 Beautiful Mineral Spheres
www.spherestoyou.com
e-mail: spheres@iswest.com

Trafford-Flynn Minerals
Affordable Worldwide Quality Minerals
www.trafford-flynn.com
e-mail: info@trafford-flynn.com

UK Mining Ventures
Fluorite–Rogerley mine, Weardale, UK
www.ukminingventures.com
e-mail: Jef520@aol.com

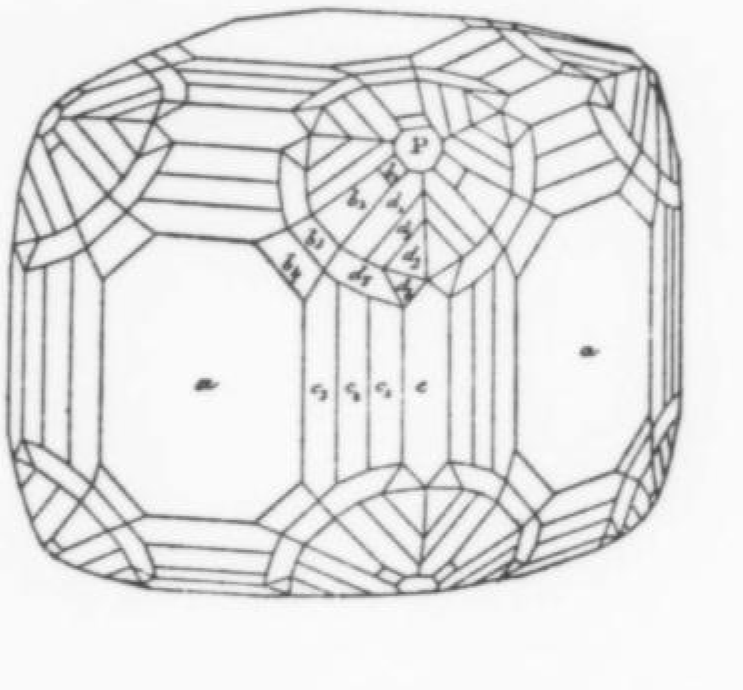
UV Systems, Inc.
SuperBright and TripleBright UV lights
www.uvsystems.com
e-mail uvsystems@aol.com

Western Minerals
Finest Quality Worldwide Minerals
www.wmtucson.com
e-mail: schlepp@wmtucson.com

**List your internet site here! Contact the editor at minrec@earthlink.net*

Rhodochrosite, 12.5 cm, Huallapon mine, Peru

ABSTRACTS OF NEW MINERAL DESCRIPTIONS



J. A. Mandarino
Chairman Emeritus of the Commission on
New Minerals and Mineral Names
of the International Mineralogical Association
and
Curator Emeritus
Department of Mineralogy
Royal Ontario Museum
100 Queen's Park
Toronto, Ontario, Canada M5S 2C6

Tegengrenite — Trigonal

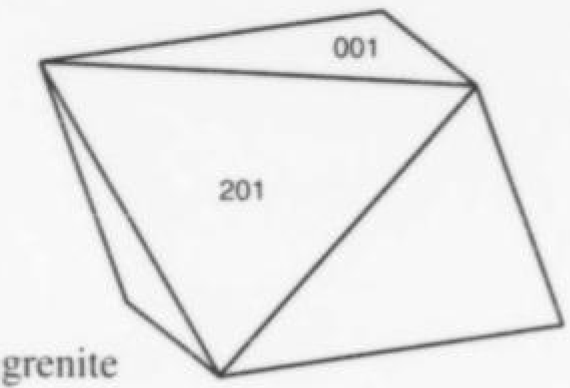
$(Mg,Mn)_2Sb^{5+}_{0.5}(Mn^{3+},Si,Ti)_{0.5}O_4$

Locality: Jakobsberg, Filipstad district, Värmland, Sweden (Lat. 59.83° N, Long. 14.11° E).

Occurrence: In a manganese-iron deposit in marble. Associated minerals are: hausmannite, calcite, brucite, dolomite, clinohumite, kinoshitalite, copper, barytocalcite, bindheimite and cerussite.

General appearance: Euhedral to subhedral crystals (up to 1 mm across).

Physical, chemical and crystallographic properties: *Luster:* subadamantine. *Diaphaneity:* translucent. *Color:* deep ruby red. *Streak:* not given. *Hardness:* not given. *Tenacity:* not given. *Cleavage:* none observed. *Fracture:* conchoidal. *Density:* could not be measured, 4.58 g/cm^3 (calc.). ***Crystallography:*** Trigonal, *R*3 or *R*$\bar{3}$, *a* 16.196, *c* 14.948 Å, *V* 3395.7 Å^3, Z 42, *c:a* = 0.9229. Morphology: pseudo-octahedra probably consisting of {001} and {201}. Twinning: the pseudo-octahedra consist of eight twin domains. ***X-ray powder diffraction data:*** 4.98 (20) (211, 003), 3.052 (33) (140, 214), 2.608 (100) (241, 143, 125), 2.162 (28) (244), 1.6652 (30) (363, 075), 1.5313 (26) (820), 1.5273 (29) (428). ***Optical data:*** In reflected light: gray, practically isotropic, orange-red internal reflections sometimes seen. R: (10.4 %) 470nm, (10.0 %) 546nm, (9.9 %) 589nm, (9.8 %) 650nm. ***Chemical analytical data:*** Means of 35 sets of electron microprobe data: MgO 21.83, MnO 25.76, ZnO 2.66, Al_2O_3 0.76, Mn_2O_3 8.12, Fe_2O_3 0.78, SiO_2 1.70, TiO_2 1.40, Sb_2O_5 36.13, Total 99.14 wt.%. Empirical formula: $(Mg_{1.22}Mn^{2+}_{0.82}Zn_{0.07})_{\Sigma 2.11}Sb^{5+}_{0.50}(Mn^{3+}_{0.23}Si_{0.06}Ti_{0.04}Al_{0.03}Fe^{3+}_{0.02})_{\Sigma 0.38}O_{4.00}$. ***Relationship to other species:*** It is chemically related to filipstadite, $Mn_2(Sb^{5+}_{0.05}Fe^{3+}_{0.05})O_4$, and both are structurally related to spinel.



Tegengrenite

Name: For Felix Tegengren (1884–1980), a renowned Finlandic-Swedish economic geologist who wrote large volumes on the ore deposits of Sweden and China. ***Comments:*** IMA No. 1999-002. The drawing given here is based on the probable forms {001} and {201} which produce a pseudo-octahedron.

HOLTSTAM, D. and LARSSON, A.-K. (2000) Tegengrenite, a new, rhombohedral spinel-related Sb mineral from the Jakobsberg Fe-Mn deposit, Värmland, Sweden. *American Mineralogist* **85**, 1315–1320.

Tumchaite — Monoclinic

$Na_2(Zr,Sn)Si_4O_{11}\cdot 2H_2O$

Locality: The Vuoriyarvi massif on the north shore of Vuoriyarvi Lake, North Karelia, Murmansk Region, Russia.

Occurrence: In a sample from a bore hole which crosscuts veined dolomite-calcite carbonatites. Associated minerals are: calcite, dolomite, a serpentine group mineral and pyrite.

General appearance: Tabular crystals (up to 0.2 x 1.2 x 2.5 mm).

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent to translucent. *Color:* colorless to white. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* VHN_{40} 410 kg/mm^2, Mohs close to 4½. *Tenacity:* very brittle. *Cleavage:* {100} perfect. *Fracture:* uneven. *Density:* 2.78 g/cm^3 (meas.), 2.77 g/cm^3 (calc.). ***Crystallography:*** Monoclinic, $P2_1/c$, *a* 9.144, *b* 8.818, *c* 7.537 Å, β 113.22°, *V* 558.49 Å^3, Z 2, *a:b:c* = 1.0370:1:0.8547. Morphology: {100}, {h0l}, {hkl}; tabular on {100} and elongated along [001]. Twinning: on {100}. ***X-ray powder diffraction data:*** 8.40 (10) (100), 5.38 (9) ($11\bar{1}$), 4.00 (8) (111), 3.401 (9) ($20\bar{2}$), 2.902 (9) (211), 2.772 (7) ($30\bar{2}$), 2.691 (9) ($13\bar{1}$), 2.190 (7) ($31\bar{3}$, $41\bar{1}$). ***Optical data:*** Biaxial (–), α 1.570, β 1.588, γ 1.594, 2V(meas.) 60°, 2V(calc.) 59°; pleochroism X = greenish gray, Y = Z = colorless; Y = *b*, $Z \wedge c = 3°$. ***Chemical analytical data:*** Six crystals were analyzed by electron microprobe (6 to 10 analyses per crystal). The data from one crystal are: Na_2O 13.72, CaO 0.15, MnO <0.02, FeO <0.02, Y_2O_3 <0.1, SiO_2 52.71, TiO_2 0.35, ZrO_2 20.41, SnO_2 5.73, HfO_2 0.60, Nb_2O_5 <0.05, H_2O (7.86), Total (101.53) wt.%. H_2O was calculated to give $2(H_2O)$. Empirical formula: $(Na_{2.03}Ca_{0.01})_{\Sigma 2.04}(Zr_{0.76}Sn_{0.17}Ti_{0.02}Hf_{0.01})_{\Sigma 0.96}Si_{4.02}O_{11.00}\cdot 2.00H_2O$. ***Relationship to other species:*** Isostructural with penkvilksite-1*M* and is chemically related to vlasovite.

Name: For the Tumcha River, near the Vuoriyarvi massif. ***Comments:*** IMA No. 1999-041.

SUBBOTIN, V. V., MERLINO, S., PUSHCHAROVSKY, D. Yu., PAKHOMOVSKY, Ya. A., FERRO, O., BOGDANOVA, A. N., VOLOSHIN, A. V., SOROKHTINA, N. V., and ZUBKOVA, N. V. (2000) Tumchaite $Na_2(Zr,Sn)Si_4O_{11}\cdot 2H_2O$—A new mineral from carbonatites of the Vuoriyarvi alkali-ultrabasic massif, Murmansk Region, Russia. *American Mineralogist* **85**, 1516–1520.

Vergasovaite

Orthorhombic

$Cu_3O[(Mo,S)O_4](SO_4)$

Locality: The fumarole "Treschina" in the northern part of the central fumarole field of cone II of the Northern Break of the Large Tolbachik Fissure Eruption, Kamchatka Peninsula, Russia.

Occurrence: Formed by sublimation from fumarole gases (temperatures 150 to 170°C). Associated minerals are: chalcocyanite, dolerophanite, euchlorine, fedotovite, tenorite, cuprian anglesite and gold. It forms directly on chalcocyanite and dolerophanite.

General appearance: Rare single crystals (up to 0.3 mm) and as intergrown crystals forming radiating aggregates (up to 0.6 mm).

Physical, chemical and crystallographic properties: *Luster:* given as vitreous, but the optical data indicate adamantine. *Diaphaneity:* transparent. *Color:* olive-green. *Streak:* light yellow. *Luminescence:* non-fluorescent. *Hardness:* VHN_{25} 357 kg/mm², Mohs 4 to 5 (measurements subparallel to (010) gave 5 to 5½). *Tenacity:* brittle. *Cleavage:* not observed. *Fracture:* uneven. *Density:* could not be determined, 4.39 g/cm³ (calc.). ***Crystallography:*** Orthorhombic, *Pnma*, *a* 7.420, *b* 6.741, *c* 13.548 Å, *V* 677.6 Å³, Z 4, *a:b:c* = 1.1007:1:2.0098. Morphology: the following forms were observed {010}, {110}, {120}, {130}, {111}, {263}, {315}. Twinning: none mentioned. ***X-ray powder diffraction data:*** 3.591 (60) (020), 3.342 (60) (113), 3.077 (100) (104), 2.542 (60) (105, 123), 2.500 (60) (220), 2.275 (60) (124). ***Optical data:*** Optical character unknown, indices of refraction are higher than 1.9; pleochroic with *c* = olive-green and the direction perpendicular to *c* = yellowish to brownish green; orientation not given. In reflected light: gray with ubiquitous light green to colorless internal reflections, anisotropism masked by the internal reflections, bireflectance measurable but not discernible, pleochroism absent. R_1, R_2: (9.85, 11.69) **470** nm, (9.4, 11.01) **546** nm, (9.22, 10.76) **589** nm, (9.00, 10.48) **650** nm. ***Chemical analytical data:*** Means of 18 sets of electron microprobe data (9 for PbO): CuO 49.81, ZnO 1.76, PbO 0.63, SO_3 21.44, MoO_3 25.29, V_2O_5 0.88, Total 99.81 wt.%. Empirical formula:$(Cu_{2.81}Zn_{0.10}Pb_{0.01})_{\Sigma 2.92}O_{1.00}[(Mo_{0.79}S_{0.20}V_{0.04})_{\Sigma 1.03}O_{4.00}](SO_4)$. ***Relationship to other species:*** It is the first known mineral which contains Cu, Mo, S and O as its main elements and it is isotypic with synthetic $Cu_3O(MoO_4)_2$.

Name: For Dr. Lidia Pavlovna Vergasova (1941–), Institute of Volcanology of the Russian Academy of Sciences, Petropavlovsk-Kamchatskii, Russia, in recognition of her contributions to the mineralogy of volcanic exhalates of Kamchatka in general and to the mineralogy of the Tolbachik region in particular. ***Comments:*** IMA No. 98-009.

BYKOVA, E. Y., BERLEPSCH, P., KARTASHOV, P. M., BRUGGER, J., ARMBRUSTER, T., and CRIDDLE, A. J. (1998) Vergasovaite $Cu_3O[(Mo,S)O_4][SO_4]$. *Schweizerische mineralogische und petrographische Mitteilungen* **78**, 479–488.

Wallkilldellite-Fe

Hexagonal

$(Ca,Cu)_4Fe_6[(As,Si)O_4]_4(OH)_8\cdot 18H_2O$

Locality: The Roua mine, Alpes Maritimes, France.

Occurrence: In a copper deposit. Associated minerals are: cuprite, native copper, native silver, algodonite, domeykite, djurleite, koutekite, olivenite, malachite, pecoraite, kolfanite, janggunite, calcite and ankerite.

General appearance: Spherules made up of thin plates tabular on {001} (up to 0.1 mm in diameter).

Physical, chemical and crystallographic properties: *Luster:* vitreous to resinous. *Diaphaneity:* translucent. *Color:* brown yellow. *Streak:* light brown. *Luminescence:* nonfluorescent. *Hardness:* 2 to 3. *Tenacity:* fragile. *Cleavage:* {001} perfect. *Fracture:* not mentioned. *Density:* 3.0 g/cm³ (meas.), 2.92 g/cm³ (calc.). ***Crystallography:*** Hexagonal, $P6_3/mmc$, $P6_3mc$ or $P\bar{6}2c$, *a* 6.548, *c* 23.21 Å, *V* 861.9 Å³, Z 1, *c:a* = 3.5446. Morphology: only {001} was observed. Twinning: none mentioned. ***X-ray powder diffraction data:*** 11.600 (100) (002), 5.670 (80) (100), 3.275 (70) (110), 2.850 (10) (114), 2.760 (15) (202), 2.547 (10) (204), 2.321 (10) (00.10), 2.139 (10) (120), 1.641 (25) (307). ***Optical data:*** Uniaxial (–), ω 1.750, ε could not be determined because of the thinness of the plates, pleochroism strong, O = brown, E = light brown yellow. ***Chemical analytical data:*** Means of nine sets of electron microprobe data: CaO 13.68, FeO 27.25, CuO 2.04, SiO_2 1.27, As_2O_5 30.03, H_2O (25.73), Total (100.00) wt.%. H_2O calculated by difference. Empirical formula: $(Ca_{3.70}Cu_{0.39})_{\Sigma 4.08}Fe_{5.75}(As_{3.96}Si_{0.32})_{\Sigma 4.28}O_{17.12}(OH)_{6.50}\cdot 18.38H_2O$. ***Relationship to other species:*** It is the Fe-dominant analogue of wallkilldellite, $Ca_4Mn_6(AsO_4)_4(OH)_8\cdot 18H_2O$.

Name: For the chemical relationship to wallkilldellite, $Ca_4Mn_6(AsO_4)_4(OH)_8\cdot 18H_2O$. ***Comments:*** IMA No. 1997-032. The subscripts of the empirical formula presented here are somewhat different from those given in the paper. The name approved by the CNMMN of IMA is wallkilldellite-(Fe) not wallkilldellite-Fe as given in the paper by Sarp *et al.* (1999).

SARP, H., MARI, G., and CHIAPPERO, P.-J. (1999) La wallkilldellite-Fe, $(Ca,Cu)_4Fe_6[(As,Si)O_4]_4(OH)_8\cdot 18H_2O$, un nouveau mineral de la mine de Roua (Alpes-Maritimes, France). *Riviéra Scientifique* **1999**, 5–12.

Xenotime-(Yb)

Tetragonal

$YbPO_4$

Locality: The SHE-5 pegmatite of the Shatford Lake pegmatite group, Township 16, Range 15 EPM, southeastern Manitoba, Canada. The map coordinates are 323750mE, 5584800mN, Zone 15U on the Rynerson Lake map sheet (52/L16).

Occurrence: Associated minerals are: ferrian muscovite, albite, microcline, quartz and ferrocolumbite.

General appearance: Granular aggregates (up to 50 µm across) and as separate small grains (up to 20 µm) in clots of ferrian muscovite.

Physical, chemical and crystallographic properties: *Luster:* vitreous. *Diaphaneity:* transparent. *Color:* colorless to pale yellowish or brownish. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* could not be determined. *Tenacity:* brittle. *Cleavage:* not observed. *Fracture:* uneven. *Density:* could not be measured, 5.86 g/cm³ (calc.). ***Crystallography:*** Tetragonal, $I4_1/amd$, *a* 6.866, *c* 6.004 Å, *V* 283.0 Å³, Z 4, *c:a* = 0.8745. Morphology: no forms were mentioned. Twinning: none mentioned. ***X-ray powder diffraction data:*** 4.515 (7) (011), 3.437 (10) (020), 2.730 (3) (121), 2.556 (8) (112), 2.138 (3) (031), 1.760 (5) (132). ***Optical data:*** Uniaxial (+), ω 1.717, ε 1.802, nonpleochroic. ***Chemical analytical data:*** Means of three sets of electron microprobe data on one of the grains characterized by X-ray diffraction: Y_2O_3 8.75, Gd_2O_3 0.26, Tb_2O_3 0.19, Dy_2O_3 3.72, Ho_2O_3 0.94, Er_2O_3 8.29, Tm_2O_3 2.86, Yb_2O_3 36.37, Lu_2O_3 7.12, P_2O_5 27.25, Total 95.75 wt.%. Empirical formula: $(Yb_{0.48}Y_{0.20}Er_{0.11}Lu_{0.09}Dy_{0.05}Tm_{0.04}Ho_{0.01})_{\Sigma 0.98}(PO_4)_{1.00}$. ***Relationship to other species:*** The Yb-dominant analogue of xenotime-(Y).

Name: For the relationship to xenotime-(Y). ***Comments:*** IMA No. 1998-049.

BUCK, H. M., COOPER, M. A., ČERNÝ, P., GRICE, J. D., and HAWTHORNE, F. C. (1999) Xenotime-(Yb), $YbPO_4$, a new mineral species from the Shatford Lake pegmatite group, southeastern Manitoba, Canada. *Canadian Mineralogist* **37**, 1303–1306.

Zálesíite Hexagonal

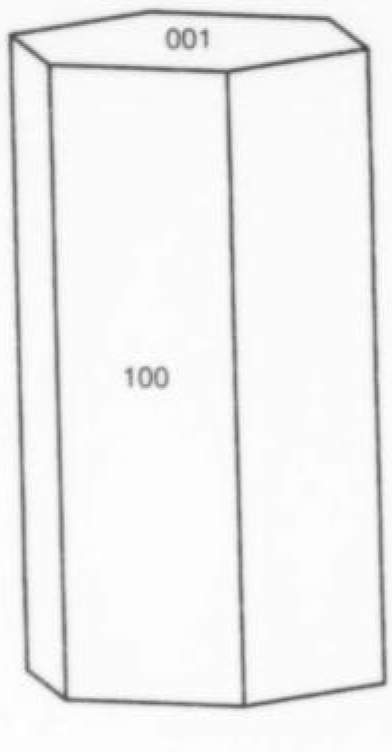
$CaCu_6[(AsO_4)_2(AsO_3OH)(OH)_6]\cdot 3H_2O$

Locality: The Zálesí (formerly known as Valdek) uranium deposit, approximately 25 km NW Jeseník and 8 km SW of Javorník, Rychlebské hory Mts., Northern Moravia, Czech Republic.

Occurrence: In cavities of silicified rocks. Associated minerals are: chalcopyrite, chrysocolla, clinoclase, conichalcite, erythrite, malachite, metanováčekite, metatorbernite, nováčekite, tyrolite, uranophane and zeunerite.

General appearance: Minute acicular crystals (up to 0.1 mm long by 2 to 10 μm wide); compact aggregates up to 5 mm, coatings, cross-fiber veinlets and chalky or small tufted aggregates or clusters of needle-shaped crystals.

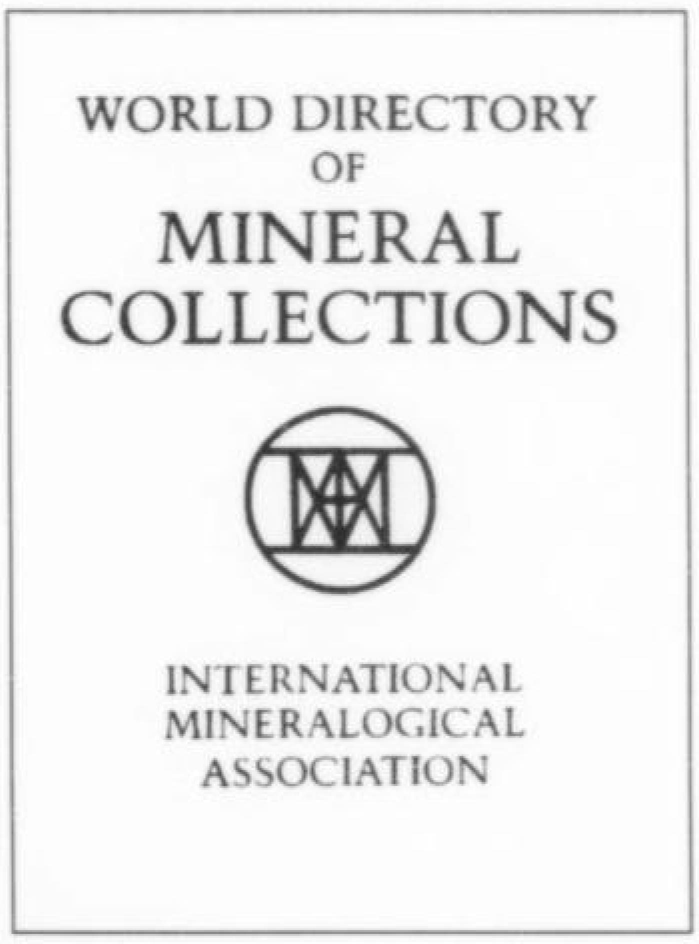
Physical, chemical and crystallographic properties: *Luster:* vitreous to resinous. *Diaphaneity:* transparent to translucent. *Color:* pale green. *Streak:* white. *Luminescence:* nonfluorescent. *Hardness:* 2 to 3. *Tenacity:* not given. *Cleavage:* not given. *Fracture:* not given. *Density:* 3.49 g/cm³ (meas.), 3.50 g/cm³ (calc.). ***Crystallography:*** Hexagonal, $P6_3/m$, a 13.571, c 5.880 Å, V 937.8 Å³, Z 2, $c:a$ = 0.4333. Morphology: {100} and {001}, elongated on [001]. Twinning: on {100}. ***X-ray powder diffraction data:*** 11.64 (100) (100), 4.431 (41) (111), 3.387 (17) (220), 3.254 (22) (130), 2.9347 (42) (221, 400), 2.6932 (29) (112, 320, 230), 2.5624 (30) (140). ***Optical data:*** Uniaxial (+), ω 1.688, ε 1.765, weak pleochroism O = pale yellow green, E = pale green. ***Chemical analytical data:*** Means of eleven sets of electron microprobe data: CaO 5.46, CuO 46.46, Y_2O_3 1.50, Al_2O_3 0.26, La_2O_3 0.10, P_2O_5 0.37, As_2O_5 34.27, H_2O 11.95, Total 100.37 wt.%. Empirical formula: $(Ca_{0.81}Y_{0.13}Al_{0.05}La_{0.01})_{\Sigma 1.00}(Cu_{5.75}Ca_{0.15})_{\Sigma 5.90}[(AsO_4)_{1.94}(PO_4)_{0.05}(AsO_3OH)(OH)_{6.02}]\cdot 3.02H_2O$. ***Relationship to other species:*** The calcium- and arsenate-dominant member of the mixite group.

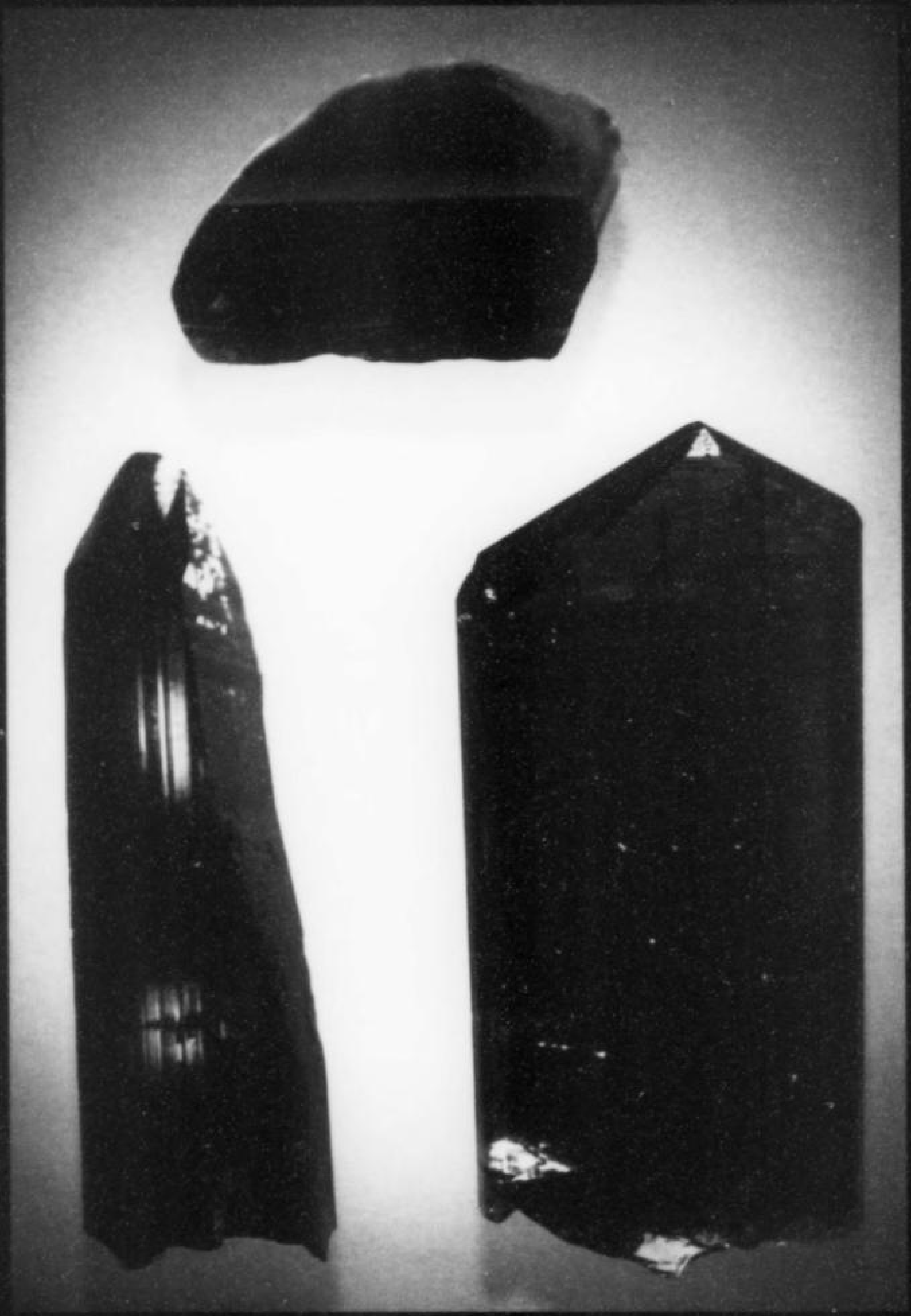


Zálesíite

Name: For the locality. ***Comments:*** IMA No. 1997-009.

SEJKORA, J., ŘÍDKOŠIL, T., and ŠREIN, V. (1999) Zálesíite, a new mineral of the mixite group, from Zálesí, Rychlebské hory Mts., Czech Republic. *Neues Jahrbuch für Mineralogie, Abhandlungen* **175(2)**, 105–124.





THE MUSEUM DIRECTORY

New York State Museum

Curator (Geol.): Dr. William Kelly
Tel: 518-474-7559
Collections Mgr. (Geol.):
Michael Hawkins
Tel: 518-486-2011
Fax: 518-486-3696
3140 Cultural Education Ctr.
Albany, NY 12230-0001
Website: www.nysm.nysed.gov
Hours: 10–5 daily (closed Thanksgiving, Christmas, New Years)
Specialty: New York & worldwide minerals
Support Org.: NY State Acad. of Mineralogy (www.nysm.nysed.gov/nysam)

Geology and Meteorite Museums University of New Mexico

Curators: Barry Kues (Geology), Rhian Jones (Meteorites)
Tel: (505) 277-4204
Dept. of Earth & Planetary Sciences
Northrop Hall, Univ. of New Mexico
Albuquerque, NM 87131
Hours: 8–12, 1–4 M–F (closed on school holidays)
Specialties: Worldwide minerals and meteorites, New Mexico fossils, Harding Pegmatite Mine Collection

Colburn Gem & Mineral Museum

Curator of Collections: Christian Richart G.G. (GIA)
Tel: (828) 254-7162
Fax: (828) 257-4505
Website: www.main.nc.us/colburn
Pack Place Education, Arts & Science Center
2 South Pack Square
Asheville, NC 28801
Hours: 10–5 Tues.–Sat.
1–5 Sun.
Closed Mondays and holidays
Specialties: North Carolina and worldwide minerals and gems
Accessible to persons with disabilities

Harvard Mineralogical Museum

Curators: Dr. Carl A. Francis
William Metropolis
Tel: (617) 495-4758
24 Oxford Street
Cambridge, Mass. 02138
Hours: 9–4:30 M–Sat.; 1–4:30 Sun.
Specialties: Systematic Mineral Coll'n

Western Museum of Mining & Industry

Curator: Terry A. Girouard
Tel: (719) 495-2182
email: curatewmmi@juno.com
Dir. of Educ.: Gary Renville
Tel: (719) 488-0880
Fax: (719) 488-9261
www.wmmi.org
1025 North Gate Road
Colorado Springs, CO 80921
Hours: 9–4 M-Sat., (12-4 Sun., June–Sept. only), closed holidays
Specialties: Colorado minerals & ores, Western mining memorabilia, 14,000-vol. research library

The Gillespie Museum of Minerals, Stetson University

Curator: Dr. Bruce Bradford
Tel: (904) 822-7331
E-mail: bbradfor@stetson.edu
Assistant Director: Holli M. Vanater
Tel: (904) 822-7330
E-mail: hvanater@stetson.edu
Fax: (904) 822-7328
234 E. Michigan Avenue
DeLand, Florida
Mailing: 421 N. Woodland Blvd., Unit 8403, DeLand, FL 32720-3757
Hours: 9–noon, 1–4 M–F when university is in session (closed on holidays, university breaks & in the summer)
Specialties: Worldwide comprehensive collection of rocks & minerals; Florida rocks, minerals & fossils; large historic fluorescent collection

Denver Museum of Natural History

Curator of Geology: Jack A. Murphy
Tel: (303) 370-6445
Dept. of Earth Sciences
20001 Colorado Blvd.
Denver, CO 80205
Hours: 9–5 daily
Specialties: Colorado minerals

Geology Museum Colorado School of Mines

Curator: Virginia A. Mast
Tel: (303) 273-3823
Golden, Colorado 80401
Hours: 9–4 M–Sat., 1–4 Sun.
(closed on school holidays & Sundays in the summer)
Specialties: Worldwide minerals; Colorado mining & minerals

A. E. Seaman Mineralogical Museum

Director: Stan Dyl
Curator (mineralogy):
George W. Robinson
Adjunct Curator: Dr. John A. Jaszczak
Tel: (906) 487-2572
Michigan Technological Univ.
Houghton, Michigan 49931
Hours: 9–4:30 M–F
Specialty: Michigan minerals, copper minerals & worldwide minerals

Houston Museum of Natural Science

Curator (mineralogy): Joel Bartsch
Tel: (713) 639-4673
Fax: (713) 523-4125
1 Herman Circle Drive
Houston, Texas 77030
Hours: 9–6 M–Sat., 12–6 Sun.
Specialty: Finest or near-finest known specimens

Museums listed alphabetically by city

Additional listings welcome!

Send vital information, as shown, to the editor. There is a modest annual fee (lower than our regular advertising rates).

THE MUSEUM DIRECTORY

Natural History Museum of Los Angeles County

Fax: (213) 749-4107
Website: http://nhm.org/minsci
Curator (Mineral Sciences):
Dr. Anthony R. Kampf
Tel: (213) 763-3328
e-mail: akampf@nhm.org
Collections Manager:
Dorothy L. Ettensohn
Tel: (213) 763-3327
e-mail: dettenso@nhm.org
900 Exposition Blvd.
Los Angeles, CA 90007
Hours: 9:30–5:00 Daily
Specialties: Calif. & worldwide minerals, gold, gem crystals, colored gemstones
Support organization:
The Gem and Mineral Council

California State Mining and Mineral Museum

Website: http//parks.ca.gov/parkpages/park_page.asp?lvl_id=227
Curator: Peggy Ronning
Tel: (209) 742-7625
Fax: (209) 966-3597
e-mail: mineralcurator@sierratel.com
5005 Fairgrounds Rd.
Mariposa, CA 95338
Mailing Address:
P.O. Box 1192
Mariposa, CA 95338
Hours: 10–6 Daily (May–Sept.)
10–4 Wed.–Mon. (Oct–Apr.)
Specialties: Gold, California minerals, California mining

Arizona Mining & Mineral Museum

Department Director: Doug Sawyer
Curator: Sue Celestian
Tel: (602) 255-3795
1502 W. Washington Avenue
Phoenix, AZ 85007
Hours: 8–5 M–F, 11–4 Sat., closed Sun. & holidays
Specialty: Arizona minerals

Carnegie Museum of Natural History

Collection Manager: Marc L. Wilson
Tel: (412) 622-3391
4400 Forbes Avenue
Pittsburgh, PA 15213
Hours: 10–5 Tues.–Sat., 10–9 F, 1–5 Sun., closed Mon. & holidays
Specialty: Worldwide minerals & gems

New Mexico Bureau of Mines & Mineral Resources—Mineral Museum

Director: Dr. Virgil W. Lueth
Tel: (505) 835-5140
E-Mail: vwlueth@nmt.edu
Fax: (505) 835-6333
Associate Curator: Robert Eveleth
Tel: (505) 835-5325
E-mail: beveleth@gis.nmt.edu
New Mexico Tech,
801 Leroy Place
Socorro, NM 87801
Hours: 8–5 M–F, 10–3 Sat., Sun
Specialties: New Mexico minerals, mining artifacts, worldwide minerals

Penn State Earth & Mineral Sciences Museum

Curator: Dr. Andrew Sicree, PhD
Tel: (814) 865-6427
E-mail: sicree@geosc.psu.edu
Steidle Building
University Park
State College, PA 16802
Hours: 9–5 M–F & by Appt. (closed holidays)
Specialties: Mineral properties exhibits; "velvet" malachite; old Penna. minerals, mining art

Arizona-Sonora Desert Museum

Collections Manager & Mineralogist: Anna M. Domitrovic
Tel: (520) 883-1380 ext. 152
Fax: (520) 883-2500
2021 N. Kinney Road
Tucson, AZ 85743-8918
Hours: 8:30-5 Daily (Oct.-Feb.)
7:30-6 Daily (Mar.-Sept.)
Specialty: Arizona minerals

Pacific Mineral Museum

Director/Curator: Mark Mauthner
Tel: (604) 689-8700
E-Mail: markm@pacificmineralmuseum.org
848 West Hastings Street
Vancouver, B.C., Canada V6C 1C8
Hours: M–F 10–5, Weekends 10–6 (Closed Mondays in winter)
Specialties: BC–Yukon–Pacific NW, worldwide, gold, silver

U.S. National Museum of Natural History (Smithsonian Institution)

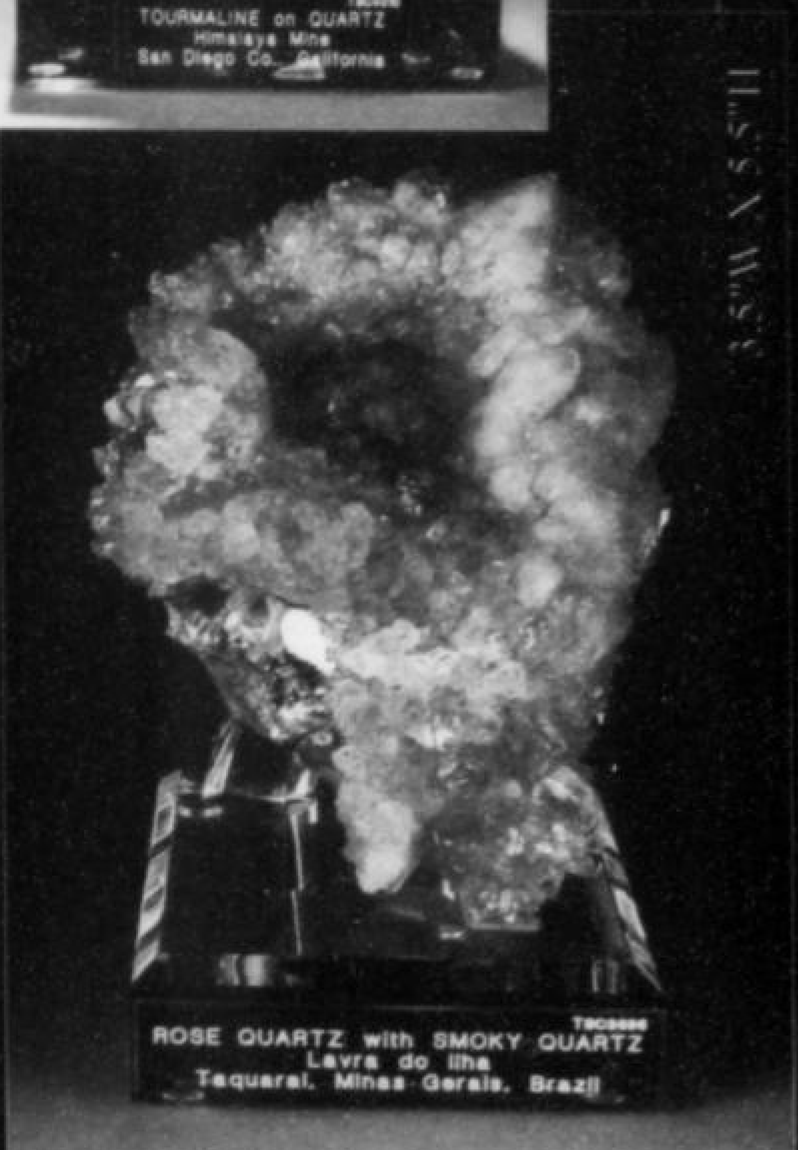
Curator: Dr. Jeffrey E. Post
e-mail: minerals@nmnh.si.edu
Collection Managers: Paul Pohwat and Russell Feather
(Dept. of Mineral Sciences)
Washington, DC 20560-0119
Hours: 10 am–5:30 pm daily
Specialties: Worldwide minerals, gems, research specimens

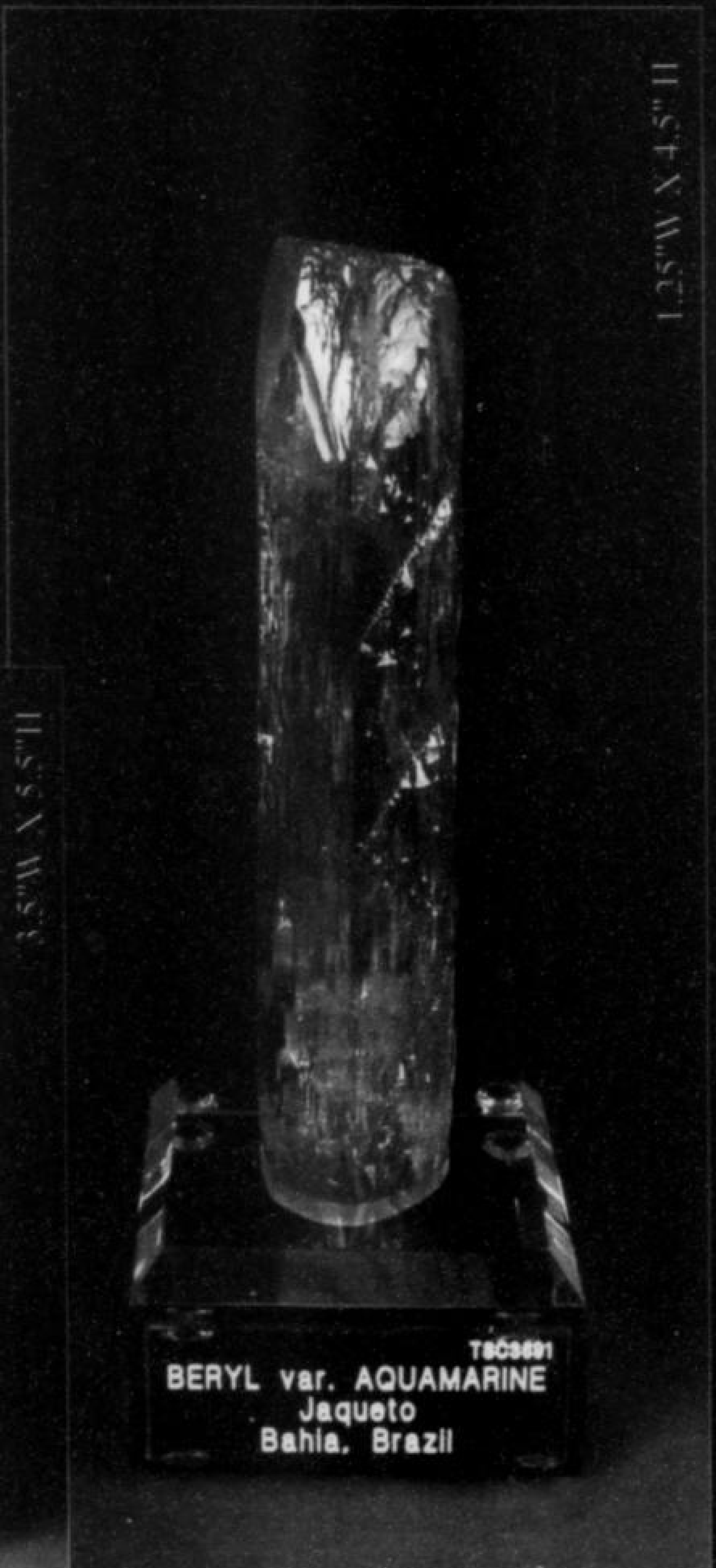
William Weinman Mineral Museum

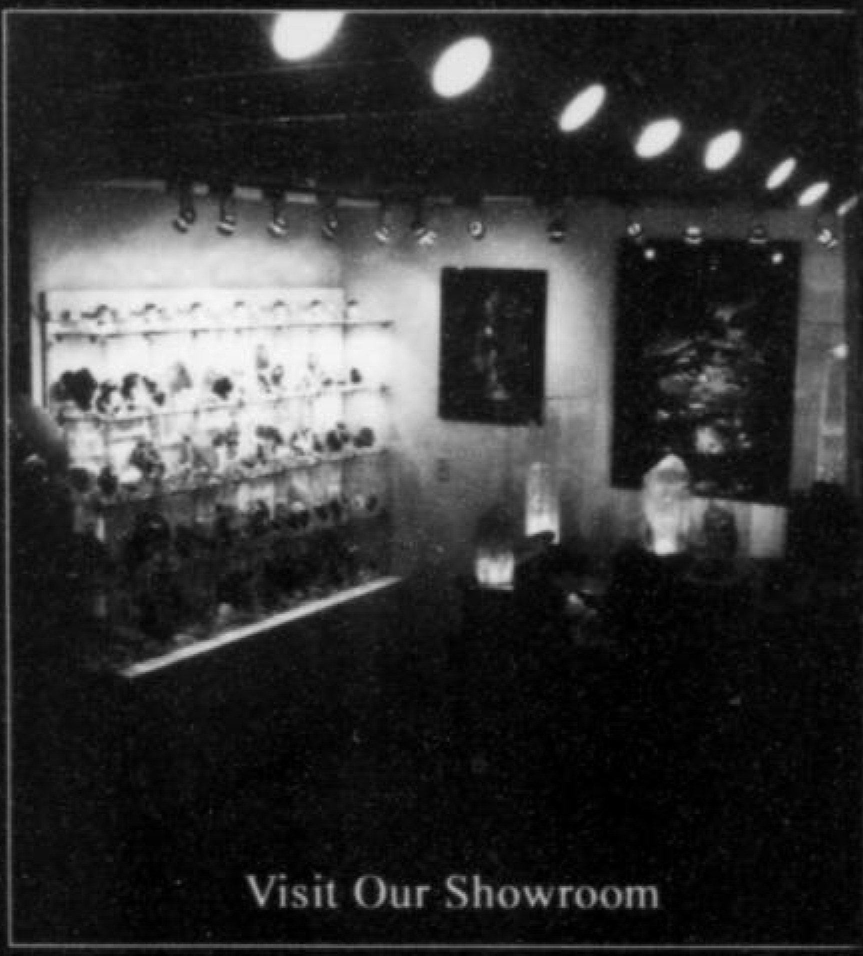
Asst. Curator: Doug Gravely
Tel: (770) 386-0576
51 Mineral Museum Dr.
White, GA 30184
Hours: 10–4:30 Tues.–Sat., 2–4:30 Sun.
Specialty: Georgia & worldwide minerals & fossils

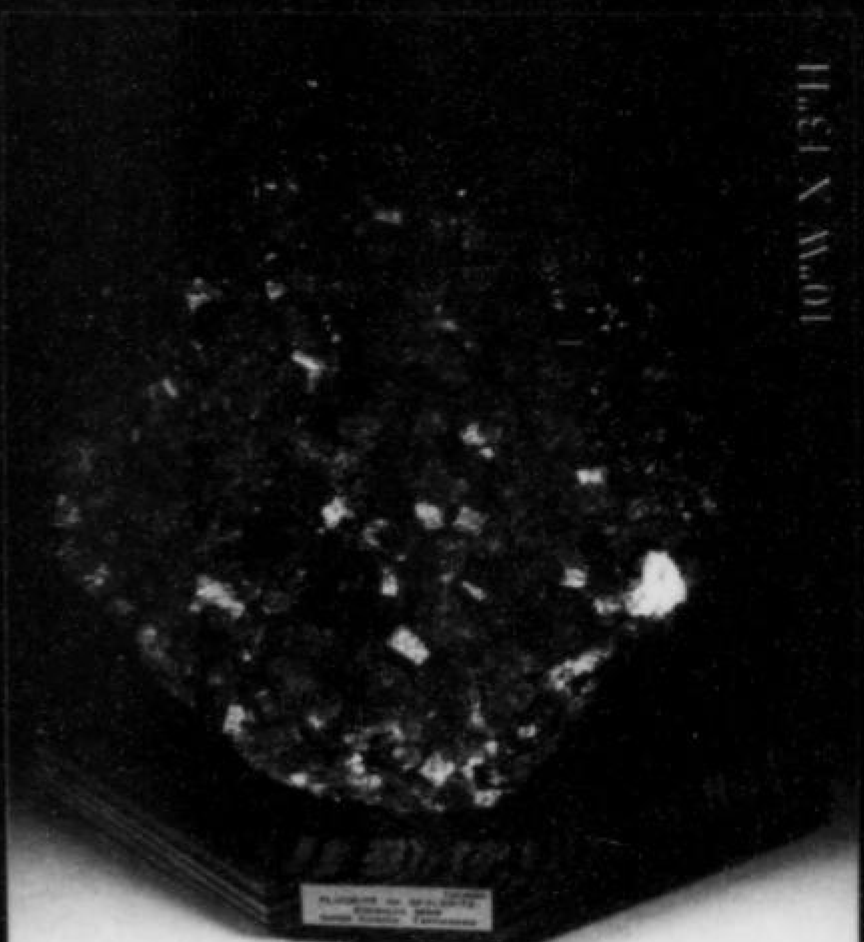

7"W X 14"H

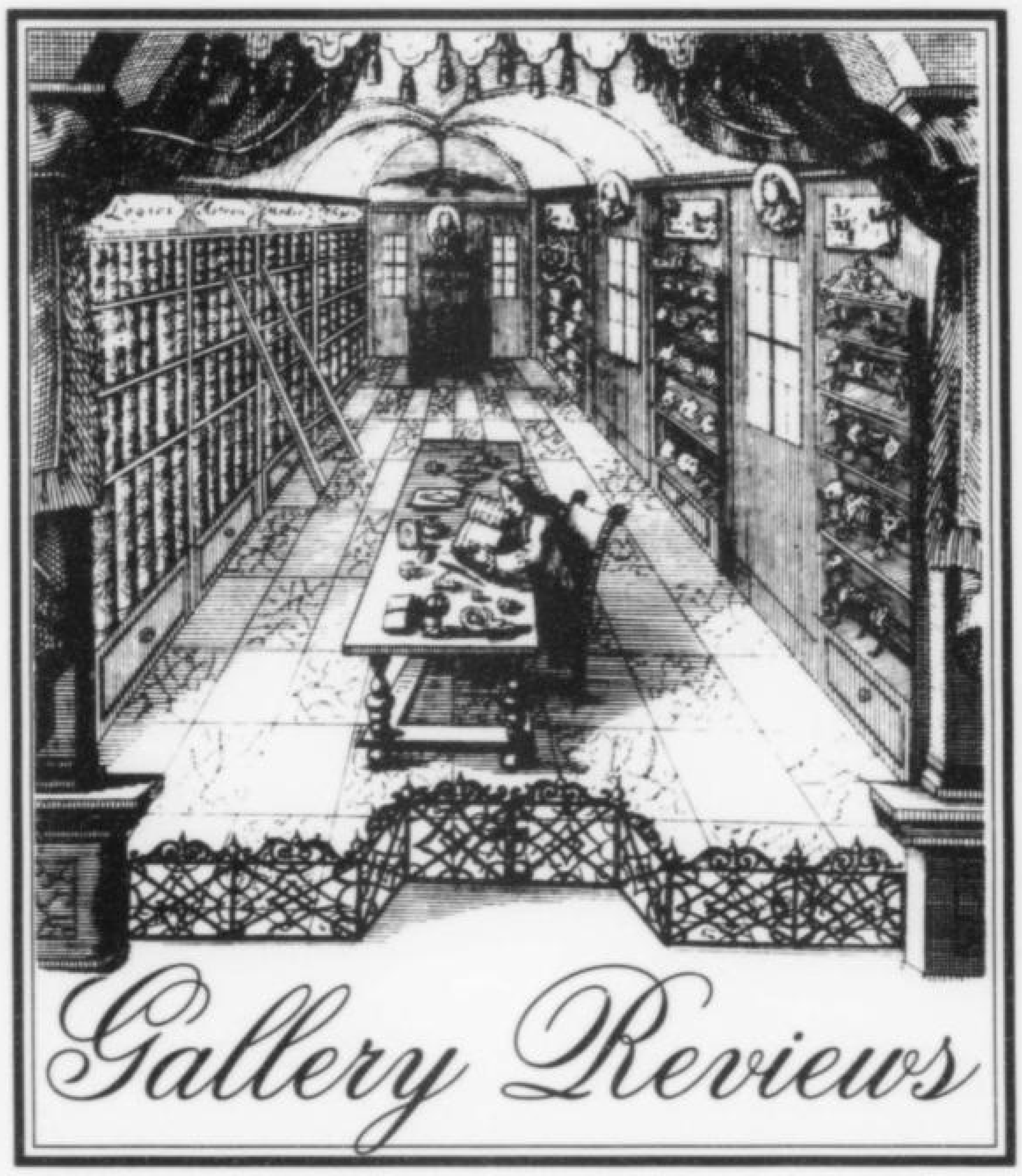

5"W X 7"H
TSC4646
TOURMALINE on QUARTZ
Himalaya Mine
San Diego Co., California


3.5"W X 5.5"H
TSC3666
ROSE QUARTZ with SMOKY QUARTZ
Lavra do Ilha
Taquaral, Minas Gerais, Brazil


12.5"W X 4.5"H
TSC3691
BERYL var. AQUAMARINE
Jaqueto
Bahia, Brazil


Visit Our Showroom


10"W X 13"H



Tourmaline—Romancing the Stone: The Many Faces of Tourmaline Harvard Mineralogical Museum

by John S. White

[February 10, 2001 through January 20, 2002]

This review is a bit of a departure from others that have appeared in this space in that it covers a *temporary* exhibit that is scheduled to close in less than a year from opening. The new tourmaline exhibit at Harvard is just off of the ancient but beautifully restored mineral gallery, well worth a visit by anyone who is interested in seeing one of the premier university collections in the world. The curators, Dr. Carl A. Francis and William Metropolis, have done a wonderful job in putting a fresh face on this marvelous old gallery through vastly improved lighting, new paint, carpeting, improved labeling and important upgrading of specimens.

***Figure 1.* John H. Marshall, Jr., instigator of Harvard's tourmaline exhibit and donor of many Newry, Maine, tourmaline specimens. Richard Cowley photo.**

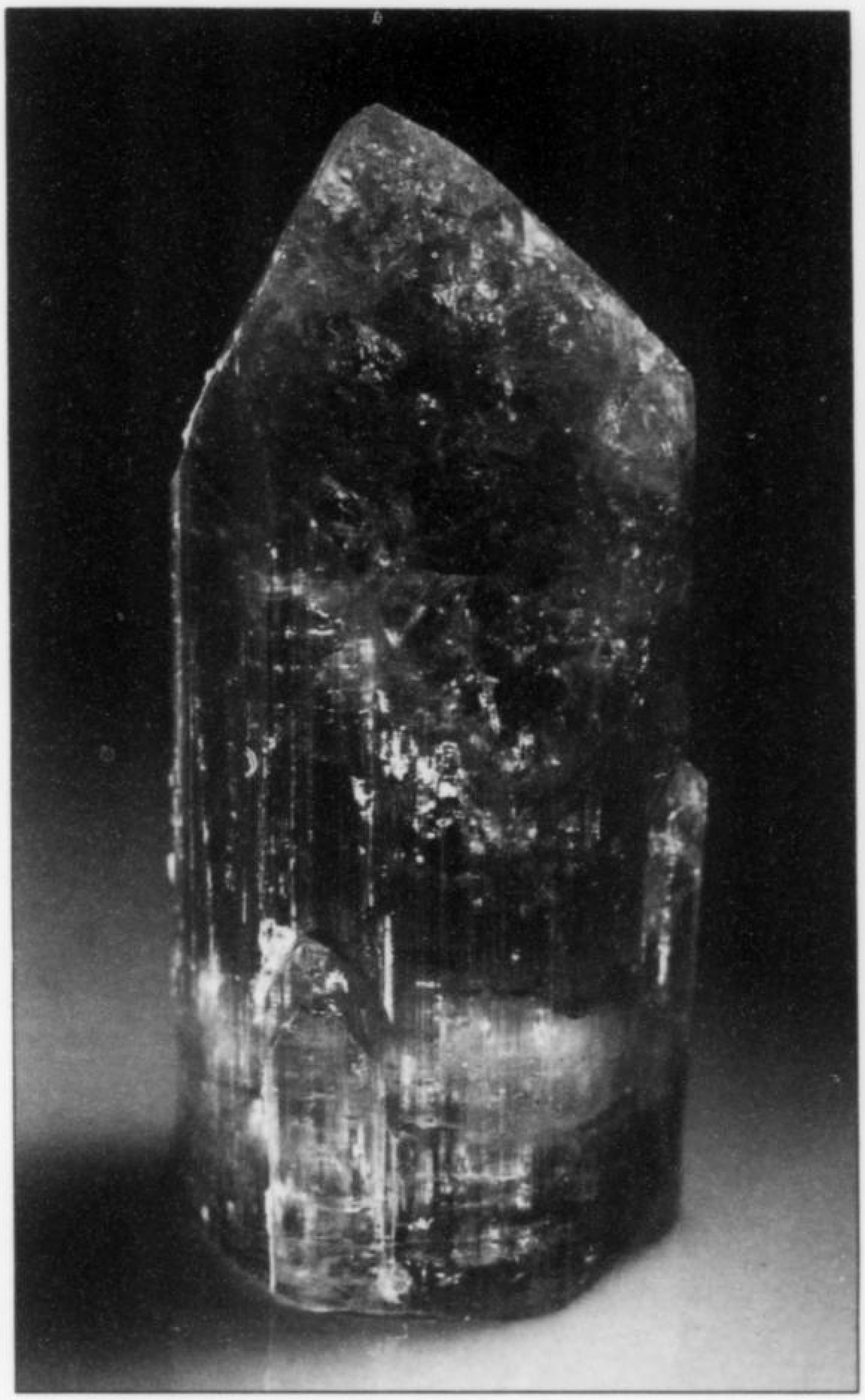


***Figure 2.* One of the finest known elbaites from the Dunton mine, Newry, Maine; 8 cm. J. H. Marshall, Jr., specimen, donated to Harvard; Chuck Mayer photo.**

The tourmaline exhibit appears to be somewhat experimental, part of an effort to get more of the local population into the museum. It is impossible for me to assess its success but the opening (Boston in February, brrrr!) was well-covered by the local media. The exhibit would not, in my judgment, justify a long trek to Boston from distant places, unless one is especially fond of New England pegmatites.

As stated in the colorful brochure produced for the event, this was "made possible by a generous contribution and an important gift of specimens from John H. Marshall (Harvard class of '29) and John H. Marshall, Jr. (Harvard class of '54)." The brochure, apart from being a very nice *souvenir* of the exhibit, contains something that I heartily endorse, three modern references to mineral literature for visitors who may care to learn more about minerals in general or tourmalines in particular. Way to go!

The exhibit occupies a roughly rectangular room about 25 by 50 feet in size with displays on all walls and a single freestanding case. If one progresses around the room, beginning on the right, there are topical cases on pegmatites, the famous and historically important Hamlin tourmaline necklace, Maine's mineral riches, the Maine State Museum's tourmaline necklace, the Dunton (Maine) mine, world occurrences of tourmaline, scientific studies of tourmaline (techniques and history), Madagascar liddicoatite slices, gems and jewelry, recreation of a tourmaline gem pocket, and photographs and specimens of California tourmalines.

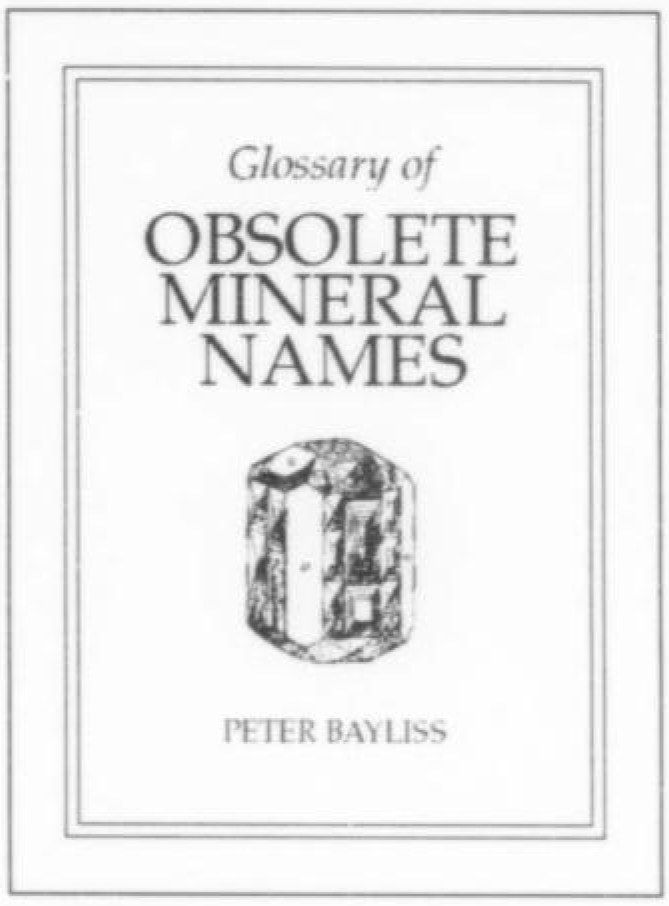
The freestanding case deals with tourmaline species and their chemistry, employing pushbuttons which are supposed to help the visitor understand the way in which compositions of the tourmaline species vary. Unfortunately, this sole attempt at interactivity requires the reading of instructions and the few young people who played with it while I was there (as well as myself) did not take the time to read the brief instructions provided so they were unable to make it work. At least one of the lights that the buttons are supposed to turn on was burned out.

The small gallery is bright (all lights are spots mounted on the high ceiling) and attractive but it lacked a "hook," something to catch the eye and make people stop dead in their tracks. How much more effective it would have been if the two marvelous necklaces, the Hamlin and the Maine State Museum's (a contemporary one on loan for the exhibit) had been featured in a dazzling showcase in the middle of the floor.

The specimen displays reflect an effort by the museum to utilize newer exhibiting techniques. Nearly all of the gems, jewelry and crystal specimens are mounted on rods with prongs so that they pop out at you. The background colors are pleasing, the use of supportive photographs is effective and the lighting is adequate. Unfortunately, I managed to find a few faults. Most off-putting to me is the excessive amount of text: much more, I feel, than you can expect casual visitors to struggle through. It may be that the university felt bound to incorporate more educational content in this exhibit than most non-university museums are likely to attempt. One can sympathize somewhat with that position, even though there has been no parallel attempt to carry that over to the permanent mineral gallery, which is very deficient in text.

Sadly, one of the most original ideas presented, the sample specimen case, was totally ignored while I was in the gallery. This was at least partly due to the fact that it isn't prominently identified for what it is supposed to represent, but also because it is presented in such an indifferent manner, making one suspect that it may have been tucked in at the last minute as an afterthought. Instead of a waist-high aluminum square block with only three drawers, it would have been much more effective if presented in the form of an antique wooden case with drawers from top to bottom, and with labels on the drawers as well as with the specimens in the drawers. All are covered, by the way, with large plates of plexiglas to protect them. Another small problem is that many of the rectangular wall-mounted cases are tilted about 15° or so, instead of being vertical, and this I found somewhat distracting.

One is left wondering if such a complex and esoteric topic is really appropriate for a small temporary exhibit. Should, in fact, a university museum believe that it has more of a mandate to produce text-heavy displays than other non-university affiliated museums? Actually, temporary exhibits tend to be text-heavy regardless of where they are presented, because their principal focus is traditionally more education-oriented. The sad reality, however, is that it succeeds only if visitors take the time to *read* the text and attempt to relate that to the objects. This is more likely to happen if visitors are drawn to a museum *because* of the temporary exhibit rather than just encountering it by accident while wandering through a museum.

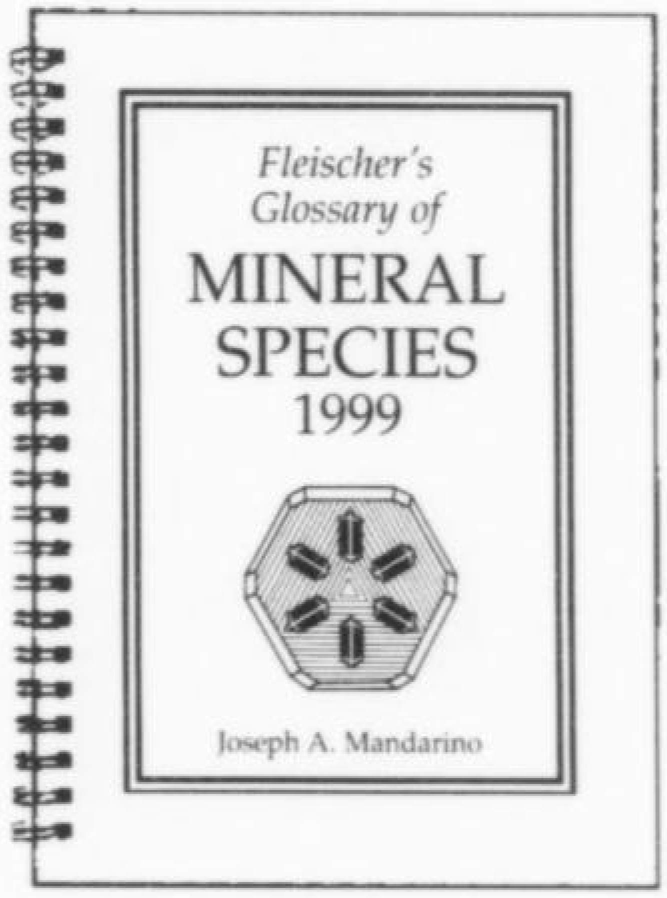


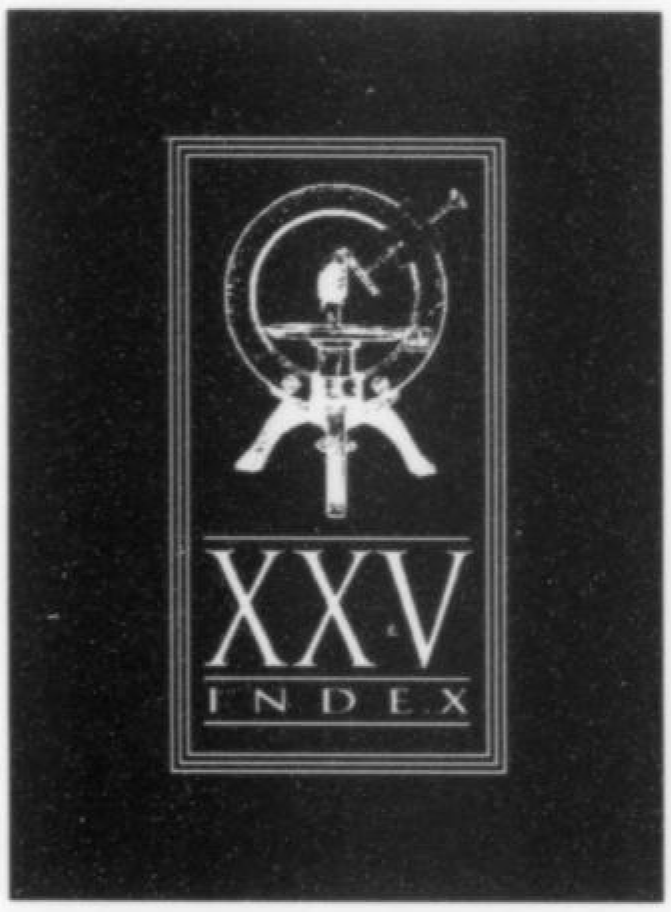
Glossary of Obsolete Mineral Names

New! Over 30,000 *referenced* synonyms, varietal names, discredited names, antiquated names and discarded names! A perfect companion to the *Glossary of Mineral Species.* Hardcover, large format, 244 pages.
by Peter Bayliss **$32**

Glossary of Mineral Species 1999

Most up-to-date reference on all 3741 valid mineral species. Spiral bound for easy use—lies flat!
by J. A. Mandarino **$18**





Mineralogical Record 25-Year Index

The ultimate index to your favorite mineral magazine! **Includes** special Author-Title Index supplement for vols. 26–30 (1999)! Have the mineral world at your fingertips! Hardcover, large format.
by Ed Clopton and Wendell Wilson **$37**

Add $2
postage
per book

Supplies
are
Limited

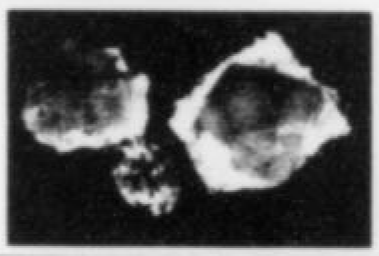
Circulation Manager
Mineralogical Record
P.O. Box 35565
Tucson, Arizona 85740

FAX YOUR CREDIT CARD ORDERS!
520-544-0815

MasterCard VISA

Trafford|Flynn Minerals
Visit us online at http:\\www.trafford-flynn.com

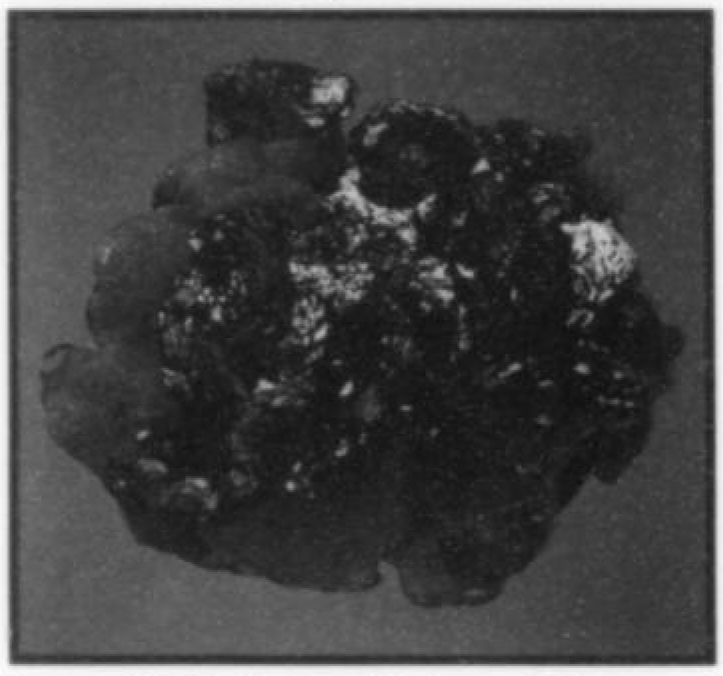
Easy to use website, frequent updates, secure server.
- Worldwide selection of fine minerals and fossils.
- Plus, direct mine distributor for Wise Mine Fluorite from Westmoreland, NH: specimens/cut/octahedrons.

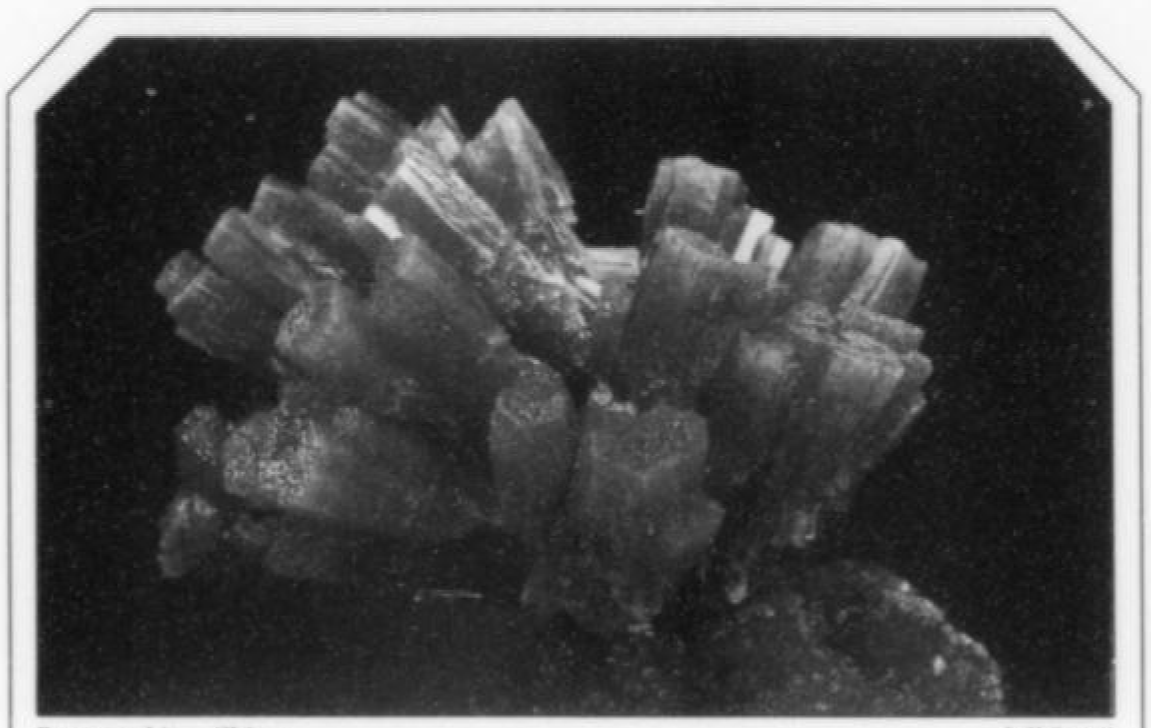


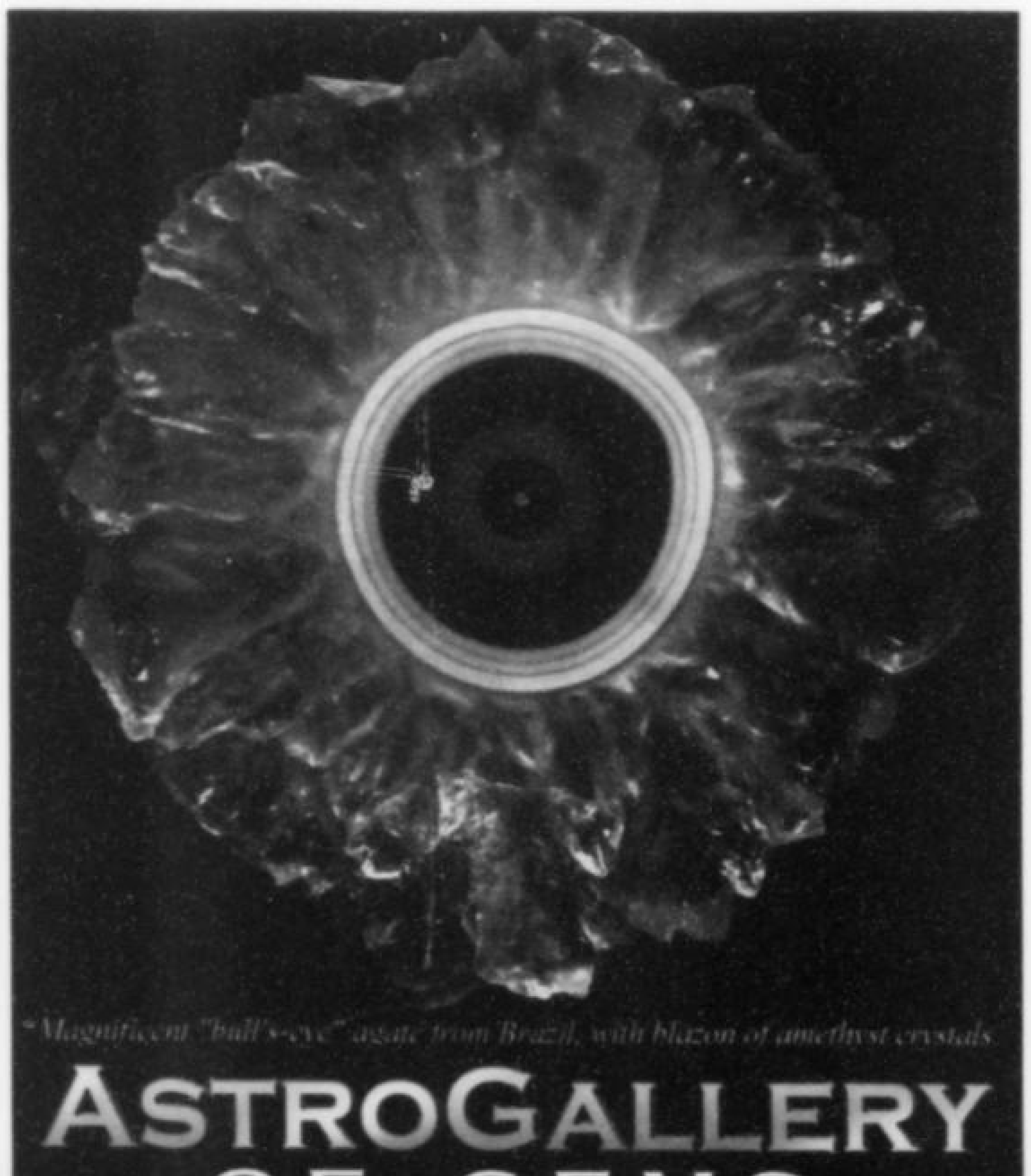
Handbook of
MINERALOGY
Anthony • Bideaux • Bladh • Nichols
New—Vol. IV
Arsenates, Phosphates, Vanadates
680 p., US$108+US$6.00 S&H (ISBN 0-9622097-3-2)
$5 Reward paid for each error found; for details:
mineraldata.com

Prepaid Orders only VISA/MCard accepted

Mineral Data Publishing
P.O. Box 37072
Tucson, Arizona 85740 USA
Tel: (520) 798-1513/(520) 297-4862
FAX: (520) 798-1514/(520)297-6330







Letters

SAXON WIRE SILVERS

[Ed. Note: Some people have been concerned about the authenticity of a large lot of Saxon wire silvers that appeared on the market a few years ago. One reason was their lack of a precise locality and provenance. German dealer Helmut Brückner (who sold many of the specimens) has researched the situation and provides the following.]

I have determined from numerous interviews with the people involved that the superb wire silvers (the ones lacking matrix or associated species and analyzing 99% Ag) which reached the market a few years ago are actually from the Wismut AG mine near Schlema.

The Wismut AG mine was a Soviet corporation from 1946 to 1951, and a joint Soviet-East German operation from 1951 until the fall of East Germany in 1989. Mining started there as a result of silver being discovered under the Church of St. Wolfgang, and soon adits were extending underneath many local private residences. The so-called "Swiss cheese" mine workings expanded in a northeasterly direction, from Oberschlema to Niederschlema, Schlema-Alberoda, and Hartenstein, reaching a depth of 1,800 meters in the search for silver and uranium. Ronneburg in Thuringia and the Zobes area (except Ehrenfriedersdorf) were also undermined by the Wismut AG workings, which eventually extended, like an interconnected spider web, across the border to Joachimsthal (CSSR).

An ex-miner and later police official who had collected the specimens gave a false locality for them: Freiberg. Most of his specimens must actually have come from the big Wismut AG mine. The major specimen suppliers and middlemen in Germany are very upset about having been given false locality information with the silvers.

According to a signed statement taken under oath from Mr. Jürgen Hoffmann: The silver specimens were collected and secretly removed from the Wismut mine between November 15, 1949 and June 29, 1950, by a miner (his logbook still exists for confirmation). This miner, deceased since 1994, was fluent in Russian and was given special privileges by the Russian management of the mine. After the 1950's he left mining to work for the police force, where he was eventually promoted to a high rank. During the years 1985 to 1989 he traded the silver he had put away (about 150 pieces) to Jürgen Hoffmann. However, in order to conceal his activity at the mine where he had worked, he cited the locality as "Freiberg." It was not until 1991 that Hoffmann finally learned of the miner's earlier connection with the Wismut mine. The miner's family has requested that his name not be published. "I swear under penalty of law that the above statements are true and that I have no doubt that the silver specimens are authentic." So said the formerly anonymous middleman, Jürgen Hoffmann.

Helmut Brückner
Germany

BILINGUAL LABELING

I finished reading the ROM review by J.S. White in the *Mineralogical Record* of March–April 2001. I followed his article with interest, and agreed with most of his comments. However, I was really cross with Mr. White when he introduced criticisms of Canadian cultural and social identities in regards to bilingualism. Regardless of what Mr. White (an American) may think of bilingual labels, as a guest in a country, Mr. White should have kept these comments to himself and the editor should have "edited" this section of the review. The *Mineralogical Record* should not become a political arena criticizing other countries' cultural and social identities. All that needs to be said is: "*Merci aux dirigeants du ROM pour avoir du respect envers leurs compatriotes francophones*." Mr. White, there are other idioms spoken on this planet. You will have to get used to it, even if the translation is obvious.

Jean des Rivières
Monkstown, Ireland

RESPONSE FROM J.S. WHITE

Sorry, no offense intended. Actually, I believe that bilingualism is a good thing, it is just that when taken to what I consider extremes, it can become troublesome. Just look at the waste generated in Canada by having to print both English and French versions of many publications. True bilingualism might be better served if the Canadian population were forced to read only some of each citizen's less-than-preferred language. I will always believe that a museum should not have to reproduce every label in both languages, particularly when so many of the terms are practically the same. The Swiss appear able to handle three languages very well. Can you imagine Swiss museums having to triplicate *all of their text and labels? They don't do it and somehow that country still manages to survive.*

SOCORRO MINERAL MUSEUM

In the ongoing commentary on the museum gallery collections, I would like to add a few comments. My wife and I recently had the pleasure of viewing the small but excellent collection of the New Mexico Bureau of Mines & Mineral Resources' Mineral Museum in Socorro, New Mexico. I remember the old collection, and this is a vast improvement.

The collection is nicely housed in new, well-designed facilities in simple, clean cases that do not detract. The room is well-lit, and all specimens are readily visible and adequately illuminated with little shadowing or distortion of color. The layout within the cases is simple, with just the specimens and a plain label giving the required information. I particularly like the series of wall-mounted cases, each devoted to a specific mineral district within New Mexico. The free-standing cases in the center of the room contain mainly specimens from outside of New Mexico. It gives a nice blend of specific mineral interest with more general interest. There is no distracting "educational" or "interactive" displays that waste both space and the viewer's time.

All in all, this exhibit is the way I have always imagined that the great collections should be, and used to be, presented. As a teenager I used to be a frequent visitor to the R.O.M. in Toronto, Ontario. I no longer go there, as I am disgusted by what I find. In their pursuit of acceptance the major collections have too often traded their responsibility for the display of quality artifacts of interest to the informed public for gate receipts, as a measure of their success.

Congratulations to the Socorro museum for a job well done.

Garry Glenn
Niagara Falls, Ontario

GALLERY REVIEWS

The *Gallery Reviews* column is a welcome and valuable addition to the mineralogical literature. Reviews of mineral and gem galleries have been few and far between. The last one I remember in the *Mineralogical Record* is Peter Leavens' 1977 review of the American Museum of Natural History's then new mineral hall in vol. 8, 28–31. New galleries and special exhibits should be reviewed regularly. As a community, we should be as familiar and comfortable with reviews of mineral galleries and displays as we are with reviews of books, films, theater and dance performances. We should also come to expect reviews with varying viewpoints.

Reviewing the new mineral galleries at the British Museum and Smithsonian Institution is a good start. I've not yet had an opportunity to visit either gallery, so I particularly appreciate the description aspects of these reviews. The criticisms, however unwelcome they may be in some circles, are sincere, heartfelt and grounded in the reviewer's deep love of minerals and extensive curatorial experience. They are sometimes misdirected because *Mineralogical Record* readers have little ability to effect change in those galleries. A well-written and well-reasoned personal letter to the museum director might have more effect. [WEW note: I have a feeling that Mr. White has done that too.] Those reviews should not deter us from visiting either gallery. Rather, they should help prepare us for the experience.

There are not enough major new galleries opening each year to sustain the column in its present form. I suggest that the column's scope be extended to cover displays at mineral shows. I've been encouraged by many developments and innovations I've observed, particularly at the Tucson Gem and Mineral Show. They offer a range of subjects that could usefully be discussed.

If reviews are thoughtful and written constructively, they will stimulate us all to think more deeply about the purposes of exhibiting and about more effective methods for exhibiting. They will help us view exhibits more intelligently and help us to conceive and mount better exhibits.

Carl A. Francis
Harvard Mineralogical Museum

Expanding the field of review to temporary exhibits at museums (as in this issue) and also temporary exhibits outside of the museum environment (as at shows) is certainly consistent with the goals of the column. I hope Mr. White will also occasionally review museum galleries that are not newly installed. Doing so will add some historical perspective to the discussion, identifying successful exhibit concepts that endure changes in fashion, and also showing where modernization can be of real benefit. Such an analysis, given the weight of publication, might also help encourage museum administrators and potential donors to facilitate changes where needed while retaining what still works.

W.E.W.

ON TAJIKISTAN "HELIODOR"

In the *Mineralogical Record*, **31** (2000), p. 449, J.S. White tries to "rein in some of the reckless and irresponsible speculation about the nature of the color of the wonderful heliodor beryls from Tajikistan". On the contrary, it seems quite reckless of Mr.

White to negate what must by now amount to a large number of observations made by knowledgeable people, noting the suspicious nature of some claimed "Tajik heliodores." The fact that Mr. White writes that the worst of the accusations actually is that the fakes are claimed to be originally Pakistani beryls (var. *aquamarine*) clearly shows that he has not even seen the material that the real fuss is (or ought to be) about. My own problem in originally accepting some of these specimens as the genuine article was exactly this fact, i.e. that minus their color, they looked very much like Pakistani beryls; from paragenetic details such as abundant euhedral (formerly, now rather kneaded) muscovite present to the morphology of the crystals. They looked nothing like the yellow beryls from Tajikistan I had seen previously, except that they were some sort of yellow.

Me, I really like the authentic (distinctive!) well-terminated, clear and beautifully colored yellow beryls from Tajikistan/the Pamirs; the problem is just that someone out there is trying to sell (e.g. at the Munich show) what are most likely artificially colored, originally "Non-heliodor beryls," which otherwise look like Pakistani material. The answer to Mr. White's question, why anybody should bother to ". . . take fine aquamarine and purposely turn it yellow?" is evident to anyone who has seen heaps of unsold, less-than-top-notch pale blue beryl at most Pakistani dealers' stands at major shows.

To finish off in his preferred style: Mr. White should keep his opinion to himself until he has seen everything he is talking about.

Eric Jonsson
Stockholm, Sweden

RESPONSE FROM J.S. WHITE

My criticism was of the accusation *that the heliodors which Mr. Jonsson appears to accept as natural, those from "the Pamirs," are treated aquamarines from Pakistan. I attend the Munich Show every year and I must confess that I did not see, nor has anyone mentioned to me, obviously treated heliodors with "rather kneaded muscovites" that must have originated in Pakistan. All of the suspicion that I have encountered, and there has been a lot of it for many years, has been directed towards those "well-terminated, clear and beautifully colored yellow beryls" which Mr. Jonsson apparently does not suspect. There indeed may be treated beryls from Pakistan on the market somewhere, but it is difficult to understand Mr. Jonsson's ire over my effort to defend the natural state of the others which he also believes are natural.*

[Ed. Note: J.S. White's original letter was written long before the 2000 Munich Show.]

RIST TRACT EMERALDS

Regarding your recent article on the Rist and Ellis Tracts, Hiddenite, North Carolina (March–April issue): It should further be noted that James Hill discovered emeralds on the Rist property in 1995 (see *Rock & Gem*, May 2000). He found a pocket containing an 858-carat emerald which was named "The Jolly Green Giant," another at 88 carats which was cut into "The Prince" (7.85 carats) and "The Carolina Queen" (18.88 carats).

Robert T. Price
Trout Run, Pennsylvania

EARTHQUAKE MAYHEM

When the earth trembles, a special terror strikes at the heart of every mineral enthusiast possessing a collection which includes vulnerable specimens. Those of us who dwell above the subterranean "Ring of Fire" may well breathe a fervent prayer at the first stirring of the terra-not-so-firma. When the first mild pulse is followed by successively stronger ones, collections on display for visual gratification are in grave danger, even those behind locked glass fronts.

My mineral room is situated downstairs in my home in San Fransisco. There I display a collection of specimens, some of them delicate. The larger ones are mounted high on lucite blocks so as to provide clear visibility for the smaller specimens in front of them. Each of the cabinets is bolted to the wall behind it, or to the floor or ceiling. Most of the shelving is wood, but some is glass.

In the late afternoon of October 17, 1989, at 5:04 p.m., I heard a sudden, ominous, rumbling and rattling sound and felt a sharp, insistent shaking. The Loma Prieta earthquake, centered 80 miles from San Francisco, had struck with a force measuring 7.1 on the Richter scale. Immediately, I sensed serious trouble.

Close to me came the sound of a heart-numbing crash as a trio of art glass vases on the mantle above the fireplace in my living room splintered on the stone hearth below. A bowl of tall flowers fell from a breakfront and shattered on the carpeted floor. Two floor-to-ceiling wooden cabinets harboring part of a collection of phonograph records fell to a haphazard, sprawling disarray on the floor, quite near me.

My thoughts swung to the minerals housed on the lower level as the 15-second-long shaking finally ceased. Lacking courage, I did not go below for two long days and nights. On the third, I gathered my resolve and headed down to the mineral room.

Utter chaos greeted my inspecting gaze as I studied the cabinets. Their contents were sprawled over the shelves. many of the specimens had tumbled. Perhaps half remained standing. A cursory inspection of the fallen ones revealed in some of them a most welcome freedom of damage. However, in others there was breakage, ranging from a complete loss of specimen integrity in some to only light damage in others. Although there were no breaks in the glass fronts or shelving, the view affronted the inspecting eye.

My friend Steve Smale phoned to proffer his assistance in restoring order. I accepted gratefully. The normal route from his East Bay home to mine involved crossing the Bay Bridge, but during the quake a section of its upper level had collapsed onto the lower span. Steve undertook a much longer and more circuitous route, involving two other bridges, to reach my home. Arriving, he rendered support, moral as well as physical. Between us, we restored some semblance of order, noting the exceptional vulnerability of crocoites, thin-bladed wulfenites and other delicate crystals.

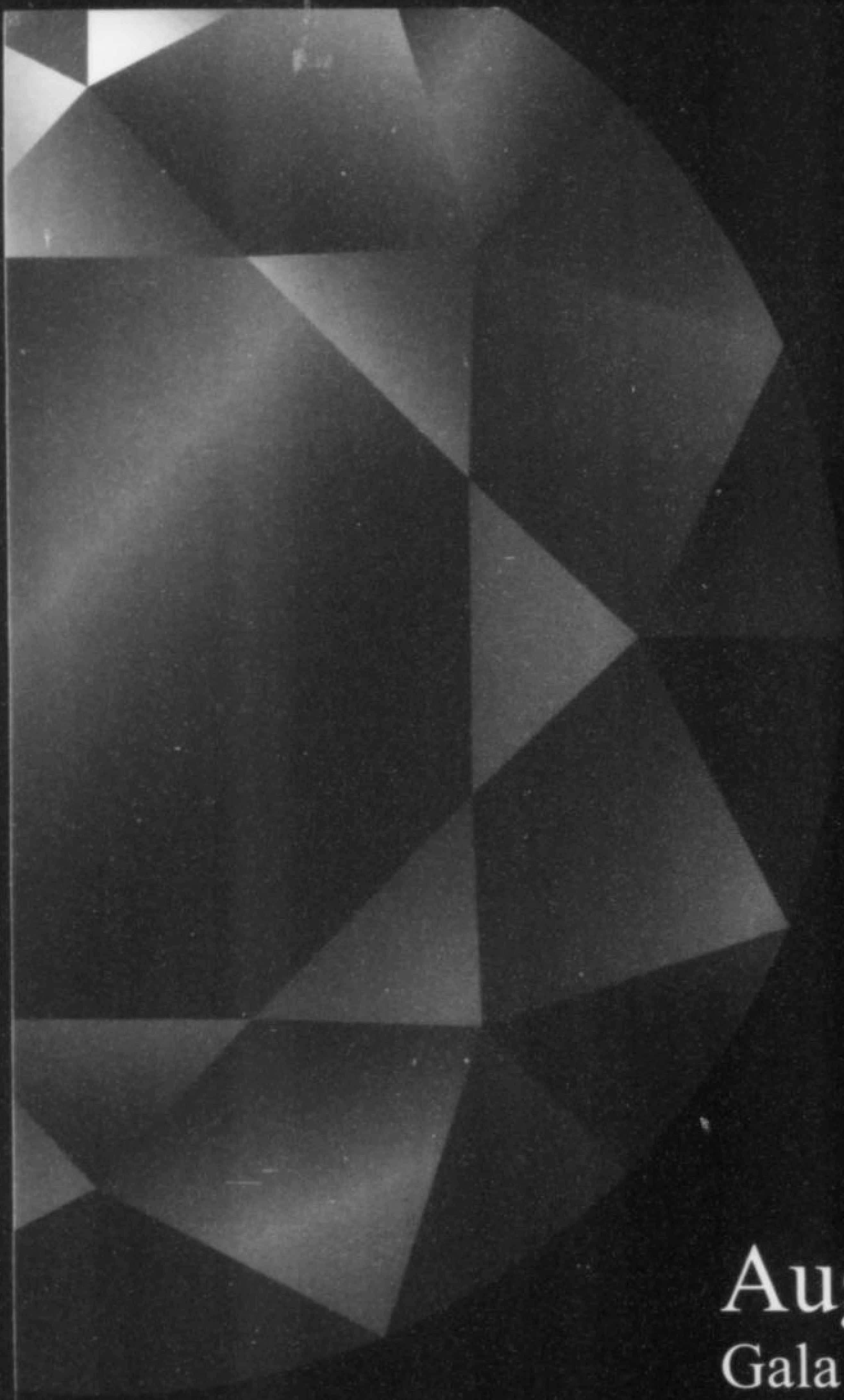
For years I have had a "Fine Arts" floater as an addendum to my Home Owners Insurance. It identifies the mineral collection and insures against all risks, specifically including earthquake damage. Thus all of my losses were fully covered by insurance.

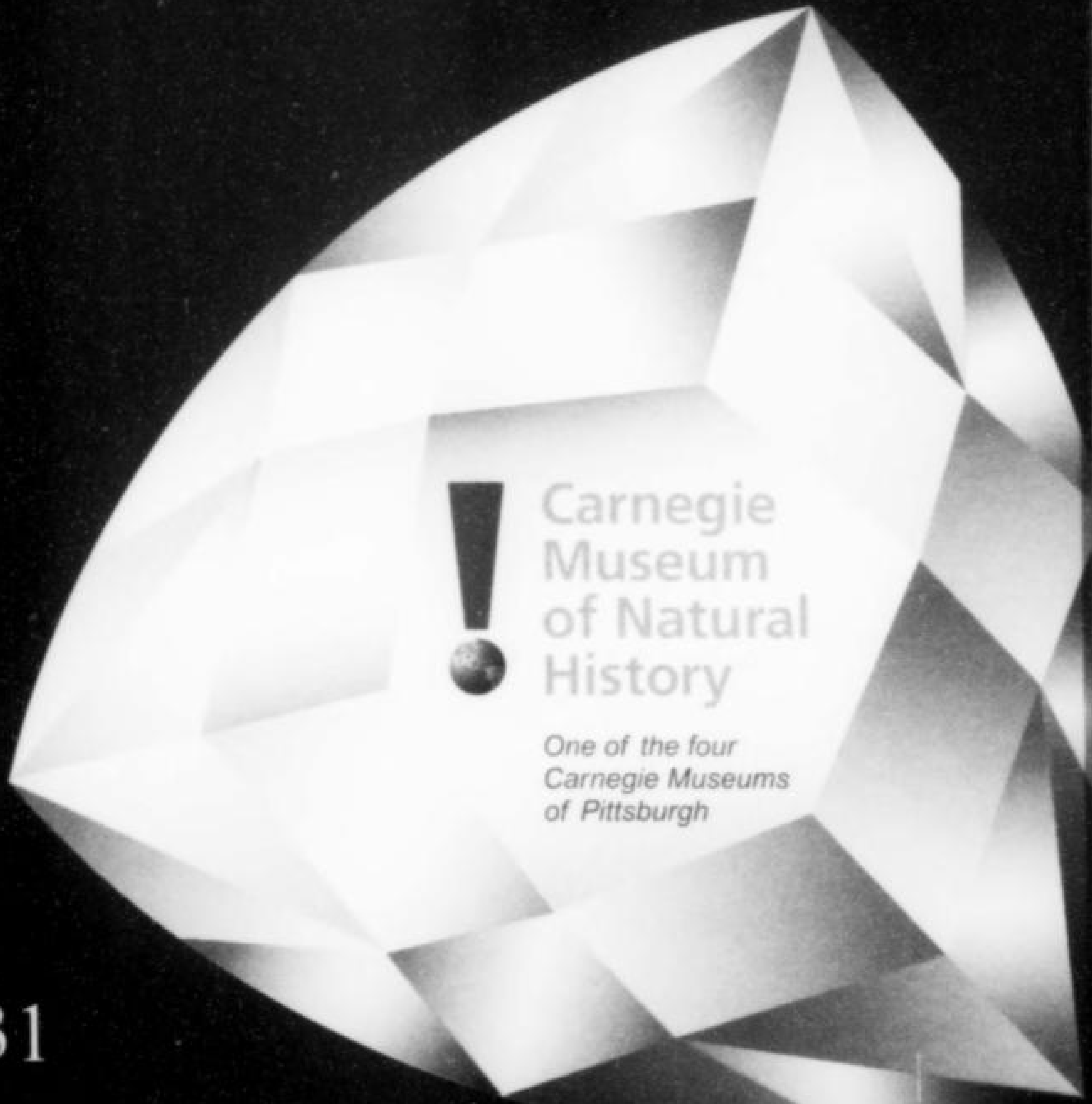
A copy of the mineral specimen listing with individual values is always on file with my insurance company. Each specimen is numbered for identification and has been appraised by an outside specialist. The insurer promptly sent an inspector to my home to assess the damage. He then made his report and I was compensated in full for the specimens which had sustained injury. However, money is scant balm for the loss of heart-linked mineral crystals. (With regard to insurance, it is possible that premiums might be lowered if a collector takes protective steps to limit the likelihood of breakage.)

Though I had expected that the inspector would cart away the damaged specimens, he did not do so. As a result, I repaired those I could and marked the repair on my labels. Sadly, I had to discard those minerals which were beyond fixing.

Some of my mineral-acquiring friends have resisted following the insurance route, quoting what they deemed to be its high cost. I, on the other hand, find it reasonable as priced by my insurer. Its annual cost is

continued on p. 327





roughly equivalent to that of one good specimen I might otherwise acquire. To me, it is a worthwhile tradeoff.

Dona and Wayne Leicht of *Kristalle* suggested that I remove from my shelves those valuable specimens which are damage-prone, and place them in boxes in the protection of drawers. This is sound advice, but I winced at the prospect of the loss of the immediate visual delight to which I had grown accustomed when I enter the mineral room. Now past 80 years old, I feel keenly the finiteness of my time for enjoyment of these wonderful and amazing natural phenomena. Therefore I have retained them on display in my cabinets, while reluctantly realizing that by doing so I may not be adequately protecting the specimens for eventual viewing by posterity.

As a result of my bitter earthquake experience, I have made some changes. To avert—or at least minimize—the impact of future shakes, I have taken some steps, the first of them instigated by a gift. Kerith and Cal Graeber presented me with a gift of a large jar of "Quake Wax." The product looks like whitish candle wax but remains malleable and sticky at normal household temperatures. "The Wax Used By Museums," the label states. The user scoops up some of the wax and affixes it to the part of the specimen which will contact the shelf. Of course, if a display stand is to be used, it, too, must be fastened—as is true for any block employed to elevate a specimen for enhanced viewing. The wax is available inexpensively at many museum gift shops (at least here in earthquake country) and at some hardware stores. I highly recommend its use.

Once a specimen has been secured in place with the wax and one desires to remove the mineral for viewing or to change its position, it may readily be lifted by hand, using a firm, twisting motion. To remove undesired remnants of the wax from the shelf or from the specimen, acetone may be employed.

Special clay available for purchase from some mineral dealers shares many of the virtues of Quake Wax™, though it may harden with time.

A fellow collector, Carolyn Manchester, has helped me in affixing specimens to shelves and in suggesting relocation of some of the minerals to positions where they might be more secure. Her willing support, together with that of my other mineral allies, is strongly appreciated.

Now, whenever possible, I place the larger, heavier specimen directly on the shelf (preferably a lower shelf), eschewing the temptation to elevate them for enhanced delight to the eye. I also avoid acquiring minerals which, by their extremely delicate structure, are particularly susceptible to damage from earthquakes.

When I originally started to display my collection, I attached tan felt cloth to the walls *and* to the wood shelving of the display cabinets so as to achieve a harmonious visual effect throughout the room. But, as wax and clay do not adhere to fabric, I have started, cabinet by cabinet, to remove the felt from the shelves and then to employ wax or clay to render each specimen safe from shaking. Those cabinets I have acquired since the quake are made with wood or glass flooring, providing an excellent surface for the adhesion of the protective bonding agent.

If your collection is stored in drawers, install stops or locking mechanisms so that, in the event of a quake, the drawers will not come completely away from their housing and spill their contents on the floor. Place a protective layer of a material such as cloth over the specimens to keep them from bouncing free from their resting space. If your minerals are secured in boxes, inspect the area surrounding and above them and take action to preclude a fall of heavy adjacent objects onto valued crystals. And, as much as feasible, position your specimens in such a manner as to avoid a domino effect if one should tumble.

You may also be able to follow the example of some museums which use clear, colorless nylon thread (fish line) to prevent a treasure, particularly a top-heavy one, from falling.

If the presentation of mineral beauty is among your collecting goals, and you reside in a place where the earth has been known to quiver, take steps *now* to protect your geological assets. Next week may be too late!

Jack Halpern
San Francisco, CA

[Ed. Note: See Anthony Kampf's article, "Earthquakes and mineral collections," in vol. 25, no. 4.]

Colorado Dealers!

Green Mountain Minerals
Stanley Korzeb
15064 E. Bails Place
Aurora, CO 80012
303-368-1209 (Call for Appt.)
Species, Fine Minerals, write for List

Mountain Minerals International
Dudley Blauwet
P.O. Box 302
Louisville, CO 80027-0302
303-665-0672
FAX: 303-664-1009
www.mtnminitl.com
Minerals, Gems, Gem Rough

Dave Bunk Minerals
Dave Bunk
1441 W. 46th Avenue, #8
Denver, CO 80211
303-477-6897
www.davebunkminerals.com
email: dave@davebunkminerals.com

Columbine Mineral Shop
Benjy & Liz Kuehling
P.O. Box 541
633 Main Street
Ouray, CO 81427
970-325-4345, 9 a.m. to 9 p.m.
Open 7 days, May 1-Oct. 31
Fine Minerals for Collectors
www.collectors-mall.com/cms
email: bkuehling@rmi.net

COLORADO MINERAL AND FOSSIL SHOW

Holiday Inn Denver North

SEPT. 12-16, 2001

10 a.m. to 7 p.m. Daily

INFO: P.O. Box 999
Evergreen, CO 80437

The Sunnywood Collection
Bill & Elsie Stone
Aurora, CO
303-363-8588
Premium Minerals, Fossils, &
Carvings Artistically Mounted
on Wood or Acrylic
email: minerals@sunnywood.com
http://www.sunnywood.com

XTAL—Dennis L. Beals
Dennis & Diane Beals
6006 S. Holly St., PMB 256
Englewood, CO 80111-4251
303-771-9225 (by Appt. only)
FAX: 303-771-9308
DBXTAL@aol.com
www.xtal-dbeals.com
Fine Mexican minerals & more

WRIGHT'S ROCK SHOP

Fine Mineral Specimens! We Buy Collections!

2001 SHOWS:

Jan. 28-Feb. 10	Tucson, AZ (Rm. 128 InnSuites)
Feb. 24-25	Jackson, MS (State Fairgrounds)
Mar. 31-Apr. 2	Raleigh, NC (State Frgrds., Kerr Scott Bldg.)
April 28-29	Franklin, NJ
Aug. 10-12	Springfield, MA (Great States Expo Ctr.)
Aug. 23-26	Pittsburgh, PA (Carnegie Museum)
Sept. 12-16	Denver, CO (Hol. Inn Rm. 115)
Sept. 20-23	Houston, TX (Humble Civic Center)
Oct. 12-14	Detroit, MI So. (Macomb Comm. Coll. Expo Ctr., Warren)

Visit our Website: wrightsrockshop.com
e-mail: wrightsr@ipa.net

3612 ALBERT PIKE, HOT SPRINGS, AR 71913 • Tel: (501) 767-4800

Oceanside

gem imports, inc.

Huge stock of fine minerals—many never shown. Wide range of Sizes/Prices. List avail. for *cut stones* only. NO SHOWS. Write or call for more information.

P.O. Box 222
Oceanside, NY 11572
Tel: (516) 678-3473 • Hrs. by Appt.

HAWTHORNEDEN

FINE MINERAL SPECIMENS
Thumbnail to Cabinet Size

WANTED TO PURCHASE—OLD COLLECTIONS

Open Mid-June to September
(Otherwise By Chance or By Appointment)

Three miles south of Bancroft, Ontario, on the West side of Hwy. 62

Wendy & Frank Melanson
L'Amable, Ontario K0L2L0
Tel: (613) 332-1032 • FAX: (613) 332-0585

MINERAL SPECIMEN MORTALITY

Wendell E. Wilson
The Mineralogical Record
4631 Paseo Tubutama
Tucson, Arizona 85750

Rock H. Currier
Jewel Tunnel Imports
13100 Spring Street
Baldwin Park, California 91706

An essay on the many ways in which mineral specimens can meet their end, illustrated by true stories from the archives of mineral collecting.

A thing of beauty is a joy forever:
Its loveliness increases; it will never
Pass into nothingness.
John Keats (1795–1821)

INTRODUCTION

Keats was not thinking of mineral specimens. All too often their loveliness *decreases,* and ultimately many or most of them do pass into nothingness. These exquisite crystalline inventions of nature, assembled an atom at a time, concocted from carefully sorted and arranged groups of elements, have nestled quietly in the darkness of the earth for thousands, millions or even billions of years. At long last, pried out of their primordial beds, they come immediately into mortal danger from the fumble-fingered touch of humankind. Some die suddenly; others suffer a protracted death of progressive disfigurement and decay until, having become pathetic shadows of their original selves, they are deemed fit only for landfill. Perhaps the words of Pietro Aretino (1512) would be more appropriate:

> "Those things that do not suffer mortal death are swiftly conducted to their end by time."

In this essay we will examine the many routes to destruction which threaten every mineral specimen. The perpetrators include virtually every collector, dealer and curator on earth, from the rank amateurs to the most experienced and venerated professionals. A series of true case histories will serve to make our point. In the end you will be amazed that *any* specimens survive the human gauntlet of accident, apathy, negligence, carelessness, ignorance and just plain bad luck. To the true lover of minerals: read on at your own risk; it won't be a pretty story.

THE LIFE-PATH OF SPECIMENS

When you really think about it, the dangers that threaten mineral specimens are numerous indeed. Of course, countless potentially fine specimens have been destroyed by nature before we ever get

The graveyard of broken mineral specimens.

our hands on them. Mostly we are blissfully and mercifully unaware of what has been lost, but sometimes we do get a hint of what might have been. Heavily etched crystal fragments are sometimes all that remain of once beautiful crystals, especially in pegmatites. Pseudomorphism can turn beautiful crystals into unsightly fossils of solid rust. Tectonic movements along fault systems where mineralization has taken place can grind fine crystals into gravel. Perhaps worst of all on a volumetric basis, simple weathering can slowly destroy mineral deposits and crystals in quantities too massive to contemplate. Example: The Sweet Home mine in Colorado, home to what many consider to be the most beautiful rhodochrosite in the world. But, in the mine levels *above* the great discoveries, what do you find? Countless stalactites of multi-toned brown-black manganese oxide mud hanging from the adit roofs, and inches deep of such mud on the floor . . . all that remains of rhodochrosite that once inhabited the oxidation zone of the deposit. What did the best of those crystals look like? We were too late to find out. We can philosophize that such chemical turnover is simply Nature's way, and that ultimately in the cycle of continental subduction and rebirth those elements will be recycled into new crystals, just as today's surviving rhodochrosites are the product of that process started long ago. The real issue is us: what happens to minerals once *we* reach for them.

A crystal rests in the ground, unchanged for years without number. And then one day an unnatural vibration reaches its dark crypt, as the work of miners chews its way closer and closer. Sometimes that vibration breaks crystals while still in the pocket. Sometimes the crystals are shattered in a sudden detonation, their first exposure to daylight taking place as their dust and fragments fly through the air.

If they are actually exposed intact, they are usually scooped up by front-end loaders, dumped into trucks and hauled off to the crusher. Should a collector be handy at that critical moment of vulnerability, and try to remove a crystal, there is still a high probability that it will suffer damage or total destruction at his hands. If it is collected intact, it may still not survive its unwrapping, cleaning and trimming. And if all that goes well, it may yet be dropped and broken, or succumb to environmental factors (heat, cold, humidity, chemical exposure, radiation damage, vibration, etc.) or natural disaster.

Because humans are mortal, a specimen will change hands many times in the decades after its discovery, each time facing the dangers of handling, wrapping, transportation, and unwrapping. If it arrives in a museum instead of a private collection, it may face repeated handling by museum visitors, and by the entire curatorial staff; and it may yet be sold or traded to another owner.

Colorful, transparent crystals face the additional threat of gemologists, lapidaries and investors lurking about making calculations as to how much *more* a crystal might be worth if cut and polished. Gemmy crystals, with most of their personality carved away, leaving only a sculpted fragment of their innards, have died, but the gemstones live on. This is marginally better than a cuprite crystal "surviving" in the form of a copper pipe (after smelting and fabrication) but not much.

Finally, there is the simple danger always present that a specimen may lose its protector. The majority of humans on this planet do not place much value in most mineral specimens. Should a specimen or a collection fall into such uncaring hands, by accident or bequest, it can soon end up in a garbage heap or a landfill, buried and forever lost. Or it may fall prey to playful children or even animals who will reduce it to rubble. In any case, once it has been liberated from the ground, it must have the continual protection of a knowledgeable human or it will soon go back to nature and be reabsorbed by the earth.

What is the survival rate for mineral specimens that fall within the grip of humanity? Our guess is that the mathematical model is asymptotic (approaches zero or infinity) in both directions. That is to say, most specimens are destroyed by mining; of what is left, many are destroyed during the collection process; of those that survive initially, destruction probability increases each time a specimen is touched, and also increases gradually from environmental factors and acts of God or acts of war with each passing decade. Some mineral specimens, like diamonds, have the potential for lasting a very long time, but in human hands their future becomes uncertain indeed. The diamonds in most engagement rings will be degraded during their lifetime. A microscopic examination of the diamonds in such rings will show fractures and chipping that are shocking to the uninitiated. Even diamond phonograph needles will wear out after a few years of normal use. Soft plastic vinyl wearing away diamond? We were never entirely clear about how that happens. Most mineral specimens are not as durable as diamond and some are as delicate as a dandelion puff. What are the odds of running across an undamaged 100-year-old dandelion puff? What about one 1000 years old? No chance at all? Because collected specimens exist to be handled, admired and studied, they can never be totally free of associated risks, and it is therefore just a matter of time before they are destroyed. That is, time on a human scale (in years and centuries) rather than a geological scale. This is especially true at educational institutions where students who don't know how to handle specimens are given access; the rapid wear, breakage and theft that result are referred to as "student erosion." A comparison of surviving specimens from the 18th and 19th centuries with illustrations done of them long ago is usually horrifying.

The examples that follow illustrate our case: with Man as the collector, no specimen is safe.

HONEY, I BLEW UP THE SPECIMENS

There are many stories about fine specimens that have been encountered in mines and, though they were recognized as being interesting, for one reason or another no effort was made to save them. One story, related to Richard Bideaux by Dr. William Lacy, who was at one time chief geologist for Cerro Corporation, was about a pocket of wire silver and proustite crystals about the size of a refrigerator which the company had encountered at the end of a drift in one of their mines in Peru. Dr. Lacy described it as being "just beautiful." Of course Dick, who loved specimens, had to ask what happened to the material and Dr. Lacy said, "Oh, we drove on through it." That means they drilled more holes for dynamite, blasted everything into small pieces, "put rocks in the box" (an occupation dear to the hearts of mining men), loaded the ore into ore cars, and sent it out of the mine to the crushers and the mill.

The fixation with ore is the demon enemy of mineral specimens. Gilbert Gauthier and Bill Pinch have both often told the sad story of the fabulous collection of uranium minerals accumulated by the Union Miniere mining company in Zaire. A visiting factotem from the front office in Belgium was brought to the large collection room and shown the beautiful things that had been saved.

"These are the treasures of the Shinkolobwe," said the proud mine manager, in reference to the company's most prolific mine.

The visiting executive was not impressed. In his view the company's shareholders were being shortchanged by not benefitting from the metal content in the specimens. He waved his arm over the collection as expansively as the proud mine manager had done: "Take it all to the crusher," he ordered. And that was the end of the Union Miniere collection.

Mine managers usually care only about ore and are often hostile to the concept of preserving mineral specimens. They hate losing time while people scrounge around the working face looking for little collectibles. Things were no different in the Maine pegmatite quarries during the 1920's. At the Maine feldspar quarry on Mount Apatite they worked to recover industrial-grade feldspar, and had only disdain for the occasional lithium mineralization. The feldspar around the little gem pockets was always of inferior grade.

In 1927 several little pockets had been encountered, and apparently the miners had stopped to collect some specimens each time. This annoyed the managers, who ordered them to "blow" (destroy) the next pocket so as to preclude any time-wasting collecting. The pockets had thus far yielded only quartz crystals; but, as luck would have it, the next one was a tourmaline pocket of huge proportions.

The first crystals seen on the working face were thumb-size gem-grade tourmalines embedded in soft cookeite. It was the largest gem pocket ever found on Mount Apatite, and perhaps in all of Maine, but it was not to be saved. It required more than a week of mining to work all the way through the huge pocket area. Under strict orders, the miners blasted away, and every blast rained tourmaline fragments across the quarry. For months afterwards, gemmy crystal sections were picked up all around the quarry, and in later years a systematic search of the dirt and dumps turned up a huge quantity of broken tourmaline fragments, in colors from a distinctive pale blue-green to "watermelon" pink and green.

People who are mining through hard rock specifically to *find* specimens often have to use explosives, too, and those explosives are generally emplaced in drilled holes. But how close is the drill hole to a good crystal pocket? Not having X-ray eyes, the driller never knows. Odds are, therefore, that good specimens are sometimes going to get blown up, even when mining with the best of intentions.

That happened to George Godas at the Pure Potential mine in La Paz County, Arizona. The Pure Potential, which George held under

"Aarrg!!"

claim, was best known for superbly bright and lustrous red vanadinite crystals, cavernous but with a high degree of transparency. George had recently dug out the best vanadinite ever found there, and had also found some remarkable little wulfenite crystals.

The Pure Potential mine is on the same fault as the nearby Red Cloud mine, world-famous for well over a century as the source of gorgeous red wulfenite. The crystals George was finding were small (under an inch) and few, but some were actually associated directly with red vanadinite, which is a rare combination. The wulfenite crystals also had pretty good luster, and a glowing, deep pink-red color superior to any of the Red Cloud wulfenites except the famous specimens found there by Ed Over in 1938. Further mining, George hoped, would yield a really good pocket of the exceptional red wulfenite, and he felt that he was close. Actually he was very close, because the next two drill holes missed it by inches, and the blast totally destroyed what would have been one of the finest wulfenite pockets ever found anywhere. The rubble of smashed but gemmy, large-size crystals was depressing, to say the least, and nothing similar has since been found.

While we're on the subject of blowing up minerals, here is another story of explosive damage:

A good friend of ours, Dr. Alfredo Petrov, had just returned to his home in Cochabamba, Bolivia, from a trip to the United States and found a message waiting for him. He had been traveling continuously for about 20 hours and was very tired. The message from one of his specimen suppliers in Potosí said that a package containing some small native silver specimens and a few other odds and ends would be waiting for him at the local bus terminal in Cochabamba. Exhausted and bleary-eyed, he nevertheless went to pick up the box rather than have it sit around the bus terminal where it would most likely disappear.

After retrieving the box he visited the post office to pick up the mail that had accumulated in his box during his absence. He then went to get some coffee and read his mail. When he finished he realized that he had left the box of specimens in the post office. He returned to the post office, only to find that there was a police barricade around the entire building because someone had said there was a bomb inside. He stayed around and watched the police run a remote control bomb disposal robot out of the building and very awkwardly down the steps into a waiting bomb disposal van. Soon television crews and cameras arrived and the word came out that the police were searching the building for more explosives.

At that point he went away to take care of other errands. Upon returning once more to the post office he found it still in a state of siege. Off to the side near one of the television crews he saw some ladies he recognized, who worked behind the counter of the post office, and he went over and asked if they remembered the package he had left behind by mistake. He carefully described the circumstances and the package.

The ladies became wide-eyed and cringed away from him, and one of them pointed at him and screamed, "El dueño de la bomba!" This translates as "The owner of the bomb!" Another lady said, "Quick, run away before the police come and arrest you." He told them that that was nonsense and that the box contained rocks and he was a geologist and that he wanted his rocks and demanded to know where they had taken his box.

By this time a police officer was listening to the conversation and told him that the box had been taken to the local police station. Off Alfredo went to the police station with the policeman tagging along behind to make sure he got there. Upon arrival, he was questioned for three hours about his role in the bomb scare.

It turned out there had been a bomb blast in the main post office in La Paz and a memo had been sent out to all the branch offices to be on the lookout for suspicious-looking boxes. In addition to that, a metal detector had been used on his box and, sure enough, it registered positive for metal inside.

Finally they told him that the box had been given over to the military for disposal. As soon as he could, Alfredo went running to military headquarters to try to get his specimens. They also questioned him for several hours and finally called the bomb disposal site to retrieve his package. "Too late," the reply came; the box had been placed in water and blown up with a cannon. "Very strange," they said. "We only found little bits of toilet paper and tiny bits of rock!"

That evening Alfredo watched the local news on television and saw the chief of police bragging about how his efficient department had been able, in less than an hour, to catch the foreigner who was responsible for the bomb.

For pure efficiency in the explosive destruction of specimens, however, nothing surpasses the world's military forces. In Hungary, for example, Russian troops invaded Budapest on November 4, 1956, in order to put down an uprising in favor of national independence from the Soviet Bloc. Soviet tanks, in an attempt to silence a downtown Budapest radio station, fired shells which accidentally struck the Hungarian National Museum of Natural History. Eighty percent of the mineral collection was destroyed, along with historical documents and antique instruments. Hundreds of fire-stained and shattered specimens are still kept in drawers because no one can bear to discard them.

Another example is the collection of the English mineralogist William Phillips (1775–1828). Phillips had published several useful mineralogical works, and was "the most distinguished geologist" among the founders of the Geological Society of London. His fine mineral collection of about 1,000 specimens was purchased by Dr. John Rutter in 1829 and later bequeathed to the Medical Institution in Liverpool. It was transferred to the Liverpool Museum in 1887 where, after having outlived its creator by more than a century, it was destroyed by German bombing in 1941.

Giving equal time to Allied bombing, we might mention the collection of the German Princess Caroline Louise von Baden (1721–1783). Her natural history collections, especially the minerals, were famous throughout Germany. She corresponded widely, exchanged specimens with other prominent collectors, and even engaged in field collecting, much to the astonishment of her subjects. Her mineral collection was inherited by her son, Carl Ludwig, Margrave of Karlsruhe, who continued to maintain and expand it. In time it became known as the Grand Ducal Naturalienkabinet and was made a public institution: the Landessammlungen für Naturkunde. The majority of the mineral specimens were destroyed by Allied bombing in 1942.

COLLECTING AND HAULING

Graham Sutton and Bill Hawes, both well-intentioned collectors, were collecting vanadinite crystals in the Old Yuma mine many years ago. Finally, after several days of diligent work with compressor and drill, they had cleaned out an area and exposed a wonderful six-inch fissure in the ceiling that extended a number of feet back into the rock. Lining the walls were hundreds of fine vanadinite crystals up to about a cm in size. The rock was very hard and they had drilled a small hole off to one side. The plan was to pack it with about a quarter stick of dynamite, just enough to pop it (loosen the rock) so that pieces of the fissure wall could be worked free with the vanadinite crystals intact. To further protect the crystals they crumpled up bunches of newspapers and carefully stuffed them into the pocket to cushion any rock movement caused by the blast. Below the fissure they built a platform of mine timbers so that any falling rocks would not have far to fall and thus the amount of damage done to falling specimens would be reduced. They lit the fuse and left the mine. Time passed and they did not hear the explosion; after about two hours they reluctantly reentered the mine and found thick black smoke roiling along the tunnel roof as they approached their work site. What had happened was that somehow the lit fuse had ignited the newspaper in the pocket but not the dynamite. The wadded up newspaper was merrily burning away when they arrived. They were fearful that the wooden platform they had built might also catch fire. So, using some water they had left in the drill line, they blew it into the crack to stop the fire. They succeeded in extinguishing the fire but created a little waterfall of charred, thermally cracked and broken vanadinite crystals which they heard popping and exploding like so much popcorn when the cold water hit them. Those crystals that were not destroyed by the thermal shock of the fire and water were blackened beyond redemption.

About 30 years ago in my misspent youth, I (RHC) was invited along on a collecting trip by Tony Jones and Dr. Gary Novak. We were to collect halotrichite in the White Queen mine near Mojave, California. It was growing in some of the abandoned poorly ventilated tunnels in lower levels of the mine. The specimens consisted of delicate, beautiful white hair-like specimens of halotrichite, many of them growing on small pieces of a soft, yellow rock matrix. To get to the collecting site we had to walk about a mile into the mine and then go down perhaps 200 feet of ladders alongside an internal shaft, before working our way into the breathless, humid tunnels where the halotrichite was growing. After collecting about 15 flats of the material we were faced with getting these boxes up the shaft and out of the mine. Rather than try to carry the boxes up the ladder we got the bright idea of tying all our rope together, dropping it down the shaft, and hoisting the boxes to the main haulage level above. For good measure we tied one of the heavy packs (with tools, water, food etc.) to the *top* of the stack of boxes containing the halotrichite. We began hoisting them up the shaft. Jones and I were hauling on the rope from the top and Novak was following it up the ladder with an occasional hand out to steady the load during its ascent. About halfway up, the rope suddenly snapped loose, and in the dark silence of the mine we heard a curse, then a whisper and whiffle of a large object falling through space and finally a distant "*boom.*" We yelled, "What happened?" and Novak shouted that one of the knots on our rope had let go.

Fifteen boxes of these delicate specimens were compressed into a space that 5 had formerly occupied. It turned out, however, that the delicate-looking hair-like locks of white crystals were somewhat flexible. Amazingly, Jones and Novak were able to salvage many of the specimens by teasing the halotrichite hairs up again with a comb and trimming them carefully with scissors.

VAN-SIZED PROBLEMS

Mineral dealers who frequently attend shows are accustomed to carting along several tons of specimens to sell, and usually a van is the most convenient method of transport. Unfortunately, vans are unstable under some circumstances, and can be very difficult to handle when fully loaded. Instances of mineral-filled vans rolling on the highway are numerous. In 1991, for example, a Jewel Tunnel Imports van rolled on the windy grade east of Yuma, Arizona, on its way back from the Tucson Show. Thanks to safety belts, no one was injured, but the windows were blown out and specimens were scattered out over the interstate. Many azurite balls from La Salle, Utah, were flattened by passing trucks before they could be retrieved . . . not a kind of demise you would expect for the average mineral specimen.

Other dealers have suffered similar accidents. Victor Yount rolled a van on the way to the Tucson Show back in the 1980's and lost many specimens when flats came open and their contents flew around. The same thing happened to mineral dealer Ron Sohn, and to mineral dealers Ken and Betty Roberts.

"Aieeee!"

THE HORROR OF FORGETFULNESS

In the late 1960's, Bob Bartsch was collecting at the Defiance mine near Gleeson, Arizona, and had just collected a fine, but very delicate specimen of the wulfenite for which this mine is famous. It was the best one he had ever found, and he has never been able to find another even close to it in quality. Before going to bed that night, he carefully laid it in its own individual box. He is a particularly experienced field collector and even carries small empty boxes in his 4 x 4 to house particularly fine individual specimens should he be fortunate enough to find them. In the morning he woke up and, while not totally awake, wondered if anything was in this basketball-size box near his bed. He picked it up with both hands and gave it a good shake, to see if anything was in it. The fine wulfenite which was not well packed, of course, thumped and bounced off the walls of the box. After about 0.09 seconds, he realized what was happening, screamed, and stopped shaking the box. With a great sinking feeling, he carefully opened the box to gaze upon the fragments of his destroyed treasure.

In the eighties I (RHC) made a number of trips to Chile and on two occasions spent about a week collecting atacamite specimens in the Farola mine near Copiapo. The atacamite most commonly occurred as beautiful green stars lying flat on breccia fragments. Sometimes they were run together as a continual sparkling green carpet, but most hoped for were the big isolated brilliant green stars, lying flat on a beautiful blue chrysocolla-stained background. The problem was that it was not easy to find small breccia fragments and more often than not you had to collect huge breccia blocks that sometimes reached small refrigerator size. The breccia was harder than the hinges of hell, and to get specimens from these large blocks you had to use a sledge hammer to try to spall off smaller specimens from the edges of the angular blocks that had atacamite on them.

Once in a while we encountered crevices large enough to put your hand into between the breccia blocks. Some of these cracks contained free-floating flattened stars of atacamite that had apparently been loosely attached to the rock during growth and had then fallen free. These were usually thin enough that you could shine a light through them and see a beautiful green color. Most of them, however, existed only as fragments because of their delicate nature. I reached into one such crack, gently felt around, and found something loose. With my eyes closed, working only by feel, with a feather-light touch, I determined the dimensions of a wafer thin something. Holding my breath, I ever so slowly drew out a flawless green glowing, sparkling round star of atacamite about two inches across. It had been lying in its dark resting place for who knows how many thousands of years. I reverently wrapped it in my only handkerchief and placed it in the front pocket of my shirt. About 15 minutes later I was walking down a tunnel, hot with sweat running into my eyes. I whipped the handkerchief out of my front pocket to mop my face. The atacamite star flipped into the air in front of my face, pinwheeled gracefully as if in slow motion, while I stood frozen, and smashed to bits on a steel rail on the tunnel floor.

DEATH BY PETTING

Cyanotrichite is an incredibly delicate, but beautiful blue mineral that is rarely collected or preserved in an undamaged state. The crystals from the Grandview mine in the Grand Canyon, Arizona, form in small balls or carpets of radiating millimeter-size blue crystals that absolutely cannot be touched by fingers or any kind of wrapping material. From the moment they are collected the specimens must be handled only in those places that do not show crystals and must be wrapped in the same fashion. In practice that means that the specimens must be wrapped in toilet paper around the sides and bottom, and that these are nestled closely to others of their kind in a box which has a lid high enough and strong enough that it will keep anything from touching the crystals. The box must then be kept so that the tops of the specimens always remain upright and carried up several miles of rough trails to the canyon rim. If at any time the box is dropped or jolted strongly enough to make the tops of the specimens touch the top of the box, the specimens will be damaged.

About 25 years ago a friend of ours, Bob Pedersen, collected what was probably the finest specimen of cyanotrichite ever produced at that mine and carried it carefully home. It was one of the bragging rocks of his collection. One day he opened the cabinet drawer in which it was stored and found that it had been "petted." Down through the center of the pristine field of fine blue crystals was a depressed furrow of matted-down crystals. Some unknowledgeable person had obviously been irresistibly drawn to its beauty and had wanted to see if the specimen felt as soft and plush as it looked.

"You fool! Look what you've done!"

Our primate ancestors were fur-covered, and groomed each other in a nurturing way that was healthful and pleasant for both participants. We still retain this instinct, and love to pet soft fur. Stroking a dog actually lowers our blood pressure, even though the dog (who lacks the same kind of tactile instinct) doesn't always understand our impulse. Consequently we have an urge to stroke anything which looks soft and furry; sadly, this includes a wide range of acicular minerals which do not spring back like real fur. This human impulse is a constant danger to furry-acicular minerals.

To continue the story of Bob's cyanotrichite, he never found out who petted it. It could have been a friend of his wife, his children, some repairman or part-time maid. It didn't matter; the specimen was ruined in the eyes of any serious collector.

He tried to remove the damage by using a vacuum cleaner to "suck" up the broken needles from the depressed area. The vacuum was stronger than he expected, and the entire specimen was sucked up smack against the mouth of the vacuum tube. In addition to the pet mark across the specimen, it now has a "ring" mark. Though I (RHC) am now ashamed of it, at the time he told me, I laughed so hard I had to hang onto the table to keep from falling out of my chair.

To cite another example, at the Tucson Gem and Mineral Show back in the early 1970's, I (RHC) had, in a glass display case, at the front of my booth, a superb acicular ulexite. This variety of ulexite is known as "cotton balls" to the miners. The case had a top, front and sides and the specimen could only be reached from the back. There was also a big sign in front of the specimen saying "DO NOT TOUCH!" On the first day of the show an elderly lady walking by stopped and stared at the specimen intently for several minutes. I thought the lengthy stare was because she knew how fine the specimen was. I was wrong. As soon as I turned my back, she leaned far over the table, to one side of the case, and was in the process of reaching around behind to grab a handful of the fine needles. I spotted her just before she touched the specimen and I screamed "STOP!" as loud as I could, causing heads to turn. Her hand jerked back as if it had been stuck with a needle. She accused me of being a rude and crude man, and no amount of explaining why I had yelled at her would get her down off her high horse. She had been completely hypnotized by the specimen. In all her life she had never seen such a thing and her whole existence had just narrowed down to her and that marvelous fluffy thing which she just had to feel, reaching the first time for fire.

The 79 mine in Arizona, to cite yet another example, produced some of the most beautiful, soft-looking druses of puffy acicular aurichalcite ever found anywhere. While collecting there in the 1970's, I (WEW) broke into a beautiful pocket and began carefully hauling out delicate sky-blue specimens of thick aurichalcite "fur." I cracked each piece out carefully with a chisel, and then grasped it delicately by the edges to extract it and then pack it open-face in a flat. As time wore on, the soft fuzzy look of the pieces I was taking out made my fingertips begin to itch; I was dying to pet them, even though I knew full well that doing so would destroy them. Finally I had to find a small inch-long piece that already had some damage and consign it to therapy; I petted it to death, and felt much better afterwards. The impulse had been overwhelming.

AT THE HANDS OF MINERS

Sometimes miners purposely destroy a specimen in order to steal it and resell it for its commodity value. Bob Hauck tells the story of a miner who found a big slab of native silver in one of the mines near Cobalt, Ontario. The thing weighed over three hundred pounds. The miner folded, bent and beat it with a big sledge hammer till he could make a load that would fit approximately on his shoulders. Then he covered it with a raincoat and had two of his friends help support him as he walked to the hoist cage, rode to the surface and walked to his car.

"It's broken . . . broken!"

Danny Trinchillo tells a sad story from the Lushi antimony mine in Henan province, China. Tunneling operations there broke into a large pocket filled with huge stibnite crystals. Not wanting to waste time, the mine manager ordered the miners to drive on through the pocket, destroying many crystals. But the pocket was wider than the adit, and so portions of it remained to the left and right which miners were free to collect. One miner selected a beautiful, terminated, undamaged crystal about 4 feet long, growing from the floor of the pocket. He snapped it off at the base, slung it over his shoulder (with the terminated end to the rear), and marched off down the narrow adit towards sunlight. Unfortunately, before he got out, the mine manager called out to him from farther back in the adit, yelling something equivalent to "Hey!" in Chinese. Without thinking, the miner whirled around to address his boss and, in the process, smashed the terminated end of the crystal off on the wall.

Miners may be well-intentioned, especially when they have been convinced of the value of specimens vs. ore. However, getting them to appreciate perfection and collect specimens carefully can take years of training and indoctrination. Otherwise, a specimen with broken crystals may appear just as pretty to them as an undamaged specimen. Mineral dealer Wayne Thompson learned this in Mexico in the early 1970's.

Wayne had been leasing the San Francisco mine in Sonora and was mining it for specimens, utilizing local miners for the heavy work. Each day they mined along the most prominent vein, drilling and blasting in the hope that it would widen out into a nice pocket.

One day it did exactly that, but unfortunately it was a day in which Wayne had driven to Tucson for supplies. The miners, delighted at finding such beautiful material, decided to mine it out for him. This they did, with an almost total absence of skill or finesse, destroying almost everything. The pocket had been large enough to walk into, and had been filled from top to bottom with gemmy orange wulfenite crystals to several inches and bright red mimetite crystals.

By the time Wayne got back to the mine, the miners had stacked up their boxes of mostly broken specimens, and the pocket was cleaned out. As Wayne walked into the ruined pocket, he realized he was standing on a layer of broken crystals six inches deep and several yards long. He scooped up a boxful of the broken crystals to keep as a memento of having been in the right place, but not at the right time.

ENVIRONMENTAL IMPACTS

Some specimens will simply self-destruct on their own once they are removed from their original environment. Spontaneous deterioration of this sort is well known. Borax and chalcanthite, in beautiful, gemmy crystals freshly collected, eventually alter to powder and cannot be preserved by normal at-home techniques. Big crystals of mirabilite from Soda Lake near Taft, California, will begin breaking down before your very eyes, within minutes of being collected. Big autunite specimens from the Daybreak mine near Spokane, Washington, are notorious for dehydrating and exfoliating or splitting over time. Some minerals quickly lose their color when exposed to sunlight, and others (such as the photosensitive silver minerals) turn dark. Metals will tarnish and sulfides will oxidize. A book could be written about damage due to environmental change.

Sunlight is particularly dangerous to many minerals, in some cases altering not only the color but the crystal structure. Realgar, for example, will alter to a different mineral entirely, the powdery orange pararealgar. Probably the finest realgar ever collected in North America was collected by Gordon Leroux from Green River Canyon near Black Diamond, Washington. It was purchased by Ed Swoboda and put on display at Stanford University in a display case in the geology library. This specimen was as good as or better than the best of the recent Chinese realgars on the market. At certain times during the day, sunlight struck the display case, and after a short period of time the specimen began to crack and turn yellow. It was taken off display but the damage was done, and the specimen eventually degraded to the point where it was in pieces and valueless. I (RHC) collected nice but much less exalted specimens from the same locality over 20 years ago and they have held up nicely. They have been and are stored, however, in a set of drawers that is rarely opened. I have also seen nice specimens of realgar from a yet earlier find at Getchell, Nevada, that are also in good condition. But again, these specimens have been wrapped and stored away in dark boxes. I think that the recent Chinese realgars will hold up well for many years if they are kept in a cool dark place. A number of them in dealers' hands have begun to crack and change color, probably from being carelessly placed under bright lights and sunlight.

CURATORIAL DISASTERS

When I lived back east I (RHC) used to visit periodically with Ernest Weidhouse, a notable old collector who lived in Westchester County, New York. I asked him about old collections and he told me about the one which his old friend James Manchester had given to the Fall River, Massachusetts, library. I drove up from New York to see it. In the library there were perhaps six large glass-topped display cases full of specimens and two or three full of shells. I asked the librarian if she knew anything about the collection. She brought out Canfield's publication and showed me the entry under Manchester, James G., New York City. It said: "This is a general collection of about 3000 specimens, the result of thirty years' labor. It is of high grade and includes many of the very finest specimens of the minerals found in the Erie Cut (1909) through Bergen Hill. About 1920 he presented it to the Public Library of Fall River, Mass., as a memorial to his wife."

A quick count of the number of specimens in the display cases indicated that about a thousand specimens were present. I then asked where the other two thousand specimens were. The personnel in the library got rather defensive at that point and the result was that they denied ever having had more specimens than were in the display cases.

The Columbia School of Mines has a wonderful mineral collection, but when it moved to new quarters they had a janitor pack up the collection, and he did a good job except that he decided that it would be better to pack the labels separately from the specimens. There was no catalogue of the collection and the specimens were not numbered. This ruined much of the value of the collection because the majority of the specimens could not be identified as to locality.

Forrest Cureton tells of visiting the Geology Department at the University of Missouri in Columbia some years ago, seeking to purchase unwanted specimens. As it happens, the administration had just recently decided that the large mineral storeroom would be better utilized as office space for graduate students, and had ordered the entire contents discarded. Forrest was told he could have whatever he wanted, so he went through the entire room, drawer by drawer, and whatever he did not wish to take was immediately carried to an open window and heaved into a dumpster. Forrest had only limited time and space, and took what he could. Broken Hill raspites, rhodonites and chlorargyrites by the hundreds perished, along with whole research suites of Crestmore minerals, to mention only a few. The study specimens carefully preserved by nearly a century of mineralogists were gone forever.

Many such stories could probably be told. In Washington, D.C., some collectors found a man at a swap meet selling some amazingly fine mineral specimens for give-away prices. It turned out that he haunted one of the local dumps and had picked up the specimens after a local university needed the room the collection was occupying and just hauled it off to the dump.

At the Smithsonian Institution, about 25 years ago the chief curator, Paul Desautels, got a call from Goucher College wondering if the Smithsonian would like some mineral specimens. The college needed the space for something else. Paul sent curator John White to get what he could. The specimens were in an unfinished basement where the specimen drawers were rotting and were falling apart. Some of the drawer bottoms were falling through into lower drawers and could not even be opened. There was also a good mineralogical book collection which was so mildewed and rotten that nothing in it could be saved. It was a real mess. A few good specimens were rescued but most of the collection was destroyed. The best gratonite specimen we ever saw came from this collection.

DRAWER DAMAGE

Many a specimen has met its end in the seeming safety of a cabinet drawer. We have seen drawers without stops pulled out and crash to the floor, even in major museums (the pulling is usually done by visitors, but sometimes by the curator himself!). We have seen countless specimens rolling around loose in cardboard specimen trays, with fine dust and crystal particles lining the tray bottom as evidence of the cumulative long-term damage.

One drawer of wulfenites in the Smithsonian Institution (back in the 1970's) used to contain a superb Hilltop mine small cabinet piece topped by a classic 1-inch yellow crystal. Unfortunately the top half of the main crystal was cleanly broken off along a suspiciously straight line. The source of its fate was obvious when the drawer was slid shut and the broken edge aligned perfectly with the sill of the drawer above it; it had originally projected above the top edge of the drawer but was scissored off the first time the drawer was closed on it.

OOPS! I DROPPED IT!

Perhaps the saddest case of specimen dropping involves one of the Vaux collection proustites from Chañarcillo, Chile, that Martin Ehrmann got from the Vaux family and sold to the Los Angeles County Museum of Natural History. Other than the big carefully sequestered proustite from Chile in the British Museum of Natural History, this cabinet-sized proustite with a six-inch-long major crystal may have been the best in the world. Curator Tony Kampf relates the tragic tale, which took place one day in the late 1970's. Early that day he delivered the proustite specimen to the museum Photo Lab. The photographer had some other shots to take first, so Tony left the specimen with explicit instructions that the photographer call him before photographing the specimen and under no circumstances handle the specimen himself. The photographer apparently didn't take the admonition seriously. A couple of hours later, with a long face, the photographer walked into Tony's office carrying a box. Contained within were the totally shattered remnants of the once-wonderful proustite specimen; not even a thumbnail-size piece had survived. The photographer explained how he had tried to produce an artistic shot by perching the specimen on a laboratory ring stand. Realizing the potential danger, he had covered the table beneath with thick foam padding. When the specimen inevitably fell, the foam, rather than gently cushioning its landing, served as a springboard, launching it again into the air and sending it crashing to the hard linoleum floor. Tony vividly remembers sitting blankly at his desk for the rest of the afternoon, suffering through what must have been the darkest day of his then-young curatorial career.

One of the best Bolivian phosphophyllite specimens used to reside in the collection of the late Dave Eidahl in California. It was illustrated on the cover of the January-February 1981 issue of the *Mineralogical Record.* Following his early death at the age of 26, Dave's family kept some of his collection together in his memory. The phosphophyllite was loaned to a local California institution for study, where it met a most mundane end: it was dropped on a hard floor and shattered into countless pieces.

You don't necessarily need to drop a specimen in order to destroy it; you can also drop something else *on* it. Some years ago the Smithsonian Institution sent a large blue aquamarine crystal on loan to the Albuquerque Museum of Natural History. It was duly installed in a high-ceiling glass case, but there was a problem with the lighting. Consequently a workman had to open up the case and do his tinkering right above the specimens. He dropped a ball-peen hammer directly on the aquamarine, with unfortunate results.

The late Paul Desautels, for many years curator of the famous Smithsonian Institution collection of gems and minerals, once told a story illustrating how even the most treasured and protected specimens can find themselves on the endangered list. The story involves the Hope Diamond, a midnight-blue lump of crystalline carbon fire that, ounce for ounce, surely qualifies as one of the most valuable single objects on earth.

For many years following its acquisition by the Smithsonian in 1964 it was kept and displayed in its mounting of small white diamonds and platinum. While preparing some information for publication one day, Paul realized that the museum did not have accurate, recent information on the actual weight of the Hope diamond. So it was decided to take the gem off public display for a short while, remove it carefully from its setting, and weigh it on a modern, highly accurate analytical balance. This was done, but as Paul was handling the stone after it had been unmounted, it slipped out of his fingers. It fell through the air in slow motion, rebounded off of a desk top, and bounced *three times* on a hard concrete floor. He just sat there in his chair without moving, staring at the miraculously undamaged stone on the floor; he was, he said, "calm on the outside but totally shattered on the inside." Big diamonds are commonly under a lot of internal stress, having originally formed under the high-pressure environment a hundred kilometers below the surface. It could well have shattered on impact. Imagine the consequences. Paul would have gone down forever in the history of gemology as the man who destroyed the Hope Diamond; everything else he had ever done in his life would have paled into insignificance and been forgotten.

Every collector, no matter what kind of specimens he carries the guilt of having accidentally broken in his life, can take heart in this story. Whatever it was, it couldn't have been as bad as if that big diamond had shattered. And no one could have had more experience handling great things than Paul Desautels. People are only human, and accidents will inevitably happen, even to the best of us.

Even in the 18th century, specimen breakage from handling was a common problem. Pedro Franco Davila (1710–1775), a Peruvian collector living in Paris, was known to be somewhat clumsy in handling specimens. And the illustrious René Just Haüy (1743–1822), a founder of modern crystallography with a large collection of his own, once dropped and broke a calcite in the collection of his friend, Jacques Defrance. Of course, Haüy, being the genius that he was, came to a fundamental realization about the nature of crystal structure when he saw the rhombohedral cleavage fragments that resulted. Few of us can justify episodes of clumsiness with a scientific breakthrough!

TORTURE BY HEAT AND COLD

Sulfur is perhaps the best-known example of a mineral highly sensitive to even small changes in temperature. I (RHC) once had a superb Sicilian sulfur specimen, consisting primarily of a single gemmy crystal about 3 inches across. One day I was showing it to a friend from the trunk of my car. The blowing wind was somewhat cold as I removed the cotton from around the specimen. As we were admiring the lovely specimen we heard a sudden "snap!" and a crack shot through the big crystal. I hastily wrapped it up again to protect it from further damage.

Other collectors have heard sulfur crack merely from the heat of one's hand while holding it. Wulfenite is not as sensitive but can suffer similar damage. Some years ago, when Bill Panczner was curator at the Arizona-Sonora Desert Museum, I (WEW) followed him around on a tour of the vault and storage areas. At one point he took out a superb San Francisco mine wulfenite cluster, the kind with water-clear orange crystals peppered with little red mimetite crystals. It was composed mainly of one of the largest single crystals known, over 4 inches across. He gingerly placed it in the palm of my hand, and I studied it admiringly. Then, though I had not moved a muscle, we heard a distinct "tink!," and it cracked through the middle, folding its wings down like a dead butterfly. Feeling somehow responsible I looked at him in panic, but he just said, "Don't worry, I'll repair it."

Speaking of mimetite, one of the most famous stories involves the wonderful Tsumeb mimetite which appeared on the cover of the Tsumeb Issue in 1977. The crystals are from the pocket of 1972 which yielded all of what are regarded as the world's finest specimens of the species. The cover specimen, owned by German gem dealer Gerhard Becker, had water-clear yellow crystals of the finest quality. One day, however, Gerhard's wife decided to help her busy husband by washing the dust off of some of his specimens. She took the mimetite to the kitchen sink and carefully immersed it in hot water, as she had probably done for many of his gemstone specimens. In an instant the water-clear crystals turned milky and nearly opaque with internal fractures! Gerhard was, of course, crushed. "But," he says wistfully, "It's still a pretty nice specimen."

Many minerals are heat-sensitive to some degree. Cerussite will crack if it gets too cold. Large, clear crystals of Spanish fluorite can be heard cracking under tap water. Kurnakovite, in large crystals, will fracture badly if immersed in water of slightly different temperature.

"Now how do you suppose THAT happened?"

Heat sensitivity is normally the result of a combination of factors: (1) low thermal conductivity and (2) high coefficient of thermal expansion. It is for this same reason that Pyrex ovenware is resistant to sudden temperature changes; it is relatively pure silica glass with high strength and an extremely low thermal expansion coefficient. It doesn't expand or contract much with changes in temperature.

A somewhat different case involved a Brazilian aquamarine. Back in the early 1970's the Detroit Gem and Mineral Show was held at the Light Guard Armory, a large gymnasium with high walls and a row of windows in places near the ceiling. Exhibit cases were set up in a different floor pattern each year, just for fun, and many fine specimens were placed on public view there during the show's heyday. One year an exhibit was set up by David Wilber which included some fine miniatures, particularly an aquamarine crystal from Espirito Santo, Brazil. Crystals from this locality had, as a distinguishing feature, many little blebby inclusions suspended in the gemmy blue interior like bubbles in carbonated water. The inclusions were also transparent, as if containing only gas or water. They certainly contained something, as showgoers soon discovered.

As the afternoon came on Saturday, the first full day of the show, a bright October sun cast squares of light on the show floor from the high windows. As the sun followed its path through the sky, the squares of light slowly moved across the show floor like a giant sundial. Across the row of exhibit cases the sunbeams fell until they shone directly onto the Espirito Santo aquamarine. Stresses began to build up inside the crystal as the inclusions heated up. Finally it exploded with a bang, in a hail of fragments. Apparently the increased temperature raised the gas pressure or the vapor pressure of the included liquid until the crystal was not strong enough to contain it. Dave had to sell the pieces as gem rough.

Obviously the worst thermal disaster that can befall a specimen is fire. Though not as common as they used to be, thanks to modern technology and fire codes, fires were at earlier times one of the major threats to mineral collections. For example, we will never known for certain what the mineral collection of James Smithson, founder of the Smithsonian Institution, looked like; it was destroyed by fire in Washington, D.C., in 1865. A careful reading of Frederick Canfield's "The final disposition of some American collections of minerals" (1923) will disclose that about 10% of all the collections listed were destroyed by fire.

CHEMICAL NIGHTMARES

Chemicals can often do as much damage to specimens as dropping them on the floor, and corrosive chemicals are especially notorious. Back in the early 1970's, we remember Smithsonian curator John White going about his duties one day, when he decided that a lovely Russian crocoite miniature needed to have a century's-worth of dust and soot knocked off. Scrubbing the soft, lustrous crystals was out of the question, because they were too fragile and easy to scratch. So he chose to use a common curatorial tool, the ultrasonic cleaner, a miniature stainless steel bathtub which would send high frequency vibrations through water to gently loosen fine particles. He plunked it in the little bath, turned it on, and left for 20 minutes or so. On returning he was horrified to find the specimen's luster destroyed and its crystals hazing over with a dull whitish film! It seems that a member of the volunteer staff had previously used the ultrasonic cleaner and, instead of leaving it full of clean water, had left it full of a weak acid solution without telling anyone.

Around 1983 some extraordinary anglesite crystals began coming out of Morocco; they had a beautiful brownish red color and high degree of gemminess. They sold for high prices, but a few people were suspicious because the color was only skin-deep, on broken surfaces as well as crystal surfaces. Ultimately it was learned that some Moroccans had been cleaning specimens in a bleach solution, and discovered accidentally that the bleach reacted with anglesite to produce a deep red-brown compound. Once this became known, it was realized that all specimens which had been treated must now be considered essentially worthless, and this included some that, even colorless, would have ranked among the finest in the world for the species.

Some minerals are purposely destroyed because they are ugly, and detract from the appearance of associated species. The removal of calcite by dissolution in acid is a common practice. A large lot of prehnite molds after laumontite, to cite another example, arrived at Jewel Tunnel Imports from India, and it was plain that their aesthetics were being compromised by some kind of black oxide material. The black mineral was removed with acidified hydrogen peroxide. Cal Tech mineralogist Dr. George Rossman later determined the black mineral to be some of the purest todorokite ever found.

"It's ruined!"

Efforts to dissolve unaesthetic minerals from more desirable ones can often go awry when both species are attacked. In 1974 a collecting buddy (Bob Bartsch) and I (RHC) went to the inesite locality at Hale Creek in northern California. With considerable effort we broke up the typical calcite and inesite boulders found in the creek bed and selected about two hundred pounds of specimens of the calcite intergrown with inesite that showed the greatest etching potential. We had to haul this material by backpack about three miles to our vehicle. Al McGuinness, another dealer/collector, told us that he used a very weak solution of hydrochloric acid kept very cold to remove the calcite. Try as we might, we could not get the solution to etch properly and we ruined many specimens. Finally we tried nitric acid which worked wonderfully even in concentrations as strong as 20%. We have also found that, if calcite must be removed from dioptase, nitric acid is the acid of choice, and that most other acids (even acetic acid) will remove any existing luster from the dioptase.

Preservation techniques gone wrong can also destroy specimens. John Mediz regularly collected wulfenite at the 79 mine in Arizona, and on one trip was fortunate to recover over 250 fine but very delicate specimens on a rather crumbly matrix. These he offered to another mineral dealer, Chris Wright. Questioning the friability, Wright was told that all he had to do was dip the soft rock in a plasticizing solution and it would stabilize and harden the matrix. But there was a misunderstanding in the communication of this technique; Wright dipped the *entire* specimen in plastic solution, rather than just the friable matrix, and the crystals of wulfenite became plastic-coated in a most obvious and unattractive way. All subsequently had to be discarded.

Chemical damage is not always of the corrosion type. Many dealers will remember the 1989 Springfield, Massachusetts, Gem and Mineral Show, held at the Civic Center in downtown Springfield. Normally some inclement weather on show weekend would be considered a plus, as attendance would increase when outdoor activities are curtailed. That weekend it rained. And rained, and rained and rained. Dealers went about their business on set-up day and then retired to their hotel rooms for a good night's sleep before the show opening. All-night guards patrolled the otherwise deserted show floor. And still it rained. Although the show floor was about six feet below street level, the entrances were well designed, and not a drop of the water that was flowing torrentially down the streets and sidewalks outside got in over the doorway thresholds.

Unfortunately the heavy rain was overloading the city's storm drainage system. Finally, at around midnight, the whole system suddenly backed up. Drain plates set into the concrete floor of the Civic Center were blown off and, according to stunned security guards, geysers of rainwater shot 20 feet in the air from the drains. Within moments the show floor was flooded and the water was rising. Most dealers had stock stored under their tables in stacks of beer flats, as always. The water level rose to one flat deep (about 4 inches), then two flats deep, then three. Finally the city engineers got the problem under control, the geysers tapered off, and the water began to recede.

Dealers were immediately awakened and rushed in to salvage their stock and clean up. For most dealers the water had done no harm, but for two exceptions. A dealer in meteorites had left a large meteorite on the floor, and the water had reacted with iron chloride in the cracks, breaking the meteorite apart.

A more interesting example was some flats of white Indian okenite puff balls on the floor of the booth of David and Celia Lare's *Jeffrey Mining Company*. At first David was delighted to see that the soggy flats had not collapsed on the fragile okenite. However, upon opening the flats he was shocked to find that all of the okenites had turned blue! Apparently the blue ink printing on the flats (which were real recycled beer flats and not unprinted commercially made mineral flats) had dissolved in the water and been taken up into the crystal structure of the okenite.

EARTHQUAKE!

Almost every older collector in California has lost specimens in earthquakes. Willard Perkin of Glendale, for example, kept most of his best large specimens in glass display cases which were destroyed by the 1971 Sylmar quake. His cases were smashed and the specimens cascaded down on each other amid a rain of broken glass, landing on a concrete floor. Fen Cooper of Freedom, California, lived less than 10 miles from the epicenter of the 1989 Loma Prieto quake. Some of his specimen drawers literally shot out of their cabinets and struck the opposite wall of the room before falling to the floor. One of the drawers broke a window 8 feet away from the cabinet. Gary Moss, a San Francisco collector who helped him clean up the mess, said it looked as if the room had been roto-tilled. Jack Halpern's collection in San Francisco also suffered extensive damage from that quake, as did the collection of a local institution that wishes to remain nameless, mostly from broken glass shelves and cases. The moral: if you live in earthquake country, use cabinets that have locking drawers and Plexiglas shelves. For more details see the article by Los Angeles County Museum of Natural History curator Tony Kampf, "Earthquakes and mineral collections" (1994, p. 245–247), and also the letter in this issue from Jack Halpern, p. 327.

DISCARDED TREASURES

A story that Carl Krotki of the New York Mineral Club used to tell was about an elderly member whose wife had restricted his collection to a particular closet in their high-rise apartment in New York City. She did not like mineral specimens, or probably more accurately resented the time and money her husband lavished on them. Often, when he bought a specimen, his wife would grill him about how much he had spent; to keep peace in the family he would always fib, moving the decimal point over a place or two. Thus a $50 specimen would be reported to her as having cost only $5 or 50 cents. From time to time they would entertain other club members, and he always seemed to have difficulty locating some of the specimens he wanted to show off. The mystery was solved one day when his wife was complaining privately to another club member's wife about the foolishness of mineral collecting. She explained that when the specimen closet got too crowded for her taste, she would simply take a few boxes and drop them down the trash chute. "After all," she said, "they didn't cost very much."

SO MUCH IS THROWN AWAY

Bottley's, the famous old English dealer, was moving to a new warehouse, and in the old warehouse he discovered a number of tea crates full of calcites and barites that had been there for many years. Rather than try to make room for them in his new facility he had them carted down to the Thames River and thrown in.

Specimens need not be totally pulverized to be destroyed. They simply need to be damaged enough to lose their value or their interest to their owner. Then what happens?

"There were MINERALS in that old box?!"

The cruel fact is that most mineral specimens are just thrown away. All specimen dealers from time to time speculate about what happens to all of the specimens that a particular locality produced. What ever happened to all those good calcite, galena and sphalerite specimens that the tri-state (Oklahoma-Kansas-Missouri) lead district produced? There were hundreds, probably thousands, of tons of specimens produced over more than the fifty years that the district was heavily mined. Boodle Lane, well known tri-state dealer, used to send barrels of specimens all over the world. The same was true about adamite and hemimorphite specimens that flooded out of Mexico and fluorite specimens from Cave-in-Rock, Illinois. There were tons of them. Where did they go? More recently there has been a flood of Indian zeolite and related specimens. Also amethysts from Brazil (at least a thousand tons per year) and pyrite from Peru. Over 100,000 specimens of San Francisco mine (Mexico) wulfenite were mined, shipped and sold. Thousands of tons of specimens. Where did they go? In the last century it was pyrites from Elba, sulfur specimens from Sicily and barites, calcites and specular hematite specimens from England.

Odds are, 99% of those specimens have by now been discarded. Most of the specimens that are sold are sold to non-collectors who are fascinated enough by minerals to buy some "samples" to keep around the house. Over the years they get dusty and dirty, their color fades, their luster dims, the kids play with them, and then they get damaged as well as dusty, dirty, faded and dull. Finally someone just throws the dirty old rocks out in the garden or trash. Those environmentally sensitive folk among you can perhaps take solace that, in a sense, the specimens, like ourselves, are recycled. From dust, to dust.

THE BULLDOZER OF DOOM

Dr. James Wishart of Rochester, New York, spent a lifetime building a fine collection. During his eighties his family talked him into joining a retirement community and offered to do all the work of helping him move and dispose of unwanted possessions; these definitely did not include the mineral collection. His home was sold to a developer and during escrow the contents of the house were removed one way or another. The day before the closing of escrow the last load was to be removed from the property, which was supposed to include the mineral collection. It had been removed from the cabinets, packed in boxes and placed in the driveway with trash and other items. For some reason the specimens were left behind and their absence was not noticed until late that evening. Dr. Wishart returned the following day to get the specimens and, upon arriving at the site of the home, found that the property had been leveled to make way for a new shopping center. The family speculates that the specimens were bulldozed along with the rest of the house and they were never recovered. The collection contained many important specimens including apparently the largest gold nugget ever found in New York state.

Lawrence Conklin related the story of the collection of Peter Zodac, founder of *Rocks & Minerals* magazine, in the March-April 1988 issue of the *Mineralogical Record*. Zodac died leaving a two-story house and basement almost completely filled with specimens. Conklin bought the lot, and had moving men clear out the ground floor and second story. But all of the boxes stored in the basement had deteriorated and collapsed into a 3-foot-deep layer of chaos. There was no time to sort through and salvage the basement storage; it was soon thereafter bulldozed over during the demolition of the condemned house.

CONCLUSIONS

What lessons can be learned from all of these horror stories?

(1) Good mineral specimens have already survived a gauntlet of dangers. Make every effort to safely preserve them from harm.

(2) Museums: hire curators who know minerals, localities and collecting at least as well as they know technical mineralogy.

(3) Try to keep explosives of all kinds away from minerals.

(4) Educate miners at every opportunity.

(5) Put thick, soft carpeting in your collection room.

(6) Make advance arrangements for the disposition of your collection, so that it does not end up in uncaring hands.

(7) Get a dog to pet.

(8) Enjoy your minerals while you can, because neither you nor they are immortal.

MORE STORIES?

Do you have your own story of doom and destruction? Your own nightmare from the mineral collecting vault of horror? We're ready to share your pain. Exorcise those demons of guilt by writing up your story for our readers and sending it to the editors. You'll feel better, and your conscience will rest easier, knowing that others may benefit from (or at least have a cathartic hysterical laugh about) your experience.

Note: Illustrations in the above article are not intended to resemble particular persons, living or dead.

33rd BOLOGNA MINERAL SHOW MINERALS, FOSSILS AND GEMS

BOLOGNA MINERAL SHOW

In the very heart of Italy, one of Europe's largest shows for the exhibition and sale of minerals, fossils and gems for collectors only.

DMF recommended

MARCH 15th/16th/17th 2002
CONVENTION CENTRE - Bologna - ITALY

Special exhibits and events:
200 years of mineralogy:
the National Museum of Natural Sciences of Paris

InfO: **Maurizio Varoli** - Via A. Guidotti 67 - 40134 Bologna - Italy
Phone and fax: ++ 39 / 051 / 644.73.15
Http: www.bolognamineralshow.com - E-Mail: info@bolognamineralshow.com

Blue Sky Mining
DANIEL BELSHER
8890 N. Federal Blvd., #52-D
Denver, CO 80221 U.S.A.
Tel: 303-428-8771 • FAX: 303-428-8773

See me at the Denver, Tucson & St. Marie-aux-Mines Shows
NO LISTS
by Appt. only

Collector, Commercial & Educational Mineral Specimens from Mexico. Wholesale/Retail

TODAY'S THE DAY
Stop Smoking
American Heart Association

Simkev Minerals
fine microminerals for discriminating collectors
MICROS ONLY - FREE LIST
79 Pine St.S., Port Hope, Ontario, L1A 3G2, Canada
Ph:(905) 885-5483 Fax:(905) 885-1161
E-mail: simkev@nhb.com

NATIONAL MINERALS
IN TUCSON
AT EXECUTIVE INN
ROOM NO. 247
JAN. 25–FEB. 14

Surprisingly affordable, very aesthetic and beautiful. Top quality Indian minerals. Something for everybody from the collector to the amateur.

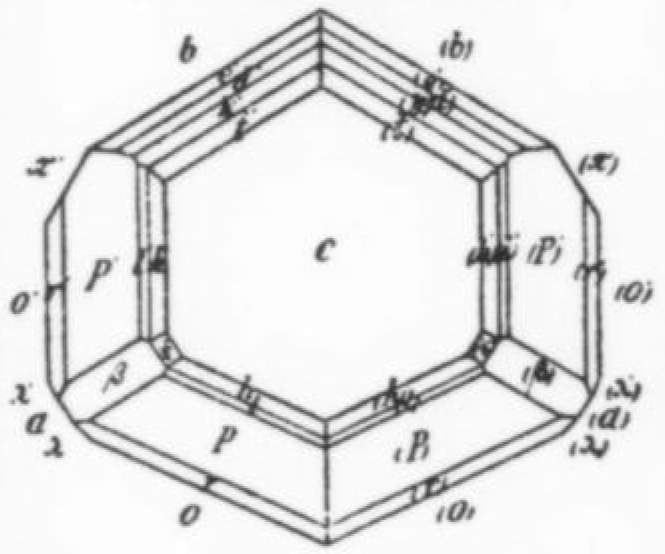
Fabulous gift products including Pretty Gemstone Bowls, Gemstone Paintings, Jewelry Boxes, Pendants, Meta-Physical Products like Pyramids, Points, Massage Sticks, Healing Sticks, Shivalingams, Eggs, Spheres, and much more including

Home Products like superb Wrought Iron Candle Holders with/without Glass Vases, Aromatic Candles, fancy Baskets, and much more.

When in India please contact us at:

National Minerals, 209/1673 Motilal Nagar No. 1, Road No. 4, Goregaon (W), Mumbai-400104, India.
Tel: 91-22-8754733, 8749984
Fax: 91-22-8736161
e-mail: nationalminerals@yahoo.com

Rare Species?
Common
Minerals?



Our customers say: "Quality material, accurate labels, excellent wrapping." Find out why! $2 brings 20 pages of listings, $3 puts you on our mailing list for a year.

Minerals Unlimited
P.O. BOX 877-MR
RIDGECREST, CALIF. 93556-0877

Fine
Mineral Specimens

Specializing in
Great Classics
Afghan & Pakistani
Pegmatite Minerals.

lists issued.

H. Obodda
Box 51 • Short Hills, N.J. 07078
(973) 467-0212

MINERALS & SUPPLIES

DIAMONDS of the WORLD COLLECTION

A valuable collection of 12 different natural diamond crystals! These will include several different colors, a variety of different forms such as cubes, octahedrons, macles etc., and all from twelve different countries! Total weight in these collections will average about three carats, and crystal sizes will range from about 2.5mm to 5mm. Every specimen is individually labeled with complete locality data, and each collection is offered at an exceptionally low, competitive per carat price.

Diamond Collection: 12 different @ only $99- per lot!

Photographic Guide to Mineral Species

The PhotoGuide CD has over 5400 mineral photographs depicting ***more than 3100 different species,*** in addition to another 225 varietal phases, by far the most comprehensive number of different minerals of any similar product! Search for mineral photos either by mineral name or by our extensive localities index. ***Our CD operates under both Macintosh and IBM-Windows operating systems with no complicated set up required.*** See our website for a sampling! This extraordinary CD, from the rare species experts, is just $69.95 plus $4.00 shipping.

Dealer inquiries invited.

MINERAL IDENTIFICATION SERVICE

X-Ray microanalysis using our in-house Energy Dispersive Spectroscopy and SEM imaging equipment. A typical analysis includes a full written report, X-ray spectra and specimen photo, all for just $45-! Tiny sample sizes & non-destructive analyses at low prices! ***See our article in the July-Aug, 1999 issue of Mineralogical Record or our website for details.***

Fersman Mineral Database-CD Version

This excellent software product is a comprehensive database of all known mineral species, now available on CD!. Information for each mineral includes chemistry, mineral group, X-ray data and space group, optical data, other physical properties as well as type locality and literature references! ***Every field or combination of fields is simultaneously searchable,*** and two user fields are included! This DOS-based program functions well under any Windows environment with an IBM-compatible system. We have prepared a full installation package and instruction guide for our clients, and this excellent software package is just $99- plus $4- shipping.

Supply Catalog: $2.00

All the items needed for your collecting pleasure: Riker Mounts, Geiger counters, fine optical triplets, microscopes, assorted mineral collections and special lots, a full line of ultraviolet lamps and supplies, lapidary equipment, tumblers, mining models, plastic & cotton filled boxes, the full line of Estwing hammers and chisels, and much more! ***NEW: High Pressure water cleaning guns for both 110V and 220V!***

NEW BOOK!
"Lovozero"

A long awaited and comprehensive treatise on the history, development and mineralogy of this re-knowned region of the Kola Peninsula by Dr. Igor Pekov. Hardcover, over 500 pages, fully illustrated with hundreds of color and b/w photos, maps and drawings. If you have any interest in Lovozero, you must have this future classic! Hardcover @ 79.00 plus 8.00 surface mail, exclusively from Excalibur!

Dealer inquiries invited!

LANGBAN!

A modern classic with over 215 pages and hundreds of color and black & white photographs, with full descriptions of the nearly 270 different species found at this historic locality! A comprehensive look at the mines, geology, minerals and people that have made Langban world famous. See the outstanding review in MinRec! Hardcover, high quality art printing from Sweden, just $75- plus $7- surface shipping. ***Dealer inquiries invited!***

RARE SPECIES!

Receive back issues plus a year's worth of our monthly descriptive catalogs for just $3.00. Learn about new minerals like cattiite, gladiusite, kampfite, litvinskite, and many others as soon as they are approved! We offer a litany of rare discoveries and special offers in each monthly list! From the recognized world leaders in rarities and reference collections at Excalibur!

EXCALIBUR MINERAL COMPANY
Rare Minerals, Meteorites & Analytical Services
1000 North Division Street - Peekskill, NY 10566
Tel: (914)739-1134 Fax: (914)739-1257
www.excaliburmineral.com

JOHN BETTS
FINE MINERALS
www.johnbetts-fineminerals.com

New Minerals
Added Every Week

Send for list

John Betts
215 W. 98 St.
NY, NY 10025
(By Appointment)
212-678-1942

Cash Paid for Mineral Collections

P.O. Box 1384 • Somerset West 7129
South Africa
International Tel: 27 21 - 855 3267
International Fax: 27 21 - 855 4119
E-mail: owen@intekom.co.za

Colin & Helga Owen

SPECIALIZING IN MINERAL SPECIMENS FROM
N'CHWANING AND WESSELS MINES,
KALAHARI MANGANESE FIELD

By Appointment Only.
Just 30 Minutes Drive from Cape Town

THE
ROCKSMITHS

July 7–8	Culver City, CA
July 14–15	Colorado Springs, CO
Aug. 3–4	[Private Showing in New Carrollton, MD]
Aug. 10–12	West Springfield,MA
Sept. 11–12, 14–15	Denver, CO "Goodenough" Holiday Inn, rm. 241
Sept. 14–16	Denver, CO [Main Show Merch. Mart]
Sept. 21–23	Humble [Houston area], TX
Sept. 29–30	Franklin, NJ

Please visit us at ROCKSMITHS.com for complete Show Schedule Information. A new selection of minerals now available on "e-case."

5th & Toughnut, Box 157, Tombstone, Arizona 85638

Volunteer Coordinators
Eastern U.S.
Charles & Marcelle Weber
1172 West Lake Ave.
Guilford, CT 06437

Advertising Information
All advertising in the Mineralogical Record must be paid in advance of the closing date. Telephone orders not accepted. Write to the editor for rates.

Closing dates:
Jan.-Feb. issue . . . . . . Oct. 15
March-April issue . . . Dec. 15
May-June issue . . . . Feb. 15
July-Aug. issue . . . . . April 15
Sept.-Oct. issue . . . . June 15
Nov.-Dec. issue . . . . Aug. 15

An additional 20 days past the closing date are allowed in which advertisers may make changes (excluding size changes) in ads already paid for.

Design
Wendell E. Wilson

Graphic Production
Capitol Communications
Crofton, MD

Printing
Cadmus Journal Services,
Easton, MD

Color Separations
Hollis Phototechnics
Tucson, AZ

Circulation
P.O. Box 35565
Tucson, AZ 85740
520-297-6709

Editing, advertising
4631 Paseo Tubutama
Tucson, AZ 85750
520-299-5274

Foreign Payments
Remittance may be made in local currency, at *prevailing exchange rates,* without surcharge, to the following people:

Belgium
Paul Van Hee
Marialei 43
B-2900 Schoten

Great Britain
Paul Lowe
"Endsleigh"
50 Daniell Road
Truro, Cornwall TR1 2DA

Italy
Renato & Adriana Pagano
P.O. Box 37
I-20092 Cinisello Balsamo MI

Japan
Bon Earth Sciences
Tsukasa Kikuchi
Nagata Bldg. 201
19-10 Kitaotsuka 2-chome
Toshima, Tokyo 170

Netherlands
W. J. R. Kwak
Kabeljauwallee 23
6865 BL Doorwerth (Gld)

Norway & Sweden
Geir Wiik
N-2740 Roa
Norway

South Africa
Horst Windisch
30 Van Wouw Street
Groenkloof, Pretoria

Germany
Christian Weise Verlag
Oberanger 6
D-80331 München 2

Affiliated with the Friends of Mineralogy, an independent, non-profit organization devoted to furthering amateur and professional interests in mineralogy. For membership information contact Roland Bounds, Treasurer
315 Stamford Drive,
Newark, DE 19711-2723

Opinions expressed are those of the authors and do not necessarily reflect those of the Mineralogical Record Inc., its editorial staff or directors.

Searching the world . . .

. . . to bring you the finest in mineral specimens and meteorites at competitive prices.

- *Fine Display-Quality Mineral Specimens, Rare Species, and Fluorescent Minerals:*
  Send for our lists of thumbnail, miniature, and cabinet specimens. First quality mineral specimens for collection and display, plus rare species for systematic collection, reference, and research. Fluorescent minerals are available for display and systematic collections.
- *Micromount and Specimen Boxes of All Kinds:*
  Separate listings are available detailing prices and sizes of micromount, plastic magnifier boxes, white cotton-lined specimen boxes, display stands, gem display boxes, paleomagnetic sampling cubes, showcase boxes, white folding boxes, display bases, etc.
- *Meteorites, Tektites, Moldavites, Fulgurites, and Trinitite:*
  Specimens of all sizes for private collections and institutional display, from worldwide localities. New and used books also available.
- *Mineralogical Books:*
  Send for our separate price list with information covering new books on mineralogical subjects, as well as older, out of print mineralogical and geology books.
- *Back Issues of the Mineralogical Record:*
  Ask for our listing of out-of-print issues currently in stock. Send us your want list, if you need back issues to complete your set. Send us your offers, if you have back issues available for sale.
- *Worldwide Mail Order Service:*
  For more than 35 years, since 1959, we have been supplying Minerals, Meteorites, Books, Boxes, and back issues of the Mineralogical Record to collectors around the world. Orders can be placed by mail, phone, FAX, or e-mail—addresses are given below.
- *Price Lists:*
  Send a very large SASE for price lists on any of the above subjects. Non-USA, send two International Reply Coupons. OR . . . . . Check out our new web site on the internet to see price lists and color photographs: http://www.minresco.com

Mineralogical Research Co.

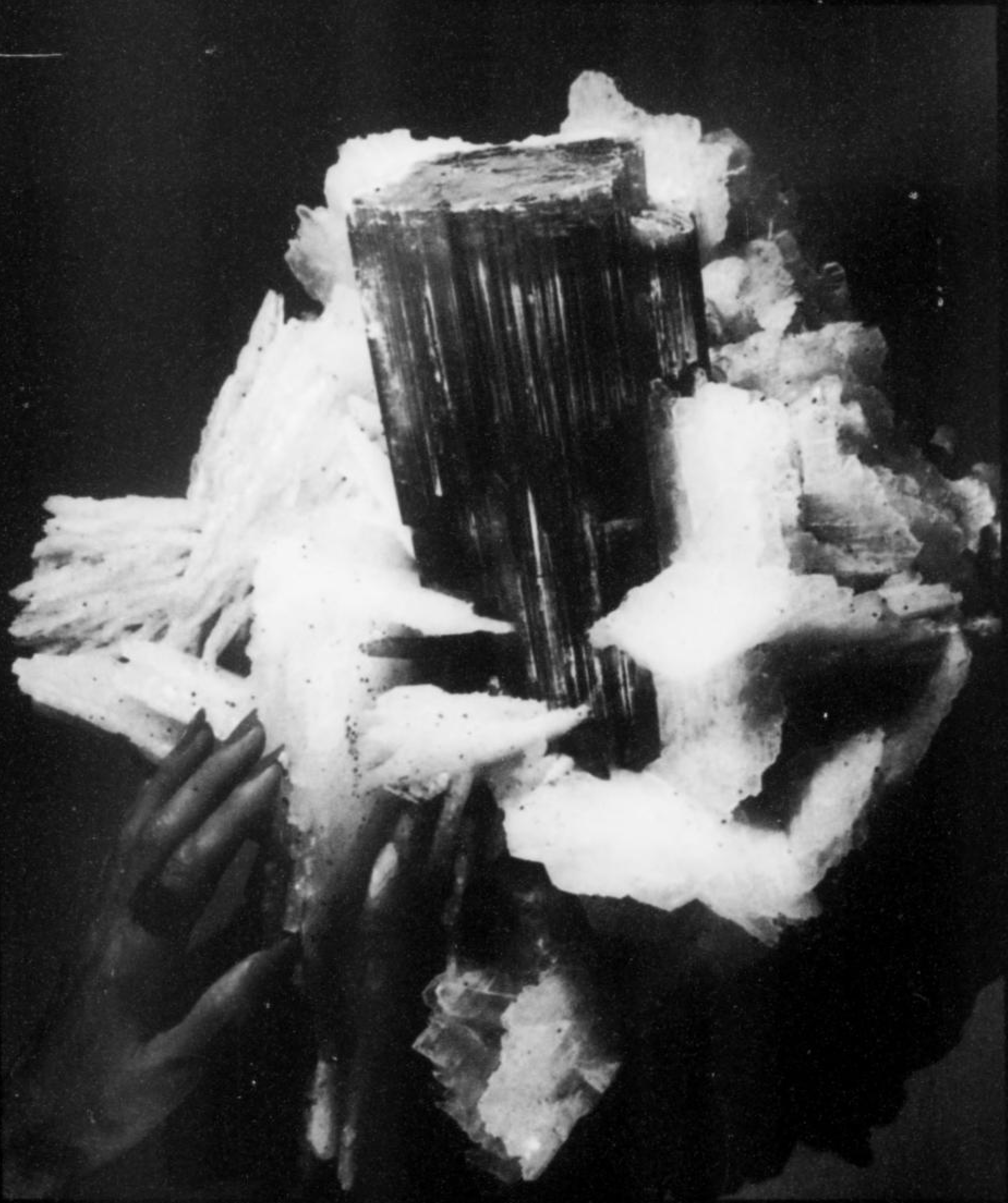
Eugene & Sharon Cisneros
15840 East Alta Vista Way, San Jose, California 95127-1737, USA
e-mail: xtls@minresco.com • PHONE: 408-923-6800 • FAX: 408-926-6015
Look for our booth at major Western U.S. Shows
A Division of the Nazca Corporation

http://www.minresco.com
WE'RE ON THE INTERNET!
CHECK OUT OUR
WEB SITE!

Advertisers Index

ONE OF THE WORLD'S PREMIER CRYSTAL COLLECTIONS

FOR SALE By Keith and Mauna Proctor! All specimens to be sold individually



* Order your 96-minute Video! Professionally produced video documentary program on worldwide localities and minerals from the Proctor Collection $32 ppd.

You can preview this collection with a 96-minute, professionally prepared video. This live-action presentation features 180 specimens, individually filmed, and 35 mine location photos to illustrate the history and workings of many great mines and their crystal treasures. This unique, educational video graphically illustrates the 12 criteria used to assemble this world-class collection. To order your video send $29.50 plus $2.50 postage.

Dr. Wendell Wilson in his video review in *M.R.*, Nov/Dec 1992, p. 504, says "The collector of aesthetic mineral specimens will find much to savor in Keith Proctor's video catalog of his collection. . . . It really delivers in terms of extraordinary mineral images and specimen information and will stand for many years to come as a historically valuable documentation of one of the great private collections of our time."

"The video offers an opportunity to see and study Proctor's exquisite specimens at leisure. Many are pictured on slowly revolving turntables, allowing all sides of the specimens to be seen, and their three-dimensional shapes to be fully realized, as reflections play across crystal faces and gemmy interiors . . . this really is one of the best private collections ever assembled." Video Review: Nov/Dec '92

KEITH PROCTOR

Contact Brook Proctor at 801-501-0995

Address: 663 E. 13800 S., Draper, UT 84020

Photo by Harold & Erica Van Pelt