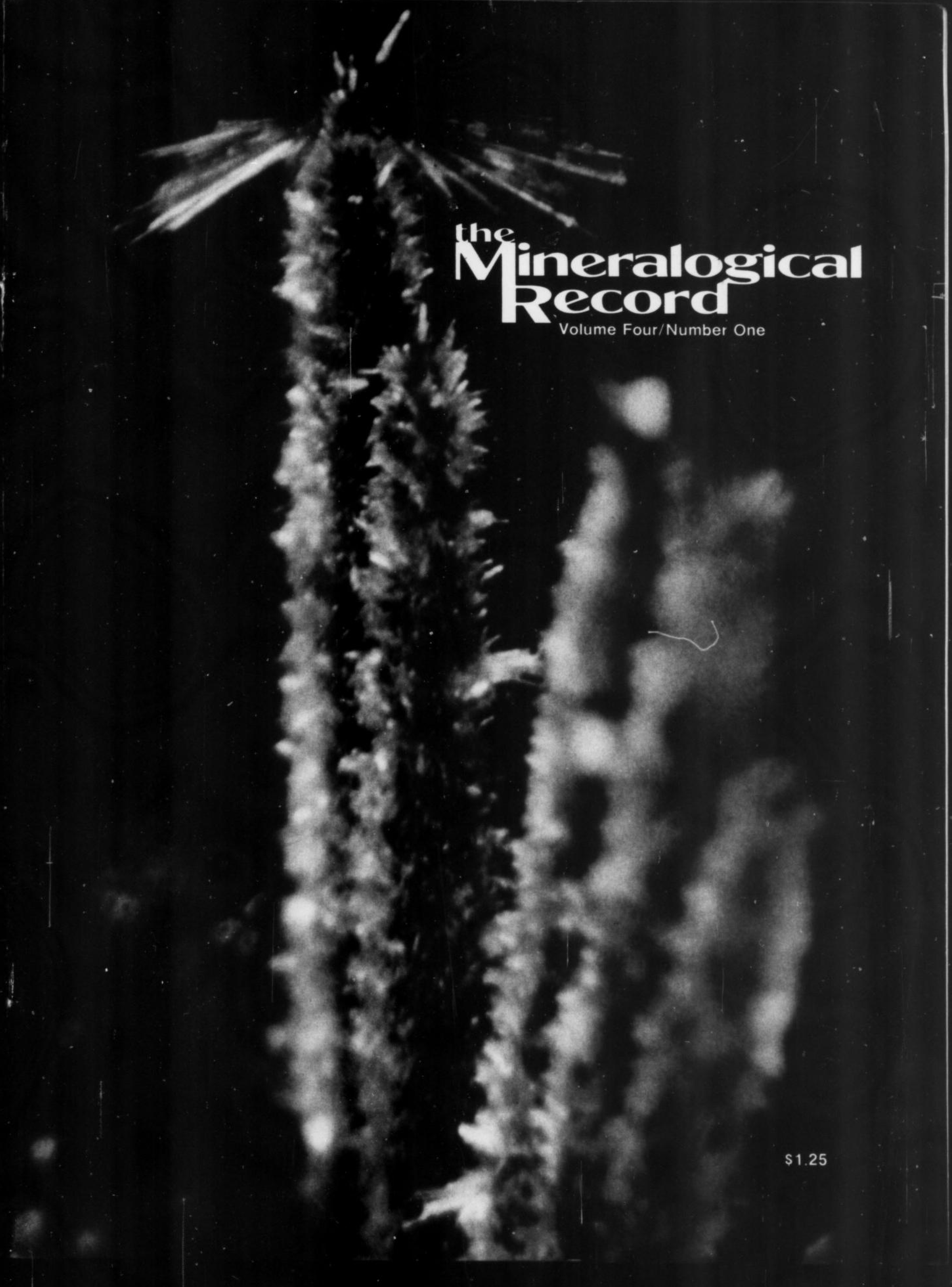

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John S. White, Jr.
Division of Mineralogy
The Smithsonian Institution

circulation manager
Mary Lynn White

design & composition
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address
the Mineralogical Record
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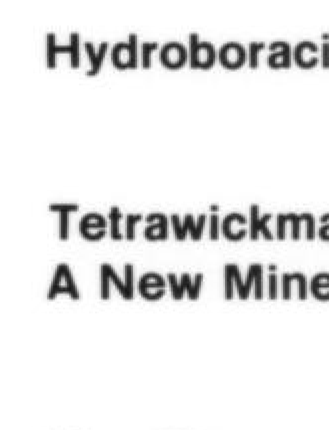

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Editorial

Comments on the Start of a New Volume

COMMUNICATIONS

Some messages, we find, are very difficult to transmit to many of our readers. This, in spite of numerous attempts in many forms, from bold notices to statements in the Editorial section to answers following letters published in the *Record*. We have repeatedly emphasized, for example, that the magazine is running slightly more than two months behind the date printed on the issue. This is because we fell into this schedule from the beginning. We are picking up time, however, as the last issue of Volume III was mailed on January 12, 1973 while the last issue of Volume II wasn't mailed until February 16, 1972, a gain of more than a month in one year. So we ask your indulgence, we are doing all we can to hurry the publication dates. The apparent delay is particularly worrisome to overseas subscribers, many of whom feel that it takes four months for the *Record* to reach them.

Another communications problem is our failure to make many readers understand that we do not bill for subscription renewals right away, in the hope that most of our loyal readers will send in their checks automatically upon receipt of the last issue of a volume. By doing so you permit us to minimize the major expense of billing. Why, you may ask, should we not expect to have to perform this odious task since other journals must do it. The reason is that the *Mineralogical Record* is still not self-supporting and any saving is important. We must find donors to provide the extra funds to keep us afloat. We are not always sure that we will find this support, without which we would be forced to cease publication.

So please note: MOST renewals are now due!

COLOR IN THE LAST ISSUE

We hasten to point out, in view of the above, that the introduction of color within the magazine was not a frivolous extravagance. That special feature was made possible through a very generous donation by a mineral collector, Randolph S. Rothschild of Baltimore, Maryland. The donation was *earmarked* specifically for the purpose of getting color photographs into one issue. We don't know at this time how long it will be before we will be able to offer interior color again.

REPRINTS

When each issue is printed we have a small number (about 25) of copies of each page (printed on one side only) run off as well. This means we can offer every author a limited number of separates (reprints) of his article at no extra cost. Special reprint orders, however, must be placed when the article is accepted for publication and we expect the authors to pay our costs for getting them printed. Ordinarily these will be saddle-stitched (stapled) in booklet form, unless the article is but a few pages or less in length.

BACK ISSUES

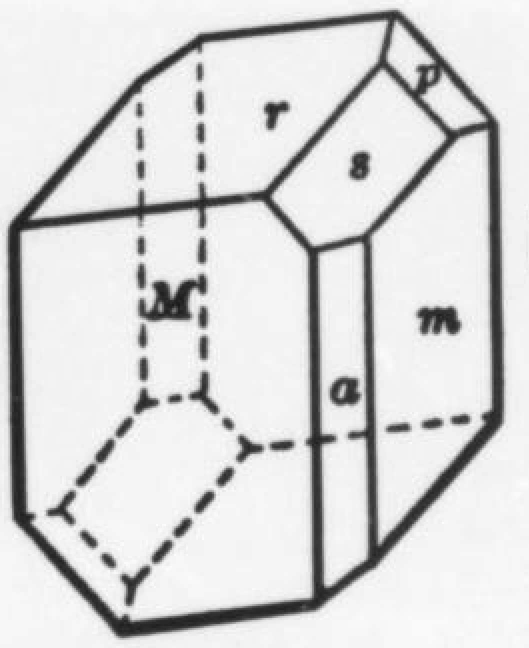
All of the early issues are still available for any readers who would like to take advantage of this opportunity to obtain complete sets of the *Record*. How long the reserve of back issues will last we cannot say. Approximately 80% of our new subscribers are buying back to the first issue. The cost is $6.00 per volume at the domestic rate, $7.00 for overseas subscribers.

FOREIGN PAYMENTS

To simplify the problem foreign subscribers have of writing checks for U. S. dollars, we now have agents in England and in Canada who will accept payments for both subscriptions and *Glossaries* (also donations!). Checks should still be written to the *Mineralogical Record*, but *in care of* the appropriate agent. See the notice in this issue which gives the names and addresses of our English and Canadian volunteer helpers. In time we hope to increase the number of countries so represented.

John S. White, Jr.

CRYSTAL SHOWCASE



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QUALITY MINERALS BY MAIL

Paul Otto proudly announces the opening of CRYSTAL SHOWCASE. CRYSTAL SHOWCASE will offer crystal specimens and rare species by mail for intermediate and advanced collectors. Plans call for full page ads in the Mineralogical Record **and bi-monthly lists. Anyone interested can be on the mailing list simply by writing. Price list no. 1 will be ready soon. Your want lists are invited and, of course, satisfaction is guaranteed.**

16. **MELANITE.** (andradite garnet). San Benito Co., Calif. Sharp, lustrous xls to 1/8" cover a 2-1/4 x 3-1/2" matrix. **$15.00.**

17. **STILBITE.** Helgusadir, Reydarfjord, East Iceland, 1/4" stilbite xls cover one side of a 2-1/2 x 3-1/2" calcite xl. **$20.00.**

18. **SELENITE.** (gypsum). Grosseto Dist., Tuscany, Italy. Terminated, transparent xl perched on aragonite 2 x 2-1/2". **$12.00.**

23. **HEMATITE.** St. Gotthard, Switz. Many 1/8" roses on and included in a cluster of quartz xls. 1-1/2 x 2". **$35.00.**

74. **SODDYITE.** Kasolo, Belgian Congo. nice near micro xls of this rare uranium mineral cover a 1-1/2 x 2" matrix. **$20.00.**

96. **QUARTZ.** Owpumin, Awomri, Japan. A group of sceptered milky quartz xls sprinkled with pyrite cubes. 2-1/2 x 2-1/2". **$17.00.**

112. **LEUCITE.** Civita Castellana, Rome, Italy. A group of xls the largest being almost 1-1/2". Shows good xl structure. 1-1/2 x 1-3/4" **$6.00.**

118. **SERANDITE.** Mt. St. Hilaire, Que. A terminated pink serandite xl about 1-1/2" standing up out of a group of analcime xls. 1-1/2 x 2-1/2". **$35.00.**

138. **EMERALD** (Beryl). Muso, Colombia. A riker mount with five unterminated xls of good color. xls about 1/16 x 1/4". Lot **$7.00.**

139. **THORIANITE.** Betroka, Madagascar. A nice single xl about 1/4" in size. **$7.50.**

174. **WITHERITE.** Cave-in-Rock, Ill., Hardin Co. A fine 1" xl standing on matrix. 1 x 1-1/4". **$6.00.**

200. **STIBICONITE** ps after stibnite. Altar, Sonora, Mexico. A single terminated xl with good sharp faces. 1/2 x 5-1/2". **$20.00.**

222. **CALCITE** ps after glauberite. Camp Verde, Ariz. A nice sharp single xl. 1-1/2 x 1-1/2". **$6.00.**

230. **MICROLITE.** Gelotte Quarry, Haddam Neck, Conn. A single sharp 1/8" octrahedron on a pegmatite matrix. 1 x 2". **$10.00.**

261. **REALGAR.** King Co., Washington. Matrix covered with sharp bright red xls up to 1/8". 1 x 1-1/2". **$8.00.**

282. **PHACOLITE** (Chabazite) Gadds Hill, Tasmania, Aust. White near 1/4" xls covering matrix. 1-3/4 x 2". **$6.00.**

298. **GALENA.** Galena, Kansas. Two 1-1/4" xls that display well on a matrix of sphalerite xls. 2-1/2 x 3". **$15.00.**

302. **BISMUTH,** Kingsgate, N.S.W., Aust. A very rich specimen of massive xline bismuth. 1 x 2" (old Wilke label). **$17.50.**

337. **SIDERITE.** Old Sterling Mine, Antwerp, N.Y. Sharp near micro xls cover one surface of this 1-1/4 x 2-1/4" specimen. **$3.00.**

394. **AUGITE.** Otter Lake, Que. With a largest xl of 1 x 3" this xl group is a nice specimen of this species. 3 x 3-1/2". **$15.00.**

423. **AQUAMARINE** (Beryl). Minas Gerais, Brazil. A single xl of good color. Milky at the base and clear at the sharp termination. 3/8" x 2-1/2". **$25.00.**

413. **APOPHYLLITE.** Poona, India. A fine 1" xl is the main part of this group of xls. 1-1/2 x 2-1/2". **$15.00.**

463. **EPIDOTE.** Green Monster Mine. Prince of Wales Is., Alaska. One small bruise shows when you display this verynice 1-1/4 x 1-1/2" single xl of epidote. **$20.00.**

490. **DESCLOIZITE.** Berg Aukus, S.W. Africa. Unusually sharp 3/8" xls cover this 2 x 3" specimen. **$25.00.**

506. **WOLFRAMITE.** Panasqueira, Portugal. Two sharp terminated xls with zinnwaldite and an apatite xl at their base. 1-1/2 x 2". **$60.00.**

534. **QUARTZ.** Lassellsville, N.Y. This is a fine thumbnail 'Herkimer Diamond' A perfect little 3/8" xl stands up on a drusy quartz matrix. 3/4". **$5.00.**

551. **STILBITE.** Green Peter Dam, Linn Co., Ore. A cluster of very sharp stilbites up to 5/8". 1-1/4 x 1-1/2". **$6.00.**

555. **ARAGONITE.** Minglailla, Cuenca, Spain. A sharp lustrous pseudo hexagonal twin. 1-1/4 x 1-1/4". **$4.00.**

903. **FLUOR–RICHTERITE.** Wilberforce, Ont. A sharp terminated xl in a calcite matrix 2 x 2". This is a newly named amphibole. **$10.00.**

Add 10% to cover postage and insurance.

THE COLLECTOR

by Richard A. Bideaux

Azurite, $Cu_3(OH)_2(CO_3)_2$, must be considered a cornerstone mineral of any collection. Sky-blue when finely divided, crystals range from azure-blue to an inky blue-black. It is reasonably available to collectors in a wide variety of habits, from drusy through nodular to extremely sharp and brilliant single crystals.

A secondary mineral of the oxidized zone of mineral deposits, especially in arid regions, it is formed by the reaction of carbonated waters with earlier sulfides, generally chalcocite or chalcopyrite. Water containing dissolved atmospheric carbon dioxide will suffice in time, accounting for azurite's world-wide distribution, but the richest deposits are found enclosed in or adjacent to limestones, which can supply a higher carbonate content. Matrix material is usually a limonitic gossan left after dissolution of pyrite and copper sulfides, or occasionally kaolin or quartz.

This discussion will be limited for the most part to the major localities which have produced uncorroded crystalline masses or crystals at least an inch in size, in sufficient quantity that many collectors might expect to acquire good examples.

Any such must start with the premier specimens from Chessy, France. This now exhausted deposit, known since antiquity but with peak production in the 1800's, has recently been described, with specimens illustrated, in the article by M. Santoni in the *Record* (**2**, 2, 1971, 69-72). Little can be added here, other than that the locality apparently produced mostly crystalline balls (chessylite *per se*), with pieces showing individual crystals in the minority. In exceptional examples, aggregated crystals can show a symmetrical rose-like arrangement. At their best, these Chessy "roses" are the finest examples of this unique habit from any locality. Few collectors are able to possess outstanding Chessy specimens, most having gravitated to museums in the interim.

Azurites of lesser quality have long been known from various European localities. Those from the millenia-old mines of Laurium, Greece, generally druses with variously colored smithsonites, are occasionally notable. Russian specimens, especially those from Solotuschinsk, Altai, are pure fist-sized masses but with indistinct crystals. These were mined prior to 1850, so are obviously rarely available today.

The immensely rich copper carbonate orebodies of the Copper Queen mine at Bisbee, Arizona, were discovered in 1880. The first body, enclosed in limestone, was about 60 feet in diameter and 400 feet deep, and produced 20 million pounds of copper entirely from copper carbonate ores before it was worked out in 1884. Other carbonate bodies, even larger and richer, were found on extension of the Copper Queen workings, but by 1910-1920 carbonate ores were in the minority. With well over a billion dollars of copper to their credit, both open pit and underground mines are still working at this writing, but will probably close in a few years. A trickle of azurite has continued to come from the upper stopes and, as the Lavender pit has encroached on the old Copper Queen area, but quality has fallen far below earlier standards.

F. L. Ransome (*USGS Prof. Paper* 21, 1904, 168 pp) states: "In the older workings of the Copper Queen mine (malachite) was abundant, occurring in large and beautiful masses with azurite and calcite in limestone caverns. The walls of these caves were covered with velvety moss-green malachite, and sparkled with the blue crystals of azurite, while from the roofs hung translucent stalactitic draperies of calcite, delicately banded and tinted with the salts of copper." These caverns were large enough that a dance floor was constructed, and entire high school graduating class parties were accommodated, according to newspaper reports of the time.

The types of azurite from Bisbee encompass a full range. Cerulean crusts and sparkling druses lined geode-like

Fig. 1. **Rosette of crystals 6 cm. across, from Chessy, France.**

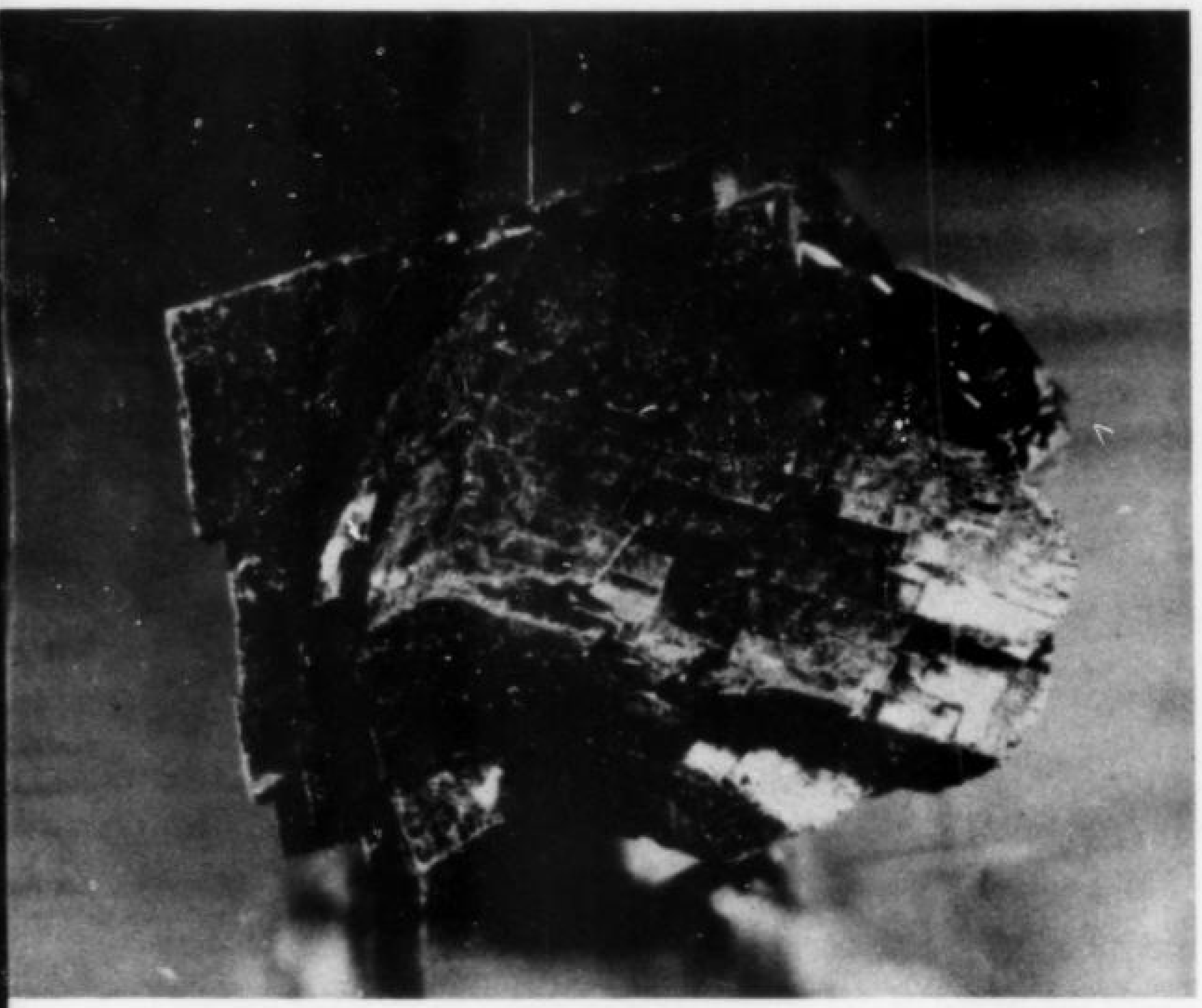

Fig. 2. **Two large crystals from Bisbee, Arizona. The group is 7 cm. across.**

Fig. 3. **2.5 cm. crystal from Bisbee, Arizona.**

cavities in limonite, while botryoidal masses of crystals to 1/8 inch, perhaps lightly sprinkled with tiny malachite pseudomorphs after cuprite, entirely incrusted matrix. Somewhat less commonly, isolated, sharply-terminated crystals of greater size occurred. With lozenge, axe- and sword-like shapes, these crystals reached as much as three inches in length, and were often complexly modified, as perfect as if faceted. Beautiful rosettes of crystals, usually extremely brilliant, were found completely formed in clay seams. Some of these nodules the size of footballs were in use in many miner's homes as doorstops. Very fine examples of malachite pseudomorphs after azurite were also found.

Although Arizona Territory was remote in the early 1900's, specimens like these brought periodic visits from such mineral dealers as Dr. A. E. Foote of Philadelphia, so many finally reached collector's hands.

Early work around 1900 in the great orebody at Morenci, and at some small mines in the Courtland-Gleeson District, both in Arizona, also provided a quantity of azurite comparable to the average from Bisbee; in fact most are probably labelled as from Bisbee, and cannot be distinguished with certainty.

Late in the life of the Mammoth mine at Tiger, around 1940-1950, a few small but choice azurites were found. The finest were blue-black prisms to two inches, in striking contrast to the always associated twinned or reticulated snow-white cerussite. In the early 1950's, the open pit at Ajo, Arizona supplied a number of fine groups of azurite crystals with a distinctive rhombohedral, pseudocubic habit.

Sharp pseudomorphs of chrysocolla, of equant habit and over an inch in size, from near Inspiration, and of bladed habit, sometimes incrusted with drusy quartz, from the Inspiration pit itself; also stellate groups from Bagdad, some with four inch crystals, show that azurites of large size once occurred in these Arizona deposits as well.

Other U. S. localities outside of Arizona which have produced specimens of note are few. Small but brilliant crystals on clay or limonite from the Kelly and Graphic mines near Magdalena, New Mexico, and the hollow incrustation pseudomorphs of azurite after gypsum crystals from the Apex mine, near St. George, Utah, bear mention.

Australia had a number of excellent localities, the most prominent by far being the Proprietary mine at Broken Hill, New South Wales. An early account speaks of an entire stope-sized volume filled by a mass of reticulated cerussite, with azurite crystals perched in the open interstices. One three-inch crystal preserved in the Australian National Museum has a cerussite sixling attached to the termination. Occasionally old specimens, usually drusy, will be seen from Cobar or Moonta. The mines at Cobar have been reopened and crystals over an inch in size reported as collected recently.

The finest crystallized azurites ever found have come from the amazing deposit at Tsumeb, South West Africa. Major mining operations started in 1907 on ores about one-half oxidized for the top 1000 feet. Leached caverns contained remarkable bladed crystals, some over a foot long, and up to six inches in width. As at Bisbee, a wealth of crystal habits were found; these have been described by C. Palache and L. Lewis (*Am. Miner.,* **12,** 4, 1927, 99-143). This crystallographic monograph was primarily based on "a suite of minerals secured at the Tsumeb mine in 1922 ... over 1500 specimens containing crystallized azurite ..." Most of these earlier crystals are partially altered to malachite, with spectacular sunbursts radiating from one or more centers.

Specimens from this era, while plentiful, are scattered all over the world, and are generally well appreciated in

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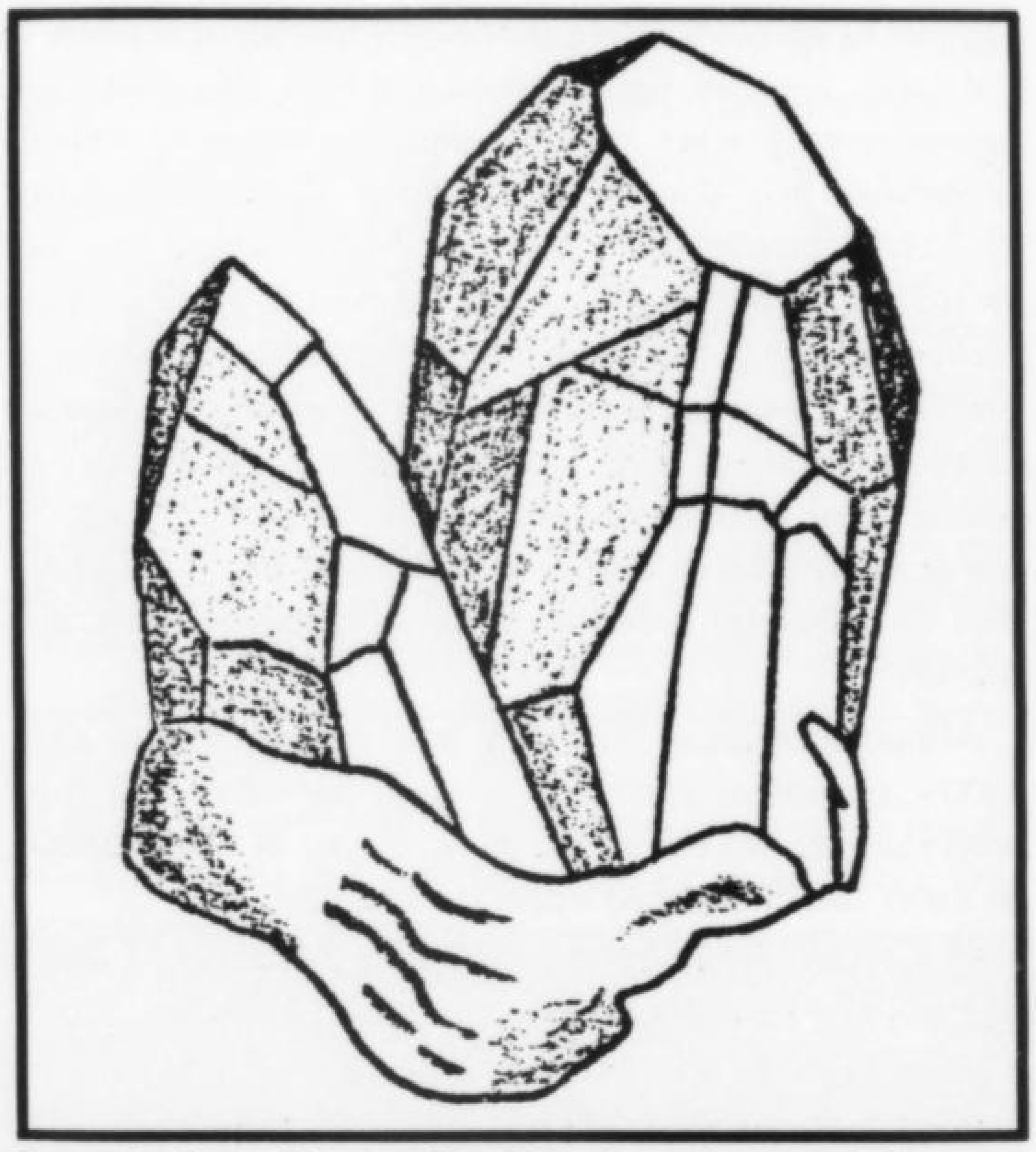
The Museum Record

by Paul E. Desautels

In 1964 Dr. Claude Guillemin, then curator of the excellent mineral collection at the Ecole de Mines on Boulevard St. Michel in Paris, decided to write a book of his impressions of the world's mineral collections. The book *En Visitant Les Grandes Collections Minéralogiques Mondialtes* (in French), published by the Bureau de Recherches Geologiques et Minieres, never got wide circulation. However, curators or owners of collections listed in it did receive copies. Fortunately, Dr. Guillemin was well qualified to do the job he set for himself. He is a man who knows exactly what a good specimen is and what a mineral collection is all about. Unfortunately the fraternity of curators has lost him because he has gone on to bigger and better things — chief of the B.R.G.M. itself.

By his own admission the book lists only those collections he visited personally between the years 1953 and 1964 and is a compendium of only those specimens he actually saw and personally appreciated. It makes delightful reading even though it consists almost entirely of annotated lists with some excellent line drawings of specimens. I've looked carefully over his listing for the Smithsonian and am delighted to see many of my own favorites included. At the same time I am struck with the number of superb things he missed and the quantity of fine things we have added since 1964.

Aside from the fact that I always find it interesting to get an outside authoritative opinion of the collection, I've always felt that there is a need for such compendia for all of us. The greatest value accrues to those who visit exhibits of minerals and want to know which specimens are considered most important by those with considerable specimen experience. Uncensored opinions by two or three people about what not to miss in the Smithsonian collection could be highly educational and lots of fun checking against your own opinions. The listings could also be a valuable guide to very important specimens which are not on public display. For a curator, the listings could act as a sort of register of his most important holdings. Also, as competent as they may be, curators do have tendencies to become quite provincial about their collections. Outside opinions can help to restore perspectives. Of course, allowances are necessary for the personal tastes and bias of those making the lists. You've all undoubtedly had the experience of visiting a private collector and been treated to a dissertation on how this particular specimen of his is far better than the one in the Harvard Museum — an obvious untruth if you had happened to see it yourself. I distinctly remember getting a comment second hand from a prominent mineralogist, with malice intended, that the Smithsonian was busy assembling a collection of mineralogical freaks because so many of the new specimens were so fine and unique — unlike the bulk of mined specimens. Well, perhaps "freaks" but that's the name of the game. Bias or not, out of a published group of opinions would emerge a pretty good picture of what is special in each collection.



Proustite from Chanarcillo, Chile from the British Museum collection as sketched in natural size *by Dr. Guillemin.*

Getting back to Dr. Guillemin's publication, his preamble expresses his feelings which I give here with apologies for any errors of translation from the French. "This is not a catalog, still less a guide, for the part played by personal appreciation is too great. These are only notes, designed to attract the attention of the amateur to the best specimens of mineral collections I have been able to visit from 1953 to 1964. Their principal weakness — aside from inevitable errors of judgement — lies in the spread of these visits over more than ten years, causing an unfortunate lack of simultaneity in appreciation, and uncertain com-

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QUARTZ, QUARTZ, QUARTZ QUARTZ, QUARTZ, QUARTZ QUARTZ, QUARTZ, QUARTZ

A Temporary Exhibition at the Royal Ontario Museum • Toronto, Ontario

by R. I. Gait

Associate Curator of Mineralogy • Royal Ontario Museum, Toronto

The Royal Ontario Museum is celebrating its Diamond Jubilee with several exhibitions, lecture series and other functions in 1972. This article describes one of these shows called "QUARTZ QUARTZ QUARTZ" which was exhibited during May and part of June.

The purpose of the exhibition was to use many specimens of one mineral to illustrate the complexity of a single species. All except two of the specimens used in the show were taken from the reference collection and not from existing displays. Quartz was chosen as a basis for the show since specimens are readily available, and the crystals exhibit many complex forms and colourful varieties. The scope of the exhibit was limited to euhedral quartz crystals and the fine-grained varieties were not shown.

The exhibit was designed primarily to be educational and to tell the public something of the crystallography of quartz. Some general views of the exhibit are shown in Figs. 1 and 2. The centre-piece is a three-foot quartz crystal from the Malagasy Republic, above which hangs a large model of the crystal structure. The centre wall (Fig. 3) contains six large and seven small portholes occupying the channels in a graphic design representing the *c*-axis projection of the crystal structure of quartz. The specimens of quartz exhibited in the portholes are attractive examples of single crystals and crystal groups.

The remainder of the exhibition consisted of eight wall cases, each three feet high, two feet wide and about six inches deep, in which specimens were used to illus-

Fig. 1. **A general view of the quartz exhibit.**

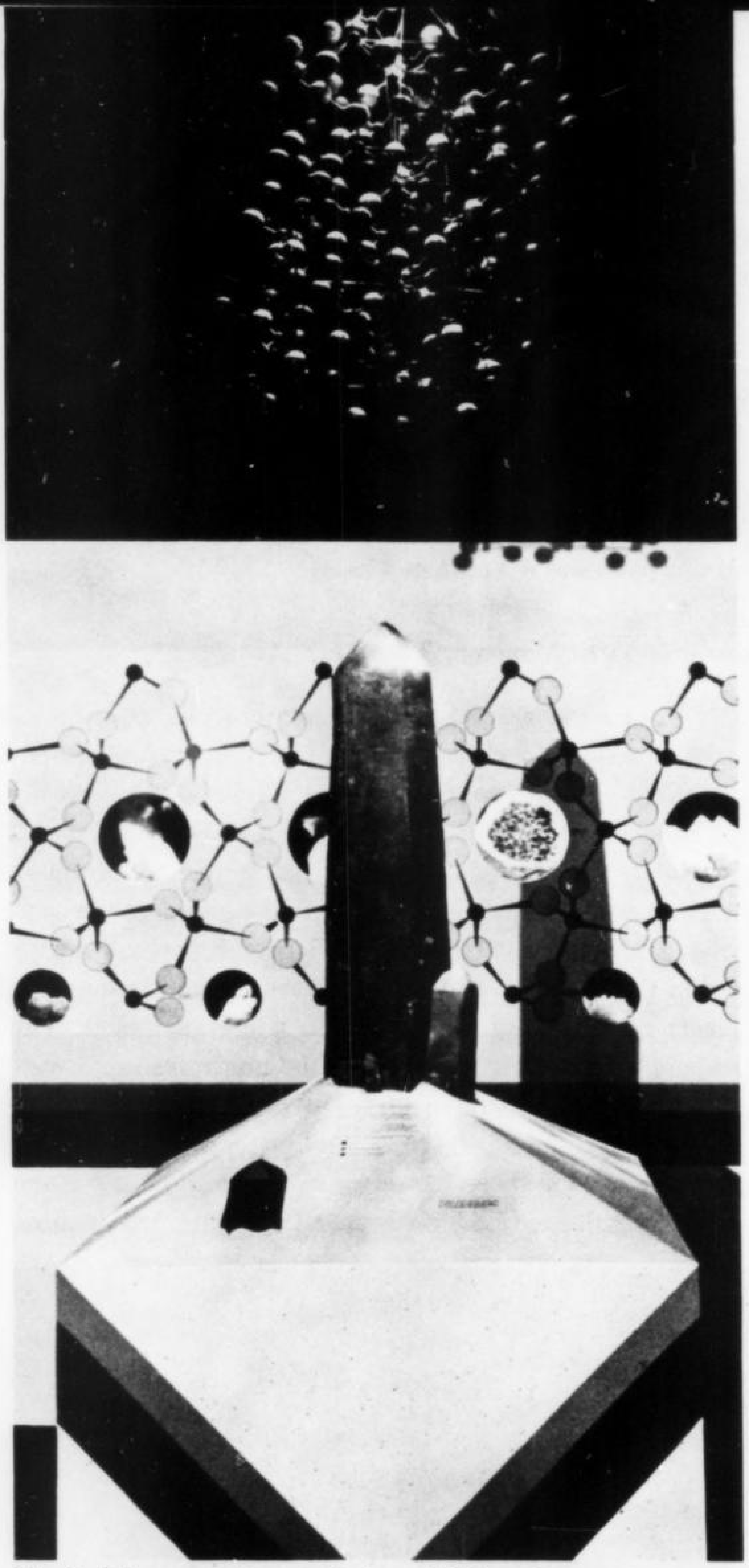

Fig. 2. **The central part of the exhibit, a large quartz crystal from the Malagasy Republic. The model above it represents the crystal structure of quartz.**

trate the crystal forms of quartz (3 cases), crystal oddities (1 case), inclusions (1 case), and varieties (3 cases). About sixty specimens were used for the exhibit.

The introduction to the show described the crystal structure of quartz and reference was made to the large graphic of the *c*-axis projection (Fig. 3). The crystal structure may be described as a three-dimensional network of silicon-oxygen tetrahedra. Every silicon atom is surrounded by four oxygen atoms as shown in Fig. 4. The oxygen atoms are about three times as large as the silicon atoms and so the small silicons fit snugly inside the tetrahedron made by the four touching oxygen atoms. In the crystal structure of quartz every corner of every $Si\text{-}O_4$ tetrahedron is shared with another $Si\text{-}O_4$ tetrahedron; thus a three-dimensional network is developed. Because of this arrangement there are twice as many oxygen atoms as there are silicon atoms and so the chemical formula of quartz is SiO_2. However, the arrangement of tetrahedra is not random as they are arranged in a regular repetitive manner which conforms to the true symmetry of quartz. Of course, it is the symmetry of the arrangement of atoms which gives rise to the symmetry of the crystals. If we look at Figure 3, which is a view of the structure seen along the *c*-axis, we can see two different kinds of rings. The large rings (corresponding to the large portholes) are surrounded by six silicon atoms (black) in perfect 6-fold symmetry; however, the larger oxygen atoms (grey) appear as pairs which repeat only three times. The true symmetry of quartz, therefore, is 3-fold along the *c*-axis. The small rings, in between the large ones, also have 3-fold symmetry. The projection along the *c*-axis in Fig. 3 is only two-dimensional and we must look at the three-dimensional model to appreciate the structure. The apparent "rings" in the projection actually are channels running parallel to the *c*-axis. In each channel the $Si\text{-}O_4$ tetrahedra are arranged spirally, the axis of the spiral being at the centre of each channel. These spirals surround both the large and the small channels in the structure, the whole of which may be described as consisting of linked spiral chains running parallel to the

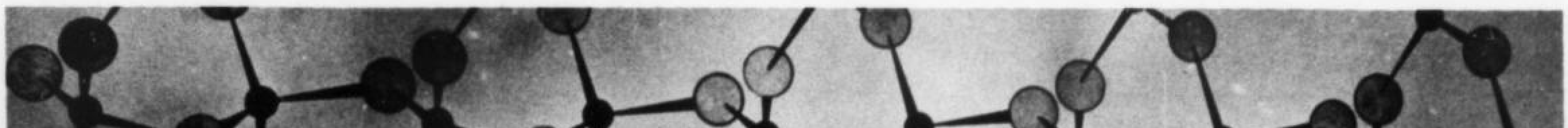

Fig. 3. **The *c*-axis projection of the crystal structure of quartz with specimens in the portholes.**

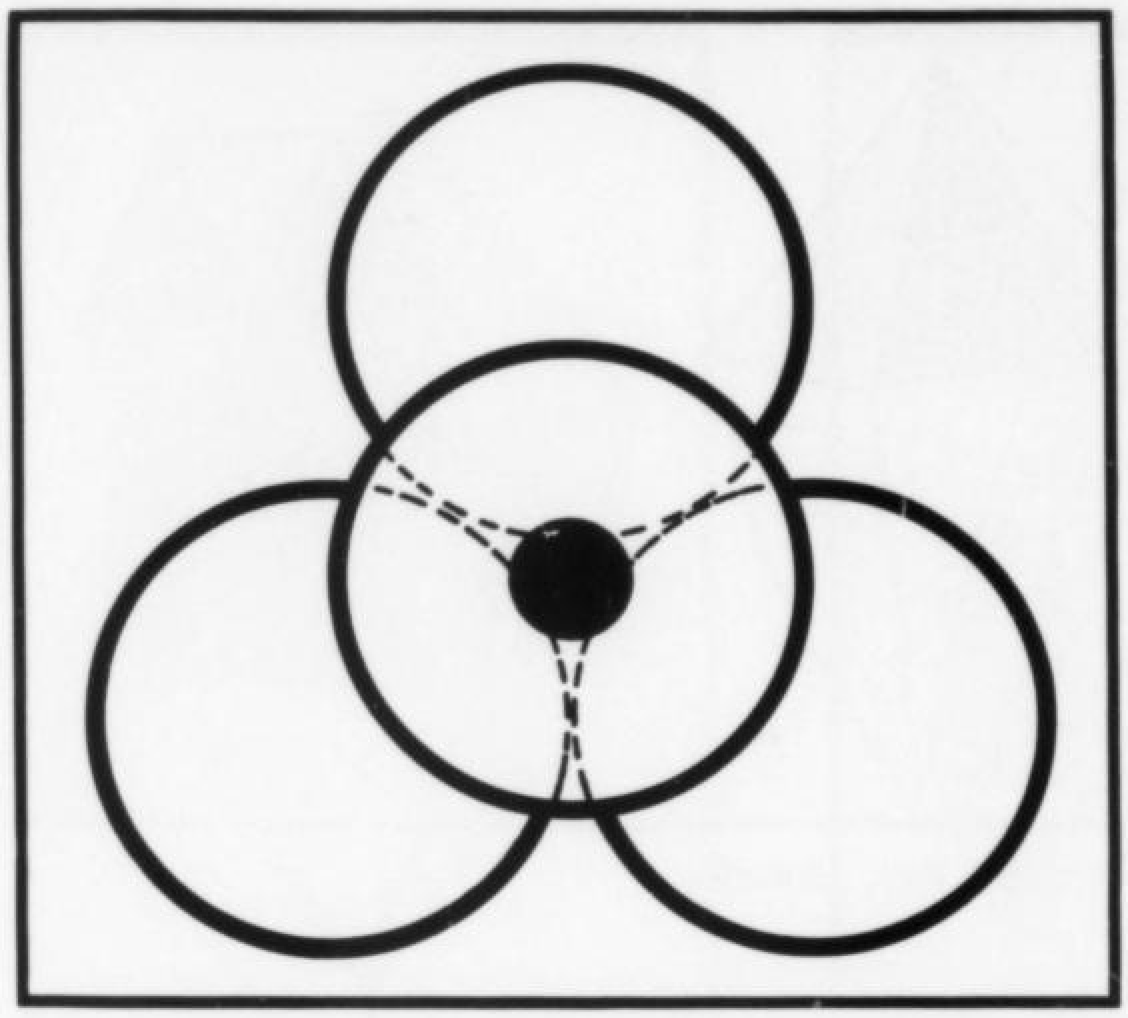

Fig. 4. (a) **The silicon-oxygen tetrahedron - all the atoms touch each other.**

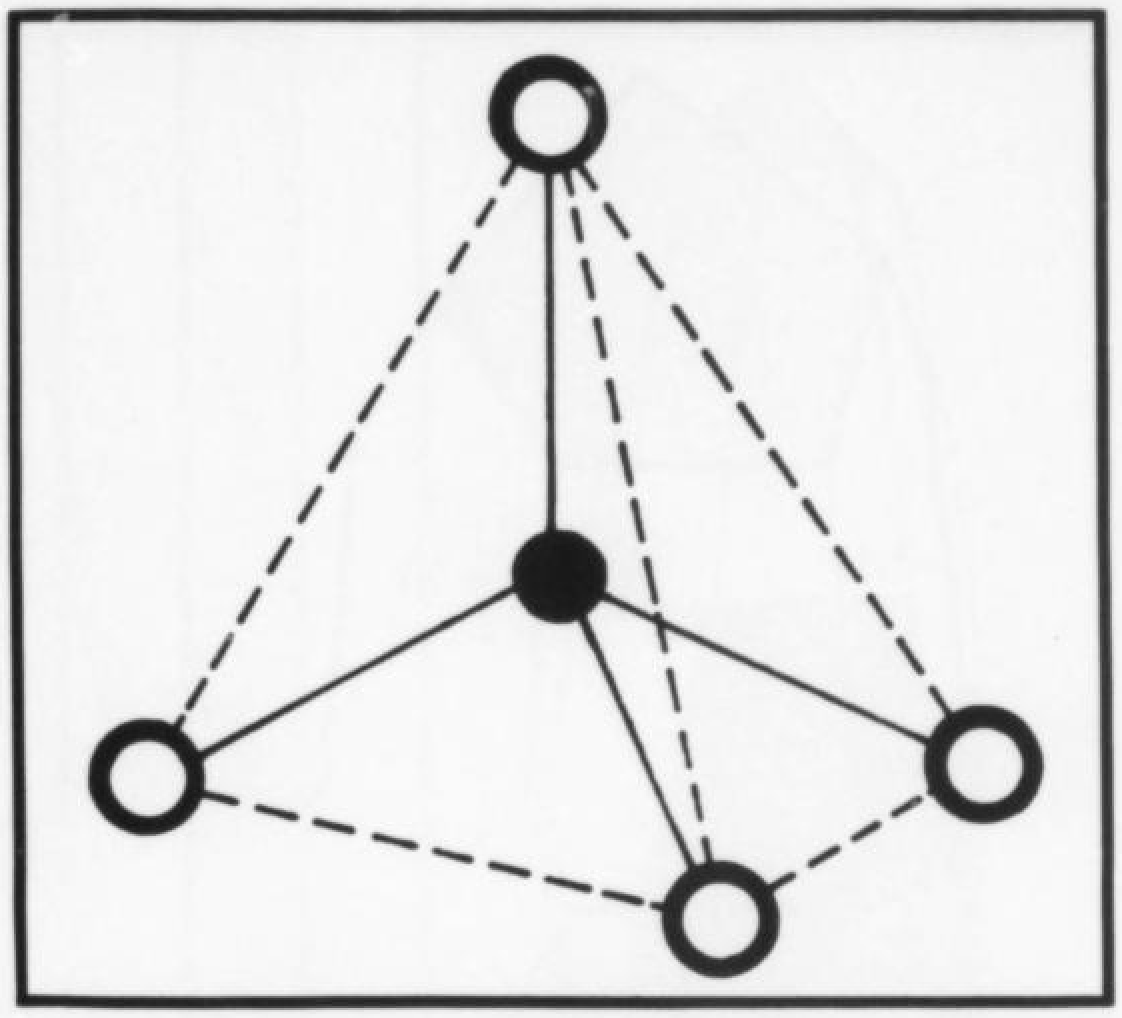

Fig. 4. (b) **The silicon-oxygen tetrahedron - an expanded view.**

c-axis. Either right-handed or left-handed spirals are possible in the crystal structure of quartz and this feature explains why some quartz crystals are left-handed and some are right-handed.

The first part of the exhibition described some of the crystal forms of quartz. Crystal specimens were shown together with free-hand sketches of each crystal. The common crystal forms are colour-coded on the drawings in this article: light grey, the positive rhombohedral faces; medium grey, the negative rhombohedral faces; dark grey, the prism faces. The less common forms are shown in white and are lettered accordingly. Figures 5 and 6

Fig. 5. **Detail of the specimens and drawings used to illustrate some complex combinations of crystal forms.**

Fig. 6. **Detail of the specimens and drawings showing some examples of inclusions in quartz.**

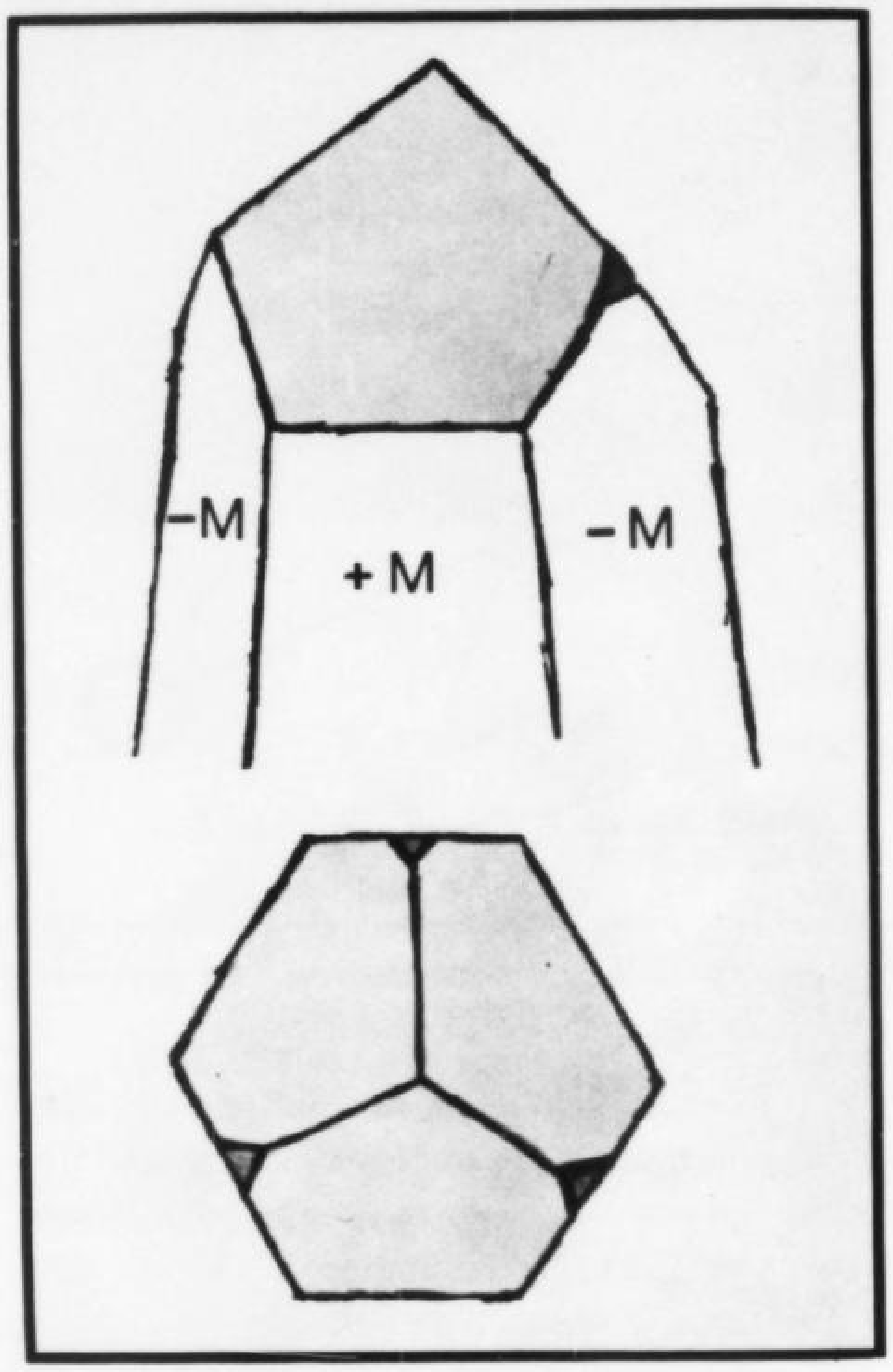

Fig. 7. **Gozak, Brazil.**

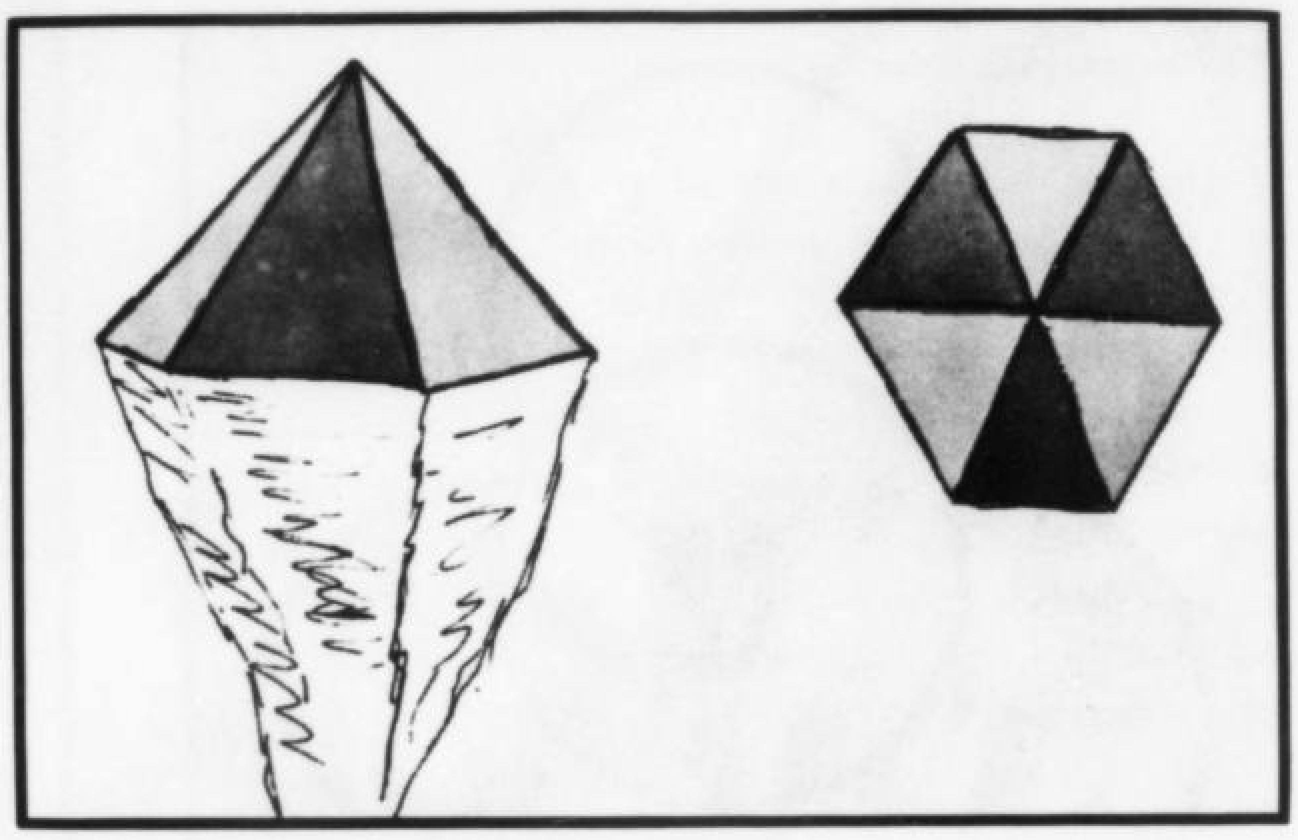

Fig. 9. **Thunder Bay, Ontario.**

Colour code:
Light grey - positive rhombohedron
Medium grey - negative rhombohedron

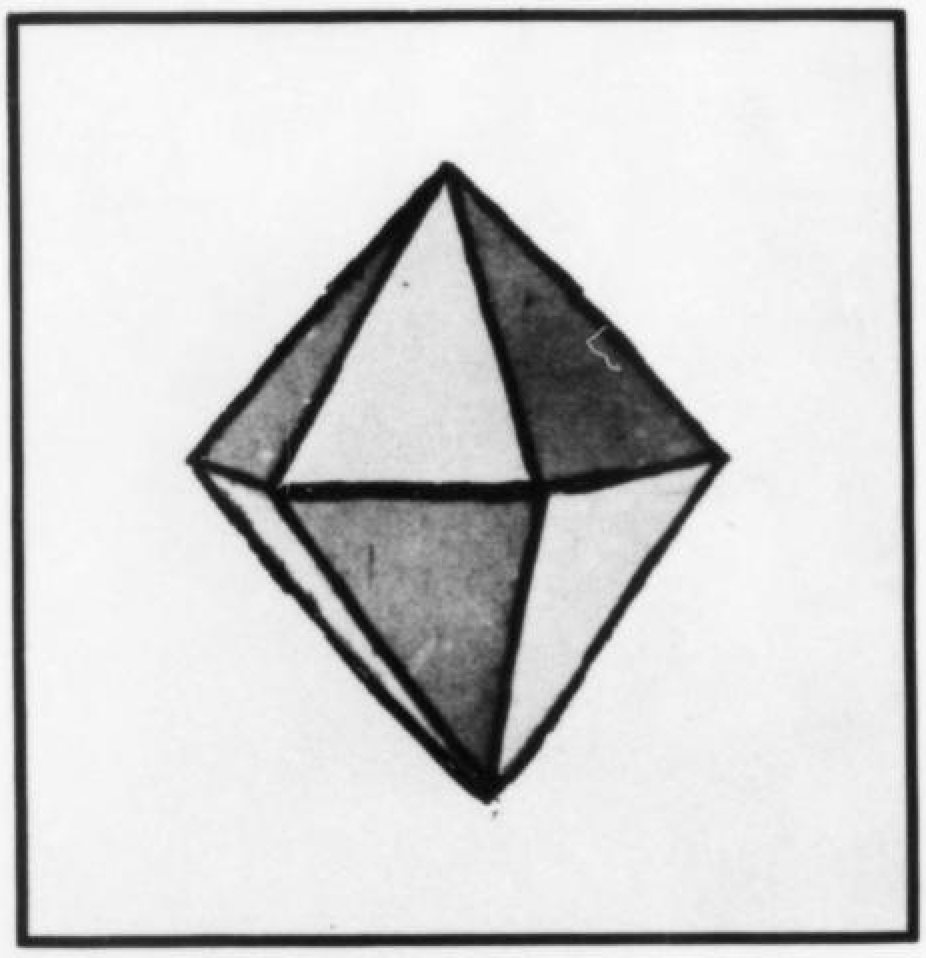

Fig. 10. **Poretta, Italy.**

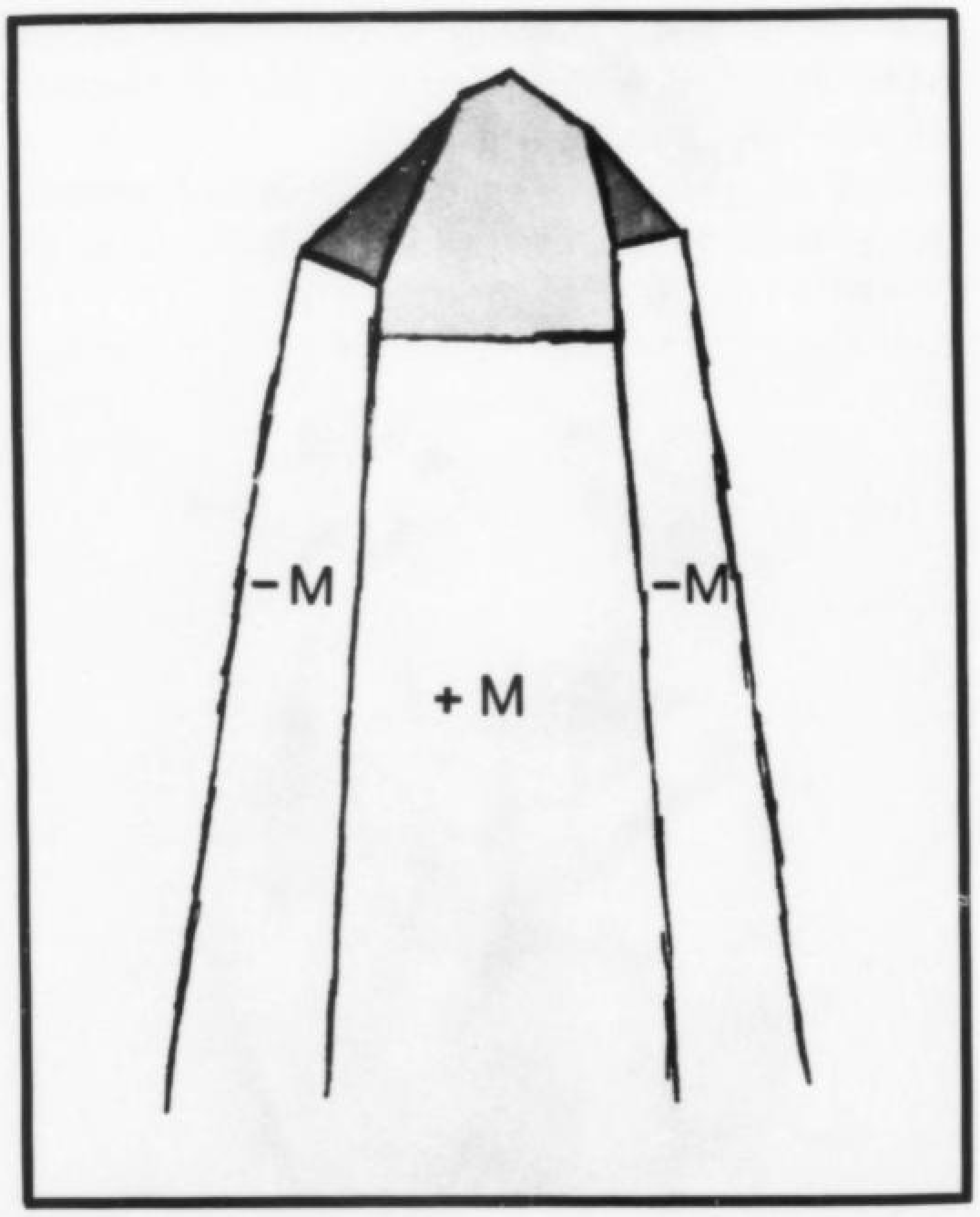

Fig. 8. **Goyaz, Brazil.**

are photographs showing the details of two cases. Photographs of the crystal drawings used in the show are described here and nearly all are shown with their c-axes vertical.

The first group of drawings is used to illustrate the 3-fold symmetry of quartz and to demonstrate the common crystal forms. Fig. 7 shows top and side views of a crystal terminated by three large faces alternating with three small faces — 3-fold symmetry is clearly demonstrated. The three large terminating faces are part of the crystal form called the positive rhombohedron. The three small ones are part of the form called the negative rhombohedron. (In this crystal +M and −M are steep positive and negative rhombohedral faces, they are not prism faces.) Fig. 8 shows the positive and negative rhombohedral faces approaching equal size, but the positive rhombohedral faces still dominate the crystal. Fig. 9 shows equal development of the positive and negative rhombohedral faces; in this case, the choice of the three positive ones is arbitrary. Figure 10 shows a crystal completely surrounded by rhombohedral faces, six positive and six negative. The colour tones on the drawing show their relationship. Fig. 11 shows all the

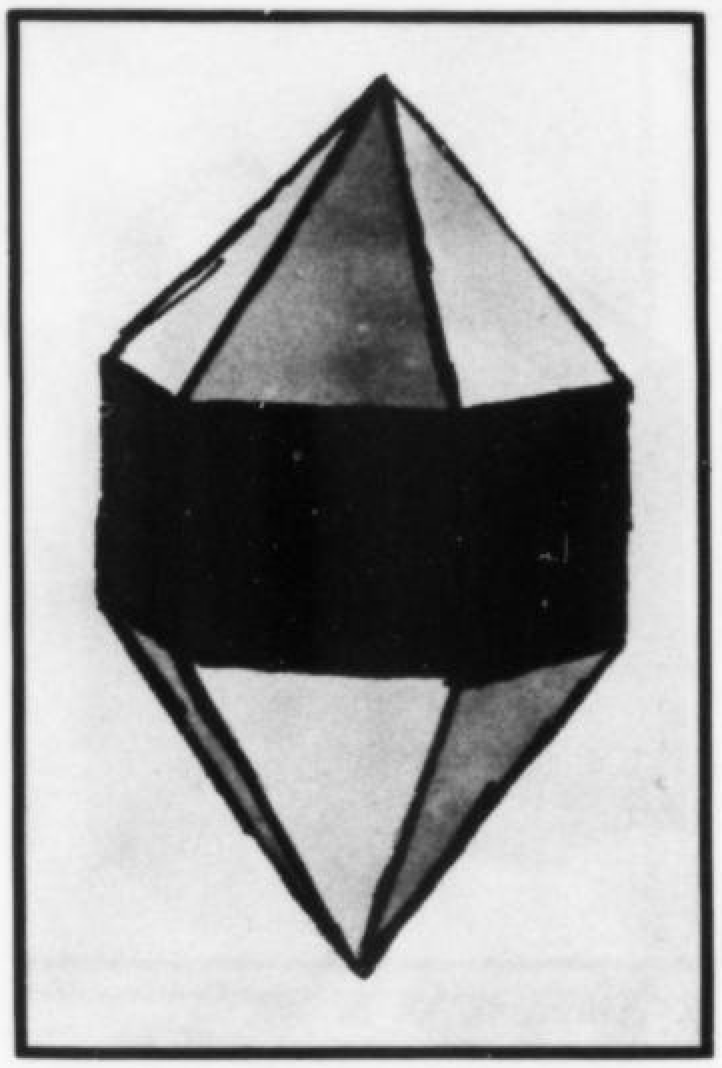

Fig. 11. **Westphalia, Germany.**

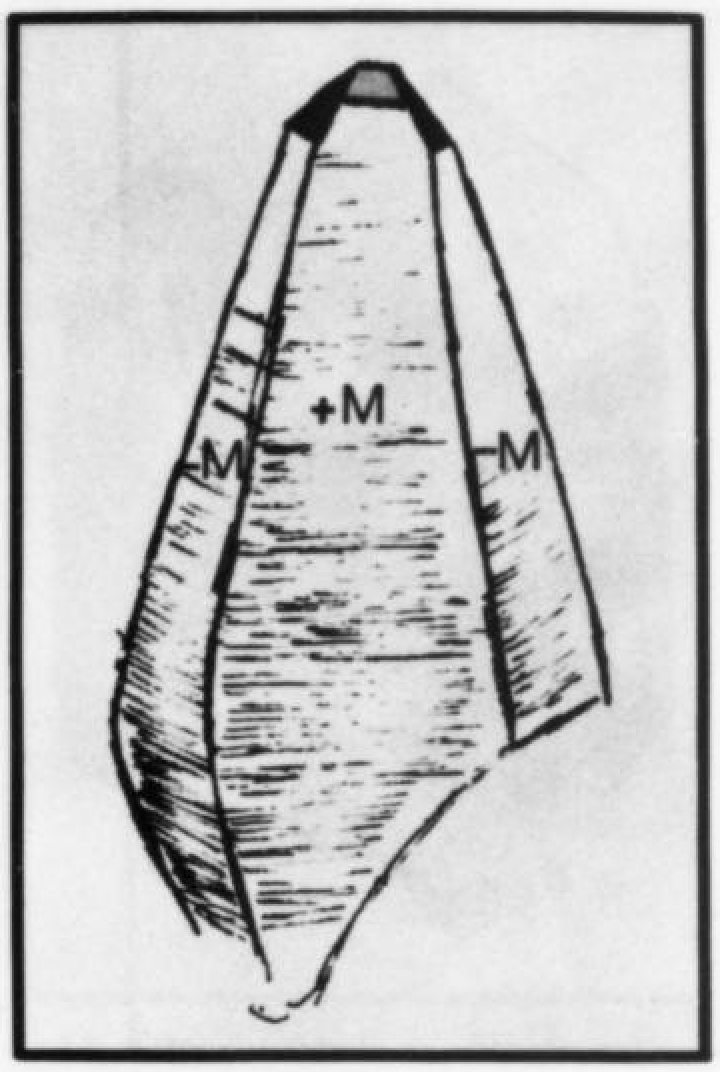

Fig. 12. **North Carolina, U. S. A.**

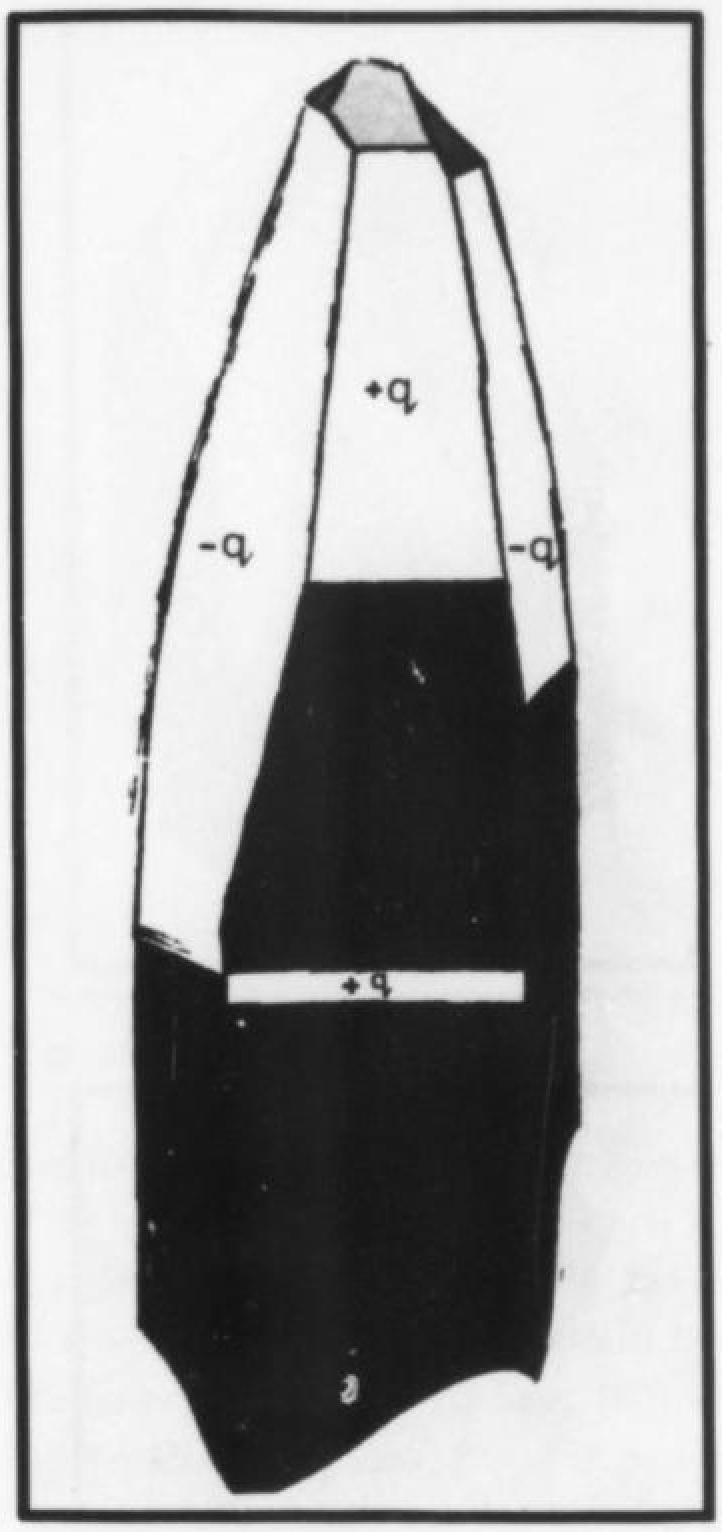

Fig. 13. **Pike's Peak, Colorado, U.S.A.**

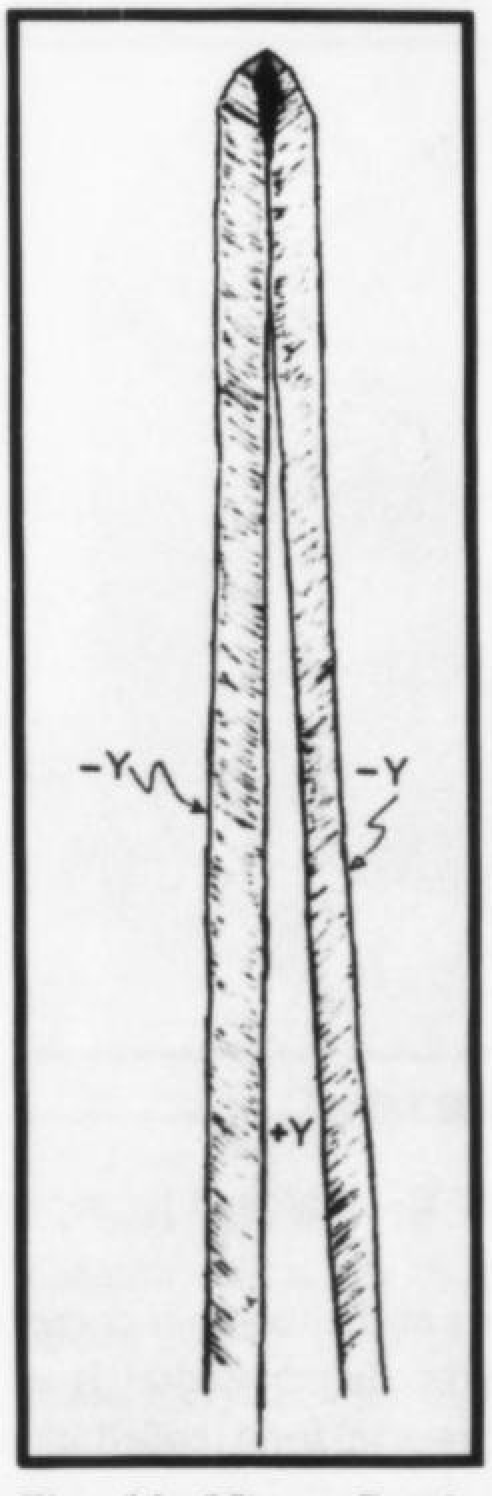

Fig. 14. **Minas Gerais, Brazil.**

The three commonest crystal forms:
Light grey - positive rhombohedron
Medium grey - negative rhombohedron
Dark grey - prism

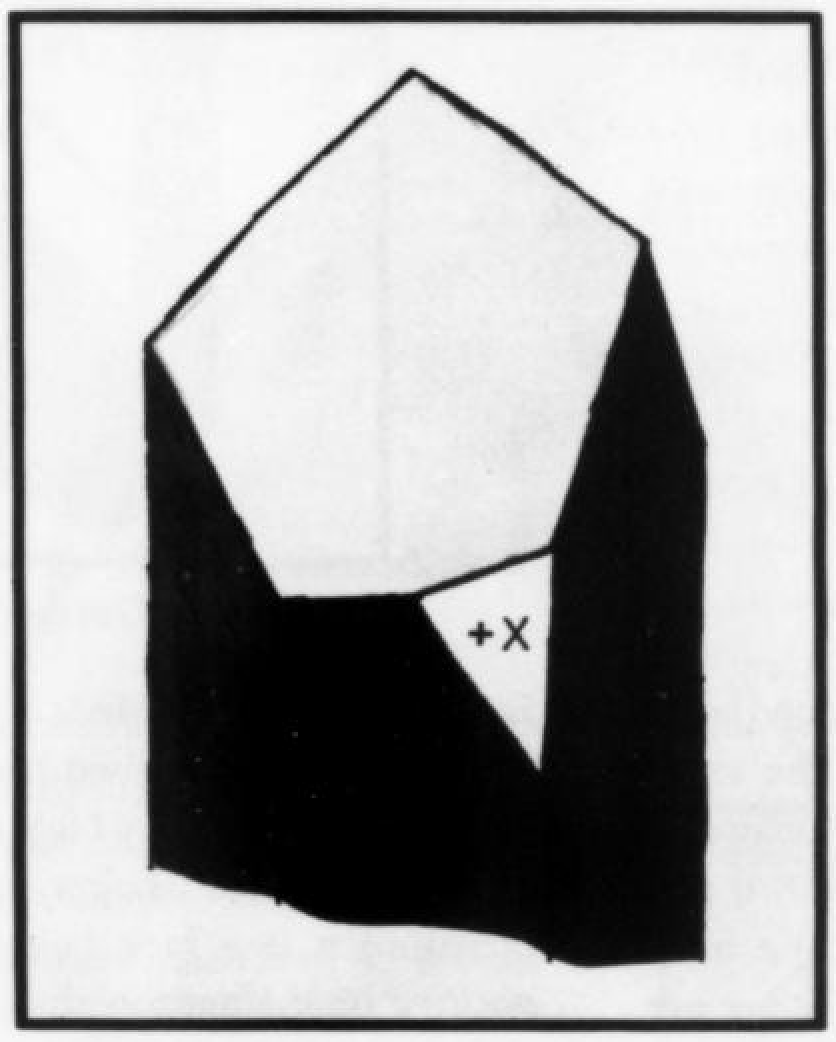

Fig. 15. **Brazil.**

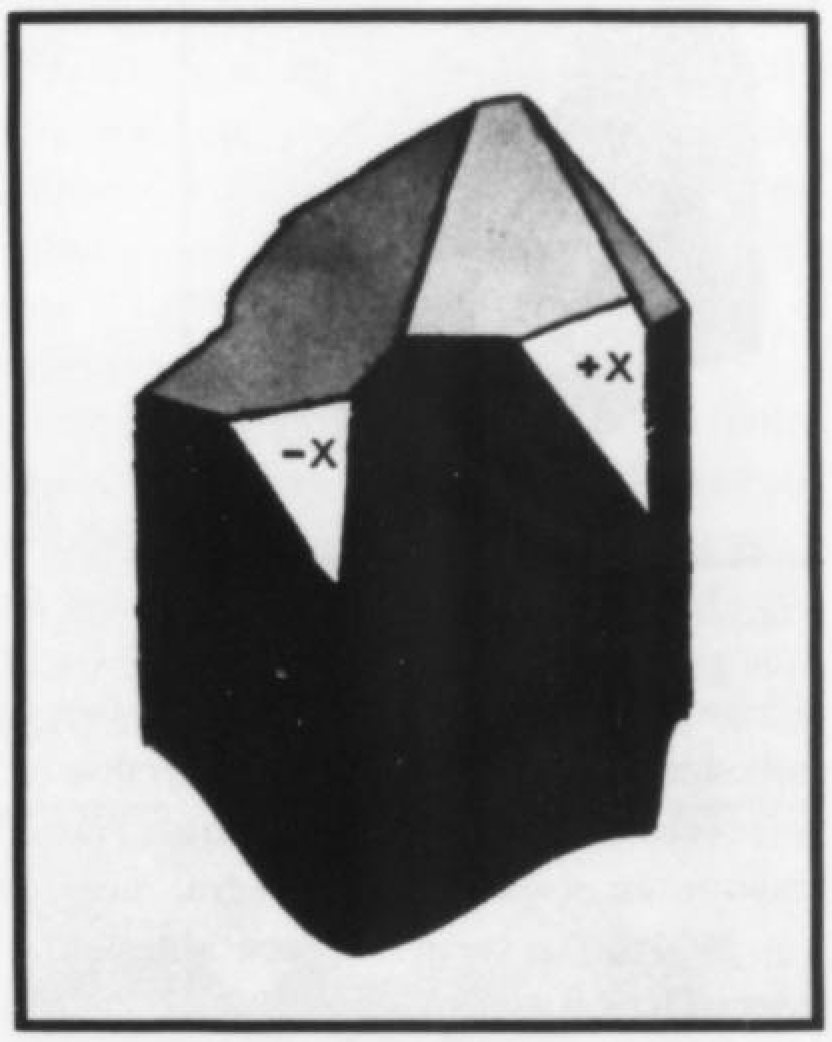

Fig. 16. **St. Gotthard, Switzerland.**

rhombohedral faces described in Fig. 10 with the addition of six prism faces. These two rhombohedra and the prism are the commonest crystal forms of quartz, and almost all quartz crystals show these forms. The identification of these faces is quite simple as explained above. The positive rhombohedron usually is taken as the largest set of three faces at the termination of the crystal. The prism faces of most quartz crystals are striated horizontally when the *c*-axis is upright, and this clue often helps in the proper positioning of a crystal for study and for the identification of the crystal forms present. Distorted crystals sometimes are difficult to orient, and the striated prism faces may help.

The positive and negative rhombohedral faces described so far are the most common of quite a number of similar sets of faces which vary only in their "steepness" and not in their position with respect to the prism faces. Fig. 12 shows a crystal from North Carolina whose steep

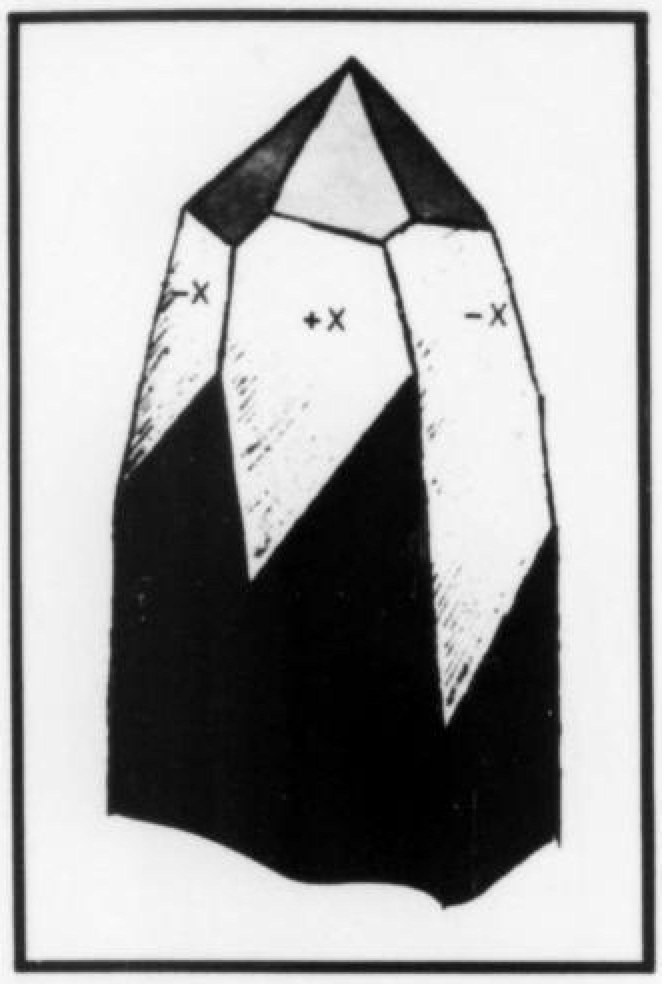

Fig. 17. **Ukraine, U. S. S. R.**

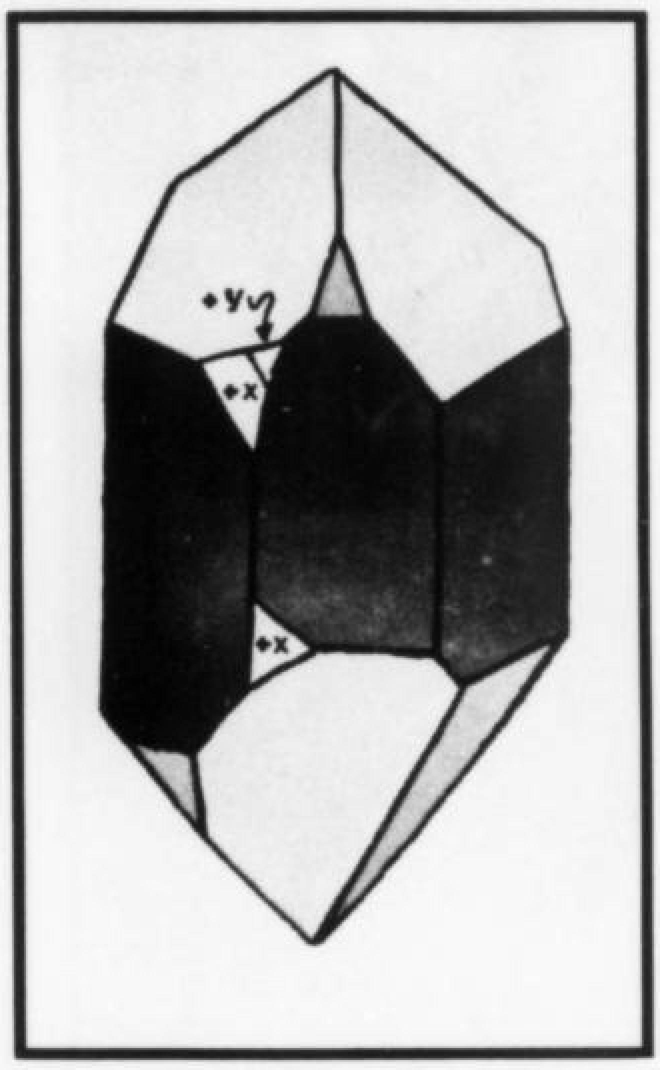

Fig. 18. **St. Gotthard, Switzerland.**

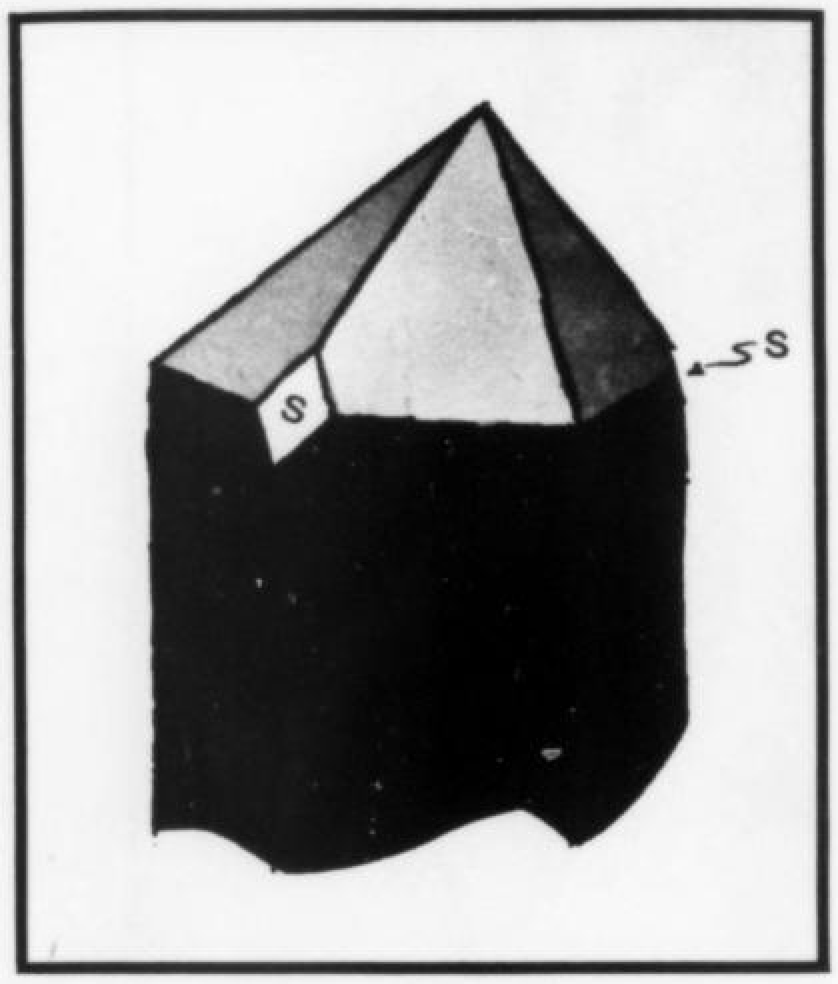

Fig. 19. **Arkansas, U. S. A.**

The three commonest crystal forms:
Light grey - positive rhombohedron
Medium grey - negative rhombohedron
Dark grey - prism

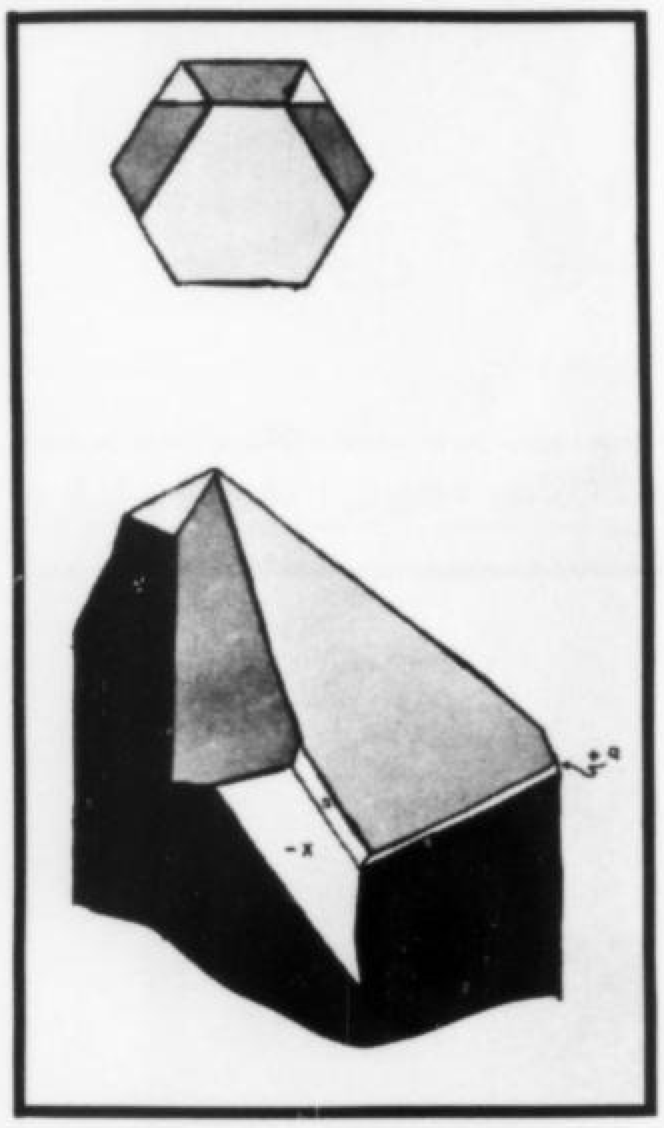

Fig. 20. **Minas Gerais, Brazil.**

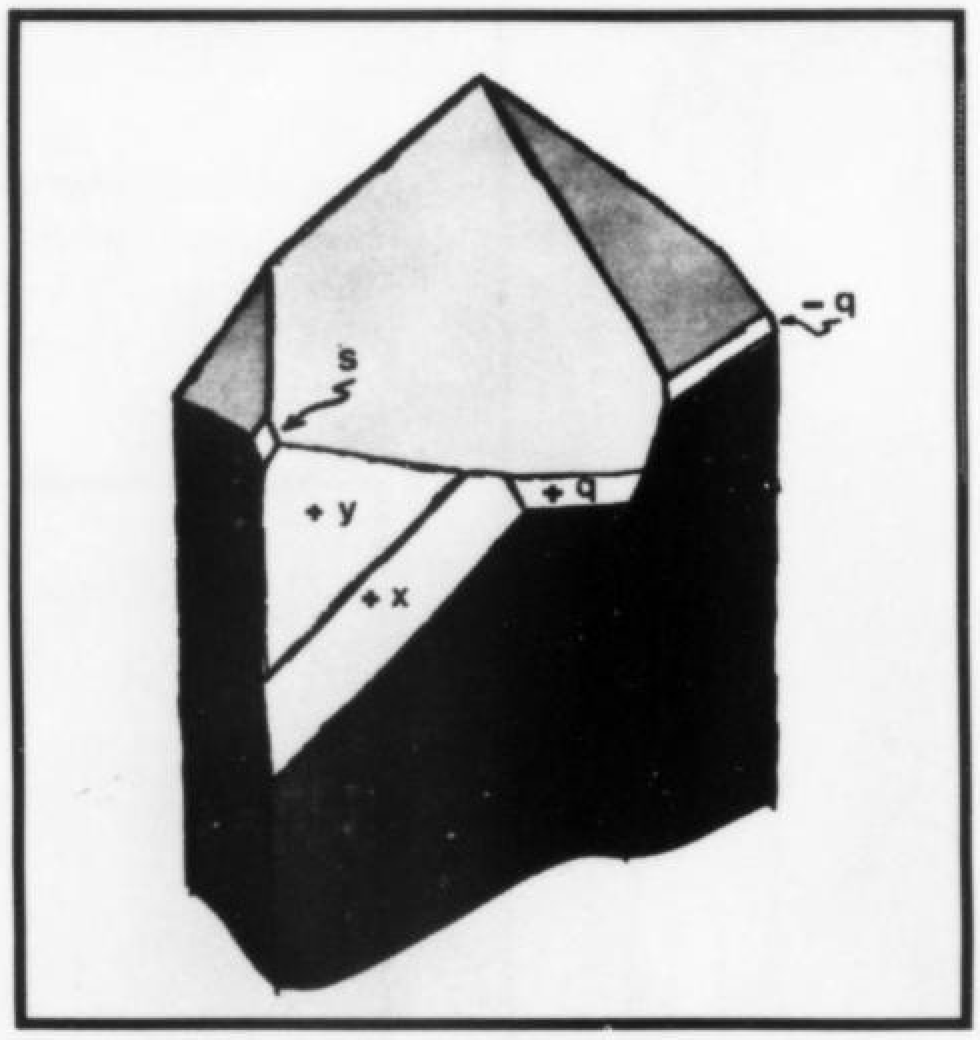

Fig. 21. **St. Gotthard, Switzerland.**

sides are labelled +M and —M; these faces are steep rhombohedral faces and the crystal terminates with the usual sets of rhombohedra. Figure 13, from Pikes Peak, Colorado, shows even steeper rhombohedral faces, labelled +q and —q. Notice the small +q face alternating with the front prism faces and making a little step. If these steps are very small, horizontal striations appear on the prism faces. Fig. 14 shows a crystal dominated by extremely steep rhombohedral faces, labelled +Y and —Y.

Right- and left-handed quartz can be identified only if some of the less common crystals forms are present. The most useful of the crystal forms is called the trigonal trapezohedron; it may be right— or left-handed, either positive or negative. On the drawings, such faces are identified by the letters X or Y, preceded by + or — signs. In the same way as rhombohedral faces show similar forms of varying steepness, so may the trigonal trapezohedral faces; thus the two kinds—X and Y—exhibited by some of the crystals described here.

Fig. 15 shows +X which appears at the top *right* corner of the prism face, below a *positive* rhombohedral face; therefore it is a face belonging to the form called the *positive right* trapezohedron, and the crystal is said to be right-handed. In Fig. 16, both positive (+X) and negative (—X) right-handed trigonal trapezohedra are present. Fig. 17 shows faces belonging to positive and negative left trigonal trapezohedra (+X and —X). Fig. 18 is a crystal from Switzerland showing two positive right trigonal trapezohedral faces (+X and +Y). Notice that the crystal is right-handed regardless of which end of the *c*-axis is at the top.

Fig. 19 shows "s", a face belonging to the crystal form called the trigonal pyramid Unlike the trigonal trapezohedral faces, the faces of the trigonal pyramid are sym-

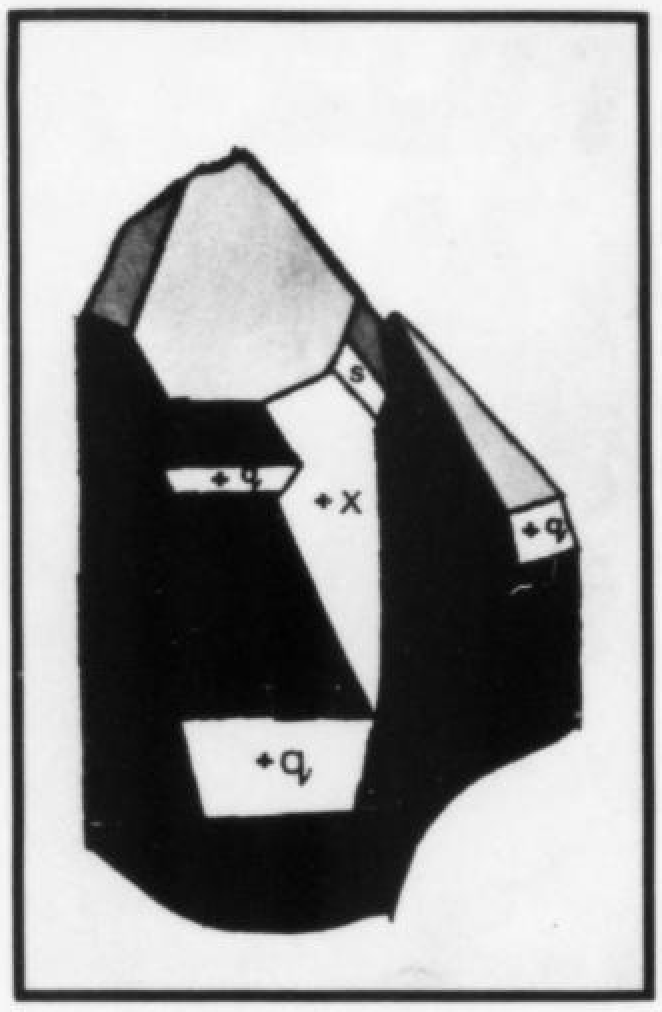

Fig. 22. **Five Islands, Nova Scotia.**

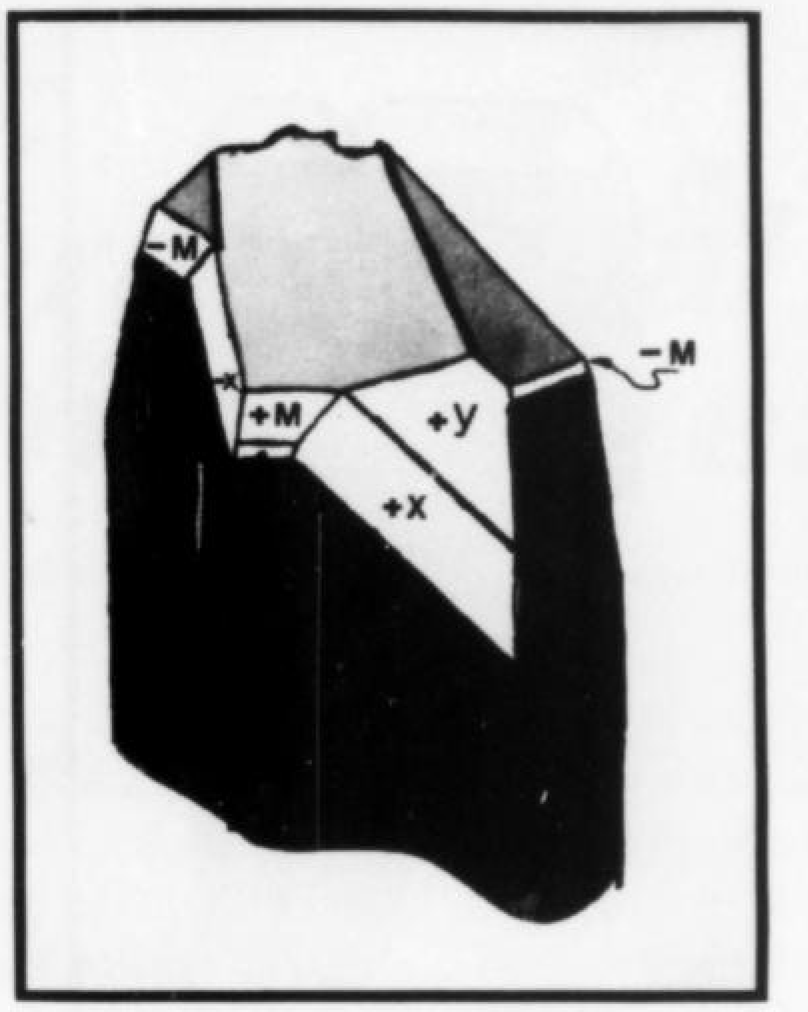

Fig. 23. **Siberia, U. S. S. R.**

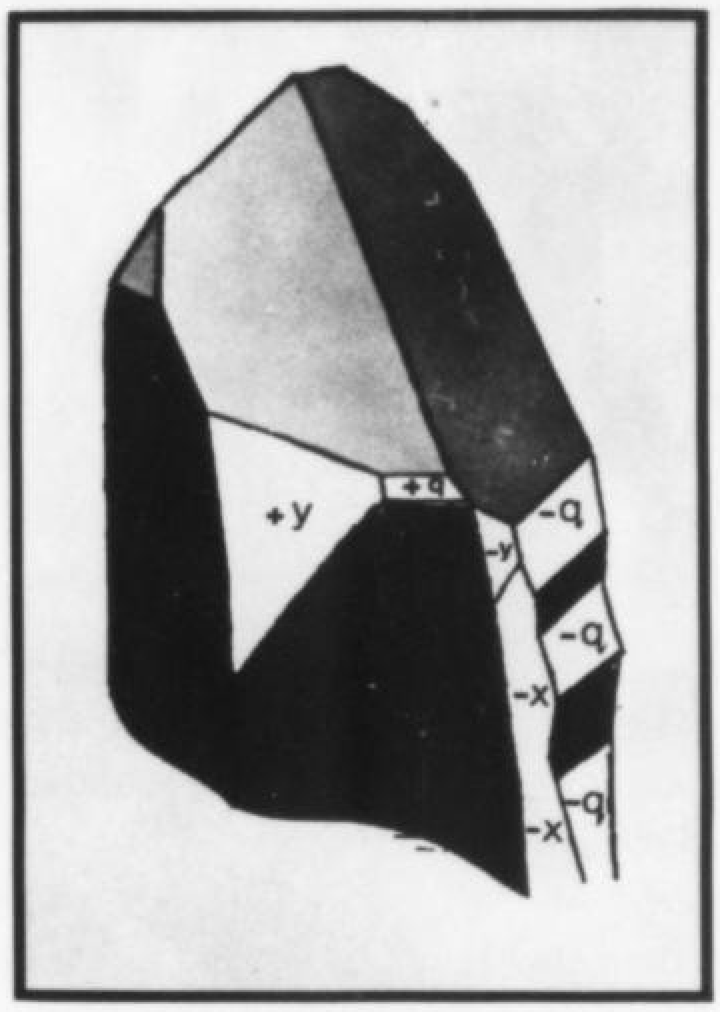

Fig. 24. **Switzerland.**

The three commonest crystal forms:
Light grey - positive rhombohedron
Medium grey - negative rhombohedron
Dark grey - prism

Fig. 25. **St. Gotthard, Switzerland.**

metrical with respect to the positive and negative rhombohedra; and so the "hand" of the crystal cannot be determined merely from the position of these faces. Fig. 20 shows a crystal with −X and s faces together: −X is a negative right trigonal trapezohedral face and so s must be a face belonging to the right trigonal pyramid.

Some examples of still more complex crystals are shown; for example, Fig. 21 is a sketch of a crystal showing faces belonging to two positive left trigonal trapezohedra (+X and +Y), also the trigonal pyramid (s) and steep rhombohedra (+q and −q); these, of course, in addition to the three common forms. Fig. 22 is similar to 21, but this crystal is right-handed. Fig. 23 is another complex right-handed crystal, and Fig. 24 is a complex left-handed crystal.

Fig. 25 is a drawing of a complex smoky quartz crystal form Switzerland. It is a right-handed crystal as indicated by +X and +Y which are both positive right trigonal trapezohedral faces. This crystal is of interest since +X appears at the upper right corner of every prism face; the normal sequence on adjacent prism faces should be +X, −X, +X, etc. The interpretation given here is that this crystal is twinned by the Dauphiné Law, the twin plane being shown by the irregular vertical line on the front prism face. Such irregular lines are common on many crystals and careful inspection reveals that the horizontal striations on the prism faces are discontinuous across the twin plane. Many apparent single crystals show similar evidence of this kind of twinning and it is possible in some crystals to recognize numerous twin planes. Such twinning makes the proper identification of the crystal forms of quartz very complicated.

Perhaps the best known quartz twin law is the Japan Law; a fine example was shown in the exhibition and the sketch of this twin (Fig. 26) shows the relationship between the crystal forms in each of the sub-individuals.

Crystal oddities of quartz are always fascinating and, in many examples, the orientation of the crystal is not

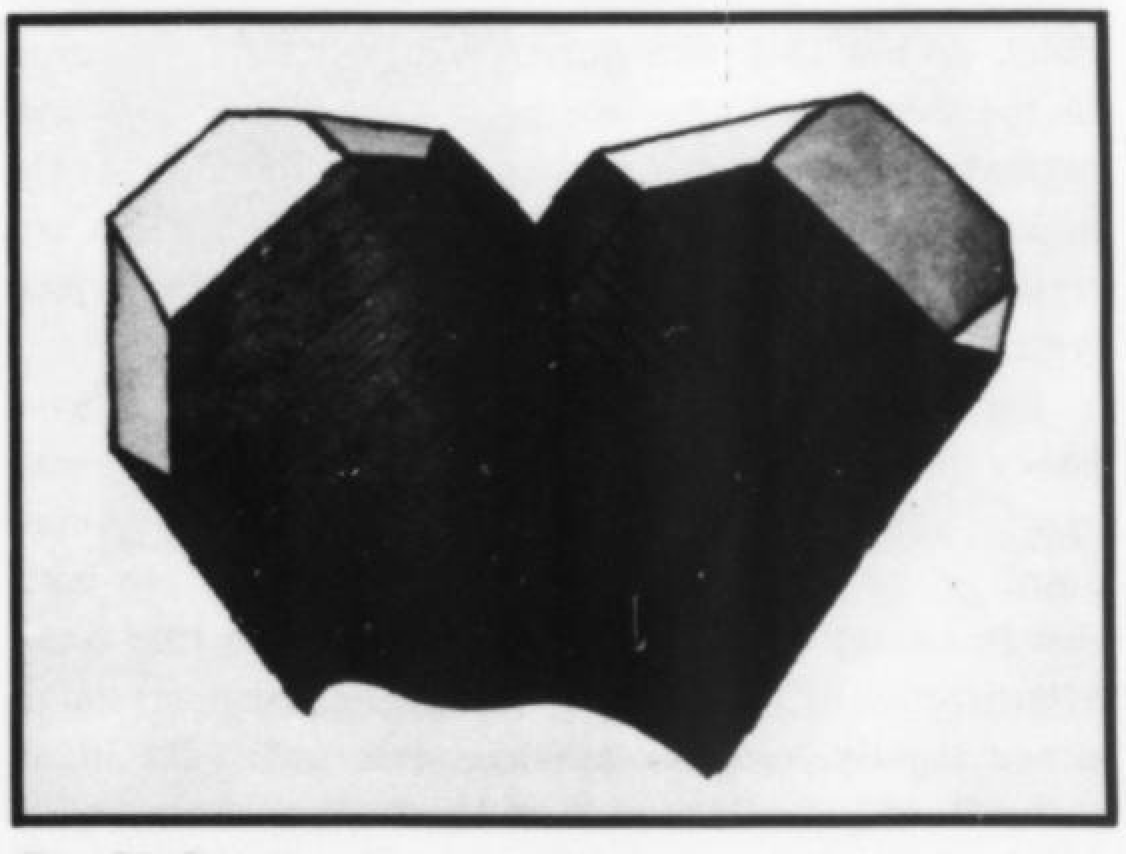

Fig. 26. **Japan.**

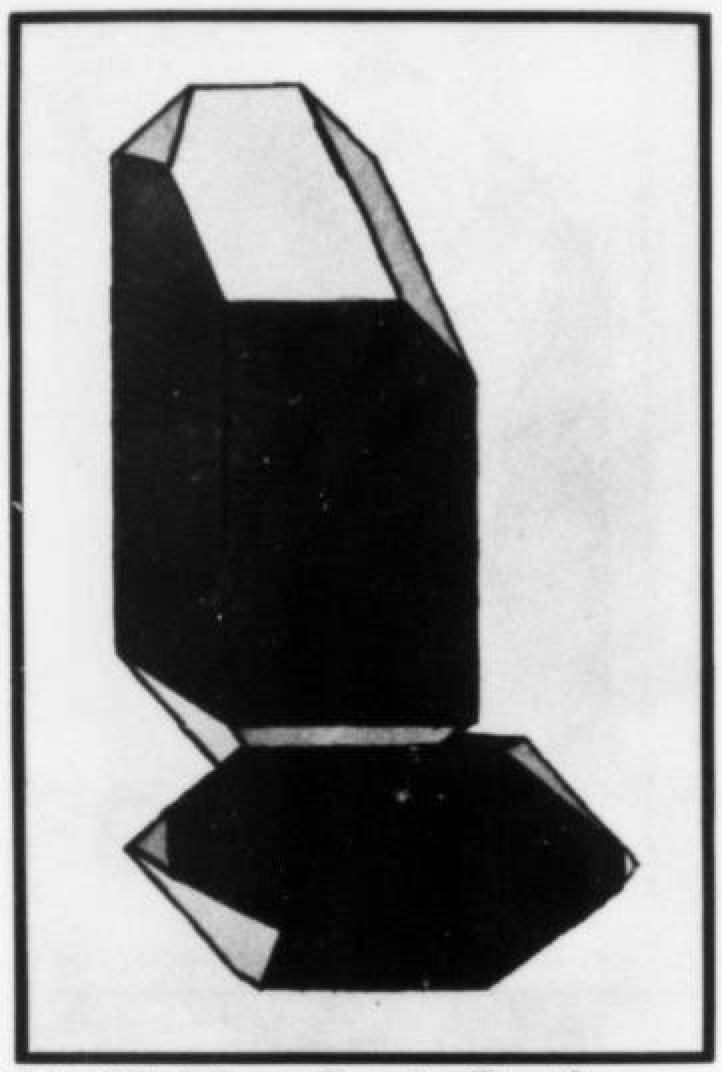

Fig. 27. **Minas Gerais, Brazil.**

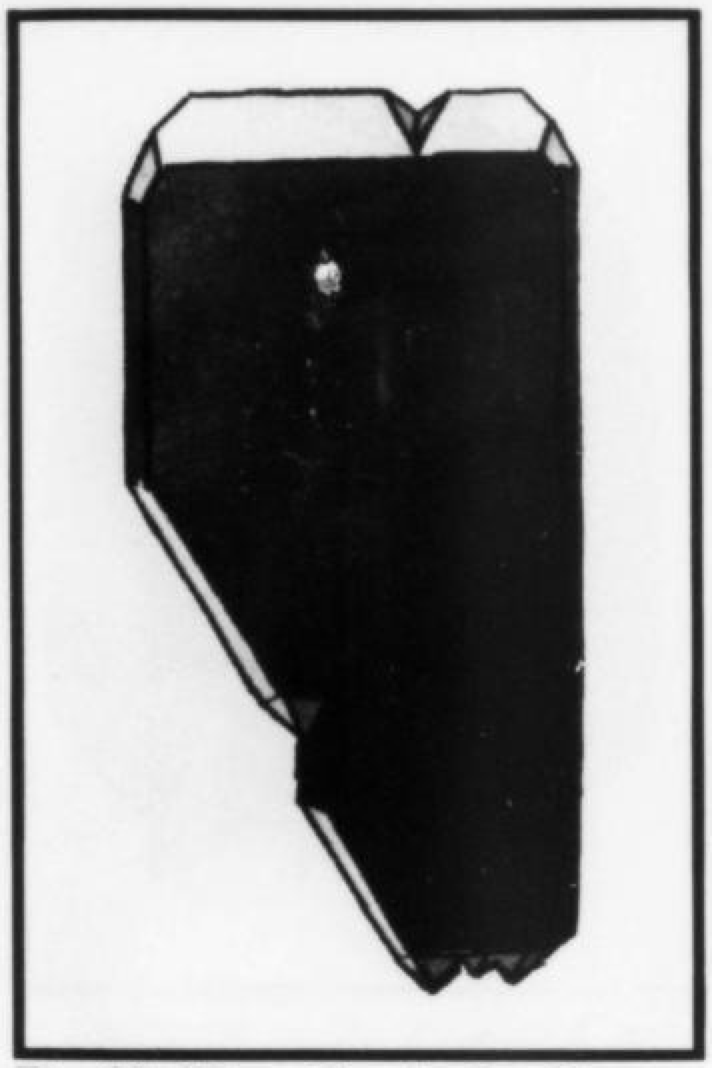

Fig. 28. **Minas Gerais, Brazil.**

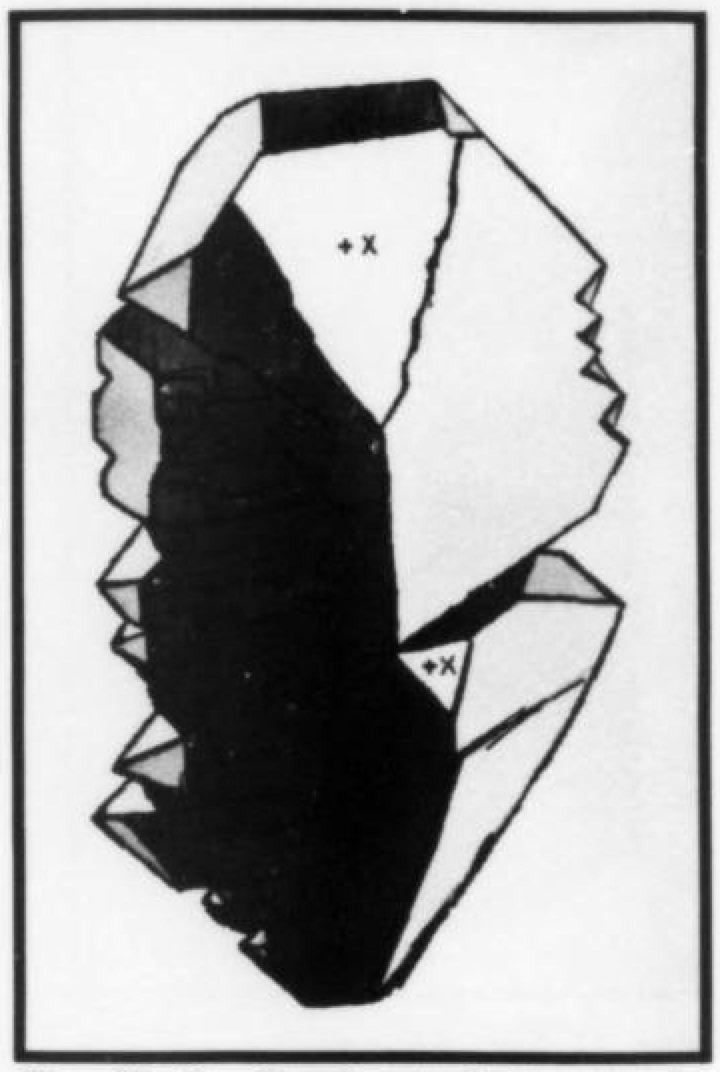

Fig. 29. **St. Gotthard, Switzerland.**

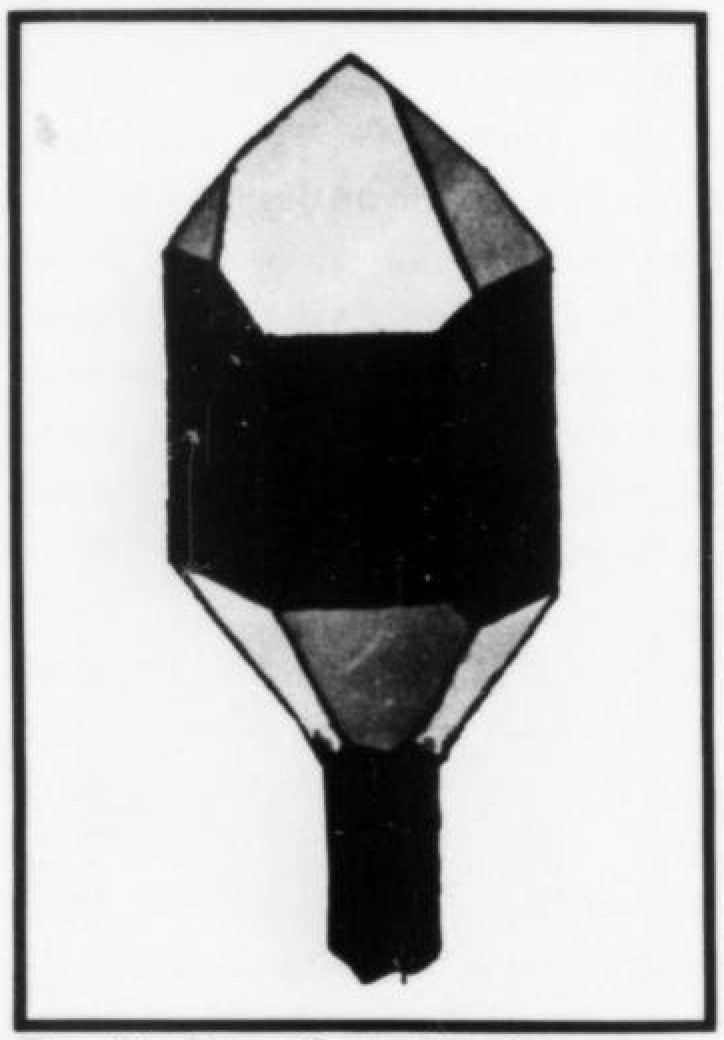

Fig. 30. **Vera Cruz, Mexico.**

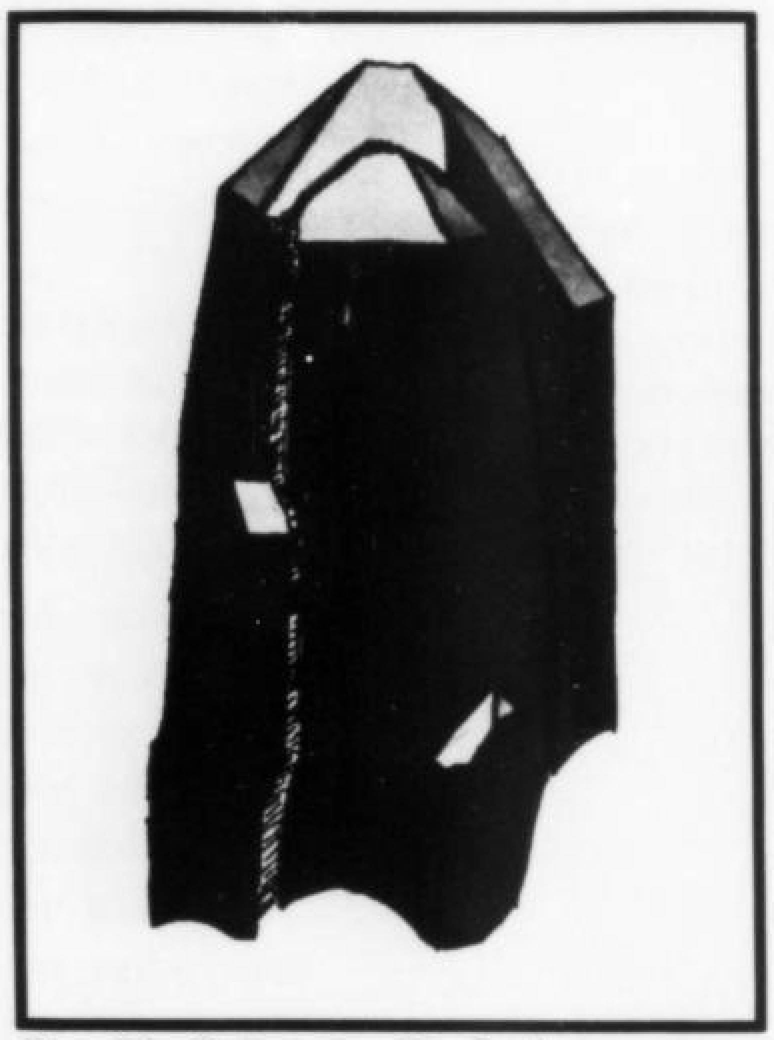

Fig. 31. **Colorado, U. S. A.**

The three commonest crystal forms:
Light grey - positive rhombohedron
Medium grey - negative rhombohedron
Dark grey - Prism

obvious. The specimens selected for the exhibition were accompanied by drawings to clarify the crystal forms and orientations. Fig. 27 shows two crystals grown together which do not look like quartz crystals at all. However, all the common forms are present and the interfacial angles between any pair of these faces is the same as the angle between the same pair of faces on a normal quartz crystal. Similar remarks may be made for the crystal sketched in Fig. 28.

Fig. 29 is a drawing of a superb example of a twisted smoky quartz specimen from Switzerland. These twisted crystals are very complex as indicated by the forms illustrated in the sketch. Actually these "crystals" are composed of many crystals in sub-parallel growth (the c-axis is horizontal in the sketch). Each successive crystal is turned slightly from the previous one, giving the effect of the "twist". The direction of the twist of these crystal may be either right- or left-handed.

Several other examples of crystal oddities were exhibited, such as skeletal crystals; "cap" quartz from Tavistock, England; naturally broken and healed crystals, the fractured ends of which are terminated by rhombohedral faces. A sceptre quartz is shown in Fig. 30.

A collection of quartz containing inclusions was exhibited. Phantom quartz, tremolite needles, rutile needles, chlorite and quartz inclusions in quartz are some examples. One specimen, shown in Fig. 31, is a partially overgrown crystal from Colorado. The original crystal is partly covered by a later growth of quartz in continuity with it. Liquid and gas inclusions were not shown owing to the difficulties of display in a temporary show.

The remaining three cases in the exhibition were devoted to the display of some specimens of the varieties of quartz: rock crystal, smoky quartz, rose and milky quartz, citrine and amethyst.

RESULTS: *The Mineralogical Record Readership Interest Survey*

by Wendell E. Wilson **Dept. of Geology and Geophysics, University of Minnesota, Minneapolis, Minn. 55455**

INTRODUCTION

This project originated during a discussion over lunch one day with the editor. We were debating the question of how to better please *Record* readers, all the while injecting our personal biases on the narrow assumption that "most" readers' interests were similar to our own and those of our immediate associates. It soon became obvious, however, that no conclusion was possible; our personal opinions had no basis in fact because no one had ever determined an interest profile for a significant number of mineral collectors. Deciding to seek some real answers, we concocted a questionnaire and sent it out to all subscribers with the May-June 1972 issue. Presented here are the results of that survey.

Every effort was made to word the questionnaire unambiguously and impartially, and to provide a place for all possible interests. We knew we could not think of (or have room for) them all, so space for write-ins was provided as well as a suggestion for additional comments of any kind. Although the questionnaire still had its faults, it was accepted quite well in general, and only one respondent felt it was "rigged".

RESPONSE

Over 550 of the *Record's* approximately 3100 subscribers, (about one-sixth), have responded to the survey, of which 93% were U.S. residents. The other 7% was composed of 24 subscribers in Canada, 7 in England, 2 in Italy, 1 in Switzerland, 1 in Spain, 1 in France, 1 in New Zealand, 1 in Norway, and 1 in Australia. It must be assumed that the respondents are typical of all non-institutional subscribers, but it is unknown whether they are typical of NON-subscribing mineral collectors as well. Non-subscribing over-the-counter *Record* buyers (about 260 people) did not receive the questionnaire but probably have the same interest profile as actual subscribers. Of the 350+ institutions which subscribe only 3 replied to the questionnaire. These were not evaluated; this study therefore presumes to speak for about 3000 readers, and does not include casual readers, students, instructors, etc., who make use of institution subscriptions.

EXPERIENCE

Figure 1 is a histogram showing the distribution of experience in mineral collecting. Year dates are assigned on the assumption that a person who said he has been collecting for 10 years, started in 1962. Most respondents (82%) started collecting sometime after 1947. The big increase at this time may have been a result of the end of WWII. The tapering-off trend from 24 through 60 years of experience is probably a function of the mortality rate rather than a gradual change in the popularity of collecting during this time.

Readers have an average experience of 15.2 years of collecting. This leads to an interesting statistic: readers have a TOTAL experience of 45,600 years! (If all our readers were one person, he would have started collecting in the Pleistocene!)

INTERESTS

Regarding the size of specimens that readers collect, the percentage distribution is as follows:

1% do not collect minerals
26% collect one particular size
23% collect two particular sizes
11% collect three sizes

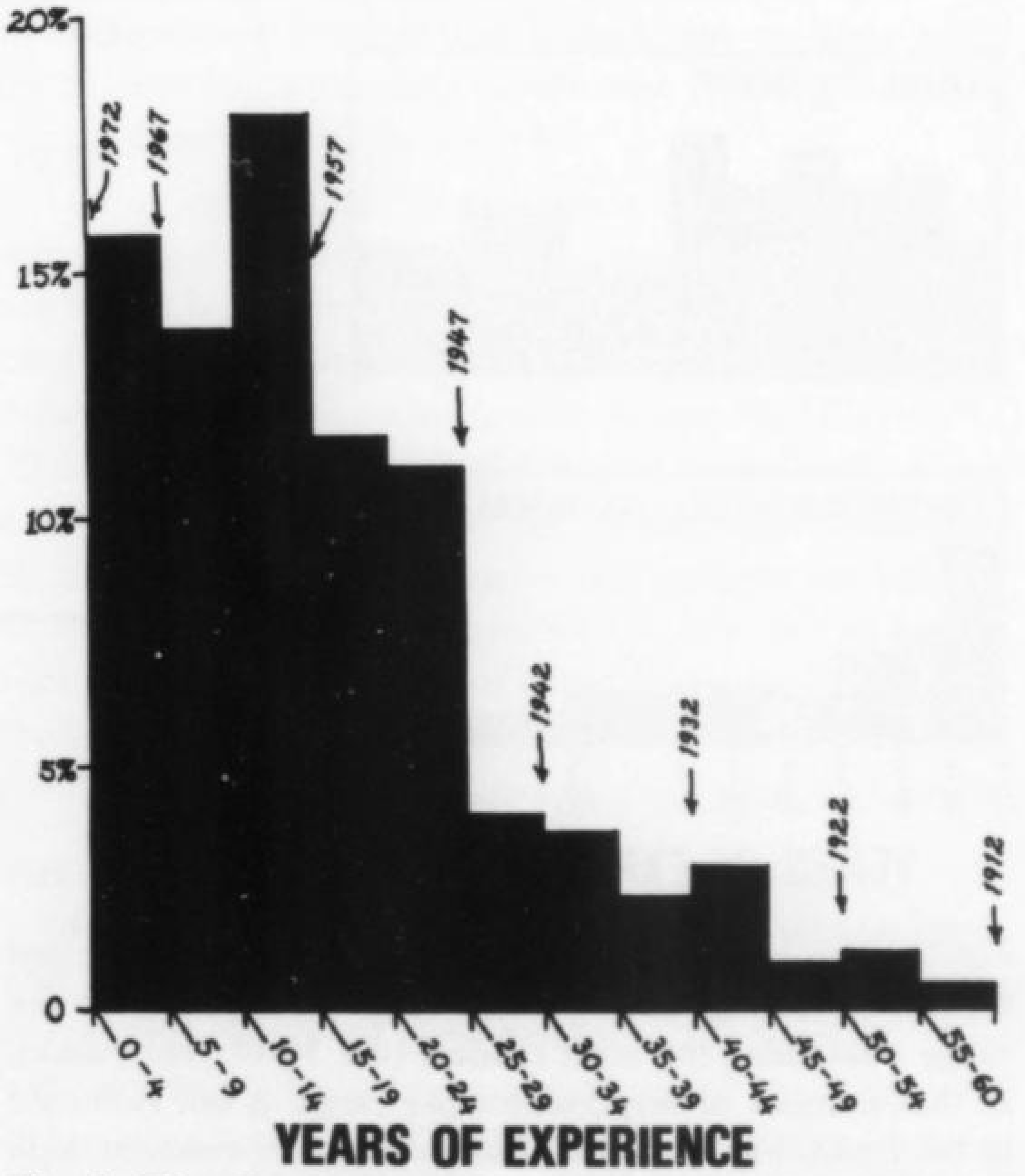

Fig. 1. **The distribution of collecting experience among collectors. Most readers have been collecting for less than 25 years, i.e. they began collecting sometime after 1947.**

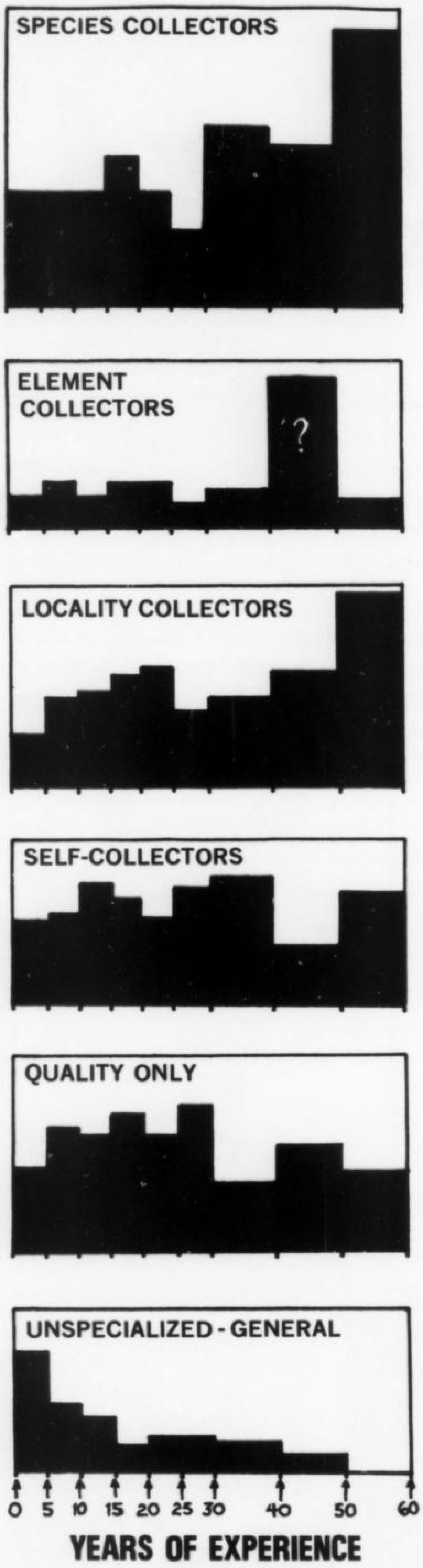

Fig. 2. **The relation between increasing experience and type of collecting. Each bar has been "normalised" to the range containing the most readers (the 10-14 year range), so that number of respondents per range is not reflected in the trend. For example, if one column is twice as high as another, this indicated that collectors of that type are twice as common *within* that experience group, regardless of the number of people in each group.**

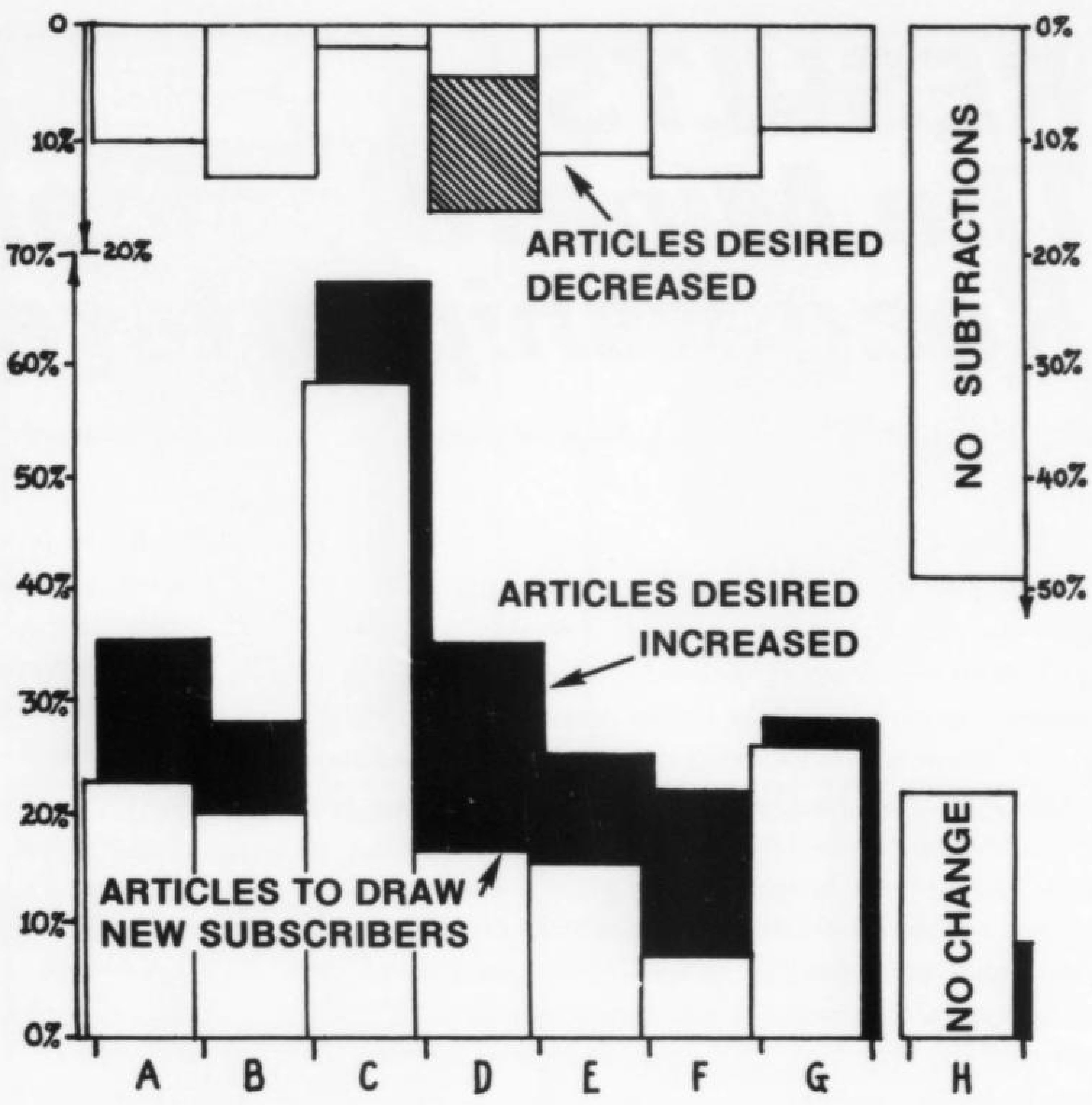

Fig. 3. **Reader article preferences. The black bars represent the percentage of readers desiring an increase in articles of that type. The white bars at the bottom represent articles which readers feel would increase magazine subscriptions. The white bars on the top, shown up-side-down for comparison with the black bars, represent articles readers wish reduced in frequency. The shaded area is the fraction of that bar which is greater than expected on the basis of the black bar trend.**

KEY:
- **A - species collecting, rare minerals**
- **B - micromount localities and minerals**
- **C - quality minerals and localities, larger than micros**
- **D - technical education**
- **E - historical educational**
- **F - original research**
- **G - opinion and current events**
- **H - no changes, no response**

39% collect any size they can get their hands on.
19% are micromounters
25% collect thumbnails
30% collect miniatures
35% collect cabinet-size and larger specimens
40% have no size specialization or do not collect.
149% (Totals over 100% indicate that some people have more than one preference.)

Most collectors have more than one type of sub-collection:

36% maintain a species collection
29% have self-collected collections

28% are locality collectors
21% collect minerals only on the basis of quality
19% are unspecialized or are beginners
12% have specific element (e.g. copper-minerals) collections
7% collect in other areas of specialization, such as pseudomorphs, fluorescents, twins, synthetics, ores, single crystals, "antique" specimens, sands, oddities, etc.
14% indicated "quality only" on the questionnaire in conjunction with other choices, apparently in an attempt to underscore their desire for quality within their specialized collections, or possibly to indicate a separate collection unspecialized but for quality.

Most people also use their collection in more than one way:

75% privately display their collections
50% engage in private study of their specimens
21% use their specimens for teaching purposes
19% display and/or compete publicly
9% have their collections in storage
6% use minerals as a form of investment
6% have other uses for their minerals.

The preceding profile reveals a number of interesting points about *Record* readers. Apparently 71% do *not* do much field collecting, or do not keep what they find. A fourth of readers do *not* display their collections at home, and fully half seem not particularly interesting in studying their own specimens. However over a fifth are engaged in teaching aspects of mineralogy to others. Over 80% of the readers do *not* engage in competitive display. Why this is, and what might be done to encourage more public competition and display might be an interesting topic for discussion. Whether public competition *should* be encouraged is another interesting topic.

The different types of collecting were plotted against years of experience to see if people's tastes change systematically with increasing experience (Figure 2). There appears to be an increase in species collectors with time, although the frequency from 0 to 14 years is constant. The trend for element collectors is probably constant; the erratic increase in the 40 to 49 year range is most likely a statistical sampling problem. Locality collectors increase with time, but the plot shows a peculiar bimodal distribution. Self-collectors remain fairly constant. Surprisingly the "quality only" group increases very little with time. We had expected people's tastes to trend more and more to higher quality specimens as their experience increased. The drop after 25 years of collecting may be due to the financial problems of approaching retirement. As expected, the unspecialized-or-beginner fraction drops off steadily.

FINANCES

Regarding the financial aspect, every effort was made to safe-guard the anonymity of respondents. Because many inadvertantly gave a return address on the envelope, I personally opened all replies and immediately discarded the envelopes.

About 88% of the collectors who returned the questionnaire confided their financial statistics to us. The other 12% either had never kept track of such information, were unable to estimate, did not want to know themselves, or simply felt it was none of our business.

Last year *Record*-reading collectors spent an average of $650 on minerals, or nearly $2,000,000 all together (what a market for advertisers!). These purchased specimens comprise only 48% of the total acquisitions for the year, indicating that *Record* readers are currently accumulating specimens at a rate of over 4 million dollars-worth a year! Now there's an active hobby.

Don't feel discouraged by the $650-per-year average. The average is pulled up by the big spenders at the top end. Actually most collectors are in the under $400-per-year range, and the median is at about $200. That is, if you spent $200 on minerals last year, there were an equal number of readers who spent more, and an equal number who spent less than you.

In detail, the average proportions for acquisitions in the last year are as follows:

34.6% self-collected
19.6% bought at shows ($796,000)
17.0% bought at shops ($690,000)
11.5% bought mail order ($467,000)
(48.1% bought total)
12.8% traded for
4.5% received as gifts

If the self-collected and kept specimens are of similar market value to the purchased specimens (another topic for debate) *Record* readers mined over 1.4 million-dollars-worth of minerals in the last year.

The average value for a reader's collection is $7432, but this is also influenced by the large collections at the top end. The median value is $1680 per collector. According to these statistics the total value for the composite collection of all *Record* readers is a staggering $22,000,000! This is more than twice Paul Desautels' admittedly rough estimate of $10,000,000 for the Smithsonian collection. So private collectors need never feel insignificant relative to the great museums. Remember too that not all collectors in the U.S. are *Record* subscribers (unfortunately), therefore the value of all private mineral collections in the U.S. might be several times the figure for subscribers.

PROVINCIALISM

Of all the items on the questionnaire this section probably came the closest to being a failure. It was intended to reveal the degree of provincialism of collectors. This assumed that all collectors are aware of the tastes and habits of collectors in OTHER provinces. Otherwise there is no basis on which they can make a comparison. People who have travelled a lot generally agree that there are

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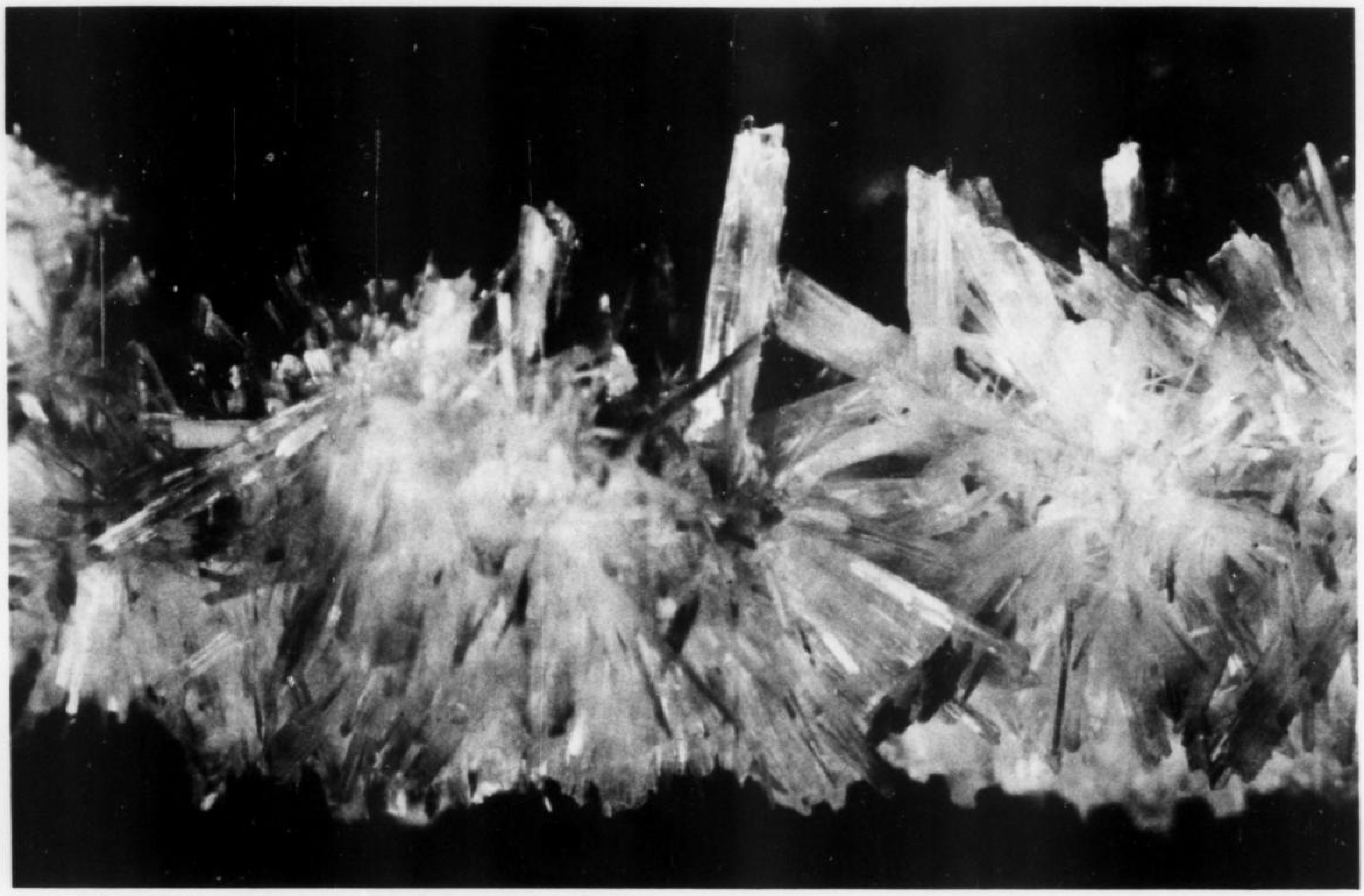

Fig. 1. **Typical specimen of hydromagnesite from Soghan.**

HYDROMAGNESITE FROM SOGHAN, IRAN

by P. Bariand, F. Cesbron, H. Vachey

Laboratorie de Mineralogie-Cristallographie, associe au C-N-R-S Universite
Paris VI, 9, Quai St. Bernard, Paris 5, France

and M. Sadrzadeh

Geological Survey of Iran, Tehran

INTRODUCTION

Hydromagnesite (magnesium carbonate hydroxide hydrate) was encountered in southeast Iran for the first time in February 1965, in the old open pit of Dovez, near the Shariar mine, Minab district. Crystals, similar to those described in this paper but no longer than 3 cm, filled cracks in chromite. Hydromagnesite is possibly rather abundant in several chromite deposits in Iran, but the systematic mineralogy of these deposits has not yet been studied.

Many ultrabasic and basic rocks (dunites, peridotites, pyroxenites, more rarely gabbros) with abundant chromite occur in Iran. Carbonates of magnesium (huntite, hydromagnesite) and calcium (calcite, aragonite) are common. Huntite—called Zadj-e-Sefid: *white alum*—has been worked for a very long time for use as the principal pigment in a local paint for whitewashing the inside of houses. In the neighborhood of Yazd, it is not rare to find aggregates of huntite weighing several kilograms in serpentinites.

During 1971, exceptional hydromagnesite specimens were found in the Soghan mine, near the Abdasht chromite mine, Esfandaque district, South of Kerman. Hydromagnesite is widespread in the mine, filling cracks in ultrabasic rocks. We think that this mineral is more abundant than one would be led to believe by the literature; chromium deposits are rarely the sites of beautiful mineral specimens and for this reason are seldom studied by mineralogists.

MORPHOLOGY

The monoclinic crystals are white to colorless when small, and their size can reach 10 cm, particularly in some groups of 40 x 30 cm (fig. 1). They are undoubtedly the best known. Not many forms occur: {100}, {110}, {011}, $\{\bar{1}11\}$, and rarely {010}. Crystals are flattened on (100), and this face is deeply striated along *c* by repetition of the {110} and {100} forms (fig. 2). The ϕ and ρ values are in good agreement with those given by Rogers (1923) (*Dana's System of Mineralogy,* 7th ed., vol. 2, p. 272). Twins on {100} are very common.

X-RAY CRYSTALLOGRAPHY

Given as monoclinic after Roger's goniometric measurements; Fenoglio (1936) assumed hydromagnesite to be orthorhombic with parameters reported in table 1; later Murdoch (1954) studied hydromagnesite from Crestmore, California, and found a monoclinic pseudo-orthorhombic symmetry with space group $C222_1$ and a doubled *a* parameter. Murdoch indexed the powder diagram in an orthorhombic cell but give such reflections as 210, 012, 212, 321, etc., which are not consistent with a *C*-centered lattice but are compatible with a *B*-centered lattice.

We began our X-ray study with a precession camera and found a monoclinic pseudo-orthorhombic cell similar to Murdoch's but with a *B*-centered lattice and a β angle of 90°15', not 90°(table 1). As a *B*-centered lattice is not conventional for a monoclinic cell, we chose a simple primitive cell according to Roger's axial ratio: thus the space group is $P2_1/c$. Twins on {100} are well seen on zero-level photographs perpendicular to the b^* axis: *hOl* spots are divided into two, except for *hOO* spots (common twin plane).

Table 2 gives an indexed X-ray powder pattern obtained with a Guinier-deWolff focusing camera. Quartz was added as internal standard, and intensities were measured with a Joyce densitometer. We also added indexing in the monoclinic pseudo-orthorhombic cell, with the same orientation as Murdoch's.

CHEMICAL COMPOSITION

"Cell contents uncertain", one can read in Dana, and the commonly accepted formula is $Mg_4(CO_3)_3(OH)_2 \bullet 3H_2O$. Unfortunately this formula gives $Z = 2.56$ per unit cell, with a density of 2.253 (new measurement with a Westphal balance). A new chemical analysis was performed, and the results (table 3) give a MgO/CO_2 ratio closer to 5/4 than to 4/3. The formula is thus:

$5MgO \bullet 4CO_2 \bullet 5H_2O$ or $Mg_5(CO_3)_4(OH)_2 \bullet 4H_2O$ ($Z = 2$).

These results agree with the formula given by Morandi (1969), established after considerations of the thermal decomposition:

$$3MgCO_3 \bullet Mg[(HCO_3)(OH)] \bullet Mg(OH)_2 \bullet 3H_2O.$$

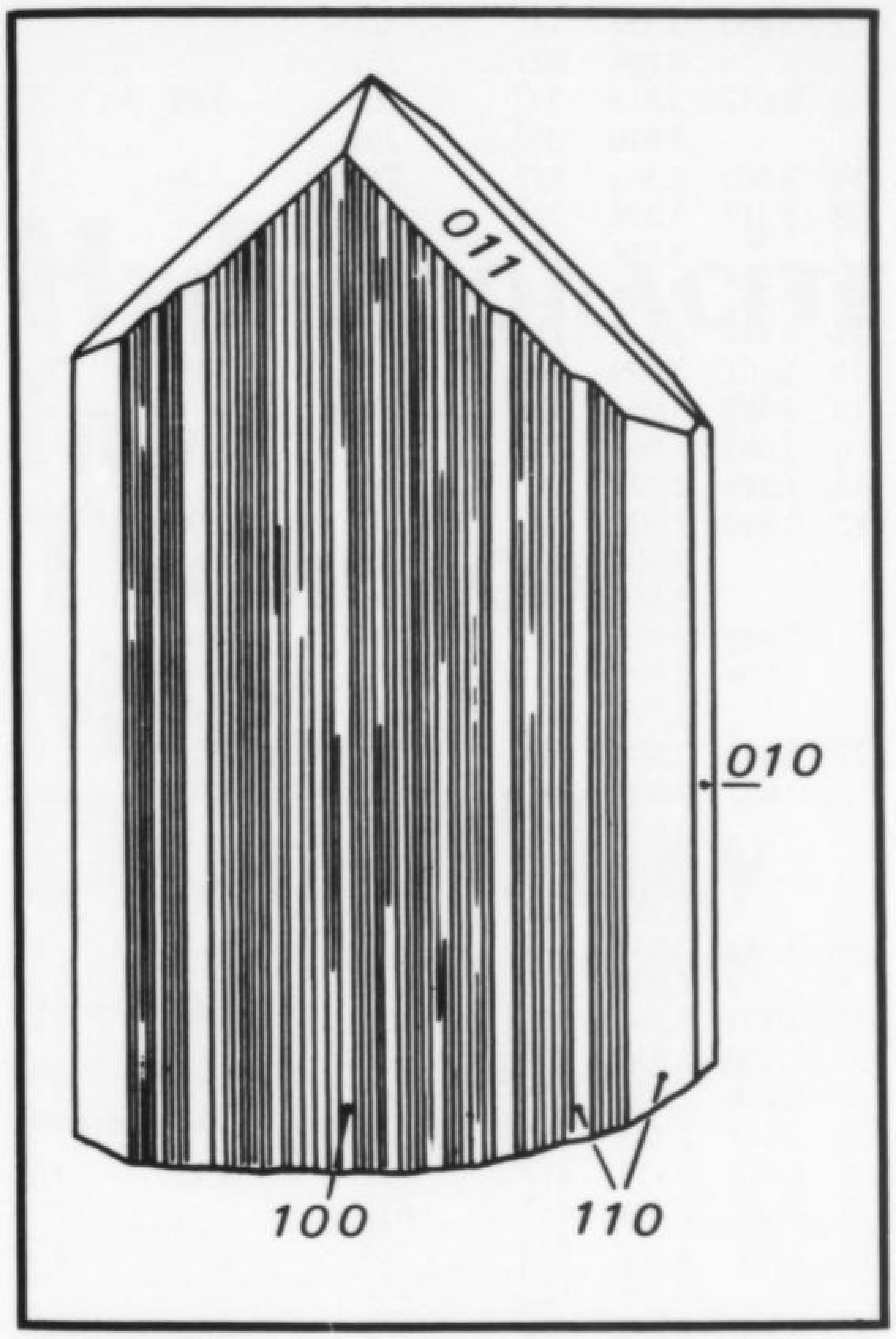

Fig. 2. **Hydromagnesite crystal drawing.**

TABLE 1

	Fenoglio	Murdoch	present study	
a	9.32 k*X**	18.58 Å	18.38 Å	10.11 Å
b	8.98	9.06	8.94	8.94
c	8.42	8.42	8.38	8.38
β		90°	90°15'	114°35'
system	orthorhombic	monoclinic (pseudo-orthorhombic)	monoclinic (pseudo-orthorhombic)	monoclinic
space group	*Pmmm*	$C222_1$	$B22_12$	$P2_1/c$
				$a:b:c = 1.131:1:0.937$ $V = 688.8$ Å³

*(k*X* = 1.002Å, k*X* units are no longer in widespread use)

TABLE 2

X-ray powder data for hydromagnesite. Guinier-de Wolff camera, Cu $K\alpha_1$ radiation.

I/Io	*dobs.*	*d*calc.	*hkl*	*hkl* (Murdoch orientation)	*d*obs. Murdoch	*I/Io*
39	9.20	9.194	100	200	9.18	4
38	6.40	6.409	110	210	6.44	4
100	5.79	5.799	011	111	5.79	10
7	4.58	4.597	200	400	4.58	1/2
17	4.46	4.470	020	020	4.47	2
31	4.186	4.190	002	002	4.21	2
12	4.090	4.088	210	410		
8	4.022	4.020	120	220	4.05	1/2

1	3.856	3.857	$12\bar{1}$	$12\bar{1}$		
		3.856	021	121		
13	3.812	3.815	$20\bar{2}$	$20\bar{2}$	3.81	1
		3.810	002	202		
14	3.503	3.505	012	212	3.50	1
28	3.317	3.318	$22\bar{1}$	$32\bar{1}$	3.31	3
		3.316	121	321		
16	3.207	3.205	220	420	3.21	1/2
22	3.142	3.149	211	511	3.15	1/2
11	3.101	3.099	$30\bar{2}$	$40\bar{2}$	3.09	1/2
10	3.088	3.094	102	402		
6	3.063	3.065	300	600		
11	2.919	2.924	112	412		
82	2.899	2.902	$22\bar{2}$	$22\bar{2}$	2.90	9
		2.900	022	222		
		2.899	310	610		
6	2.840	2.835	130	230	2.84	1/2
7	2.779	2.776	$13\bar{1}$	$13\bar{1}$	2.78	1/2
		2.775	031	131		
27	2.692	2.691	$32\bar{1}$	$52\bar{1}$	2.69	3
5	2.637	2.639	$21\bar{3}$	$11\bar{3}$	2.63	1/2
		2.638	$11\bar{3}$	113		
5	2.556	2.553	$23\bar{1}$	$33\bar{1}$		
		2.552	131	331		
4	2.543	2.544	122	422		
9	2.529	2.528	320	620		
22	2.504	2.501	230	430	2.50	3
10	2.478	2.476	$40\bar{2}$	$60\bar{2}$		
10	2.469	2.472	202	602		
5	2.442	2.443	013	313		
7	2.417	2.415	$41\bar{1}$	$71\bar{1}$	2.42	1/2
2	2.387	2.386	$41\bar{2}$	$61\bar{2}$		
14	2.350	2.350	$22\bar{3}$	$12\bar{3}$	2.35	1/2
		2.349	$12\bar{3}$	123		
33	2.298	2.299	400	800	2.30	3
4	2.233	2.235	040	040		
		2.232	$33\bar{1}$	$53\bar{1}$		
23	2.207	2.208	023	323	2.20	1
11	2.189	2.187	$42\bar{1}$	$72\bar{1}$		
11	2.185	2.186	321	721		
7	2.174	2.172	140	240		
20	2.161	2.163	222	622		
		2.160	$41\bar{3}$	$51\bar{3}$		
24	2.154	2.157	113	513	2.15	5
19	2.146	2.146	132	432		
		2.145	$14\bar{1}$	$14\bar{1}$		
		2.145	041	141		
12	2.137	2.137	330	630		
1	2.093	2.095	$20\bar{4}$	004	2.09	1/2
6	2.040	2.042	$10\bar{4}$	204	2.03	1/2
		2.040	$21\bar{4}$	014		
8	2.025	2.026	$23\bar{3}$	$13\bar{3}$		
		2.025	$13\bar{3}$	133		
5	2.012	2.014	302	802		
		2.010	240	440		
27	1.994	1.993	$42\bar{3}$	$52\bar{3}$	1.99	2
		1.992	$31\bar{4}$	$21\bar{4}$		
19	1.988	1.990	123	523		
4	1.974	1.972	$\bar{1}42$	042		
4	1.968	1.967	$51\bar{2}$	$81\bar{2}$	1.966	1/2
5	1.962	1.964	312	812		

TABLE 3

	1	2	3	4	
MgO	42.80%	43.9%	43.10%	1.0888	5.11
CO_2	37.20	37.5	37.64	0.8521	4
H_2O	18.65	19.0	19.26	1.0556	4.95
CaO	0.63				
Fe_2O_3	0.14				
SiO_2	0.30				
Total	99.72%	100.4%	100.00		

1. Hydromagnesite from Dovez, Iran; analyst H. Vachey
2. Hydromagnesite from Soghan, Iran; analyst H. Vachey
3. Theoretical composition for $Mg_5(CO_3)_4(OH)_4 \cdot 4H_2O$
4. 'Molecular' ratios for analysis No. 1

ACKNOWLEDGEMENTS

The authors express special thanks to Mr. Khadem, Head of the Geological Survey Institute of Iran, for his support and interest in the study of Iranian mineralogy, and to the Rezai Mining Company for their help in visiting the chromium deposits.

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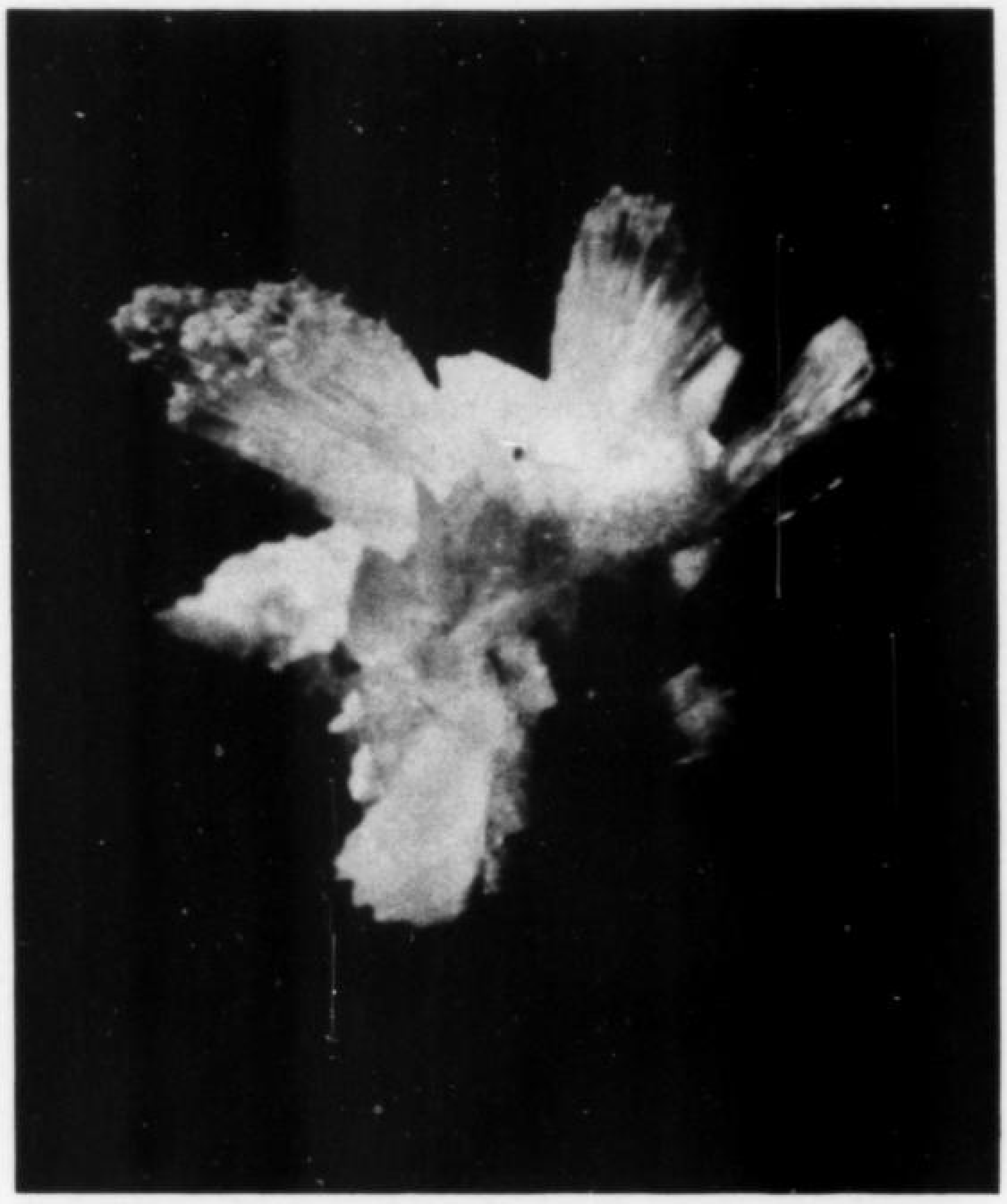

Thumbnail group of fan type crystals. Approximately 1" in size. ***Dick Kean, Reno, photographer.***

Hydroboracite from the Thompson Mine, Death Valley

by James W. Minette **25918 Cherryhill Drive, Boron, California**

and by David P. Wilber **P.O. Box 624 Woodland Hills, California**

INTRODUCTION

In November 1971, a major find of well-crystallized hydroboracite was made in the Thompson mine near Ryan, Death Valley, California. This mine has produced practically the first specimen-quality material available to collectors in the United States since the mineral was identified.

HISTORY OF HYDROBORACITE

Hydroboracite is a monoclinic hydrated calcium-magnesium borate ($CaMgB_6O_{11} \cdot 6H_2O$). It is white, and normally comes in long radiating crystals or fibrous-to-compact masses. It was first described in 1843 from a specimen from an unknown locality in the Russian Caucasus[1]. Since then, it has been noted in most of the major borate deposits of the world, but rarely in good display quality specimens.

Following are brief notes on known hydroboracite occurrences with regard to specimen quality. The authors recognize that these are, by their nature, subjective, and will elicit "But I saw in the Southern Mongolian Museum..." type of comments. The authors would like to receive these comments and perhaps see that the information is put into the *Mineralogical Record* in the future.

Russia — Inder Province, Kazakhstan. It occurs with other borates as an enriched zone at the contact of a salt dome and overlying gypsum beds[2]. Little is known about the quality as almost none has found its way into the Western World.

Germany — Stassfurt. Minor quantities are found embedded in salt beds. This is not a significant specimen locality.

Argentina — Salar de Cauchari.[3] This locality is described as a prominent hydroboracite locality. In fact, no hydroboracite was observed at this locality in the course of an extensive investigation of South American borate deposits. This type of error was observed in several places while tying to correlate the literature with a given borate deposit. (Pers. comm. Dr. Siegfried Meussig)

Argentina — Pastas Grande. A large body of fine grained to fibrous bedded hydroboracite is found at this locality, about 25 miles from Salar de Cauchari. This is probably the deposit referred to in the Argentine literature. No terminated crystals have been observed so far. (Pers. comm. Lloyd Fusby)

Turkey. The various borate deposits in Turkey have yielded some good material. It is described as two-inch spherolitic aggregates of needle-like crystals (personal communication with Dr. Werner Lieber). Comparative quality is not known, as little or none has found its way to the United States.

California — Boron. One large boulder containing long fibrous masses of hydroboracite was noted some years ago, but little was saved. This boulder had relatively long crystals, but the vugs never opened sufficiently to permit good hand specimens. Occurrences of good microcrystals were noted associated with tunellite-bearing vugs between 1957 and 1961. At about this same time, one fine hand specimen with 1-inch terminated crystals on colemanite was found. This specimen, now in the Rock H. Currier collection, compares favorably with the new Death Valley material.

California — Death Valley. This area has been known to contain hydroboracite since the 1930's. One fine specimen of well-crystallized material was found by the late Harry Gower in an abandoned miner's cabin in Furnace Creek Wash, with no clue as to source (— Thompson mine?). This specimen is now in the Borax Museum at Furnace Creek Ranch.

Hydroboracite was also reported from the Furnace Creek area, but with little indication of its quality[4]. At least no good specimens were ever seen or heard of.

Thus, it appears that few really good hydroboracite specimens were known to exist prior to the 1971 find in the Thompson mine. Others may lie unrecognized in collections confused with colemanite or ulexite.

HISTORY OF THE THOMPSON MINE

The Thompson mine is located about two miles west of Ryan in Furnace Creek Wash, Death Valley, California. The mine was developed and worked in the mid-1920's. It was shut down in the 1930's, and worked briefly again in the 1960's by the Kern County Land Company (now merged with Tenneco). The deposit is primarily colemanite, which occurs as beds with lake bed shales of the Furnace Creek formation in a long, tightly-folded, synclinal structure. The mine is opened by three vertical shafts which reach a maximum depth of 120 feet. Three levels take off from the shafts, and several small stopes are found between the levels. These workings produced several thousand tons of colemanite during the two production periods.

The current owners, Tenneco, have shut down the underground mine and are developing the deposit to the west with an open pit. The surface extension of the open pit will intersect and destroy the shafts within a few months.

The Thompson mine has long been noted as the source of milk-white, fist-sized colemanite crystals. These large crystals have been the focal point of interest to collectors at this site and are partly the reason that the hydroboracite escaped detection for nearly forty years.

DESCRIPTION OF FIND

The hydroboracite described herein was found by the authors on the bottom level of the mine in vugs with small colemanite crystals. At first glance in the mine, it looks much like colemanite. The first material collected was literally hanging out of the wall — a rarity today.

The mineral was noted in numerous occurrences along approximately 200 feet of drift length, but only two spots produced specimens worth collecting. In the rest of the deposit, an unsightly calcareous clay filled most of the openings, and the vugs themselves were much smaller.

The best occurrence was about 100 feet west of the main shaft where several fairly large colemanite vugs (baseball-sized to one over 3' X 1' X 6") were noted. This zone, about three feet high by ten feet long, sloped up into the ceiling and wall of the drift. The opposite wall was unproductive. About half of the vugs proved to be barren of hydroboracite. Even in the most productive vugs, hydroboracite amounted to less than 25% of total borates, with colemanite comprising the rest.

Two types of hydroboracite crystals were noted here, both snow-white to cream colored. The first type, which occurred predominately, but not exclusively, in tops and sides of vugs consisted of solid radial mounds of well-terminated crystals about 1 inch long by 1/8 inch wide. The crystals radiated from a central point, so maximum mound size was about 2 1/2 inches. These mounds were scattered among similar appearing mounds of 1/2 inch colemanite crystals. Hydroboracite formation started first, with the colemanite crystals' growth beginning about midway in the hydroboracite growth stage and continuing a little after. A few colemanite crystals were implanted on top of hydroboracite, but for the most part they were distinctly separate.

The second type of crystal was found on the bottom and lower sides of the same vugs. These were in very distinct individual fans of 3/8 inch long crystals growing out of colemanite. Fans reached a width of 5/8 inch at the top. This type made superb thumbnails and miniatures when two or more fans were joined at the base, or several fans sprouted out of a mound of colemanite. Few cabinet-sized pieces were collected of the fan type, as these tended to form in the smaller vugs.

The second good spot was about 20 feet west of the first, in the back of the drift, near a large ore chute. This spot produced very few specimens, but two were quite exceptional. Hydroboracite here was more tannish colored than in the first location. The groups were again radiating mounds and sprays but did not have a common point. Crystal size was about one inch long by 1/8 inch wide.

The largest specimen collected came from this area — about 6x8x3 inches — and is a large mound covered with 1/2 to 3/4 inch sprays of crystals. It is now in the Smithsonian collection. In case people tend to forget the effort involved in field collecting, eight hours in a two-day period were spent on this one piece, mostly with a four-pound sledge hammer while working overhead from an improvised scaffold!

A notable associated mineral from this spot was tunellite, found in sharp tabular crystals ranging up to 1/2 inch, but mostly microcrystals. The order of formation in this area appeared to be: *massive colemanite-hydroboracite-calcareous clay-tunellite.* Tunellite was inconspicuous but widespread. Only in a couple of pieces was it a significant associate with the larger hydroboracite crystals. It was noted closely adhering to colemanite crystals and, more commonly, loosely resting on clay. To the authors' knowledge, this is the first specific description of tunellite from the Thompson mine, and the fourth or fifth world occurrence.

Total hydroboracite collected by the authors and two other collectors amounted to approximately three or four flat boxes of really top grade specimens, and ten of good, well-crystallized representative material.

FUTURE

The productive zone has been moved back several feet into the wall, and the rock is very difficult to work now. Also, the size and quality of new vugs exposed on the last trip was decidedly inferior. Thus, while there is probably more material to be had, the bonanza days are definitely over.

It is possible the open pit will expose the zone in a few years, but the chances of a collector being on hand at the right time and the material surviving the mining process look rather slim.

We wish to thank Mr. Vincent Morgan and Dr. Gary Hansen for the original physical identification and X-ray checks on the hydroboracite. Dr. Gary Novak is also currently checking the tunellite in regard to strontium and barium content. Mr. Vincent Morgan provided invaluable help in regard to editing, advice on worldwide borate localities, and use of his very extensive technical library on borates.

The authors, because of the professional mining background of one, were able to obtain permission to collect in the Thompson mine. However, Tenneco does not normally grant entry into the underground mine. This is primarily due to the fact that the Thompson is an abandoned mine in the process of being razed as the open pit encroaches on it. Permission to collect in the open pit is easier to obtain due to fewer safety problems.

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Tetrawickmanite, Tetragonal $MnSn(OH)_6$ A New Mineral From North Carolina, And The Stottite Group

by John S. White, Jr. and Joseph A. Nelen

Smithsonian Institution

In 1966 one of us (JSW) received a large specimen of pegmatite from the Foote Mineral Company's spodumene mine, Kings Mountain, North Carolina, sent by Mr. Ed Heard of Raleigh, North Carolina. It consisted of intergrown masses of curved, platy crystals of gray-colored albite. Throughout the mass were irregular vugs averaging about 1 cm in diameter wholly or partly filled with dense, white, chalky-looking bavenite. The vugs all appeared to be connected by thin fractures, usually lined with the same chalky bavenite. A large vug on one side of the specimen was partially filled with bavenite. Implanted upon the bavenite surface, and partlyembedded in it, were approximately ten rounded, rough-surfaced, globule-like masses of a translucent, honey-yellow mineral. They averaged about 1 mm in diameter. A few were selected for x-raying and, on the basis of the powder pattern, the mineral was identified as wickmanite, isometric $MnSn(OH)_6$, a mineral that had just been described[1] by Moore and Smith (1967) from Långban, Sweden. With thoughts of writing a short note about a *second* occurrence of wickmanite, we went on to examine some of the other minerals of the Foote mine.

Several months later, on another specimen, crystals of the same color were observed but these were better formed and clearly tetragonal. The basal pinacoid was obvious. An x-ray diffraction pattern of these also seemed a good match for wickmanite but close examination of back-reflection lines revealed splitting, characteristic of a tetragonal, pseudo-cubic phase. The mineral, therefore, was not wickmanite, but its tetragonal dimorph! To emphasize this dimorphic relationship the mineral has been named tetrawickmanite, and the name has been approved by the I. M. A. Commission on New Minerals and Mineral Names.

Tetrawickmanite is rare at the Foote mine and has been found on a very small number of specimens. In addition to the specimens mentioned above, it has been found attached to the side of a free-standing eakerite crystal and perched upon quartz and late albite druses in an open cavity in spodumene-albite pegmatite. These crystals are turbid, brownish-orange in color. It is also found in association with siderite-rhodochrosite on late albite druses nearly buried in very fine-grained, sugary quartz. The sharpest, most transparent, brightest yellow crystals are those of the latter association. All of this type were supplied by Mr. Jack Eaker of Kings Mountain.

CRYSTALLOGRAPHY

The habit is such that the crystals remind one of tiny wulfenite crystals (Figs. 1a, 1b). The only forms identified on them are the prominent pyramid {112}, the pinacoid {001}, and a very minor prism {100}. Under the microscope the faces appear sharp enough to produce good signals on the goniometer. However, no useful reflection could be obtained from the pyramid faces. The scanning electron microscope photograph at a magnification of 6500X (Fig. 1c) reveals why this is so. The pyramid faces are very irregular and consist of a stack of plate-like units reminiscent of a brick wall where the mortar has been squeezed out between the rows of bricks. The indices of the pyramid therefore were assigned on the basis of the approximate interfacial angle and the knowledge, from single crystal precession photographs, that the *a* axes emerge from corners rather than from the centers of edges, that is, the pyramid is of the first order. The cell parameters, determined from precession photographs and computer refined powder data, are $a = 7.7870$, $c = 7.797$ (both ± 0.001) Å.

Subtle differences in the powder patterns of tetrawickmanite and wickmanite, alluded to above, are discernible in the powder data table. These differences are of the type one would expect of a pseudo-cubic tetragonal dimorph and, together with the mineral's tetragonal morphology and its uniaxiality, force the conclusion that the mineral is tetragonal. At the same time all evidence indicates that wickmanite is unquestionably isometric.

The space group, by analogy with stottite (tetragonal $FeGe(OH)_6$), is probably C^4_{4h}-$P4_2/n$.

CHEMISTRY

The mineral was analysed by electron microprobe using cassiterite and pure tin as standards. The authors had in-

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[1] The authors were provided with a preprint in 1966.

tended to use *type* wickmanite as a standard but our analysis differed so from that of Moore and Smith (Table 2) that we felt we should not. This difference in analyses is perhaps due to the use of different wickmanite crystals, even though taken from the type specimen. We tried growing synthetic $MnSn(OH)_6$ crystals for use as standards but without success. The analysis of tetrawickmanite generates the formula $(Mn_{.94}Fe_{.045}Ca_{.01}Mg_{.005})(Sn_{.984}Si_{.011}Al_{.005})(OH)_6$, if it is assumed that the iron is ferrous. However, the iron may be ferric, substituting for tin. A corresponding amount of hydroxyl would have to be converted to water to maintain charge balance. As will be seen, the optics and density lend support to this interpretation.

OPTICAL PROPERTIES AND DENSITY

Tetrawickmanite is uniaxial, negative, with $nO = 1.724$, $nE = 1.720$. Wickmanite has an index of 1.705 ±0.003. One would not expect such a great difference in indices between the two minerals if the iron in tetrawickmanite were ferrous. Ferric iron, on the other hand, in the amount of 2.3% could very well produce an index escalation of this magnitude.

Much tetrawickmanite appeared turbid under the microscope but transparent crystals were found. No evidence of twinning or cleavage was seen.

Density was measured by Berman balance and by Clerici solution flotation using grains of minerals of known density for comparison. From calculations it is apparent that tetragonal $MnSn(OH)_6$ should have a slightly higher density than the isometric form, it has a smaller cell volume. Ferrous iron replacing manganese would increase the density even more, but ferric iron replacing tin would serve to lower the density. In Clerici solution tetrawickmanite floats slightly higher than wickmanite so once again the ferric iron for tin interpretation is supported.

An error in the calculated density reported by Moore and Smith (1966) for wickmanite was discovered during the course of determining that of tetrawickmanite. A new value is given in Table 3.

OCCURRENCE

The pegmatite in which the mineral was found is considered to be a part of a narrow tin-lithium belt which runs across the middle of North Carolina in a NNE direction. It is mined principally for spodumene. A number of minerals regarded by one of the authors (JSW) as late hydrothermal are enriched in tin and/or manganese. The tin silicates eakerite, unknown #7 (potassium-lithium-tin silicate), and stannian titanite (∼4-6% Sn) are found in open fissures and in vugs produced by dissolution of primary minerals, chiefly spodumene. Many secondary manganese phosphates have been found in addition to abundant bavenite, vivianite and siderite-rhodochrosite. Primary cassiterite and manganoan apatite are dispersed throughout the fresh pegmatite suggesting that these minerals provided tin, manganese and phosphorus to late solutions as they were dissolved out of what is now vuggy pegmatite. Beryl,

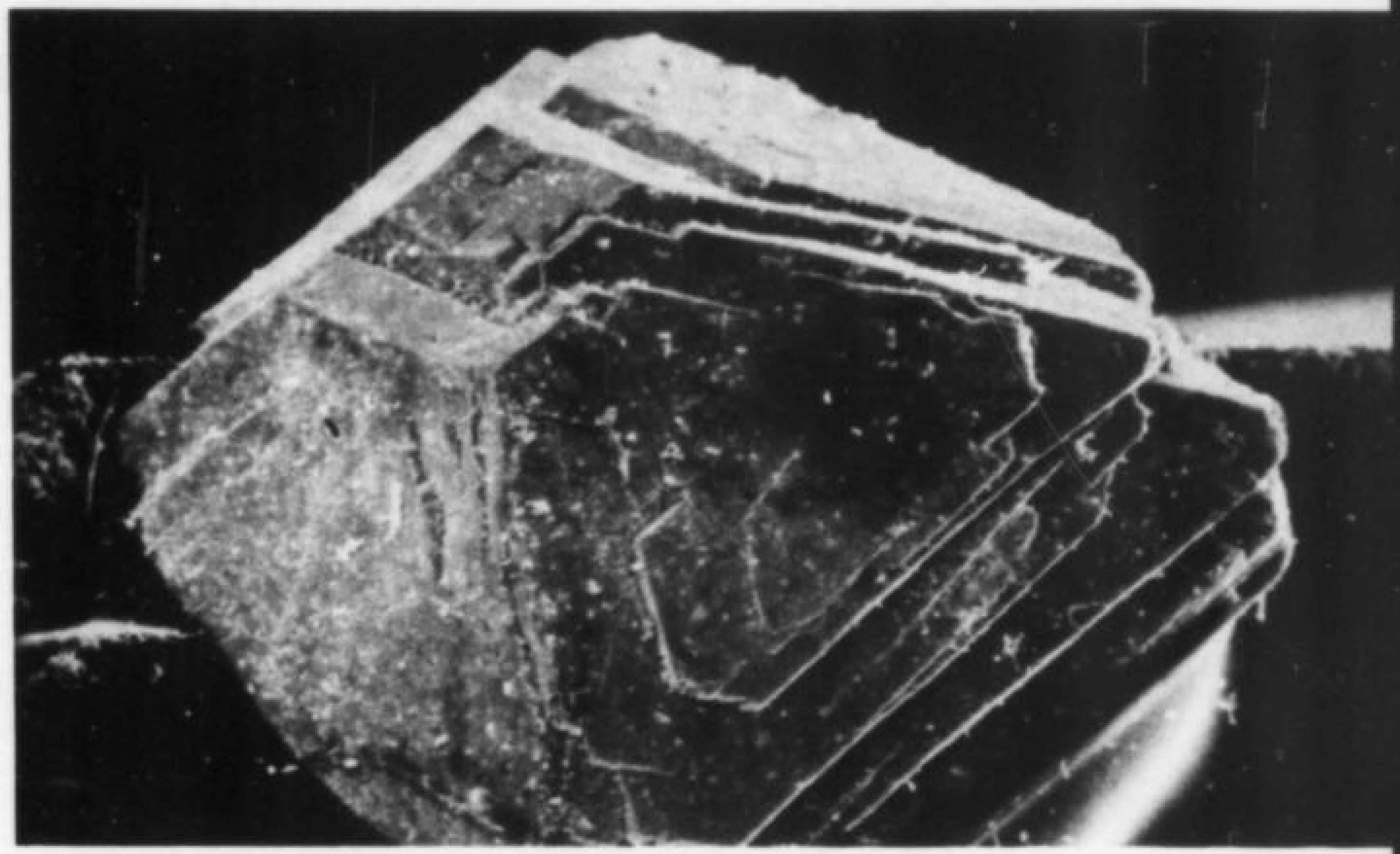

Fig. 1a.* Tetrawickmanite at 130X. *SEM photo.

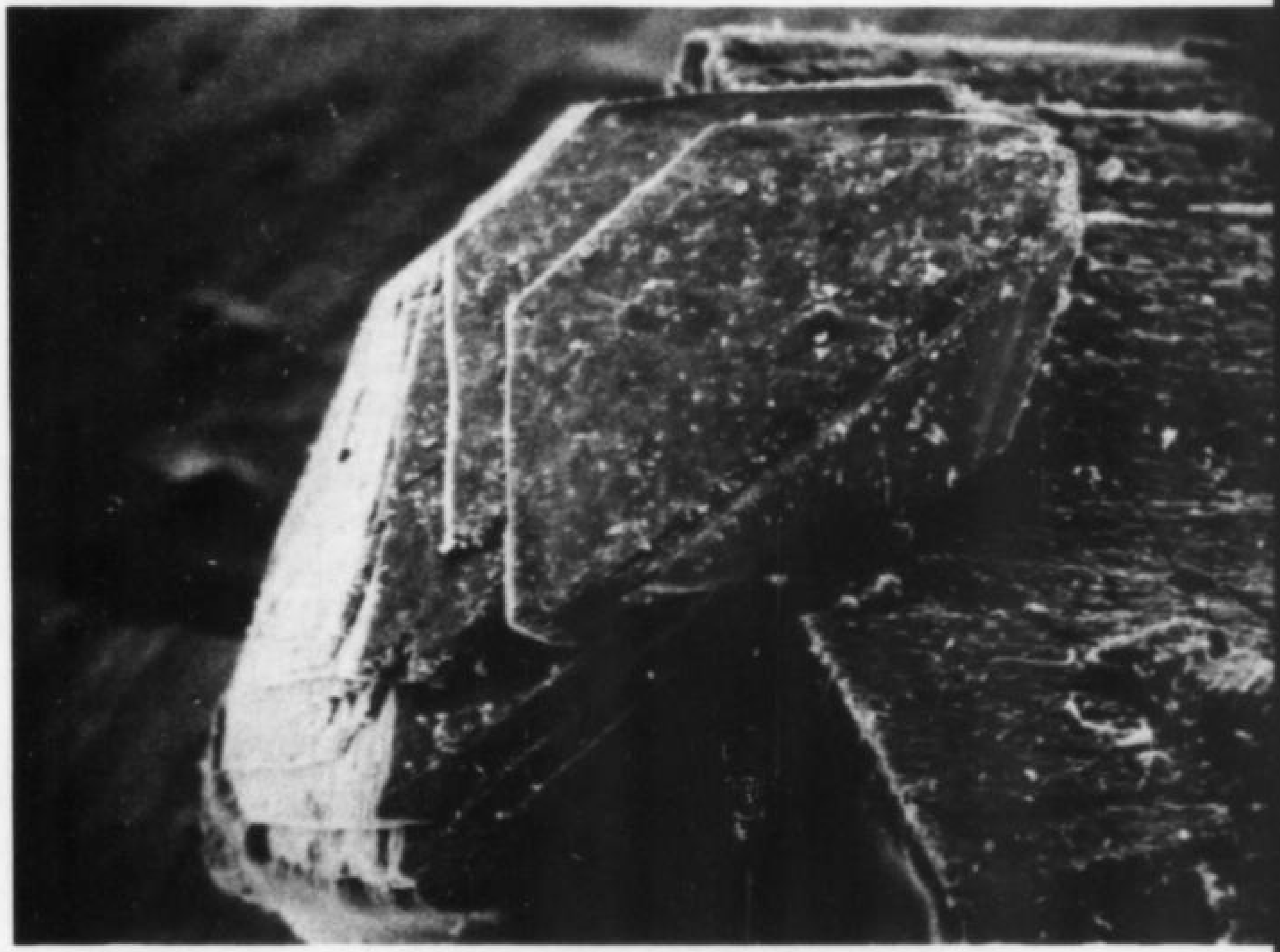

Fig. 1b.* Tetrawickmanite at 130X. *SEM photo.

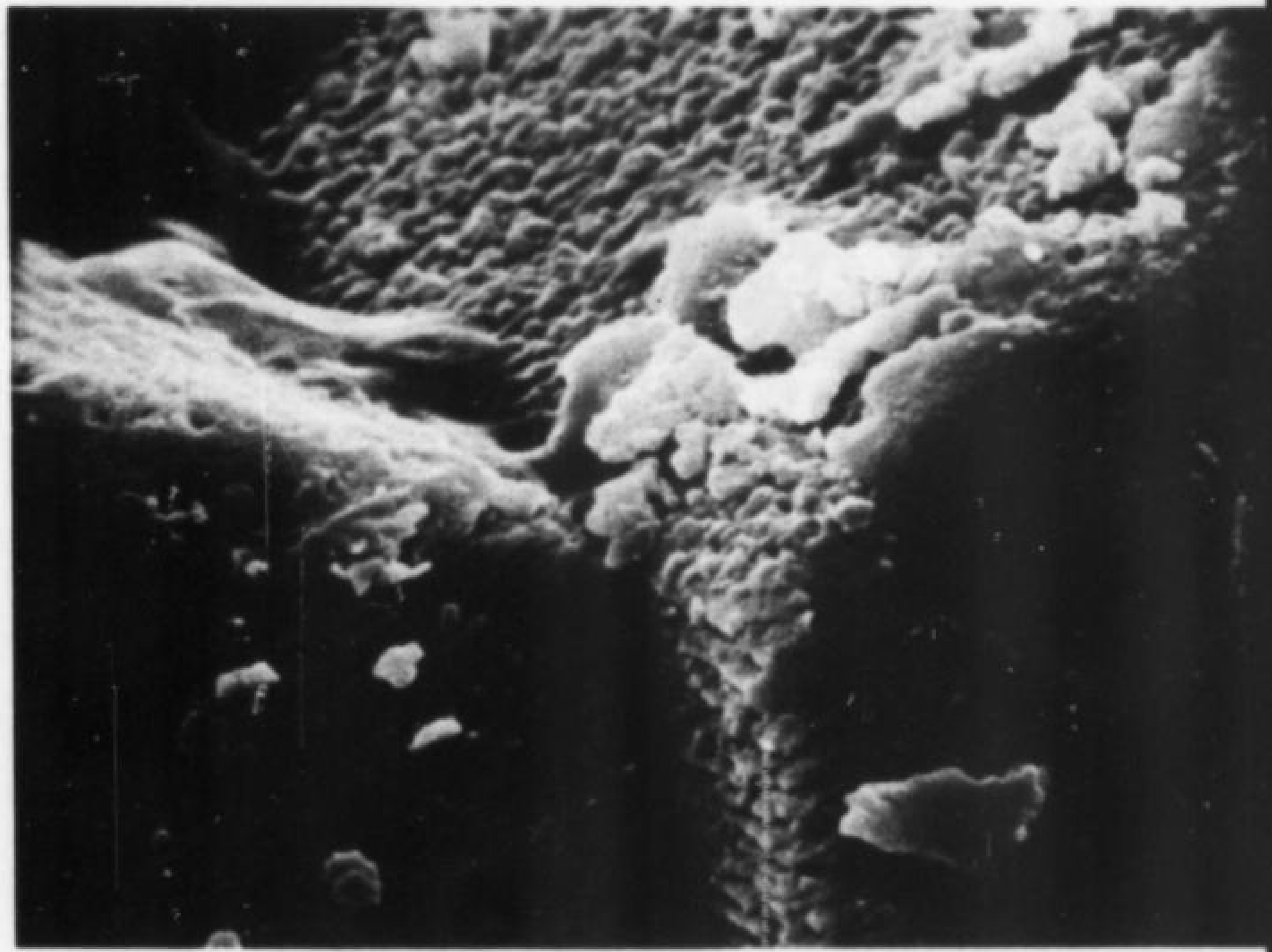

Fig. 1c.* Tetrawickmanite showing surface detail at 6500X. *SEM photo.

Table 1. Tetrawickmanite and wickmanite powder data.

TETRAWICKMANITE				**WICKMANITE**[1]	
I/Io	***dhkl*obs.**	***dhkl*calc.**	***hkl***	***dhkl*obs.**	***hkl***
30	4.518	4.529	111	4.552	111
100	3.939	3.935	200	3.931	200
30	3.880	3.898	002		
90	2.7698	2.7693	202	2.778	220
10	2.4820	2.4862	301	2.487	310
<5	2.4656	2.4678	103		
20	2.3697	2.3707	311	2.372	311
10	2.3535	2.3547	113		
25	2.2637	2.2647	222	2.273	222
5	2.1006	2.1018	321	2.104	321
20	1.9690	1.9674	400	1.9710	400
10	1.9493	1.9491	004		
				1.8060	331
50	1.7604	1.7600	420	1.7618	420
25	1.7458	1.7466	204		
40	1.6050	1.6039	422	1.6080	422
20	1.5970	1.5964	224		
				1.5138	511
10	1.3923	1.3912	440	1.4038	440
5	1.3850	1.3847	404		
5	1.3290	1.3270	531	1.3315	531
10	1.3222	1.3213	315		
				1.3130	600
5	1.3103	1.3102	442		
<5	1.3059	1.3061	424		
10	1.2434	1.2431	602	1.2452	620
5	1.2338	1.2339	206		
				1.2000	533
10	1.1851	1.1854	622	1.1882	622
5	1.1776	1.1774	226		
<5	1.1320	1.1323	444		
<5	1.0893	1.0882	604	1.0929	640
<5	1.0857	1.0843	406		
5	1.0660	1.0663	525		
<5	1.0453	1.0453	426	1.0536	642
5	.9522	.9522	644		
<5	.9504	.9496	446		
<5	.9443	.9453 .9411	724 427		
<5	.9252	.9274	660		
<5	.9226	.9231	606		
<5	.9180	.9188	616		
<5	.9005	,9023 .8987	662 626		
<5	.8970	.8964	832		
<5	.8560	,8560	119		
<5	,8505	,8502	706		
<5	.8352	.8357	646		
<5	.8334	.8334	843		
<5	.7998	.8019 .7982	844 448		
<5	.7978	.7980	904		
<5	.7961	.7963	656		
<5	.7852	.7849	339		
<5	.7829	.7828	942		
<5	.7804	.7804	816		

Cu/Ni radiation; 114.6 mm camera diameter; corrected for film shrinkage; visual intensity estimates.

[1] Moore and Smith (1966).

an uncommon mineral, certainly could have been the source of the beryllium that went into bavenite, bertrandite and milarite; and spodumene must have provided the lithium for bikitaite, eucryptite, lithiophilite and unk. #7. That tetrawickmanite is later even than siderite-rhodochrosite is demonstrated on one specimen where tetrawickmanite crystals have grown upon hemispheres of the carbonate. More than eighty species have been identified thus far at this exciting mineral locality.

The type specimens carry the catalog numbers 120239 and 121265 and are preserved in the collections of the National Museum of Natural History, Smithsonian Institution, Washington, D. C. There is so little tetrawickmanite on these samples that solicitations for specimens cannot be honored.

THE STOTTITE GROUP OF MINERALS

It may be an unprecedented phenomenon in mineralogy that an entire *group* of minerals made its appearance within the rather limited time span of about 15 years. Strunz *et al* (1958) published a description of stottite, iron germanium hydroxide ($FeGe(OH)_6$), found at Tsumeb, Southwest Africa. Although tetragonal, the mineral closely approximates cubic symmetry. Seemingly the discovery of this mineral helped to trigger a succession of new mineral descriptions. Strunz and Contag (1960) described a series of synthetic tin hydroxides (of iron, manganese, cobalt, magnesium and calcium) and it is perhaps true that this series was produced as a byproduct of an attempt to grow stottite, or its tin analog, in the laboratory. The synthetics, however, all turned out to be isometric.

Strunz then published (1965) a description of another Tsumeb mineral, sohngeite, given as $Ga(OH)_3$ and described as isotypic with dzhalindite but, when written as $GaGa(OH)_6$ and noting that it is cubic, the similarity to the cubic tin hydroxides of Strunz and Contag becomes apparent. The same may be said, of course, for dzhalindite (Genkin and Murav'eva, 1963), which may be written

Table 2. Electron microprobe analyses of tetrawickmanite and wickmanite.

	$MnSn(OH)_6$	Wickmanite (Moore & Smith)	Wickmanite (White & Nelen)	Tetrawickmanite (White & Nelen)
Mn	19.90	16.6	19.9	19.5
Fe	-	0.1	0.2	0.9
Ca	-	0.2	0.2	0.2
Mg	-	0.3	0.2	0.1
Sn	43.08	47.2	39.2	36.0
Si	-	-	0.05	0.4
Al	-	-	0.1	0.2

	$MnSn(OH)_6$	Wickmanite (M&S)	Wickmanite (W&N)	Tetrawickmanite (W&N)
(Mn,Fe,Ca,Mg)O	25.7	22.1	26.5	26.7
$(Sn,Si,Al)O_2$	54.7	59.9	50.0	46.4

$InIn(OH)_6$. Dzhalindite was found with cassiterite at the Dzhalindin deposit, Little Khingan Ridge, Far Eastern Siberia.

Little more than a year after Strunz's sohngeite came the description by Moore and Smith (1967) of wickmanite, cubic $MnSn(OH)_6$, from Långban, Sweden. Wickmanite is a mineral counterpart of one of the synthetic compounds of Strunz and Contag. Some five years later Faust and Schaller (1971) described schoenfliesite, $MgSn(OH)_6$, another of the cubic tin compounds made by Strunz and Contag. It occurs as a late-stage hydrothermal alteration product in a contact-metamorphic zone on Brooks Mountain, Seward Peninsula, Alaska.

The introduction here of tetrawickmanite, the tetragonal dimorph of wickmanite and the manganese-tin analog of stottite, further extends the list. Yet, the stottite group is even larger, but the existence of two more members is based in part upon indirect evidence so complete descriptions, and the naming of these two new minerals, will have to wait until new specimens are discovered. In his study of the minerals of the tin mines of Cerro de Llallagua, Bolivia, Gordon (1944) concluded with a note about an unknown that was in the form of an incomplete description:

> "*Dark brown twelvelings* (Text fig. 82). Tiny dark brown crystals of octahedral habit were seen on a single small fragment of a quartz veinlet. Perched upon druses of quartz crystals on a yellow felt-like aggregate of tourmaline needles, were isolated crystals of apatite, siderite, cubes of pyrite, and a few bladed crystals of franckeite.
>
> The unidentified crystals, rarely as much as 0.1 mm. in diameter, occurred upon the franckeite as a rule. They are slowly soluble in HCl, and consist of an isotropic core, slightly greenish-brown under the petrographic microscope, with an index of refraction of 1.745.
>
> The isotropic core has upon each of its twelve octahedral edges a prismatic crystal, four of them meeting on each cube face, and having exactly isometric angles. The prismatic crystals have about the same index of refraction as the isotropic core, and weak birefringence, with positive elongation. They are probably tetragonal, and uniaxial negative, with the crystal forms *a* (100), and *p* (111), and c/a = 0.707."

To the authors there seems little doubt that Gordon's material is $FeSn(OH)_6$ and belongs in the "stottite group." Wickmanite has an index of refraction of 1.705. One would expect the iron analog to have a higher index and the "isotropic core" and the "prismatic crystals" of Gordon have an index of 1.745.

The U. S. National Museum of Natural History inherited much of Gordon's Llallagua collection but the "dark brown twelvelings" could not be found. However, careful examination of other specimens of Gordon's revealed a few tiny brownish-orange crude spherules (up to 0.1 mm) with apatite, siderite, pyrite and franckeite. These produced a powder pattern very similar to that of wickmanite except that the lines are spread further apart reflecting the smaller cell of the iron analog. The strongest lines of the powder pattern are 3.83 (10)(200), 2.71 (9)(220), 1.710 (9)(420), 1.560 (8)(422), 4.40 (7)(111), 2.30 (5)(311), 2.21 (5)(222), and 1.910 (5)(400), intensities visually estimated and indices assigned by comparison with the data for synthetic FeSn $(OH)_6$ (Strunz and Contag, 1960). The pattern is clearly that of an isometric mineral, so the Llallagua mineral is an analog of wickmanite rather than tetrawickmanite. A microprobe analysis of one of these grains gave the following rough values:

	Ideal $FeSn(OH)_6$	Llallagua mineral	
Fe	20.2	19.0	31.4
Mn	-	1.4	
Ca	-	10.5	
Mg	-	0.5	
Sn	42.6	32.5	

There can be no doubt that the iron analog of wickmanite exists. Actually Gordon has shown that the iron analogs

Table 3. Tetrawickmanite and wickmanite densities.

	Moore & Smith (1967) Calc.	Moore & Smith (1967) Obs.	Present study Calc.	Present study Obs.
Wickmanite	3.75*	3.89±0.05	3.76	3.65
Tetrawickmanite	--	--	3.79	3.65(+)

*the calculated density of 3.82 reported in Moore & Smith (1967) was based on a faulty cell volume calculation.

of *both* wickmanite and tetrawickmanite exist, and on the same crystal! All evidence indicates that Gordon's crystals are composed of isometric $FeSn(OH)_6$ in the cores (simple octahedra) with oriented overgrowths along the edges of the tetragonal dimorph. He suggested that the overgrowths are tetragonal but he assigned the indices incorrectly. He should probably have realized that his 0.707 (a/c) equals sin 45°, a strong indication of misinterpretation. That the overgrowing phase is tetragonal is supported only by Gordon's statement that it shows weak birefringence and positive elongation and is probably uniaxial negative. Note that he reported the index of refraction to be the same as the core.

There are some problems in analysing the data from Gordon's material but they can be explained, even though the loss of the crystals he actually described precludes absolute proof. The chemical analysis, for example, shows that the sum of Fe, Mn, Ca, and Mg is far in excess of the ideal and the Sn content is much too low. Further, the refractive index is too high (1.745), for calculations using the Gladstone and Dale rule show that it should be about 1.723. Both the analysis and refractive index become reasonable, however, if we assume that some of the iron is trivalent and substituting for tin as described earlier in this paper in the case of tetrawickmanite. If we would calculate an analysis based upon one coupled Ca for Fe^{II} and one Fe^{III} for Sn substitution out of every four formula units, or:

$$Fe^{II}_2Ca_2Fe^{III}Sn_3(OH)_{23}H_2O,$$

the results are very reassuring.

	Hypothetical	Llallagua material
Fe^{II}	19%	17%
Ca	10.5	8
$Sn+Fe^{III}$	32.5	35

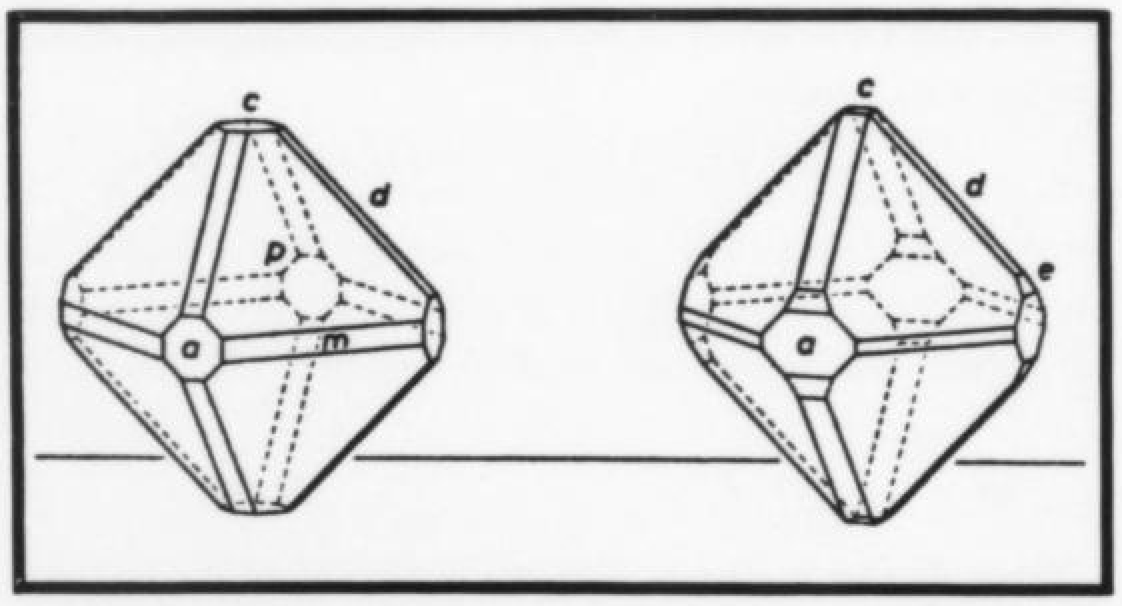

Fig. 2. **Drawing of stottite from Tsumeb, Strunz *et al* (1958).**

The presence of ferric iron will once again account for the higher than expected refractive index. All of this has only a minimal effect upon the size of the unit cell. The cell of the Llallagua mineral is 7.65Å (from powder data). Pure synthetic $FeSn(OH)_6$, as reported by Strunz and Contag (1960), is 7.79Å. Substitution of Ca^{II} for Fe^{II} (0.99Å vs. 0.76Å) is to some extent offset by the Fe^{III} for Sn^{IV} substitution (0.64Å vs. 0.71Å), so there is little overall cell size difference.

Therefore we may assume that the isometric and tetragonal iron hexahydroxostannates exist as minerals and that it will only be a matter of time before suitable crystals will be found to establish these new species. Any tin- and iron-rich locale would be a good place to look.

One such locality is Tsumeb. Geier and Ottemann (1970) provided brief descriptions of phases from Tsumeb which belong in the stottite group. They referred to these as *Minerals A, B, C,* and *D*.

Mineral A is a zincian stottite with the composition Fe 13.4, Zn 12.6, Co 0.9, Ni 0.2 and Ge 30.1. Cell parameters are $a = 7.512$ and $c = 7.438$Å.

Mineral B is the germanium analog of either wickmanite or tetrawickmanite, no powder or optical data provided. The analysis is Mn 23.2, Fe 1.2, Sn 2.7, and Ge 31.4.

Mineral C is isotropic so it is a germanian wickmanite with the composition Mn 21.5, Fe 3.5, Sn 39.6 and Ge 4.0.

Mineral D is described as a tin analog of stottite. It is essentially the same as either the isotropic or tetragonal mineral Gordon described from Llallagua. The analysis is Fe 14.2, Mn 3.5, Sn 43.4 and Ge 1.0. There is no powder or optical data provided.

There is still another locality reported for a mineral having the composition $FeSn(OH)_6$. Grubb and Hannaford (1966) identified extremely minute inclusions in Malayan

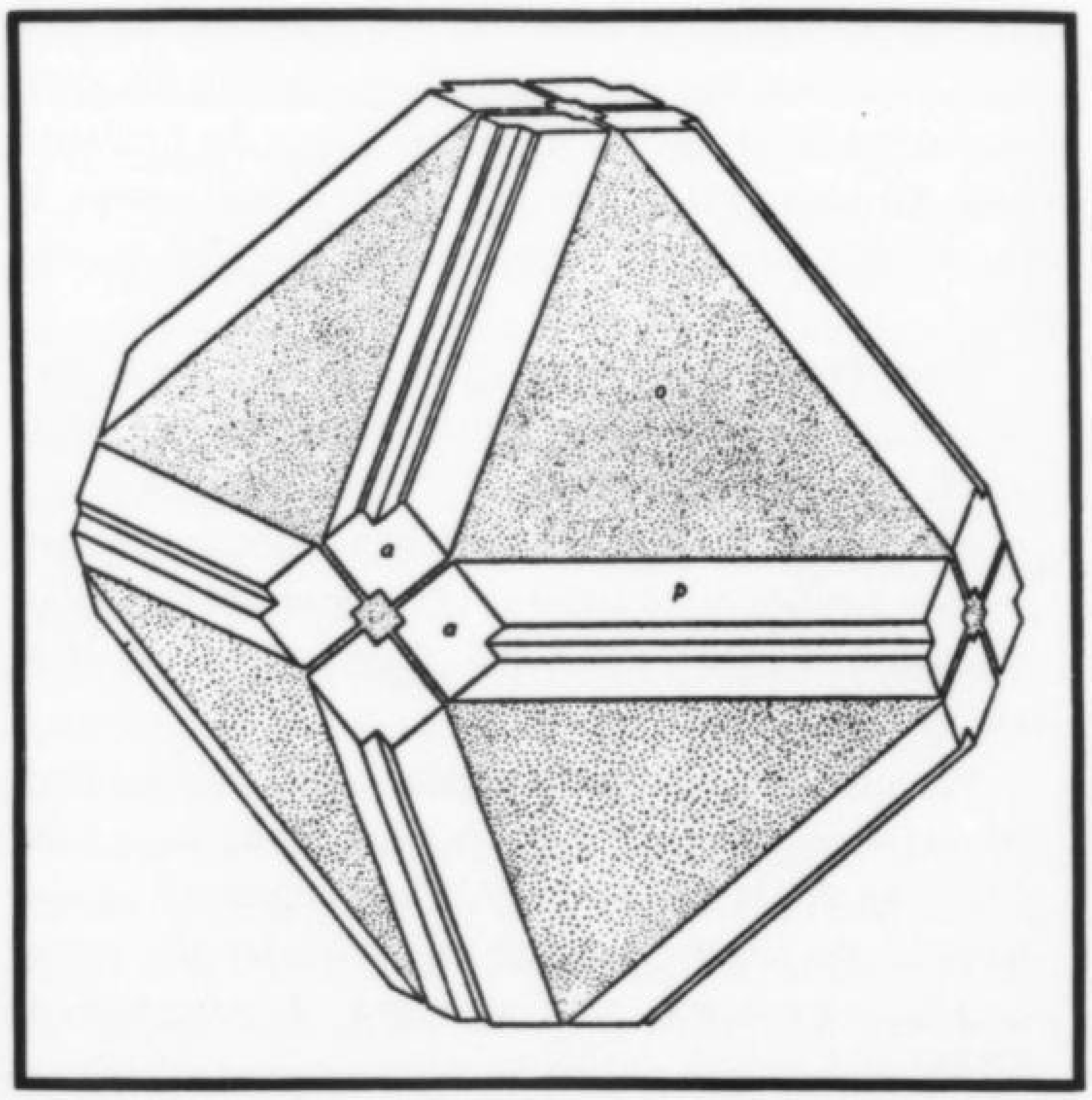

Fig. 3. **Drawing by Gordon (1944) of the "dark brown twelveling" from Llallagua.**

Table 4. Minerals of the stottite group and related synthetic compounds.

COMPOUND	SYNTHETIC		MINERAL			
	Cell Parameters	Reference	Mineral Name	Cell Parameters	Locality	Reference
ISOMETRIC						
$In(OH)_3$	7.958	Roy & Shafer*	dzhalindite	7.95	Far Eastern Siberia, USSR	Genkin & Murav'era
$Ga(OH)_3$			söhngeite	7.47	Tsumeb	Strunz
$FeSn(OH)_6$	7.79	Strunz & Contag	(unnamed)	7.65	Llallagua	Gordon White & Nelen
$MnSn(OH)_6$	7.88	Strunz & Contag	wickmanite	7.873	Långban	Moore & Smith
			mineral C			Geier & Ottemann
$CoSn(OH)_6$	7.78	Strunz & Contag				
$MgSn(OH)_6$	7.77	Strunz & Contag	schoenfliesite	7.759	Alaska	Faust & Schaller
$CaSn(OH)_6$	8.13	Strunz & Contag				
$ZnSn(OH)_6$	7.80	Cohen-Addad**				
$NiSn(OH)_6$	7.711	Morganstern & Badnan***				
TETRAGONAL						
$FeGe(OH)_6$			stottite	a = 7.55 c = 7.47	Tsumeb	Strunz, Söhnge, & Geier
$(Fe,Zn)Ge(OH)_6$			zincian stottite (A)	a = 7.512 c = 7.438	Tsumeb	Geier & Ottemann
$MnSn(OH)_6$			tetrawickmanite	a = 7.870 c = 7.797	North Carolina	White & Nelen
$FeSn(OH)_6$			(unnamed)		Llallagua	Gordon
CRYSTALLOGRAPHY UNKNOWN						
$MnGe(OH)_6$			mineral B		Tsumeb	Geier & Ottemann
$(Fe,Mn)(Sn,Ge)(OH)_6$			mineral D		Tsumeb	Geier & Ottemann

* Roy & Shafer, *J. Phys. Chem.*, **58,** 372 (1954)

** Cohen-Addad, *Bull. Soc. franc. Mineral. Cristallogr.*, **90,** 32 (1967)

***Morganstern & Badnan, Lab. Chim. Mineral., Univ. of Paris, France (1968)

cassiterite as iron hexahydroxostannate but it is very unlikely that crystals of sufficient quality to properly characterize the species will ever be found in this material. The best prospects appear to be the Llallaguan and Tsumeb occurrences.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the important contribution of Walter R. Brown (Smithsonian Institution) in taking the SEM photographs of tetrawickmanite. The x-ray data refinement was done by Miss Judy Konnert, of the U. S. Geological Survey.

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Note: A second locality for wickmanite has been recently reported by R. Åmli and W. L. Griffin, "Three Minerals

New to Norway: Wickmannite, Leadhillite and Hydrocerussite", *Norsk Geologisk Tidsskrift*, **52**, 193-196, 1972. Wickmanite was found as a poorly developed 0.5 mm crystal which was deep golden yellow under the binocular microscope. Associated with it are analcime, fluorite and a chlorite. It was found in a syenitic pegmatite intruding larvikite at Tvedalen (Heia quarry) near Larvik, southern Norway.

It is unfortunate that the authors misspelled wickmanite in the title and throughout the article.

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The Stevenson Bennett Mine, New Mexico

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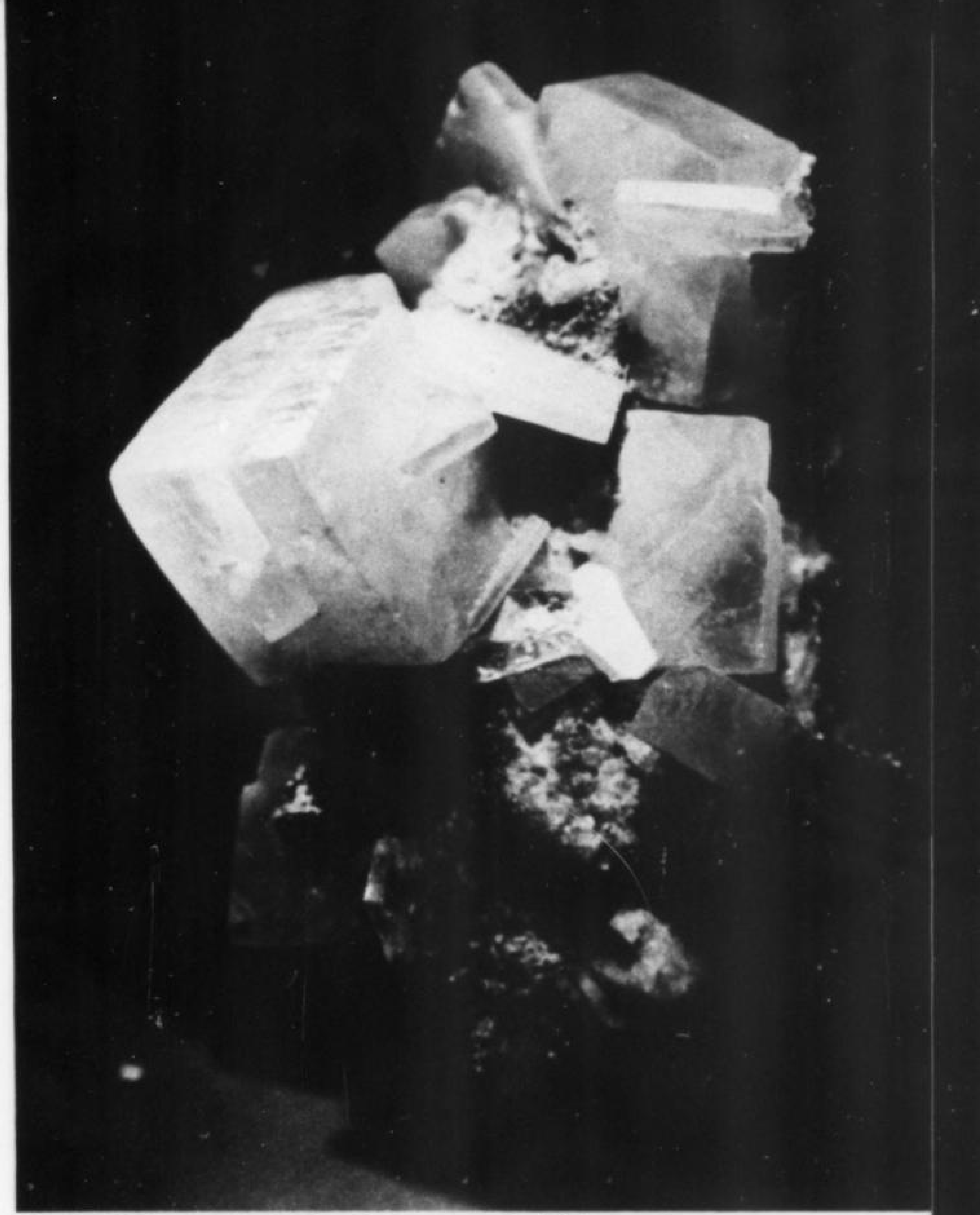

Fig. 1. **Wulfenite in thick tabular crystals. This specimen, from the Smithsonian collection, is 1-1/2 inches high.** ***Photo by Wendell E. Wilson.***

INTRODUCTION

The Stevenson-Bennett mine is historically significant as one of New Mexico's early silver mines and as the first lead producer in the state. Mineralogically it is of interest because of the mineral specimens it produced. Older specimens from the mine rival those from some of today's well-known localities. It produced wulfenite in pseudo-cubic crystals virtually indistinguishable from the Los Lamentos wulfenite, hemimorphite surprisingly similar to that from Mapimi, Durango, and cerussite which could pass as being from Tsumeb. Other minerals from the mine include galena, pyrite, quartz, aragonite, smithsonite, fluorite, sphalerite, pyromorphite, and caledonite. Its easy accessibility and the variety of material to be found on the dumps make it a worthwhile collecting locality, especially for those interested in the smaller sizes of specimens. In addition, the geological features which aided the mineralization of the area are easily observed.

LOCATION

The Stevenson-Bennett mine is in the Organ district, Dona Ana County, New Mexico. It is approximately 13 miles northeast of Las Cruces and 1.5 miles south of the town of Organ. The mine is easily seen from U. S. Highway 70 when traveling east. One mile west of Organ on U. S. Highway 70 there is a good dirt road to the south. Approximately 0.6 miles to the south on the dirt road is a pasture gate and a lesser road to the east. This road leads to the main workings of the mine, about 1.1 miles farther to the east. About a block south of the pasture gate is the gate to the driveway to the home of A. B. Cox. Permission to collect at the mine should be obtained at the house before entering the property.

The mine is shown on some topographic maps as the Empire Zinc Mine.

HISTORY

The property known as the Stevenson-Bennett mine is comprised of mines in two related ore bodies. The Stevenson lode was discovered in 1849 by a Mexican. Hugh Stevenson, a local resident, soon became a partner and later sole owner of the mine. In 1858 Stevenson sold the mine for $12,500 to United States Army officers stationed at nearby Ft. Fillmore. Up to that time the mine had produced about $90,000 worth of silver and lead. The mining had been done solely with pick and shovel. Ore was carried out on the backs of laborers, and then on to burrows for transport to the smelter, an adobe furnace at Ft. Fillmore (Jones, 1905).

The early operators of the mine were hampered by hostile Apache Indians, but the army officers had other troubles. In 1861 soon after their machinery for the mine had arrived, it was confiscated by the Confederates who had captured Ft. Fillmore. Their attempts to work the mine after the war were frustrated by the fact that it had been relocated. The litigations which followed resulted in the officers sharing half interest with the new locators (Dunham, 1935).

The Bennett ore body was discovered in 1887 by Carrera who was then leasing the property. Although less rich in silver than the Stevenson lode, it proved to be considerably larger. $250,000 in lead and silver were produced during 1887-1888. Carrera's lease then expired and mining was continued by the Stevenson-Bennett Consolidated Mining

Fig. 2. **Wulfenite in pseudo-cubic crystals up to one-half inch on an edge. Smithsonian Institution specimen.** ***Photo by Wendell E. Wilson.***

Fig. 3. **Tabular wulfenite crystals. This Smithsonian specimen is two inches long.** ***Photo by Wendell E. Wilson.***

Company which operated a mill on the property (Dunham, 1935).

In 1916 Phelps Dodge Copper Company took a lease on the Stevenson-Bennett and other local mines. Concentrating on development work, they relinquished their lease in 1917. American Smelting and Refining Company then leased the property, and removed a considerable quantity of ore. The mine equipment was dismantled in 1920, and little underground work has been done since then. Small milling operations processed some ore from the dumps in later years. The total production of the mine in 1935 was estimated at $1,200,000 (Dunham, 1935).

The underground workings of the mine have deteriorated considerably with time. Some of the tunnel portals have collapsed entirely. As early as 1935 the southern half of the mine was considered unsafe, and since then a fire has destroyed the timbering in the northern portion.

GEOLOGY

The Stevenson-Bennett ore bodies are in altered sedimentary beds which flank the Organ Mountains batholith. The geology of the Organ district was mapped and described by Dunham (1935). In relation to the ore bodies, the most important structure is a several-mile long north-south trending fault zone composed of parallel faults. The ore bodies lie in a one-mile long, narrow fault block in this zone which is bounded on the north and south by post-mineralization faults. Also important in relation to the ore bodies is an intrusive sheet of quartz monzonite porphyry. Generally the sheet strikes northeast and dips northwest. The sedimentary beds into which it was injected dip steeply to the west.

The creation of the fault zone took place after the intrusion of the porphyry sheet, providing channels for the circulation of mineralizing solutions. Along the faults are zones of brecciated dolomite and limestone. These were later silicified.

The ore bodies are related to faults, fissures and dolomite-porphyry contacts. They are tabular, irregular replacements in dolomite. The Stevenson ore body follows one of the eastern faults at and near the surface, and at depth follows the lower contact of the porphyry sheet. The most common minerals of the Stevenson ore body were quartz, green fluorite, smithsonite, cerussite, and a few residual masses of argentiferous galena. The larger Bennett ore body lies to the west. A fracture-controlled, tabular mass dipping steeply to the west, it averages 10 feet in width with a known vertical extent of 600 feet and a maximum length of 500 feet. The controlling fracture passes through the porphyry sheet, and the ore body resumes above the contact but does not reach the surface. Common minerals in the oxidized zone of this deposit were limonite, cerussite, and locally abundant wulfenite. Present in minor amounts were anglesite, smithsonite, and pale blue aragonite. This zone had natural caves filled with limonite containing much cerussite. Since this was easily mined, there is none left.

The lower levels of the Bennett ore body contained pyrite, galena, and sphalerite in a gangue of quartz and silicified dolomite. Much of this ore is still present in the mine. A small north-south fracture related deposit known as the Page ore body is located between the Stevenson and Bennett lodes. Minerals found there were largely limonite with cerussite and smithsonite in the oxidized zone, and pyrite and galena below (Dunham, 1935).

MINERALOGY

The following minerals merit individual comment. They include those presently collectable on the dumps, and older finds which have been preserved or recorded in the literature. Some older specimens are labeled with a combination of the following: Bennett mine, Organ Mountains, near Las Cruces, Dona Ana County.

Anglesite is found in its typical form as an alteration coating on galena cubes.

Aragonite is usually found as white botryoidal masses, but some pieces show bands of pale green. Some of the less compact growths suggest its typical pseudohexagonal form.

Caledonite was collected from the dump in 1896. Several crystals were found with the largest measuring 5 mm long by 3 mm wide (Northrop, 1959).

Cerussite. Superb specimens of cerussite were encountered during mining operations. Three of these are in the Harvard University collection. The finest is a nine inch long simple twin very similar to that shown in Figure 5. Since cerussite was a principal ore mineral, virtually all of it has been removed from the mine. Only a few small crystals may now be found on the dumps.

Fluorite is relatively abundant, especially on the upper dumps. It is found as cleavage fragments and partial crystals commonly larger than 1 cm. Usually a translucent green, it is also colorless and, more rarely, purple.

Galena may be found occasionally as well-formed single crystals about 1 cm on a side. These as well as less distinctive clusters are coated with anglesite.

Hemimorphite is best represented by some of the older specimens from the mine. Those in the Smithsonian's collection are composed of 2 to 3 cm long nearly transparent crystals in attractive sprays. Presently hemimorphite is readily found on the dumps in clusters of crystals in the neighborhood of 5 mm long. These crystals are usually well-formed and colorless, and have a high luster. Crystals 1 cm and longer are also available on the dumps, but quality seems to deteriorate with increase in size. Ford and Ward (1909) described hemimorphite from the Organ district which may well have come from the Stevenson-Bennett mine.

Linarite was found in small quantity in 1900 (Northrop, 1959).

Phosgenite. Several fine crystals of phosgenite were found prior to 1936. One crystal reported is 1 1/2 inches long, and some of the crystals are said to be larger (Northrop, 1959).

Fig. 4.* Hemimorphite crystals slightly longer than one inch. This is a portion of a crystal covered plate about six by four inches in the collection of the Smithsonian Institution. *Photo by Wendell E. Wilson.

Pyrite is common, especially on the lower dumps. Consistently occurring as pyritohedrons, the tarnished crystals are rarely larger than small peas.

Pyromorphite. A specimen with several elongated olive-green crystals was found recently on the dump. The crystals were about 2 mm in length, and were identified on the basis of crystal form, color, and hardness.

Quartz is abundant in small crystals. Among the more interesting are clear crystals with phantoms outlined by hematite.

Wulfenite is common in scattered areas on the dumps. Crystals range from opaque orange-brown pseudo-cubes to opaque or transparent bright yellow wafers. Few well-formed crystals, recently found on the dumps, are larger than 5 mm on an edge. While the mine was in operation

fine specimens were recovered. Some good specimens are said to have been removed from the mine recently, however, entering the mine is not considered prudent.

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Fig. 5.* Cerussite in a simple twin, about 1-1/2 inches long. Smithsonian Institution specimen. *Photo by Wendell E. Wilson.

The Collector, continued from page 5

their present resting places. With the unexpected discovery of more oxidized ore below the 2000 foot level within the last ten years, collectors have had a bonus chance at obtaining a fine Tsumeb azurite. These recent crystals for the most part are unaltered blue-black prisms, slender in their ratio of length to width, and commonly attaining sizes to several inches. Many cement breccia, and unfortunately their growth may thereby have been interrupted. Exceptional by any other standards, they suffer only by comparison to the earlier found crystals, and their like may never be seen again.

Mexico, however, may yet produce their equals. Distinctive, Roman-sword-shaped crystals, incrusting limonite, were imported into the U. S. in the early 1950's, from Concepcion del Oro, Zacetecas. Of unusual transparency, and commonly only 1/8 - 1/4 inch long, they rarely reached a length of one inch, and on one specimen I saw, two inches.

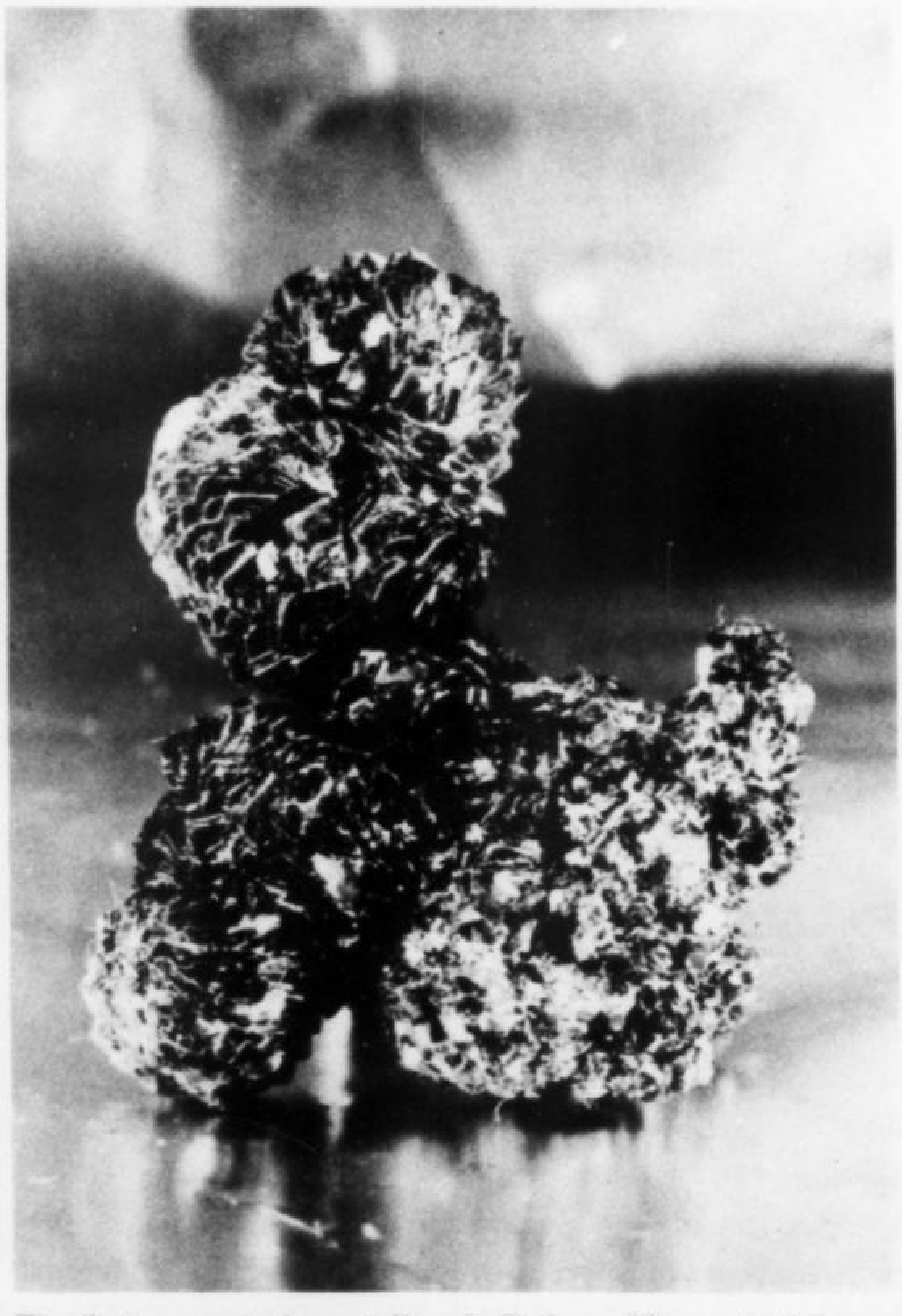


***Fig. 4.* Aggregated crystalline balls from Morenci, Arizona, 6 cm. high.**

***Fig. 5.* Morenci, Arizona. 2.5 cm. single crystal.**

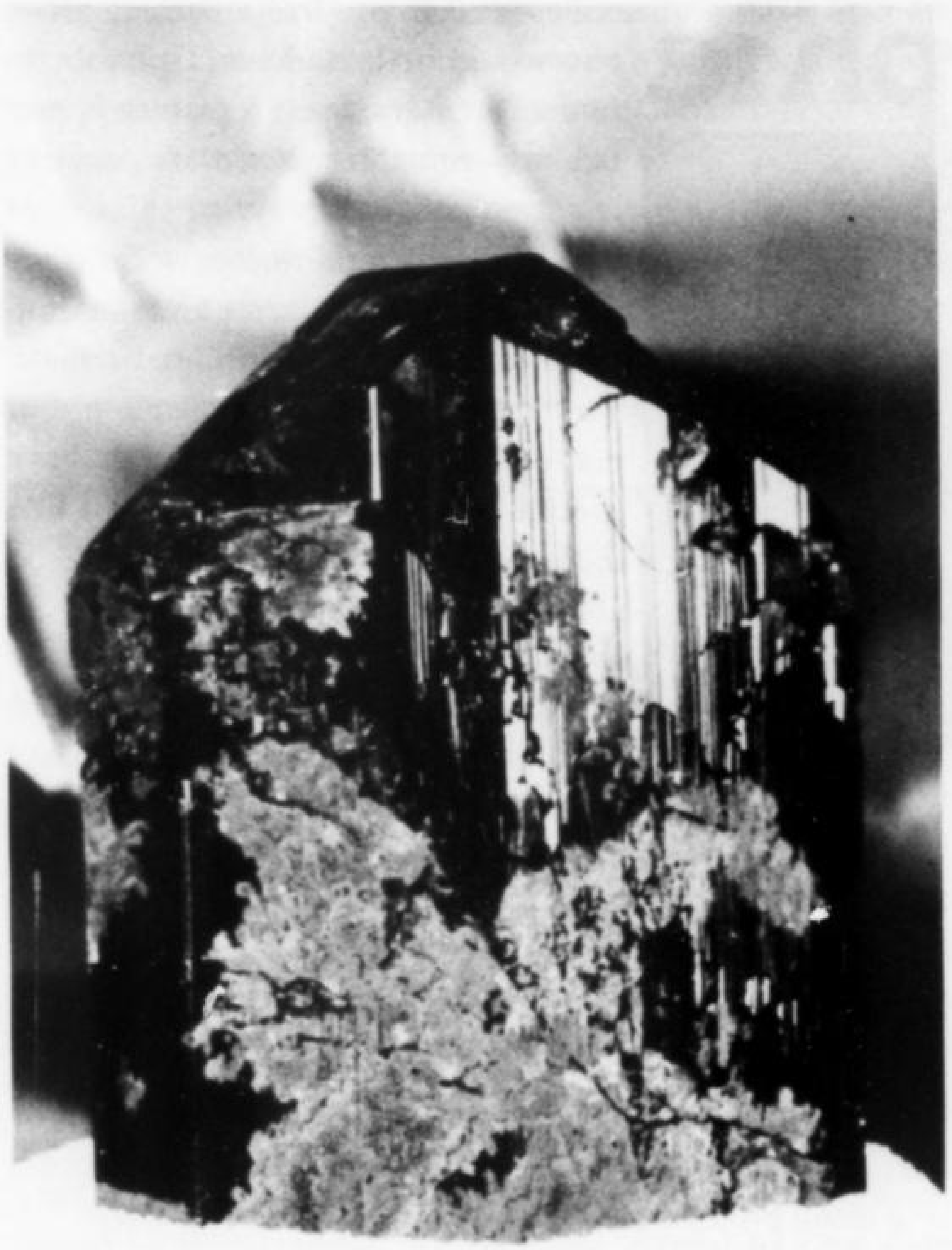


Fig. 6. **8 x 5 cm. crystal altering to malachite. Tsumeb, South West Africa.**

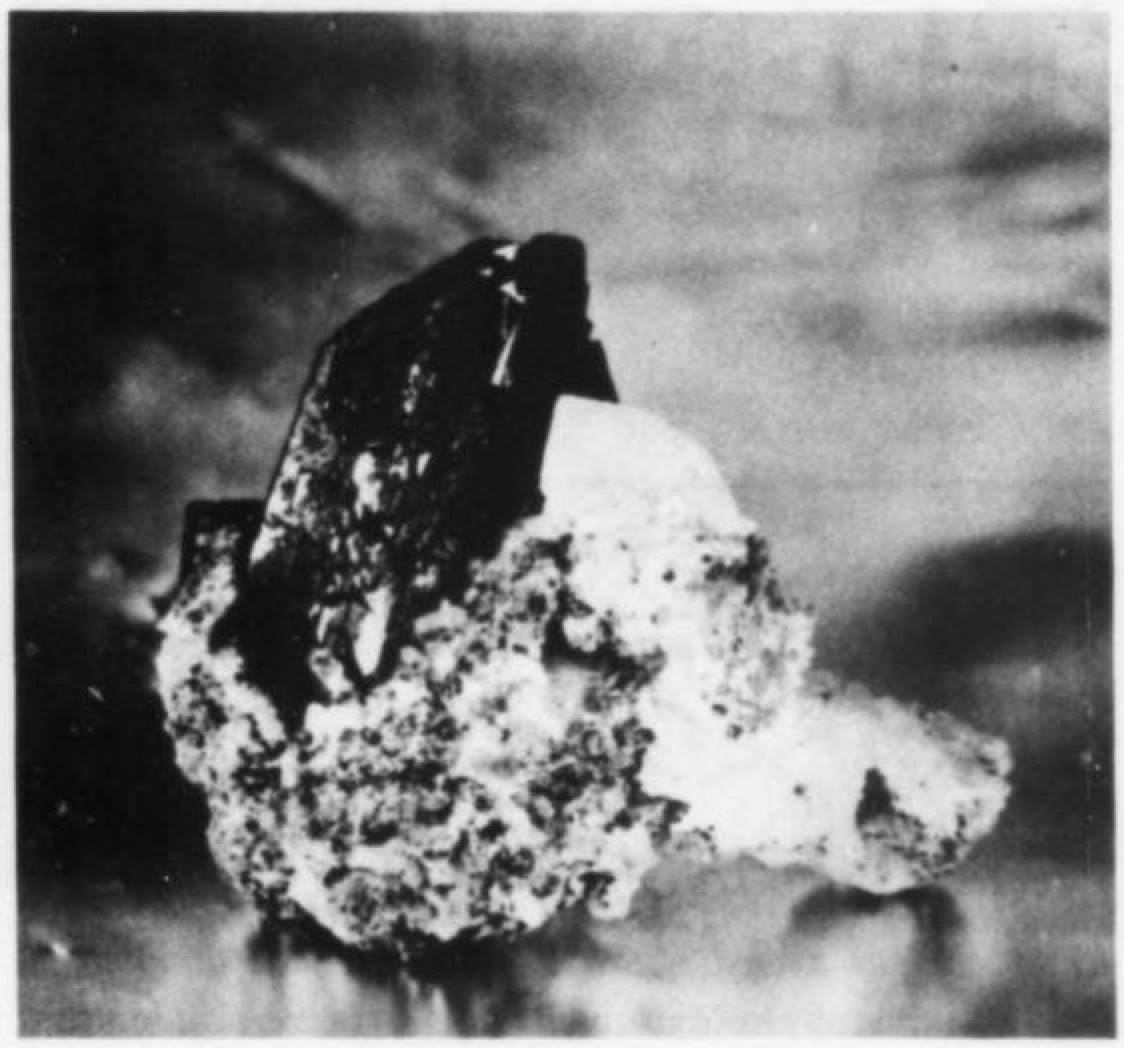
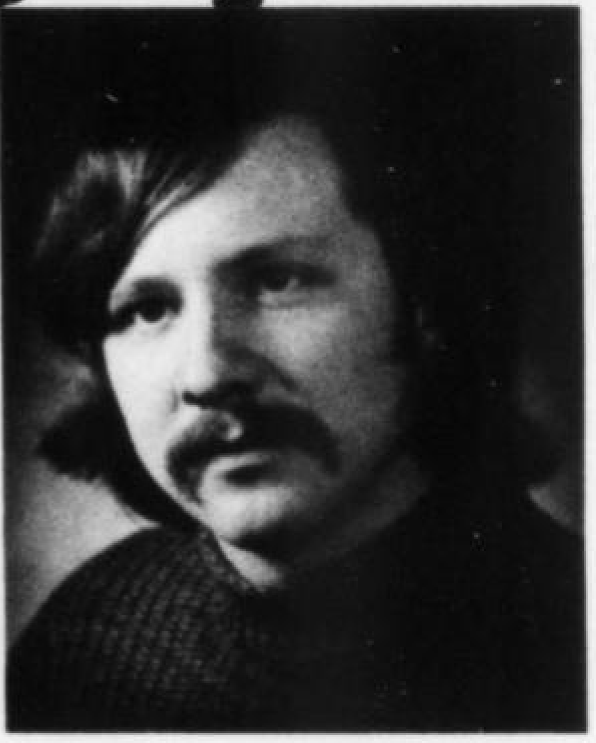


Fig. 7. **Azurite crystal 2.5 cm. high with quartz crystals on matrix. El Cobre, Zacetecas, Mexico.**

Several flats of pure crystalline masses, reminiscent of the Russian material earlier described, were seen several years ago from the El Cobre district, Zacetecas. Even larger crystals, very Tsumeb-like in their habit and alteration to malachite, and associated with calcite crystals, have been brought in by miners in small numbers from the El Cobre district. One large specimen has completely altered crystals the size of the palm of one's hand. Whether this is from long-abandoned workings, or from on top of another Bisbee, only time may tell.

All specimens figured are from the Richard A. Bideaux collection and the photographs were taken by the author.

The Photographic Record



by Wendell E. Wilson

Here begins a new column which shall be devoted to amateur mineral photography. Maybe you've noticed that really practical, useful information for the amateur is scarce. Most good photographers learned their skills and little tricks either directly from a photographer friend or through frustrating, expensive trial and error, I hope to provide here a source of such knowledge, as well as a forum for other photographers to share their acquired mystical secrets. Helpful advice, hints, corrections, etc., are eagerly solicited from readers, and will be published. Advice from the likes of Arem, Boltin, Weber and others will also be relayed to you through this column. Funnelling photographic insights through my own amateur brain to these pages, it is hoped, will keep the level intelligible to even the most foggy beginner.

If you aren't yet into mineral photography, consider the advantages before you dismiss it. I can think of at least ten ways you could benefit.

1. Collectors can acquire a great deal of simple satisfaction through photography of minerals. Not only is it a labor of love, but it seems to "amplify" your specimens in your own eyes. With skillful lighting and backgrounds, that modest thumbnail you kind of like is transformed into a breath-taking treasure. You may notice features of the specimen you never fully appreciated before. For one thing, photography is the Great Equalizer of specimens ... they all look the same size on film or print, and a thumbnail or even a micromount can suddenly put your favorite cabinet piece to shame.

2. Through photography you can "display" your collection to friends who are not able to visit your home, whether they be trading buddies in foreign countries or people met on trips. You can carry your slides or a scrap-book of color prints when travelling, so that you're never caught rhapsodizing, "If only you could see it!". Actually they may appreciate your smaller specimens *more* as a 5x7 print or projection on the wall, than they would holding the little thing in their hand.

3. When was the last time you gazed in hopeless fascination at some superb piece in a museum, show or friend's collection? If you had a camera along you would at least have a picture to remember it by. Such a picture is particularly valuable when the specimen is not on public display.

4. With mineral prices what they are today, every collector and museum must consider the possibility of theft. You can insure your collection but many pieces are irreplacable or have special personal value, and you'd like them back if possible. You *must* be able to identify your specimens in court. Catalog numbers can easily be removed by the thief, so without photographic documentation the court has only your word. All the defense counsel need do is show the judge two apparently identical galena cubes, and your case goes out the window.

5. According to the best data (*M.R.'s* Readership Interest Survey) nearly 13% of reader's specimens are acquired by trade, and over 11% are bought by mail. What better description to send your distant trading friends or customers than a picture? A slide costs only 12 or 14 cents — a small price to pay if it helps in a big trade or sale.

6. If you're a teacher, color slides of minerals can be one of the most spectacular teaching aids you can use. Good photography can make a fine crystal specimen look like the Crown Jewels, and very few will be unimpressed, even if they previously had no interest in science or mineralogy at all. Furthermore you can use your slides to illustrate lectures about field trips and collecting for mineral clubs, groups or shows. Next to a fine museum (and there are so few) photography is the best publicity agent mineral collecting has.

7. Skills learned photographing minerals are applicable to other types of photography. Try shooting a portrait of your favorite person as if he or she were a cabinet specimen. Good lighting and backgrounds are always a plus, and certain aspects are even applicable to scenery photography. Your mineral photography may evolve into a broad range of photographic abilities.

8. Have you found yourself sitting at home with no field trips in the near future, no shows coming up, nothing new at your local dealer, and a frustrating two-month wait before your next issue of *MR* arrives? You won't feel like your hobby is stagnating if you can while away hours questing after the Perfect Shot of your favorite specimens. And you'll be improving your skill with every hour you spend.

9. If you ever write research papers, reports, or articles for publication you will be amazed at how much a few photos can add. Even if minerals are not the subject, your photographic skills can capture your new orchid species, rare coin, new fossil discovery, newly invented apparatus, or whatever.

10. Photography of minerals can easily evolve into an art form. The photos themselves can become abstract compositions of great depth and beauty. Accurate or complete representation of the mineral is often subordinated to pure artistic expression. Paintings or drawings can be done using a photo or series of photos as a guide.

Readers undoubtedly have found more uses and are invited to let me know. I'll pass them on to readers of this column. The fact becomes obvious that mineral photography is a valuable skill in mineralogy and mineral collecting, and can greatly increase your enjoyment of minerals.

Wendell E. Wilson
8042 Bryant Ave. So.
Bloomington, Minn. 55420

Readership Interest Survey, continued from page 17

significant differences in the orientation and preferences of collectors from the western U.S., eastern U.S., and Europe. These differences are often accompanied by a certain regrettable degree of mutual disdain.

Nearly a third of all respondents (32.2%) frankly noted that they did not understand the distinction. Nearly another third (31.8%) considered themselves atypical, but there is no way of knowing their actual degree of perspective in the matter. Of the remaining third, nearly equal portions considered themselves "typically" Western and Eastern (16% and 13% respectively); similarly there is no way of knowing how many thought the question was just another way of asking "where do you live?". Less than 2% considered themselves typically European, and 5% did not respond to the question. Readers are invited to formulate their own conclusions from these data. Other questions arise: to what degree is a person's taste influenced or dictated by his geographical location? Are collectors at the mercy of their local dealers?

ARTICLE PREFERENCES

One of the most pertinent aspects of this study deals with reader's suggested improvements for the *Mineralogical Record.* Figure 3 illustrates the profile of suggested changes in the balance of articles. One of the features of note is the majority preference for more articles on "quality minerals and localities for TN and larger specimens". This is the ONLY type of article which a majority of readers agreed should be increased. Original research was least preferred for increases. Regarding the types which readers felt would draw more subscribers if increased, the trend was very similar as expected. However there was a significantly lower vote for original research and technical educational articles. The trend for articles readers desired reduced in number was generally inversely proportional to those they wished increased in number, with one exception: technical educational articles were desired reduced by a disproportionately large number of readers. A large porportion did vote for no subtractions at all, and no type of article drew more than a 16% desire for reduction. This indicates a commendable degree of tolerance and diversity of interest among readers. On the *average* it appears that the balance of articles satisfies most readers except for a desire for more articles on quality minerals and localities. All other types drew a significant vote with only minor differences, among which was a sensitivity to technical articles. The interest in technical articles would probably seem greater if the many readers using institutional copies had been polled.

WRITE—INS

Two-hundred twenty of the respondents availed themselves of the back side of the questionnaire for further comments. The most oft-mentioned plea was for color photos inside the magazine. Most also understood the financial problems involved for the magazine at this time. Be assured that the editor will add color inside the magazine, as a permanent feature, as soon as it becomes feasible. Other suggestions included low-level abstracts with technical articles, articles on display and competition techniques, labeling-cataloging-storage, specimen cleaning and preservation, classified ads, an exchange column for minerals, basic mineralogy articles, collecting techniques, mineral photography, obscure literature reclamation, optical mineralogy, old mineral books, a published list of subscribers, a "lost localities" column, home specimen testing, and a great many more.

One reader suggested an annual "mineral index" so that all references to any particular mineral can be located immediately. Another suggested that all locality articles be accompanied at the end by ads from dealers carrying the specimens discussed. There was a significant number of requests to avoid club news, as this is adequately covered elsewhere. Also notable was an undying paranoia regarding lapidary. Incidentally, more than one reader did not understand that "What's New In Minerals?" is written, and always has been, by John S. White Jr.

Obviously the write-in comments were of great diversity. For this reason all 220 questionnaires containing additional comments were bound up and presented to the editor for his personal perusal.

Finally, a plea was expressed for published photos of the editor and circulation manager, since just about everyone else on the staff has been seen. (Certainly a photo of the circulation manager would increase the appeal of ANY publication!) I will pressure the editor on this but cannot guarantee results.

ACKNOWLEDGMENTS

I would like to thank the 550 subscribers who took the time to fill out our questionnaire and send it in. An active, enthusiastic readership is an asset to any publication. I would also like to thank Miss Carolyn Wiese for the many hours she spent helping me go through the questionnaires.

Upcoming Shows

Apr. 5-7	South DeKalb (Atlanta), Georgia	(South DeKalb Mall Gem & Mineral Show)
Apr. 12-14	Dolton, Alabama	(Northside Mall Gem & Mineral Show)
Apr. 14-15	Hicksville, New York	(Hicksville Gem & Mineral Show)
Apr. 7-8	Emigsville, Pennsylvania	(York Rock & Mineral Club Show)
Apr. 28-29	Louisville, Kentucky	(KYANA Geological Society Show)
May 5-6	Lafayette, Indiana	(Wabash Valley Gem & Mineral Show)
May 5-6	Rochester, New York	("World's Greatest Little Gem & Mineral Show")
May 12-13	Lincoln, Nebraska	(Lincoln Gem & Mineral Show)
May 18-20	Washington, D. C.	(International Gem & Mineral Show)
June 2-3	St. Catharines, Ontario	(Niagara Peninsula Geological Society)
June 9-10	Bethlehem, Pennsylvania	(Mineral Society of Pennsylvania Earth Science & Gem Show)
June 9-10	Shartlesville, Pennsylvania	(Pennsylvania Rock Swap & Sell)
June 10	Hackensack, New Jersey	(Bergen County Mineralogy & Paleontology Society)
June 14-16	Chattanooga, Tennessee	(Eastgate Center Gem & Mineral Show)
June 15-17	**Turlock, California**	**(California Federation)**
June 15-17	**Oklahoma City, Oklahoma**	**(Rocky Mountain Federation)**
June 16-17	Topsfield, Massachusetts	(New England Gem & Mineral Show)
June 21-23	Atlanta, Georgia	(Perimeter Mall Gem & Mineral Show)
June 28-30	El Cajon (San Diego), California	(Parkway Plaza Mall Gem & Mineral Show)
June 28-July 1	**Charlotte, North Carolina**	**(American Federation and Eastern Federation)**
July 26-29	**Cincinnati, Ohio**	**(Midwest Federation)**

The Museum Record, continued from page 6

parisons; in addition the first collections encountered have been notably enriched since my visit, and my visits themselves were not always exhaustive, only the specimens showing being in general examined.

All this being admitted, these notes would make it possible to visit a collection and quickly see the best specimens. They also give information on the major mineral localities of the world, the form, the characteristics of the most beautiful specimens, helping one to think of an "Imaginary Museum" where all the marvels of the mineral world would be deposited."

The collections listed for the United States are: Harvard University in Cambridge, Massachusetts; American Museum of Natural History in New York; George Burnham in Los Angeles; John Jago in San Francisco; the Smithsonian in Washington. Since the time of writing, the Jago collection has become part of the Smithsonian's. There are 47 specimens which he classes as *spécimens exceptionels* (without doubt the best in the world) listed for the American Museum, Harvard and the Smithsonian. Interestingly, there is an overlap in only eight of these species in the three museums — beryl, microlite, orpiment, rhodochrosite, spodumene, titanite, topaz and tourmaline. Of these, the spodumene, titanite and tourmaline represent different localities so that on the whole his judgements of "best in the world" seem to hold up pretty well in this limited U. S. check.

Renewing my acquaintance with the publication while I'm writing this column, it's a pleasure to be reminded of my favorite specimens I have seen in many of these collections. Harvard's cerussite from the Stevenson-Bennett mine in New Mexico; the American Museum's rutile from Graves Mt., Georgia; Jack Jago's Bolivian vivianite and our own Brazilian chrysoberyl from the Roebling collection seem like old friends revisited. I must go soon again and bow three times before each of them.

THE MINES OF TRAVERSELLA

by Prof. Sergio Gallo

Via Ventimiglia no. 188
10127 Torino, Italy

The Traversella mines and the village of Traversella are located at nearly 800 meters of altitude near Ivrea (25 km) and not far from Turin (70 km), in northern Italy. In September, 1971, when the Fiat Company definitely closed the activities of Traversella's magnetite mines, the news was met with profound regret in the European world of mineral collectors. This is a large group of deeply interested followers who, on weekends and holidays, climbed to the mines and went to the miners' villages to look for and acquire minerals from the mines, famous for their beauty and rarity the world over.

The story of the Traversella mines is a very old one. Glancing through the old documents in the museums and public buildings of the valley, it is possible to find information of extreme interest. The first record of mineral activity in this deposit is found in the writings of Tito Livio, who told the story of how the Consul Appio Claudio (5th Century AD), after a hard struggle against the Salassi, occupied the Salassis' mines, which included "Phornellus Proemium", i.e. Traversella. Following the story of these mines in the centuries after, we find testimonies of remarkable mineral and metallurgical activities in the valley and of the operations of the Romans until the Middle Ages — evidenced by the presence of the furnaces for the preparation of iron, that the early artisans and armourers were looking for because of its superior hardness and resistence. The better characteristics of the Traversella iron are now explained by the presence in the magnetite of small quantities of a tungsten ore (scheelite).

In 1387 a document gave to the Dukes of Savoia (a family which has carried for successive centuries the sovereignty of Italy) the direct rights to the mines of Traversella. From this date the mines developed greatly and in the period from 1450 to 1500 there were more than 22 furnaces for the reduction of the minerals from the local mines. The mines in this area knew good periods of prosperity, as during the time of Napoleon. A document of 1800 reports about 75 km of tunnels for all the mining complex, with a yearly production of about 8,000 tons of ore.

In more recent years, from 1939, the Fiat Company extracted magnetite with rates of production of 400 to 500 tons per day, recovering with magnetic separation and foam flotation the minerals pyrite, chalcopyrite and scheelite. In the last few years, the scheelite deposit has been almost completely exhausted, and the production of magnetite has become less and less economic, the activity of the mining area becoming smaller until mining ceased.

The mines of Traversella are the birthplace of two processes of enrichment of the minerals which today are used all over the world: magnetic separation and foam flotation. In fact, the magnetic separation of minerals was experimented with and improved in these mines in 1855 by the engineers Q. Sella and Froment, and a model of their equip-

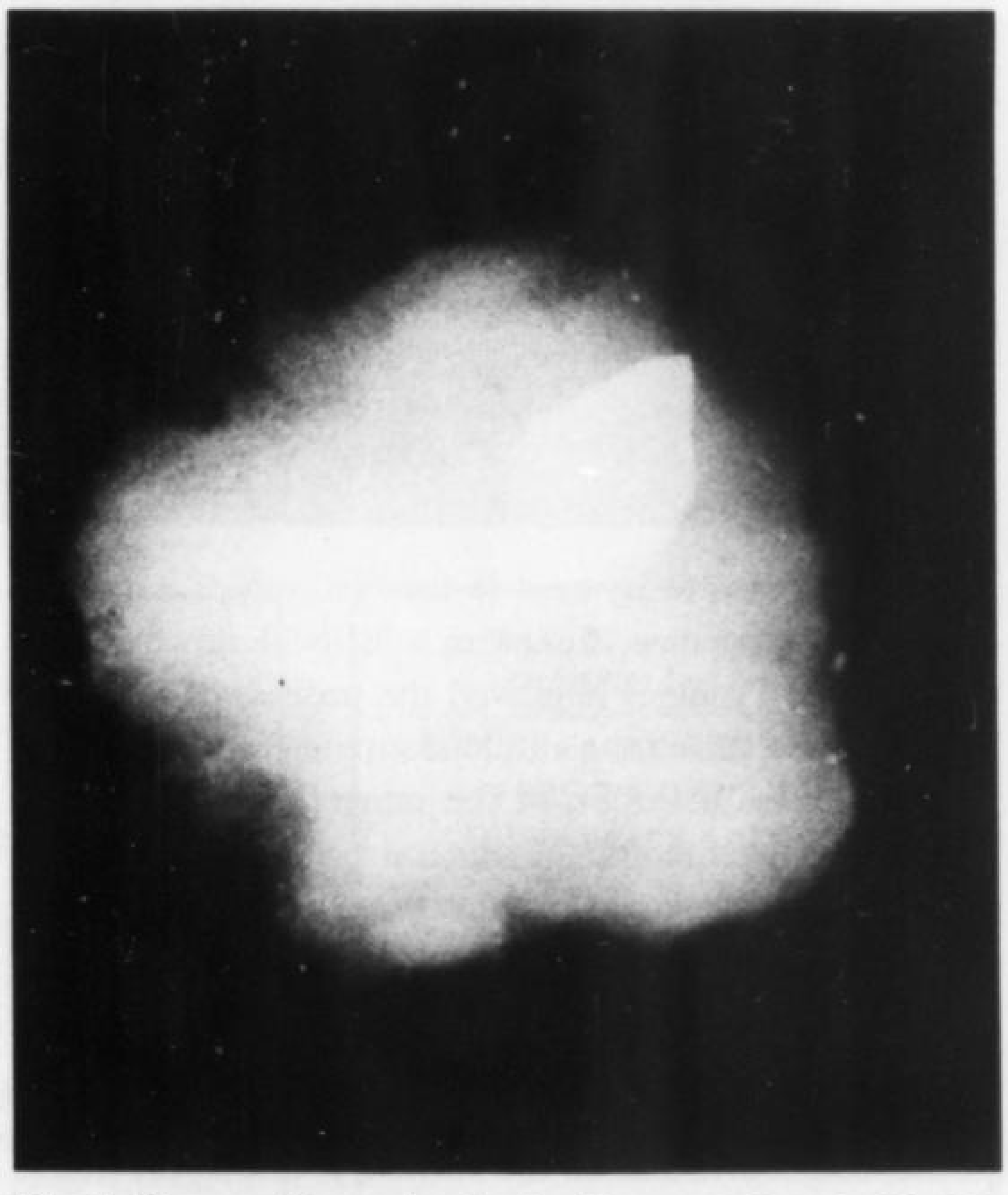


Fig. 1. **X-ray radiograph of scheelite crystal embedded in schist. The form of the 4 cm. long crystal is clearly outlined.**

Fig. 2. **A 7 cm. long scheelite crystal in matrix.**

Fig. 3. **An exceptionally large scheelite crystal, it measures 9 cm. in length.**

Fig. 4. **One of the largest and richest groups of scheelite crystals ever found. It is nearly 30 x 20 cm. and the weight is nearly 20 pounds.**

Fig. 5. **Large white dolomite crystals with ferroan magnesite (mesitite) in flat brown disc-shaped crystals. The specimen measures 15 x 12 cm.**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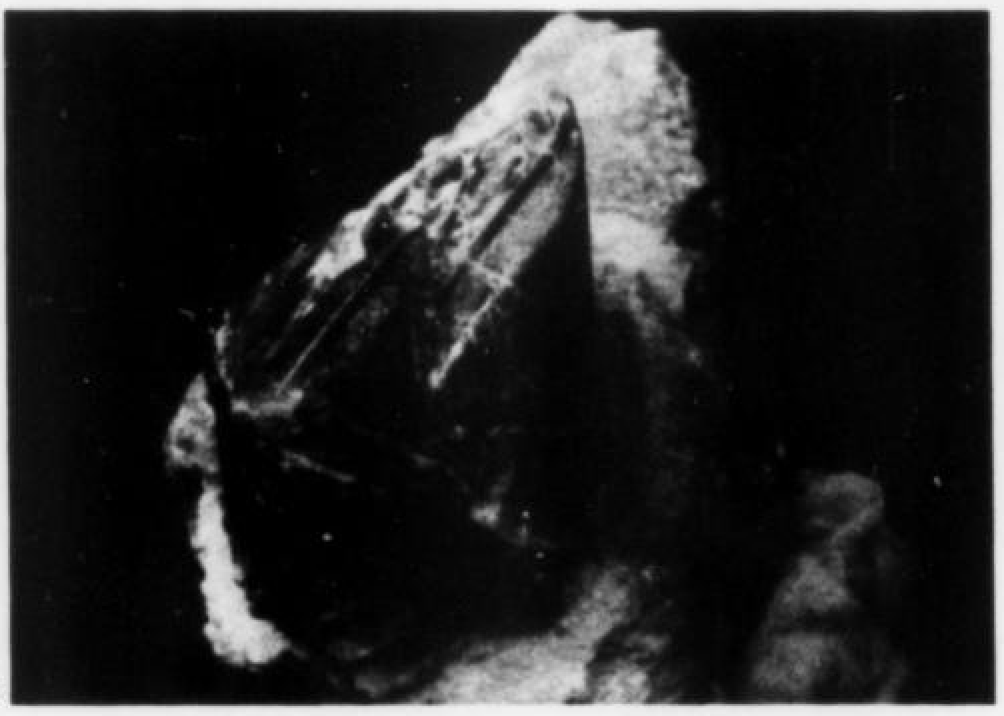
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ment (of 1858) is today kept in the "Istituto di Arte Mineraria del Politecnico di Torino". In the following years the engineer Froment improved the process of foam flotation for the separation of chalcopyrite from magnetite.

Although the attention of the miners has always been turned to magnetite, for the mineral collector the Traversella's mines represented a source of many and varied minerals. A very old legend of the miners says that the good God, after having made the earth, began to distribute from his sack all the minerals on the earth's surface, scattering gold, silver, malachite, pyrite, rhodochrosite, epidote, galena, magnetite, etc. on the various points of the globe, until He arrived at Traversella and found that the sack was empty. He shook it and all the pieces fell out, forming this mine. In it you can always find, in small quantities, very many minerals (Table I). Over 70 different species or varieties are listed among which are traversellite, a variety of actinolite, and at least one mineral (of which the writer has a few samples with crystals similar to those of boulangerite), found once in a small pocket, that has not yet been identified. Among the best known and beautiful are: scheelite, magnetite, dolomite, ankerite, quartz, mesitite (ferroan magnesite), pyrite, hornblende, epidote, fassaite (a clinopyroxene), galena, garnets, calcite and siderite.

Without a doubt the most looked for, because of its beauty and crystal perfection as well as its extreme rarity, is the scheelite. The straw-colored crystals in the bi-pyramidal habit, sometimes of remarkable dimensions, are rarely

Table I.

Species and varieties of Minerals found at Traversella

Actinolite
Ankerite
Apatite
Apophyllite
Aragonite
Arsenopyrite
Augite
Azurite
Barite
Biotite
Bismuthinite
Byssolite (var. of actinolite)
Calcite
Cerussite
Chabazite
Chalcopyrite
Chlorite
Chrysocolla
Clinochlore
Cobaltite
Copper
Cordierite
Cubanite
Cyanotrichite
Diopside
Dolomite
Edenite (var. of hornblende)
Epidote
Fassaite (var. of augite)
Fluorite
Galena
Garnets (esp. grossular, var. hessonite)
Goethite
Gold
Hedenbergite
Hematite
Hornblende
Ilmenite
Limonite
Magnetite
Malachite
Marcasite
Mesitite (ferroan magnesite)
Molybdenite
Nacrite
Olivine
Orthoclase
Pyrite
Pyrrhotite
Quartz
Rutile
Scheelite
Serpentine (var. chrysotile)
Siderite
Speziaite (a clinoamphibole
Sphalerite (var. marmatite)
Spinel
Stibnite
Stilbite
Sulphur
Talc (var. steatite)
Tetrahedrite
Titanite
Traversellite (var. of actinolite)
Tremolite
Uraninite
Villarsite (altered olivine)
Wolframite
Zoisite

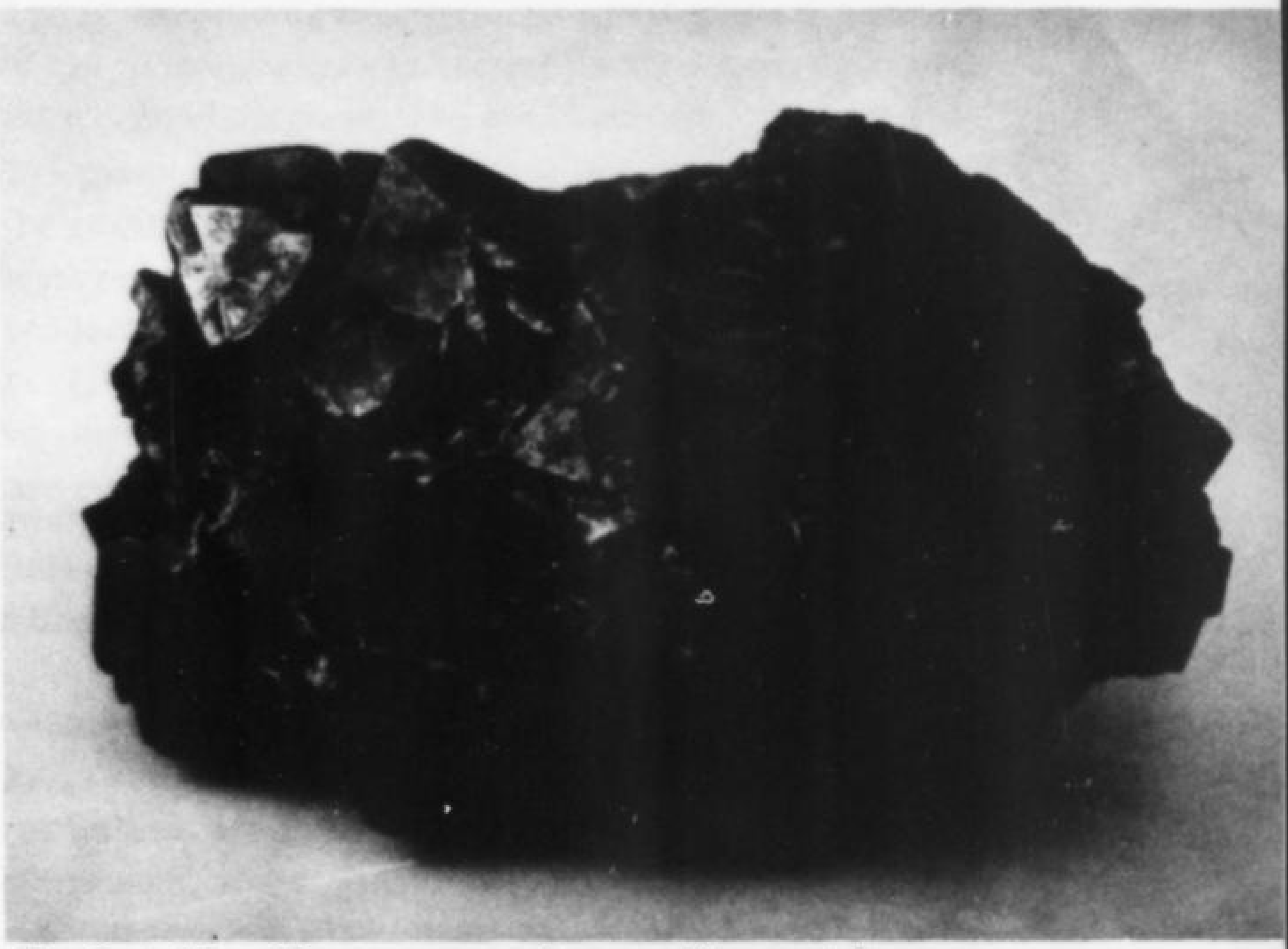

Fig. 6. **A 15 x 10 cm. group of magnetite crystals.**

found in cavities. They are normally buried in the chlorite and talc schist. Their extreme brittleness makes them very difficult to mine and separate from the matrix. The writer has used the following process to locate crystals: pieces of the schist in which scheelite crystals are exposed or their presence is suspected because of the weight of the sample are examined with x-rays. The tungsten content makes these crystals very absorbant of the x-rays, so on the radiographic plate they are clearly visible. Figure 1 is an x-ray photograph of a fragment of rock with the crystal embedded in it. All of the samples shown in this article have been recovered by this procedure.

It is a sincere wish of all mineral collectors that the old and glorious mines of Traversella, which have supplied an excellent source of iron to the Roman Empire, to the squires of the Middle Ages and to the young Kingdom of Italy, which has given marvellous specimens of minerals to all of the world's museums, and where have been born processes of enrichment of the minerals used all over the world, can resume mining and put this enterprise into action again.

All of the specimens illustrated in this article are in the author's collection.

QA column

Q. I have a specimen which supposedly came from an *old* European collection, labelled as wavellite from Schneeberg, Saxony. It consists of several spherules of radiating crystals up to 1/4 inch long with a definite sapphire blue color sitting on a thin crust of a yellow-green then white material coating black shale. The specimen is 3-1/4 inches long. I have not been able to find any information on this in any reference book. This seems strange because the overall beauty indicates that this material should be well-known among collectors. I would like to know if you have seen similar specimens. Does the locality fit? What is the green mineral? Do you know how long ago this was produced and in what quantity? Is the locality of Schneeberg used to encompass a number of specific sites around that town?

George Foster
St. Louis, Missouri

A. We are indebted to Dr. Werner Lieber, of Heidelberg, Germany for the following: "Schneeberg is a large mining district, and there have been a dozen different names used with it. The mines belong to the so-called 'cobalt-nickel-silver-bismuth-uran-formation' and have been worked for silver and cobalt predominantly. After World War II the Russians opened many of the old (abandoned) mines again to work them for uranium. During the first years after 1945 they found much pitchblend and bismuth (mostly native), and seldom fine mineral specimens of native silver and proustite. I have never heard of any find of wavellite. The specimen is probably from 'Tagebau Lichtenberg at Ronneburg, Thuringen' and the green material is said to be scorodite. A black shale does not occur at Schneeberg localities, the country rock there is granite. So, I suppose, the location 'Schneeberg' is an error."

The wavellite specimens from Ronneburg are indeed beautiful. While not plentiful, quite a few have been seen in recent years. From all appearances they appear to be newly mined material.

Q. A fairly recent find of very large morganite crystals penetrated with very dark green (black) tourmaline needles around the periphery has been in evidence at mineral shows. Do you know of any more specific locality data than Minas Gerais, Brazil? Another fairly recent Minas Gerais find (3 or 4 years ago) was tourmaline with a rubellite core of almost the same shade as the recent Tourmaline Queen find at Pala, California. However, the outside layer and termination were a very pale lime green or colorless, alternating with the green. Do you know any more specific locality data for this? Some of the crystals have corroded terminations.

Victor Rose
New York, New York

A. The locality for the morganite is reported to be the Galilea mine, Conselhiera Pena, in Minas Gerais. That of the tourmaline is the Santa Rosa mine, also Minas Gerais.

Q. On the dump of the Juanita mine next to the Kelly mine in New Mexico I collected some micros that have azurite and malachite, but I have also found some octahedrons that are green with red centers. Could this be cuprite with a malachite coating?

Robert Bates
McPherson, Kansas

A. Indeed it could and it very likely is. Malachite replacements of octahedral cuprite are well known, especially from Chessy, France and Bisbee, Arizona. The malachite may be only a thin crust over fresh cuprite (which is red) or it may entirely replace the cuprite. Since other copper carbonates are found in association there is little chance that the green mineral would be one of the copper sulfates brochantite or antlerite.

Q. As you know, the Kelly mine in New Mexico is a well known locality for smithsonite. Its normal occurrence here is in botryoidal masses. On rare occasions it occurs in a small, rice-grain shaped habit (known locally as rice-grain smithsonite) or in a small, slightly flattened, football shaped habit.

Many of the people with whom I have had contact have called these crystals. I have collected specimens of these habits on several occasions and I do not believe they are true crystals. Can you clear up this question for me?

William H. Wilkinson
Arlington, Virginia

A. Your fellow collectors are, I fear, correct. While the botryoidal habit is much more common, smithsonite is sometimes found in single crystals which tend to be elongated, terminated by the rhombohedron, and the faces of single crystals are usually curved. The rice-grain habit is not restricted to the Kelly mine. Smithsonite from the Ojuela mine, Mapimi, Mexico, for example, occurs in similar snow-white crystals.

Q. In Table 1 of the "Mineralogy of the Miarolitic Cavities in the Plutonic Rocks of the Oslo Region, Norway", Vol. 3, p. 7 (*Mineralogical Record*) quartz is noted as an oxide, but surely it is a silicate.

R. Laikin
London, England

A. Oxides are defined as compounds in which cations, usually of one or more metals, are combined with oxygen. Quartz (SiO_2) is composed of a metal (silicon) and oxygen. Some authorities prefer to think of quartz as an oxide and others find it more convenient to include it with the silicates. This is only one example of divergent opinions among the "experts" in mineralogy.

Q. In the Glossary of *Mineral Species 1971* there is listed Indium (In) as a native element. Is this a new discovery? Are there any references?

Ronald D. Smith
Canterbury, Connecticut

A. Native indium was described 1964 by V. V. Ivanov. The description, in Russian, appeared in *Geochemistry, mineralogy, and genetic types of rare elements,* v. 2, p. 568-569, Izdatelstvo "Nauka," Moscow. An abstract of this paper by Michael Fleischer may be found in *The American Mineralogist,* v. 52, p. 299, 1967.

Q. Do you think sawed specimens are generally well-accepted among good collectors?

Rock Trimmer
Fallbrook, California

A. Mineral collectors are as varied a group as you will find and this is very much in evidence in their taste in specimens and the special considerations which limit what they collect. Since you used the term "generally" in your question I feel the answer can be yes. However, there are sawed specimens and there are sawed specimens. In answering yes, I am assuming that the cut is tastefully done and not more than slightly in evidence when the specimen is viewed from its forward side. Most good collectors would object to sawed surfaces that are in the front of the specimen although there certainly are specimens for which exceptions will be made by most collectors. The geodes from Chihuahua, Mexico are just one example, and the rutilated quartz from Bahia, Brazil is another. There are, of course, collectors who swear that they will never own a sawed specimen but I think they are in a very small minority.

Q. I note that Mr. Desautels' book, *The Mineral Kingdom,* is being offered for sale as a new printing claimed to have a list price of $7.95 by a mineral book discounter. The book has been available at some bookstores in this area for several months at $7.95 a copy, while the "original edition" is still available at other bookstores for $14.95. From your vantage as "Record Bookshelf" editor your comments regarding how these various printings differ in content and/or quality of production would be appreciated. Or, to add to the confusion, are all of the various printings identical?!

Richard F. Scholl
Oxford, Ohio

A. The correct list price for the original printing of *The Mineral Kingdom* is $14.95 and the newer printing is listed at $7.95 as entered on the dust cover. The newer printing is very similar to the original and most of the differences are rather subtle. The most obvious is the weight of the paper. The less expensive version is some 25% thinner and, perhaps because cheaper paper was used, the quality of the color printing is somewhat inferior. Both were printed by the same company. The cover of the newer product is smooth while that of the other is rough textured cloth. These differences are so insignificant that they will be disregarded by all but the most critical readers. They are certainly more than offset by the $7.00 reduction in price.

It is somewhat distressing however to see dealers implying in their ads that they are offering a $14.95 book for $7.95. This they are not doing. It is a $7.95 book and when sold for that figure it is not being discounted.

Q. In reading the article about Walter F. Ferrier in the September/October 1972 issue of *MR* I noted mention of Thomas A. Edison's mineral collection. Does anyone know what became of it? I wonder if it could be at the Ford Museum although I did not see it there when I visited the Museum quite a few years ago.

Ben Chromy
Saratoga, California

A. The Edison collection is in the Ford Museum at Greenfield Village, in Dearborn, Michigan. This collection, while of some historic interest, is rather insignificant.

The Record Bookshelf

***The Minerals of Franklin and Sterling Hill: A Check List,* by Clifford Frondel. Wiley-Interscience, New York, 94 pp., 1972, ($9.95)**

One wishes that every important mineral locality had a description and check list such as this! Professor Frondel has long been interested in the minerals of Franklin and Sterling Hill, as his many publications - and this book - indicate. This Check List certainly should be in the hands of all Franklin collectors, and has much of interest to all mineralogists, amateur and professional alike. It also should serve as a model for anyone writing such a book for any other locality.

The book starts with a list of notable collections of Franklin minerals, a survey of earlier check lists, and a fascinating history of the region and its mines. The geology and mineralogy of the area are well described, and the remarkable similiarity to the Swedish Långban deposits noted. A most useful feature is a series of lists of minerals found in: the massive ore; the skarn; the altered, replaced or recrystallized skarn; the dolomite veins of the Buckwheat Pit; the sulfide veins; the Franklin marble; the magnetite deposits; the pegmatite dikes; and minerals produced by weathering and oxidation. (The reviewer has already reduced by two the number of his unknown Franklin micromounts using these tables). There are thirty-three black and white mineral photographs included; only the attractive dust cover is in color.

The valuable check list (about half the book) contains the names of two hundred thirty valid mineral species and established, authenticated varieties that occur in the area. There are more than a hundred additional names, including synonyms, discarded names, and minerals not yet validated. It is noteworthy that forty-four new mineral species have been described from the Franklin area (in addition to a host of others not validated).

The check list gives in words the chemical structure of most of the valid species and, for most minerals, gives a brief account of the first identification in the area, where found, appearance, characteristics and habit, associated minerals, and other useful data.

The bibliography gives references to most post-1934 publications (about 160) cited in the text and check list. References earlier than 1935 are often not in the bibliography as they - 297 in all - are listed in Palache's monumental work on the Franklin minerals published in 1935. This omission could be a slight inconvenience to some, as Palache is now out of print, although it was reprinted in 1937 and 1961.

The book is remarkably free of errors; a few minor ones were noted in the bibliography. Some users may have forgotten that Ma_6Me_4 (under scapolite) means marialite 60%, meionite 40%, and that Cn 52 (under celsian) and Cn 35 (under hyalophane) is a measure of the barium content.

The author and the publisher are to be congratulated for producing a most useful book describing the mineralogy of what is probably the foremost mineral locality in the world.

Arthur Roe

***Handbook of Crystal and Mineral Collecting,* by William B. Sanborn, Gembooks, Mentone, California, 1966, 81 pp., ($2.00)**

An extensive library of books is currently available for the mineral collector, ranging from advanced textbooks to popular introductions. The latter category has been flooded in recent years by a veritable torrent of titles. Since, in essence, the information contained in all of these books is the same, choice among them is based on photographic quality, or coffee-table appearance, or the presence or lack of long tables, or even the attractiveness of the cover. Sanborn's opus is noteworthy in that it is well written, very comprehensive, inexpensive and heavily illustrated. It is an almost ideal book for the beginner, or for the person who simply wants to find out what the hobby of collecting minerals is all about.

The photographs are all black and white, but of excellent quality and well reproduced. Many of the illustrations are publicity photographs supplied by major museums, universities, mineral dealers and geological surveys. The chapters include physical properties, crystals, where to collect, how to collect, labeling and housing a collection and the variety of specimen size categories and collection types. The author has extracted basic information from a variety of popular textbooks and field guides, and reassembled it in a logical and intelligent fashion. There is even a final chapter on the value of mineral specimens, with guidelines to trading, the mineral market, quality factors and gems.

Parts of the book suffer from an abundance of typographical and grammatical errors, and there are occasional oversimplifications. But, overall, the *Handbook* is a worthwhile addition to any collector's library. It is just the right book to "loan to that friend who wants to know what a rockhound or mineral collector is and does."

Joel E. Arem

***Index of Crystallographic Supplies,* by Reuben Rudman, International Union of Crystallography, Utrecht, The Netherlands, 1972 (3rd ed.) 57 pp., ($3.50) (Order from: Polycrystal Book Service, P.O. Box 11567, Pittsburgh, Pennsylvania 15238)**

The professional crystallographer is often at a loss as to where to obtain a needed item of equipment or supplies. Rudman's book offers a starting point for obtaining needed information directly from suppliers and manufacturers. A section of the book gives a detailed listing of names and addresses of companies manufacturing crystallographic devices. These are all given codes which are referred to in a summary of apparatus types. The apparatus list is long and detailed, with major headings for safety, X-ray generators, tubes and monochromators, detectors and accessories, powder techniques, single crystal techniques (mounting, film detectors, diffractometers), automation and interfacing, environmental control, other techniques and miscellany (including crystal structure models and computing information). About one-third of the book consists of advertisements of crystallographic equipment.

The book has limited usefulness, in that one can only obtain from it the name of a company to write to for further information. The company may or may not make exactly what you are looking for, and the book cannot tell you that. But since the alternative is a series of phone calls to colleagues who may or may not even know where to go for information about a specific type of apparatus, the *Index* is an inexpensive enough form of security. It should certainly be in every laboratory devoted wholly or partly to X-ray analysis.

Joel E. Arem

***The Studio Handbook of Minerals*, by Hellmuth Boegel, revised and edited by John Sinkankas, Viking Press, New York, 1971, 304 pp. ($8.95)**

This book, originally written in German, later translated into English, has been revised and updated by John Sinkankas. The *Studio Handbook* is basically a textbook in format, comparable to the Dana *Manual of Mineralogy* (C. S. Hurlbut, now in the 18th edition). Sinkankas has added greatly to the usefulness of the text by providing detailed treatments of mineral origin and the formation of mineral deposits. He also changed crystallographic nomenclature and notation to make these portions of the text more understandable to U. S. readers who would constitute the major portion of the intended market. The result is a delightfully written, very informative and elegant little book that should occupy a place of distinction on the shelf of every mineral collector.

The format of the book resembles that of many other texts: an introduction, chapters on general mineralogy (structure, composition, crystallography, formation and ore deposits, collecting and preparing minerals, identification) and descriptive mineralogy (name, chemistry, physical properties, identification and formation, occurrence). As might be expected from a European author, many of the localities listed are European; I feel that this is a distinct advantage to the American collector who would otherwise have to search through the literature for details of some of these classic occurrences. Sinkankas has added flavor to the occurrence listings by inserting exclamation points (!) singly or in multiples (!!!) to indicate sources of especially fine specimens. The text itself is accurate, concise and well organized. The last part of the book is a determinative table for mineral identification.

The book is profusely illustrated with top-quality watercolor paintings, very well reproduced, prepared over a span of several years by Claus Caspari. The artist, himself an avid mineral collector, painted these illustrations specifically for Boegel's book. His collector's eye enabled him to achieve accuracy of form and color not typical of paintings of mineral specimens. There are 48 exquisite color plates, all works of extreme skill and devotion to detail.

The *Studio Handbook* does not fill a great gap in the mineralogical literature. But it does offer essentially the same information to be found in competing books, and additionally provides superb color illustrations. It is a "must" for the mineral book collector, and deserves careful consideration by anyone looking for a handy reference work for his library.

Joel E. Arem

To the Editor

ON COLOR STANDARDS

Dear Sir:

I was interested to read Peter Embrey's suggestions for standardizing the colour description of minerals (May/June 1972). Certainly the vague descriptions so often given are oddly at variance with the mathematical precision we expect for other properties. It is a disadvantage that the very limited choice of internationally recognized systems results in an investment which would be very expensive for the average amateur.

Experience in colour matching in other fields has shown up the difficulty of visually comparing a plain standard colour panel with a specimen which is differently shaped and may have a very different texture and gloss, as well as the vital importance of standardizing the illumination. Even more expensive instruments are of course available to overcome this difficulty! Nevertheless within its practical limitations I do regard the suggestion as a major step towards the scientific reporting of colour, and certainly cannot suggest any cheaper, simpler or better way.

Incidentally studies in both the U. S. A. and U. K. have shown that about 8.0% of males suffer from some degree of blue-green colour blindness as compared with no more than 0.5% of females. Colour blindness can readily be self checked using the Ishihara colour test charts (probably there are other types also), alternatively get your wife to check your colour assessment!

On rather a different subject, may I put in a plea for an article in the *Mineralogical Record* to tell us about the various methods of displaying mineral specimens: I mean those larger than the thumbnail or micromount size which seem to be very well catered for. I believe that many, maybe the majority of, amateurs still give pride of place to the larger specimens in cabinets with all sorts of mounting, labelling and lighting.

In my small collection the larger specimens are set out on glass shelves against a background of black velvet, illuminated by concealed strip lights in wall cabinets - I suspect that the average home probably has more available wall than floor space!

Whilst I am quite pleased with the effect, I see that most museums which I have visited use a white background irrespective of the colour of specimen displayed. There is presumably a 'best' method of display which maximizes the effect of the object display and minimizes that of the background - could we have the views of some experts and advice for the 'do it yourself' collector.

A. G. Pollard
Berkshire, England

Dear Sir:

In the May/June issue, p. 130, Peter Embrey discussed some rather expensive colour charts for describing minerals. I wonder whether something simpler would not suit most people better.

The stamp dealers Stanley Gibbons Ltd, 391 Strand, London WC2R OLX, England, produce a very satisfactory colour key for only 75 pence (under $2). It consists of 200 colours printed on 5-1/2 x 1-inch paper strips that can be opened like a fan, five colours per strip, with a hole in each patch of colour to aid matching. The colours are named (e.g., "crimson", "lake", "brown-lake", "carmine-lake", and "deep carmine" on the first strip) but not related to any other system of colour measurement. Only a few of them seem inappropriate — "agate" (a very dark brown!) and "stone", for example. Though designed for stamps, the key works well with minerals, and for me it has solved problems such as distinguishing between mauve, purple and violet tints.

Does anyone know, on the other hand, how best to describe the minerals with metallic lustre? Like others, I say "tin-white", "brassy", "bronzy",

etc.; but who checks against a clean piece of bronze?

George Ryback
Sittingbourne, Kent, England

ON GEODES

Dear Sir:

My thanks to you for a really fine magazine. The article in the September/October issue relating to geodes was of particular interest.

As an amateur mineral collector I have read a number of recent books including those by DESAUTELS and HURLBUT but I have yet to read a detailed, comprehensive account as to how geodes are formed and how the interior build-up of minerals takes place.

May I suggest that, with the talented group of authors available, this be the subject of a future article in the *Record*?

Lt. Col. Raymond V. Todd
Clermont, Florida

We anticipate that one of our talented authors will come through for us on this subject. Ed.

A PRICELESS MAGAZINE

Dear Sir:

As much as I enjoy the *Mineralogical Record*, I feel that some criticism is in order.

First - the printing of the price on the front cover is totally unnecessary and certainly detracts from the fine color reproductions.

Second - the illustrations on pages 195 and 230 of the September/October 1972 issue are very reminiscent of the majority of lapidary monthlies.

Please, let us maintain the high standards set forth in the initial issues.

Gerhard G. H. Muehle
Long Beach, California

Printing the price on the cover is a concession to the dealers who sell the magazine over the counter. Ed.

COVERS OFFCOLOR

Dear Sir:

I would like to comment on your recent cover, the photo of a Chinese cinnabar specimen. This photograph is not scientifically accurate, nor does

it look in the least like any cinnabar I have ever seen. The glowing red blob is not the color of cinnabar and the blue calcite matrix is ridiculous. The whole thing is merely an arty eyecatcher accomplished by trick lighting.

I realize this opinion is probably in the minority since the photo polled more votes than any other in the 1972 competition, even though many of the others were excellent and scientifically correct. However, every other serious mineralogist with whom I have spoken seems to share my opinion. The same criticism could be made about the cover showing a German rhodochrosite group in Volume II, no. 3.

It would be desirable to have accuracy as one of the criteria in selecting the winner of this competition, or at least reserve the honor of appearing on the magazine's cover to photographs that fulfill this requirement.

Richard V. Gaines
Pottstown, Pennsylvania

ERRATUM
Volume 3, No. 4, p. 152

It was incorrectly implied that the SEM forms images using only reflected electrons. Actually reflected electrons comprise a smaller portion of the electrons forming the image; the main portion is composed of electrons blasted loose from the surface of the sample (secondary electrons) by the primary beam. Together the secondary electrons and reflected electrons are collected to form the image.

Mac vs. Mc.

Dear Sir:

Dr. Fleischer's comments (Sept/Oct *MR*) on "Mac vs. Mc in Mineral Names" gave an interesting account, including the amusing anecdote about the suggestion that Ms. Vlisidis and Ms. Mrose change their names. (The non-liberated titles of the ladies are Mrs. and Miss, respectively.)

Nevertheless, with humor or ill-humor, the principal point involves: Not the question of two consonants (vl or mr) beginning a name, but the question of restoration from an abbreviation.

A person of my acquaintance is named George St. Pierre. Were a mineral to be named after him, should it be stpierrite, stpierreite or st.pierreite? Restoration (elimination of the abbreviation) would give something sensible: saintpierrite. Other persons might wish to clobber his "good name" with geostpite or possibly erreiptsite (stpierre with the order reversed, plus ite).

If mineralogists wish to appear ludicrous in the eyes of chemists and physicists, they should surely persist in preservation of their "good names" — continue to use abbreviations such as mc for mac.

Should anybody consider naming a mineral after me llennoccmite (or llennoccamite) he had better wait until I'm deceased!

Duncan McConnell
Columbus, Ohio

I hope that all those clamoring to name minerals for Dr. McConnell will take note. Ed.

BEATING the GAME

In my experience there has never been a successful collection formed without the guidance of a top flight dealer, either in the capacity of an advisor or as a direct source of supply and outright purchase.

The value of the professional is threefold: (1) to judge quality, (2) to determine value, and (3) to judge authenticity.

The ability to judge quality and to determine value is predicated not only on his innate good judgement and taste but also on the range of specimens he has seen and compared.

Rating a mineral as to its comparative quality can only be judged against the whole panorama of the field. Attempting to compare it with examples in the contemporary market is but one aspect. The thousands of examples I have handled in over 17 years of specialization give me a panorama which has vital significance. Furthermore pricing based on quality is measured by an active marketing experience.

Comparing prices by type alone can be very misleading. There is a tremendous price range between an exceptional example and an average example. I have seen many of my customers hopelessly overpay for an average example by comparing its lower price elsewhere to one of my top drawer pieces.

For some strange reason the very person who would not think of making a judgement without the advice of either a top tax man, accountant or legal counsellor in his own field will blithely enter a strange field and attempt to beat the expert at his own game. This of course may be fun and recreation at low level prices, but in today's current market, the price of this challenge can become extremely costly.

* * *

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NEW LISTINGS M — 7

In lieu of quarterly lists we are planning full page specimen listings in future issues of the Mineralogical Record. Please contact us for specific requirements in minerals, reference material or cut gemstones. Please include a check with your order and postage consideration. Any specimen may be returned for cash or credit if you are not satisfied. Refer to list M-7. See us at the following 1973 shows: International Gem and Mineral Show — May 18-20, Washington D.C.; Cincinnati (Midwest Fed.), Oklahoma City (Rocky Mtn. Fed.). Hansen's Minerals, Inc. Dr. Gary R. and Maurine Hansen. Ph. (314) 432-2882. (Showroom: 149 N. Meramec, Clayton, Missouri). Shop ph. (314) 726-2236. Mon. - Fri. 9:00 - 5:00, Sat. 9:00 - 2:00.

ULTRASONIC CLEANER

We are very pleased that we have been selected to offer to our mineral customers a very fine ultrasonic cleaner manufactured by the Bulova Watch Company. We have used this unit, MODEL TR-168, for over 1000 hours in our mineral preparation laboratory with NO service problems and have cleaned species from Crocoite to Stibnite. The unit is fully transistorized and produces a high peak power output at the desirable low frequencies of 38 to 50 kHZ. The stainless steel generator tank has a capacity of 4.6 quarts and has internal dimentions of 9.5 x 5.5 x 5 inches. The unit, complete with timer and cover, is priced at $200.00 f.o.b. St. Louis. The unit carries a TWO-YEAR GUARANTEE and comes with a complete set of operating instructions.

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GREEN APOPHYLLITE. Poona, India. Beautiful old specimens of a *deep* green color. Extremely attractive. TN, **$10.00 - $30.00,** miniature **$15.00 - $60.00**

DESCLOIZITE. Berg Aukas, Southwest Africa. We purchased a beautiful selection of specimens that came out five years ago. Very fine crystallized groups, approximately 2 x 2 to 3 x 3 inches, at **$25.00 - $45.00**

CALCITE. St. Joseph Lead District. Beautiful groups of golden hexagonal crystals with pinacoidal terminations, very reminiscent of Cumberland, England, 2.5 x 2.5 up to 4 x 4 at **$10.00 - $25.00,** several superb cabinet to museum specimens at **$35.00 - $100.00.** We also continue to secure a limited number of superb galena specimens, single crystals and groups. Please write us concerning your requirements.

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SIEGENITE. St. Joseph Lead District. This rare cobalt nickel sulfide was found in D-Bench in an isolated pocket as brilliant octahedral crystals. We have a limited number of miniature to cabinet specimens available on an EXCHANGE BASIS, preferably for saleable display material, but I will welcome and consider your available exchange material.

WE LOOK FORWARD TO MEETING
ALL THE EAST COAST COLLECTORS
AT THE INTERNATIONAL GEM & MINERAL SHOW.