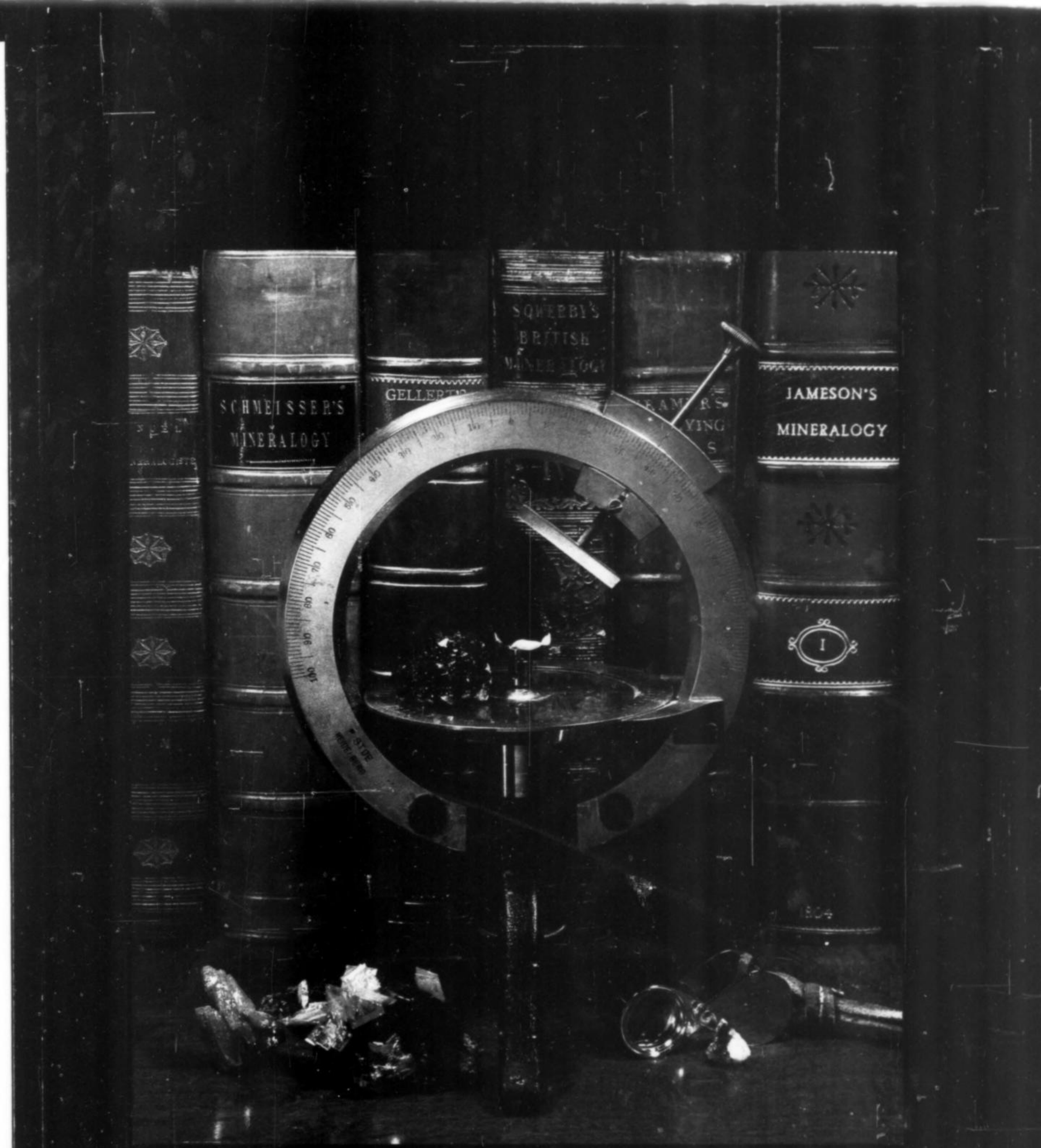
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The Mineralogical Record magazine is published by the Mineralogical Record Inc., 7413 N. Mowry Place Tucson, Arizona 85741

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Subscriptions
- **Individuals (U.S.):** $33 for one year; $63 for two years. (First-class mailing available; write to circulation manager for rates.)
- **Individuals (outside the U.S.):** $36 for one year, $69 for two years. (Airmail mailing available; write to circulation manager for rates.)
- **Libraries, Companies and institutions (worldwide):** $55 for one year. (First-class or Airmail mailing available; write to circulation manager for rates.)

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ISSN 0026-4628

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the Mineralogical Record®

January–February 1990
Volume Twenty-one, Number One

Twentieth Anniversary Issue

COVER PHOTO: The Mineralogical Record's trademark goniometer, made by P. Stoe in Heidelberg shortly after the turn of the century; it came into the possession of the Smithsonian Institution and was subsequently acquired through exchange by the Mineralogical Record Inc. It has been pictured on the title page of almost every issue since vol. 1, no. 1. Resting on the table of the goniometer is a dioptase specimen from Tsumeb which is sprinkled with small, white crystals of *minrecordite* (described as a new species in vol. 13, no. 3). At lower left are specimens of pyromorphite from the Bunker Hill mine, Idaho (see vol. 13, no. 5) and wulfenite from the 79 mine, Arizona (see vol. 3, no. 6). The mineralogy books are from the Record Library. Photo by Wendell E. Wilson.

Editorial

Twenty Years of Abundance

Twenty years ago, when the *Mineralogical Record* was founded, there were people saying that the heyday of mineral collecting was over. All important deposits, they said, had already been discovered and their best zones mined out. The famous localities were dead or dying. Never again would we see the like of the great English calcites and barites, the German silvers and proustites, the Russian beryls and the California tourmalines. Oh, for the days when these great classics were still coming out of the ground, and could be purchased in droves by lucky collectors!

As it turns out, there was no cause for alarm. In fact, the last two decades have been among the most remarkably prolific in history; new deposits have indeed been discovered, and many classic localities have been producing anew. Dozens upon dozens of specimens have been found which are the world's best, even though the species have been known for centuries. At the same time, well over a thousand new species have been discovered.

THE NEGATIVE FACTORS

And yet, one can hardly blame the pessimists for their misguided predictions. Look at the factors that have been working against the discovery and preservation of fine mineral specimens:

Preferential Depletion of Near-surface Ores

The best mineral specimens typically occur in the uppermost zones of ore deposits where secondary minerals can form in the oxide zone. But these upper zones, aside from being the most accessible, are often enriched in valuable metals; so they are mined out first, as promptly as contemporary technology will allow. Consequently, even where many famous mines continue in operation on lower levels, they are no longer as productive of fine mineral specimens.

Efficiency of Past Exploration

High-level deposits are typically the first orebodies to be discovered because they generally crop out at the surface, and are easy prey to sharp-eyed prospectors. Such prospectors have been scouring the accessible areas of the earth for centuries. And it is nearly all accessible; there are relatively few areas left in the world that can truly be considered remote, and almost none that are still unexplored wilderness. The end of an era has come upon us in this century; the time has arrived when there is hardly a square centimeter of space left on the surface of the planet which has not been scrutinized for indications of ore. One would think that the "easy" ore must surely be gone, on a worldwide basis, and that the best potential specimen ground is forever gone as well.

Modern Mining Technology

Modern mining technology has become so automated, and explosives so powerful, that the chances afforded the common miner to save a fine specimen have greatly diminished. In addition, many modern mining companies preoccupied with efficiency now actively prohibit collecting by miners even where significant highgrading of ore values is impossible. A modern miner, with today's powerful equipment, can extract ore so rapidly and efficiently that his *time* becomes more valuable than almost anything else. One man, operating a 12-cubic-yard shovel, can load a 50-ton ore truck in 40 seconds! Therefore one would expect the specimen productivity of working mines to be greatly reduced.

Trend to Ultra-low-grade Deposits

The depletion of high-grade ore deposits with time has been accompanied by a progressive improvement in mining and beneficiation technology which allows ever lower grades of ore to be profitably processed. As a result, working mines today are more commonly exploiting huge, very low grade orebodies with metal concentrations so low as to render formation of even microcrystals of interesting minerals a rare phenomenon. Hence there is often little or nothing to collect at working mines these days.

Collecting Pressure on Localities

Non-commercial and economically dormant mineral occurrences have been so heavily frequented by mineral collectors that an alarming number have been worked out. For many of those that remain, property owners have withdrawn access because of liability problems or because of bad experiences with collectors. Consequently field collecting opportunities for the common collector (as distinct from the working miner) have greatly diminished.

In view of these five factors, the situation twenty years ago looked dismal indeed. No wonder some people were pessimistic.

THE POSITIVE FACTORS

What happened? What forces so effectively overwhelmed these negative circumstances as to produce the incredible wealth that we have seen? The following factors have been at least partially responsible.

More Money in the System

The growth in value of fine mineral specimens, and the increasing market for them among sophisticated collectors, has stimulated activity. More money has funded more collecting and buying trips to remote areas, and has meant more incentive for mining people to preserve specimens. And it has helped to convince mining executives that fine mineral specimens are on a par with rare paintings, important historical documents and other objects of high cultural significance. Money talks, and people listen. Collectors should therefore be more tolerant of seemingly high mineral prices which have, in the long run, been very beneficial all around.

Dealer Efforts at Education

Mineral dealers have been waging a long-term battle against ignorance and apathy in the mining community. They have made great strides in the education of miners and mining executives as to the

cultural, scientific and financial value of mineral specimens. They have even gone so far as to teach careful collecting techniques and sight-identification skills to miners. They have also encouraged mines to donate representative specimens to museums and other scientific institutions.

Mining Company Cooperation

An increasing number of mining companies are responding to the request from dealers, collectors, curators and scientists that they preserve and protect the mineralogical and scientific treasures in their orebodies. Just as construction companies today will assist in the study and preservation of archeological sites accidentally uncovered on construction sites, so too have some mining companies given gracious cooperation when significant mineral occurrences are encountered. These companies deserve our highest commendation for their conservation efforts.

Sophisticated Field Collectors

In comparison with earlier decades, modern mineralogical field collectors are more sophisticated, more skilled, better equipped and better informed than their predecessors. Collectors are also considerably more *numerous*, more systematic and more thorough in their collecting. This is a general trend only, and not meant to suggest that there have not always been a *few* highly skilled and sophisticated field collectors. But today there is a small army of such individuals ready to exploit discoveries in most reasonably civilized countries of the world, whereas there were very few in the thirties and forties, and almost none around the turn of the century and before.

Mineral Deposits

In terms of the mineral deposits themselves, there have been important mitigating factors. Some mines which had at one time been abandoned or shut down were not actually worked out. They were a victim of the "economic cut-off," which means that mining was suspended when it became unprofitable, regardless of any important reserves still remaining. These mines were therefore susceptible to revival when the market for their ore later improved, and many have indeed been reopened. The California goldfields are a prime example. Quarries and non-metallic deposits are also sensitive to economic factors.

Furthermore, it became clear that many excellent deposits had not yet been discovered after all, and when found they have yielded specimen bonanzas. Other mines which had long been specimen producers continued their yield unabated. Mines which had not produced specimens for many years suddenly came into productive ground again. And some old mines, which had *never* produced anything worthwhile, suddenly yielded great treasures! Rumors of the death of collecting potential, it turned out, had been greatly exaggerated.

Here then, are five positive factors which have combined to overcome the five negative influences listed earlier.

WHAT ABOUT THE FUTURE?

Pessimists, however, are rarely converted to unbridled optimism. They may well ask, what about the *next* twenty years? That's a good question. A careful consideration of the above factors will suggest that there are definite things we can do to assure another twenty years of mineralogical abundance.

Maintenance of the Market

Support your local mineral dealer, and support specimen prices high enough to keep the ball rolling. Dealers are an important link in the chain of specimen preservation. They need our encouragement and our assistance.

Symbiosis with the Mining Community

We must continue to work at cultivating and enlightening the mining community. Dealers and, to some extent, collectors have been doing most of the work up until now. It's time that institutions, curators and professional mineralogists become more involved in directly influencing mining company policy. This is not to say that we should pester them; it must be done positively. Incentives and recognition need to be employed.

Small mining companies might appreciate receiving a share of the profits or the specimens. But financial incentives will be of only limited interest to large companies, which typically operate on a scale so huge as to render insignificant any possible income from specimen sales or royalties. Therefore the recognition must be primarily symbolic. For example, it would be good to see some prestigious awards established by major museums for corporations and mining companies instrumental in specimen preservation. The American Mineralogical Society, the Friends of Mineralogy, and other such organizations around the world could also establish awards. As mining executives begin to notice these things, proudly displayed on their colleagues' (and competitors') office walls and corporate meeting rooms, they might begin to appreciate the legitimate significance and the cultural and scientific contribution to society which specimen preservation embodies.

Good publicity is always appreciated by mining companies. Museums could arrange temporary or permanent exhibits featuring the minerals of certain mines, with a prominent placard commending the mining company for its conservation-minded efforts and cooperation. An 8 x 10 photo (or larger) of the exhibit case, with the placard clearly legible, could be presented to the company for their files or for framing. Private exhibitors at mineral shows could do the same thing.

Mineral labels in public museums, especially for specimens on display, could give a credit line where it's due ("Preserved through the cooperation of the ABC Mining Company").

All specimens sold by dealers could carry a similar credit line on the dealer's label. Using this as a guide, all mineralogical research published which is based on these specimens (or specimens which the researcher obtained more directly from the company) could include proper credit for the company in the author's acknowledgments. Following publication the author could send a reprint to the company office.

Private collectors given company permission to collect should be equally meticulous with their own labels and record-keeping, especially if any of their specimens are subsequently conveyed to researchers for study.

It is critically important that all field collectors carry personal accidental injury, disability and life insurance which will cover them for accidents on mining company property. Nothing will bring an end to amicable relations faster than a lawsuit against a mining company by an injured collector.

Finally, there is the simple letter of gratitude sent to appropriate mining officials who graciously allow collecting access. Collectors, clubs, curators, researchers and dealers should all willingly allot time on a regular basis to let these mining people know how very much their cooperation is appreciated. Each letter needn't be particularly long or eloquent. Just a brief moment of communication is all that's needed; such things, if received regularly, will accumulate nicely in the minds of these important and gracious people. They deserve our thanks and we should not forget them.

Professionalism in the Field

The field collectors among us must continue to work at maintaining and improving what we might call our "level of professionalism." This means first of all the careful avoidance of any action or inaction which might offend or aggravate mine owners. Secondly it means the most careful and skillful removal of specimens possible, with an absolute minimum of loss through damage, carelessness or impatient collecting shortcuts. Thirdly it means learning as much as possible about geology and mineralogy, keeping abreast of local mining activities, keeping in touch with mining people so as to be well prepared when opportunities arise, and doing the detective work necessary in

the library and in the field to locate new occurrences. Finally, it means meticulous attention to physical safety precautions in order to avoid accidents and injuries.

Self-collecting Scientists

We need more field-collecting curators and mineralogists. These people, by virtue of their scientific standing, will be able to gain collecting access where dealers and private collectors may fail. They can salvage mineral specimens on a significant scale, which will provide research material, enrich their institutions' exhibits and serve as valuable trading stock for obtaining even more useful specimens. Too many mineralogists today are satisfied to study individual specimens collected by someone else, with hardly a thought for their complex paragenesis. Researchers who self-collect their own study material gain a tremendous scientific advantage in understanding mineral formation and interrelationships.

Maintaining our Numbers

The last, and perhaps the most important task of mineral collectors today is to inspire and encourage new collectors. It is a common misconception that if there were half as many collectors, there would be twice as many minerals for each to enjoy. In fact, if the number of collectors were cut in half, the result would probably be far *less* than half the original number of specimens available on the market. Mineral dealers must operate with the benefit of certain economies of scale. If the market is reduced too far there could easily be a catastrophic decline in the mineral business, marked primarily by a great reduction in the total number of mineral dealers. This would mean fewer dealers traveling to foreign countries and remote areas, rescuing specimens from the ever-hungry crusher. Few miners would bother to collect specimens if no one was coming around regularly to buy them. Mining companies would interpret the lower level of interest as an indication that specimen preservation is not of much importance after all.

It is a paradox that the existence of more collectors will result in more specimens available per capita rather than less. One tends to think in terms of an isolated discovery yielding a fixed number of pieces to be distributed among the extant collections. But that view is too narrow; the world is a much wider, more dynamic place, and we are not at present preserving a very large proportion of the total specimens possible. Charles Key, for years one of the top dealers in aesthetic specimens, capsulized this best when he was asked about the present location of the finest specimens of various species mined at Tsumeb, Namibia. "Quantitatively," he said, "nearly all the best Tsumeb specimens are by now in the form of copper wiring, lead plumbing and other mundane fabrications."

In numbers there is strength. And with strength we can sway public opinion, influence legislation, educate people on the value of these beautiful miracles of nature, and see to it that a greater and greater number of specimens are preserved. With such a base of strength, money, knowledge and influence we can make the next twenty years even better than the last.

W.E.W.

notes from the EDITOR

TWENTIETH ANNIVERSARY ISSUE

This special Twentieth Anniversary Issue is a change from our usual concepts for special issues. It does not focus on a particular mineral, mineral group or element, nor on a particular locality, district, state or geological environment. It focuses instead on the activity of mineral collecting itself, from the turn of one century to the turn of another and into our present age. The people, the shows, the philosophy of collecting, and the sources of our recent abundance in specimens are all considered. There is no technical data or complex geologic discussions anywhere in this issue; for this anniversary we will take a temporary break from descriptive mineralogy and instead take a largely historical look at some of the people, places, specimens and ideas important to mineral collecting. It's a lean-back, put-your-feet-up-and-read kind of an issue.

LOOKING BACK ON TWENTY YEARS

The twentieth anniversary issue of the *Mineralogical Record* seems like an appropriate time and place to briefly review some aspects of the magazine. Those of our readers who are charter subscribers or who have managed to gather complete sets of the back issues know that a gradual evolution toward more color photography and more pages has been going on since the beginning. But it is nevertheless interesting to see graphs of the actual numbers confirming those general impressions.

This evolution has not been easy to accomplish under the restriction of a subscription curve that has remained nearly flat since 1977 (see

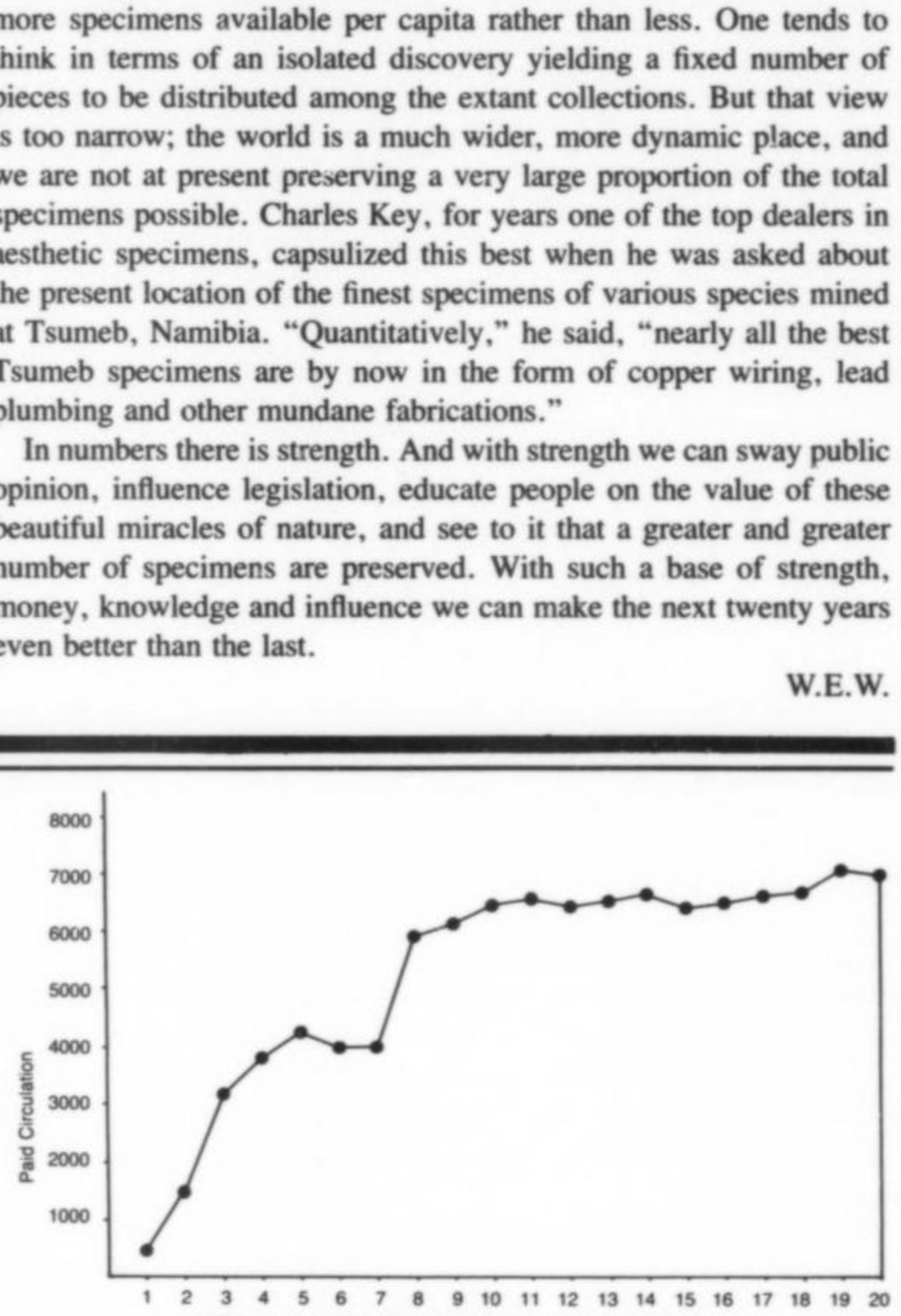

Figure 1. **Subscriptions, 1970–1989.**

Fig. 1). The support of our two biggest donors, Randy Rothschild and our anonymous donor from Georgia, plus the many people who have donated to, bought from, or worked on our annual fund-raising auctions, have in large part made our continuing success possible.

Other factors, such as tight control of overhead, improved and carefully chosen color technologies, and the production of special-topic issues which find a market beyond our regular subscribers, have allowed us to stretch our funds to the maximum in improving the magazine. Resisting the temptation to hire additional staff for the magazine has been a critical factor in controlling overhead; a single new staff member might cost as much as our two major donors combined give us for color work each year. We are still basically a two-person staff, with all other work done by volunteers or subcontracted service companies (secretarial, computer, etc.). Although cost-efficient, having a staff of only two means those two are kept pretty busy, and must occasionally ask for your patience. But any alternative would take funds away from magazine production or would cause a drastic increase in advertising rates and the cost of a subscription.

With regard to the subscription price, inflation in production costs (commensurate more or less with decreases in the value of the dollar over the years) has made periodic increases essential, not only for us but for all other magazines as well. We hate doing this, especially

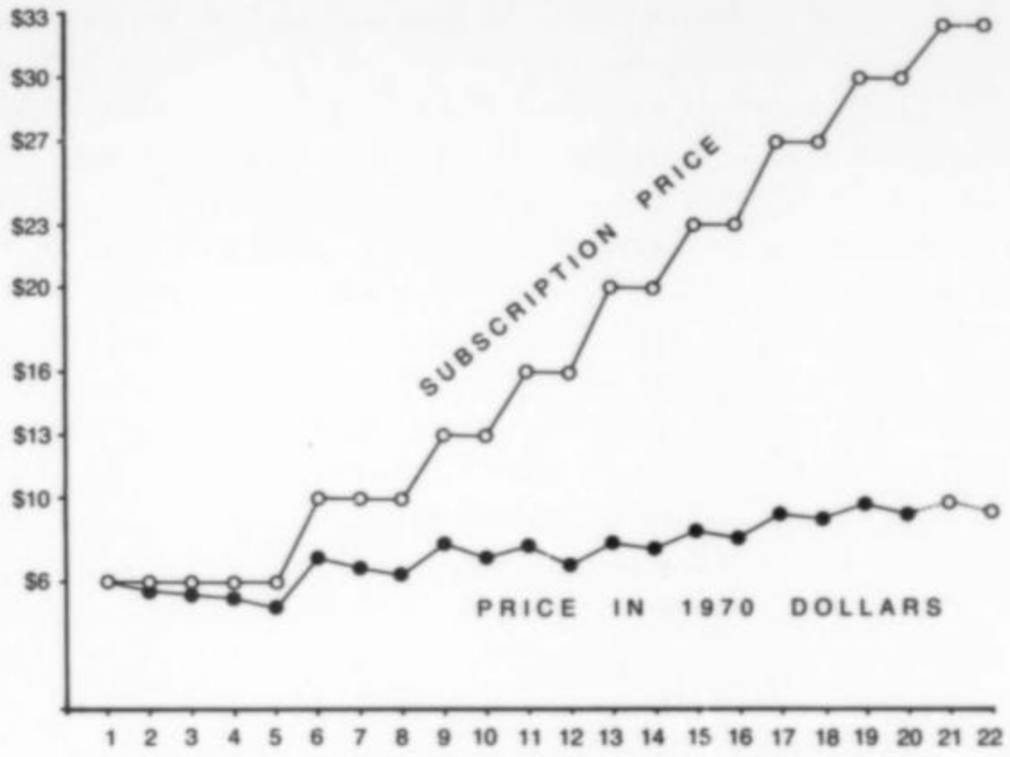

Figure 2. **Annual subscription price and equivalent in constant-value 1970 dollars, 1970–1989 (data courtesy of the Bureau of Labor Statistics, Washington).**

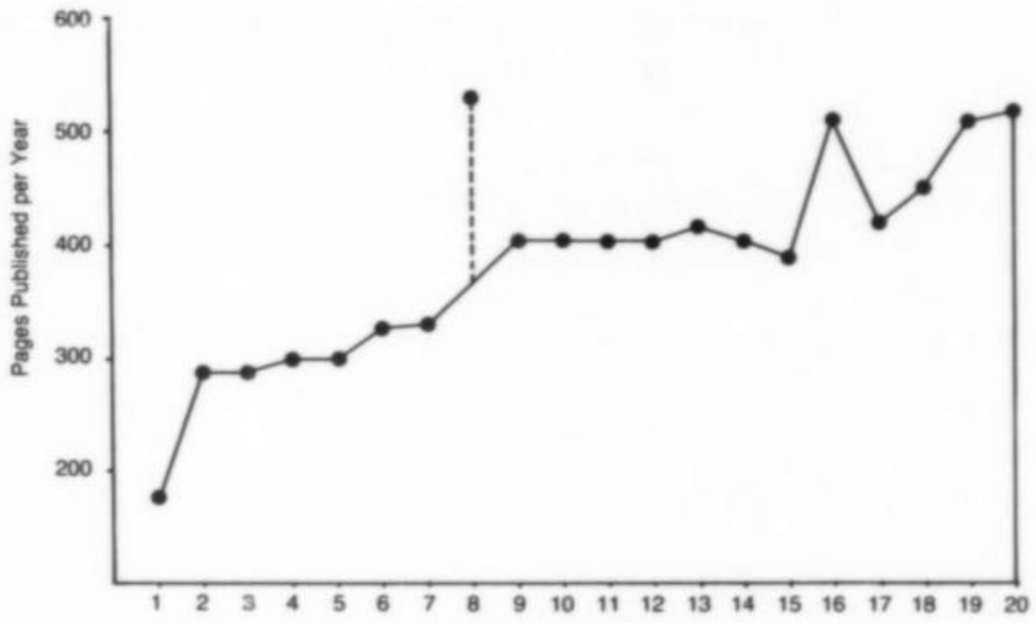

Figure 3. **Total pages published annually, 1970–1989. (Outlier = Tsumeb Issue.)**

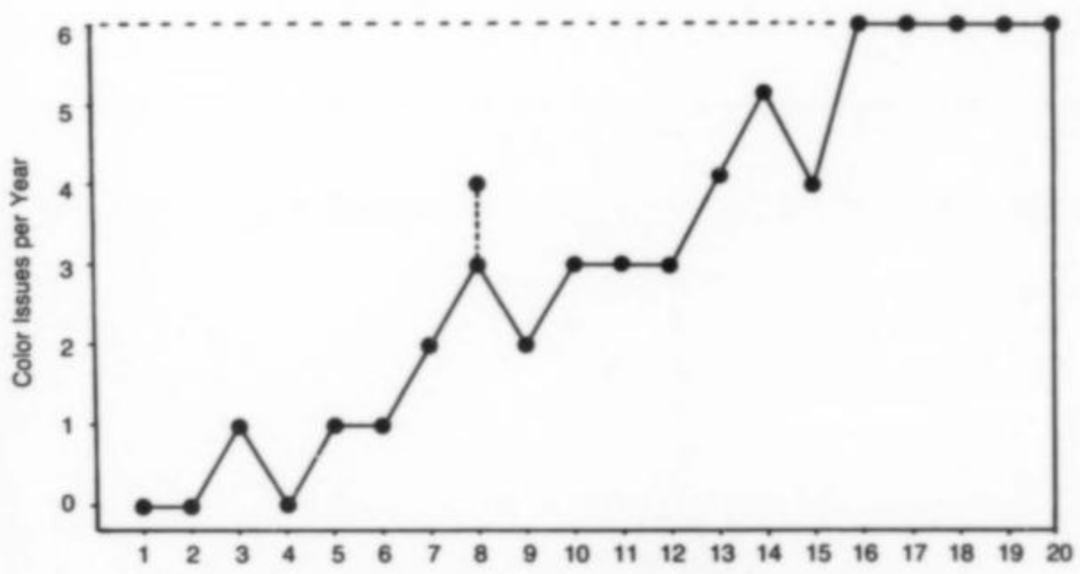

Figure 4. **Color issues published annually, 1970–1989. (Outlier = Tsumeb Issue.)**

because of the hardship it causes those of our subscribers who are on a fixed income. But if we are to stay in business it must be done. Founding editor and publisher John White tried to avoid such increases during the magazine's first five years and watched the purchasing power of subscription income begin to drop off significantly (see Fig. 2); only the massive support of the magazine's founding donor, Arthur Montgomery, kept the publication going in those early years. After he ceased contributing, a 67% jump in the price of a subscription (from $6 to $10) had to be imposed to adjust for inflation over those first five years, then another 30% increase three years later. Since then we have made a price adjustment every two years. However,

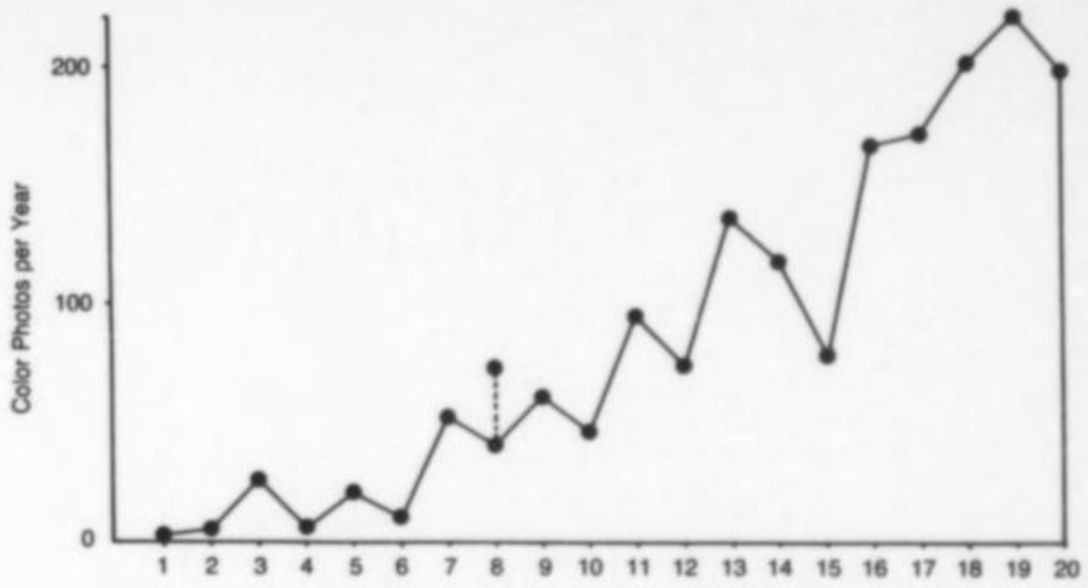

Figure 5. **Number of color photos published annually, 1970–1989. (Outlier = Tsumeb Issue.)**

over the twenty-year history of the magazine, the actual cost of a subscription in constant-value 1970 dollars has hardly risen at all, relatively speaking, whereas the magazine itself has grown significantly in size (Fig. 3), color (Figs. 4 and 5) and production quality. Consequently it is a much better buy *now* at the current price than it was in its early years. And the most recent biennial price adjustment is the smallest percentage increase in the magazine's history.

The outlook for the next twenty years is better than it's ever been. We're looking forward to providing our readers with a wealth of new and interesting reading about minerals, which they won't want to miss. Please join us!

LETTERS TO THE EDITOR

Now might also be a good time to remind readers that your editor strives to be responsive to the ideas and wishes of the readership. Please drop me a note or card with any ideas, compliments, criticisms, or suggestions you may have, not necessarily for publication in the *Letters* column, but just between you and me, if you like. Feedback (even negative comments) is always interesting and eventually bears results more often than people might think. It may certainly take many months and possibly years to process article ideas, for example, all the way through to publication, but the sooner a good idea is put forward, the sooner we can get to work on it. You may think that, with the voices of eight or nine thousand other readers to compete with, yours will not be noticed; but the vast majority of those readers never write to us. Throughout the history of the magazine, three letters on any one topic has been considered a "flood" of mail, relatively speaking. Individual voices *are* heard. So don't hold back; this is your magazine, and we enjoy hearing from you.

SCHMIEDEL

There are a few special books that mineral-oriented book collectors all want, but that almost none can possess. One of these is Kasimir Christoph Schmiedel's *Erz Stuffen und Berg Arten* (1753), which in English would probably have been titled *Specimens of the Metallic Ore Minerals*. It consists of a series of hand-colored copperplate engravings of specimens accompanied by detailed descriptive texts in German and Latin. Mineral literature historian Curtis Schuh has written:

> . . . The descriptions are so detailed and so exact [that] Schmiedel forged a system of mineralogy based on external characteristics. This volume is, therefore, not only a fine colored mineralogy, but also an early effort at systematic mineral description . . .

The book was originally issued piecemeal in 3-plate sections like a subscription to a periodical, beginning in 1753. By 1765, twenty-eight plates and associated text had been distributed before production

was halted. The work became very popular in the following years, encouraging Schmiedel to issue more sections beginning in 1771, eventually bringing the total to 42 plates before publication again ceased. Standard bibliographical references consider a 42-plate copy to be complete. Nevertheless, a few years later he issued four more plates with text, thus a few very rare volumes today contain 46 plates instead of 42.

The various plates show specimens from many of the most famous mining districts of the eighteenth century: Freiberg, Kongsberg, Schemnitz, Verespatak ("Apro Bannya"), Schwarzenberg, Johanngeorgenstadt, Ehrenfriedersdorf, Schneeberg, Schlagenwald, Nagyag, Ceylon, Ekaterinberg (Sverdlovsk), and others. The specimens are depicted as examples of the ores of gold, silver, zinc, lead, copper and cobalt, to assist in the education of mining men; consequently not all are fine specimens by today's standards, but they are nonetheless interesting and some are quite attractive.

Herb Obodda owns one of the rare 46-plate Schmiedels, which he graciously loaned to the Mineralogical Record for study and reproduction. At a current market value of $10,000 or more, an original is something we could never afford to own, even in the unlikely event that one ever came on the market. But we wanted very much to have a copy for reference.

We began by preparing a high-quality master duplicate of the text portion (rearranged and repaginated so that each plate description can begin on the page facing the corresponding plate). From this we had 20 complete text copies made on heavy, 24-pound, 100% cotton paper. Then we had 20 *full-color* copies made of each of the 46 plates, using the same cotton paper and one of the new Canon Laser Copiers, which yield virtually photographic-quality reproductions. After interleaving the color plates with the text, we had each new 231-page book hardbound. Copy number one will go into the Record Library; the other 19 numbered copies will be presented as gifts to persons making a donation of $200 or more to the Record Library. Considering that these cost us over $70 each to make (and that $130 of the donation should therefore be deductible), I don't think we're asking too much. Your donation will allow you to enjoy and help preserve an extraordinarily rare work, *and* will also help to enrich the Record Library, to the ultimate benefit of the *Mineralogical Record* magazine and its readers.

If this modest project is well-received, we will reproduce some other rare and unobtainable works. People who have previously made a donation and received the Schmiedel will be given first priority on subsequent books we decide to reproduce.

Write to the Editor, Mineralogical Record, 4631 Paseo Tubutama, Tucson, Arizona 85715.

CONNOISSEURSHIP
in Minerals

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It is within the reach of almost every mineral collector and mineralogist, if they wish, to achieve some degree of connoisseurship. Understanding the nature of that goal, and the philosophical decisions involved, will make the quest more efficient and more enjoyable.

INTRODUCTION

The word *connoisseur* is derived from a word in Old French meaning "a judge, one well versed," which in turn comes from the Latin word for "one who knows." Today we define a connoisseur as "a person who has expert knowledge and keen discrimination in some field," and as "a person who is especially competent to pass critical judgments in matters of taste."

Connoisseurship in minerals is a complex and challenging subject, based on knowledge, discrimination, enthusiasm and aesthetics. Because the principal attribute of a connoisseur is that he or she be qualified to judge, it is not absolutely necessary that he own specimens. More fundamental are his knowledgeability, his development of standards or criteria for specimen evaluation, and his ability to apply those standards accurately and intelligently. In actual practice, however, it is usually essential that the connoisseur have a background as a mineral collector, even though he may no longer possess a collection.

Scientific and historical knowledge of mineralogy may be gained from books and through formal study, but the development of an aesthetic sense is not so simple. Paul Desautels, former Smithsonian curator and one of the leading mineral connoisseurs of our time, wrote in 1988 that, "The greatest mineral collectors of all time have collected both scientifically and aesthetically." It is necessary to understand these components separately, along with several other factors, before combining them into a coherent concept of connoisseurship.

There will, however, be no attempt made here at defining who is and who is not a connoisseur. No one can achieve total knowledge and perfect sensitivity with regard to minerals, so the complete goal is out of everyone's reach. It is more a matter of achieving *some degree* of connoisseurship, and perhaps eventually a high degree, but there is no clear dividing line; it's a continuum.

In a sense, aesthetic and scientific appreciation of minerals can be thought of as dealing primarily with the visible and the invisible, respectively. Purely aesthetic appreciation requires no mineralogical knowledge whatsoever; it deals only with what we see. But once we lapse into an appreciation of the unseen aspects which a specimen represents or reflects, we are necessarily involved in a scientific experience requiring some scientific knowledge.

SCIENTIFIC APPRECIATION

The mineralogist, trained in the concepts of crystallography and chemistry, sees in minerals a complex system of atomic relationships which is a direct consequence or expression of the laws of chemistry and physics. That such a wide range of orderly structures and compositions can form naturally seems to testify in favor of an orderly universe, and a scientist virtually by definition finds that order beautiful. Each new discovery, each unique crystal structure solved, each new relationship revealed, each new species identified yields satisfaction in seeing a new piece fit into the immense jigsaw puzzle of nature. Everything relates to everything else at one level or another. These are intellectual concepts; much foreknowledge is necessary to appreciate the way a particular mineral fits into the pattern.

Scientific appreciation of minerals is therefore based on a drive to gain knowledge of the unseen. For some mineralogists and mineral collectors this quest is enough, and yields ample joy for a full life. They feel no need to invest time, energy and money in the study of aesthetics; they prefer instead to devote all their personal resources to the enjoyment of the scientific experience.

Scientific Criteria

There are two basic criteria for any scientific appreciation of minerals. The first of these is visibility (that the specimen itself is visible or can be made visible with available magnification), and the second is accurate identification. Some collectors can exist solely on this much, acquiring sand-grain-size or smaller specimens properly identified by someone else as to species. The enjoyment comes virtually entirely from what they know about the purported species rather than what they can visually evaluate in the actual specimen.

A third criterion, and one insisted upon by connoisseurs, is that the specimen show enough of its potential characteristics to be identified by sight alone. It is impossible to be a connoisseur of something based entirely on data or analyses dependent on the skill or equipment of others, because one's own skill and knowledge are then not required. Connoisseurship must rely on one's personal skill or it has no meaning.

An extension of this is the visual clue to unseen aspects. This may be, for example, a re-entrant angle indicative of twinning, a color or zonation indicating chemical or structural peculiarities, a crystal form giving evidence of unusual internal symmetry, surface growth features suggesting a certain chemical environment, and so on. These clues are what trigger the scientific appreciation of mineral specimens. The more frequent and better developed they are, the more affecting they become. In this sense only can relative judgments be imposed on specimens from the scientific viewpoint. To appreciate and evaluate them it is clear that a connoisseur must possess significant scientific knowledge.

Of all these scientific criteria, the presence of a recognizable, euhedral or subhedral crystal shape is generally held to be the most important. The crystal forms are a manifestation of the internal structure which, together with chemical composition, defines the mineral's identity.

A fourth criterion is the demonstration of relationships. Epitaxy, associated species, intergrowth textures, and so on provide clues to the many ways in which one mineral can be chemically, crystallographically or temporally related to another. Clues to relationships involved in a mineral's origin are especially valued. Here again, the visual clue by itself cannot yield scientific appreciation in the untrained mind; knowledge of mineralogical science is essential.

A fifth criterion (really an extension of the third and fourth) is the visible aspect which presents a scientific mystery. It might be argued that a lack of data to explain a phenomenon cannot be scientifically appealing, and this is a strong point. But the mystery which presents itself is really the door to understanding, and is highly valued in science. Such mysteries do show data, but data which we cannot as yet fully interpret. (Consider, for example, mineral rings and cylinders or the "bulging" faces of diamond crystals.) Thus a visible mystery is not really an informational void but rather a clue to new knowledge.

These criteria for the scientific appreciation of minerals are often not recognized as such by the average collector. The word he uses for them is "interesting," because of the new understandings or the new mysteries which the specimens provide regarding the unseen aspects of mineralogy.

AESTHETIC APPRECIATION

Aesthetics is a different matter, and a more essentially subjective one. It cannot be defined without reference to man. The relative judgments we make in pronouncing one mineral specimen more aesthetic than a hundred others of the same species are purely a reflection of our own individual minds. Thus, defining or explaining mineral aesthetics is to some extent an empirical problem: if enough people pronounce something beautiful, then it *is* beautiful. If a certain standard is widely applied by many people in making aesthetic judgments, there can be no arguing with its statistical validity. Nevertheless, no person's judgment can be proclaimed wrong, even if he is the only person on the planet holding that view. Each human judgment is individually as valid as anyone else's. A person's judgment on aesthetics can only be called wrong if his statistics are wrong, that is, if he inaccurately claims that a certain proportion of other people would agree with him.

In this discussion the goal must therefore be essentially statistical: to identify and explain the criteria that most people use in judging mineral aesthetics. Unfortunately, however, statistics cannot be the *sole* element in evaluating aesthetics. Two other aspects must be incorporated: experience and fashion.

If experience were not a factor in judging aesthetics, each of us would be born with perfect taste, and there could be no such thing as a *refined* sense of aesthetics. To develop taste, a person needs a large mental databank and a collateral learned sensitivity to subtle variations. Without these he cannot intelligently define and apply his own aesthetic criteria, whatever they may be. Certainly it is all a matter of degree, and everyone has at least some experience with viewing solid matter and sensing differences. At worst, a normal person can only have "poorly developed" or "unusual" taste. Naturally, for the purposes of this discussion, we will weight the statistical analysis in favor of those persons having maximum experience and sensitivity. There is nothing objectionably discriminatory in this approach; it merely allows us to see the human mind in sharper focus.

The second mitigating factor, fashion, is an even more obtuse variable in that it changes with the times and it can be dictated by the elite. In truth, no one can dictate taste . . . they can only dictate fashion. A person may ignore his own taste and cave in to fashion; he may devalue his own judgment in his own mind so that he abides by someone else's stated preferences. But his taste is individual and can be refined only through direct experience; fashion is social and can be swayed by social pressures having nothing to do with aesthetics. Being social animals, we can never be entirely sure we have factored out the transitory social components from our aesthetic judgments.

In this discussion we will strive to distinguish those eternal aesthetic verities (presumed to exist) that allow taste to rise above temporary fashion. But we can never be sure of totally achieving that ideal. Any confirmation will require the perspective of centuries on the part of writers and thinkers looking back from the far future. It's important to remember that questions of aesthetics have been debated by the finest minds for more than 2,000 years, so we're probably not going to settle them once and for all in this issue of the *Mineralogical Record*.

By whatever means it is that we each arrive at our own criteria for judging aesthetics, it is the satisfying of these criteria that yields us beauty and joy. For some mineral collectors this is enjoyment enough; they feel no need to invest time, energy and money in the acquisition of scientific competence and understanding. They prefer instead to devote all their personal resources to the enjoyment of aesthetics.

Aesthetic Criteria

To say that a specimen is beautiful begs the question: *why* is it beautiful, in the absence of all technical knowledge about it?

Perhaps the most significant characteristics that some minerals can possess, which are universally thought of as beautiful, are clean color (lacking overriding gray, brown or milky tones) and transparency. For some obscure reason, people derive pleasure from gazing into a colorful, transparent solid . . . it seems to be a fundamental peculiarity of the human mind, producing an almost tranquilizing effect. Many mineral species are incapable of exhibiting these characteristics, the opaque metallic minerals for instance, but for any species that *can* show bright color and transparency, the connoisseur will expect it to do so in the finest specimens.

Transparency gives evidence of internal perfection, as if the crystal interior had been swept clean of litter and dirt. It also requires a lack of internal damage (cracks), and a lack of growth flaws and inclusions. These are characteristics which people value in all areas of life, not just in minerals, so we can feel relatively certain that the criterion of

transparency is a fundamental one and not a passing fashion. The ultimate transparent specimens are referred to as "waterclear" (a word having equivalents in several languages), so perhaps the basic human need for pure drinking water is an underlying factor in our minds.

Clean, bright color as a standard of beauty is difficult to trace to its origins. Perhaps it stems from our ancestral primate recognition of ripeness in fruit being associated with bright color. Even bees use this color cue as a guide to food, in flowers. Then again, experience shows us that as things age and deteriorate they again lose the brightness of their colors. This is especially true of food, but also of most other living things. "From (relatively colorless) dust we are born, and to (relatively colorless) dust we (and all life on the planet) shall return." "Fresh" color is quite literally a sign of vitality, and the ability to recognize it and be attracted to it is a fundamental survival characteristic common not only to humans but to many other animals as well. So, once again, we can feel relatively confident that clean, fresh, strong color is an enduring standard of beauty. It should be remembered that, in purely aesthetic terms, the actual origin of the color in a mineral is immaterial; origin is one of those unseen aspects which the trained mineralogist understands intellectually but cannot determine visually . . . such falls within the province of scientific appreciation.

A broken or stream-rounded lump of mineral can possess color and transparency, but has no coherent external design. Why do we prefer things to have recognizable, rational, relatively consistent shapes? Probably as an aid to recognition; we learn as infants to begin recognizing things by their shapes, perhaps even before we can recognize colors. This, however, is an intellectual reason for appreciating coherent design. The mere possession of crystal faces is not an aesthetic criterion. To impress us aesthetically, the overall shape of crystals, crystal groups and matrix, individually and in concert, must take on a pleasing "sculptural" quality.

We will probably never understand fully what makes one shape slightly more aesthetically pleasing than another. Personally I suspect it has to do with subconscious mathematics. A part of our mind is constantly engaged in making visual proportional estimates and comparisons on several levels. (Benoit Mandelbrot, known for his work in fractal mathematics, said that beauty exists when there is detail at all levels.) When numbers or ratios are found to repeat, resonate or harmonize in novel ways, a sort of pleasure alarm goes off in our minds. This may, in part, be a parallel to the scientist's appreciation for a universe that is logically consistent and interrelated. But to some extent it may also be inborn in the human mind, as evidenced by extensive cross-cultural studies showing general aesthetic preference for rectangles having a ratio of side lengths equalling 1:1.618 (the so-called "golden section").

In any case, the detailed computations involved in recognizing aesthetic shapes must be developed, refined and expanded over a lifetime. Only through long experience can a person become a connoisseur with respect to aesthetic shapes and compositions. The intensive study of art aids in this developmental process just as much as the study of fine mineral specimens. The subconscious computational center of the mind must be exercised over and over, preferably in the analysis of already recognized artistic masterpieces and great mineral specimens in museums (overlooking, of course, the many inferior specimens in museums!). In this way the great connoisseurs of the past, who have identified these masterworks for us, can help save us time in learning aesthetic compositional analysis. It is not something that can be explained in words, beyond telling us that this one is bad, this one good, and that one great in its composition. Given that much to go on, our subconscious minds must then work out the hidden mathematics. This is beyond the abilities of some people, but it is an essential aspect of connoisseurship.

We have discussed the importance of shape, but the quality or nature of the surface is a separate characteristic. Luster is a general term describing the overall reflective effect resulting from the fine-scale shape of a surface and the refractive and absorption index of the species.[1] With minerals we are generally speaking of crystal surfaces which, if perfect, are absolutely flat all the way down to the atomic level. In nature there is no such thing as literal perfection, but the approach can be quite close. Imperfections, or deviations from flatness, can come about in a variety of ways, from crystal growth defects to growth around surface contaminants and reverse growth or dissolution as a result of corrosive liquids or gases. All irregularities reduce the amount of light that is reflected in a single direction from a face, reducing the brilliance of the reflection. The ultimate is generally referred to as brilliant luster or mirror-smooth faces.

It should be remembered that, in the case of transparent crystals, light can be reflected from the interior side of each face as well as the exterior side, thus increasing the total amount of light being reflected back to the viewer. With colored minerals this effect can deepen the apparent color (because a beam of light passing through a crystal, being reflected off an interior face, and then passing back out through the crystal again has a longer path; the effect is the same as if the crystal were thicker). Attractive color effects based on the vector-dependency of pleochroism can also arise. Thus a high luster can contribute toward the criterion of intense color.

It is difficult to say why a brilliantly reflective surface is considered beautiful. Through experience we learn that such surfaces are more perfect, simply because they can be degraded so easily by scratches and other damage. Here we approach once more a fundamental peculiarity of the human mind: the search for perfection. Perhaps this too is fundamentally mathematical. Perfection requires the simplest mathematics to fully describe, and produces a unique resonance in the analytical mind. To study a perfect crystal face, searching for the inevitable defects through a whole range of scales but finding none, can produce a momentarily vertiginous feeling, like looking down a well. The effect can be almost unsettling, because we know that the greater the degree of perfection, the greater the fragility of that perfection, and somehow the more precious it is. In any case, we can be sure that the criterion of perfection, in a wide range of different aspects, is an eternal one.

Some crystal faces are actually composed of alternating or distorted crystal faces of several different orientations. There is a continuous range in terms of scale and size, but at some point the irregularities pass from being evaluated as luster to being judged for shape. A lack of surficial perfection may conceivably pass into a superior variation in overall shape, one criterion merging with or transforming insensibly into another. The connoisseur's skill in applying his criteria and making finely discriminating judgments is essential.

Damage is, of course, the antithesis of perfection, so much so that freedom from damage becomes a criterion of its own. It is, in a way, the more practical approach, because with the abundance of damage in the world it is far easier to look for damage than perfection . . . a sort of process of elimination. In rare instances, certain kinds of damage can contribute to improvement relative to other criteria (internal reflectivity and color intensity, for example). Similarly, with regard to luster, a crystal with alternating lustrous and frosty faces may be extremely aesthetic. In such cases the criteria must be balanced against each other in making a judgment, and the fine sensibilities of the connoisseur are once again essential.

OTHER FACTORS

Size

Size is a surprisingly difficult aspect to evaluate in terms of fundamental appeal. All other things being equal, bigger is probably

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[1]Refractive indices lower than about 1.7 have lower luster (e.g. "vitreous") whereas indices above 1.7 are brighter (e.g. "adamantine"). Higher degrees of absorption result in submetallic and metallic lusters.

better. Unfortunately, all other things never *are* equal. With increasing size goes an increasing tendency toward defects of all kinds. Micromounters know well that the very best and most beautiful crystals of a great many species are under one or two millimeters in size. When size is balanced against the associated disadvantages relative to other criteria, people fail to agree on an optimum. Thus there are micromounters, thumbnail collectors, miniature collectors, cabinet specimen collectors, and collectors who avoid size entirely as a criterion.[2] Size should probably not be considered an aesthetic factor. Bigger may be better or more desirable, but beauty, in my opinion, exists independently of size.

In practice, the well-rounded connoisseur is able to appreciate and evaluate specimens of any measurement, applying all of his other criteria *in the context* of size.

Provenance

A specimen's provenance, the history of that specimen since the time it was collected, is always of interest to the connoisseur. Being, like the scientifically appreciated aspects, an unseen factor, provenance requires both a confidence in the data and a significant historical database for comparison.

Generally speaking, the more a person knows about the history of mineralogy and the history of mineral collecting, the more he will appreciate provenance. In an exact parallel to scientific appreciation, the provenance data accompanying a specimen can be correlated with its place in human history to yield insights and intellectual satisfaction. To know that a specimen was, for example, once a part of the collection of René Just Haüy is as enjoyable to contemplate historically as knowing scientifically that the species is the sole representative of its crystal class. But one must know *who* René Just Haüy was (the founder of crystallography), just as one must understand the derivation of the crystal classes. Consequently, a connoisseur must know some history, as well as science and art.

In order to appreciate provenance the connoisseur must also be shrewd in his ability to critically evaluate a specimen's purported history. Simply taking someone else's word for it requires no discriminatory powers. Has the specimen passed exclusively through reliable and unbiased hands? Can it be correlated with published descriptions or illustrations? Does the label appear authentic, and does it match catalog numbers that may be painted on the specimen? Can the handwriting on the label be recognized? Is the original catalog still extant and can an entry therein be matched with the specimen? Are letters or other supporting documents available? Many questions must be answered before important provenance is accepted. And many specimens have irretrievably lost their provenance. Although scientific aspects may often be rediscovered through new analyses, provenance, once lost, is likely never to be regained. Consequently the connoisseur does all he can to verify and preserve labels and other provenance documentation.

Rarity

Rarity is not an aesthetic factor or attribute, although in many minds it certainly contributes to a specimen's desirability. Why do we like things that are rare? Perhaps it comes from our innate curiosity, expressing itself as a deeply felt gratitude to Nature or fate that we are allowed to explore data of very low general availability. Then again, perhaps part of it is a selfish or elitist pleasure in owning something which most collectors cannot own.

Nevertheless, rarity is a circumstance, an outside factor, and perhaps even an accident of only temporary nature. Rarity of an individual specimen can change drastically without the specimen itself being physically altered in any way.

Of course, certain chemical *elements* may have greater rarity, and thus to some extent the species which contain those elements may be considered rare, but there are many extremely rare species composed of very common elements. Germanium, for example, is considered rare along with its minerals, but those minerals have been recovered by the ton at Tsumeb. Contrast this with minerals like bideauxite, $Pb_2AgCl_3(F,OH)_2$, or taaffeite, $Mg_3Al_8BeO_{16}$, containing much more common elements but known in total quantities of only a few grams. Cosmic elemental abundance is therefore an unreliable standard for appreciating the rarity of minerals.

That rarity can be temporary is also well known. New discoveries are being made constantly, and in every case where earlier specimens are known, those specimens suffer a change in their rarity.

Rarity can be evaluated from many different viewpoints; including (1) rarity of the species, (2) rarity of the species from a certain locality, (3) rarity of the species having a certain crystal habit or color, (4) rarity of specimens having a certain provenance or history, (5) rarity of a species in crystallized specimens, and so on. Perhaps the most common approach to rarity is based on the *degree* to which specimens satisfy one of the various scientific and aesthetic criteria. Naturally the biggest, most richly colored, most lustrous, most transparent or most sculpturally pleasing specimens are virtually by definition rare, although proximity to the next specimens in rank makes a significant difference in how that rarity is weighed.

The evaluation of rarity is in part simply a statistical exercise: "How many specimens have I seen like this or better?" The more massive one's personal databank for comparison, the more significant the answer. But rarity is linked with size and with aesthetic, historical and scientific criteria in ways that make it difficult or impossible to meaningfully isolate. In terms of *desirability,* a specimen which is as ugly as dirt and carries no scientific interest, benefits hardly at all from also being rare (or, for that matter, from being large or having an interesting provenance); but a very beautiful specimen benefits tremendously. Rarity, provenance and size tie the various scientific and aesthetic criteria together to form an interactive complex. They function as desirability enhancers, and their effect is more or less proportional to a specimen's scientific/aesthetic desirability.

Repair

Repaired specimens are a special case. Where the repair is obvious, or where pieces are clearly missing, desirability must inevitably suffer. But where expert repairs are essentially invisible, many connoisseurs will feel no decrease in their appreciation for the specimen. An invisible repair cannot affect aesthetics (which deals only with the visible), nor does it alter any of the existing scientific elements relating to the unseen aspects, parameters and concepts of mineralogy. The glue is a purely practical adjunct, its use comparable to mounting a specimen on a base for exhibit purposes. Less sophisticated collectors, lacking confidence in their own ability to discriminate between good repairs and bad ones, are inclined to shun *all* repaired specimens in order to protect themselves. Although understandable from a beginner's viewpoint, this can quite literally develop into an irrational collecting phobia which is difficult to shake in later years. Most connoisseurs, on the other hand, are confident and capable of making the necessary fine distinctions; where their standards for repair are fully met, they feel no need to penalize the specimen.

Cost

Cost is obviously neither a scientific nor an aesthetic characteristic. And yet, cost has a definite effect on the mind in determining how we view a specimen's desirability. It is possibly an effect against which connoisseurs should learn to insulate themselves, but on the other hand it can be a distinct additional pleasure to view an emerald crystal and to know that it is worth five million dollars in cutting material! The philosopher George Santayana wrote on this point in his book *The Sense of Beauty* (1896):

> There is no reason why cost should not heighten the tone of

[2]The late Neal Yedlin, a connoisseur known primarily as a leading micromounter, was often asked about the many larger specimens he owned, and always replied, "I collect minerals, not sizes."

> consciousness, and add to the pleasure with which we view an object. [A high cost] gives interest and poignancy to that which is present; our attention and wonder are engaged, and a new meaning and importance is added to such intrinsic beauty as the object may possess.

The connoisseur, of course, can judge a specimen's dollar value for himself and need not rely on the statements (or asking price) of someone else in any particular case. This helps him avoid being unduly impressed by a high price tag. Some mineral dealers, for example, use the cost effect to their advantage: if a specimen has remained unsold for too long, they will *double* its price and see what happens. Often it will then sell promptly!

Personal Factors

There are elements of appreciation which are specific to each collector, and he should be careful to factor these out of his judgments when necessary. For example, a specimen which was once given by a dear friend, or which calls to mind the collecting days of one's youth, will have no such value for anyone else.

A problem involving personal factors often arises when a collector decides that the time has come to sell his collection. This is often an emotional time which marks a great turning point in his life. Because of personal factors, he will be strongly inclined to make two fundamental errors: (a) he may overprice the collection, and (b) he may wish to see it sold as a unit to someone who will keep it all together instead of breaking it up.

The source of the first error is usually the price originally paid for each specimen. Many collectors feel that they have a right to recoup their original "investment," and some people also fully expect appreciation in value, as if interest were being earned on a bank account. Unfortunately, there is no validity to either of these expectations. Current market conditions and nothing else will determine the retail value of a specimen; original purchase price and date of purchase mean nothing. The market value of individual minerals may go up, down or remain static over time. To quote Santayana (1896) again, "Nothing so much enhances a good [object] as to make sacrifices for it"; but the sacrifices, in terms of money spent or effort expended in acquiring specimens, are the owner's alone. Personal sacrifices are of little interest to anyone else. The connoisseur must be able to purge his mind of such personal factors if he is to accurately evaluate his own specimens.

The source of the second error is the similar belief that all the work, time and money expended in the assembly of the *collection* should have some enduring value to others. But this is no more true of collections as a whole than it is of individual specimens. Other people are involved in building their own memories and their own collections, and cannot feel the same way as another collector might about his own collection. It is actually quite rare that a mineral collection will deserve to be kept together as an inviolate unit, for historical, scientific or aesthetic purposes, or perhaps as a study collection for teaching purposes, after it passes from the hands of its builder. The connoisseur dispassionately recognizes those collections which would benefit others by being kept together, and those which should be broken up, even in the case of his own.

OTHER SKILLS

Recognizing Fakes

Human nature being what it is, there is always the danger that some specimens will have been artificially modified so as to better meet the standards of the connoisseur. Luster, color, clarity and shape can all be altered to improve aesthetic appeal; even scientific aspects can be falsified (e.g. addition of foreign matrix, or falsification of locality data) (see Bentley *et al.*, 1986). A critical, suspicious and discerning eye is necessary for the connoisseur to avoid being fooled. It is of little use to have highly refined scientific and aesthetic criteria if those criteria can be easily circumvented or deceived by unscrupulous people. Protection requires knowledge and experience, so that very subtle deviations from the natural state can be recognized (see Dunn *et al.*, 1981).

Making Appraisals

One of the skills which people expect of a connoisseur is the ability to accurately appraise the dollar value of any mineral specimen. This can be extremely difficult because all factors come into play, including the transient ones such as fashion, and all specimens must be reduced to a common denominator. Furthermore, different dollar values may apply to a single specimen, depending, for example, on whether a quick replacement value (for insurance purposes) or a quick sale value (for forced liquidation) is wanted. It also matters which dealer will be doing the selling or buying. To know dollar values, one must know "the market"; that means knowing most of the people in it, and using these contacts to track the prices that good specimens are bringing at any given time. A "system" for valuation (such as that proposed by George L. English in 1927), no matter how carefully constructed, will always be inferior to experience and empirical pricing data regarding actual sales. (Desautels, in his chapter on connoisseurship in *The Mineral Kingdom* (1968) explains at some length why this is so.) These market characteristics are simply facts which must be monitored and processed; they have nothing to do with the connoisseur's personal standards, but only with his ability to be finely discriminating in determining what the market will bear. This is fortunate because it means that dollar value is not always commensurate with a specimen's ability to meet the connoisseur's high standards. Therefore, it is possible to be a connoisseur at all price levels, whether a person can afford $50 specimens or $5000 specimens. Although the large, rare and beautiful specimens may be worth a great deal, those which are merely beautiful or scientifically interesting can sometimes be much more affordable and can meet nearly all of one's requirements.

And what of those specimens which have *only* rarity and no important scientific or aesthetic qualities to recommend them? As with anything else, the market determines their dollar values; but rarity by itself offers no opportunity for the connoisseur to exercise his other hard-won skills. Consequently, rarity alone is never enough to satisfy a connoisseur, no matter how high the dollar value may be.

SPECIALIZATION vs. PROVINCIALISM

The fullest expression of connoisseurship in minerals, and the most challenging, is the generalist approach in which all minerals from all localities are studied. However, the concept of limited connoisseurship is valid, and is also more achievable for many collectors. Specialization in the minerals of a certain country, geographic subdivision or single locality is relatively common among collectors; usually a collector lives in or near his geographic area of specialization, but not always. As an alternative, people may specialize in non-geographical subdivisions such as geological environments (pegmatites, skarns, etc.), chemical categories (phosphates, lead minerals), crystallochemical categories, twins, pseudomorphs, physical properties, highly colored minerals, gemstone species, and so on. Within these limited parameters a person has less information to master, and perhaps an advantage in the local availability of specimens to study and acquire. By concentrating on a selected area of the mineral world it is possible to achieve some level of connoisseurship in a shorter period of time. And, within that area, it will eventually be possible to become more knowledgeable than most generalist connoisseurs.

The principal pitfall for the person who aspires to limited connoisseurship is lack of perspective. Provincialism in its worst manifestation, beyond simple specialization in a certain province, involves ignorance of and lack of exposure to the "outside world," and a judgment that one's own area of specialization is somehow superior to all others in an absolute sense. Considering that a connoisseur's

fundamental skill is the ability to make judgments, it is an overshadowing flaw to overestimate and misjudge the importance of one's own specialty relative to all others. An element of arrogance can lead specialists to believe that the *selection* of a speciality is, in itself, a judgment based on connoisseurship instead of a matter involving personal taste supported by no consensus among other connoisseurs. The generalists see this clearly, but the specialists often do not.

A specialist must have a good understanding of the connectedness of the mineral world, that is, how his area of specialization meshes with and relates to all others. Consequently it is wise for all specialists to gain a good general background, and not concentrate their studies too exclusively on their chosen area.

GENERAL REMARKS

A common feature in the development of connoisseurship is the application of criteria at an ever smaller scale. Beginners may fail to notice a difference between two specimens which are as different as night and day to the connoisseur. The criteria discussed here operate on a sliding scale, rather like a logarithmic progression of increasing magnification. This is fortunate, because the overall concepts can be grasped by beginners before they embark on a lifetime of gradual refinement.

Only a few times in the life of any connoisseur does a specimen present itself which ranks at the top in *all* of his criteria. For the most part, a connoisseur applies his skill not only in measuring specimens against his personal criteria, but in weighing the criteria against each other with respect to different strengths and shortcomings in the specimens. Tempering these different comparisons must be the knowledge of rarity and provenance, of what is ultimately possible for each species, and what the best known examples are like. Evaluating the interactions within the "criteria complex" is ultimately the connoisseur's most hard-won skill.

Those who adhere solely to the scientific view of mineral appreciation tend to feel superior because their fundamental criterion (scientific truth, physical reality, the accurate understanding of nature) is supposedly immutable. Those who adhere solely to the aesthetic view tend to be less judgmental of their scientific counterparts, but often view them as culturally stunted. Pure historians, respected but viewed as eccentric, may grieve for both of them. The connoisseur sees instead a rare opportunity to indulge in a field where the sciences, history and the humanities meet and intermingle. These concepts, taken as a whole, are greater than the sum of their parts. Appreciation of all three viewpoints can result in a far richer and more profound enjoyment than any alone. Each requires an investment of time, energy and money to develop; few people make the conscious decision to master them all, and pursue that decision over many years. Therefore highly developed connoisseurship in minerals is still relatively rare, and will probably remain so, but it is an aspiration with sublime rewards.

ACKNOWLEDGMENTS

Having yet to achieve connoisseur Nirvana myself, I am indebted to many others for their insightful ideas, comments and criticisms, and thought-provoking discussions while this essay was in its formative stages: (in alphabetical order) Richard A. Bideaux, Dr. Steven C. Chamberlain, Forrest Cureton, Paul E. Desautels, Dr. Pete J. Dunn, Stanley J. Dyl II, Richard C. Erd, Dr. Carl A. Francis, George Godas, Thomas Gressman, Dr. Anthony R. Kampf, William Larson, Wayne C. Leicht, Dr. Joseph A. Mandarino, Gloria Olson, John Sampson White, and Lorraine H. Wilson. This is not meant to imply that each of these people has seen or agrees with every statement contained here; whatever errors in reasoning that may remain are mine alone.

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Washington A. Roebling

His Life and His Mineral Collection

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The Washington A. Roebling mineral collection of about 16,000 specimens was donated to the Smithsonian Institution by Roebling's son, John, in 1927. It was undoubtedly one of the largest and finest private mineral collections of its time. This acquisition, together with the Canfield collection of about 9100 specimens, obtained that same year, at once made the Smithsonian's mineral assemblage one of the best in the world.

INTRODUCTION

Mineral collecting was far from being Roebling's only activity. He designed and supervised construction of the famous Brooklyn Bridge as well as other bridges at Pittsburgh, Cincinnati-Covington, and Niagara Falls. Of particular interest to readers of this journal is the Roebling Bridge connecting Mapimi, Durago, Mexico, with the Ojuela mine—at the time of its construction (1899) the second longest suspension bridge in the world. Roebling was an accomplished musician, a linguist and a classical scholar. The gardens surrounding his Trenton, New Jersey, home contained many rare trees and plants, and he was an occasional flower show judge. He was active in civic affairs and in Republican politics; his first vote was for Lincoln and he was an Elector for McKinley and Coolidge. And, he had a distinguished military career, retiring as a Colonel.

The Archives of the Smithsonian, from which much of the material in this article was taken, contain letters to the Colonel from many well-known mineralogists, dealers and collectors with whom he was acquainted or had dealings. Among them were: Frederick A. Canfield, Charles Palache, Waldemar Lindgren, Esper S. Larsen, George F. Kunz, W. F. Hillebrand, George L. English, George P. Merrill, Waldemar T. Schaller, Earl V. Shannon, William F. Foshag, R. B. Gage, Albert H. Chester, Samuel G. Gordon, Alexander H. Phillips, George Smith (Australia), and L. J. Spencer (England). The British Museum (Natural History) also has many Roebling letters and other documents. Copies of some of these were kindly furnished me by Paul W. Pohwat of the Smithsonian.

In many cases, Roebling wrote comments on the letters, perhaps to indicate what would be in his reply. Most of Roebling's letters were written by hand. Excerpts from some of his more interesting letters are quoted below. They indicate, among other things, Roebling's wide-ranging interest in and knowledge of minerals, how he acquired some of them, the extensive interchange of information and minerals between the Colonel and his many friends and, occasionally, what he thought of some of his contemporaries. Many of Roebling's letters and some of the replies are unfortunately not preserved, sometimes leaving tantalizing gaps.

Washington Augustus Roebling was born on May 5, 1837, in Saxonburg, Butler County, Pennsylvania, the eldest of three sons of the John A. Roeblings, who had come from Germany some years earlier.

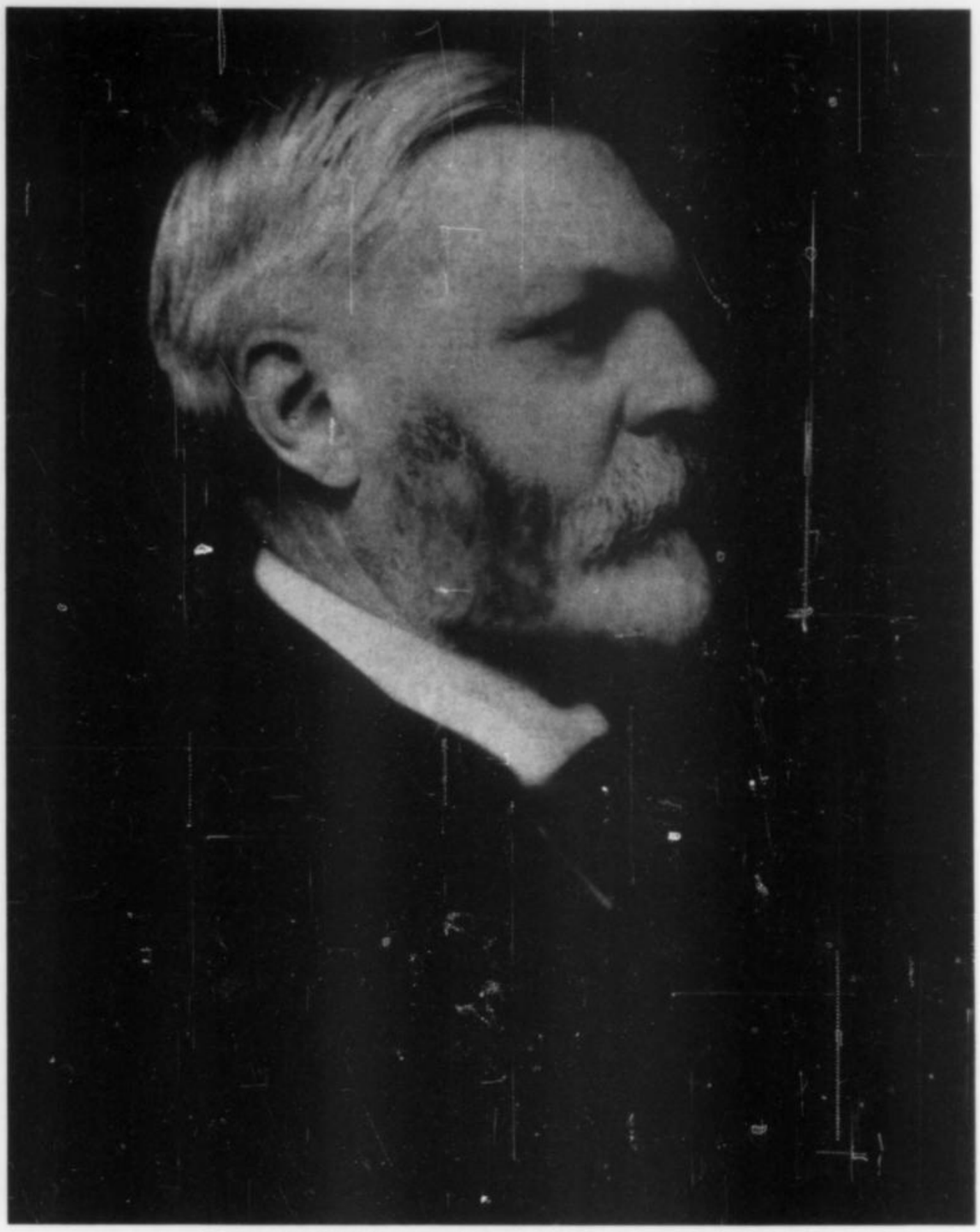

Figure 1. **Washington Augustus Roebling (1837–1926).**

Washington died in his eighty-ninth year in Trenton, New Jersey, on July 21, 1926.

John Roebling moved his family from Saxonburg to Trenton, New Jersey, in 1849, and established there a small wire rope factory, which led soon to the building of suspension bridges. Washington attended Trenton Academy, then enrolled in Rensselaer Polytechnic Institute, graduating with a degree in civil engineering in 1857. He joined his father's wire manufacturing and bridge building company and helped with the construction of several large bridges. His peacetime activities were interrupted by the attack on Fort Sumter on April 15, 1861; he enlisted as a private the next day. His engineering ability, however, soon earned him a commission, and he served as a staff officer for the rest of the Civil War, acquiring nevertheless a full measure of battlefield experience.

ROEBLING and the CIVIL WAR

A week or so before the battle of Gettysburg, he had been doing his daily chore of surveillance from a tethered balloon when he spotted the first sign of General Lee's troops moving toward town. The Union officers discovered, to their dismay, that no adequately detailed map of that part of Pennsylvania was to be had. Colonel Roebling remembered that his father had one; he was dispatched forthwith to Trenton to fetch it and others available there. When he returned, both armies had moved and he was unable to find either. The Confederates almost captured him, but he hid with his horse in a cave for the night.

On the second day of the battle, he was on Little Round Top with General Warren (whose daughter he later married) when Hood's furious attack began. Colonel Roebling helped haul a cannon up the hill to blunt that attack which, if successful, would have outflanked the Union Army with disastrous results.

On the third day of the battle of Gettysburg, Colonel Roebling was examining a map on a table at General Meade's headquarters when a Confederate cannonball knocked off two of the table's legs.

Roebling participated in a dozen or so more battles, including those around Richmond and Petersburg. He was responsible for some vital information which led to Lee's defeat and subsequent surrender at Appomattox, and was present at that ceremony on April 9, 1865.

His other activities while in the army included building a 370-meter suspension bridge over the Rappahannock, and another over the Shenandoah at Harper's Ferry. During the battle of Antietam, the bridge was captured by the Confederates, who tore out the flooring. Roebling observed the bridge while it was still in enemy hands, and prepared new flooring. This was promptly installed when the Union Army recaptured the area.

THE BROOKLYN BRIDGE

After almost four years of active service, he resigned his commission as Colonel in 1865. That same month he married Emily Warren, and resumed work with his father's company. Later he went to Europe for a year to study pneumatic caissons for bridge foundation construc-

tion, which would be necessary for the Brooklyn Bridge. His father was making preliminary plans for this famous structure, but they were not far along when he died as a result of a ferry accident while locating the Brooklyn terminal of the bridge. This left the planning and construction to son Washington who, with his two brothers, formed the John A. Roebling Sons Company to carry on the bridge building activities. He remained active in this company until a week or so before his death. It had factories in Trenton and Roebling, New Jersey.

Colonel Roebling had moved to Brooklyn to be near the construction site, and supervised all details of the work very closely at first. In 1872 he was seriously injured, however, by staying too long in the compressed air atmosphere of the caisson, and for a time his life was in jeopardy. He suffered from "caisson fever"—now known as the bends—and was confined to bed in a dark room for some time. He continued the planning work, however, observing progress on the bridge through the window of his sickroom. Thanks to able assistants and the help of his wife (who made sure his plans were carried out by the assistants), the bridge was completed. Construction was started on January 2, 1870, and finished May 22, 1882, resulting in what was then the longest clear span in the world, 467 meters. The cost was about $15,000,000. President Chester A. Arthur and New York Governor Grover Cleveland were present at the dedication.

In 1884 Colonel Roebling moved to Troy, New York, and four years later to Trenton, New Jersey, where he spent the remainder of his long life. He never fully recovered from his illness, and was in pain much of the time. His first wife Emily died in 1903; five years later he married Cornelia Witsell Farrow of Charleston, South Carolina.

ROEBLING and MINERALS

Colonel Roebling first became interested in minerals while at Rensellaer Polytechnic Institute; he probably studied the subject formally. He did do some blowpipe analyses, as attested in a letter dated March 20, 1926, from Professor Walter F. Hunt of the University of Michigan, then editor of the *American Mineralogist:*

> I have read with interest your account [this account not in the archives] of your introduction to minerals while in college. My interest was likewise stimulated through the blowpipe methods as I started out specializing in chemistry. It has always been a puzzle to me why more engineers—especially civil and chemical—do not elect more work in minerals. [Hunt goes on to say:] I had no idea your collection numbered as many as 16,000 specimens. I hope that some day while I am in the East I may have the privilege of seeing it.

In his memorial of Roebling in the *American Mineralogist* (1927), Professor Phillips of Princeton says:

> To alleviate this suffering from the then little understood ailment, he was kept in a dark room; and for amusement and diversion he studied, by the light of a candle, his then small collection. Colonel Roebling collected minerals, as he did everything else, with that meticulous attention to detail which led him to study each individual specimen and to verify the correctness of its identification and locality. He knew his collection so thoroughly (and there were more than 16,000 specimens) that he could describe instantly the specimens representing any species in his collection. He read the literature, noting carefully the descriptions of new species, and corresponded at once for specimens from the type locality; and when a species was represented by but a few specimens, he followed the wanderings of each, and always persisted in the chase until the desired object was obtained. The Roebling collection was never cataloged, nor was a specimen ever numbered to connect it with its label.[1] For this reason he was very particular in the handling of his specimens, as he had the constant fear of getting the labels misplaced. Very often the history of a specimen would be found neatly folded in the tray. Here and there a tray would be empty, with a note 'This specimen has been loaned now for two years. Time it was returned.'

ROEBLING and CANFIELD

Roebling was well acquainted with Frederick Canfield[2] and his collection. In a memo dated October 31, 1891, headed "Fred Canfield's private collection at Dover—minerals that impressed me," Roebling listed 40 or so specimens and added notes, exclamation marks, and partial descriptions. One note after pyrargyrite says "Bolivia—hundreds of them. Red and transparent. He paid $100 to a poor devil for a spec. worth $500." After blödite are the words "I have it," in different ink and presumably added later. The name "broquinardite" is on the list; Roebling marked it "Bolivia—very fine—rare." In a letter to the Colonel dated June 6, 1896, Canfield wrote "The mineral I called broquinardite (on authority of the specimen in the South Kensington Collection) is either argyrodite or canfieldite and comes from Colquechaca, Bolivia."

ROEBLING and the BRITISH MUSEUM

Roebling dealt with many museums, dealers and mineral collectors abroad. A letter from George L. Prior, Keeper of Minerals, British Museum (Natural History) of October 6, 1910, thanks Roebling for sending a list of his duplicates and names 13 minerals they do not have. "If you could kindly send specimens of these (together with a list of your desiderata) I dare say we could arrange a satisfactory exchange." Roebling's note on the letter says he sent all but two—"forgot them." A list of Roebling's duplicates in the archives is dated 1897 and contains about 325 minerals.

Roebling and L. J. Spencer of the British Museum (Natural History) exchanged minerals and letters over quite a period of time. A letter from Spencer dated November 18, 1902, reads:

> After much delay we have at last arranged a small exchange, which as you remark in one of your letters, is a difficult thing to do. From the large lot sent by you in October for us to select from, we have taken Knoxvillite [now discredited; = copiapite] with Redingtonite, in return for which we give a portion of the original Baddeckite [now discredited; a mixture of hematite and clay] described by Dr. G. Chr. Hoffmann, who gave this name in 1898. This we hope you will consider satisfactory. The exchange of Selen-tellurium for Daphnite [now discredited; = magnesian chamosite] had been previously arranged. These two (Daphnite and Baddeckite) together with your 12 specimens we now send to you carriage paid.
>
> Our reason for returning so many of your specimens is that such doubtful or obscure species are scarcely worth collecting unless they agree exactly with the original descriptions or are guaranteed by their authors. I may add that many of the names in your list of desiderata are not represented at all in this Museum and of others we have no duplicates which could be spared.

A letter from Roebling to Mr. Lazarus Fletcher at the British Museum, dated May 29, 1902, had said selen-tellurium was being sent,

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[1]When the collection was obtained by the Smithsonian, the specimens to be retained were numbered, with an "R" prefix to indicate the origin.

[2]Canfield died, incidentally, about three weeks before Roebling on July 3, 1926. The deaths of these two prominent and acquisitive mineral collectors, coming so close together, are said to have considerably depressed the mineral specimen market. This in turn lowered the appraised value of the two collections, made by Professor Phillips of Princeton about three months later.

and suggested daphnite as a suitable exchange. Another, dated June 21 that same year, states:

> Your formidable list of desiderata, which some years back would have been appalling, no longer possess any horrors for me because I have all but 10 out of the 75. . . . I shall send you 6 out of the lot. . . . There are about 14 of your desiderata which I think you will never acquire.

A letter to Spencer of January 20, 1925:

> I am sending two boxes of minerals—some rare ones from Mr. R. B. Gage and some of not much account from myself. It is a difficult matter to send anything to a museum. They want only the finest specimens which I want also. Ordinary ones are only relegated to the scrapheap or help to swell the duplicate list. . . . Many years have passed since I've been prospecting myself—am compelled to fall back on dealers and friends for additions. . . . The "Chariot of Phoebus" is coming from Nevada for inspection—and opal size of a Coconut—the Nevada opals all crack on a polished surface as they dry out. Too much moisture in them—15%. Other opals have only 10%. I have a number that cracked [worth] from 100 to 250, now only worth 25 to 50. The "Chariot" belongs to a lady who owns 17 mining claims in Nevada—her name is Flora Haines Longhead of San Andreas, California. . . . Mr. English of the Ward Co. went to Europe over a month ago, on a very secret mineral expedition. I feel sure he will call on you. I am one of his top price victims and have to get others to buy for me. Of course a dealer must have a large margin else he could not live. There are too many risks. . . . Manganosite is being cut as a gem—rather dark.

Again, Roebling wrote on March 23, 1925:

> Time to answer some of the questions in yours of March 2º. Clarence Sweet Bement is the full name of this noted collector. Born in Indiana, member of the machinery firm of Miles Bement & Co. in Philadelphia—was only 72 when he died [Roebling was 88 when he wrote this]. Had the finest private collection of his day. Sold it finally to the Am. Museum of Nat. History for about $80,000. J. P. Morgan supplied this money at the request of Dr. Kunz. For many years Morgan had given Kunz $3000 per annum to buy gems and fine minerals for the Museum. Bement invested the above sum in the Lake Superior Steel Works—which were not successful—a loss. He then collected old envelopes, stamps and truck—his mind had failed a little, perhaps from looking at too many minerals. I hope I will not go that way . . . "Roebling" in Burlington Co. N.J. is my town—I own the most of it and wish I did not. 10,000 inhabitants. On the banks of the Delaware 12 miles from Trenton, a subsidiary of our Trenton Works. . . . New finds are being made from time to time. Mr. Gage has identified "Hedyphane" from Franklin. The demand for recent Franklin minerals can not be satisfied. . . . Antimonates do not occur at Franklin, and only recently a few arsenates have been found there. There is little copper (all native) and less lead. On the other hand Långban has no zinc at all. . . . Foshag's patience has been rewarded by having a mineral named after him—a lime silicate from Riverside, Cal. [foshagite], probably near Hillebrandite—to be described shortly. Foshag brings me from Manhattan in Nevada a new find of Haidingerite on red realgar, a striking combination! . . .
>
> Bement had a Swiss friend, a mineral dealer named Hasens living in Basel. On his annual trips they would hire horse and carriage and visit all the localities in the various Cantons, noted for fine specimens. Often the local priest was inclined that way and helped them to secure fine Swiss rubies, anatase and quartz crystals of huge size—smoky. These sort of trips have been denied to me, owing to an injury in 1872. I have not been able to ride in a vehicle or automobile ever since.

From an undated fragment of a letter in the British Museum, the following from Roebling to Spencer:

> From Roger's famous [quarry] at Riverside I have at last succeeded in getting a few samples like Kempite, Ganophyllite, Hausmannite, etc.—They are so wretched that they are only fit for the waste basket. . . .
>
> Fifteen years ago Palache finished his exhaustive description of all Franklin minerals to date. Owing to want of funds the manuscript still lies unpublished. Prof. Wolfe his superior was opposed to the expense. Since then Wolfe has retired and Palache takes his place. Furthermore, a wealthy mine owner named Holden has died, leaving the enormous sum of $500,000 to Harvard University for the *mineral department*. They actually have the money. On the strength of this Palache has been able to travel through South Africa and many other countries and is buying the finest minerals offered. . . . Palache has secured the services of Esper Larson, who was with the National Museum [actually the U.S. Geological Survey]. They are again interesting themselves in the analysis of Franklin minerals. . . . Am having my minerals drawers covered with glass to keep out the dust—a long job, as there are 14,000 specimens.

Again, on December 1, 1924:

> I have decided to keep the chrysoberyls and large dolomites. The visiting mineralogists are so impressed with them that they think they should remain in this country.
>
> I send you a large Roeblingite, largest found, in 1898, coated with impure Willemite—a faint tinge of blue is noticeable. Some are quite blue, due to invisible crocidolite?
>
> A mineralogical friend Mr. E. D. Nevel (present address Andover, Maine) is going to Brazil next week to buy Topaz, Beryls, aquamarines and chrysoberyls. I have furnished him with the exact localities and names of some people who know about them. The N. York dealers keep very quiet about such matters, especially Dr. Kunz. . . . Schallerite from Franklin is a new silico-arsenate—have only one.

And on December 27, 1924:

> Glad to have your letter of the 3rd and Monograph on Chloroxiphite and Diaboleite. Have read it carefully and must congratulate you on your enthusiasum and infinite patience.
>
> After reading your pamphlet I [decided] to look at my mendipites. Was agreeably surprised to find one excellent specimen of the mineral, with chloro-xiphite, diaboleite, crednerite, etc.—It was sent me from London in 1894 by Oscar Penzig, who was formerly the mineral man for Dr. Schnehardt of Görlitz—after his death Penzig came to London. I gave him a roving commission to send me anything he might find of interest. This spec. with many others, came in due time. . . . I now have a plumbo-nacrite from Heddle—one of the few minerals I could ever get from him, he turned a deaf ear to Rubislite [now discredited] and Tobermorite, but was anxious to sell me his collection for $12,000—long ago.
>
> New Zincite twin has just appeared at Franklin, remarkable! End to end. [Here follows a drawing.]
>
> My mineral chatter must be tiring so I will close with best wishes for the new year. I have not been well.

OTHER MINERALOGISTS, FOREIGN and DOMESTIC

Colonel Roebling had some dealings with Dr. F. Krantz of Bonn, Germany. On November 14, 1919, Krantz sent a bill for strengite ($30) and phosphosiderite ($130) both from Kreuzberg near Pleystein.

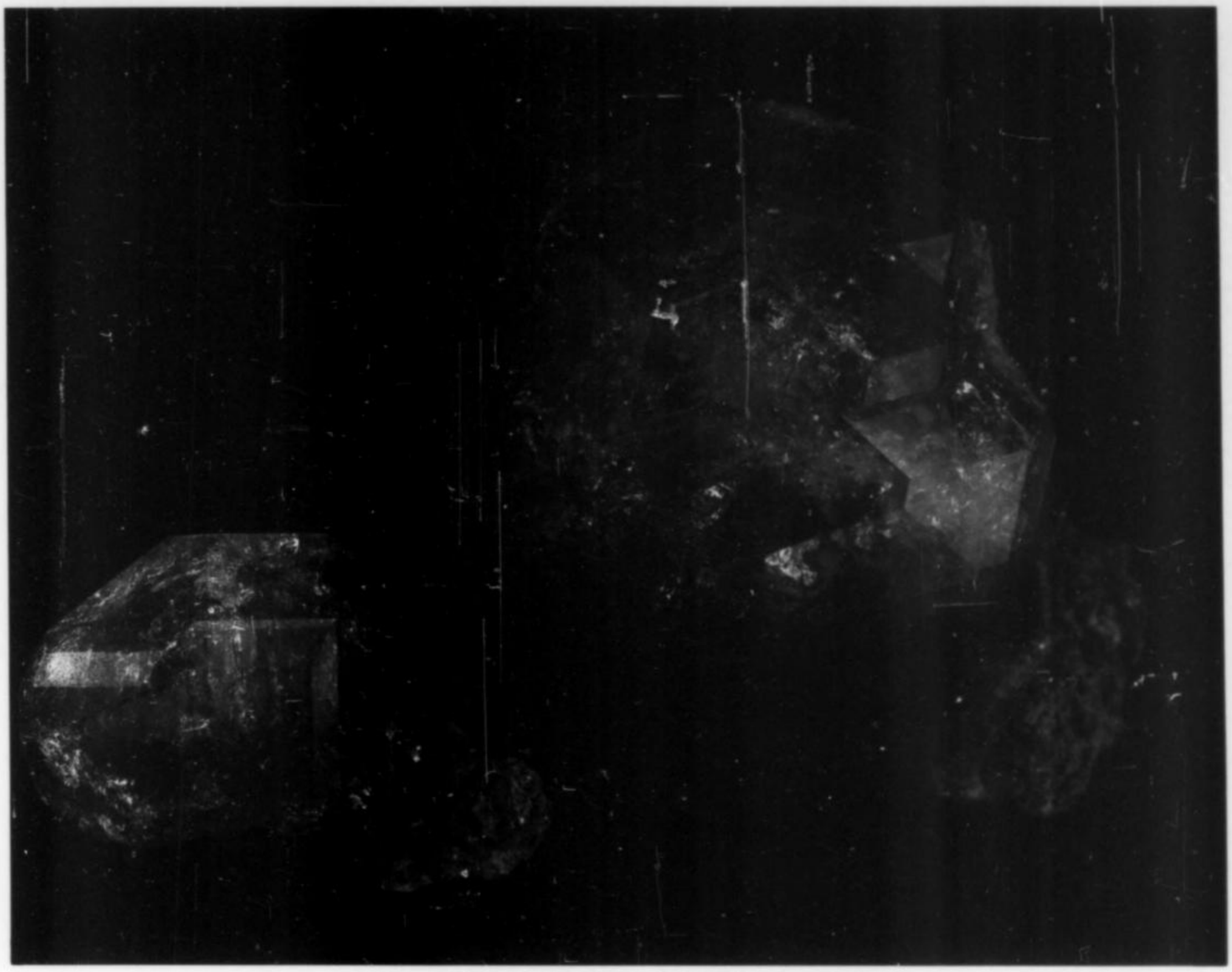


Figure 2. **Fluorapatite from the Pulsifer quarry, Auburn, Maine. This is the famous "Roebling apatite," measuring 6 cm across, described and figured in the *American Journal of Science* in 1917 (#R17). Photo by Chip Clark.**

Another invoice of the same date lists klaprothite with wittichenite and ussingite with steenstrupine from Greenland for $47.75, including a 25¢ charge for shipping and handling from Hamburg to Bonn. Earlier, Krantz had sent an invoice for ten minerals for a total of $307.50. Roebling wrote on that invoice "These minerals never arrived and I do not believe he ever sent them. The last four arrived March 26, 1920, and he charged me the enormous price of $205.50 for them. I told him $80.00 for margarosite was an outrage; ditto for $32 for klaprothite and $13.50 for ussingite."

On February 11, 1913, Alexandre Steuer of 4, Rue de Castlelene, Paris, sent an invoice for 19 minerals at a price of 1560 francs. Roebling's letter to Steuer on March 13, 1913:

> The [illegible] minerals have arrived—you are of course aware that they are worthless. I have thrown most of them in the ash barrel. I am sorry to see a man of your reputation associated with such a transaction. Most of those sent me I did not order. Among the lot sent by you for approval I have kept the three greenockites and the lanarkite. My credit of 500 francs balances the cost of the greenockites and for the lanarkite I enclose a draft for 100 francs. [Apparently two lots were sent—one on approval and another considerably less satisfactory.]

On March 24, 1897, Dr. E. Glussak, of São Paulo, Brazil, told the Colonel of his recent trip to Minas Gerais and offered over a dozen minerals for sale. Included were the new mineral derbylite; an aquamarine 10 cm high and 5 cm thick, weighing 500 grams ($50); a pyrrhotite 5.5 cm by 3.5 cm ($30); anatase; xenotime; a rutile pseudomorph after anatase; a rutile twin; pyrope garnet; zircon; arsenopyrite; and gold. Roebling's notes on the letter indicate he bought several of the offerings.

Roebling carried on an extensive exchange of letters and minerals with George Smith of Broken Hill, New South Wales. One letter from Smith dated July 21, 1896, said:

> Your favor of 30th April reached me on the 27th ult. accompanied by the small Spinel Ruby, and the box of minerals reached me on the 18th inst. I have just dispatched a return lot so I have wasted no time. Pray accept my best thanks for your kindness, and allow me to hope that my box on its arrival may give you as much pleasure as the receipt of yours gave me. I also hope your health may permit you to appreciate them if they prove worthy of your acceptance. . . . Now to answer your queries: Powellite and Scheelite have not yet been identified here, though we have fine Wolfram. . . . Strengite had not been found here. You say globules of Hg are visible in the specimen of Tocornalite from here. I have never seen the Hg native from the field. "Proprietory" means Broken Hill Proprietory Mine, the largest mine in this field. Chloro-iodide [?] has been found here several times. Dana may not have reported

it, but then he is much behind the times in regard to Australia. If he left all the tedious mention of American localities in which certain minerals are found, out of his System of Mineralogy, devoted more time to other localities, his book would be more valuable. . . . In the box I am sending are 2 or 3 large samples and I would call your attention to two of them, 1st. the supposed Aurichalcite and 2nd. Stolzite XX on garnet sandstone. These are equally as good as mine, both are larger and I have only one of each left. I would also call your special attention to a sample of the new mineral, vis. the antimonial chloride of silver (antimoniate chloride) [?]. This is a better piece than mine because the minerals in it are more distinct. You will notice the Dyscrasite is altered in the center where it is changed into the antl.-chloride, the latter retains the form of the former (pseudomorph). The silver which has been leached out to make room for the chlorine shows on the outside as ordinary Cerargyrite (not chloro-bromite). I would like you to show this to Professor Penfield if you can. It will tarnish on exposure to sunlight. There is only one other piece like this (besides mine) extant and that is in the Sydney Mines Museum. . . . To prevent duplication I keep a list of what I send to you. 2 or 3 have been inadvertently enclosed without explanatory tickets. These are I think—#772—Calamine XX($ZnCO_3$) on manganese oxide—B. H. Proprietory Mine; #183 Nickel Silicate—New Caledonia; #379 Cerussite with nat. Ag.—North B. H. Mine; Not numbered—3 Garnet XX, Almandine—Barrier Ridge, NSW; Bromo-choloride Silver in ferruginous cerussite-B. H. Proprietory ?. . . . What do you mean by the question "do you like salt?" Is it a joke or are you referring to the minerals? . . . I hope to hear from you as early as convenient. The box leaves Australia by the P & O Mail Steamer *Balarrat* on the 29th inst.

Robert Sticht (of stichtite fame) wrote on November 15, 1916, that he was sending from Australia, via his son, several pounds of that mineral. And from Mosgeiel Parsonage, Dunedin, New Zealand, the Rev. J. T. Pinfold wrote that he is sending some dunite and websterite, and related the difficulties he encountered in obtaining these.

A list of desiderata in minerals from W. F. Ferrier of Ottawa, Canada, dated 1898, contained about 160 minerals, most of which had a penned "R" by them, presumably indicating Roebling had them. A note in the Colonel's hand said "He never gave me anything for the 31 minerals I gave him, many very rare. Thief."

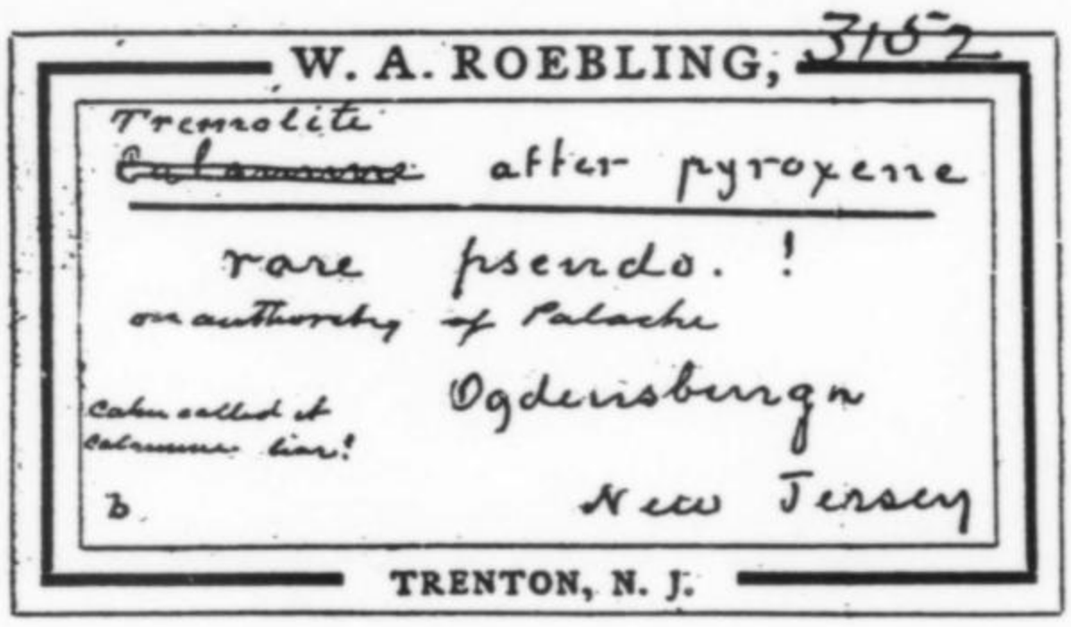
Closer to home, a printed list of minerals for sale by a Dr. Otto Kunze of Iowa City, Iowa, is dated October 1898 in Roebling's hand. The text accompanying the list says "I will like you better than I like a man, who wrote to me, that he had a collection of 10,000 specimens; but whether he can distinguish a crystal of quartz from a crystal of calcite, without looking at the label, I do not care to decide." Underlining this sentence Roebling wrote "W. A. Roebling," and underneath added "This fool soon got to the end of his string and now raises cabbages."

Roebling had dealings with Ward's Natural Science Establishment, as indicated by a letter from George English dated May 8, 1925:

> We have had a specimen of trimerite laid aside for you for some time past in response to a previous letter. We are sorry to say we are not able to send you the full suite of Belgian Congo minerals. We would like, however, to forward to you the best possible series of these specimens as we believe that a number of those which we have are greatly superior to anything you have heretofore obtained. In the meantime will you kindly let us know whether you think you would be interested in a fine large specimen of chinkolobwite [now sklowdowskite] at $50 and a large fine mass of kasolite and curite at $75, and several other fine masses of curite, kasolite and soddyite all showing good crystals. We are sorry to say we are unable to obtain any specimens of flinkite from Sweden. You speak of dioptase from the Congo. We have some fine specimens from that locality but we have greatly superior specimens from Guchab, S.W. Africa. One or two of these we believe could not fail to please you, no matter what else you have from Africa.

A method Roebling often used to obtain minerals is shown in a letter he received from R. A. Daly of Harvard, dated September 16, 1915: "I regret to say that I have no large specimen of phillipstadtite [now var. hornblende], but am sending you a small piece, as well as the $5 which you offered. It is impossible to put a market value to this material and I have pleasure in presenting it to you."

Sometimes the Colonel was a bit hasty in his judgments. Lazard Cahn, a New York mineral dealer who retired to Colorado Springs, sold Roebling a calamine after pyroxene, calling it a rare pseudomorph (UNSM #R3152). Palache examined the specimen and pronounced it tremolite. On his label (shown below), Colonel Roebling wrote "Cahn called it calamine. Liar!" (The author, whose interest in mineralogy was aroused in a twice-a-week two-year study with Mr. Cahn, can testify this must have been an honest mistake. Mr. Cahn was the soul of integrity.)



ROEBLING and the SMITHSONIAN INSTITUTION

The gift of the Roebling collection to the Smithsonian by his son is discussed later. In his time, the Colonel was well acquainted with the staff of the Division of Mineralogy there: W. F. Foshag, Earl V. Shannon and George P. Merrill. They were always welcome to study his collection. He gave the Smithsonian many mineral specimens during his lifetime, and loaned many more for study and analysis. He also received many specimens from the staff for his own collection. Many letters flowed between Washington, D.C. and Trenton, New Jersey.

Foshag wrote on March 27, 1923:

> Last year I collected at Crestmore, California, a number of specimens of a peculiar pegmatite made up largely of feldspar, datolite, and brown platy prehnite. The quartz in these pegmatites is largely replaced by a mineral that resembles in general appearance and chemical composition the mineral centrallasite [now gyrolite]. I wonder if, by any change, you have any of the Nova Scotia centrallasite in your collection. If so would it be possible for me to get a small fragment for a determination of its optical properties. If you have no centrallasite I will be glad to send you some of the Crestmore stuff. I have also a specimen of vesuvianite that shows a very small bunch of riversideite. Riversideite is exceedingly rare at Crestmore now although at one time it was a common mineral. I had some specimens with fibers several inches long that I used to call asbestos before I knew much about minerals and finally threw them away. Crestmore was a remarkable locality for minerals

but was not visited by mineralogists until it had passed its best stages. In the early days of the quarry the best crystallized stuff came out. This single small hill produced over fifty minerals and there was a time crystallized vesuvianite, diopside, wollastonite and many of the rarer minerals could be found in abundance. A neighboring quarry, the one that produced the new mineral vonsenite, at one time produced axinite crystals ten inches long and large epidotes of a clear smoky green color but this material all went into the dumps.

On March 13, 1926, Foshag wrote again:

> Thank you for sending some of your rare minerals down by Gage. Both magnesioferrite and paramelaconite are new to me. The gold crystal is the most perfect I have seen. We received a series of minerals from Russia too, but our tyuminite [sic] and lamprophyllite are inferior to yours. [And on April 7, 1926:] Thank you very much for the parasettensite [sic] and tinzenite. They are an interesting addition to our collection. I tried to make parasettensite identical with bementite but there are appreciable differences. Per Geijer is describing two new Swedish minerals—one, fluoborite, is believed to be identical with the unknown material mentioned by Gillson and Shannon in their description of Nevada szaibelyite. The other is $Mg_2SiO_4 \cdot Mg(F,OH)$ or the same as prolectite, but he has restudied prolectite and finds it only chondrodite. The new one he calls norbergite.

On January 16, 1922, Earl Shannon wrote:

> I am returning, today, your specimens of cuprite and palygorskite for the use of which please accept my sincere thanks. I have measured a crystal of the cuprite and have examined the palygorskite optically. I will send you a specimen of the Goose Creek material as soon as I pay another visit to the quarry. I am stirring Larsen up on his lot of material borrowed from you. The delay is partly my fault. I am also waking Schaller up with regard to your specimens. He was examining several of them through a lens and deliberating on them when I saw him yesterday. [At that time the offices of U.S.G.S. mineralogists were located in the Smithsonian.] [On December 6, 1925, Shannon wrote:] The analysis of trudellite [now discredited] was made by me in a private laboratory near my house and I am sure the results and formula are correct. Gage talked me out of the small piece I had left from the analysis, for you, but I am not sure it was ethical for me to give it to him since it is [Samuel] Gordon's mineral and Gordon doubtless has plans for furnishing you with a much larger and finer specimen and will be offended if he finds I went ahead of him in supplying you. [Roebling penciled in the margin: "Not much."] I have recently reanalyzed vauxite and paravauxite for Gordon, obtaining excellent results which seem to show them to be different hydrates of the same compound with much simpler formulas than those first given. Larsen and I seem to have another new mineral, a hydrous magnesium carbonate with the simple formula $MgCO_3 \cdot H_2O$. It is from Hanover, New Mexico, and comes in thin films which look like stilbite. I will send you a small piece as soon as we decide definitely that it is new and requires a new name. Everybody except me is going to New Haven for the Christmas meeting of the Mineralogical Society. I cannot afford to go and shall hold down the Museum while Dr. Merrill and Foshag are away.

On October 7, 1924, Roebling wrote to Shannon:

> My Dear Sir, I thank you very much for the Szaibelyite—the Fluormeionite and "Merrillite." They have been inspected by some Phil. mineralogists who came up on a visit—Merrillite is almost invisible! I have an excellent specimen of Hungarian Szaibelyite, flattened nodules, with a buff center, surrounded by a fringe of short creamy white fibres, not pointed, about 20 of them on limestone.
>
> In the current number of the *Mineralogist* magazine I notice your appeal for Remingtonite [now discredited]. I am sending you a Cobalt specimen brought by Gage several years ago. It is mostly erythrite associated with a rose colored limy material—HCl produces bubbles—The question seems to be whether the erythrite is merely disseminated through the lime microscopically, in which case the bubbles would come from the Ca—or whether it is a true chemical compound. That I will leave to you to settle.
>
> This is fine weather for a Conn. trip.

Added above the address at the top of the page—191 West State Street, Trenton, N.J.—is the following: "I only have the Vesuvius Meionite in XX. If the Remingtonite is genuine, I should like to have it back."

On April 26, 1926, about two months before his death, Roebling wrote Shannon:

> Your great work on the minerals of Idaho received [Shannon, 1926]. It finds me in bed on my back with small chance of recovery. This book of yours has demanded an immense amount of research—of description and analysis. Your style improves as you progress. Since the many occurrences you mention have long since been abandoned, it is also a historic record. Only recently I learned about the great volcanic deposit in South Eastern Idaho, whose plagioclase feldspars are described by you. I should like to have seen it. When I look at the anglesite from the Hypotheek mine, Idaho, it still surpasses all the others even those from Tunis, which are the largest. Neither have I forgotten your masterly description of the various Trap inclusions in the Goose Creek Va. quarries. Those traps are a difficult problem to handle.

Roebling goes on to tell of his two nephews who have been operating a poor gold mine 15 miles northeast of Idaho city which is barely making expenses. "It should be abandoned. I would like to write more but do not feel able."

Roebling did watch his nickels and dimes occasionally, as indicated in a letter to Dr. Merrill dated November 6, 1914:

> I have had the three nuggets of osmiridium on my table for 10 days debating whether to pay the high price and finally concluded to take one and have returned the other two to the Baum Corporation of Los Angeles. The fate of the nugget will be that it lies in a dark drawer for a couple of years unnoticed—unseen and then will probably go to some dealer at ¼ its value. The politicians have made such inroads on my property that I have to economize on minerals and everything else.

(Roebling is probably referring to the Sixteenth Amendment to the U.S. Constitution authorizing a Federal income tax, which was ratified in 1913.)

Again to Dr. Merrill on June 5, 1925:

> I wish to thank you once more for the magnificent specimen of Wulfenite, which I think must be the finest in the U.S.—and also to take occasion to thank you for an enjoyable afternoon—It is very satisfactory to be able to show minerals to a man who enjoys them, appreciates their fine points, their rarity and perfection—too many visitors do not know one mineral from another and can only say "how lovely"—I regret that I forgot to show you the latest Euclase—One transparent mass of a greenish hue is about 1½ x 1¾ x 1 inch. No flaw. The other is a cut gem, translucent—of three or four carats, showing

Figure 3. **Chrysoberyl sixlings, 8 cm, from Colatina, Espirito Santo, Brazil (#R53). Photo by Chip Clark.**

the blending of blue and green as exhibited in emeralds—I prize it just as highly—also have white Euclase. You asked me how Euclase occurs? Can show you a fair sized crystal, not very valuable, but imbedded in the solid Pegmatite as it is found in Brazil—with its associations—Locality "Villa Rica." I am sweltering in my shirt sleeves praying for a let up. Yours Truly, W. A. Roebling.

ROEBLING and the U.S. GEOLOGICAL SURVEY

Roebling was on the best of terms with the staff of the U.S. Geological Survey: W. F. Hillebrand, W. Lindgren, Waldemar T. Schaller and Esper S. Larsen (who later went to Harvard). On April 14, 1885, Hillebrand, who was then with the U.S.G.S., Mining Geology, Division of the Rocky Mountains, wrote:

In reply to yours of the 9th. I must inform you that I am unable to provide you with specimens of zunyite and guitermanite [now discredited] coming from myself, but I shall be pleased to send you a specimen of the former from the collection of the Colorado Scientific Society, for which the Society only asks in exchange whatever you think it worth. Of the guitermanite there are but two or three small specimens in the Society's collection and I know no way of getting more at present. Of Utahlite [now natrojarosite] I can give you no information. With this I am sending you a copy of Vol. 1 of the Proc. of the Colo. Scient. Soc., containing descriptions of the zunyite, guitermanite and other minerals.

Hillebrand again on December 13, 1904 (he was then in Washington):

Figure 4. **Diamond crystal, 1.65 cm (17.85 carats), from Murfreesboro, Pike County, Arkansas (#R2). Photo by Chip Clark.**

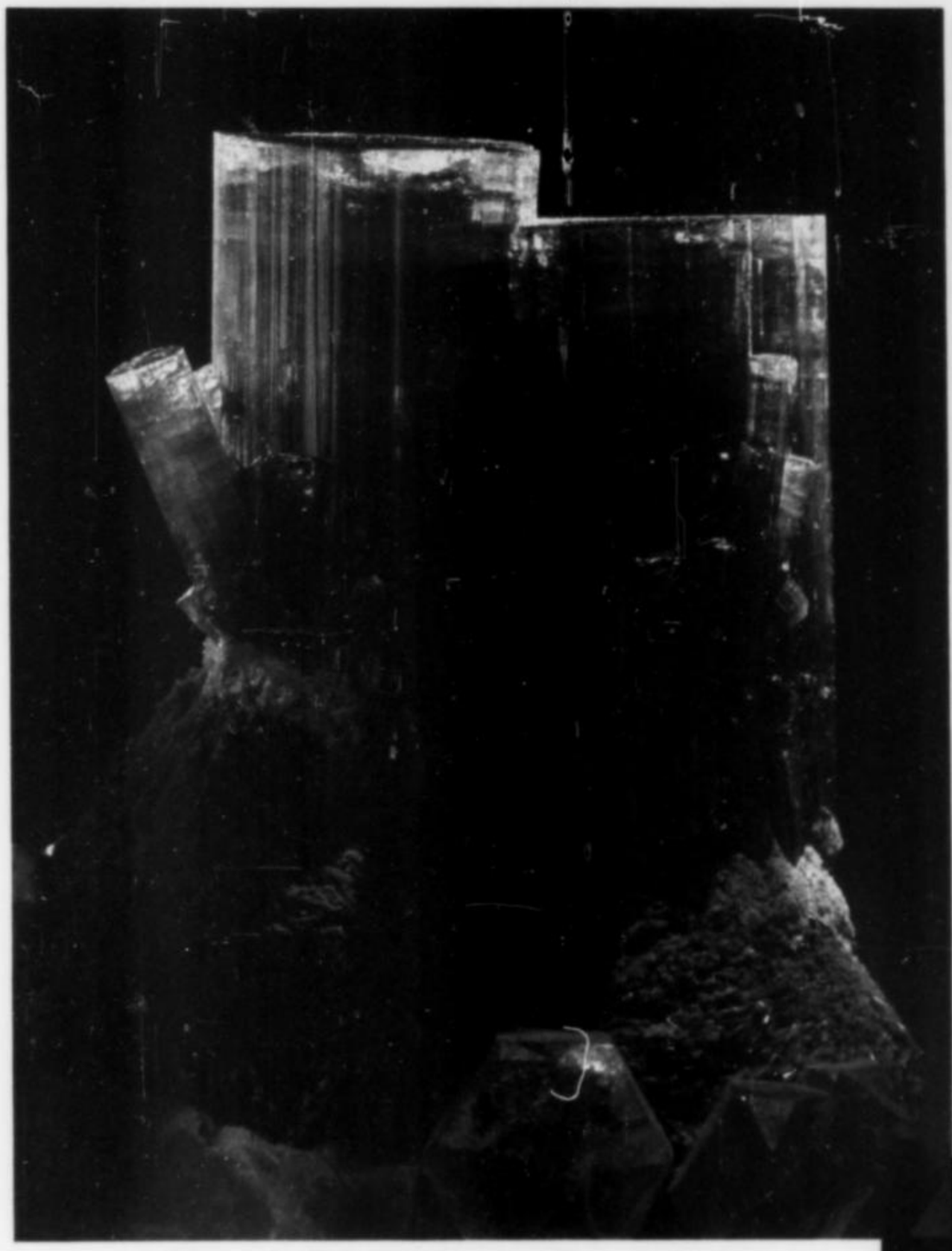


Figure 5. **The famous tourmaline specimen known as "the Steamboat": elbaite crystals about 15 cm tall, on albite and quartz from San Diego County [probably the Tourmaline Queen mine, Pala], California (#R51). Photo by Dane Penland.**

I send you herewith the specimens which Mr. Lindgren is able to spare, and regret very much that the list is so incomplete. Of the gerhardtite and spangolite there is so little left that none can be spared. The same is true of the original morencite [now nontronite], but a specimen from Cripple Creek which does not show the fibrous structure characteristics of that from Clifton is included. The specimen of emmonsite, native gold, calaverite, and tellurite from Cripple Creek is very characteristic of much of the material from there, but it shows the emmonsite only in very small patches. The tellurite is, however, very good. If even better material shows up I shall be glad to send you some of it. [On the letter Roebling wrote: "He sent morencite, emmonsite, libethenite, and vrondite."]

Schaller on November 16, 1921, wrote:

Mr. Larsen has been finding a few other wavellites that resemble the one you have from Streigis [Langenstriegis?] labeled peganite [now variscite], and would like, if possible, to again borrow that specimen for examination. [Roebling notes: "Send it again."] He has been unable to find any true variscite, except from Lucin, Utah. Have you have variscite from Messbach near Plauen in Saxon Voigtland that he might borrow? [Roebling

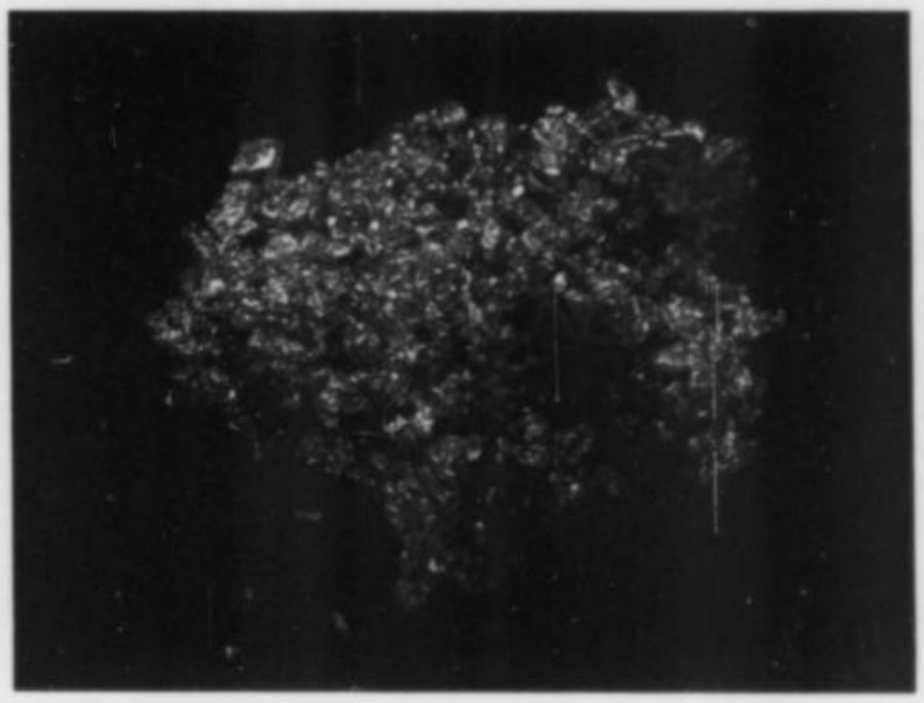


Figure 6. **Gold group, 2.5 cm, from Brown's Flat, Tuolumne County, California (#R41). Photo by Dane Penland.**

Figure 7. **Gold group, 8 cm tall, from Grass Valley, Nevada County, California (#R36). Photo by Dane Penland.**

notes: "Yes; Shannon took it. Look for more."] He is finding five different minerals labeled wardite. A careful optical examination of minerals certainly shows up wrong labeling.

On the above letter Roebling wrote these notes (numbering by the author): (1) "I had lusianite [now wavellite] but gave it away." (2) "I also sent a new undetermined Franklin mineral (maybe old), brown, found last winter H = 4–5; barite? a new form of hodgkinsonite?" (3) "I also have 2 Arkansas wavellites, showing perfect isolated crystals under the binocular—can send them if you wish; the picture in Dana is much thicker than the Arkansas spec." (4) "Earl V. Shannon was here for a visit." (5) "My peganite is a fake. The spec. is an interesting spec. of [illegible] calcite, says Shannon." (6) "I gave Shannon a blue wavellite from Germany for Larsen to look at—it may be what you want. Also a variscite from Plauen, Sax. for examination." (7) "Dr. Merrill spent a day here looking at the five meteorites I had—he hankered after some. These were all the foreign ones I had." (8) "Have plenty of Utah variscites—number of various kinds." (9) "I must look in the wavellite drawer again."

Schaller again on November 23, 1922:

> It is very kind of you to send me the specimens of tephroite for inspection and comparison. I will not keep them long. Gordon sent me some of his material; it is exactly like your "prize package" and of course is tephroite and not glaucochroite. I am writing him suggesting that he correct his error before someone criticizes him for making such a mistake. Moreover, I cannot understand how he can call his material bluish-green—it is either colorless or some shade or combination of gray, red, or brown, just as your specimens are. Many thanks for the copy of Gordon's paper which I have returned as he has sent me one. His crystal drawings are good although he makes no mention of the decided variation of the prismatic striations.

On the above letter Roebling wrote: "The situation is becoming interesting. Gordon may claim that it is a new variety—different from either. I am wondering if G. will back out. Today I sent Schaller the original glaucochroite analyzed by Nason 23 years ago. He had not seen that."

In his speech accepting the Roebling Medal of the Mineralogical Society of America in 1938, Schaller said: "When the first edition of Larsen's tables appeared, [Roebling] wrote me: 'on page 33 Larsen gives the names of 28 minerals which he has not been able to find—I have 24 of them.' " (Larsen was the second Medalist; the first was Professor Palache of Harvard.)

Colonel Roebling had heard that the Seligmann collection was for sale. Schaller wrote on December 20, 1922:

> I was much interested in what you said about the Seligmann collection being for sale. I saw it in 1912 and, in fact, kept up correspondence with Mr. Seligmann until we entered the war. His collection is small but very choice. Some of the crystals are truly wonderful. The price you mention seems rather high but such a collection is not only unique but could not be duplicated today at any price.

Professor Charles Palache of Harvard wrote Roebling on February 28, 1923:

> I am most interested in what you say as to the Seligmann collection. I suppose it is one of the finest private collections in existence if what I have heard is true. Would you perhaps be interested in making a joint purchase of it with us, using what you desired of its contents to extend your collections? I do not know at what price it is held but seem to have heard of some very high value as a hundred thousand dollars. I have not much doubt that a much smaller offer would buy it but perhaps you have information on that point. I would gladly go over next Spring and look it over but I do not believe we could handle the money end of the whole thing alone.

Some of the Seligmann collection was purchased by Carl Bosch, whose collection the Smithsonian acquired in 1966 (Roe, 1978).

Back to the U.S.G.S. after this Seligmann detour: A letter to Roebling from Esper S. Larsen in Washington dated April 27, 1917:

> I have completed my optical study of the rare minerals which you so kindly sent me some time ago. I am also sending you a good specimen of creedite in fine, clear crystals, a part of the best specimen that I have; the rest is gone to the U.S. National Museum. I am also sending you a sample of eakleite [now xonotlite] the description of which will appear shortly in the *American Journal of Science*. I am sending also a small tube of natron from Soda Lake, San Luis Valley, Colorado. I doubt if you have any. You will also find small specimens of zinc copper melanterite and zinc copper chalcanthite and small specimens of leverrierite [now considered a mixture] from Colorado which Wherry and I described some months ago. Mr. Brown and I have submitted a description of the new uranium mineral gilpinite from Gilpin County, Colorado. We used all the specimen for analysis. However, you probably have specimens of the material from Gilpin County, Colorado, labeled uranopilite or johannite. If you care to have any specimens identified send them to me. The specimen you sent labeled uranopilite from Cornwall, England, is also gilpinite. [Gilpinite is now johannite and uranopilite is now a valid species.]

Roebling received an interesting letter dated May 8, 1922, on Smithsonian stationery from Frank L. Hess, who signed himself "Honorary Custodian of Rare Earths and Rare Metals" although his mailing address was given as the U.S.G.S.:

> I am glad to say that I can furnish you a few specimens and I wish I could furnish you more. Of the so-called "lambertite" [now uranophane] from Lusk, I am enclosing a piece numbered 1029. I am also sending you two pieces of pintadoite that I collected last Fall. The larger piece, numbered 1160, is from Bull Canyon, San Miguel County, Colorado. The smaller piece is one of the best I have found. It is from Temple Mountain, San Rafael Swell, Emery County, Utah. Dr. Schaller and Mr. Larsen are working on serendibite from northern New York. The "robellasite" is, I think, a purely apocryphal mineral. Unfortunately I do not have any specimens of the melanovanadite. Please do not think of having to make an exchange, or to pay me for the specimens. You have done so much for the Survey geologists and mineralogists that we all feel under obligation to you. Dr. Schaller and I are working on a number of minerals that may prove to be new. If they are, I shall try to see that you have specimens of them.

ROEBLING and CHARLES PALACHE

Professor Charles Palache of Harvard and Colonel Roebling were good friends. Palache's letter about the Seligmann collection is quoted above. In that same 1923 letter, Palache says:

> You speak of a specimen of ganophyllite from Franklin having been sold recently with my guarantee. I do not know who had the right to give any such guarantee. I never saw but one specimen from Franklin which answered the description of that mineral. This was a small bit sent by Foote for identification years ago and I still have the specimen. I have not had time to work on the specimens you were so kind to loan me except one—the specimen of Mr. Gage's which I thought when I saw it was allactite and which I am now practically sure is that mineral.

Palache again on February 15, 1923:

> I have your note of recent date and will accept to see the minerals in a few days. Thank you very much for the gift of the large specimen of altering willemite. I now imagine that the blocky original mineral was bementite, though how it can be proved is more than doubtful. I am glad you found pleasure in showing me some of your minerals for it was certainly a keen delight to me to study them and I only wish I had more time for a leisurely visit. I am sending a small package today containing a bit of the form of black diamond or bort recently named framesite [now discredited]; and a sample of the nickel-iron mineral known to the South African geologists as trevorite. On the backs of the labels you will find such references as I have to the original descriptions. The trevorite does not seem to have found its way into the mineralogies yet.

On February 8, 1926, Palache wrote about some Russian minerals which both of them had received. The specimens from the Kola Peninsula were good, but he was less enthusiastic about those from the "old localities." He then added the following:

> I would be interested to know what you think of the plan which the *American Mineralogist* has adopted during the past year of publishing numbers of extra size financed by the aid of institution furnishing the material. Personally it seems to me an excellent plan. I look forward, however, to a time when the *Mineralogist* shall be sufficiently endowed to publish such papers without the author or his institution having to bear the charges. I can think of no means of furthering the science of mineralogy in this country more effectively than the establishment of a publication fund with an income sufficient to do this. I know that you have helped the Society and the *Mineralogist* in the past but would invite your earnest consideration to this suggestion for a movement to secure a permanent fund which should be ultimately not less than $50,000.

This letter apparently led Colonel Roebling later that month to give the *American Mineralogist* some municipal bonds, the sale of which brought the sum of $49,323.03 to that journal. The bonds were delivered to Professor Alexander H. Phillips of Princeton, then Treasurer of the Mineralogical Society of America, by R. B. Gage, a Franklin mineral specialist and a close friend of the Colonel. Roebling received many letters of thanks from the officers of the M.S.A. and others for this gift.

ROEBLING and SAMUEL GORDON

Samuel G. Gordon of the Academy of Natural Sciences of Philadelphia has already been mentioned a time or two. A letter of his to Colonel Roebling dated October 10, 1919, sheds some light on how minerals occasionally got from here to there.

> I am taking the liberty of sending you, on approval, a suite of nesquehonite and lansfordite, from Nesquehoning, Carbon Co., Pa., the price of which is $175. I rediscovered the locality in July, at the time gathering the best nesquehonite and the lansfordite. All the latter altered in a few days (during shipment) to the former. Wednesday I again visited the locality and gathered the few lansfordite stalactite-crystals left, bringing them down in mine water, and then putting them in kerosene. I also gathered some second grade nesquehonite for Ward's. The best series of course I presented to the Academy. I made up three suites for yourself, American Museum, and Harvard; the quality of the collections being in the order named. My object in selling them (at Dr. Wherry's request) is to raise money for a trip to Ivigut and Narsarsuk, Greenland, next summer. If you are disposed to buy the material kindly make out a check in my name. [A note by Roebling says: "Send him check for $130."]

Gordon again on November 10, 1922:

> Under separate cover we are mailing you *two* specimens of rhomboclase of somewhat different appearance on approval. The mineral was found in the abandoned stopes of the Esperanza mine, Cerro de Pasco, Peru, associated with stalactites of chalcanthite and other sulfates. There are two species on your list of duplicates which we lack; haidingerite and loranskite. Of these we desire the haidingerite. I am very sorry we have no duplicates of vauxite or paravauxite. It was with difficulty that we put together enough for the analyses (which have not yet been published).

ROEBLING and R. B. GAGE

R. B. Gage, who lived in Trenton and knew Roebling well, was a chemist with the New Jersey State Highway Commission, and had access to the "picking table" at Franklin. He supplied the Colonel, and others, with many choice Franklin minerals from the table and from his acquaintances in Franklin. A series of somewhat wordy letters to Roebling beginning December 21, 1925, have some points of interest about minerals and mineralogists of the day. December 21:

> I was in Franklin on Saturday the 19th, but unfortunately the company had arranged to work until four o'clock instead of stopping at noon so the employees would have more time off between Christmas and New Years. This made it very difficult to see many of the collectors, but I was able to catch a few Saturday night and Sunday morning. There have been some additional finds of massive hodgkinsonite that look very good, but I have not been able to secure any. A few specimens of schallerite have been found recently, one of which I secured and will send you. There have also been a few nice specimens of transparent willemite crystals imbedded in bluish grey serpentine. There has also been analyzed some reddish material, the analysis of which shows it to be hedyphane. I secured a specimen of this and it adds another mineral to the long list already found at Franklin Furnace. I believe Palache has arranged to have it inserted in his folio. I also secured a specimen of inverted zincite crystals that are coated with smithsonite balls and some fine crystals of an unknown material. I stopped by to see Mr. Canfield. He told me that Gordon had sent him a box of minerals, practically all of which were returned for they were not of much value. No specimen of paravauxite was included.

Gage on January 21, 1926:

> I am returning your specimens and am very glad to state that they pleased everyone very much. The Smithsonian Institute [sic] had also secured a box of specimens from Russia, but the quality of their specimens did not begin to compare with yours. They did not get any gold crystals, and Dr. Merrill was very much surprised that you should get such a nice crystal at the price. We were able to quite definitely establish that the specimens that I thought were jerseyite [now discredited] are not the same as Canfield's jerseyite. Canfield's jerseyite appears to be arsenosiderite. I would like very much to see some of your specimens of this material. If Mr. Canfield would let loose a couple of his specimens, there would be enough of the material on them to definitely establish this fact, but mineralogists are not prone to do such tricks. He had had these specimens for about twenty years and, if he wants to know what they are, he will never have a better chance than now. Shannon is also analyzing the new lead silicate from Franklin and should have the analysis done within the next week.

(The reason for Gage's less than enthusiastic view of Fredrick Canfield is not clear. Canfield's collection of Franklin minerals was unsur-

Figure 8. **Stibnite group, 13 cm, from the Ichinokawa mine, Iyo, Japan (#R77). Photo by Chip Clark.**

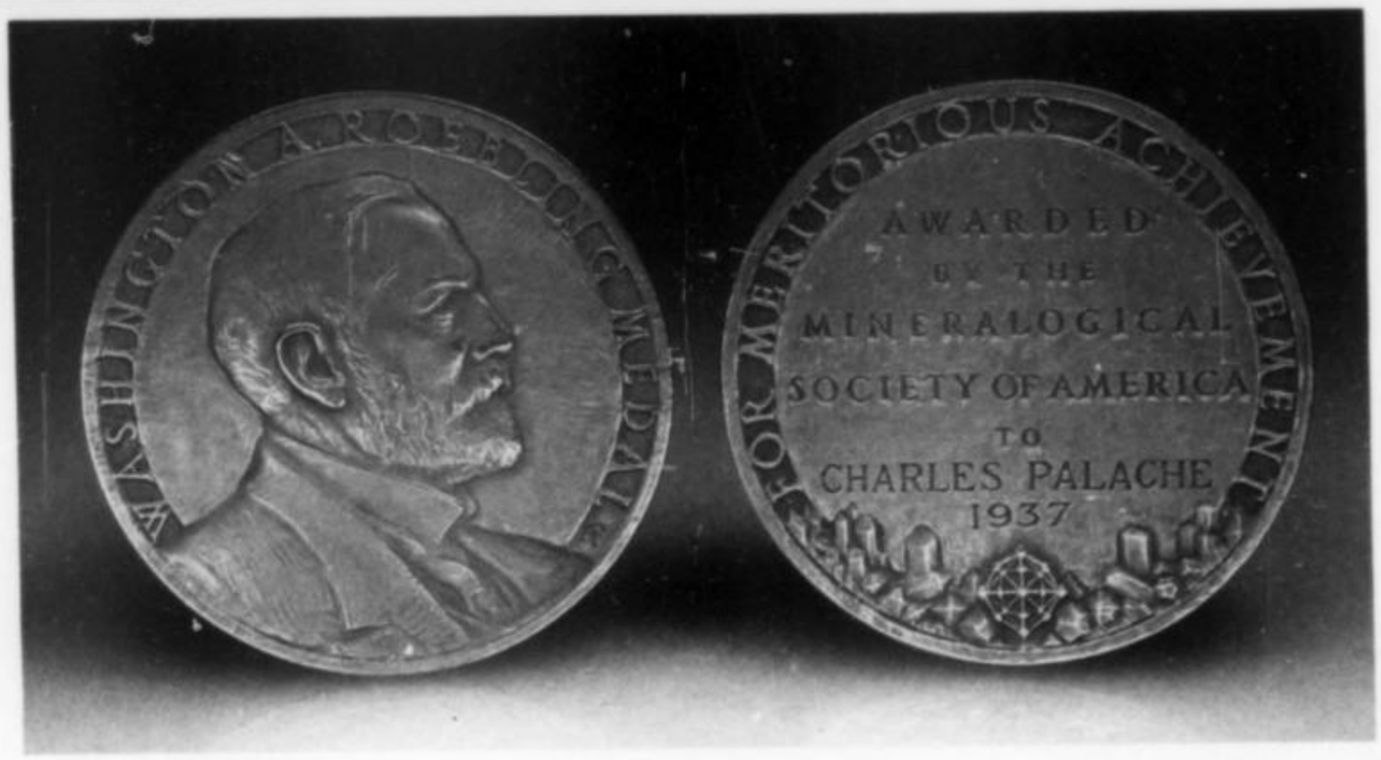


Figure 9. **The Roebling Medal, presented each year to an outstanding mineralogist by the Mineralogical Society of America. Harvard collection.**

passed, according to Palache, although a surprising number of fakes have been discovered among his specimens.)

Gage again on January 27:

> I have just received a letter from Professor Palache, regarding the pink lead silicate that I found at Franklin Furnace last summer, a specimen of which I secured for you. Each party who examined this material mentioned what he thought it was, but, if I remember correctly, you were the only one who thought it was alamosite and it is certainly gratifying to note that you guessed correctly. Alamosite appears to be as rare in other places as at Franklin. I have received another letter from Mr. Canfield. Apparently he is quite peeved at the critics in the U.S. Geological Survey who criticized Professor Palache's Franklin Furnace bulletin. The Survey objected to having Professor Palache cite a specimen in one collection when there are several collections in the country that have just as good specimens. He [Canfield] would probably like to have it appear that he has the only, or the best, specimens and the Survey do not want their publications to give any such impression. Professor Palache will have to change his bulletin considerably before they will publish it.

("The Minerals of Franklin and Sterling Hill, Sussex County, New Jersey," by Charles Palache, was published in 1935 as *U.S. Geological Survey Professional Paper 180*; it was reprinted in 1960.)

Again, Gage to Roebling on April 10, 1926:

> I want to show Mr. Foshag the white crystals on the pyrochroite and get the optical properties for we should have our analysis soon and would like to have the full data of these crystals at the time the analysis is finished. If the white crystals are pyrochroite, they certainly differ tremendously from any I have ever seen. I have heard lately that this material came from Sterling Mine so, if these crystals are new, I will go to Franklin soon and secure some more of them. [And on April 20:] I am sending you herewith a few more specimens of Franklin Furnace material including a chrysotile which is the only one I have been able to secure and made three trips to Franklin to get it. There is also a specimen of bustamite altering to glaucochroite. Professor Phillips [Princeton] has just informed me that Mr. Hunt [Editor of the *American Mineralogist*] returned Gordon's paper in regard to the similarity of tephroite and gageite, stating that the data he presented was not sufficient to draw any conclusions from and I guess it was fortunate that he did so, otherwise Phillip's answer would have made Gordon's data look as though it were hastily prepared and incorrectly interpreted.

On June 22, 1926, the last letter from Gage in the archives:

> The work on the new mineral that occurs with hedyphane has been completed and it was found to be a calcium-boro-arsenate, which, according to Mr. Bauer, is an entirely new type of mineral for he says there does not appear to be anything like it in Dana. It has the formula $4CaO \cdot As_2O_5 \cdot B_2O_3 \cdot 4H_2O$. His analysis was very carefully done and checked out. It has been decided to name it McGovernite on account of the interest Mr. McGovern had in Franklin Furnace minerals for so many years. I think this is an appropriate thing to do and will probably please everybody.

Gage proved wrong on this; the mineral was named cahnite, described by Palache and Bauer (1927). The formula was revised in 1961 (Prewett and Buerger, 1961). McGovernite was described also by Palache and Bauer (1927), and the structure determined (Foit, 1966).

A FEW MORE LETTERS THROWING LIGHT on MINERALS and COLLECTORS

On December 7, 1895, Professor Albert H. Chester, of Rutgers, wrote:

> Your two letters and the package of minerals have been received for which I am obliged. I am glad to have a chance to look up the names [of minerals] you sent, for some of them I had lost track of. I send you answers to those I have been able to find so far [the answers were not in the archives]. Some of the rest are so new they have not got into my books yet, and some are so old as to have been dropped entirely. Domeyko's Mineralogy I have not only not been able to get, but I have not found a copy in any library. I have been trying for several years to obtain a copy, and will pay any reasonable price for it. I have written twice to Chile for it. Do you have any correspondent in Santiago who could look it up there? The minerals you sent are very acceptable. The urbanite [now discredited] I had not seen, but I have lindesite [now discredited] which is said to be the same thing. The strengite is interesting and differs from my specimen decidedly, so that both go into my collection. I had no water drop in smoky quartz, and consider the specimen an addition. I shall hope at your next visit you will find something for yourself. When will you come? [Roebling notes: "He died shortly after of heart disease."]

W. Tovote, of Bisbee and Tombstone, had some correspondence with the Colonel. On June 23, 1914:

> I found your letter and specimens. In regard to the latter I wish to say, that you are putting me under altogether too heavy an obligation. They are splendid and so far above what I sent you, that I am almost ashamed to accept them. Please accept my most sincere thanks. [He goes on to list some pyromorphite and other minerals from the Tombstone area. Then:] P.S. I encouraged Wheelock to offer you his gold specimen because I have never seen anything like it. Crystallized pyrite with coarse, I believe, crystallized gold on top of the pyrite crystals. It looks so unnatural and freakish, but he claims he paid $20 for it and that is probably too much. [Roebling noted on the margin: "Write to him to ask Wheelock at Kingman to send gold on pyrite for $25."]

Another from Tovote dated July 18, 1915, said he had requested Wheelock to send the gold to New Jersey. Also: "Am sending you today several pieces from the Lucky Cuss [mine] here at Tombstone, two of which I suspect to be the ettringite you mention. From the same level two copper-lead pieces marked 'linarite.' I do not know whether the blue mineral is really linarite." Roebling noted: "It is aurichalcite." Tovote mentions some other minerals he is sending, including some manganese material ". . . from the Oregon mine with silver-gray crystals, perhaps psilomelane." He further mentions he will send, if Roebling desires it, some aurichalcite, wulfenite (with acicular pyromorphite) and horn-silver. "There is some tellurium in our gold ores, but I have not been able to identify the mineral."

The mineral cocinerite (discredited; a mixture of chalcocite and silver) had been reported by G. J. Hough (Bureau of Soils, U.S. Department of Agriculture); Roebling wrote him for a specimen. The answer, dated March 8, 1921:

> I have your favor of the 5th. inst. regarding a sample of cocinerite and regret to inform you that I cannot supply you with any of the same. There was only a small amount of the mineral discovered, and I have only one small specimen in my collection, and would not part with it. The mine from which it came has not been worked for years, and I have long since lost track

of my fellow workers who may have had samples of it. Enclosed I am returning the five dollars you sent.

Colonel Roebling received letters from all sorts of mineral collectors. From Portland, Oregon, a dentist named Henry C. Dake wrote on March 12, 1926:

> I am taking the liberty of writing you relative to an article by Arthur Eakle which appeared in the March number of the *American Mineralogist*. I join Dr. Eakle in regretting that more popular interest is not taken in this interesting and educational study and hobby, the collection of minerals. It is possible that more universal interest could be aroused if there was an opportunity for freer communication between collectors. Would it not be possible for the *American Mineralogist* to publish a list of the names and addresses of collectors willing to exchange with others. Personally I have been collecting minerals for a number of years and I live in a medium size city, yet as mentioned by Dr. Eakle it has not been my pleasure as yet of meeting or even having the pleasure of communicating with a brother collector.

In spite of his serious illness, Roebling replied speedily, for on April 21 that year Dake wrote: "Your letter of the 16th. is at hand and I thank you for the information contained therein. I am glad that the specimen of laurite was satisfactory." (Roebling noted on the letter that it was.) Dake lists three specimens from Roebling's duplicate list, one of which he would like to exchange. He added: "My father and mother both came over from Germany but not as early as yours did. I realize it is an effort for you to write, being handicapped with eye trouble, but it is always a pleasure to hear from you and I thank you for the information you gave me in your last letter."

Interesting light is shed on some early minerals, mines and California happenings in two letters from Henry S. Durden, State Geologist of California. The first, dated January 23, 1893:

> I have forwarded some chips containing selen-tellurium and also incidentally some durdenite [now emmonsite]. The other two we know nothing of. I made several attempts to secure napalite [now discredited] for you, you probably remember asking for it some years ago . . . no longer found. I am expecting some awaruite which I notice in your want list. If you should still be in want of it six months hence let me know. The latest information I have as to the Redington mine is that it was full of water, but that a former employee was still gouging around near the surface and scratching over the old dump and running one furnace part of the time. I was promised a liberal supply of the selen-tellurium by the owner of the mine in Honduras whom I met one evening on a street car quite by chance, but up to date it has failed to materialize. [On November 26, 1907 (after he had retired), Durden wrote:] The specimen you selected forwarded by express today, and if not satisfactory please return at my expense. The chip of meteorite is too trifling to put a price on. The native zinc from Shasta is rather a long story, but after investigation by three different persons qualified to judge, it turned out to be more of an accident than anything else. It seems there is abundance of sphalerite in calcite gangue in the locality, and that a great fire occurred in the forest, several trees rolling down into a narrow gulch and forming a bed of hot coals where a cropping of sphalerite occurred. This reduced some of the ore, the metal running into the crevices of the rock, and appearing like native zinc. A German blacksmith in the neighborhood claiming to have a knowledge of metallurgy made a great noise about it, and tried to deceive people as to its origin.

ROEBLING'S GENEROSITY

Colonel Roebling was extremely generous with his time, money and minerals. He had a constant stream of visitors wishing to view his collection. He was happier if the visitors knew one mineral from another, but was kind and courteous to all. He occasionally gave specimens to collectors (and institutions), and was often over-generous in his numerous trades with individuals.

Some of his monetary gifts have already been mentioned. He gave two gifts of $1000 to the Smithsonian in 1924 and 1925 for the purchase of minerals—"educational purposes" as the letters stated. He wrote to Dr. Merrill on January 2, 1926:

> I duly received your letter of thanks for the gift I made to the Smithsonian—also Dr. Walcott's fine letter to the same effect. I filed them away so effectively that I cannot find them. So please send me a short receipt in duplicate. The Revenue Department is very ugly about this small matter, claiming that many false gifts are made in order to reduce the taxable principal. Thus the only protection consisting in genuine receipts for gifts. Have had many celebrated mineralogists visit me from Washington.

A letter signed by twelve members of the Philadelphia Mineralogical Society written December 11, 1919, expressed their ". . . deep appreciation for the long, long to be remembered day spent at your home, Sunday, December seventh. We sincerely appreciate your great kindness and hospitality."

The Colonel on occasion loaned minerals to be shown to various groups. For example, the minutes of the Academy of Natural Sciences of Philadelphia, October 8, 1925, contain the following:

> Mr. Gage exhibited a number of very fine specimens of topaz, rhodochrosite, hedyphane, carbonado diamond, roeblingite, plancheite and other minerals belonging to Colonel Washington A. Roebling of Trenton, N.J. Mr. Gage was requested to convey the thanks of the Society to Colonel Roebling.

Colonel Roebling had other scientific interests in addition to minerals. He gave, for example, almost $150,000 over a period of time to the Smithsonian for use in investigating sun spots, solar radiation and meteorology.

ROEBLINGITE—THE MINERAL

Roeblingite, $Pb_2Ca_6Mn(Si_6O_{18})(SO_4)_2 \cdot 4H_2O$, was described by Penfield and Foote (1897) as a silicate and sulph*ite* of calcium and lead from Franklin, New Jersey. The authors wrote: "At the request of Mr. Nason [who supplied the material], the authors take pleasure in naming this mineral roeblingite, in honor of the celebrated engineer Mr. W. A. Roebling of Trenton, New Jersey." Blix (1931) determined the mineral to be a sulph*ate* and not a sulphite. Foit (1966) did further work on the structure, and Dunn, Norberg and Leavens (1982) reported further work on the mineral's chemistry. Moore and Shen (1984) determined the crystal structure of roeblingite to be monoclinic and space group C2/m.

The only other reported occurrence of the mineral is in Långban, Sweden.

WHERE WAS the ROEBLING COLLECTION TO GO?

There was, quite naturally, considerable speculation as to the ultimate disposition of this remarkable private collection. In a letter to Roebling from Professor Palache dated February 28, 1923 (part of which has already been quoted), Palache says:

> I wonder if it would be too great a liberty for me to make a suggestion to you regarding a matter which I have had at heart ever since I first saw your collection. I do not know of course what disposition you expect to make of your collection. If it

is to be preserved intact in some large institution my suggestion falls to the ground. But if it is not to be preserved, it would be a great pity if the extraordinary array of out-of-the-way minerals, authentic author's specimens of rare and little-known species of which you have such an unrivalled number; it would be a pity I say and a great loss to the science if these were not kept together in some public museum where they would be accessible to students. The National Museum is one such place; the Brush collection at New Haven another; our Mineralogical Museum a third. I name the last because the Holden Fund insures the maintenance in perpetuity of our collection and its growth ultimately to great importance. An income of $30,000 a year to be spent on the collection in one way or another—much of it of course for salaries—means that in the course of years the collection is bound to become one of the great accumulations of minerals. Please forgive my freedom in speaking thus but I cannot but hope that in some way you will keep the part of your collection I am thinking about together, whatever happens to the rest of it.

Roebling's friend R. B. Gage also had some ideas about the disposition of the collection, and was not bashful about expressing them in a somewhat rambling letter of February 16, 1926:

> In accordance with your request I delivered the bonds to Professor Phillips. Apparently this donation aroused his curiosity in regard to what disposition eventually would be made of your collection. He tried very hard to find out if I knew, but I could truthfully inform him that I knew no more on this point than he. He certainly would like very much to secure the collection and I certainly cannot blame him or anyone else for such desires. In fact, there are a great many men in the same position as Professor Phillips, wondering and wishing they might secure this collection for their own museum or college. I believe that I have previously given my views in regard to your collection, but I would like to repeat that I personally believe that the collection should in some way be kept intact and kept in New Jersey. If you do not desire to have your collection kept intact, I certainly hope you will make some provision so that I can secure your Franklin Furnace and trap rock minerals. Consequently, if you ever feel so inclined that you would like to help me out in any way, I would like to have it along the lines above suggested; that is, to be able to secure your New Jersey minerals in case your collection is not kept intact and also some provision whereby I can keep my interest in the collection and also the collection up to date by the addition of new specimens. However, whether anything is done along these lines or not, I want you to feel that I have received a great many favors from you for which I am certainly very thankful. I sincerely hope your health will be improved with the coming of Spring and that you will be on your feet again as in previous years.

The letter to Gage from George P. Merrill (Smithsonian) dated May 4, 1926, must have left Gage with very mixed feelings.

> I leave for Madrid a week from today. It is natural that my thoughts should turn to the condition of Colonel Roebling and the disposition of his collection when the inevitable happens. We make no secret of our wanting it and I feel that here it will better subserve the cause of science than anywhere else. It ought to come here and if with it a goodly sum of money to keep it up, so much the better. *But,* we want the collection when it shall have served its present purpose. I have tried to convey this idea to the Colonel, but may not have succeeded. It is of course possible that Princeton or other universities may urge their claim. If so may we not rely on you to present ours? It will be work in a good cause and doubtless you would profit by it yourself in the end. I shall feel much easier during my absence if I know that you have our interests in mind.

Gage replied on May 6:

> I have yours of the 4th. instant and note very carefully the remarks and desires regarding Colonel Roebling and his mineral collection. While I do not know what disposition may be made of these minerals, you can rest assured that it would please me very much to see them go to the Smithsonian Institution for I know that they would be in very good hands, well taken care of and appreciated more than if they should happen to get into some college. In the past, I have spoken about this matter several times to Colonel Roebling and suggested that the collection be kept intact as much as possible and that I believed the Smithsonian Institute could, no doubt, do this to better advantage than many other places. Should I get any additional opportunities to make any further suggestions, you can rest assured that I will do so.

Earl V. Shannon (Smithsonian) was in Dover, New Jersey, appraising (with Professor Phillips of Princeton) and packing the Canfield collection for shipment to the Smithsonian. On Wednesday, September 8, 1926, he wrote Dr. Merrill:

> I am all ears and voiceless in re the disposition of the Roebling collection. Was glad to be able to say I had heard nothing about it. Jokingly Phillips remarked at lunch "We are trying to steal one of your collections but it doesn't look like we are going to be able to do it." P.P.S. Have reopened this to add that at dinner Phillips told me that we are going to certainly get the Roebling collection with endowment proportional to the Canfield endowment, based on the appraised values of the two. I presume this is an old story to you and the Administration. It is needless to warn me against mentioning it to anyone else.

SMITHSONIAN ACQUISITION of the ROEBLING COLLECTION

In a letter from Bernardsville, New Jersey, dated August 26, 1926, Colonel Roebling's son, John A. Roebling, wrote to Dr. Abbot, then Assistant Secretary of the Smithsonian:

> Would it be convenient for you to come to Boulderwood to consult with me in reference to my father's collection of minerals? I wish to give it to the Smithsonian, but would like to discuss some of the details with you before writing the formal letter of presentation.

After receiving that exciting letter, there was considerable discussion within the Smithsonian about the terms of the gift; suggestions for a suitable endowment; where the collection would be housed; labeling and cataloging the collection; and other important matters, bearing in mind that the Canfield collection had come with the provision that none of the minerals in it would be exchanged. Dr. Abbot went to Boulderwood on September 5 and 6.

Many of the matters discussed at Boulderwood were included in the Deed of Gift, excerpted below. In addition, it was noted that the Colonel's will bequeathed several boxes of cut stones to his wife, and the balance to his son John. John kept a few specimens for himself and his family, but felt that "he would be following the desires of his father in presenting the remainder to the Smithsonian Institution." Mr. Roebling drew attention to the "prevailing lack of showy cut stones and large display specimens" in the collection, and hoped that part of the endowment might be used to strengthen these features. He also pointed out that there were some specimens from the collection now on loan to Palache, Gage and the National Museum, and that these should be "secured to the collection."

A matter of considerable importance to the Museum was discussed in a letter from Dr. Abbot to Roebling dated January 10, 1927: "Dr. Merrill would prefer, if you approve, that it should not be necessary to place the whole of the Roebling collection by itself, but that he be free to arrange these and other minerals from the Museum and Canfield collections in a way best to present the subject of mineralogy. I fear this may be a delicate request, and you, of course, will be the final judge in relation to it." This request apparently was approved, though there is nothing more about it in the Archive.

The Deed of Gift was executed by the Smithsonian on February 26, 1927, and said, in part:

> I, John A. Roebling . . . in memory of my father . . . do hereby give, grant and convey unto the Smithsonian Institution . . . all of the collection of minerals and meteorites . . . now in the physical custody of said Institution and, in connection with the said collection, a sum of One Hundred and Fifty Thousand Dollars ($150,000) . . . the gift being subject, as an entirety, to acceptance by the Smithsonian Institution . . . upon the following conditions: (1) The collection is always to remain in the possession of the Smithsonian Institution. (2) The specimens now in, or that shall hereafter be added to the collection are each to bear an appropriate label marked "Roebling Collection," and, in addition, each specimen shall be marked with a number or like notation whereby reference is distinctly made to the data relating to the specimen; and the specimens shall be cataloged consecutively to maintain the identify of the collection as a whole. (3) Specimens of the proper kind shall be placed on exhibition in a public exhibit; others shall be arranged where they shall be accessible for study and investigation under supervision . . . (4) No specimen shall be cut, sold, exchanged, given away or otherwise marred or disposed of, except as to duplicate or inferior specimens when either the collection as a whole or science generally will reasonably gain by the incident; but the Smithsonian may make tests of any specimen for scientific purposes . . . (5) Appropriate position and display near the collection will be given to a bronze tablet presently to be given by me, the said tablet to bear the portrait of my father and . . . a descriptive inscription. (6) The fund of One Hundred and Fifty Thousand Dollars ($150,000) is to be known as the Roebling fund; it is to be a permanent fund . . . the income received therefrom shall be first devoted to the care of the collection, to the improvement and extension thereof by the purchase or other acquisition of specimens of like quality with those now therein . . . (including) the costs of expeditions by experts from the Institution to acquire minerals; the Smithsonian Institution may then apply any surplus of income then remaining . . . to research work along pertinent lines and to the printing of literature descriptive either of the collection or of such work . . . In witness thereof, I have hereunto set my hand and seal . . .

It may be of interest to show how the amount of the Roebling fund was calculated. John Roebling in a letter to Dr. Abbot dated December 7, 1926, said:

> It is time to determine the amount of the endowment that will accompany the collection. Professor Alexander H. Phillips of Princeton examined and appraised both the Canfield and the Roebling collections; his figures are therefore peculiarly fitted for determining the proper proportionate endowment for the Roebling collection. In his letter to me of November 12 Prof. Phillips appraised the Canfield collection at $25,134.00 and the Roebling collection at $70,884.00. As the Canfield endowment was $50,000 we have 70,884.00/25,134.00 x 50,000 = 141,012 for the Roebling endowment. Taking the next highest round number, we have, $150,000.00. I will therefore give the Smithsonian Institution one hundred and fifty thousand dollars as an endowment to accompany the gift of my father's collection of minerals—this sum will be paid to the institution sometime in 1927.

Roebling received an ecstatic reply to this letter, and to his letter of March 10, 1927, which accompanied the check.

A further demonstration of John Roebling's generosity was his insistence on paying for the ten mineral specimens he and the family kept as mementos: an aquamarine pebble; black opal; orpiment; pyrite; a quartz ball; rhodonite; a polished rhodonite dish; roeblingite; a rose quartz ball and native silver. He sent a check for $2,130 for these minerals, the money to be apart from the endowment, and immediately available for use in purchasing other minerals. Dr. Abbot, in acknowledging the check, said:

> It seems to us very extraordinary that you should have done this, and should not have selected such mementos as you pleased and given us the balance without reimbursement, but I know from long association with you how carefully you think out your course of action and how reasonable and generous it always is.

MOVING the COLLECTION to WASHINGTON

Dr. Foshag and John Roebling went to Trenton on October 14, 1926; there Foshag selected "such specimens as might attract thieves" and took them to Washington with him. He and an assistant or two started the packing soon afterward, and on November 3 he wrote:

> The work at Roebling's is going ahead at a good pace. We have packed to date fifty boxes and have only a small part of the collection done. We have finished the sulphides and sulphosalts and many of the chlorides. There is much that is fine in the collection. Today six marshites (very rare), fine cerargyrites, bromyrites, and iodyrites and many rare ones. Great stuff!

The packing was completed on December 2, and sent by truck to Washington. For those who are interested in what it took to pack about 16,000 specimens, and what it cost, the following list is informative: 350 packing boxes @ 65¢, $227; hauling fee from Atlas to Trenton, $55; 800 lbs. excelsior, $15; tissue paper, $35; cotton, $23; hauling to Washington (3 loads), $500; room and board, 2 months, 3 persons @ $5 a day, $900; railroad fares, $45; miscellaneous, $100 for a total of $1900 (which John Roebling paid, as well as $500 for insurance during shipment).

Colonel Roebling's mineral books and journals were also sent to Washington. John Roebling decided that there were not enough books to necessitate the printing of a special bookplate; the books were simply put in the Division of Mineralogy library.

By September of 1927, part of the collection was arranged for public display, as Dr. Wetmore told John Roebling in a letter dated September 22:

> You will be interested to learn that work on the Roebling collection of minerals has progressed to the point where we have arranged an exhibit of some of the more showy and valuable specimens in our public halls. More will be added to these as the entire collection is rearranged and more carefully studied. If you are in Washington at any time both Dr. Merrill and I will be greatly pleased to have you visit the Museum to view the present arrangement which I feel sure will please you.

THE ROEBLING COLLECTION TODAY

The first entry in the Smithsonian Roebling catalog is dated March 21, 1927: a blue diamond from South Africa. By 1929 there were just over 6000 entries, and the cataloging was essentially completed.

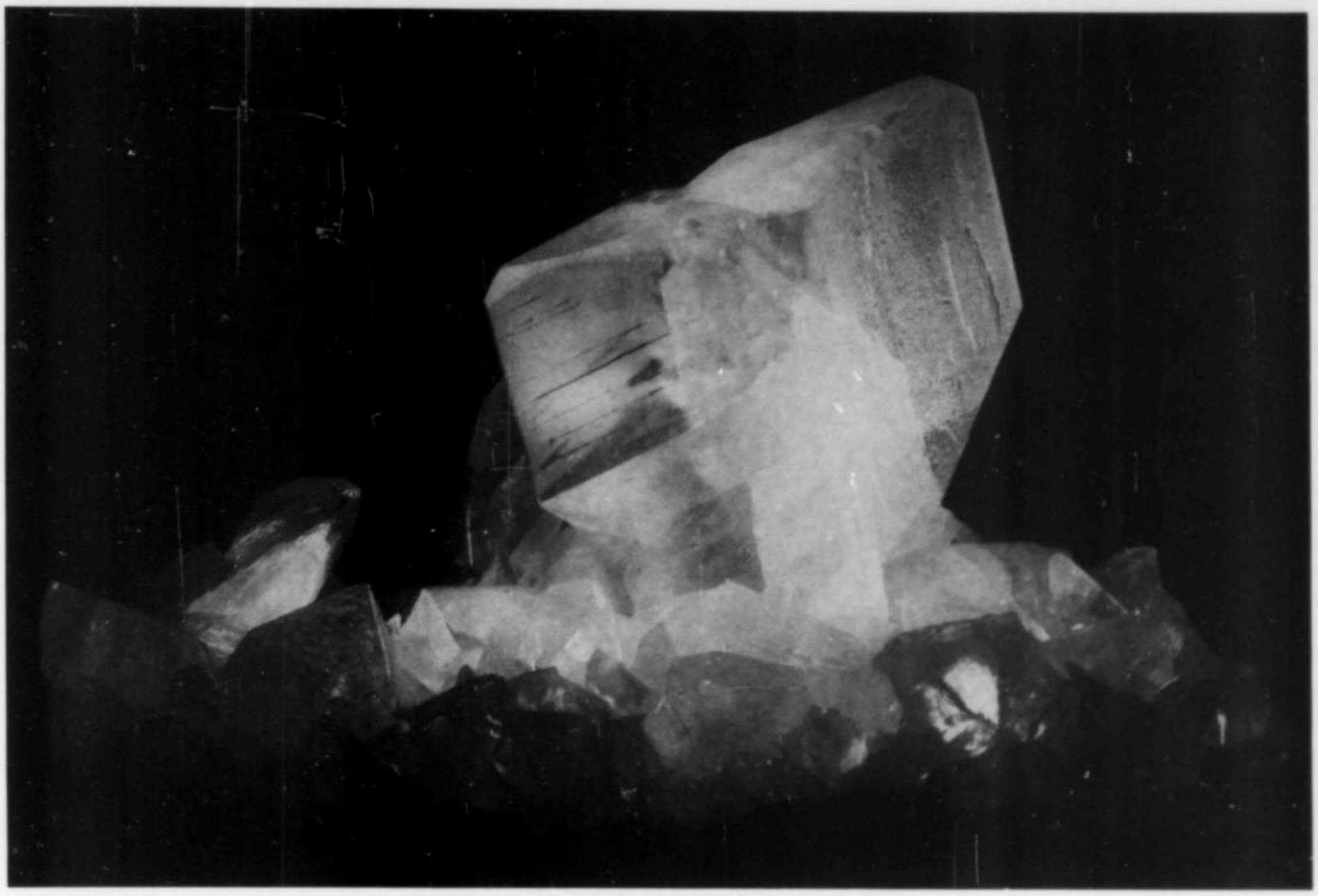


Figure 10. **Calcite specimen, 17 cm, from Guanajuato, Mexico (#R86). Photo by Chip Clark.**

The discrepancy between 6000 catalog entries and 16,000 specimens in the collection when it was received is due to the fact that many entries represent multiple pieces. The 13,000-plus entries after 1929 are specimens purchased with the Roebling fund mentioned earlier. On March 3, 1933, No. R6733 was entered. The latest entry is No. R19349, dated July 19, 1989.

John Sampson White, who is today Curator-in-charge of the Smithsonian Department of Mineral Sciences, has listed his choices for the ten best original Roebling specimens. They are, together with their catalog numbers:

Topaz (R33) Nerchinsk, Siberia, U.S.S.R.
Elbaite (R51) Pala, San Diego County, California
Apatite (R17) Pulsifer quarry, Auburn, Maine (the famous "Roebling apatite")
Phenakite (R54) São Miguel de Piracicaba, Minas Gerais, Brazil
Chrysoberyl (R53) Espirito Santo, Minas Gerais, Brazil
Azurite (R78) Copper Queen mine, Bisbee, Arizona
Diamond (R2) Murfreesboro, Pike County, Arkansas
Stolzite (R92) Broken Hill, New South Wales, Australia
Kyanite (R3752) Monte Campions, St. Gothard, Switzerland
Realgar (R360) Sacaramb, Transylvania, Romania

The present excellence of the Smithsonian mineral collection, certainly one of the two best in the world, is due in great part to the 1927 acquisition of the Roebling and Canfield collections and the endowments accompanying them.

ACKNOWLEDGMENTS

John White supplied information about the Smithsonian Roebling catalog, selected the best ten minerals among the 16,000 or so original Roebling specimens, furnished photographs of them, and gave thoughtful help after reading the manuscript. Paul Pohwat kindly supplied copies of Roebling correspondence and other pertinent documents in the British Museum (Natural History) and offered useful advice for the article. Professor Terry Wallace, Robert Massey and Richard Thomssen also read the manuscript, offering constructive suggestions. Wendell Wilson edited the manuscript with his usual skill.

Much of the material in this article is from the Smithsonian Archives: Record Unit 305, United States National Museum, Accession Records 93118 and 93625; Record Unit 7152, Washington A. Roebling Papers, box 1; Record Unit 45, Office of the Secretary of Records, 1903–1924, boxes 80 and 191; Record Unit 46, Office of the Secretary, Records 1924–1929, box 89; Record Unit 7230, Department of Geology, Biographical file, box 3; and Record Unit 7177, George P. Merrill Collection, boxes 16 and 20.

My thanks to all.

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Frederick A. Canfield

His Life and His Mineral Collection

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Frederick Canfield and a few others including Clarence Bement and Washington Roebling were the elite among turn-of-the-century American mineral collectors. Canfield's collection joined with Roebling's after their deaths to make the Smithsonian collection one of the greatest in the world.

INTRODUCTION

It came as a most pleasant surprise when, on a hot day in the middle of July 1926, Charles Wolcott, Secretary of the National Museum of Natural History (the Smithsonian Institution) received a letter from the executors of the estate of Frederick Canfield that Canfield's mineral collection, together with a bequest of $50,000 to maintain it, was left to the Smithsonian. There had been no prior correspondence from Canfield about this action, although Mr. R. B. Gage of the New Jersey Highway Commission, a mineral collector and friend of Canfield, had hinted at this possibility a few days earlier.

The letter, dated July 22, 1926, from Executor Alfred E. Mills to the Smithsonian, said in part: "The late Frederick A. Canfield (Jr.) of Ferre Monte, near Dover, Morris County, New Jersey, died on July 3rd, 1926. . . . In and by his last will . . . he gives his extremely valuable collection of minerals to the Smithsonian Institution under certain conditions. Also the sum of $50,000 provided the mineral collection is accepted by the Smithsonian. . . . If the collection is to be accepted we would like to know within a couple of months so that arrangements can be made to take the minerals from Mr. Canfield's home not later than the first of November." The will stated that all specimens bequeathed in the will or which may be acquired through the funds bequeathed by Mr. Canfield shall bear his name on the labels attached. It further stated that the "minerals, meteors, photoplates of minerals and catalogs of the collection shall be kept in the possession of the Smithsonian and not be distributed or sold . . . the meteors are not to be cut for distribution, but the Smithsonian may make tests of the minerals and meteors for scientific purposes under the direction of its officers. The collection shall be placed in the U.S. National Museum."

The acquisition of this collection, and that of Col. Washington Roebling (Roe, 1990) a few months later—together they contained over 25,000 specimens—at once vaulted the Smithsonian to the top among North American mineral museums.

CANFIELD'S LIFE

Frederick Canfield was born April 7, 1849, near Dover, New Jersey, at the Canfield homestead called *Ferremonte* (or *Ferre Monte*). Both he and his father were mining men, and their home was in the midst of then-active iron mines. Canfield graduated from Rutgers College in 1870 and received the degree of Mining Engineer from Columbia School of Mines in 1873. He was given the honorary degree of Doctor of Science by Rutgers in 1914.

Canfield's iron mining activities were largely in New Jersey, Virginia and North Carolina. From 1885 to 1887 he did mining engineering work in Bolivia, and in 1890 visited iron mines in Brazil. His activities in Bolivia were not confined to mining; he discovered fossil plants there which placed the geological age of the silver deposits of Cerro de Potosi in the Tertiary (over 50 million years ago). He also collected Bolivian minerals, among them the rare germanium mineral argyrodite (Ag_8GeS_6), and a new related tin mineral which, in due season, Penfield, (1894) described and named *canfieldite* (Ag_8SnS_6) in his honor. Penfield (1893) had a year earlier mistakenly named a

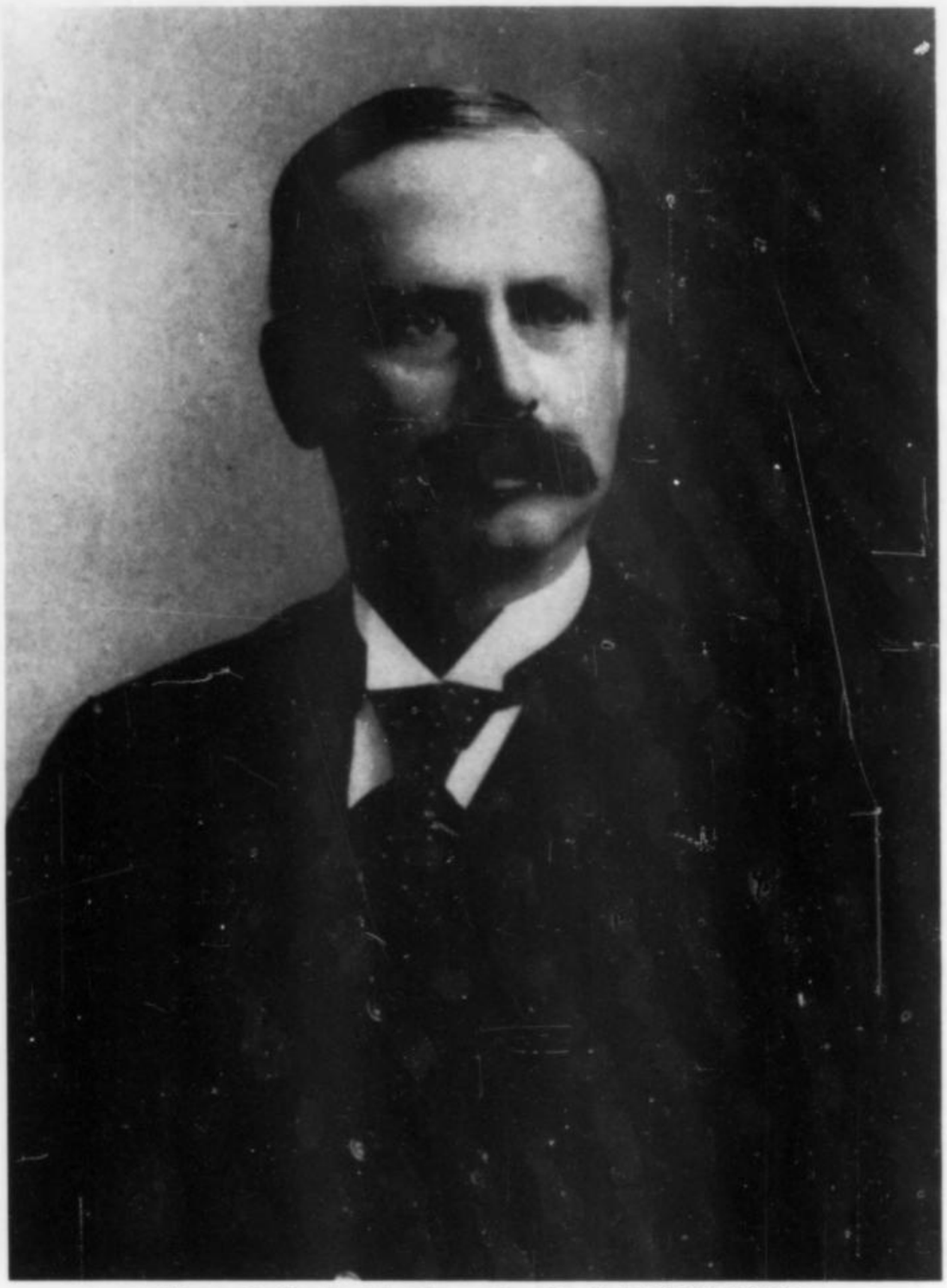


Figure 1. **Frederick Alexander Canfield (1849–1926).**

mineral canfieldite which, in reality, was argyrodite, already an established species.

Canfield never married, and lived the greater part of his life alone at Ferremonte, devoting his last years almost entirely to his mineral collection. Some further details of Canfield's life were given in a memorial by Professor Charles Palache (1927) of Harvard: "Canfield was a member of the American Institute of Mining Engineers from 1874 until his death but took no active part in its affairs. . . . [He] was a charter fellow of the Mineralogical Society of America and its vice-president during the year 1922–23. He was also long a member of the New Jersey Historical Society and was deeply versed in genealogy and the early history of the state. His collection of coins of New Jersey and other objects of historical interest were bequeathed to this society. His Genealogy of the Canfield Family is said to be a model of what such a work should be." Canfield was also appointed to the Board of Managers of the Geological Survey of New Jersey, a position he held for 17 years.

Canfield died on July 3, 1926. His only living relatives were two second cousins living in Glen Ridge, New Jersey. Professor Palache again: "The death of Mr. Canfield leaves an irreparable gap in the ranks of American mineralogists. Although not a large contributor to the literature of science, he was one of the most active and discriminating collectors of his period. To quote his own words, the collector 'takes a scientific or an aesthetic pleasure in accumulating new, strange and interesting objects, which may be studied with profit or arranged to please the eye.' In both respects he satisfied his definition. He was himself a keen student of the characters of minerals and his interest in their correct and scientific determination led him to take counsel with many of the active workers in the science and thereby repeatedly brought to light new and important mineralogical facts. Those whose privilege it was to see him in his home and with his minerals cannot easily forget the keenness of his delight in his treasures. And his accurate observations made in many lands, together with his remarkable memory for events and specimens, made his conversation replete with interest to the mineral lover."

Canfield had an accident in December of 1925, described in a letter from R. B. Gage to Colonel Roebling dated December 21, 1925: "I stopped to see Mr. Canfield and was certainly much grieved to be informed of the trouble he has had recently. You will recall that he tripped over a cat and fell down a cellar, hurting his knee. Apparently his knee has healed and is in good condition, but shortly after this he got some boils on his neck which developed into carbuncles and spread over his back so that he has been confined to bed, I think, for the last month. He is around again now, but is certainly very badly crippled and looks at least ten years older than when he visited you a couple of months ago [the only mention in the Smithsonian Archives of Canfield's visiting Roebling]. He is at a loss to know what caused these and they apparently have worried him a great deal, for his expression shows that he has suffered. We talked minerals for a half hour or so, but it was labor for him to since he could only get around

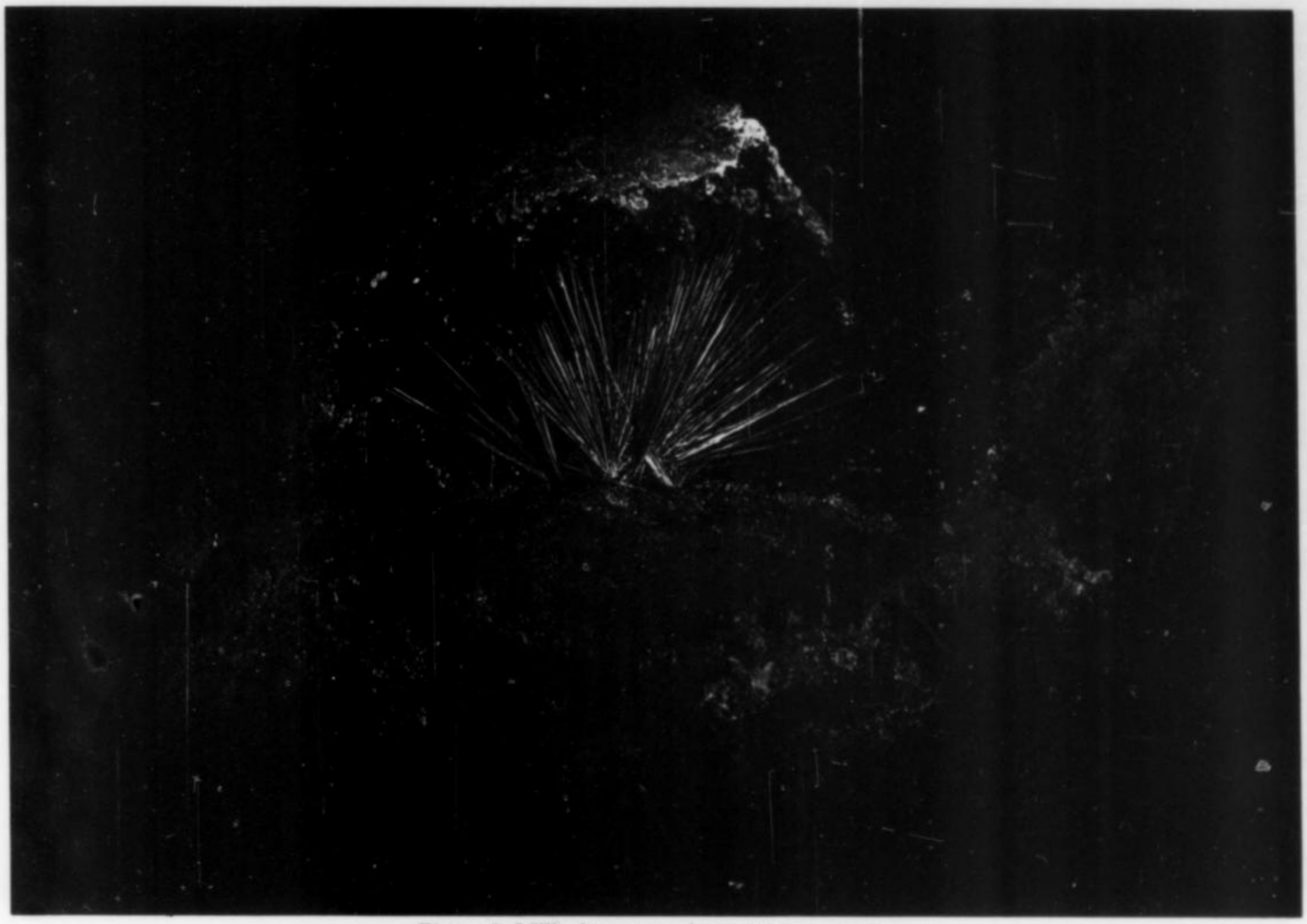


Figure 2. **Millerite spray, 4 cm across, on magnetite after hematite from the Sterling mine, Antwerp, New York (#C24). Photo by Chip Clark.**

with difficulty . . . Mr. Canfield told me Gordon [Samuel G. Gordon of the Academy of Natural Sciences of Philadelphia] had sent him a box of minerals, practically all of which he returned, for they were not of much value. No specimen of paravauxite was included . . . Mr. Canfield would like to go to the mineral meeting at New Haven, but will not be able. He suggested that I try to have some of the mineralogists stop off on their way back, and if I can arrange to do so, will bring some of them with me and we could look at your collection and then I could take them on up and show them his later." A later letter dated January 26 from Gage to Roebling said Canfield had recovered, and dispensed with his doctor.

THE CANFIELD COLLECTION

The nucleus of the Canfield collection was formed in the early 1800's by Mahlon D. Dickerson, a collector in Dover, New Jersey. Dickerson's collection passed into the hands of his nephew, Canfield's father, at an unknown date. The elder Canfield, with the help of his son, continued to build on it, eventually forming an excellent collection from the Franklin, New Jersey, area numbering 1474 specimens, which the younger Canfield kept in their original cases after his father's death. To quote Palache's memorial again: "Mr. Canfield [added to the collection] up to the last year of his life. He early specialized in minerals of New Jersey, particularly those of that most prolific of American localities, Franklin, and the zeolites of Bergen Hill and Paterson. In 1899 he prepared for the *Final Report of the State Geologist of New Jersey* a catalogue of minerals found in the state, giving exhaustive details of localities for each which proved his careful study of the subject. . . . His mineral collection, besides containing rich and unique series of local minerals, became a general one and ultimately grew to number eight or nine thousand specimens [actually 8868]. He spent days over his binocular microscope developing partly hidden crystals on his favorite specimens. To insure completeness of his collection, he prepared a most ingenious check-list comprising the names and characters of all known minerals, kept up to date as new minerals were described. This check-list might well be published; none so complete and so compact is in existence."

Earl V. Shannon of the Smithsonian, who packed the collection, with the assistance of George M. Hyland, Jr., and James Benn, for shipment from Dover, remembered seeing this list and described the handbook (as he called it) as ". . . a black pebbled morocco spring binder with alphabetical arrangement and finding tabs. The sheets were ruled in columns, the left hand and largest containing the name, the others containing various symbols, the Dana numbers, etc. This handbook was a particularly handy and condensed finding list of all mineral names with symbolic marks to give bibliographic references and to indicate whether the species or variety was included in the Canfield collection." This check list was not sent with the other catalogs, and on March 17, 1927, Dr. A. Wetmore, Assistant Secretary of the Smithsonian, wrote Judge Mills describing it and asking that it be sent. It was received a few days later.

There were three catalogs with the collection, all written by hand: (1) Mahlon Dickerson's original catalog; (2) the elder Canfield's catalog, in the first volume of which he transcribed the contents of Dickerson's catalog; and (3) the second volume of the Canfield catalog. There are entries in the latter two catalogs by both Canfields, indicating that the son was active well before inheriting the collection at his father's death. The Canfield catalogs contain 8869 entries representing about 9100 specimens.

Asked to describe some of the best of these 9100 specimens, John S. White of the Smithsonian said:

With such a large and diverse collection as the original Canfield Collection, it is difficult to single out just a few that merit special praise. The quality level throughout is high and this makes the exercise a real challenge, one in which it is hard to prevent personal bias from overinfluencing the selection. There are two specimens that stand out prominently in my mind: the very famous millerite "fan" from the Sterling mine, Antwerp, New York, and the less universally appreciated but equally exciting rhodochrosite from the Sweet Home mine, Colorado. The latter warrants more attention than it has received because of the striking contrast between the deep red rhombs and the lovely green malachite carpet upon which they sit. It really is a glorious specimen. There are hundreds of Canfield specimens distributed throughout the mineral hall. In the native elements and sulfides case, for example, 31 of the 187 specimens are from the original Canfield collection. Another 28, nearly the same number, were subsequently purchased with Canfield funds, meaning that one-third of the case's contents are Canfield specimens. In the case devoted to Franklin, New Jersey, which is filled with large to very large specimens, all 24 of those in the case are Canfield specimens, reflecting his keen interest in obtaining the best large specimens available from this famous homestate locality. The Jersey zeolites, too, are well-represented. The two best thomsonites, for example, that we own are Canfield specimens from Paterson. Among the others is the best group of stibnite crystals from the Ambrose mine, San Benito County, California, that I have seen. All of the true classics of his time are well-represented: English fluorite and calcite, Michigan copper, Mexican acanthite, Chinese cinnabar, Arkansas quartz, and typical Tri-state minerals such as calcite, sphalerite and galena.

There is no doubt that the Canfield collection was one of the very best of its vintage. Canfield's bequest (like Roebling's) has continued to enrich the U.S. National Collection through its endowment, which provides us with funds each year to make purchases of better material and thereby remain competitive with the other mineral museums worldwide. It is an impressive experience to review the specimens that have subsequently become part of the Canfield and Roebling collections through purchases with the money that these gentlemen provided.

Not all of the minerals Canfield collected went to the Smithsonian. There were some that had not been cataloged, perhaps, Shannon suggested, because they had not been studied sufficiently. There was some discussion between the executors and the Smithsonian as to whether these uncataloged minerals were part of the collection. On the one hand, it was suggested that as they were not cataloged, they did not belong in the collection. On the other hand, it was pointed out that Canfield's will said ". . . all my collection of minerals . . . ," which might well include those not cataloged. The executors' interest in this matter was occasioned by the fact that there was an apparent shortage of cash and easily convertible assets for covering all the cash bequests in the will, the expenses of Canfield's last illness and the expenses of administering the estate. They hoped some money could be raised by selling these minerals. It was finally agreed that Harvard University would purchase the residual minerals for $1100, which the executors thought was low but fair; Shannon agreed. Palache suggested that four minerals from this lot be sent to the Smithsonian: kleinite; a ruby silver; a probable canfieldite; and a meteorite. This was done.

Shannon had, with the executors' permission, shipped a few of the questioned minerals to Washington with the collection. Included were three trays of Franklin material and Bolivian silver ores which Shannon coveted.

It was made very clear, by several letters in the Archives, that all negotiations regarding the Smithsonian bequest were most amicable, and each side thanked the other for the courtesy and understanding displayed throughout the period.

Not all the minerals in the Canfield collection were genuine. Dunn, Bentley and Wilson (1981) describe a Franklin specimen (C1592) consisting of a plaster core, cleverly darkened, in which calcite and franklinite were embedded. The back of the specimen was sawed off to reveal the fraud after suspicions were aroused. Paul Powhat of the Smithsonian tells of some other fakes in the collection. One is pictured in Plate 5A of Palache (1935), an alleged gahnite from Franklin; it is actually composed of broken gahnite crystals pieced together with a smooth white plaster, that has been darkened. Palache says of Franklin gahnites: "At Sterling Hill beautiful crystals of gahnite . . . were found very early by mineral collectors. . . . The best specimens are preserved in the Canfield collection and are among its greatest ornaments."

Another manufactured specimen is a zircon group from Iron Mine Hill, NMNH C2943-1. The "matrix" is a glob of smooth white plaster colored for effect; a lacquer was painted on the zircons to enhance luster, and perhaps to hold fractured crystals together. Palache again: "A remarkable series of specimens of zircon preserved in the Canfield collection was found near the Hill iron mine on Balls Hill a little south of Franklin. The main group consists of 16 crystals implanted on rough pyroxene and dark-brown garnet. The largest zircon is 2 inches long and half an inch square. The crystals are black and of splendant luster. . . . In grouping, brilliance, complexity, and large average size of crystals these specimens of zircon are unique, and they are among the most striking features of the Franklin series of minerals. Plate 16, A, shows the best group of them in the Canfield collection." This remarkable fake eluded discovery by Canfield, Palache and many others. To add insult to injury, the zircons may well be from Canada and not from New Jersey!

There are other fake Canfield specimens. Paul Powhat is doing research on this matter which will be published in due course. Paul says, incidentally, that the large Franklin pyrite of Canfield's, illustrated in Plate 2B of Palache's paper, no longer exists, having succumbed to "pyrite disease."

A glimpse of the Canfield collection in 1891 is given by Colonel Roebling—an acquaintance and fierce competitor of Canfield where mineral acquisitions were concerned—who wrote by hand a memorandum on October 31 that year entitled "Fred. Canfield's private collection at Dover; minerals that impressed me." Some of the minerals on the list, and Roebling's comments, including exclamation marks, follow; not all had localities given.

Pyrargyrite ! Bolivia—hundreds of them—red and transparent
Stylotypite [now tetrahedrite]
Blödite ["I have it" written in different ink]
Melanophlogite—remarkable
Cancrinite—big crystal—rare
Polianite [now pyrolusite]
Anatase—blue and big yellow
Brookite—Cornwall—flat red xtal
Bastnaesite—[illegible]—flat red crystal
Pyrite—elongated—French Creek
Calcite—blue stalagmite—Bisbee
Calcite—stalactite—*terminated*
Chlorite—green crystal and curved like a ramshorn [drawing] associated with essonite from Traversilla
Lapis Lazuli—crystal—Siberia—rare
Cinnabar—Spain
Selenite—clear crystal group—prismatic—Spain
Copper crystal—Lake Superior!!
Anameckite [a mixture]—Silver islet—big as a hen's egg
Calcite—Joplin
Phantom crystal in quartz and calcite

Chessylite !!! [now azurite]
Natrolite on Prehnite ! Magnificient & large—Bergen H.
Microlite—large mass—Amelia Co.
Apatite after Aragonite
Cupro-calcite—Bisbee
Corundum—good
Röpperite—very large [now ferroan tephroite or manganoan zincian fayalite]
Babel silver ! cubes of calcite gone
Double term. crystal of Topaz—Potosi, Mex. [drawing]
Mica-Phlogopite--classic horn of mica—very flexible [drawing]
Bornite—Bolivia—very fine
Bournonite—Bolivia—very fine
Broquinardite—Bolivia—very fine—rare. In June Canfield writes me that he now thinks the Broquinardite is in reality Argyrodite or Canfieldite
Strengite—red—Virginia
Aegirine—long crystal—Potosi, Mexico
Chondrodite—Franklin—big but not perfect
Azurite cut like iolite [now cordierite]—Bisbee
Hydrofranklinite [now chalcophanite]
Meionite

On this same long page is also a hand-written list of 14 minerals in Mr. Hancock's collection at Burlington, New Jersey, with which Roebling was impressed.

Since acquiring the Canfield collection in 1926, the Smithsonian has used interest from the cash portion of the bequest to purchase more than 2000 additional specimens. Particularly important acquisitions include the collection of Larson Bauer (Franklin, New Jersey, minerals, many of which have been analyzed), the Frederico Ahlfeld collection of Bolivian minerals (Ahlfeld was senior author of *Las Especies Minerales de Bolivia*, 1955), the Mark C. Bandy collection of Chilean minerals (acquired by Bandy during his expedition described in the *Mineralogical Record*, **14**, 355–361; **15**, 67–74, 157–162), Colorado minerals from the Arthur Montgomery collection, and some exceptional Brazilian specimens from Allan Caplan (shown in vol. 11, p. 351–360, Figs. 4, 9, 14). The original $50,000 cash bequest has grown over the years, despite the removal of some interest for purchases; its current "book value" is over $207,000, with an actual market value close to $300,000.

CANFIELD and ROEBLING

It is impossible to determine now exactly the relationship 'twixt Canfield and Roebling, but what evidence there is indicates they were far from being bosom pals. Canfield in 1923 published a pamphlet entitled *The Final Disposition of Some American Collections of Minerals* (reprinted in this issue of the *Mineralogical Record*). Here he lists over a hundred old and contemporary collections. The Roebling collection is not mentioned, although at that time it must have contained at least 14,000 specimens! Perhaps, since Roebling was still alive, Canfield reasoned that his collection had not been "disposed of" yet. (Canfield does not list his own collection either, although he does list his father's.)

Canfield did visit Roebling on occasion, and Roebling did visit Dover at least once (see Roebling's list of Canfield's minerals that impressed him, above), although his travels were severely limited by illness. One letter from Canfield to Roebling was dated June 6, 1896: "Dear Sir: In reply to yours of the 4th. inst. I would say that I am not certain that the mineral I called 'Stylotipite' is correctly named—it may be a variety of Bournonite. It is found at Machacamarca—near Potosi—in silver mines that are abandoned. The mineral I called Broquinardite (on authority of the specimen in South Kensington Collection) is either Argyrodite or Canfieldite and comes from Colquechaca, Bolivia. Recent letters from that country inform me that no more is to be had, as the mines that furnished it are idle. I have never been able to trace the Hidden specimen of Canfieldite, further than I am sure it did not come from any mine near La Paz. My friends in Bolivia have not been able to learn anything about the mineral. I regret to say that I have added little or nothing to my collection this year. There are two boxes on the road from South America, both overdue and may never reach New York. I hope you are more successful than I. Yours Truly, Fred A. Canfield."

CANFIELD and R. B. GAGE

R. B. Gage has been referred to earlier; he knew both Canfield and Roebling. A letter from Canfield to Gage dated December 5, 1922:

> Yours of the 7th. inst. received today. I regret to say that I can tell you nothing about Prof. Palache's examinations of Franklin minerals during late years. I know of nothing that has not been published . . . I regret to say you showed me so many strange and curious specimens from Franklin when you were here, that I cannot recall those which you said have been proved to be Tephroite. I remember the wonderful Margarosanite that you had. I have several queer specimens from Franklin which I am unable to identify. With best wishes for the Holidays, I am, yours truly, Fred. A. Canfield. P.S. Since typing the above I have recalled that in 1916 Mr. L. Cahn [Lazard Cahn, then a New York mineral dealer] got some specimens at Franklin which showed some acute lilac colored crystals upon which were perched some thin rectangular crystals of Friedelite and Cahnite. He gave the best of these specimens to Prof. Palache, who said the lilac crystals were Glaucochroite and the rectangular crystals were Tephroite. I do not think he ever published any description of these specimens.

APPRAISAL of the COLLECTION

The Smithsonian's mineralogist Earl V. Shannon was assigned the task of appraising and preparing Canfield's collection for shipment to Washington. His appraisal came to $22,137. He explained this amount in a letter to Assistant Secretary Wetmore on August 31, 1926: "I wish it understood that such an appraisal of a collection of such magnitude is almost without precedent in our experience. I made the fairest valuation, all factors considered, which I could. In this I was guided in placing the valuation low by the fact that, at the present time, there is no market abroad for such specimens, and there are practically no buyers in this country who are interested in rare minerals beyond a few scattered private collectors of small means and small buying power [Col. Roebling had died shortly before on July 21, 1926]. If sold at public auction, I do not believe that this collection would bring more than $12,000. Opposed to this valuation is the fact that the collection could not be duplicated. It probably represents a cost outlay of at least $50,000 on the part of Mr. Canfield, and represents in addition some thirty years of enthusiastic work on the part of a trained and energetic man. Its real—not present market—value is nearer $150,000 than my meager figure, yet it is not negotiable and at forced sale would not realize my appraised value."

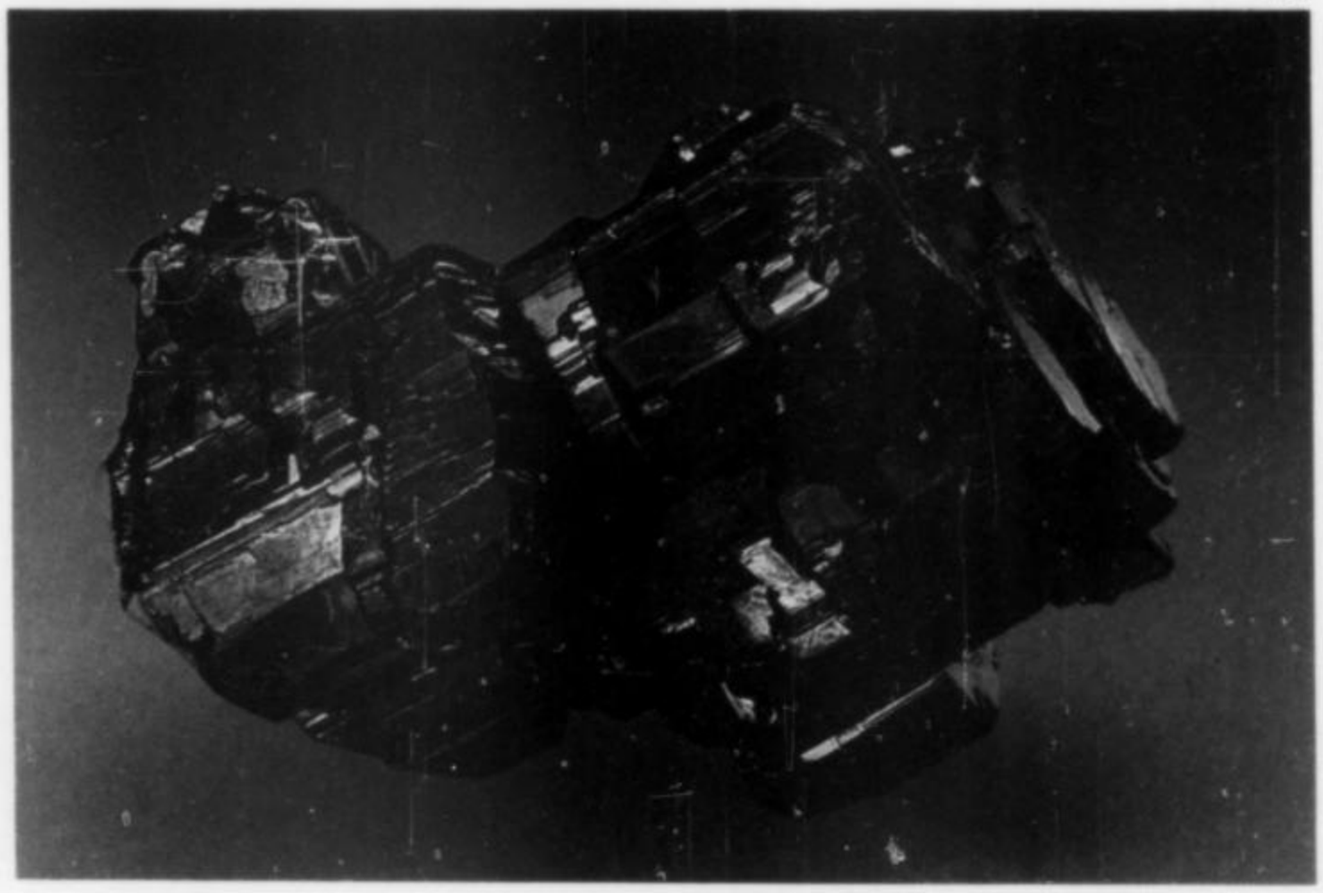
Judge Mills, an executor, wrote Wetmore on September 2 that the appraised value made by Shannon was entirely satisfactory, but ". . . we felt it would not be proper to neglect to inform the officials at Trenton . . . so that if the Comptroller of the Treasury . . . decided he would prefer to have someone other than Mr. Shannon make the appraisal it could be done. . . . Professor Alexander H. Phillips of Princeton University . . . has been engaged to appraise the mineral collection." Professor Phillips appraised the Canfield collection at $25,134. Mr. Shannon was present during Phillips' appraisal but did not interfere, rather ". . . I poked into nooks and crannies." In a later letter, Shannon stated ". . . (Phillips) is sore at so many specimens leaving Jersey as you predicted but acted very decently."

WEW

Figure 3. **Rhodonite crystals to 1.5 cm, with franklinite, from Franklin, New Jersey (#C2484).**

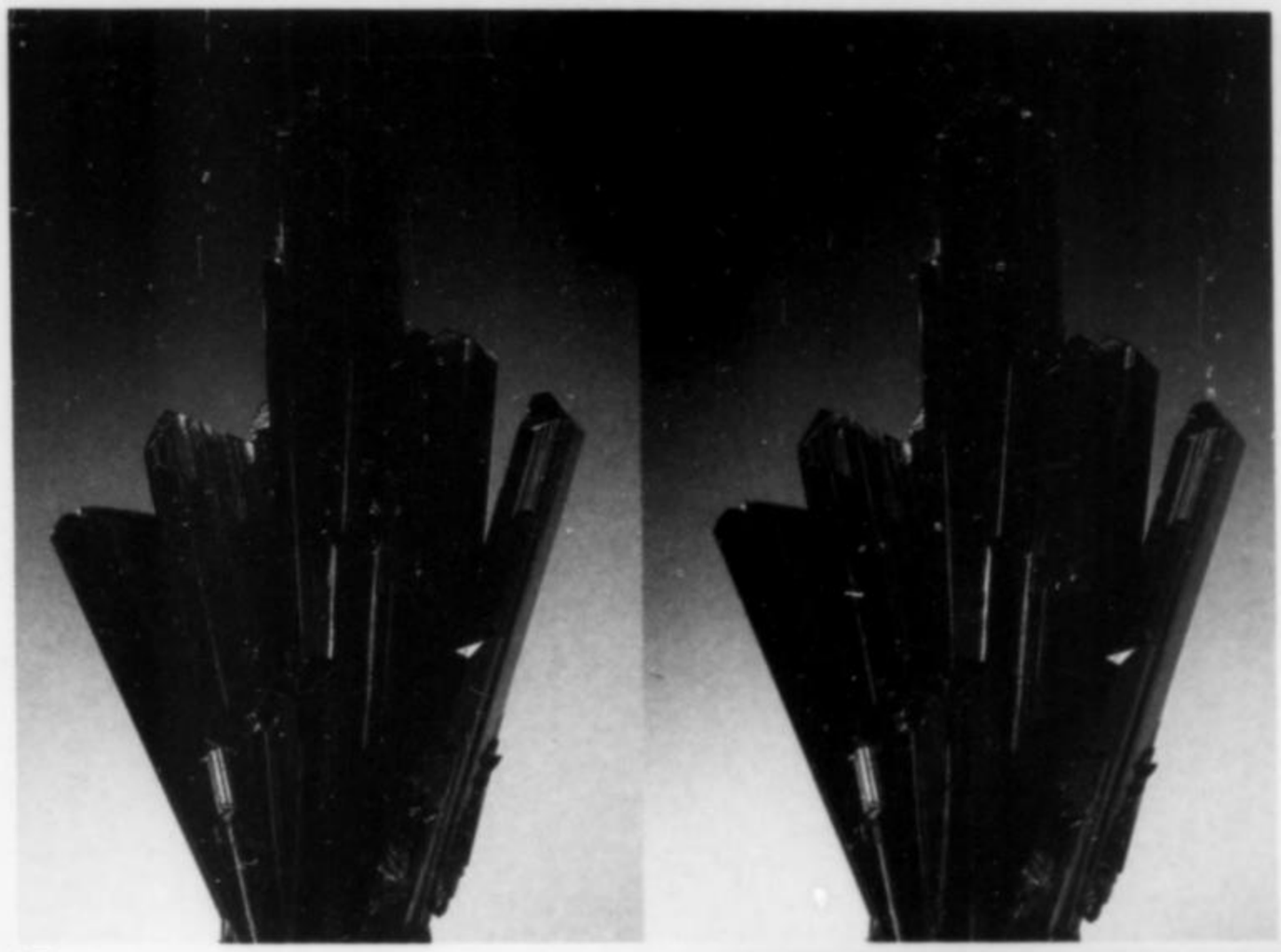
WEW

Figure 4. **Quartz crystals on a siderite crystal group, 9 cm across, from Allevard, France (#C2022-1).**



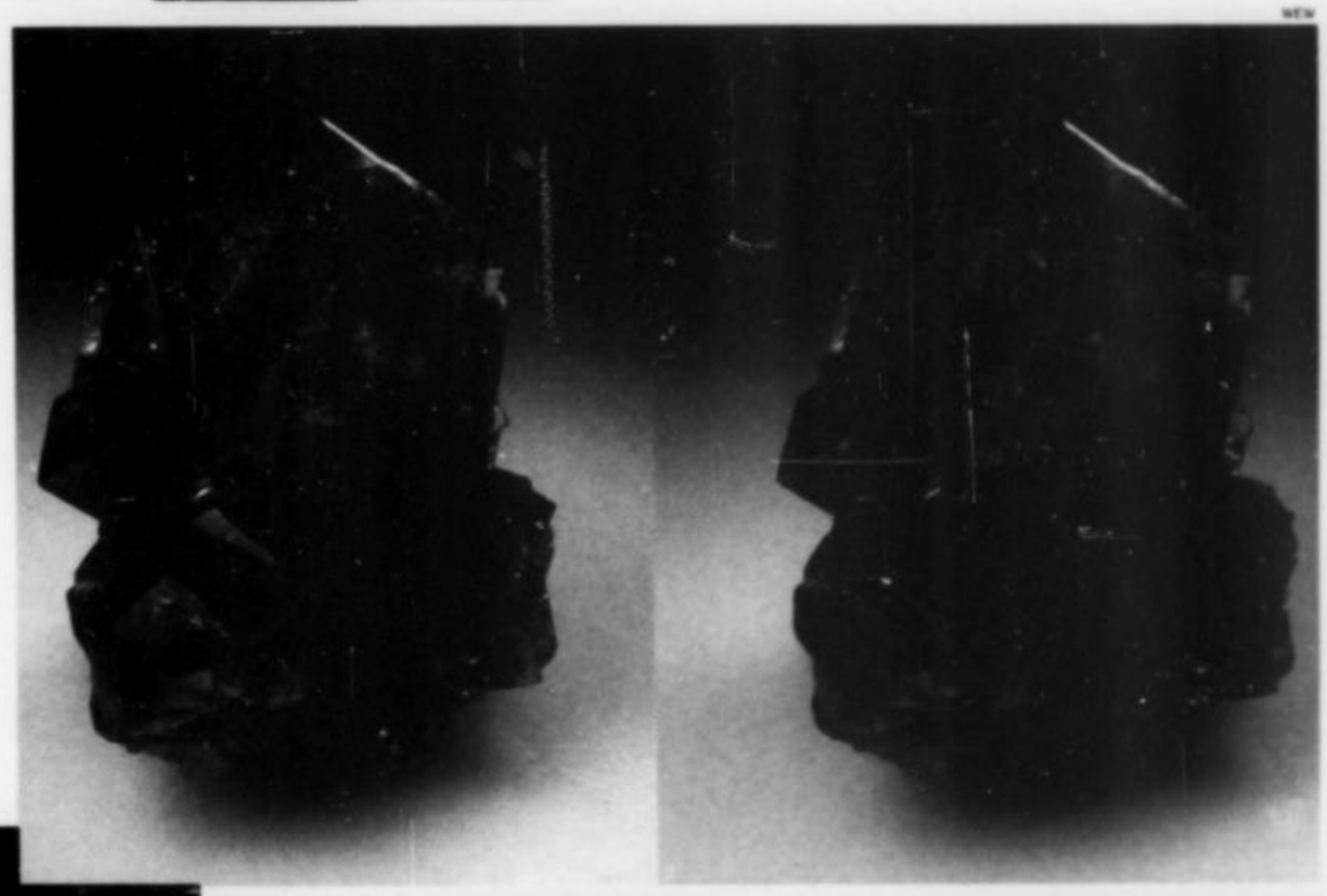
WEW

Figure 5. **Stephanite, 3.8 cm, from Colquechaca, Bolivia (#C831-1).**



WEW

Figure 6. **Epidote crystal group, 8 cm tall, from Untersulzbachtal, Austria (stereopair; use viewers supplied with vol. 18, no. 6) (#C3108).**



WEW

Figure 7. **Fluorite crystal, 3.8 cm on an edge, from Cumberland, England (stereopair) (#C958-10).**

WEW

Figure 8. **Calcite group, 9 cm, from the Bigrigg mine, Egremont, Cumberland, England (#C1889-1).**

Figure 9. **Calcite group, 7 cm across, from the Stank mine, Lancashire, England (#C1896-2).**

Figure 10. **An ambitious fake unwittingly acquired by Canfield, purported to be a zircon group from Franklin, New Jersey (#C2943-1). Many of the zircon crystals have been heavily restored, and the various components of the group assembled around a core of plaster.**

PACKING and SHIPMENT of the COLLECTION

The packing was started in early September, and a truck with the collection left Dover on October 7, 1926, headed for Washington. Shannon was in charge of the packing—which was done in the barn—assisted by Mr. Benn (Smithsonian) and occasionally Mr. Hyland, a local helper. The collection was packed in boxes, 100 of which were obtained for $65.00 from the Atlas Powder Company, labeled "TNT—HIGH EXPLOSIVES." They cost much less than if they had been obtained through U.S. Government bidding procedures, Dr. Wetmore noted delightedly. The cost of the packing operation was estimated at $272.00 (including hotel at $3.50 per day), plus trucking expenses. This estimate proved a bit low, for it took longer than Shannon estimated.

Some miscellaneous information from Shannon's letters to Dr. Wetmore: The collection was scattered all over the house, but mostly in two large rooms on the first floor. He found a large 40-pound meteorite with meager data; a Canfield note said he acquired it in Bolivia from a friend who got it from a priest who bought it for 600 gold escudos. He found a bona fida fragment of a tuffaceous chondrite in the elder Canfield's collection, supposed to be an old Maryland fall. Shannon disapproved of local labor, because it cost between 60 and 70 cents an hour, and never worked on Sunday. He had dinner with Professor Phillips, who told him the Smithsonian would get the Roebling collection, and it would be better for him to bring the gems and certain small minerals personally with him rather than to ship them in the truck. He asked and received permission to visit Franklin to look for minerals, but Wetmore said it would be "inexpedient" for him to visit the Sesquicentennial Exposition in Philadelphia. Canfield's father's collection had been "sealed" for 60 years (probably meaning it had been kept in the original cases all that time). He noted that everyone in New Jersey connected with the appraisal, packing and shipping of the collection had been most helpful and cooperative at all times.

CANFIELD'S PUBLICATIONS

Palache (1927) listed Canfield's publications as follows:

(1) Catalogue of Minerals found in New Jersey. *New Jersey Geological Survey Field Report* **2**, 1–42B (1889)

(2) Mineralogical Notes (Willemite, N.J., Argyrodite and Canfieldite, Bolivia), *American Journal of Science*, (4) **23**, 20–22 (1907)

(3) Mosesite, a New Mercury Mineral from Terlingua, Texas (with Hillebrand, W. F. and Shaller, W. T.), *American Journal of Science*, (4) **30**, 202–208 (1910); *Zeitschrift für Krystallographie*, **49**, 1–8 (1911).

(4) Thomsonite in New Jersey. *Columbia School of Mines Quarterly*, **32**, 215–216 (1911)

(5) Mosesite. *Columbia of School of Mines Quarterly*, No. 3 (1913)

(6) Twinning in the New Jersey "Pseudomorphs." *American Mineralogist*, **2**, 48 (1917)

(7) *The Final Disposition of Some American Collections of Minerals*. Dover, N.J. (1923) (reprinted in full in this issue of the *Mineralogical Record*)

Some further information about Canfield is contained in the article on Roebling in this issue, page 15.

ACKNOWLEDGMENTS

The author acknowledges with considerable thanks the help of John Sampson White and Paul Desautels who, many years ago, suggested Roebling and Canfield as good subjects for *Mineralogical Record* articles. They smoothed the way for me to the Smithsonian Archives, whose custodians were most helpful. John Sampson White also supplied ideas and information, and minerals for Dr. Wendell Wilson, with his usual skill, to photograph. Paul Pohwat furnished some information on fakes in the Canfield collection.

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Canfield's Dispositions *(continued from p. 46)*

that were found in the Perkiomen and the Phoenixville mines. It also contained some fine foreign minerals. He sold his collection in 1858 to Edward C. Delavan, of Albany, N.Y., for $10,000. Mr. Delavan presented it to Union College, of Schenectady, N.Y.

WILCOMB, CHARLES P., San Francisco, Cal. He had a general collection of 1000 specimens which he sold to a dealer in 1904.

WILLCOX, ALBERT, Staten Island, N.Y. His sons divided his collection. A portion of it was left in Saratoga, N.Y., where he died about 1900.

WILLCOX, JOSEPH, Philadelphia, Penn. He broke up his collection and allowed Mr. Bement to make the first selection. The British Museum had the second pick. The other specimens,—chiefly from Pennsylvania, were deposited in the National Museum, September 8th, 1891. He had some splendid specimens.

WOODRUFF, SAMUEL, Sparta, N.J. He was one of the original searchers for isolated deposits of the many kinds of minerals found on the Franklin region. He probably discovered, and dug with his own hands, more and better specimens, than any other man. He also watched the output of the zinc mines with great care. He made several collections, the last of which was purchased by a dealer in 1885.

YOUNG, J. P., Edenville, N.Y. This was one of the early (1830) collections of the minerals of Orange Co., N.Y. It was purchased by William Horton, of Goshen, N.Y.

YOUNG, SILAS C., Edenville, N.Y. This was a modern collection of specimens from Orange Co. and from the zinc mines at Franklin Furnace and Stirling Hill, N.J. None of his minerals came from the collection of his father (J. P. Young). It was sold in 1914, to the New York State Museum, at Albany, N.Y., for $1,000. ⊠

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The Final Disposition
of some
American Collections of Minerals

Frederick A. Canfield

EDITOR'S NOTE

One of the most interesting but most difficult to find references on early American mineral collecting is Canfield's *Dispositions*, published as a pamphlet by the author himself at Dover, New Jersey, in 1923. In order to preserve the work for the sake of history, we are reprinting it here in full. Our thanks to Joseph J. Peters of the American Museum of Natural History for providing a copy of the original.

W.E.W.

PREFACE

This compilation is really the extension or development of a habit which many people have of clipping from the current newspapers such items as are of particular interest.

Whenever the compiler noticed in print, a reference to a collection of minerals, it was clipped and laid away.

Many items were not seen, and frequently the disposition of a collection remained unknown to him for years.

A similar lack of knowledge is so prevalent among mineral collectors that it seems worth while to record such facts in a more permanent form.

There are two kinds of collectors, who differ in the spirit or motive for pursuing their hobby. The one takes a scientific or an aesthetic pleasure in accumulating new, strange and interesting objects, which may be studied with profit or arranged to please the eye. The other has only a financial interest in his quest and expects to realize a money profit at the first opportunity. It is not important that the disposition of the latter sort of collections should be noted and recorded, except when they are acquired by public institutions, and thus become a basis or foundation, upon which is built a better collection. This record will then furnish an item of history for such a collection.

The compiler is well aware that this list is far from being complete. It is meant to be correct as far as it goes.

Many other collections have been considered, but were rejected for lack of importance—perhaps more should have been omitted. A few were left out because no data concerning them could be obtained.

The thanks of the compiler are due to so many persons who have furnished him with data, that it is quite impossible to publish their names.

DOVER, N.J., Feb., 1923.

COLLECTIONS

ABERT, JOHN T., Washington, D.C. His collection was acquired by the National Museum Feb. 10, 1883. It contained 800 specimens.

ALGER, FRANCIS, Boston, Mass. His collection is at Bowdoin College, Brunswick, Maine. He was an early collector of the minerals which occur at Franklin, N.J.

ALLEN, FRANCIS R., Boston, Mass. He presented his collection to Amherst College.

ALLEN, JOHN, New York City. He had a small collection of very large specimens of extra quality. It was sold at auction in New York City about 1864.

ALLEN, O. D., New Haven, Conn. His collection was purchased by the Johns Hopkins University, Baltimore, Md.

AMEND, BERNARD G., New York City. His collection is held intact by his legatees.

AMES, J. T., Chicopee, Mass. A general collection—It was sold to a dealer about 1918.

ARNOLD, DELOS, Pasadena, Cal. He presented his collection of minerals and fossils to the Stanford University in 1908.

ARNOLD, E. S. F., New York City. He presented his collection to the Mount Saint Vincent Academy of New York City.

BAILEY, JOEL, East Marlborough, Chester Co., Penn. His collection descended to his nephew Joel Scarlett, whose heirs presented it to Swarthmore College, Swarthmore, Penn. It was a collection of old time specimens from eastern Pennsylvania.

BAILEY, S. C. H., Oscawana, N.Y. His first collection was purchased by The American Museum of Natural History, of New York City, in 1875, for $5,000. Most of the specimens were sold to dealers after the museum acquired the Bement collection. His second collection was inherited by his niece who sold it to the same museum. The museum added the meteoric specimens to its own collection and sold the minerals to a dealer who scattered them.

BEADLE, E. R., Philadelphia, Penn. His collection was inherited by his son, the Rev. Heber H. Beadle, of Bridgeton, N.J., who presented it to Yale University, in 1916. It was a very large collection. The specimens were said to weigh 15 tons.

BECK, LEWIS C., New Brunswick, N.J. Many of his specimens are in the New York State Museum at Albany, N.Y. Rutgers College purchased his private collection from his heirs. It is kept intact in the college museum, in New Brunswick, N.J. It is an old collection of New York and New Jersey minerals. It contains many type specimens. Professor Beck collected from 1818 to 1847.

BEMENT, CLARENCE S., Philadelphia, Penn. This was the finest private collection of minerals ever made. It is the best public collection in America—it has but two rivals in the world. It contained about 16,000 specimens. In 1900 he sold it to the late J. Pierpont Morgan, who presented it to The American Museum of Natural History, of New York City. The price paid was never published, but is said to have been only sixty per cent of the cost of the collection. Mr. Bement culled many of the choicest specimens from private collections, by purchase or exchange.

BIERWIRTH, LEOPOLD C., Dover, N.J. This was a small general collection of good specimens. In March, 1917, his widow presented the collection to Swarthmore College, as a memorial to her son, who was an alumnus.

BIXBY, MAYNARD, Salt Lake City, Utah. This collection, consisting chiefly of fine specimens from the western states, was purchased by the Field Museum, of Chicago.

BOUVE, THOMAS T., Boston, Mass. He gave most of his collection to The Boston Society of Natural History. He also gave some choice specimens to the Public Library in Hingham, Mass.

BRADLEY, MICHAEL, Chester, Penn. This was a general collection of about 1200 specimens. It was purchased by a dealer in 1919.

BRAVERMAN, MAX, San Francisco, Cal. He gave his collection to Golden Gate Park Museum, of San Francisco. It was a general collection, but rich in California minerals. It contained about 800 specimens of medium quality.

BROOKS, THOMAS B., Newburg, N.Y. He gave a portion of his collection to Harvard University. The remainder was given to Union College, Schenectady, N.Y., by his son Alfred H. Brooks in 1908.

BRUMBY, RICHARD T., Columbia, S.C. His collection was sold at auction in New York City in 1869. It was acquired by Davidson College of Davidson, N.C.

BRUSH, GEORGE J., New Haven, Conn. He presented his library and his collection of minerals to the Sheffield Scientific School, in 1904. It is a large collection of high quality, and contains many type specimens of rare minerals. His gift was valued at $40,000.

CAMPION, JOHN F., Denver, Col. He presented his collection to the State Museum, at Denver. His specimens of crystallized gold from Farncomb Hill, near Breckinridge, Col., were of great value for bullion.

CANFIELD, CHAUNCEY L., San Francisco, Cal. His collection was destroyed by the earthquake and fire of 1906.

CANFIELD, FREDERICK, Dover, N.J. His collection remains intact as he arranged it in the years 1858 and 1864. It contains about 1600 specimens. He collected the more important ones himself, at, or near Franklin Furnace and Stirling Hill, N.J., between the years 1840 and 1866. [Ed. note: subsequently donated to the Smithsonian.]

CARDEZA, JOHN T. M., Claymont, Del. At one time, his collection was offered for sale for $2500. It is now owned by the University of Pennsylvania. It is composed largely of minerals found in Chester and Delaware counties, Penn.

CARR, SILAS, Jamestown, R.I. This was a general collection containing about 1200 specimens and a few fossils. It favored the minerals of Rhode Island. It was purchased by Mr. J. W. Bahn, of Pawtucket, R.I., in May, 1917.

CASWELL, JOHN H., New York City. This was a large general collection containing some choice specimens. His widow presented it to Trinity College (Hartford, Conn.) in April, 1911.

CHAMBERLAIN, BENJAMIN B., New York City. This collection consisted exclusively of minerals found on Manhattan Island. It was purchased by the New York Mineralogical Club. It is now deposited in The American Museum of Natural History.

CHAMBERS, JAMES B., Schenectady, N.Y. This collection was rich in specimens found at Ellenville, N.Y. It was purchased by Mr. M. F. Westover, of Schenectady.

CHATARD, FERDINAND C., Baltimore, Md. His widow presented his collection to the Maryland Academy of Sciences, of Baltimore.

CHESTER, ALBERT H., New Brunswick, N.J. His collection was presented to Rutgers College by his son. It is a general collection of choice specimens. It is rich in the minerals that are found in the northern part of the State of New York.

CHILDS, CHARLES G., Floral Park, N.Y. This was a modern collection of high class specimens. In 1921 it was divided into four parts. His family reserved about 750 specimens—many were given to the public schools—a dealer bought about 200 specimens—the remainder were purchased by Mr. M. L. Morgenthau, of New York City.

CHILTON, JAMES R., New York City. This was a general collection, which contained some unique specimens. It was broken up by a dealer. The great specimen of Rutile crystals in Quartz, which was found in New Hampshire, is in the collection of Mr. George Vaux, Jr., of Bryn Mawr, Penn. The crystal of Calcite containing a gill of water, found at Rossie, N.Y., is owned by the Academy of Natural Sciences, of Philadelphia, Penn.

CLARK, DANIEL, Tyringham, Mass. His collection is in the Athenæum, in Pittsfield, Mass.

CLAY, JOSEPH A., Philadelphia, Penn. This collection was held intact by his family for many years. It finally went to the University of Pennsylvania. It was an old time, general collection, which contained some choice specimens.

COOPER, J.C., Topeka, Kan. A fine collection of minerals from the Joplin, Mo., zinc mines. It was bought and scattered by a dealer in 1911.

COOPER, THOMAS, Columbia, S.C. This very old collection was acquired many years ago by the South Carolina College, of Columbia. It received rough treatment by the soldiers during the Civil War.

COX, JAMES N., Calumet, Mich. His first and second collections were sold to Prof. L. L. Hubbard, of Houghton, Mich. His third collection was sold in small lots to other collectors. The specimens were found in the copper mines near Calumet.

CURTIS, THOMAS E. H., Plainfield, N.J. This was a general collection which contained some specimens of high quality. Nearly 2000 specimens were sold at auction in New York City, in December, 1918.

DALYRYMPLE, E. A., Baltimore, Md. His collection was purchased by the Maryland Academy of Sciences. It was not a large collection, but it contained good specimens.

DANIELS, JOHN, Calumet, Mich. His collection was held intact by his family for many years. It contained from 1500 to 1800 specimens from the copper mines of Lake Superior. Some of them were of rare quality.

DAVIS, J. Z., San Francisco, Cal. A portion of his collection was destroyed by the earthquake of 1906. He gave some of his specimens to the California State Bureau of Mines. He sold some to dealers. It was a general collection.

DEEMS, J. W., New York City. He had a fine general collection which he disposed of himself, at retail.

DELAFIELD, JOSEPH, New York City. In his will of January 16, 1869, he bequeathed his collection to the New York Lyceum of Natural History, under certain conditions which were never satisfied. His family donated the collection to the New York University about 1890, stipulating that it should be preserved separate and intact. It was a general collection of about 2500 specimens, and was reputed to be the finest collection in New York City.

DENISON, CHARLES HYDE, New York City. He presented his collection to the Public Library of Westerly, R.I.

DICKERSON, MAHLON, Dover, N.J. He was collecting as early as 1808—in which year he escorted Mr. S. Godon, of Philadelphia, to Franklin Furnace, N.J. His collection was a small one. It was probably acquired by his nephew, Frederick Canfield.

DICKINSON, JOHN, Forestville, Conn. (in 1879). His collection was purchased by the University of Southern California (Los Angeles), which institution was unable to pay for it. It was acquired by Throop Institute, of Pasadena, Cal. It was a general collection. It contained fine specimens of the rare minerals that were found at Branchville, Conn.

DISBROW, WILLIAM S., Newark, N.J. This was a general collection of a great number of specimens—most of which he collected at the various localities in New Jersey. He presented it to the Newark Museum Association in 1912. He also gave many of his finest specimens to the National Museum at Washington, D.C.

DOHRMAN, J. H., California. His collection, which was principally specimens of native Gold, was sold at auction in Philadelphia, Penn., December, 1886.

DYER, H. ANTHONY. His collection is owned by the Park Museum, of Providence, R.I.

EGLESTON, THOMAS, New York City. His collection was absorbed by the collection in the School of Mines, Columbia University. It was a general collection of good specimens.

EHRMAN, ARTIS M., Brooklyn, N.Y. His collection was broken up and scattered by his heirs.

ELSNER, JOHN, Denver, Col. This was a collection of Colorado minerals. It contained many specimens of Amazon stone. It was rich in tellurides from Boulder Co., Col. It was sold to the State of Colorado for $15,000, and is now in the State Bureau of Mines, in Denver.

EMMONS, EBENEZER, Williamstown, Mass. It would appear that he made two collections—one of which is in Williams College, at Williamstown—the other collection, consisting of large crystallized specimens found in New York State, was acquired in 1870, by the New York State Museum, at Albany, N.Y., by gift from Hon. Erastus Corning.

EYERMAN, JOHN, Easton, Penn. He collected chiefly, the minerals of Pennsylvania. In 1915 he sold his collection to a dealer who added it to his stock. There were about 1600 specimens.

FERRIER, WALTER F., Toronto, Canada. He sold his first collection to the University of Toronto. He sold his second collection to McGill University, of Montreal, for, it is said, $18,000. The latter contained more than 5000 specimens, among which are many of the rarest species.

FEUCHTWANGER, LEWIS, New York City. His daughters presented his collection to the Society of Ethical Culture, of New York City, about 1900. It was a general collection. Many years ago, while this collection was exhibited in the Old Arsenal in Central Park, some of the specimens were stolen.

FINCKE, WILLIAM M., New York City. His collection was put in a dealer's hands, to be sold intact, about 1890. No sale was effected. The owners took the collection back and have forgotten its existence. It was a small collection, with fine specimens of Ruby Silver, and minerals form the Tilly Foster mine, at Brewsters, N.Y.

FORBES, R. W., Brooklyn, N.Y. A general collection of choice specimens. He had particularly fine specimens of crystallized Gold, also Chrysoberyls from Haddam, Conn. All were bought by a dealer in 1920.

FORRESTER, ROBERT, Salt Lake City, Utah. This was a general collection, strong in minerals from Utah, and the neighboring States. It numbered about 2300 specimens. It was partially robbed soon after the death of Mr. Forrester. A dealer purchased 650 specimens—the remainder were given to Westminster College, of Salt Lake City, by Mrs. Forrester.

FOWLER, SAMUEL, Franklin Furnace, N.J. A small portion of his collection was given to Princeton College. The remainder was burned with his residence. It was a local collection, being limited to the minerals of the Franklin region.

FOWLER, SAMUEL, JR., Port Jervis, N.Y. This was a local collection of the minerals found at Stirling Hill and Franklin Furnace, N.J. Its fate is uncertain. One story is, the collection was stolen when Col. Fowler was moving his household effects from Port Jervis to Newton, N.J. A man who claims to know, says the collection was left in Port Jervis, and was gradually scattered and lost.

FOX, HENRY STEPHEN, Washington, D.C. He was the Minister of Great Britain from 1836 to the time of his death in 1844. He died in Washington, where his collection was sold. Francis Markoe, Jr., bought many of the specimens. Some of the specimens are in the National Museum. This collection contained very fine specimens from Brazil.

FRECKLETON, JOHN W., Brooklyn, N.Y. His collection, consisting of specimens from the trap rock quarries in New Jersey, was scattered by a dealer.

GARRETT, HENRY, Willistown, Penn. He sold his best specimens to a dealer. His heirs disposed of the remainder in the same manner.

GENTH, FREDERICK A., Philadelphia, Penn. Many years ago he sold his collection to the University of Pennsylvania. His second collection has been offered for sale for $12,000.

GIBBES, LOUIS R., Charleston, S.C. A portion of his collection was purchased by the South Carolina College, of Columbia, S.C., about 1900.

GIBBS, GEORGE, New Haven, Conn. This was a very old collection. He sold it to Yale College many years ago.

GILCHRIST, C. A., Philadelphia, Penn. His collection was broken up and scattered by a dealer in New York City, in 1903. It contained many fine specimens.

GLASER, LOUIS A., Sewickley, Penn. His collection was purchased by the Merrick Museum of New Brighton, Penn. It was a general collection numbering 1500 specimens,—the result of thirty years labor.

GODON, S., Philadelphia, Penn. He was one of the earliest of the American collectors. He visited Franklin Furnace, N.J. in 1808, with Maylon Dickerson. His collection was acquired by Dr. Benjamin Smith Barton, at whose sale it was purchased by Joseph Watson, who presented it to the Academy of Natural Sciences in 1816. It was the beginning of the Academy's collection of minerals.

GRIFFITH, CHARLES, Phoenixville, Penn. This was a collection of about 1500 specimens of good quality. The owner died in 1912, leaving his collection to his heirs who sold it at retail to collectors.

HAINES, BENJAMIN, Elizabeth, N.J. His collection was sold at retail by a dealer in New York City. It consisted, principally, of the Zeolites and associated minerals, found in the old Erie tunnel through Bergen Hill.

HALL, JAMES, Albany, N.Y. His collection was sold to the Chicago University.

HAMLIN, AUGUSTUS C., Bangor, Me. His collection was purchased by the late James Garland, of New York City, who presented it to Harvard University. It consisted exclusively, of crystals of Tourmaline from Paris, Me.

HAMMOND, GEORGE WARREN, Yarmouthville, Me. He presented his collection to Bowdoin College. It numbered about 800 specimens, most of which were found in Maine and Colorado. One, a gem Beryl, from Topsham, Maine, was of great value.

HANCOCK, ELWOOD, P., Burlington, N.J. This was a general collection of fine quality, with many superb crystals, collected by himself at Franklin Furnace, N.J., at Tilly Foster Mine, N.Y., and at the mica mines in Amelia Co., Va. He displayed exceptional talent in the selection and in the care of his specimens. His collection was purchased by Harvard University, in 1916.

HARTMAN, JOHN M., Philadelphia, Penn. He presented his collection to the Academy of Natural Sciences, many years ago. It was a general collection.

HAWES, GEORGE W., Washington, D.C. His collection is in the National Museum. It contained 450 specimens—chiefly American.

HERON, JAMES, Warwick, N.Y. His was an old time historic collection of specimens found in Orange Co., N.Y. He was an active collector in 1830. No record has been found of the disposition of his specimens. They were probably distributed among some of the more recent collections.

HIDDEN, WILLIAM EARL, Newark, N.J. His collection was purchased by the Royal Museum, in Vienna, Austria. It was very rich in the minerals of North Carolina.

HOLDEN, ALBERT F., Cleveland, O. This collection of 6000 specimens was of the highest quality—many of them were unique. In 1911 he purchased the Losey collection of Franklin minerals. He died in February, 1913, and left his collection to Harvard University, with a large endowment fund for its support.

HOLZMAN, JOHN, Newark, N.J. This was a modern general collection of 5000 specimens—the result of twenty years labor. It contained more than 300 principal species and a large number of subspecies. It was offered for sale for $3,500. It was scattered by an auction sale in New York City, in February, 1923.

HORTON, SILAS R., Craigville, N.Y. His best specimens were sold by his family,—the others are held by his heirs. It was chiefly a collection of the minerals of Orange Co., N.Y., and of the zinc region of Sussex Co., N.J. It was probably, the best collection of Orange County minerals that has been made.

HORTON, WILLIAM, Goshen, N.Y. His was a collection of the minerals of Orange Co., N.Y. It contained specimens from the J. P. Young collection, and no doubt, had some from Dr. Heron's. It became the foundation of the collection of his son, Dr. Silas R. Horton.

HOWE, HENRY, of Nova Scotia. This was a local collection of Nova Scotia minerals. Many years ago Messrs. A. H. and C. T. Barney purchased the collection and presented it to the School of Mines, Columbia University, New York City. The collection which he prepared for the Paris International Exposition of 1867, was purchased in that year by the Government of Nova Scotia, and is now in the Provincial Museum, in Halifax, N.S.

HUNT, T. STERRY, Montreal, Can. This was a collection of geologic and economic specimens. It was so poorly cared for that the labels got mixed or lost, so that the fossils and ore samples became valueless. He gave his mineral specimens to the late Dr. James Douglas, of New York City.

JACKSON, CHARLES T., Boston, Mass. This old time collection is probably, in the possession of the Boston Society of Natural History. Dr. Jackson was a warm friend of this society, and it is known that he gave it many minerals.

JEFFERIS, WILLIAM W., West Chester, Penn. He sold his collection in 1904 to the Carnegie Museum, of Pittsburg, Penn., for more than $20,000. It was a large general collection with fine suites of minerals from eastern Pennsylvania, and northern New York. Many of them he obtained himself at the localities.

JENKINS, JOHN, Monroe, N.Y. He sold his collection to James Nelson, of Cold Spring, N.Y. It consisted of a fine lot of specimens which he collected at the localities in Orange Co., N.Y.

JEWELL, PLINY, Hartford, Conn. His collection was scattered by a dealer. It contained some wonderful specimens from Connecticut.

JOHNSON, HORACE I., Waltham, Mass. This was a fine collection, rich in the minerals of New England. It was sold for about $3,000, to several wealthy men who presented it to Wellesley College.

JOHNSON, WALTER R. This old time collection was presented to the National Museum, September, 1890, by Mrs. Mary A. Stroud. It contained specimens from the Fox collection.

JONES, CHARLES H., East Orange, N.J. This was a general collection. He bequeathed it to Heidelberg University, of Tiffin, O., in 1919.

KEIM, J. DEB., Reading, Penn. In 1868 his heirs presented his collection to Lehigh University, of South Bethlehem, Penn. It was a local collection of the minerals of the Schuykill Valley. It numbered about 500 specimens.

KEMBLE, WILLIAM J. I., Newton, N.J. He made a large collection of the minerals of the Franklin region. The heirs of his widow retain most of the specimens.

KENDALL, THEODORE A., Reading, Penn. A general collection, rich in the minerals of Pennsylvania. It numbered about 1600 specimens. It was offered for sale by his heirs in 1920.

KIRK, ISAAC S., Fremont, Penn. A general collection of medium quality. It was bought by a dealer in 1910.

KUNZ, GEORGE F., New York City. He sold his first collection to the University of Minnesota, in December 1876. His second collection was purchased by the Rose Polytechnic Institute of Terre Haute, Ind., in 1879. It was a general collection containing 6000 specimens. He sold his third collection to Amherst College. It was a large collection. He sold his fourth collection to the New York State Museum at Albany, N.Y. It contained 6000 specimens. It was rich in the minerals found in the tunnels through Bergen Hill, and Union Hill, in New Jersey. He sold his fifth collection to the Field Museum of Chicago. It contained minerals and meteors, also 7000 books

and pamphlets on mining, metallurgy, mineralogy and precious stones. He sold his sixth collection to Thomas A. Edison for $8,000. It was a large general collection.

LANG, THOMAS, Franklin Furnace, N.J. He sold his collection about 1894, to a dealer who broke it up and scattered the specimens among his customers. It was devoted almost exclusively, to the minerals of the Franklin region.

LEA, ISAAC, Philadelphia, Penn. He bequeathed his collection to the National Museum, where it was received March 30, 1888. It was the largest and the finest collection of minerals ever given to this museum.

LEIDY, JOSEPH, Philadelphia, Penn. He sold some of his best specimens to dealers. The others were purchased from his heirs by the U.S. Government. The gems went to the National Museum—the minerals to the U.S. Geological Survey. All of the specimens are in the National Museum.

LEONARD, FREDERICK B., Lansingburgh, N.Y. His daughter, Mrs. Hugh L. Rose, bequeathed his collection to Yale College. It was deposited in the Peabody Museum. It was a general collection of high grade specimens.

LOSEY, SAMUEL R., Franklin Furnace, N.J. His collection consisted chiefly, of fine specimens of the minerals peculiar to the Franklin region. It was purchased in 1911 by Albert F. Holden, of Cleveland, O., for $2,365. It is now owned by Harvard University.

LOWE, LEONTINA A., Pasadena, Cal. She had a large general collection which contained many fine specimens. She purchased the J. Grier Ralston collection. In 1917 her collection was bought by a dealer who distributed it among his patrons.

LYCEUM OF NATURAL HISTORY OF NEW YORK. The collections of this society were stored in the basement of the University Medical College building in East 14th Street, New York City. On May 21st, 1866, the building and its contents were burned.

MACMARTIN, ARCHIBALD, New York City. This was a small general collection of very choice specimens. He bequeathed it to Princeton University.

MANCHESTER, JAMES G., New York City. This is a general collection of about 3000 specimens, the result of thirty years' labor. It is of high grade and includes many of the very finest specimens of the minerals found in the Erie Cut (1909) through Bergen Hill. About 1920 he presented it to the Public Library of Fall River, Mass., as a memorial to his wife.

MARKOE, FRANCIS, JR., Philadelphia, Penn. His collection was purchased by William S. Vaux. At one time it was the finest collection of minerals in America. It contained many of the best specimens from the Fox collection.

MARTIN, BENJAMIN N., Brooklyn, N.Y. He collected with his son, Prof. D. S. Martin, until his death in 1883.

MARTIN, DANIEL S., Brooklyn, N.Y. He continued to collect minerals, fossils and shells after the death of his father. He divided his collections between the Charleston (S.C.) Museum, Chicora College of Greenville, S.C., and the Brooklyn Museum. He also gave a fine suite of the minerals found in the trap rocks of New Jersey, to the Library, and to the High School of Bayonne, N.J.

MILLER, H.D., Plainville, Conn. He gave his collection to the Hartford (Conn.), Museum, in 1909, where it was beautifully installed in 1914. This is a collection of high class specimens which were gathered during a period of thirty years. It numbers about 4100 specimens, which represent about 400 species.

MITCHELL, SAMUEL L., New York City. His collection was given to the New York Lyceum of Natural History, by his widow. It was valued at $10,000. It was lost in 1866, in the fire that consumed the other collections of the Lyceum.

MOHR, CHARLES, Mobile, Ala. He gave his extensive collections of minerals and fossils to the University of Alabama, at Tuscaloosa.

MORRIS, _____. His collection was sold at auction in Philadelphia, in 1868. Many of the specimens were purchased for the Wagner Free Institute of Science, of Philadelphia. It contained some fine specimens from the copper mines of Lake Superior.

NEW YORK HISTORICAL SOCIETY, New York City. In 1817, this society undertook the collection of objects of natural history. Col. George Gibbs, chairman of the Mineralogical Committee, was particularly active in promoting the collection of minerals. This department became so large that, in 1829, it was decided by the Society to present its specimens to the New York Lyceum of Natural History.

PARNALL, WILLIAM E., Calumet, Mich. His collection contained about 500 specimens from the copper mines of Lake Superior. Many of them were of the finest quality. They were divided between his two sons.

PENNYPACKER, CHARLES H., West Chester, Conn. He sold his collection to Henry Garrett, of Willistown, Penn.

POHNDORF, A. P., Butte, Mont. He collected at Bisbee, Ariz., and at Butte. He had particularly fine copper minerals which he sold to a dealer in 1909.

PUMPELLY, RALPHAEL, Newport, R.I. His valuable collection was destroyed March 26th, 1919, when his summer home in Dublin, N.H., was burned. It was a general collection gathered by himself in many foreign countries.

QUARLES, CHARLES, Milwaukee, Wis. This was a general collection, strong in copper minerals of the Lake Superior region. It is now owned by the Milwaukee Museum.

RAKESTRAW, C. C., Tacony, Penn. His specimens were microscopic mounts. He sold them to a dealer in New York City.

RALSTON, J. GRIER, Norristown, Penn. Most of his collection was acquired by Mrs. Leontina A. Lowe,—once of Norristown—later of Pasadena, Cal.

RAND, THEODORE D., Philadelphia, Penn. This was a very large collection. Counting the minerals and the fossils it numbered more than 20,000 specimens. It was rich in the minerals found in or near Philadelphia. His daughter Mrs. Charles Stillwell Aldredge, of Radnor, Penn., presented it to Bryn Mawr Female College in 1904.

REILEY, DE WITT T., New Brunswick, N.J. His collection was sold at retail, by a dealer in New York City, in 1891. It was a small collection with some very choice specimens.

ROBARTS, J. O. D., Phoenixville, Penn. An old time general collection. It was poorly cared for, and was finally bought and scattered by a dealer in 1916.

ROEPPER, WILLIAM T., Bethlehem, Penn. He deposited his collection in the museum of Lehigh University. The University purchased it from his widow. It was a general collection of about 3000 specimens.

ROOT, OREN, Clinton, N.Y. His collection is in Hamilton College in Clinton.

ROSE, JOHN F., Oxford, Penn. His collection was sold to the Oxford High School.

ROTHE, WILLIAM G., Brooklyn, N.Y. A general collection, which was sold at retail in 1893, by a dealer in New York City. This was one of the best collections that have been broken up in this country.

ROTHWELL, RICHARD P., New York City. He gave away his best specimens—the others were sold by his executors. It was an economic collection.

SANSON, JOSEPH, Philadelphia, Penn. 1750–1820. About 1832 his widow donated his collection to Haverford College.

SCHERNIKOW, ERNEST, New York City. His collection was bought by a dealer who allowed Mr. C. S. Bement to make the first selection

and then sold the other specimens at retail. It contained many choice specimens.

SCHOENFELD, JOHN, Reading, Penn. This collection is in the Public Library and Museum in Reading. It is a large collection, rich in the minerals of eastern Pennsylvania.

SCHOONMAKER, WILLIAM D., Orange, N.J. He had a general collection of about 2000 specimens which he disposed of through a dealer.

SEEBOECK, W. C. E., Chicago, Ill. A large general collection—very rich in rare species. It was acquired by a dealer who scattered the specimens among his patrons.

SEYBERT, ADAM, Philadelphia, Penn. His collection was presented to the Academy of Natural Sciences, by his son, Henry Seybert, about 1825. It was a general collection of about 2000 specimens. It is kept intact, in its original cabinet, because of its historical interest.

SHAW, WILLIAM H., Chester, Penn. This was a collection of about 2000 specimens—half of which were local. Many were of fine quality. His son, Charles K. Shaw, presented them to the Academy of Natural Sciences, of Philadelphia.

SHEPARD, CHARLES U., Amherst, Mass. His first collection was purchased by Amherst College. It was burnt in 1880. His son, Dr. Charles U. Shepard, Jr., of Summerville, S.C., presented another of his father's collections to the college, to replace the one that was destroyed. He also bequeathed his father's working collection to the National Museum, in Washington, D.C. The last contained many type specimens.

SILLIMAN, BENJAMIN, New Haven, Conn. He put his specimens in the collection of Yale College.

SILLIMAN, BENJAMIN, JR., New Haven, Conn. He sold his collections to Cornell University.

SMITH, FRANCIS L., Brooklyn, N.Y. He sold his collection to William C. Paul. It was a fine collection of microscopic mounts.

SMITH, J. LAWRENCE, Louisville, Ky. His colleciton of meteorites was purchased by Harvard University in 1883.

SPANG, NORMAN, Pittsburgh, Penn. This collection was the result of great expense and of years of exertion. Its standards were of the highest rank, and its only rivals in America were the Vaux and the Bement collections. It is said that Mr. Bement paid $22,500 for the privilege of taking only such specimens as would not be duplicates in his own collection. The other specimens went to a dealer in New York City, who sold some at retail for $3,000, and then sold the remainder to the American Museum of Natural History for $8,000. When the museum acquired the Bement collection in 1900, many of the Spang specimens became duplicates, and were sold to a dealer, who scattered them.

SPENCER, J. SELDON, Tarrytown, N.Y. He broke up his collection and sold his minerals to collectors and dealers. It contained many choice and valuable specimens.

STANTON, FRANK MCMILLAN, New York City. This was a general collection—very rich in minerals from the copper mines of Lake Superior. He bequeathed it to his brother who, after making some additions, sold it to M. L. Morgenthau, of New York City, for—it is said—$4,000.

STEPHENSON, J. A. D., Statesville, N.C. He supplied collectors and dealers with the rare minerals of Alexander Co., N.C. He discovered Hiddenite and Emeralds, also the Quartz crystals which were studied by Von Rath. It is said that the bulk of his collection was acquired by the State Museum of North Carolina.

STONE, CHARLES, New York City. He made a large and general collection of a practical educational character, which he used in teaching his students in the Cooper Union. The collection was purchased from his widow by the trustees of the Cooper Union.

SWIFT, EDWARD, Easton, Penn. His collections of minerals and Indian relics are possessed by the Northampton County (Penn.) Historical Society.

SWIFT, JOSEPH K., Easton, Penn. His collection went to Lafayette College of Easton, and was lost in the fire that burned Pardee Hall, in 1879.

TALSON, JOSEPH F., Jersey City, N.J. His collection was presented to the American Museum of Natural History.

TESCHERMACHER, J.E., Boston, Mass. This collection was in existence in 1854. It is said that John C. Trautwine, of Philadelphia, bought much of it. It is thought that some of the specimens were acquired by The Boston Society of Natural History.

TRAUTWINE, JOHN C., Philadelphia, Penn. A large collection of good specimens. In 1883 it was sold by his heirs to a dealer in Philadelphia, who scattered it.

TROOST, GERHARD, Louisville, Ky. This collection embraced about 14,000 mineralogical and more than 5,000 geological specimens. It was sold by his heirs for $20,000. It was acquired by the Louisville, Public Library. [Ed. note: see *Mineralogical Record*, **15**, 141–147.]

TYSON, SAMUEL, King of Prussia, Penn. It was a general collection containing some very fine specimens. Mr. Bement selected the best of them,—the others were inherited by his son who sold them to a dealer in 1909.

UNDERHILL, EDWARD B., Cortland-on-Hudson, N.Y. He gave his collection to Amherst College.

URBAN, WILLIAM J., Brooklyn, N.Y. He presented his collection to Colgate University, at Hamilton, N.Y.

VAN SANTVOORD, A., New York City (?). His collection was not a large one but it contained some choice specimens. It was sold at retail by a dealer in New York City, in December, 1889.

VANUXEM, LARDER, Philadelphia and Bristol, Penn. His cabinet of minerals and fossils was claimed to be the largest, finest and most systematically arranged private collection in the United States. After his death (1848) it became the property of the Masonic College at Clarksville, Tenn.

VAUX, WILLIAM S., Philadelphia, Penn. It was a general collection of the finest specimens that could be obtained. It absorbed the Markoe collection many years ago. For a long time it was the finest collection of minerals in the United States, and it was only surpassed, later, by the Bement collection. He bequeathed it to the Academy of Natural Sciences, of Philadelphia, reserving however, twenty-five specimens for his family. These are in the possession of George Vaux, Jr., of Bryn Mawr, Penn. Mr. Vaux provided an endowment fund, so that his collection continues to be active.

VEILE, EGBERT L., New York City. This was a general collection of about 600 specimens. It went to his son.

WAGNER, WILLIAM, Philadelphia, Penn. He founded the Wagner Free Institute of Science, in Philadelphia, and put his collection of minerals in it. He was one of the earliest of the American collectors.

WARD, HENRY A., Rochester, N.Y. The collection which he exhibited at the New Orleans Exposition of 1884, was purchased by the Tulane University of that city. The collection he exhibited at the Chicago Exposition of 1893, was bought by the Chicago University. The Ward-Coonley collection of meteors was purchased by the Field Museum, of Chicago.

WETHERILL, J. P., Philadelphia, Penn. For years his collection was stored in a house in Philadelphia. Many of the specimens were stolen and sold to a dealer who sold them at retail. It contained many specimens from the lead and zinc mines of Pennsylvania.

WHEATLEY, CHARLES M., Phoenixville, Penn. This was a special or local collection. It contained the very finest of the lead minerals

(continued on p. 39)

Clarence S. Bement

The Consummate Collector

Joseph J. Peters and **Charles L. Pearson**
Department of Mineral Sciences
American Museum of Natural History
Central Park West at 79th Street
New York, New York 10024

In 1900, J. Pierpont Morgan presented to the American Museum of Natural History the mineral collection of Clarence Sweet Bement. Morgan, who was a trustee of the Museum, paid $100,000 for this extraordinary collection of 12,300 specimens which included 769 species and 500 meteorites.

Introduction

Morris K. Jesup, President of the American Museum of Natural History, wrote, "Through the acquisition of the Bement collection our mineral department at once rivals the greatest museums of the world" (Jesup, 1901). What made this collection so notable was the wealth of splendid European minerals as well as excellent specimens from the newly emerging American localities, all in far above average quality.

This astounding collection was assembled between the end of the Civil War and the beginning of the 20th century, a time many refer to as the "Golden Age" of American mineral collecting. Philadelphia and the surrounding region was a "hotbed" of mineral collecting activities and studies.

Systematic mineral studies in the United States began at the end of the 18th century. Interest in the natural sciences at that time centered in Philadelphia, the leading American city in scientific thinking. The Academy of Natural Sciences, founded in 1812, provided a forum for the observations of pioneering American mineralogists, whose ranks included medical doctors, lawyers and men of wealth, as well as those with formal training in mineralogy. The American Philosophical Society, the Chemical Society and the Linnaen Society, all founded before 1812, also contributed to the growth of mineralogy in Philadelphia (see, for example, Green and Burke, 1978; and Anné, 1978).

By the early 19th century, Pennsylvania "became the center of several world-famous collecting localities: the lead-zinc mines in the Phoenixville area, the chrome mines in southwestern Lancaster County, the corundum mines at Unionville, Chester County, the iron mines at French Creek, and the serpentine from Brinton's quarry south of West Chester" (Anné, 1978).

New mining districts in the West further stimulated interest in mineral collecting (Palache, 1951). Active mining at Bisbee, Arizona, one of the most famous and prolific of Western American mineral localities, began in late 1877 (Graeme, 1981). Vast quantities of superbly crystallized azurite and malachite were produced by the famous Copper Queen mine and brought East by such mineral dealers as Albert E. Foote.[1] Thus began the Golden Age of American Mineral Collecting.

[1]A. E. Foote, M.D., a former professor of chemistry and mineralogy at the University of Michigan, settled in Philadelphia after successfully selling minerals at the Centennial Exposition of 1876 (Toothaker, 1951). Dr. Foote traveled west every winter to relieve a tubercular condition and to collect minerals for his company. His modus operandi was to contact the local physician, introduce himself as a fellow medico interested in minerals, and ask for the names and addresses of local miners. The Joplin, Missouri, mining district was a favorite stopover on the trek west. The company "could usually be sure of a dozen or

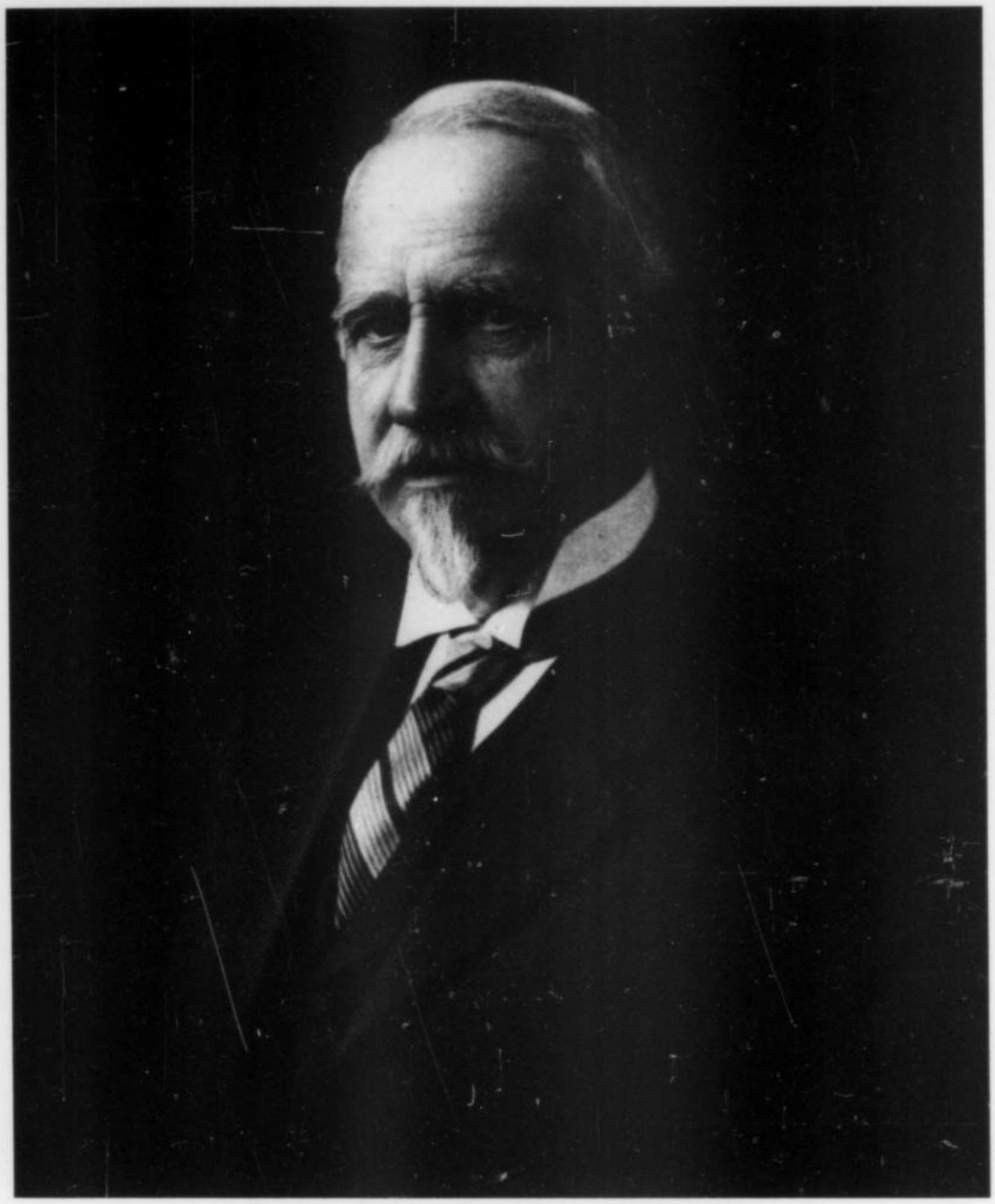

Figure 1. **Clarence Sweet Bement (1843–1923).**
Photo courtesy of Lawrence H. Conklin.

Bement's Early Life

Many notable American collections were assembled during the late 19th century; the finest in overall quality was that of Clarence Sweet Bement. Bement was born in Mishewaka, Indiana, on April 11, 1843, the eldest of five surviving children born to William Barnes and Emily Russell Bement. The family was descended from John Bement, who settled in Massachusetts in 1635. Francis Cooke, a Mayflower passenger, was another ancestor (Rosenbach, 1929).

William Barnes Bement, Clarence's father, had a natural mechanical aptitude. He began his career in 1837 apprenticed to a manufacturer of woolen and cotton machinery, and for a number of years was engaged in the New England textile industry (Anonymous, 1875). Early in his career he saw the rising need for machine tools and, with his experience and innovative ideas, Bement moved to Philadelphia in 1851. There he formed a firm in partnership with E. D. Marshall, a foundryman, and G. A. Colby, a machinist. The firm, known as the "Industrial Works," manufactured machine tools for the railroad and shipbuilding industries (Roe, 1916). Expanding rapidly, they occupied several square blocks in northwest Philadelphia. At one time the "Industrial Works" was the largest establishment of its kind in the United States, employing up to 1000 workers. Its reputation for craftsmanship and reliability became known worldwide (Anonymous, 1891).

The period between Clarence Bement's birth and 1870, when he became a partner in his father's firm, remains the most obscure of his life. A granddaughter, Marion Bement LeGoff (personal communication), recalls a family legend that he was a drummer boy during the Civil War. What might lend credence to this story is the fact that Mr. James Dougherty, a partner of William Bement in the "Industrial Works," was one of the first to respond to Pennsylvania Governor Curtin's call for troops when General Lee invaded Pennsylvania. He raised a company from among the employees at the "Industrial Works" (Anonymous, 1891). However, Bement was 18 at the start of the Civil War, making him too old to be a drummer boy. According to Marion LeGoff, Clarence did not attend a university, but may have been early employed in the family business. It is known that by December, 1871, Bement married and settled into his business career with collecting as an avocation (Russell Bement, personal communication).

(footnote 1 continued)
twenty boxes from Joplin if Dr. Foote stayed there ten days" (Toothaker, 1951). Joplin calcites and Arizona azurites and malachites were eagerly sought by collectors because of their great beauty and degree of crystal perfection. These glorious American minerals could rightly take their place in collectors' cabinets alongside their European counterparts (Palache, 1951).

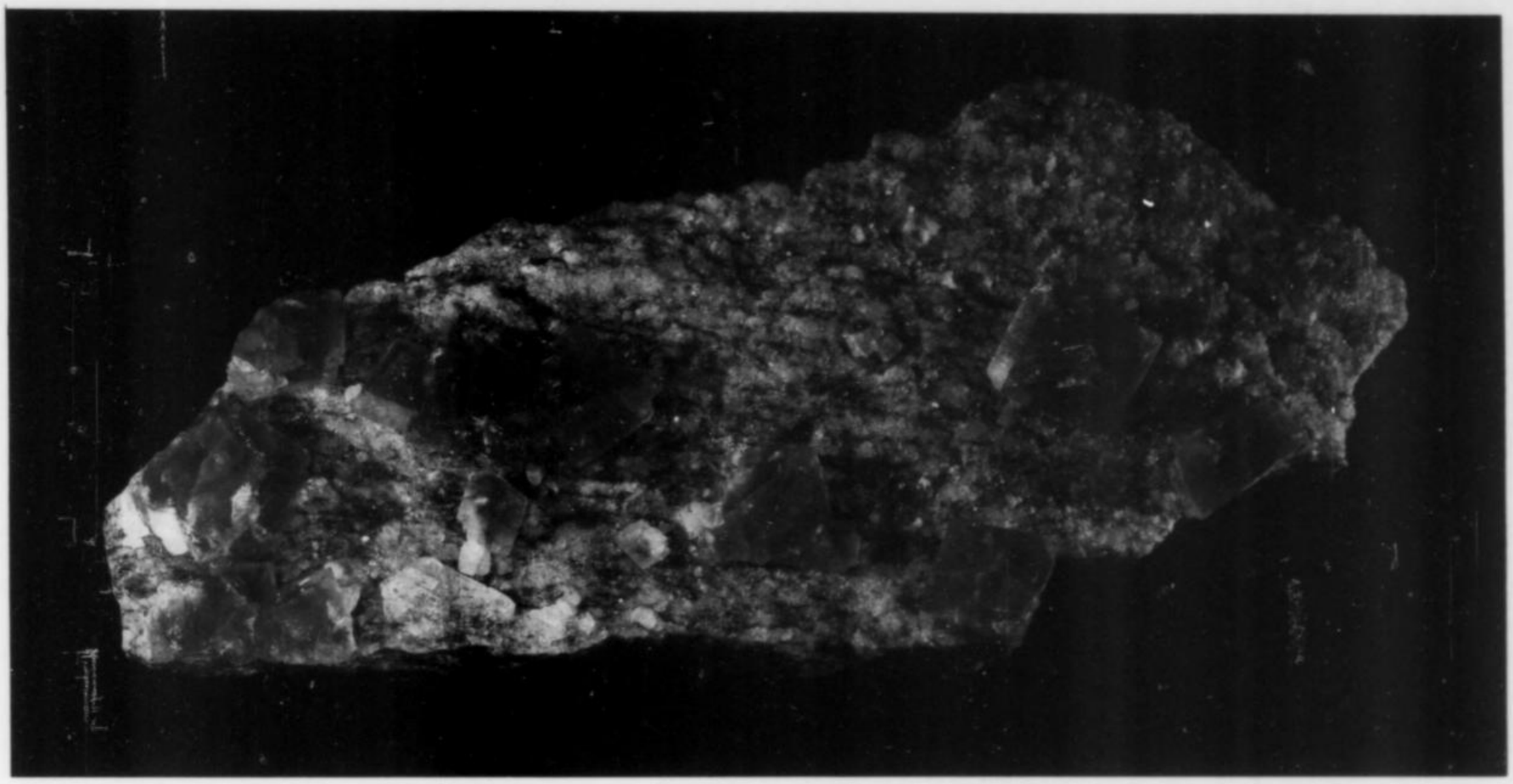

Figure 2. **Bement purchased a group of pink fluorite specimens from Göschenen, Switzerland, "not excelled anywhere." The finest of these, with crystals to 1.5 cm, is shown here; AMNH 2761. AMNH photo by Kerry Perkins and Jackie Beckett.**

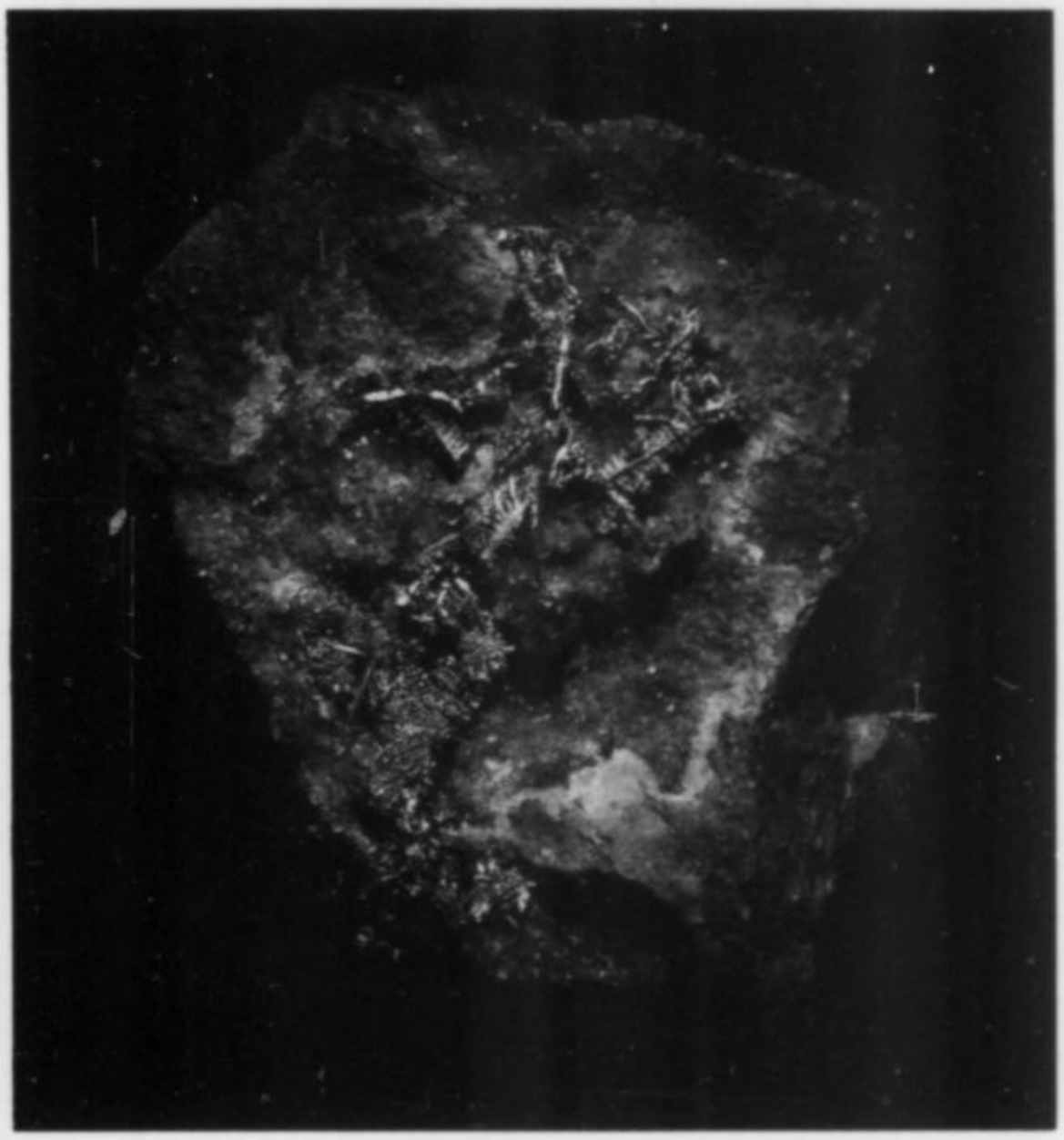

Figure 3. **Baron Braun of Vienna presented this Transylvanian gold specimen, 6.3 cm, to Bement in 1876; AMNH 219. AMNH photo by Kerry Perkins and Jackie Beckett.**

Figure 4. **A well-formed octahedron of fluorite, 25 cm on an edge, from Westmoreland, New Hampshire; AMNH 2680. AMNH photo by Kerry Perkins and Jackie Beckett.**

Figure 5. **Clarence Bement as he appeared when he started collecting minerals (circa 1866). Photo courtesy of Russell Bement, Jr.**

Wide-ranging Collecting Interests

As a collector Bement had an extensive range of interests. His collection of American coins and Continental paper money, which was sold at auction in 1916, brought $12,000 (see Chapman, 1916). One of the finest pieces in this collection was the Indian Peace medal that was presented to the chief of the Miami tribe by President George Washington in 1793. Another collection of ancient Greek and Roman coins was sold at auction in Lausanne, Switzerland, in January of 1924 by his estate (Rosenbach, 1929). As a young girl, Marion LeGoff remembers watching her grandfather removing red velvet-lined drawers from his coin cabinet and examining the shiny gold and silver coins, "a pretty sight," she said (personal communication).

In the late 1880's, Bement developed an interest in rare books and first editions. He spent many afternoons at the antiquarian bookstore of Moses Polock in Philadelphia, where Polock's nephew, the noted bookman, Dr. A. S. W. Rosenbach, related that . . . "To hear Clarence Bement try to cajole the old man into letting him buy a book was a revelation, for here was a study of the irrational bookish desire to buy and the equally irrational desire to keep" (Wolf and Fleming, 1960). In 1903, Moses Polock sold his business to Rosenbach, at which time Bement became a silent partner. He did not put up any money, but offered Rosenbach selected volumes from his collection on consignment. Many of his volumes eventually found their way into J. P. Morgan's library. A notable one was the great "He" issue of the King James Bible of 1611. Other Bement volumes were purchased by George C. Thomas, a former partner in the "Industrial Works," and Harry Elkins Wiedner, whose library was obtained by Harvard University (Wolf and Fleming, 1960). In 1913, Bement sold the balance of his collection to Rosenbach for $15,000.

Bement also assembled a major collection of Franklin and Washington prints and engravings. These were purchased by Dr. Thomas A. Emmet and later acquired by the New York Public Library (Kunz, 1886).

Mineral Collecting

Minerals were Bement's abiding passion. He always desired to own the very best specimens, and to this end he was eminently successful. Frederick A. Canfield (1923), a contemporary whose collection is now in the U.S. National Museum, considered Bement's collection "the finest ever assembled by a private individual." When Harvard mineralogy professor Charles Palache saw the collection for the first time in 1898 he wrote, "All day I have feasted my eyes on minerals such as I scarcely dreamed existed" (Palache, 1951).

Thirty-five years went into bringing together this remarkable collection. Bement showed exquisite taste and sound judgment when he bought specimens. He once wrote to his close friend, Dr. Joseph Leidy (a noted paleontologist, mineral collector and President of the Academy of Natural Sciences of Philadelphia), that "quality is, of course, the first consideration. Size the next" (Bement, 1882b). Price was important, but never a deterrent if the specimen was one he desired.

Collecting Trips Abroad

Bement bought most of his minerals from leading dealers. On his trips to England, Bryce M. Wright and S. Henson of London were his principal sources. On the Continent, Bement patronized Emile Bertrand, Paris; Dr. A. Krantz and B. Strutz, Bonn; and Böhm & Wiedeman, Munich. In America he bought extensively from Dr. A. E. Foote of A. E. Foote & Co. and Charles L. English of English & Co., Philadelphia; Professor Henry A. Ward of Ward & Howell, Rochester; Lazard Cahn and Dr. George F. Kunz, New York City. Labels with his minerals attest to the fact that there was hardly a dealer in Europe or America with whom he was not acquainted. Ernest Schernikow, a prominent mineral dealer and member of the New York Mineralogical Club, recalls that "during his trip to Europe last year, almost all the curators of the leading mineralogical museum collections in Switzerland, Austria, Germany and England had a kind word for Mr. Bement, whom they remembered with pleasure" (Kunz, 1923?).

On the Continent, Bement's agent was the Swiss mineral dealer Friedrich Herrmann Hoseus. Hoseus served as guide, translator and advisor on many mineral buying trips in Switzerland, Germany and Eastern Europe. He had great respect for Bement, and this was demonstrated in 1884, when he presented a slice of the Hammond (Wisconsin) meteorite to Bement. Etched on its polished surface were the words: "To Clarence S. Bement, Esq. Respectfully presented, F.

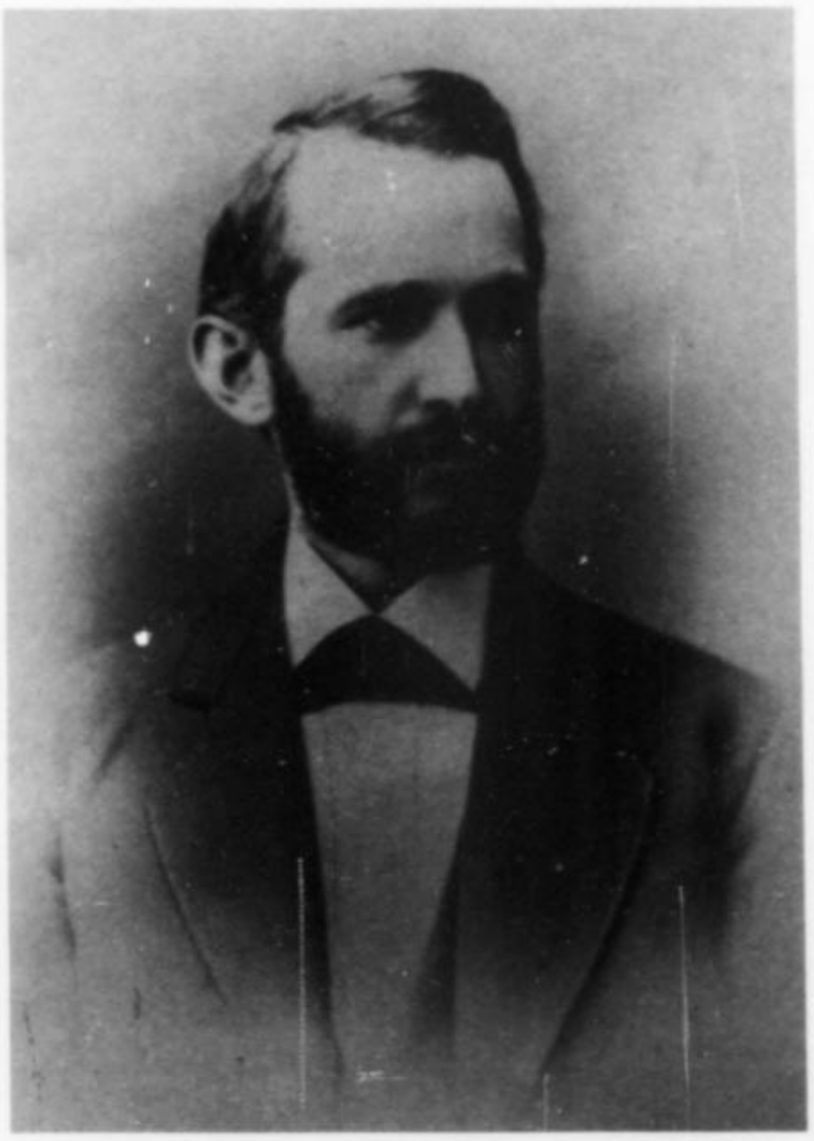

Figure 6. **Clarence Bement in the early 1870's shortly after his marriage and entrance into the family business. Photo courtesy of Russell Bement, Jr.**

Hoseus." The meteorite can be seen today in the Museum's Arthur Ross Hall of Meteorites.

Bement wrote often from Europe to Leidy about his mineral buying excursions. From Dissentis, Switzerland (1875), he wrote, "Mineralogically I have been successful . . . several quartzes of fine smoky color and good modifications, some twisted, have fallen into my hands." Continuing, he laments, "In Basel I was terribly homesick, would have sold my collection to the highest bidder and did not care much whether I was on land or in the river." In a humorous postscript, he added "I bought about $850 worth from H! (I am truly a poor man now)."

From Paris (1882a) he informed Leidy that he "whiled away a couple of weeks in London." He did not "pick up many good specimens. They are so scarce. Among the few bagged, I may name a phosgenite from Matlock, an enormous rubellite with flat top from Russia, from Wright, an enormous mass of matlockite." He mentions other minerals that he bought in Paris from the dealer Pisani. He was not seeking bargains, and prices sometimes were high. "A clear beryl about two and a half inches long . . . is dear at 75 francs. Still, I may buy it." Or, Wright has a proustite from Chile, "excessively dear at 150 £." Bement told Leidy that Hoseus suggested a quick trip to Germany "to avoid competition, or rather the loss of opportunities from the breaking up of the University sessions which leaves the professors and students free to buy the fine things." Closing on a personal note, he wrote "I am quite anxious about the health of our baby, but for that I could feel quite comfortable during my wanderings. The little scamp is very dear to me, and very essential to my happiness, so I sincerely hope that I may find her well and hearty when I return." His warm feelings for Leidy are evident when he regrets the passing of their mutual friend, William S. Vaux, a wealthy Philadelphia collector . . . "Now that Mr. Vaux is gone, I shall depend upon your companionship more than ever." Except for these personal asides, Bement wrote mainly about mineral purchases.

Several weeks later Bement (1882b) wrote Leidy from Vienna, "I have made a rapid and somewhat tiresome, though interesting journey with Hoseus through Heidelberg, Mainz, Cologne, Hanover, Gottingen, Berlin, Leipzig, Dresden, Prague, Brunn, and on Friday . . . we go to Pesth." This would be an arduous trip even with today's transportation. He continued, "But for Hoseus I do not know how I could have managed either to enjoy my trip or to obtain the minerals that have been bought thus far." This letter reads like a mineral dealer's catalog! Many specimens were "bagged." This trip was made at the peak of his mineral collecting activities. There were other trips, but none as rewarding. He commented, "You will be amused at my greediness in buying so many phosgenites and anglesites . . . certainly I have seen no better ones in any museum."

From Basel, Bement (1882c) wrote that "Foote writes something about a 9 in. zircon sold sometime since, but thinks I would not have taken it. I wonder what it was like?" An expert dealer like Foote would know if the Bement collection lacked a large zircon or whether this type of specimen would appeal to him. Bement's curiosity about the zircon illustrates his intense desire to own *every* important mineral specimen. This letter to Leidy also mentioned the evaluation of the William S. Vaux collection . . . "I wonder that Mr. V's collection footed [was sold for] only $21,000 even at a moderate valuation! Possibly we have overestimated its value, or perhaps my things have cost more than they ought. Hoseus assures me that I could not replace my cabinet for what it has cost. Good minerals are very high in Europe." Bement's concern is common to all collectors. He "expended more than 1500 francs for minerals, including a series of pink fluorites not excelled anywhere." One of the fluorites is pictured. This specimen was certainly worth every franc!

In the Summer of 1881, Bement was in Andermatt, Switzerland, where he wrote Leidy, "It is beautifully clear today and a brisk breeze is blowing up the valley from the Oberfals, 6500 ft. above the sea, consequently it is deliciously cool. We are resting from a long trip to Dissentis and back which we made yesterday—a distance of nearly 50 miles." The indefatigable Bement, accompanied by Hoseus, left Andermatt the following day for a journey down the Rhone Valley in search of Chamonix fluorite and a new scheelite occurrence near Meyringen. He wrote "Near Meyringen we found, by the mearest [sic] accident, a villager who had seen more of the scheelites and some curious quartzes. Two of the scheelites were fine and will go into my collection." The largest and finest scheelite recovered, nearly 4 inches long, "is in the Bern museum in a glass case, but they have bored a hole partly through it to receive a pin to hold it up! How any sane man can do such a thing is beyond my comprehension." Specimens were purchased at a rapid pace. Bement remarked, "Though I do not remember many of the specimens, I ran up a bill with Hoseus of between $500 and $600." Among the minerals obtained were "three specimens of smoky quartz which may help me or they may not, it is so difficult at this distance to recall what one has." Bement's failure to recall what he had just purchased or what his collection contained, is a common phase of collecting. The urge to fill every gap in a collection is eventually felt by collectors of minerals, or any other collectable, for that matter.

On his way to the Continent, Bement stopped in London, to view the stock of dealers Bryce M. Wright, James R. Gregory and S. Henson, and to examine the public exhibition of minerals at the British Museum. Concerning the British Museum, Bement (1881) wrote, "By the way, the B.M. have only £600 to expend each year for minerals and consequently, are always behind in their payments. The collection there, though finer than when I last saw it, did not impress me so strongly, probably because my minerals have improved so much in the interim."

According to Ernest Schernikow, Bement "looks upon it as an exaggeration to speak of him as the foremost collector of this hemisphere, and he believes that had not his declining years been marred by failing eyesight, he would have brought together a collection even greater than that of the British Museum" (Kunz, 1923?). The British Museum's collection was (and remains) the yardstick by which others are measured. Bement's friendly rivalry did not prevent him from donating to the Museum a fine group of rhodochrosite crystals from Colorado (Spencer, 1922).

Regarding mineral purchases in London, Bement (1881) complained, "My mineralogical conquests have not been great." Nevertheless, he was excited by . . .

> A remarkable lot of calcite twins from Cumberland. These are called butterfly twins and are extremely beautiful, some being colorless and almost transparent, while many of them are 4 to 5 inches across. In some cases, one of the individuals projects beyond the other, showing both terminations of that crystal. In addition to these, some simple crystals were found 2 to 4 inches long, almost like iceland spar in quality. But for the rather low rhombohedral terminations one would at first sight mistake them for quartzes they are so pellucid. I confess to a weakness, which might almost be called pardonable, in selecting a suite of these beautiful crystals, my series numbering not less than thirty, counting groups and single xls.

Bement also bought . . .

> two groups of celestite from Henson which will make your mouth water. Mr. Butler was the source of about a half a dozen Frizington barites, one being . . . a most remarkable as well as interesting grouping of crystals somewhat as shown by sketch. It is the only one of its kind I ever saw and would have gone to the B.M. if I had not rather insisted in a mild way that he ought to include it in my lot, as I had bought so much.[2]

[2]The authors have been unable to locate this specimen in the AMNH collection.

Figure 7. **Cumberland, England, calcites: The "butterfly" twin at right, 7.8 cm, was purchased in 1888 in London; AMNH 6462. The other two, 8.1 and 11.5 cm, were purchased from George L. English in 1891; AMNH 6476 and 6451. AMNH photo by Jackie Beckett and Kerry Perkins.**

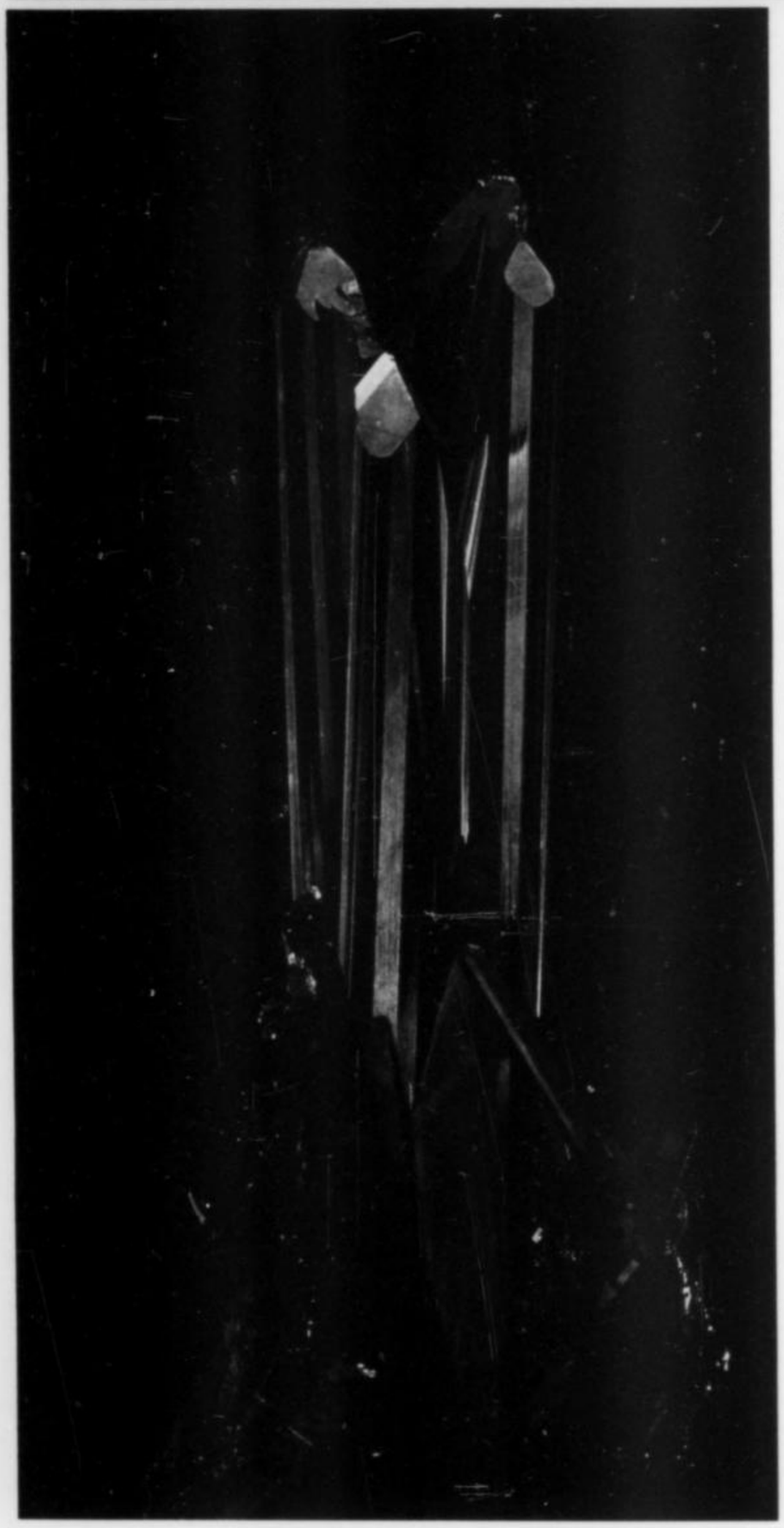

Figure 8. **Stibnite crystal group, 26.2 cm, from the Ichinokawa mine, Iyo, Japan; AMNH 645. AMNH photo by Arthur Singer.**

Acquisitions Reach Their Peak

Early in the 1870's Bement had assembled a superior collection and by the mid-1880's his collecting activities reached their zenith. Minerals were purchased at a furious pace. Entire collections were drawn into a mineralogical treasure-house, located in his home on Spring Garden Street, Philadelphia. On October 3, 1890, he wrote to Tiffany & Company Vice President George Kunz that he could accommodate no more than eight people at one time viewing his collection for fear their weight together with the mineral cabinets would be more than the floors could bear (Bement, 1890).

It was a common practice for dealers to send to their serious collectors "boxes" or "lots" of minerals on a consignment basis. When Dr. Foote sent minerals from the field, he instructed assistant Charles Toothaker "which boxes were to be opened first and gave directions to offer certain specimens to Bement, others to Vaux" (Toothaker, 1951). Generally these selections would be sent to the homes of Bement, William Vaux, George Vaux, Sr. and Dr. Leidy. These gentlemen would then gather together to examine the minerals and make their selection. It was generally understood that Bement would have first choice. George Vaux, Jr. recalled seeing Mr. Bement at his father's home examining such consignments (Robert G. Middleton, personal communication). Frequently, shipments sent to Bement didn't meet his high standards. He remarked to Kunz in 1884 that "Damon's things came last week—no good sent all back."

A year later (1885f) he wrote Kunz that "I am surprised that Dr. Hintze should send such trash . . . he ought to know my collection better."[3] Bement reproached Kunz for jacking up his prices. Referring to an azurite he writes, "If my information is correct that you only paid $15 for it you are asking rather more profit than is usual. Mr. Spang thinks the prices excessively high. The box goes back today."

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[3]In 1885 Dr. Carl Hintze (1851–1916) was employed by Dr. F. Krantz's geological supply house. After leaving Krantz he took a post as Professor of Mineralogy and Petrology at the University of Breslau, and in 1889 began his famous series of volumes entitled *Handbuch der Mineralogie*.

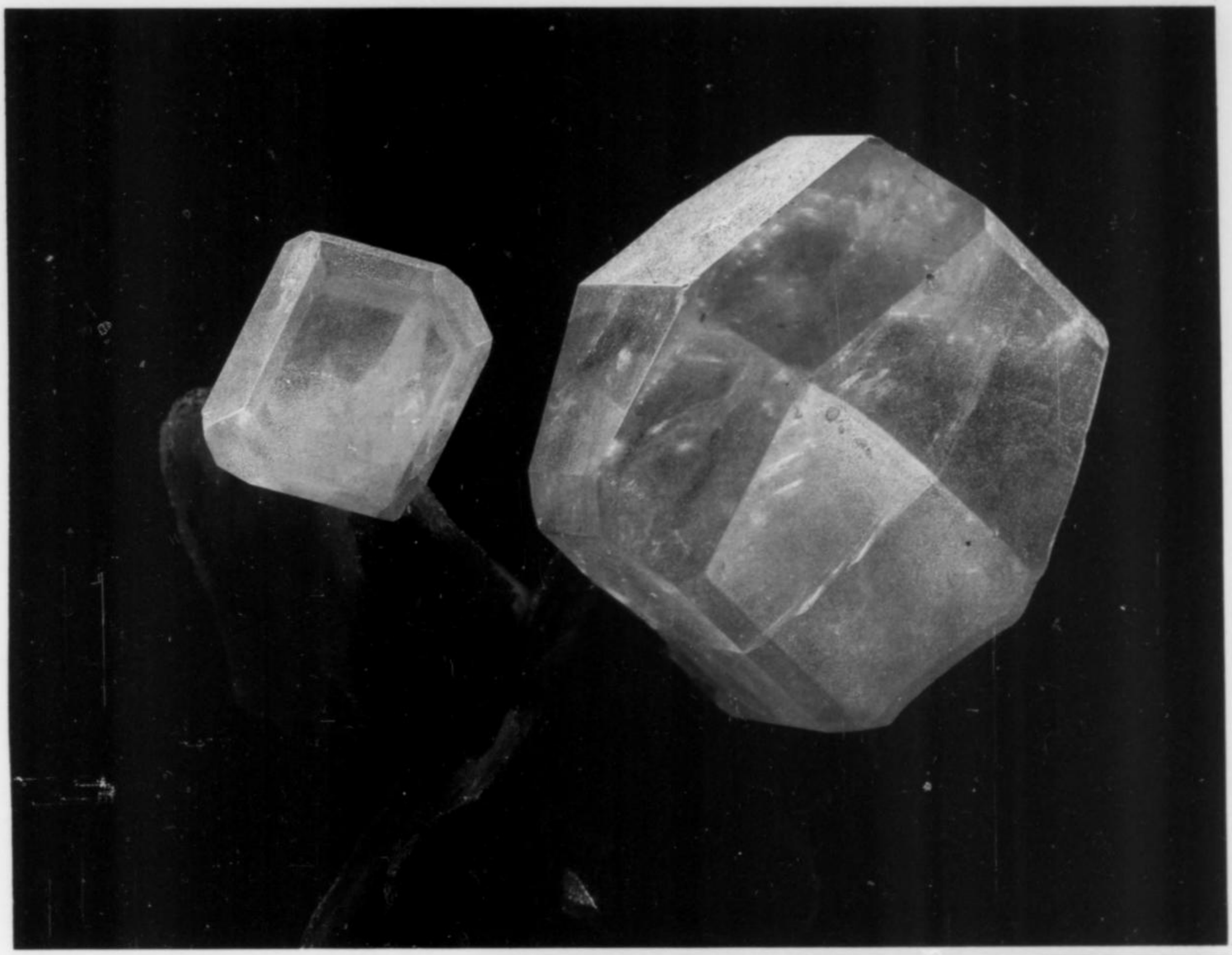

Figure 9. **One of Bement's more notable specimens is this matrix sulfur group from Girgenti (Cianciana), Sicily. The large crystal measures 3 cm; AMNH 93. AMNH photo by Arthur Singer.**

Figure 10. **A radiating group of erythrite crystals in a limonite cavity, 10 cm, from Schneeberg, Saxony, East Germany. Bement purchased this specimen in 1892 from *K. S. Mineralien* of Freiberg; AMNH 15502.**

Bement didn't normally quibble about prices, and ordinary collectors complained that he overpaid for specimens. In the November, 1901, issue of the *Mineral Collector,* contributor Charles H. Pennypacker commented on this subject:

> People asked me how it was that all the fine things went to the Bement collection. I would reply: That's an easy one! You belong to the skinflint fraternity. You are always afraid that you will pay too much for a mineral, and when you find out that some other collector has secured a better specimen than yours at a less price than you paid, you mourn as one without hope. None of these traits exist in Mr. Bement.

Researches

The scientific value of the Bement collection should not be overlooked. Because of the size and perfection of his crystals, the breadth of his cabinet, and his generous nature, noted mineralogists of the day often sought to examine his specimens. In a letter from Professor E. S. Dana to Bement dated July 26, 1885, Dana requested that Bement send him a few crystals of New Mexico descloizite for a study to be conducted by Professor DesCloizeaux in Paris (Dana, 1885). DesCloizeaux was then involved in determining whether descloizite crystallized in the orthorhombic or the monoclinic system.

In June of 1886 Professor Dana thanked Bement for the loan of 26 crystals of brookite from Magnet Cove, Arkansas. Dana exclaimed: "The brookites are fine! Your collection contained hardly any duplicates, and I admire the discernment with which you have brought it together." He concluded: "I will also work up the other material you kindly loaned me, and so make way for the coppers, and if you approve, for the calcites too" (Dana, 1886a). Dana did "make way for the coppers"; he published "On the crystallization of copper" (*American Journal of Science,* vol. XXXII, Dec. 1886, p. 413–429).

Bement was proud that his collection was frequently used by mineralogists. In a letter to Harvard Professor J. E. Wolff dated June 20, 1896, he wrote: "My minerals have been referred to more or less incidentally in many original papers, and some of Dana's types in his new edition are from my crystals" (Bement, 1896b).

In 1887, Dr. George Koenig of the University of Pennsylvania described a new mineral from Franklin, New Jersey, and named it *bementite* ($Mn_8Si_6O_{15}(OH)_{10}$), in recognition of Bement's contributions to mineralogy. Recent study of "bementite" from the Olympic Mountains, Washington, and from Fallota, Grisons, Switzerland (Guggenheim *et al.,* 1980), have identified this material as a manganese-rich caryopilite. Tan, acicular or brush-like "bementite" overgrowths on pink rhodonite from Franklin, New Jersey, are johannsenite (Dr. Pete J. Dunn, personal communication, 1988). Further research is needed to determine whether bementite should be discredited as a species.

Cataloging and Coding

Bement recorded his purchases in catalog books. Five catalog books accompanied the collection when it was acquired by the American Museum. Unfortunately, these important documents have been lost. The price he paid for a specimen was recorded in code on the back of the original label. His code was the ten letter word mineralogy, the letter X was his decimal point. If X was the first letter, the specimen cost under a dollar, as in XGY ($0.90). The double-letter YX equalled .00 (no cents), as the GYX ($9.00). This rather simple code may have stumped the occasional visitor, but not the experienced collector. Several years ago the prominent New York City mineral dealer Lawrence H. Conklin deciphered Bement's code, and informed us of his discovery. The German collector Carl Bosch, Sr., whose cabinet was acquired by the Smithsonian, used the German mineral name *ambylgonit* (ambylgonite) for his personal code (Roe, 1978).

Acquisitions Decrease

Bement was cautious when commenting on a rival's collection. Concerning the Canfield collection, now housed in the Smithsonian, Bement (1885e) wrote Kunz: "Had the great pleasure of seeing Mr. Canfield's minerals which are much finer than I imagined, notwithstanding all the glowing descriptions I had of them."

In another 1885 letter to Kunz, Bement (1885c) mentioned that "The sources of supply for me are gradually narrowing down and it is only by going through cabinets that I can hope to make any notable additions." The situation continued to worsen. In 1897 he wrote, "Minerals come to me very slowly now, partly because I am continually elevating my standards and partly because most of the dealers advertise their wares to be on exhibition on a certain day and hour, expecting me to scramble with the others for the spoils, which I *will not do*" (Bement, 1897b).

In 1884, Professor Gerhard vom Rath, of Bonn University, traveled to Philadelphia, drawn by the irresistible pull of Clarence Bement's mineral collection. An article entitled *The Bement Collection of Minerals* was translated into English in the January, 1886, issue of the *Jeweler's Circular*. Vom Rath wrote, "Inspired by an enthusiasm for science, and aided by a fine mineralogical eye, Mr. Bement, after searching far and wide, has succeeded in bringing together a collection of about 9,000 choice specimens. Without seeing this (undoubtedly the most remarkable private collection in the world), I should have had but a faint idea of the beauty of American minerals."

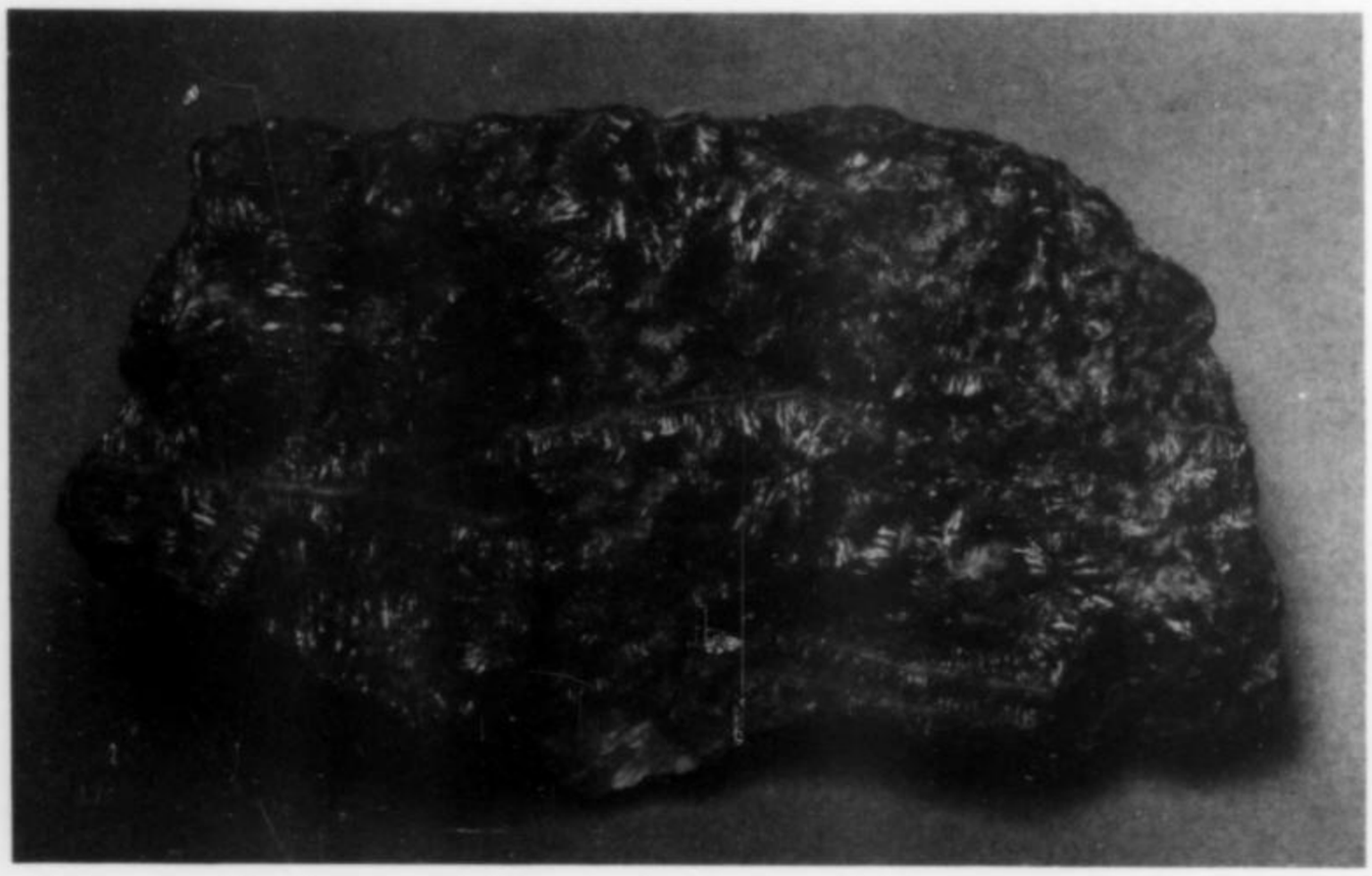

Figure 11. **Tan-colored bementite, 9 cm, from the Trotter mine, Franklin Furnace, New Jersey; AMNH 14120. George Koenig described this species in 1887, naming it in recognition of Bement's contribution to mineralogy. AMNH photo by Kerry Perkins and Jackie Beckett.**

Highgrading Collections

Bement's usual method for increasing both the quality and quantity of his collection was to "highgrade" the collections of others. Vom Rath (1884) wrote, "About ten years ago there were about a dozen good mineralogical cabinets in this country, some of the owners of which gave Mr. Bement the privilege of choosing what he wished."

In Kunz's introduction to the English translation, he wrote:

> Prof. vom Rath mentions 9,000 specimens; the collection now numbers over 10,500, 1,500 specimens having been added since the writing of the article. This number was principally swelled through the addition of selections from several well known collections, one of them a well known collection of Franklin minerals [Thomas Lang], another containing a number of choice things that have recently been found and described.

Other collections highgraded were those of S. C. H. Bailey, Norman Spang, Joseph Wilcox, Joseph Leidy, George Kunz, William E. Hidden and Baron Braun of Vienna.

The most important collection Bement highgraded was that of Norman Spang. Spang was a wealthy steel manufacturer of Etna, Pennsylvania. His collection, started by his father Charles during the 1830's, was considered one of America's finest private collections. Bement did not attempt to purchase the entire collection. The price would have been too steep and it contained specimens duplicated in his own collection. About 1882, true to his methods, Bement paid Spang $22,500 for "the privilege of taking only such specimens as would not be duplicates in his own collection" (Canfield, 1923). Eight years later Bement (1889) wrote Leidy, "When I see you I will give an account of Spang's Collection." Spang invited Bement for a "second helping" before he sold the balance of his collection to George L. English & Co., who, in turn, sold $3,000 worth at wholesale, the remainder going to the American Museum of Natural History for $8,000 in 1890. Dividing up the Spang collection in this fashion proved advantageous for Spang, Bement and English, but less so for the museum, which probably paid too much for its share. Ironically, "When the Museum acquired the Bement collection in 1900, many of the Spang specimens became duplicates, and were sold to a dealer [probably George L. English] who scattered them" (Canfield, 1923).

Meteorites

Bement's interest in meteorites was an up and down affair. He started collecting in the early 1880's. Many of his meteorites were purchased or exchanged from Ward & Howell or Kunz. On June 5, 1885, he wrote Kunz: "The craze on this subject has assumed such an intensity that I feel very much like abandoning the field, for I don't see so much value in specimens so nearly alike and lacking crystallization, which is the main interest to me in most minerals." Nevertheless, Bement was interested enough to privately print catalogs of his collection which by 1897 enumerated 413 falls and finds (Bement, 1897a). He expressed his feelings about meteorite collecting in a letter (1896d) to Professor Wolff of Harvard:

> The ideas of private collections vary, but my desire is to procure specimens large enough to show the physical characters, as well as to satisfy the needs of a museum in the event of a sale of the collection . . . which I hope may be deferred at least as long as I live . . . I have over 350 falls which I shall hope to increase to 400 before long.

By 1900 the collection contained 580 meteorites, representing nearly 500 different falls and finds (Mason, 1964). He considered the pricing of meteorites, at times, excessive. On September 5, 1885, he wrote Kunz, "W & H are stiff in pricing meteorites. It is very possible I will not buy any more."

Economic Problems

The 1870's were a time rife with scandals and economic woes. The Panic of 1873 was caused by the failure of many important eastern manufacturers and banking houses. Jay Cooke and Company, one of America's leading bankers, failed on September 18th. Days of chaos followed, during which Bement wrote Leidy, "This morning my equinimity was most disturbed by the report of the failure of Henry Clews & Co. (Bankers of New York), and the wholesale discharge of operations in the large manufacturing establishments." The depression that followed was, at that time, the most severe in American history. Bement's firm was affected, but did not fail. However, it did have several difficult years, forcing Bement to curtail his collecting activities. On April 24, 1877, he wrote to Prof. A. S. Bickmore, President of the recently established American Museum of Natural History in New York:

> My object is to announce definitely that my collection of minerals is for sale; price, as stated to you, was $20,000—and cost to me in *money* (time not counted) about $26,000 . . . I am not at all tired of minerals, but the protracted depression in the iron trade leads to the conclusion that I cannot afford to own unproductive property.

There are no Museum records to indicate whether the offer was even considered. The museum, founded in 1869, had considerable capital tied up in their building plans. Additionally, they had purchased the S. C. H. Bailey collection in 1875 for $5,000, a sizeable sum for those depression years.

Figure 12. **The Swiss mineral dealer Frederich H. Hoseus presented this slab of the Hammond (Wisconsin) meteorite to Bement in 1874. It weighs 842 grams (nearly 2 pounds); AMNH 125. AMNH photo by Kerry Perkins and Jackie Beckett.**

The following was recorded in the *Minutes of the Annual Meeting of the American Museum of Natural History Board of Trustees* (Jesup, 1901):

> In 1884, the United States National Museum reported that the purchase of Bement's collection would place that Institution on a par with many of the great Museums in Europe. Efforts were made to secure it at that time, by a well known foreign Museum,

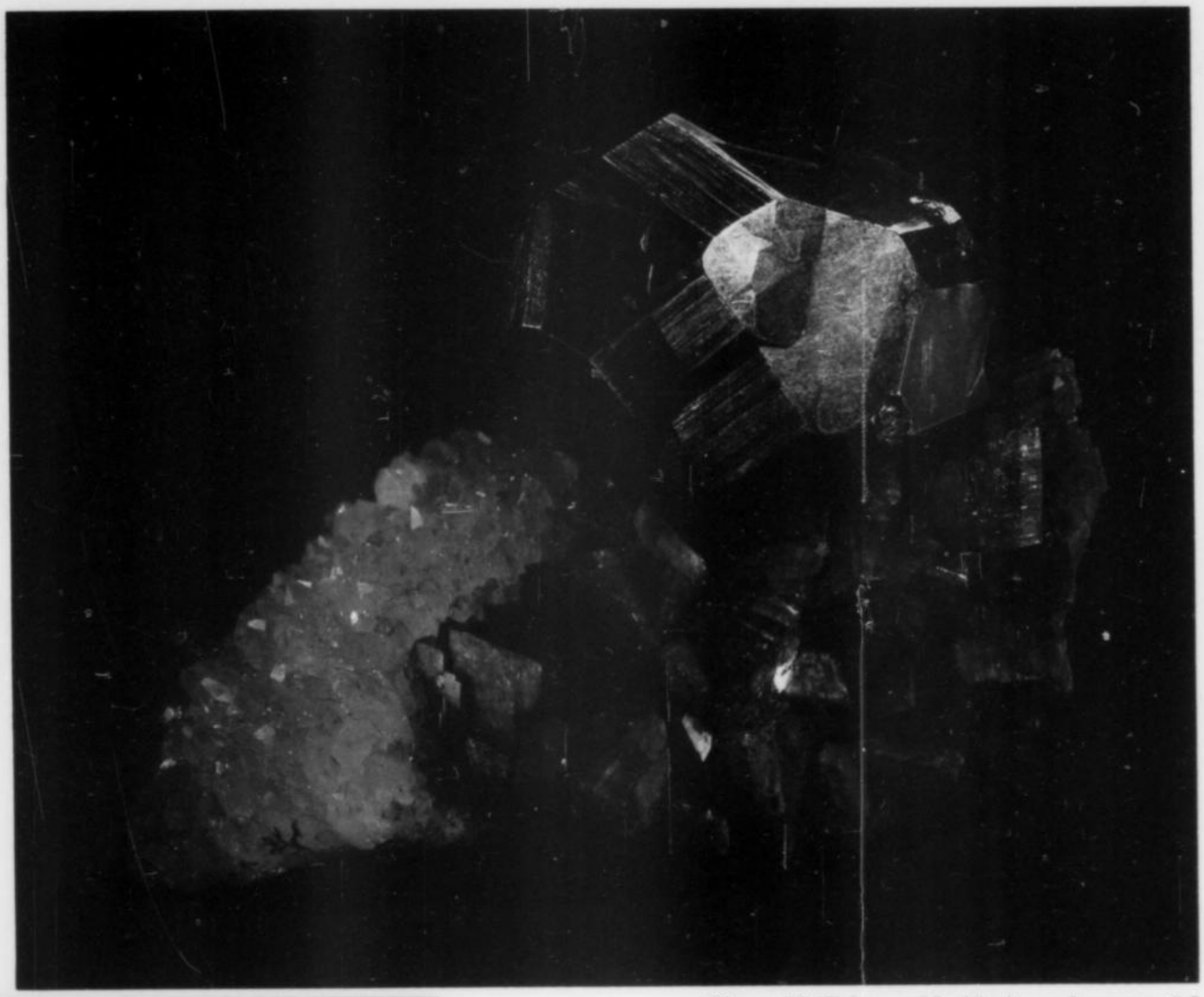

Figure 13. **Galena with siderite and quartz, 6.2 cm, from Neudorf, East Germany; AMNH 860. Bement acquired this specimen from the estate of Gustav Rose (1798–1873) in 1874. AMNH photo by Arthur Singer.**

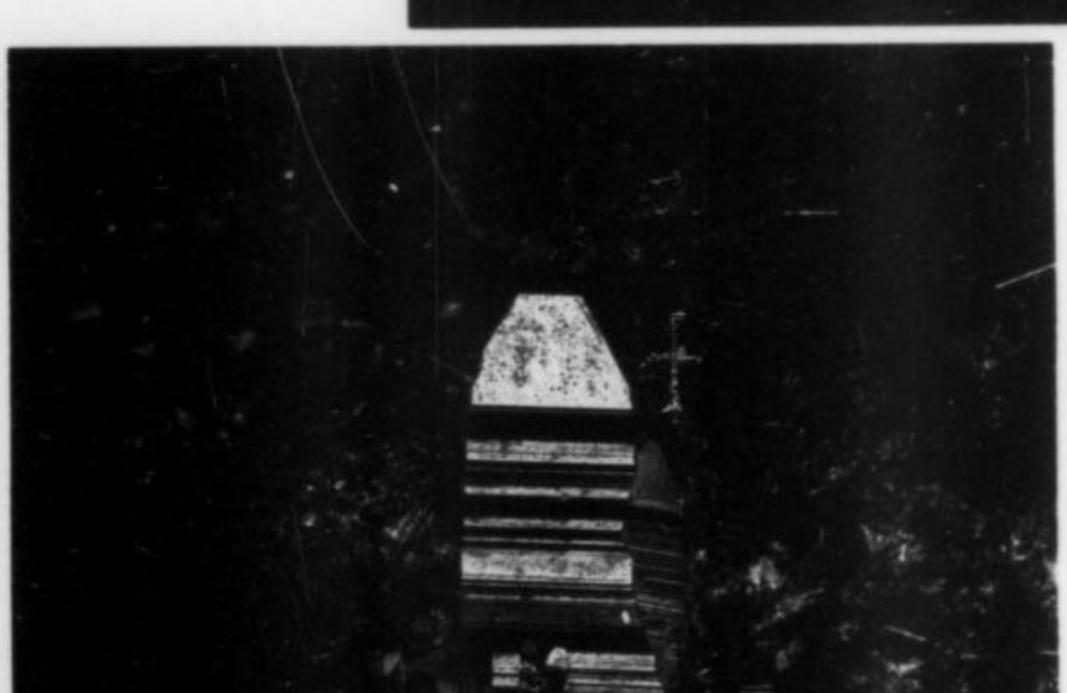

Figure 14. **The mineral dealer A. E. Foote visited Bisbee, Arizona, and recovered two extraordinary specimens of paramelaconite which Bement purchased for $100. The largest crystal, shown here, measures 7.5 cm; AMNH 4630; AMNH photo by Arthur Singer.**

> but fortunately for the American Museum of Natural History, the amount of money required was too difficult to secure and the effort was very reluctantly abandoned.

Attempts were made to confirm that the Smithsonian tried to purchase the collection and to identify the "well known foreign Museum." John Cox, Assistant Archivist (personal communication), says that no record exists of the Smithsonian's attempt to secure the Bement collection. No record of an offering to sell by Bement was found in the Archives of the British Museum of Natural History (Peter Embrey, personal communication), the National Museum at Paris (Dr. H. J. Schubnel, personal communication) or the Vienna Natural History Museum (Dr. Gerhard Niedermayr, personal communication).

In June of 1896, Bement wrote to Harvard University Professor J. E. Wolff offering to sell his collection. He wrote that it cost him nearly $100,000, not counting the meteorites.

> [I do not expect] any institution like Harvard to purchase the entire aggregation . . . I should be willing to sell $75,000 worth at cost, and retain the less desirable remainder, giving the buyer a free choice of the best specimens. I have not made an offer

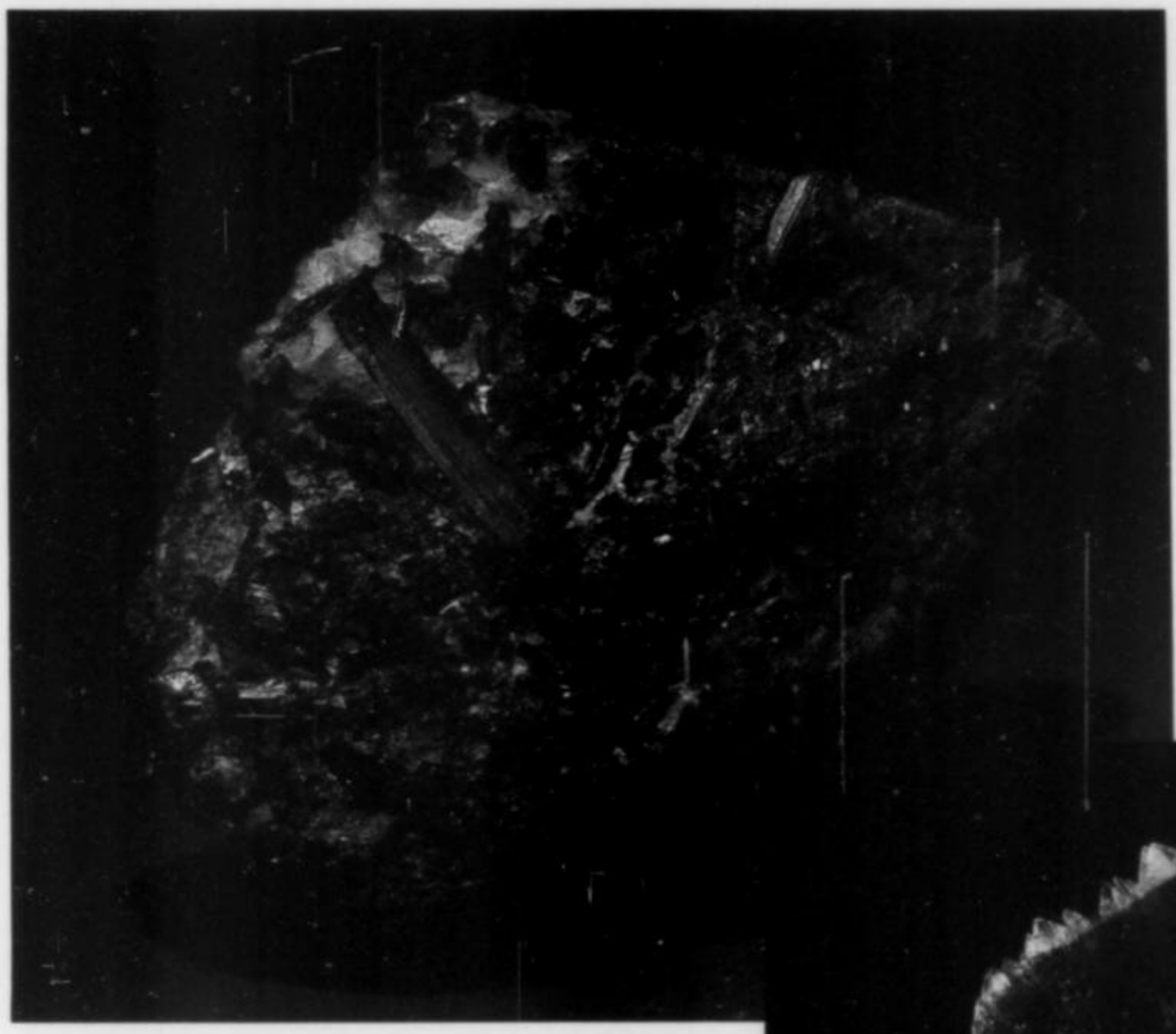

Figure 15. **In 1884 Bement purchased this fine matrix hiddenite (green spodumene), 12.5 cm, from William Hidden himself for only $150. It was subsequently illustrated in George F. Kunz's *The History of the Gems found in North Carolina* (1907, plate XII); AMNH 42943. AMNH photo by Arthur Singer.**

Figure 16. **A titanite twin, 5.5 cm, from Zillerthal, Tyrol, Austria. On the back of the label Bement wrote: "promised me in 1870(?) by Hoseus, but by misunderstanding went to Spang." Bement purchased it from Norman Spang in 1882 for $125; AMNH 1416. AMNH photo by Jackie Beckett and Kerry Perkins.**

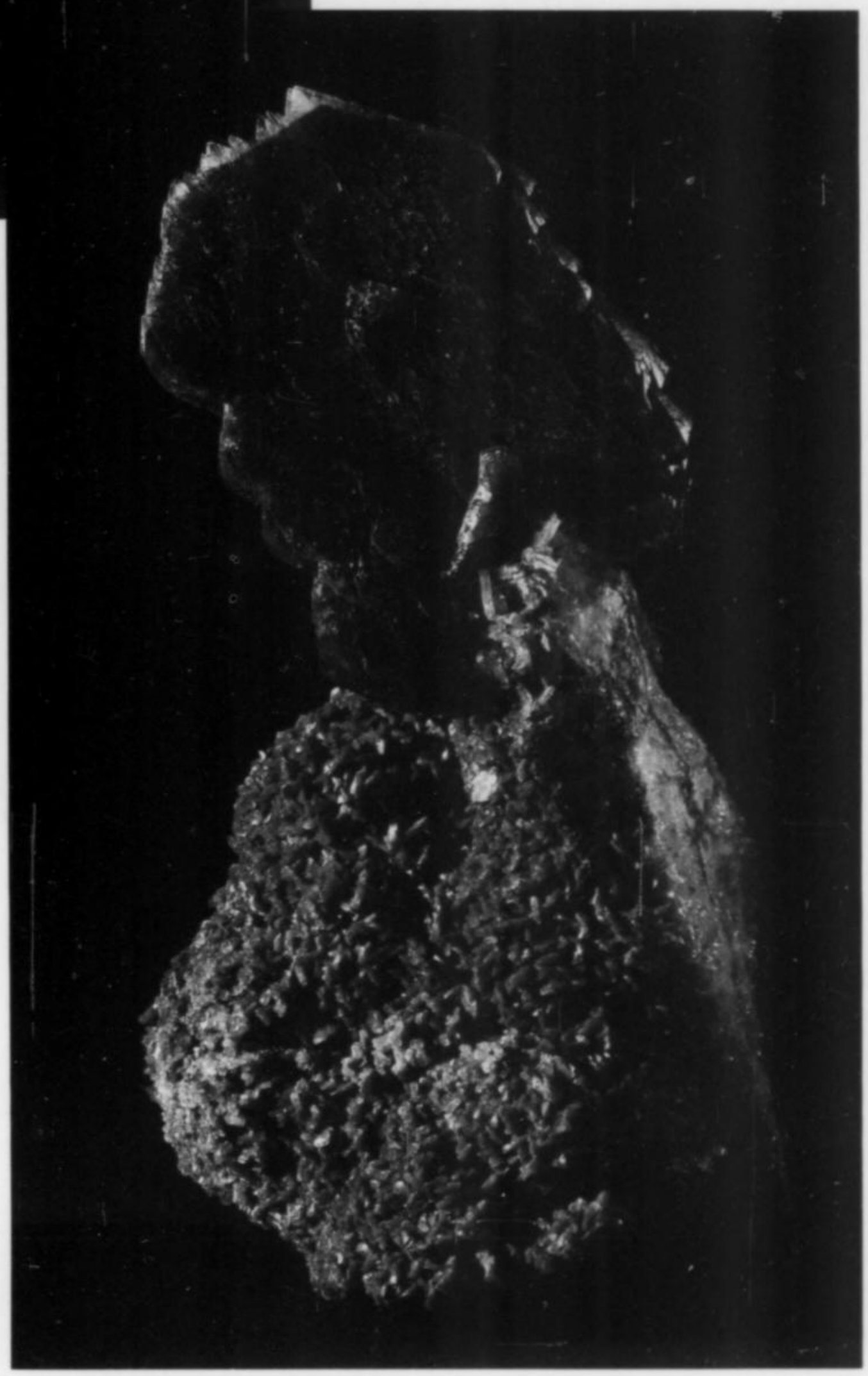

Figure 17. **This remarkable barite, 10 cm, from Frizington, Cumberland, England, was one of 179 barites in the Bement collection; AMNH 3210. AMNH photo by Jackie Beckett and Dennis Finnin.**

> in this form to anyone else; in fact, no direct application has been made to me, except by Major Powell some years ago, who hoped to be able to secure the entire collection for the National Museum. My only object in suggesting a possible disposition of the collection is to avoid burdening my family with an undesirable piece of property in the event of my death. It also seems as though such material should be located where it can be of more general service than in its present quarters. (Bement, 1896a)

Efforts to find a donor to purchase the collection for Harvard were unsuccessful. Writing to Wolff on September 4, 1896, Bement stated, "As I am not always in the selling mood, I would prefer to have the matter considered 'off,' to be taken up again in the future if the University should want to make the purchase and I should feel willing to dispose of the collection" (Bement, 1896c).

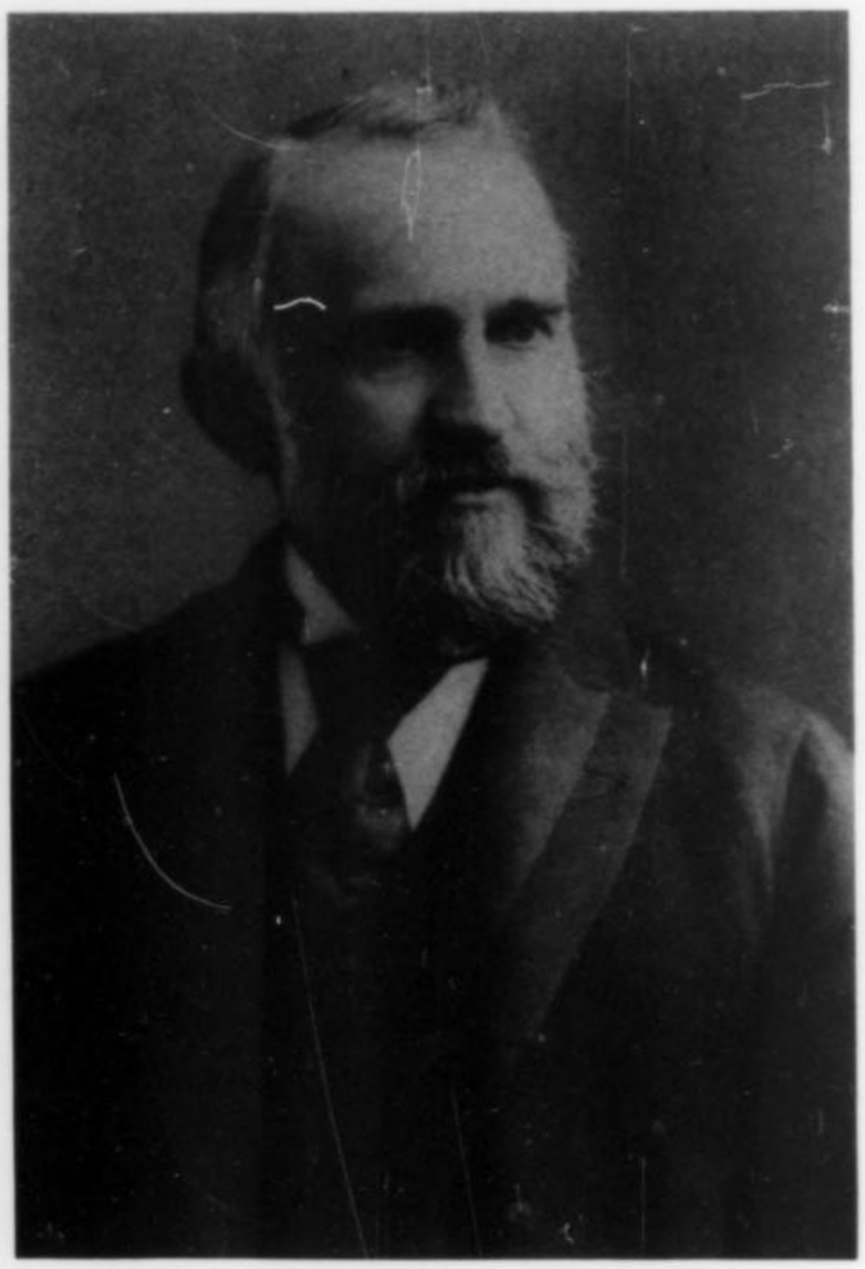

Figure 18. **Clarence Bement (circa 1892). Four years later, he would offer to sell his collection to Harvard University. Photo courtesy of Russell Bement, Jr.**

The Collection is Sold

In 1900, with the encouragement of George F. Kunz, J. P. Morgan purchased the Bement collection. It is uncertain what Kunz's exact role was in this transaction, but he probably acted as broker. Morgan presented Bement's outstanding collection to the American Museum of Natural History. Mr. Morgan, always a generous donor, was obviously in a buying mood: that same year, Morgan bought the second Tiffany-Morgan gem collection and also made a gift of it to the Museum (Gratacap, 1901).

The importance of the Bement acquisition can best be appreciated by quoting from the February 11, 1901, Annual Meeting of the Board of Trustees of the AMNH, a minute presented by Trustee Abram S. Hewitt:

> The Trustees rejoice that the Museum begins the new century with the acquisition of two very remarkable, if not unique, collections of minerals, which, added to the treasures already in its possession, raises its position among the Museums of the world to the level occupied by the British Museum, heretofore by common consent, regarded as rich beyond comparison in rare specimens.

The first of these additions is known as the Bement Collection, consisting of 10,000 [actually 12,500] specimens of minerals gathered without regard to expense in order to illustrate the mineral world, with a perfection, elegance and crystallographic beauty unequalled by any collection of similar size and comprehensiveness in this or any other country. It represents many years of painstaking and exhaustive examination by the resources of dealers throughout the world. In American minerals it is particularly rich. To the eye and mind of the mineralogist it presents a wonderful and stimulating view of the greater part of the mineral Kingdom. In it are included a collection of meteorites unequalled in this country and through their relations to the great realms of space beyond our world, are of peculiar value in connection with the other treasures of the Museum.

Figure 19. **J. P. Morgan (1837–1913) purchased the 12,300-specimen Bement collection for $100,000 in 1900 and presented it to the American Museum of Natural History.**

The Bement collection was so large that two railroad boxcars were needed to transport it from Philadelphia (Seaman, 1965). Bement's friend, Elwood P. Hancock, accompanied the collection and assisted in its unpacking and display (Gratacap, 1901). The size and quality was such that it displaced the Bailey and Spang collections. The museum's collection, with the addition of Bement's, now numbered 19,300 specimens of 861 species, prompting the museum to create a new Department of Mineralogy, putting it under the curatorship of Louis P. Gratacap.

Mr. Gratacap, a graduate of the Columbia School of Mines, began his museum career as assistant curator of mineralogy in 1875 (Seaman, 1965). A man with a wide range of interests, he wrote many books

on such diverse topics as science fiction, politics, geology and mineralogy. His best known work, *A Popular Guide to Minerals*, published in 1912, contained several chapters on the Bement collection.

Bement's love affair with minerals continued after the sale. He maintained a small collection from which he presented to the museum in 1909 a splendid specimen of tourmaline from Haddam Neck, Connecticut.

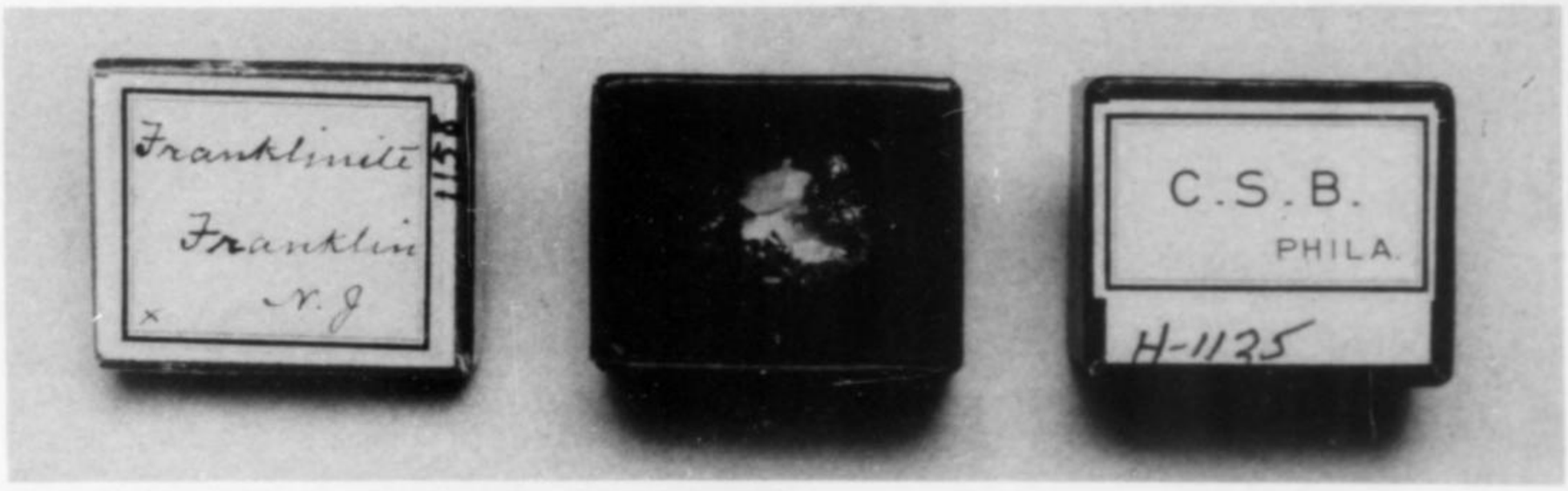

Figure 20. **Bement's interest in microminerals began in 1897 when he purchased specimens from Reverend George Rakestraw. He sold his collection to George Fiss in 1912, who in turn sold his to Harvard alumnus Albert Holden; Harvard acquired the collection a year later when Holden died. AMNH photo by Kerry Perkins and Jackie Beckett.**

Bement's Micromount Collection

Bement's attention shifted to collecting micromounts in 1897 when Reverend George Rakestraw sold him many of his better mounts (Francis, 1982). Bement didn't prepare his own mounts; fellow enthusiast George Fiss made them with material supplied by Lazard Cahn, a New York mineral dealer, and others (Palache, 1951). By 1904, Fiss and Hancock regularly visited Bement at his home on Sundays to study microminerals. Bement affectionately referred to this study group as the "Sunday School." Charles Palache attended a few of Mr. Bement's "Sunday School" meetings. In 1912, Bement's eyesight failed to the extent that he could no longer clearly see his microcrystals under the scope. He sold the collection to George Fiss, who in turn sold it to Albert F. Holden, a Harvard alumnus. At the death of Holden it went to Harvard University where today it is available for research. In 1982, Bement was elected to the Micromounter's Hall of Fame by the Baltimore Mineral Society (Francis, 1982). A commemorative plaque marking this event is in the Harvard Mineralogical Museum.

Organizations

During his long and productive life, Bement was not only a businessman and collector, but also a member of the American Philosophical Society, the Academy of Natural Sciences of Philadelphia, the Pennsylvania Academy of the Fine Arts, the Philobiblon Club, the Franklin Institute, the Historical Society of Pennsylvania, the Colonial Society and the Pennsylvania Chapter of the Sons of the American Revolution. Bement was honored with a medal of appreciation by the University of Munich in recognition of his mineral collection (Rosenbach and Johnson, 1929). He was a charter member of the Mineralogical Section of the Academy of Natural Sciences of Philadelphia, the oldest mineral study group for collectors in the United States, established in 1876.[4] He was a charter member of the New York Mineralogical Club, founded ten years later. Reporting the minutes of the second meeting of the New York Mineralogical Club, Secretary George F. Kunz (1886) recorded twice, "Mr. Bement is present." Fellow Club members were obviously honored by his presence . . . in spite of such inclemency of the weather. Bement retained his association with the club for many years. In 1920, Dr. Kunz proposed a life membership in a distinguished professional organi-

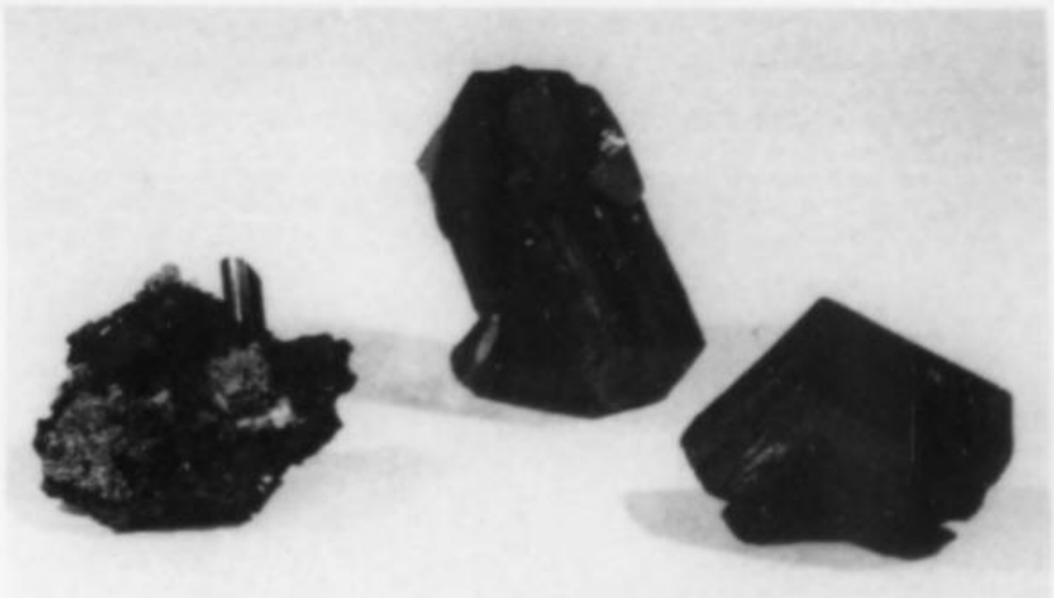

Figure 21. **Vom Rath (1884) considered rutile to be "one of the crowning glories" of the Bement collection. Shown here are specimens from Stony Point, North Carolina (AMNH 5543; 2.5 cm crystal), Graves Mountain, Georgia (AMNH 5577; 8.5 cm) and Parksburg, Pennsylvania (AMNH 5630; 8.2 cm). AMNH photo by Kerry Perkins and Jackie Beckett.**

zation (probably the American Geological Congress; Lawrence Conklin, personal communication). Bement replied, "Many years have elapsed since my active interest in this subject was a ruling passion . . . my interests have verged to other subjects . . . as to a life membership my stay on earth is sure to be very short and it would hardly pay to go to that expense . . . and therefore feel that I must decline the offer."

A Career Ends

Bement's prediction was borne out. He died on January 27, 1923, in his 80th year. His obituary notice in the *Philadelphia Inquirer* mentioned only the funeral home and a request that no flowers be sent. A fascinating career had ended.

In a posthumous biographical sketch of Bement, Kunz (1923?) related the following remembrance of Ernest Schernikow: "that the better he [Schernikow] learned to know him the more loveable did he find him and he pays a warm tribute to Bement's keen sense of the beautiful, his appreciation of the slightest favors shown him, his love of nature, his broad-mindedness, and his many acts of kindness and charity."

Clarence S. Bement was the consummate collector. His mineral

[4]The A.N.S.P group, established in 1876, was a mineral study group and not a club. The New York Mineralogical Club was established in 1886 and is still active. The Philadelphia Mineralogical Society (originally known as the Philadelphia Students Mineral Club) was founded in 1892, and is also still active.

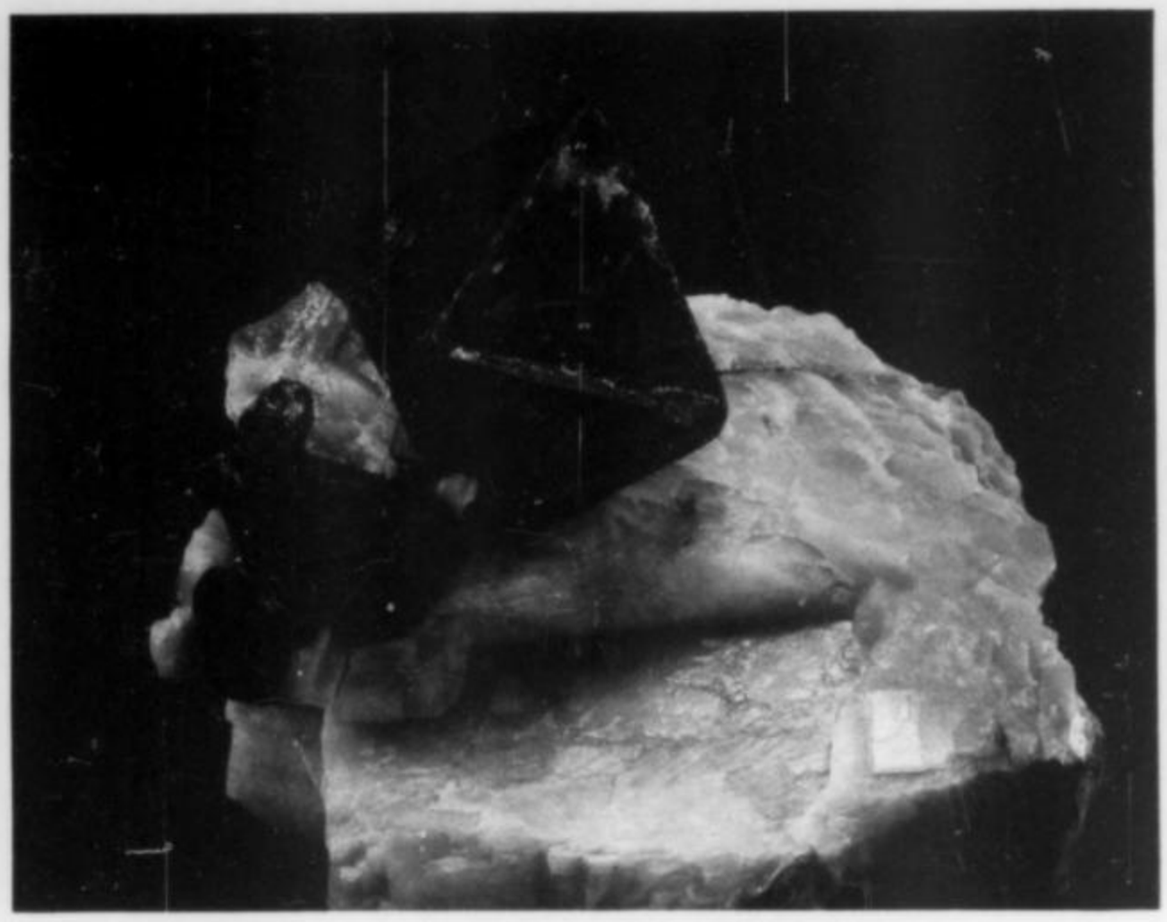

Figure 22. **A group of sharp franklinite octahedra to 3.5 cm on edge in calcite from Franklin, New Jersey; AMNH 5186. AMNH photo by Kerry Perkins and Jackie Beckett.**

Figure 23. **A 9.5-cm composite crystal of matlockite from Matlock, Derbyshire, England, obtained in 1882 from London dealer S. Henson; AMNH 3113. AMNH photo by Kerry Perkins and Jackie Beckett.**

Figure 24. **Malachite, 20 cm, from the Copper Queen mine, Bisbee, Ariziona; AMNH 25798. AMNH photo by Jackie Beckett and Kerry Perkins.**

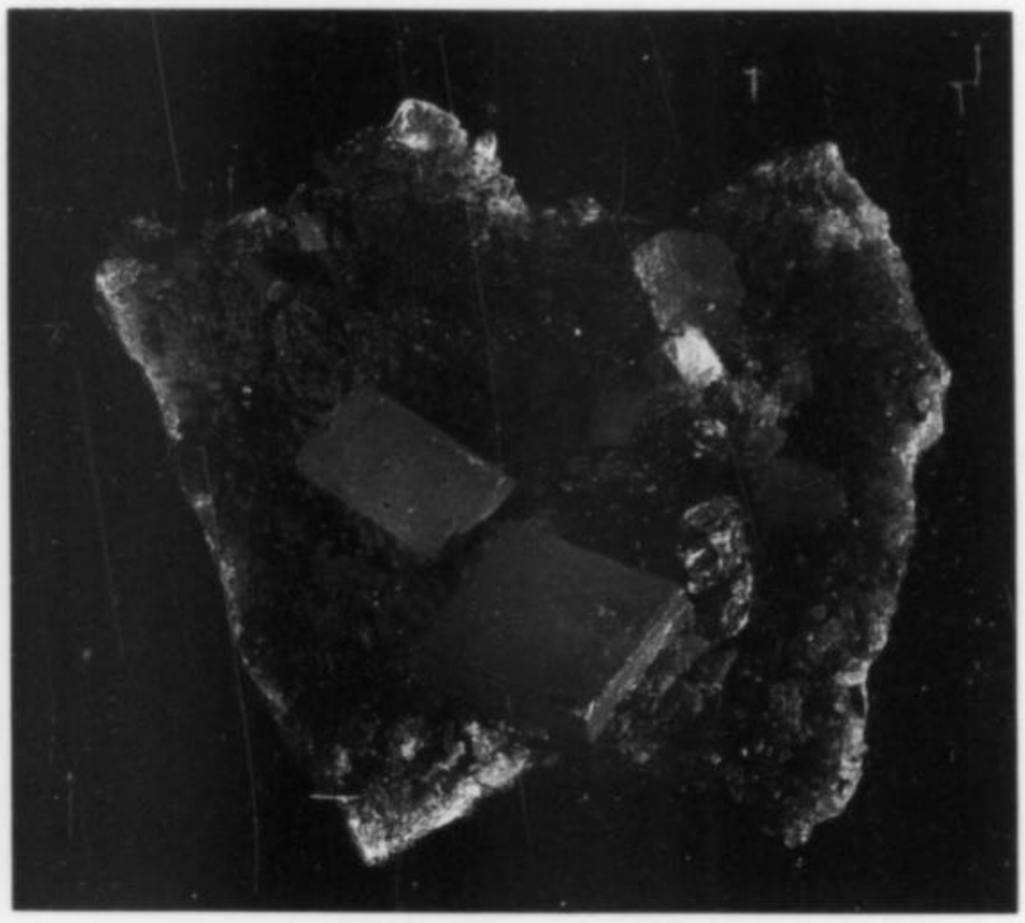

Figure 25. **Baron Braun of Vienna was the source of this realgar-stained barite, 6.3 cm, from Baia Sprie, Romania; AMNH 16013. AMNH photo by Kerry Perkins and Jackie Beckett.**

collection was undoubtedly one of the finest, if not *the* finest, ever assembled by a private individual. It is unlikely a collection of this quality and magnitude could be assembled by any one individual today. Perhaps a collector will appear on the horizon with the time, determination and funds to assemble a world-class collection the equal of Mr. Bement's. However, this effort will come to nought if such a collector does not have the philanthropic frame of mind to ensure that his collection is maintained for the future rather than being dispersed through sales.

Acknowledgments

The authors are grateful to Lawrence H. Conklin, acknowledged expert on Clarence Bement, for reviewing this paper. Another Bement expert, Robert Middleton of the Los Angeles County Natural History Museum, kindly read our manuscript, as did Dr. George E. Harlow, Curator of Minerals and Gems at the American Museum of Natural History.

The assistance of the following institutions and individuals is gratefully acknowledged: Penelope Bodry-Saunders, Valerie Wheat, Carol Tucker, Carmen Collazo and Russel Rak, AMNH Library; Jackie Beckett, Kerry Perkins and Dennis Finnin, AMNH Photo Studio; Dr. Demetrius Pohl, Dr. Martin Prinz, William Zeek, Michael Weisberg, Joan Shepard, Dept. of Mineral Sciences, AMNH; Ralph Bauer, Exhibition Dept., AMNH; Thomas A. Peters, Paterson (N.J.) Museum; Dr. Carl A. Francis and William C. Metropolis, Harvard Mineralogical Museum; John Sampson White, Dr. Pete J. Dunn and William Cox

of the Smithsonian Institution; Professor H. J. Schubnel, Muséum National d'Histoire Naturelle; Peter G. Embrey, Curator Emeritus, British Museum (Natural History); Dr. Gerhard Niedermayr, Naturhistoriches Museum Wien (Vienna); Richard Souza, Carnegie Museum of Natural History; Carol Delaney, College of Staten Island; Herb Corbett, Baltimore Mineral Society; Carol Lipinsky, Burlington County Historical Society; Carol Spawn, Academy of Natural Sciences of Philadelphia; Jeanne Roberts, The Historical Society of Pennsylvania; Dr. Harley P. Holden, Harry Elkins Wiedner Library, Harvard University Archives; Dr. William E. Metcalf, American Numismatic Society; Marie E. Korey and Walter A. Frankel, Free Public Library of Philadelphia; Dr. Thomas M. Whitehead, Temple University Library; Louis Zara, author and historian; Bernard C. Carlitz, Philadelphia rare book dealer; and David H. Shayt, Smithsonian Institution.

Words cannot express our indebtedness to Marion Bement LeGoff and Russell Bement, Jr., Clarence Bement's granddaughter and grandnephew, respectively, for generously sharing family information, photographs and memorabilia.

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L'EXPOSITION UNIVERSELLE DE 1900 PARIS

The Greatest Mineral Show of All Time

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It drew mineral exhibits from around the world on a scale unprecedented. It attracted over 50 million visitors. The Paris World's Fair of 1900 was arguably the greatest single mineral event in history.

INTRODUCTION

The Paris Exposition of 1900 was probably the greatest mineral show of all time, and certainly ranks as the greatest of the World's Fairs. And yet it is amazing how deeply a major historical event and all that goes with it can be buried under the sediments of time, even in the relatively short span of 90 years. There is hardly a mineral collector, curator, mineralogist or dealer today who has heard of it; school children do not learn of it; authors practically never mention it, and so it sinks into undeserved oblivion. As time passes, records are lost, the people who saw it for themselves quietly accumulate in cemeteries, and dust gathers on the dwindling evidence of its former existence. The great exposition buildings, built at a cost of many millions of dollars, decay into ruins and are swept away. The mineral specimens exhibited there are scattered, most of them losing their extraordinary pedigree, and many of them ultimately being lost or destroyed. It is almost as if the great event had never happened.

The Paris Exposition of 1900 *is* nevertheless a fascinating chapter in the history of mineralogy, despite its present obscurity. It deserves to be better known and remembered; hence this article. From an author's standpoint it was a uniquely engrossing research experience to blow the dust off so many obscure reports, and to leaf carefully through so many crumbling books from the turn of the century, and then to play detective trying to track the history of specimens and exhibits through 90 years of obscurity to their present-day dispositions (with varying success). I hope a little of that sense of unexpected discovery will be felt by the reader of this article, along with a slight touch of sadness that we ourselves had no chance to personally experience the Paris Exposition in all its glory.

HISTORICAL PERSPECTIVE

Fairs of one sort or another have been common throughout much of recorded history. Medieval trade fairs were important to the commerce and intellectual life of Europe, growing larger as local princes began promoting them for political purposes.

In the early 1700's a new kind of fair took place in Paris: a public art show sponsored periodically by the King and staged by his Academy of Fine Arts. These "salons" had become annual events by the turn of that century, spreading to other European capitals.

The first industrial fair took place in London in 1760. The Royal

Figure 1. **Jules Clement Chaplain's Paris Exposition Medal of 1900, 6.3 cm. National Numismatic Collection, Smithsonian Institution, Washington, D.C.**

Society of Arts had purchased some prize-winning models of agricultural tools, cranes, windmills and sawmills which they put on public display in a warehouse for five weeks. It proved very popular, and by the end of the eighteenth century, exhibits of inventions and machines were common in Europe.

The first truly national exhibition evolved almost accidentally in France in 1797. Industrial equipment being stored in French national warehouses had accumulated alarmingly because of the English blockade of the Continent. As a sales promotion, these goods were publicly displayed at an empty chateau in St. Cloud; band concerts and a lottery helped to draw in the public, and sales were quite satisfactory. An expanded "public exhibition of the products of French industry" was held in Paris the following year. There were parades, speeches, music and prizes; the pattern was set.

French national exhibitions continued every few years under Napoleon's reign and afterward, becoming ever larger with time. The last, in 1848, was the most ambitious; but it was England's Prince Albert who promoted the first international fair, held in 1851 in an enormous greenhouse-like structure ("bigger than St. Peter's") dubbed the Crystal Palace. It attracted 6 million visitors and generated a substantial profit. Henceforth it became a major purpose of exhibitions to encourage international applications of the arts and sciences for the general benefit of society, education and industry.

The Crystal Palace Exhibition spawned imitators in New York (1853), Dublin (1853) and Munich (1854), but the French were particularly determined to better it in the first Paris *exposition universelle* of 1855. Although it lost money, the French were satisfied with it as a political and intellectual victory, and began planning their next exposition for 1867.

The exposition of 1867 was an even greater triumph. Eighteen monarchs visited Paris to see it; aluminum was first displayed there, along with the first distillation of petroleum. Individual nations for the first time had separate pavilions as their headquarters. Exotic restaurants, ethnic music, beautifully landscaped gardens, and an amusement park added to the festive atmosphere.

International fairs proliferated. In 1876 the first American World's Fair was held in Philadelphia, drawing nearly 10 million people. The Paris exposition of 1878 drew 16 million. An international exposition was held in Sydney in 1878–79, in Melbourne in 1380–81, and even in Calcutta in 1883–84.

Mandell (1967) in his notes on the history of World Fairs, wrote that, "By the 1880's it appeared the world community had adopted a new kind of quasi-educational amusement that served the purposes of industrialists, artists, scholars, entertainers and politicians alike. All of these expositions were made possible by widespread international idealism among educated, powerful men."

Because the Paris exposition of 1889 fell on the centennial of the French Revolution, the French government spared no expense. Called the *Exposition Tricolorée,* it drew almost 40 million visitors and boasted the extraordinary Eiffel Tower as its centerpiece. The World Columbian Exposition held in Chicago in 1893 was dwarfed by comparison; it drew "only" 2½ million visitors.

Then came the astounding Paris Exposition of 1900, drawing over 50 million fairgoers from around the world, and boasting of a mind-boggling *83,000* exhibitors (Orly, 1982). The twentieth century had started off with a party like no other, celebrating unbridled optimism in the technological and artistic future of the world. There were many World's Fairs to follow, in St. Louis, San Francisco, Chicago, Brussels, New York and Paris, but none achieved the magnitude of the 1900 exposition. Attendances did not again pass the 50 million mark (during one year) until the Montreal and Osaka Fairs of 1967 and 1970, by which time the event had changed its face significantly to reflect our modern times and priorities.

In 1900, unlike today, national governments around the world were very interested in showing off their country's mineral wealth. Today ore deposits are viewed primarily as raw material to be exploited rather than as subjects of national pride; it is industrial technology that modern corporations are proud of, not natural resources. But attitudes were very different in 1900. Vast amounts of taxpayer's money were spent assembling and exhibiting *national mineral collections* at the exposition. It is a sad fact that such expenditures by world governments would be unthinkable today.

It is interesting to imagine what it would have been like to attend the Paris Exposition in 1900. Americans would first have to schedule their travel arrangements: two weeks each way by steamship, not to mention time spent crossing America to reach Eastern seaports. If one was going to invest a month of one's time just going to and fro, it certainly made sense to stay at least a month in Paris . . . where the hotel situation was sure to be chaotic (*50 million visitors!*). Exposition tickets had to be purchased in advance, by mail, in blocks of 20 one-day tickets at 1 franc (about $3) each. The American visitor would likely be a person of some means, who could afford the time and expense, or a person whose profession urged him to come. For example, the International Congress of Mining and Metallurgy was held concurrently in Paris, giving many mining men the excuse to make the trip, perhaps at company or government expense.

Figure 2. **Admission ticket.**

Figure 3. **George F. Kunz (1856–1932). (Courtesy of L. H. Conklin.)**

KUNZ'S REPORT

George F. Kunz, the well-known American gem specialist (see Conklin, 1987), was such a personage. He traveled to Paris in order to mount the Tiffany exhibits and to report on gemological and mineralogical aspects for the U.S. Geological Survey. His notes on the exposition were published in *Mineral Resources of the United States, Calendar Year 1900*, reproduced here in full:

MINERALS AT THE PARIS EXPOSITION OF 1900.

The mineralogical and metallurgical exhibits at the Paris Exposition of 1900 exceeded in beauty and scientific interest those of any previous exposition. Only a few leading points can be noted, but these will give some idea of the mineralogical and geological treasures assembled.

In the exhibit made by the Alpine Club, of France, M. Demarty, well known as a specialist and a writer concerning the minerals of the Auvergne district, displayed a most interesting collection of the rocks and minerals of that remarkable region of central France. Prominent among these were the Auvergne amethysts, both in polished form and in small, dark, richly colored crystals, with jasper and other siliceous minerals found in association with them.

In section 63 the Norwegian Government exhibited some of the most remarkable specimens of crystallized native silver ever found from the mines of Kongsberg—"the mines of the pauper and the King," as they are called—comprising many types of crystals, groups of cubes and cubo-octahedrons measuring as much as an inch on the face, also wires and ropes of silver nearly a foot in length, in masses weighing up to 1 pound each, besides isolated crystals, and masses of silver on the gangue. There was also a superb collection of thorites and organizites; and columns of polished labradorite and gabbro 12 to 15 inches in diameter and over 20 feet in height. The labradorite is very dark in color, almost black, and the reflections are small and silvery blue.

Another interesting exhibit was that of the soapstone from the quarry of Gudbrandsdalen, used in the interior decoration of the cathedral at Trondjhelm.

In the Finland pavilion was shown the meteorite of the Bjurbo fall, a chondrite that fell on March 12, 1899. The 800-pound mass, broken into many pieces, but with the crust unusually fresh and interesting, was well shown in a cylindrical glass case.

The Russian section contained a magnificent collection of minerals from the Ural Mountains, splendid crystals of beryl, rubellite, topaz, etc., and a wonderful display of vases of rhodonite, malachite, lapis lazuli, and other characteristic Russian minerals; a single bowl of jasper from Kolyvan, Siberia, measured 8 feet in height and 6 in diameter. There was also a superb collection of cut objects of jade and aventurine from the Imperial Lapidary works at Peterhoff.

Among the most remarkable, one might say sensational, exhibits in the whole exposition, was the jeweled map of France, presented by the Czar Nicholas II to President Loubet. This map is about one meter square, and is made entirely of Russian semiprecious stones, set as a mosaic, for the several departments and inlaid with gem stones for the cities. Each department is represented by one special stone—jade, onyx, agate, carnelian, malachite, etc., and a great variety of colored jaspers, for which Russia is noted. For the principal cities, Paris is represented by a ruby, Marseille by an emerald, Lyon by a diamond, Bordeaux by an opal, Lille by a turquoise, etc. The size of each stone is in proportion to the importance of the city or town. The value of this unique map is estimated at two million francs. The emerald alone that represents Marseille is valued at 900 rubles. During the exposition it was displayed in the Russian section of the Art Industry Building. It is now in the museum of the Louvre, having been turned over to the Government of the French Republic by President Loubet as properly national rather than private property.

The only object comparable to this map is probably the jeweled

Figure 4. **Main entrance to the Exposition. (Photo: Roger-Viollet)**

globe belonging to the Shah of Persia, at Teheran, which has rarely been seen by Western eyes.

Denmark appeared especially in her colony of Iceland, whence were displayed hundreds of pounds of Iceland spar, the crystals being of "irreproachable transparency," as the French express it. One crystal, nearly a foot in diameter, had its faces coated with magnificent zeolites—stilbite, epistilbite, heulandite, etc.

The Baltic amber was shown in one of the most comprehensive collections ever made, prepared by Dr. Klebs, of Konigsberg, Prussia, the celebrated amber expert. This collection comprised all the various forms in which amber occurs and all the very interesting inclusions, as of woody matter, insects, spiders, moving bubbles, etc., all accompanied with full explanatory labels and a good catalogue.

In the Austrian and Hungarian sections there was a magnificent collection of minerals, conspicuous among which were crystals of salt from the mines at Wieliczka, which have been worked for hundreds of years; from Transylvania, realgar and orpiment, and a great variety of the occurrences of native gold from the mines at Vöröspatak. The Dubnik mines were represented by a fine collection of noble opals and hydrophanes. These mines are now worked under Government patronage, but the recently developed Australian opal fields are outstripping them many-fold in production.

The Servian pavilion contained some fine copper minerals, as well as magnificent crystals of cinnabar, the white chloride, and other mercury compounds.

Passing from Europe to America, in the United States section there was shown a complete metallurgical exhibit of this country, prepared by the chief of the department of mines, Mr. F. J. V. Skiff. Among American mineral dealers only one had an exhibit—Mr. Warren M. Foote, of Philadelphia—who showed a fine collection of both American and foreign minerals. A very complete exhibit of the mineralogy of the United States was for the first time prepared and shown under a cooperative arrangement between the Bureau of Mining Industry and a number of our leading universities, including Cornell, Princeton, Chicago, Michigan, and others. Some 4,000 specimens in all were displayed, the collecting being made as complete as possible. It was arranged according to Dana's Mineralogy, each institution taking one section of it.

In the American section was the Tiffany collection of precious and ornamental stones of the United States, and in the Diversified Industries sections the Tiffany collection of foreign gems. In both collections were the finest obtainable examples of the most perfect natural crystals, the choicest broken fragments, and rolled pebbles, as well as the largest and finest obtainable gems. These were all purchased to be combined with the collection of gems that constituted the central figure of the Paris Exposition of 1889, and were presented to the American Museum of Natural History, New York, by the donor of the Bement collection, Mr. J. Pierpont Morgan, whose generous gift makes this collection of gems now in the American Museum of Natural History the best in existence. The collection is now being arranged in a special building—Morgan Hall. Both these collections were formed by the writer.

The Canadian exhibit, in charge of Mr. Fairbault, contained a noble collection of the minerals of the Dominion, notable among which

were great crystals of apatite, polished slabs of labradorite, large masses of sodalite, and a great variety of gold and other precious minerals.

In the Mexican section, in addition to the large variety of silver minerals usually shown, was a collection of beautiful specimens of crystallized boleite, cumengite, azurite, and other species from the famous mines at Boleo, in Lower California.

The Australian and Japanese exhibits were especially notable. Among the gems of the entire collection were the extraordinary twin crystals of quartz from Japan. One of these were crystals from 9 to 12 inches long at an angle of 45°. Superb groups of crystallized stibnite and an entire collection of the minerals of Japan, gathered by Mr. Tsunashirō Wada, and many specimens of remarkable beauty from a collection by Mr. Takudzi Ogawa, all are worthy of special mention.

Unquestionably the finest collection shown by any government was that from West Australia, prepared by Mr. Holroyd, who with indefatigable energy and great intelligence induced the many mine owners of that country to make an exhibit of gold and tellurium minerals such as never before has been seen. This collection is valued at not less than $200,000. In some cases several thousand dollars are represented in a single specimen. Every important mine in every district of West

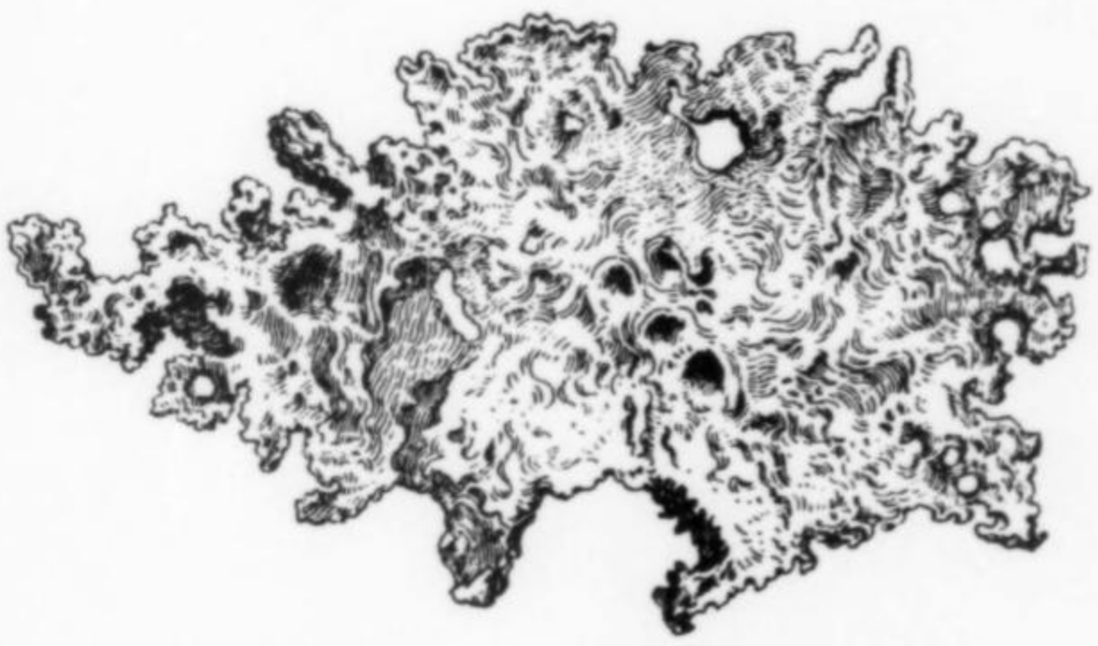


Figure 5. **Leaf and sponge gold specimens, each 13 cm across, from Western Australia, exhibited in the Holroyd collection (Hauser, 1901).**

Australia was represented by masses of the rock, with free gold, generally associated with tellurides; and besides the products of each mine, there were fine photographs or superb enlarged transparencies. The specimens were all freshly broken and unrubbed, and such large rich masses of free gold, associated with either petzite, calaverite, hessite, or other tellurium minerals, have never been seen together before. At other times the gold is in spongy and wire forms, or in fine dust, which Mr. Holroyd calls "mustard gold."

The French colony of New Caledonia showed magnificent examples of noumeite, garnerite, and associated species.

The richest mineral specimen at the exposition, however, one in which art has added to the work of nature, was the immense diamond from South Africa found in 1893 in Jagersfontein. It was then a crystal of 961 carats in weight, but has been cut into a brilliant of 239 carats—a superb and faultless gem, blue-white in color, now known as the "Imperial" diamond, and valued at $2,000,000.

Several valuable handbooks were prepared for the Paris Exposition, dealing with mineralogy and mining, especially in Russia and Japan. Among these, reference should be made to the following:

(1) *Catalogue des Objets exposées par les Usines de Taguil et de Lounia (Oural) appartenant aux héritiers* de M. Paul Demidoff, Prince de San-Donato. This little pamphlet gave a carefully classified list of the extensive mineral exhibit from this famous mining region.

(2) *Mines et Usines Metallurgiques du District de Lysva (Oural), Domain du Compto P. P. Schonvaloff.* This handbook contained a large amount of valuable information as to the gold and platinum workings and the numerous metallurgical establishments of this portion of the Ural region, and has already been cited in regard to the occurrence of diamonds.

(3) *Catalogue des Minéraux du Japon* (collection de M. Tsunashirō Wada), pour l'Exposition Universelle de 1900, à Paris. Service Géologique Impérial du Japon; Tokyo. This pamphlet gives a list of some 350 numbers, comprising a fine selection of Japanese minerals, partly described above.

(4) An interesting paper on the pleochroism and polychroism of the historical locality of the island of Elba, by Prof. Giovanni D'Archiardi. Dr. D'Achiardi dwells particularly on the coexistence of achroite, rubelite, indicolite, afrizite, and their variations of perpendicular and horizontal arrangements of color.

BOURGEOIS'S REPORT

Naturally the members of the French Mineralogical Society were also in attendance; in fact a "team" organized by L. Bourgeois was assigned to canvass the Fair and report to the other members at the July meeting. His report, published in the society's bulletin (and translated for the *Mineralogical Record* by C. W. Guerchon), is as follows:

Report of the Visit Paid by the Mineralogical Society to the 1900 International World Exposition (read by Mr. L. Bourgeois)

As it had done in 1889, the French Mineralogical Society decided at its 10 May session to undertake an extensive visit to all portions of the 1900 International World Exposition of some interest from the mineralogical and crystallographic point of view. The Society saw fit to entrust me with the organization of this excursion.

It was arranged to meet at 9 A.M. on Thursday, 28 June, at the foot of the east pillar of the Eiffel Tower. Those present included Messrs. Baret, Bel, Blondel, Bourgeois, Dufet, de la Durandiere, Gaubert, Gentil, Joffre, Kunz, Lacour, de Lapparent, Le Chatelier, de Mauroy, Michel, Pisani, Richard, Stuer, Taub, Termier, Wallerant, de Watteville, Wyrouboff and Zujovic; Mrs. Boubee, Intendant General Pavot; and Abbott Porcher. The group was joined by General Avon; Messrs. G. Bertrand, Boubee, Carimey, Clarke, Dumont,

Figure 6. **The Champs-de-Mars; the mining and metallurgy exhibit was in the building at left. (Photo: Roger-Viollet)**

Jollivet, Haiche, G. Lemoine, Lemoine, Jr., Memin, Perruchot and A. Verneuil; and Mrs. Stuer, who were introduced by the members of the Society. Our colleagues, Messrs. Barrois, Bergeron, Bureau, Chabrie, Cumenge, Damour, Demarty, de Gramont, Kampmann, Lovisato, Maskelyne and Offret, sent their regrets at being unable to join us.

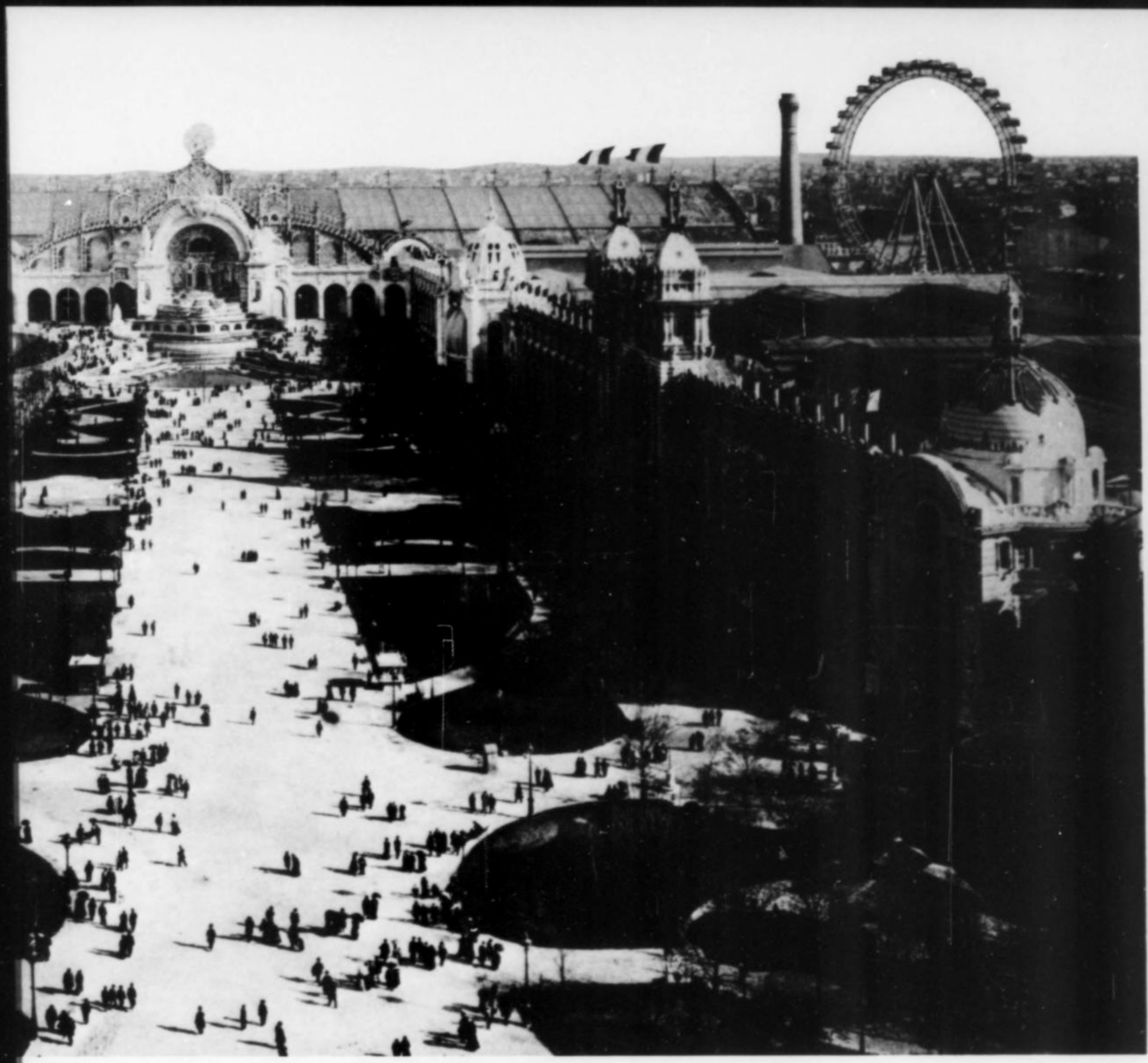
Before entering the exhibition halls at the Champ de Mars, we began by having a look at the chalet of the French Alpine Club, in which our colleague, Mr. Demarty, was exhibiting a series of rocks and minerals from Auvergne; ornamental objects in amethyst, jasper, flint, etc. from that region; and a relief model of the Puys Mountain chain on a scale of 1:20,000, done in the traditional geological map colors. We also saw, among other things, a beautiful smoky quartz from the Argentiere Glacier.

We then went into the Champ de Mars exhibition hall devoted to mines and metallurgy, in order to tour the Category 63 Exhibit on mines, mineral deposits and quarries. We went first to the Norwegian section, where we admired the specimens from the Kongsberg silver mines, the "Paupers' and King's Mines." Among the many types of filiform silver and other silver ores, we particularly noted a sample of native silver in three beautiful cubes and cubo-octahedrons, which constituted a unique display.

Just adjacent, Messrs. Schmidt and Thomsen, through the intermediary of Mr. and Mrs. Boubee, were exhibiting beautiful thorites in matrix and isolated crystals. The same hall contained monuments of polished gabbro and labradorite with the most sumptuous artistic effect, and also specimens of soapstone from the Gudbrandsdalen quarry used as ashlars (Trondhjelm Cathedral), fired bricks, etc.

A stroll of just a few meters took us to the United States, which was represented most brilliantly on this occasion, as it was in 1889. Mr. G. Kunz, of Tiffany and Company, was good enough to show us his display cases, which contained diamonds from California, rubies and rhodolite garnets from North Carolina, tourmalines, beryls and aquamarines, zircons, opals, rock crystal, an enormous cut ball crowning the display, amethysts, turquoise, rhodonites, dialogite in transparent rhombohedrons of a gorgeous red, etc. For purposes of comparison, there were some minerals and gems of different origins.

Quite nearby, Mr. W. M. Foote of Philadelphia exhibited, as he had in 1889, a very extensive series of minerals of all kinds, coming for the most part from the United States. There were, among other



things, herderite, pollucite (very large crystals), well-crystallized thaumasite, lanthanite, amazonite, garnets, endlichite, meteoritic iron and wulfenite.

In the North American section, we also admired a fine general mineralogical collection assembled by the Geological Survey, gold nuggets from California, malachite in large masses, azurite, native copper from Lake Superior, and in particular a specimen of this metal in cubes in a very transparent calcite, borates from Borax Lake, gypsum in crystals of prodigious dimensions, corundum, etc.

The Austrian and Hungarian sections offered for our view rock salts from Wieliczka, gold ores, realgar, orpiment, tellurium ores, a very large quantity of pure tellurium in its various forms prepared by Professor Schelle of Schemnitz, opals of amazing beauty, etc.

We mounted to the halls on the second floor. The Japanese section displayed for us superb twinned quartzes and remarkable stibnites. We also noted the fine geological maps for which the scholars of this country deserve exclusive credit. Mr. Takudzi Ogawa, a geological engineer, explained the interesting points in this section to us.

We paused briefly at the rocks from Sardinia being exhibited by Professor Lovisato in the Italian section and the succinites in the German section. We then toured the excellent detailed geological map halls arranged by France, which were decorated with maps and sections showing the complicated configuration of our principal mineral deposits in a most illustrative way. A little farther on we came to the display cabinets so beautifully presented by Mr. Stuer, and so well-conceived to inspire a taste for our science in the uninitiated.

We went downstairs again, left the exhibit hall for mines, and walking across the gardens to the other side of the Champ de Mars, entered the exhibit halls there. For lack of time, we were forced to make too hasty a tour of Category 87, chemical products, which were exhibited on the second floor of the chemical industries exhibit hall. Everyone nonetheless admired the beautiful artificial crystals of organic substances exhibited by Mr. Tanret, and at the other end of the gallery, the prodigious series of rare earth salts extracted, over a period of many years of labor, from 3,000 kilograms of monazite sands by Messrs. Chenal, Douilhet, et al., using the methods of Messrs. Wyrouboff and Verneuil. The extraordinary nuances and beautiful crystalline forms of the sulfates of neodymium, praseodymium and samarium (formerly called didymium) won the approbation of everyone. (These 3,000 kilograms of monazite sands provided about 300 kilo-

grams of oxides of other rare metals after the cerium and thorium oxides has been eliminated.)

Some of us walked down for a moment to the Centennial Museum exhibiting Category 87, where there were many remembrances of chemists of the bygone and contemporary eras. These included, among other things, artificial minerals by H. Sainte-Claire Deville and Debray (arsenious acid in its two forms); Egyptian blue by Mr. Fouque; and rubies by Messrs. Fremy and Verneuil. We then visited the German section, with its imposing collective and anonymous exhibits (aromatic products, beautiful crystals of artificial indigotin, benzidine, alizarin, thymol, ferrocyanides, Stassfurt salts, etc.).

Progressing along the galleries on the second floor, we came to the exhibit hall for teaching and education—Category 3, pertaining to higher education and scientific institutions. Mr. Termier called our attention to very beautiful microscopic preparations of minerals and rocks done by Mr. Terrier. A little further on, Mr. Bel showed us the minerals, rocks and various fossils he had brought back from Laos and Siam. Next we stopped in front of the display cases of the laboratories of higher educational institutions, particularly those of the Sorbonne. There Mr. Hautefeuille, our eminent president, had on exhibit an incomparable series of artificial minerals, in part in collaboration with Mr. Perrey. These were obtained by prolonged heating lasting months. There we saw zircons, emeralds, phenakites, anatase, etc. The zircons, in particular, were more beautiful than those found in nature. This same display also included Mr. L. Michel's handsome artificial tungstates (wolfram, scheelite, powellite, etc.).

Prominent among the exhibits by the scholarly societies was a bound volume exhibited by our Society including all its publications since 1889. Quite nearby, in the Category 2 exhibit provided by the secondary schools, Mr. and Mrs. Boubee showed us their very beautiful exhibit (calcite in rough scalenohedrons, stibnite from Japan, dioptase, boleite, cumengite, etc.).

On the same floor, we passed through several halls, viewing a part of Category 15, precision and optical instruments. It was there that

Figure 8. **A view down the pont Alexandre III. (Photo: Roger-Viollet)**

Figure 7. **The American pavilion. (Photo: Roger-Viollet)**

a remarkable collective exhibit by the German manufacturers of precision instruments was to be seen. The representative of this association, Mr. Drosten, as well as Professors Westphal and Czpaski, most cordially pointed out all of the details for us. They made special mention of the Fuess microscopes for mineralogical and petrographic studies, and above all, the new model with Nicol prisms which can, when desired, be made interdependent; the goniometers manufactured by that same firm; the Zeiss and Leitz microscopes and lenses which are so well-known; the Pulfrich and Abbé refractometers manufactured by the Zeiss firm; the Iena glassware; chemical vessels of glass with high resistance to shock, sudden changes of temperature and corrosive agents; optical glass, in particular extra-heavy flint glass (n = 1.97), lenses of molten silica; etc.

Going downstairs again in that same hall, we visited the French section of the exhibits in this same category. There we saw the spectroscope with an adjustable wavelength scale exhibited by Mr. A. de Gramont; microscopes manufactured by the Nachet firm, in particular a large mineralogical model with all of the latest features; another model with Nicol prisms which can be made interdependent during rotation, as in the Fuess model; and finally, a large microscope for examining opaque objects, even with magnification of the highest power.

Leaving the hall, we heard the gun fired from the Eiffel Tower to signal the noon hour. Fortunately, we had been able to complete our entire morning schedule, but we were somewhat tired. Crossing the Iena Bridge, we reached the Algerian restaurant where luncheon awaited us.

After an hour and a half of well-earned relaxation, we set off again for the buildings at the Trocadero. However, the crowds and the heat

(happily less than that today) made the end of our tour less agreeable. We were to lose some of our group, and regrettable gaps developed in our ranks.

We began with the official Algerian exhibit hall, where numerous series of very interesting rocks and minerals were displayed by our colleagues, Messrs. Pouyanne and Gentil. We moved through the exhibits of Tunisia and then New Caledonia, where we were provided with extensive explanations by Messrs. Dislere and Caubry. Then, at the exhibit of the Danish colonies, we viewed admirable specimens of Iceland spar, some showing their natural facets and surrounding groups of zeolites, and others in solid form, with cleavage of impeccable transparency.

The Asian Russian hall displayed for us, as it had in 1889, the most beautiful topazes and other gemstones from the Ovtchinnikoff firm, as well as dioptases and ornamental objects of rhodonite, in particular a monumental cup of this latter material.

We then undertook a rather long tour through the exhibits of the British colonies. Ceylon offered us a large number of various cut gemstones; British India corundums, muscovites, etc.; while in the Canadian exhibit, the engineer, Mr. Faribault, provided us with valuable information. We admired in particular the Klondike gold, the apatites, the slabs of labradorite and sodalite with a marvelous luster, and the relief models of mines with movable segments. Finally, in the Western Australian exhibit, with another very cordial engineer, Mr. Holroyd, as our guide, we were dazzled by gold nuggets of fabulous weights and dimensions, telluretted ores of this precious metal, petzites, calaverites, etc., and natural gold sponges, or what are called "mustard gold."

We still had some distance to go in order to complete our schedule, and it was with regret that we abandoned our contemplation of the splendors of the Trocadero. The bravest of us then crossed the great footwalk of the Palace of the Armies, finding ourselves again on the Left Bank. We set off along the Rue des Nations.

Mexico offered us a display of fine specimens of balls of azurite or "boleos," crystals of boleite, cumengite, etc., displayed by Mr. Cumenge. Just adjacent, we cast a rapid glance at the Hellenic exhibit; the ores from Laurium, less well displayed than in 1889; the mercury ores from Mount Avala in Serbia; the rock salts from Romania; and the beautiful breccia marbles from Portugal. In the most original exhibit by Finland, we saw polished slabs of spherical granites, potstones, the Bjurbola meteorite (a chondrite free of metallic iron), very large numbers of huge fragments of which fell on 10 March 1899, and geological maps. All of these items are described in an excellent brochure published by the Finnish Geological Commission, which was available free at the exhibit.

Finally we arrived at the Esplanade des Invalides, where Category 85, jewelry, was displayed. We visited the United States section to see the display cases of Tiffany and Company, where Mr. Kunz again did the honors for us, and we saw in cut and mounted form the gems we had seen in the rough at the Champ de Mars during the morning (enormous topazes, beryls, zircons, peridots, rubies, sapphires, opals, alexandrites, rhodonites, etc.). Mr. Foote then showed us another collection of American minerals, carefully chosen for study. Just adjacent there was a display of turquoises and also petrified wood from Arizona in polished slabs in a rich variety of colors. Passing through several more halls, we reached the Russian section, and we could not but exclaim over the famous map of France in stone inlay, using hard rocks with gemstones set in, all of Russian origin, a gift from His

Figure 9. **The Siberia pavilion, where the Ural Mountains mineral exhibits were housed. (Photo: Bibliothek Nationale)**

Majesty the Emperor of Russia to our country. Close by a curious collection of jewels belonging to the Empress was exhibited.

Crossing the main avenue, we reached the French jewelry section. The superb Jubilee diamond, standing alone on a rotating base, drew everyone's eyes. A case displaying the work of our best artists contained a myriad of diamonds, some colorless, others endowed with vivid hues, as well as rubies, sapphires, etc., displayed in such a way as to show off their finest qualities. In passing, we noted a huge octahedral yellow diamond, only partially cut and mounted in a most original fashion by the Lalique firm.

Behind the Palais des Invalides, at the intersection of the Rue de Grenelle and the Rue de Constantine, we found a very interesting annex devoted to cut precious stones. The specimens of rough gems exhibited by the Gauthier and Pinier firms were most curious, as were the colored diamonds exhibited by Mr. Eknayan.

It was by then about 6 P.M. Not everyone completed the tour simultaneously, and we have already explained the reasons for this scattering.

Also, we had no opportunity that day, as we had in 1889, to express our thanks to all of those, Society members and others, stewards, engineers, exhibitors, etc., who contributed to the interesting and pleasurable nature of this gathering. Let me take this opportunity to ask the Society to be so kind as to do this for us today.

In Bourgeois's report we begin to get some idea of the sheer immensity of the exposition, so large that a full day was insufficient merely to scan through all the exhibits having to do with minerals. One attendee complained: "No man has been able actually to see this vast, indeed too vast, labyrinth of labyrinths, this enormous multitude of collections, this museum of museums" (Geddes, 1900).

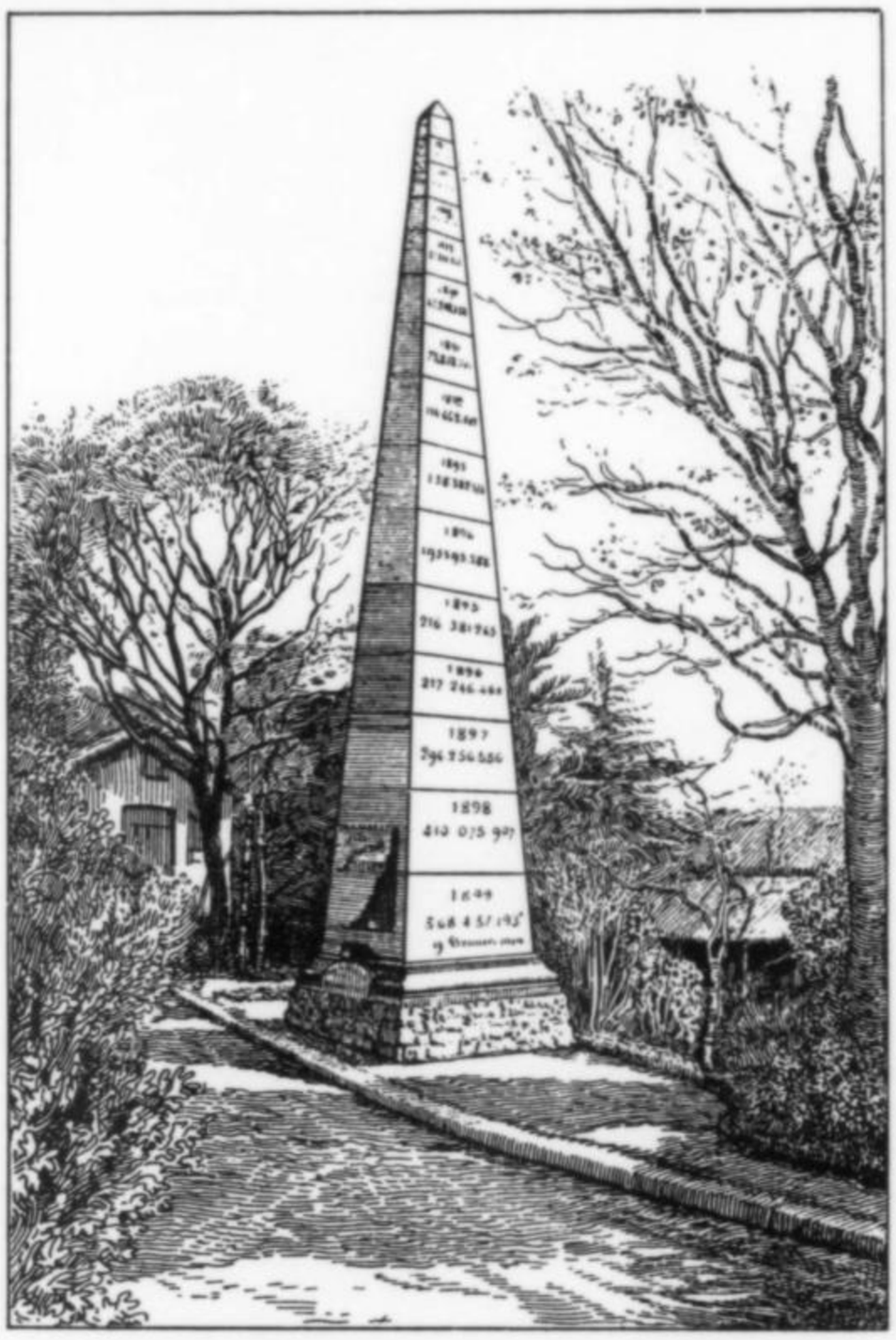


Figure 10. **Gold-plated masonry obelisk, the "Pyramide d'or du Transvaal" showing fairgoers the amount of gold that had been mined in the Transvaal (Hauser, 1901).**

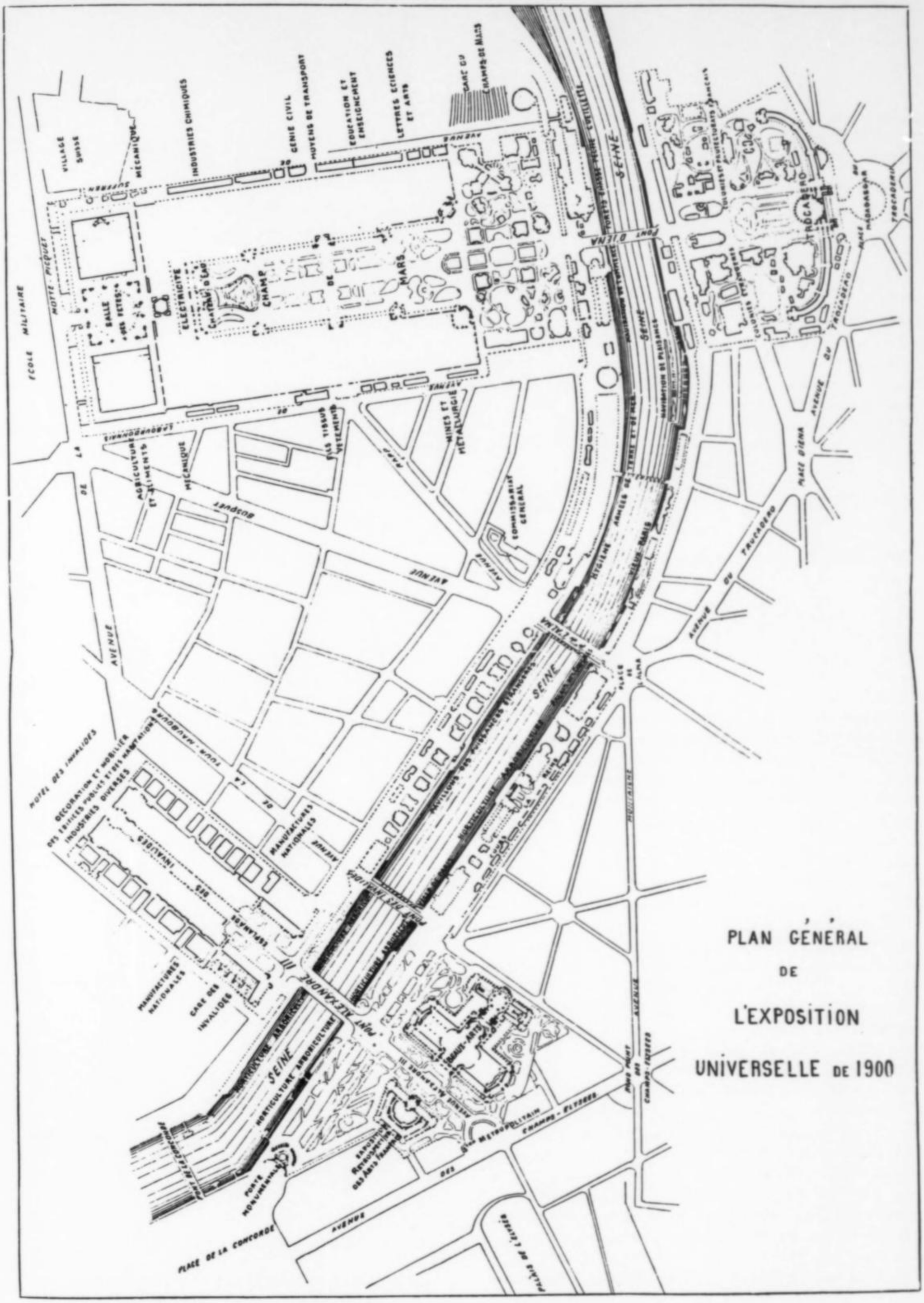


Figure 11. **General plan of the exposition.**

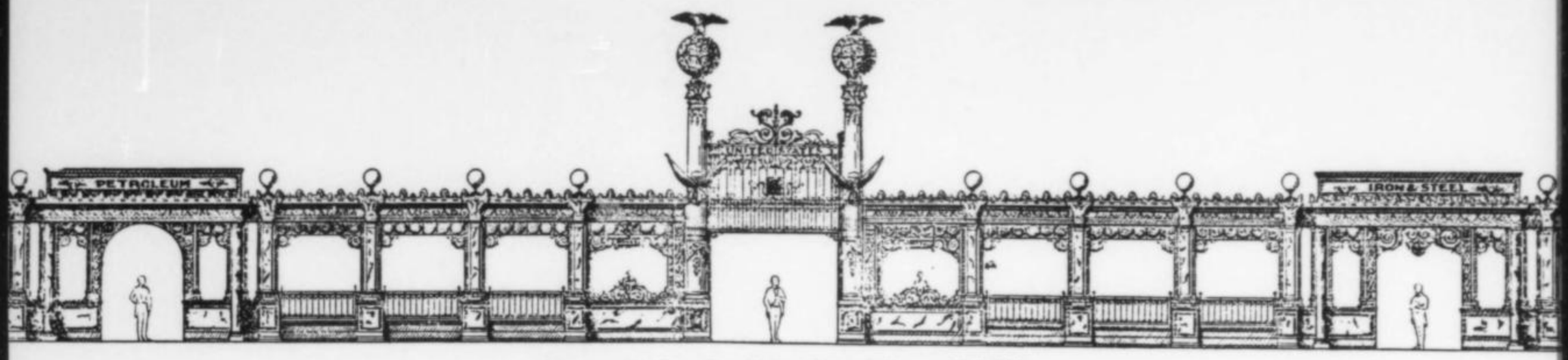


Figure 12. **Facade of the United States Exhibit of Mining and Metallurgy (Farrington, 1900).**

EMJ REPORT

The Engineering and Mining Journal had agents at the Fair as well, and they reported regularly for their American readers. Notes appeared in February, March, May, June, July, August and November of 1900. Some excerpts are as follows, beginning with some preliminary reports that appeared before the Fair opened:

THE MINING AND METALLURGICAL EXHIBIT AT PARIS

February 10

A special feature of the United States Department of Mining and Metallurgy in the Mineral Palace at the coming Paris Exposition that is likely to attract the attention and interest of scholars and students, is associated with the collective exhibits of systematic mineralogy and metallurgy. Early in the year the director of this department decided that this exhibit should contain samples, so far as they could be obtained, of all the minerals occurring in the United States and indicated in the eight groups of Dana's system of classification.

The peculiar feature of this work is to be found, however, in the fact that the collection of these minerals has been committed to representatives of five of our leading educational institutions. In order to bring this plan to a successful conclusion, it became necessary to secure certain sums of money over and above that which could be spared from the national fund. To effect this, the department entered into communication with State boards, the institutions themselves, and private friends and patrons of the same, the sum required being promptly secured. The next step was to authorize the directors of each institution to name a candidate who should receive the title of "Honorary Mineralogist for the Commissioner-General of the United States to the Paris Exposition of 1900"—a recognition and honor which was fully appreciated and willingly accepted by all.

As an additional incentive to active effort, and in view of the fact that the institutions or their friends had rendered material financial assistance, as well as intelligent professional service, it was decided that each of these several collections should at the end of the Exposition be returned to and become the property of the institution whose candidate had collected and arranged it. The results have far exceeded anticipation, and the complete display is certain to command admiration not only because of its intrinsic value and completeness, but also owing to the unique character of its origin. The names of the institutions and the honorary mineralogists representing them, together with the groups with which they have to do, are as follows:

Michigan School of Mines: H. T. Mercer; Group I, Dana Classification—native elements.

Colorado College, Colorado: Rufus M. Bagg, Jr.; Group II.—sulphides, etc.

Cornell University: A. C. Gill; Groups III., IV., VII. and VIII.—sulphosalts, haloide, salts or organic acids, hydrocarbons, etc.

Princeton University, New Jersey: E. R. Hewitt; Group V.—Oxides.

Massachusetts Institute of Technology: W. O. Crosby; portion of Group VI.—Oxygen Salts.

Chicago University: J. P. Iddings; portion of Group VI.—Silicates, etc.

Figure 13. **Gold nugget rosary made from Yukon nuggets and presented to Mr. Gendreau, a vicar in Dawson City, by the local miners. Shown at the exposition (Hauser, 1901).**

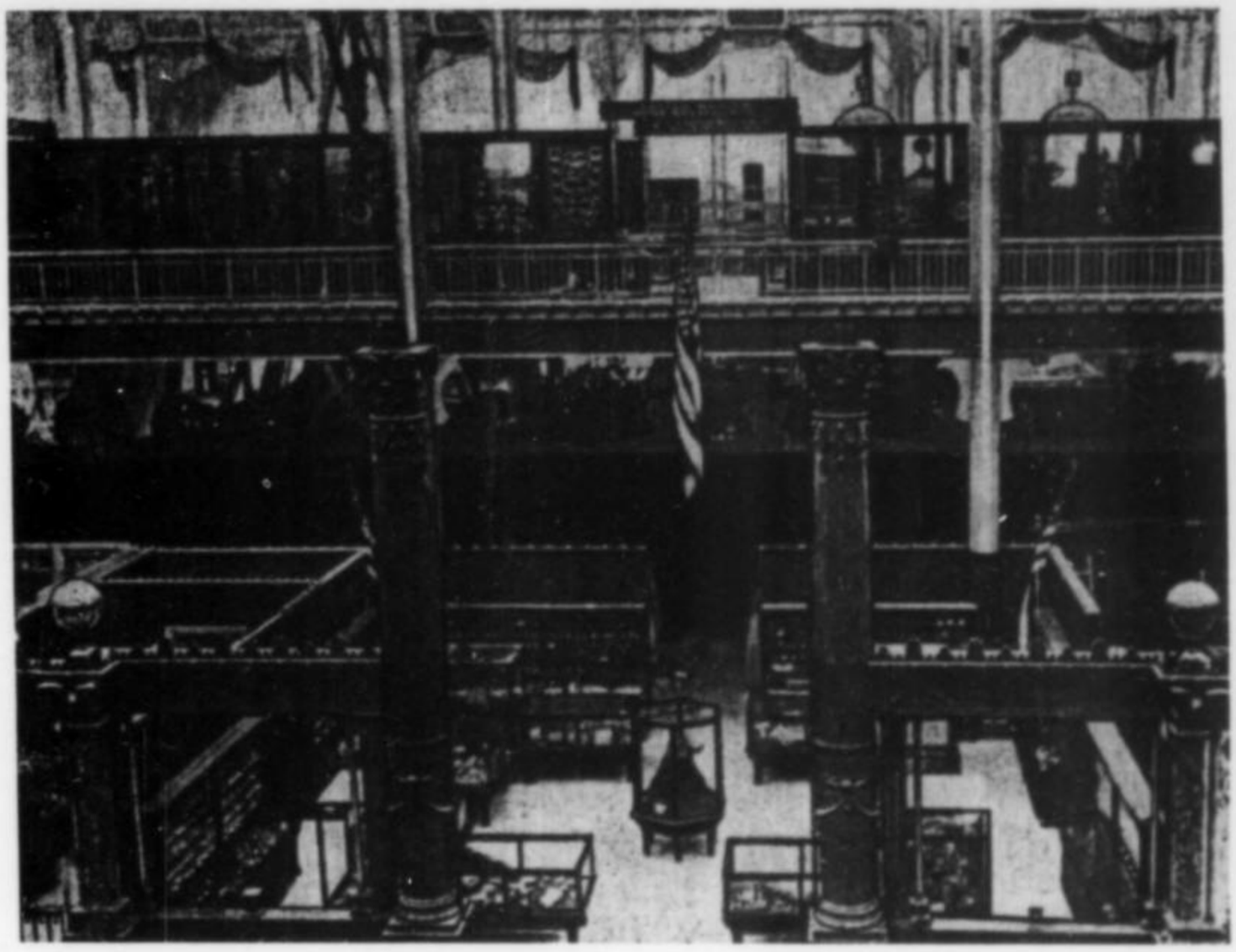


Figure 14. **A view of part of the United States mining exhibit (Farrington, 1900).**

Figure 15. **Exhibit case of gold nuggets from California shown at the exposition (Hauser, 1901).**

In this immediate connection should be mentioned the Field Columbian Museum, O. C. Farrington, to whom has been committed a collection of crystals of the United States, illustrating crystalography, under the patronage of W. J. Chalmers.

The commissioner-general has set aside a room to be the headquarters in the Department of Mining and Metallurgy for the members of the American Institute of Mining Engineers, which room will be graced by portraits of leading American scientists. In this room will be installed the library, containing all the leading American publications on Mining and Metallurgy. Above the bookshelves and portraits will be placed a continuous frieze of colored transparencies containing views of mining regions, metallurgical works, stone quarries, ore docks, etc. This apartment will also be furnished with chairs, tables, writing materials and scientific periodicals. It immediately adjoins the special exhibit of Systematic Mineralogy, and gives promise to being a rendezvous for both American and foreign representatives whose labors and interests are associated with these special displays.

The installation of exhibits in this department promises to prove one of rare beauty and attractiveness. The main facade, which extends for 164 ft. along the principal aisle in the Palace of Mines, is of bronze and marble, with granite columns of peculiar beauty. The panels are of rare marbles, and the columns of the heavier structural stones. The main central entrance is in the form of a port-cullis, and the two other openings are beautiful examples of the iron and stoneworker's art. This facade is sufficiently open along its whole length to admit of a comprehensive view from the exterior, and one standing within the main portal will take in by an upward glance the facade of the minor metallurgy or hardware exhibit, which extends a length of 80 ft. along the main gallery above.

March 3

Native Metals for Paris Exposition.—Mr. Mercer of the Michigan School of Mines has completed his collection of native metals from the United States, and it has been shipped to Chicago, from where it will be transported to Paris. The collection includes copper, silver, gold, sulphur, carbon, antimony, bismuth, tellurium, platinum and iridosmine, about 100 specimens in all, valued at from $360 to $375. The collection includes a specimen of gold-bearing quartz taken from a "pocket" in the Michigan Gold Mine near Ishpeming, Mich., that

is 4 or 5 in. in diameter and contains about $15 worth of gold; this was loaned by Hon. Peter White of Marquette. Another specimen is native lead associated with native copper, from Franklin, N.J. There are specimens of crystallized gold, crystallized copper and crystallized silver and of the "half breeds"—copper and silver—which are frequently found in the copper mines of Michigan. The exhibit includes 2 or 3 pieces of meteoric iron, one weighing 50 lbs., from the meteoric fall in Canyon Diablo, Arizona, and there is a smaller one from the Sacramento Mountains of New Mexico. Both of these specimens are polished and one is etched, to show the Wiedmanstattian figures. There is also some josephinite from New Mexico. A beautiful specimen of branch copper, fern-like, on a natural pedestal of rock 4 in. square, comes from the Michigan Mine. A specimen of hematite iron ore, with native copper attached, came from Tower, Minn. In Ontonagon County, Mich., Mr. Mercer encountered a beautiful piece of crystallized silver. The back is composed of calcite crystals, while in the front are 4 rows of silver crystals, arranged similar to the features of an Indian's head dress. This is 3 or 4 in. in diameter and came from the Mass Mine. There are different modes of copper. Two or three pieces are crystallized after the form of cuprite, and after the form of azurite. There is crystallized gold from Colorado and California and platinum from California and Oregon.

May 26 (by O. C. Farrington)

THE UNITED STATES MINING EXHIBIT AT THE PARIS EXPOSITION.

The exhibit of the United States at the Paris Exposition in the departments of mining and metallurgy is acknowledged on all sides to be very creditable, and in some respects far surpasses the similar displays of other countries. Not only has a large and thoroughly representative collection of the ores and minerals of the country been secured and richly and attractively installed, but the exhibits of metallurgical and manufactured products made by various firms and corporations are also very extensive and serve to favorably impress the foreign visitor as to the extent and variety of our resources. The splendid façade, 162 ft. in length, fronting the exhibit, is the first eye-opener to the foreigner, showing him as it does that the power of producing artistic creations in metal and stone is no longer to be a monopoly of the Old World. The façade is the work of Winslow Brothers, of Chicago, and is shown in the second illustration. It is not only wholly of American design, but is made entirely of American materials. The framework is of cast iron with bronze finish. Into its ornamentation are wrought heads of the Rocky Mountain sheep, American eagles and the seals of the various States and Indian nations. Pillars and slabs of American marbles and spheres and rods of American copper also enter into the composition of the work.

Entering between the two central pillars of the façade (shown in the first illustration), the visitor finds himself in the space devoted to the exhibition of ores from the United States. In the central case of this section is displayed an unrivaled series of specimens of crystallized gold, and of gold nuggets and dust. Among these may be mentioned about 20 specimens of crystallized gold from the Lillian Mine, of Leadville, Colo.; a large specimen of crystallized gold from Nevada County, Cal.; large polished specimens of gold-bearing quartz from the Smuggler Union Mine, Telluride, Colo., exhibited by the Colorado Scientific Society, and from the Topeka Mine, Central City, Colo., and a series of gold nuggets and dust from New Mexico, Washington and California, exhibited by the Maxwell Land Grant Company, the Bank of Commerce, Seattle, and the California Commission respectively. About the central case of the section are grouped two parallel rows of cases, the first being table cases and the second wall cases. The cases are constructed of mahogany and plate glass. Next to the gold collections already referred to, the case which attracts most attention is that containing a solid mass of native silver from the Mollie Gibson Mine, Aspen, Colo. This mass is of flattened oval shape, its greatest diameter is about 2 ft. and its weight is 338 lbs. Surrounding it a series of specimens of crystallized copper and silver from Michigan is exhibited by Leopold Brothers, of Chicago. In the two cases adjoining, the Copper Queen Mining Company displays the finest specimens of malachite and azurite which have ever come from the mines. This display attracts much delighted comment.

The case at the left of the entrance is devoted to American gems, Tiffany & Company, of New York, being the chief exhibitors. An amethyst from Maine, Wisconsin diamonds, and rutilated quartz from North Carolina are especially worthy of notice here. In square cases at the corners of the inner quadrangle are exhibited large single specimens. These include a block of zinc ore 2 by 1 by 1 ft., from the mines of the New Jersey Zinc Company, Franklin, N.J.; a block of iron ore (magnetite) of about the same size from the Champion Mining Company, Champion, Mich., and a 2-ft. cube of natural sulphate and carbonate of soda from Downey Lakes, Wyo. Another specimen worthy of especial note is a spheroidal mass of native antimony nearly 1 ft. in diameter from Kern County, Cal. This is exhibited by the California State Mining Bureau. Smaller specimens of ores are exhibited, chiefly in the wall cases, and here a very complete and satisfactory showing has been made. Among the gold ores thus shown, a series of roasted telluride ores from the Independence Mine, Cripple

Figure 16. **The soda nitre pavilion.**

Figure 17. **One of the Foote Mineral Company exhibit cases, purchased at the Exposition by A. E. Seaman for the Michigan School of Mines (where the original invoice itemizing all the specimens is still on file).**

Creek, Colo., attracts much attention. The Woods Investment Company, of Cripple Creek, also shows a complete collection of telluride ores and the accompanying phonolite and granite. In the ores shown by the Golden Gate Mining Company, of Mercur, Utah, the association of realgar with the richer ores is a point which elicits much interested inquiry from foreign mining engineers.

The chief exhibits of silver ores are from the mines of Washington, Idaho, Colorado and South Dakota. The series from the Graphic Mine, Magdalena, N.M., shows limestone, iron and lead, flux and ore all occurring in the same mine, while it is stated that wood for fuel can be obtained near by. The New Almaden, Cal., quicksilver ores are very fully represented, some remarkable sections of veins containing free quicksilver being shown.

Adjoining the exhibit of ores is an extensive collection of minerals and crystals of the United States, prepared with especial reference to their scientific interest. This collection was gathered through the co-operation of seven educational institutions of the country, according to a plan already described in the "Engineering and Mining Journal." The great variety of minerals to be found in the United States is illustrated by the fact that of the 850 known mineral species, about 350 are represented in this collection. It is doubtful if any other country in the world could exhibit so large and varied a collection of this worth. Specimens of special interest in the portion of the collection exhibited by the Michigan School of Mines are occurrences of copper in hematite from Vermilion Range, Minnesota, and of copper after cuprite from Old Dominion Mine, Arizona. Brilliant pyrite and chalcopyrite specimens from Colorado and Missouri, and crystallized molybdenite from Okanogan County, Wash., are especially worthy of note in the collection contributed by Colorado College. Cornell University's exhibit contains some superb specimens of fluorite, also pyrargyrite, stephanite, etc., from a new locality, Lake Chelan District, Washington. In Princeton University's exhibit the series of spinels from New York and of quartz from Arkansas is especially fine. The Massachusetts Institute of Technology exhibits a showy series of Joplin calcite and Arizona azurite and malachite, and some fine specimens of variscite and pyromorphite. In the University of Chicago's exhibit, which includes the silicates and sulphates, a large crystallized specimen of rhodonite from New Jersey, another of mountain leather from New Almaden, Cal., and the series of tourmalines may be noted as of especial interest. The collection of crystals of the United States, exhibited by the Field Columbian Museum, contains about 250 specimens of single crystals, fully illustrating the forms of different species and the six systems of crystallization. They range in size from the huge Utah selenites to the little quartz brilliants from New York. In addition to the above collective mineral exhibit, the States of North Carolina and California make a very complete display of their minerals and the firm of A. E. Foote, Philadelphia, fills two brilliantly lighted arches with showy American minerals.

June 16

UNDERGROUND WORKINGS AT THE PARIS EXPOSITION.

The "Galeries Minieres" and the "Monde Souterrain," underneath the Trocadéro Park, which is included in the Paris Exhibition, were inaugurated on May 5th and opened to the public on the following day in a nearly complete state.

Near the"Exposition des Phares," or Lighthouse Exhibition, is the large iron headgear (intended for the Anzin Colliery in the Departement du Nord) that can be seen from the Avenue du Trocadero outside the Exhibition railings. The engine-room, gained by a flight of steps, contains the 3,000-H.P. compound hoisting engine, made by M. Dubois of Anzin, the largest yet turned out in France, that will be eventually erected on the Arenberg shaft of the Anzin Colliery.

As the engine is not yet in working order, visitors are let down in a lift, made by MM. Roux, Combaluzier & Cie., one side of which is a glass plate, so that intermediate landings can be seen during the descent. Miners in white uniform with the traditional crossed hammers embroidered on the collar, and wearing the regulation stout leather hats for protection from falling stones, etc., either descend with the visitors or meet them on arriving at the bottom, and then conduct them through the workings, which are well lighted by incandescent electric lamps at frequent intervals. The main trolley-way, kept up with iron frames of the Bruay type, is laid with three lines of way, which, however, merge into a single one on the road becoming narrower, when the roof is supported by timber; and, indeed, all varieties of timbering are exemplified in the remainder of the factitious workings. At one point is an engine-room, apparently hewn out of the rock, where an electric pump is supposed to force the mine water to the surface; and at another there is an underground stable with a real live horse. There is a full-size reproduction of a set of mine tubs hauled by an electric locomotive, as at the Marles Colliery, for bringing to the shaft from 1,500 to 1,800 tons daily. So far as it is possible to show factitiously where no real coal exists, an illustration is given of a working place occupied by several men, represented by life-size figures.

By a sudden transition, chiefly distinguished by the absence of timbering, the gallery, or heading, enters an iron pyrites mine like that of Saint-Bel, near Saint-Etienne, worked by blasting with dynamite, the shot-holes being bored by electric rock-drills. Deposits of galena, argentiferous blende and rock salt are traversed in succession; and then the mining of slate at Angers is illustrated, after which comes a Colorado gold mine, for seeing which an extra 50 centimes (10c.) is demanded, and a Transvaal gold mine, for which there is no extra charge.

These galleries have been driven very sinuously underneath the east wing of the Trocadero Palace, the exhibition of China and that of the Dutch East Indies, the exit being near the cascade that was made in 1878. Whereas the "Galeries Souterraines" or "Exposition Miniere Souterraine" (as the workings already described are variously named), illustrate mining of the present day, the other underground exhibition, the "Monde Souterrain," which occupies a site underneath the Trocadero cascade, is claimed to represent all the marvels that now exist or have existed in the earth's interior. There may be seen the very earliest mine workings, and again those of the Middle Ages, archaeological monuments faithfully reproduced, the chief episodes of geological history, the consolidation of the earth's crust, a French lake during the carboniferous epoch, and various celebrated underground grottoes, while the entrance is guarded by an immense iguanodon of the secondary, and the exit by a megatherium of the tertiary epoch.

Hall No. 1 affords a representation of the first mine workings effected by the Phoenicians about 3,000 years ago, with slaves bringing down the cupriferous rock, while the water is taken off by a series of wheels with floats. The next hall represents a lead mine of the sixteenth century, with a curious winding engine formed by a double wheel turned by hand, and a ventilator consisting of enormous bellows worked by pedals. There are also reproductions of the blue grotto at Capri, the Padirac grotto with underground river in the south of France, the hermits' grotto of the Dead Sea, an Etruscan sepulchre, the catacombs at Rome, and many other wonders.

The more one reads of the Paris Exposition, the more one realizes what a vast and complex phenomenon it was. Each writer sees some of the same things as his colleagues, but also a wide range of interesting exhibits and extraordinary mineral specimens which the others missed. How much there was to see in total may never be fully known.

Prizes and medals were awarded to the best of the 83,000 exhibitors in a lavish ceremony. Among the winners in the Mining and Metallurgy category were the Copper Queen Consolidated Mining Company, the A. E. Foote Mineral Company, the American Museum of Natural History, George F. Kunz, the New York State Museum in Albany, and Roebling's Sons & Co., Trenton, New Jersey.

AFTERMATH

The Australian Gold

What happened to those thousands upon thousands of mineral specimens exhibited at Paris in 1900? The spectacular Western Australian display of gold seemed like it should have been difficult to misplace, so I began there. An inquiry was directed to Bill Birch, curator of minerals at the Museum of Victoria and author of a comprehensive survey of Australian gold mines and specimens published in the *Mineralogical Record* in 1987. Birch's report included nothing on the Holroyd gold collection, however, and he had not previously been aware of its existence. Through the help of Alex Bevan, Curator of Minerals at the Western Australian Museum, Birch was able to track it as far as the Geological Survey of Western Australia; but the collection was not in the Survey's museum. Finally it was learned that, for security reasons, the gold had been stored in a vault in the Perth Mint since its return from Paris, and is *still there*. P. E. Playford, Director of the Geological Survey, supplied the following information in a letter of June 22, 1987:

> A search of our old files has indicated that the original Holroyd set, which included many species of minerals in addition to gold and tellurides, was purchased [from Holroyd] by the Franco-British Exhibition Committee and displayed in Paris [in 1900] and [later] in Glasgow. Some of these specimens were later returned to Western Australia to form the basis of our existing gold collection, which has of course been added to since that time.
>
> It is a matter of regret that many fine specimens from the Survey's collection were melted down during the Depression of the 1930's to assist in meeting the state's deficit. These included at least some of the Holroyd specimens, in particular the "Map of England" nugget.
>
> Holroyd was the mineralogist and assayer who first identified telluride minerals at Kalgoorlie and recognized their potential as valuable ores of gold. Up to that time, tellurides had been discarded during mining, and some even ended up as road metal on the streets of Kalgoorlie and Boulder.

The Jeweled Map of France

Although more of a lapidary item than a mineral specimen, the jeweled map of France presented by Czar Nicholas to President Loubet sounded spectacular, judging from the descriptions of Kunz and Bourgeois. Kunz stated that Loubet had transferred it to the Louvre, where

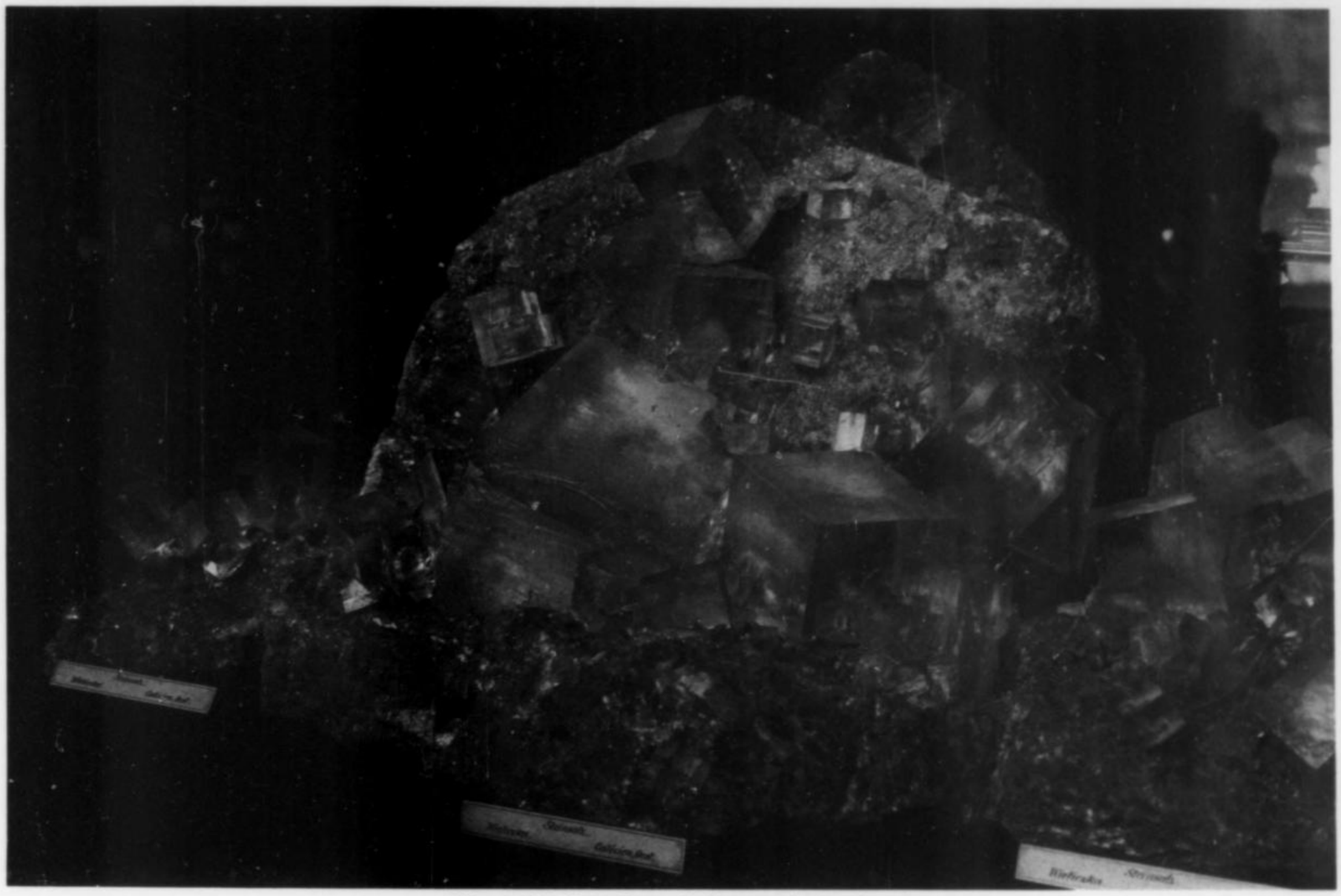


Figure 18. **Very large halite specimens from Wieliczka, Poland shown at the exposition; the labels are about 3 cm tall. Naturhistorisches Museum, Vienna; taken at the museum in 1908 by S. Schramm.**

it should still be found. Pierre Bariand, curator of minerals at the Sorbonne in Paris, made inquiries on our behalf; the map was not present in the Louvre. In fact it had never been at the Louvre. Through diligence, Bariand eventually located the map in a small museum outside Paris called the Compiegne Museum. Bariand wrote, on May 13, 1987:

> I called the curator; he has no documentation but will agree to let us photograph it. The map is badly displayed in a very old fixture . . . it will take at least a day to do the work and maybe more to clean and prepare the map.

Bariand and his wife Nelly cleaned and photographed the map for this article. (See Fig. 21.)

Wieliczka Halite Specimens

A letter was sent to Gerhard Niedermayr, curator of minerals at the Museum of Natural History in Vienna. Kunz had mentioned "the Austrian and Hungarian sections," and the Vienna museum, being as old as it is (see Niedermayr, 1989), seemed a logical place to begin. Here paydirt was struck immediately. Niedermayr was quite aware of the Paris Exposition, and had a vintage photo of one of the enormous groups of halite from the Wieliczka mine in Poland, probably the very one exhibited in Paris. Niedermayr wrote on June 24, 1987:

> We obtained very fine salt specimens from the mines at Wieliczka in 1901, just after the end of the exposition. They were given to our museum by the Ministry of Finance. Only this ministry, because of the salt monopoly, was authorized to make such a gift. Nevertheless, our catalog entries do not state specifically that these specimens had been at the Paris Exposition.

So a little doubt remains, but the circumstantial evidence is compelling enough.

The Boleo Minerals

Cumenge himself was a respected member of the Mineralogical Society of France, so it seemed likely that the cumengites and boleites from Boleo, Mexico, had been deposited in France following the exposition. Inquiries at the Sorbonne, the Paris School of Mines and the Natural History Museum in Paris unfortunately turned up nothing. They had cumengites and boleites, to be sure, but all acquired years later than 1900, and from what were clearly other sources.

Thinking that perhaps the specimens had returned to Mexico, I contacted Miguel Romero, a prominent collector in Tehuacan, near Mexico City. Despite many inquiries on our behalf at Mexican museums, no trace of the Paris specimens was found. The final disposition of the Boleo specimens remains a mystery.

The Wada Collection

Tsunashiro Wada is well known among book collectors as the author of *Minerals of Japan* (1904) a very rare work which contains many photos of excellent specimens from his own collection. Following the exposition his minerals were returned to him in Japan, where he continued to build the collection. But where were they now? Following a lead supplied by Peter Bancroft, I wrote to the Mitsubishi Metal Corporation in Omiya, Japan. Isao Takatori, manager of the Mineral

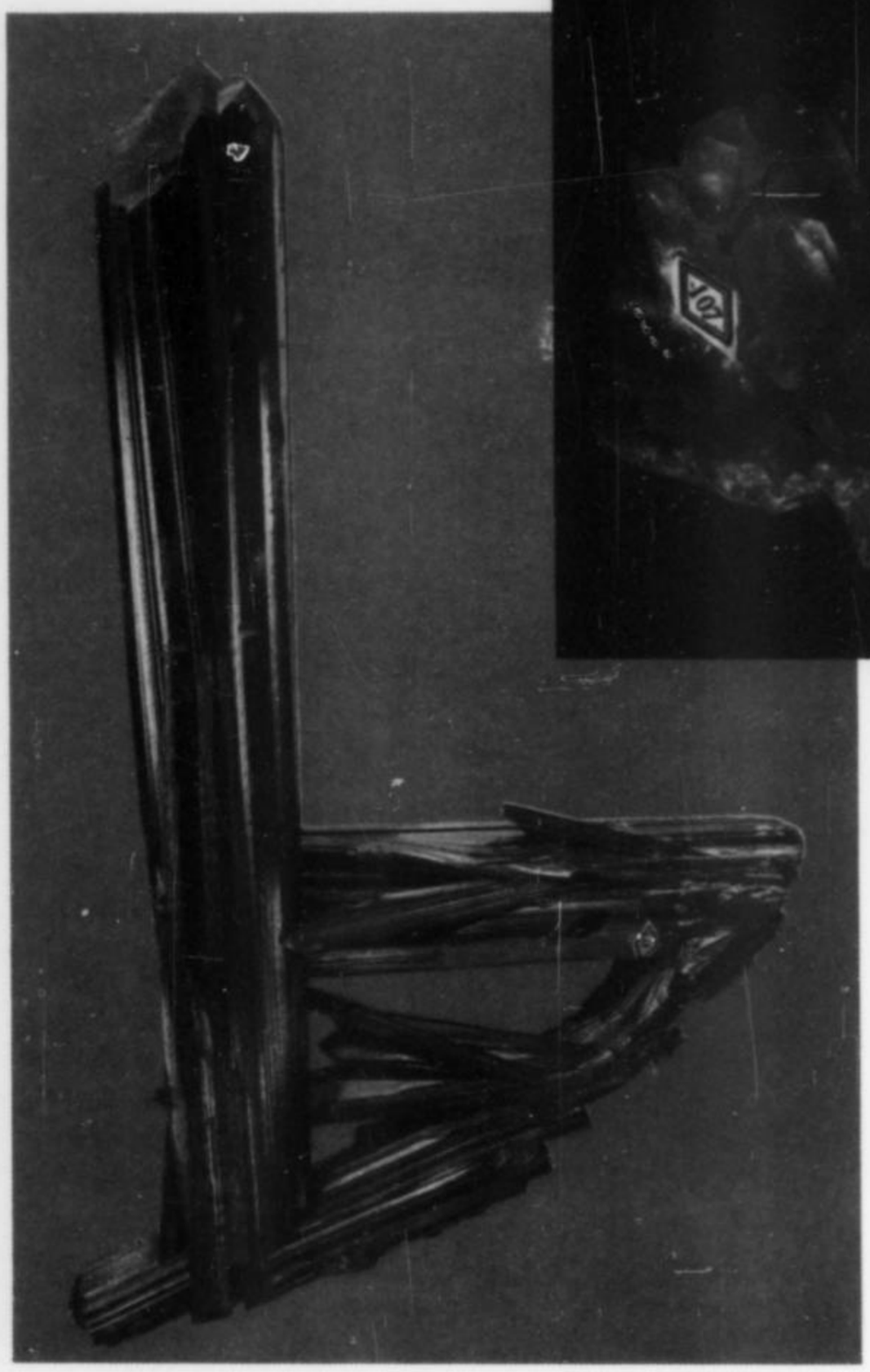


Figure 19. **Stibnite group, 43 cm tall, from the Ichinokawa mine, Ehime Prefecture, Japan. Wada Collection; photo courtesy of the Mitsubishi Metal Corporation.**

Resources Division of the corporation's Central Research Institute, responded as follows in a letter dated May 14, 1987:

> The Mitsubishi Mineral Collection consists chiefly of mineral specimens formerly included in the Wada Collection, which was collected by Dr. Tsunashiro Wada (1856–1920). It contains many excellent specimens of representative minerals and ores found in Japan.
>
> Dr. Wada, a pioneer mineralogist during the Meiji era in Japan, collected many beautiful samples of minerals and ores from mines all over Japan during the late 19th and early 20th century. In order to prevent the collection from being scattered and lost after Dr. Wada's death, the entire collection was passed to the Mitsubishi Company in 1920.
>
> The Wada Collection contained over 3000 pieces representing 158 species, including many rare specimens that can no longer be obtained. Under the ownership of the Mitsubishi Metal Corporation, some 1000 pieces have been added to the original collection, [so that it] currently contains over 4000 specimens representing 240 species.
>
> I am enclosing herewith [some photos] of the specimens in the Wada Collection, made two years ago.

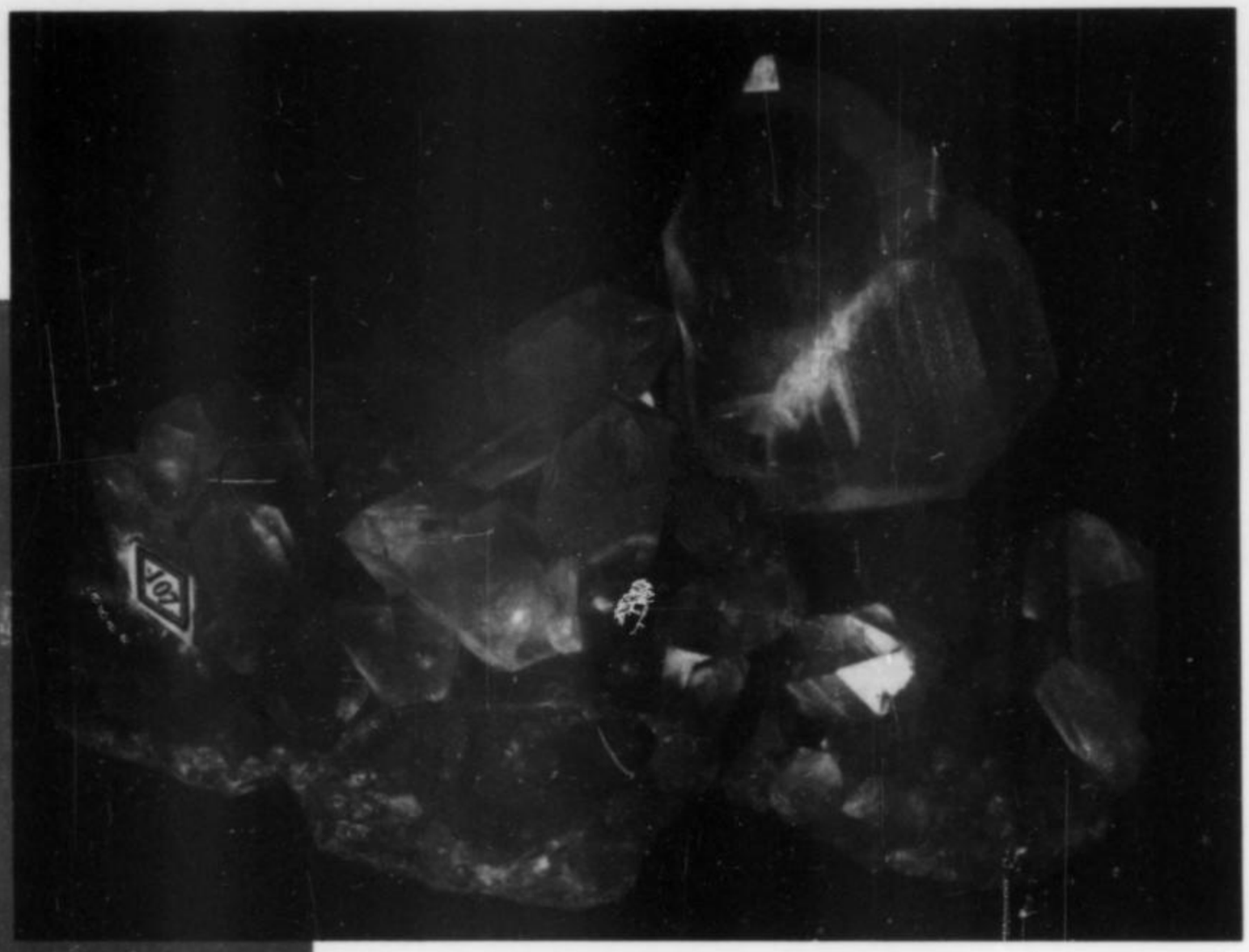


Figure 20. **Japan-law quartz twin, 8.5 cm across, on matrix from the Otome mine, Yamanashi Prefecture, Japan. Wada Collection; photo courtesy of the Mitsubishi Metal Corporation.**

The American Collections

As Kunz mentioned, the Tiffany gemstone collection which he assembled, including many uncut crystals, was purchased following the exposition by J. P. Morgan and presented to the American Museum of Natural History. There it resides today, although it is no longer possible to identify many of the specimens as having come from that source, even though a specially printed exposition catalog survives.

The 4000-specimen collection assembled to illustrate the mineralogy of the United States was presumably broken up after the exposition and its parts returned to the several American universities and colleges that sponsored it. Inquiries at most of these institutions, including also the Field Museum in Chicago which was said to receive the single-crystal collection, have been fruitless. The specimens may well have returned there, but in each case were integrated into the pre-existing collections without any record of their historical source.

The one notable exception is Michigan Technological University in Houghton, Michigan. They have kept much of their exhibition material together, and it is still referred to as "the Paris collection." According to curator Stanley J. Dyl, the majority of the specimens were purchased at the exposition from A. E. Foote, and the original invoices are still on file. (See Fig. 18.)

A large specimen of gold ore accompanied by an exposition medal is on display in the Denver Museum of Natural History, but the side of the medal bearing the winner's name is glued to the display panel and cannot be removed. The winner was most likely a mining company (probably the Colorado Smelting and Mining Company of Denver) unrelated to the main exhibit of American minerals.

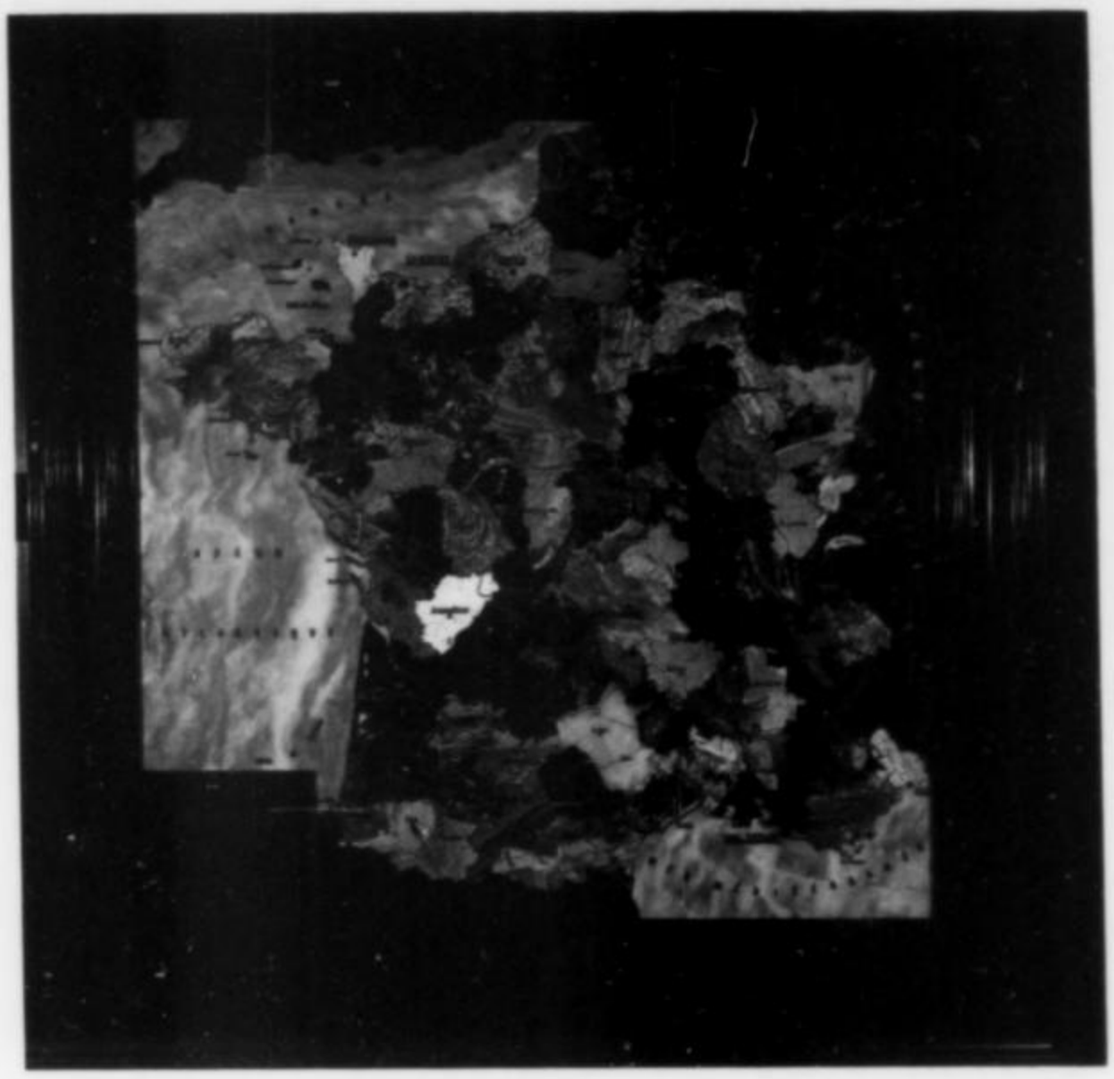


Figure 21. **Gemstone map of France, made under the direction of S. E. Mostovenko in the Imperial lapidary studio at Ekaterinburg (Sverdlovsk) and presented by Czar Nicholas to the President of France at the exposition. It measures about 1 meter square, and is now in the Compiegne Museum. Photo by Pierre and Nelly Bariand.**

Other Collections

The trails of several other collections were followed but without success. The Canadian collection, said to contain "a great variety of gold" as well as other crystallized minerals, seems to have left no trace. The Geologisk Museum in Copenhagen had "no information on this Paris exhibition in our files." I have not pursued further most of the other exhibits, the Finland pavilion, the Russian collection of Ural Mountains minerals, the Hungarian collection, the minerals from the Servian pavilion, Takudzi Ogawa's collection, the French colonial exhibits, and so on. Some of these may yet be in existence and identifiable.

The Publications

The many catalogs and special publications issued by various countries as a supplement to their mineral exhibits are extremely rare today. Kunz mentions four, two of them dealing with the minerals of the Ural Mountains and one being a catalog of the Wada collection. Thorough investigations among libraries (including the Library of Congress) and rare book collectors failed to turn up a single copy, or anyone who had ever heard of the books. Lawrence Conklin, a Kunz specialist, happened to mention to me that Kunz's personal library was acquired by the U.S. Geological Survey following his death in

Figure 22.
The Esplenade de Invalides.

1932. Barbara Chappell, librarian at the U.S.G.S. headquarters in Reston, Virginia, went into the stacks and came up with Kunz's personal copy of the Demidoff catalog of Urals minerals; so at least that one copy has survived. Gerhard Niedermayr and Pierre Bariand each located a few other catalogs, some of which merely listed exhibitors with a line or two about the general content of their exhibits. Many others probably exist in the dark corners of libraries around the world, but the acidic paper used in 1900 is crumbling, and soon this record will be gone.

ACKNOWLEDGMENTS

My sincere thanks to all of those people, mentioned in the text, who took time to search for evidence of the exposition at my request, and especially to Pierre and Nelly Bariand for the photo of the gemstone map, and for locating the Bourgeois report. Sylvia Pettem of The Book Lode provided the Record Library with a copy of *Mineral Resources of the United States, 1900* which contains the Kunz report and which launched this study. My thanks also to the many people in the Interlibrary Loan service, without which such research would be nearly impossible. Finally, my thanks to L. W. Vosloh of the Smithsonian's National Numismatic Collection for providing photos of the exposition medal designed by Jules Clement Chaplain.

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A Collecting Trip through Transylvania & Hungary

❖

1802

by Edward Daniel Clarke

INTRODUCTION

Readers of the *Mineralogical Record* have, at various times in the past, enjoyed the collecting exploits of a variety of world-traveling mineralogists: Mark Chance Bandy in Chile (1935), Fred Cassirer in Europe and America (1888–1979), Sam Gordon in Africa and Greenland (1920's), Ed Over in Arizona (1938), Louis Vance at Los Lamentos (1949), Allan Caplan in Brazil (1930's and 40's), Victor Yount and also Anne Voileau in Morocco (1970's), T. A. Rickard in the San Juans (1902), Porte Crayon in the Georgia gold mines (1857) and many others. Despite the exotic locations and the wide span of time, similarities in the experiences of these intrepid men and women stand out and sound surprisingly familiar to the modern field collector. We have no difficulty in relating to them and feeling very much like their traveling companions as we read their diaries, journals and memoirs. What they sought is what we seek, and what they loved is what we love. To a remarkable degree we have all experienced the same difficulties and the same joys.

The collecting memoir presented here is the oldest of the lot thus far: a trip through Transylvania and Hungary nearly two centuries ago. René Just Haüy's *Traité de Minéralogie*, a landmark recognized as the beginning of modern mineralogical science, was published only the year before. Werner was 53 years old and in his prime. Napoleon had not yet crowned himself Emperor.

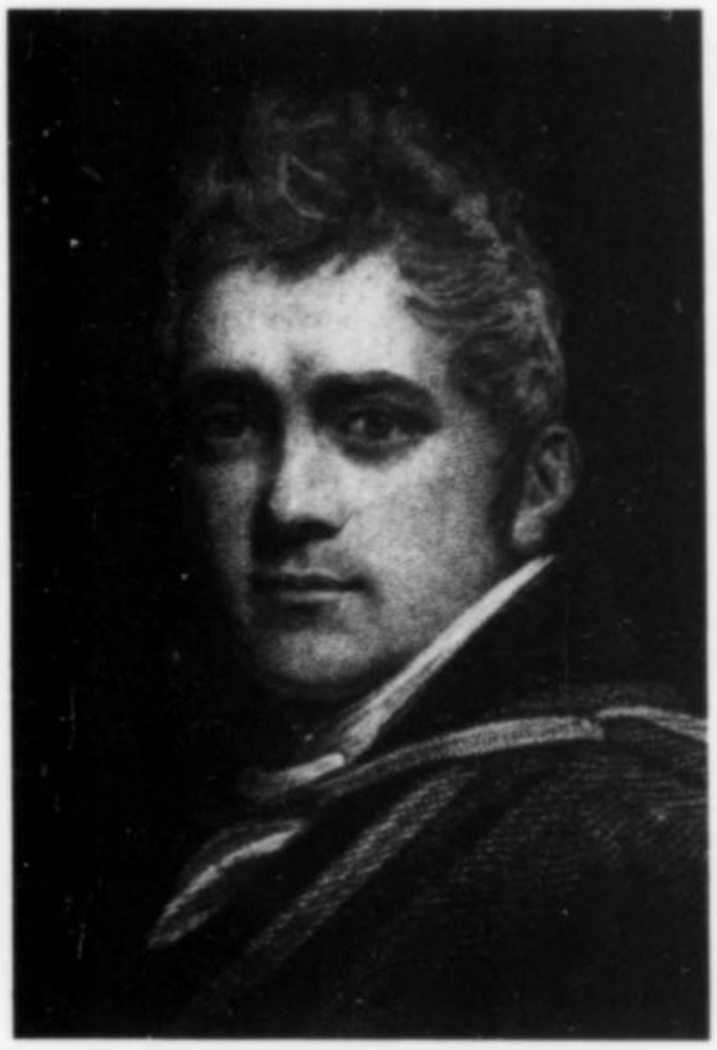

Figure 1. Edward Daniel Clarke, 1769–1822 (from Otter, 1825).

Top: Gold Transylvanian six-ducat piece, struck at the Nagybanya mint from Transylvanian gold in 1694.

The collector was Edward Daniel Clarke, Professor of Mineralogy at the University of Cambridge, England. Clarke was born to a long line of scholars on June 5, 1769, at Willingdon in the County of Sussex. He was educated at Cambridge, and published his first travel narrative in 1791, at the age of 22. During his life he traveled and published extensively, and is also credited with inventing the glass blow-pipe. He died on March 9, 1822, leaving a large family and an extensive and valuable mineral collection (appraised by the University at 1500£).

Romania and Hungary at the end of the 18th century were in many ways as remote and little-known as parts of Africa and South America are today. Clarke was embarking on a brave adventure; his knowledge of the areas he was to visit did not come from modern travel guides but largely from Herodotus, Strabo, Ptolemy, Pliny and other ancient writers . . . and from one more recent mineralogist, Ignaz von Born, who had traveled the same trail in 1777. Clarke's subsequently published travelogs were read with fascination by scientists and laymen alike. The story here has been taken

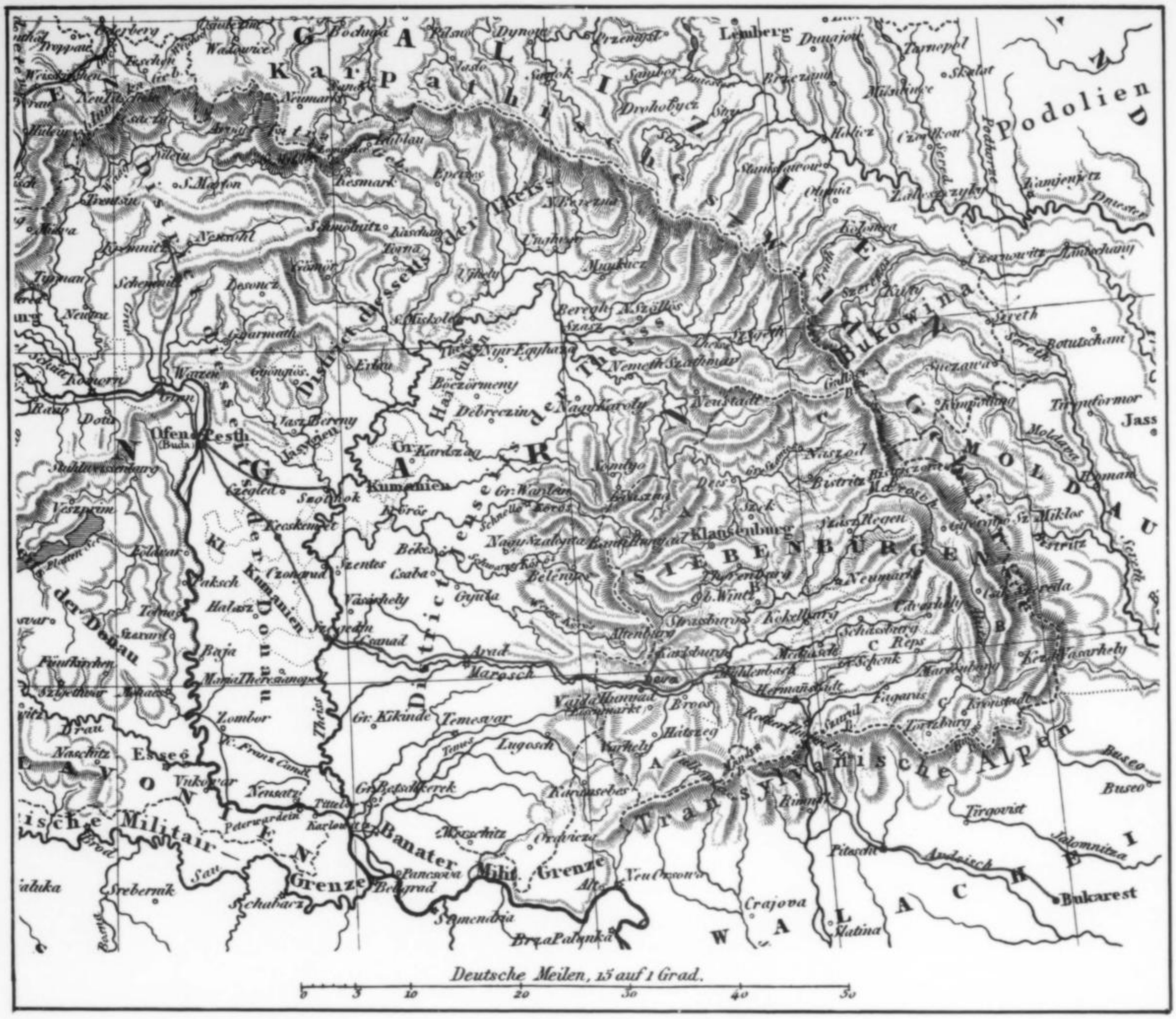

Figure 2. Map showing Clarke's route from Bucharest to Nagyag and from there to Schemnitz and Kremnitz.

(with some editing) from his *Travels in Various Countries of Europe, Asia and Africa* (part the second, section the third), published in London in 1816. A copy of this work was loaned for study to the *Mineralogical Record* by Richard Hauck, a courtesy for which we are very grateful. The specimens pictured are not Clarke's own, but are the same species from the same localities he visited.

We join Clarke as he is leaving Bucharest, Romania, on his way to cross the Carpathian Mountains to descend into Transylvania; notes and equivalent mineral names inserted by the editor are in square brackets.

W.E.W.

April 26. On Monday we left Bukorest. We no longer traveled on horseback, having purchased a small open carriage. The trees were not yet in leaf, and the country exhibited a complete desert, flat and uncultivated. We reached Buletin in four hours, then Marunice three hours later. We passed through Gayest, a village distant three hours; and Kirchinof, three hours more, round which village the country was better cultivated. And, as it was Easter week, the amusements which are common during the same season in Russia were here in full force. We saw villagers in their best attire, diverting themselves with swings and turning machines.

At the distance of four hours from Kirchinof, we came to Pitesti, having traveled the whole day over the plains. The *Hospodar* had granted us an order for forty-three horses, and had also, unknown to us, directed that the chiefs of all the villages should be responsible for our being well supplied with lodgings and provisions.

April 27. The following day we traveled through a flat country to Munichest. Three hours beyond Munichest, we came to Corte D'Argish, where the view of the village with its church, of mountains covered with forests, and of more distant summits capped with snow, reminded us of the Tirol. From this place we took with us four men, besides the postillions [drivers], to assist during the route; as we had a journey of five hours to perform to the next station, Salatroick, through the mountains. High snowy summits were now in view, belonging to the great Carpathian barrier which separates Walachia from Transylvania.

Not finding good horses in Salatroick, we prevailed upon the postillions to continue the journey as far as Kinnin, distant thirteen hours beyond Salatroick, the last place in the dominions of the Prince of Walachia.

Soon after leaving Kinnin, a sentinel hut by the way-side marks the limit of the principality. The welcome sight of the arms of the Emperor of Germany, painted on a board and placed upon the side of a moun-

tain, announced the agreeable intelligence to us that by passing a little bridge which appeared before us, we should now quit the Ottoman Empire. Upon the Transylvanian side a peasant, standing before another hut, is also stationed as a sentinel.

After crossing, we began to climb a steep and difficult ascent, by a most dangerous road, hanging over a stupendous precipice, beneath which rolled the rapid waters of the Aluta. This river is accurately described by Ptolemy as dividing Dacia towards the north, and flowing *impetuously*; it has, moreover, preserved its ancient name unaltered.

The scenery here is of the most striking description: the bold perpendicular rocks, the hanging forests, the appearance of the river flowing in a deep chasm below the road, and the dangerous nature of the pass itself; all these contribute to its heightened sublimity. The masses of rock above us were covered with a beautiful white saxifrage, in full bloom, displaying the richest clusters of flowers. It is certainly one of the most remarkable passes in Europe, if not in the whole world; and might be rendered impregnable simply by throwing down the shelves, or artificial wooden roads, which in many parts of it offer the only means of access.

April 29. We continued along the mountainous pass, above the river. We came to Rothenthurn, the ruins of a very massive old red tower, and to Boitza, where our luggage was submitted to scrutiny. The officer of the Customs had some of the Boitza minerals upon sale; but he asked considerable prices for them. We were rather surprised by a fine specimen of malachite, for which he asked four ducats. He had also a few of the ores of gold from the Boitza mines, particularly that extraordinary and rare association of native gold with crystallized sulphuret of antimony [stibnite], hitherto peculiar to the mines in the neighborhood of this place.

The principal mine of Boitza has been worked in syenite porphyry. The uppermost gallery, when Baron Born visited these mines, is excavated in limestone, but the deeper gallery ran in sandstone until it reached the argillaceous rocks. The veins and fissures consist of blende [sphalerite] and galena containing both gold and silver. Some specimens exhibit native gold adhering, at the same time, to the sphalerite and the galena. A hundredweight of the Boitza ore yields two to six German ounces of silver; and, as all the silver of Transylvania and Hungary contains gold, that of Boitza averages two ounces of gold to every pound weight of silver. A list of all the auriferous minerals exhibited for sale at Boitza is subjoined:

1. Auriferous [sphalerite]
2. Auriferous galena
3. Auriferous iron pyrites found in clay
4. Native gold on cobaltiferous arsenic
5. Argentiferous iron pyrite in black hornstone

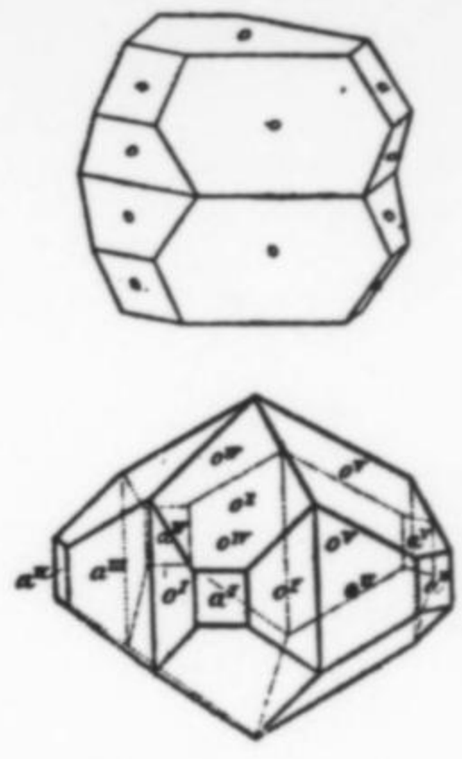

Figure 3. Gold crystals from Boitza (Rose, 1831: see Goldschmidt, 1913–1923, for full references on all crystal drawings shown here).

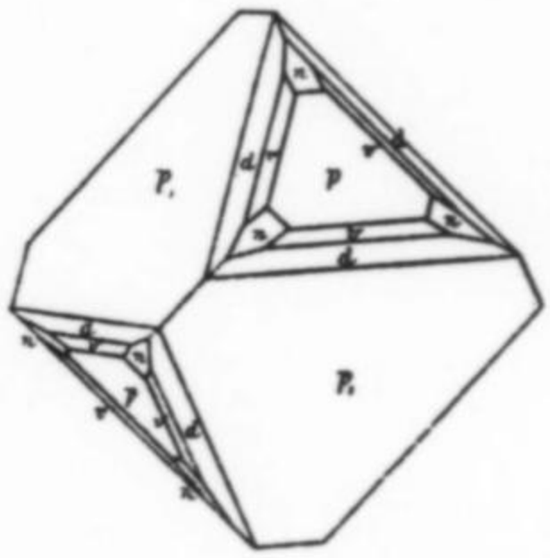

Figure 4. Sphalerite crystal from Boitza (Toborffy, 1908).

6. Capillary native silver on galena, containing gold
7. Native gold on crystallized [stibnite]
8. Auriferous quartz
9. Auriferous carbonate of lime
10. Auriferous antimonial silver [pyrargyrite]

After leaving Boitza the country again became open, and we descended from the mountains into the fertile territories of Transylvania. Here everything wore a new aspect;—immense plains of waving corn; jolly, smiling peasants; stout cattle; numerous villages; nothing, in short, that seemed like the country we had quitted. At four hours distance from Rothenthurn we arrived at Hermanstadt [Sibiu]; it had also the name of Hermanopolis (whence Hermanstadt), from a Roman Emperor of the name of Hermannus, supposed to have been its founder. It is the capital of the province, a large and opulent town of fifteen thousand inhabitants.

Having brought with us a letter of introduction from the Lady of Baron Herbert, the German Internuncio at Constantinople, to Baron Bruckenthal, a venerable nobleman who had been the favorite of [Austrian Empress] Maria Theresa, we presented it soon after our arrival and were invited to spend the whole of the following day at his house, and see his immense collection of pictures, antiquities and *natural history*.

April 30. We went early to visit Baron Bruckenthal, after settling some dispute at the Custom-house. We visited the Collection of Minerals, consisting principally of gold ores. We shall only mention five remarkable appearances of this metal, because they particularly characterize the Transylvanian ores of gold. Of all these the Baron possessed the most magnificent specimens.

1. Laminary native gold, in large leaves, upon ferruginous quartz
2. Laminary native gold, on crystallized [stibnite]
3. Native gold, crystallized in octahedrons and in tetrahedral prisms; from Boitza and from Abrudbanya[1] in Transylvania
4. Gold, mineralized by tellurium, from Nagyag in Transylvania; both crystallized and in laminary forms.
5. Gold, as exhibited in globules upon the tellurium, by the disengagement of the sulphur [probably "roasted" gold]

Figure 5. Gold crystal from Verespatak, near Abrudbanya (Baumhauer, 1889).

Figure 6. Gold specimen from Verespatak, near Abrudbanya (Rath, 1877).

[1]Ed. note: There are no mines at Abrudbanya, but nearby are the mines of Verespatak and Botes, which were probably the sources of Clarke's "Abrudbanya" specimens.

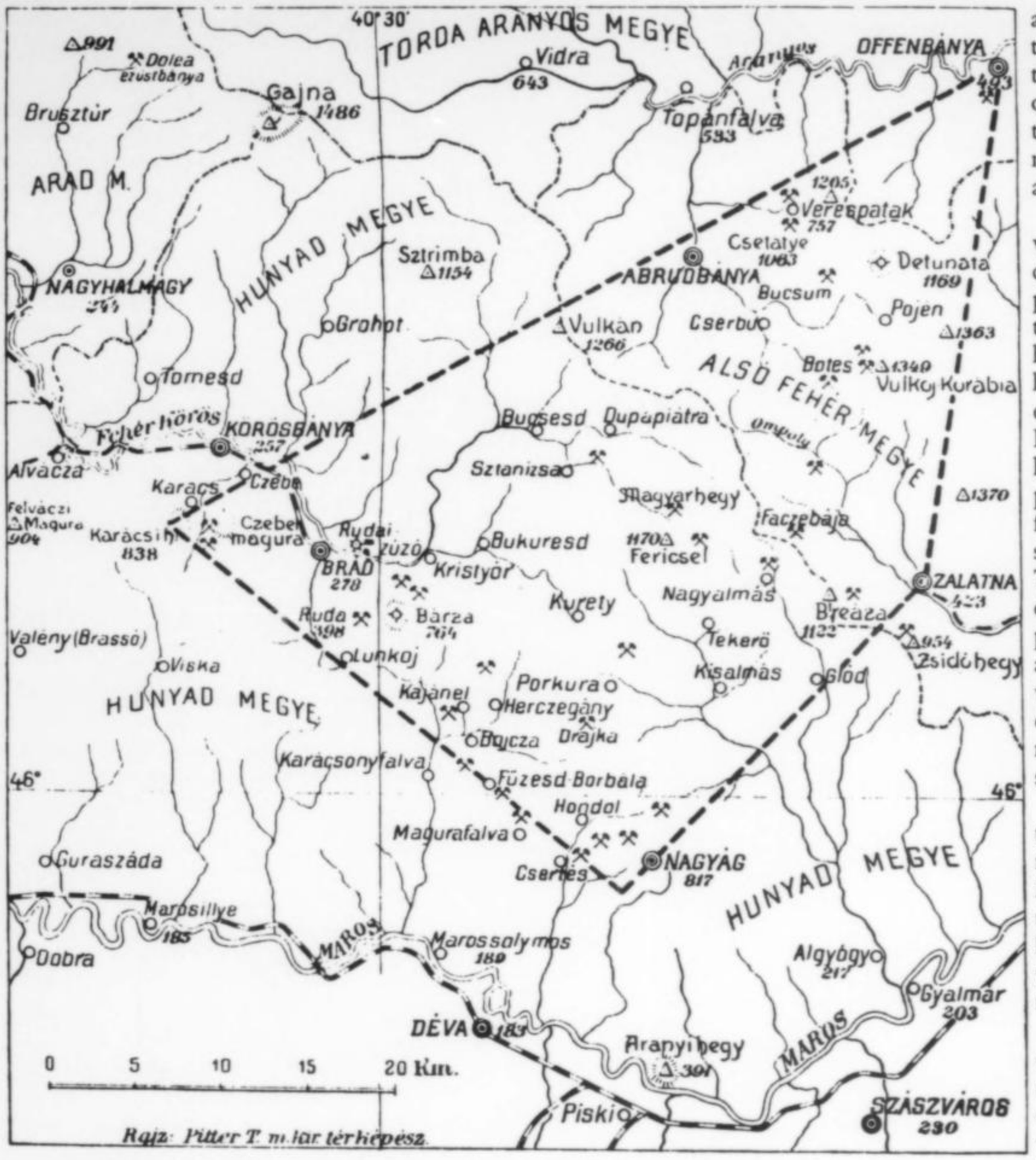

Figure 7. Map showing mines in the "Golden Quadrilateral" of Transylvania.

In the afternoon the Baron's secretary accompanied us to the house of a dealer in minerals, where we found some of the rarest of the Transylvanian ores. But, discovering that we were Englishmen, we had no sooner agreed to any of his prices, than he increased his demands to such a degree that we found "even gold might be bought too dear": we were therefore constrained to leave the most valuable specimens unpurchased.

May 1. We left Hermanstadt, and passed through the river Cibin, whence the town had its name of Cibinium. In the first part of our journey the roads were very bad, and almost impassable. The village of Magh is reckoned only one German mile[2] distant from Hermanstadt, but we were half the day in reaching it.

One German mile beyond Magh we came to Reismark. The costume of the women along this route is very remarkable, because it resembles that of the Arabs, particularly in the attire of the head: but among all the inhabitants of Transylvania there has never been any people connected with the Arabs. According to Pliny, the original inhabitants were *Gatae*, afterwards called *Daci* by the Romans. The people were governed by their own kings until Trajan reduced the country to a Roman province. Afterwards they were successively subdued by the *Sarmatae*, the *Gothi*, and the *Hunni*; and, lastly, the *Saxons*, driven by the conquests of Charlemagne, established themselves in Dacia, since subdivided into the various partitions of Hungary, Transylvania, Walachia and Moldavia. The Saxons principally concentrated themselves in Transylvania, or "Mediterranean Dacia," a fertile region surrounded by forests and metalliferous mountains; and to their coming must be entirely attributed the origin of its cultivation. All its principal towns were built by them; the traces of their language are still retained; and it is from them that Transylvania received the name of Sibenburgen, or "Region of Seven Cities." Modern inhabitants may be divided into three distinct families: the *Siculi*, a barbarous race descended from the ancient Scythians, now inhabiting the districts contiguous to Russia and Moldavia; the *Hungarians*, who dwell along the borders of the Marisus River; and the *Saxons* upon the south towards Walachia, and upon the north towards Hungary; to these must be added the *Gipsies*.

Presently we arrived at Muhlenbach, where there was but one bad inn. On Monday we set out from Muhlenbach, and passed through Sibot, to Szasavaros. We had then a violent storm; with some difficulty, however, we advanced farther on to Deva; having found everywhere difficulty in procuring horses. Upon a high rock above Deva are the remains of a Citadel, said to have been constructed by Augustus; but probably by Trajan, as Roman coins are found here, both of that Emperor and of his successors. We bought one or two coins of Trajan, and one of Faustina. It was nearly dark when we entered Deva; we were surprised by the number of persons, both men and women, in a state of intoxication. Its vicinity to the mines may account for this circumstance; according to Born, "every nobleman keeps on his grounds an inn, to sell wine to the miners."

The mine of Nagyag is distant about fifteen English miles, in the heights of the mountains, lying upon the north side of the Maros. As we had brought a letter [of introduction] from Baron Bruckenthal to Mr. Franzenau, director of the works at the Nagyag mine, we determined to quit the main route and visit Nagyag the next day.

May 3. We crossed the impetuous current of the Maros, by means of a ferry. A lofty range of mountains extends along the northern side of the Maros: after crossing the river we began immediately to climb these heights. The roads were not bad, but almost the whole journey to Nagyag was up a steep ascent: we were five hours, although drawn by four horses in a light car, before we reached the small town where the mine has been opened.

As Transylvania is the only country in the whole world where tellurium has yet been discovered (found only in Nagyag and Offenbanya), our curiosity was greatly excited to view the Nagyag mine. At last the prospect of it opened, with great boldness of scenery, quite among the summits of this mountainous region, and in a manner highly picturesque and striking. The situation of the mine was distinguished by an immense heap of discarded minerals, thrown out in working it: above this heap appeared the buildings of what is now called Nagyag. (The original and proper name of this place is Sekeremb; but as the village of Nagyag, at an hour and a half's distance below it, was the nearest inhabited spot when the mine was discovered, the locality took the name of the place to which the miners resorted before the town of Sekeremb was built.)

The whole village has been undermined: the works are not only carried on upon a grand and extensive scale, but they are con-

[2]Upon entering the dominions of the Emperor of Germany, the traveler no longer finds the distance reckoned by *hours*, but by *German miles*; whereof every one is equal to two hours.

Figure 8. A view of the Nagyag mine area.

ducted with a degree of neatness for which the Germans have long been famous in mining.

Having presented our letter to the Director, we were most kindly received by him, and permitted to examine everything. He also allowed us to inspect every variety of the ore, and to make whatever purchases we pleased. But some specimens of tellurium are so exceedingly rich in gold that it was necessary to weigh them, and to estimate the price according to the proportion of gold they contain. This kind of ore is always kept locked in particular warehouses.

The town, surrounded by mountains and forests, consists of the warehouses, washing-houses, stamping-mills, a council-house, a church, and the dwellings of the miners, which altogether amount to some hundred buildings. The temperature of its elevated situation renders the land around Nagyag unfit for agriculture; consequently, nothing is going on, excepting what relates to the business and interests of the mine. When this mine was first discovered, the mountains around it were covered with forests; but the timber necessary for the works, especially for timbering the mine itself, has cleared the neighborhood of large trees, so that wood is now brought from distant parts, being floated on the Maros at the foot of the mountain. Deva itself is visible from this spot, and nothing can be more beautiful than the commanding prospect here afforded of the valley in which it lies.

The history of the discovery of this mine deserves particular attention, as it contains a remarkable testimony to the universality of an opinion among miners, that "lambent flames," which are sometimes observed playing upon the surface of the earth, denote the presence of metallic veins in the fissures below. The flame here alluded to is a gaseous emanation of hydrogen, whereof no metallic substance, however pure, is destitute. The circumstance is thus related by Born, as it was told to him:

"A Walachian named Armenian John came to my father, who was at that time possessed of a rich silver mine at Csertes, telling him that, as he constantly observed a flame issuing from and playing upon a fissure in the Nagyag forest, he was of the opinion that rich ores must lie hidden underground. My father was adventurous enough to listen to this poor man's tale; and accordingly he drove a gallery in the ground which the Walachian had pointed out. The work went on some years without any success, and my father resolved to give it up. However, he made a last drift towards the fissure, and there he hit the rich black and lamellated gold ores, which were first looked upon as *iron glimmer*, but appeared what really they are as soon as assayed by fire."

Soon after, other fissures were discovered, all running parallel to each other in the direction of the valley of Nagyag, from south to north, and dipping east. When Born visited Nagyag, the mine had only been worked to a depth of 60 fathoms [about 360 feet]; its depth is now 150. The vein rock consists of red feldspar and white quartz. The richer ores are laminary, splendent, of a dark gray color approaching black, and in some instances quite black. Among the rich ore native silver sometimes occurs mixed with gold. Another variety the miners call "cotton ore": it consists of little native silvery gold grains in tellurium on an argillaceous matrix. But in all the richer ores not a particle of native gold can be discerned, either by the naked eye or by the aid of the most powerful microscope. The gold in these ores is therefore completely mineralized, either by tellurium, or by sulfur; and in either case it must be considered unique in its kind. From the resemblance of its laminary form and splendent gray color to antimony, it was at first considered to be that metal; and for a long time, under the names of *aurum problematicum* and *aurum paradoxum* [= native tellurium], it puzzled all the chemists of Europe. Sometimes an effect of crystallization has given to this laminary substance a rude resemblance to Hebrew characters; and to such an appearance the name of *aurum graphicum* [= sylvanite] was given. When Klaproth detected in this ore the presence of a new metal, and bestowed upon it the name tellurium, its real nature became more fully developed. But the manner in which the gold is combined with the tellurium has not yet been determined.

The sulphuret of antimony [stibnite] is sometimes found either as a radiated crystallization or in the form called *plumose*, owing to the minuteness and length of its crystals. We saw also very fine specimens of the red sulphuret of arsenic [realgar], both in masses and crystallized; also yellow pulverulent oxide of antimony [senarmontite or valentinite?], and white pulverulent oxide of arsenic [arsenolite or claudetite?], lying,

in both instances, among the crystals of their sulfides. All the semi-metals found at Nagyag are found to contain minute portions of gold. But not all the ores contain silver.

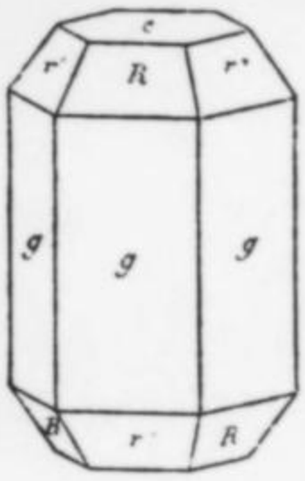

Figure 9. Tellurium crystal from Zalatna (Rose, 1849).

We purchased several specimens of the tellurium, both in its massive and crystalline forms. We also bought minerals from other mines of Transylvania, in the house of the Inspector. For the advantage of other travelers, perhaps it will be better to give a brief list of the principal substances to be purchased at this place:

1. The richest tellurets of gold. This is the "gray gold" of Born [= nagyagite].
2. Native tellurium, crystallized in regular hexagons.
3. Native tellurium in laminary forms.
4. Aurum graphicum [sylvanite] from Offenbanya, or plumbiferous telluret of gold and silver [nagyagite?]
5. Silver fahlerz, crystallized [argentiferous tetrahedrite].
6. Crystallized sulphuret of antimony [stibnite] with laminary native gold from Topliz, in Transylvania.
7. Native gold, from Topliz, in rich laminary forms.
8. Amethysts of fine color from Porcura in Transylvania.
9. Siliciferous oxide of manganese, crystallized and of a beautiful rose color [rhodonite].
10. Sulphurets of arsenic, red and yellow, in transparent crystals [realgar and orpiment].

Provisions are extremely dear at Nagyag, being carried thither by porters or upon horses. Therefore, the wages of the miners are higher than in other places. Nevertheless, Born calculated that in the course of twenty years, above four million florins in gold and silver had been produced [about 450,000 British pounds sterling], clear of all expenses, by the Nagyag mine. At the time of our arrival it had been constantly worked during sixty years [i.e. since 1742]; and it was fully as productive as at any period of its prosperity.

Whether it were owing to the high wages given to the miners, or to the salubrious state of the atmosphere at so great an elevation, we could not learn. But we remarked that we had never seen such robust

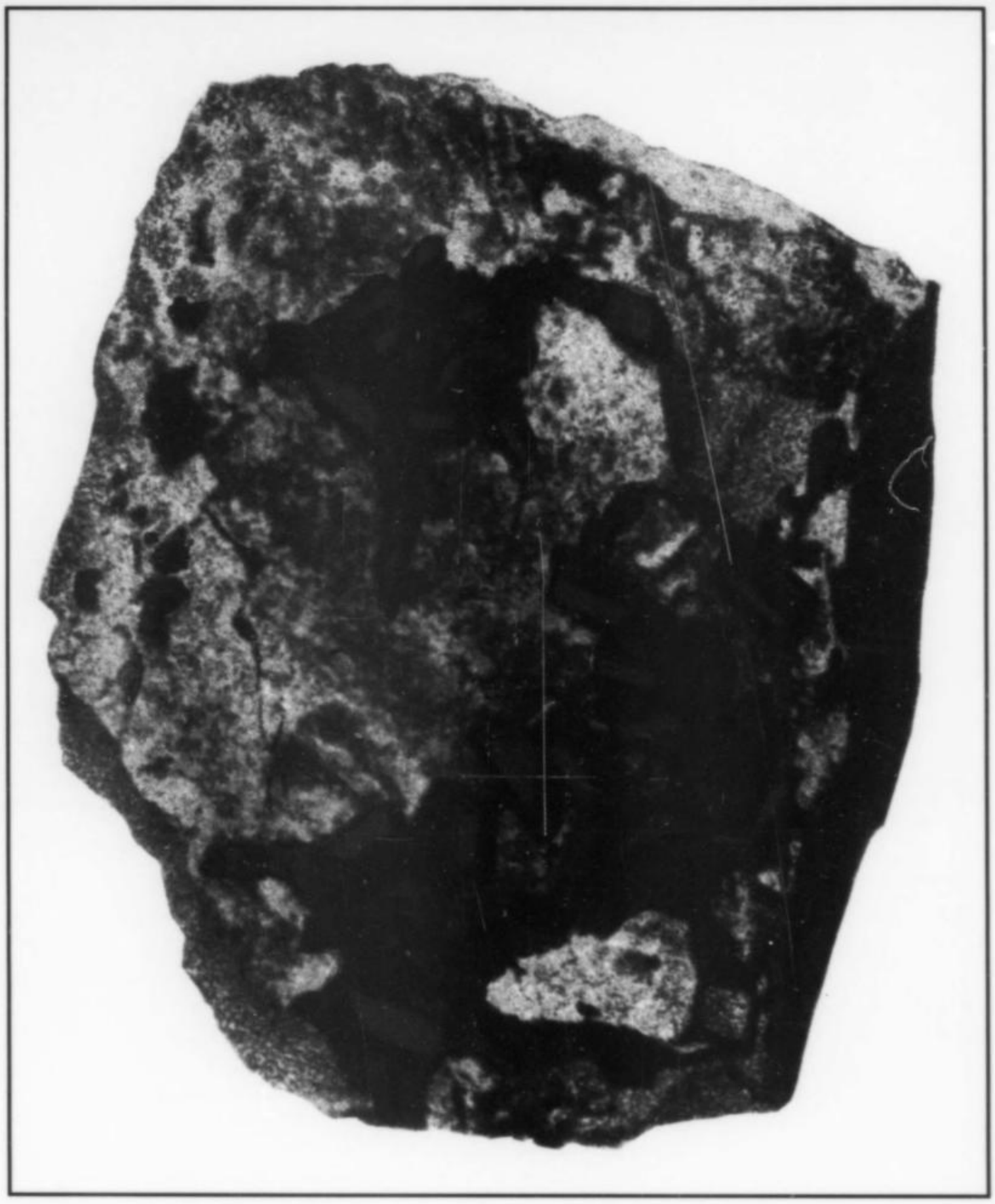

Figure 10. Realgar on matrix from Nagyag (Brauns, 1903). MRL

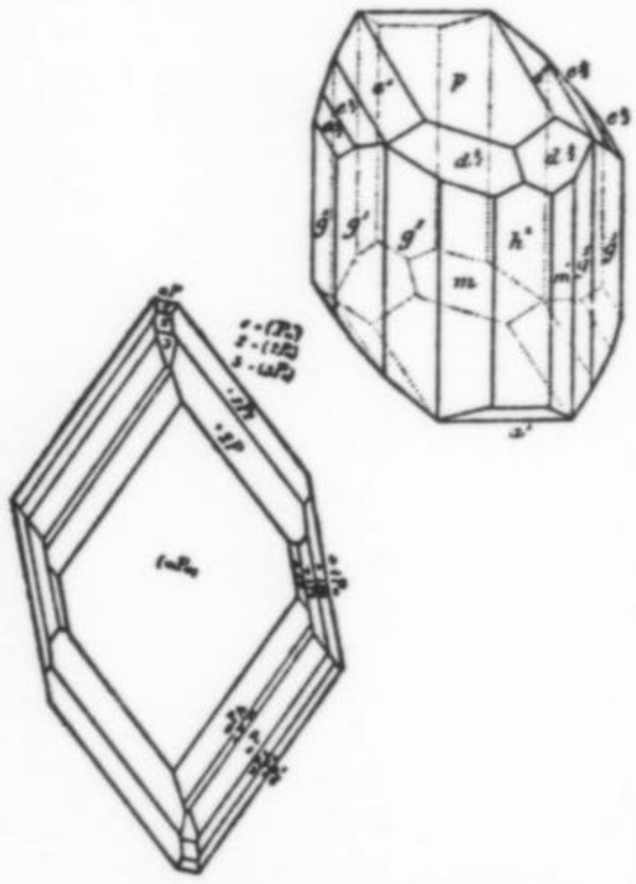

Figure 11. Realgar crystals from Nagyag (Levy, 1837; Hessenberg, 1861).

miners as those of Nagyag. A party of them descending to their labor, each bearing in his hand a large lamp, resembled the German miners figured in the work of George Agricola (*De Re Metallica*). And the countenances indicated a degree of health and cheerfulness not usually characteristic of such employment.

Towards evening, having finished our examination of the tellurium mine and its productions, we paid for our specimens, took leave of the Inspector, and prepared to continue our journey.

May 4. Came from Deva to Dobra, through the most beautiful scenery imaginable. In the first part of our journey, however, the roads were as bad as when Born's carriage was dragged over them by eight oxen, besides the four horses of his vehicle; but afterwards, near Dobra, they became better.

At Dobra we found a crowded fair, and Gipsies begging in the midst of the uproar. A change in the manner of building seemed to indicate a different tribe, the dwellings being constructed with whole trunks of trees piled horizontally one above another.

From Dobra we were accompanied by

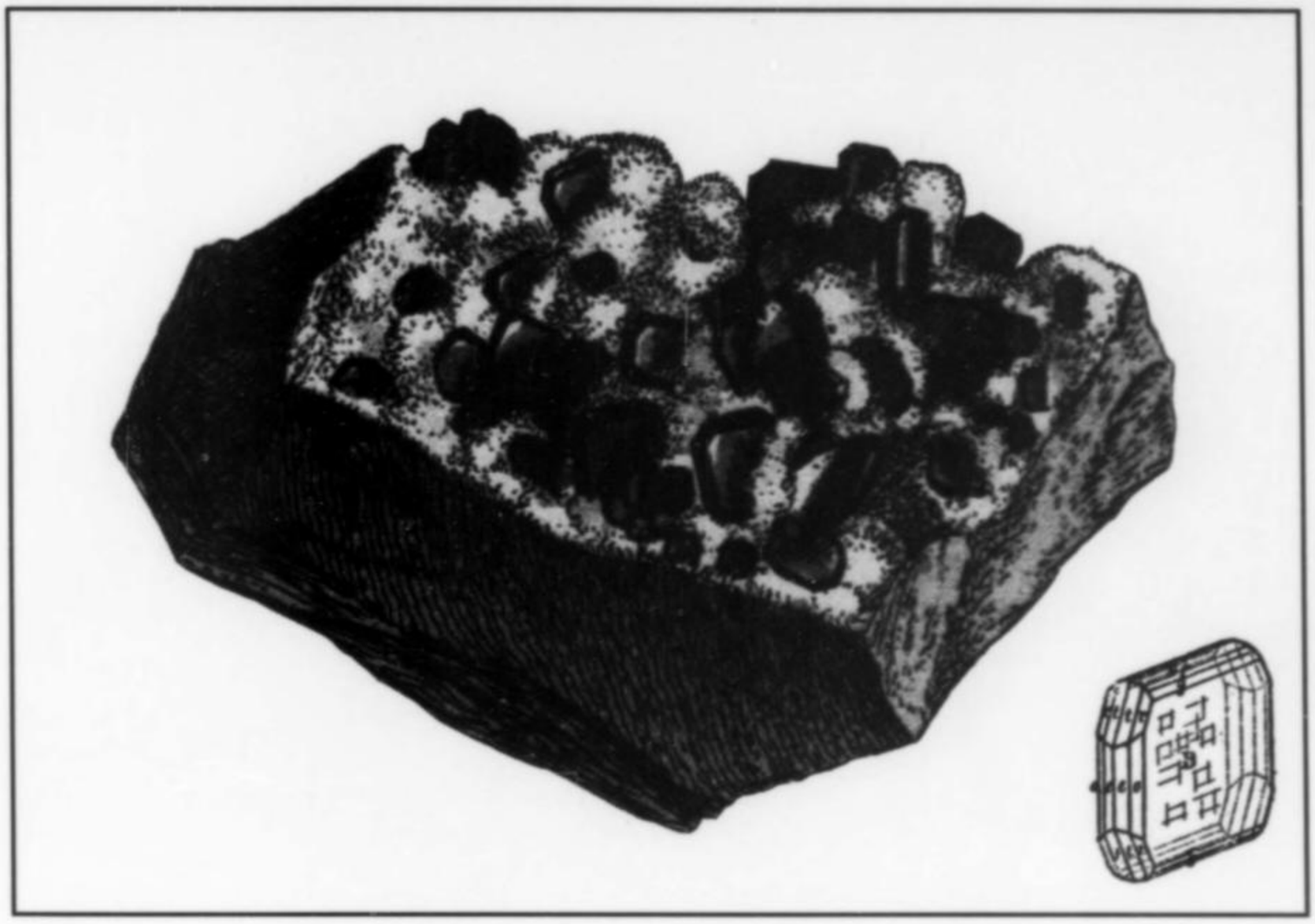

Figure 12. Nagyagite crystal group from Nagyag (Sowerby, 1817). Leicht Library.
Inset: Nagyagite crystal from Nagyag (Schrauf, 1878).

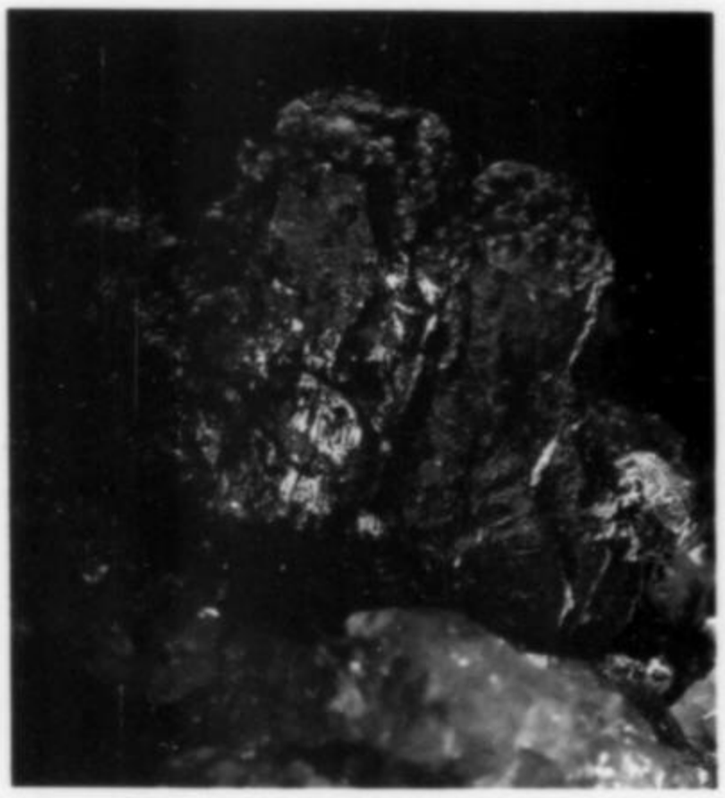

Figure 13. Nagyagite crystal, 1.8 cm with rhodochrosite from Nagyag. Werner Lieber photo.

before us, our driver insisted upon pursuing them, galloping his horses at a furious rate. Nothing that we could say served to check our insensate charioteer, and we performed the distance to Bossar in less than three quarters of an hour.

From Bossar to Lugos the road had been greatly infested by banditti, who had practiced the most unheard-of cruelties to extort money; having cut off a woman's tongue and one of her breasts, and roasted the feet of a priest. They had also bound chains of red-hot iron round the bodies of the poor peasants, to force them to confess where they had concealed their money. The alarm, however, had nearly subsided, by the apprehension of most of their gang. We found

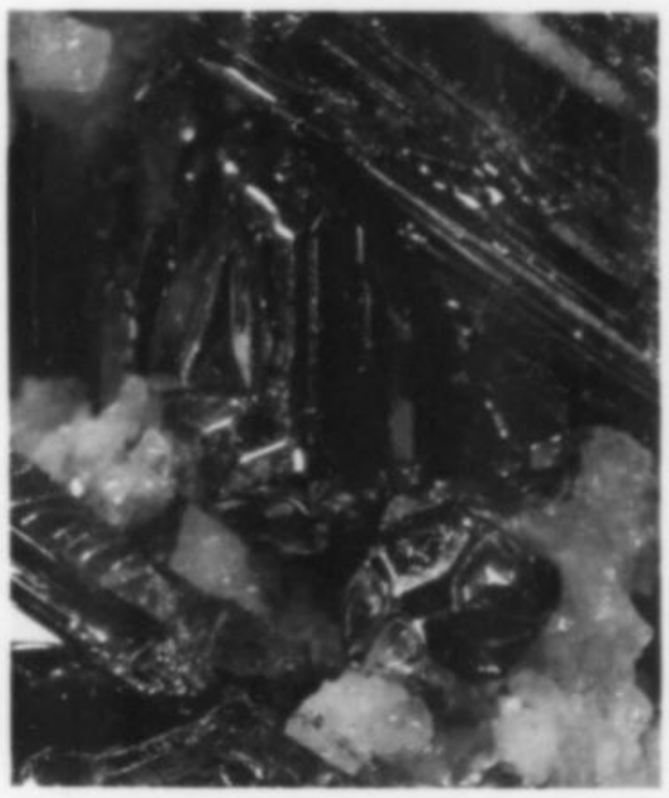

Figure 15. Sylvanite crystals to 1 cm, from Nagyag. Werner Lieber photo.

two hussars as guards, owing to the robbers who infest the frontier of the Bannat of Temeswar. We crossed a high ridge of mountains separating Transylvania from the Bannat of Hungary. We passed a sleepless night in a small post-house, being tormented by bugs, some as large as woodlice.

The next morning (***May 5***) we rose at three o'clock and, when daylight appeared, set out for Fazced, where we found a good inn. Thence from Fazced to Bossar. The hussars being in full speed the whole way

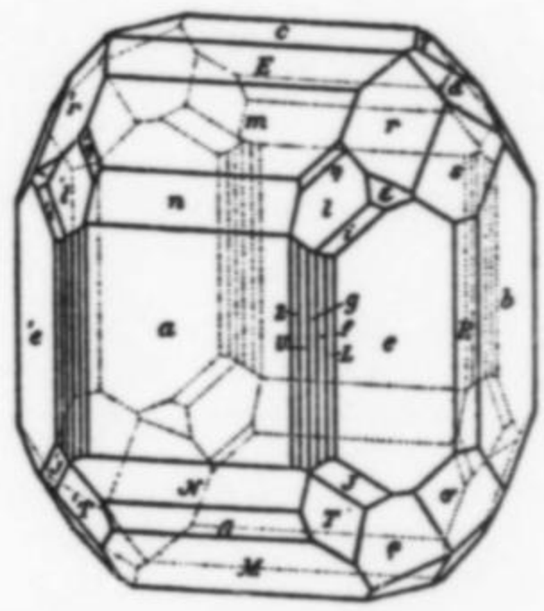

Figure 14. Sylvanite crystals from Nagyag (Schrauf, 1878; Vrba, 1894).

150 of them imprisoned at Lugos, six of whom were already condemned to be executed in the course of the week. We went to see the chief of the gang; a ferocious looking culprit, with long bushy hair. He was chained by the neck, arms, feet and waist; regarding all who approached him with the wildness of a savage.

May 7. Having quitted the Bannat, we proceeded through Horgos to Segedin: a wretched, dirty, straggling town, with a small fortress. The inn here, called the *Gulden Adler*, was filthy and detestable; the mis-

Figure 16. Clarke's illustration showing the Gypsies of Bannat washing for placer gold.

tress of it being drunk and insolent. We saw nothing that was good in Segedin, excepting its bread, and this was of an excellent quality.

May 8. All the country between Segedin and Ketschemet is flat and swampy, where nothing is heard but the croaking of toads. Two posts before arriving at Ketschemet is a place called Felegyhaza. There are some public edifices here: the post house was the best that we had seen, and the inn good; but the inhabitants rude and insolent to strangers. As soon as we began to perceive that this behavior was characteristic of the people, we tried the experiment of treating them in their own way; which invariably made them become more civil.

The Gipsies of the Bannat get their livelihood by rambling about as blacksmiths and itinerant musicians. During the summer they go nearly naked, and are then employed in washing gold from the sand of the rivers and plains. The very simplicity of their manipulation denotes its antiquity; it is probably practiced now, by these Gipsies, as it was here by the Romans. It consists in nothing more than pouring sand, mixed with water, over an inclined plane, the heavier particles of gold remaining upon the surface, while the lighter particles are washed away. Sometimes the inclined plane is covered with a woolen cloth, to which the gold adheres; wanting the cloth, the Gipsies now and then use the ancient substitute of fleece. In the rivers of Colchis the custom is still retained of placing sheep-skins in the beds of auriferous streams to collect particles of gold; hence the fabulous history of the Argonauts as far as it related to the "golden fleece."

May 9. We came from Ketschemet to Inares, thence proceeding through the villages of Ocsa and Soroksar. We had no sooner quitted the last than we beheld the spires of Pest, and the citadel of Buda, situated upon different sides of the Danube at the foot of a chain of mountains. The Danube separates the two cities, in other respects one. Between the two cities there is an immense bridge of boats, three-quarters of a mile in length. Pest is a very large and handsome city. We were conducted to its principal Inn *The Seven Electors*. The streets are full of shops, and there are two theatres. We were quite surprised by the magnificence of these two cities, of which so little intelligence has been communicated to other parts of Europe.

May 10. As soon as we had breakfasted, we waited upon the Governor of Pest (Baron Leeuwen), and afterward upon the Governor of Buda. (General Orft), requesting a passport and permission to visit the mines of Schemnitz and Cremnitz. We were assured that we might go to any of the Hungarian mines, without any other passport than that which we had brought from Constantinople.

At Buda we heard that the Diet would soon be assembled at Presburg, and that the Prince of the Palatinate was there. We were permitted to see the palace belonging to his Highness, as it was furnished by the present Emperor of Russia, after the marriage of the Prince with his sister. It was really magnificent: indeed there are few finer palaces in Europe. We saw a superb collection of the most costly minerals of Siberia; among these may be mentioned a superb crystal of wolfram (the *ferruginal scheelin* of Haüy and of Brogniart) [wolframite], in its matrix; also a ruby the size of a hazel-nut; and many of the gold ores of Siberia.

The view from the balcony of the palace, elevated upon a rock above the Danube, exhibited one of the most striking sights we ever saw. It consisted of an extensive prospect of the Danube, diversified by islets covered with trees, the long bridge of boats, and the whole city of Pest, the gardens of the palace, and the suburbs backed by lofty mountains which surround the city. Buda is well built, and more magnificent in its appearance than Pest; but both together, added to the advantages of their situation upon the Danube, their numerous gardens and diversified appearance, make this a delightful place of residence.

Before the invasion of Hungary by the Turks, Buda was the capital of the country. Some writers have believed that it was either the "Curta" of Ptolemy or the "Aquincum" of the *Itinerary of Antoninus*; but according to Bonifinius, the ancient name of Buda was Sicambria; it was called Buda, from *Bleda*, the brother of Attila. Several Roman antiquities remain in different parts of the town. The inhabitants of Buda amount to 22,000; those of Pest 16,000; making altogether a population equal to 38,000 persons. [Buda and Pest were joined as Budapest in 1872; population in 1970 was 1.9 million].

Upon our return from Buda and Pest we dined with Baron Leeuwen, and were introduced to the Baroness, a lady of the most extraordinary beauty, unaffected simplicity, and polished manners. We then went to the principal theatre, where we were amused by a ballet. A new female dancer made her debut, under circumstances somewhat extraordinary: being far advanced in pregnancy. This woman obtained unbounded

applause; but in the astonishing leaps and turns she made, the exhibition was rather more painful than pleasing. We were much struck by the general beauty of the Hungarian women at Pest; perhaps there is not in the German Empire a town where there are so many handsome females in proportion to the number of inhabitants.

May 11. After breakfasting with the Governor, we were conducted to the University. Entering the public library, we were met by the Professors, who requested that we inscribe our signatures, and the places of our residence in England, in a register containing the names of all foreign visitants. As soon as we had so done, and also added that we were members of the University of Cambridge, we were amused by a question from the principal lecturer, who came towards us with a large atlas in his hand, requesting that we point out to him the situation of Cambridge; as neither he nor any of his brother Professors had ever heard of the existence of such a University. When we had satisfied his curiosity in this respect, as he was making a pompous explanatory speech in Latin, we begged he would spare himself the trouble of an apology, assuring him that, if he were to honor Cambridge with a visit, a similar question might be put to him respecting the situation of the University of Pest.

The Public Library contains all the best editions of the classics, and also some manuscripts, but none of the latter merit a particular notice. The Cabinet of Natural History is more remarkable: it contains sixty thousand minerals, but they are displayed without classification, and the specimens are of the most ordinary kind.

May 12. The next morning, having taken leave, with great regret, of the Baron and Baroness Leeuwen, by whom we had been so hospitably entertained, we crossed once more the bridge of boats to Buda, and took the road to Gran. Our journey conducted us through a delightful valley, covered with corn, having on each side of it mountains planted with vineyards to their summits. All this part of Hungary is highly cultivated, rich, and populous. The traveler sees everywhere pleasing villages, filled with healthy inhabitants; and the towns are not only clean, but elegant.

Having left the Danube upon our right, the road extending between the mountains upon the left, we passed through Woroschwar and Dorogh, where we quitted the grand route to Vienna, in order to visit the mines of Schemnitz and Cremnitz.

In more than one instance we observed Latin as a general language in use among the inhabitants. We heard it spoken in the post-houses by Hungarian gentlemen who were traveling; and probably it has continued in this country as it was left by the Romans when they were possessors of the Dacian [Transylvanian] mines. Indeed there is no part of Hungary where Latin is not understood, even by the lower orders.

May 13. We journeyed from Parkany by Komend Zelitz, and Lewa, to Bakabanya where there are mines of gold and silver. The mine of Bakabanya is hardly mentioned by Born, although the works here have existed above four hundred years. Nothing can be more agreeably picturesque than its situation, between the town and the mountains; amidst groves of fruit trees that were now covered with blossoms; being also shaded by enormous oaks and other large trees of the forest. The inhabitants consider the Bakabanya mine as ranking next in importance to those of Cremnitz, not only for the gold it annually yields, but also for the silver.

May 14. The next morning we were occupied in collecting minerals from the Bakabanya mine. Besides the rich ore of the mine, which consists of quartz penetrated by auriferous clay, and by iron oxide, we obtained here the following minerals:

1. Native gold in quartz
2. Black silver with auriferous pyrite
3. Sulfide of silver containing gold
4. Black silver, with primary crystals of barite, etc. etc.

The ore here is richer in gold than that of any other mine in all Hungary, but it does not hence follow that this is the most productive mine. It is hardly necessary to state that the poorest mines have sometimes the richest ores; as in the example of the mine of native silver at Kongsberg in Norway.

We obtained a great variety of specimens, but none of them equal in beauty to the minerals of Transylvania; among others, the rare ductile sulfide of silver.

The magistrates of the town accompanied us to see the mine and the works for stamping and washing the ore. We were admitted to the Bakabanya mine by means of a level [adit] with the greatest possible facility:—but, having to relate later our visit to the larger mines of Schemnitz and Cremnitz, we shall not particularly describe its interior.

The principal part of the road from Bakabanya to Schemnitz exhibits that grandeur of scenery which is represented by the best pictures of Gaspar Poussin. The views of Schemnitz in approaching the town would be considered by all admirers of beautiful scenery as well worth a journey thither, independent of any other inducement. The traveler, surrounded by the sublimest natural scenery, sees to his surprise the greatest artificial labors accomplished with neatness, ornament, and economy; beautiful roads through recesses and over steeps that would otherwise be impassable; churches crowning the most elevated summits; towns and villages; gardens and vineyards; all decorating, without diminishing, the wild grandeur of the Hungarian Alps. If an Englishman were disposed to quit his native land, he might well be tempted to fix his residence in this part of Hungary; to enjoy the beauties of nature, where the inhabitants, owing to their elevated situation, breathe a pure, wholesome and bracing atmosphere; and are remarkable for active industry, and civility to strangers.

Upon our arrival in Schemnitz we found the town prepared for the reception of two princes, Anton and Reiner, brothers of the Emperor. The inn to which we were conducted deserves to be mentioned as perhaps superior to every other in Europe, and certainly as the cleanest in the world.

There is here a College of Mines; and in no part of the world is the national importance of the science of mineralogy more fully manifested. The college consists of 112 students, of all nations but principally from Germany. There was one student, however, even from Spain, where mineralogy is at its lowest ebb. There are two Professors, Passern and Möhling, besides a number of instructors. Professor Passern delivered lectures in Chemistry and Mineralogy. Professor Möhling's lectures were confined to mining operations. They conducted us to the Laboratory, where we found the students busily occupied in assaying the different ores. These young men, who appeared to be about 18 to 20 years of age or upwards, wore the uniform of the mines. Some of them were of noble families; but the same uniform, designating an officer of the mines, is worn by all the students, from the prince to the son of a peasant. It consists of a jacket of gray cloth with gold epaulets; black pantaloons; a girdle of black leather with a gold clasp in front; and a short, black, leather apron which is the most singular part of the dress, as it is not worn in front but hangs behind. In this uniform they are considered as being properly clad, even to go to court if it were necessary. The same dress was worn, upon all public occasions, but the two brothers of the Emperor during the time they remained in Schemnitz.

May 15. As we desired to accompany their Highnesses during their descent into the mines, and they were not expected before the evening of the next day, we hastened forward to Cremnitz that we might avail ourselves of the interval before their arrival to visit the works of that place. The road to Cremnitz lies due north of Schemnitz. The first half of this distance is by descent, from Schemnitz to a place called Yalack. After leaving Yalack we ascended the whole way to Cremnitz, the oldest mining town in all Hungary.

Fortunately for us, upon our arrival at Cremnitz a young Italian named Gayio, hearing of the coming of strangers, called at the inn. After introducing himself as an agent of the mines and inspector of the mint, he offered to conduct us to everything worthy of notice. Having first obtained permission from the magistrates and superior officers, he conducted us to the principal mine. The passage into it is so commodious that were conducted in a carriage drawn by horses, which had been placed ready for the arrival of the two princes.

We were two hours employed in the examination of the mine's interior; being con-

ducted to the vein of gold ore by tunnels kept everywhere clean and dry. The miners were employed in digging this ore; and as they had laid open a very rich part of it, we took the picks into our hands, and fell to work ourselves, that we might the better understand the nature of the vein. It consisted of white quartz containing auriferous silver ore and auriferous pyrite. We brought away several specimens of the ore, which we detached ourselves from the vein. Like many of the Hungarian auriferous ores, it consists of clay, quartz, galena and iron oxide traversing a porphyritic rock beneath a superincumbent stratum of slate.

To the east of Cremnitz a steep mountain of porphyritic rock covered with slate separates it from Newsohl. Some years ago the surface at this mine, being too much excavated [undercut], gave way and fell into the cavity of the mine, leaving an opening in the form of a vast and frightful crater.

Having visited the interior of this mine, Signor Gayio conducted us to the Imperial mine to view the enormous machinery by which the pumps are worked for draining water from the mine; and the workmen conveyed up and down.

In everything we witnessed, both here and in Transylvania, the art of mining is conducted upon so magnificent a scale, and at the same time with such discreet economy, that it must be confessed the Germans have left other nations far behind them in managing these important resources of national wealth. This is the impression made by viewing their superior skill and industry in the art of mining; the spacious entrances to their mines; the dry, airy and clean workings; and the great encouragement given to the study of mineralogy.

The same mode of treatment is used for all Hungarian ores, and they are all brought to Cremnitz to be smelted. The last [step in the reduction] process, that of separating the gold from the silver, is very curious, and we shall therefore be minute in its explanation. Of all the works seen at Cremnitz, those of the Grand Laboratory employed for this purpose are the most interesting. Although it may be considered as one of the finest chemical exhibitions in the world, it is rarely shown to strangers. Germans delight in making a mystery of everything.

The *cake* or combined regulus of gold and silver obtained from the purification furnace is melted and cast molten into cold water. It is then easily divided into thin scales which are put into immense glass retorts of spherical form, nearly filled with nitric acid. Here the silver dissolves. The sight was beautiful. The laboratory was a spacious and lofty hall, filled with enormous globes of glass ranged in rows, whence the nitrous gas was escaping in red fumes to the roof; the dissolution of silver being evident in all of them by the effervescence it caused; the gold falling as a black powder to the bottom of every retort. After the dissolution of the silver is complete, the acid containing the silver is decanted into another retort, leaving the gold behind. Afterward, increasing the heat on

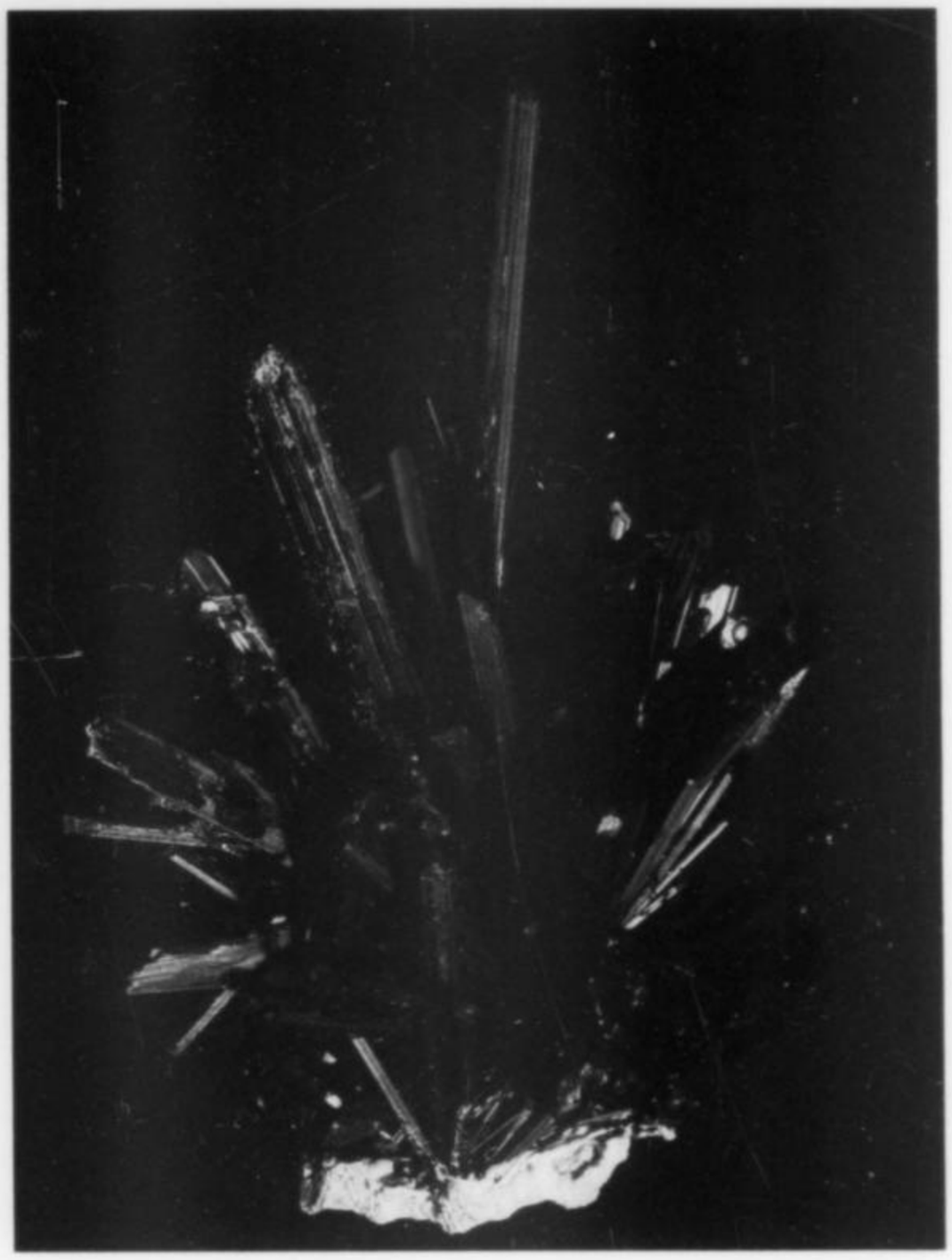

Figure 17. Stibnite crystal group, 15 cm, from Kremnitz. Slovak Mining Museum collection; photo by Ivan Ladziansky. Drawing: Krenner, 1865.

the side of the silver, the whole of the acid is driven off and the silver remains beautifully crystallized in the retort. The gold is smelted into ingots of 12,000 florins [about 1,300 British pounds sterling] each. The annual production of gold and silver at Cremnitz amounts to 800,000 marks of silver and 3,000 of gold.

The Cremnitz ore specimens, even when most rich, have nothing beautiful in their appearance. We bought, however, at Cremnitz, other minerals that were both beautiful and rare. The most remarkable are:

1. Red antimonial silver [pyrargyrite], crystallized, containing gold
2. Sulfide of silver [argentite], crystallized in cubes, containing gold
3. Phosphate of lead [pyromorphite] crystallized in hexagons
4. "Pearl spar" in spheroidal tubercles upon silver ore
5. Molybdenous silver [hessite-pilsenite mixture], crystallized, containing gold
6. Native gold, crystallized, from Cremnitz
7. The richest gold ore of Bakabanya
8. Native gold from Boitza in Transylvania, crystallized in octahedrons
9. Primary crystals of quartz in the cubic form, not pseudomorphose
10. Red pycnite [topaz] from Moravia

Cremnitz is the oldest of all the towns where there are mines: and of the seven famous mining districts—Schemnitz, Cremnitz, Neusohl, Konigsberg, Bakabanya, Libethen and Tiln—Cremnitz, although not the most abundant in precious [ultra-high-grade] ore, is said to be the richest. Its deepest mine has been worked to the depth of 300 fathoms [1800 feet].

May 16. We left Cremnitz in the afternoon and returned to Schemnitz. Here we found all the inhabitants assembled, awaiting the coming of the young princes. A great concourse of the miners and other spectators preceding the royal carriages and shouting

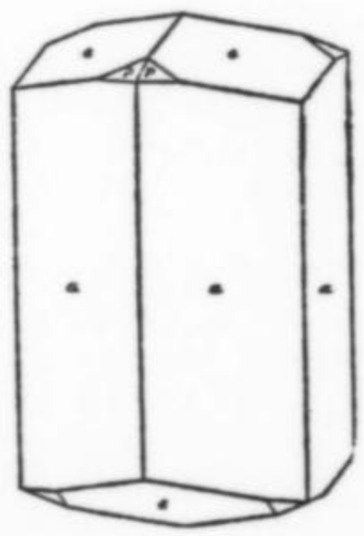

Figure 18. Pyragyrite crystal from Kremnitz (Moesz, 1902).

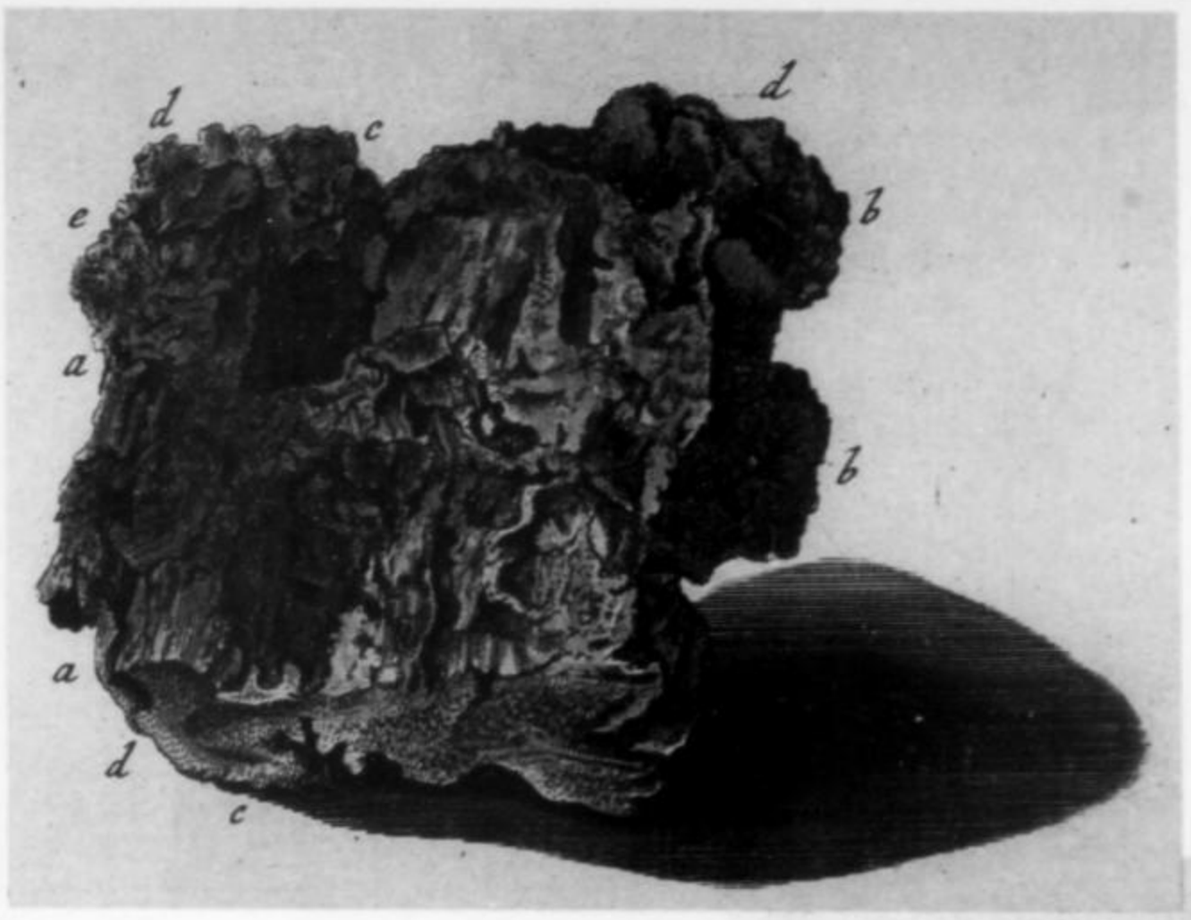

Figure 19. Chlorargyrite with argentiferous marcasite from Schemnitz (Schmiedel, 1753, Plate XV). MRL

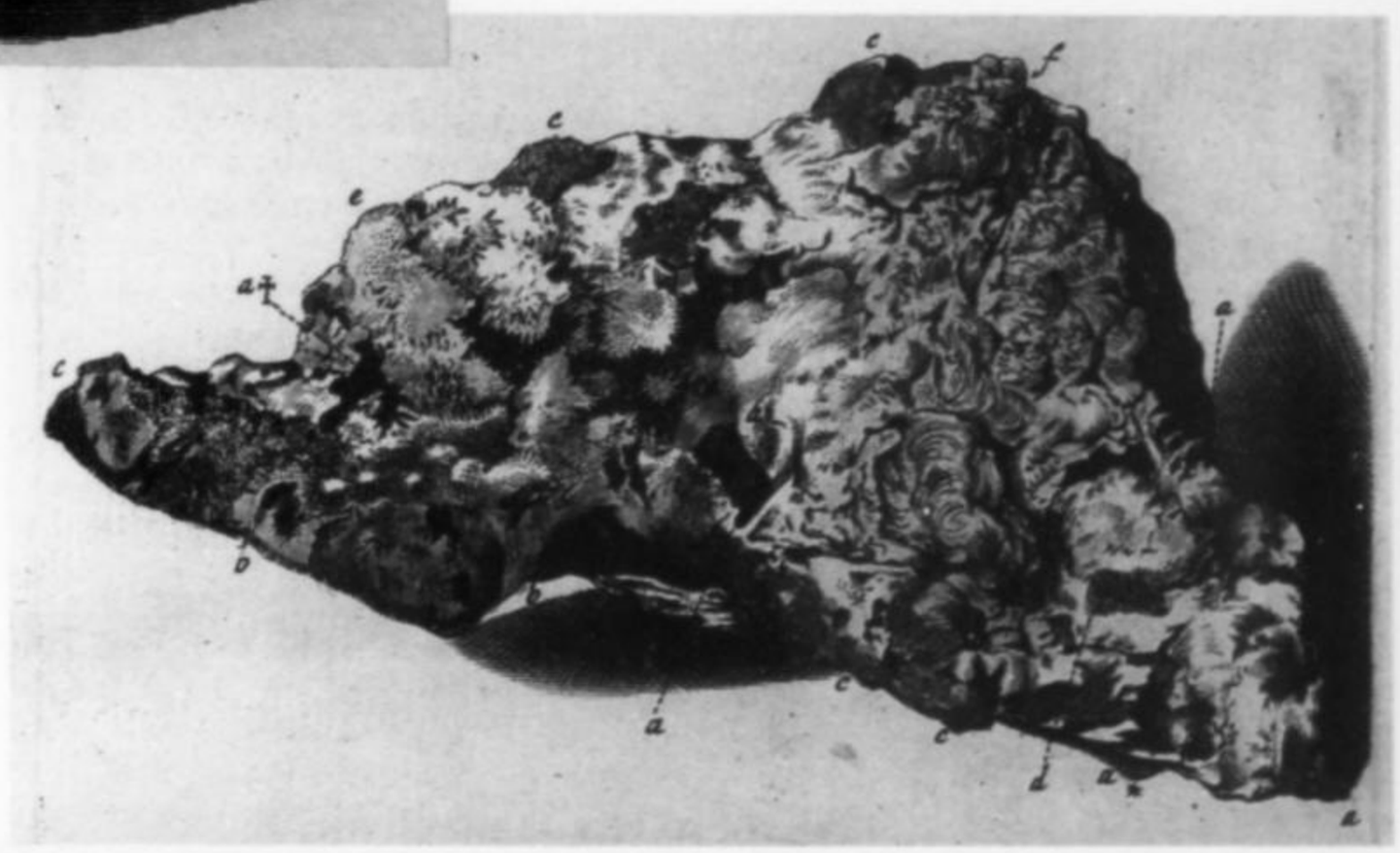

Figure 20. Native silver with marcasite and quartz, from Schemnitz (Schmiedel, 1753, Plate 1). MRL

"*Vivat!*" gave us the first news of their being in town. During the whole night, the noise of drums, musical instruments and fireworks kept up a rejoicing in the streets until the morning.

May 17. We were occupied the whole day in inspecting, buying and packing minerals, assisted by the two Professors Passern and Möhling, who came to visit us. Some specimens of crystallized sulfide of antimony [stibnite] being offered to us for sale, containing flakes of native gold among the crystals, Professor Möhling suspected that the association had been artificially contrived. Upon placing the specimens in hot water, the gold became disengaged from a gum cement, and the trick was manifest. This induced us to submit our Transylvanian specimens to the same trial, and one or two of them proved equally spurious; that is to say, the antimony and gold were severally genuine, but their association was false.

Professor Möhling and one of the students dined with us. From these gentlemen and from our own observations we obtained the following particulars respecting the mines of Schemnitz.

The whole town of Schemnitz is undermined; and to such a degree that some of the houses have already fallen, owing to excavations beneath their foundations. The principal veins are six in number, but there are many smaller ramifications from these which often prove very rich. The six principal veins are the following; from west to east:

I. The Theresa-schadt (vein width 12 feet)
II. The Hospital vein (vein width 132 feet)

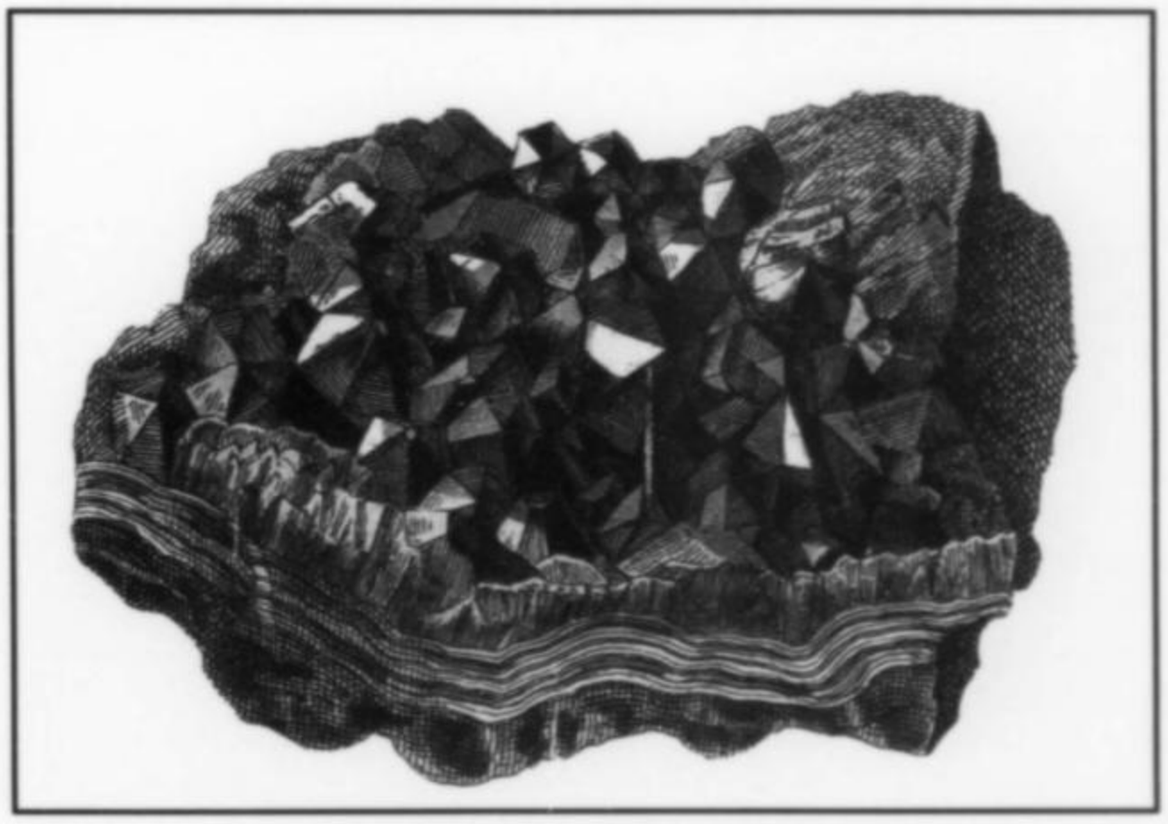

Figure 21. Amethyst group from Schemnitz (Kurr, 1859). MRL

III. The Oberbiber-stohln
IV. The Johan-schadt
V. The Stephano-schadt
VI. The Green-stohln

The Stephano-schadt is the most famous of all the mines at Schemnitz. This vein should rather be considered as an assemblage of several contiguous parallel veins than of one alone, reaching to the breadth of 48 feet; but since the intermediary minerals are rich in precious ore, a name has been given to the whole as of a single vein. The works carried on in this vein are upon a more magnificent scale than in any of the others; the galleries are better constructed, and the machinery is of greater magnitude: but it is never exhibited to strangers; even their Highnesses the Archdukes [the two princes] were not permitted to descend into this mine.

The first two of the Schemnitz veins lie near to the surface and are very rich: they were the earliest discovered. The riches of the third and fourth veins lie at the depth of 6000 [sic] feet. The greatest production of the Schemnitz ores, and which continued only for eight or ten years, came from a ramification of the third vein in an area south of town called Siegelsberg. In the year 1763, the proprietors obtained in one week, 881 pounds of silver. From the fifth vein, the Stephano-schadt, in the short space of 14 days were obtained 350 pounds of pure silver. Eight men having sunk a shaft into the same vein, realized in 15 days a clear profit of 80,000 florins [nearly 9,000 British pounds sterling]. During the time they were employed in this work, they made their appearance with visages as black as if their faces had been rubbed with the dust of plumbago: possibly this may give a clue as to the nature of the ore.

The whole length of the excavations at Schemnitz equals 18,000 feet [3.4 miles]; and these mines have been worked for six or seven centuries. These remarks apply only to the Imperial mines. Westward of Schemnitz there are many other mines which belong only to individuals: concerning these it is difficult to obtain valid information.

The number of miners at Schemnitz, employed by the Crown, amounts to 8,000: at Cremnitz there are only 1,500. Formerly they all carried arms, but this custom no longer exists. (It is to the kindness of the Archduke Anton that the author owes this information; together with some other facts concerning the mines of Schemnitz, which his Highness condescendingly communicated.) Both males and females begin to labor so early as six or seven years of age, and continue the employment until they die.

In the evening we visited Baron de Slagen, who by making application to Count Sporck, the nobleman entrusted with the care and education of the young princes, obtained permission for us to accompany them into the Wind-schadt mine, upon the following day.

May 18. We rose at six o'clock; and at seven were presented by Count Sporck to their Highnesses the Archdukes. We then set out for the Wind-schadt mine. Upon our arrival we entered the mine by a level floored the whole way with planks, and so spacious that three persons might walk abreast of each other with ease. The entrance to the mine was adorned with garlands, in honor of the two princes, and a discharge of artillery announced the moment of their descent. The floor and sides of this mine were so clean that a lady in her court apparel might have accompanied us, as through the apartments of a palace.

We continued to a very great distance along this level, conducted by the light of torches. When we reached the vein at its termination, the Archduke Anton asked several questions respecting the ore and its associations, proving that he was well acquainted with mineralogy.

After having visited two or three veins in different directions we were conducted to a chamber brilliantly illuminated, and prepared for the reception of their Highnesses. As soon as they entered the illuminated chamber, a band of musicians stationed in an elevated gallery of the mine, above our heads, began to play national airs. As a curious accompaniment to this music, there were then seen two men, descending through a shaft of the mine to the spot where the two Archdukes were placed. These persons, being let down into the presence of their Highnesses, began to exemplify the manner in which the sides of the mine are boarded, and the timbering applied. After this an officer of the mines, accompanied by one of the miners, descended into the lower works, and presently returning, brought up with him some specimens of the ore and several beautiful minerals, to be presented to the two Archdukes. (Upon this occasion, their Highnesses most condescendingly presented a portion of these minerals to us. The Archduke Anton gave to the author a magnificent specimen of crystallized [stibnite], which he has since often exhibited during his Mineralogical Lectures in the University of Cambridge.)

In the evening there was a ball in honor of the Archdukes. We were invited. Their Highnesses complimented the inhabitants by appearing as miners, wearing the peculiar dress which has been already described as the uniform of the mines. It was highly gratifying to us to bear testimony to the countenance and judicious patronage bestowed by the German government upon everything connected with the science of mineralogy, and with the art of mining.

May 19. Their Highnesses set out this day to visit the mines of Newsohl and Cremnitz.

The most beautiful minerals of Schemnitz are amethysts invested by effloresccnt *manganese-spar* [rhodonite or rhodochrosite] in a minute crystallization upon the surface of the amethyst crystals. The most valuable minerals are those rich sulphurets of silver called by the Germans *Glaz Erz* [chlorargyrite], which is so malleable that medals have been struck from the unwrought ore, in honor of regal visitants; it is so fusible that it melts even in the flame of a candle.

We saw several collections of minerals from the Schemnitz mines, and they all contained more or less of the [chlorargyrite] ore. The mineral is found both in the massive and crystallized state. In the massive state it is associated with white, earthy pearl-spar [dolomite or ankerite] and with quartz crystals. Sometimes quartz crystals are so penetrated by the black sulfide of silver [argentite] as to appear of a jet color. And in no other country are the dodecahedral crystallizations of quartz exhibited under such a variety of singular shapes and aggregations; owing to this circumstance, Scopoli composed a work, entitled *Crystallographia Hungarica*, which is filled with these mineral deformities. Native silver is found in the Stephano-schadt mine; and very beautiful crystallizations of ruby silver [proustite and/or pyrargyrite].

Other minerals of Schemnitz, besides the ores of gold and silver, are exceedingly numerous. Among them may be mentioned the following:

1. Phosphates and carbonates of lead, crystallized
2. Red plumose hydro-sulphurets of antimony [kermesite], crystallized
3. Diaphanous crystals of barite
4. Red sulphurets of arsenic [realgar], crystallized

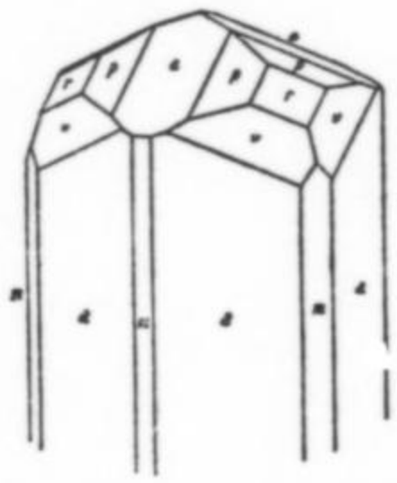

Figure 22. Pyrargyrite crystal from Schemnitz (Toborffy, 1910).

5. Red antimonial silver [pyrargyrite], crystallized in quartz, with galena and pyrite
6. The "white silver" of Werner; rich in gold. It is a triple sulphuret of lead, iron and antimony, containing silver and gold [probably argentian freibergite or freieslebenite]
7. Beautiful, diaphanous crystals of sulphuret of zinc [sphalerite] of a yellow topaz color

May 20. We were employed in collecting and analyzing minerals, and in making experiments, in the public laboratory with the students of the College of Mines. Almost all the students smoke tobacco, seldom making their appearance in the morning without tobacco-pipes in their mouths.

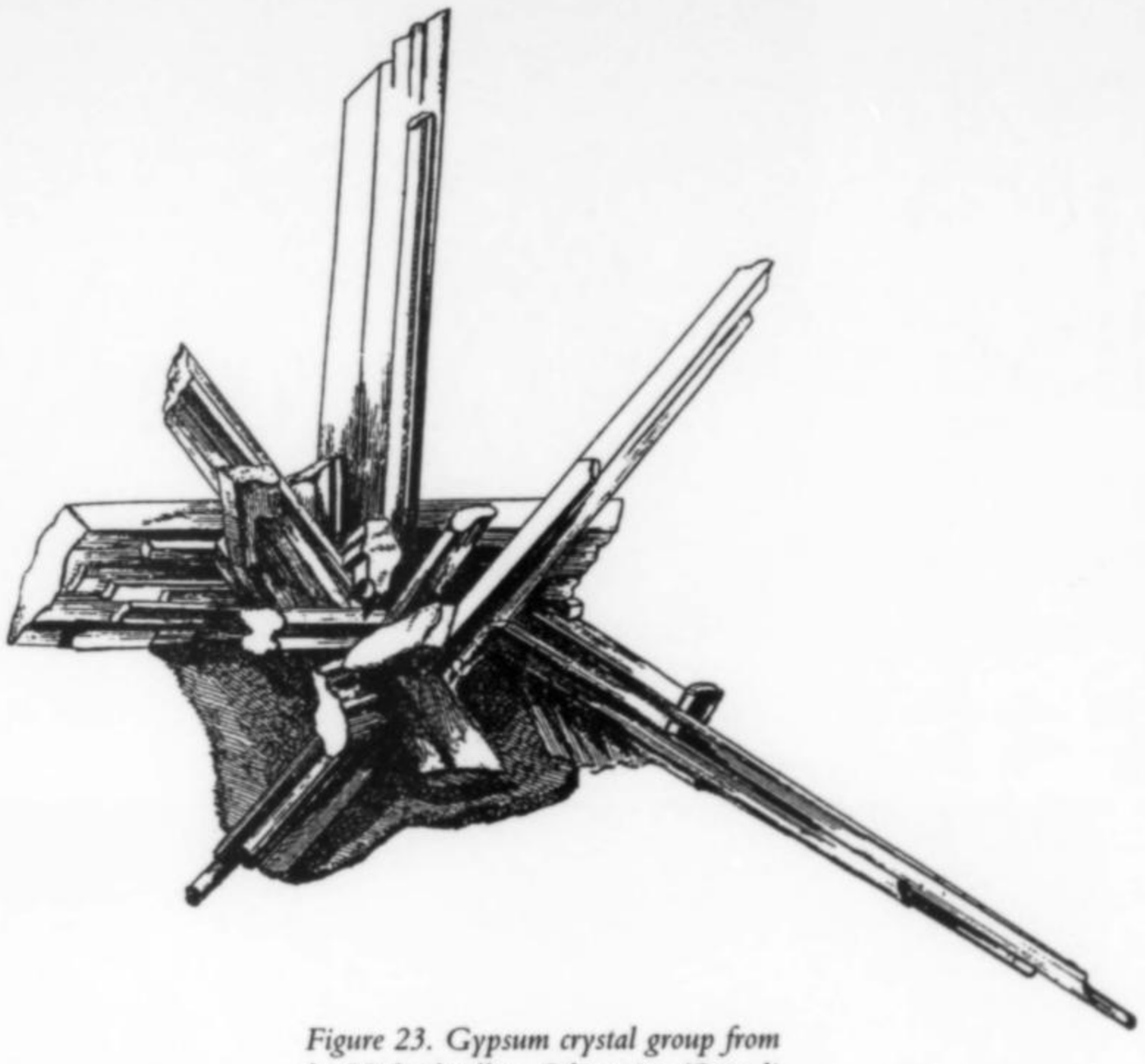

Figure 23. Gypsum crystal group from the Michaelstollen, Schemnitz (Scopoli, 1776). Obodda Library.

May 21. We visited the most celebrated collections of minerals at Schemnitz and in the neighborhood; particularly one (belonging to the *Conseiller des Mines* at the Wind-schadt mine) remarkable for the superior beauty and abundance of the amethysts it contained. The owner afterward conducted us to the council chamber of the mines belonging to the Crown. Upon shelves were exhibited the most magnificent specimens of the sulphurets of silver [chlorargyrite, argentite] that had been lately found. Such specimens are here exposed for sale, according to their weight, to benefit students in mineralogy, being priced only according to the value of silver they contain, without the smallest increase of price in consequence of their beauty or rarity. We bought several and sent them to England, together with specimens of every kind of ore found in the Hungarian mines.

May 22. We rose at five this morning to accompany one of the students, Mr. Charles Pistl, into the Paquer-stoln, one of the largest and deepest mines in Schemnitz. We descended 540 feet and were then conducted, by [adits and drifts] as airy and spacious as the corridors of a fine theatre, to different parts of the mine where laborers were working the ore. All the Imperial mines have a connection with each other, offering in their whole extent a subterranean passage which reaches to the astonishing length of nearly three miles and a half. The sight of the interior of the Paquer-stohln convinced us that there are no other mines in the world like those of Hungary. How wretched in comparison appear the mines of Cornwall and Wales, where it is sometimes necessary to creep upon hands and knees, wet through, over all sorts of rubbish, in order to pass along a level from one shaft to another. The mode of descent into our English mines is always attended with difficulty, and almost always with danger: but the inside of a Hungarian mine may be compared to the interior arrangement of one of our best frigates, where space has been so husbanded, and cleanliness so strictly maintained, that nothing is seen out of its place, and there is room enough for every operation.

[Clarke left Schemnitz on May 24, and traveled to Presburg, where he met the Emperor, and from there to Vienna on May 29. He concludes his narrative as follows:]

And now, having brought our readers to Vienna, we shall here leave them; pursuing without observation, the rest of our journey through Germany and France to England. It shall suffice to add that, after remaining in Vienna until the middle of July, where we collected many valuable books and some manuscripts of classic authors, we hastened by way of Munich, Augsburg and Strasburg to Paris. Here we had an interview with Napoleon Buonaparte. It was granted to us by that extraordinary man in consequence of the kindness shown by the author's late brother, Captain George Clark, when commander of the *Braakel*, to a part of the French army which he convoyed from Egypt to Marseilles.

In Paris we became acquainted with several Members of the Institute, and constantly attended the lectures of Haüy in Mineralogy. At Paris we were also introduced to the celebrated Werner during a visit that he made to his rival, Haüy; the French capital being at that time thronged by men of science from all parts of Europe. After remaining in Paris until the end of September, we set out for Boulogne; and thence sailing to Dover, were once more safely landed in our beloved country.

LOCALITY NAMES mentioned by Clarke, and their modern equivalents

Boitza = Băiţa
Siebenburgen = Transylvania
Abrudbanya = Abrud
Verespatak = Roşia Montană
Botes = Boţeşti
Nagyag mine = Săcărâmb
Offenbanya = Baia de Arieş
Sekeremb = Sačărâmb
Topliz = Teplice
Porcura = Valişoara
Schemnitz = Banská Štiavnica
Cremnitz = Kremnica
Bakabanya = Pucanec
Neusohl = Banská Bystrica
Libethen = Lubietová
Königsberg = Nová Baňa
Nagybanya = Baia Mare
Temeswar = Timişoara

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What's New in Minerals?

Figure 3. **Groutite crystals on matrix, 5 cm across, from the Cuyuna iron range, Minnesota. Keith Christy specimen.**

DENVER SHOW 1989

The Denver Gem & Mineral Show (sponsored by the Denver Council of Gem and Mineral Societies) and the associated satellite shows (of which Marty Zinn's Colorado Mineral & Fossil Show at the Holiday Inn is of most interest to mineral collectors) were held again this past September, and were as enjoyable as ever.

The biggest news was the recent discovery of a large pocket of blue barite by Bryan Lees (*Collector's Edge*) and Dennis Wilson at the

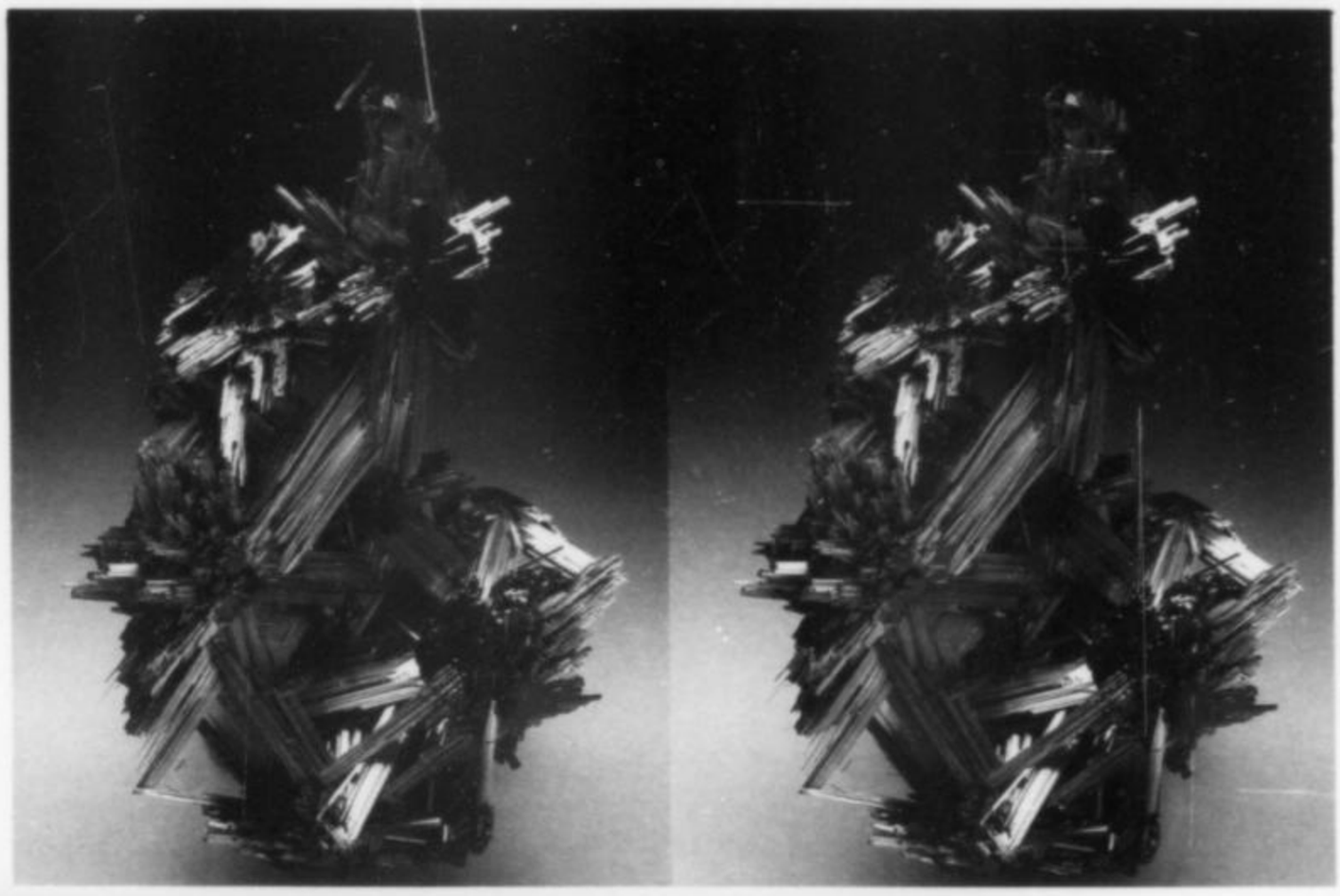
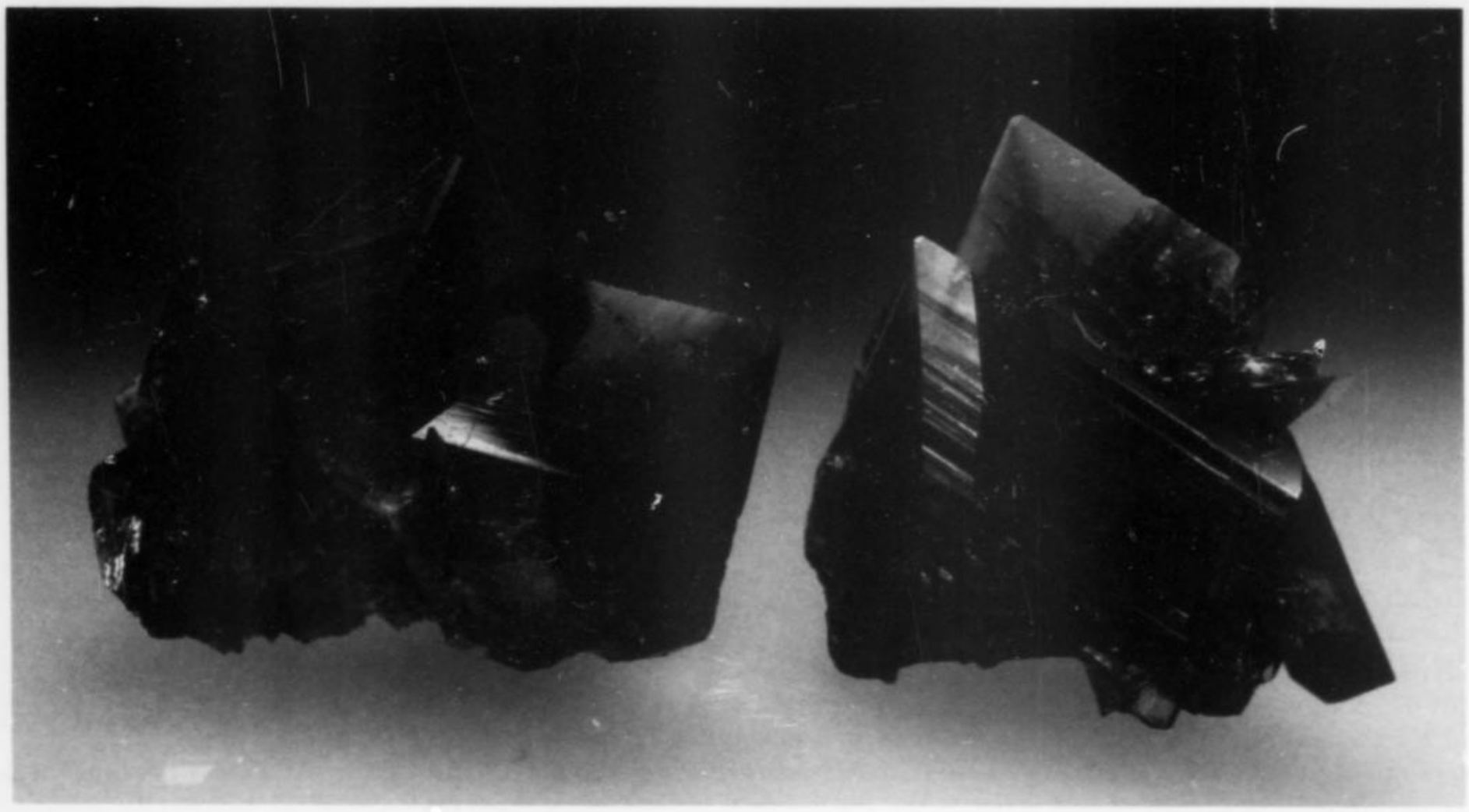


Figure 1. **Rutile epitaxially oriented on black ilmenite crystals, from Ibitiara, Bahia (stereo pair). The group measures 7.5 cm tall. Luis Menezes specimen, now in the Smithsonian collection.**

Figure 2. **Axinite crystals from Le Bourg d'Oisans, France; the specimen at left measures 2.5 cm. Joachim Karl specimen (*Mineralien & Fossilien Galerie*, Frankfurt).**



famous Stoneham locality in Weld County, Colorado (see the article on this locality in vol. 17, no. 4, p. 255–258). The pocket was a wide, very flat cavity covered on the bottom face by thousands of superb crystals. Bryan had roughly 800 specimens for sale, including many fine thumbnails, miniatures and small-cabinet-size pieces, and a fair number of medium-cabinet-size (7 to 10 cm) specimens. Two thousand more specimens from this find had been sold wholesale to another dealer, according to Bryan. The crystal quality and color are perhaps the best ever for this locality, very similar to the specimens pictured earlier here from the 1985 find by Norm Bennet and others (reference cited above). It was particularly exciting to see so many fine thumbnails, which have previously been found only rarely and in very small numbers.

Also prominent at the show was a large quantity of very fine rose quartz crystal groups from Brazil, distributed among many dealers including Luis Menezes (a wholesale source for many of the retail dealers), Ken Roberts, the Rocksmiths, and others. Some labels give the locality as the Sapucaia mine, a famous old occurrence, whence came the Smithsonian's great piece nicknamed the "Van Allen Belt." Menezes and Carlos Barbosa say that the original Sapucaia mine has long since been exhausted, and that the new specimens actually come from the nearby Pitorra mine, Galileia County, Minas Gerais. Other specimens are labeled as coming from the Regal mine near Araçuai, probably a distinct occurrence. (Araçuai is near Brazil's other famous rose quartz crystal locality, Lavra da Ilha; see vol. 4, no. 5, p. 207–213.) Hundreds of thumbnails and small miniatures, along with a few larger specimens, were available.

Menezes also brought in a large lot of another Brazilian discovery: golden rutile needles radiating epitaxially from platy hexagonal ilmenite crystals. These were found near Ibitiara, Bahia, where tons of fine rutilated quartz crystals have been recovered in recent years. But these new specimens lack enclosing quartz. The crystals occur singly and in interlocking groups, with individual ilmenites ranging from roughly 1 to 3 cm across. The identification as ilmenite rather than hematite is based solely on the black rather than red streak given by this material; Menezes has arranged for X-ray confirmation and will announce the results shortly. About 200 specimens were recovered.

A large amount of newly collected wavellite—250 flats!—was available from *Starfire Quartz Crystal Mines* (Star Route 1, Box 306, Mt. Ida, Arkansas). The locality is Mauldin Mountain, Montgomery County (see the article on this locality in vol. 16, no. 4, p. 291–295), where the wavellite typically occurs in smaller spherules of a paler green than wavellite from the more famous Arkansas locality at Dug Hill. Thumbnails to cabinet specimens with full coatings and also individual wavellite spherules to 5 or 6 mm were available.

Carlos Barbosa had a number of fine specimens of spodumene, in thick pale pink and also pale green crystals up to fist-size, from Resplendor. It was a big find: half a *ton* of crystals. Tom Palmer (*Crystal Cavern Minerals*) had more from this discovery but these were of a different habit; long, flat and thin, like shards from a broken window, but actually showing faces all around. Most of the spodumene of both habits is flawless and gemmy clear. Incidentally, Resplendor is also the locality for the colorless, gemmy, poker-chip beryl crystals reported and pictured here in vol. 20, no. 1, p. 69 (it would not be improper to make a marginal note to that effect in your copy of that issue).

Dennis Beals (*XTAL*, 20 N. Iowa, Colorado Springs, Colorado 80909) had a very attractive and interesting lot of golden barite from the Ojuela mine, Mapimi, Durango, Mexico. The crystals are relatively clear, squarish, thin-edged plates to 2 or 3 cm across, with somewhat irregular surfaces, resembling wulfenite from Tombstone, Arizona, or Morocco. The black matrix and the loose grouping of crystals thereon adds to the attractiveness of the specimens. About eight flats of thumbnail to cabinet-size specimens comprised the lot; a few pieces show a very different, brushy habit.

Jim Walker and Mary Fong/Walker (*Ikon Mining*) and Bryan Lees obtained some very rare sperrylite crystals from Talnach Norilsk, Siberia. Some are free crystals to 1.5 cm or so; others are partially enclosed in a brownish rock matrix.

Bill Larson (*Pala International*) had some new gold specimens from the Oro flame mine, Placer County, California. The habit is distinctive: frosty, branching to vermiform groups and masses without matrix, in sizes up to 8 or 9 cm. Bill also had some very fine, gemmy green tourmaline crystals with pink bases, to 8 or 9 cm in length and beautifully terminated, from Jos, Nigeria. It almost goes without saying these days that this is in addition to large numbers of fine tourmaline crystals from the Himalaya mine.

Enrique Kucera Gomez (*Natura Kucera*, c/Urgeli 171, Barcelona, Spain) was one of several European dealers who arrived for the show. He brought Spanish pyrite (see the previous issue), good erythrite groups with crystals to over 1 cm from Bou Azzer, Morocco, some unusual druses of stubby, large (for a druse) blue-gray quartz crystals from Orihuela, Murcia, Spain, and yellow-green pyromorphite from Cordoba.

Keith Christy (P.O. Box 22551, Billings, Montana 59104) had some excellent specimens of splendent black groutite crystals and druses on matrix from the Robert mine, Cuyuna iron range, Minnesota. Roughly six to ten flats of specimens were derived from the break-up of a large sample collected in 1980. Some excellent miniatures along with a few thumbnails and cabinet pieces comprised the lot.

Don and Gloria Olson had just returned from a buying trip to Namibia, bringing a large selection of fine Tsumeb dioptase and some unusual, pale blue anglesite crystals in milky plates to 6 or 7 cm across. Miners at Tsumeb told them that many more pieces of the blue anglesite had been bought up by Namibian collectors, and that much larger crystals had occurred in the pocket but were fragmented by a blast too close to the vug.

Joachim Karl (*Mineralien & Fossilien Galerie*, Fahrgasse 88, D-6000 Frankfurt, West Germany) had some very attractive new European finds, including pink octahedral fluorite crystals on white granite from Mont Blanc, near Chamonix, France (roughly one and a half flats), and superb, undamaged ferroaxinite thumbnails from the classic locality at Le Bourg d'Oisans, France. I also noticed in a nearby flat an extraordinary old classic: a group of undamaged, 2–3 cm bournonite cogwheels on matrix from the Herodsfoot mine, Cornwall, England. Few museums in the world can boast of a bournonite this good, but it seemed to be an unnoticed sleeper (perhaps because Karl is much better known for recently collected minerals than for century-old classics of this sort).

Every once in a while the Pakistani topaz deposit at Ghundao Hill, Katlang, produces a really superb crystal of red topaz. An example may be seen in Bill Larson's ad on the outside back cover of this issue; another is in the Smithsonian and was on exhibit at the Denver Show; and yet another was for sale in Denver by Herb Obodda. The latter specimen is an exquisitely clear and vibrant thumbnail crystal on matrix, which sold promptly despite a (justifiably) high price.

Horst Burkard (Dornheckenstrasse 20, D-5300 Bonn 3, West Germany) brought a surprising lot of bright green cubic fluorite groups sprinkled with diamond-like little calcite crystals, from El Hammam, Morocco. About 20 cabinet pieces, including five really big ones, comprised the lot.

The big news in old collections being recycled is the collection of the late Marian Godshaw: 25,000 specimens assembled over four decades. Cal and Kerith Graeber are bringing most of these to market, along with a few other dealers who are taking portions through the Graebers. The work of sorting, pricing and labeling such a large collection is greater than most collectors can understand; a few thousand pieces were available in Denver (including many fine thumbnails) and the rest will be processed in time for the Tucson Show.

It was a pleasure to see the Soviet Union represented at the Denver Show by the Director of the Fersman Mineralogical Museum in Mos-

cow, Prof. Alexander Godovikov, and curator Dr. Leo Bulgak. They brought along a few flats of specimens which they offered for sale in Bryan Lees' booth, and also an exhibit of fine old museum specimens, expenses for which were generously underwritten by Bryan Lees. Both gentlemen speak English, and were quite cordial in discussing specimens and localities with interested collectors. Other, more extensive exhibits in the United States are being planned.

The Fersman Museum, although not especially well stocked with recent discoveries, is a treasure house of old classics. Their Denver Show exhibit included several blue topaz crystals from Mursinka, in the Ural Mountains, collected in 1896; a brilliant red topaz crystal, 3 cm, from near Sanarka in the Urals, collected in 1912; yellow, hexagonal-prismatic beryl crystals to about 8 cm, on matrix, from Alabashka in the Urals, collected in 1876; one of the new sperrylites from northern Siberia; and one of the new creedite groups found in 1986 at Akchatau, Kazakhstan.

But this wasn't all from Mother Russia. A portion of the private collection of Vladimir Pelepenko, which was exhibited at the 1988 Munich Show (see vol. 20, no. 1, p. 73–75), was brought to Denver through the efforts of Marty Zinn and Johannes Keilmann. Although only a small fraction of the 160 specimens shown in Munich could be transported, it still filled three four-foot exhibit cases and dazzled visitors at the Holiday Inn and later at the main show at the Merchandise Mart. Many of these were collected relatively recently, at several mines in the Dal'negorsk district, Primorskiy Kray, about 300 km northeast of Vladivostok; large ilvaite crystals, pyrrhotite crystals to 10 cm, bright galena groups to 10 cm, large sphalerite crystals, lustrous green datolite crystals and large, gemmy calcite crystals were all labeled Dal'negorsk. Cinnabar twins to 1 cm on blue fluorite cubes (Tschauwaj, central Asia), green fluorite octahedrons to 7 cm on edge, on an even larger huebnerite plate (Kara-Oba, central Kazakhstan) and large orange scheelite crystals on cubic pyrite (Beresovsk) were among the highlights. Pelepenko himself was unfortunately not able to attend, but he is owed a sincere *spasebo* ("thanks") for allowing his valuable specimens to travel so far in order to share them with American collectors. I wonder how many of us would be willing to see our best specimens travel half-way around the world without us.

There were, of course, many other fine exhibits to be seen, and I will not be comprehensive in listing these but will pause only to mention a few outstanding specimens that caught my eye.

No less than 20 public museums from across the country, not to mention the Soviet exhibits, prepared showcases, and many of these contained some remarkable specimens. The Lyman Museum (Hilo, Hawaii) display included a huge, blackish brown manganotantalite crystal, 8 or 9 cm across, from the Murrua mine in the famous Alto Ligonha pegmatite district, Mozambique. The Harvard case was spectacularly filled with their best gold specimens. The Smithsonian's exhibit of topaz included a large, blue, Russian crystal from Mursinka, the aforementioned red topaz from Pakistan, and two flawless brown crystals, 4 or 5 cm, from Tepetates, San Luis Potosi, Mexico. The (Canadian) National Museum of Natural Science brought an exhibit of specimens from the Jeffrey mine, Asbestos, Quebec, including one of the finest known miniatures of gemmy orange grossular on matrix. The California State Mining Museum also exhibited a case full of gold. Montana Tech displayed Butte minerals including a superb cabinet-size group of enargite crystals from the Leonard mine and a fine rhodochrosite from the Emma mine. Richard Souza of the Carnegie Museum in Pittsburgh brought some exceptional pieces from a recently acquired Bolivian collection, including what must surely be the world's finest wurtzite: a fist-size matrix covered with thick, velvety, 2.5-cm leaves of wurtzite, from the Animas vein, Chocaya district, Potosi department. From the same collection a group of large andorite crystals on matrix, from the San Jose mine in Oruro, was also shown. There were many other fine institutional cases, as I said, and this is only a sampling.

Among the privately owned cases, in addition to Pelepenko's, there were also some very interesting things to see. The large (at least 3 cm) single axinite crystal perched on a small bit of matrix from Le Bourg d'Oisans, France, in the case of Chris, Grace and Mel Dyck sticks in my mind, as do the self-collected Colorado barites (Dan and Diane Kile), Richard Graeme's famous Bisbee collection, an exhibit of mineral fakes and Gene Tribbey's thumbnail collection. And I have to admit that it was amusing to hear the large, mechanized Dynamation dinosaur periodically roaring at the many school children who always seemed to be gathered in awe around it.

The 1990 show is scheduled for September 14–16.

FM-TGMS-MSA WULFENITE SYMPOSIUM

The 11th annual Tucson Mineralogical Symposium, sponsored by Friends of Mineralogy, the Tucson Gem and Mineral Society, and the Mineralogical Society of America, is to be held on Saturday, February 10, 1990, in conjunction with the Tucson Gem and Mineral Show. Wulfenite is the 1990 Tucson show mineral, and hence, was chosen as the subject for the 1990 mineral symposium.

Wulfenite has always been very popular among mineral collectors, primarily because of its brilliant orange to reddish orange color, adamantine luster, and commonly large crystal size. It is a lead molybdate, $PbMoO_4$, which in general occurs in relatively pure form with some substitution by Ca for Pb and up to 50% substitution of W for Mo. Small concentrations of V and traces of Cr and As have also been reported. Arizona contains several of the most famous wulfenite localities: most notable is the Red Cloud mine, though the 79, Hilltop, Old Yuma, Defiance, Glove, Rowley and Mammoth mines are also well known. Other famous localities nearby in Mexico include the Ojuela mine, Mapimi, Durango; the Los Lamentos mine, Chihuahua; and the San Francisco mine, Magdalena, Sonora. Elsewhere in the world, well-known wulfenite localities include, Chillagoe, Queensland, and the Broken Hill district, New South Wales, Australia; Tsumeb, Namibia; Bleiberg, Austria; Oudida and Jebel Mahser, Morocco; and Sidi Rouman, Algeria.

11th ANNUAL MINERALOGICAL SYMPOSIUM

10:15 AM-1:00 PM

Saturday, February 10, 1990

10:15-10:20 AM	Introductory remarks—Symposium Chairperson *Dr. Karen J. Wenrich*
10:20-10:50 AM	Wulfenite, Fickle Mineral of Exquisite Crystals and Lackluster Ores *Dr. Peter Bancroft*
10:50-11:15 AM	Wulfenite Twins *Dr. Emmanuel Fritsch*
11:15-11:40 AM	Synthetic Wulfenite *Dr. Kurt Nassau*
11:40-12:05 noon	Stolzite, Wulfenite's Hidden Brother: Occurrence at the Fat Jack Gold Mine, Yavapai County, Arizona *Dr. Peter J. Modreski*
12:05-12:30 PM	Wulfenite in Mexico *Dr. Miguel Romero and Peter McGraw*
12:30-1:00 PM	Wulfenite Occurrences in Colorado *Tom Rosemeyer*

WULFENITE, FICKLE MINERAL OF EXQUISITE CRYSTALS AND LACKLUSTER ORES

Dr. Peter Bancroft
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A secondary mineral of little economic importance, wulfenite forms most frequently in arid lands near the surface of lead veins. Aside from certain chemical and crystallographic differences, wulfenite shares similar characteristics of bright red color, hardness and a lead heritage with crocoite and vanadinite. Interestingly, the differentiating elements of the three minerals: wulfenite (Mo), crocoite (Cr) and vanadinite (V) are in close proximity on the periodic table.

In 1785 the Jesuit naturalist, Baron F. X. von Wulfen of Klagenfurt, Austria, first described the new mineral in his monograph *Abhandlung vom karnthnerischen Bleyspathe* ("lead spars from Carinthia"). It wasn't until 1845 that W. Haidinger suggested that Carinthian lead spar be renamed wulfenite in Wulfen's honor.

As an ore wulfenite is almost never of economic importance. At best it might be considered as a mineral indicator for lead orebodies. Sizeable deposits of wulfenite have occurred in only a few mines. Nearly all wulfenite occurs crystallized; the extremely brilliant and gaily colored crystals easily attract the miner's attention.

Wulfenite comes in a wide variety of colors: black, brown, yellow, green, orange, red and colorless. Crystals are usually tabular, frequently paper-thin. Growth patterns may be shown by color banding and phantoms. Some prism faces on crystal plates may not be sharply bounded. More unusual are wulfenite crystals which occur in pyramidal or prismatic habits.

Exceptional wulfenite crystals have been found in Morocco, China, Germany, Iran, Austria and elsewhere, but the following occurrences may readily be considered among the most important: Tsumeb, Namibia, (honey-yellow plates up to 8 cm on an edge); Cucurpe, Sonora, Mexico (transparent red-orange plates to 13 cm, frequently encrusted with druses of red mimetite); Mfouati, Congo-Brazzaville (incredible medium-brown stocky crystals up to 9 cm on an edge and 2.5 cm thick!); and La Paz County, Arizona (bright orange to orange-red plates up to 6 cm on an edge, frequently on goethite matrix).

Wulfenite seldom receives serious attention from geologists; but museum curators and private collectors are eager to add good wulfenites to their collections. Bright, sassy, colorful—a good wulfenite could easily become a centerpiece of any mineral collection.

WULFENITE TWINS

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Wulfenite is cherished by mineral collectors for its beautiful tabular crystals, found in many localities. Less known by the mineral enthusiast is that most of these crystals are twins. This arises from the fact that they generally do not show reentrant angles, as many twinned crystals of other species do.

In 1955, Hurlbut described twinned crystals of wulfenite from Schwarzenbach, Jugoslavia, exhibiting reentrant angles and a $\{00\bar{1}\}$ composition plane. In contrast with former studies, this demonstrated that the wulfenite crystal structure does not have a center of symmetry, and that its four-fold axis is polar. This was further proved by the detection of a weak but definite piezoelectric response on one single crystal. Therefore, a twin law restoring the center of symmetry, such as {001} twin plane, is possible.

By etching in dilute nitric acid, it was further demonstrated that crystals from Mexico and the Red Cloud Mine, Arizona, were also twins, although they did not exhibit reentrant angles. Morphology and surface features lead the author to believe that wulfenite crystals from Mies, Jugoslavia, and Pribram, Czechoslovakia, may be single crystals. Hurlbut hypothesized that twins with composition plane $\{00\bar{1}\}$ would show a reentrant angle, whereas those with composition plane {001} would have a pseudo-dipyramidal symmetry with no reentrant angle.

The Smithsonian Collection contains a specimen (# R-8122) from the Mammoth Mine, Tiger, Arizona, which looks like a twin with two intergrown crystals, one rotated 45° from the other around the fourfold axis. Such a twin law is however forbidden by symmetry rules, because it would imply the existence of an eight-fold axis of symmetry.

Trace element chemistry also has an influence on the morphology and twinning of wulfenite.

REFERENCE

HURLBUT, C. S., JR. (1955) Wulfenite symmetry as shown on crystals from Jugoslavia. *American Mineralogist*, **40**, 857–860.

SYNTHETIC WULFENITE

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Wulfenite has a number of potentially promising properties which could serve in acousto-optic devices such as modulators and beam deflectors. Crystal growth has been investigated to the point where crystals over one inch in diameter and many inches long can be grown.

Flux growth, using fluxes such as NaCl, produces only tiny crystals. Growth of large crystals is most readily achieved using Czochralski growth, also known as pulling from the melt. Details of this technique can be found, e.g., in *Gems Made by Man* by K. Nassau (Gemological Institute of America, Santa Monica, CA, 1987).

Typically, purified $PbMoO_4$ is melted in a thick-walled platinum crucible with radio frequency heating and held just above the melting point of 1075°C. A small rotating seed crystal is touched to the surface of the melt and slowly withdrawn as the crystal grows by the solidification of melt onto it. Annealing in a controlled atmosphere may be necessary to obtain the lightest color. For details see W. Van Loo, (1975) (*Journals of Solid State Chemistry*, **14**, 359) and references there cited.

Various growth techniques can also be used for isostructural or closely related minerals in the wolframite, scheelite and wulfenite groups:

Huebnerite $MnWO_4$	Scheelite $CaWO_4$
Wolframite $(Fe,Mn)WO_4$	Stolzite $PbWO_4$
Ferberite $FeWO_4$	Powellite $CaMoO_4$
Sanmartinite $ZnWO_4$	

. . . as well as related compounds not occurring in nature, such as $ZnMoO_4$ and $FeMoO_4$. Drawings and photographs of the Czochralski apparatus and of synthetic wulfenite crystals will be shown.

STOLZITE, WULFENITE'S HIDDEN BROTHER: OCCURRENCE AT THE FAT JACK GOLD MINE, YAVAPAI COUNTY, ARIZONA

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Stolzite, the tetragonal form of lead tungstate, $PbWO_4$, is isostructural with wulfenite ($PbMoO_4$) and greatly resembles it in color, crystal habit, and in its usual mode of occurrence in oxidized lead

deposits. Both minerals are of the tetragonal-pyramidal class; crystals are commonly tabular (flattened on *c*) or bipyramidal, and pale yellow to orange-red in color. The two minerals are distinguishable by chemical analysis, X-ray diffraction, and, if it can be measured, by specific gravity (stolzite 8.4, wulfenite, 6.8). Stolzite usually does not show the deeper red-orange colors and large, tabular crystals for which wulfenite is noted, and, especially in the larger reported crystals, stolzite is more likely to have a bipyramidal habit than is wulfenite. Both minerals have been reported to fluoresce yellow or white (under shortwave ultraviolet radiation) and orange or red (under longwave ultraviolet), although this appears to be more consistently observed for stolzite.

Stolzite has been reported from only about 30 localities worldwide, including seven in Arizona. A complete isomorphous series is believed to extend between stolzite and wulfenite. Some published analyses are near end-member stolzite; several show about 25 mole % $PbMoO_4$; and material from Chillagoe, Queensland, near 50:50 Mo:W, has inspired the varietal term "chillagite" for compositions intermediate in the series. "Chillagite" (in this case, tungstatian wulfenite) with 36-39 mole % $PbWO_4$ is known from Santa Rosa, Argentina.

The Fat Jack mine, in the Bradshaw Mountains south of Crown King, Arizona, is a gold deposit noted for amethyst-tipped and smoky-tipped scepter quartz crystals. Stolzite at this locality occurs as pale yellow-white to yellow-orange crystals associated with quartz, pyromorphite, mottramite, cerussite, osarizawaite, jarosite and limonite. It forms tabular crystals up to 8 mm across, and less commonly forms acute bipyramids not more than 1 mm long. The stolzite is variably fluorescent under ultraviolet light; weak to moderate yellow, yellow-white or pinkish-yellow under shortwave ultraviolet, and generally darker orange-yellow or brownish-yellow under longwave. Some is non-fluorescent. In addition, all the stolzite shows bluish to greenish white cathodoluminescence under electron bombardment in the microprobe. It is a molybdatian stolzite, $Pb(W,Mo)O_4$; preliminary microprobe analyses show a compositional range from about 50-90 mole % $PbWO_4$, and 50-10 mole percent $PbMoO_4$. X-ray diffraction confirms the identity as stolzite; the less common, monoclinic polymorph of $CaWO_4$, raspite, has not been found at the mine. Because of the physical resemblance of stolzite to wulfenite and the difficulty in distinguishing them without chemical or X-ray data, it is likely that close examination of other "wulfenite" will identify more localities for stolzite in the southwestern U.S.

WULFENITE OCCURRENCES IN COLORADO

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Connoisseurs of wulfenite probably do not think of Colorado as a noteworthy state that has produced fine specimens of wulfenite, and this is partially true. Surprisingly though, fine microcrystals of wulfenite have been found in a variety of ore deposits throughout the state. A good portion of the Colorado wulfenite localities do not compare with those in Arizona and New Mexico, but the microcrystals of wulfenite and associated minerals make interesting and rare additions to the micromounter's collection.

The majority of the documented wulfenite finds in Colorado have been made in the last 25 years, either as a result of new mining operations or of explorations made in abandoned mines.

Following is a brief description of some of the more noteworthy occurrences of wulfenite in Colorado:

(1) Wulfenite occurs as tiny, yellow to red crystals coating fractures in three pegmatite bodies near St. Peters Dome, in El Paso County.

(2) Wulfenite occurs in a number of mines in the San Juan Mountains, in the southwestern portion of the state. The wulfenite occurs as small crystals in the oxidized portion of base metal hydrothermal veins, and is associated with other secondary minerals of lead and copper.

(3) The *crème de la crème* wulfenite locality for Colorado is the Sherman Tunnel near Leadville, Lake County. The wulfenite here occurs with a large variety of secondary minerals in the oxidized portion of the orebodies. The most outstanding association occurs where wulfenite has crystallized on rosasite. The wulfenite occurs as bright orange-red tabular crystals up to 1 cm, perched on edge on bright blue botryoidal rosasite. The association of the two colorful minerals makes it the best known occurrence of wulfenite in Colorado.

WULFENITE OCCURRENCES OF NORTHERN MEXICO

Miguel Romero, Jorge D. de Leon,
and **Peter K. M. Megaw**

Exceptional wulfenite specimens have been recovered from the oxidized zones of many of the Pb-Zn-Ag (Cu, Au) deposits of northern Mexico. The best known localities are Los Lamentos and San Carlos, Chihuahua; Cucurpe, Sonora; and Mapimi, Durango, but good to excellent examples have also been found at: San Pedro Corralitos, Cuchillo Parado and Santa Eulalia, Chihuahua; Velardena, Durango; and Mazapil, Zacatecas. The wulfenite generally occurs on a matrix of mixed iron oxides, carbonates and quartz, with mimetite and vanadinite being the most common associated minerals of collecting interest.

The majority of the wulfenite localities are carbonate-hosted skarn and replacement deposits (Megaw and others, 1988), except for Cucurpe and Mazapil which are sediment-hosted vein deposits. The depth of oxidation varies from tens to hundreds of meters in most of these deposits, and wulfenite was an important ore mineral in some of them during the days of oxide production. The hypogene assemblage in all the deposits is dominated by galena, sphalerite, pyrite and/or pyrrhotite, with lesser amounts of chalcopyrite and sulfosalts. Molybdenite has been reported only from Mapimi. This general lack of molybdenite in wulfenite-rich deposits has also been noted in Arizona (Wilt and Keith, 1980), leaving open the question of the molybdenum source for the wulfenite.

REFERENCES

WILT, J. C., and KEITH, S. B. (1980) Molybdenum in Arizona. *Arizona Bureau of Geology and Mineral Technology, Fieldnotes*, **10**, #3, 1–12.

MEGAW, P. K. M., RUIZ, J., and TITLEY, S. R. (1988) High-temperature, carbonate-hosted Ag-Pb-Zn (Cu) deposits of Northern Mexico. *Economic Geology*, **83**, 1856–1885.

Congratulations to
Dr. John Sinkankas,
recipient of the
1988 Carnegie Mineralogical Award!

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

Please plan to attend the presentation of the **1989 Carnegie Mineralogical Award** during the *T.G.M.S. Awards Ceremony,* 9:00 pm Saturday evening, February 10th, at the Tucson Convention Center.

Nominations for the **1990 Carnegie Mineralogical Award** will be accepted until December 31st. If you have a candidate for the Award, please send your nomination to the address below. An official form will be sent to you by return mail. Thank You!

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FINE MINERALS

1. ***CHALCOCITE** pseudomorph after Covellite, Leonard Mine, Butte, Montana. A superb xld. "rose" lightly dusted with Malachite. Rare in this quality. 2¾ x 2 x 1¼. $750.00
2. **SMOKY QUARTZ,** Pike's Peak, Colorado. Very long, handsome, tapering xl. mounted on an old-time circular wooden base. Crystal probably repaired at base. 8¼ x 2½ x 2. ..... $750.00
3. ***CALCITE,** Ith, Brunswick, Germany. Group of large xls. No matrix. Fine and rare old-timer. 3¼ x 2½ x 1¾. $300.00
4. ***HEULANDITE,** Berufiord, Iceland. Excellent xls. up to 1" covering matrix. 4¼ x 2½ x 1¼. $350.00
5. ***SYLVANITE,** Offenbanya, Hungary. Richly and superbly xld. on matrix. 4 x 3 x 1½. $1500.00
6. ***ARGENTITE,** Freiberg, Saxony, Germany. Very well xld. on matrix with minutely xld. Proustite. 3 x 2½ x 1. ..... $500.00
7. ***NATIVE ARSENIC,** St. Andreasberg, Harz Mts., Germany. Fine large mamillary mass. 3½ x 3 x 1. ..... $250.00
8. ***GALENA** pseudomorph after Pyrrhotite, Freiberg, Saxony, Germany. Tapering xl. partly encrusted with Calcite. 1¾ x 1 x 1. ..... $150.00
9. **SCHEELITE,** Primorski Krai, Khakassia, U.S.S.R. Fine golden-brown compound xl. 1½ x 1¼ x ¾. ... $250.00
10. ***EMBOLITE,** Broken Hill Mines, New South Wales, Australia. Fine roughly xld. pure mass. 1½ x ¾ x ¾. $250.00
11. **CUBANITE,** Henderson #2 Mine. Chibougamau, Quebec, Canada. One of the finest examples of this rare species in existence. The front face of the large (7 x 7) matrix is approximately one-third covered with flat bright radiating xls. up to 1¾ across. In addition there are several excellent stout xls. on the back. 7 x 7 x 2. ..... $3500.00
12. **MILLERITE,** Orford, Quebec, Canada. An amazing terminated xl. (1 x ⅛) on Calcite. 2¾ x 1 x ⅞. $500.00
13. ***KRENNERITE,** Nagyag, Transylvania. A minutely xld. mass approximately 1 x 1, intergrown with xld. Quartz on matrix. 2½ x 1½ x 1. ..... $500.00
14. ***CALCITE,** Guanajuato, Guanajuato, Mexico. A superb twinned xl. on a bit of matrix. 2½ x 1¼ x ¾. $550.00
15. **STANNITE,** San Jose Mine, Oruro, Bolivia. Fine almost pure xld. mass. 2 x 1¼ x 1. ..... $500.00
16. **AXINITE,** Kyushu, Japan. Very fine *bright* group of large xls., and very rare thus. No matrix. 2 x 1½ x 1. ... $1000.00
17. ***LINARITE,** Roughten Gill, Cumberland, England. An exceptional specimen! Two individualized xls., ⅜ and ½, form a "V" on the matrix. 1⅛ x 1⅛ x ⅝. $750.00
18. ***LANGITE,** Cornwall, England. Micro xld. crust almost completely covering top face of matrix. 2 x 1¼ x ¾. $500.00
19. **NATIVE BISMUTH,** Niederschlema-Hartenstein, Erzgebirge, Saxony, Germany. An absolutely superb mass of large xls. with minor Siderite and Erythrite. 3½ x 1¾ x 1¾. $5000.00
20. **EPIDOTE,** Untersulzbachtal, Tyrol, Austria. Extremely fine loose well terminated compound xl. Translucent. 2¾ x ⅞ x ½. $875.00
21. **URANINITE,** Gatineau Lookout, Quebec, Canada. A fine ¾" octahedron on matrix. 2 x 1½ x 1½. $350.00
22. **GALENA,** Neudorf, Harz Mts., Germany. Two complex xls., ⅞ x ⅞ and ½ x ½ on a matrix of minutely xld. Siderite and Quartz. 3½ x 3 x 1½. $550.00
23. ***SMALTITE,** Schneeberg, Saxony, Germany. Well xld. on matrix with Quartz. Rare. 2½ x 2¼ x 1½. $500.00
24. ***GALENA** pseudomorph after Pyromorphite, Mosel, Germany. Crystals up to ½" covering matrix. 4½ x 3 x 2. ..... $1200.00
25. ***PYRARGYRITE,** Samson Mine, St. Andreasberg, Saxony, Germany. A superb xld. area 2½ x 2 on a flattened vein-filling matrix. Collected in 1864. 3 x 2¾ x ½. $1500.00
26. **PYRARGYRITE,** Schlema, Erzgebirge, Saxony, Germany. An extremely well xld. mass. No matrix. 1¾ x 1½ x 1. ..... $2000.00
27. ***MENDIPITE,** Kunibert Mine, near Brilon, Westphalia, Germany. A very rare old-time xlline. mass. 3 x 1 x ¾. $450.00
28. ***NATIVE SILVER,** Lake Superior Region, Michigan. A superb group of blocky xls. up to ¾" with minor Native Copper. It is very rare to find superb Michigan Silvers in other than the flattened arborescent xl. form. A very important specimen. 2¾ x 2¼ x 1⅜. $8500.00
29. **ARGENTITE,** Himmelsfuerst Mine, Freiberg, Saxony, Germany. Very well xld., featuring a somewhat cavernous xl. 1" across, perched with other xls. on a small matrix. 1¾ x 1¾ x 1. ..... $900.00
30. **CINNABAR,** Chau-Way, Hydercahn, Kazakhstan, U.S.S.R. Two nice red twinned xls., ¼" plus each, on xld. Quartz. Rare. 1¼ x ⅝ x ⅝. $500.00
31. ***CATAPLEIITE,** Narsarsuk, Greenland. Superb compound xl. ⅝ x ⅝ x ¼. $350.00
32. ***NATIVE TELLURIUM,** Faczebaia, Transylvania. Several micro xls. in vugs in Quartz. 1½ x ¾ x ¾. ... $350.00
33. **TOPAZ,** South Baldface Mountain, near Chatham, New Hampshire. *Almost certainly the finest known example from the locality.* It is a *very* large blocky single xl., cleaved on the base so it sits up perfectly. With a ½" Phenakite xl. and a smaller one attached to a side face, Superb! 2⅝ x 2⅝ x 2¼. $4500.00
34. ***CROCOITE,** Beresov, Govt. Tobolsk, Siberia, U.S.S.R. Superbly xld. on matrix. Many individualized xls. in high relief, not flattened as usual, on matrix. With a ½" clear Quartz xl. Very rare in this quality. 3¾ x 3 x 1¼. $1250.00
35. **KERMESITE,** Freiberg, Saxony, Germany. A fine flattened spray of xls., ⅞ x ⅝, with other xls. on matrix. Very rare. 3 x 1¾ x 1¼. $750.00
36. **BERYL var. HELIODOR,** Wolodarsk, Wolyn, Ukraine, U.S.S.R. A superb facet-quality, sceptre-like, gem xl. of excellent yellow-golden color. Doubly-terminated. 2 x ¾ x ¾. $2000.00
37. **SCORODITE,** Tsumeb, S.W. Africa. A fine loose xl. ⅝ x ⅝ x ¼. $500.00
38. **SCAPOLITE,** Itaguassu, Minas Gerais, Brazil. A very fine virtually flawless gem xl. of a lovely champagne color. 2 x ¾ x ½. $1500.00
39. **MIARGYRITE,** San Genaro Mine, Huancavilica, Peru. A superb solid mass of spherical xl. clusters up to ½" covering entire top face of specimen. One of the finest known examples. 5 x 4¼ x 1¾. $8500.00
40. ***CHALCOSIDERITE,** West Phoenix Mine, Cornwall, England. Superb xld. spheres in vug in rock. Extremely rare in this quality. 2 x 1¾ x 1½. $950.00

41. ***MATLOCKITE,** Cromford, Derbyshire, England. Extremely rare. Xld. overgrowth on an Anglesite xl. 3/4 x 1/2 x 1/4. ..... $350.00

42. **BERYLLONITE,** Stoneham, Maine. One of the finest xls. known! A completely transparent *twinned* xl. with distinct faces. 7/8 x 3/4 x 1/4. ..... $1000.00

43. **NATIVE SILVER** on Argentite, Comstock Lode, Nevada. The silver is in low relief and somewhat arborescent on a solid mass of Argentite. Very few samples of ore from this famous locality have survived. 2 x 2 x 3/4. ..... $500.00

44. ***TOPAZ,** Florissant, El Paso Co., Colorado. A very fine doubly-terminated xl., 1 1/2 x 7/8 x 7/8 sits on a chip of matrix with a 1/4" Phenakite xl. Choice. 1 1/2 x 1 1/4 x 1. ..... $500.00

45. **DIASPORE,** Selcuk, Mugla Province, Turkey. A superb cuttable transparent twinned gem xl. 1 1/4 x 7/8 x 3/4. ..... $500.00

46. ***CHRYSOPRASE,** Szklary, Silesia, Poland. A fine partly polished rough mass displaying a 3/4" vein in rock. 4 1/2 x 3 1/2 x 1 1/2. ..... $350.00

47. ***SCORODITE,** Noche Buena Mine, Zacatecas, Mexico. Well xld. almost completely covering top of matrix. 1 3/4 x 1 1/4 x 3/4. ..... $600.00

48. ***TOPAZ,** Thabeikkyn-Mogok Road, near Mogok, Burma. *An extreme rarity.* Only a handful of such specimens are known, and those are in the major museum collections. A very large loose well terminated colorless xl. 2 7/8 x 3 x 2. ..... $5000.00

49. ***CALAVERITE,** Victor Mine, Cripple Creek, Teller Co., Colorado. Superb and huge loose doubly-terminated xl. with a bit of matrix. 1/2 x 3/16 x 1/8. ..... $1000.00

50. **URANINITE,** Uluguru Mts., Morogoro District, Tanzania. Superb group of huge xls. coated with yellow alteration products. No matrix. 1 3/4 x 1 1/4 x 1 1/4. ..... $1250.00

51. **SYLVANITE,** Spotted Horse Mine, Fregus Co., Montana. Flattened xl. plates almost completely covering top face of matrix. Rare. 3 x 1 1/2 x 3/4. ..... $500.00

52. ***MILLERITE,** Gap Mine, Lancaster Co., Penn. Extremely bright fibrous vein in ore. 3 3/4 x 2 x 1. ..... $500.00

53. ***MANGANITE,** Ilfeld, Harz Mts., Germany. An extremely fine group of xls. up to 1 1/8 on massive Manganite. 4 x 3 x 2 1/2. ..... $4500.00

54. ***TOPAZ,** Schneckenstein, Germany. Several fine xls. up to 1/2" on matrix. 2 1/4 x 2 1/4 x 1. ..... $350.00

55. ***SARTORITE,** Binnenthal, Switzerland. Flattened xl., 1/4 x 1/4, in vug in matrix. 1 3/4 x 1 3/4 x 1. ..... $175.00

56. ***BINNITE,** Binnenthal, Switzerland. Tiny xl. in vug in matrix. 2 1/2 x 2 x 1 1/4. ..... $75.00

57. **CHALCOCITE,** Tsumeb, S.W. Africa. A large single xl. with some Pyrite. 1 1/2 x 1 1/4 x 1 1/4. ..... $350.00

58. **PREHNITE,** Jeffrey Mine, Asbestos, Quebec, Canada. A large single terminated xl. partly invested with minute bright green Grossular xls. A little beauty. 1 1/4 x 3/8 x 3/8. ..... $250.00

59. ***NATIVE SILVER,** Batopilas, Mexico. A superb mass of xls. including the longest, a beautiful spear-like individual 2 1/2" long! This specimen was mined before 1910, and unlike most modern examples from the locality, is not delicate or likely to crumble. 3 3/4 x 2 x 1. ..... $5000.00

60. **BORNITE,** Kazakhstan, U.S.S.R. A flattened xl., 5/8 across on matrix with xld. Quartz. 3 x 2 x 1 1/4. ..... $350.00

61. ***ANHYDRITE,** Stassfurt, Germany. A superb loose pinkish xl. A perfect "thumbnail." 3/4 x 3/4 x 1/2. ..... $500.00

62. ***SCHEELITE,** Dragoon Mts., Arizona. A very fine orange-brown loose xl. 1 x 3/4 x 3/4. ..... $150.00

63. **VALENTINITE,** Antimony Mine, Wolf Co., Quebec, Canada. Very well xld. on matrix with xld. Kermesite and Stibnite. Very rare. 1 3/4 x 1 1/4 x 1. ..... $500.00

64. ***DIAPHORITE,** Pribram, Czechoslovakia. Small xld. area on matrix. Rare. 3 x 2 1/4 x 1 1/2. ..... $250.00

65. **STRONTIANITE,** Obendorf-Lamming, Steiermark, Austria. A very fine xld. mass. 2 1/4 x 2 x 1. ..... $150.00

66. **MELIPHANITE,** Langesundfiord, Norway. A good xl. 3/4" across, on matrix. Rare. 2 x 1 x 1/2. ..... $75.00

67. ***PSEUDOMALACHITE,** Libethen, Neusohl, Hungary. Fine partly lustrous botryoidal mass. 2 3/4 x 2 1/4 x 1 1/4. ..... $250.00

68. **CUBANITE,** Henderson #2 Mine, Chibougamau, Quebec, Canada. A superb loose terminated tabular xl. 1 1/4 x 1 x 1/4. ..... $750.00

69. ***FREIESLEBENITE,** San Carlos Mines, Hiendelencina, Spain. Richly xld. on rock. 3 3/4 x 2 1/2 x 1 1/4. ... $375.00

70. **PHOSGENITE,** Touissit, Morocco. A very fine large terminated *prismatic* loose xl. Clear. 2 1/4 x 1/2 x 5/16. ..... $900.00

71. ***ATACAMITE,** Wallaroo, Australia. An absolutely superb group of long terminated xls. growing up from matrix. A perfect miniature. 1 3/4 x 1 1/2 x 1 1/4. ..... $3500.00

72. **ELBAITE TOURMALINE,** Dunton Mine, Newry, Maine. An extremely rare old-timer. A terminated bi-color xl. on a matrix of Lepidolite. 1 3/4 x 1 1/4 x 1 1/4. ..... $500.00

73. ***CUMENGEITE & PSEUDOBOLEITE,** Boleo, near Santa Rosalia, Baja California, Mexico. Two loose xls. The Cumengeite app. 3/8 and the Pseudoboleite app. 3/16. For the two— $750.00

74. ***MILLERITE,** Friedrich Mine, Wissen, Germany. Extremely fine and rich flattened intergrowths of bright xls. on matrix. Rare. 4 1/2 x 3 1/2 x 2. ..... $1500.00

75. **FLUORITE,** Clara Mine, Oberwolfach, Schwarzwald, Germany. A very fine group of three intergrown pale-blue xls. No matrix. 2 3/4 x 2 1/4 x 2. ..... $350.00

76. **DIASPORE,** Selcuk, Mugla Province, Turkey. A huge transparent cuttable, terminated gem xl. Quite similar to the example on page 389, Volume 20, #5 of the Mineralogical Record. A lovely rarity. 3 1/2 x 1 x 1/2. ..... $3500.00

77. ***ZINKENITE,** Wolfsberg, Harz Mts., Germany. A mass of *terminated* xls., and extremely rare thus. 1 1/4 x 3/4 x 1/2. ..... $500.00

78. **MALACHITE,** Copper Queen Mine, Bisbee, Arizona. A superb doubly-terminated xl., pseudomorph after Azurite, sitting perfectly on matrix. The xl. measures 2 x 1 and overall, 3 3/4 x 2 1/2 x 2. ..... $3500.00

79. **QUARTZ,** Kimposan, Kai, Japan. A very large fine Japan Law twinned xl. 3 1/4 x 3 x 3/4. ..... $900.00

80. **DYSCRASITE,** Samson Mine, St. Andreasberg, Harz Mts., Germany. A superbly xld. little mass. Rare. 1 x 1/2 x 1/2. ..... $600.00

81-82. **CINNABAR,** Altoona, Trinity County, California. Superb for the locality. A 1 x 3/4 vug of sharp, intergrown xls up to 3/16, on matrix. 3 x 2 x 1 1/2. Another **CINNABAR,** New Almaden, Santa Clara County, California. Superb for the locality, which is now a public park. A 1 1/2 x 1 1/2 area of intergrown twins up to 1/4 on matrix. 2 1/4 x 1 3/4 x 1. Price for the two $4500.00

83. **CINNABAR,** Almaden, Spain. Superbly xld. on matrix and very rare thus. Features two brilliant xls., one is 1/2" across. Finest I have ever had. 3 1/4 x 2 1/2 x 1 1/2. ..... $2000.00

84. ***IODYRITE,** Broken Hill Mines, New South Wales, Australia. Xl. masses almost completely covering face of rock. 3 1/4 x 2 1/4 x 1 1/2. ..... $350.00
85. ***MAGNETITE,** Chillago, Queensland, Australia. Mass of huge xls. intergrown without matrix. 4 1/4 x 2 1/2 x 2. ..... $250.00
86. **DURANGITE,** Thomas Range, Utah. Richly minutely xld. on matrix. 2 x 1 1/2 x 1. ..... $250.00
87. **NAGYAGITE,** Transylvania, Rumania. Superbly and richly xld. on matrix. 3 x 2 x 1 1/4. ..... $1000.00
88. ***SCORODITE,** Antonio Pereira, Minas Gerais, Brazil. Well xld. in shallow vugs in matrix. Extremely rare. 3 x 2 x 1 1/4. ..... $1000.00
89. **WURTZITE,** Leonard Mine, Butte, Montana. Extremely fine xld. aggregates virtually covering Pyrite matrix. 2 x 1 1/2 x 3/4. ..... $500.00
90. **CANFIELDITE,** Aullagas, Colquechaca, Bolivia. Well xld. mass with Argyrodite. Collected by Mark Bandy. 1 1/4 x 1 x 1/2. ..... $500.00
91. ***TIEMANNITE,** Maysvale, Utah. A few sharp minute xls. scattered on matrix. 3 x 1 1/2 x 1. ..... $400.00
92. **NATIVE SILVER,** Kongsberg, Norway. Superb group of sharp xls. 1 x 5/8 x 3/8. ..... $500.00
93. **CUBANITE,** Henderson #2 Mine, Chibougamau, Quebec, Canada. Superb loose xl. 1 x 3/4 x 1/8. ..... $500.00
94. **FLUORITE,** Penfield, New York. Unusual pale blue xl. with frosted faces, exhibiting green color zoning in the cube corners. 1 1/2 x 1 1/4 x 3/4. ..... $350.00
95. ***TOPAZ,** Tanokayama, Japan. Superb loose well terminated, flawless, colorless xl. 1 x 1 1/4 x 7/8. ..... $500.00
96. **KERMESITE,** Phoenix & Globe Mine, Que Que, Southern Rhodesia. Extremely well xld. on matrix. A beauty. 2 x 1 1/4 x 1 1/2. ..... $2250.00
97. ***STOLZITE,** Broken Hill Mines, New South Wales, Australia. One 1/4" xl. and many minute ones on matrix. Very rare. 2 1/4 x 1 3/4 x 1 1/2. ..... $1500.00
98. **MAGNETITE,** Togoland. Huge loose dodecahedral xl. 2 1/4 x 1 3/4 x 1 1/2. ..... $250.00
99. **NATIVE BISMUTH,** Pribram, Czechoslovakia. Superb xld. pure mass. Exceptional specimen. 2 1/2 x 2 x 1 3/4. ..... $2500.00
100. ***MICROCLINE var. AMAZONITE,** Pike's Peak, El Paso Co., Colorado. Superb group of large old-time xls. on matrix. 4 x 3 x 2 1/2. ..... $1500.00
101. **CHRYSOBERYL var. ALEXANDRITE,** Fort Victoria, Zimbabwe (Rhodesia). A mass of individualized xls. up to 5/8" across on a small piece of matrix. Exceptional. 2 x 1 1/2 x 1 1/4. ..... $2000.00
102. ***ANATASE,** Binnenthal, Switzerland. Fine compound xl., 3/8 x 5/16, on matrix with xld. Quartz. 1 3/4 x 1 1/2 x 1 1/4. ..... $250.00
103. **DIAMOND,** Mir Pipe, Mironova, Siberia, U.S.S.R. A clear gem xl. of one carat + weight in Kimberlite. 1 1/2 x 1 1/4 x 5/8. ..... $2000.00
104. **NATIVE SILVER** pseudomorph after Dyscrasite, Pribram, Czechoslovakia. A superb large xld. mass. No matrix. 4 3/4 x 3 x 1 1/2. ..... $2500.00
105. **PROUSTITE,** Chanarcillo, Chile. Superb blood-red mass of xls. 1 x 1 x 1/2. ..... $1000.00
106. **SAPPHIRE,** Near Akwanga, Nigeria. Deep blue gem facet-grade xl. saved from a parcel of cutting rough. 3/4 x 5/8 x 1/2. ..... $1000.00
107. ***BROOKITE,** Tremadoc, Wales. Extremely rare 3/8" compound xl. on matrix with xld. Quartz. Ex. Coll.: Clarence S. Bement. 2 1/2 x 1 1/4 x 1/2. ..... $2000.00
108. **AZURITE,** Touissit, Morocco. Extremely fine compound doubly-terminated xl. 2 1/4 x 1 x 1/2. ..... $1000.00
109. **RHODIZITE,** Mount Bity, Antsirabe, Madagascar. A fine 1 x 5/8 xl. perched on a pegmatite matrix. Choice and rare. 2 3/4 x 2 1/2 x 1 1/2. ..... $1500.00
110. **BERYL var. AQUAMARINE,** Marambaia, Minas Gerais, Brazil. Choice deep blue xl. with a fine pyramidal termination. 2 1/4 x 5/8 x 1/2. ..... $900.00
111. **PHOSPHOPHYLLITE,** Potosi, Bolivia. A fine loose pale green xl. 1 5/8 x 7/8 x 3/8. ..... $500.00
112. ***WULFENITE,** Red Cloud Mine, Yuma Co., Arizona. Bright orange xls. up to 3/4 covering top of matrix. An old-timer that came out before 1910. 3 1/4 x 2 x 1. ..... $1500.00
113. **EPIDOTE,** Knappenwand, Austria. A fine large compound xl. with two contact terminations. Translucent. Repaired. 6 x 2 1/4 x 3/4. ..... $1000.00
114. **AZURITE,** Detroit Mine, Morenci, Arizona. Superb xld. "ball" of that bright intense blue color that only certain Azurites possess. 2 1/4 x 2 1/4 x 1 1/2. ..... $2000.00
115. **MICROLITE,** Virgem da Lapa, Minas Gerais, Brazil. Fine yellow 1/2" and 3/8" xls. on lovely xld. Lepidolite. 3 x 2 1/2 x 1 3/4. ..... $1500.00
116. ***BRUCITE,** Wood's Chrome Mine, Texas, Lancaster Co., Penn. Very fine parallel growth grouping of terminated xls., transparent to translucent. 3 3/4 x 2 1/2 x 3/4. ..... $750.00
117. **KERMESITE,** Pesinok, Czechoslovakia. Radiating xld. masses densely covering matrix. 3 3/4 x 2 3/4 x 1 1/2. ..... $1000.00
118. ***MOLYBDENITE,** Miask, Ural Mts., U.S.S.R. Extremely large and important loose tabular xl. of excellent form. Old-timer. 4 x 2 3/4 x 1. ..... $950.00
119. **RASPITE,** Broken Hill Mines, New South Wales, Australia. Several microscopic xls. on matrix. 1 1/2 x 1 x 1/2. ..... $150.00
120. ***ULLMANITE,** Montenarba, Sarrabus, Sardinia, Italy. Well xld. on matrix with Breithauptite. 2 x 1 1/2 x 1 1/2. ..... $350.00
121. **POLYBASITE,** Guanajuato, Guanajuato, Mexico. Xls. up to 1/4" rich on matrix. 1 3/4 x 1 1/4 x 1. ..... $750.00
122. **PROUSTITE & STEPHANITE,** Keeley Frontier Mine, South Lorrain, Cobalt, Ontario, Canada. Minutely xld. on roughly xld. Argentite. 1 1/2 x 1 1/4 x 7/8 ..... $250.00
123. ***MEIONITE,** Monte Somma, Vesuvius, Italy. Large xls. (up to 5/8) on matrix. Rare in this quality. 3 3/4 x 2 1/4 x 1 1/2. ..... $350.00
124. **LIROCONITE,** Cornwall, England. Superbly xld. on matrix. A far better example than most on the market today. 2 x 1 1/4 x 1 1/4. ..... $1000.00
125. ***LEADHILLITE,** Leadhills, Lanarkshire, Scotland. A bright tabular xl. app. 3/4 x 1/2 in a shallow vug of xld. Cerussite. Extremely rare. 1 3/4 x 1 1/2 x 3/4. .... $1500.00
126. **BOURNONITE,** Herodsfoot Mine, Cornwall, England. A superb group of large (up to 1") xls. No matrix. 1 5/8 x 1 1/4 x 1. ..... $1500.00
127. ***AZURITE,** Chessy, Rhone, France. A most unusual specimen, and perhaps a unique one! A rough dodecahedron of Azurite pseudomorph after Cuprite that

measures 1¼" across. That in itself is a rarity, as it is only the second *Azurite* pseudo. after Cuprite to pass through my hands in 34 years! But, that is not the end of the description. Perched on the top of the dodecahedron is a cluster, somewhat rosebud-like, of bright sharp Azurite xls. A jewel. 1¾ x 1¼ x 1¼. $2500.00

128. **BETAFITE,** Betafo, Madagascar. One of the finest examples of this species known, perhaps the second finest in the world. It is essentially a group of three somewhat modified octahedrons, the largest measuring approximately 3½ x 3½! Ex. Coll.: The Sorbonne in Paris, France. 5 x 4½ x 2¼. $5000.00

IMPORTANT AMERICAN GEMSTONES

129. **CORUNDUM var. SAPPHIRE,** Eldorado Bar of the Missouri River, near Helena, Lewis and Clark County, Montana. An amazing survival, and possibly a unique collection of twelve (12) faceted stones of various colors. *These stones are in exceptionally large sizes, averaging over 2 carats each.* Total weight is 26.75 carats. They were mined prior to World War I and have not been heated, treated or irradiated. The individual stones are as follows:
    a. Oval. 2.05 carats. 8 x 6 millimeters. Green with a hint of blue.
    b. Round. 2.16 ct. 7 mm. Another shade of green with a little grey.
    c. Oval. 2.40 ct. 8.5 x 6.5 mm. A very nice pink, and extremely rare and important thus!
    d. Oval. 2.13 ct. 8.3 x 5.4 mm. A lovely chrysoberyl yellow color.
    e. Oval. 2.85 ct. 9 x 7.5 mm. A fine blue-green, and a very large sized stone from this locality.
    f. Round. 1.85 ct. 7 mm. An unusual zircon-blue color.
    g. Oval. 2.01 ct. 8 x 6.2 mm. Unusual lavender-blue color.
    h. Round. 2.15 ct. 7.5 mm. A rich green color.
    i. Pearshape. 2.04 ct. 8.5 x 6 mm. Bluish green color.
    j. Round. 2.69 ct. 7.8 mm. Strange shade of green with an alexandrite like color change.
    k. Round. 2.26 ct. 7.5 mm. Another shade of green.
    l. Oval. 2.19 ct. 7.6 x 6.5 mm. A nice steel-blue color.
    This collection of stones is worthy of any advanced or museum collection. 26.75 carats @ $500.00 per carat for a total of $13,375.00

130. **PROUSTITE,** St. Mickaelis Mine, near Freiberg, Saxony, Germany. Brilliant red dog-tooth xls. up to ⅜ completely covering 4¾ x 3 inch face. From Clarence Bement's collection. His original label reads: "found July 14, 1874 and said to be the finest by all odds that was taken out in a period of twenty-four years." It is one of the very finest German Proustites in existence. 4¾ x 3 x 2. ..... $10,000.00

A TEXAS CLASSIC

And one of the best historically documented mineral specimens extant!

131. **CELESTITE,** Lampasas Co., Texas. Large pale blue xls. up to 3¼" in one half of a large geode. Overall size—10 x 7½ x 7. This great specimen is discussed in a handwritten letter from the great dealer Dr. A. E. Foote to the unequaled collector Clarence Bement, as follows: "New Orleans, April 21, 1886. C. S. Bement Esq. Dear Sir. When at Lampasas Texas I saw a specimen of blue celestite that the person who sold Prof. Ward the specimen that he sold you for $30.00 said was much handsomer than that. The person owning this specimen did not then wish to sell it. I visited the locality a R.R. cut where it was found and did not get a single particle of blue celestite. The price talked of was so much (tho not high for so fine a specimen) that I did not feel as if I could purchase it till I knew what you were going to do about the Mexican things. I have since my return sold the University of Miss $400 got the money for ½ so I sent the party the am't asked. I was more inclined to do this for both Preston & Prof. Ward said they considered the price ridiculously low. They thought another specimen could not be got. As I scoured the country for 3 days I am pretty sure of it. I send it to you by express. It cost me $35.00 not counting my time or express here. Certainly $50.00 net is cheap for it. I leave tomorrow night for Northern Georgia. Gave a lecture at the courthouse here last night on Mexico. Yours respy A. E. Foote." This wonderful piece was honored in 1912 when it was pictured in L. P. Gratacap's *A Popular Guide to Minerals* facing page 306. A copy of the book accompanies the specimen. $7500.00

THE ORIGINAL SPECIMENS OF KUNZITE

132. **SPODUMENE var. KUNZITE,** Pala, San Diego County, California. "The original specimens of Kunzite from the personal collection of the late Charles Baskerville who named the mineral after Geo. Frederick Kunz, Gem Expert." Baskerville was a professor of chemistry at the City College of New York where the specimens remained until the above quoted labelling was done by Daniel T. O'Connell who has initialled the label. O'Connell, a long-time professor of geology at C.C.N.Y. probably never met Baskerville who died in 1922, as O'Connell arrived on the City College scene in 1928; however, he recognized the importance of these specimens, and saw to it that their history was not lost. In a letter from Charles Baskerville to George Kunz, dated November 24, 1903, Baskerville states—"Perhaps it may be necessary for me to have a little more of the kunzite. I prefer the colored pieces, the small refuse from the cutting will answer." Twelve of the "small refuse" pieces are here in a plastic micromount box as well as two very nice crystals.
    1. 3¾ x 1 x ½, and 2. 2 x ⅝ x ⅜. $5000.00

A SPECIAL BOOK

133. **Notes and Commentaries on Letters to George Frederick Kunz** by Lawrence H. Conklin. Privately printed, 1986. One of the 43 specially signed and numbered copies, bound in *full leather* by the Green Dragon Bindery, *that includes one of the original letters reproduced in the book.* Further details and descriptive brochure on request. $750.00

All measurements are in inches unless otherwise noted.
All specimens are subject to prior sale.

Please note the asterisks *. All specimens so marked carry one or more old labels, and therefore it may be inferred that these specimens are old-timers and are from a distinguished old collection.

Specimens are available for approval shipments to people known to us. Others must send check in full payment; refunds will be made upon return of specimens. Many of these specimens will be available for examination during the Tucson Show, Desert Inn Room 146.

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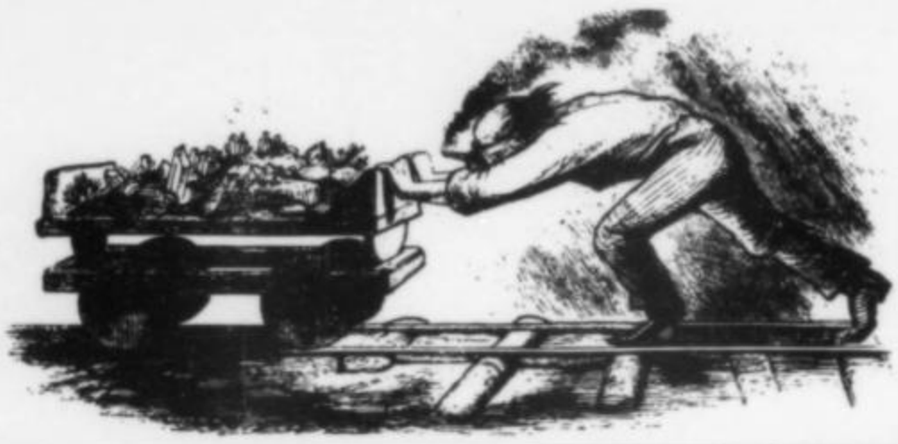
Colorado  Dealers

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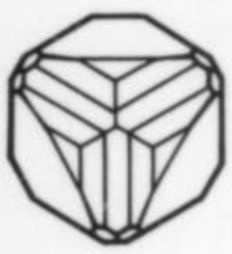

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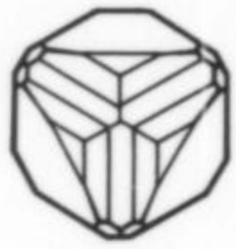

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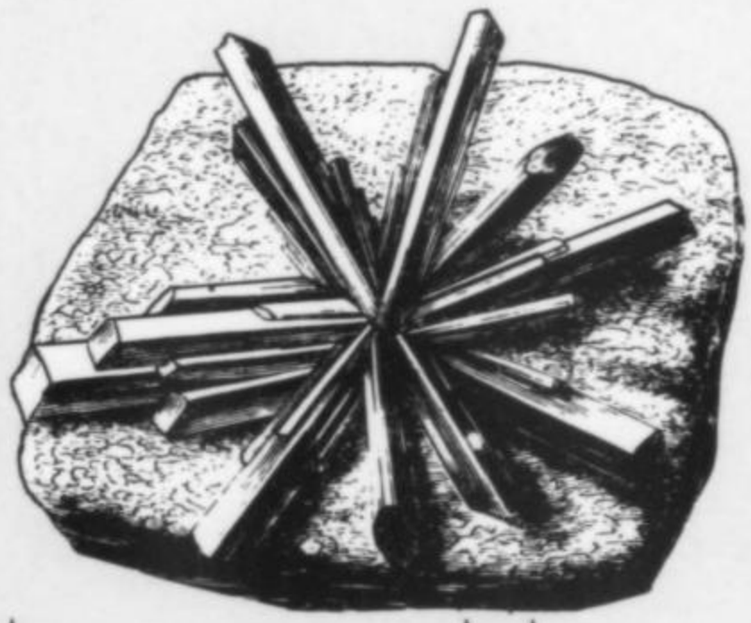

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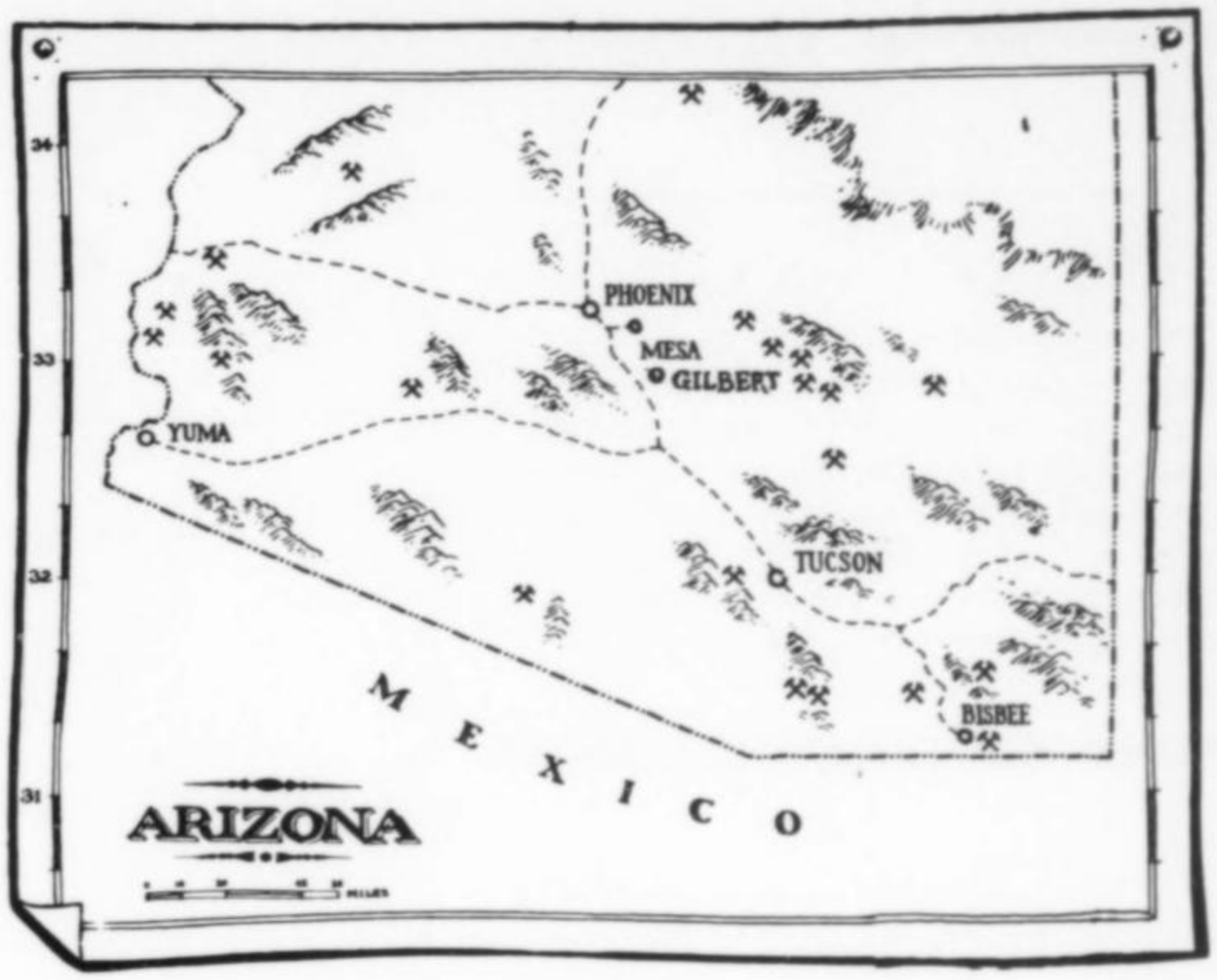

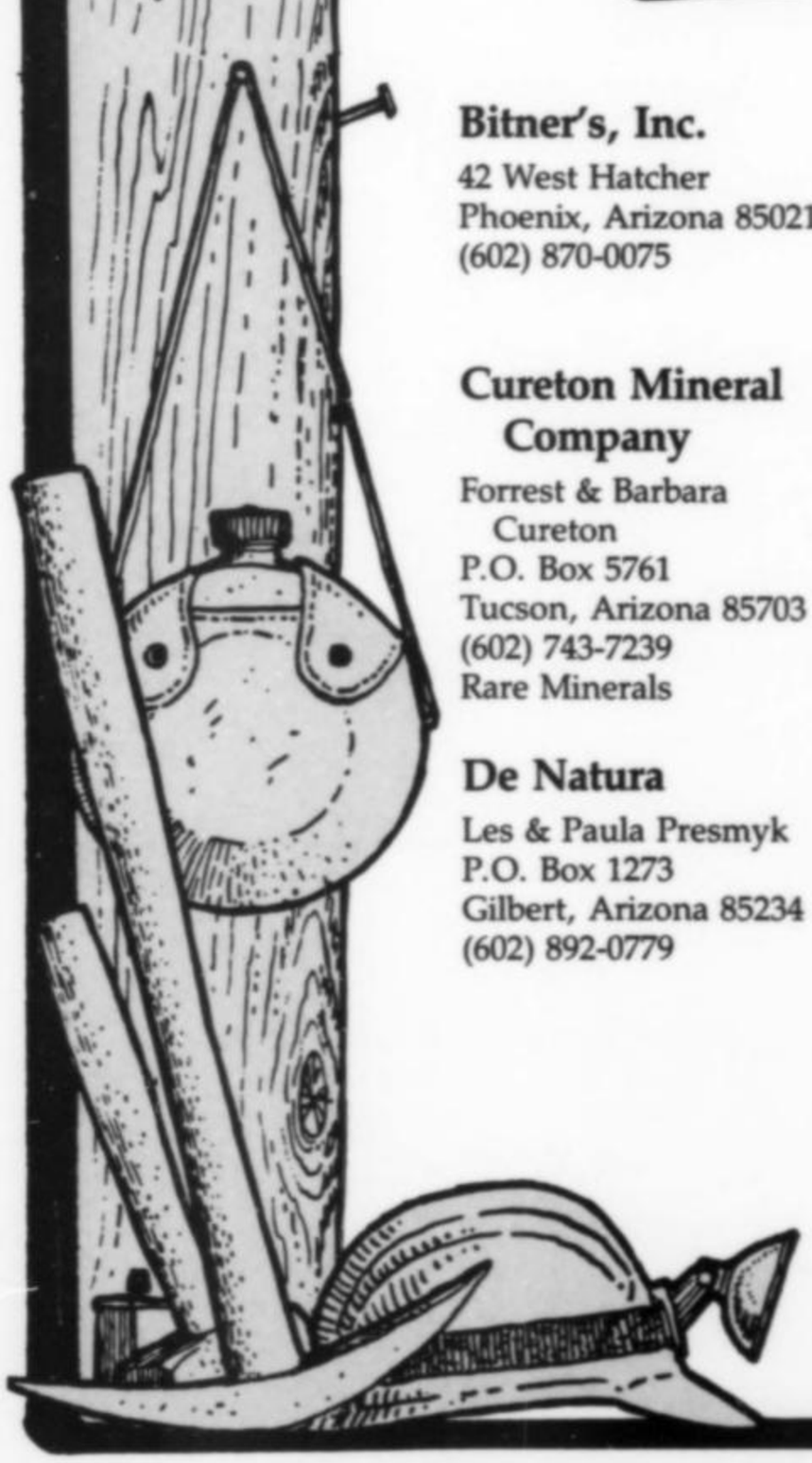

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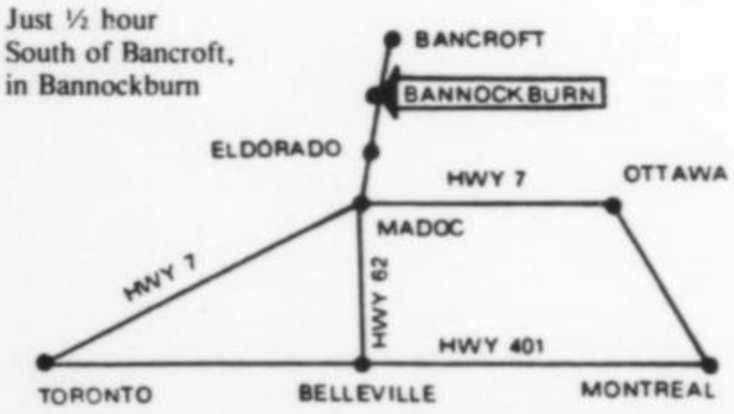

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An additional 20 days past the closing date are allowed in which advertisers may make changes (excluding size changes) in ads already paid for.

Design
Wendell E. Wilson

Graphic Production
Capitol Communications
Crofton, MD

Printing
Waverly Press, Easton, MD

Color Separations
Hollis Phototechnics
Tucson, AZ

Circulation
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