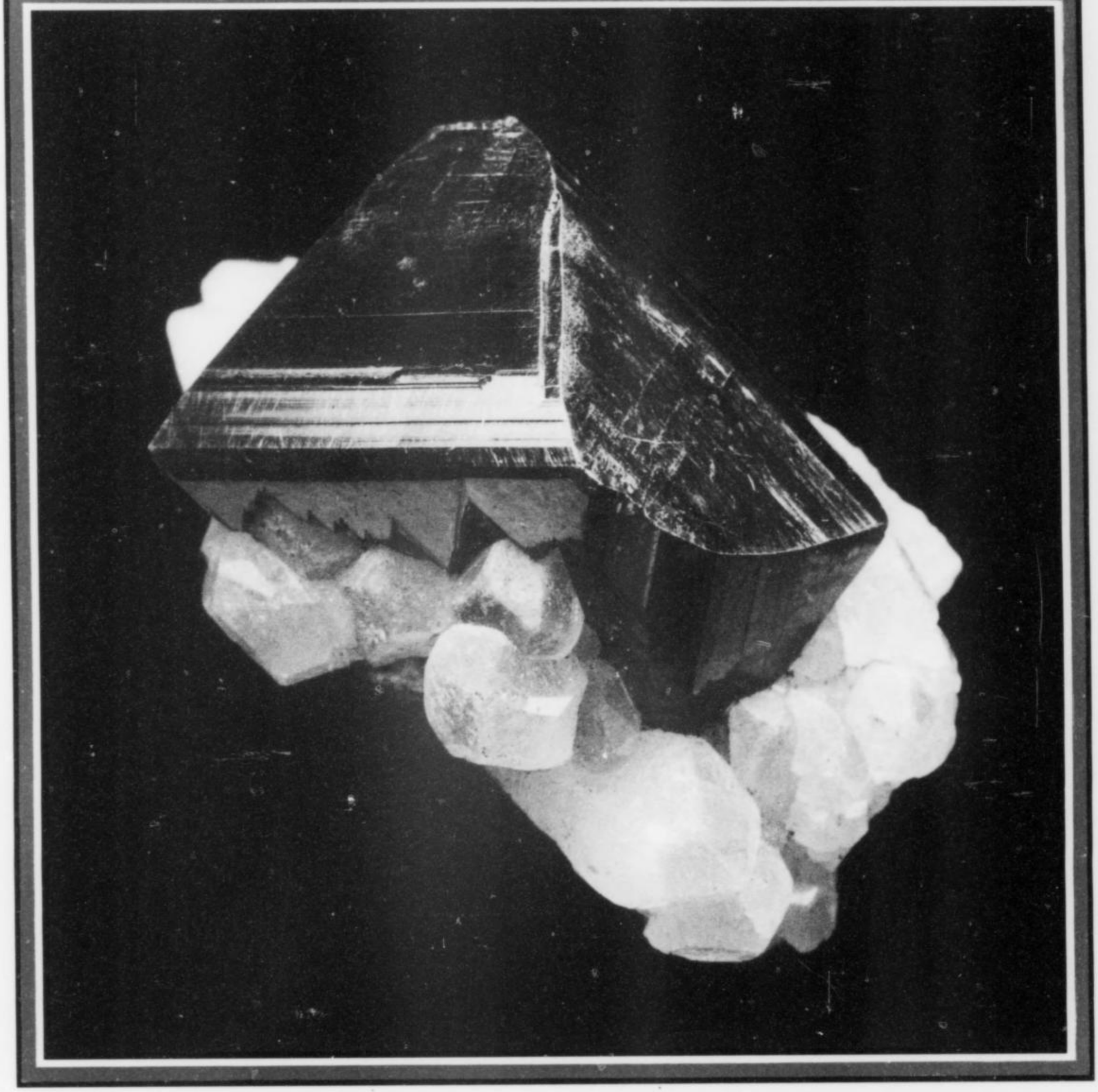
矿物 CHINA 中国



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China

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Editorial & Advertising
4631 Paseo Tubutama
Tucson, AZ 85750
Tel: 520-299-5274
e-mail: minrec@earthlink.net

Subscriptions, Books & Back Issues
P.O. Box 35565
Tucson, AZ 85740
Tel: 520-297-6709
Fax: 520-544-0815
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Front Cover
CINNABAR crystal, 2.1 cm, from the Dadongla (Yunchang-ping) mine near Tongren, Guizhou Province, China. Marcus Budil specimen; Jeff Scovil photo.

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China

For most of our lifetimes, except for those of us who can remember the years before World War II, China has been a relatively closed society. It appeared that the paranoia of the Cold War period which followed WWII led the Chinese government to be less than open about many ore deposits, especially those deemed "strategic" in some sense, and information published about them tended to be extremely vague. Consequently one never saw comprehensive articles on Chinese mineral localities in the popular press, and hard-to-find Chinese professional journals such as *Acta Mineralogical Sinica, Acta Geologica Sinica, Scientia Geologica Sinica* and *Acta Petrologica Mineralogica et Analytica,* while reporting the occasional new species description (generally in Chinese, with English abstracts), provided little of interest to the topographical mineralogist. Likewise almost the only collectible Chinese minerals on the market were a few old cinnabar specimens, most of them bruised from handling and darkened or opacified from long-term exposure to light. These old specimens were considered classics, the finest which the species had to offer, but they were antiques.

So it was a pleasant shock in 1984–1987 when a few *newly collected* cinnabar specimens began to trickle out of China. The commercial waters were being tested by a few brave, pioneering Chinese entrepreneurs. Then, following the fall of the Iron Curtain in 1989, the minerals of what had been the Soviet Union burst upon the scene and were eagerly absorbed by the Western market. Perhaps Russia's neighbor to the south noticed the money that was being brought into that country as a result of this new trade in specimens.

China underwent no abrupt change in government comparable to the fall of communism in the Soviet Union. However, China's leaders began to loosen the tight restraints on capitalist business operations—gradually and very slowly, so as not to overly disrupt China's culture and economy. The officials and the Chinese producers slowly learned how to interface with the capitalist world in order to sell their products to the Western countries and enjoy a much improved balance of payments situation. A new generation of small businessmen was born in China, and they proved to be fast learners. At the same time, publication restrictions began to diminish in the 1990's, and more detailed information on many ore deposits began to appear, in English.

Newly mined Chinese mineral specimens began to show up on the Western market, usually at the Tucson, Munich and Ste.-Marie-aux-Mines shows, through American and European intermediaries in the early 1990's. Within a couple of years, Chinese dealers themselves began to arrive in Tucson, bringing more minerals. Many spoke no English, and yet they managed to arrange accommodations, set up their showrooms and make their sales. They made some mistakes at first in what they chose to bring for stock, but they soon learned which kinds of minerals sell, and they learned the overwhelming importance of avoiding and preventing damage to specimens. Upon their return to China they passed this information back along the specimen supply chain to the miners, who also learned quickly. And, being polite and friendly, the new Chinese dealers quickly ingratiated themselves with American and European collectors.

Unlike in Russia, with its massive state-owned mining operations, mining in China is still conducted in large part by very small operations of the kind that are ideal for allowing the preservation of specimens, and small enough to make income from specimen sales significant to the operators. As a result, far more minerals have emerged from China in the past decade than from the countries of the former Soviet Union. It seems as if a cornucopia of Chinese mineral specimens has been opened, and a stunning variety and quantity of material has poured out. Our only problem as collectors is to assimilate the flood of new locality names which threaten to tie our tongues in knots—Xuebaoding, Yaogangxian, Xikuangshan, Yunchangping, Hongshuidong, Niujiaotan . . . a whole new body of geography to learn. It's a challenge that we are happy and grateful to accept.

Nevertheless, it is only very recently that people have appeared on the scene who were both willing and able to write articles for publication describing Chinese mineral localities. For years we tried to solicit substantive articles from Chinese geologists, dealers and curators, but they were always reluctant to draw attention to themselves and risk possible government disapproval. Two picture books on Chinese minerals were published in Beijing in the 1990's, but they are almost entirely lacking in any useful locality data or even, in many cases, locality names! Now, however, two authors have stepped forward to fill the gap: Guanghua Liu and Berthold Ottens. Dr. Liu is a mineral dealer now living in Germany, but his home town is Xikuangshan, the site of the world's largest stibnite mine. Berthold Ottens is a German dealer and author of the *Mineralogical Record*'s special issue on Indian Zeolites; when that big project was finally finished he turned his considerable energies to China, and has made many investigative trips there. Early versions of some of his articles appeared in *Lapis*, and have been translated for this issue by Tom Moore, then augmented to one degree or another by the editors and authors. Also contributing to this special China Issue are Bill and Carol Smith (authors of the previously published guides to the mineral localities of the former Soviet Union, Bolivia and Pakistan), who, with Dr. Liu and Herr Ottens, have compiled a highly useful China locality gazetteer.

Thus we present for your enjoyment and elucidation this first China Issue of the *Mineralogical Record*. It will not be the last: in fact we already have a good start on the articles for a second China Issue.

As you browse through the articles here you will see that, as a decorative touch, each is headed by the Chinese national crest (as it is our habit to include the national or provincial crest as a graphic design element in all locality articles); in addition, you will observe Chinese characters, and these do indeed spell out the article or locality name in Chinese. So if you happen to have a mineral label written in Chinese (many of the first dealers tended to issue these with specimens), and are wondering whether it says, for example, "Xuebaoding mines, Sichuan," you can compare it to these characters. Just remember that they read from top to bottom and right to left.

Finally, for those wondering whether a hardbound edition will be available, at the present time the answer is no, but we are planning to combine the first and second China Issues as one hardcover edition once the second issue has been published. Watch for it in the future!

Wendell E. Wilson

Figure 1. **Shen Kuo (1031–1095) famous scientist and geographer of the Song Dynasty, the "Golden Age" of traditional science and technology in China. His most prominent work, *Brush Talks from the Dream Creek*, is regarded as one of the most remarkable documents in early science. He intelligently discussed aspects of chemistry, fossilization, geography, geology and metallurgy and many other topics in science.**

採礦 中國

MINING IN CHINA

A 3000-Year Tradition

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau
Germany

The mining of metals and coal in China goes back at least 3,000 years, but Chinese mining technology has remained primitive by western standards for almost all of that time. Today, rapid industrialization, a rapid growth in geological and mineralogical knowledge, and a growing awareness of the mineral specimen market, all promise to keep increasing the supply of fine collector mineral specimens from China.

HISTORY

"People naturally don't like the dark. Who would want to be a miner digging galleries in the vicinity of the yellow springs?"
Want Chung Lun Hong, A.D. 82

Mining is known to have taken place within the boundaries of modern China more than 3,000 years ago (Zhu Xun, 2002). Archeological excavations in the mining center of Tonglushan, near the city of Daye in Hubei Province, have revealed important historical information concerning mines that were active during the time of the Chinese bronze culture, whose original settlements go back to the beginning of the Shang Dynasty, firmly dated at 1766–1121 B.C. There in 1973 a 3,000-year-old copper mine with smelting facilities was discovered on Mt. Verdigris. At this site, near the Yangtze River about 20 km southwest of Huangshi, more than 400,000 tonnes of ancient slag were found, covering a surface area of 20,000 square meters.

The ancient Tonglushan mines worked the oxidized zone of a high-grade copper deposit, probably discovered because of malachite showings on the surface. Archaeological excavations unearthed tools made of bronze, iron, bamboo, wood and stone, as well as uncovering more than 100 separate diggings and dozens of smelting furnaces; the total length of the trenches and shafts has been estimated at 8,000 meters. These workings can be dated as having existed between the 11th century B.C. and the 2nd century A.D., during which time a total quantity of copper between 80,000 and 120,000 tonnes was extracted. It is interesting to note that one of the early excavations revealed a 60-meter-deep shaft extending 23 meters below the water table as it was then. In Tonglushan today, near the ancient mine workings, there is a large open-pit copper mine which provides small calcite crystals and low-quality azurite rosettes to modern collectors.

To be sure, the Chinese culture was not the first to use metals, but in the first and second millennia before Christ, China held a high place in the ancient world for metal mining and metalworking. Regrettably, there are no early descriptions of mining and minerals in China except as connected with traditional writings on the themes of pharmacy and medicine. In one of the first important Chinese works on geography, Shan-Hai Ching's *The Classic of the Mountains and Seas* (3rd to 1st century B.C.), 89 metallic and nonmetallic materials are described, but there are only a few interesting remarks concerning mines. The work is a geographical gazetteer of ancient China and a catalogue of natural and supernatural flora and fauna; it is also a repository of folkways, medical superstitions, and oral and written traditions from earlier times.

During the Tang and Song Dynasties (7th through 13th centuries

Figure 2. **An early depiction of salt mining in the mountains of China; Han Dynasty, 25–200 A.D.**

A.D.), mining in China evolved into the country's second most important economic activity (after agriculture), as measured by the value of its products. As measured by numbers of people involved, mining held third place, behind agriculture and the making of clothing. However, the Chinese mining industry at no time achieved the social importance that it had in Europe, and it did not stimulate any general technological development. Historical research, as well as archaeological finds of tools in ancient workings, show clearly that from the time of the first intensive metal mining, about 1000 B.C., to the Middle Ages, no significant developments in the field took place.

To understand Chinese mining and its development, it is necessary to be aware of the special conditions in that huge empire. China has always had at its disposal an enormous number of deposits of many different raw materials, scattered widely over the country. Most of these deposits are very small and irregularly configured, and consequently it is often not economical to institute more modern technology that would require heavy capital investment. Furthermore, since earliest times there has been an oversupply of very cheap labor, but very little ready capital to invest in mining. Climatic factors also play a significant role: mine work is necessarily seasonal. And the limited availability of water in the relatively dry northern plains has historically been a further hindrance to technological development.

The earliest thorough written description of ore-processing methods in China is an encyclopedia of natural science and technology, *Tiangong Kaiwu*, composed in 1637 by the scholar Song Yingxing. This work is a remarkable documentation of Chinese technology during the latter Ming Dynasty. It describes production, preparation and treatment methods for a variety of mineral materials and manufactured goods, with interesting graphic illustrations. However, no comprehensive treatment of mining itself is included.

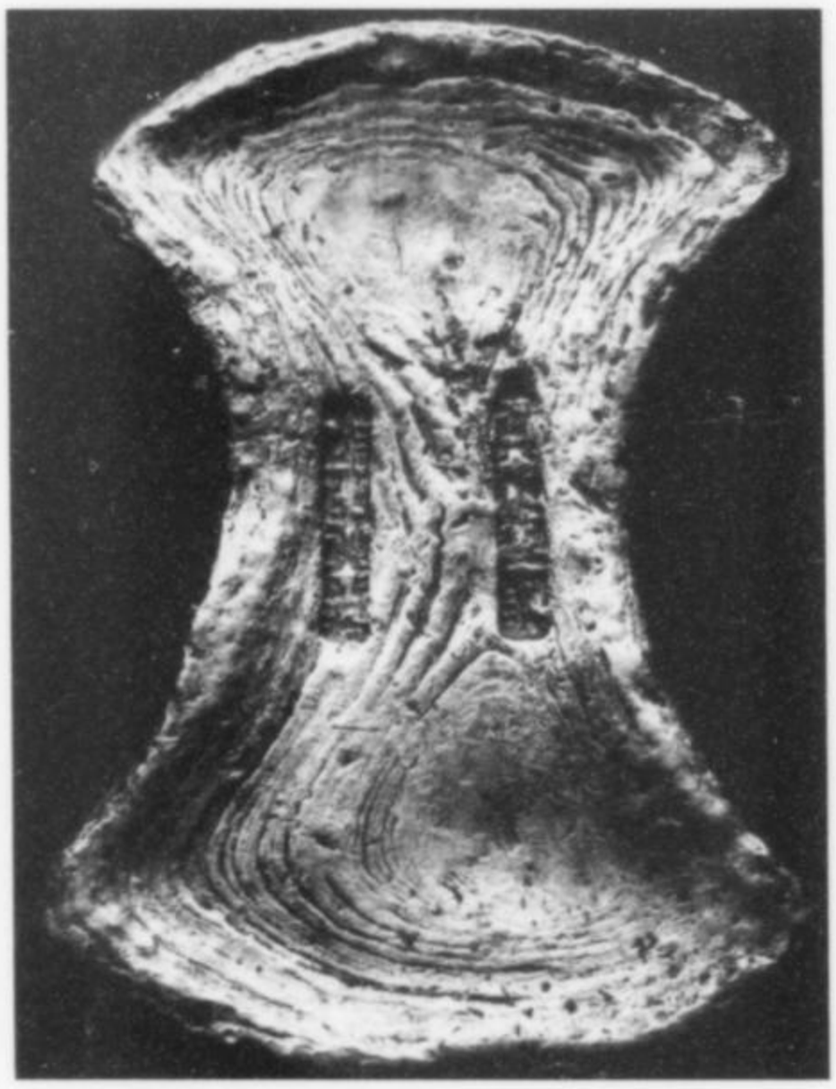

Figure 3. **A 971-gram silver ingot from the southern Song Dynasty (1127–1280 A.D.) used for a tax payment.**

It is a wholly remarkable fact that in 1640 (during the Ming period: 1368–1644 A.D.), under the influence of the German Jesuit priest Johann Adam Schall von Bell, Agricola's *De Re Metallica* was translated from Latin into Chinese (becoming *Kunyu Gezhi*) in order to pass on to China the technological progress that had been made in Europe (Vogel, 1982; Pan Jixing *et al.*, 1989). The Jesuits traveled widely, disseminating western scientific and technological knowledge as a means to achieve their higher goal of the Chris-

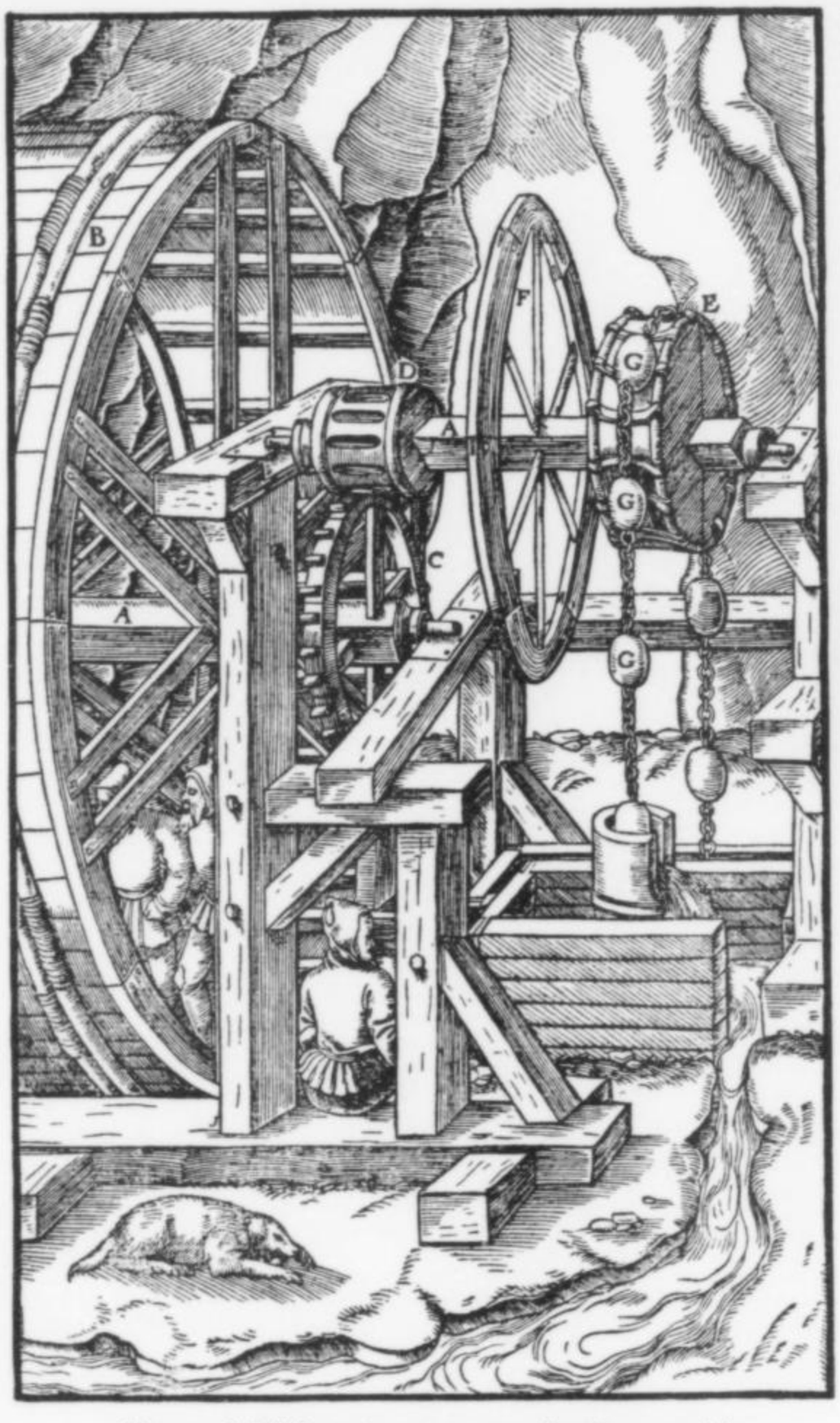

Figure 4. **Elaborate pump mechanism used in the Saxon mines, as illustrated in Agricola's *De re metallica* (1556), the standard European text of its day on mining and smelting technology.**

Figure 5. **Georgius Agricola (Georg Bauer) (1494–1555), physician in St. Joachimsthal and Chemnitz, is considered the "Father of Mineralogy"; he wrote several important works on mining which were ultimately translated into numerous foreign languages. His seminal *De re metallica* was translated into Chinese in 1640.**

tianization of China. They proposed that the clear superiority (as was then the case) of western scientific and technical understanding showed the superiority of western religion as well. The Chinese bureaucracy, under the influence of Li Tianjing, who had been impressed by Agricola's work, did indeed want to increase the productivity of the antiquated mines, but purely as a means by which bureaucrats personally could serve the empire. In the deciding phase of the dispute concerning the practical application of Agricola's *De Re Metallica*, the positive argument was made that mining is a natural use to which to put heaven and earth, and may certainly be pursued without abusing nature. But the important high administrator Ni Yuanlu took the contrary view that mining is not beneficial—he emphasized that mining requires great sums of money, and consequently involves economic risks; that it injures the landscape and desecrates grave sites; that it has adverse effects on the geomantic patterns (employed in divination) of the countryside; that excessive tax increases are levied by mining officials; and that the mines encourage banditry. (Today these are still the essential arguments against mining all over the world.) The reigning Emperor Chongzhen shared the attitudes of Ni Yuanlu, but because of the deficits in the national budget he decided to adapt western technological methods in the mines anyway. We know that some of the mines of greatest interest to collectors today, e.g. Xianghualing and Yaogangxian, were already being mined for ore during the Ming Dynasty, although, unfortunately, no published accounts of them are known.

By the end of Ming times the translation of Agricola's work had been distributed to the provinces, although the knowledge presented therein was only very irregularly being put into practice (Sommerlatte, 1985).

The province of Yunnan, in the southwestern part of the Chinese empire, is rich in copper deposits, and beginning in the second decade of the 18th century the province developed into one of the most important centers of mining and ore processing in China. Around 1845, Wu Qijun, then governor of Yunnan, published a very detailed and complete documentation of Chinese mining techniques. This work, *Diannan kuangchang tulüe* (*An Illustrated Account of the Mines and Smelters of Yunnan*), contained abundant pictures showing mining methods and tools, reports on the miners' customs and folkways, and accounts of mining accidents, as well as reports on the finances of the copper mines of Yunnan (Golas and Vogel, 2004). Wu Qijun (1789–1847) became known as the "Chinese Agricola," although his book cannot compare to *De Re Metallica* for detail, scope and comprehensiveness.

Beginning in the second half of the 19th century, mining opportunities drew many westerners like Ferdinand von Richthofen, Herbert Hoover, T.T. Read and Hans Carl von Carlowitz to China. With their training and their experience in modern mining methods, they were able to see the native Chinese methods from a radically different perspective. Happily, they not only observed the scene but also wrote about it, in some cases prolifically (Golas, 1999). The western travelers strove to provide their employers (European corporations) with knowledge pertinent both to Chinese geography and to the potential profitability of Chinese mineral resources. Modern Chinese mining history began at the end of the

南塘先生校訂

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浪華書林

菅生堂

19th century, as a consequence of the influence of European industrialization. Modern geological methods and mining and ore-processing technologies were introduced, and most of the larger mines, such as the Xikuangshan antimony mine in Hunan and the Wanshan mercury mine in Guangxi, were operated by Europeans.

By the beginning of the 20th century, China led the world in the production of antimony, tungsten and tin, and systematic geological surveys were under way. In 1922 the Geological Survey of China was established. At the founding of the People's Republic of China in 1949, only about 800 people with some geological knowledge were employed in the whole country; of these, only 200 were fully trained geologists. Today, about 160,000 professionals are at work, and about 200,000 mineral deposits are registered, most of them clearly having considerable reserves.

No general survey of mining in China should leave coal production out of the account. Coal is found in almost all parts of the country and has been used as an energy source from early times. Producing it was especially important in the forest-poor north. At the end of the 13th century, Marco Polo reported that coal was in widespread use for cooking, heating bathhouses, and making ceramic products, including bricks. It is believed that during later imperial times in China (1279–1911), there was five to ten times as much mining activity under way for coal extraction as there was for all other raw materials combined.

Presently, there are in China more than 10,000 medium-sized to large, state-operated mines, and 280,000 workings registered as privately or communally owned. However, it should be remembered that most of these mines are fairly small. A Chinese miners' proverb says "Thousands of mountains have outcrops, but only one mountain has valuable ore."

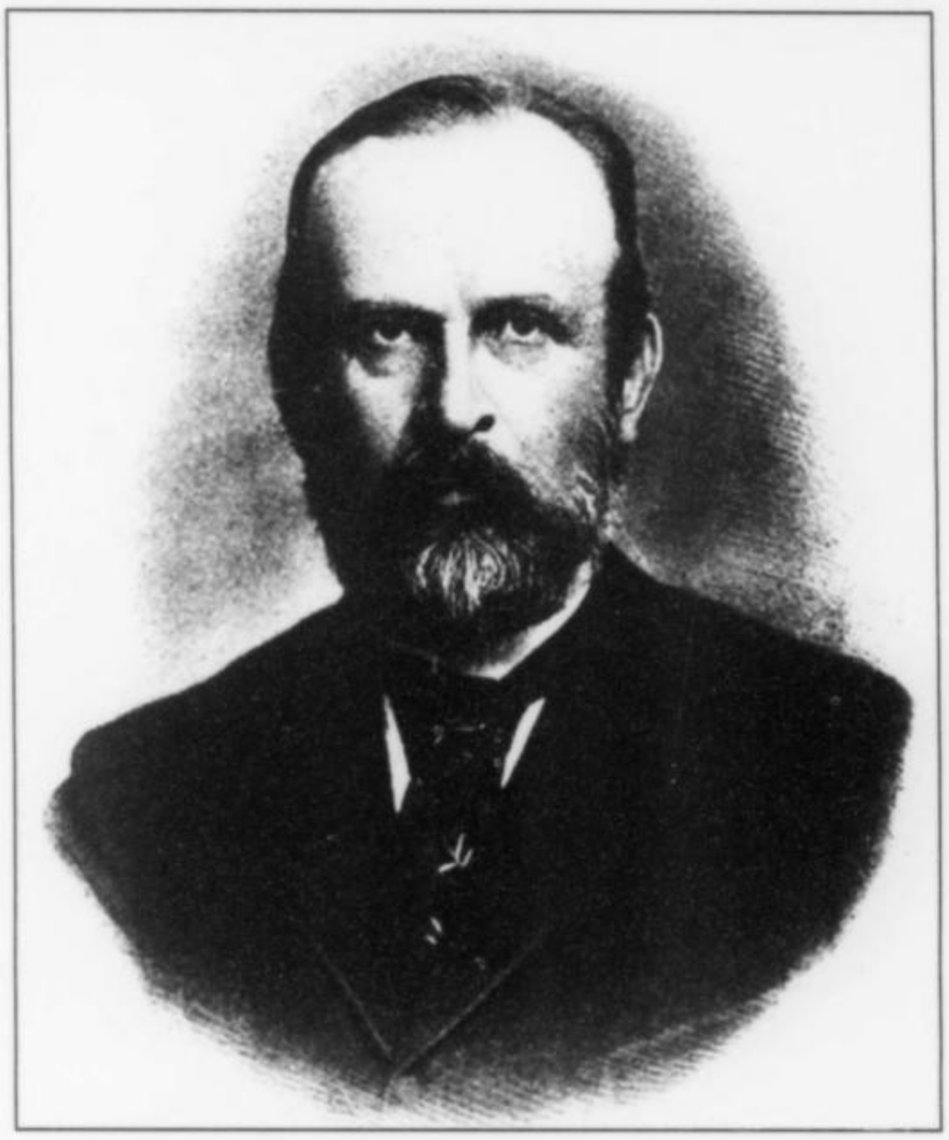

Figure 7. **Ferdinand von Richthofen (1833–1905), an accomplished German geologist who traveled to China three times between 1860 and 1872 to study the ore deposits and geography. He published *Führer für Forschungsreisende* (1886) on the Geology of China, and *Geomorphologische Studien aus Ostasien* (1900–1904) on the geomorphology of China.**

TECHNOLOGY

The earliest mining tools used in China were made of stone, wood and bone. Better tools were made when metals like bronze, copper and iron became available. Although limited in their types, these early implements were, for the most part, used very effectively by Chinese miners in remote times.

Commonly the rock was attacked, not only with mining tools, but also by means of the fire-setting method. Although black powder was invented in China and used extensively in fireworks, it was not used as an industrial explosive for mining. The compass was also invented in China, but it is certain that compasses were not admitted to use in the mines. The methods for surveying and taking measurements in the Chinese mines remained far behind those in Europe. On the contrary, geomancy (divination) and *fengshui* played major roles in prospecting for minerals in China. Among the more empirical techniques used were looking for obvious surface traces of mineralization (e.g. malachite), observing topography, and noting indicator plants and other sometimes-related botanical phemomena.

For a long time, mining techniques in China remained comparable to those found in 16th-century Europe. Up to the 21st century the production of ores depended on cheap and abundant supplies of human labor. Underground mining through vertical or near-vertical shafts was widely utilized; horizontal tunnels, adits and drifts were less common because of the lack of wood for timbering. Rope hoists worked by men were the prevalent means of raising ore. For dewatering mines, diverse pumping systems were used which originally were developed for agriculture. Open oil lamps were employed for lighting the mines. Outside weather conditions had considerable effects on shallower tunnels and shafts, e.g. in hot seasons a lack of oxygen in the mines often compelled the work to stop.

It is chiefly for cultural reasons that the technology of Chinese mining failed to develop more than it did over nearly three thousand years, and despite the economic importance of mining. As a rule, a mine belonged to the landowner, who in turn leased out the workings. The operators of the mines were seldom proficient people, or affluent people; on the contrary, they usually came from the margins of society, and were reckless and irresponsible. Small mines and prospects nearby were often worked by farmers, who generally made poor mine managers. Moreover, capital to invest in better technology was not often available, and, for small deposits, such investment would not have proven economical anyway.

Because the tunnels were low and the shafts narrow, boys eight to ten years old were regularly employed to work in them, and women routinely worked underground. In the larger mines, foremen took supervisory roles in technical matters and in the handling of workers. On the whole, the influence of the State during different epochs was relatively slight; however, there were phases during which the rulers used soldiers to protect the mines from attacks by robbers, and levied considerable taxes on mining.

Figure 6. (facing page) **Title page and illustrations from Song Yingxing's *Tiangong Kaiwu* (1637), the earliest thorough description of ore processing methods in China, accompanied by illustrations depicting mining.**

DEPOSITS

Natural resources have consistently sparked the development of countries and regions. One thinks, for example, of early mining at Laurium in ancient Greece and in the German "Ore Mountains"

Figure 8. **A cavern lined with rhombohedral calcite crystals in the Kangjiawan mine, Shuikoushan, Hunan.**

(Erzgebirge), or of modern developments in oil-producing countries. In early historical periods, mining for copper to make bronze, and for copper, silver and gold for use in coinage and jewelry, was especially significant. Also, the mining of salt has often encouraged the development of the art of mining.

> All five metals found in nature are useful for the people. But gold and silver appear only in very small quantities, while iron and tin are too low in value. Only copper has proven suitable in the past, as today, for currency.
>
> Sun Cheng-tse, 17th century A.D.

During the industrial age, the list of economically useful materials grew enormously. Not only the abundant raw materials for the production of iron, aluminum or cement, but also many rare elements and their natural minerals came to be important. Because of its use in electrification, copper was a necessary prerequisite for continuing industrialization. Today, lead, zinc, nickel, manganese, tungsten and antimony are crucial, and the rare-earth elements are of growing importance in the manufacture of high-tech products. China, with more than a billion people, is the most populous country on earth, and to raise the living standards of its people it needs, among other things, raw materials and sources of energy. In a few categories of material, e.g. copper and aluminum, the deposits already developed are insufficient for domestic needs, while in other materials, e.g. tungsten, antimony and the rare earths, China dominates the world market. In order that the country's balance of trade not be unnecessarily skewed, the exploration for and development of new deposits were assigned highest priority under successive Five Year Plans.

With an area of 9,560,980 square kilometers, China is geographically the world's third largest country, and as a result of its many-phased geologic history it has countless mineral occurrences to call its own. The unfortunate fact is that most of the deposits are small and irregular. Part of the reason for the patchy quality of many Chinese deposits is that erosion has not proceeded sufficiently to form broad zones of secondary enrichment with solid, high-grade deposits (Golas, 1999). A glance at a distributional map of the ore deposits shows which regions offer the greatest potential. The provinces of Hubei, Hunan, Jiangxi, Guangdong and Guangxi, notwithstanding their relatively small areas, are endowed with rich natural resources, but interesting deposits are also found in a few neighboring provinces. Western China and the high-mountain regions are still the least developed areas, but here, as well as in northern China, prospecting work suggests the presence of rich deposits and some interesting mineral occurrences of the future.

SOCIAL ASPECTS

Since the founding of the People's Republic ca. 1950, mining activity in China has intensified considerably, and today the industry, employing almost five million people, is extremely complex with respect to technology and organization. In addition to the large mines worked by large mining companies—mines which are largely in the hands of the State—there is an enormous number of small mines and prospects worked simply and by hand. For some raw materials, the combined production of these small workings reaches significant percentages of the country's total output: for example, 46% of the antimony, 43% of the coal, 30% of the lead and zinc, 35% of the tungsten, and 9% of the copper. By the end of the 1990's, the central government was privatizing growing numbers of state-owned mines and turning over responsibility for them to the provincial governments.

But it is worrisome, as it has always been, that there are so many

small, very primitive mine workings scattered throughout the country (Gunson and Yue Jian, 2001), since as a result of the lack of expertise and of capital, there are enormous problems with safety and health in these workings. Between January and October of 2002, in the (particularly dangerous) coal mines alone, there were 2,378 accidents, and 4,547 people were killed. Between January and the end of October of 2003, accidents in all Chinese mines (most of them in the coal mines) took the lives of 13,283 people in all. There is insufficient understanding of how to prevent accidents, and thoughts of environmental protection—keeping the water and air clean—are only now beginning to occur to responsible people.

While a few large, state-run mines, such as the Kangjiawan mine in Shuikoushan, Hunan, boast ultra-modern facilities, the outdated technology of the countless small and middle-sized mines still poses a large economic problem, particularly in the areas of ore-processing and smelting. Since the beginning of economic liberalization about 20 years ago, there has, however, been major and increasing investment of foreign capital and expertise.

MINERALS

China can be regarded as a country with almost unlimited possibilities for mineral collectors in the foreseeable future. The country's huge, not yet fully developed resources can be expected to yield interesting minerals and associations, not just from the mines but also from quarries, prospects, and exploration sites in the high mountain regions.

The mineral specimen trade has already begun to flourish in China, of course, and in general terms its development (having already commenced) is easy to chart in advance. At first, Chinese mineral dealers will give, and have given, their closest attention to products of the more accessible mines; at the same time, mine workers will learn to collect minerals carefully. In the beginning, rare minerals will commonly be overlooked; it is much easier to lavish attention on aesthetic specimens which fetch a higher price and are not risky to market. Since there are virtually no mineral collectors in China, foreign collectors and dealers must take the initiative to exert gentle pressure on Chinese dealers to recognize rare minerals and to learn to collect specimens without damage. Clearly the vastness of distances in China has an important effect on the trade. The original middlemen, largely based in Changsha, the capital city of Hunan, are not in a position to carry on inquiries in far-distant provinces. It remains to be seen how quickly new centers of dealing in other regions can be established.

The closing of many small mine operations and the increasing development of large mines are having some detrimental effects on the mineral market. In small mines, because of the limited use of high-tech mining methods, specimens can much more easily be extracted; good, undamaged pieces can be carved out by the miners who can earn more profit in that way than by simply digging ore. In the large, modern mines, the use of sophisticated mining equipment affords workers fewer chances to find and save collector-quality specimens. As is often the case in the West, the mining companies are interested in producing the highest possible ore tonnages per man-hour of labor, and not in rescuing undamaged mineral specimens.

The minerals which have thus far appeared on the market represent only a small part of the real potential of China. Even in the relatively well-worked-over region of Hunan and its neighboring provinces there are numerous mines whose collector-quality minerals have not yet been offered on the market. Then there are the provinces of Jiangxi, Sichuan, Tibet, and Xinjiang, and there is Inner Mongolia, with its extraordinary deposits at Bayan-Obo, the greatest concentration of rare-earth elements on earth. Numerous new mineral species from Bayan-Obo have already been discovered and described by the scientific community, although only a very few specimens have appeared so far on the mineral market.

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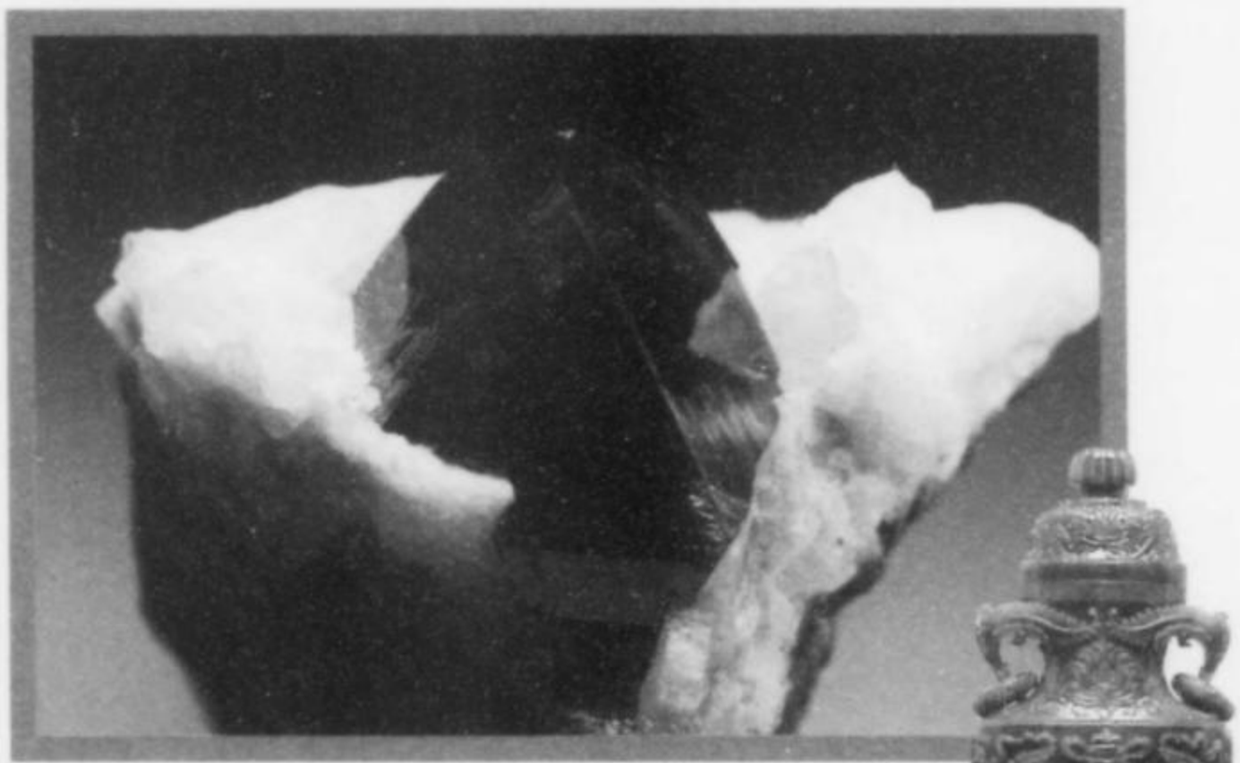

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Mineral photo: Cinnabar, Hunan, China. Photographer: Wendell E. Wilson.
Jade vase photo courtesy of the Lizzardo Museum of Lapidary Art.

地質中國

GEOLOGY OF CHINA

Guanghua Liu
AAA Minerals International
Französische Allee 24
72072 Tübingen, Germany
Email: ghliu@aaamineral.com

China has 96 million km² of land with various geological provinces ranging from high mountain chains in the western regions (including the Himalayas) to the basin and range systems in the southern and northeastern regions to the northern China fluvial plain and the eastern China coastal plains. Within these different units, a vast number of mineral deposits were developed by multiple geological processes and tectonic evolution.

GEOLOGICAL FRAMEWORK and TECTONIC EVOLUTION

In terms of plate tectonics, the Chinese continent is a product of complex, long-term interaction between the Siberia, Tarim, North China, Yangtze, South China, Indian and Pacific palaeoplates plus other relatively small plates or blocks. Along the converging margins of these plates, fold zones formed as a result of the plate collisions, whereas in the centers of the plates, basins and plains were developed because of stable tectonic settings and sedimentation. Mineralization related to endogenic geological processes normally took place in the fold zones, or mountain areas; for example pegmatite bodies occur mainly within these fold zones in association with magmatic activity.

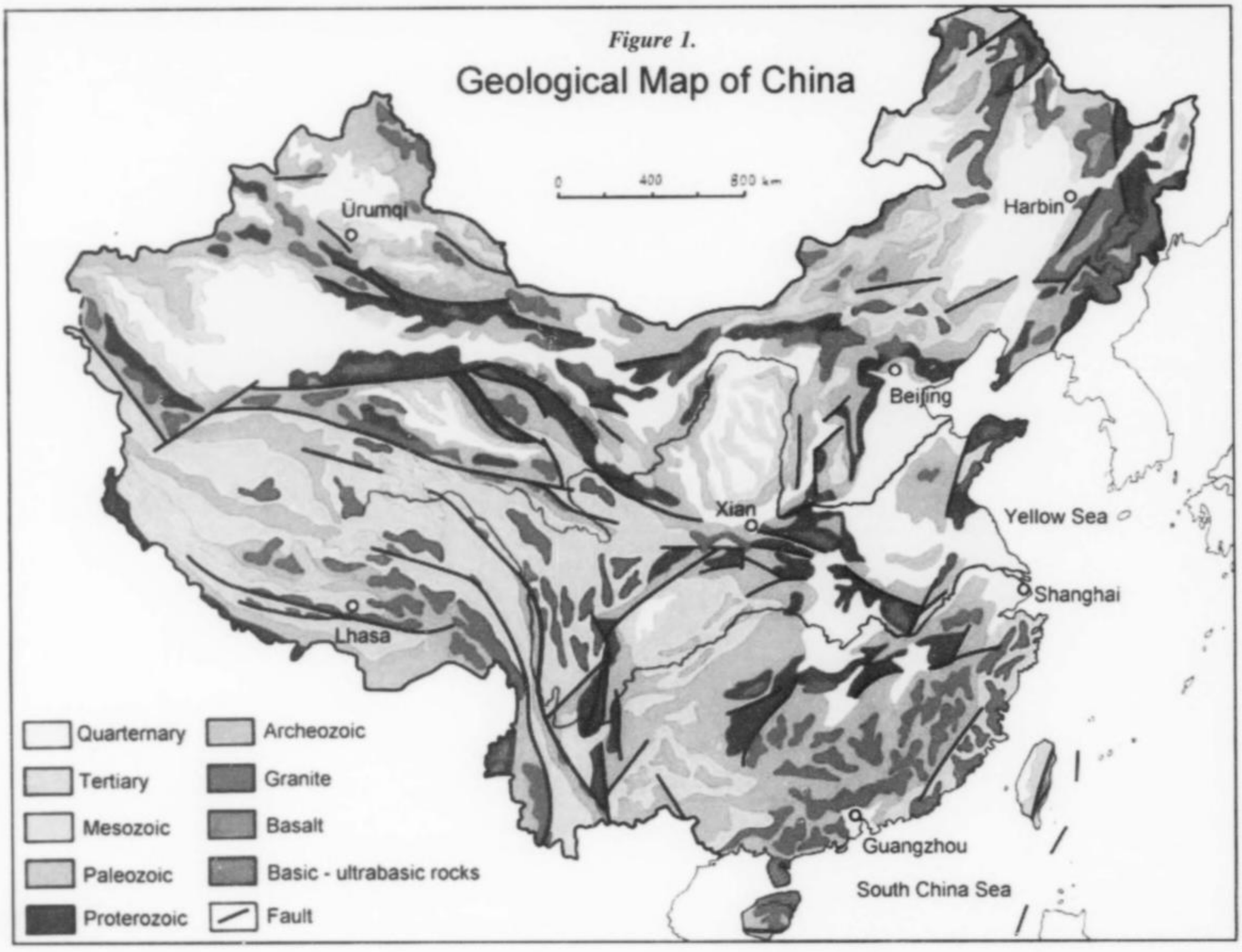
Northern China represents the main part of the North China paleoplate, the so-called North China platform. The oldest rocks in China have been found in this plate, dated to between 3,800 and 3,500 million years ago, in the Archean era. The main part of the continent may have been consolidated during the Early Proterozoic (2,600 to 1,850 Ma) and the plate was separated from the Siberian-Mongolian plate in the north and from the South China plate in the south by lost oceans (the Mongolian Sea in the north, and the Paleo-Tethys Sea in the south) during the Early Paleozoic. Marine sediments were widely deposited on this plate during that period.

The North China plate merged with the Siberian-Mongolian Continent in the later Paleozoic, which led to the formation of the Tianshan-Yingshan Mountain zone along the northern margin and a regressive depositional sequence consisting of alluvial, fluvial, coastal and shallow marine clastic and coal deposits in the center and southern margin. At the same time the Tarim micro-continent also melded into the Siberia-Mongolian plate in the west. In the Paleozioc period, the South China plate was broken away from the Gondwana supercontinent in the southern hemisphere and drifted northward. The surface of the continent was mainly covered by shallow marine and coastal plains.

During the latest Permian and Triassic periods (ca. 250 to 205 Ma), the integrated continent of North China and Tarim, with its continental accretions, collided with the South China plate in the east and with the Paleo-Tethyan plate in the west, resulting in the uplift of the Kunlun-Qinling fold zone between them. The collision-associated volcanism and metamorphism caused the extensive mineralization in this mountain zone and its margin belts.

From the Late Mesozoic to Early Tertiary (ca. 200 Ma to ca. 50 Ma), the Indian continental plate and the Tethyan oceanic plate, with several micro-plates or blocks, converged and collided with the Eurasian continent respectively, as a result of the gradual northward drift of the Indian plate. This series of tectonic movements, continuing to the present day, has resulted in crustal compression and uplift in western China which has led to the formation of the Himalayas, the Tibet plateau, and the high mountain chains of southwestern China. The origins of the mostly endogenic minerals, especially gemstones, in these regions are

Figure 1.



closely related to the magmatism, metamorphism and tectonic activity of these periods.

With the westward movement and subduction of the Pacific plate from the Late Jurassic (ca. 140–150 Ma) to the present, eastern China became a part of the active continental margin. The Nanling mountain belt and the NNE-SSW fractures, with volcanic belts in southeastern China, were mainly formed during these periods. The magmatic activity and mineralization of eastern China are strongly controlled by the tectonics of the Circum-Pacific region. As a result of the upward movement of mantle magma (caused by the subduction of Pacific oceanic crust and the NNE-SSW folding and faulting) as well as the abundance of groundwater supplied by the high rainfall in these areas, hydrothermal mineralization became very important.

MINERALIZATION and the FACTORS CONTROLLING IT

Long-term geological evolution, diverse tectonic patterns, multiple geological processes and the wide range of climates of China are favorable conditions for various types of mineralization. This explains why nearly all world mineral species have also been discovered somewhere in China. To date, 168 different kinds of economic mineral deposits have been found in China. According to their environments and origins, we can categorize these deposits as endogenic, exogenic or combined types.

Endogenic Mineralization

The endogenic minerals were mainly formed by igneous intrusive, volcanic and metamorphic processes; they include most of the minerals with high hardness and chemical stability and nearly all of gemstones. The formation and distribution of such minerals took place always within tectonically active zones. As discussed above, China developed a series of folds and fracture zones, including the Altai Mountains in Xinjiang Uygur Autonomous Region, the Tianshan-Yanshan fold zone in northwestern and northeastern China, the Kunlun-Qinling Mountains between northern and southern China, the Himalayan-Ailaoshan fold zone in western and southwestern China, the Nanling fold zone in Guizhou, Guangxi, Hunan, Guangdong and Jianxi provinces, and Wuyishan Mountain in Fujian province. In these areas, especially in the western high mountain regions, iron, chromium, lead, zinc, nickel and copper deposits are widely found associated with mafic to ultramafic intrusions. Examples include the chromite deposits in Xinjiang and Tibet, and the copper-nickel ores in Gansu, Jilin and Sichuan provinces. Sapphire deposits in Changle of Shandong are regarded as having this origin too. Volcanic iron and lead-zinc deposits have been found in the Tianshan, Kunlun, and Qinling Mountains and many locations in eastern China. Minerals and orebodies formed by mineralization associated with granitic intrusions and pegmatites are also widely distributed in these fold and intrusion-developed zones. Examples include aquamarine, tourmaline, garnet and other gem minerals, and gold, titanium, and tantalum-niobium deposits in the Altai and Tianshan Mountains of Xinjiang, Emeishan Mountain in western Sichuan, Ailaoshan Mountain in Western Yunnan, Wuyishan Mountain in southern Fujian, and some locations in northern Hunan province.

Many mineral deposits are formed by element replacement and metamorphism at the contact zones between igneous intrusions and host rocks along the former continental margins. Hydrothermal

Figure 2.
The Great Wall of China, in the high mountains. Ottens photo.

processes normally also play an important role in this kind of mineralization. Typical deposits formed range from copper-molybdenum, lead-zinc, tin, and molybdenum-wolfram mineral associations to iron-copper, copper-lead-zinc, wolfram-tin-molybdenum-bismuth and other polymetallic orebodies. In turn these can be subdivided into porphyry-type and skarn-type ores, depending on the types of host rocks. Typical porphyry-type deposits are copper ore in Yulong, Tibet, and copper and polymetallic deposits in Dexing (Jiangxi province) and Duobaoshan (Heilongjiang). The skarn-type minerals are widely distributed in eastern and southern China. Examples include the iron-copper deposits at Daye (Hubei), copper deposits in Tongguangshan (Anhui); copper deposits in Wushan and Chengmenshan (Jiangxi), polymetallic mineral deposits at Yaogangxian, and the Shizhuyuan lead-zinc mine in Shuikoushan (Hunan) among others.

Minerals and ores formed by hydrothermal activity are mainly distributed in the eastern parts of northern and southern China; these mineralization zones are dominated by W, Sn, Mo, Zn, Pb, Sb, Hg and Cu-bearing metal deposits as well as many fluorite, barite, calcite and other non-metal deposits. Most of the collectible minerals, including cinnabar, realgar, stibnite, fluorite, calcite, barite and many others from southern China, belong to this genetic type. Their distribution is normally controlled by deep fractures and regional igneous activity, as well as the groundwater regimes. Because eastern and southern China are situated on the margin of the Eurasian plate and close to the subduction zone of the Pacific plate, their crustal geothermal systems were strongly influenced by the upward movement of mantle material. As a result, hydrothermal fluid-related minerals are concentrated in these areas.

Exogenic Mineralization

Secondary or exogenic minerals occur widely in China, especially in eastern China. This kind of mineralogy originated mainly from the oxidation and hydration of the other minerals and rocks in surface or near-surface settings, with the aid of groundwater. This may also account for the widespread formation of cave calcite, aragonite and other stalactitic minerals, such as hemimorphite and malachite in southern and southwestern China, where a hot and wet climate prevails. The beautiful green pyromophite and yellow mimetite found recently in the lead-zinc mines of Guangxi and Guiling are also examples of this type of mineralization.

FLUORITE crystals on Quartz, 3 inches, Yaogangxian, China

Clara and Steve Smale

COLLECTORS

PHOTO BY STEVE SMALE

交易 矿物

MINERAL DEALING in China

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau
Germany

Ever since China began to "open" in the early 1990's, dealing in local mineral specimens, like other forms of capitalism in China, has flourished. Western collectors owe the present abundance of Chinese specimens on the mineral market to favorable cultural and economic conditions and to the energy of Chinese dealers. Although the business has some troubling features (especially when it comes to "enhancement" of specimens), the future of Chinese mineral dealing looks promising and exciting.

HUNAN PROVINCE: THE CENTER OF THE MINERAL TRADE

Hunan is commonly cited as a locality for mineral specimens—is this correct or not? In many cases it is, but specific information is nevertheless missing. Hunan is a province in southern China with an area of 210,000 square kilometers and a population of 65 million people: comparable, by both measures, with the former West Germany. A remarkable diversity of rich mineral deposits is distributed throughout the province. Hunan has produced 138 mineral groups from more than 6,000 mines of varying sizes; it is the most productive of China's provinces for tungsten, bismuth, antimony, monazite and fluorite, and is one of the leading provinces in the production of manganese, vanadium and rubidium. Its production of lead, tin, zinc, mercury and even diamonds is also significant. In the recent past, additional natural resources of interest have been investigated using modern methods of exploration. According to some reports, large investments are planned to facilitate gold mining in Shuikoushan, in central Hunan, and to increase the production of uranium in the Nanling Mountains.

Hunan lies just south of the middle reaches of the Yangtze River. With the exception of the large drainage basin around Dongting Lake in the north, the terrain is characterized by hilly regions and by mountains with elevations reaching to more than 2,000 meters. The people of Hunan proudly point out that Mao Zedong's birthplace lies near Changsha.

Economically, Hunan is somewhat overshadowed by the special economic zones of southern China and by newly modernized cities like Shanghai and Guangzhou. Changsha, the capital of Hunan Province, counts 2.5 million people in the city proper and 6 million people in the wider metropolitan area. In general the province is prosperous, with a good infrastructure and much potential. In addition to industry, the agricultural economy still plays an important role. In the moist, warm climate, rice and vegetables are harvested almost all year long. Besides these agricultural products, delicious freshwater fish from countless lakes and streams are an essential element of the extremely spicy cuisine of Hunan.

At present, Changsha is the center of the Chinese mineral trade. In China's capital city, Beijing, practically no minerals are to be had, but Chenzhou in Hunan and Guilin in the southern autonomous region of Guangxi are important regional centers for mineral dealing. In other local centers, such as Chengdu and Leshan in Sichuan province, the trade is limited to minerals from the few

occurrences in immediately surrounding regions. As a rule, visitors from abroad find it hard to function in remote provinces where people are not yet used to hearing foreign languages, and in general cannot speak them.

THE GROWTH OF MINERAL DEALING IN CHINA

Almost all of the Chinese dealers who began in the trade in the early 1990's have some education in the earth sciences. Originally, in the course of their employment by geological institutes or provincial geological surveys, many of them were required to manage specific mines. The commercial success of the mineral trade has caused more dealers to appear, and these were (and still are) interested solely in realizing the highest possible profits. The rapid growth of this latter group resulted in more minerals becoming available, surely, but there was decreasing care regarding correct identification of species, careful handling of specimens, and especially the precise designation of localities. Several of these merchants even represented themselves on their calling cards as curators of imaginary museums with impressive names. Some of them, if questioned as a test of their knowledge of the simplest things, would laugh and say that they didn't need to know these things when dealing with foreigners. Some of the addresses they gave for their "museums" turned out, when visited, to be gloomy warehouses or storerooms in abandoned dwellings.

The first Chinese minerals offered on the international market were snapped up eagerly. Who could tell how long the country would remain "open" and what else, if anything, might be expected? It didn't matter whether or not a specific locality was cited—everything was bought up. The dealers quickly learned how higher prices could be realized: soon, damaged crystals were acquiring new faces by virtue of painstaking "craftsmanship," and aesthetic crystal groups were coming into being thanks to adroit "mounting." The person who closely scrutinized specimens with, for example, large cinnabar crystals would soon conclude that it was very hard to find pieces with crystals *not* glued onto the matrix. And if the cinnabar truly was not glued on, a cute quartz crystal had perhaps been appended.

After Chinese minerals like fluorite and cinnabar had been offered in plenty all over the world, a few dealers realized that service and expert advice belong, as a matter of proper business ethics, to any good sale. These dealers finally began providing precise locality information. Moreover, collectors and dealers from abroad went themselves to the most important localities to get a firsthand look at them. But it remained difficult, just as before, to pick up adequate background information on geological settings, mineral assemblages or the history of individual mines. In the last few years, literature on Chinese deposits has become increasingly accessible, and, fortunately, English summaries have commonly been prepared, but the number of full books and articles written in English remains quite small. The most important of these modern references is probably the five-volume set of *Mineral Deposits of China,* published in 1990–1996 by the Geological Publishing House in Beijing.

In Changsha, mineral dealing was established in the shadow of the geological institute of Hunan. In modest quarters in the so-called "mineral market," the specimens were stored in boxes, and later in piled-up plastic crates. Gradually, display methods improved, until at last the better material was offered in relatively upscale places of business, such as jewelry stores, in the heart of Changsha. Lesser-quality minerals are still sold from the old mineral stores, the back rooms and back yards of houses, and other out-of-the-way corners of Chansha's mineral market.

Originally hardly any Chinese dealers traveled to Europe or America: they lacked the knowledge of the appropriate languages,

Figure 1. **A naturally eroded and sculpted rock of the kind that is very popular in China and Japan. This one has been set in a park in Guilin City. Ottens photo.**

and so instead Western middle-men were the primary purveyors. But soon the first adventurous Chinese dealers began showing up at the Tucson Show to evaluate the Western market for themselves, and they learned quickly despite the language barrier. Within two or three years the big mineral shows in Europe and America came to be populated by legions of Chinese dealers. (A part of the selling area at the 2003 Ste.-Marie-aux-Mines show even came to be called "Chinatown.")

The entry of Chinese dealers onto the Western show scene has had several causes and several effects. On the positive side, the dealers have learned to recognize what is usual on the market and thereby to adapt to what the customers are looking for and what they are ready to pay. After such trips abroad, dealers' fantasy-prices come up against hard limits. Of course Chinese dealers like to visit foreign countries because they hope to realize higher profits: why should they relinquish their minerals cheaply to a foreign buyer in China if they can sell them for much more abroad? Commonly, however, there comes a rude awakening when dealers discover that, particularly at the smaller shows, the expense of making the trip and of taking part in the show can exceed the proceeds from selling specimens. Consequently many of them prefer to visit only the large shows, e.g. Tucson, Munich or Ste.-Marie-aux-Mines.

Chinese dealers do not observe the established Western rules as scrupulously as their foreign competitors: the obligations of honor regarding the labeling and pricing of specimens are foreign concepts to them and are sometimes ignored, knowingly or unknowingly. And what show manager, even if his rules are clearly defined, can really take action against such behavior? The problem essen-

Figure 2. **Entrance to the mineral market street in the city of Changsha, Hunan. Every year more jewelry and lapidary shops open here, forcing the mineral warehouses to move around to the back side of the buildings. Ottens photo.**

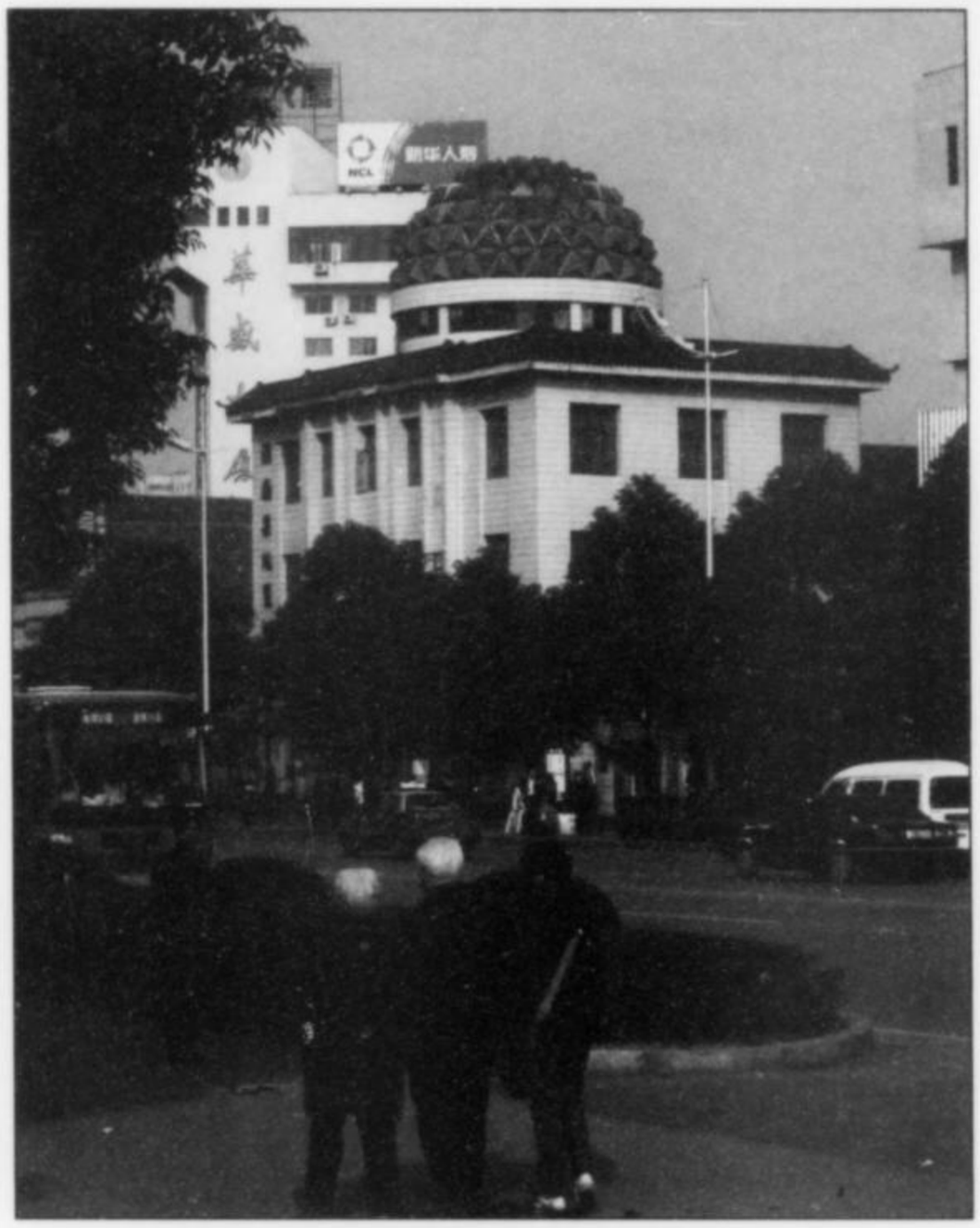


Figure 3. **The Geological Institute of Changsha, Hunan—the cradle of the Chinese mineral specimen industry. Ottens photo.**

tially is that the Chinese have a different view of "honor" than their western hosts do. For them, to flout or shade the (mostly unwritten) codes of ethics is not to be unlawful but simply to be resourceful and clever.

Some Chinese dealers have decided, as a first priority, not to handle general material but to focus on investigating new deposits and sniffing out interesting minerals. The discoveries, for example, of extraordinarily large kermesite crystals and of outstanding mimetite led to considerable commercial success for dealers of this sort. The great size of China, with its innumerable sources of collector-quality minerals in still-unexploited localities, represents an almost unlimited potential for the near future. This potential can be realized thanks to the low cost of mining and the insatiable interest of collectors around the world. The money to be made should help dealers maintain enough motivation, in coming years, to continue tracking down new and lucrative localities and gathering rare and exotic mineral specimens from them.

A troublesome aspect of the trade in Chinese minerals, however, is that the Chinese have always been willing to "enhance" specimens in ways, and to extents, which scrupulous western collectors regard as unacceptable. For example, color-changing irradiation of specimens has always been a common practice in China. For five U.S. dollars per kilo, enterprising dealers can have minerals irradiated in medical facilities in Changsha. The technique is especially successful in changing pale colors in fluorite to intense greens or blues. Mediocre colorless or gray quartz from Yaogangxian leaves the radiation chambers as "morion" (very dark smoky quartz). The dealers customarily swear that these specimens are

Figure 4. **Mr. Zheng Jian Rong, one of the long-established mineral dealers in Changsha. Ottens photo.**

completely natural. The most recent exercise in "radiation doping" has bestowed interesting blue edges and corners on beryl crystals from Xuebaoding. Who knows what's coming tomorrow?!

Then there is the matter of oiling. Fluorite does not always come naturally with a luster as bright as collectors would wish. After the Chinese dealers have bathed specimens for several hours in concentrated hydrochloric acid, the crystal faces have paid the price. And fluorite crystals etched out of enclosing quartz with hydrofluoric acid are left with only a matte luster. To camouflage this damage they are coated with oil. In recent years, however, buyers from Europe and America have learned to recognize the odors of different kinds of oil. And while examining specimens they have learned to recognize the feel of the oil, or whatever else has been applied: silicone spray, hairspray, or even liquid wax.

Such "improvements" of specimens are only temporarily effective—and we collectors also bear some guilt for them. At one major mineral show, a Chinese dealer laid trays of fluorite specimens on his table, one after another, and proceeded to oil specimen after specimen, right before the eyes of visitors. If you believe that he wasn't able then to move his material, you are in error: everything was sold!

One improvement which has occurred in the trade is the increasing tendency to provide specimen labels that have mineral names and locality names written in Roman characters. In 1979 the Chinese government officially introduced the Pinyin method as the generally authorized, standardized way to transliterate Chinese characters into Roman letters. It is important to remember that in the provinces, dialects are spoken in addition to the "high Chinese" Mandarin language. In southern Hunan, for example, one is apt to drop the "g" at the end of a syllable, so "Xianghualing" becomes "Xianghualin." The standards of written correctness for proper names are founded in Mandarin; what is problematic is representing the vowel sounds. The name of the old copper mine near Daye is best rendered phonetically as "Tonglüshan," but since there is no "ü" sound in English the word is written in all English texts as "Tonglushan." So as not to create additional problems or risk further distorting the name of the locality, the English spelling is customarily used. A further convention being applied is to represent sounds which run together as words run together; for example, Yao Gang Xian is written as Yaogangxian.

Attentive observers of written Chinese will notice that certain important syllables occur commonly, e.g. "Shan" (mountain or hills) and "Jiang" (river). "Hunan" is formed from "Hu" (inland lake) and "Nan" (below); "Hubei" is formed from "Hu" and "Bei" (above). Whoever wants to delve a little more deeply into the (certainly difficult) Chinese language can easily infer the meanings of many words in this way.

EARTH MATERIALS and CHINESE CULTURE

The present mineral trade has brought on a wider cultural change in China. Chinese people have never collected mineral specimens in the same way as the Europeans have for centuries. A different attitude toward nature and natural forms prevails in Chinese culture. People are traditionally not interested in attractive crystals which are brought to daylight from the bowels of the earth. Good cinnabar crystals, for example, have interest only as pharmaceutical components of better than average purity. Instead, valuable rocks are those with aesthetic natural shapes and interesting phenocrysts which mimic botanical forms. They are valued as natural art pieces, as in the Western category of art referred to as "found objects." Pieces of stone with interesting structure or graininess, or with attractive sculptural forms caused by weather-

Figure 5. **Mrs. Li Rio Qian, formerly a geologist with the Hunan Geological Institute, calculating lot prices with her son. Ottens photo.**

ing, are valued most highly, and are even signed by their artist-discoverers. Special displays of such "natural stones" are to be found in almost all of the large public gardens in all major cities. The rapidly growing prosperity in China, and a coincident appreciation of natural "sculptures in stone" in Taiwan, Singapore and southeast Asia, has led to serious inquiry about these stone objects. It is noteworthy that the price structure for them is not linked to production costs; rather, the standards for pricing are like those for works of art. Since, in some cases, extraordinarily high prices—well over 10,000 dollars—are paid for pieces weighing less than 100 kilograms, this new market has grown extremely attractive to dealers. The interesting cross-over element with mineral collecting is that very large mineral specimens which are damaged and are therefore unsaleable on the Western market, can easily be sold as decorative, natural art objects on the domestic market.

The modern market for such objects has sprung up rather quickly, being particularly well developed in Guilin. Farmers from the area broke stalactites, stalagmites and other limestone formations out of the countless caves in the karst terrain and offered them in a market in Guilin created expressly for selling tourist items. For the presentation of the stone objects, artistic wooden stands carved from roots—also products of the Guilin area—have commonly been used. In the immediate neighborhood of the tourist market countless workshops have been established, and in these an enormous variety of artistic objects are being fashioned from wood, from the simplest reworkings of tree roots to the finest products of the woodcarver's art.

Both "decorative" stone pieces and rough boulders of rock to several tonnes are sold at the stone market in Guilin; also among the wares are rock plates to a few meters long displaying fossils. Sculptures from a rock type known as "chrysanthemum stone" (because the white phenocrysts in a fine-grained black groundmass look like chrysanthemum flowers) enjoy a growing popularity. The enterprising dealers have noticed that in addition to their sales of stones to Chinese customers, a market in minerals for foreigners has developed. Mineral specimens which the Chinese dealers themselves may find attractive cannot be exported successfully because the crystals are damaged; therefore they have decided to market such pieces as decorative objects. Specimens which are especially suitable for handling in this way are those from the pyrite workings at Shangbao: impressive crystal groups of quartz and pyrite freed from enclosing dolomite by hydrochloric acid. Also, the quartz/hematite specimens from the region of Jinlong in Guangdong meet with great approval. At the great Kangjiawan mine, exploiting the Shuikoushan lead/zinc deposit in central Hunan, about 30 tonnes of material each year are sold exclusively for decorator purposes. Unusual formations from the karst caves in this mine include calcite crystals measuring 5 cm across the rhombohedral faces, with well individualized honey-yellow sphalerite crystals sprinkled on them.

The market for decorative specimens in Guilin is experiencing such a boom that some minerals from far-distant provinces are being imported. Among the first such material to be brought to Guilin were specimens of long-prismatic (almost needle-like) quartz crystals associated with barite from Jinkouhe in Sichuan province. A few lots of better quality or individually selected specimens of this material appeared first on the foreign trade-oriented market in Changsha, Hunan. A few hundred meters away from the mineral market in Guilin is the wholesale depot for stones and decorative specimens. In very recent times the demand for larger pieces has grown rapidly, so that countless specimens weighing between 50 and 500 kg's are being offered. Among these are many fluorite plates from around Xianghualing, with heavily damaged crystals. At first glance these specimens are very attractive, if one leaves out of account the effects of oiling and the clever use of display lighting. Inspired by the vigorous sales turnover of stones and minerals, many miners and farmers from faraway regions bring their wares first to Guilin and offer them at the weekly market there. Thus the pyromorphite from near Yangshuo and the mimetite from the north of Guangdong province came first to Guilin, before being channeled to Changsha and passing from there to the mineral markets of the western world.

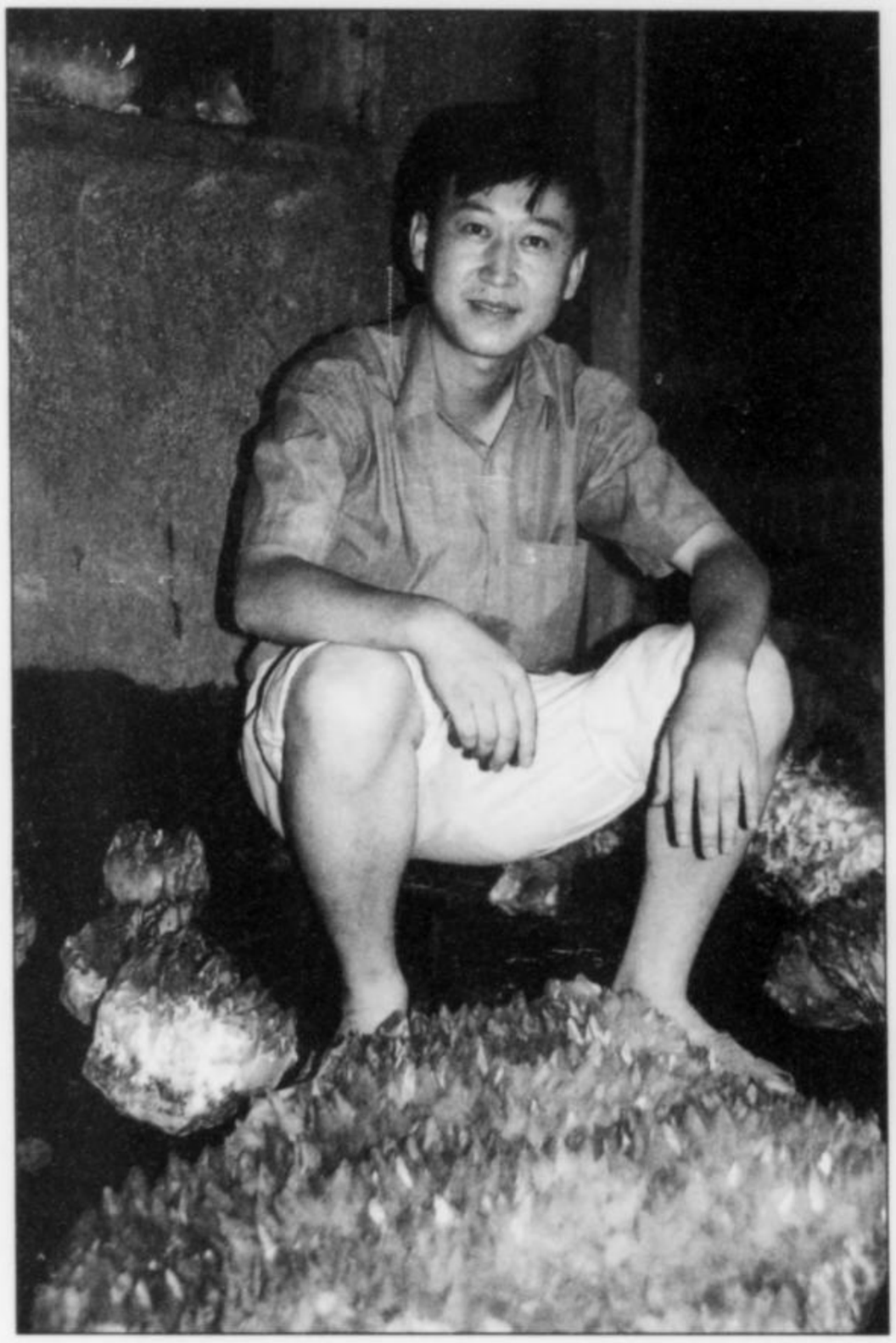


Figure 6. **Mr. Zhang Min with a new lot of hematite-included red calcite specimens. Ottens photo.**

For many Chinese dealers who began merely with handling minerals for collectors, the new, domestic Chinese market in stone objects has become very interesting. Foreign mineral collectors are always wanting new mineral species and associations from new localities, and in specimens of perfect quality; such requirements are not easy to satisfy. For natural stone objects for decorative purposes, however, these criteria play no roles. It is only a question of individual tastes, and different points of view are routine. And the prices are good. While the geologically educated dealers from the earliest days remain true to collector minerals, it is already foreseeable that some of the younger dealers, purely oriented towards commerce, will turn to the more lucrative field of decorative objects or to the jewelry trade.

ECONOMIC AND CULTURAL CHANGE

It is interesting not only to analyze the development of the Chinese mineral market, but also to observe, on the scene, political changes and how they are connected to changes in the business.

My first trip to China took me to Changsha in April 1995. The

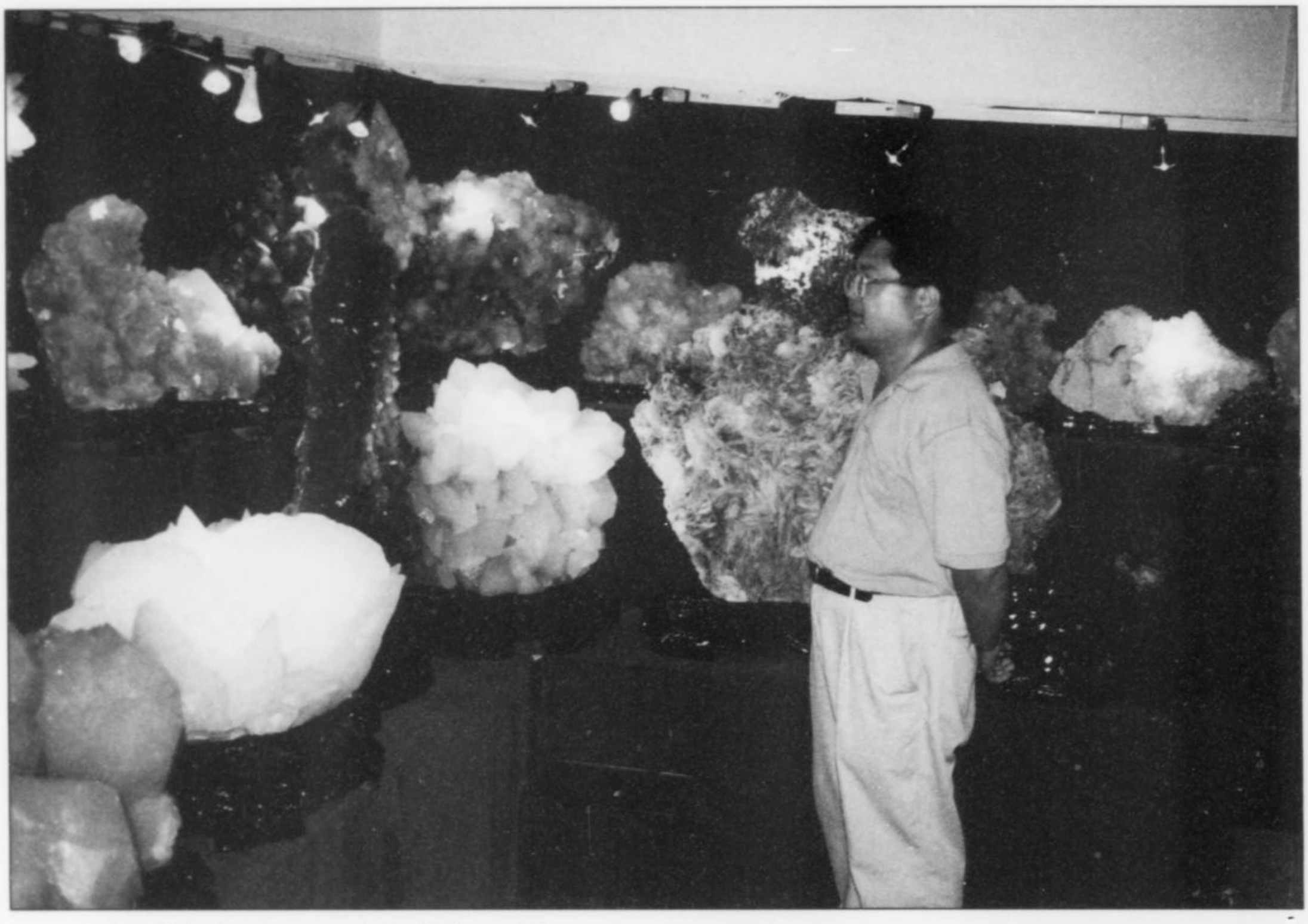


Figure 7. **A showroom stocked with large and decorative specimens intended primarily for Chinese customers; crystal quality is of secondary concern compared to overall sculptural appeal. Ottens photo.**

Figure 8. **A so-called "museum," actually just a mineral business showroom. Many dealers claim on their business cards to be curators associated with museums, but this is often merely a marketing ploy. Ottens photo.**

physical prospect, with low, gray clouds, light rain, and a temperature of 10° C, was not especially appealing. The cold, damp air was heavily laden with fumes from the countless small stoves fueled by coal very high in sulfur. Only a few of the streets were blacktop; the sidewalks were fragmented, with red mud from building sites and weathered stone appearing between the disjointed blocks. Little red taxis, in which puddles accumulated on the passenger side because of the leaky floors, ruled the traffic. Private cars were not permitted. People crouched around stoves in small shops open to the street. Fresh vegetables, meat and other essentials for daily life were for sale. There were a great many tiny eating houses where noodle and cereal dishes were offered for a few Renminbi ($1 = about 8.2 RMB). Clothing was dark, and the "Mao look" was still occasionally to be seen. Hotel rooms were somewhat damp because of the leaky windows, and the television offered only local programming. Everything was gray on gray.

In comparison, consider the scene in late November 2003: by this time I had traveled to China and Changsha more than 25 times, and the permanent changes which had transpired were enormous.

After arrival in the new, multidimensional airport, one now moved smoothly along the just-opened superhighway, passing a Disneyland-style amusement park in a dynamically growing Changsha. All along the wide, well-surfaced asphalt highway appeared high-rise apartment buildings more than 30 stories tall. The hotel in which I had stayed during my first trip in 1995 looked like a shadow out of the past. The old Friendship department store was closed and would soon be torn down. Facing the hotel in which I had been staying each year for the past five years, an old part of the city had been demolished early in 2002. The huge sports stadium with attached shopping center, with other sports facilities, built since then provided a powerful backdrop. The little taxis of former times were gone; larger and newer models had replaced them. In addition to the mostly black state-owned and business-owned vehicles, cars which were clearly privately owned ruled the streets. (It should be noted that a car here costs about twice what it does in the west—owning one is a sign of substantial wealth.)

In the city's center was now a new "golden shopping street," with malls and department stores in solid rows displaying their goods to appeal to different consumer groups. There were snack bars with Chinese food, but there were also fast-food chain outlets including McDonalds and Kentucky Fried Chicken. It was Sunday, and ten thousand people or so were shoving their way through the streets and pedestrian zones. The young people, dressed neatly and colorfully, in some cases elegantly, were cheerful, and enjoyed snacking or conversing on cell phones. It was evident that making a cell phone call in China is now just as much a routine matter as making an Internet connection.

On the hotel TV set, in addition to receiving almost countless numbers of stations from isolated provinces, I could tune in to CNN, BBC and Deutsche Welle. Everything could be found in the stores, which of course were open on Sundays. Here consumerism and commerce rule. Whoever does not set up as a "businessman" (or at least act like one) will not be accepted as successful.

These observations can lead to the false conclusion that in this dynamically growing and changing China, everything develops in an uncomplicated way. Certainly the new, architecturally interesting buildings radiate luster from afar, but upon closer examination, many errors in planning and deficiencies in execution prove impossible to ignore. Their burgeoning society is still on a learning curve with some ways yet to go. The wet climate leaves its traces behind in no time. Building facades deteriorate, panels and tiles are damaged, and mediocre materials cannot stand up under the strain. Because of poor upkeep during the past ten years the quality of my old hotel has fallen off so sharply that it no longer meets the requirements of guests from the west. If a wandering visitor strays away from the showcase streets he enters a quarter characterized by gray buildings, antediluvian electrical power facilities, and tiny old houses. Here the rains will bring mud, and I feel myself transported back in time to the early 1990's, when I made my first visits to China. But it is only a matter of time before improved central planning comes here, too, with its bulldozers, and creates new and more colorful and more architecturally pretentious living spaces.

However, the development of the big cities should not disguise the fact that by far the greater part of the Chinese people are employed in agriculture, and these people do not partake in progress to any comparable extent. To journey to the mines in distant regions is to see clearly the simpler country life of living on the land, as it has been carried on for centuries.

Figure 9. **Packing a fragile stibnite specimen for shipment to a Western buyer. Ottens photo.**

CONCLUSION

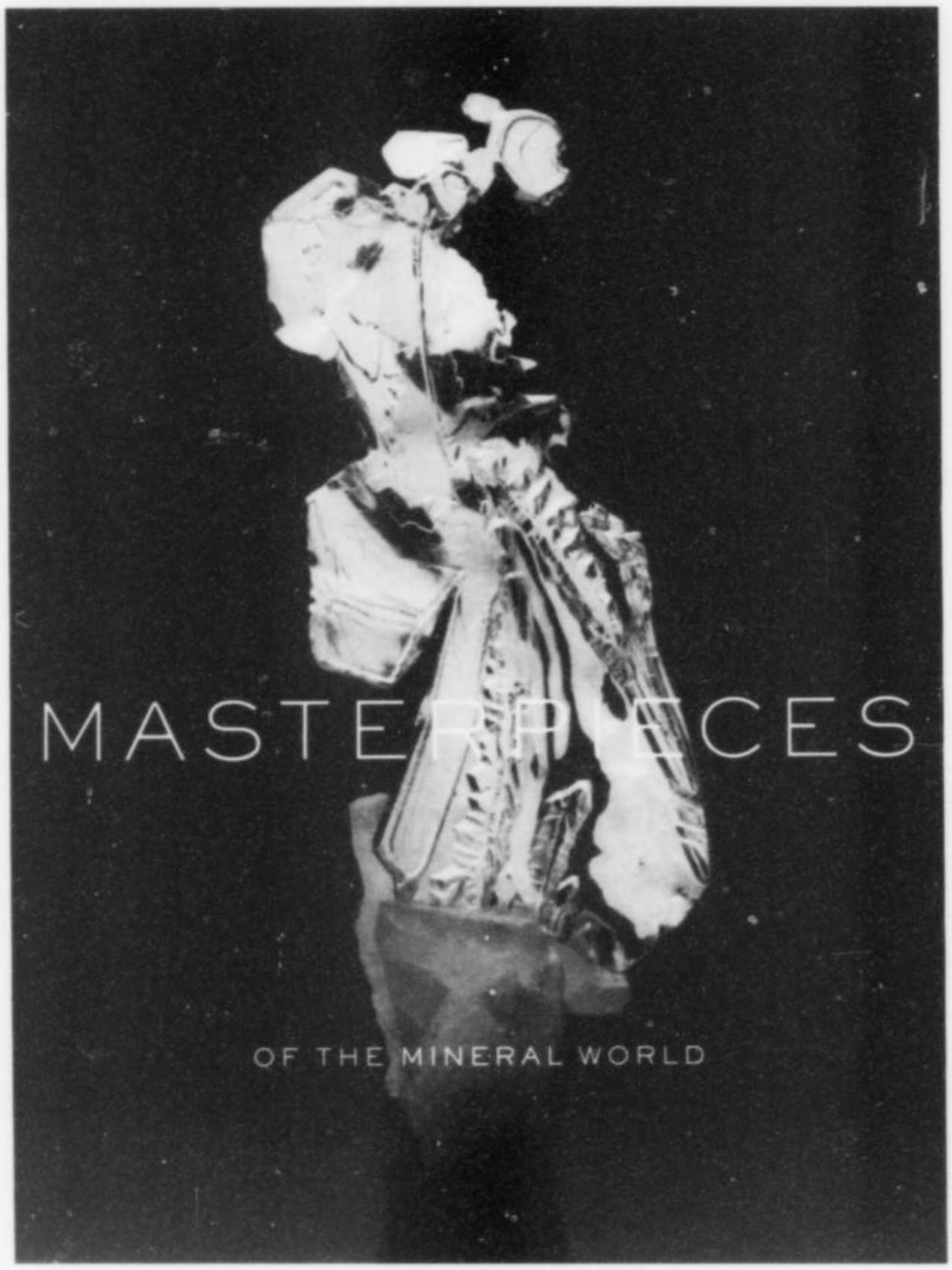
As recently as 20 years ago, Chinese minerals were simply not to be seen on Western markets (except for a few old "classic" cinnabar specimens). The situation has so radically changed since then that today China and its minerals can be the theme of the great mineral shows at Munich and Tucson, and the unprecedented outpouring of Chinese mineral specimens is sufficient to justify this first special China Issue of the *Mineralogical Record*. For these developments we have to thank the thousands of highly industrious miners, middlemen and world-traveling mineral dealers of China. These merchant-adventurer-capitalists, despite their socialist upbringing, have learned the business quickly. And they have educated miners about careful specimen recovery to minimize damage (a lesson still to be learned in other mining areas of the Third World). In general they have done a commendable job of making available to collectors everywhere the enormous specimen wealth of the Middle Kingdom.

Masterpieces of the Mineral World

A new book published by the Houston Museum of Natural Science, featuring the treasures of the mineral collection. Distributed by the Mineralogical Record.

Written by **Wendell E. Wilson**, editor-in-chief and publisher of ***The Mineralogical Record***, and **Joel A. Bartsch**, president of the Houston Museum of Natural Science, with **Mark Mauthner**, associate curator of gems and minerals.

Photography by
Jeffrey A. Scovil
and
Harold & Erica Van Pelt



The magnificent mineral collection housed in the Houston Museum of Natural Science is among the finest and best known in the world. Now the treasures of this unique repository are shown in beautiful full-page photographs that will seduce both the connoisseur of beauty and the student of natural history. The spectacular and rare specimens on display here, from a huge imperial topaz weighing more than 2,000 carats to a 6.8-cm phosphophyllite crystal and crystallized gold clusters that are among the most highly coveted objects in the Mineral Kingdom, are true masterpieces, like the Rembrandts and Van Goghs of the natural world. Prized for their rare aesthetic qualities—their highly developed luster, color, size, and sculptural composition—as well as their often exotic provenances, these specimens have come to the museum from elite private collections such as that of Perkins and Ann Sams, and a remarkable, enormously valuable (anonymous) private collection just recently acquired. The majority of the specimens pictured have not been previously published, and many of the others have been rephotographed. All are accompanied by much more background information than was provided in the 1992 Houston Museum Supplement to the *Mineralogical Record.*

An introduction to the museum, its history and its collection is followed by an analysis of connoisseurship ("The Discerning Eye—What makes a mineral collectible?"). The history of aristocratic mineral collecting, from the 16th to the 20th centuries, is recounted ("A Royal Passion"). Eighty full-page color plates show the breathtaking highlights of the museum's collection, with each specimen described in full, its aesthetic qualifications analyzed, and its locality of origin described, often with interesting historical sidelights. Finally, a Selected Bibliography points the reader toward additional reading.

This book will be read with equal interest by seasoned long-time collectors and those new to the hobby. Produced in association with Harry N. Abrams, publisher of the widely known and respected Abrams art books, the paper, binding and production quality of *Masterpieces of the Mineral World* meet the same high standards. Size 9.5 x 13 inches, hardcover, 264 pages.

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Daoping Mine
Guangxi, China

Guanghua Liu
Französische Allee 24
D-72072 Tübingen
Germany

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau
Germany

Discoveries of bright green pyromorphite in China beginning in 1999 aroused great interest in the worldwide collector community. These discoveries produced not just a few, but great numbers of wonderful specimens! The color of the pyromorphite ranges from pale yellow-green through yellow-orange, bright medium-green and dark green. The largest crystals are several centimeters long, which is extraordinary for the species.

INTRODUCTION

At first, Chinese dealers, as is their custom, kept the true locality for the new pyromorphite specimens shrouded in secrecy. Somewhere near Guilin in the autonomous region of Guangxi, it was said, was an abandoned mine in which this extraordinary find had been made. Collectors around the world became wildly enthusiastic and paid very high prices for the first specimens to come out, even though just two years previously a large find of comparable pyromorphite from the San Andrés mine in Villaviciosa, Corboda, Spain had come onto the market, and even though first-class pyromorphite specimens from the Bunker Hill mine, Idaho and from the classic localities of Bad Ems, Germany and the Les Farges mine, France are found in many collections. The highly lustrous green crystals from the Chinese locality are truly superb, and the countless specimens offered, down to the smallest ones, sold very quickly.

LOCATION AND SETTING

By the time the first excitement had settled down and, possibly, most of the best crystal pockets had already been cleaned out, the correct locality finally became known. The well-known tourist city of Guilin lies in the autonomous region of Guangxi, not far from the southwestern border of the province of Hunan. There, the karst terrain and the River Li have built steep green hills of chalk, a landscape unique in China.

Southeast of Guilin, in a branch of the more than 2,000-meter-high Haiyang Mountain, is a lead-zinc orebody straddling two counties and being exploited by two active mines. The principal mine is the Daoping lead-zinc mine, employing about 300 people; it lies on the eastern side of the same ridge, about 30 kilometers from the city of Gongcheng, in Gongcheng County. The other, smaller workings are known as the Yangshuo lead-zinc mine, employing 100 people; it lies on the western side of the mountain ridge, northeast of Yangshuo, in the county of the same name. Both of these mines produce massive galena and sphalerite ore, and also pyromorphite specimens. In 2003 the workings of the two mines were connected underground. The pyromorphite occurrences, near the juncture of the two workings, are at an elevation of 1,200–1,600 meters.

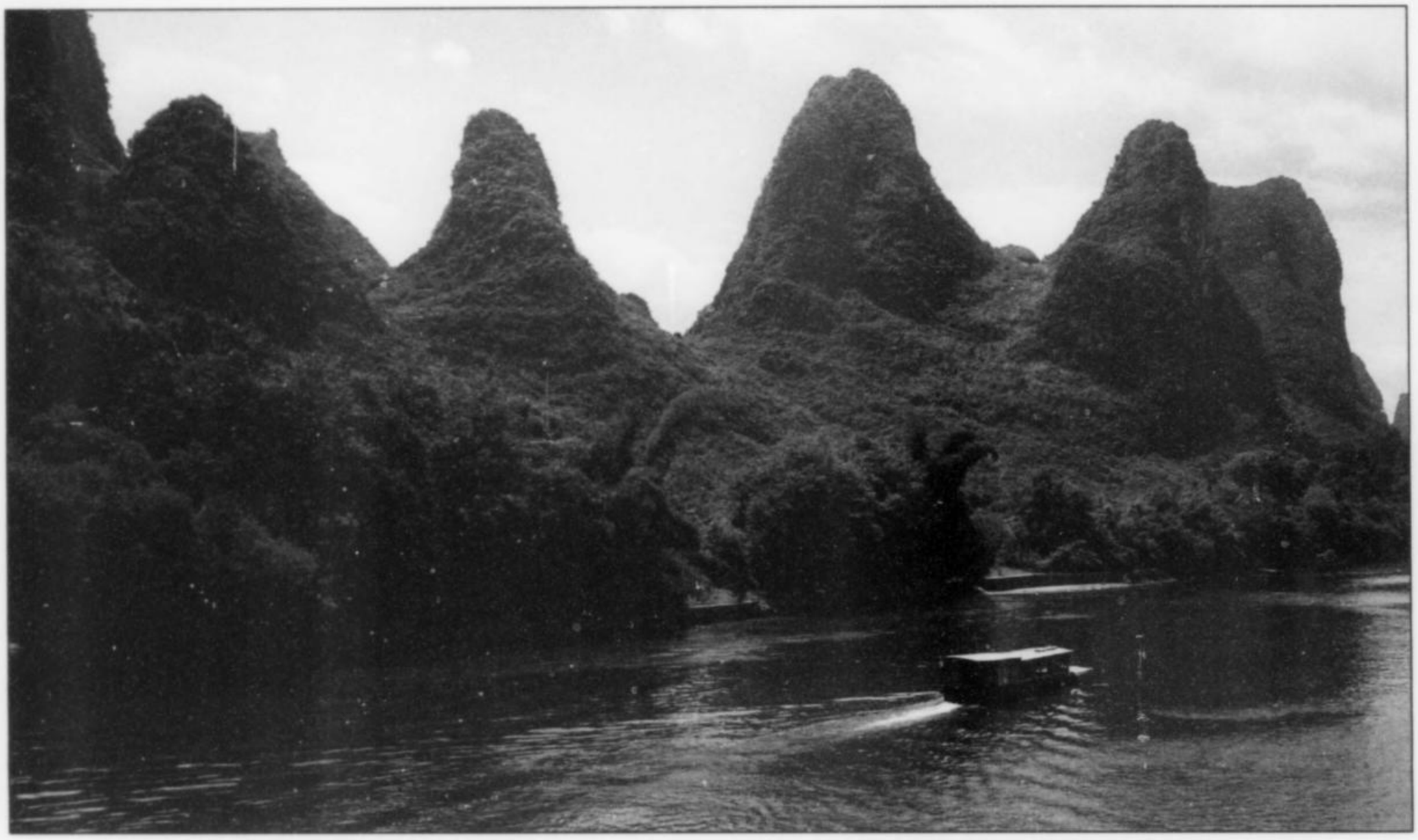


Figure 1. **The world famous Li River between Guilin and Yangshuo. Steep limestone hills form a picturesque contrast to the peacefully flowing river. Ottens photo.**

Figure 2. **Location of the Daoping and Yangshuo mines. Note the county line passing between the mines.**

Access to the Daoping mine is by Gongcheng, capital of Gongcheng County, which is reached by a good road from Yangshuo. Twenty kilometers past the city the asphalt road ends, and an eroded dirt road winds up between the steep cliffs of Haiyang Mountain, towards a reservoir. Rice and vegetable fields are seen in the valleys, but the vegetation along the route then changes. Bamboo plants, ferns and diverse bushes prevail on the slopes. On still higher levels, forests are being logged. After passing the end of the reservoir the road climbs steeply, and in the distance one can make out the settlement at the Daoping mine, at 1,200 meters elevation. A cross-country vehicle can cover the 50 kilometers between Gongcheng and the Daoping mining camp in somewhat less than three hours.

The Yangshuo portal is easily reached via a major highway from Guilin. On both sides of the highway, the picturesque forms of the conical chalk hills rise steeply. The ripening fields of rice in various hues of green and gold create a wondrous prospect in the light of the setting sun. Even more impressive is the journey from Guilin to Yangshuo by boat along the world-famous River Li. Many Chinese poets have sung in their verses of the amazing views of karst landscapes, which are for us Westerners the quintessence of Chinese painting. When one has seen firsthand how the steep hills, jutting up from the plain, are reflected in the smooth, calm waters of the Li, one knows clearly that the famous paintings were not derived from a fantasy, but reproduce realistically a paradise of Nature (this was Henry Kissinger's observation after a visit to Guilin).

HISTORY

Mining of the Daoping lead-zinc orebody from both sides of the mountain ridge, i.e. from both the Yangshuo and the Gongcheng

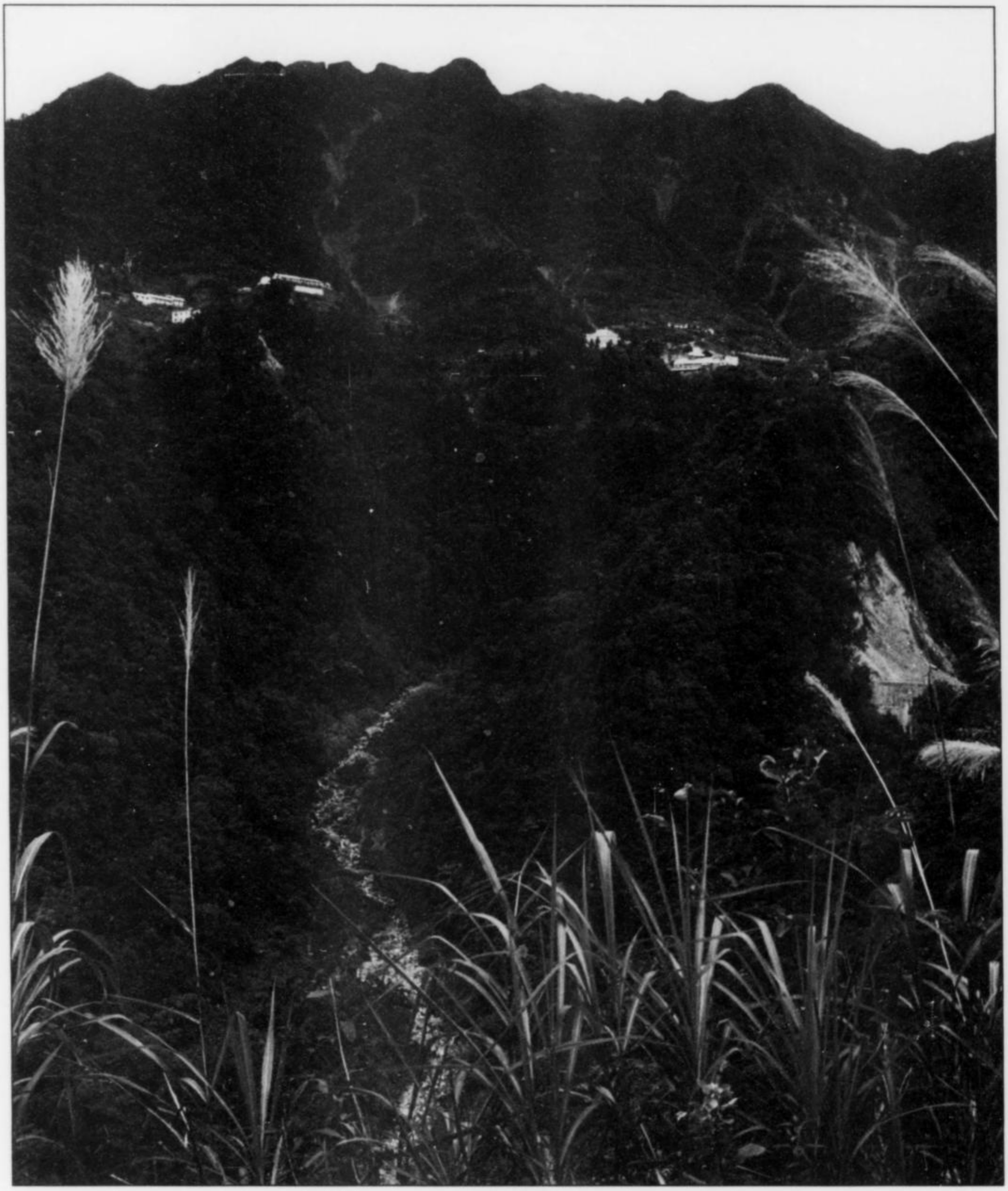


Figure 3. **The Daoping mine high on the mountainside of the Haiyang Mountains at an elevation of 1200 meters. Ottens photo.**

sides, began in 1958. The two mines have always been operated by the two county governments. Simple and traditional, manual labor-dominated mining techniques are used in the underground workings. From the Gongcheng side, as mentioned, the mine is called the Daoping lead-zinc mine, and from the Yangshuo side it has been called the Yangshuo lead-zinc mine. Most of the ore is smelted in local facilities.

A simple, rough road connects the Daoping mine to the city of Gongcheng, and from there the ore is transported to smelting works nearby. During the past 40 years, the Daoping mine has employed between 300 and 500 workers per year; presently there are slightly more than 300. Before 1989 the mine produced between 3000 and 4000 tonnes of lead and zinc annually; during the 1990's it produced between 6000 and 7000 tonnes. More than 100 drifts have been dug, of which about 70 are still productive. Most mine portal entrances are on the slope of the mountain, and hence are not accessible by car; miners have to walk or climb to them. Ore and waste rock are transported by mine trams from underground to the outside, and ore is transported to the main trucking road by cable car. Pyromorphite has only been found in a few of the drifts, and before 2000 it was dealt with as ore. Specimens for collectors have only been saved since early 2000.

The Yangshuo mine, located about 25 km east of Yangshuo city, is smaller than the Daoping mine: it employs about 100 permanent

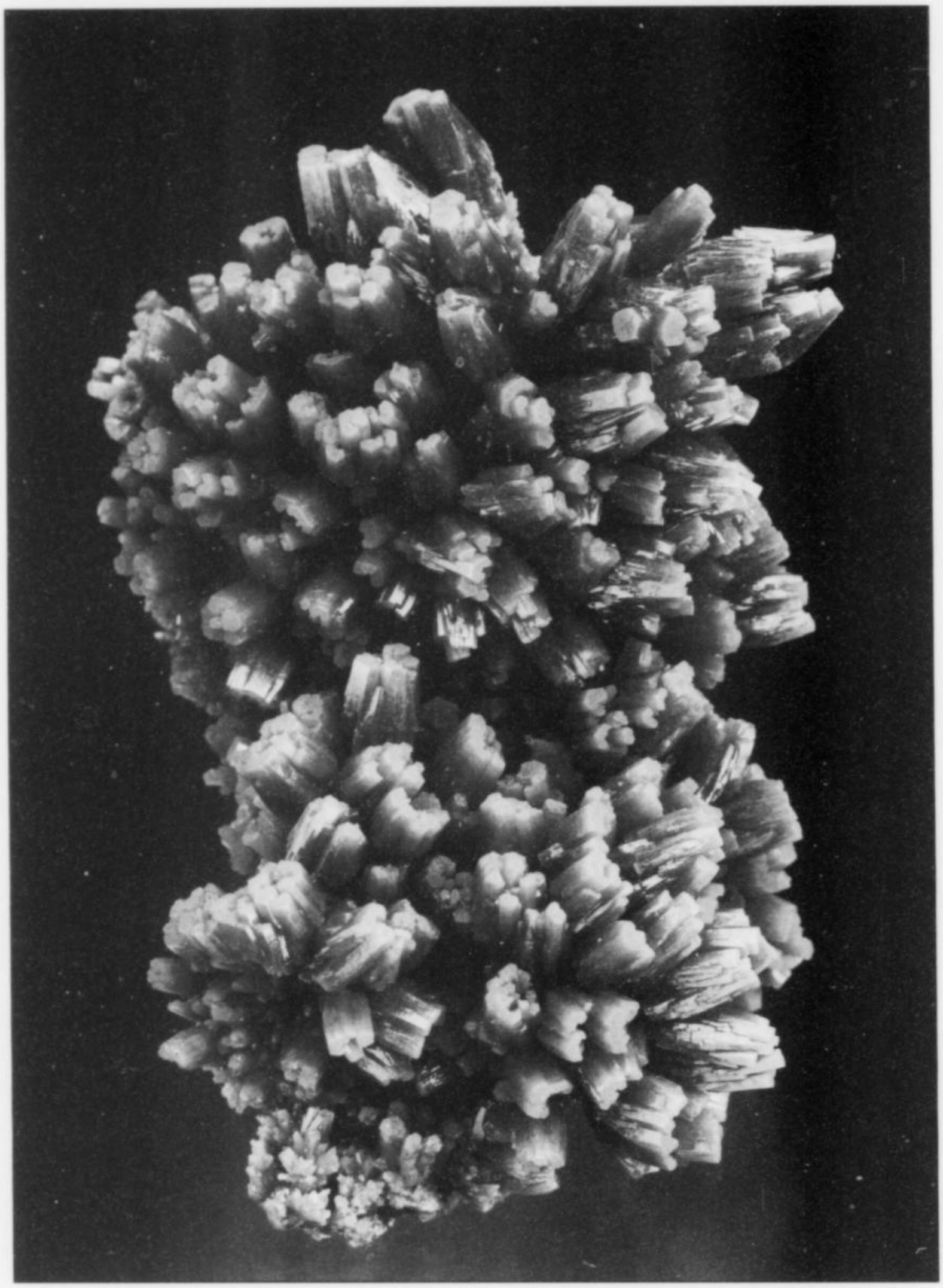


Figure 4. **Pyromorphite cluster, 9.6 cm, from Daoping. Sandor Fuss collection; Jeff Scovil photo.**

workers and some temporary ones. In recent years, the mine's lead-zinc production has ranged between 4000 and 5000 tonnes. 60 drifts have been dug since 1958, and 30 of these are still producing ore.

GEOLOGICAL OVERVIEW

All significant Chinese pyromorphite specimens which appeared on the international mineral market in 2000 and 2001 were recovered from the Daoping oxidized orebody. Haiyang Shan Mountain, in which the deposit is located, generally strikes north-northeast to south-southwest, but the ridge branching from it in the vicinity of the orebody strikes north-south.

The lead-zinc deposit is hydrothermal in origin; it is developed within fracture zones related to a regional extension fault which strikes north-northwest. The host rocks are predominantly Devonian limestone, sandstone and shale, locally intruded by granitic rocks and some lamprophyre dikes. The orebody crops out on the upper part of the mountain, between cliffs 600 meters high at elevations between 1,200 and 1,800 meters (the elevation of the mountain's peak is just under 2000 meters). Pyromorphite pockets in the oxidized zone are mainly found at elevations greater than 1190 meters.

COLLECTING HISTORY

Although pyromorphite had occasionally been encountered earlier in the course of mining, no specimens were collected until June 1999. Early in that year, one of us (GL) was shown a few low-quality specimens by a dealer in Changsha, and, thinking that this could be a promising new discovery, asked the dealer to look for more. After some time, the dealer procured more specimens from another dealer in Guilin. As the locality was being kept secret, no one at the time knew that the specimens came from the Yangshuo mine.

In June and July, 1999, several pockets of yellow and yellow-green pyromorphite were mined on the #1370 and #1335 drifts (the numbers refer to the elevations) in the Yangshuo workings. When

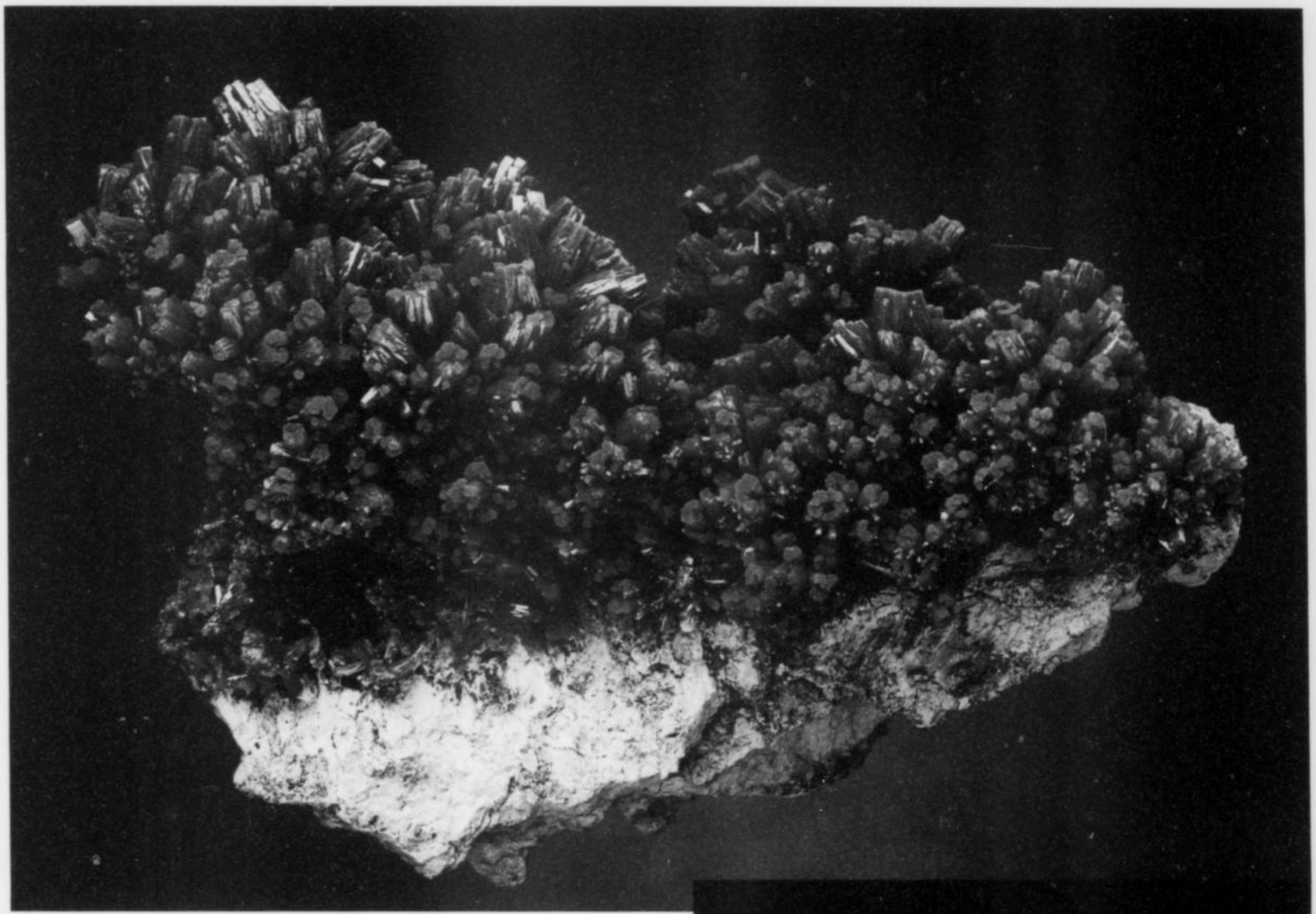


Figure 5. **Pyromorphite cluster, 13.8 cm, from Daoping. Fine Minerals International specimen; Jeff Scovil photo.**

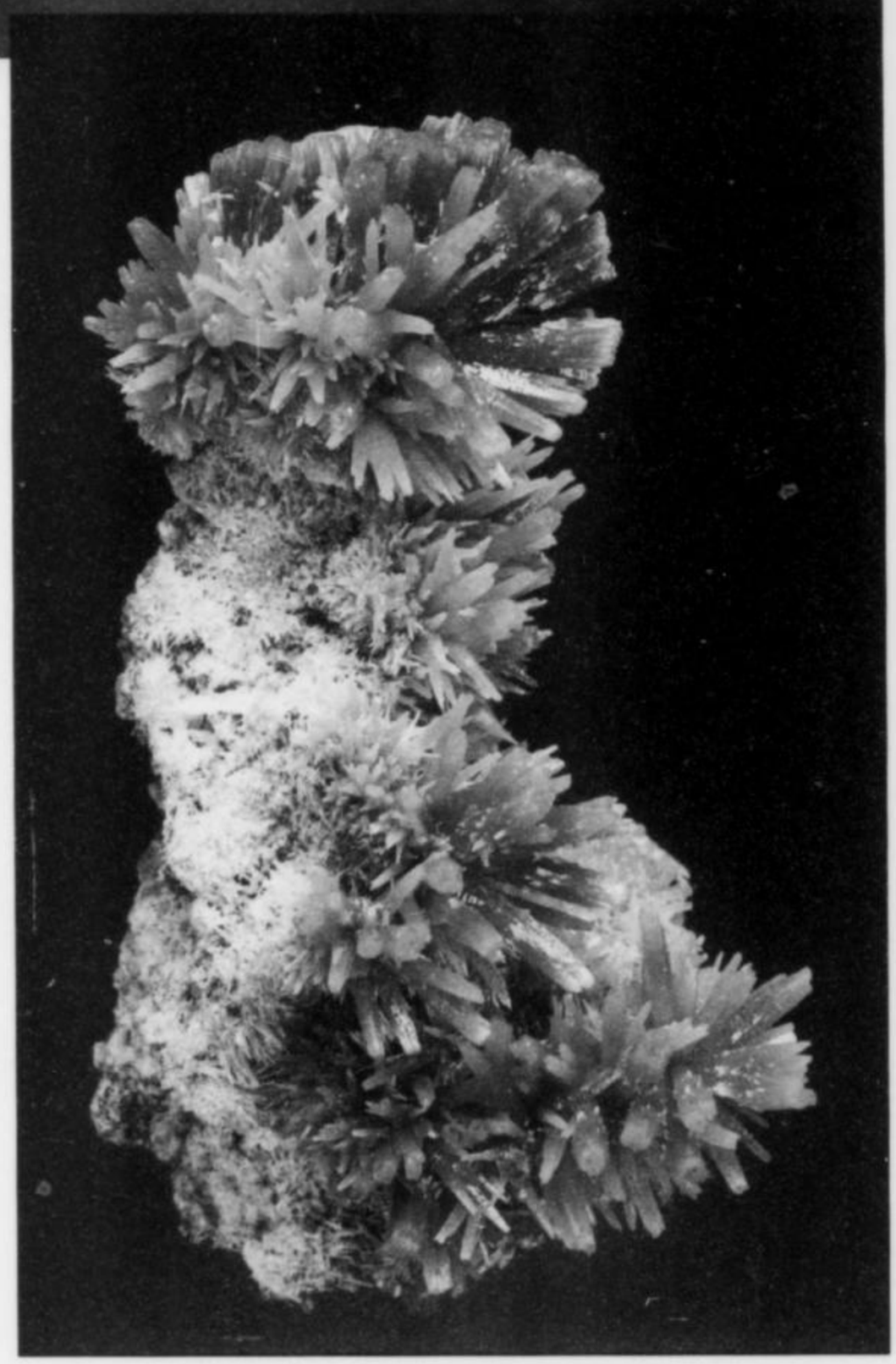


Figure 6. **Pyromorphite cluster, 3.7 cm, from Daoping. Collector's Edge specimen; Jeff Scovil photo.**

these specimens had been successfully sold, the miners began to look in the Daoping mine for more pyromorphite. In late January and February, 2000, specimens of pyromorphite were found in three drifts of the Daoping mine; these drifts were designated by code numbers #2398, #3250 and #3199. The first digit of each designation refers to the mining area and the last three digits signify elevations; thus the drifts are at 1398, 1250 and 1199 meters above sea level, respectively. In February 2000 the administration of the Daoping mine signed contracts with several miners, including Mr. Zhou and Mr. Jiang, permitting them to dig for specimen-quality pyromorphite.

A great amount of yellow pyromorphite—more than 10,000 specimens—was recovered at the Daoping mine between February and April, 2000, in drift #3119. Single crystals on these specimens reach 7 mm in diameter, and overall specimen sizes range from less than 2 cm to about 30 x 30 cm. Pyromorphite-bearing pockets varied in size from 20 x 30 cm to 1 x 1 x 2 meters. Only a few small pockets with acicular green and yellow pyromorphite crystals were found in drift #3119 after February, and no significant specimens came from this drift after late June of 2000.

The best and most widely varying pyromorphite specimens came from drift #3250 in the Daoping mine. On June 17, 2000, a large pocket containing dark green crystals to 1 cm diameter was

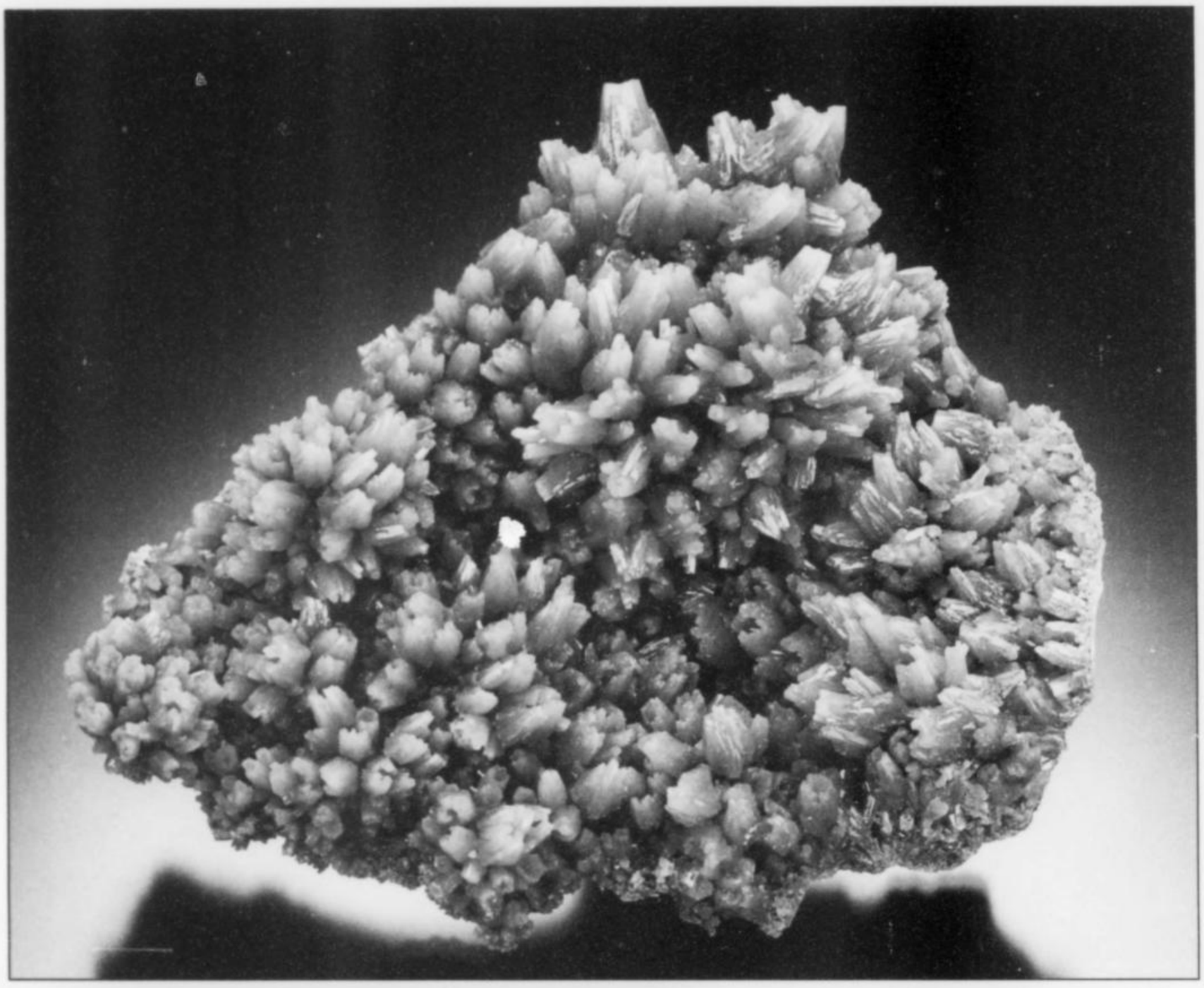


Figure 7. **Pyromorphite cluster, 9.4 cm, from Daoping. George Stacey collection; Jeff Scovil photo.**

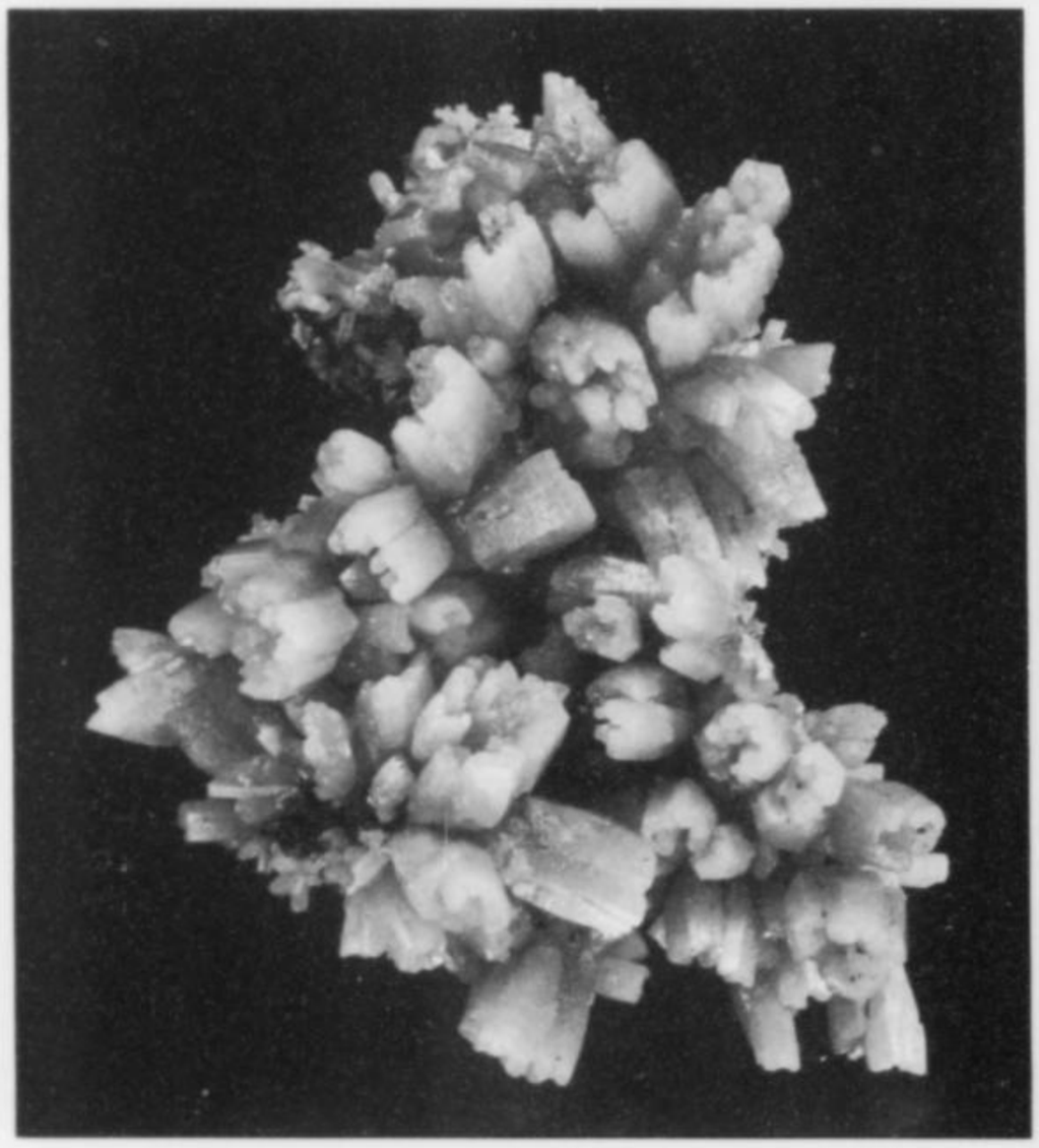


Figure 8. **Pyromorphite cluster, 6 cm, from Daoping. Francis Benjamin collection; Jeff Scovil photo.**

Figure 9. **Pyromorphite cluster, 4.5 cm, from Daoping. Collector's Edge specimen; Jeff Scovil photo.**

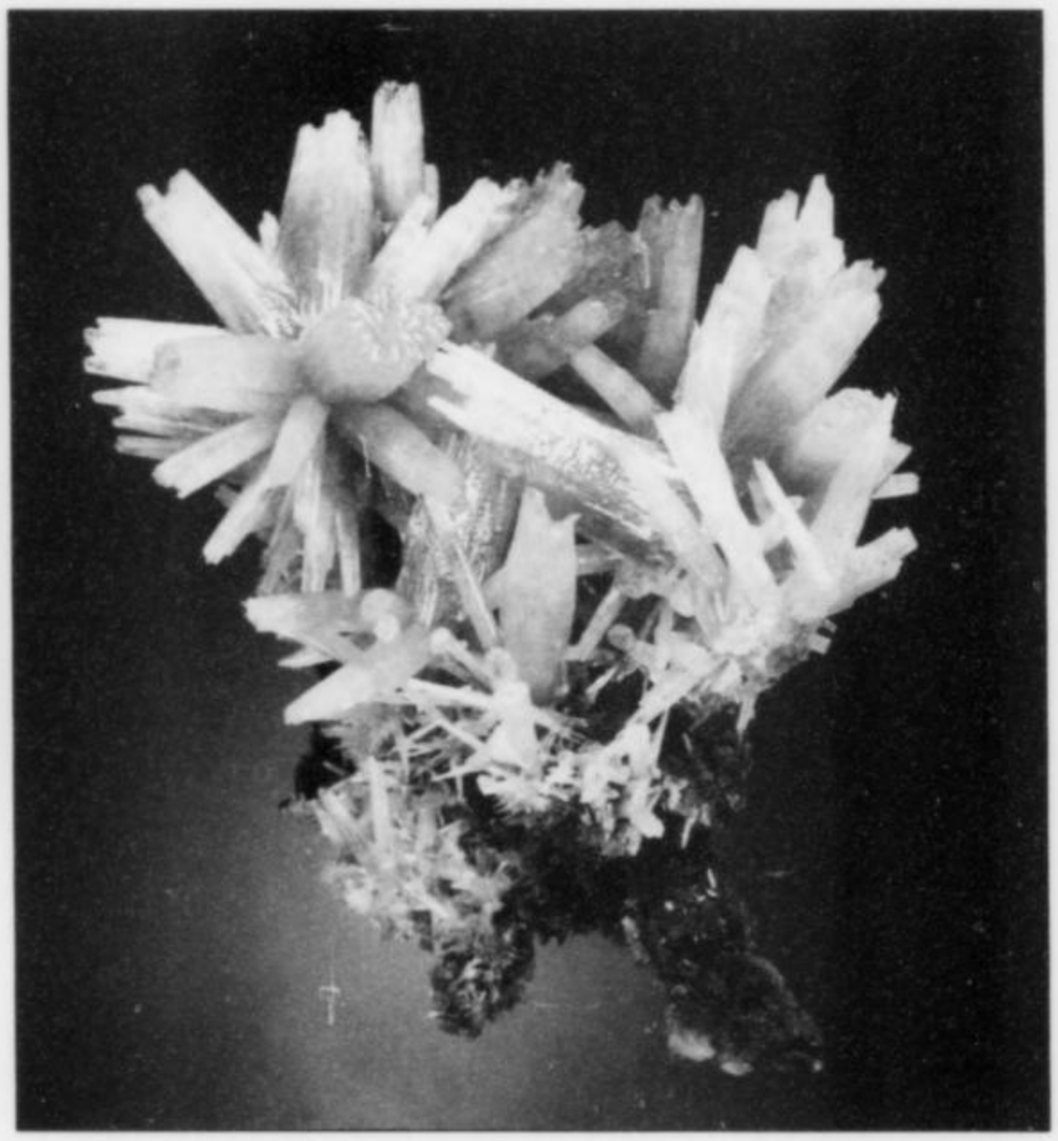


Figure 10. **Pyromorphite cluster, 6.8 cm, from Daoping. Fine Minerals International specimen; Jeff Scovil photo.**

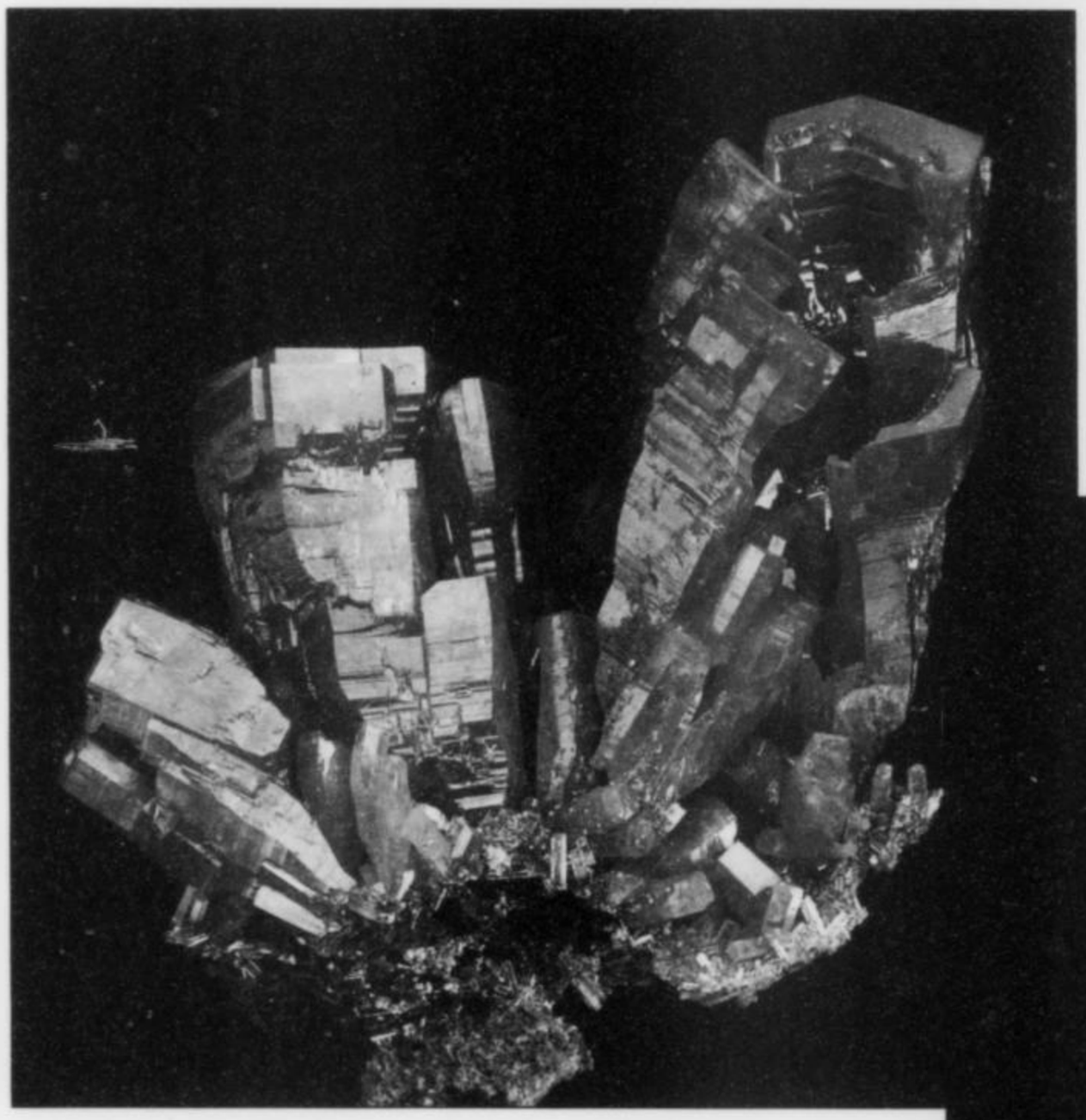


Figure 11. **Pyromorphite cluster, 4.8 cm, from Daoping. Fine Minerals International specimen; Jeff Scovil photo.**

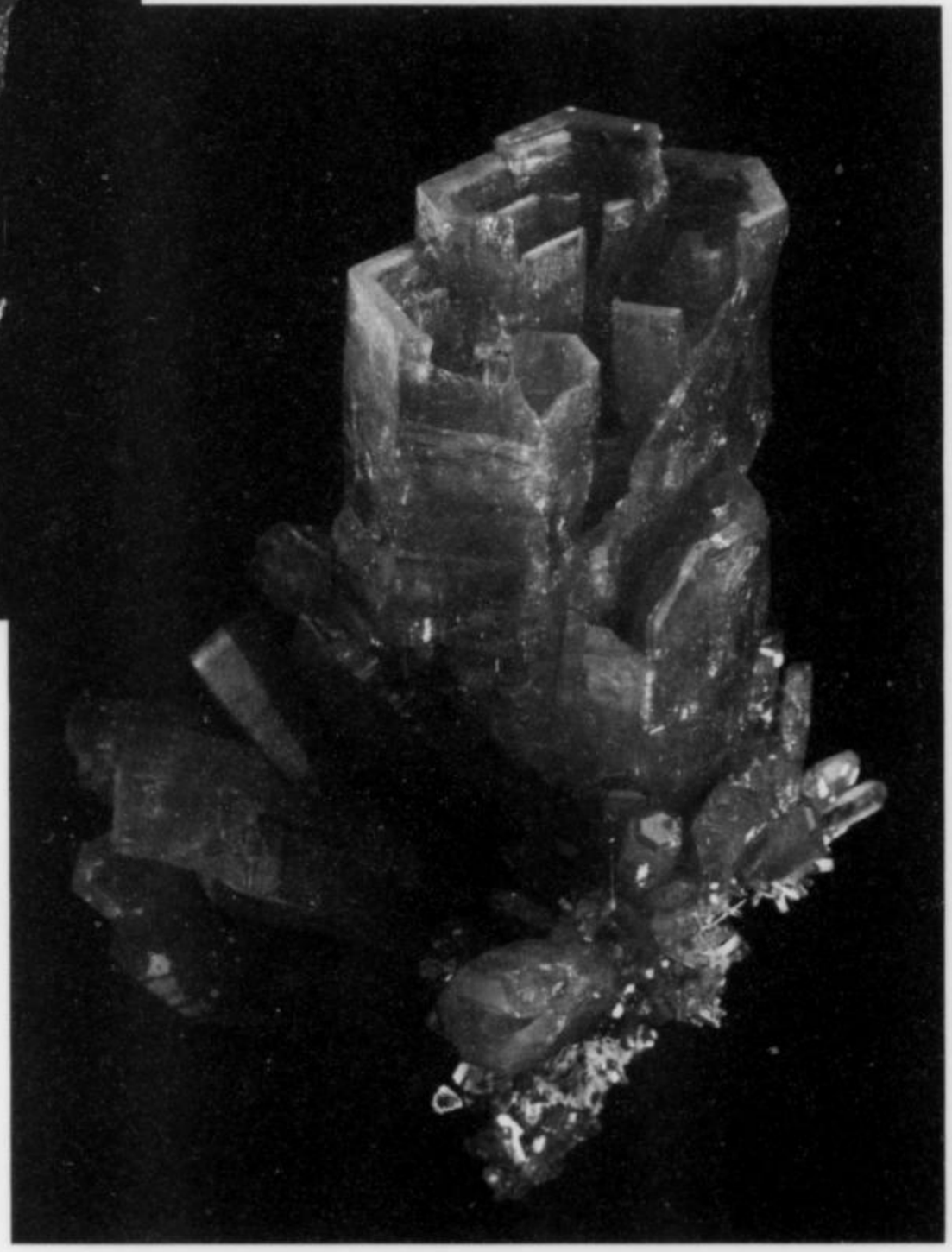


Figure 12. **Pyromorphite cluster, 3.7 cm, from Daoping. Fine Minerals International specimen; Jeff Scovil photo.**

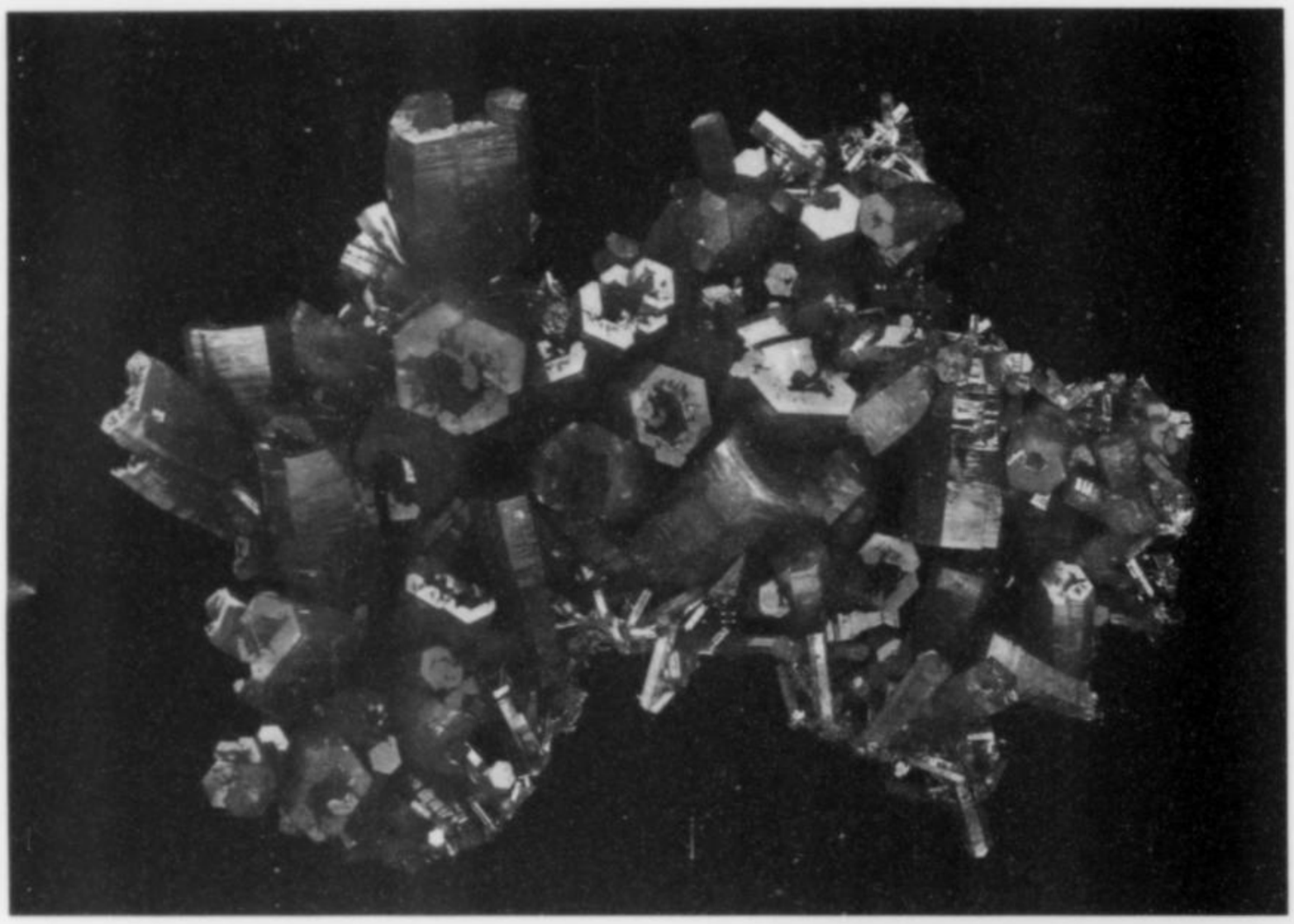


Figure 13. **Pyromorphite cluster, 6.2 cm, from Daoping. Fine Minerals International specimen; Jeff Scovil photo.**

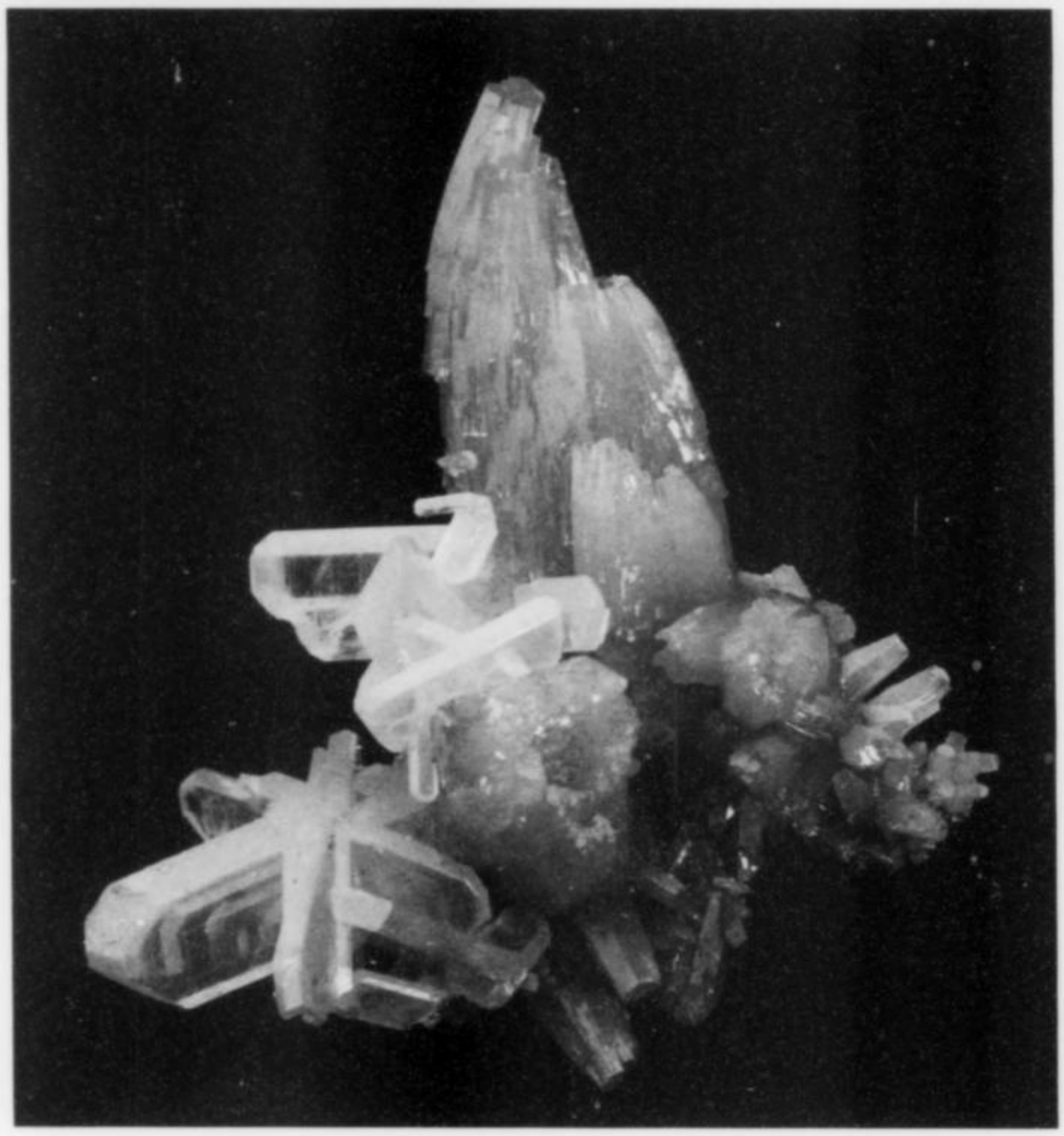


Figure 14. **Pyromorphite cluster with attached cerussite crystals and twins, 2.7 cm, from Daoping. Gilles Emringer collection; Jeff Scovil photo.**

found in that drift, and between June 18 and June 21 a series of smaller pockets along a fracture zone yielded crystals of various habits and colors. Individual pyromorphite crystals range from 1 mm to 1 cm in diameter and from a few mm to nearly 3 cm long. Overall specimen sizes range from a few centimeters to 30 x 40 cm. Most of the finest and most expensive specimens seen on the international market came from this pocket zone, which has produced no pyromorphite since. According to Mr. Zhou, the contractor, the discovery produced about 70 boxes of specimens in all: several thousand pieces weighing roughly 1100 kilograms altogether.

Pyromorphite from drift #2398 also displays a variety of colors and habits. Production of specimens here began in March 2000, and in April Mr. Jiang signed a contract to dig for pyromorphite in this tunnel. Because the crystal-bearing fractures are fairly narrow (reaching only 5 cm wide) in most places, the crystals and crystal groups are quite small; individual crystals do not exceed 5 mm in diameter and 1.5 cm long, and are most commonly dark green. Drift #2398 follows the strike of the fracture zone, and small pockets are regularly found. The drift's total production of specimens to November, 2000, is between 400 and 500 kg.

A considerable amount of low-quality yellow pyromorphite was

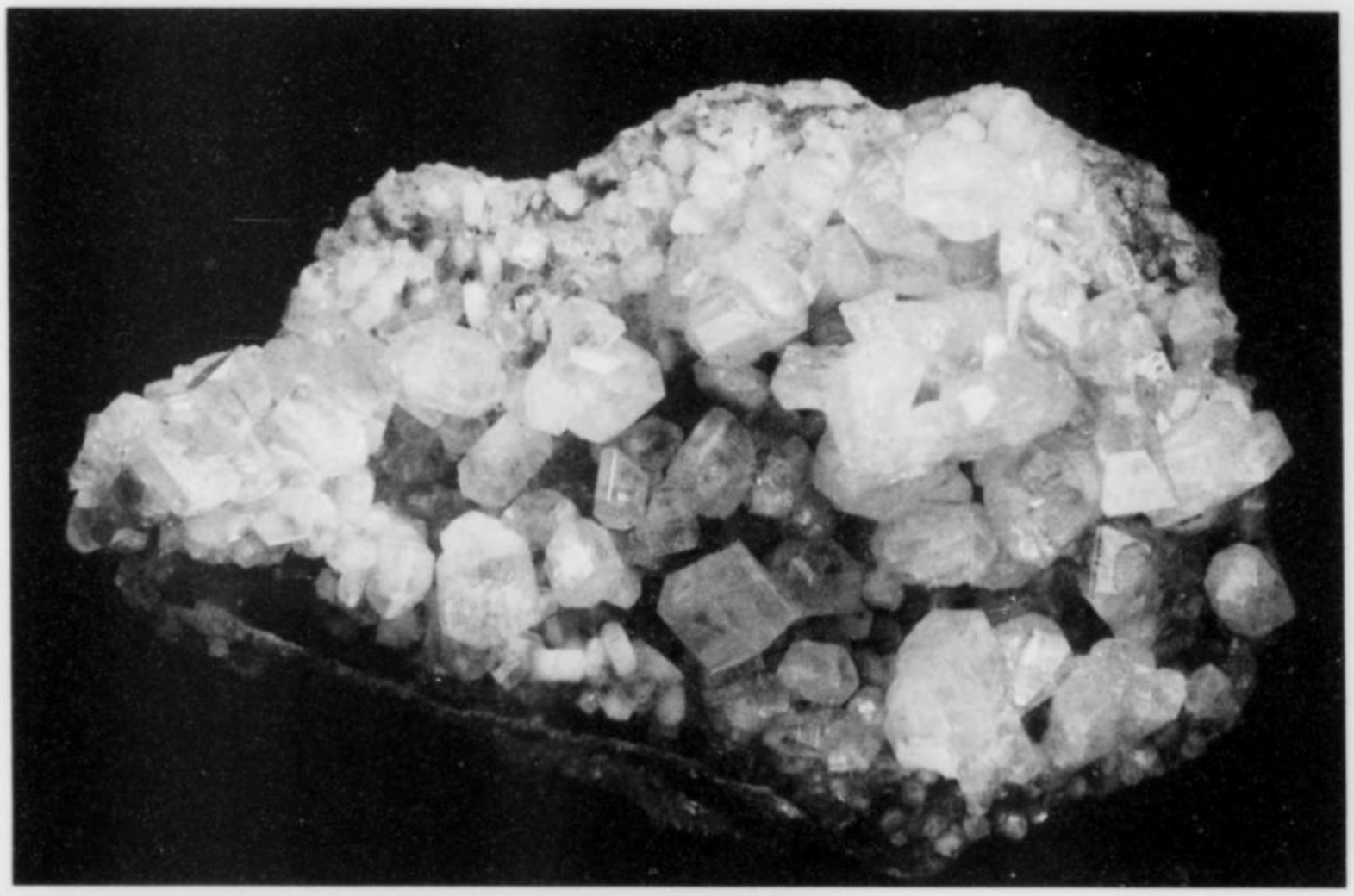


Figure 15. **Cerussite crystals on rock, 7.2 cm, from Daoping. Collector's Edge specimen; Jeff Scovil photo.**

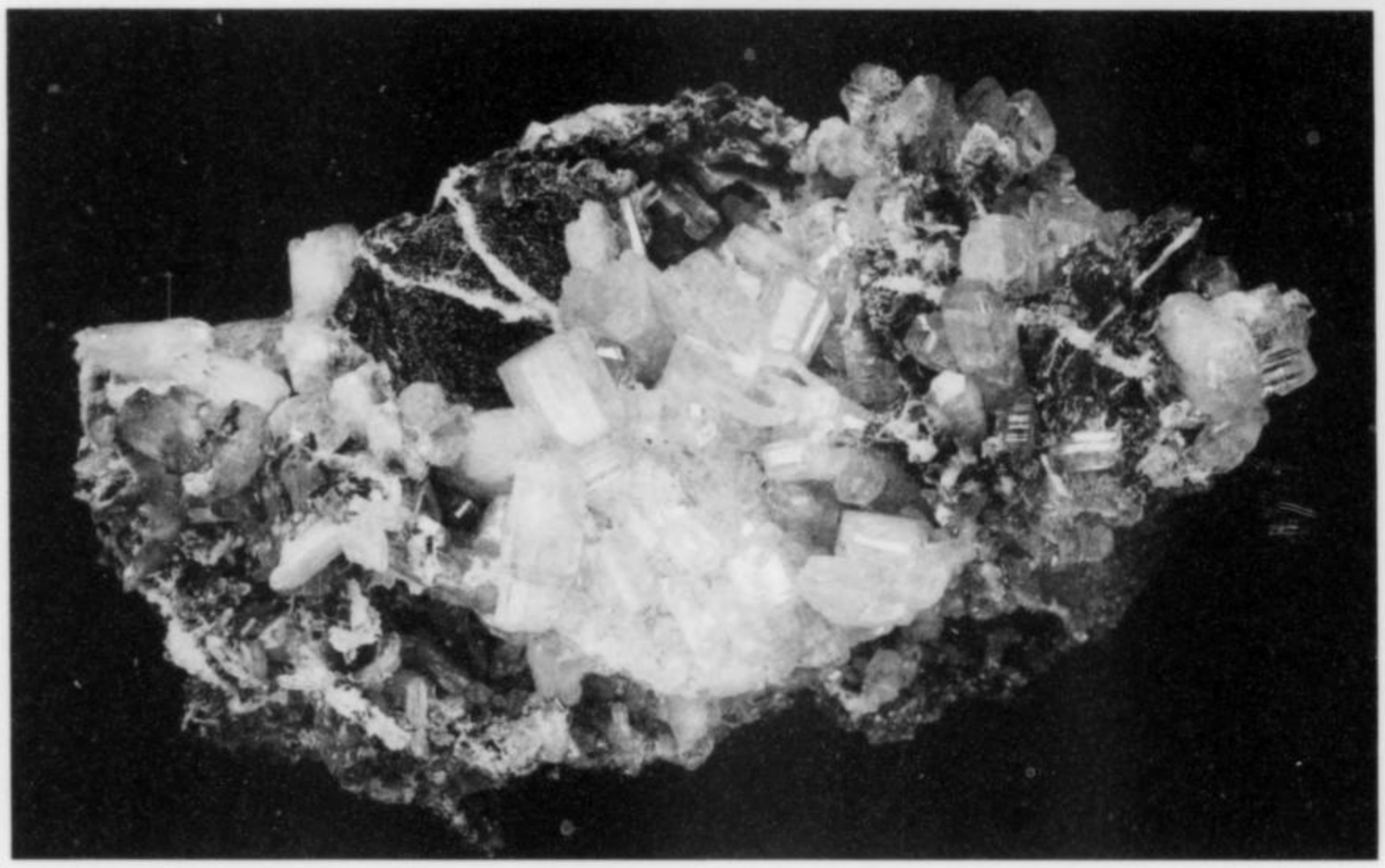


Figure 16. **Cerussite crystals on rock, 7.9 cm, from Daoping. Jordi Fabre specimen; Jeff Scovil photo.**

found in drifts #1370 and #1335 of the Yangshuo mine between June 1999 and April 2000, including crystals up to 2.5 x 4 cm found in April. The pocket containing these crystals was about 60 x 70 cm; it yielded four huge specimens (all around 20 x 20 x 20 cm) and many small ones. No further pockets with good-quality pyromorphite were found in these drifts after May 2000.

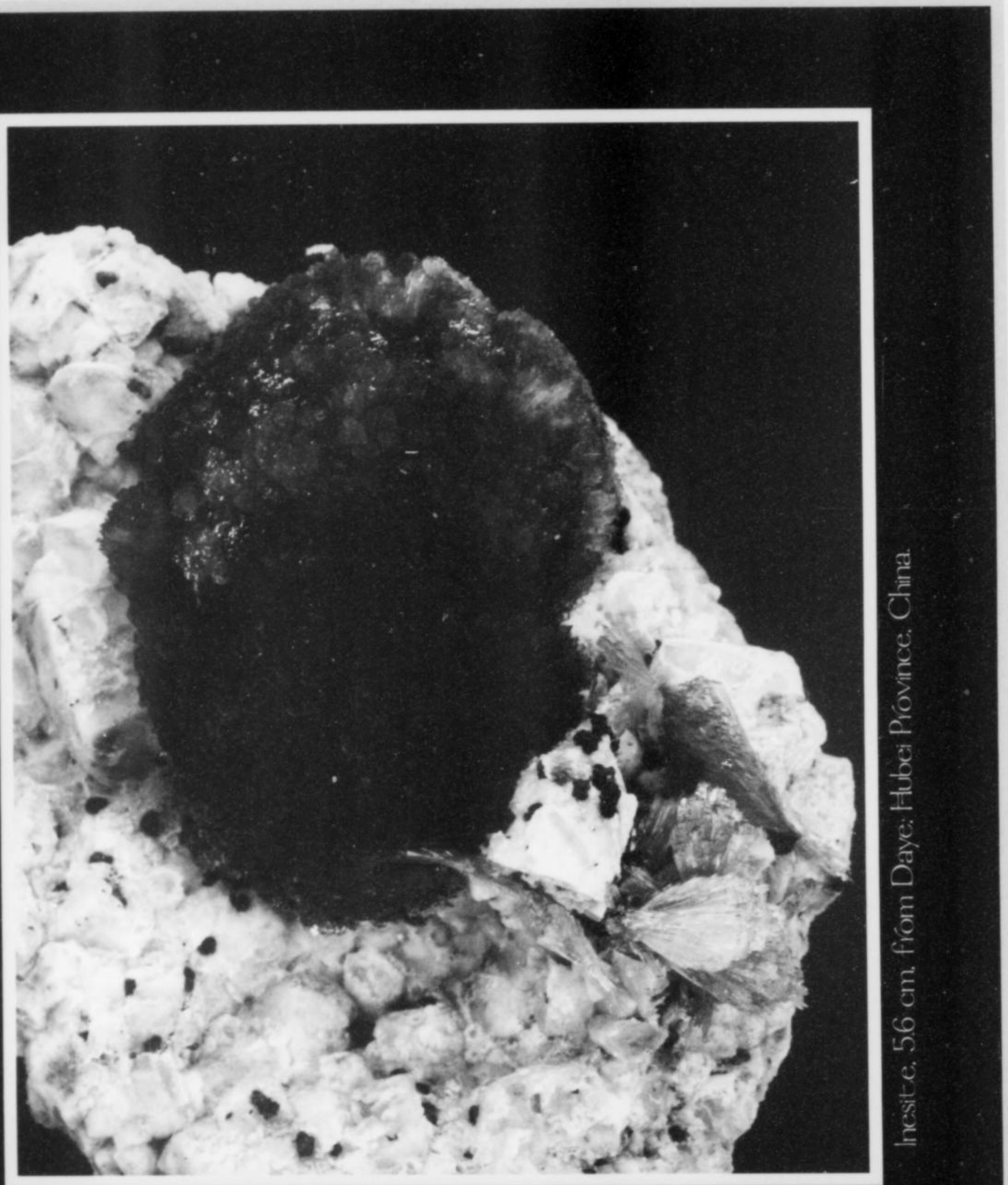
Cerussite was also found in the Yangshuo and Daoping mines, mostly as yellow crystals only a few mm long. A few specimens excellently displaying twinned forms reach 5 cm, but these are brown and were heavily damaged during collecting. Commonly the cerussite crystals have thin coatings of malachite.

LABELING RECOMMENDATIONS

It would be ideal, theoretically, to be able to confidently label all specimens either "Daoping mine, Gongcheng County, Guangxi, China" or "Yangshuo mine, Yangshuo County, Guangxi, China." In practice, however, only those specimens definitely known to have been mined in 1999 can be unambiguously assigned to the Yangshuo mine. Dealers close to the source have thus far never bothered to make a distinction between the two mines, and all specimens recovered are routinely assigned to the Daoping mine. Particularly inasmuch as the best specimens have come from the Daoping mine, that will probably remain the default locality designation. Collectors wishing to circumvent this problem might use the designation "Daoping-Yangshuo orebody" instead of choosing a mine name, and avoid giving the county.

CONCLUSION

The Daoping and Yangshuo mines continue to operate and, as long as they do, there is a good chance that more pyromorphite pockets will be encountered. The two mine managements are enlightened about specimen values and will no doubt continue to support their preservation from the crusher and their subsequent distribution in the Western specimen market.



Inside, 56 cm, from Daye, Hubei Province, China

Sandor P. Fuss

Collector

SandorFuss@aol.com

福建 通贝

TONGBEI

Spessartine Localities, Fujian Province, China

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau
Germany

Specimens in which beautiful, commonly gemmy, red-orange spessartine crystals form coatings on orthoclase and smoky quartz crystals have become quite familiar on the market during the past few years. These specimens are collected from granite outcrops in Fujian Province, near two villages where a healthy trade in mineral specimens is now flourishing.

INTRODUCTION

In 1998, Chinese dealers offered the mineral market's first specimens of beautiful red Chinese garnet crystals associated with smoky quartz and feldspar. The locality repeatedly cited was the city of Lechang in the north of Guangdong Province, close to the border with Hunan. However, even after intensive questioning, the dealers who had the material gave no further information regarding the kind of occurrence, or its precise location. This vagueness was hardly believable in view of the fact that the city of Lechang lies only about 150 km south of the regional capital city of Chenzhou, and in the neighborhood of that city lie the mines of Yaogangxian and Xianghualing, both very important in the mineral trade, and both routine destinations of the dealers.

In the following years, increasing numbers of these very distinctive specimens appeared on the market, and at the end of 2001, for the first time, a few dealers gave the province of Fujian as the true locality, and Yunxiao as the nearest large city. By this time several Chinese dealers had been to the locality themselves, and it could no longer remain secret. In the meantime, many thousands of garnet/quartz specimens, large and small, had been sold all over the world.

THE LOCALITY: SETTING AND HISTORY

On the occasion of a trip to Hunan Province, I made a personal visit to this locality in Fujian Province, as a side-trip. With a personable Chinese dealer as traveling companion, I took a 75-minute flight from Changsha to Xiamen, a large city on the coast of the South China Sea and about 300 km south of Fuzhou, capital of Fujian Province. Low-hanging clouds and a light rain permitted only a limited view of a seemingly modern city with impressive architecture. Large shopping centers suggesting Metro or Wal-mart were recognizable from a distance, as were a few occurrences of the golden arches of McDonald's.

By taxi and bus we traveled past Zhangzhou, not far from the coast, southwesterly on a large road under extensive construction, to the city of Yunxiao (population 80,000). Along the road we observed countless factories and smaller workshops where granite was being processed for a variety of uses. This region is known for the manufacture and export of granite products such as paving stones, gravestones and very expensive flagstones.

The prefecture of Zhangzhou, home to 3.9 million people, has a subtropical climate with an average yearly temperature of 70° Fahrenheit. It is famous for its wide variety of fruits, especially Tianbao bananas and mandarin oranges, as well as flowering narcissus plants. The city of Yunxiao, in the county of the same name, lies on the Zhangjiang River near the coast of the South China Sea. The Weihui Temple still bears witness to the city's long history.

On the next morning the rain had stopped, but the clouds still hung low over the land and afforded only a limited view of coastal hills to the northwest. With a local guide we passed through a narrow valley with many banana and orange trees. As the valley

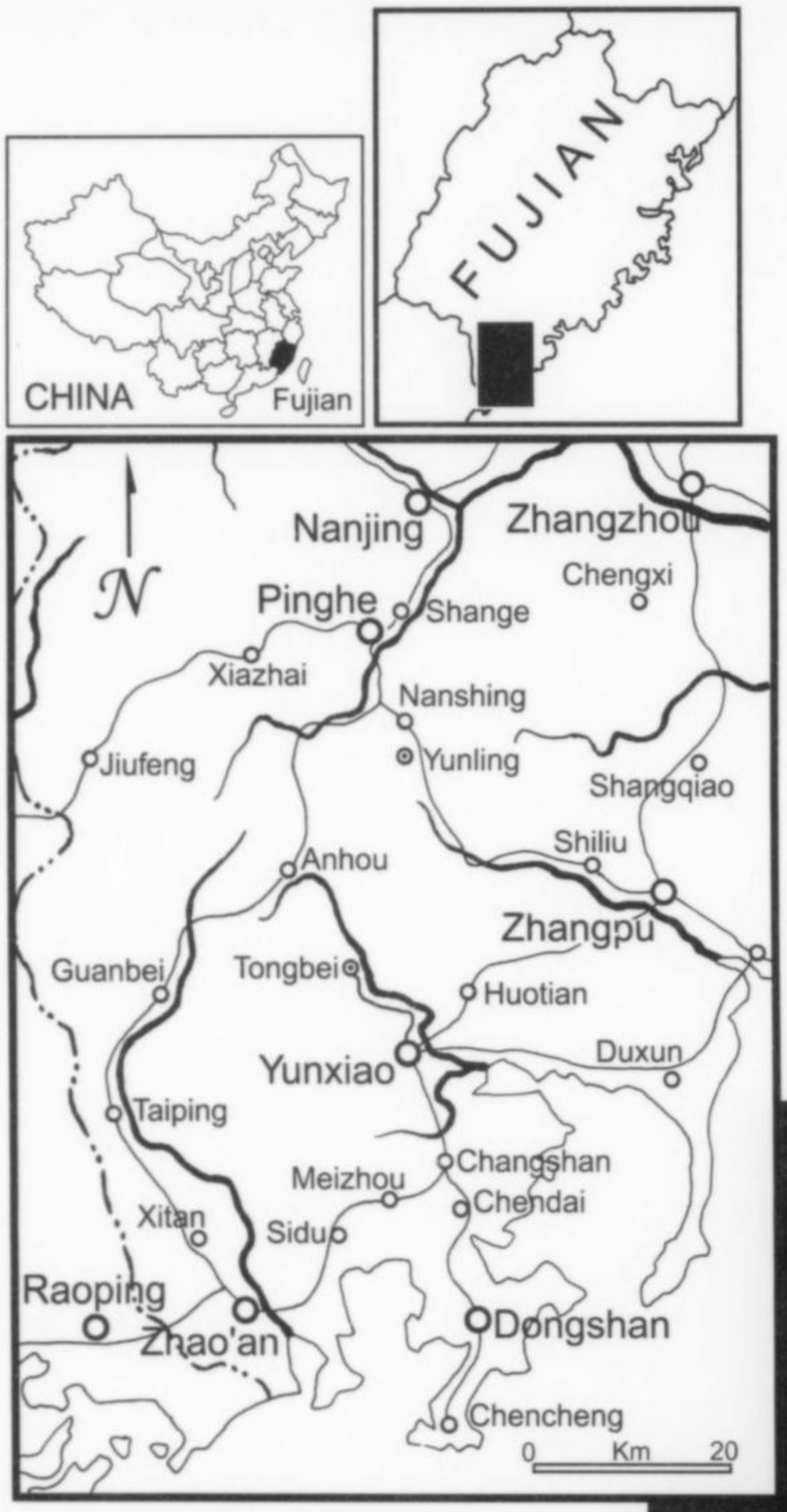


Figure 1. **Location map showing Tongbei and Yunling in southern Fujian province.**

ascended and grew even narrower, the agricultural style changed to terraced rice fields. Luckily, the very narrow road had for the first time been paved with asphalt in the previous year; otherwise the steep climb would have taken several hours. The driver skillfully steered the little bus around the many hairpin turns. On the precipitous slopes, a variety of different vegetables were being cultivated in plots sometimes only a few square meters wide. Farmsteads were built, characteristically, as round houses. At an elevation of 800 meters a hanging valley began, and what had been the good asphalt road gave way to one wholly choked with mud. The uncultivated hillslopes beyond the road were overgrown with ferns, and there were conspicuous outcrops of granite. From the sides of the hanging valley itself—to the extent that one could see through the low clouds—isolated hills and cliffs jutted out, with woolly-looking weathering caps observable on their granite crests. The moist, warm climate of this region leads to rapid weathering of feldspars, so that the soil in the upper parts of the valleys is a sort of humus enriched with granite sand. The climate at 800 meters is already so different from that near the coast that at this elevation rice can only be harvested once a year, and by the simplest methods.

After a drive of more than an hour we reached the village of Tongbei, whose 600 or so inhabitants include some who deal in garnets from the nearby workings. Communications between our guide and the villagers were difficult, since the latter do not speak Mandarin, the official language of China, but a local language. In the house of the chief dealer, the garnet specimens recovered during the previous week were presented in woven baskets. Individual finds differed widely in character and quality. Only a

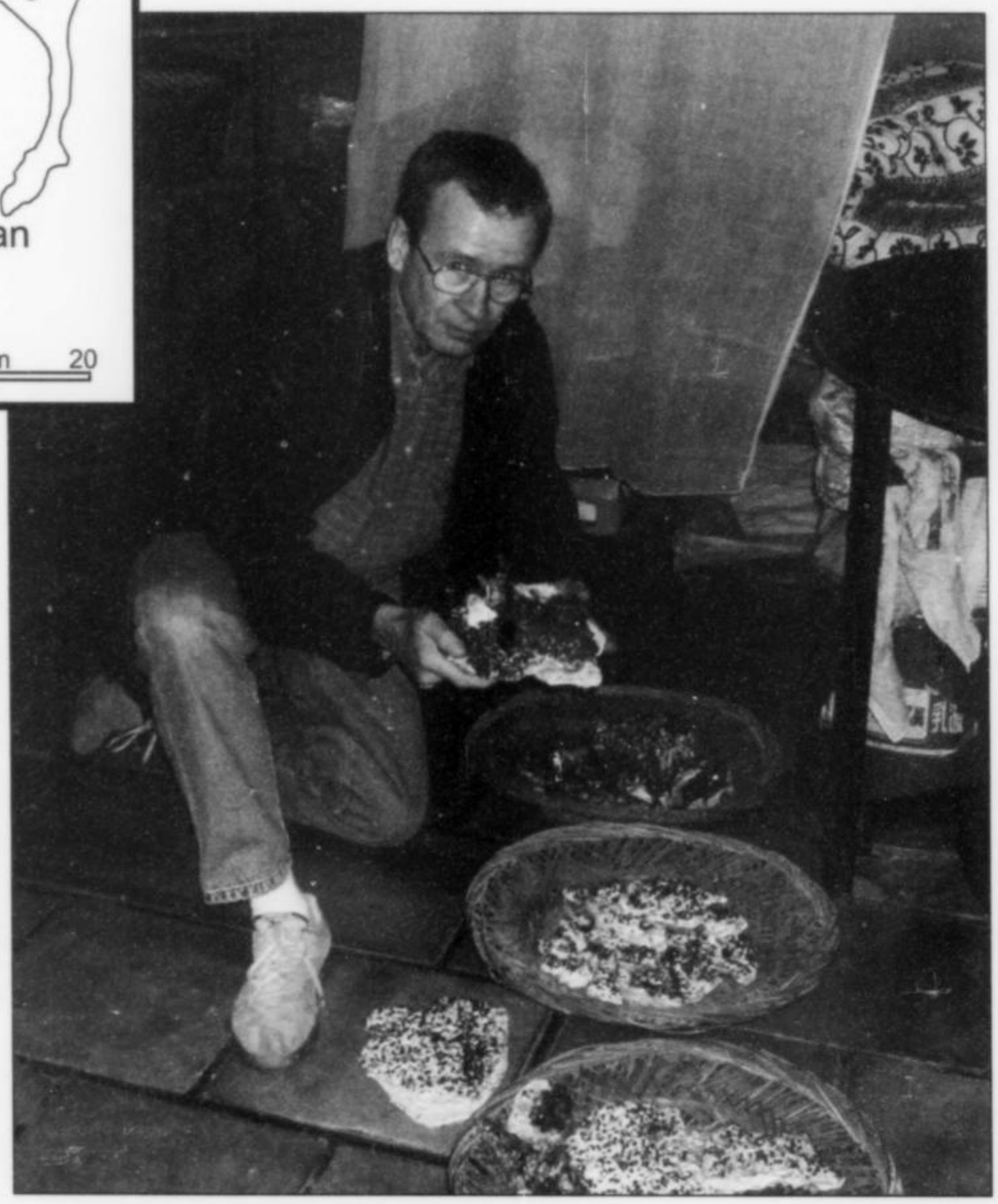


Figure 2. **Finding some excellent spessartine under the bed of a Tongbei mineral dealer.**

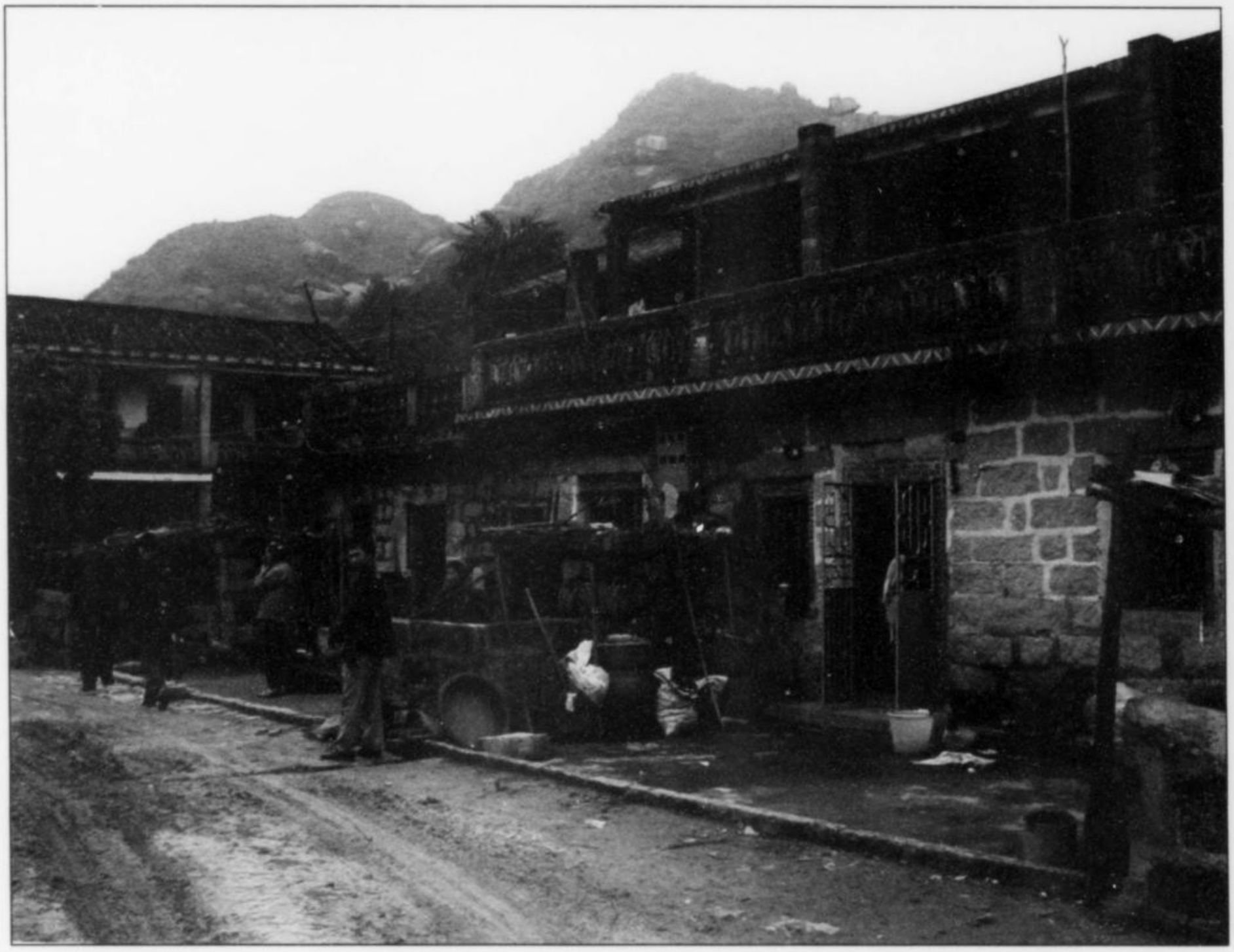


Figure 3. **All of the houses in Tongbei are constructed of granite, the principal product of the area. Ottens photo.**

few specimens showed highly lustrous garnet crystals; most featured relatively dull red-brown crystals overgrowing the matrix.

While it would have been interesting to prolong the traditional tea ceremony, the better to establish hospitable relations, it was more important to visit the collecting site. It was explained to us that because of the weather we could only visit one of the nearer workings; to visit a more distant one would require a march of several hours on foot, and the whole trip would take more than a day.

After a brief ride of about one kilometer, we went on foot for about 500 meters along a trail, up into a little side valley. Here, enormous amounts of rubble, consisting of boulders of fresh granite, were visible on overhangs on both sides of the valley. The prospecting, solely for collector specimens, was proceeding mainly along the contacts between what was once natural alluvium and the steeply ascending, naked rock. These contacts were easily reachable without mechanical aids, and open pockets or mineral-rich veins were easily spotted. The granite seen in place is relatively fine-grained and dense, with red feldspar, quartz and a little mica. In a pocket which had been opened shortly before, good crystals of smoky quartz, feldspar and garnet rested on a thin feldspar layer.

About 30 people work in the diggings in the immediate vicinity of Tongbei. Blast holes are created by gasoline-powered drilling machines; the workers are not squeamish about blasting, and great quantities of granite rubble are allowed to fall into the valley. The area around the collecting sites is already so defaced that the local authorities are considering a prohibition on further mining.

Since many interesting crystals rest on large masses of granite, such boulders are hauled into the village of Tongbei, where trimming with hammer and chisel liberates many quartz and garnet crystals.

Conversation with the dealers revealed that the garnet/smoky quartz specimens come from two major collecting sites, with several separate workings in each. The first site lies near the village of Tongbei, 30 km west of Yunxiao. The second site is reached by traveling from the city of Sui'an (Zhangpu) about 30 km northwest, towards Yunling. The two localities differ only negligibly in their mineralizations. At Tongbei, helvite and topaz occur, but no fluorite has been found to date. The color of the Tongbei garnet is orange-red, while the garnet of Yunling tends to be reddish brown, and is associated with octahedral crystals of blue fluorite. For both localities, however, it is nearly impossible to attribute specimens to particular collecting sites; for this reason the minerals will not be described here in terms of specific sites.

The discovery of the locality took place about 15 years ago when the inhabitants of region began gathering weathered quartz from the fields and selling it to the glass-manufacturing industry. One of these people, having noticed garnet crystals on the quartz, showed some specimens to a mineral dealer from Changsha, who quickly realized that a lucrative trade could be developed.

GEOLOGY

No detailed geological reports on the garnet localities are known, but isolated publications on the geological situation of the region are available. The granites of the southern coast of Fujian originated as intrusions in the region of Zhangzhou/Yuanxiao in the late Yanshanian Epoch (80–139 million years ago). In the late Mesozoic, the Fujian coastal area was located at the continental

Figure 4. **The local inhabitants have excavated granite outcrops in search of spessartine. Ottens photo.**

margin, where there was severe magmatism as a result of the subduction of the Paleo-Pacific Plate under the continental plate of southeastern China. Studies (Shen Weizhou *et al.*, 2000) of the alkali-feldspar granite have shown that zircon first crystallized before about 97 Ma (million years ago) at a temperature of 700° C and at a depth of 4.7 km, and that crystallization of K-feldspar at about 150° C and at a depth of 1000 meters essentially ended about 50 Ma. No reports treat of younger mineral formation; however, it is clear that cooling extended over a time span of more than 50 Ma. The intrusions of the region are not homogenous; gabbro-diorite, quartz diorite, granodiorite, monzonitic granite, miarolitic alkali-feldspar granite and alkali-feldspar granite porphyry have all been identified. Minor minerals reported include magnetite, ilmenite, zircon, monazite, fluorite, garnets, apatite, aegirine and arfvedsonite.

Zhangzhou Prefecture is also known for volcanic activity, evidence of which may be seen in Volcano Geology Park in Zhangzhou. It is not surprising that in the coastal region of Fujian, many hot springs with temperatures of 40–97° C are to be found, and a high geothermal gradient has been ascertained.

MINERALS

Beryl $Be_3Al_2Si_6O_{18}$

Beryl has been observed very rarely, as pale green crystals to a few mm long.

Feldspar Group

Orthoclase is the most common mineral in the crystal pockets. The cream-colored crystals reach sizes of several centimeters; very rarely, Manebach twins have been observed. Because of the wet, warm climate, feldspar crystals in near-surface pockets are often seen to be in the process of kaolinization. Their appearance is clearly different from that of crystals which have been "cleaned" with a solution of hydrochloric acid. Unfortunately, a few of the dealers treat specimens of all of the minerals with highly concentrated HCl. In the case of the feldspars, iron compounds are only removed with difficulty by such treatment, and a characteristic yellow color is the result. Pseudomorphs of mica minerals after feldspars are occasionally observed, and these are overgrown, in turn, by garnet.

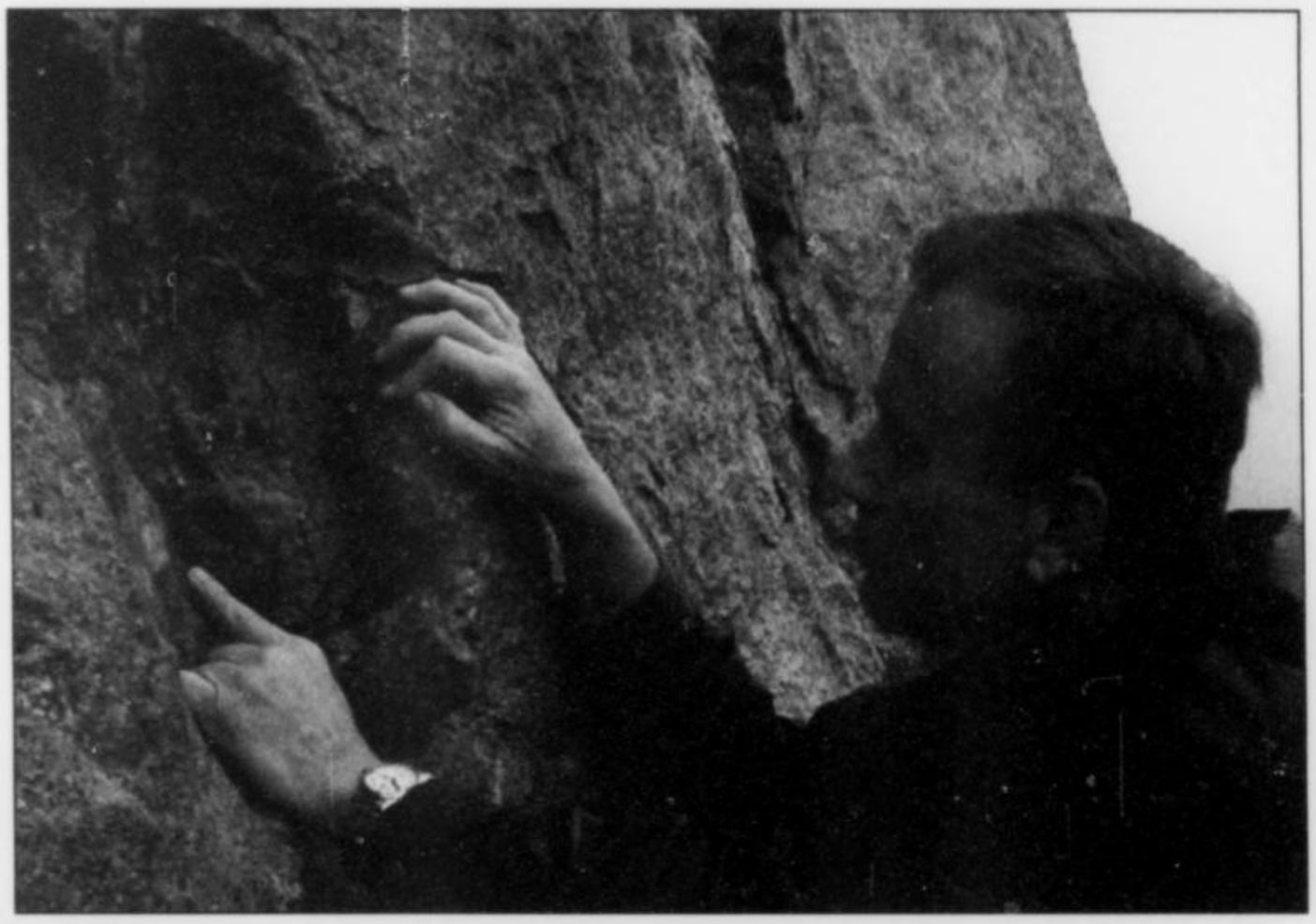
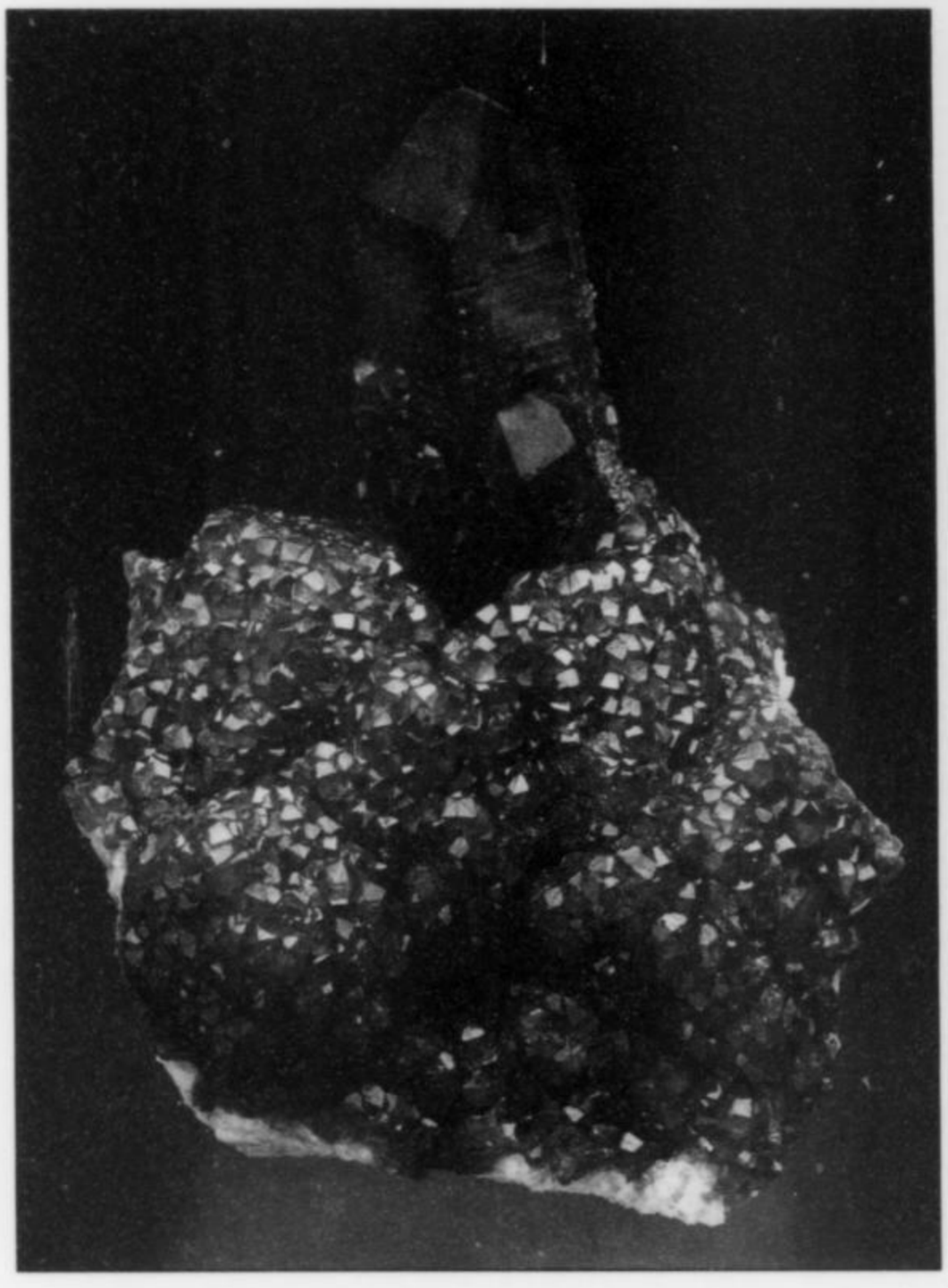
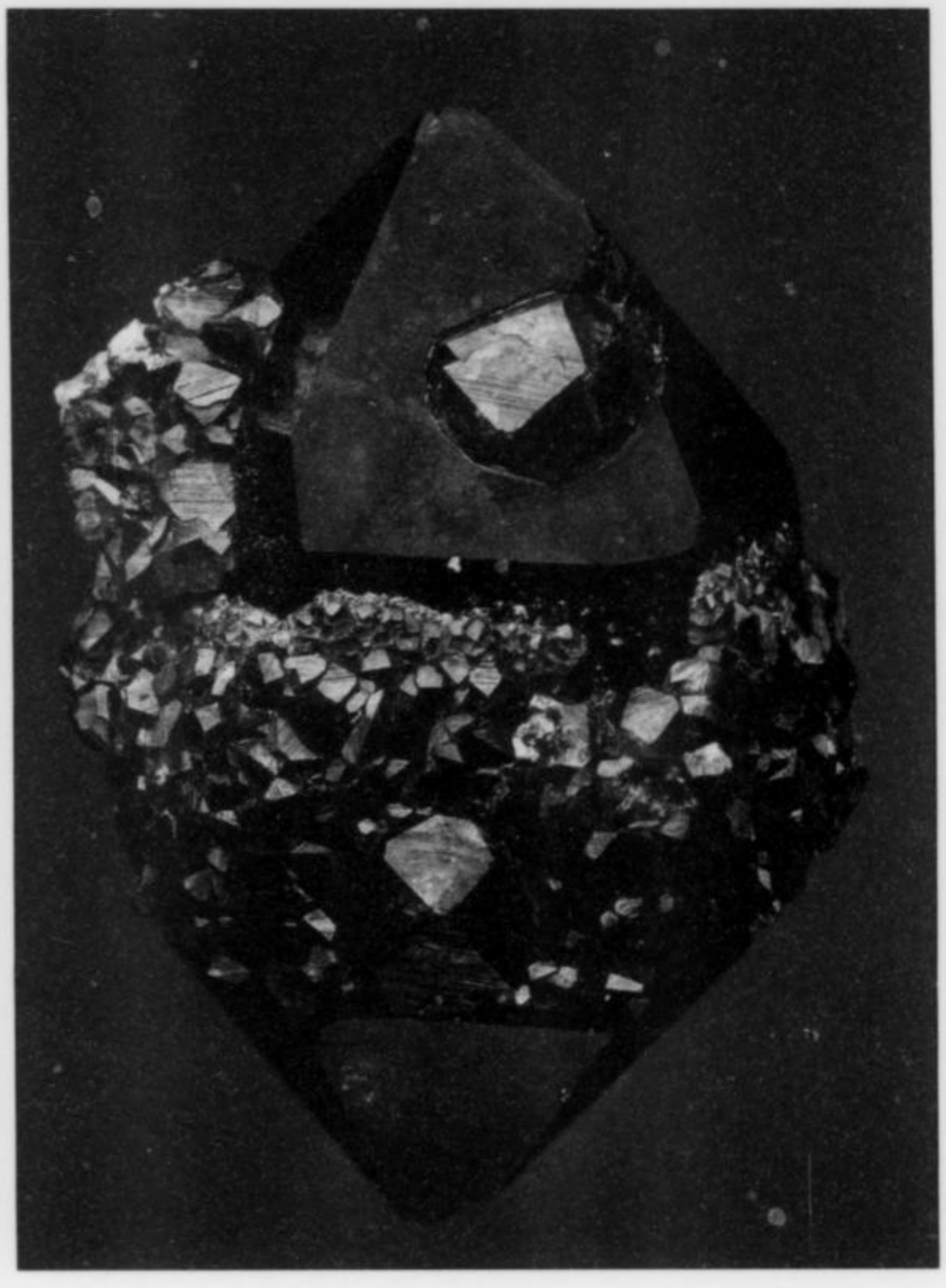


Figure 5. (right) **A spessartine pocket in place.**

Figure 6. (below) **Spessartine encrusting white feldspar with smoky quartz, 8.5 cm, from near Tongbei. Collector's Edge specimen; Jeff Scovil photo.**

Figure 7. (below right) **Spessartine crystals partially coating a doubly terminated smoky quartz crystal, 3.6 cm, from near Tongbei. Martin Zinn collection; Jeff Scovil photo.**





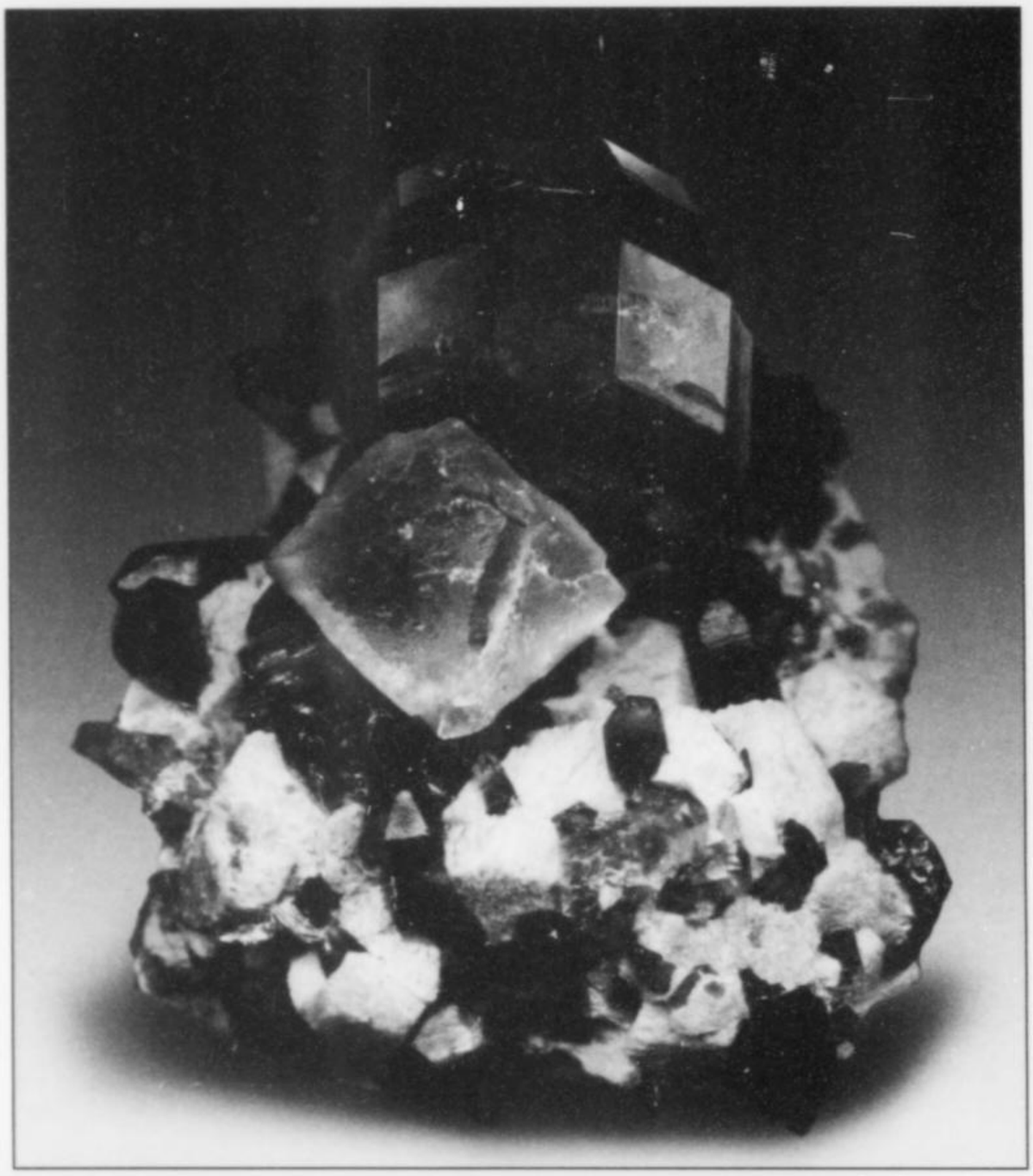
Fluorite CaF_2

Fluorite occurs commonly as pale to dark blue octahedral crystals, but only, as already mentioned, at the Yunling locality. The crystal faces display a parquet texture. Close inspection reveals that the color is unevenly distributed, although not clearly zoned. Rarely, the octahedral crystals are almost colorless or pale green. The largest fluorite crystal so far found measures about 10 cm across.

Helvite $Mn_4^{2+}Be_3(SiO_4)_3S$

The rare species helvite was first found in China in 2000 at Jinlong, Guangdong Province—an occurrence then being worked for collector specimens of quartz and hematite. The helvite crystals from that locality reach a previously unheard-of size of 7 cm on edge. They are colored black by manganese compounds which reach deep into the crystals.

Surprisingly, at the end of 2001, pseudo-octahedral helvite crystals with similar dark surface coatings were discovered at Tongbei. Under the coatings the crystals are homogenously yellow, and testing has shown that the species is indeed helvite. The pseudo-octahedral habit results from the combination of negative and positive tetrahedrons. The crystals rest either on feldspar or on smoky quartz. Helvite crystals discovered at later times lack the



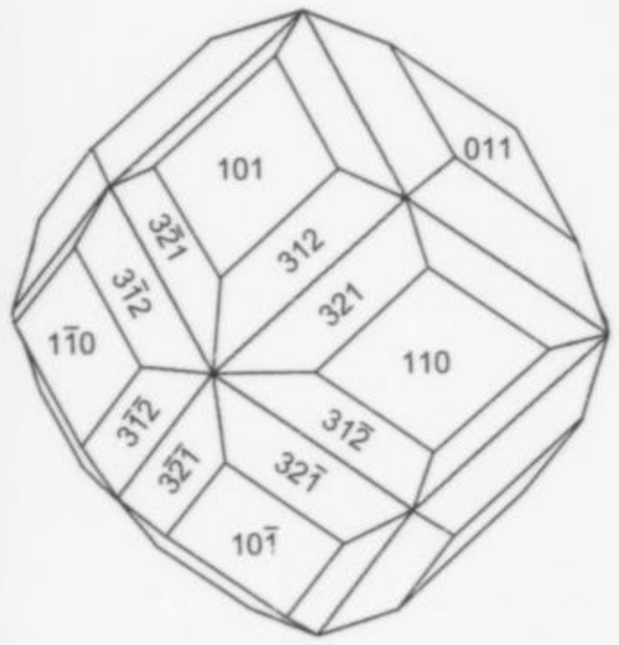


Figure 8. **Spessartine crystal (left) on feldspar and smoky quartz with a colorless octahedral fluorite crystal, 2.5 cm, from near Yunling. The apparent trapezohedron faces modifying the garnet dodecahedron are actually re-entrant troughs composed of hexoctahedron faces, as shown in the approximated crystal drawing (above) by R. Peter Richards. Daniel Trinchillo specimen, now Wendell Wilson collection (and photo).**

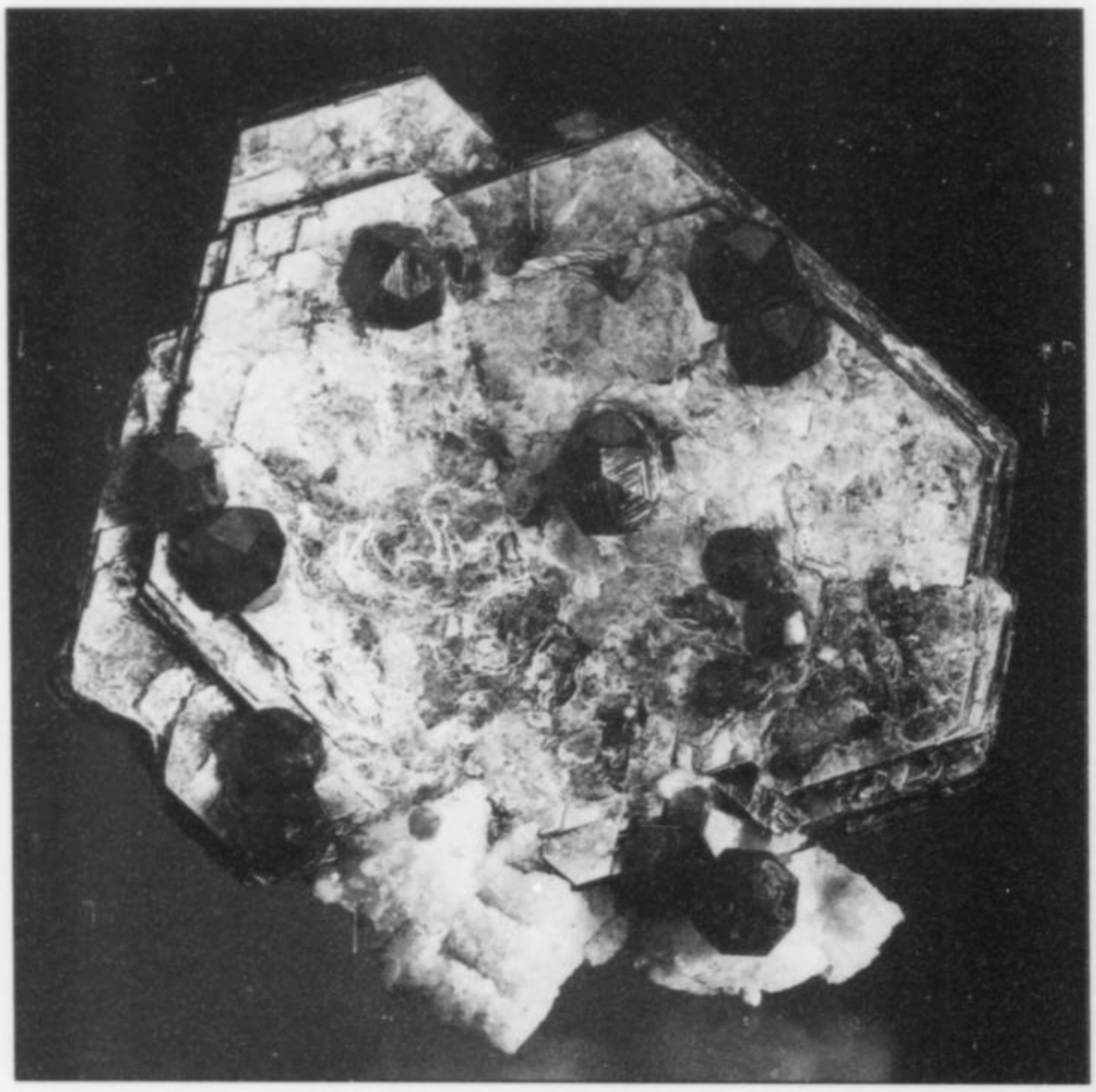


Figure 9. (left) **Trapezohedral spessartine crystals on a muscovite crystal, 4 cm, from near Tongbei. Jerry Rosenthal collection; Jeff Scovil photo.**

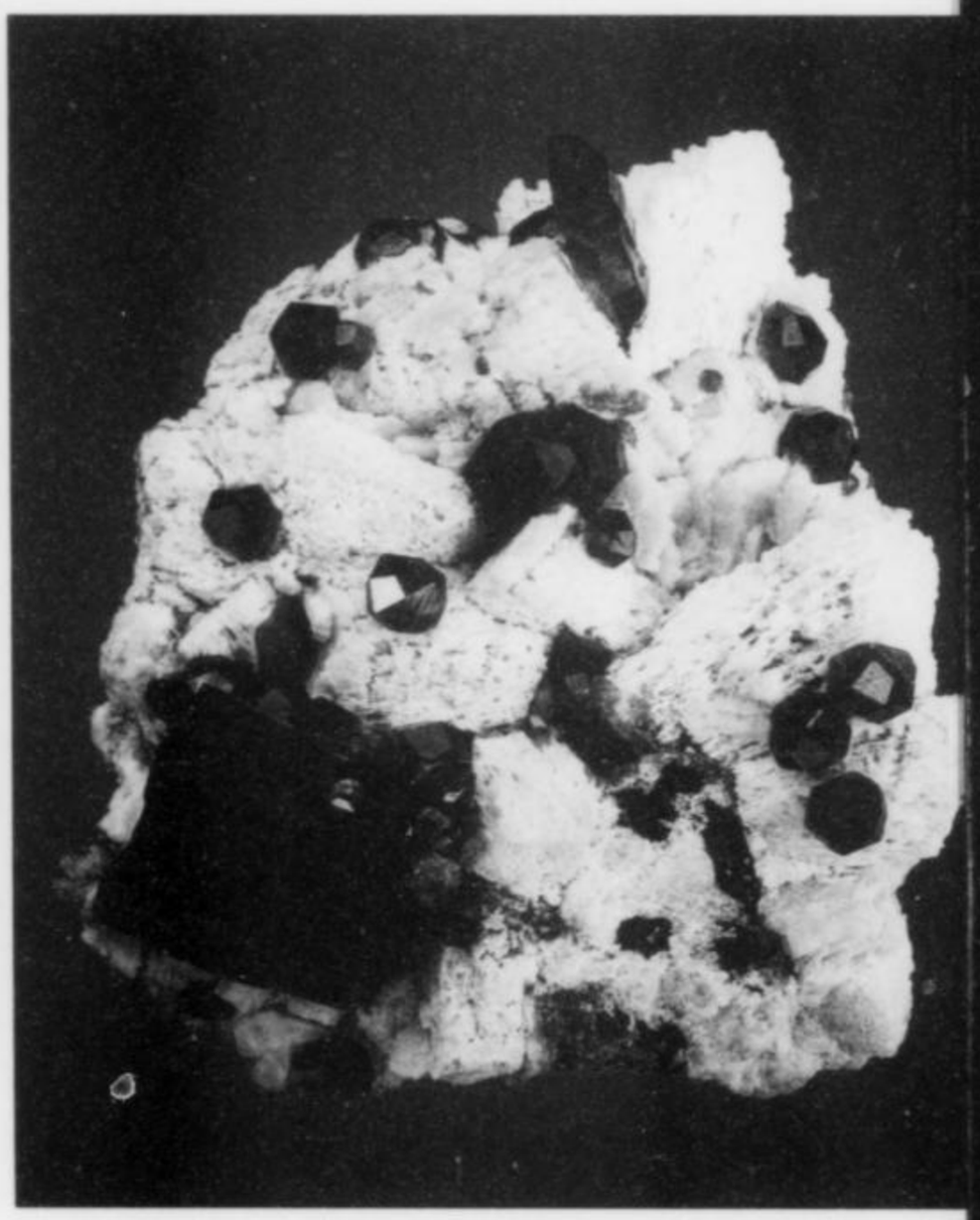


Figure 10. (right) **Muscovite book on feldspar with spessartine crystals, 8.6 cm, from near Tongbei. Martin Zinn collection; Jeff Scovil photo.**

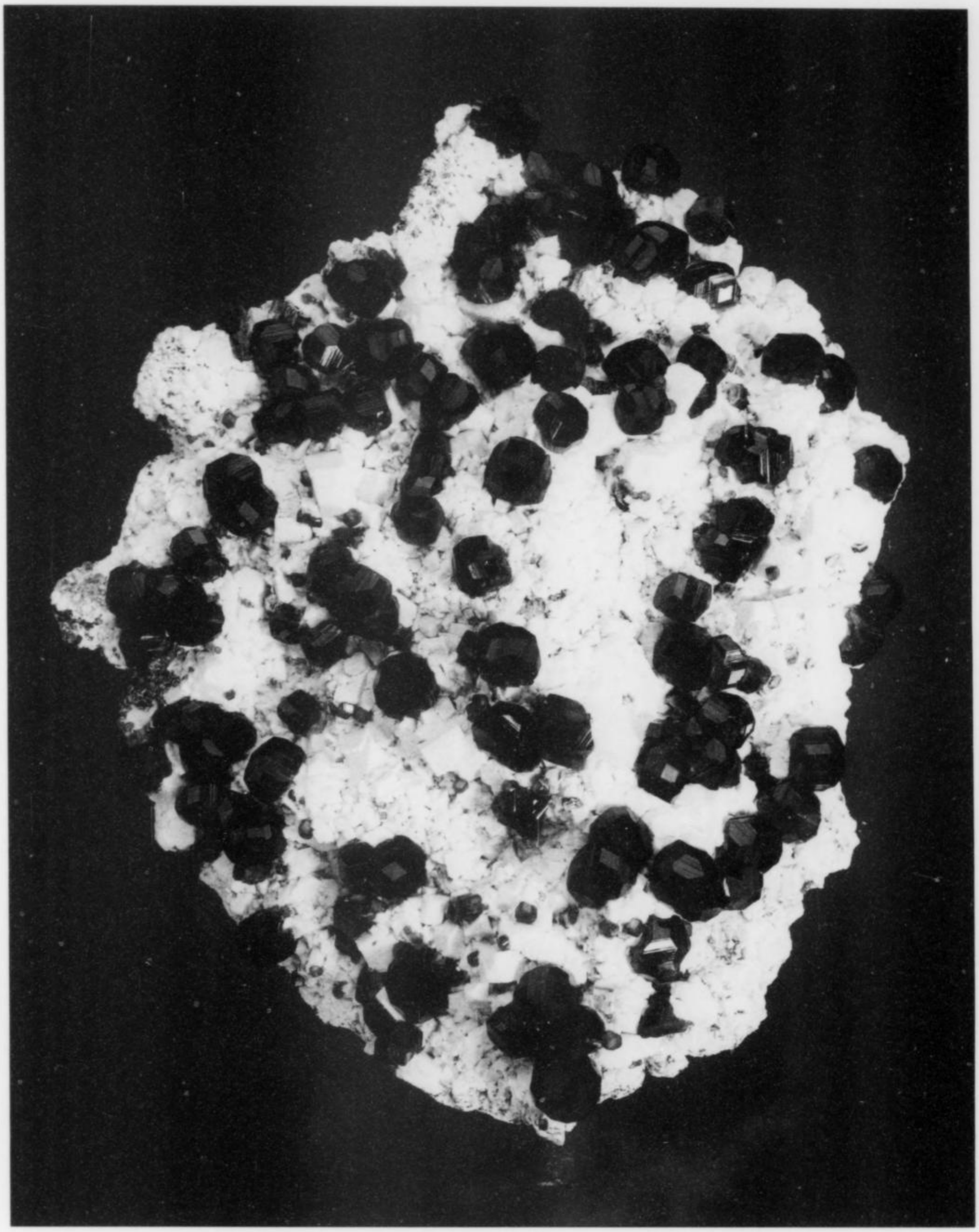


Figure 11. **Spessartine crystals on feldspar crystal crust, 17.6 cm, from near Tongbei. Collector's Edge specimen; Jeff Scovil photo.**

dark surface coatings, but it is suspected that such pieces have been treated in Tongbei with hydrochloric acid.

Hematite Fe_2O_3

Hematite crystals to about 2 mm are commonly encountered. At the Munich Show in 2003, one specimen appeared which displays beautiful smoky quartz crystals and pale green fluorite crystals with tabular hematite crystals about 2 mm thick and almost 2 cm across.

Mica Group

Mica-group minerals form dark greenish gray crystals to 3 cm thick and 5 cm across. Very commonly the crystals are partly or wholly overgrown by crusts of feldspar or garnet crystals.

Milarite $KCa_2AlBe_2Si_{12}O_{30}\cdot 0.5H_2O$

The rare beryllium silicate milarite has been found as crystals to 0.5 mm long.

Opal (Hyalite) $SiO_2\cdot nH_2O$

A glassy coating of hyaline opal on feldspar can be observed in some specimens, and white crusts to 5 cm thick on quartz and feldspar have been noted at several collecting sites. This material is intensely fluorescent.

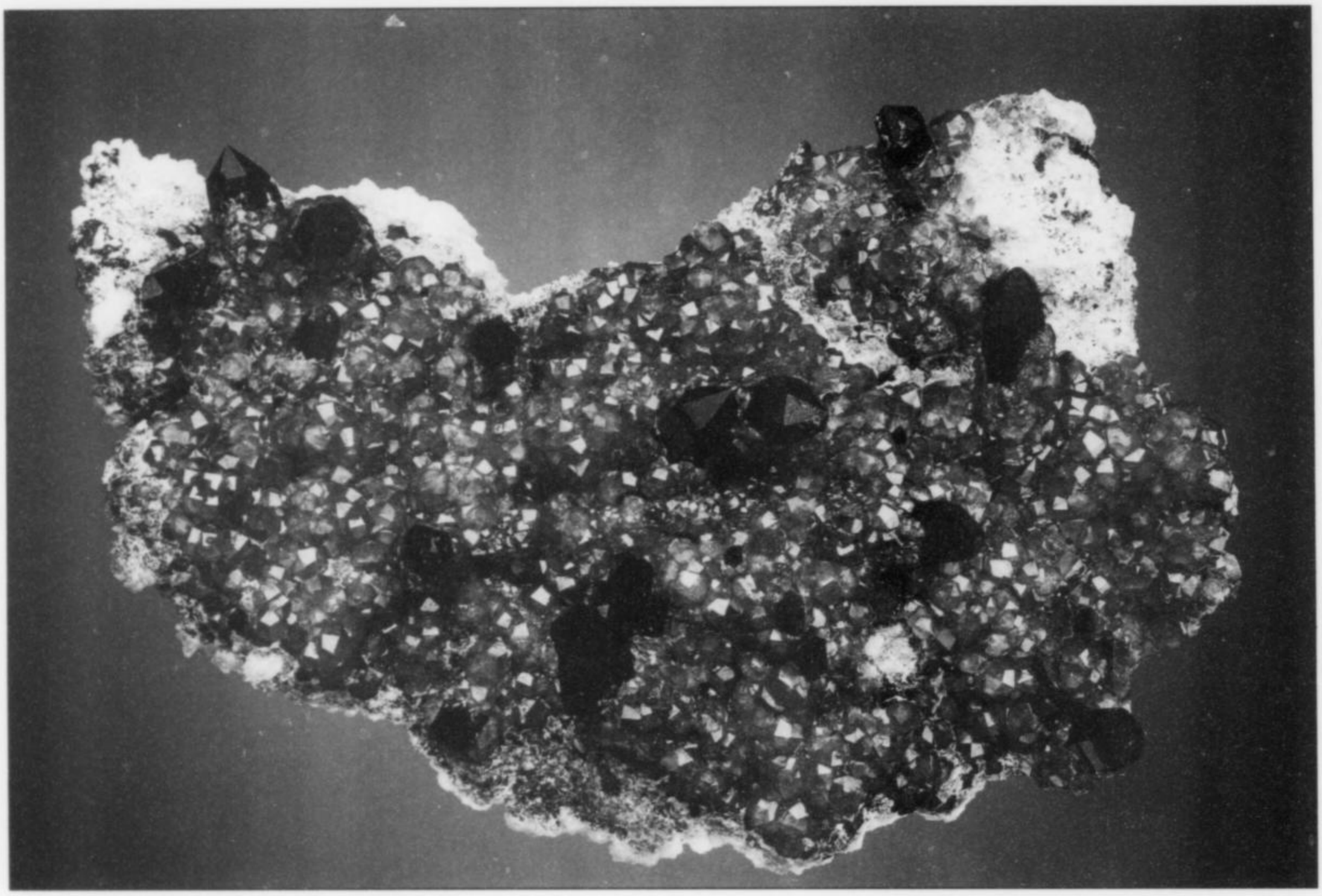


Figure 12. **Spessartine crystals with smoky quartz crystals on granite, 20 cm, from near Tongbei. Marvin Rausch collection; Jeff Scovil photo.**

Pyrite FeS_2

Cubic crystals of pyrite on feldspar have been observed rarely. A few strongly limonitized pyrite crystals to 5 cm have been found.

Quartz SiO_2

Quartz occurs almost exclusively as smoky quartz, in crystals to 30 cm long. Right or left-handed Dauphiné twins are commonly found, in some cases on the same specimen. In a few specimens—very few, unfortunately—the smoky quartz crystals are transparent and lustrous, and beautifully colored, with transparent spessartine crystals resting on their faces. In most cases, either the smoky quartz or the spessartine has a dull luster.

Spessartine $Mn_3^{2+}Al_2(SiO_4)_3$

Analytical tests performed at the University of Göttingen have shown that the bright orange, transparent garnet crystals from this locality are a relatively pure spessartine. It has not yet been determined whether the darker (in some cases almost black) crystals are also spessartine, or a transitional phase, or even another garnet species.

The transparent orange crystals superficially resemble the "hessonite" of the Jeffrey mine in Quebec, and reach 5 mm in size. Larger crystals are opaque as a rule, and have a frosty luster at best. The spessartine crystals, for which the dominant form is the trapezohedron modified by the dodecahedron, formed late, and are associated commonly with smoky quartz, feldspar and mica, less commonly with other minerals such as pyrite. Fluorite and hyaline opal seem invariably to have formed later than spessartine. However, many observations confirm that the spessartine crystals began

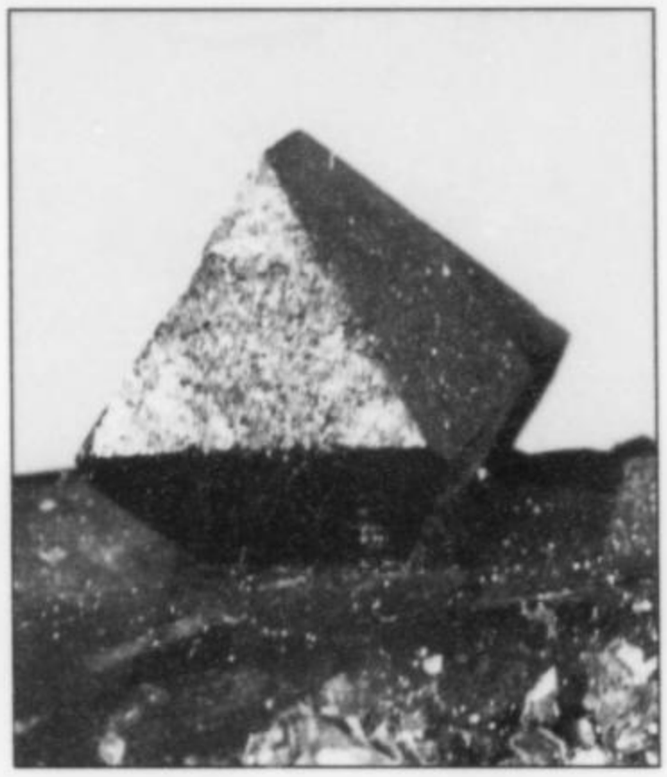


Figure 13. **Helvite crystal on quartz, 5 mm, from near Tongbei. Ottens specimen and photo.**

forming at the end of the period of quartz formation, and continued to form from then on, sometimes enclosing the quartz. The crystals do not rest at all firmly on the quartz crystals; they can be detached fairly easily with a fingernail.

The dealers in Tongbei have learned extraordinarily quickly which aesthetic factors must be taken into account if profits are to be maximized, and unfortunately they have learned just as quickly how to "improve" specimens aesthetically. Thus it is necessary to examine closely any apparently very fine specimen.

Topaz $Al_2SiO_4(F,OH)_2$

Topaz, which occurs sparsely at Tongbei, is one of the specialties of the locality. The colorless, transparent crystals reach only a few millimeters, but the dealers' price structure for these specimens is beyond good and evil. For a 7 x 7-cm specimen with mediocre

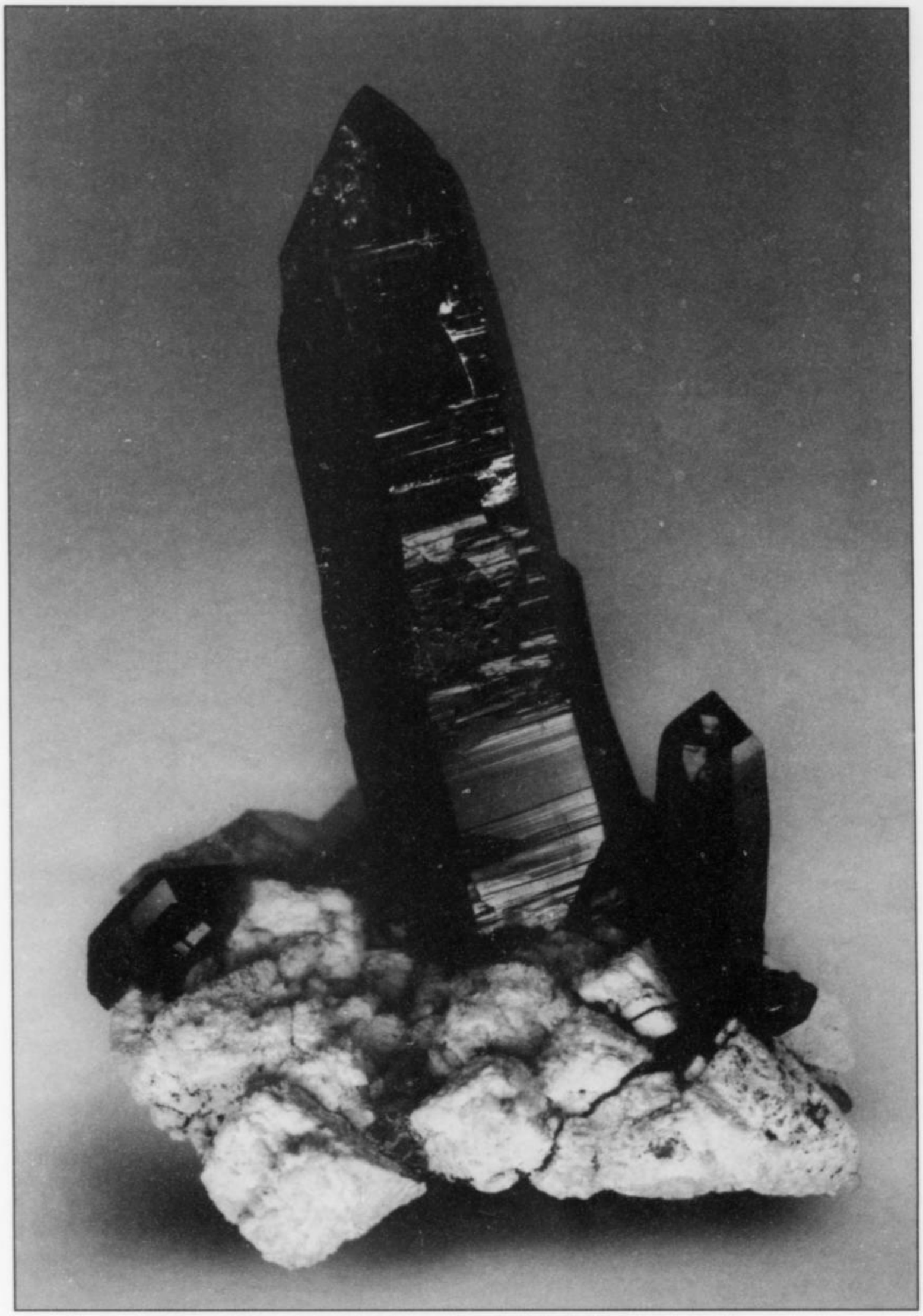


Figure 14. **Smoky quartz crystals on corroded feldspar, 6.2 cm, from near Tongbei. Wendell Wilson collection and photo.**

spessartine and feldspar and a 5-mm topaz crystal, one has to bring 500 U.S. dollars to Tongbei. With luck, the collectors and dealers may not recognize topaz as such, so that an interesting specimen might be obtained for a reasonable price.

Tourmaline Group

A black tourmaline mineral, probably schorl, is occasionally found as crystals wholly overgrown by feldspar.

CONCLUSION

Further production of mineral specimens from Tongbei and Yunling depends upon whether the excavations can be made environment-friendly, and upon how much longer the lower-quality specimens remain salable for prices sufficient to justify further work at the sites.

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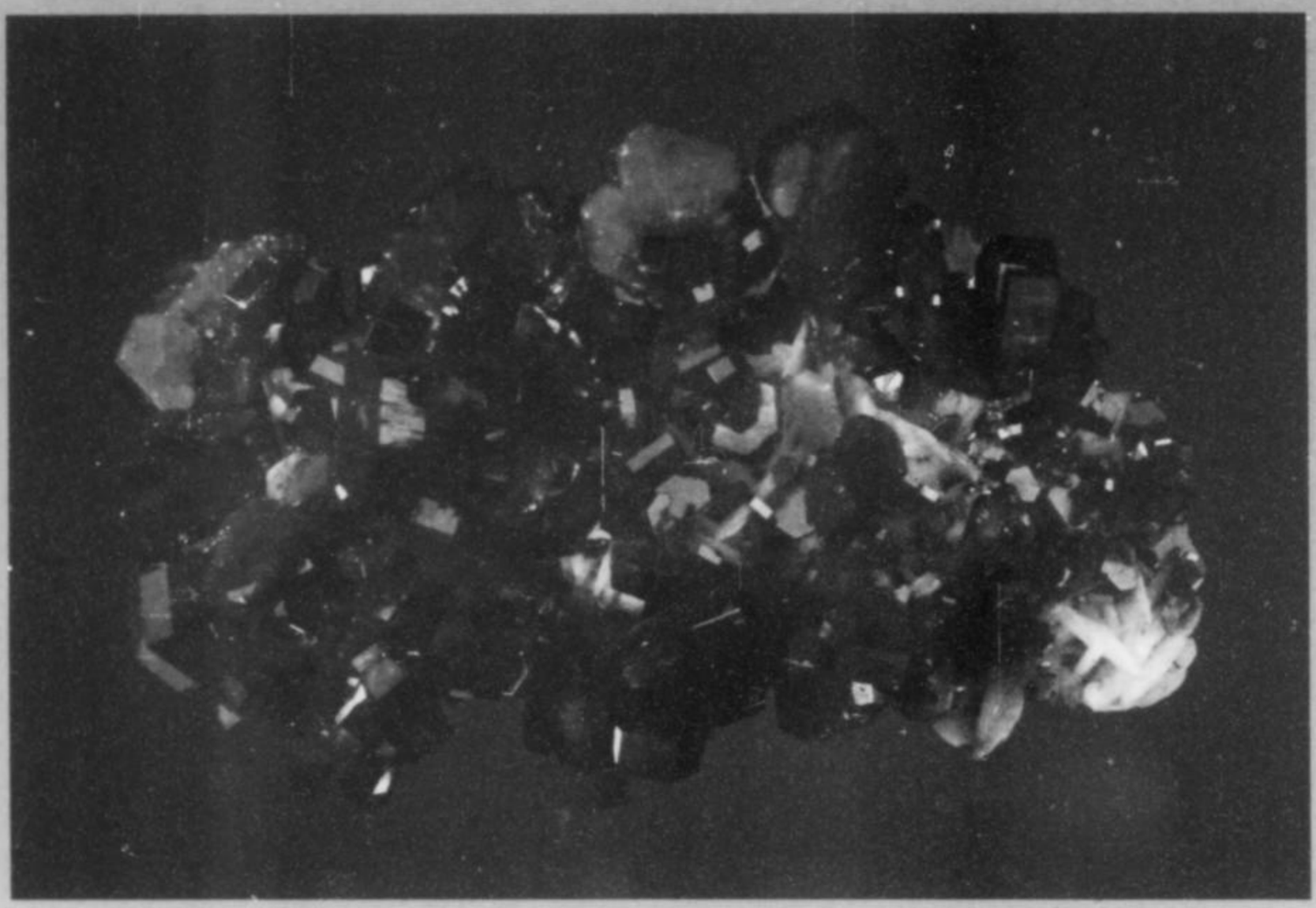
Fine Minerals



VANADINITE, 10 cm, from Mibladen, Morocco. Jeff Scovil photo.

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四川 雪宝顶

XUEBAODING

Pingwu County, Sichuan Province, China

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau
Germany

Beautiful specimens showing large, lustrous, deep orange crystals of scheelite associated with brilliant black twinned cassiterite crystals and tabular, gemmy crystals of aquamarine beryl on beds of muscovite crystals are characteristic of Mount Xuebaoding, Sichuan Province, China. These specimens have already become familiar to mineral collectors in the West, and supplies of them should continue to be available, thanks to active specimen mining and marketing by the Chinese.

INTRODUCTION: THE SETTING

"Pingwu," "Songpan," "Mount Xuebaoding," "Xue Bao Diang" and occasionally "Huya" are the locality designations generally cited for specimens of orange scheelite associated with cassiterite and beryl from Sichuan Province in central China. Xuebaoding (pronounced "Shway-bow-ding") Mountain, known to the local Tibetan population as Shardungri, is the source of the scheelite; it lies in the autonomous Tibetan Aba Prefecture, on the eastern border of Songpan County. Part of the mountain lies in Songpan County and part lies in Pingwu County. At 5,588 meters, the mountain boasts a year-round snowcap and is one of the highest peaks in Sichuan Province (the highest is the 7,556-meter Gongga).

The town of Songpan, lying at an elevation of 3,000 meters in the valley of the Minjiang River, is an important center of tourism thanks to its picturesque appearance and its many Tibetan inhabitants. During the Ming Dynasty (1368–1644 A.D.), the Tibetan-style old quarter of the town was encircled by a 6,200-meter-long city wall made of brick, and several impressive gates are still preserved. From Songpan, trekking tours may be undertaken—those done on horseback are especially popular. The town lies 320 km from Chengdu, the capital of Sichuan Province, and it may be reached from there by public bus in about 10 hours. The area around Songpan, called Munigou, is a special attraction for tourists, and is now under development by the government of Songpan County, as are the adjoining Jiuzahaigou and Hualong areas. These parts of Aba Prefecture offer a characteristic local charm because they display the customs and folkways of the cultures of Tibet and of the Qiang peoples. 50 km northeast of Songpan one traverses a mountain pass at 4,000 meters and comes into the impressive Hualong National Park, at 3,300–3,600 meters above sea level. In the valley of Hualong ("yellow dragon"), which is regarded as holy, there are wonderful terraced formations of travertine enclosing countless little lakes. From the head of the valley, lying at 3,700 meters elevation, one can enjoy on clear days a tremendous view of the peak of Xuebaoding Mountain.

The town of Pingwu lies on the Fujiang River about 100 km southeast of Xuebaoding Mountain and on the border between the Longmenshan and Minshan Mountains (Nakamura, 2003). A 500-year-old Buddhist temple there was saved from destruction during the Cultural Revolution, and is now one of the town's few points of interest for visitors. The nature preserves near the towns of Wanglang and Huya presently hold more than 250 living panda bears.

MINE WORKINGS

To reach the scheelite specimen workings—locally called a mine—the visitor travels from Pingwu (elevation 800 meters) up a

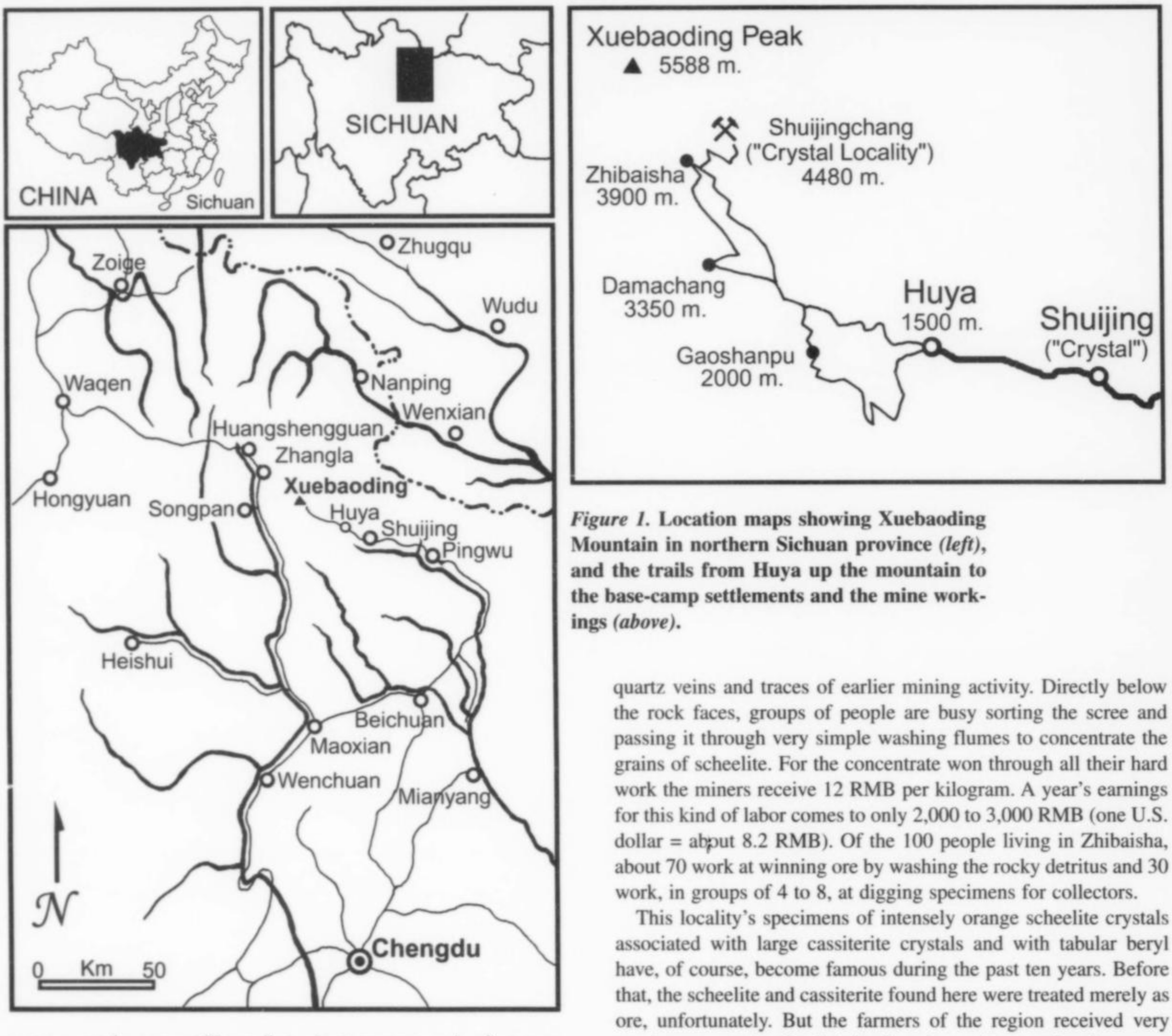

Figure 1. **Location maps showing Xuebaoding Mountain in northern Sichuan province *(left)*, and the trails from Huya up the mountain to the base-camp settlements and the mine workings *(above)*.**

narrow, partly canyon-like valley, along an unpaved, often very muddy road, towards Huya. This village (elevation 1,500 meters) is ringed by steep mountains, and lies on the edge of Huya Xuebaoding National Park, one of the protected panda bear habitats. From there the collecting area is reached by a laborious climb on foot along a steep path, through wonderfully varying vegetation. Depending on elevation, one can admire orchids, different species of azaleas, bamboo plants with mushrooms growing among them, and, after 3,500 meters, high-alpine flora. Since the mountain people travel this route entirely on horseback, the path is heavily trodden and very muddy, but not dangerous. The last part of the climb leads over a ridge at an elevation of about 4,000 meters, and then to the mining settlement called Zhibaisha, at 3,900 meters.

During the snow-free season (May through October), about 100 people live at the workings and dig for scheelite ore and specimens, more or less in large groups. A greenhouse-like structure serves as accommodation: constructed of bamboo and torn plastic sheeting, partly collapsed and thoroughly stained, it is in the middle of a deep marsh, and gives an impression of total dilapidation. All food supplies, fuel, and mining equipment must be transported on horseback from Huya; the trip takes a day, even for local people accustomed to the high mountains.

To the northeast of Zhibaisha are steeply ascending rock faces to elevations from 4,100 to 4,300 meters, with clearly delineated quartz veins and traces of earlier mining activity. Directly below the rock faces, groups of people are busy sorting the scree and passing it through very simple washing flumes to concentrate the grains of scheelite. For the concentrate won through all their hard work the miners receive 12 RMB per kilogram. A year's earnings for this kind of labor comes to only 2,000 to 3,000 RMB (one U.S. dollar = about 8.2 RMB). Of the 100 people living in Zhibaisha, about 70 work at winning ore by washing the rocky detritus and 30 work, in groups of 4 to 8, at digging specimens for collectors.

This locality's specimens of intensely orange scheelite crystals associated with large cassiterite crystals and with tabular beryl have, of course, become famous during the past ten years. Before that, the scheelite and cassiterite found here were treated merely as ore, unfortunately. But the farmers of the region received very scant compensation for their hard work as miners, and as they came to realize that they could earn many times more money by collecting minimally damaged mineral specimens, they learned quickly to accommodate the requirements of collectors. Whereas previously nearly all of the scheelite crystals had been found by washing the loose detritus, with only very limited collecting from the country rock, some of the workers now turned their attention to the tunnel workings. Recognizing that other minerals which occurred here were of interest also, and therefore were valuable, they came to pay increasing attention to minerals less commonly seen in the workings, e.g. fluorite and apatite, and to rare species such as këesterite.

The major collecting site is marked by quartz veins cropping out on steep hill slopes. Some of the veins which were fully exposed on the rock faces were worked at first by simple methods, but presently the deposit must be worked through underground tunnels. The timber line in the Minshan Mountains is at about 3,300 meters elevation; at the collecting site, between 4,000 and 4,500 meters high, there is only moss and lichen. Despite the high elevation the locality is free of snow between May and roughly the end of October. In August, at 4,000 meters, the daytime temperature is around 20° C and the nighttime temperature somewhat over 10° C. Because of the monsoons the summer months are very rainy; dry, frost-free weather arrives in September and October.

Figure 2. **Xuebaoding Mountain in the distance, viewed up Huanglong Valley, with travertine terraces in the foreground. Ottens photo.**

Having visited this locality personally, I can offer some further details. Mining activities take place in an area of about 4 square kilometers, at an elevation between 4,000 and 4,500 meters, on the south slope of the Xuebaoding massif. The nearest mountain peak with its own name is the 5,440-meter-high Xiaoxuebaoding (the "Xiao" prefix means "little"). According to the accounts of local people, there are other collecting sites in the mountains west of Huya, in the direction of Songpan; however, no detailed information about them is available. For the specimens offered on the worldwide mineral market, no special mine names are given, and as a rule it is not known from which particular working a given specimen has come. It seems most advisable simply to give "Xuebaoding" as the locality. It should be remembered that the occurrence lies within a nature-conservation area subject to strict rules. A conversation in May 2004 with the chief executive of Pingwu County and with the director of the conservation area established that the mining activities are being watched with critical concern, and that a forced termination of them is not out of the question.

One mine which lies at an elevation of 4,480 meters can be reached from Zhibaisha by an acclimatized person in two hours. There, two quartz veins only 10 meters apart are worked in an underground operation. The longer, horizontal tunnel is 2 to 3 meters high and about 200 meters long. The mine's relatively young owner, Zheng Bo, works here along with six other people, including a young woman. The roughly 50-year-old Huang Kai Hua, who runs another mine in the immediate area, is a pioneer of ore mining at Xuebaoding, where he began about 30 years ago to gather ore, particularly scheelite. He became aware of the value of mineral specimens in the Western world when China opened up after 1990. Individual tunnel workings here have no special names. The area is simply called Shuijingchang, which means, approximately, "crystal mine." No electrical generators are available, so the work underground must proceed by candlelight.

Inspecting a tunnel in which blasting has just taken place, one can see abundant quartz as opaque crystals which reach 15 cm long and 25 cm in diameter, but which are not attractive. Surprisingly, there are also green fluorite crystals to 20 cm, including very sharp cubes to more than 5 cm on edge. In the vicinity of the quartz veins neither scheelite, cassiterite or beryl appear, but in fissures separated from the quartz, mica has formed as a wall-lining, and scheelite, beryl and cassiterite crystals are embedded in it. These minerals are not observed in direct association with quartz in the mine.

Some specimens fresh from the mountain are completely clean, but there are also specimens coated with films of iron oxides from weathering. The specimens receive a crude trimming on-site to reduce their weight. Cleaning with concentrated hydrochloric acid and finer trimming with a diamond saw will be handled by the dealers in Huya. Preparing specimens exclusively with a hammer or with a pincer-vise is possible, but difficult, since the grain of the rock runs diagonally to the open faces of pockets; in any case, the technique is unknown here. A majority of collectors today accept the practice of using saws to shape specimens. Although the miners and the dealers in Huya know the importance of keeping crystals damage-free, the prevailing methods of mining and of packing specimens sometimes make this impossible. At the mine site, many

Figure 3. **The village of Huya, in Pingwu County. From here (elevation 1500 meters) one must climb on foot to the mine site at 4480 meters. Ottens photo.**

Figure 4. **The trail to the mine leads through the Huya Xuebaoding National Park, a protected habitat for Giant Panda bears such as this one, spotted climbing a tree near the trail. Ottens photo.**

specimens, not individually wrapped, are taken out of a sack to be shown and offered the visitor, and it is no wonder that every one shows damage.

In a good year a mine like this, with the whole group of miners working together, can show a clear profit of up to 30,000 RMB, which comes to 4,000 RMB, or $500, per person. Specimens are sold regularly to the dealers who live in Huya, who in their turn dispose of them to other dealers, especially those going to Changsha. If visitors to Huya want to acquire good specimens, they need to be lucky enough to find just-mined ones, for all good finds are sold very quickly. In fact, news of them is, as a rule, called in immediately via cell phone to the dealers in Changsha, who grab up the specimens right away to forestall competition.

GEOLOGY

The Xuebaoding beryl-scheelite vein deposits in Pingwu County belong structurally to the sub-Pankouwan Dome, which is north of Longmenshan, west of the Huyaguan fault, and east of the Xuebaoding Dome of the western Yangtze paraplatform. Frequent tectonic movements and magmatic activities in this region in the course of geologic history have given rise to deposits of tungsten, tin, copper, lead, zinc and gold. Up to now, only a very few scientific studies have been available, but because of the economic significance of the area, further research is to be expected.

Figure 5. **Zhibaisha, the muddy base camp at 3900 meters where around 100 miners live during the summertime. Ottens photo.**

The regional stratigraphic formations belong to a Triassic system, including the lower Bocigou, middle Zhagashan, and upper Zhowou Series, a sequence of metamorphosed rocks with intercalated carbonate rocks whose total thickness is between 1,500 and 2,000 meters. These are the host rocks of the tungsten, tin and beryllium minerals. The dominant igneous rocks are alkali granites, occurring as scattered intrusions in the area of the Xuebaoding massif. The intrusive rock is an adamellite-monzodiorite with muscovite; it is composed of plagioclase (to 64.33%); K-feldspar, chiefly microcline (12%); muscovite (20%); quartz (2%); tourmaline (2 to 3%); and trace minerals including magnetite, ilmenite, zircon and apatite. On the basis of its chemical composition this alkali granite can be considered aluminum-supersaturated. Studies have established that igneous rocks of the Yanshanian period (170 million years ago)—the matrix material of the scheelite crystals—contain a high concentration of WO_3 (0.03–0.3%). The main ore-controlling structure is the Xuebaoding anticlinorium, on the southeastern side of the Xuebaoding dome.

In the mining area, the orebodies occur in muscovite-rich quartz veins and arizonite (a rock type composed of 80% quartz and 18% alkali feldspar with accessory mica and apatite). The ore-bearing veins are contiguous to the alkali granite intrusions. Two types of veins can be distinguished: muscovite-quartz and muscovite-feldspar-quartz. In addition to scheelite, cassiterite and beryl, other minerals, including tourmaline, fluorite and calcite have been observed in various veins. Malachite and pyrite may be found on the mine dumps.

A Chinese scientific study (Cao Zhimin *et al.*, 2002) on fluid and gas inclusions in beryl and scheelite crystals is pertinent to the Xuebaoding vein occurrence, as it sheds light on the conditions of formation of the minerals. Mineralization took place at temperatures between 147° and 343° C, and chiefly between 200° and 310° C. The hydrothermal fluids, emanating from a pluton, were relatively low in NaCl (3–6% by weight), but high in volatile CO_2. On the basis of a verified pressure of 15.2–27.4 MPa, the depth of mineralization can be determined to have been 160–280 meters—thus the process can be described as near-surface and mesothermal. On the basis of a study of the $^{40}Ar/^{39}Ar$ isotopes, ore formation can be dated to 187 million years ago, during the Yanshanian Epoch.

MINERALS

Apatite Group $Ca_5(PO_4)_3(F,OH,Cl)$

Bright pink, thick-tabular to equant crystals to 4 cm of an apatite-group species, probably fluorapatite, occur at Xuebaoding. The pink apatite crystals have been found there more often than pink beryl crystals, which they resemble, though neither are common. Forms include a first-order and second-order prism, two first-order bipyramids, one second order bipyramid and the basal pinacoid. As with beryl, the crystals occur on coarse druses of muscovite crystals lining vein fractures in the rock, sometimes in association with cassiterite. The pink apatite crystals are easily distinguishable from pink beryl in that they show very little transparency and are less lustrous; furthermore the apatite, but not the morganite, shows good fluorescence.

Beryl $Be_3Al_2Si_6O_{18}$

Beryl occurs at Xuebaoding in three color varieties: colorless (variety goshenite), pale blue (variety aquamarine) and, very rarely, pink (variety morganite). The crystal habit is always thick-tabular, regardless of color, and in some cases the crystals have re-entrant angles around the rim due to parallel growth. And, whereas tabular beryl from other localities always contains elevated levels of alkali metals, particularly cesium, beryl from Xuebaoding contains relatively little Cs, only 0.23 weight % (White and Richards, 1999). The highly lustrous crystals reach several cm in diameter, and up to 20 cm in exceptional cases. A few heavily corroded crystals have been recovered; while the prism faces of some of these are intact,

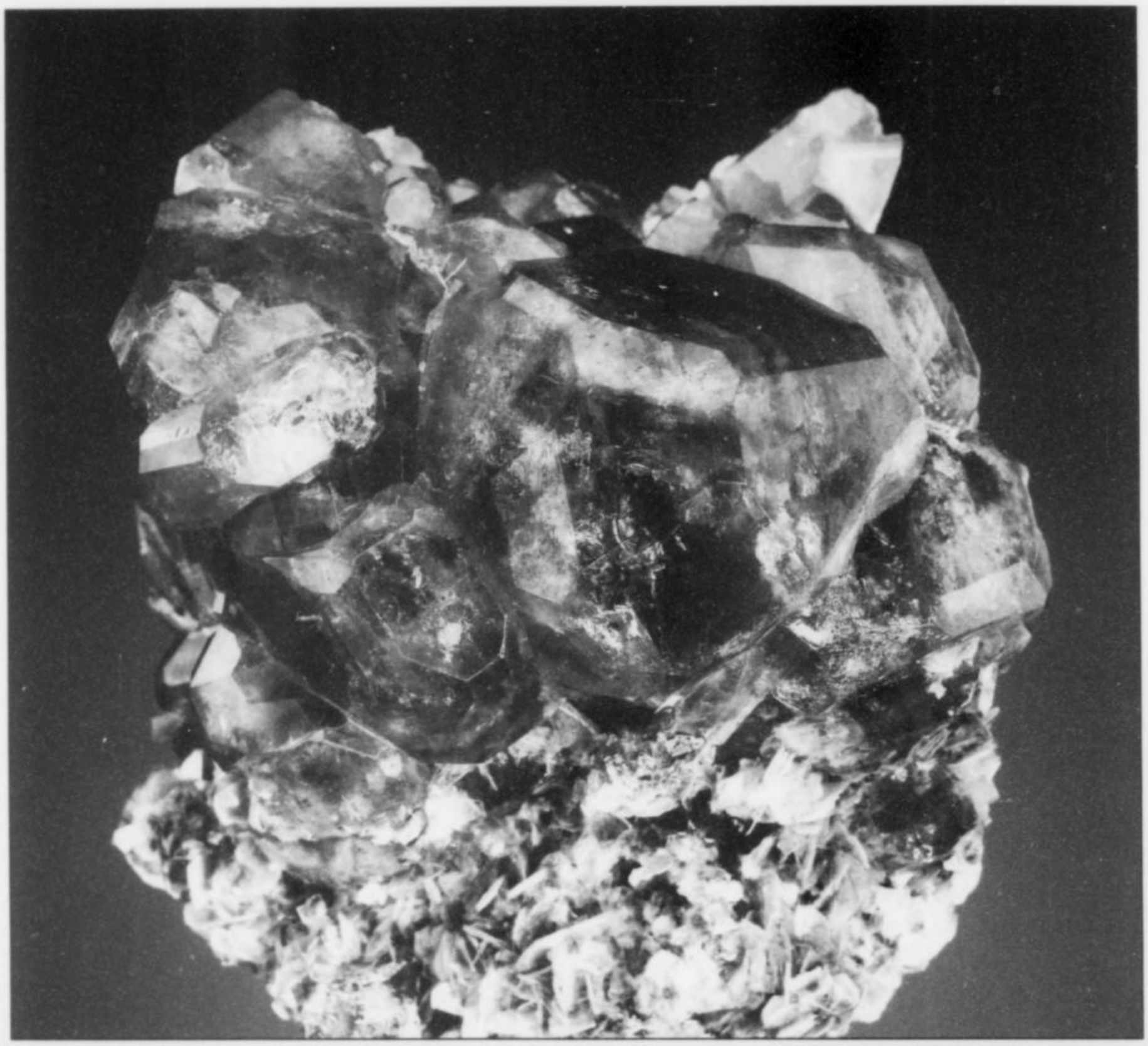

Figure 6. **Fluorapatite crystal cluster on muscovite, 8.2 cm, from Xuebaoding. Collector's Edge specimen; Jeff Scovil photo.**

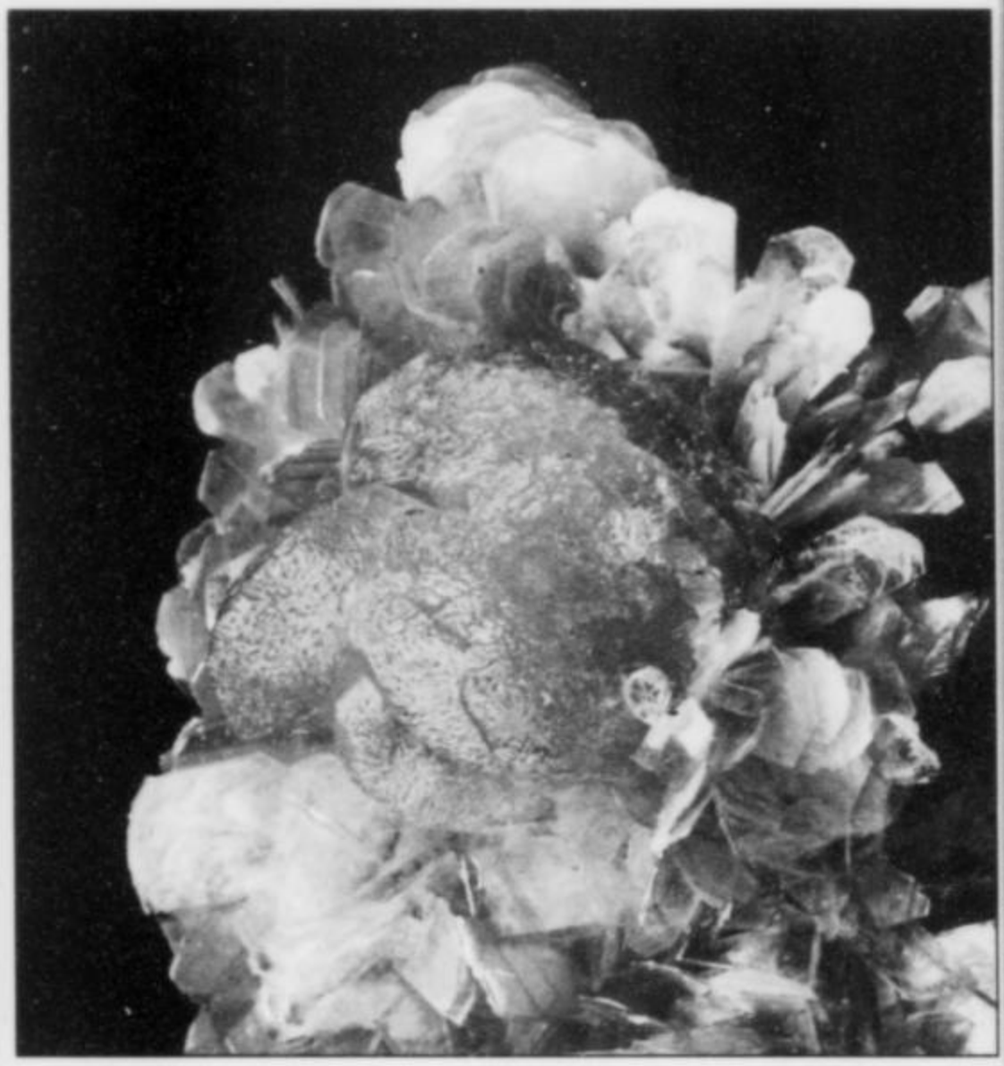

Figure 7. **Pink fluorapatite crystal cluster, 2.5 cm, on muscovite, from Xuebaoding. Jürgen Tron specimen; Jeff Scovil photo.**

Figure 8. **Cassiterite crystals on pink fluorapatite crystals, 4.7 cm, from Xuebaoding. Martin Zinn collection; Jeff Scovil photo.**

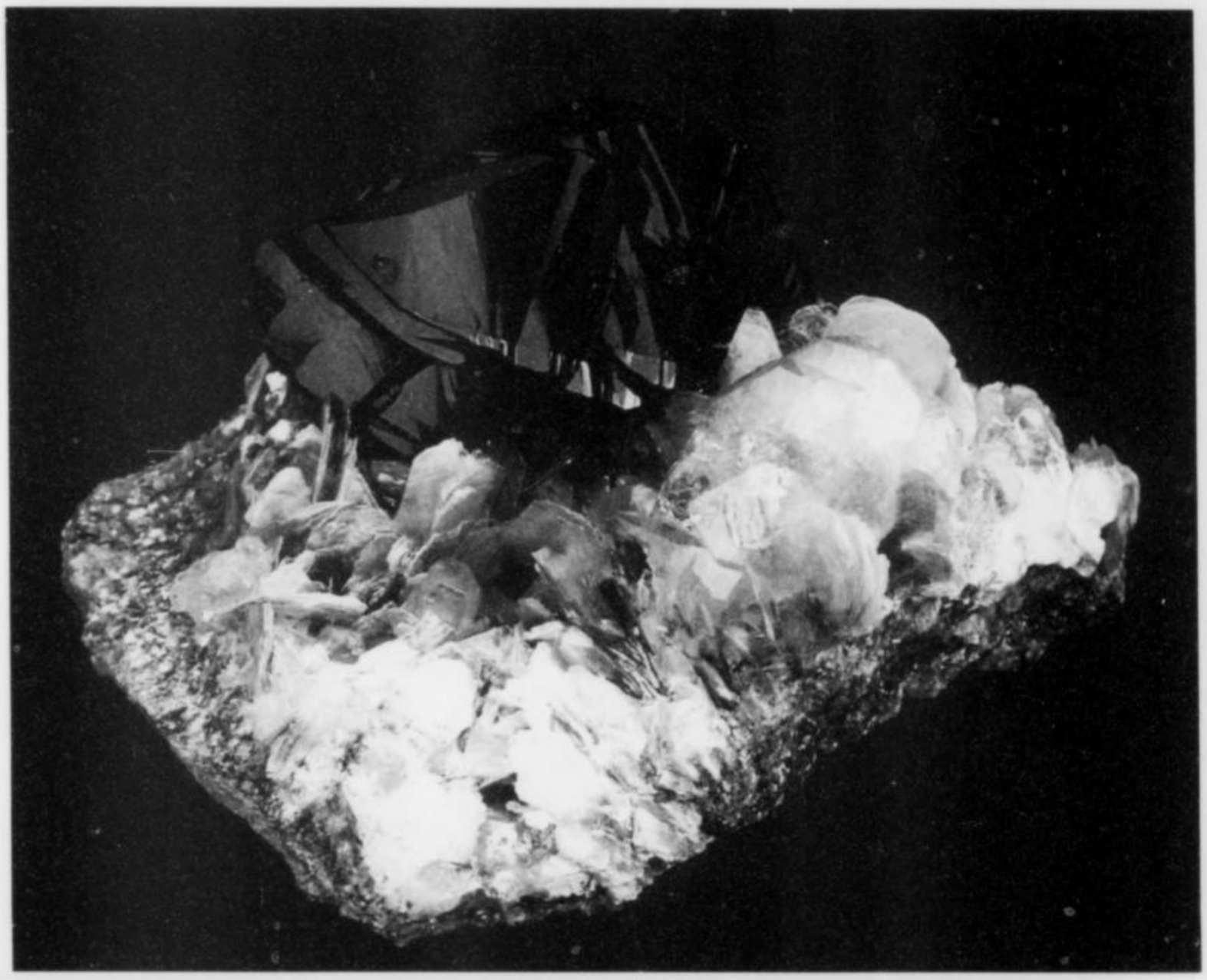

Figure 9. **Cassiterite crystals with pink beryl crystals on muscovite, 6.1 cm, from Xuebaoding. Fine Minerals International specimen; Jeff Scovil photo.**

Figure 10. **Scheelite crystal with pink beryl crystal, 3.2 cm, from Xuebaoding. Mike Bergmann specimen; Jeff Scovil photo.**

Figure 11. **Colorless beryl crystal on scheelite crystals, 3 cm, from Xuebaoding. Fine Minerals International specimen; Jeff Scovil photo.**

others show marked dissolution of the prism faces. Regrettably, some artificially irradiated crystals have been offered; these display an unnaturally intense blue color along the edges and at the corners.

Cassiterite SnO_2

Cassiterite is one of the most common minerals at the locality, occurring in high-quality crystals and twins to more than 7 cm. Most of the black, wedge-shaped crystals are highly lustrous, and are typically intergrown as V-twins. Single, short-prismatic crystals displaying the forms {100}, {110}, {101} and {111} occur rarely; in some cases these are twinned, like rutile, on the (101) plane. The cassiterite crystals and twins occur on the coarse drusy muscovite layers which line fissures.

Euclase $BeAlSiO_4(OH)$

There was a surprise in store for the observant visitor to the Munich Show in October 2003. Among the enormous and often bewildering stocks of the countless Chinese dealers there was a specimen from Xuebaoding with colorless, transparent crystals to 2 cm; the species in question was not clearly determinable upon

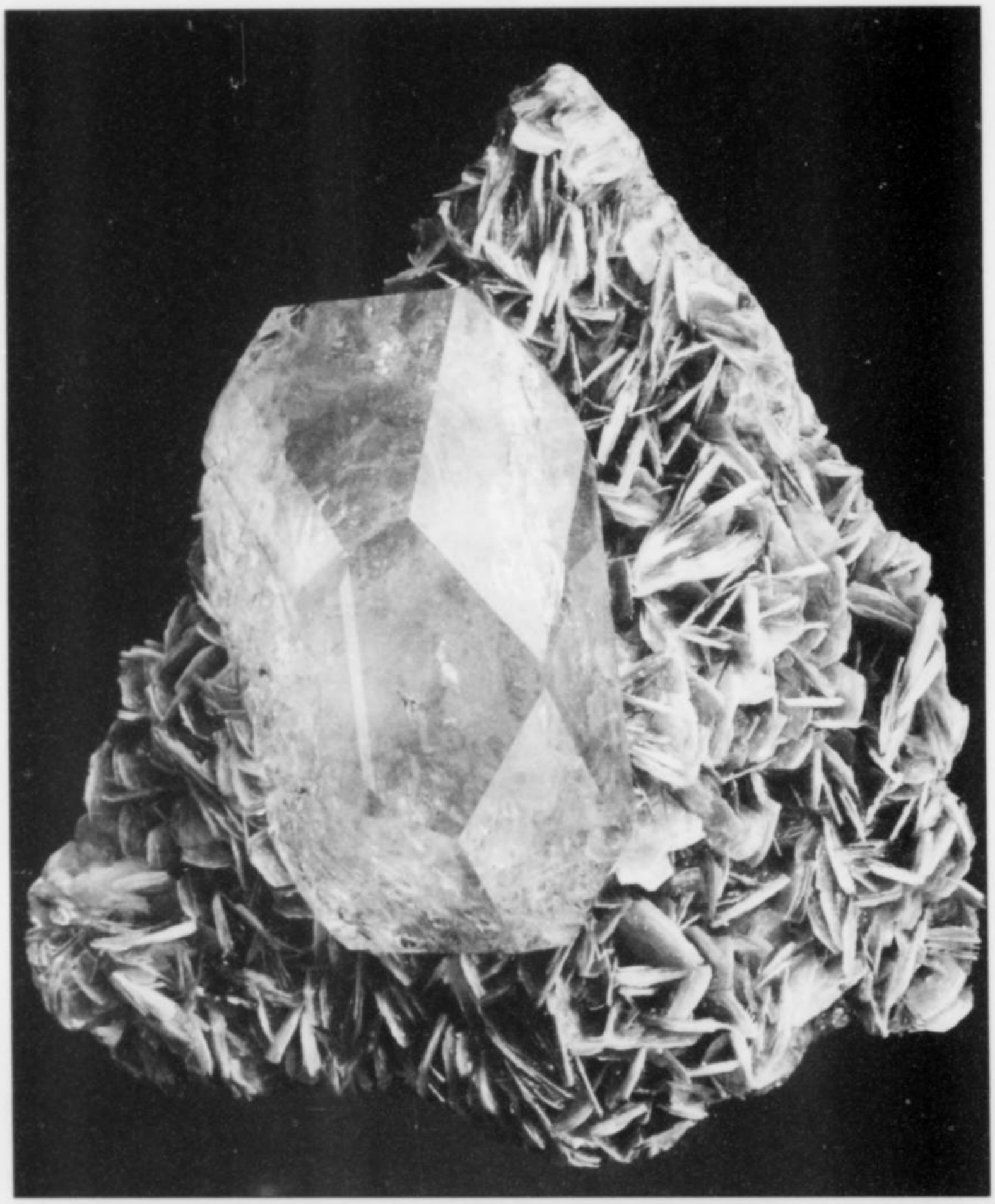

Figure 12. **Blue beryl (aquamarine) crystal on muscovite, 9.3 cm, from Xuebaoding. Collector's Edge specimen; Jeff Scovil photo.**

Figure 14. **Euclase crystal with scheelite on muscovite, 2.2 cm, from Xuebaoding. Peter Schlegel collection; Jeff Scovil photo.**

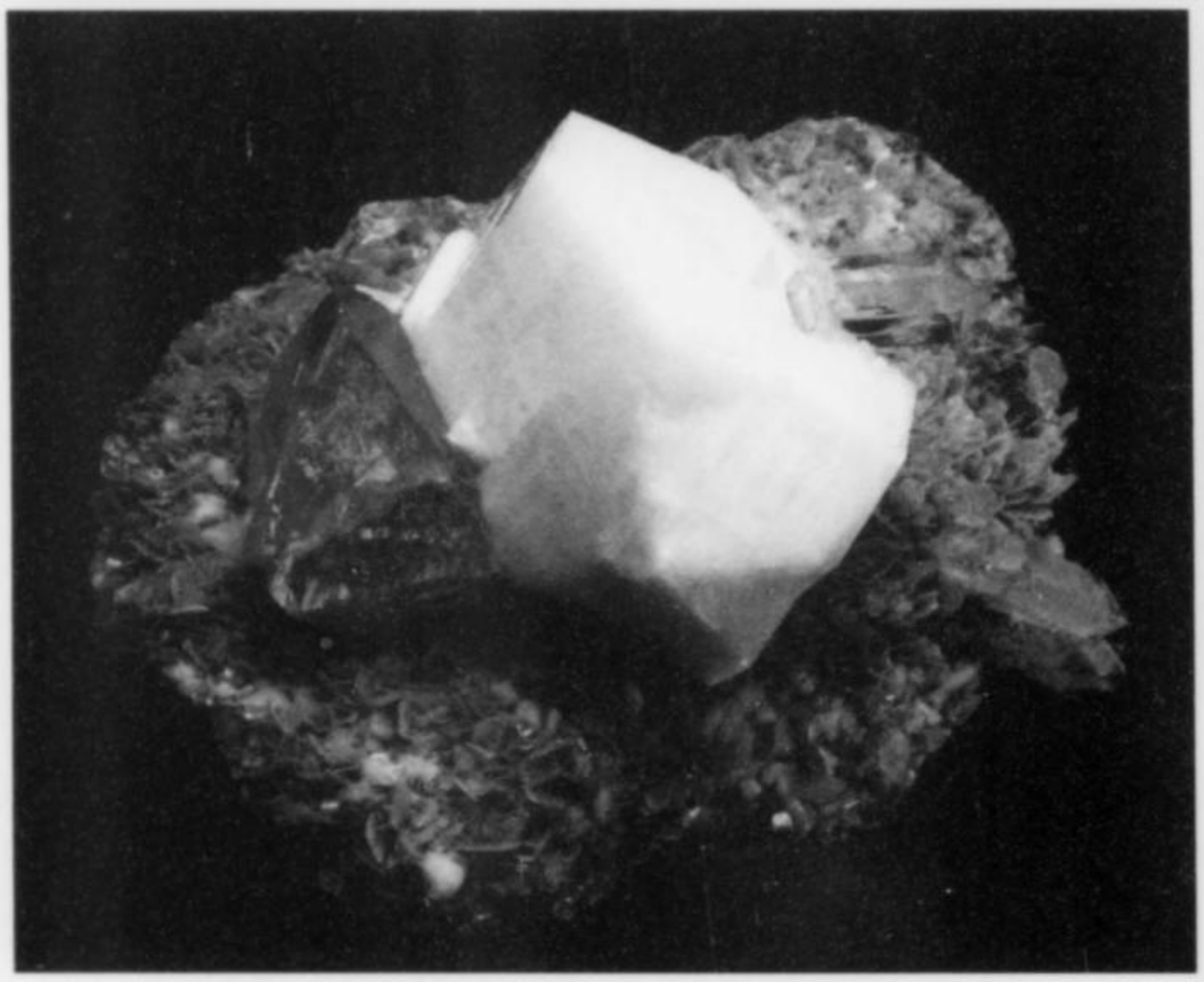

Figure 13. **Microcline crystal with scheelite crystal on muscovite, 8 cm, from Xuebaoding. Martin Zinn collection; Jeff Scovil photo.**

Figure 15. **Blue beryl (aquamarine) crystal on muscovite, 4.9 cm, from Xuebaoding. Fine Minerals International specimen; Jeff Scovil photo.**

Figure 16. **Cassiterite twinned crystal, 2.8 cm, on muscovite, from Xuebaoding. Wendell Wilson collection and photo.**

visual inspection. Only after examination at the University of Dresden were the crystals identified as euclase. Inevitably this specimen, and perhaps others, disappeared into private hands before it could be determined whether the specimen(s) show other species which also had not yet been seen, or are very rare, at Xuebaoding.

Feldspar Minerals

The locality has excited the interest of feldspar collectors by producing perfectly formed albite crystals, some almost entirely transparent, to several cm across. Orthoclase has also been observed in very well-developed, opaque white crystals and Manebach twins on muscovite matrix with beryl.

Fluorite CaF_2

Fluorite is comparatively rare at the locality, and specimens are therefore highly coveted. The cubic crystals are colorless to pale blue and can be quite large; the largest found so far measures about 15 cm along an edge. A frosty surface appearance apparently caused by partial resorption is characteristic.

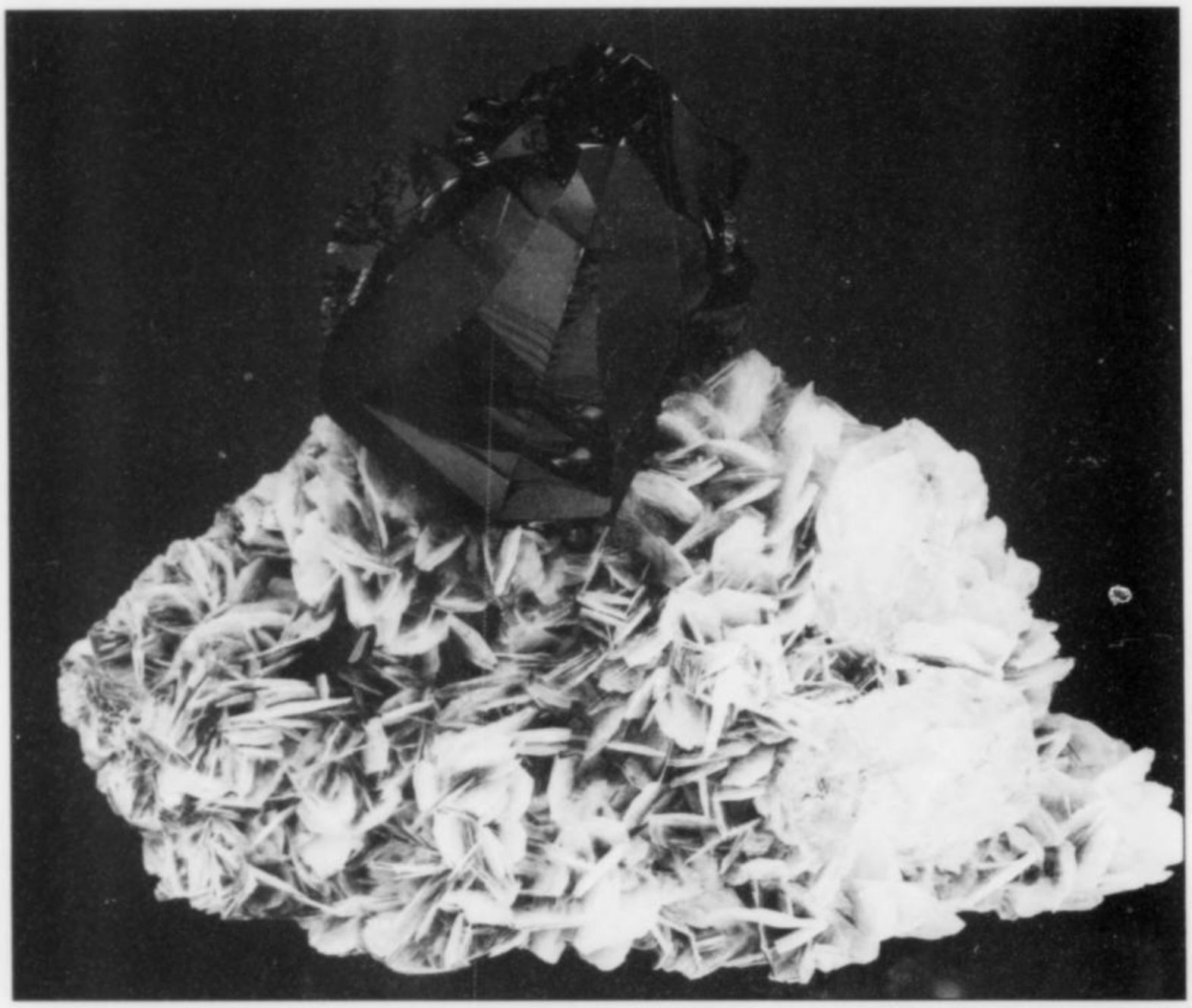

Figure 17. **Cassiterite twinned crystals on muscovite with beryl, 11.7 cm, from Xuebaoding. Sandor Fuss collection; Jeff Scovil photo.**

Figure 18. **Green fluorite crystal, 30 cm, in a custom-carved wooden base, from Xuebaoding. Ottens specimen and photo.**

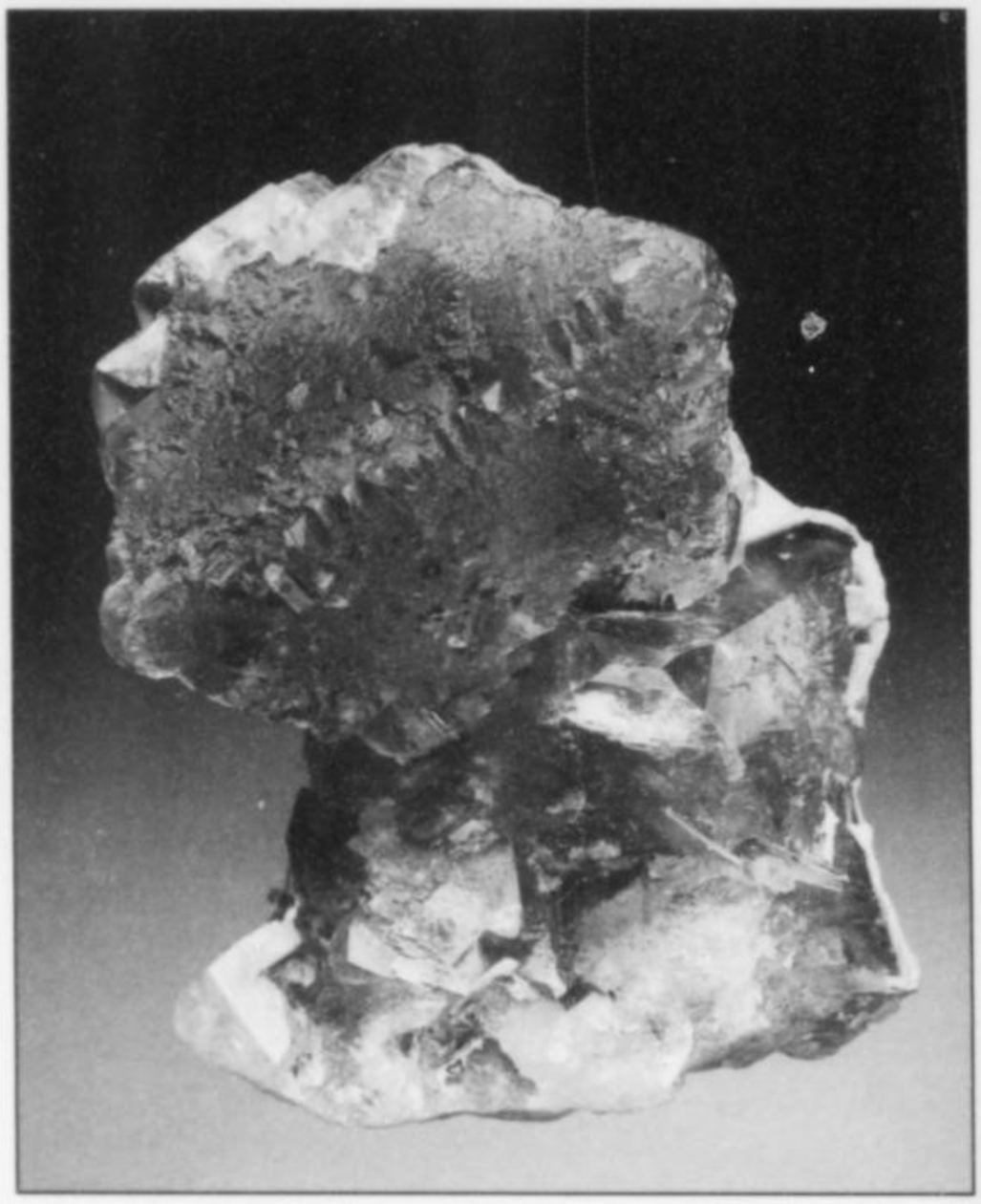

Figure 19. **Purple fluorite crystal on scheelite, 6 cm, from Xuebaoding. Frederic Escaut collection; Jeff Scovil photo.**

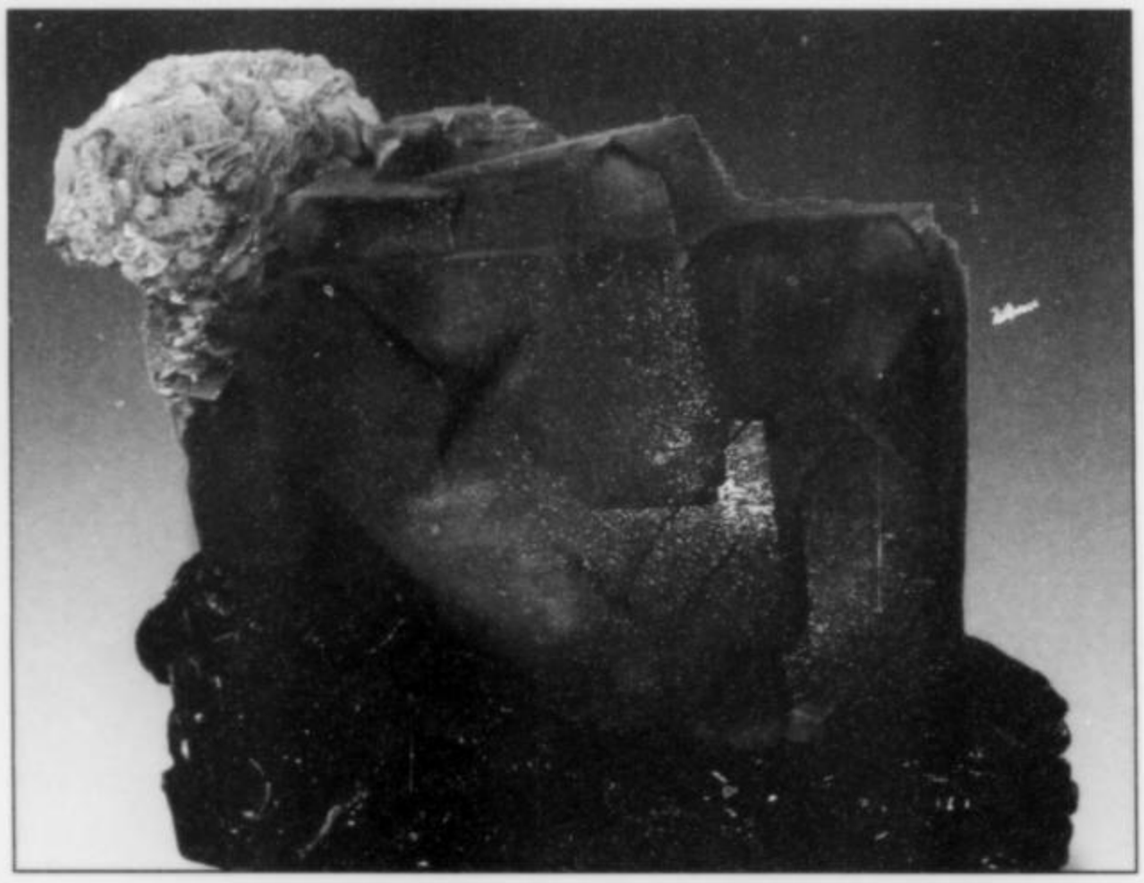

Figure 20. **Colorless fluorite crystals with scheelite on muscovite, 8 cm, from Xuebaoding. Brandstetter collection and photo.**

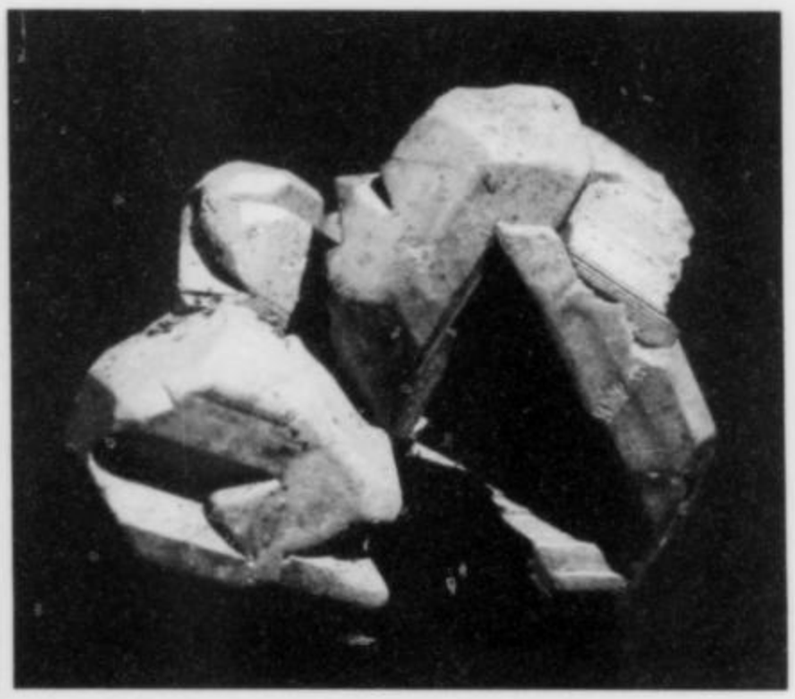

Figure 21. (above) **Këwhile crystals with green mushistonite coating, 3 cm, from Xuebaoding. Ottens collection and photo.**

Figure 22. (above left) **Këwhile crystals with green mushistonite coating on muscovite, 2.5 cm, from Xuebaoding. Trinity Minerals specimen; John Veevaert photo.**

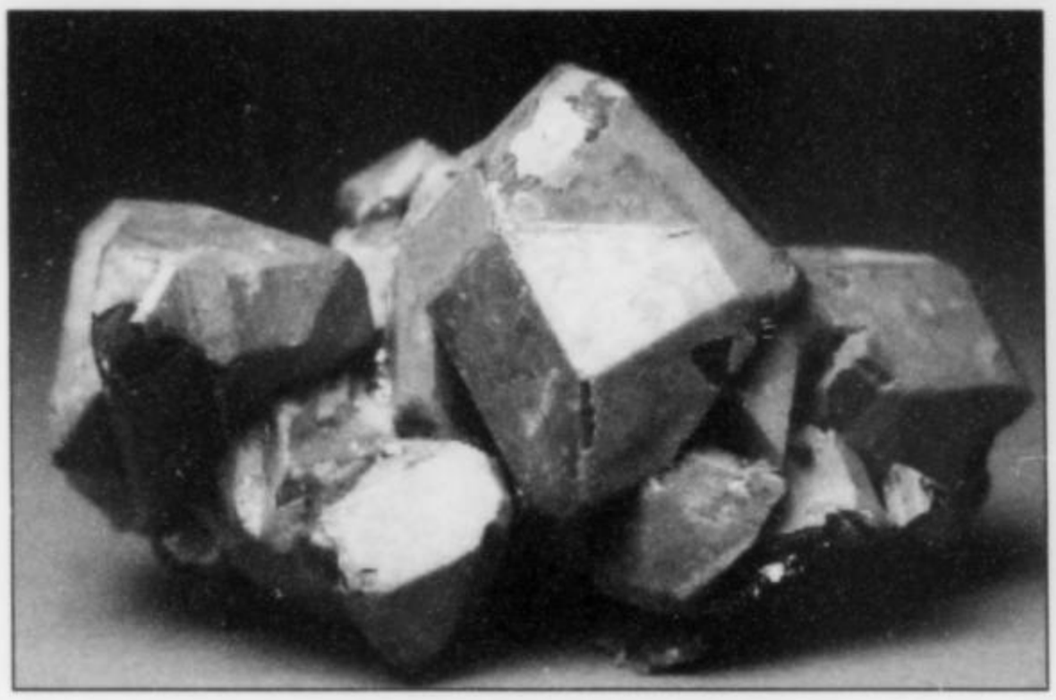

Figure 23. **Këwhile crystals with green mushistonite coating, 1.6 cm, from Xuebaoding. Shinichi Kato collection and photo.**

Figure 24. **Këwhile crystals with green mushistonite coating, 1.6 cm, from Xuebaoding. Shinichi Kato collection and photo.**

Këwhile $Cu_2(Zn,Fe)SnS_4$ and
Mushistonite $CuSn(OH)_6$

Two very interesting rare species occurring at Xuebaoding are këwhile and mushistonite. In 2001 and 2002 a few black crystals measuring about 1 cm and showing a greenish coating were recovered and were thought to be the species "pandaite," but soon it turned out that these in fact are extraordinarily large crystals of këwhile, a copper and zinc sulfide related to stannite. The best discovery took place early in 2003, when a number of very well-developed crystals, probably the finest known for the species, were found in a cleft. Individual këwhile crystals from this find reach more than 3 cm and carry a thin partial coating of white to pale yellow to pale green mushistonite, a copper-tin hydroxide. The sharp tetragonal disphenoidal crystals are usually intergrown, perhaps with some twinning, and are difficult to orient. They occur on muscovite, on beryl and on cassiterite crystals, as well as next to (but not on) scheelite.

Muscovite $KAl_2\square AlSi_3O_{10}(OH)_2$

Specimens from Xuebaoding characteristically show larger muscovite crystals perched on the typical cavity-lining coatings of muscovite.

Quartz SiO_2

The most attractive specimens from Xuebaoding are those in which scheelite, beryl and cassiterite appear on the same specimen, especially if well-developed crystals of quartz are also present. Quartz occurs in crystals to more than 50 cm long, and in beautiful crystal clusters, but specimens in which quartz is associated with the other major Xuebaoding species are unfortunately rare.

Scheelite $CaWO_4$

Although scheelite—a common ore species in China—is rarely of collector quality at other Chinese localities, it is one of the extraordinary highlights of Xuebaoding. The tetragonal dipyramidal crystals are of typical pseudo-octahedral habit and reach 10 cm across. The color ranges from pale beige to a beautiful deep orange and a stunning red-orange. The more richly colored crystals, especially those that are in large part transparent and have a mirror-bright luster, are the most highly valued and rank among the world's finest scheelite crystals.

Because of the brittleness of the crystals, their points are very frequently damaged during mining. Resourceful dealers quickly learned to create new crystal "faces" by filing and polishing, thereby concealing the problem areas. A practiced eye can easily recognize that the new faces do not match the ones possible for the crystal class of scheelite, and a close examination with a hand-magnifier clearly reveals the signs of filing and polishing. Sometimes, too, crystals which have fallen off the original matrix are seen to be glued back on.

Figure 25. **Scheelite crystal, 4.3 cm, with feldspar, muscovite and beryl, from Xuebaoding. Martin Zinn collection; Jeff Scovil photo.**

Topaz $Al_2SiO_4(F,OH)_2$

While investigating Internet offerings of minerals from Xuebaoding, I came across a specimen with crystals, associated with scheelite, identified as topaz. This did not seem believable, since the form resembled that of fluorite. During a visit to a dealer in Huya in the course of a trip in early 2004, a specimen was found with very similar-looking crystals: colorless and wholly transparent, the crystals reach 4 cm and are intergrown in a cluster 10 cm across. Inspecting the cleavage and crystal angles and testing for hardness quickly revealed that the mineral is indeed topaz, not

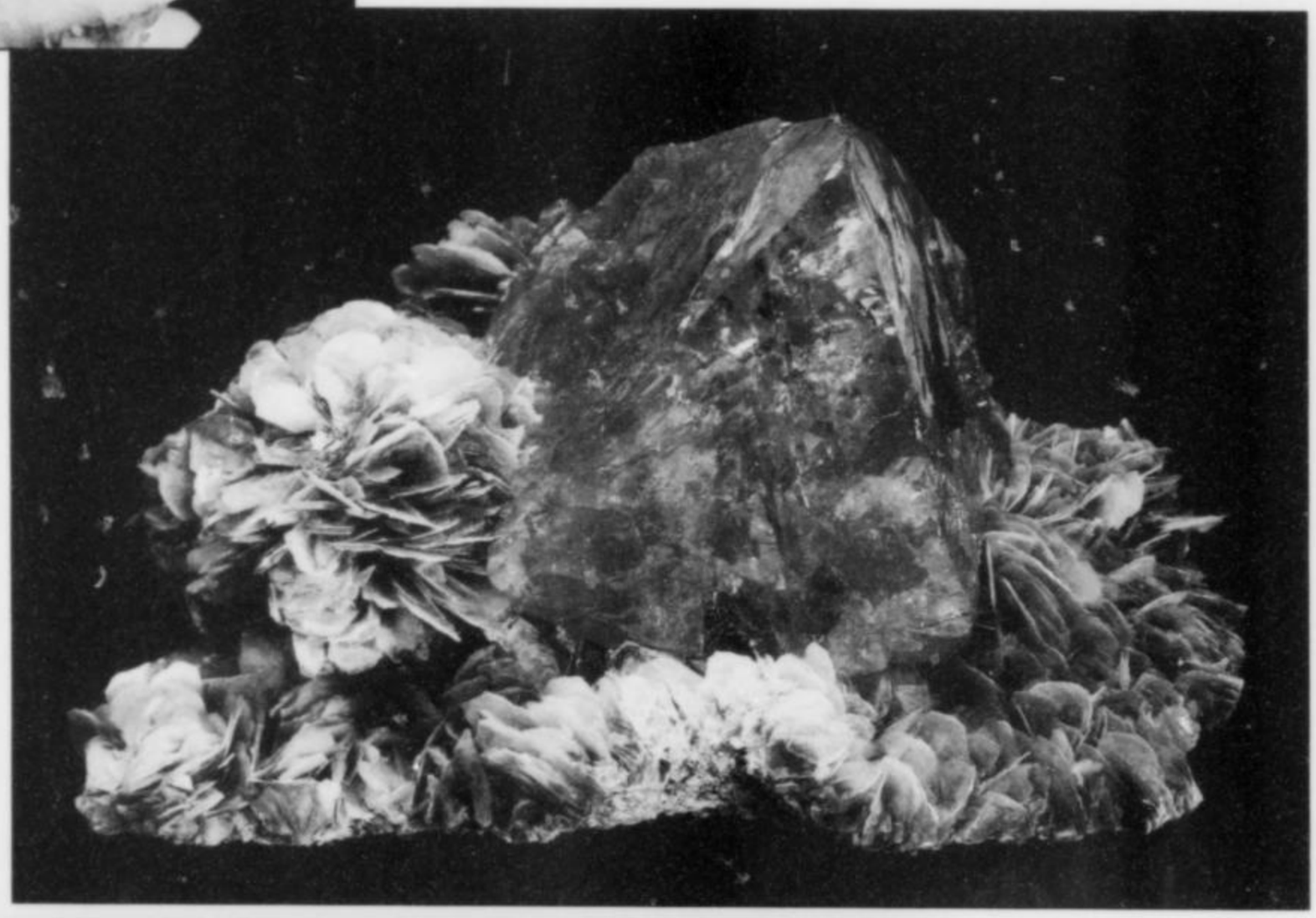

Figure 26. **Scheelite crystal on muscovite, 15.8 cm, from Xuebaoding. Steve Neely collection; Jeff Scovil photo.**

Figure 27. **Scheelite crystal on muscovite, 8.3 cm, from Xuebaoding. Irv Brown collection (ex Sandor Fuss collection); Jeff Scovil photo.**

Figure 28. **Scheelite crystal on muscovite with beryl, 11 cm, from Xuebaoding. Steven and Clara Smale collection; Jeff Scovil photo.**

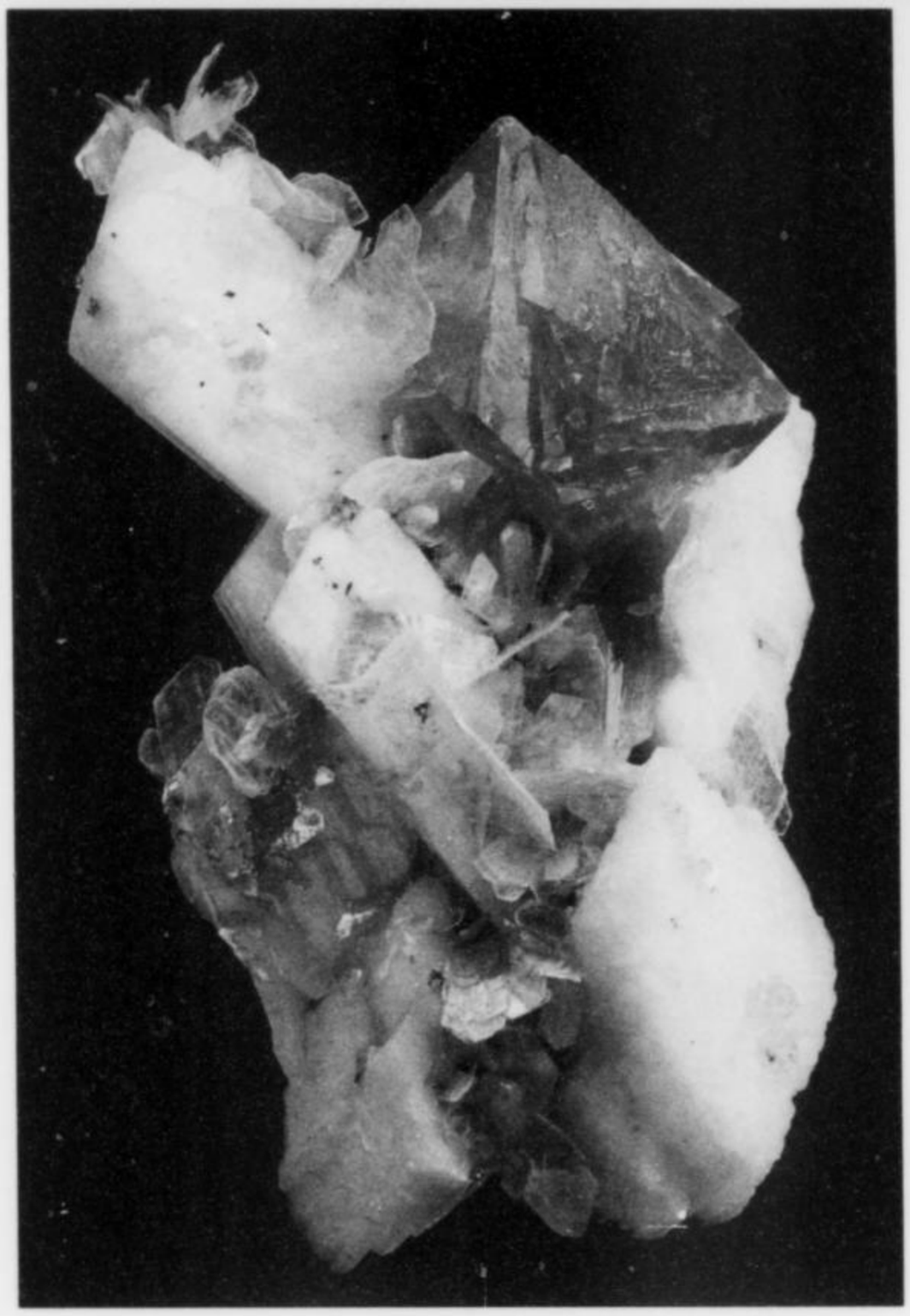

Figure 29. **Scheelite crystal on pericline crystals with muscovite, 5.5 cm, from Xuebaoding. Francis Benjamin collection; Jeff Scovil photo.**

fluorite, and that the specimen seen on the Internet had after all been correctly labeled. Surely more surprises like this from Xuebaoding await us in the future.

Other Minerals

Calcite crystals, white and corroded, have been seen on some scheelite specimens. Dolomite and phenakite have also been reported but have not been confirmed.

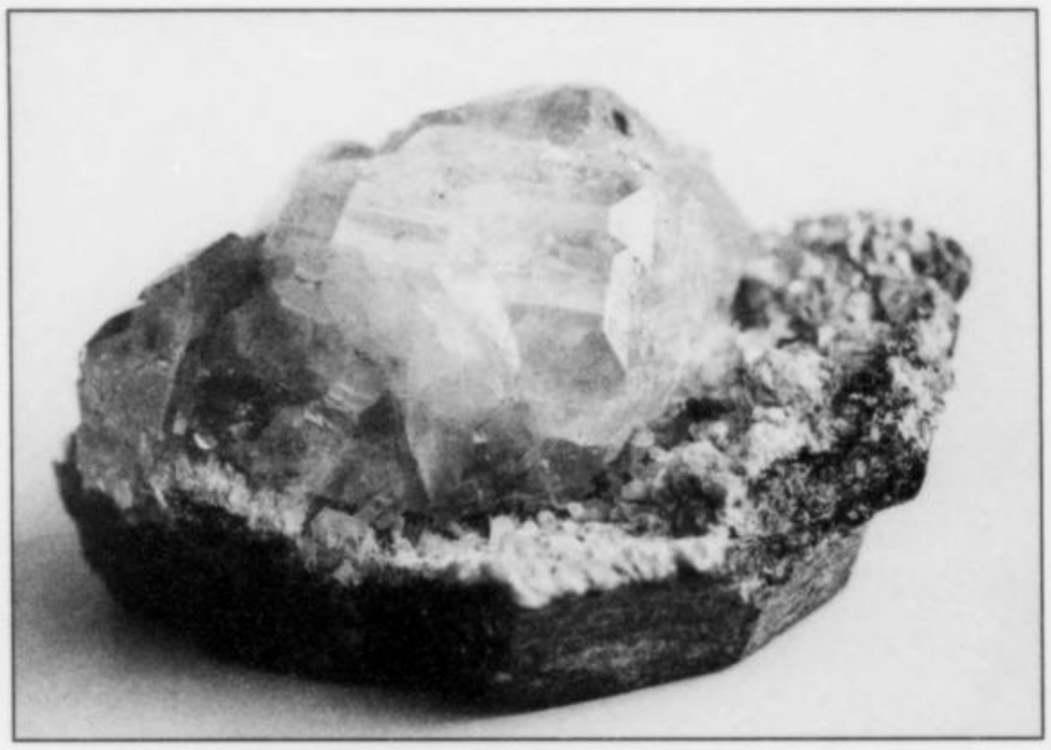

Figure 30. **Topaz crystals on muscovite, 10 cm, from Xuebaoding. Ottens specimen and photo.**

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Fluorite, 9 inches, from the Yaogangxian mine, Hunan, China.

Stuart Wilensky photo.

中國 螢石

CHINESE FLUORITE

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau
Germany

Of all the minerals which have come from China in fine specimens since about 1990, fluorite has thus far been the most abundant and most varied in habit, color and associations. Many specimens are oiled or otherwise objectionably enhanced by Chinese middlemen, but the fact remains that some Chinese fluorite localities are of world-class importance, and more discoveries may be expected.

INTRODUCTION

When the first new mineral specimens from China began appearing on the mineral Western market in the late 1980's and early 1990's, enormous stibnite crystals, fine cinnabar crystals and fascinating specimens of realgar and orpiment were among the highlights which provided a new impulse to collecting activities. Offerings of Chinese minerals grew considerably over the next few years, generally without full and precise locality information in most cases. Such information has since appeared in only a few publications, e.g. Bancroft (1997), Liu (1995), Behling *et al.* (2002), Hawthorne (2002) and Ottens (2003). The present article is intended to fill the informational gap regarding Chinese fluorite, now commonly offered on the market.

THE MARKET FOR CHINESE FLUORITE

When minerals appeared for sale in the Western world after the opening of China, fluorite specimens from Hunan were quickly numbered among the most interesting items. Aesthetically attractive clusters of pale blue Shangbao fluorite crystals, many of them transparent, were highly coveted. In 1995, abundant beautiful specimens of green fluorite were produced from the Xianghualing mining district. The Chinese dealers, having learned quickly that fluorite is quite easy to sell, then developed more localities as supply sources. Especially notable among these is the Yaogangxian mine, with sharp blue cubic crystals. Most recently, violet and green crystals of various forms embedded in white quartz matrix have come from mines in Jiangxi and Guangdong provinces. The selection of Chinese fluorite specimens available has turned out to be extraordinarily varied with respect to forms, colors, associations and localities. It is heartening that the miners have learned so quickly to collect specimens with the utmost care, so that undamaged specimens may be offered in quantity. Unfortunately, however, the well-motivated dealers have learned how a dull luster, or damage to crystals, may be concealed. Consequently, fluorite specimens in China are commonly stored in water, or are "improved" with all sorts of oils, or with hairspray or silicone. It is regrettable that at mineral shows, fluorite specimens are oiled right under the eyes of customers—and not only by Chinese dealers—and nevertheless are sold.

It should be noted that most of the fluorite offered in the form of collector specimens is found as a gangue mineral in ore veins, in deposits mined for other minerals. But, interestingly, at about 4 million tonnes per year (Zho Xun *et al.*, 2002), China leads the world in fluorite production, and provides more than half the world's total. Fluorite is mined in almost every province, from nearly 900 deposits.

The most important deposits for industrial purposes are in the provinces of Zhejiang, Fujian, Hunan and Guizhou. No collector-quality fluorite has been reported from most of these occurrences, although a few deposits do produce beautifully color-banded massive material from which artistic objects such as sculptures, bowls and figurines have been fashioned. Especially attractive are the very thin bowls made of violet and green-banded fluorite with

natural pyrite coatings around their rims. An astonishing craftsmanship and feeling for form shows forth in these beautiful and fragile objects.

China inherits an ancient tradition of working jade into fine artistic creations, and by "jade" one certainly does not just mean jadeite or nephrite; many other minerals, and not least fluorite, are used in the decorative arts as jade substitutes. Whereas in earlier centuries the majority of the people could not afford to acquire "jade" sculptures, they can be acquired much more cheaply today thanks to the use of more common materials and to mass production techniques. The wide spectrum of offerings now includes not only sculptures made from pale greenish fluorite but also animal figures, pyramids, obelisks, etc., made from interestingly color-banded material. Also, the people who attribute special esoteric powers to earth materials are fond of tumbled stones and other artifacts made from Chinese fluorite.

To date, fluorite is certainly the Chinese mineral of greatest abundance on the Western market. Some of the more important occurrences are examined more closely below.

MAJOR FLUORITE SPECIMEN OCCURRENCES

Hunan Province

Of particular significance is Hunan Province, where 37 fluorite-bearing deposits and 43 other occurrences of fluorite have been investigated. Of the deposits, seven produce fluorite as an industrial byproduct. One example is the **Taolin** lead/zinc deposit, which, besides being a source of interesting mineral specimens, has a remaining reserve of 60 million tonnes of fluorite. The world-famous polymetallic deposit of **Shizhuyuan**, in the southern part of the province, has a proven reserve of 45 million tonnes of fluorite; up to now, only a few collector pieces from Shizhuyuan have come on to the market, despite intensive mining. One of the reasons why so much collector-quality fluorite has been found in Hunan Province particularly may be that a great many of the ore deposits there were formed by the intrusion of granitic magmas into older sedimentary rocks, and cracks and fissures in the latter make ideal environments for the formation of fluorite crystals.

One of the deposits classified as belonging to the "polymetallic sulfide" type, and greatly enriched in tin, is **Xianghualing**, in the Nanling Mountains, about 80 km southwest of Chenzhou in Linwu County—a region rich in ore deposits. Discoveries of ancient copper-smelting ovens and mine workings have dated the earliest mining activities here to 907–960 A.D. During the Ming Dynasty (1573–1620 A.D.), in addition to earlier tin and arsenic mines, lead/zinc mines were worked at Taipingli, Caiyuanzi, and other sites in the Xianghualing area. The Xianghualing orebody, extending over an area of 36 square km, is emplaced in Devonian sedimentary rocks with intrusions of Mesozoic-age granites. With regard to mineralization and the relationship between ore and country rock, the deposit can be assigned to different genetic types: a granitic tantalum/silver deposit, a hydrothermal tin/beryllium and tin/lead/zinc deposit, and a tin-bearing occurrence in sandstone. The formation and distribution of the fluorite bodies is a result of hydrothermal activity and intermittent tectonic events.

In the Xianghualing district, ore is taken from several large mines and from numerous small, unconnected workings. These workings are visible from a distance on the steep slopes of the mountain. The district includes mines directly adjacent to the village of **Xianghualing**, and mines at **Xianghuapu** and **Dongshan**. Presently the ore reserves are nearing exhaustion, but new, interesting occurrences in the region certainly await discovery. As soon as sufficient capital and foreign investment become available, new mines will be opened in the vicinity of Xianghualing. Uranium minerals are of special significance with a view to energy supplies.

At an elevation of about 1,594 meters on Mount Xianghualing there is a **cassiterite mine**; however, it produces no collector-quality specimens of cassiterite, as it is a greisen deposit, with the ore finely divided in country rock. The significance of this deposit for collectors is that between 1996 and 1998, large quantities of deep green fluorite in cubic crystals to more than 10 cm were found there. Specimens with deep green and totally transparent cubic crystals are highly coveted; green octahedral crystals with matte luster are rarer. Also, fluorite specimens showing crystals of a later generation and different habit overgrown on earlier crystals are characteristic of Xianghualing (Rustemeyer, 2002). In the most commonly observed specimens of this type, cubic crystals rest on octahedral ones; in a few discoveries, the first generation of octahedral crystals is overgrown by a thin quartz crust, upon which rest cubic crystals of the second fluorite generation. Faden crystals of fluorite are another specialty of Xianghualing.

Calcite occurs commonly, in some cases as flattened, very thin crystals, in others as rhombohedral crystals to 10 cm. In long-wave ultraviolet light, some of the fluorite fluoresces blue, and some of the calcite fluoresces bright orange. Rarely, scheelite is found as white crystals to 1 cm. Some of the fluorite discoveries at Xianghualing have attracted special attention, and commanded

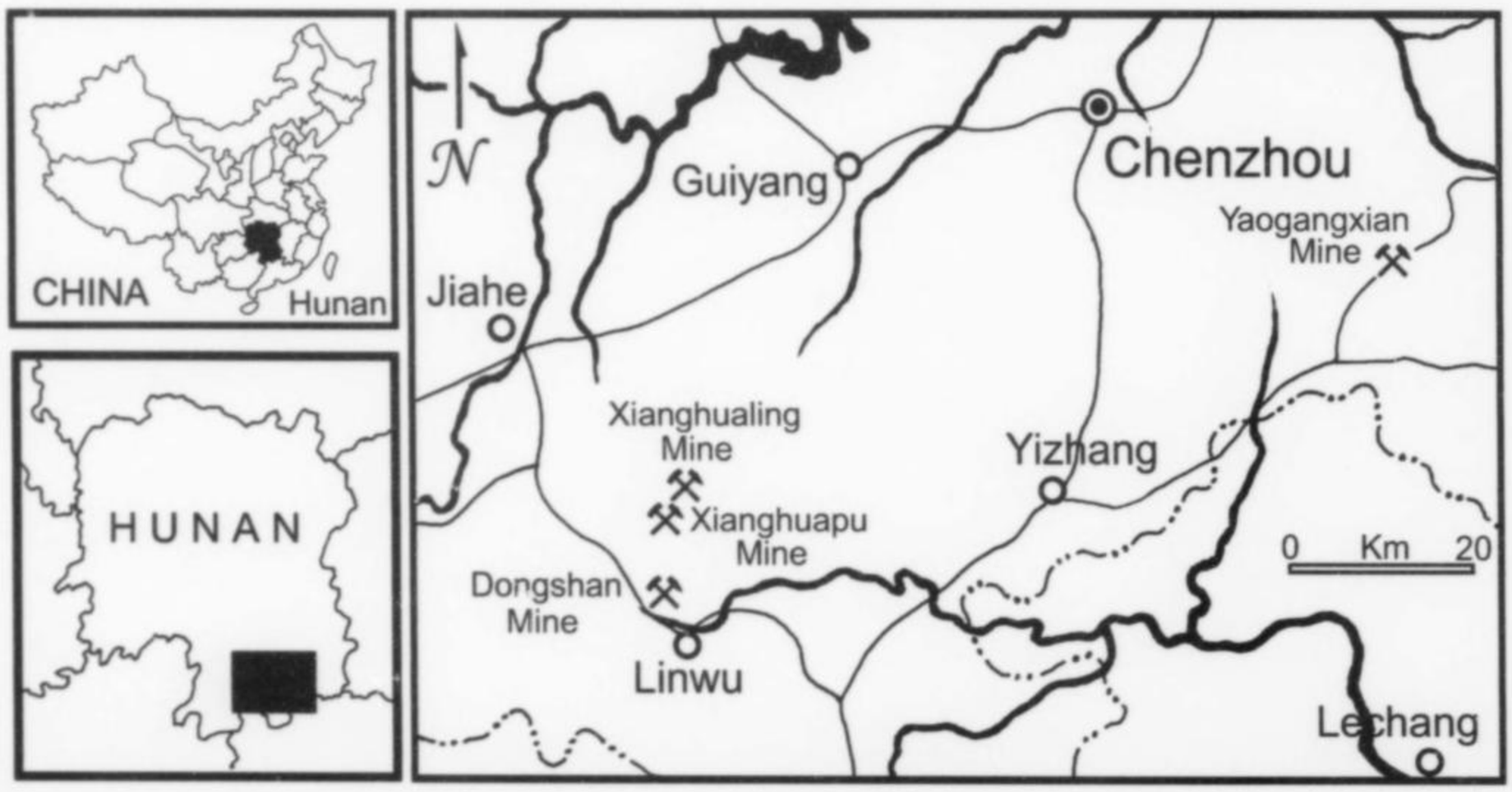


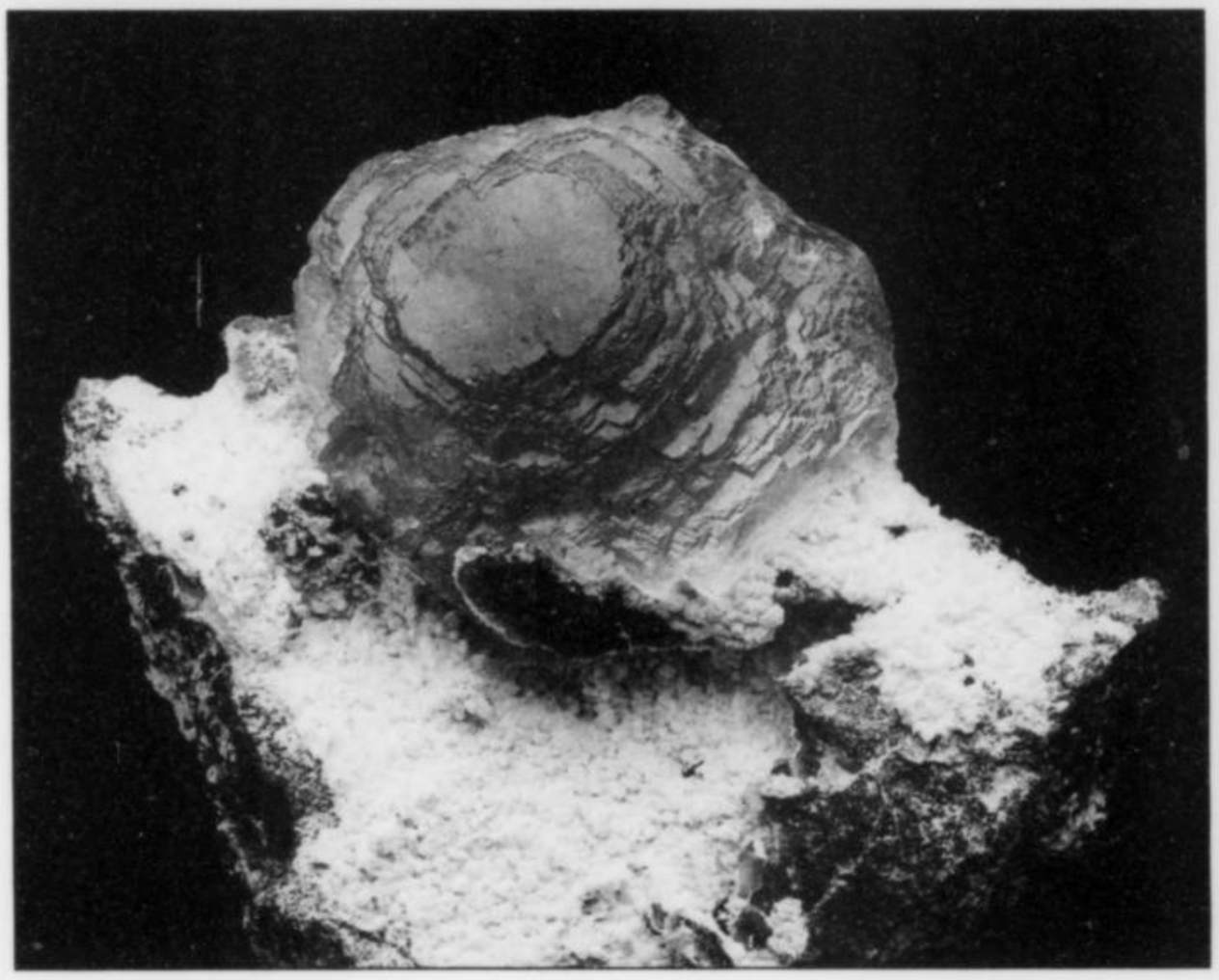
Figure 1. **Location map showing the Xianghualing, Xianghuapu, Dongshan and Yaogangxian mines.**

Figure 2. **The Xianghualing cassiterite mine in Linwu County, Chenzhou prefecture, Hunan—famous for green fluorite specimens; Ottens photo.**

Figure 3. (left) **Fluorite crystals on matrix, 10 cm, from the Xianghualing mine. Cliff Vermont collection; Jeff Scovil photo.**

Figure 4. (below left) **Fluorite crystal on matrix, 12.2 cm, from the Xianghualing mine. Carolyn Scita collection; Jeff Scovil photo.**

Figure 5. (below) **Cubic fluorite crystals as a second generation growth on an octahedral fluorite crystal, 6 cm, from the Xianghualing mine. Jeff Scovil photo.**



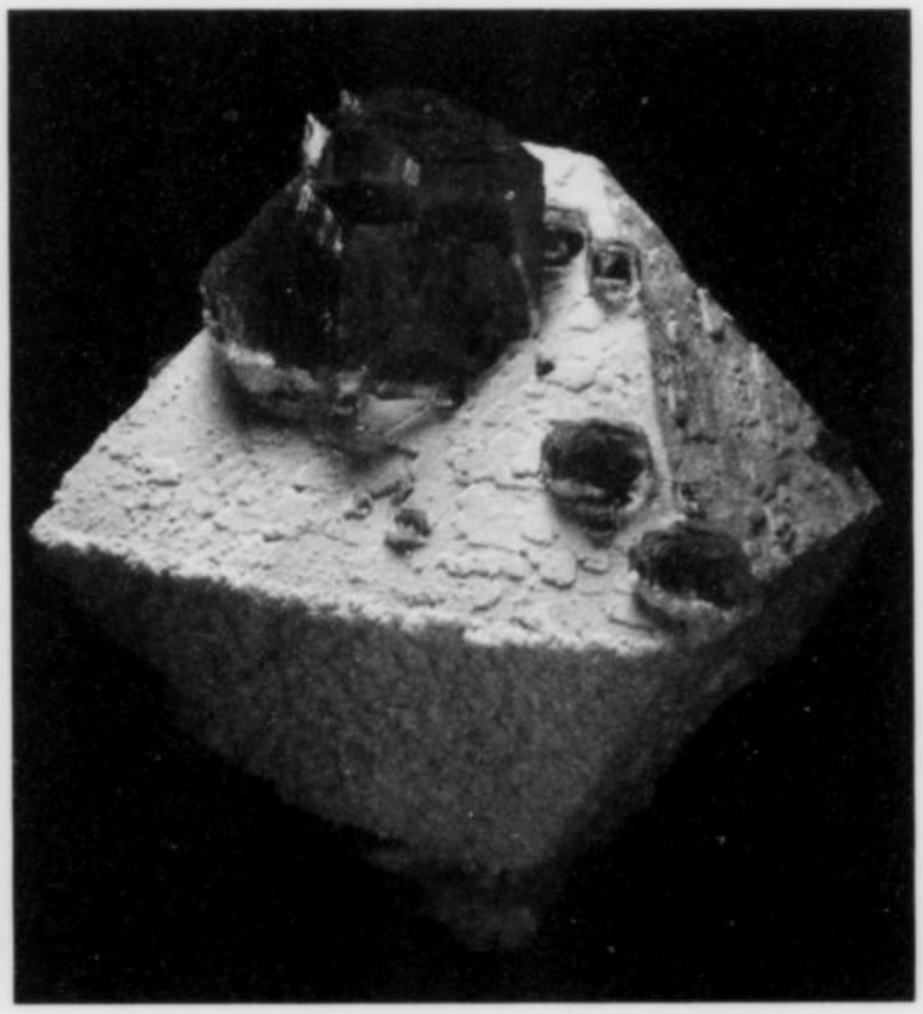


Figure 6. **The Xianghuapu tungsten mine, Linwu County, Chenzhou prefecture, Hunan—famous for pale green, zoned fluorite with pink calcite. Ottens photo.**

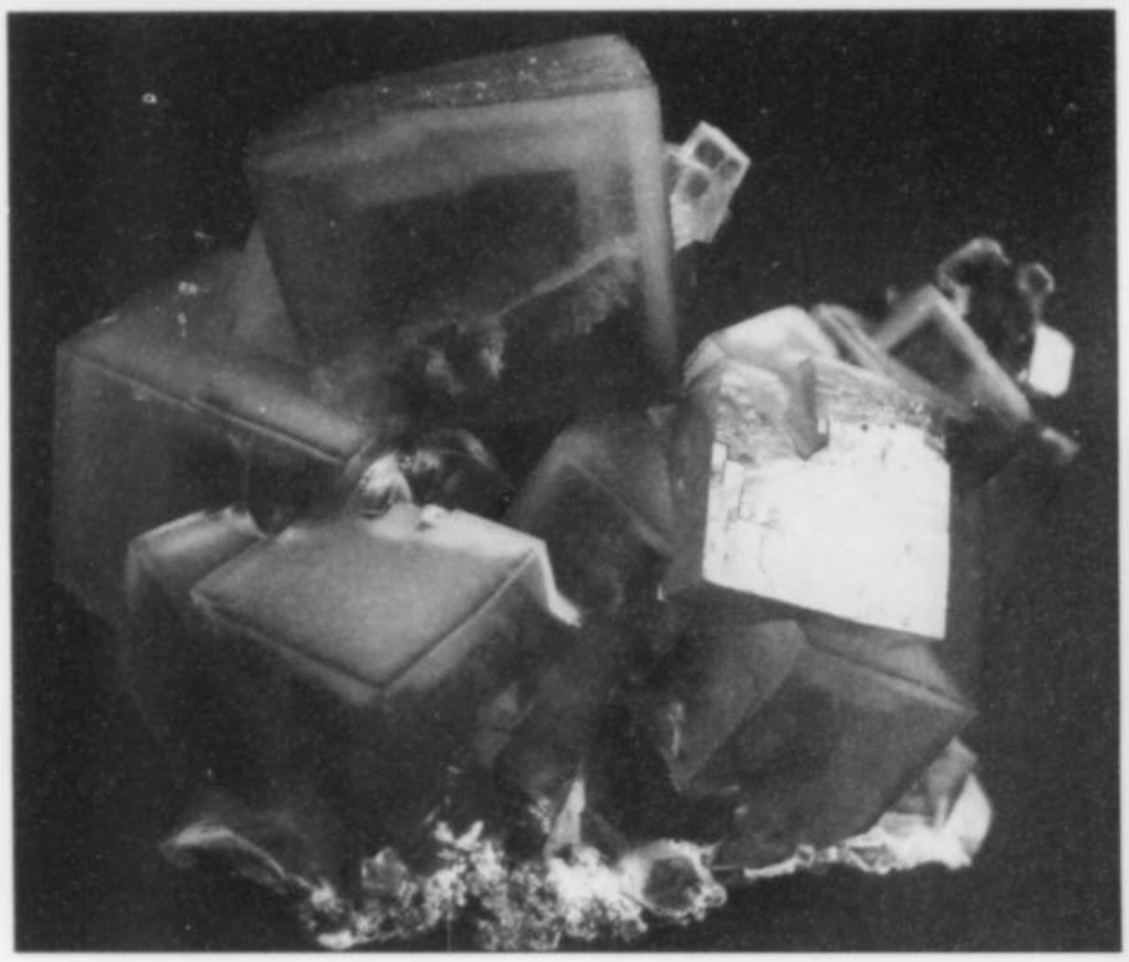


Figure 7. **Green fluorite with phantoms or color zones, 8 cm, from the Xianghuapu mine. Robert Brandstetter collection and photo.**

very high prices, because of the great size, intense color, and clarity of the crystals. Unfortunately, this popularity has led to the use of irradiation to "improve" the green color of what were originally unremarkable specimens. This artificially induced color is not stable, however; after several months, or a year, the crystals revert to a pale hue. Any calcite present in the irradiated specimens changes in color also—from white to brownish gray.

A great rarity from the deposit—until recently known only from Xianghualing, its type locality—is hsianghualite, a lithium and beryllium-bearing zeolite which belongs to the isometric system and forms face-rich, almost spherical white crystals to 3 mm in diameter.

The mine at **Xianghuapu**, lying halfway between Linwu and Xianghualing, is also of great interest for collectors. This polymetallic occurrence chiefly produces tungsten and tin. The fluorite which occurs there is commonly green with brownish interior color zones, but large, sharp, colorless and bright blue,

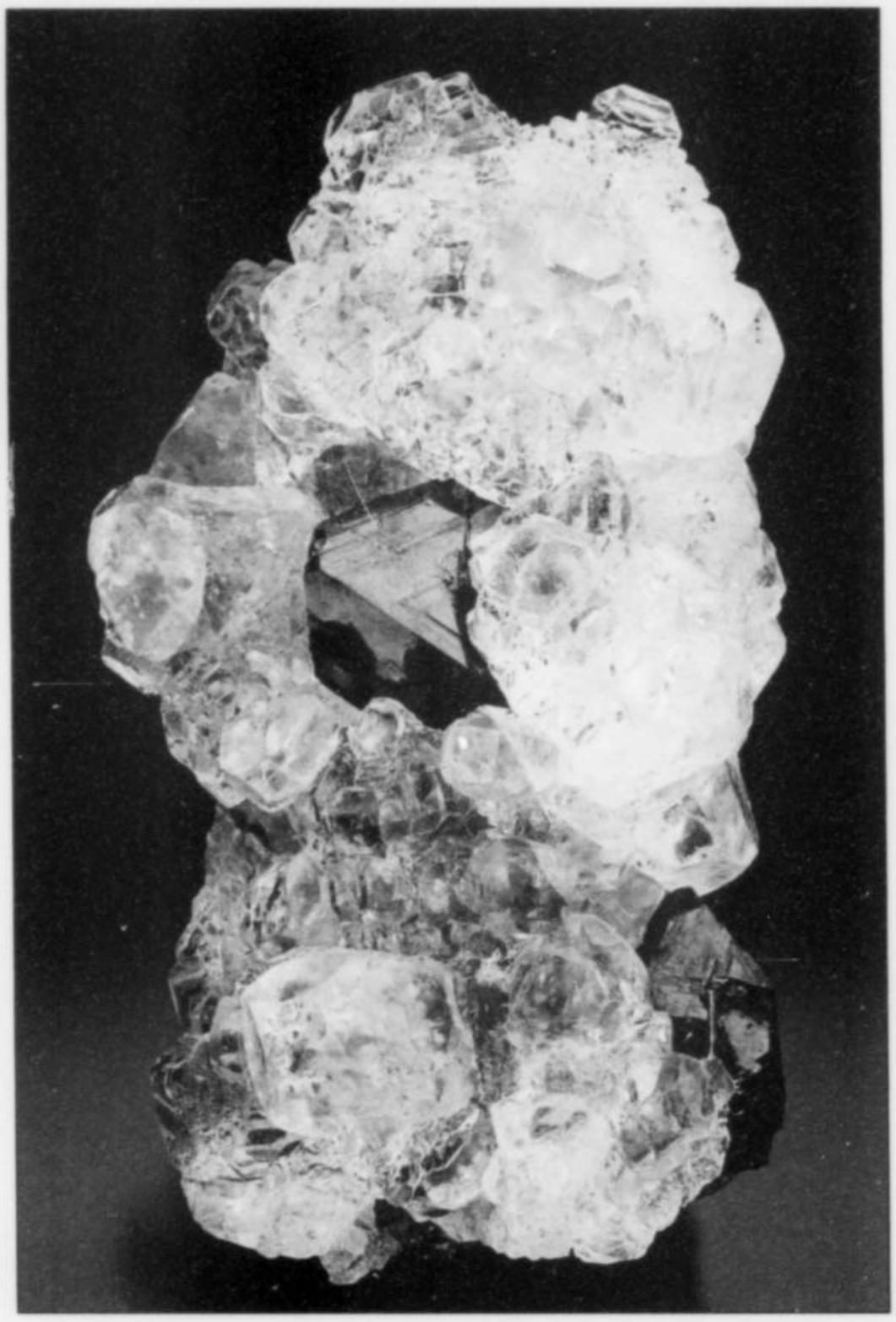
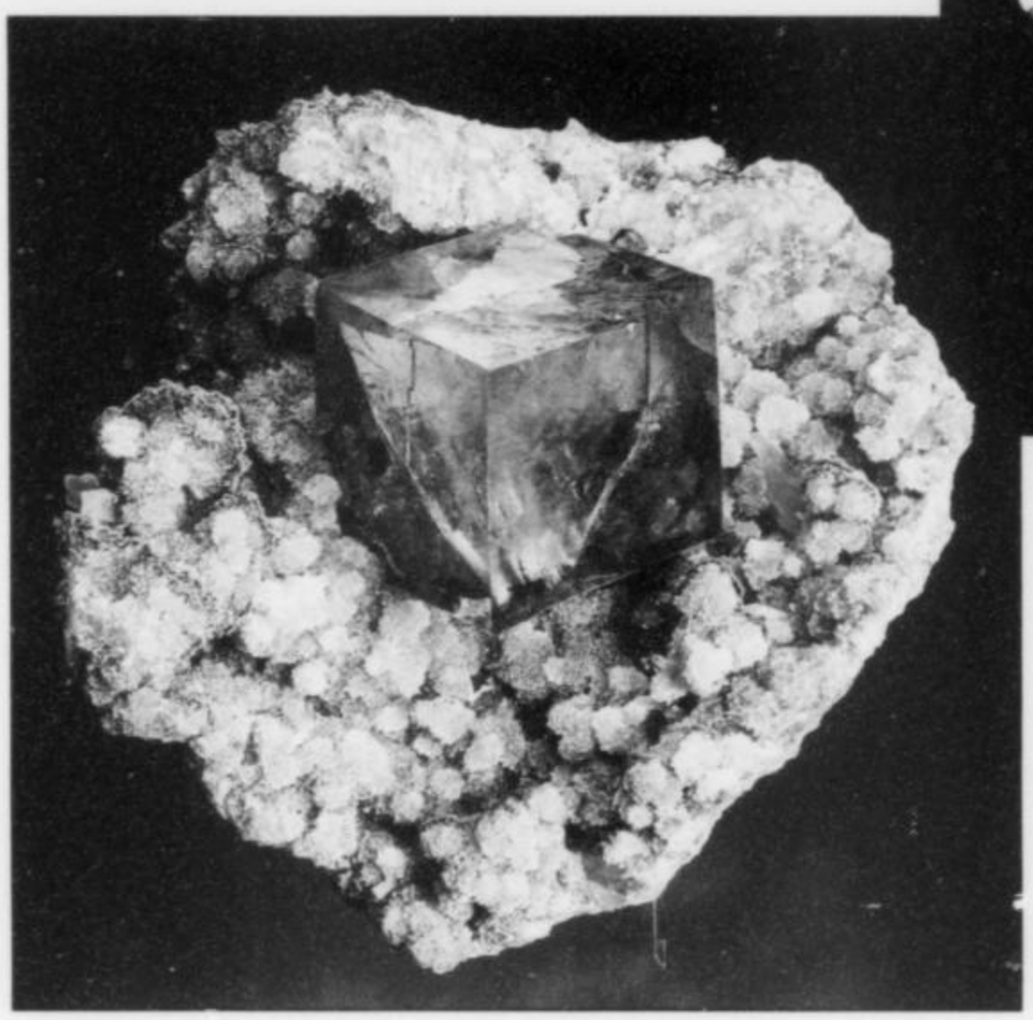


Figure 8. **Pale green fluorite surrounding dark brown scheelite crystals, 8 cm, from the Dongshan mine, Linwu County, Hunan. Jeff Scovil photo.**

Figure 9. **Pale blue fluorite crystals on matrix with arsenopyrite, 10 cm, from the Yaogangxian mine, Hunan. Cliff Vermont collection; Jeff Scovil photo.**

Figure 10. **Purple fluorite on matrix, 8.3 cm, from the Yaogangxian mine, Hunan. Collector's Edge specimen; Jeff Scovil photo.**



cubic fluorite crystals have also been found there recently. At the end of 2003, some pockets in fissures yielded bright green, exceptionally transparent fluorite crystals showing cubic and rhombic-dodecahedral forms, overgrown by pink calcite. To date, the Xianghuapu mine has produced no specimens in which fluorite is associated with crystallized quartz.

Work has already ceased in the region of the former scheelite mine at **Dongshan**, which lies only 6 km north of the town of Linwu, the county seat. Only a few of the workings in the old district are still being mined on a private basis. The scheelite ore is extensively overgrown by fluorite, and rare specimens exhibit scheelite crystals to 5 cm protruding from massive yellow-brown scheelite. Fluorite from Dongshan is attractive chiefly for its total transparency and high luster. Its colors vary from almost colorless through bright blue and bright green, and crystals reach 10 cm. Until a short time ago, unfortunately, no special care was taken to collect specimens without damage; therefore, the very best specimens date only to very recent times. One of the specialties of the Dongshan skarn deposit is pale green fluorite with blue-colored zones at the corners. Typical associated species include pink dolomite and white quartz in short-prismatic crystals. Massive galena and sphalerite are found at the deposit's contact with granite.

Not far from Chenzhou lie three important mines: **Huangshaping** (lead/zinc), **Shizhuyuan** (a polymetallic deposit, with tungsten and bismuth), and **Yaogangxian** (tungsten). Up to now, Huangshaping and Shizhuyuan have produced only a few interesting specimens for collectors. Shizhuyuan has mainly given up very good manganocalcite, and occasionally galena and sphalerite; however, early in 2003 the Chinese dealers began offering specimens from a new discovery of bright green fluorite from Shizhuyuan. The transparent crystals reach 3 cm, and in contrast to their contemporaries from Xianghualing they display a combination of the hexahedron {100} and the rhombic dodecahedron {110}. They are remarkably well formed. These specimens come from a mine called **Dongpo, Shizhuyuan district**, about 25 km southeast of Chenzhou. The green fluorite crystals are characteristically overgrown in part—on three faces at most—by small, white, flattened rhombohedral crystals of calcite.

In the Nanling Mountains in the southern part of the province of Hunan, not far from the border with Guangdong, lies the huge **Yaogangxian** tungsten mine—about 50 km southeast of the prefectural capital of Chenzhou, in Yizhang County. Mining here began around 1914. At times employing more than 5,000 people, the Yaogangxian is one of the most important mines in Hunan, producing more than 1500 tonnes of wolframite and other ores (including scheelite and cassiterite) per year. Presently, though, the future of the established mines is uncertain, as the State wants to close or sell off several mines which are no longer economically viable, and the Yaogangxian, with its complex geology and its consistently expensive mining technology, seems imperiled.

The geological situation at Yaogangxian is complex (Li Yiqun and Yan Xiaozhong, 1991; Song Shuhe *et al.*, 1992). The orebody penetrates a granite and overlying sandstone of Cambrian age, as well as a Devonian shale and overlying limestone. The surrounding skarn and the gangue contents of the ore veins are most important for collector-quality minerals. More than 200 ore veins up to 1000 meters long and 1300 meters deep are known; the veins can be more than 2 meters thick. Some of the minerals, including ferberite, arsenopyrite, stannite and fluorite, are found in quartz veins, while

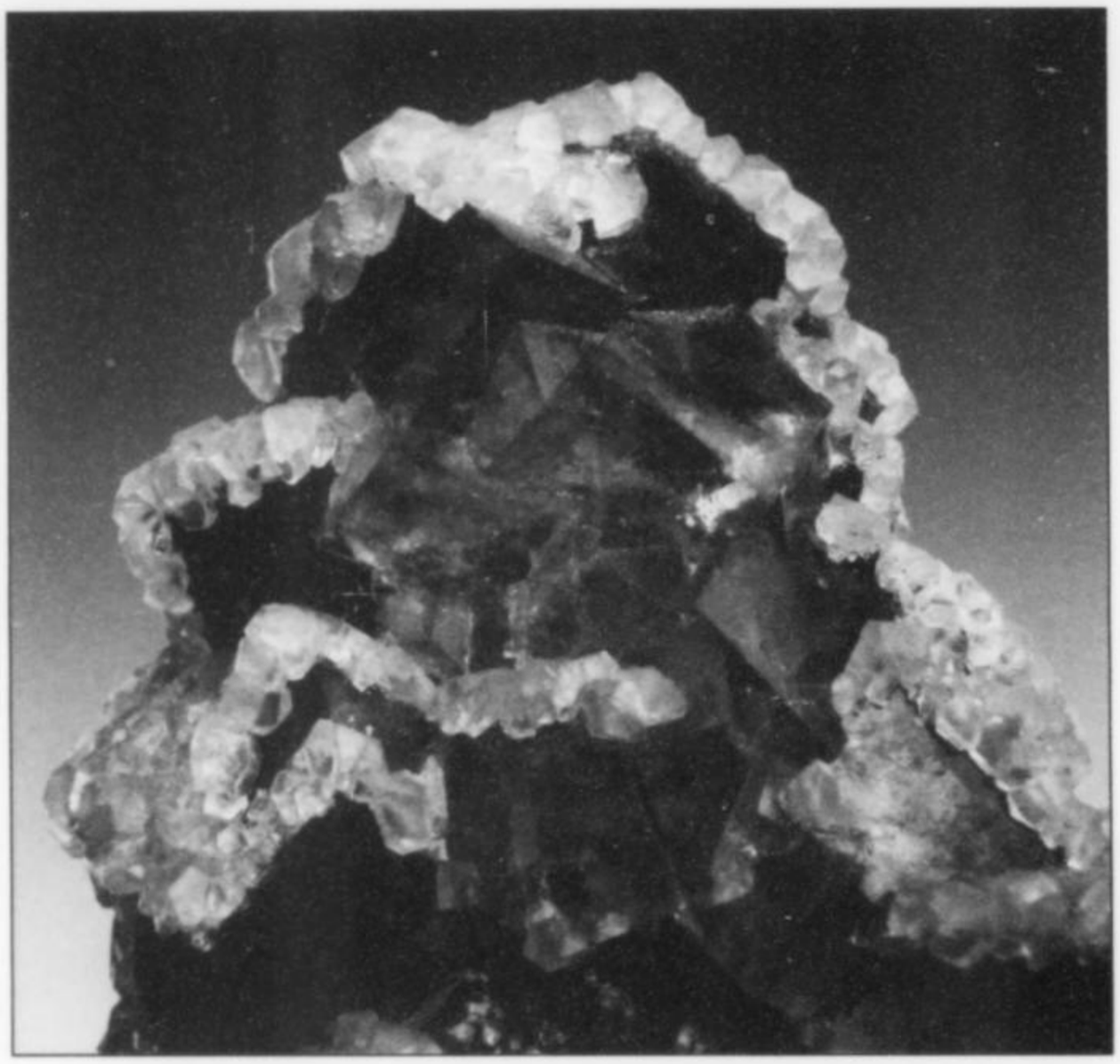


Figure 11. **Pale green fluorite partially overgrown by white calcite crystals, 8 cm, from the Dongpo mine, Shizhuyuan, Hunan. Ottens specimen and photo.**

others, including scheelite, chalcopyrite and bismuthinite, are found in the skarn. Tungsten ores also occur as finely divided particles in a greisen-type stockwork.

Fluorite occurs most commonly in cubic crystals only a few millimeters on edge; rare examples in which the crystals reach 4 cm or so are highly coveted. The color ranges from pale to medium blue and is uniformly distributed; color-zoned crystals with dark blue cores are found only rarely. Octahedral fluorite crystals, both blue and deep green, are also among the rarities of Yaogangxian. Some unusual finds have been described in which a first generation of octahedral crystals is overgrown by a second generation of cubic crystals. A particular fascination of specimens from Yaogangxian lies in the association of fluorite with quartz, ferberite, arsenopyrite and other species, creating highly aesthetic effects. Some fluorite crystals appear blue-green and have a matte luster; a close inspection of these reveals inclusions of countless hairlike crystals of jamesonite. Once in a while, irradiated specimens of Yaogangxian fluorite are offered. If the crystals rest on quartz or are associated with calcite, these species will show a blackish or brownish discoloration if they have been irradiated.

The pyrite mine formerly worked at **Shangbao** is, without a doubt, among the most important fluorite localities in Hunan Province, but this locality will be described in a separate article in a forthcoming issue.

The **Taolin** lead/zinc deposit, 37.8 square km in extent, lies about 170 km north of Changsha, 20 km east of Yueyang (the administrative seat of Yueyang Prefecture) and 15 km south of Linxiang. The deposit lies between granite (Song Shuhe *et al.*, 1992), a slightly metamorphosed Precambrian sandstone, and a red Tertiary conglomerate. The emplacement of the orebody was influenced by faulting. This lead/zinc/fluorite body counts as one of the largest high-temperature hydrothermal vein occurrences in China. Galena and sphalerite are the chief ores mined; they are only occasionally found as good specimens, sphalerite in particular being noted as honey-brown crystals to 10 cm. Most galena crystals found show combinations of cubic and octahedral faces, and have a matte luster. Fluorite is very common, and has been recovered in very large groups of green, translucent to transparent crystals. There is no dominant form, but essentially the crystals are octahedral, and there is a later generation of cubic crystals. White, tabular barite crystals are associated with fluorite on some specimens, for a beautiful color-contrast.

Jiangxi Province

The province of **Jiangxi** is blessed with numerous very important deposits and mining areas—among them the tungsten occurrence in the Dayu Mountains, the rare earth-element mines in the Nanling Mountains, and the copper mines at Jiujiang and Dexing. For several years, however, no fluorite specimens were known from these mining regions. Chinese dealers first offered specimens of white quartz matrix with violet fluorite crystals at the Tucson and Ste.-Marie-aux-Mines shows of 2002. The face-rich, commonly quite transparent crystals have been partially freed from the enclosing quartz by hydrofluoric acid treatment, and as a rule they have (when not oiled) a matte luster. Single crystals to 4 cm in diameter are especially attractive. Most of these crystals display combinations of cubic and rhombo-dodecahedral faces, and appear almost spherical. Originally their locality was given as Yiwu, in Zheijiang Province, but eventually it became known that the true locality was the De'an fluorite workings at **Wushan, near De'an**, in the county of the same name, in Jiangxi Province. In the open-pit workings at Wushan, fluorite is found in limestone, the fluorite being overgrown by a quartz layer between 5 mm and 5 cm thick, with the terminal faces of quartz crystals sometimes well developed. The largest fluorite crystal ever found in the mine, 160 cm in diameter, is displayed in the courtyard of an administrative building in Wushan.

Preparation of specimens by etching quartz away from the fluorite is done, not in De'an, but in a headquarters for such work in Chenzhou, in southern Hunan Province. From this place, at the end of 2003, green-blue octahedral fluorite crystals also emerged onto the mineral market. In order to keep the real locality secret, a great number of specimens were falsely labeled, unfortunately, as having come from De'an. According to a communication from a reliable source, the true locality is in the **Ganzhou** area, about 500 km south of De'an but also in Jiangxi Province. The region is easy to reach from Chenzhou, about 200 km west of it. For now

Figure 12. **Entrance of the Jiangxi De'an Yongfei Mineral Industry Ltd. Company in Wushan, Jiangxi. Ottens photo.**

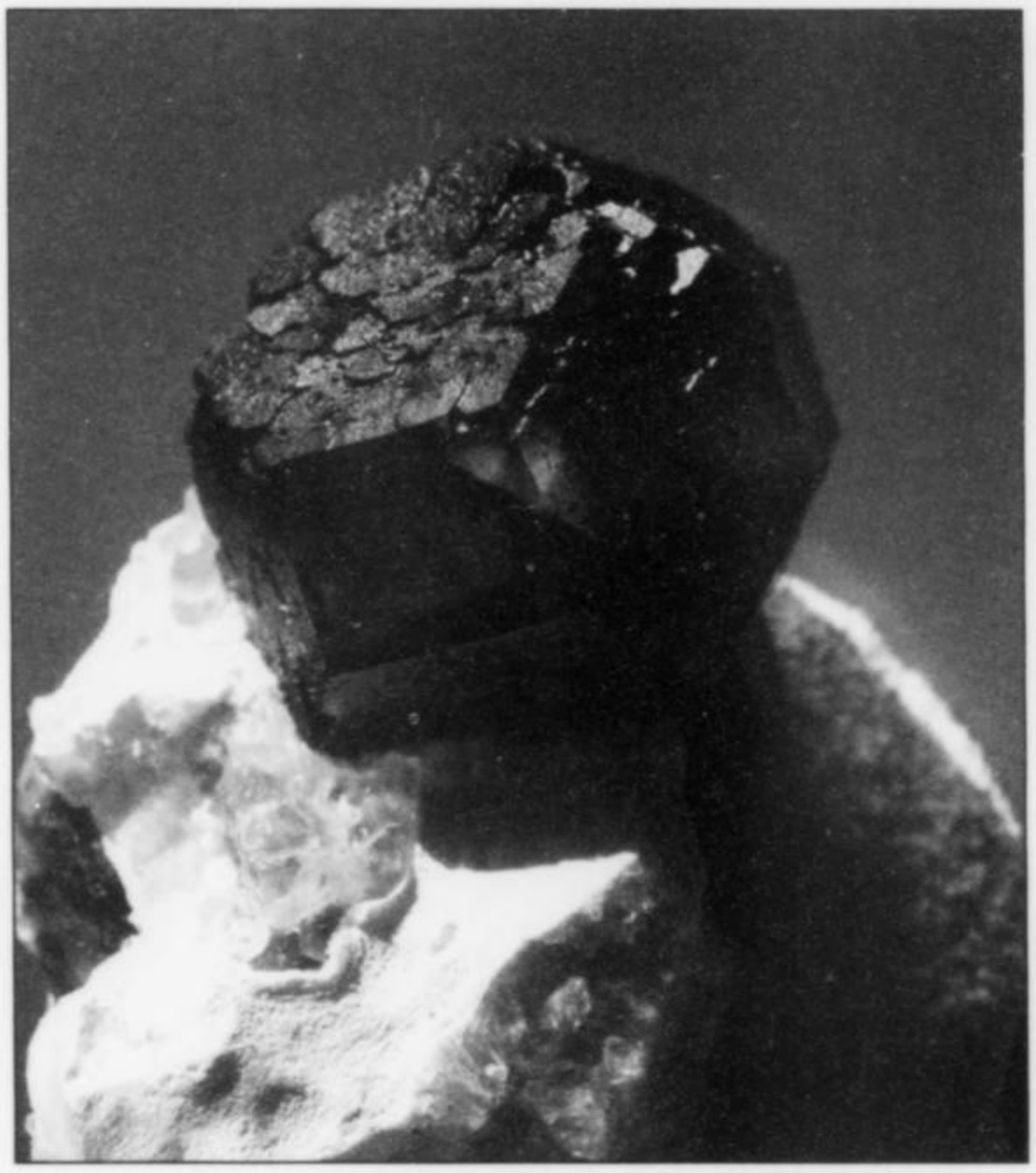


Figure 13. **A typical purple fluorite cuboctahedron, 3 cm, partially etched out of enclosing quartz, from the Wushan open-pit mine near De'an, Jiangxi. Ottens specimen and photo.**

"Ganzhou" must suffice as a locality designation.

Regrettably it is customary in China to keep secret for a long time the real names of deposits which offer interesting collector-quality minerals. Although prices asked in China for large plates of etched quartz with fluorite crystals can far exceed $1,000, the dealers who offer the material in Chenzhou are not ready to provide precise locality information. Many such dealers who buy the specimens and bring them to Changsha (the Chinese headquarters of mineral dealing) or to Europe do not know the real locality, and may themselves believe the false attribution.

Mineral dealers in Chenzhou have specialized in etching fluorite out of quartz. In order not to use too much hydrofluoric acid (which is dangerous to handle) and to reduce costs, the blocks of quartz with embedded green fluorite are cut into flat slabs, so that the quartz can be partly or wholly dissolved away with relatively little use of acid. The fluorite etched out in this way consists of octahedrons to 5 cm, commonly as thin plates of mutually attached crystals. The predominant color is green, but with zones of blue. The luster is uniformly frosty, so that specimens either show an attractive play of colors when backlit or, if oiled, display a bright luster. Because they have been exposed by etching, most of the crystals are undamaged. Plates more than a meter long and 60 cm wide have been prepared.

Zhejiang Province

It should be mentioned at this point that besides the market for collector pieces of interest to Westerners, a demand has developed in China, during the last ten years, for large "decorative" specimens. At no time in the history of China has collecting minerals been as important as it has long been in Europe. Minerals have, however, been sought and valued as materials used for pharmaceutical purposes. Further, naturally formed stones on which weathering has bestowed unusual shapes or interesting structures appeal

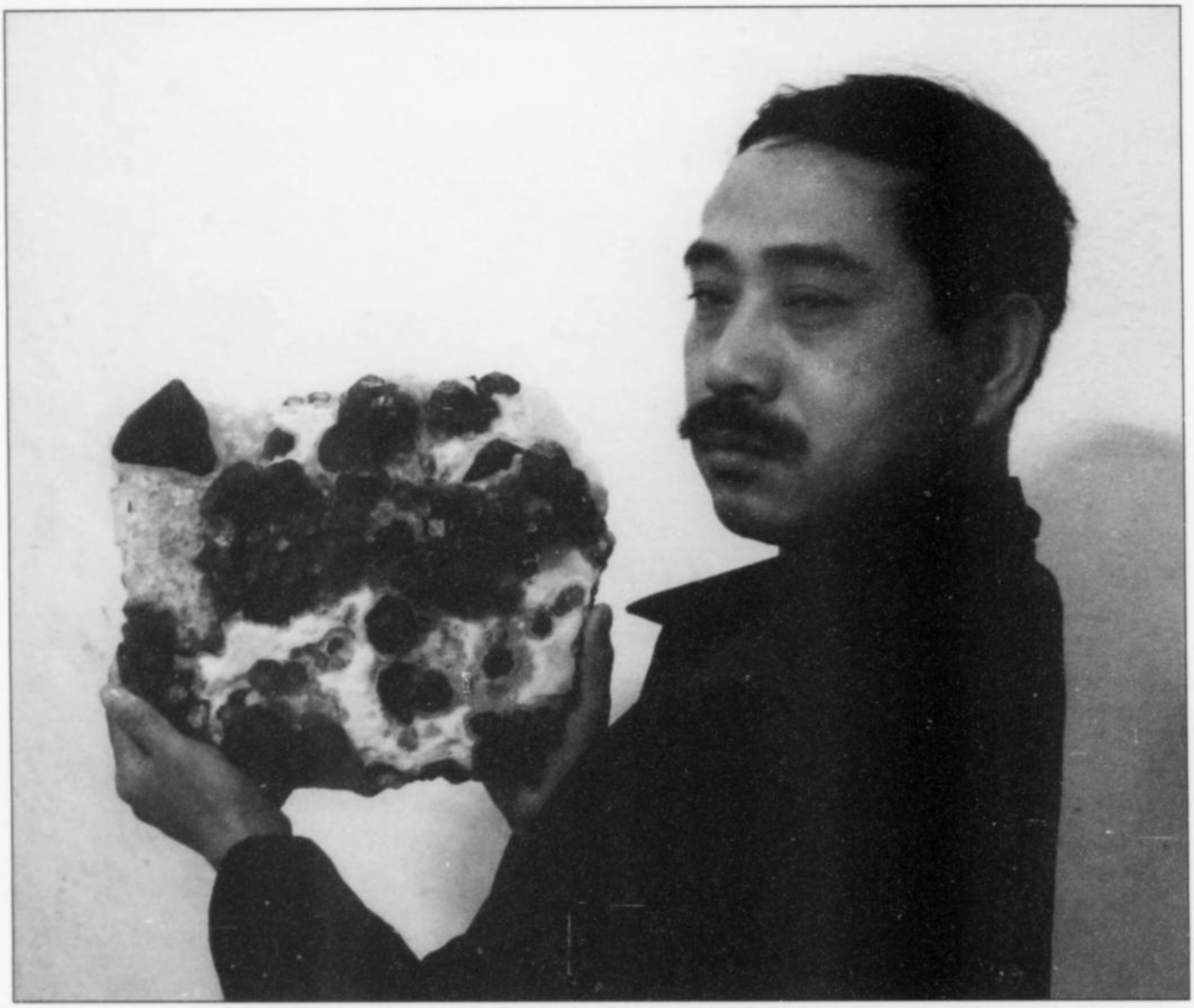


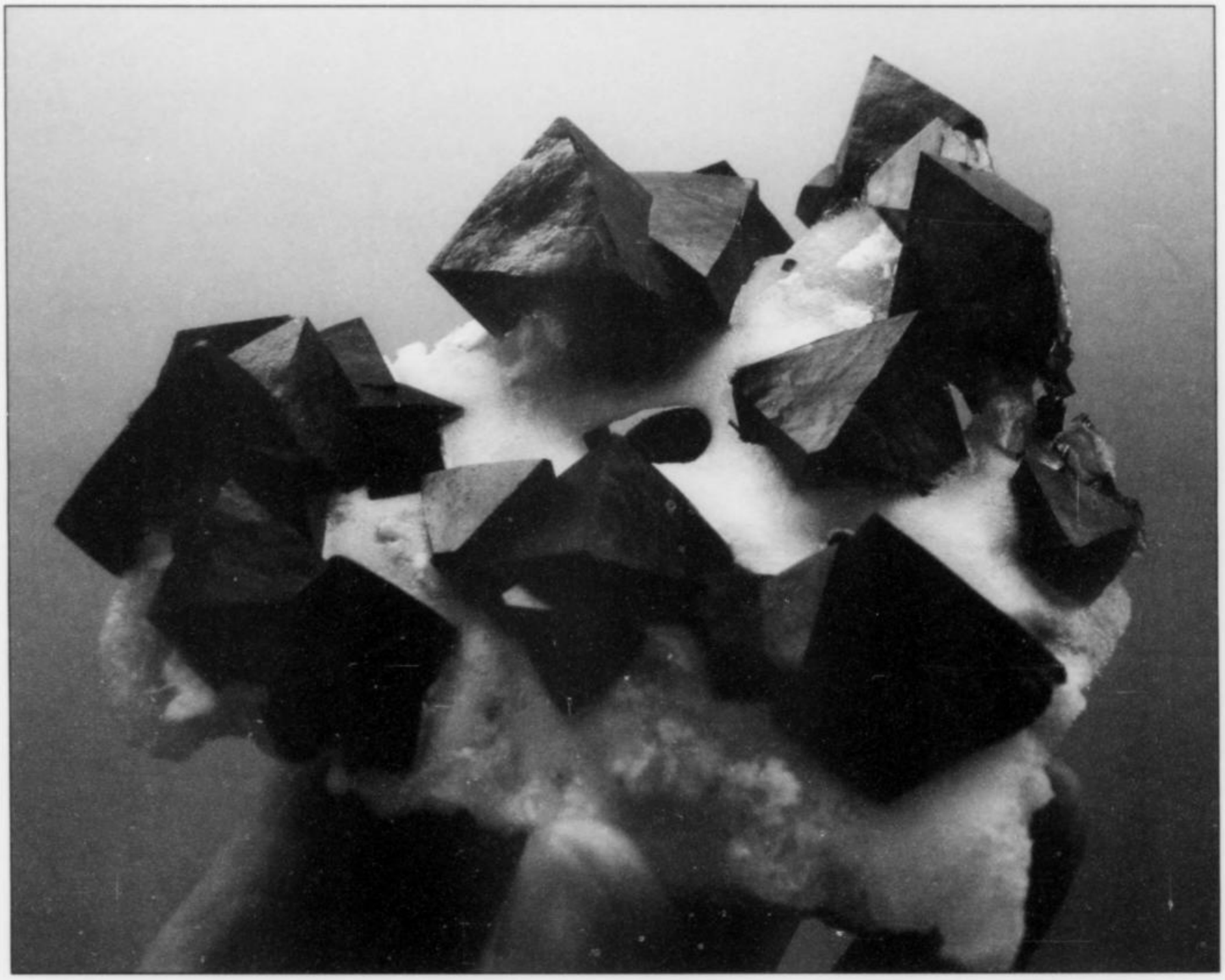
Figure 14. **Mr. Cai, a mineral dealer, showing a superb cabinet specimen of fluorite from the Wushan mine near De'an. Ottens photo.**

Figure 15. **Mr. Huang, a mineral dealer, showing a typical crystal cluster of bright green octahedral fluorite from Ruyuan, Lechang County, Guangdong province. Like the fluorite from De'an, these crystals are found enclosed in quartz which must be dissolved away. Ottens photo.**

strongly to the aesthetic sense of the Chinese and also have been closely related to the teachings of Taoism. Large mineral specimens which would not be salable at all, or only with great difficulty, in the west are easily sold in China, even if they show obvious damage. This is as true for fluorite specimens as for calcite, quartz, pyrite, or stalactites. Thick plates with green fluorite from **Yiwu, Zhejiang Province** are particularly well suited for such "decorative" purposes. From a layer of fluorite about 10 cm thick protude crystal formations from 5 to 10 cm across, showing no particular habit.

Figure 16. **Museum-size specimens of green fluorite on matrix from Yiwu in Zhejiang Province. Ottens photo.**

Figure 17. **Sharp, green fluorite octahedrons partially etched out of enclosing quartz, 15 cm, from the Shangrao area, Jiangxi Province. Ottens specimen and photo.**



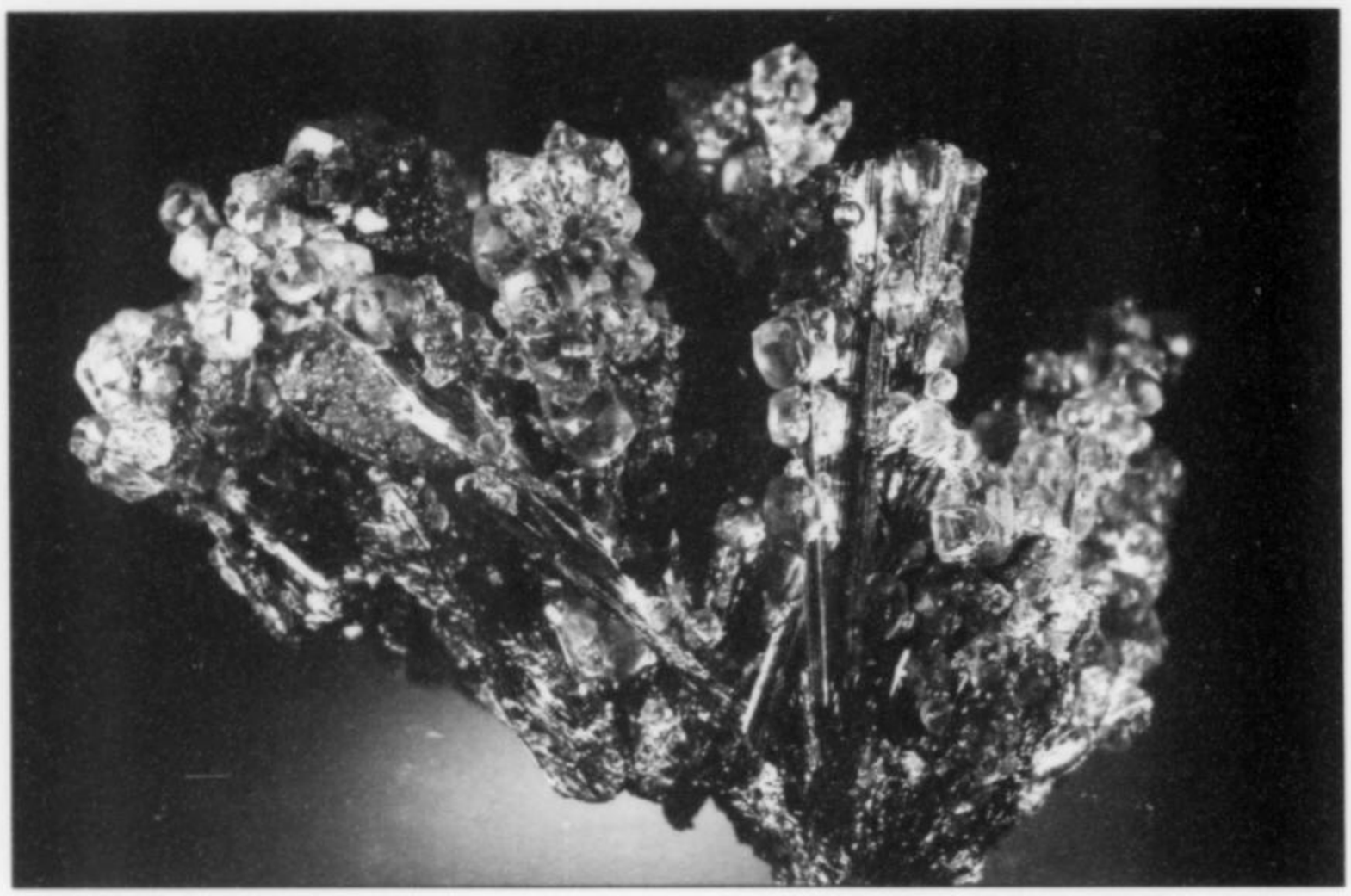


Figure 18. **Small purple fluorite crystals covering stibnite crystals, 8 cm, from the Banpo stibnite mine, Dushan, Guizhou Province. Ottens specimen and photo.**

Guangdong Province

From the province of **Guangdong**, which borders Hunan on the south, deep green octahedral fluorite was offered first in 2002. These crystals come from **Ruyuan, Lechang County**, and, like the crystals from De'an, are exposed by dissolving away a white quartz matrix.

Guizhou Province

Among the more unusual fluorite occurrences is the **Dushan mine near Mawi, Guizhou Province**, where violet fluorite crystals, only a few mm on edge, form overgrowths on stibnite.

Fujian Province

From **Fujian Province**, specimens with spessartine, smoky quartz and cream-colored feldspar crystals are aesthetically impressive, and therefore highly valued, and such specimens are still more desirable when fluorite crystals also appear on them. The spessartine collecting sites lie in the mountains of the southeastern coast, one near the village of Tongbei, Yunxiao County, the other, 30 km distant, at **Yunling, Zhangpu County**. Reportedly, fluorite crystals appear only on specimens from Yunling. The minerals are dug, exclusively for collectors' purposes, from steep, unvegetated mountain slopes. Fluorite occurs predominantly as blue octahedral crystals; however, quite recently bright green crystals and crystals of cubic habit have been observed. As a rule the fluorite crystals from this locality measure around 2 cm, the largest so far seen measuring 15 cm.

Sichuan Province

Rare "association" pieces for fluorite collectors come from the region of **Xuebaoding, Pingwu County, Sichuan Province**. Mines between Pingwu and Songpan on Xuebaoding Mountain, in the Minshan Mountains, produce fluorite with scheelite, cassiterite and beryl. The cubic crystals are colorless, bluish or greenish; most display a frosty luster, and few are larger than 2 cm, although one notable discovery produced crystals to more than 15 cm on edge. The most highly coveted specimens are those which display the associated species characteristic of this locality, namely orange scheelite, colorless to pale blue beryl, cassiterite and quartz.

Xinjiang Province

There is considerable potential for fluorite specimens in the Altai Mountains of Inner Mongolia and in Xinjiang Province. In the years between 2000 and 2003, a great number of specimens with dark violet, face-rich crystals came onto the market from this region. Since nearly all of the crystals have been etched out with acid, the faces are frosty. To date, the Artaishan mine at Nanjiang has been given as the locality, but this must be regarded as doubtful. So far the locality has not been verified by serious Chinese dealers or by western visitors, and locality data in such cases must always be regarded as provisional.

Other Regions

Not all Chinese fluorite specimens which have appeared so far have been attributed to definite localities. Such is the case, for example, for the blue cubic crystals resting on faces of smoky quartz crystals, and for the very beautiful bright blue cubes on dolomite allegedly from somewhere in Guangdong.

In the coming years, a series of new discoveries of the much-cherished mineral fluorite may be expected from a multitude of ore deposits and richly mineralized regions in China.

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中國
辰砂

CHINESE CINNABAR

Guanghua Liu
Französische Allee 24
72072 Tübingen, Germany
Email: ghliu@aaamineral.com

For thousands of years a mercury-mining region centered on Wanshan, in Guizhou Province, has produced cinnabar ore, ornamental and "medicinal" cinnabar, and cinnabar crystal specimens which clearly are the world's finest. The reappearance of Chinese cinnabar on the collector market in the late 1980's was the vanguard of the present abundance of Chinese collector minerals; at that time, as now, cinnabar specimens were coming in a variety of habits from several distinct occurrences in the Chinese mercury belt.

INTRODUCTION

Chinese cinnabar, like Chinese realgar and stibnite, is very popular with mineral collectors because the crystals come in a variety of habits, display attractive colors, and can be quite large. Also, because cinnabar occurs in several deposits scattered over a wide area, specimens may show varying mineral associations. Cinnabar was the earliest of the significant Chinese minerals to have appeared on the international mineral market after the mid-1980's, and many museums and private collections in America, Europe and worldwide today own one or more Chinese cinnabar specimens. Nevertheless, detailed information on specific cinnabar localities in China has not been generally available in the Western world.

Cinnabar is the most important ore of mercury, and such deposits are relatively abundant in China. According to the Editorial Committee of Chinese Natural Resources (1996), China has 81,400 tonnes of recoverable mercury reserves, making it the third richest in mercury of all countries in the world. One hundred and three mercury deposits have been noted by geologists in 13 provinces of the country. The deposits in Guizhou Province account for 40% of the total number; Shaanxi and Sichuan are the next richest provinces. The most significant mercury mines are Wanshan, Tongren, Wuchuan and Danzhai in Guizhou Province; Xinhuang in Hunan Province; Yangsikeng in Sichuan Province; and Xunyang in Shaanxi Province.

Most of the Chinese mercury deposits are low-temperature hydrothermal, strata-bound orebodies hosted by carbonate rocks; less than 10% are hosted by siliceous clastic rocks and igneous rocks (Liu *et al.,* 1996). In most mercury deposits, cinnabar is common as massive material within the host rocks, and crystals are rare and very small. Nearly all good crystals of Chinese cinnabar are found within the belt extending from the Tongren-Wanshan area of Guizhou Province to Fenghuang County in Hunan Province: the so-called Tongren-Fenghuang mercury belt (Wang and Hu, 1989), the best and largest crystals coming chiefly from the Yanwuping and Yunchangping mining areas. This article will deal only with localities within the Tongren-Fenghuang belt.

THE MINING REGIONS

The Tongren-Fenghuang belt of mercury deposits crosses the border between Hunan and Guizhou provinces, from Xinhuang in Hunan to Tongren in Guizhou in the southeast, then to Chatian and Machong, Fenghuang, in Hunan, in the northeast. This mercury-bearing area is 150 km long and 5 to 10 km wide, and its measured reserves of mercury account for 50% of the total mercury reserves of China (Wang and Hu, 1989). The main mining areas in this belt include Jiudiantang, Xiangjiadi, Wanshan, Lengfengdong, Yanwuping, Yunchangping (Dadongla), Hepingzhen, Chatian and Houziping.

Figure 1. **Location map showing towns and some of the mercury mines in the Wanshan-Tongren-Fenghuang area.**

Each of these mines has produced at least a few cinnabar crystals, but most of the crystals are very small (<0.5 mm). Nearly all of the larger and finer crystals have been found in the mines lying in the belt's central segment, most notably the Wanshan, Yanwuping, Yunchangping and Chatian mines. The first three of these lie within the area of Tongren City, Guizhou Province, while the Chatian mine lies in Fenghuang County, Hunan Province

Tongren City, representing a prefecture of Guizhou Province, embraces 18,023 square kilometers of urban and rural areas. (Tongren means "copper kernel.") Tongren has a population of 3.75 million, encompassing 26 different nationalities including Han, Tujia, Miao, Tong and Gela. The region is very beautiful, and offers many attractive sites to visit. In the west is Mt. Fanjingshan (the name means "Forever Pure Land" in Chinese). With an elevation of 2,572 meters, Fanjingshan is the highest mountain in Tongren and indeed in all of Guizhou. In 1986, the mountain was classified as a National Reserve, and in the same year it became part of the "Man and Biosphere" nature preserve network of UNESCO. Abundant vegetation grows on the mountain: more than 3,000 species of plants, some of which are found nowhere else in the world. Twenty-one kinds of high-altitude plants, including the dove tree, are listed as nationally protected species. Also, 382 species of vertebrate animals have been identified on Mt. Fanjingshan, of which 14, including the Guizhou golden monkey and South China tiger, are nationally protected. And Fanjingshan is a sacred mountain for Buddhists; 48 Buddhist temples existed here during the Qing Dynasty (1644–1911).

About 17 kilometers southeast of Tongren City lies Nine-Dragon Cave, considered one of the top ten attractions of Guizhou Province. A legend says that a long time ago, six yellow dragons living on the Liulong Hill (Six-Dragon Hill) invited three black dragons living in the nearby Jinjiang River to a meeting in a cave. When the nine dragons entered the cave, all saw it as a wonderful place, and each one wanted to live in it all alone. They began to quarrel and fight. A thousand years later the nine dragons died in the cave and turned into colorful stalagmites and stalactites. Nine-Dragon Cave is 70 to 100 meters wide, 30 to 70 meters high, and 2258 meters deep, and boasts a hundred beautiful stalagmites and stalactites.

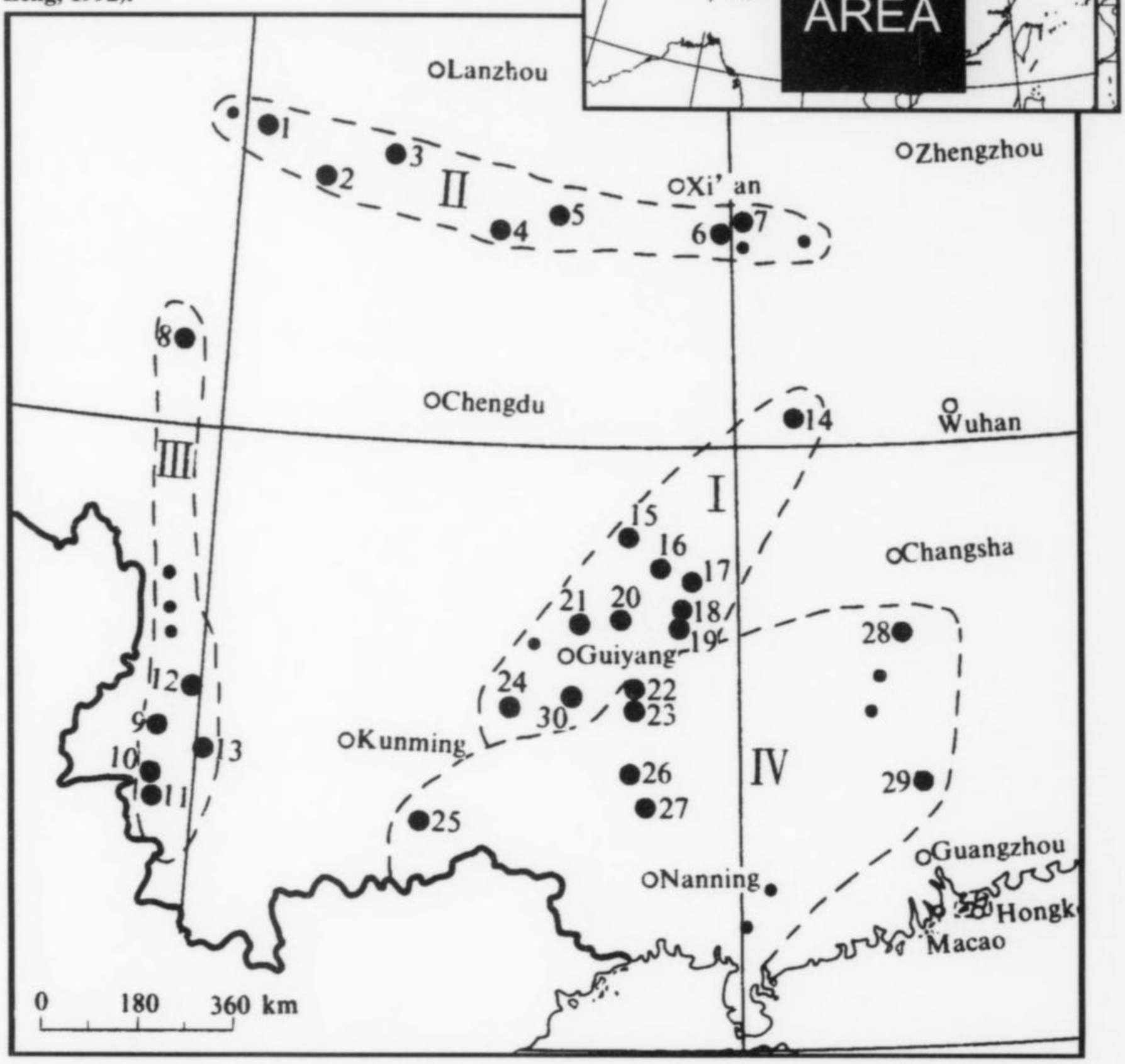
Economically Tongren is dominated by agriculture and forestry, but it is also rich in mineral resources. Coal, mercury, manganese, lead/zinc, potassium, barite and marble deposits have been found there, and mining activities began thousands of years ago.

The mercury mines lie mainly in the southwestern part of the prefecture. The principal mining companies were Wanshan Mercury Mining and Tongren Mercury Mining—both are state-owned, and both went bankrupt in 2001 and 1997 respectively. Wanshan Mercury Mining's headquarters are situated in the town of Wanshan, 25 km south of Tongren city and 350 km northeast of Guiyang, the capital city of Guizhou Province. Wanshan has a population of 70,000 people, most of whom used to be associated with the mining company. Before its bankruptcy in 2001, the Wanshan Mercury Mining Company owned 6 mines and 3 subsidiaries. The mines are mainly located in Wanshan and Yanwuping, in a mining area measuring about 15 km east to west and 35 km north to south. All mines can be reached by road, although some stretches in rural areas are unpaved. In its heyday the Wanshan mercury mine was the biggest cinnabar-producing mine in the world. Currently, only a few small private mines are in operation, producing mercury ore and cinnabar crystals.

The former Tongren Mercury Mining Company had its headquarters in Yunchangping town, and its mine excavations are scattered in Lula, Dadongla, Hongshuidong and Huilongxi. Since 1997 these mines have either been inactive or have been run by privately owned companies. Because the orebodies are very shallow, and many crop out on the surface, small-scale open cuts and tunnels can be seen all over the mining area. During the last two years many lustrous, gemmy cinnabar crystals were found in this area, mainly in drifts and open cuts near the Hongshuidong, Huilongxi and Masaxi adits.

Fenghuang County in Hunan Province is also a tourist destination because of its spectacular geography and diverse nationalities. Fenghuang means "phoenix" in Chinese: the county is named for a phoenix-like hill in its southwestern part. An area of about 1,757 square kilometers dominated by mountains and valleys is inhabited by 370,000 people of Miao, Han, Tujia and Hui nationalities, the Miao people making up a majority. The county has been a military and political center of western Hunan for over a thousand years. Fenghuang town, the county seat, is a scenic place with many historical spots; its architecture is a spectacular mix of Miao and Han styles, and a unique South Chinese Great Wall (141 km long) runs through the town. To the south there is a national forest and park, and to the north lies the famous Wulingyuan (Zhangjiajie) sandstone forest resort.

Figure 2. **The distribution of mercury deposits in China, showing the four major metallogenic regions or belts: I = Upper Yangtze, II = Kunlun-Qinling, III = Sanjiang and IV = South China metallogenic belt. The mining areas are: (1) Muhei, Qinghai; (2) Hegeleng, Qinghai; (3) Xigouhe, Gansu; (4) Jiuyuangou, Gansu; (5) Majiashan, Gansu; (6) Gongguan, Shaanxi; (7) Xipoling, Shaanxi; (8) Kongmasi, Sichuan; (9) Shuiyinchang, Yunnan; (10) Jinjiashan, Yunnan; (11) Maocaopo, Yunnan; (12) Wenshuihe, Yunnan; (13) Ma'anshan, Yunnan; (14) Tianzhushan, Hubei; (15) Muyouchang, Guizhou; (16) Yangshikeng, Sichuan; (17) Dadongla-Tongen, Guizhou; (18) Wanshan, Guizhou; (19) Jiudiantang, Hunan; (20) Zhifang, Guizhou; (21) Baimadong, Guizhou; (22) Shuiyinchang, Guizhou; (23) Jiaoli, Guizhou; (24) Lanmuchang, Guizhou; (25) Ximatang, Yunnan; (26) Yulan, Guangxi; (27) Shuiluo, Hechi; (28) Shixia, Hunan; (29) Xi'an, Guangdong; (30) Duyun, Guizhou (from He and Zeng, 1992).**



The cinnabar-producing area of Fenghuang County is centered on Chatian, a small town about 30 kilometers southwest of the county seat. At the heart of a mining region inhabited by about 30,000 people, Chatian can be reached by a narrow but mostly paved motorway. Farmers and miners are the predominant sorts of workers here; some of the latter once worked in the mines of Guizhou Province, just over the border. Mercury mining and trade began here fully four thousand years ago, and there are hundreds of small, abandoned pits and tunnels scattered about the countryside. The major mines are located at Mazi'ao and Hehuicun (or Hehui Village). Before the late 1990's, three state-owned mercury mines, called #1, #2 and #3 Shafts, were operated by the Xinhuang Mercury Mining Company. Currently, local farmers and miners of Hehuicun and Chatian work ten small mines for cinnabar ore and crystals. Last year, beautiful, gemmy, twinned crystals of cinnabar were found in a small mine close to Hehuicun.

Access to Tongren and Fenghuang is relatively easy. There is a small airport (Daxing Airport) between Tongren and Fenghuang, and many flights from the cities of Guiyang, Chongqing, Guangzhou and Shenzhen touch down at the airport. Two major railways traverse the eastern and southern parts of Tongren and Fenghuang.

HISTORY

The mining and utilization of cinnabar is more ancient in China than anywhere else, going back to a time to some 5,000 years ago, when the mineral was called "red sands" or "red ore" and was used as a pigment. About 3,000 years ago cinnabar began to be of interest to alchemists, Taoist priests, wizards and sorcerers, as well

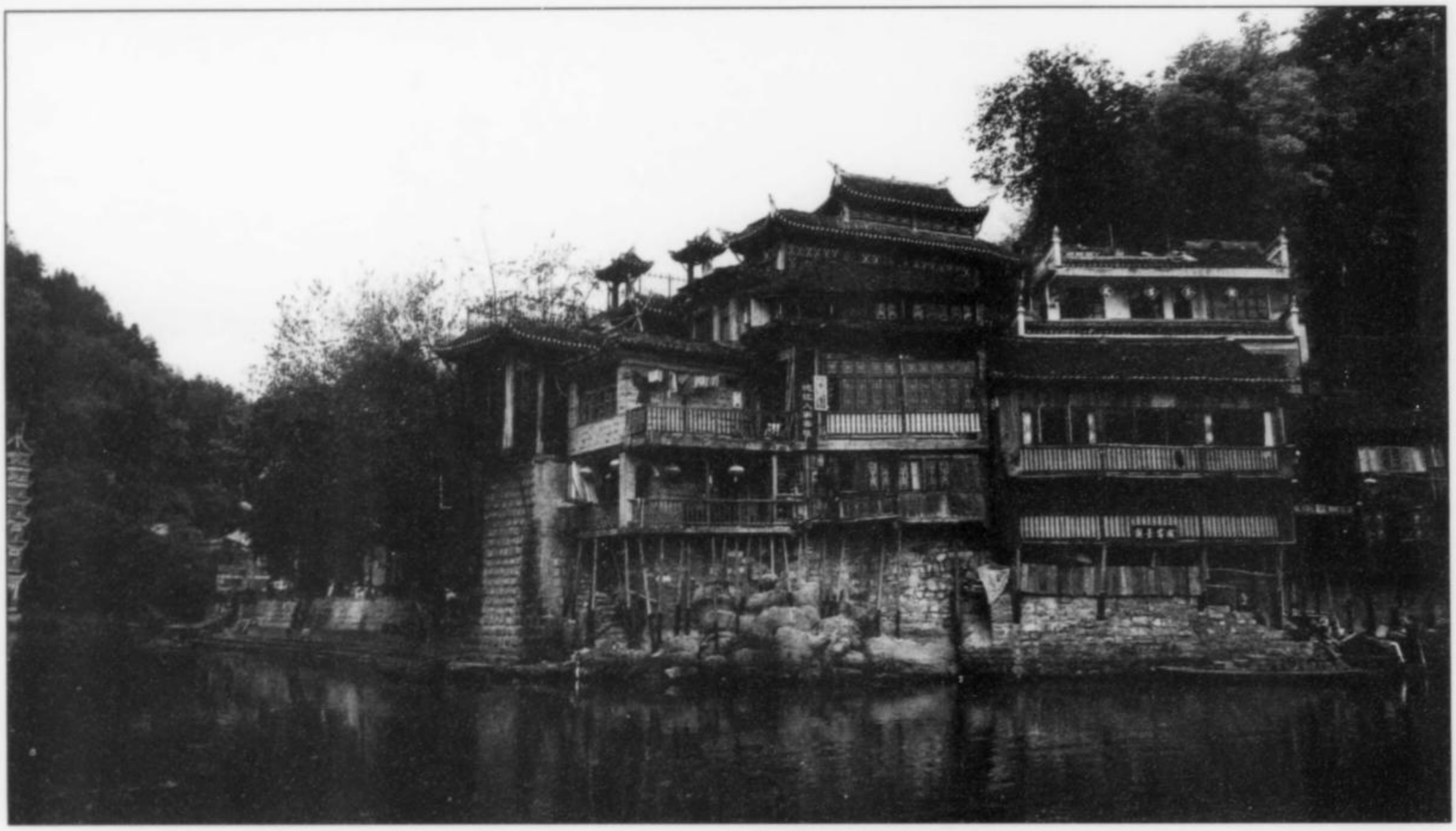


Figure 3. **Typical Miao-style houses over-looking (and overhanging) the river in the town of Fenghuang, Hunan. G. Liu photo.**

as physicians, and it acquired its present name, *chensha*, meaning "celestial sands" or "god's sand."

For many centuries thereafter, cinnabar mining in China prospered. Alchemists believed that with the help of this mineral they could miraculously transform ordinary metals into silver and gold; consequently, cinnabar was highly coveted by the ancient nobility. Taoist priests used cinnabar to make pills to promote longevity and perhaps even bring immortality (it was not as poisonous as one might think, inasmuch as cinnabar is relatively insoluble in the body). Today, the ruins of pill-making and alchemical facilities are found widely in northeastern Guizhou, western Hunan, and other areas.

For about 2500 years, cinnabar was widely used in sympathetic magic, at first by wizards and sorcerers to dispel devils, later by Chinese doctors to heal all kinds of diseases, to relieve pain and to bring on sleep, and as a preservative and antiseptic. Today, besides continuing to be used in medical and industrial applications, cinnabar is also regarded as a beautiful decorative material, as well as a good-luck-bringer or Feng-Shui object. In Asian countries, especially in Japan and Korea, cinnabar crystals, fragments or tablets are widely used in these ways, and large numbers of cinnabar crystal products are exported from China to other countries in Asia. In recent years, about 20% of Chinese cinnabar output has been consumed by the medical industry.

The modern period of mercury-mining in China began in the 1910's, and China remained a major mercury-producing country until the 1950's. But industrial demand for cinnabar and mercury gradually decreased from peak levels in the 1960's and early 1970's, while at the same time many Chinese deposits were mined almost to exhaustion. By the 1990's, there were 11 important state-run mercury mines and processing facilities with an overall production capacity of 1,200 tons per year (Liu *et al.*, 1996). The biggest mines, those with a metallic mercury output of more than

Figure 4. **Typical Miao women dressed in their traditional costumes in Fenghuang, Hunan. G. Liu photo.**

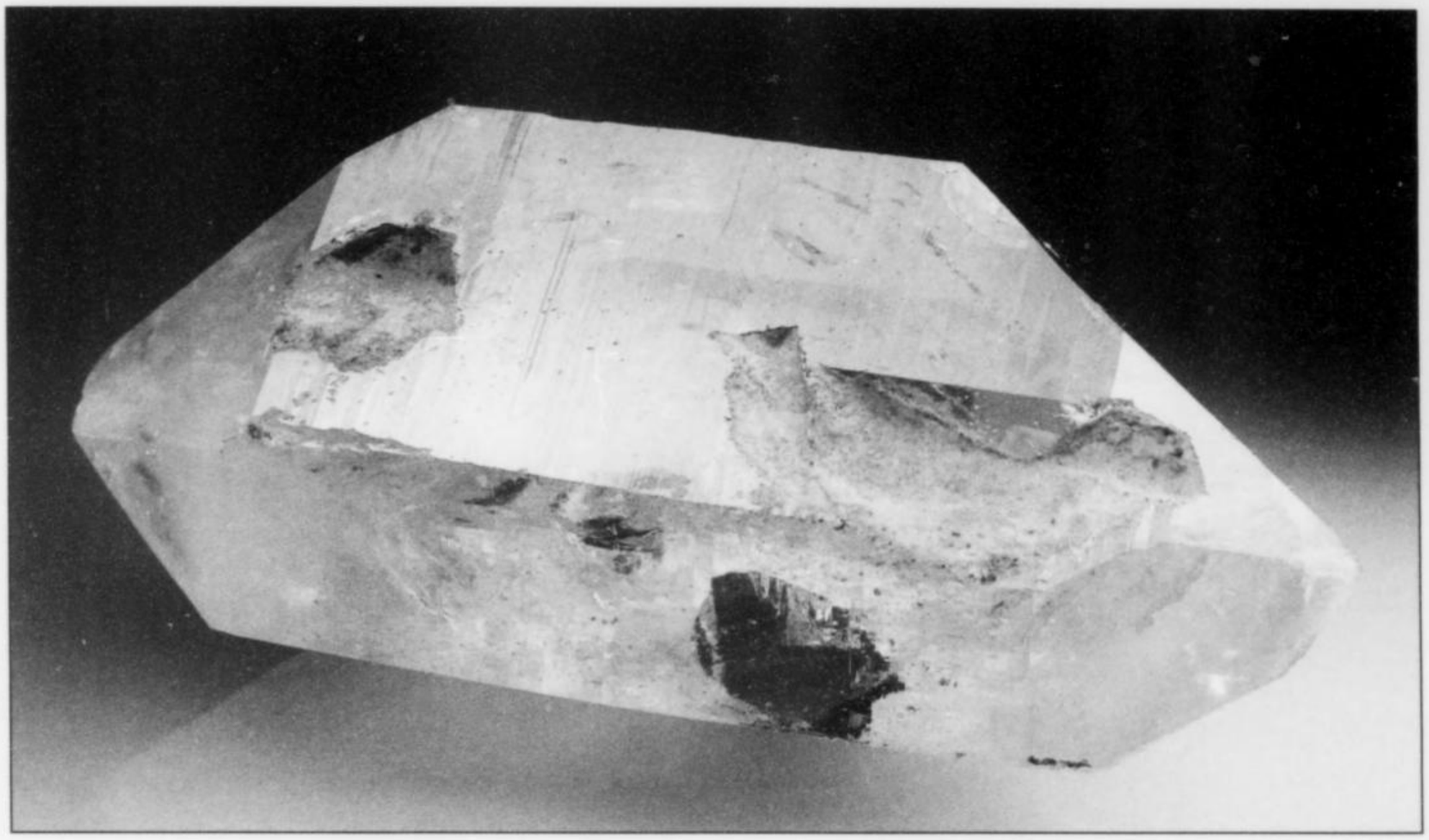


Figure 5. **Cinnabar crystal enclosed in a quartz crystal, 7.4 cm, from the Yanwuping mines, Guizhou. Edward Tripp collection (1987); Wendell Wilson photo.**

Figure 6. (left) **Classic cinnabar penetration twin, 1.6 cm, from the Yanwuping mines, Guizhou. Edward Tripp collection (1987); Wendell Wilson photo.**

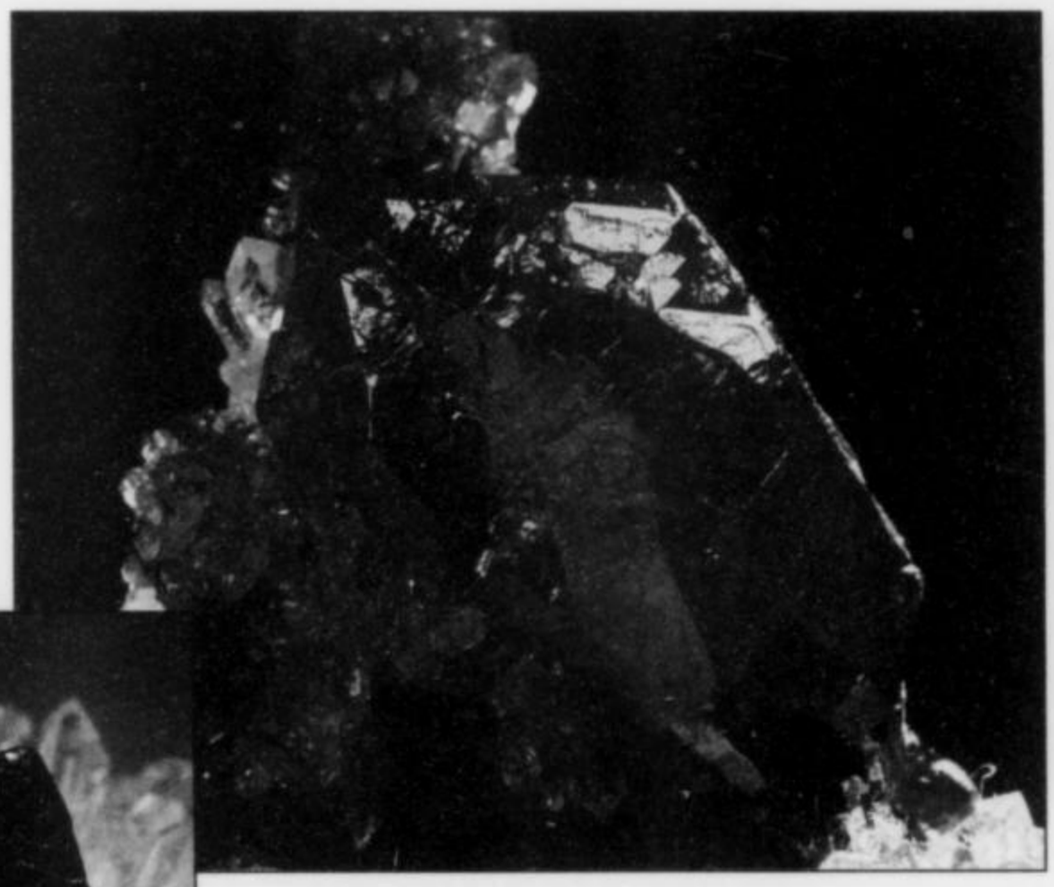


Figure 7. **A dark-colored cinnabar penetration twin (strongly back-lit), 1.8 cm, on quartz from the Yanwuping mines, Guizhou. Wendell Wilson specimen and photo.**

Figure 8. **Dark red cinnabar twins to 1.7 cm on quartz, from the Yanwuping mines, Guizhou (the dark color is caused by trace contents of manganese and selenium). Edward Tripp collection (1987); Wendell Wilson photo.**

Figure 9. **Cinnabar crystals to 1.4 cm on quartz, from the Yanwuping mines, Guizhou. *Kristalle* specimen (1987); Wendell Wilson photo.**

100 tons per year in the early and middle 1990's, were the Wanshan, Tongren and Wuchuan mines in Guizhou Province. However, the demand for mercury reached a new low in the late 1990's, and all state-run Chinese mines have had to be shut down one by one during the past 10 years. Currently, only small mines, mainly operated by private companies or township governments, are still in production, but their ore output is small.

Wanshan and Yanwuping

Wanshan, the most important mining area, was originally a district of former Yuping County but became a part of Tongren County around 1960. After the state-run mercury mine was established in 1962, Wanshan, because of its strategic importance, became a special district directly administered by the central government. In 1970 Wanshan reverted to a county-level administrative district of Tongren Prefecture.

Cinnabar mining at Wanshan began about 4,000 years ago, during the Qin Dynasty. During the Tang and Song dynasties, cinnabar production at Wanshan was high, and trade with neighboring areas was very active. During this time the old term for cinnabar, a word meaning "red ore," was replaced by a word meaning "celestial sands"—consequently, the town which was the center of the cinnabar trade was renamed "Celestial City" (*Chenzhou* in Chinese; its current name is Yuanling); the river on which the cinnabar was transported came to be called "Celestial River" (*Chenshui* in Chinese); and the port town on the river became "Celestial Creek" (*Chenxi* in Chinese).

In 1275 the Chinese government set up an office at Wanshan to administer the cinnabar mines. Large-scale mining activities there were first documented in the literature 600 years ago. In 1899, a joint-venture British-French mining company took over the mines at Wanshan, and over the next ten years it produced 700 tons of mercury and made a profit estimated at 4 million silver dollars (the Chinese currency during the Qing Dynasty). The British and French withdrew in 1908, and private companies ran the five cinnabar mines separately until 1937, when a state-owned mining company took over all of the mines. After World War II, this company sold the mines off to private individuals again.

Since 1949, when the People's Republic of China was founded, the mines and mercury mills of Wanshan have been mainly controlled by the government. In 1952, the Guizhou Mercury Mine and Mill Company was established and authorized to run all mining facilities in the Tongren area. In 1953, control of the Yunchangping area was removed from this organization, and the Tongren Mercury Mine Company was set up to administer Yunchangping. In 1959, Guizhou Mercury Mine and Mill at Wanshan owned 6 shafts and three subsidiary firms and employed 6,690 people. In 1961 the mercury production of this enterprise hit its historical high of 1,262 tons. By 1990, Guizhou Mercury Mine and Mill at Wanshan had become one of the largest state-owned mining companies in China. But with the decrease in demand for mercury and the depletion of resources in the mid-1990's, the central government closed all state mines and allowed the company to go into bankruptcy in 2001. Although there are now more than 20 small private mines operating, their production is very limited.

In the course of more than 100 years of intensive development, the Wanshan and Yanwuping mines were worked on seven levels, to depths of more than 700 meters, and more than 1,000 km of underground workings were excavated; the longest continuous adit is 300 meters.

Yunchangping

The mining history of Yunchangping is much like those of the Wanshan and Yanwuping areas. Before 1953, the Yunchangping area mines were operated by the Guizhou Mercury Mine and Mill Company, owned by the central government. After that date the

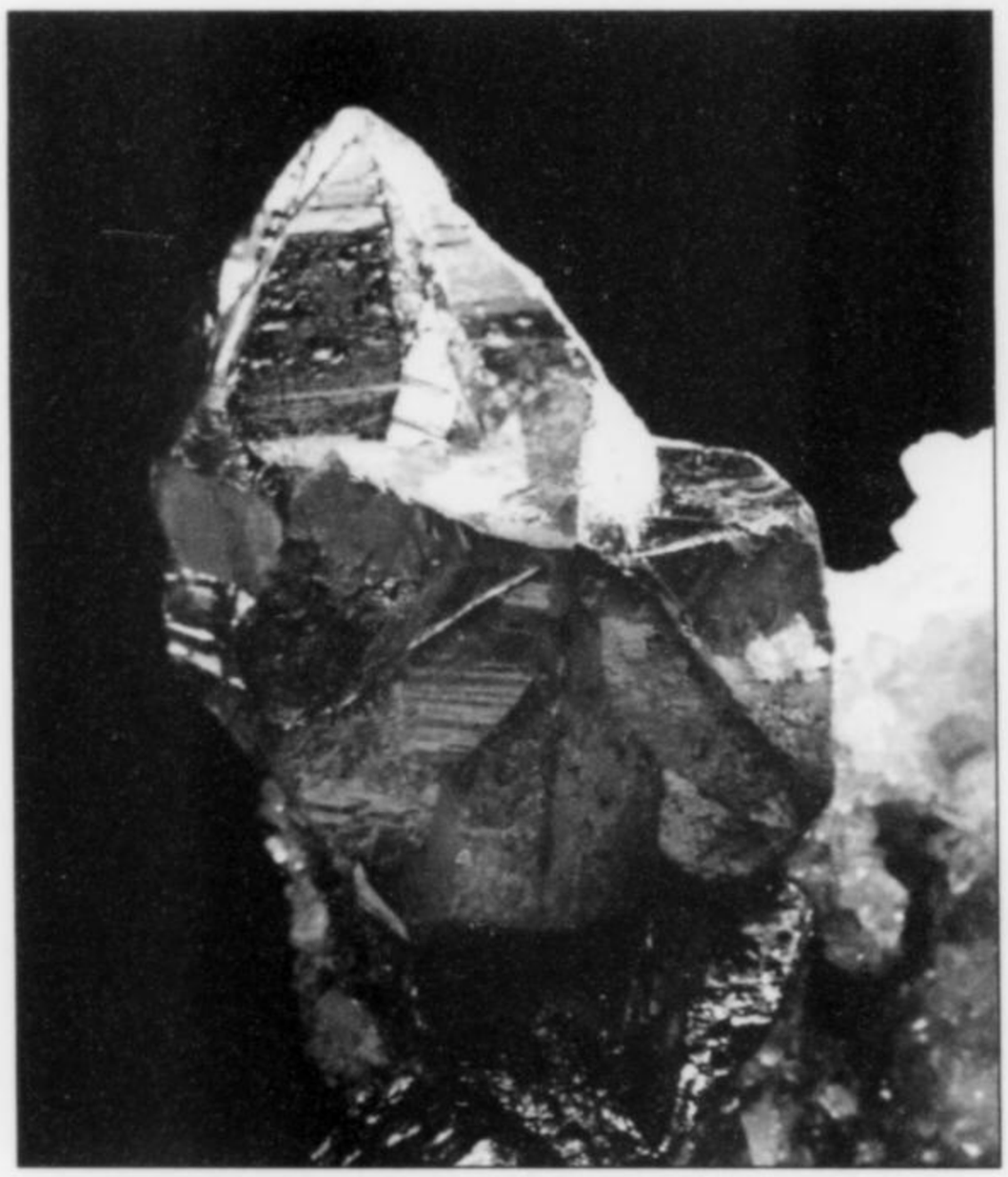


Figure 10. **Intergrown cinnabar penetration twins on quartz matrix, 5.8 cm, from the Yanwuping mines, Guizhou. William Larson specimen (1990); Jeff Scovil photo.**

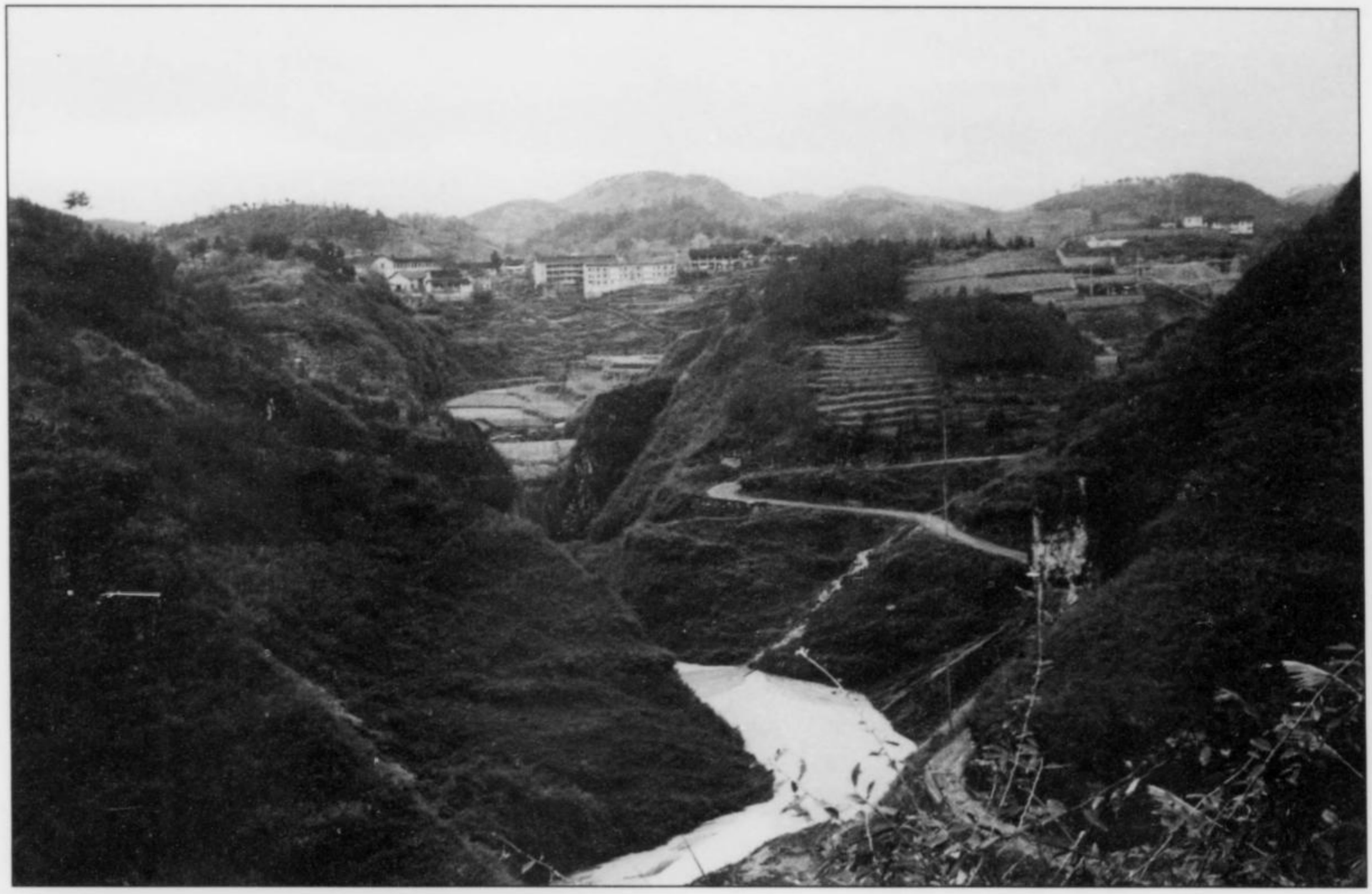


Figure 11. **The Dadongla (Yunchangping) mining area near Tongren, Guizhou. G. Liu photo.**

Figure 12. (left) **Untwinned hexagonal-prismatic cinnabar crystal, 2 cm, on dolomite, from the Dadongla (Yunchangping) mine near Tongren, Guizhou. Anna Chrapowicki specimen (1989); Wendell Wilson photo.**

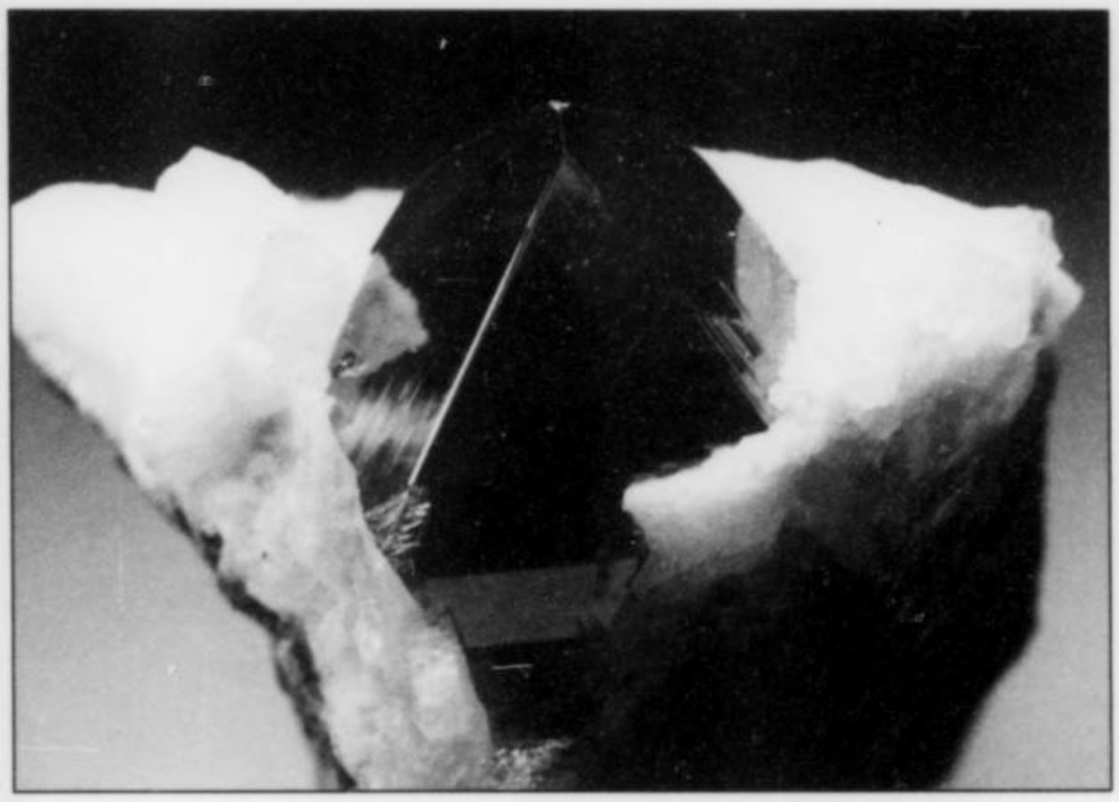


Figure 13. **Remarkably lustrous and gemmy cinnabar crystal, 1.6 cm, on dolomite from the Dadongla (Yunchangping) mine near Tongren, Guizhou. William Larson collection (1987); Wendell Wilson photo.**

Figure 14. (left) **Intergrown but untwinned cinnabar crystals, 1.9 cm wide, on dolomite, from the Dadongla (Yunchangping) mine near Tongren, Guizhou. Betty Llewellyn collection (1992); Jeff Scovil photo.**

Figure 15. (below) **Untwinned rhombohedral cinnabar crystals to 2 cm, on dolomite, collected in 2004 at the Hongshuidong mine, Yunchangping area, near Tongren, Guizhou. Guanghua Liu collection and photo.**

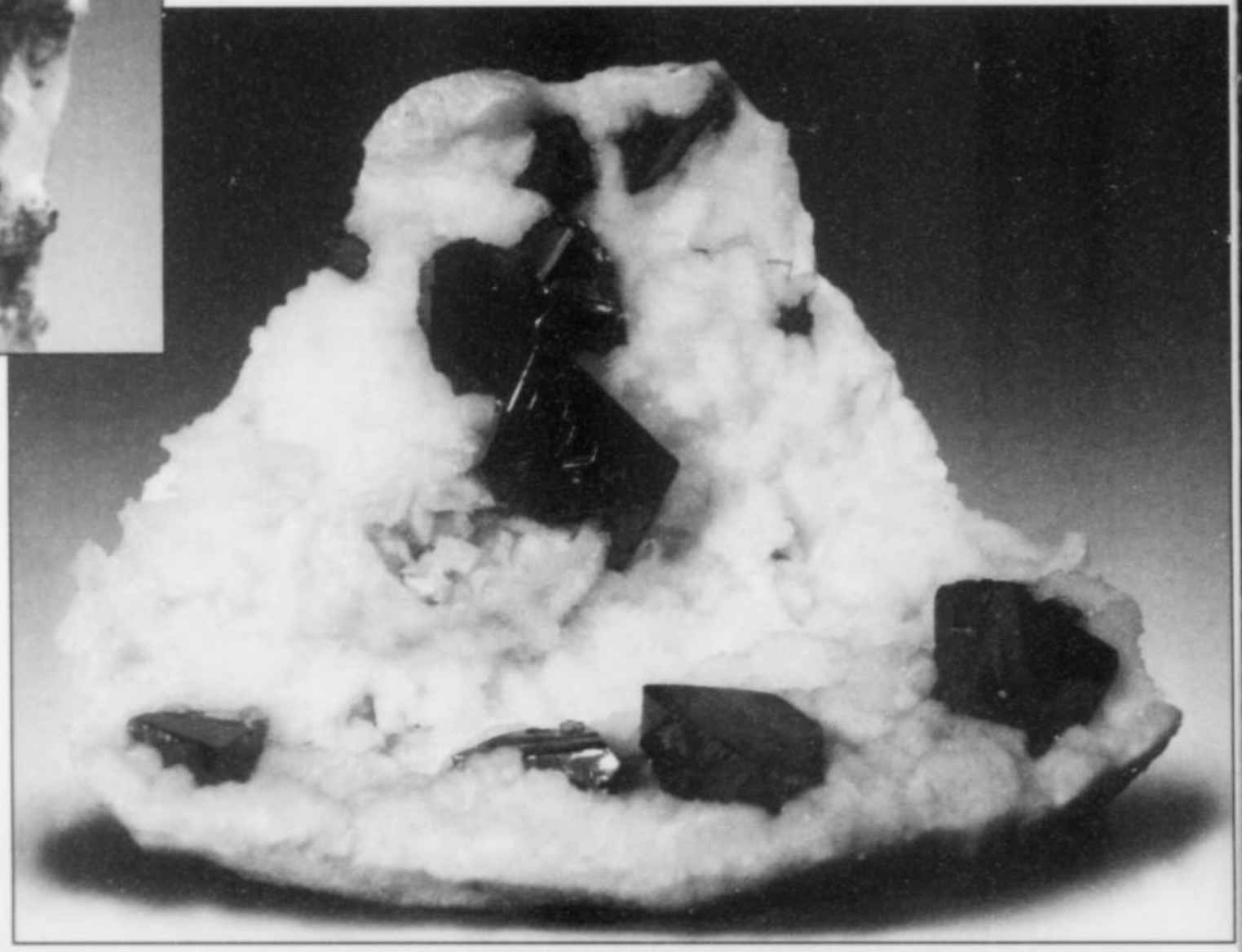


Figure 16. **Untwinned hexagonal-prismatic cinnabar crystal, 1.4 cm, on dolomite, from the Dadongla (Yunchangping) mine near Tongren, Guizhou. Edward Tripp specimen (1987); Wendell Wilson photo.**

Figure 17. **Untwinned rhombohedral cinnabar crystal, 2.5 cm, on dolomite, from the Hongshuidong mine near Tongren, Guizhou. Anna Chrapowicki specimen (1989); Wendell Wilson photo.**

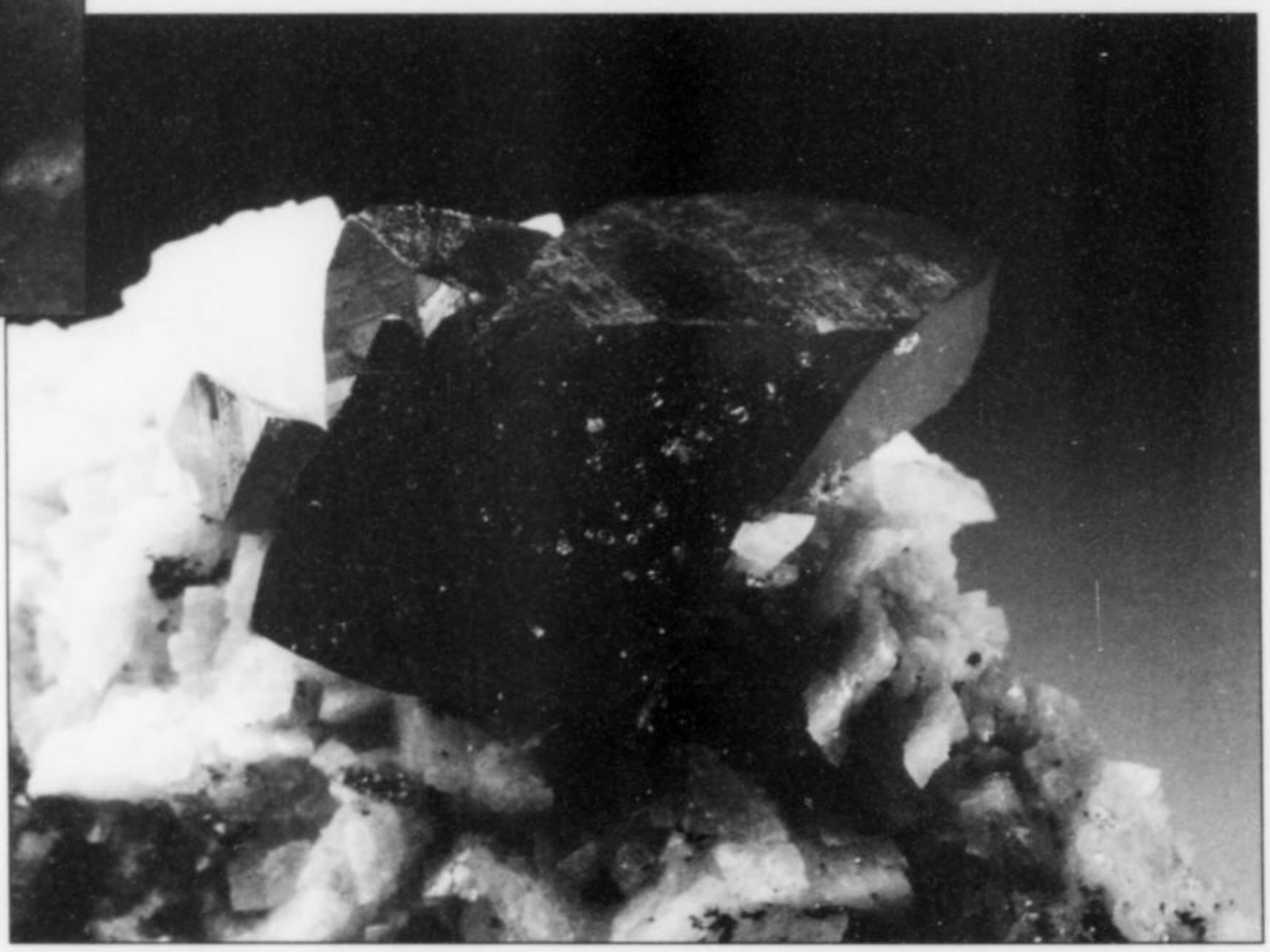


Figure 18. **The Hehuicun #3 mine near Chatian, Hunan. G. Liu photo.**

Figure 19. **Twinned cinnabar crystal, 1 cm, with quartz crystals, from the Yanwuping mines near Tongren, Guizhou. Francis Benjamin collection; Jeff Scovil photo.**

mines were transferred to the Guizhou provincial government, which established a new entity, the Tongren Mercury Mine Company, to administer them. This was an unusual mining company in that all of the miners it employed were convicted criminals.

In 1997 the company was dissolved, and most of the mining pits and underground workings were abandoned or sold to individuals. These pits and tunnels, all of which are small, are scattered throughout the western and northern parts of the town of Yunchangping. The western mining area extends from Lula to Dadongla, and the northern area encompasses Palaxi, Huilongxi, Hongshuidong and Masaxi. East of Yunchangping is Hehuicun, in Hunan Province. Most of the mine pits of Hongshuidong, Masaxi and Pala have been active in recent years.

Chatian

Widespread ruins of mining facilities indicate that Chatian, like other areas, including Tongren, has a very long history of cinnabar mining. Between 1946 and 1958, nearly all mines in western Hunan and eastern Guizhou were administered by the government. In 1958 the Xinhuang Mercury Mine Company of Hunan Province was established, and Chatian's mining areas were allocated to it. The company renovated three mines in Mazi'ao and Hehuicun, (called simply the #1, #2 and #3 mines). Xinhuang Mercury Mine Company eventually relinquished the rights to these three mines to local people. When I visited this area in October 2003, I found that only four small mines were still active. The annual production of cinnabar crystals in this area is less than 500 kilograms; the cinnabar is mainly put to medical uses or exported to Korea. In one of the mines (#3 mine), a pocket with gemmy red, lustrous, twinned cinnabar crystals associated with small quartz and dolomite crystals was recently found.

GEOLOGY AND MINERALOGY

The Tongren-Fenghuang mercury deposits occur mainly in the middle Cambrian Aoxi and Huaqiao Formations, locally in the Lower Cambrian Qingxudong Formation. The Aoxi and Huaqiao Formations are dominated by thinly bedded intraclastic limestone, dolomite and dolomitic limestone, intercalated with laminated black shale and marl in the lower units. These rocks are interpreted to have been formed chiefly in a depositional setting on a carbonate platform (Yan Junping and Liu Ping, 1989). The Lower Cambrian

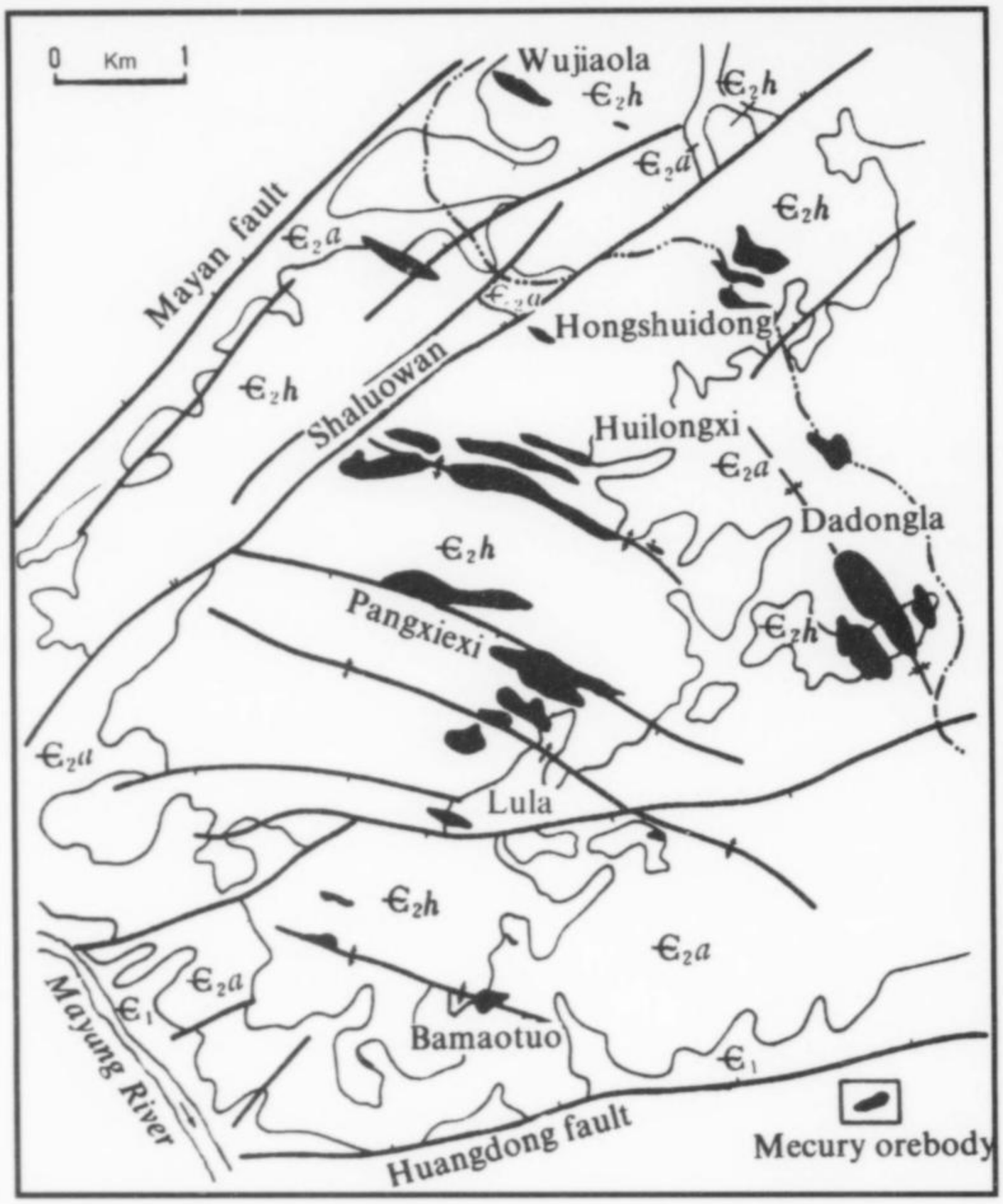


Figure 20. **Schematic geological map of the Dadongla (Yunchangping) mercury orefield illustrating fault-control of the mercury orebodies (from He and Zeng, 1992).**

Qingxudong Formation is characterized by interbedded dark limestone and dolomitic limestone: rock types typically deposited in relatively deep-water sedimentary facies in continental platform slope and platform front environments (Wang and Hu, 1989). The mercury-rich belts are stretched north-northeast, in conformity with the strike of major regional structures. These observations suggest that formation and distribution of mercury deposits are controlled by both sedimentation and tectonic movements. Although there are several interpretations of the origin of the cinnabar-bearing deposits, it is widely accepted that the cinnabar-forming materials are mainly derived from the Hg-rich carbonate and black shale deposited in marine environments, and that the Hg mineralization took place during diagenesis, as a byproduct of post-depositional geochemical and physical processes. Faults and folds generally striking north-northeast are the traces of tectonic events which provided passages and spaces into which the Hg-rich hydrothermal fluids could migrate. Orebodies occur mainly in openings created by structural tensions, such as along the axes of folds, along normal faults, and in pull-apart areas at the boundaries between formations. Cinnabar also is found within the breccias of compression faults, but only as massive material or very small crystals.

According to Wang and Hu (1989), post-depositional mercury mineralization in the Tongren-Fenghuang area can be divided into four phases: silicification, calcitization, baritization and pyritization. The formation of cinnabar crystals is mainly associated with silicification. Because multiple phases of hydrothermal and diagenetic activity took place, these four mineralization phases normally occurred sequentially or simultaneously, so that in either case recystallization and mineral replacement took place within most orebodies. The characteristic minerals of the mercury deposits include cinnabar, dolomite, quartz, calcite, pyrite, sphalerite, metacinnabar, barite, realgar, orpiment, stibnite and "asphalt." Cinnabar, dolomite, quartz and calcite crystals are predominant in most of the orebodies, the other minerals being rare, and some being visible only under the microscope. Analysis of gas and liquid inclusions in these crystals indicates that most of the minerals of these deposits formed between 60°C and 260°C. These low-temperature hydrothermal fluids may not be related to magmatic intrusions nearby, because no such intrusions have been discovered.

Among the ten mercury-rich zones shown on the geological map, it is chiefly the Wanshan, Yanwuping, Dadongla (Yunchangping) and Chatian areas which have produced large cinnabar crystals. In the Wanshan-Yanwuping area there are 12 mercury orebodies, all of which have been mined; the most important are at Shamudong, Zhangjiawan, Yanwuping, Lenfengdong and Kezhai. These orebodies range in size from 220 meters long (at Yanwuping) to 1250 meters long (at Shamudong), and from 40 to 140 meters wide and 1.1 to 22.7 meters thick.

The cinnabar crystals of the Wanshan-Yanwuping area are typically dark red or scarlet red penetration twins associated with dolomite and quartz crystals (Liu, 1995). The crystals are normally between 5 mm and 1.5 cm long, but crystals to 6 cm across have been reported from crystal vugs and small caverns. In 1980, a twinned crystal measuring 6.45 x 3.5 x 3.7 cm and weighing 237 g was collected by the Geological museum of China (Beijing) from a

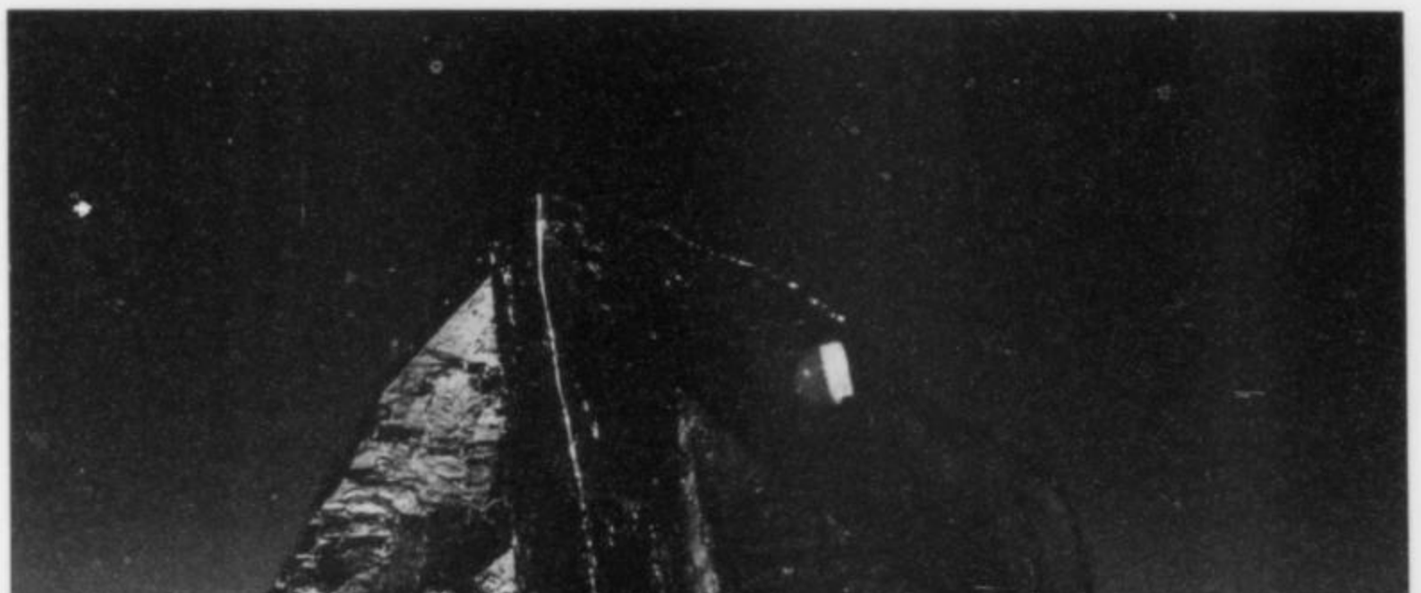


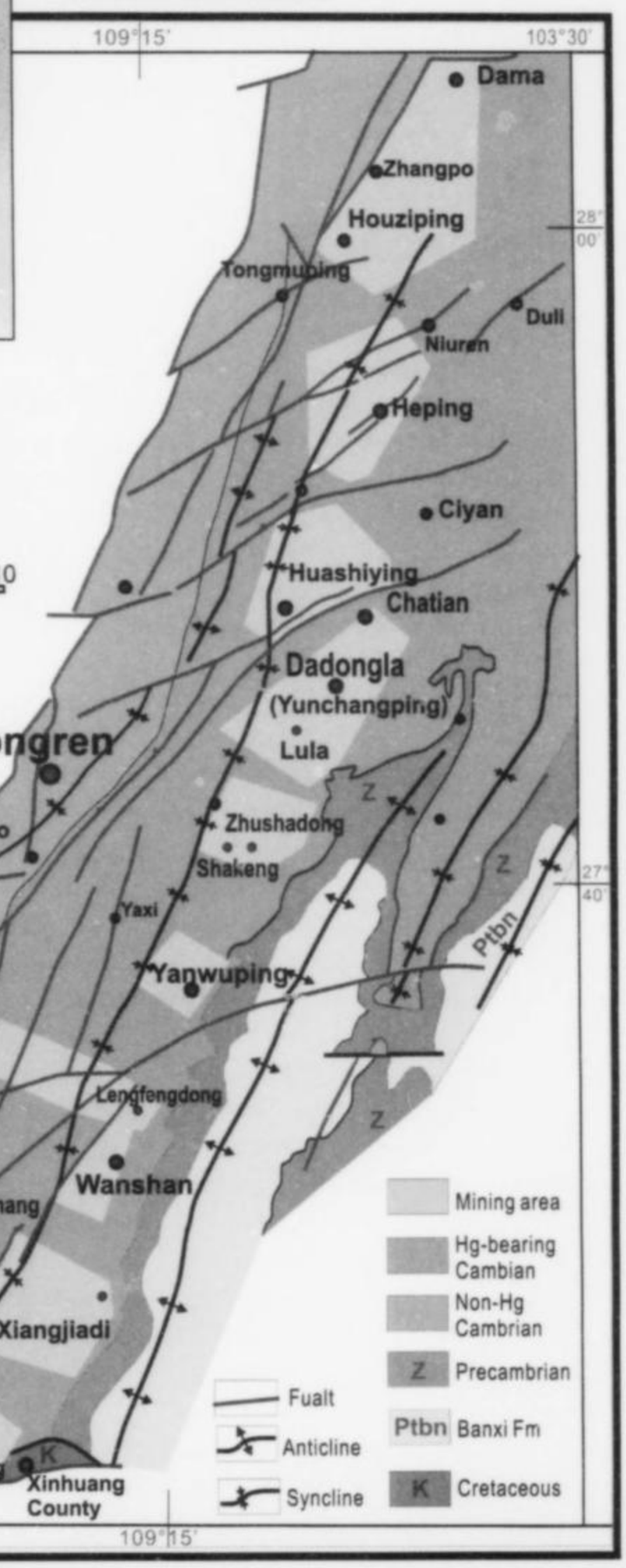
Figure 21. **Extraordinary 3.7-cm cinnabar twin from the Niujiaotang deposit at Duyun, Guizhou, located about 220 km southwest of Wanshan (see Fig. 2). Natural History Museum of Los Angeles County collection, acquired (1991) from Tom Palmer; Wendell Wilson photo.**

mine in Yanwuping. Cinnabar crystals from the Wanshan-Yanwuping mines are well known for their strong metallic-adamantine luster, dark or brick-red color, large sizes, pyramidal shape formed by penetration twinning, and attractive association with quartz and dolomite. The dark color of the cinnabar here is believed to result from relatively high trace contents of manganese and selenium. The majority of the Chinese cinnabar specimens which appeared on the international mineral market before 2000 are from the Wanshan-Yanwuping mines.

There are eight mercury orebodies in area of Yunchangping-Chatian. The most important deposits are at Dadongla, Hongshuidong, Masaxi and Lula in Guizhou Province, and Mazi'ao and Hehuicun in Hunan Province; most cinnabar mines are concentrated in these areas. Although the formation mechanisms of mercury deposits in these mines are similar, their cinnabar crystals vary widely from mine to mine, in habit, color and mineral associations.

Dark penetration-twinned crystals up to 4 cm across on white dolomite are found chiefly in the mines of Dadongla and Lula, although other mines in the region may also produce specimens of this kind. Bright red, translucent, relatively small penetration-twinned cinnabar crystals predominate at the Mazi'an and Hehuicun mines (i.e. the #1, #2 and #3 mines) in southern Chatian. Highly lustrous cinnabar as bright red tabular and prismatic rhombohedrons (hexagonal and trigonal) is more common in the mines of Hongshuidong and Masaxi. In 2002 and 2003, an open pit in Hongshuidong produced many specimens with large cinnabar crystal clusters; underground work is currently proceeding there. During the last two years, several pockets have been discovered, mainly in the Hongshuidong and Masaxi mines in Yunchangping and in the #3 mine in Hehuicun, which have yielded highly

Figure 22. **Geological map of the Wanshan-Tongren-Fenghuang mercury trend, Guizhou and Hunan.**



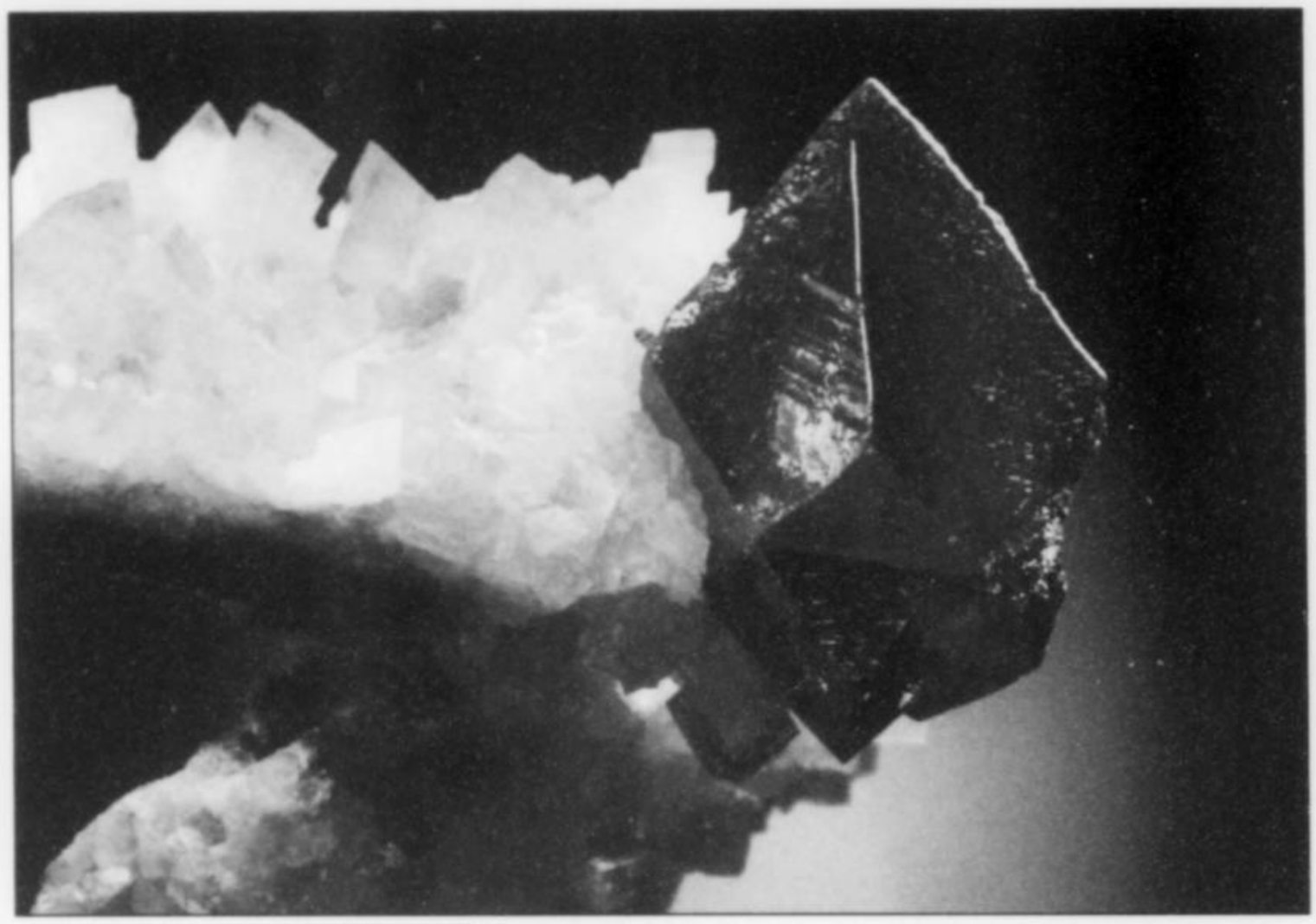


Figure 23. **Cinnabar twin on dolomite, 4.5 cm, from near Chatian, Hunan. Collector's Edge specimen (2003); Jeff Scovil photo.**

lustrous, bright red, gemmy, tabular and prismatic cinnabar crystals to 3 cm with quartz and dolomite, and in some cases with yellow translucent calcite.

THE CINNABAR TRADE

Although the cinnabar trade can be traced back thousands of years, the use of cinnabar crystals as decorative and ornamental objects might have begun about 300 years ago, during the Ming Dynasty. In these early times, thin pieces of cinnabar were packed for sale in small wooden boxes, each box weighing about 500 grams. Between 1955 and 1984, when the government of the People's Republic of China controlled all of the mercury mines, all cinnabar found in the mines was smelted as mercury ore. In 1985 the business of selling thin cinnabar blades in packages was revived, but the packages became smaller—from 100 to 200 grams weight—and the boxes were given glass covers. Most of these boxes were, and still are, exported to Korea and Japan.

The following is a summary of the contemporary cinnabar specimen trade, based on communications with Mr. Fu Zimin, an active dealer of Hehuicun, Chatian, and Mr. Zhang of Yunchangping.

During the modern era, collection specimens of cinnabar began being sold just after the discovery in 1980 of the largest known crystal (this specimen, already mentioned, weighs 237 g and is now on exhibit in the Geological Museum of China). Early in the 1980's the Geological Museum received some orders for cinnabar from dealers in the U.S.A., Hong Kong and Japan, and forwarded the orders to the Guizhou Mercury Mining Company in Wanshan. Until September 1983 the cinnabar business in China was controlled by state authorities, but in that month Ms. Zhou Xiaomei, a woman related to a miner, brought some specimens to Beijing and sold them directly to a Chinese-American dealer; in this she was assisted by Mr. Zhou Tingkuan, the person in charge of making purchases for the museum. From then on, more and more miners stole cinnabar crystals from the state mines and sold them to staff members of museums and geological institutes in Beijing and Changsha, the capital city of Hunan.

International demand for Chinese cinnabar crystals grew, and in response, in the early 1990's, some miners and dealers began gluing loose cinnabar crystals onto matrix and thus creating many "top specimens"—a practice which worried serious dealers and collectors. Mr. Tong, a young farmer in Wanshan, was so successful at this type of specimen manufacturing that he was able to buy a home in the center of Tongren city with his profits. The skill of some fabricators reached such a high level that it is wise for collectors to check all Chinese cinnabar specimens with microscopes or by chemical methods. Although the number of falsified specimens has decreased since the early 1980's, buyers still should be cautious, especially with unusual-looking specimens.

The first dealer, Ms. Zhou, earned a considerable amount of money and became a prosperous citizen of the Tongren area. In the 1990's, as the market for cinnabar fell off, she changed her business, moving into the clothing trade. Since the end of state ownership of the mines in the late 1990's, the trade in cinnabar has been conducted only among private merchants. Currently, about ten local cinnabar dealers are actively moving between the mines and the major domestic mineral markets, including those in Changsha, Guilin, Beijing and Guangzhou. In the summer of 2004, the first cinnabar dealer from Chatian, Mr. Yang, came to the St.-Marie-aux-Mines mineral show.

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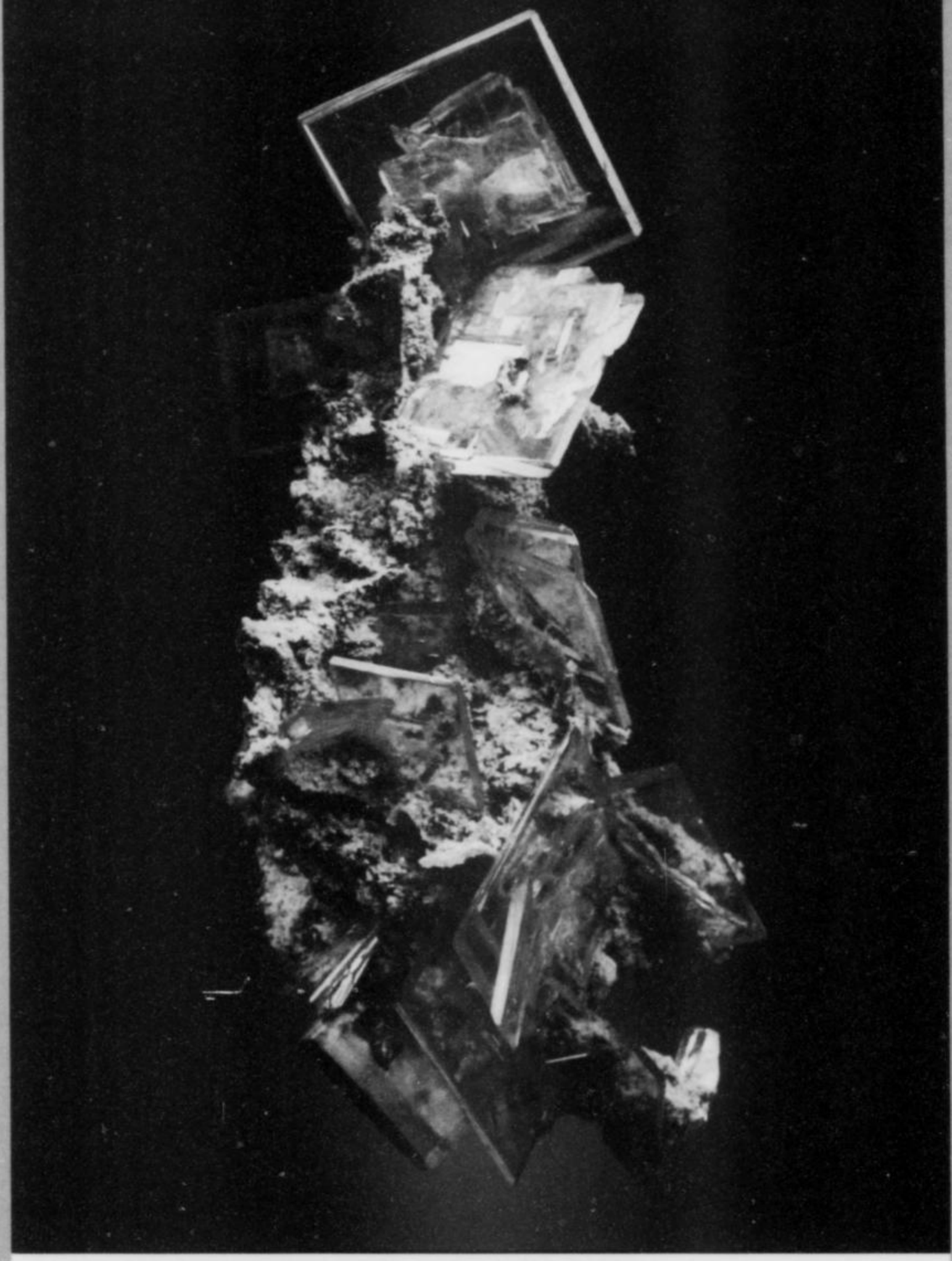

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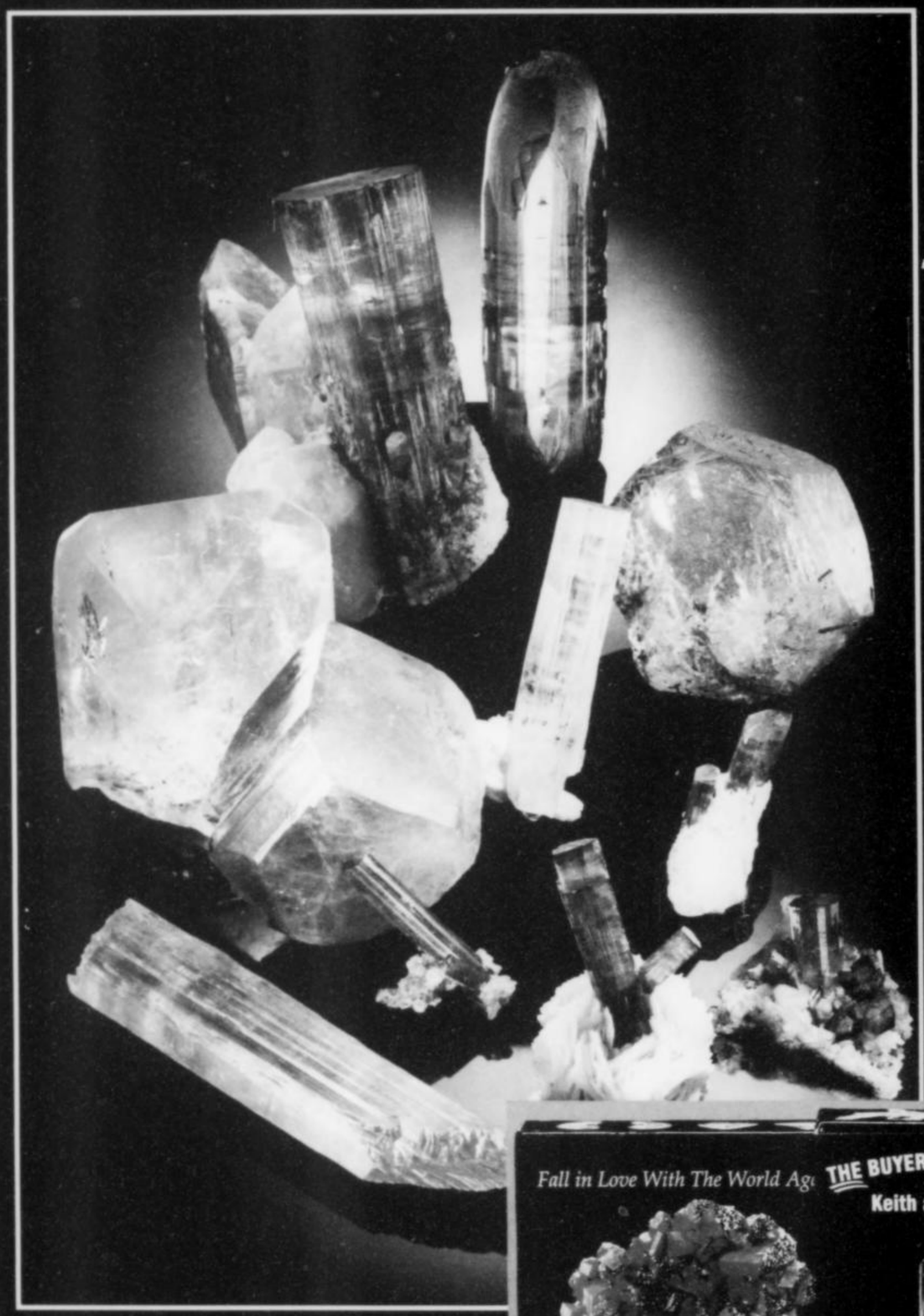

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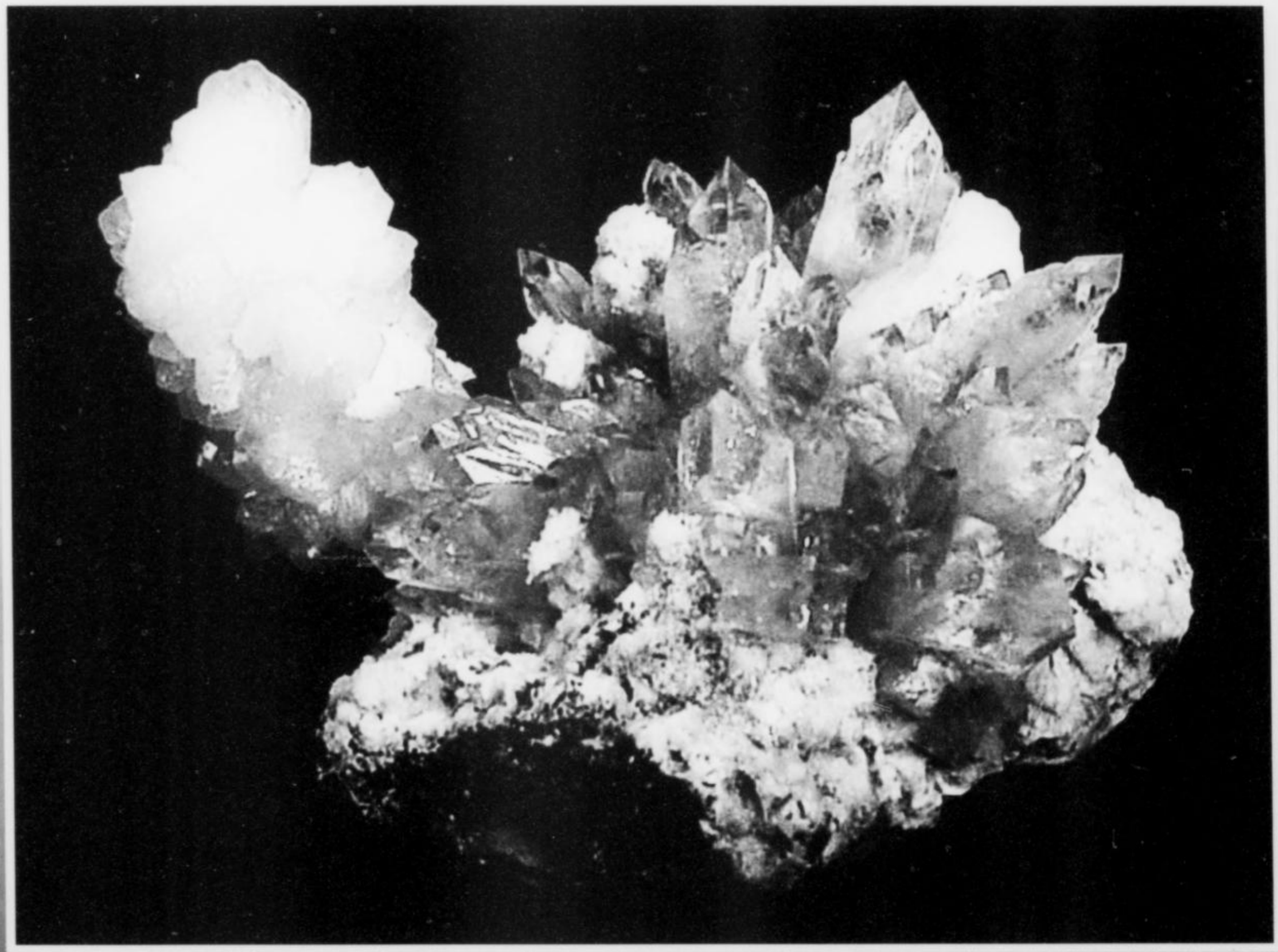

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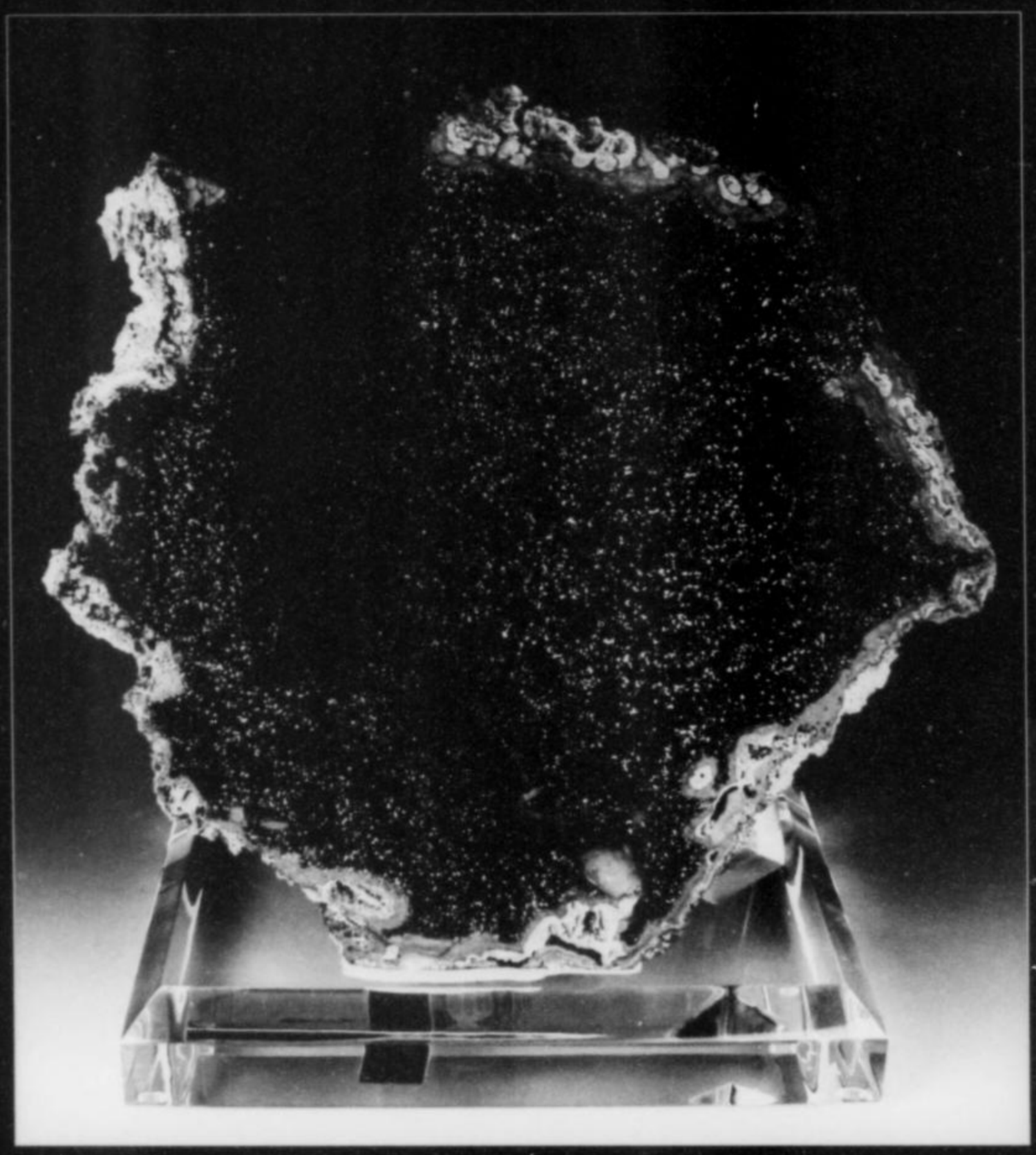

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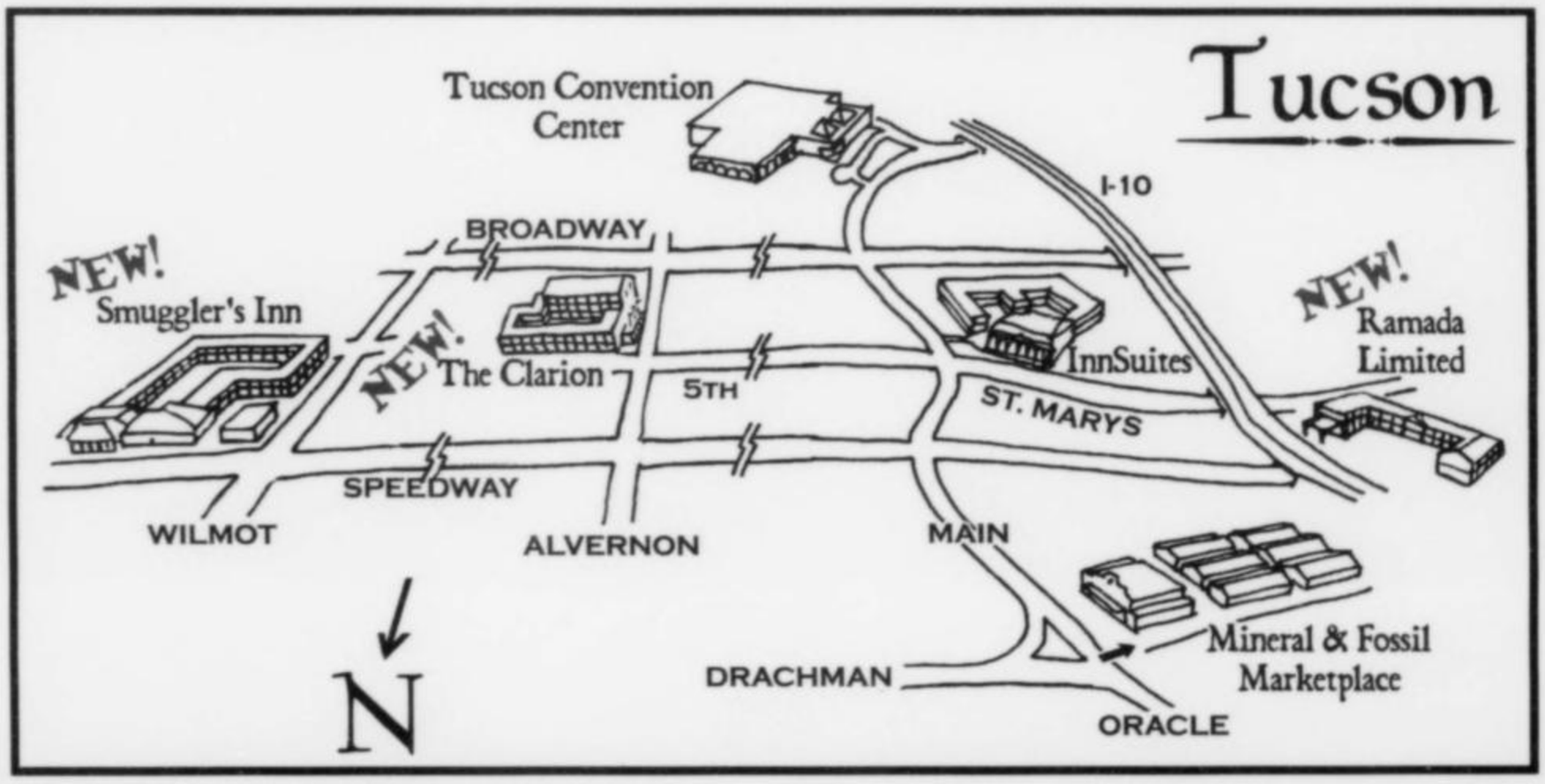

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指南 地点

A Guide to Mineral Localities in China

Bill Smith and **Carol Smith**
1731 Daphne
Broomfield, Colorado 80020
smith72@attglobal.net

Guanghua Liu
Französische Allee 24
D-72072 Tübingen, Germany
GhLiu@t-online.de

Berthold Ottens
Klingenbrunn Bahnhof 24
D-94518 Spiegelau, Germany
ottens-mineralien@t-online.de

China is the world's third largest country in land area, so it is not surprising that, with its opening to the West, there has appeared on the world market a flood of specimens from an increasing number of localities. Unfortunately this flood has not been accompanied by an equally copious flow of information about these localities. With this gazetteer we hope to begin to alleviate this problem.

A LITTLE GEOGRAPHY

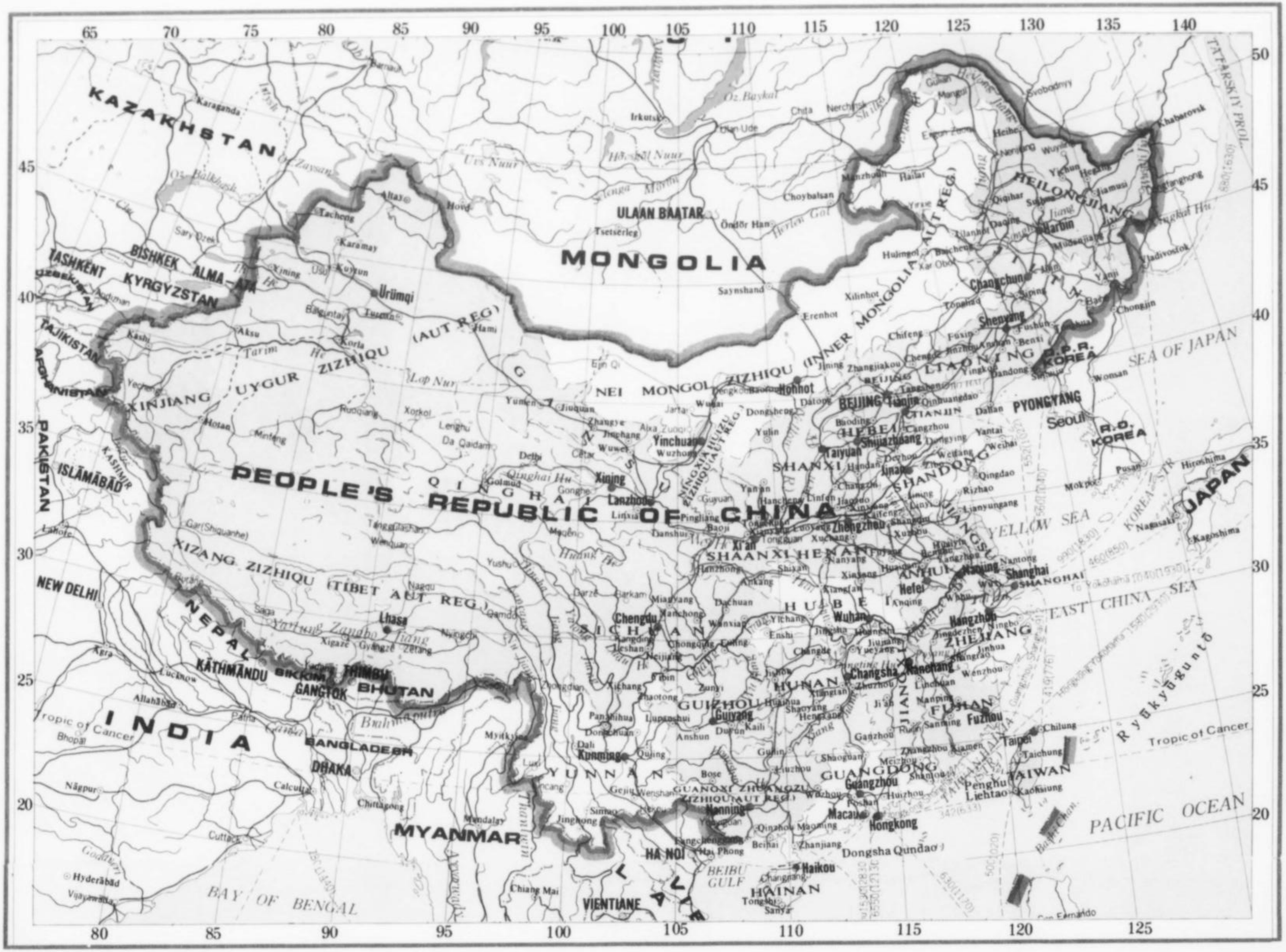
The geography of many large countries can be characterized fairly simply: for example, the United States has its eastern mountains and piedmont, interior plains, and western mountains, valleys and plateaus; Russia is the land of forests and steppes; Australia is characterized by a dry interior surrounded by a broad fringe of well-watered mountains and coastal plains. But China, with its varied concatenation of mountains, plateaus, basins, and plains, is not nearly so easy to sketch geographically.

If you must have but one word to describe China, it is "mountains." Approximately one third of the country can be described as mountainous, and many of the "flat" lands of the Xinjiang and Tarim basins and the Tibet-Qinghai, Mongolian and Yunnan-Quizhou plateaus are the results of mountain-building orogenies.

China's geography is best described in terms of three levels of elevation folded around each other in sinuous bands. The highest level is the Tibet-Qinghai plateau, rising to 4000 meters and more and bounded on the south by the Himalaya (to 8848 meters) and Karakoram ranges, and on the north by the Kunlun Shan (to 7723 meters).

The second tier, wrapping around the first from the north, northeast, and southeast, consists of mountains and plateaus of somewhat lower elevation than the first tier, although the Tian Shan rises to 7437 meters. It also contains significantly depressed basins, especially the Turfan, with China's lowest point at −154 meters. In the west the mountains of the second elevational tier strike east-west; these include the Tian Shan, the Altay, and Qinling. The Mongolian and Loess plateaus dominate the central part of this belt. In the northeast, north-south-trending ranges predominate, such as the Greater Hinggen and the Taihang Shan; the ranges of the Yunnan-Guizhou also strike north-south.

ADMINISTRATIVE DIVISIONS OF CHINA



The lowest elevational tier consists of the northeastern Manchurian plains and of the eastern riverine plains of the Huang He and Chang Jiang. It also contains the Southeastern Uplands, with much lower mountains striking NNE-SSW, and with broad and narrow intermontane valleys. Many beautiful minerals come from this region.

Some useful words:

bei—north	*jiang*—river	*shamo*—desert
da—big	*ling*—ridge	*shan*—mountain(s)
dao—island	*men*—pass	*xi*—west
dong—east	*nan*—south	*xiao*—little
he—river	*pendi*—basin	*zhong*–center, middle
hu—lake		

A LITTLE GEOLOGY

What created all these mountains and mineral deposits? Continents and subcontinents like North America, Australia, and southern Africa have huge, stable cratons (continental cores), mostly dating from the Precambrian, to which a modest number of exotic terranes may have accreted. But China sits on at least seven modern or paleoplates, and has added a number of exotic terranes. These attachments did not come gently; collisions between plates and terranes created China's mountain systems. And collisions continue today: the thrust of the Indian subcontinent is driving the uplift of the Himalaya, Karakoram, and Yunnan-Guizhou ranges, and of the Tibetan-Qinqhai plateau; the subduction of this plate is also elevating the Kunlun and Tian Shan ranges. The Pacific plate is subducting under eastern China, driving up the Nanling ranges and the mountains of the Southeast uplands; much vulcanism and many ultrabasic intrusions are offspring of this subduction.

Approximately 168 different kinds of mineral deposits are the creations of this vigorous tectonic activity; these deposits contain the vast majority of all known mineral species. China is especially rich in hydrothermal vein and replacement deposits, skarns, pegmatites, and ultrabasic and rare-earth deposits. On the other hand, China does not appear to have an abundance of Mississippi Valley-type deposits.

A LITTLE (MINING) HISTORY

Coal carvings have been radiometrically dated to over 4,000 years B.C. Bronze was in wide use during the Shang Dynasty (1600–1100 B.C.). The still-active Daye copper mines have been worked for over 2,800 years, and thousands of other ancient mine sites are known to exist in China.

Mining in China today is much more intense than in the past. At the end of 2003, China had about 10,000 state-operated medium-size to large mines, and 280,000 township and private mines. Collectible minerals come largely from the smaller mines, but these mines also contribute disproportionately to the mining accident and death rate, and to environmental degradation. For these reasons, the central government has closed approximately 10,000 small mines, and such closures will continue.

POLITICAL GEOGRAPHY

The People's Republic of China is divided into 23 provinces (sheng), five autonomous regions (zizhiqu), abbreviated hereafter as A.R., four municipalities (shi), abbreviated hereafter as M, and two special administrative zones: Hong Kong and Macao. The four municipalities consist of very large urban agglomerations with enough non-urban area that they contain some mineral localities (e.g. topaz from Laojuntang, Beijing).

There are two principal methods for transliterating Chinese ideograms into Roman characters that can be read phonetically: the *Wade* and the *Pinyin* systems. For the benefit of those holding labels and atlases using the older conventional (Wade) locality names, we provide the list shown below, equating the conventional spellings of these provinces, etc., with the now-preferred Pinyin spelling. Note that the Beijing government counts Taiwan as the twenty-third province (but no Taiwanese mineral localities are included here). The provinces of Heilongjiang, Jilin, and Liaoning constitute the region known as Manchuria (in Chinese: *Dongbei* = Northeast); its Manchu population is closely related to the Han population of the other provinces.

Anhwei — Anhui
Chungking — Chongqing M
Chekiang — Zhejiang
Fukien — Fujian
Hainan — Hainan
Heilungkiang — Heilongjiang
Honan — Henan
Hopeh — Hebei
Hunan — Hunan
Hupei — Hubei
Inner Mongolia, Neimeng Ku — Nei Mongol AR
Kansu — Gansu
Kiangsi — Jiangxi
Kiangsu — Jiangsu
Kirin — Jilin
Kwangsi Chuang — Guangxi AR
Kwangtung — Guangdong
Kweichow — Guizhou
Liaoning — Liaoning
Ningsia Hui — Ningxia Huizu AR
Peking — Beijing M
Shanghai — Shanghai M
Shansi — Shanxi
Shantung — Shandong
Shensi — Shaanxi
Sinkiang Uighur — Xinjiang Uygur AR
Szechwan — Sichuan
Taiwan — Taiwan
Tibet — Xizang AR
Tientsin — Tianjin M
Tsinghai — Qinghai
Yunnan — Yunnan

Following conventional usage, we will continue to use both "Tibet" and "Inner Mongolia" in our table, but "Sinkiang Uighur" will be replaced by "Xinjiang Uygur Autonomous Region."

The highest level of internal government consists of the Provinces, Autonomous Regions and Municipalities; the next level below is frequently translated as "prefectures" (*diqu*). There are roughly 150 of these, plus approximately 200 cities whose administrations operate at the prefectural level.

The third level of administration is usually translated as "counties" (*xian*); there are over 2,000 of these, and more than 700 cities that function as counties. The name of the county is taken from the name of the city or town that serves as the county seat.

Below the county level are "districts" (*qu*) and "areas" (*xiang*); the *qu* are largely urban and the *xiang* are largely rural. The lowest level are "villages" (*cun*) and "small towns" (*zhen*).

LANGUAGES AND TRANSLITERATION

The official version of Chinese is the Puitonghua (= "standard") version, based on the Beijing dialect; this dialect more or less equates to what was once called Mandarin, and it is in wide use in northern China. In southern China, however, a wide variety of

other languages are in use: Wu-Hu (90 million speakers), Yue, or Cantonese (70 million speakers), Hakka and others; there are over 100 dialects in Fujian Province alone. China also has over 50 minority (non-Han) languages. It is therefore quite possible that a mineral locality has more than one name; this problem is worsened because we report more mineral localities in southern China than in the north. The primary names we provide here are those used by the national government, but if we know of variant names, we include them as well.

The transliteration used throughout our gazetteer is the standard Pinyin as formally adopted by China in 1979. The older conventional (Wade) transliteration is still in use in Taiwan. Readers should know that in Pinyin, "q" is pronounced close to the English "ch" and "x" is pronounced approximately "sh". Pinyin also uses "ch" and "sh" which are pronounced slightly differently than "q" and "x"; the differences are sufficiently narrow that one of the junior authors cannot detect them when the spoken language is transmitted through electronic hearing aids.

In the following table the meanings of the first two column headings are obvious. The third column contains the county seat, whose name is also that of the county in which this locality resides.

The "Lat, Long/dist from mine" column has entries that should be read as from the locality to the county seat; thus for our second entry **from** Amo **to** Ximeng. These distances and directions are only approximate.

The Province is always that in which the listed locality and county lie.

An asterisk (*) preceding a mineral name means that this is the type locality for this species. We have attempted to include all minerals of collector interest, as well as associated species that may serve as diagnostic aids. We have also included some localities of high scientific interest (Bayan Obo, Koktokay). No inferred species are included.

Readers must accept that this gazetteer is both incomplete and contains errors that we have not detected.

SOURCES

The senior author provided the basic table of localities; he and the second author provided the mineral species attributed to these localities. The senior author also provided the geological and historical comments. Much use was made of the *Columbia Gazetteer of the World* (with 3,736 Chinese entries); other invaluable tools were the *Handbook of Mineralogy* (Anthony, *et al.*), and *Fleischer's Glossary of Mineral Species* (Mandarino, 1999).

Special thanks are due to Dr. Marvin Rausch, who provided the essential personal introduction that initiated this project. Clara and Steve Smale and *Collector's Edge* both provided data that helped to get our project moving. We are grateful to the late Richard Bideaux for his careful reading of our table, which led to the correction of many imperfections.

CHINA MINERAL GAZETTEER

Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
884 (Leiping Mining area)	Mine	Guiyuan	25°43′ N 112°43′ E 27 km SW	Hunan	v-twinned calcite, galena, pyrite, arsenopyrite, fluorite
Altay	Mining district	Altay City	47°50′ N 88°12′ E 10 km S	Xinjiang, Uygur A.R.	albite, amazonite, apatite, aquamarine, epidote, fluorite, garnet, gold, polylithionite, molybdenite, muscovite, pollucite, pyrite, sphalerite, spodumene, topaz, tourmaline, zircon
Amo	Mine	Ximeng	22°44′ N 99°26′ E 36 km SE	Yunnan	cassiterite
Anpeng	Mine	Tongbai	32°21′ N 113°24′ E 31 km SE	Henan	gypsum
Anyuan	Mine	Linwu	25°16′ N 112°32′ E 56 km N	Hunan	arsenopyrite
Aoshan	Iron mine	Ma'anshan City	31°43′ N 118°28′ E 30 km NW	Anhui	apatite, calcite, hematite, pyrite
Babu	Area	Hezhou City (Hexian)	24°25′ N 111°32′ E 10 km NW	Guangxi, Zhuang A.R.	aurichalcite, calcite, rhodochrosite

* denotes that this is the type locality for this species

Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Baisha	Quarry	Changning	26°24′ N 112°23′ N 40 km NW	Hunan	calcite
Baiyinchang	Mine	Baiyin City	36°33′ N 104°12′ E 10 km S	Gansu	arsenopyrite, bornite, chalcopyrite, galena, jarosite, pyrite, sphalerite, stannite
Bantanhe	Mine	Taishan City	22°15′ N 112°48′ E 20 km SW	Guangdong	zircon, samarskite
Bayan Obo (Baiyunerbo)	Mine	Baotou City	40°39′ N 109°49′ E 29 km S	Inner Mongolia	*aeschynite-(Nd), *baotite, *bafertisite, bastnäsite-(Ce), calcite, carbocernaite, *cebaite-(Ce), *cebaite-(Nd), cordylite-(Ce), *daqingshanite-(Ce), *fergusonite-beta-(Ce), *fergusonite-beta-(Nd), *fergusonite-beta-(Y) *fergusonite-(Ce), *fergusonite-(Nd), fergusonite-(Y), hematite, *huanghoite, *magbasite, magnetite, monazite-(Ce), nioboaeschynite-(Ce), *parisite-(Nd), strontianite, witherite
Beiwagou	Jade mine	Xiuyan	40°17′ N 123°17′ E 56 km W	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Beiyan	Mountain, village	Changle	36°42′ N 118°50′ E 14 km N	Shandong	sapphire
Bianning	Jade mine	Xiuyan	40°17′ N 123°17′ E 24 km SE	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Bofang	Copper mine	Changning	26°24′ N 112°23′ E 20 km S	Hunan	adamite, "limonite"
Caiwa	Antimony mine	Danfeng	33°42′ N 110°21′ E 16 km S	Shaanxi	kermesite, pääkkönenite, senarmontite
Chalaka	Area	Geji	32°25′ N 81°08′ E 75 km W	Tibet A.R.	borax
Changbai	Mountain range	Tonghua	41°43′ N 125°56′ E 25 km N	Jilin	*changbaiite
Chashan	Lead and zinc mine	Linwu (Chenzhou)	25°16′ N 112°32′ E 17 km S	Hunan	galena, pyrite, quartz, dolomite, fluorites and calcite
Chao'an Chaozhou	Area	Chao'an City	23°27′ N 116°40′ E 6 km S	Guangdong	helvite
Chaobuleng	Area	Xilinhot City	43°57′ N 116°03′ E 40 km N	Inner Mongolia	xilingolite

* denotes that this is the type locality for this species

Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Chatian (incl. #1, #2, #3 shafts and ten small mines nearby)	Town, mine	Fenghuang	27°56′ N 109°36′ E 28 km NE	Hunan	cinnabar, barite, pyrite, quartz, sphalerite
Chengmenshan (incl. Weijia mine)	Copper mine	Shahe County, Jiujiang City	29°43′ N 115°58′ E 8 km N	Jiangxi	azurite, chalcopyrite, copper, cuprite (chalcotrichite), pyrite, quartz
Chimashan	Mine	Yangxin	29°49′ N 115°13′ E 34 km SE	Hubei	chalcocite
Daba	Tin mine	Leiyang	26°24′ N 112°51′ E 30 km NE	Hunan	calcite
Dachang	Mine	Qinglong (Liancheng)	25°50′ N 105°13′ E 14 km NE	Guizhou Zhuang A.R.	arsenopyrite, barite, calcite, cassiterite, fluorite, jamesonite, marcasite, pyrite, sphalerite, stibnite
Dafangshen	Jade mine	Xiuyan	40°177′ N 123°17′ E 24 km S	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Dahegou	Mine	Lushi	34°03′ N 111°02′ E 45 km N	Henan	calcite, barite, stibiconite, stibnite
Damiao	Town	Chengde City	40°46′ N 118°09′ E 25 km SE	Hebei	*damiaoite
Daoping	Lead-zinc mine	Gongcheng	24°51′ N 110°4′ E 30 km SE	Guangxi Zhuang A.R.	cerussite, galena, pyromorphite, sphalerite
Daye (incl. some small mines)	Copper & iron mines	Daye	30°06′ N 114°58′ E 2 km E	Hubei	calcite, azurite, malachite, hematite
De'an	Mine	De'an	29°19′ N 115°45′ E 26 km NE	Jiangxi	fluorite
Dingjiagang	Area	Changde	29°02′ N 111°51′ E 17 km NE	Hunan	diamond
Donghai	Area	Donghai, Niushan	34°32′ N 118°45′ E 12 km E	Jiangsu	carbonate-apatite, quartz
Dongshan	Tungsten mine	Linwu	25°16′ N 112°32′ E 10 km S	Hunan	fluorite, scheelite, calcite
Ebian	Area	Ebian	29°14′ N 103°16′ E 26 km NE	Sichuan	barite, quartz
Ertixi (#3 pegmatite)	River	Fuyan	47°02′ N 89°29′ E 20 km	Xinjiang, Uygar A.R.	*ertixiite

* denotes that this is the type locality for this species

Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Fengjiashan	Wollastonite mine	Daye	30°06′ N 114°58′ E 7 km E	Hubei	amethyst, apophyllite, braunite, calcite, chalcopyrite, datolite, hubeite, ilvaite, inesite, japanese twins, pyrite, stilbite/stellarite, wollastonite
Fenglin	Mine	Dongxiang	28°13′ N 116°37′ E 8 km S	Jiangxi	chalcocite
Fengsandong	Mine	Yangxin	29°49′ N 115°13′ E 49 km W	Hubei	amethyst, bornite, apophyllite, chalcopyrite, datolite, inesite, molybdenite, pyrite, parsettensite, stilbite
Fushan	Iron mine	Xintai City	37°04′ N 114°30′ E 56 km E	Hebei	vesuvianite, hematite
Fushun	Mine	Fushun City	41°51′ N 123°54′ E 5 km S	Liaoning	amber
Fuyun	Area	Fuyun	47°02′ N 89°29′ E 20 km	Xinjiang, Uygur A.R.	aquamarine, fluorite, garnet, hiddennite, pollucite, tourmaline
Gaiyang	Area	Mingxi (Xuefeng)	26°21′ N 117°12′ E 18 km SE	Fujian	sapphire, pyrope
Ganzhou Dayu	Area, mountains	Dayu	25°23′ N 114°22′ E 47 km SE	Jiangxi	barite, bismuth, cassiterite, fluorite, scheelite, sphalerite, wolframite
Gaofeng	Area	Qianshan	30°37′ N 116°34′ E 71 km S	Anhui	epidote, garnet
Gaoligongshan	Mountain	Fugong	26°54′ N 98°54′ E 12 km E	Yunnan	topaz, tourmaline
Gaoshitai	Village	Chengde City	40°46′ N 118°09′ E 15 km S	Hebei	*gaotaiite
Gaowang	Mine	Conghua (Jiekou)	23°33′ N 113°33′ E 15 km SE	Guangdong	fergusonite, samarskite
Gejiu	Mine	Gejiu City	23°21′ N 103°09′ E 29 km N	Yunnan	barite, bornite, cassiterite, hemimorphite
Gongchangling	Iron mine	Liaoyang	41°13′ N 123°03′ E 31 km NW	Liaoning	magnetite
Gongga	Village, mountain	Ningnan	27°05′ N 102°46′ E 20 km	Sichuan	barite
Gongxian	Mines	Gongxian	34°46′ N 112°58′ E 45 km SW	Henan	bauxite (diaspore, boehmite)

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Guangshanzai	Mine	Yunxi	32°59′ N 110°25′ E 59 km NE	Hubei	turquoise
Guichi	Copper mine	Guichi City	30°39′ N 117°28′ E 10 km NW	Anhui	azurite, malachite
Guilin	Area	Guiliun	25°17′ N 110°17′ E	Guangxi Zhuang A.R.	calcite
Harhada	Area (orebody)	Erenhot Erlian City	43°38′ N 111°58′ E 28 km E	Inner Mongolia A.R.	*erlianite
Hazhen	Jade mine	Xiuyan	40°17′ N 123°17′ E 52 km SW	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Heshan	Iron mine	Chengde City	40°46′ N 118°09′ E 46 km S	Hebei	coulsonite, (Ti-rich) magnetite
Honggou	Copper mine	Qilian	38°10′ N 100°12′ E 36 km SW	Qinghai	chalcopyrite
Hongqizhen	Quarry	Meigu	27°28′ N 101°22′ E 25 km SE	Sichuan	epidote, quartz
Hongshan	Mine	Guangning (Nanjie)	23°38′ N 112°25′ E 48 km NE	Guangdong	ferrocolumbite, tantalite
Hongshuidong	see Yungchangping				
Houshan	Mountain	Mianning	28°36′ N 102°10′ E 20 km S	Sichuan	hematite, quartz
Huahe	Mine	Hong'an	31°17′ N 114°37′ E 20 km SE	Hubei	fluorite
Huangcheng	Mine	Zhushan	32°13′ N 110°12′ E 37 km S	Hubei	turquoise
Huangjindong	Mine	Pingjiang	28°42′ N 113°33′ E 36 km W	Hunan	gold
Huangpolong	see Leiping				
Huangpuzhen	Quarry	Qianshan	30°37′ N 116°34′ E 11 km S	Anhui	rutilated quartz, calcite
Huangshaping	Mine	Guiyang	25°43′ N 112°43′ E 8 km NE	Hunan	calcite, fluorite, galena, sphalerite, wolframite

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Huaniushan	Mine	Anxi (Yuanquan)	40°31′ N 95°48′ E 75 km SE	Gansu	chalcocite, sphalerite
Huoshosi	Mine	Yunxian	32°49′ N 110°49′ E 45 km NW	Hubei	turquoise
Jialu	Mine	Luonan	34°06′ N 110°09′ E 28 km N	Shaanxi	chalcopyrite, *chrombismite, pyrite
Jiangcheng	Copper mine	Jiangcheng	24°25′ N 102°48′ E 20 km N	Yunnan	tennantite
Jiguanshan	Jade mine	Fengcheng	40°28′ N 124°02′ E 14 km SE	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Jinchuan	Mine, area	Jinchang City	38°28′ N 102°10′ E 6 km S	Gansu	pentlandite, pyrite, pyrrhotite
Jinduicheng	Mine, town	Huaxian	34°30′ N 109°46′ E 24 km NW	Shaanxi	molybdenite
Jingtieshan	Mine	Jiayugaun City	39°48′ N 98°14′ E 30 km SE	Gansu	calcite, barite, hematite, pyrite
Jining	Area	Jining City	41°02′ N 113°06′ E 26 km S	Inner Mongolia A.R.	amazonite, apatite, muscovite, phlogopite, quartz
Jinkouhe	Town	Ebian	29°14′ N 103°16′ E 25 km SE	Sichuan	barite, quartz
Jinliantong	Mine	Zhushan	32°13′ N 110°12′ E 45 km NW	Hubei	turquoise
Jinlong (incl. Rushan Xiacun), closed to Shangping Zhen (town)	Village	Longchuan (Laolong)	24°05′ N 115°15′ E 55 km SW	Guangdong	helvite, hematite, quartz,
Kangjiawan (Shuikoushan)	Lead-zinc mine	Changning	26°24′ N 112°23′ N 25 km SW	Hunan	calcite, chalcopyrite, galena, sphalerite
Koktokay	Mines	Fuyun	46°31′ N 90°25′ E 30 km SW	Xinjiang, Uygur A.R.	allanite-(Ce), albite, amazonite, apatite, aquamarine, ashanite, bimushite, bismutomicrolite, chrysoberyl, *cygrayite, epidote, ertixiite, fluorite, garnet, hiddenite, holmquistite, ilmenite, ishikawaite, manganotantalite, manganocolumbite, molybdenite, muscovite, phenakite, pollucite, polylithionite, pyrite, *qingheite, samarskite, scheelite, sphalerite, spodumene, staurolite, topaz, tourmaline, trilithionite, uraninite, zircon

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Labashan	Mine	Zhushan	32°13′ N 110°12′ E 57 km SE	Hubei	turquoise
Laiyuan	Iron mines	Laiyuan	39°19′ N 114°4′ E 20 km W	Hebei	hematite, ludwigite
Lamo	Mine	Nandan City	24°54′ N 107°32′ E 25 km NW	Guangxi, Zhuang A.R.	apatite, galena, pyrite, quartz, rhodochrosite, sphalerite
Laojuntang	Area	Changping	40°13′ N 116°14′ E 12 km SW	Beijing M.	topaz
Laotiangou	Mine	Wafangdian City	39°37′ N 122°00′ E 46 km NE	Liaoning	diamond
Leiping (incl. Huangpolong, New May First and ten small mines)	Mining area	Guiyang	25°43′ N 112°43′ E 26 km SW	Hunan	calcite (twins), fluorite, pyrite
Lianshan	Mountain	Liuhe	31°31′ N 121°15′ E 37 km W	Jiangsu	sapphire
Lianyuan	Coal mine	Lianyuan	27°41′ N 111°41′ E 15 km NE	Hunan	selenite
Lieshiting	Phosphate mine	Qianshan	30°37′ N 116°34′ E 14 km SW	Anhui	apatite, calcite, pyrite
Lin Xian	Areas	Linxian	37°57′ N 110°58′ E 16 km S	Shanxi	orthoclase
Libo	Mine	Libo	24°55′ N 107°30′ E	Guizhou	Mg-calcite, stibnite
Limu	Mine	Gongcheng	24°51′ N 110°4′ E 30 km SE	Guangxi Zhuang A.R.	cassiterite, lepidolite, niobite, tantalite, topaz
Liufengshan	Copper mine	Guichi City	30°39′ N 117°28′ E 10 km NW	Anhui	azurite, malachite
Liuhuang-Kuang	Mine	Subei (Dangchengwan)	39°30′ N 94°52′ E 5 km N	Gansu	pyrite, sulfur
Luanhe	Area, river	Chengde City	40°46′ N 118°09′ E 14 km E	Hebei	*changchengite, *chendeite
Lucun	Village	Jianshui	23°38′ N 102°49′ E 27 km NW	Yunnan	calcite (orange), *jianshuiite

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Lufeng	Area	Lufeng	25°09′ N 102°05′ E 20 km SE	Yunnan	Cu-bearing aragonite
Lugucun	Village	Huili	26°41′ N 102°13′ E 10 km NE	Sichuan	*jinshajiangite
Majiagou	Mine	Yunxi	32°59′ N 110°25′ E 26 km SE	Hubei	turquoise
Malipo	Town	Malipo	23°07′ N 104°41′ E 15 km SE	Yunnan	emerald, hemimorphite, hydrozincite, scheelite
Molongshan	Mountain	Honghe	23°21′ N 102°24′ E 2 km N	Yunnan	aquamarine, quartz
Nanjiangqiao	Area	Pingjiang	28°42′ N 113°33′ E 35 km SW	Hunan	aquamarine, garnet, tantalite
Nanshan	Iron & copper mine	Ma'anshan City	31°43′ N 118°28′ E 27 km NW	Anhui	turquoise, hematite
Nanshankeng	Mine	Yiwu	29°18′ N 120°04′ E 49 km N	Zhejiang	fluorite
Nanshu	Mine	Laixi City	36°52′ N 120°31′ E 24 km SE	Shandong	graphite
Ningdu	Area	Ningdu	26°28′ N 116°00′ E 21 km SE	Jiangxi	hemimorphite
Nuanshui	Lead-zinc mine	Rucheng (Chenzhou)	25°45′ N 113°01′ E 10 km	Hunan	sphalerite, galena, quartz
Pangjiabao	Iron mine	Xuanhua	40°37′ N 115°02′ E 33 km W	Hebei	hematite, siderite, cordierite
Pangushan	Wolfram mine	Yudu	25°57′ N 115°23′ E 32 km N	Jiangxi	wolframite
Panshan	Mountain	Jixian	40°02′ N 117°24′ E 10 km SE	Tienjin	*jixianite
Penglai	Mine	Wenchang	19°36′ N 110°45′ E 30 km NE	Hainan	bauxite (gibbsite)
Pingdu	Mine	Pingdu City	36°47′ N 119°58′ E 24 km S	Shandong	rutile

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Pingtouling	Mine	Liannan (Sanjiang)	24°42′ N 112°18′ E 20 km N	Guangdong	mimetite
Qingjiang	Mine	Wuning	29°15′ N 115°05′ E 30 km NE	Jiangxi	barite, calcite, stibnite
Qingshuigou	Area	Qilian	38°10′ N 100°12′ E 28 km SE	Qinghai	glaucophane
Qinghe	Mountain	Qinghe	47°00′ N 90°20′ E 20 km S	Xinjiang, Uygur A.R.	aquamarine, garnet, tourmaline
Qinjiafang (Hupei)	Mine	Pingjiang	28°42′ N 113°33′ E 20 km SW	Hunan	aquamarine, garnet, tantalite
Ruyan	Area	Lechang	25°09′ N 113°21′ E 40 km NE	Guangdong	fluorite
Sha'ertuohai	Mine	Tuoli	45°56′ N 83°37′ E 47 km SE	Xinjiang, Uygur A.R.	chromite
Shangbao	Pyrite mine	Leiyang	26°24′ N 112°51′ E 32 km NW	Hunan	calcite, bismuthinite, dolomite, fluorite, pyrite, quartz
Shangyangpo	Mine	Yunxian	32°49′ N 110°49′ E 26 km NW	Hubei	turquoise
Shilu	Copper mine	Yangchun (Chuncheng)	22°10′ N 111°48′ E 15 km SE	Guangdong	azurite, malachite
Shilu	Mine	Changjiang (Shilu)	19°16′ N 109°03′ E 10 km N	Hainan	hematite
Shimen (Jiepiayu)	Mine	Shimen	27°46′ N 110°01′ E 33 km SE	Hunan	calcite, orpiment, picropharmacolite, realgar
Shitouzui	Copper-iron mine	Daye	30°06′ N 114°58′ E 18 km SW	Hubei	azurite
Shizhuyuan	Mine	Chenzhou City	25°46′ N 113°02′ E 14 km W	Hunan	bismuthinite, calcite, cassiterite, fluorite, galena, muscovite, pyrrhotite, pyrite, scheelite, sphalerite, Ta/Nb oxides, wolframite
Shuijingping	Village	Yunxiao	23°58′ N 117°21′ E 20 km S	Fujian	feldspar, fluorite, helvite, pyrite, smoky quartz, spessartite
Shuikoushan	see Kangjiawan				

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Siding	Mine	Rong'an	25°13′ N 109°22′ E 25 km NW	Guangxi, Zhuang A.R.	hydrozincite
Suzhou	Area	Suzhou City	31°19′ N 120°37′ E	Jiangsu	annite (F-rich)
Taolin	Mine	Linxiang	29°29′ N 113°27′ E 14 km N	Hunan	barite, fluorite, galena, quartz, sphalerite
Tongbei	Area	Yunxiao	23°58′ N 117°21′ E 30 km	Fujian	beryl, feldspar, fluorite, helvite, hematite, mica, milarite, pyrite, schorl, smoky quartz, spessartite, topaz
Tong-guangshan	Copper mine	Tongling & Tongling City	30°35′ N 117°48′ E 2.5 km NW	Anhui	azurite, chalcopyrite, garnet, limonite, malachite, pyrrhotite, wollastonite
Tonglushan	Copper mine	Daye City	30°06′ N 114°58′ E 10 km E	Hubei	azurite, chalcopyrite, cuprite, malachite
Tongshan	Copper & iron mine	Guichi City	30°39′ N 117°28 30 km NE	Anhui	azurite, chrysocolla, malachite
Tongshankou	Copper-iron mine	Daye	30°06′ N 114°58′ E 34 km NE	Hubei	azurite, chalcopyrite, cuprite, malachite
Wagou	Jade mine	Xiuyan	40°17′ N 123°17′ E 22 km SE	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Weija	see Chengmenshan				
Wenchuan	Area	Wenchua	31°57′ N 106°18′ E 68 km W	Sichuan	tourmaline
Wenshan	Area	Jiashan	32°47′ N 117°58′ E 27 km NE	Anhui	anorthoclase
Wenyu	Mine	Lingbao	34°31′ N 110°52′ E 58 km NW	Henan	gold
Wuning (Wuling), Qingjiang	Mine	Wuning	29°12′ N 115°03′ E 40 km NE	Jiangxi	stibnite
Wushan	Copper mines	Ruichang	29°40′ N 115°38′ E 10 km S	Jiangxi	azurite
Wutaishan	Mountain	Pangjiapu	39°00′ N 113°30′ E 17 km S	Shanxi	tourmaline
Wuyu-Shuilou	Area	Hechi City	24°42′ N 107°51′ E 25 km NE	Guangxi Zhuang A.R.	calcite, galena, realgar, sphalerite, stibnite

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Location	Location type	County, town or city	Lat/Long, dist. from mine	Province	Minerals
Xianghualing (incl. many small mines)	Tin mine	Linwu (Chenzhou)	25°16′ N 112°32′ E 20 km S	Hunan	calcite, cassiterite, fluorite, *hsianghualite, scheelite, topaz
Xianghuapu (incl. Maiwan & other small mines)	Mine	Linwu (Chenzhou)	25°16′ N 112°32′ E 13 km S	Hunan	barite, calcite, fluorite, zinnwaldite
Xiangtan	Mine	Xiangtan City	27°52′ N 112°53′ E 7 km N	Hunan	manganite
Xiaojie	Mine	Panzhihua	26°44′ N 101°41′ E	Sichuan	amazonite, quartz
Xiaosongshan	Mountain	Alashan Zuoqi	38°50′ N 105°41′ E 69 km SE	Ningxia	diopside
Xikuangshan	Antimony mine	Lenshuijiang City	27°42′ N 111°26′ E 9 km SW	Hunan	barite, calcite, cervantite, fluorite, gypsum, pyrite, quartz, senarmontite, stibiconite, stibnite, sulfur, valentinite
Xinzai	Village	Wenshan city	23°22′ N 104°13′ E 97 km W	Yunnan	cassiterite
Xiongxiong'ga	Iron mine	Hezhang	27°07′ N 104°42′ E 38 km NE	Guizhou	hematite, "limonite," siderite
Xixia	Area	Xixia	33°18′ N 111°29′ E 13 km SE	Henan	andalusite
Xiyugou	Jade mine	Xiuyan	40°17′ N 123°17′ E 45 km NE	Liaoning	antigorite, chlorite, chrysotile, lizardite, talc, tremolite
Xuebaoding (Hujia)	Mountain	Pingwu	32°26′ N 104°31′ E 40 km SE	Sichuan	apatite, aquamarine, cassiterite, dolomite, feldspar, fluorite, goshenite, morganite, muscovite, quartz, scheelite
Yangliuping	Mine	Danba	30°52′ N 101°52′ E 30 km N	Sichuan	bornite, chromium, *danbaite, gold, linnaeite, sperrylite, testiobiopallasite, violarite
Yangshuo	Area, mine	Yangshuo	25°17′ N 110°17′ E 40 km SW	Guangxi, Zhuang A.R.	calcite, cerussite, pyromorphite
Yanmeitong	Mine	Laiyuan	37°11′ N 112°31′ E 14 km SW	Hebei	asbestos, serpentine
Yanwuping (incl. Zhangjiawan & other small mines)	Mine	Wanshan	27°31′ N 109°12′ E 12 km SW	Guizhou	barite, calcite, cinnabar, dolomite, pyrite, quartz, sphalerite

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Yanzigou	Mine	Daixian	39°04′ N 112°57′ E 47 km SE	Shanxi	rutile
Yaogangxian	Wolfram mine	Yizhang	25°46′ N 113°02′ E 45 km SW	Hunan	apatite, arsenopyrite, bismuthinite, bornite, boulangerite, bournonite, calcite, cassiterite, chalcopyrite, dolomite, fluorite, jamesonite, mica, pyrite, quartz, rhodochrosite, scheelite, sphalerite, stannite, topaz, wolframite
Yianpo	Mine	Yunxi	32°59′ N 110°25′ E 47 km SW	Hubei	turquoise
Yingcheng	Mine	Yingcheng City	30°57′ N 113°33′ E 57 km N	Hubei	gypsum
Yujangyan	Mine	Zhushan	32°13′ N 110°12′ E 49 km S	Hubei	turquoise
Yunchangping (incl. Hong-shuidong, Dadongla, and other mines)	Mining area	Tongren City	27°43′ N 109°12′ E 13 km SW	Guizhou	cinnabar, calcite, dolomite, quartz, pyrite, sphalerite, barite
Yungaisi	Mine	Yunxian	32°49′ N 110°49′ E 56 km W	Hubei	turquoise
Yunling	Area	Zhangpu (Siu'an)	24°06′ N 117°37′ E 30 km SE	Fujian	feldspar, fluorite, helvite, mica, pyrite, smoky quartz, spessartine, topaz
Yunzhongshan	Mountain	Linqiu	39°26′ N 114°13′ E 36 km S	Shanxi	tourmaline
Yushipo	Area	Shangzhou	33°52′ N 109°57′ E 47 km S	Shaanxi	fluorite
Zhang'ergou	Mine	Lushi	34°03′ N 111°02′ E 48 km N	Henan	barite, calcite, stibnite
Zhongjia	Mine	Longyan City	25°06′ N 117°01′ E 15 km NW	Fujian	scheelite, topaz, wolframite
Zhongxingtang	Mine	Dongyang	29°14′ N 120°14′ E 30 km N	Zhejiang	fluorite
Zhoukoudian	Area	Fangshan	39°42′ N 115°58′ E 6 km W	Beijing	andalusite

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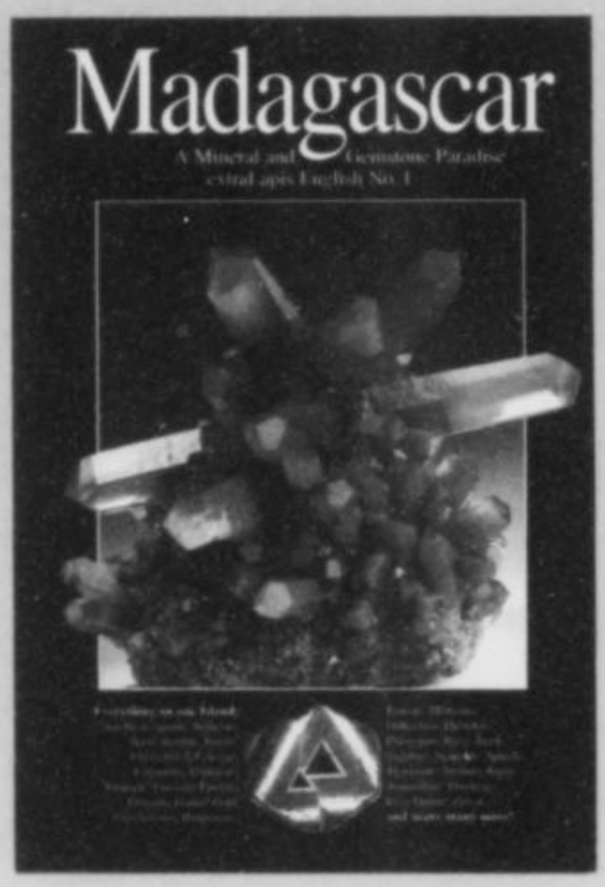

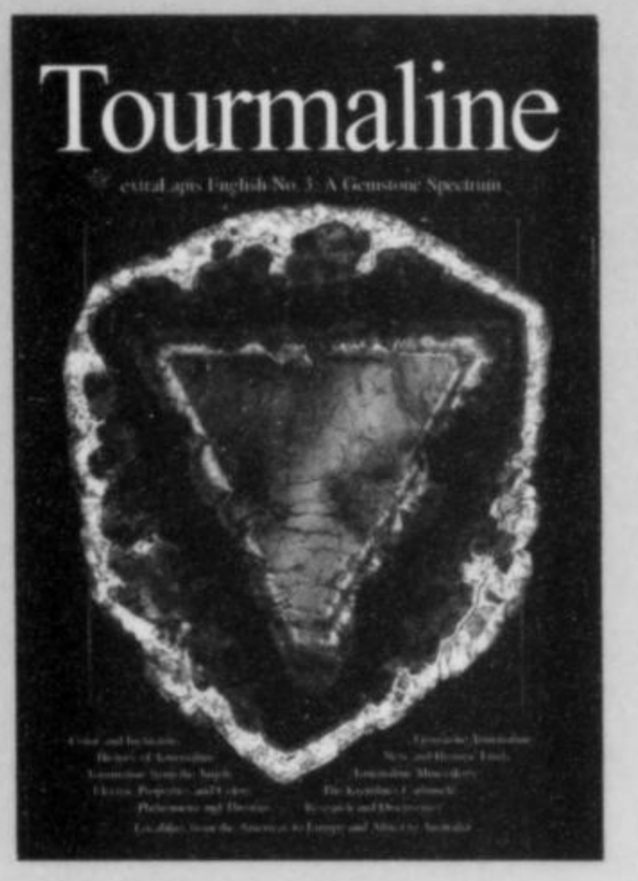

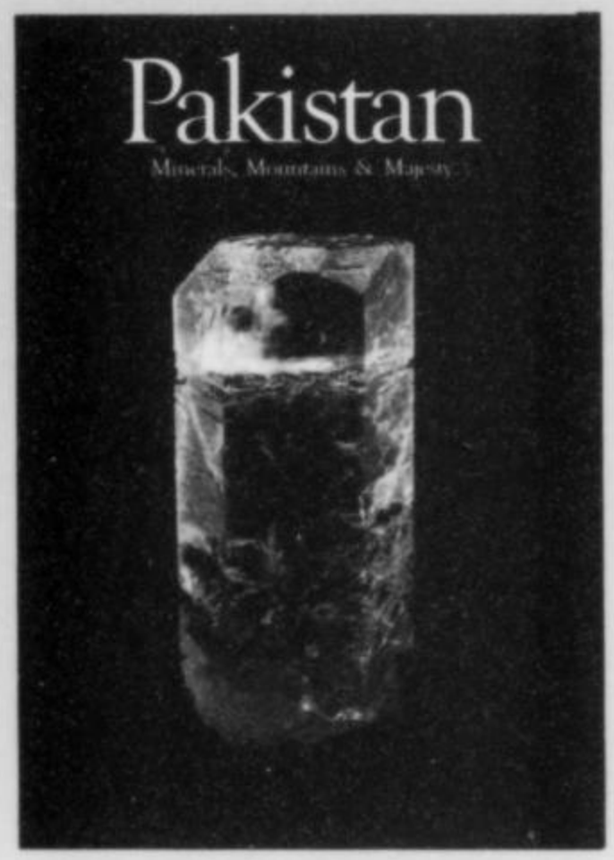

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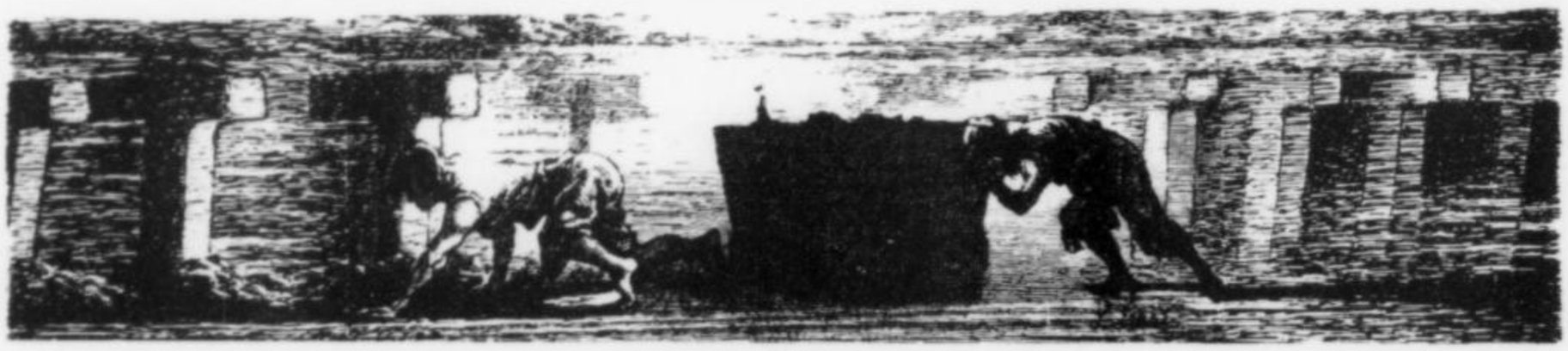

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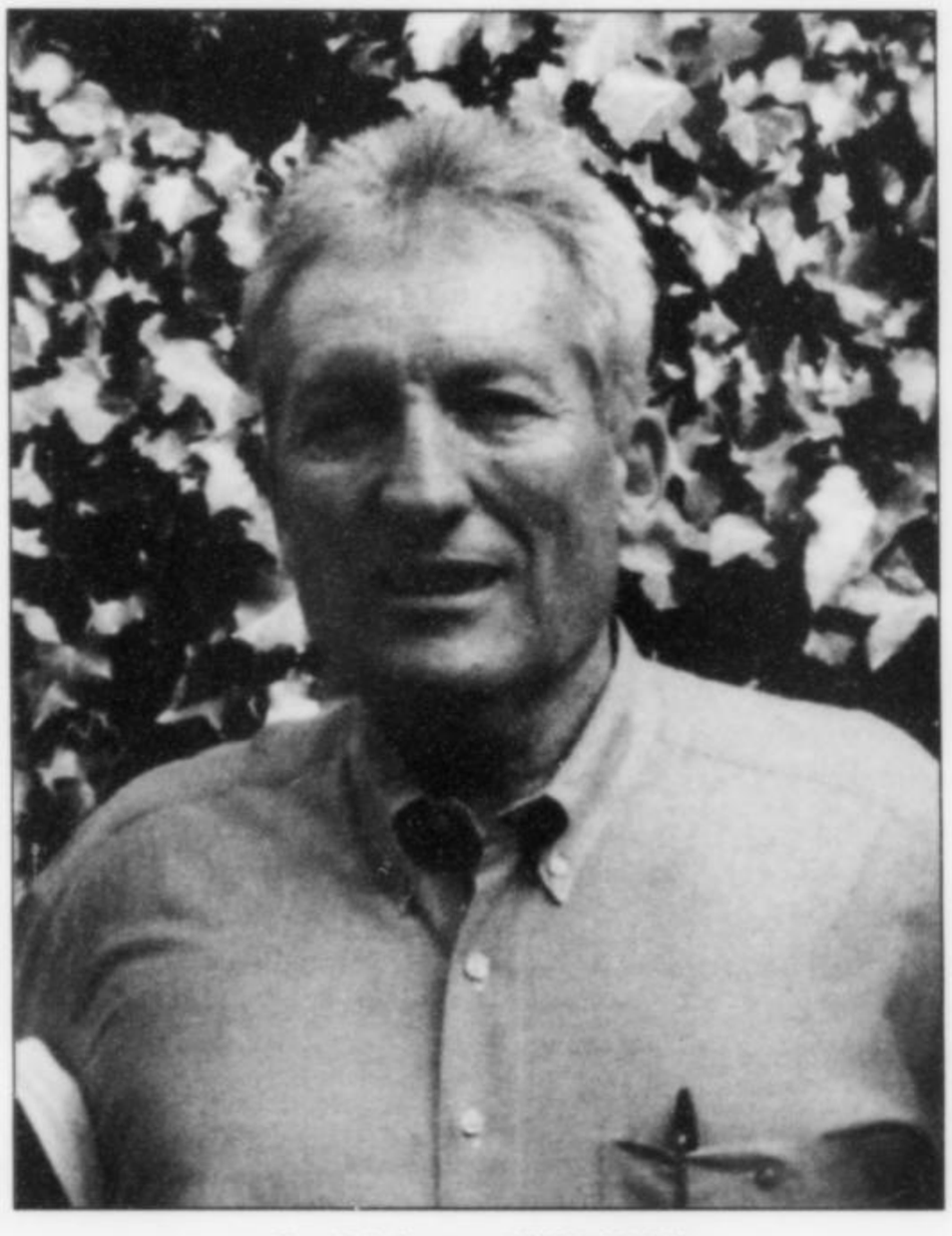


Jay Lininger (1939-2004)

Died, Jesse L. Lininger, Jr., 64

Jesse "Jay" Lininger was born on December 9, 1939 and died unexpectedly at his home in Dillsburg, Pennsylvania on October 18, 2004. Jay, with the help of his wife Paula, was the founder and President of MATRIX Publishing Services and MATRIX Art Services. He was also well known in the mineral world as an author, publisher, lecturer, and most of all as a mineral collector. Jay's fascination with the science of mineralogy began when he was a young teenager and continued throughout his life.

Jay was one of the foremost authorities on the minerals of Pennsylvania, and had a special love for the history of minerals, mineral localities and mineral collecting. His passion for the science and its historical background is attested to by his internationally known publication, *MATRIX, a Journal of the History of Minerals,* which he founded in 1988 with Lawrence Conklin and later continued to publish on his own. Among his other publications are a book of the memoirs of Arthur Montgomery, and a facsimile reprint of all 15 volumes of the early journal *The Mineral Collector*; this reprint saved the journal from extinction.

He was a cofounder and lifelong member of the York Rock and Mineral Club and was active in the Pennsylvania Chapter of Friends of Mineralogy, serving as a board member and past President. Because of his love for the history of the science of mineralogy in Pennsylvania, he recently took over the design and publication of the FM Pennsylvania Chapter's newsletter.

Jay was also a gifted artist and illustrator. He served his country as a medic in the US Army National Guard, and in the 1970's he was a member of a popular York area folk music group, "The Summit Singers."

He is survived by his wife of 30 years, Paula, his mother and father, two sons, one daughter, one sister, two brothers, and nine grandchildren. Memorial contributions may be made to the American Heart Association, 1517 Cedar Cliff Dr., Camp Hill, PA 17011-7705.

WEW

Richard A. Bideaux (1935-2004)

Died, Richard A. Bideaux, 69

Richard August Bideaux, well known and respected mineralogist, author, collector and former mineral dealer, was found dead on October 26, 2004 at his summer residence in Prescott, Arizona. Through his books and articles on mineral-related topics and through the force of his personality, he inspired many collectors to study mineralogy, while also aiding his professional colleagues in advancing the science. He is well known to longtime readers of the *Mineralogical Record* for his column, "The Collector," which appeared in the early years, and for his superb article on the mineralogy of Tiger, Arizona, published in 1980. By bringing together Arthur Montgomery and John White in 1970, Richard helped to found the *Mineralogical Record*, and has maintained a strong interest ever since.

Richard was born on March 28, 1935 in Tucson, Arizona, where he resided for much of his life. As a young boy he became interested in minerals, and when he discovered that there were locations around Tucson where he could do his own collecting, Richard cajoled his father George to take him on collecting trips. One of the localities they visited was the famous Old Yuma mine, a few miles northwest of the city. He collected many specimens there and organized them into a display that explained their

mineralogical paragenesis; in 1952 this display won a National Prize in the 11th annual Westinghouse Science Talent Search (equivalent to a Science Fair of today). As part of the award, he was sent to Washington, D.C., where he asked to visit the mineral collection of the Smithsonian Institution and meet then-curator George Switzer. That visit, the first of many that Richard would make to the Institution, helped cement his interest in the science and hobby of minerals; in later years he donated significant specimens to the Smithsonian collection.

As he grew older, Richard formed a collecting partnership with Richard "Dick" Jones (1933-1982), and together they collected and preserved many notable Arizona specimens, including fine examples of Defiance mine and Glove mine wulfenite. At the same time, he was attending the University of Arizona, where he received his Bachelors degree in Geological Engineering in 1959. After graduation, Richard was drafted into the Army, and, because he scored unusually high on his initial aptitude test, he was allowed to select his own assignment. Since he wanted to visit mineral collectors and dealers on the east coast, he selected a base in New Jersey, where he received training in the relatively new field of computer programming. On weekend passes he visited and became friendly with the New York mineral dealers and collectors, notably Hugh Ford, Lawrence Conklin and Arthur Montgomery.

Following his stint in the service, Richard moved to Pasadena, California, where he was employed by the Jet Propulsion Laboratory. During the Lunar Surveyor missions he was responsible for processing imaging data from the first pictures ever received of a heavenly body other than the earth. During this time, he also became acquainted with many West Coast mineral collectors and dealers.

Seeking to further his education in mineralogical science, Richard went back east to attend Harvard University, graduating in 1968 with a master's degree. He then returned to Tucson and founded (with two partners) Computing Associates, Inc. This was a pioneering company devoted to computer applications in geology and mine engineering; the software he developed has been responsible for determining the ore reserves of many mineral deposits throughout the world.

In recognition of his achievements in this new field, the University of Arizona conferred upon him the professional degree of Geological Engineer in 1978. In the same year, Computing Associates was sold, allowing Richard the time and means to concentrate on mineralogical projects for the rest of his life. In 1977, in co-authorship with his good friend and former mineralogy professor John Anthony and long-time friend Sid Williams, Richard wrote the first edition of *Mineralogy of Arizona*. This was a major work in topographical mineralogy, and it has been loved and used by collectors of Arizona minerals everywhere. The book went through two subsequent editions; the third, prepared in collaboration with Raymond Grant, was published in 1995.

In 1979, after the death of his father, Richard took over Bideaux Minerals, which his father, George, had founded in the 1960's. Through this outlet, mineral specimens of all types found their way into private collections and museums around the world.

Around 1980, Richard, collaborating with John Anthony, Ken Bladh and Monte Nichols, undertook another major project in descriptive mineralogy. The multi-volume *Handbook of Mineralogy* that resulted is one of the most important and valuable mineralogical reference works ever written, surpassed in the scope of its treatment of descriptive mineralogy only by C.A.F. Hintze's monumental but long-outdated *Handbuch der Mineralogie* (Leipzig, 1898-1933). The new *Handbook* is valuable to amateurs and professionals alike, especially in that it gives complete references and comparative chemical data for even the rarest species. In addition, through the authors' expertise in judging specimen quality, exact information is provided on localities where the best specimens have been found. It was a great source of satisfaction to Richard and his co-authors that readers and reviewers recognized the importance of this work. In fact, the files that were used to publish the *Handbook* were given to the Mineralogical Society of America, and at the time of his death Richard was actively engaged in updating the species information for inclusion on the Society's website. As an officer of the Mineralogical Society's outreach committee, he was again advancing the information technology revolution by working to digitize the world's collective knowledge of minerals.

Richard was a founding member, and first president, of the Friends of Mineralogy, a life fellow of the Mineralogical Society of America, and a member of the Arizona Geological Society. He collected minerals throughout his life, although the major portion of his collection was dispersed through Kristalle in 1985. Richard was a long-time patron of the University of Arizona Mineralogical Museum and was instrumental in building its collections. He was also a mainstay of the Tucson Gem & Mineral Society for over 50 years, and was a significant partner in making the TGMS Show the international event that it is today.

The very rare mineral species *bideauxite* was named in Richard's honor by Sid Williams in 1970. Richard had recognized crystals of the then-unknown species on a specimen from Tiger which became the type specimen of bideauxite.

At last year's Tucson Show, Richard held a party at his home to celebrate two major events: the 50th anniversary of the Tucson Show (Richard won a blue ribbon at the very first show, in 1955) and the completion of the last volume of his *Handbook of Mineralogy*. Attending was a large cross-section of the people Richard knew, including museum curators, mineral dealers and collectors both well-known and obscure, his co-authors, professional mineralogists and crystallographers, students and other friends. This was the last time that many would see Richard before his death, and it is a tribute to his influence in both the professional and amateur mineral worlds that so many people of both kinds sought him out and called him friend or colleague.

Richard's interests and knowledge ranged widely beyond minerals. A voracious reader, he could sustain rigorous conversations about tennis, mining, historic books and maps, Arizona history, meteorites, game theory, politics, natural history, natural physical phenomena, and many other subjects. His encyclopedic knowledge of minerals and mineral localities, his sense of humor, his intellectual acumen, his generosity and his friendship will be greatly missed by those who knew him.

Curtis Schuh

What's New in Minerals

Sainte-Marie-aux-Mines Show 2004

by Bill Larson

[June 24–27]

What shall I say about the 2004 Sainte-Marie Show that is different from what I've said about this event over the past several years for the *Mineralogical Record*? It's still my favorite show to attend in Europe, or perhaps anywhere else outside of Tucson—it may even be more fun than Tucson.

On set-up day, Tuesday morning, there was a buzz over the new **brookite** from Pakistan, and some fine individual specimens of other kinds from Pakistan and Afghanistan had already been described to me, including a marvelous **pollucite/apatite** combination. I got to see this specimen before Herb Obodda did, but unluckily he decided to buy it before I did—not surprisingly, since it is great. One of the reasons I find this a terrific show is that when I come to it I often get such advance looks at fine specimens. Sainte-Marie reminds me of mineral shows in the 70's in the United States, except, of course, that the prices are not those of the 70's, but are commensurate with prices at other great shows today. Still, Sainte-Marie, more than most other shows, offers a certain family-affair feeling of fun in the air.

The weather in the Vosges Mountains is changeable: it will be sprinkling and gray one moment and hot and sunny just a short time later. This year, the clouds during the first few days were sparse, so that showgoers could really get around and see everything. Perhaps, I thought, this year I can try to focus just on the really new things. On the other hand, certain dealers are very good friends of mine, and will be sure to show me things, old and new, that I will find exciting.

My first stop on Tuesday was to visit the gregarious show manager and creator, Michel Schwab (www.minerapole.com). He greeted me like a long-lost friend, since I had earlier told him that I was going to travel to Burma and wouldn't be able to make it to Sainte-Marie. But then my Burmese contacts had told me to delay my trip until July, so I was free after all to visit France in June. Michel gave me a show pass, and more importantly a parking pass: parking can be very difficult during the show.

Since I arrived later this year than in most earlier years, there was less confusion than I usually see on my first day; still, only half the people had set up. I entered the theater where the premier dealers are always located and went to the stand of Marcus Grossmann (www.the-mineral-web.com), who had e-mailed me beautiful photos of a fine **lazurite** crystal and one of the new **brookite** specimens from Pakistan. He was unable to show me the brookites, as he had them out for photography, but he promised to give me a shot at them when they returned. His taste in minerals is impeccable, and I enjoyed selecting several other items as he picked them out and set them up in his cases. Marcus travels regularly to Pakistan, and his public offerings of minerals from that country are as good as any I've ever seen. One specimen at his stand at Sainte-Marie is an absolutely pristine **spessartine**, just under 2.5 cm, perched on feldspar on a larger matrix of pegmatite. This truly extraordinary specimen sold within 15 minutes of his putting it out, even though set-up day was still young.

Another buzz was that there would be fewer American dealers attending this year, but the spessartine specimen sold to an American, and before long I began to see quite a few of the usual suspects. For example, I saw Herb Obodda, and I saw Sandor Fuss and his lovely wife Oana, and while driving to the show I passed Steve Smale and his wife Clara, who were walking up the main boulevard; when I got to the theater, Marshall Sussman was just entering it. Inside, *Escaut Minerals* (frederic.escaut1@libertysurf.f) had five glass cases filled with fine, well-mounted minerals. These included some fine Chinese miniatures with hexagonal crystals of **calcite;** seven fine, mirror-bright Chinese specimens of **pyrrhotite**, marked between €500 and €1000; some specimens of **calcite** with crystallized **chalcopyrite** forming a Mercedes Benz triangle; and specimens of the new **barite** from Hunan Province, one a fine large miniature marked at €250. The final case was filled mostly with fine **fluorite** miniatures—black fluorite filled with **boulangerite** inclusions on calcite is a brand-new discovery from Hunan Province.

Next door were the Gobins (www.mineralsweb.com) with two lovely glass cases full of colorful, well-selected minerals. One stand-out group was about a dozen excellent specimens of **cuprosklodowskite** from the Democratic Republic of the Congo. One fine small miniature with brilliant green needles to 3.75 cm was marked €2200 and sold in five minutes. In the far case was a magnificent doubly terminated **spodumene** measuring about 10 x 10 cm and showing a splendid greenish blue color, which will change to pink upon exposure to sunlight.

Across the way there was *Pregi Gemme* (Riccardo Prato, pregigemme@iol.it), with the finest miniature-size Namibian **aquamarine** scepter I've ever seen. The rest of the specimens here were well-selected miniatures to large cabinet pieces, mostly from Brazil, including some very fine cabinet specimens of **titanite** from Capelinha, Minas Gerais, some with crystals over 7 cm. At the end of the theater, Kristalle and Ian Bruce of Crystal Classics (www.crystalclassics.co.uk) echoed what they had shown in Denver, presenting four of their wonderful wooden showcases filled with beautiful miniatures and small cabinet specimens from worldwide localities, plus a couple of fine, large specimens of California **gold**.

Our old friend Gilbert Gauthier (7 av. Alexandre III, 78600 Maisons Laffitte, France) presided over about 20 feet of space featuring many rarities from the Congo, including a brand-new discovery of **dioptase** resembling the occurrence in the Tartara mine, near Shinkolobwe, Katanga (see the Tucson Show report in May/June 2004). Next came *Matrix India Minerals* (M. F. Makki,

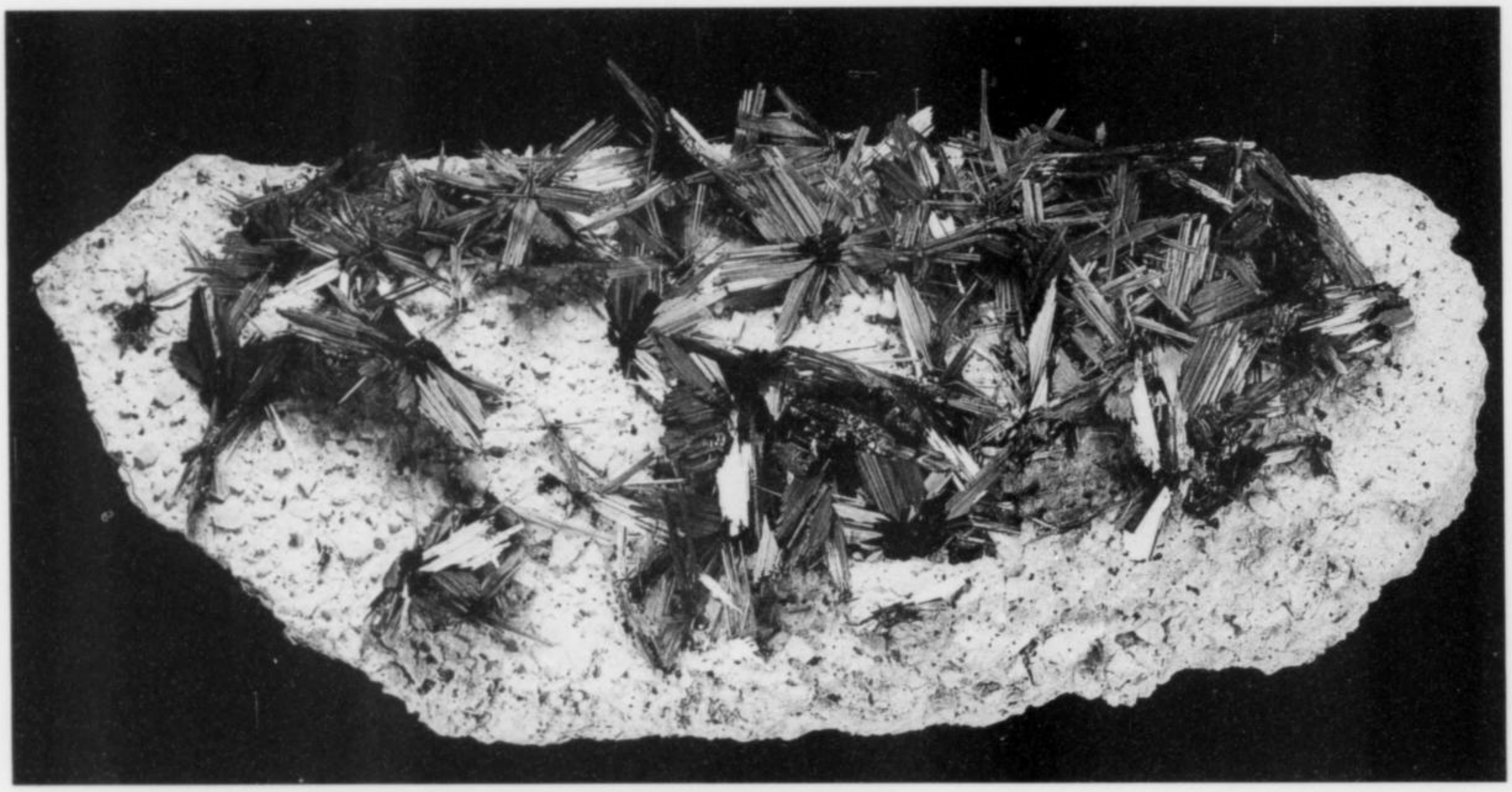


Figure 1. **Rutile crystals on hematite crystals, 29 cm, from Ibitiara, Bahia, Brazil. Luis Menezes and Frank Melanson specimen; L.-D. Bayle photo.**

Figure 2. **Bismuthinite crystals on matrix, approximately 30 cm (?) across, from Tazna, Bolivia. Christophe Dubois specimen; Roger de Ascencao Guedes photo, courtesy of L.-D. Bayle.**

Figure 3. **Pyrrhotite crystal, 4.8 cm, from the Yaogangxian mine, Hunan, China. Frédéric Escaut specimen; L.-D. Bayle photo.**

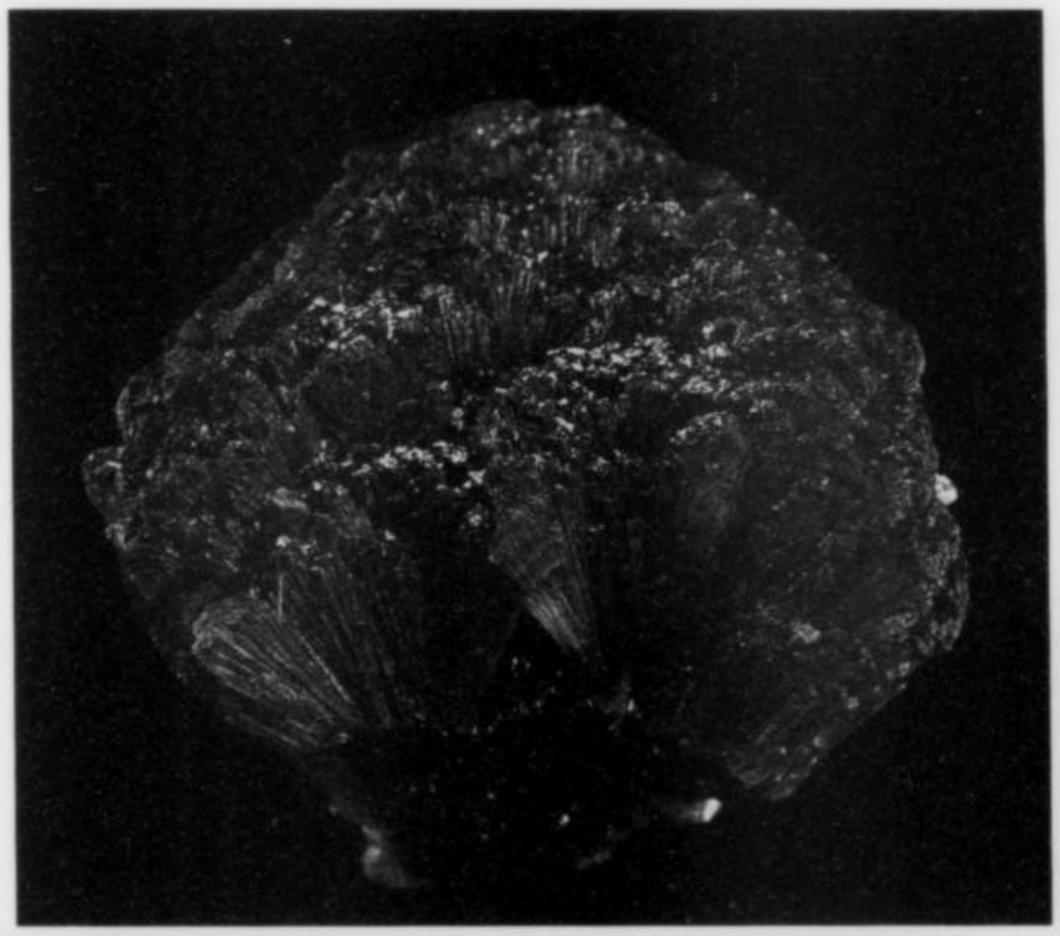
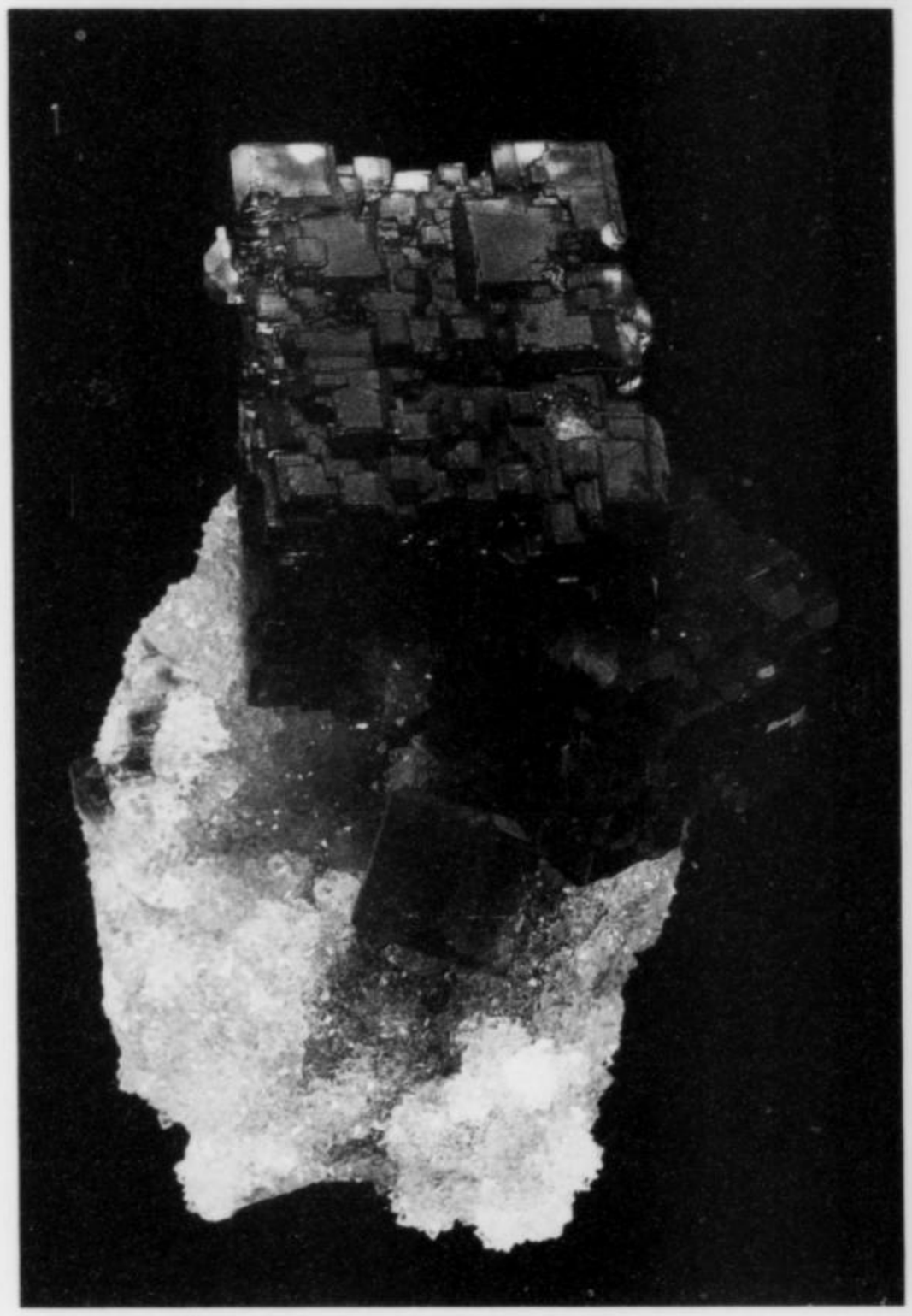


Figure 4. **Elbaite, 3 cm, from Momeik, Mogok, Myanmar (Burma). KARP specimen; L.-D. Bayle photo.**

Figure 5. **Fluorite crystal, 2.8 cm, from Yunling, Zangzhou, China. Jordi Fabre specimen; L.-D. Bayle photo.**



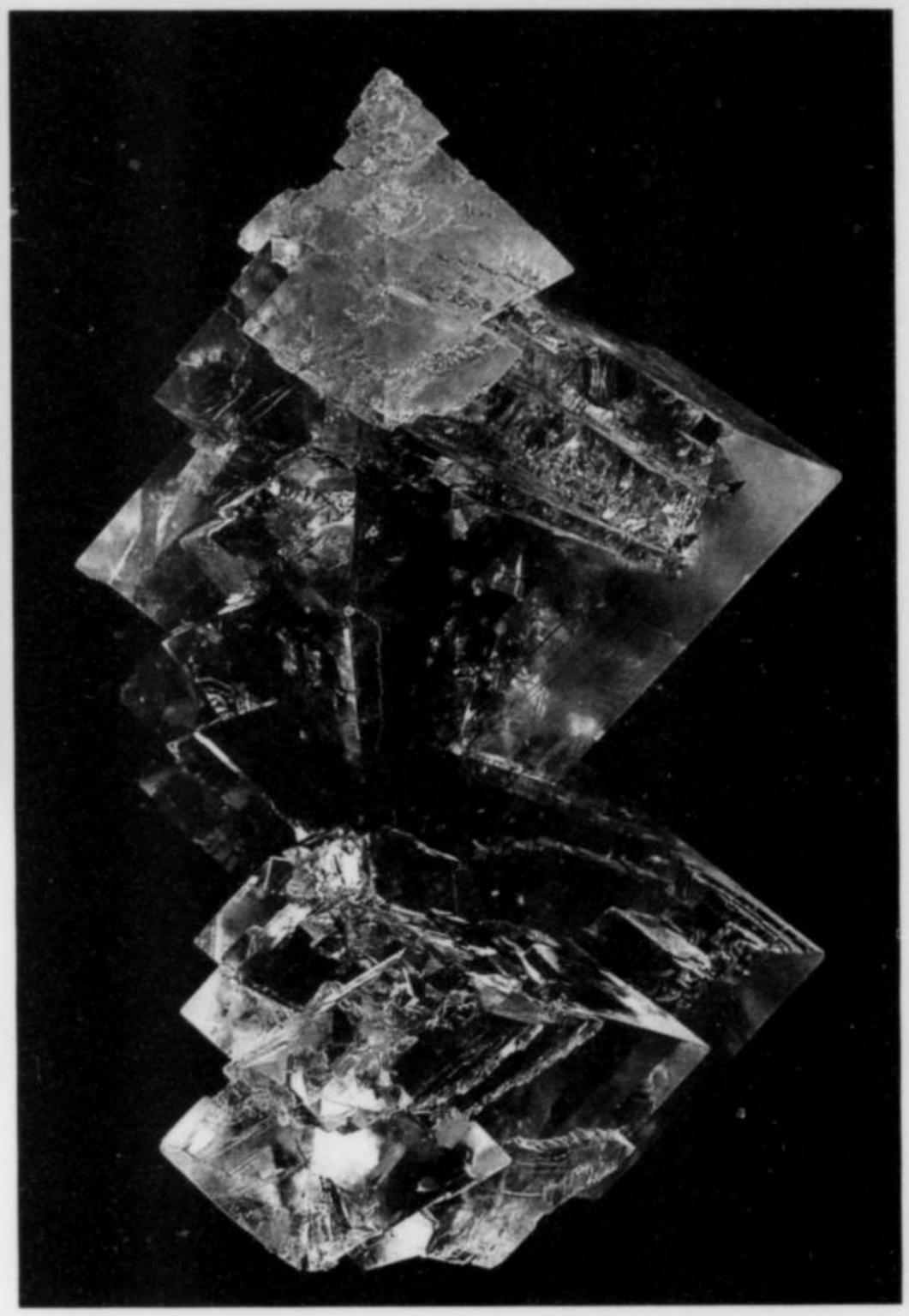


Figure 6. **Fluorite crystals on matrix, 9 cm, from La Collada, Asturias, Spain. Jordi Fabre specimen; L.-D. Bayle photo.**

Figure 7. **Calcite crystal group, 7 cm, from Sambawa, Madagascar. Spirifer specimen; L.-D. Bayle photo.**

www.matrixmineralia.com) with specimens from a major new pocket of **cavansite**, and a type of **apophyllite** showing clusters of pseudocubic crystals, somewhat similar to the find of two years ago.

Behind Makki was Marcus Budil's well-lit booth featuring mostly things from Brazil, including many rough and cut stones, as well as four superb, pale green specimens of **torbernite** from France, carefully prepared and of excellent quality. Two miniatures of the torbernite were marked €600 and €650.

Little Big Stone (Frédéric Gautier, BP 5221, 101 Antananarivo, Madagascar) had an excellent array of crystallized specimens from this island: there was a small group of **euclase** specimens, mostly thumbnails, and one small miniature, marked up to €170, and there was **pezzottaite** priced from $120–$160/gram for loose hexagonal crystals up to small miniature size.

Mineralien Power-Magnete had a very fine selection of the new **prehnite** from Cerrodelas Culebras; the color is pale, but the forms are reminiscent of the finest French specimens. One 10 x 15-cm matrix featuring a 2.5-cm spherical crystallized group was marked €98; with some trimming this would be an excellent aesthetic specimen.

K. C. Pandey (*Superb Minerals India*) had elected not to come to the show, but sent his very competent staff with four large cases filled with newly mined zeolites. They flagged me down and showed me several fine new specimens of **powellite**, one having a mirror-bright, doubly terminated powellite crystal 2.5 cm across on a spray of **scolecite** measuring about 1.25 x 10 cm.

Barris Gautier (BGM3@wanadoo.fr) has often dazzled me with the quality of his displays, which routinely consist of well mounted, extraordinarily carefully selected minerals. In time for Ste-Marie this dealership had picked up a collection of very large **spessartine** garnets on feldspar with smoky quartz crystals, from Tongbei, Fujian Province, China. Some of these specimens are over 10 x 25 cm and are without damage, and very well cleaned. The spessartine crystals are somewhat small, but the overall appearance is very beautiful.

Merveilles Delaterre (Claudette Cabrol, 14 rue Colbert, 38000 Grenoble, Switzerland) offered more fine blue **fluorite** specimens from France, including miniatures in the €120 range and several large cabinet pieces. Unfortunately, most show bits of damage, but there is hope that more specimens will be collected next summer.

Fabre Minerals (www.fabreminerals.com) had perhaps 30 feet of well-selected, mostly miniature, worldwide minerals, and Jordi could be seen constantly running around selecting more fine examples and then cleaning them. I bought from him a very fine Chinese "**limonite**" stalactite, overgrown with a coating which lends a diffraction-grating play of color to the aesthetic effect; I paid €125 for this specimen.

Neighboring Jordi was Gene François Astier (*Astier Mineraux*, 39 rue Granges Galand, 37554 St. Avertin Cedex, France) with, as usual, a nice display of carefully selected minerals on black cloth, and one find which is genuinely new, at least to me: several dozen specimens of **acanthite** from Imiter, Morocco. These are very feathery crystal groups, mostly small miniatures and thumbnails, marked €200–€300 for the finest. Astier also had a special specimen of **amethyst**, featuring radiating crystals grading from almost colorless to pale violet, from Rio Grande do Sul, Brazil, marked €3000. The specimen has one absolutely perfect disc of crystals about 12.5 cm in diameter with an underlying disc coming off at right angles, forming a 10 x 12.5-cm base. This is a fantastic piece.

At *Tironi Minerali* (Marco Tironi, via Nazionale 11/A, 23020 Prata Camportaccio So, Italy) there were seven cases filled with Brazilian minerals, and in the central case was the finest specimen I had yet seen at the show—already sold, or I would have attempted to buy it. It is a fully terminated, 15 x 35-cm crystal of **quartz**, without any damage and so mirror-faced that it looks polished. Two-thirds of it is pale smoky and opaque, but the top third is transparent and filled with golden acicular crystals of **rutile** oriented parallel to the major face. Two or 3 cm below the surface is a perfect 7 x 7-cm star of oriented *rutile* on a *hematite crystal*—the likes of which I've never seen before. I brought Herb Obodda and Monsignor Briard from the Sorbonne to look at this specimen, and they agreed—they would also have purchased it. It is going to a lucky private collector somewhere in Italy.

Francis Benjamin (34 av des Platanes, 17200 Royan, France) displayed pieces from his collection, mostly miniatures and a few cabinet specimens, in four small cases. One beautiful **vivianite** from Bolivia is a perfect radiating spray of terminated crystals, the spray measuring 1.25 x 11.25 cm, marked €1480. Francis also offered a very unusual stalactiform **celestine** from Floristella, Sicily, measuring 1.25 x 20 cm and marked €890.

Across the way was Andreas Weerth (www.weerth-mineralien.de), who has purchased more or less the entire pocket of a new find of crystallized **vesuvianite** from Khyber Agency, Pakistan, somewhat reminiscent of Italian vesuvianite. The crystals are dark brownish green, appearing almost black, mirror bright, and measure up to 1.25 cm; they rest on matrix of **albite**. Andreas showed me a small cabinet specimen marked €480. Also, he pointed me to a very fine **beryl/hambergite** specimen that is totally different from anything I've ever seen (Pakistan is always showing us something new). It is a pure white hambergite embedded in a doubly-terminated beryl crystal; the beryl measures about 4 x 8 cm and is a beautiful pale blue on the top. This specimen is opaque, so it is not as expensive as a gem-quality piece would be—it is perched up on a 13 x 15-cm feldspar and quartz matrix and is very aesthetic. Finally, Andreas had a fine specimen of **xenotime** from Zegi Mountain, Pakistan, with numerous well-terminated crystals on a 1.25 x 2-cm schist matrix, marked €1500.

Hot off the press and just delivered to Andreas Weerth's stand by Gloria Staebler was the new *ExtraLapis* English book on *Pakistan: Minerals, Mountains and Majesty* (available through the Mineralogical Record for $27 ppd.). We looked through it together, agreeing that the minerals pictured are excellent.

Laverriere Mineraux (Jean-Michel Laverriere, 9 bis rue Colombier, 69380 Chazay d'Azergues, France) had a magnificent **calcite** scepter from China, which I purchased and will be displaying at Tucson as part of a special exhibit of Chinese minerals.

Louis Miguel Minerals (Escosura 22, E 50005 Zaragoza, Spain) featured fine new specimens of **rhodochrosite**, some of which are beautifully crystallized, just mined from the Uchucchacua mine, Huanuco Department, Peru. Two of the specimens have magnificent quartz bases and could, with proper trimming, be extraordinary. The best specimen features a 10 x 10-cm vug of mirror-bright, pristine, drusy black **quartz** crystals, with six or eight doubly terminated, 1-cm red rhodochrosite crystals. It is truly extraordinary. The same dealership also offered quite a number of **dioptase on chrysocolla** specimens from Mina Cobrebampa in Nazzaica, Peru; they are beautiful and were selling fast. The dioptase crystals are somewhat small (the largest I saw is less than a centimeter), but brilliant. Miniatures were priced around €65–€165 and small cabinet specimens around €1100.

On the streets we passed Johannes Keilmann (www.mineralientage.de), the man in charge of the fabulous Munich Show, checking out his friendly competition.

Minerama (Maurice Eyraud, minerama.fe@wanadoo.fr) had an extraordinarily large booth, perhaps 100 feet long, that has been in the same space for the past several years, and part of it, this year, contained an enormous number of specimens of the new **rutile/**

hematite from Ibitiara, Bahia, Brazil. Mostly small miniatures, these were keystoned (=half-priced) at €20–€30 each, and there were finer pieces, including one major cabinet specimen (price on request) which is worth describing. It is a perfect, 7.5 x 12.5-cm smoky quartz crystal with hematite crystals to 7.5 x 7.5 cm girdling it, the hematites having epitaxial overgrowths of rutile all over them. There are also some wonderful small cabinet specimens in the 7.5 to 10-cm range, priced anywhere from €180 to €2600.

Minerama also had another new find of Brazilian garnets. They are **spessartine**, somewhat paler in color than the recent finds from the Navegador mine, Minas Gerais (but said to be from the same area); the crystals rest on matrix of albite (variety cleavelandite), and there is a potential here for fabulous specimens. Herb Obodda got to this stand first and plucked the finest specimen: a perfect 3-cm crystal on a 1.5-cm cluster of albite crystals. It is truly extraordinary, and I am properly jealous.

The crowds at the show this year were large, and included hundreds of school children—a good sign for the future of mineral collecting. There were many Moroccan dealers, as always, but much less vanadinite; Rasheed had a tent in which he was showing some beautiful new **cobaltoan calcites** from Bou Azzer. Unluckily, I got there a little late, and the specimens already had been picked over. Many remaining ones were still nice, however, and were marked anywhere from €60 to €150.

Across the street, *Zeb Gul Mineralien* (zebgul@hotmail.com) was featuring fine Pakistani things, especially some newly unearthed **aquamarine**. At the stand of Manfred Grimmel (Königbergerstr. 79, 42277 Wuppertal, Germany) from Germany, there was quite a large selection of the new **vivianite** from the Conotillos mine, Bolivia (see the most recent Denver report): several nice small miniatures each marked €65 show quite lovely, transparent green crystals to 1 x 3 cm. At *3G Environment* (Laurent Gautron, 3genvy@wanadoo.fr) and *Mikon* (www.mikon-online.com), the gregarious Mathias Rheinlaender offered quite a few rare species, including **bultfonteinite** from the N'Chwaning #2 mine in the Kalahari Manganese Fields, Northern Cape Province, South Africa; he showed me quite a nice representative sample marked €29. Mathias also had some small, loose, doubly terminated crystals of **epidote** from Mali, and specimens, also from Mali, showing spherical crystal aggregates of **prehnite**—very few of these, as there was a big run on them earlier. I was also shown some blue **spinel** crystals from Betroka, Madagascar, which are glassier and quite a bit better than most I've seen before. One very good miniature is a matrix piece about 2 x 3 cm with a deeply etched, medium-blue spinel crystal measuring 2.5 cm; this specimen was marked €45, and there were several nice thumbnails in the €28 range.

Some new **calcite** twins from Patoni, Durango, Mexico were to be found at the booth of Matthias Jurgeit (www.matsminerals.com). These specimens were first marketed in 2001 (see the Denver Show report in Jan./Feb. 2002), and the locality was then known as "Rodeo," but the place name has changed, and Matthias has a much larger selection now than he did three years ago, with more interesting calcite twins and clusters of twins. Some small butterfly twins are marked in the €30–€60 range, and some of the clusters which show multiple twins and measure to 10 x 15 cm are marked €350. The finest one is familiarly known as "the Frog King," and Matthias has a wonderful photograph of it. It is 10 cm wide, with three crystals right in the center, and will be featured in an upcoming issue of *Lapis*.

On my second visit to Gilbert Gauthier's booth, I noticed some **pyrope** garnet specimens from the high-pressure metamorphic environment at Casa Parigi, Pidma, Italy. These are quite exotic garnets, white and completely opaque and having surface coatings of a mica-group mineral, but with sharp dodecahedral form and measuring up to 15 cm. For the rare-mineral collector, included in these pyrope crystals are crystals of **ellenbergerite** up to 5 mm, which is quite large for the species.

Lino Caserini (linocase@tin.it) had specimens of the first significant discovery of **uvite** in Madagascar—verified as to species by Federico Pezzotta. There were three fine miniatures with perfectly terminated crystals to 7.5 cm, which were found at Manapa, Madagascar.

Hidden on the stage above the theater was the excellent booth of François Lietard (*Minerive*, François.lietard@wanadoo.fr), with his usual very fine selection of Afghanistan and Pakistan specimens. François had several beautifully colored **pink beryl** specimens of small cabinet size, mostly single crystals with a little bit of matrix. There was a fine small one, about 6 x 7 cm with half of a crystal, but excellent color, marked at €1100; the rest were considerably more expensive. On the bottom shelf were five very nice specimens of a **mica** mineral, and 1-cm crystals of **hambergite** from the Nuristan area, the latter a new find, with very sharp, translucent to transparent hambergite crystals. François also had the finest single green **grossular** crystal from the Iran-Afghan border that I have ever seen: a perfect dodecahedron more than 3 cm in diameter, 90% complete and quite sharp.

I left the theater thinking that I'd completed the show and there was nothing else new to report, but as I walked down the main street I spotted a selection of large **bournonite** specimens from St. Laurent Le Minier, France, ranging from 2 to10 cm, with beautiful crystal shapes. Unfortunately they are dull-lustered, but interesting for this locality. And remember, there is never a dull moment at the Sainte-Marie-aux-Mines Show!

Springfield Show 2004

by Joe Polityka

[August 13–15, 2004]

As I approached the East Coast Gem and Mineral Show at the Eastern States Exposition Center in West Springfield, Massachusetts, I breathed a sigh of relief for having beaten the edge of the most recent hurricane that had just battered the Caribbean and Florida. I was happy to be in familiar surroundings and was feeling the excitement a collector feels prior to a mineral show opening. As in past years, the mineral collection of a prominent mineral collector was being featured. In 2003 it was the collection of Rock Currier; this year the special exhibitors honoring us with their presence were Dan and Diane Kile of Littleton, Colorado.

What makes the Kiles' collection special is the fact that the majority of the specimens exhibited were self-collected. According to the show program:

> Dan and Dianne Kile became passionate mineral collectors when they moved to Colorado in 1971. Their hard work, dedication and skill are evidenced by the quality and variety of their collection. Their collection provides a mineral tour of the state of Colorado and serves as an inspiration to field-collectors everywhere. The Kiles are also displaying selections from their collection of scientific instruments, including antique petrographic microscopes, mine-surveying instruments, and mining artifacts.

As in past years the featured collection was set up just beyond the entrance to the show. Fifty or so cases displayed what truly is a labor of love on the part of the Kile family. I was told they went field collecting almost every weekend rain or shine. The minerals on display prove what can be accomplished by dedicated, diligent and knowledgeable field collectors.

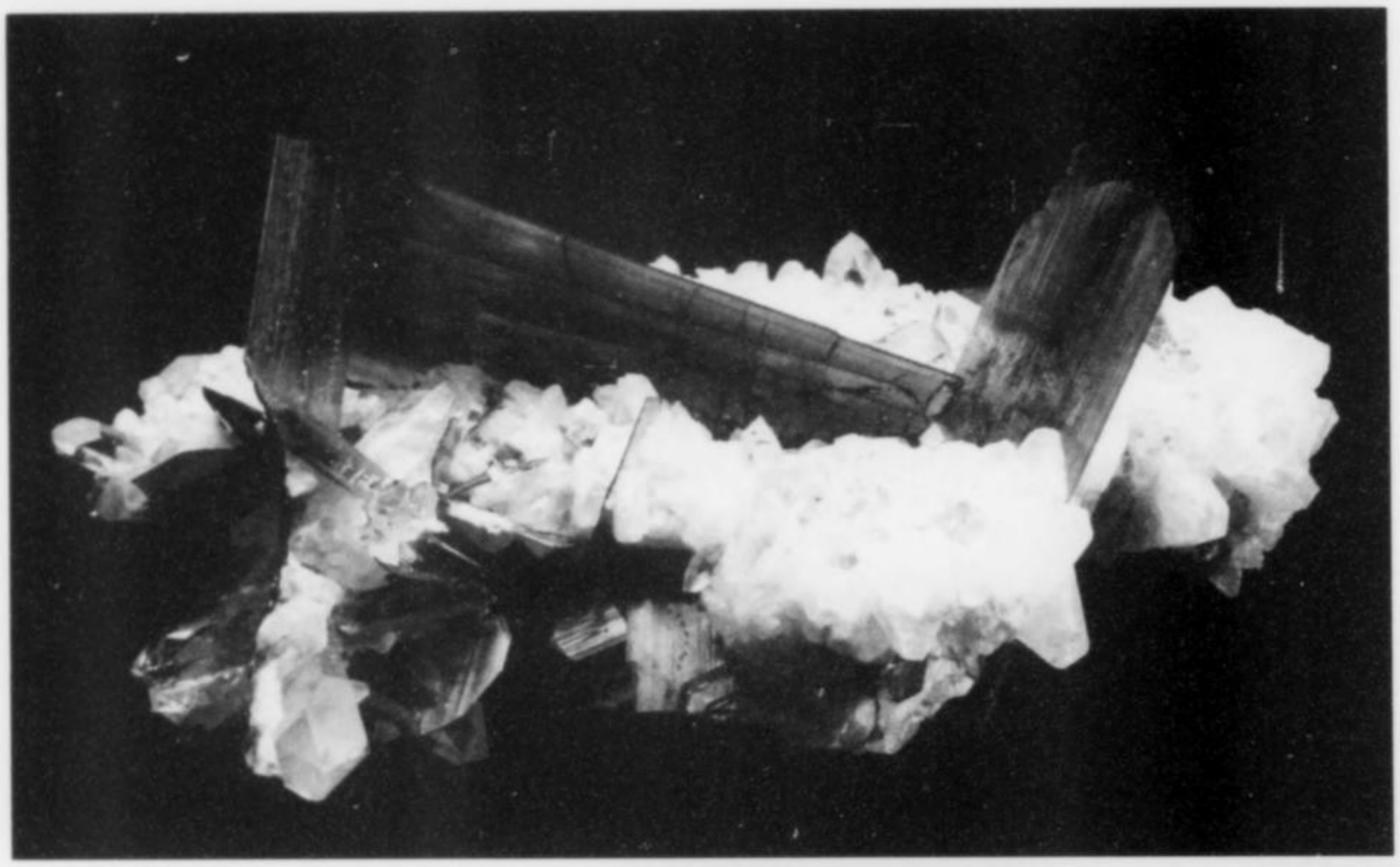


Figure 8. **Brookite crystals on quartz, 6.1 cm, from Mt. Kharan near Balbundi, Baluchistan, Pakistan. Collector's Edge specimen; Jeff Scovil photo.**

Figure 9. **Brookite crystals to 2.4 cm on quartz, from Mt. Kharan near Balbundi, Baluchistan, Pakistan. Marcus Grossmann specimen; L.-D. Bayle photo.**

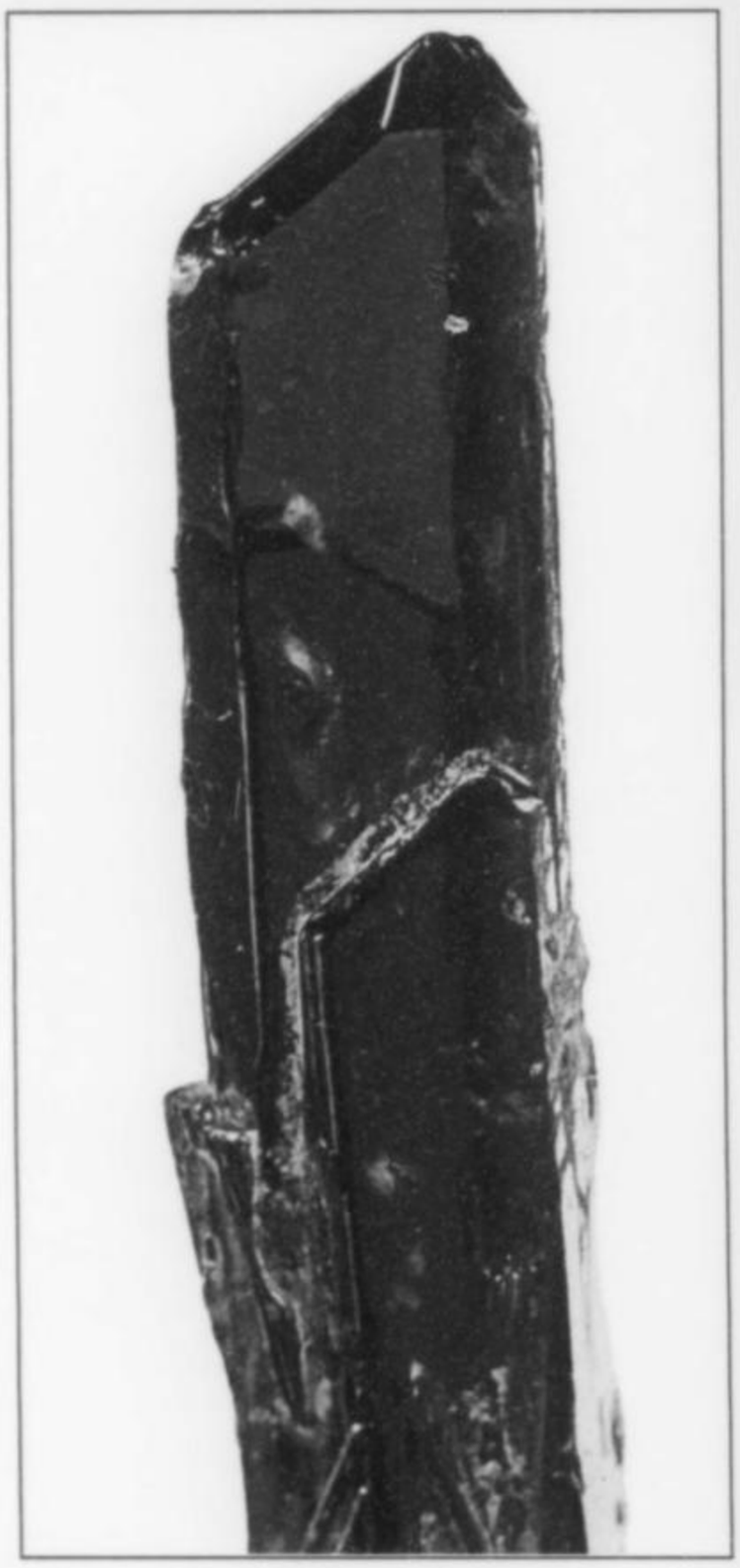


Figure 10. **Blue fluorapatite crystal, 2.7 cm x 7 mm, from Mogok, Myanmar (Burma). C. Dubois specimen; L.-D. Bayle photo.**

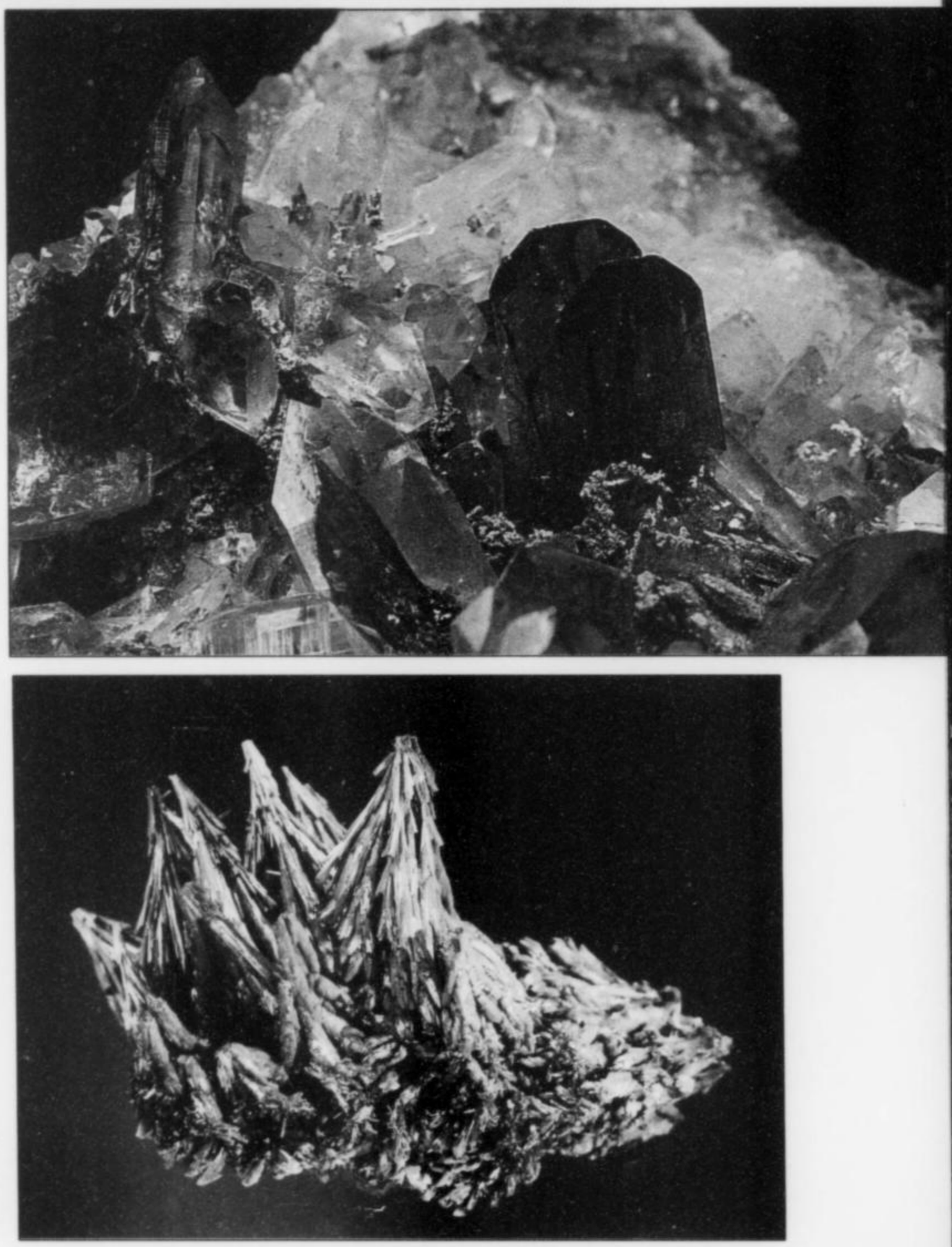
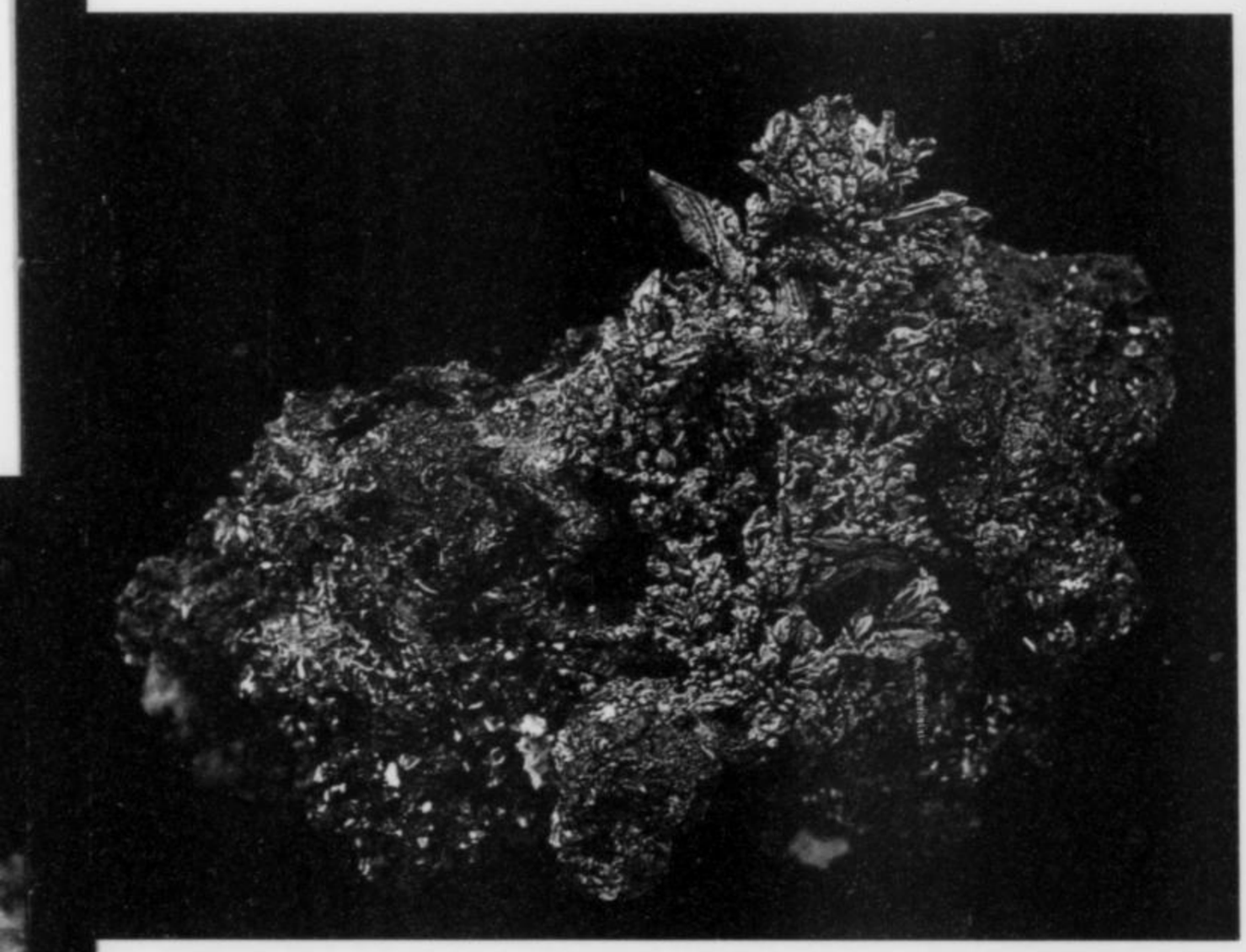


Figure 11. **Vanadinite, 6 cm, from the Thanksgiving pocket, North Home mine, Broadwater County, Montana. M. and E. Raine collection; Jeff Scovil photo.**

Figure 12. **Copper with cuprite, 4 cm, from Le Moulinal, St.-Jean-de-Jeanne, Tarn, France. Denis Koern collection; L.-D. Bayle photo.**



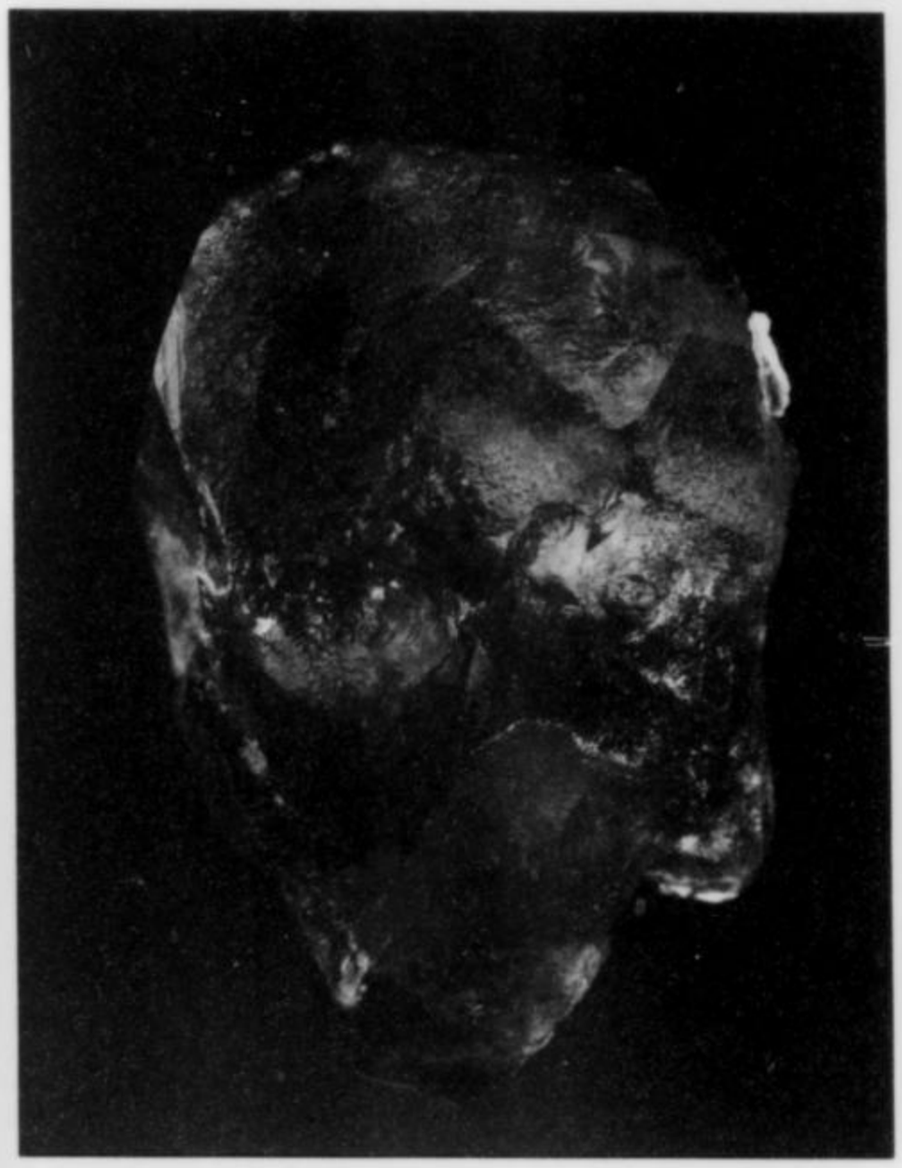


Figure 13. **Villiaumite crystal, 2.7 cm, from the Aris Phonolite, Namibia. The Arkenstone specimen via Galena Rock Shop; Jeff Scovil photo.**

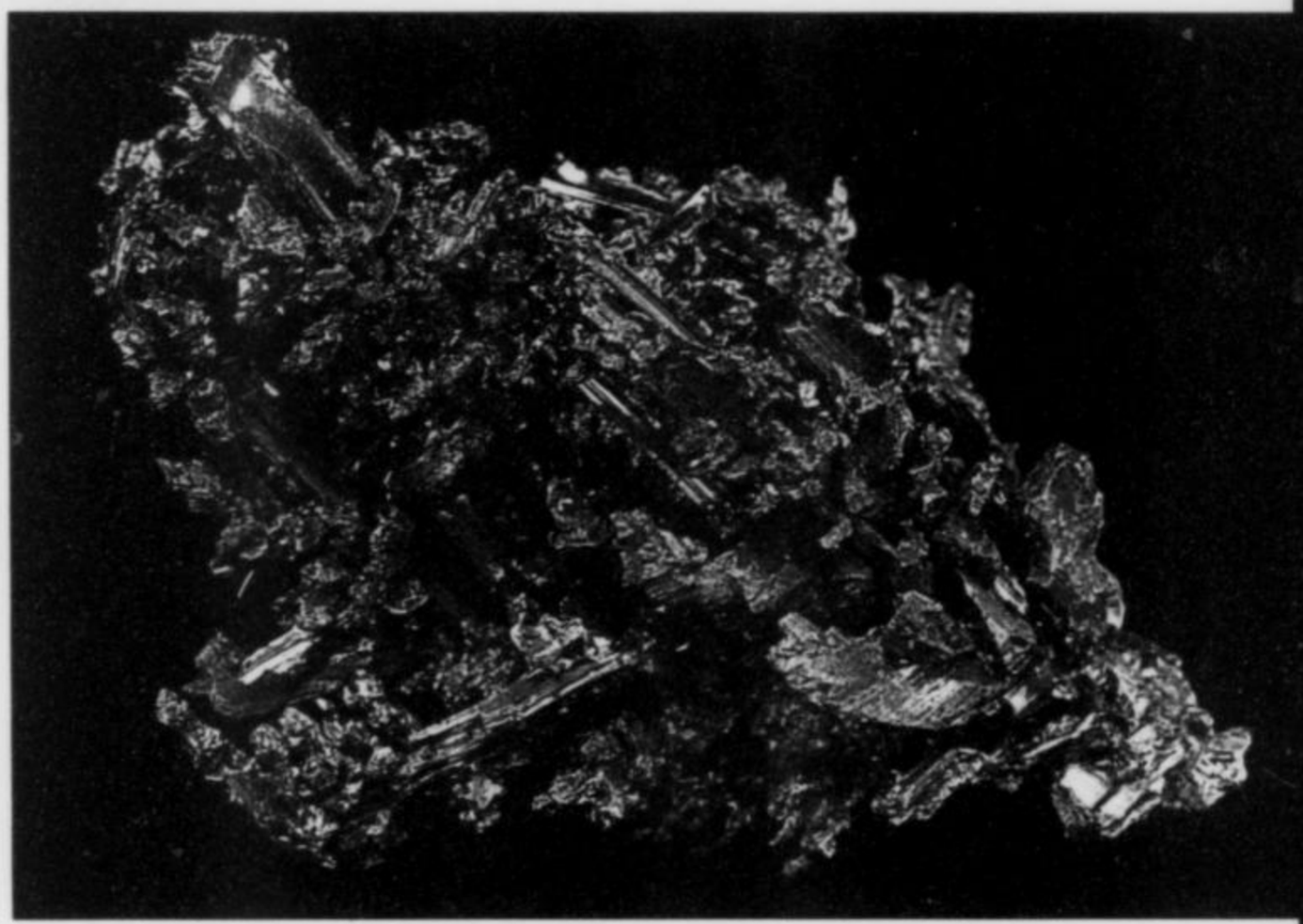


Figure 14. **Acanthite crystals, 3.2 cm, from Imiter, Norocco. Jean-François Astier specimen; L.-D. Bayle photo.**

Figure 15. **Bultfonteinite (acicular) with poldervaartite, 6 mm, from the N'Chwaning mine, Cape Province, South Africa. Rocko Rosenblatt specimen; Jeff Scovil photo.**

Dan Kile has written numerous articles for *Rocks & Minerals* and *The Mineralogical Record*, including a monograph on the history of the petrographic microscope, published as a special supplement to *The Mineralogical Record*. When you go field collecting, it helps if you know where to look.

The premier specimen displayed, in my humble opinion, was the 22-cm-plus smoky quartz crystal with amazonite from Crystal Peak, Teller County, Colorado. This killer was featured in *Rocks & Minerals*, Volume 66—September-October 1991. Each case was dedicated to a particular mine or location in Colorado with some specimens ranking at the top of the scale for quality and size. I especially liked the barite, in water-clear 15-cm crystals from the Book Cliffs, Mesa County, Colorado. How the Kiles managed to collect these specimens undamaged is a real tribute to their skill. Also, the barite from this location is very, very sensitive to the ambient temperature, which suggests they were wrapped in a baby blanket and transported in an incubator after being collected. The specimens were displayed with a large metal scorpion, which suggests what you might encounter at the Book Cliffs when you shove your unprotected hand into a pocket.

I admired amethyst scepters, with crystals to 10 cm, from the Rainbow Lode, Red Feather Lakes, Larimer County, Colorado. milky quartz casts after fluorite octahedrons 7 cm in size from the Genoa mine, San Juan County, Colorado, and various zeolites from Table Mountain in Golden, Colorado, a location that sits right above the Coors brewery. There were a lot of fine minerals represented, from astrophyllite to zircon, all self-collected and all in fine condition. Most of Colorado's historic mining districts were represented by excellent specimens from the sulfide suite.

Upon learning that none of the Kiles' specimens were for sale, I wandered into the retail area to see what I could see. There were over 200 retail and wholesale dealers set up, which gave me very little time to spend at each booth. As in previous years, the majority of the dealers set up at the show had many singular specimens that were quite attractive. One problem I face in trying to report on the show is getting to see and examine these specimens before they are sold. Now you see them and now you don't! So I had to hustle.

Leonard Himes of *Minerals America* showed me some loose crystals of **phenakite** (some twins) to 2.5 cm. The glassy, transparent chisel-shaped white crystals were found at Momeik, Burma

(Myanmar). Leonard also had a small miniature with crystals to one cm in size.

Jeff Collins of *Mohawk Minerals* featured about ten fine miniature-size specimens of **emerald beryl** from the mines of Colombia. Jeff had specimens from the Polberos, Coscuez, Cunez, La Pita and Concorcio mines. Jeff also had a rare fossil oddity: **emerald beryl after gastropods** from the famous Gachala mine, Boyaca Province, Columbia. Bill Butkowski of *The Mineral Cabinet* had a fine small cabinet-sized matrix with a 2.5-cm emerald crystal.

Michael Walter of *Geologic Desires* (P.O. Box 137, Nicholville, NY 12965) is a teacher who spends his spare time roaming the Precambrian hills of St. Lawrence County, New York. Michael had about 50 recently collected specimens of **uvite** from the Power's Farm, Pierrepont, New York. This is a classic locality which almost every East Coast field collector has visited. The specimens, with black lustrous crystals to 2 cm, were available in thumbnail, miniature and small cabinet sizes, many of them associated with milky quartz crystals.

Hawthorneden had some reddish brown single crystals of **monazite** from Mina Juan Torres, Muqui, Espirito Santo, Brazil.

Excalibur Mineral Company recently purchased the entire **diamond crystal** inventory of David New, well-known mineral dealer in business since the 1950's. Tony Nikischer told me he has thousands of crystals from over 25 different locations world-wide. Most crystals of course are small but are individually fascinating, and some are twinned.

Quite a few dealers featured **fluorite** from the Wushan mine, De'an, Jiangxi Province, China. *Wright's Rock Shop, Wendy's Minerals, Mohawk Minerals* and *Rocko's Minerals* had a wide selection of these beautiful octahedrons (to 5 cm) in purple to green crystals. The crystals sit on a white etched quartz matrix reminiscent of the purple Grant County, New Mexico specimens.

Donald Olsen (P.O. Box 858, Bonsall, CA) was disbursing an antique collection of mixed specimens. One piece that caught my eye was a gray schist matrix with a vein of massive **gold** running through the center of the cigar-shaped chunk. The specimen, which quickly sold, was from the Bralorne mine, British Columbia, Canada and was collected by W. Ringsleben, a former employee at the mine.

Jeff Fast of *JBJ Minerals* showed me a photograph of a **wire silver** specimen from a still-secret new find in Mexico. The small cabinet-sized specimen features wires to 7 cm on an etched calcite matrix. Jeff promises more information and specimens in the future.

Terry Szenics always has some surprises in the what's-new department. This year was no exception. **Quartz crystals with molybdenite crystal inclusions** from Tilama, Chile just north of the capital of Santiago, was featured in natural and polished crystals. According to Terry the crystals have inclusions of platy hexagonal crystals and flakes of molybdenite, with some specimens showing phantoms. The quartz crystals reach around 7 cm and are mostly singles with a ratio of 1 inch in width for every two inches in length. This is truly a new item on the mineral market and a must for every quartz collector. Tilama, Chile is an area known for the mining of industrial-grade quartz. Terry also had **red wulfenite** (which he introduced last year), in bipyramidal crystals 2 to 4 mm on matrix, from the Chapacase mine, Tocopilla, Chile. This occurrence of beautiful chromium-rich wulfenite was discovered this past Easter Sunday. Terry said they worked all of "Semana Santa or Holy Week, a serious holiday in Chile." It took the miners two days to clean out the pocket. The specimens are nearly identical to, but richer than, the red wulfenite found three decades ago at the Florence lead-zinc mine in Arizona.

In the not-so-good news department Terry Szenics reports that the wonderful blue drusy chrysocolla from Diego de Almagro (which had been a mainstay of their Chilean specimen business) looks to be at its end; the copper orebody has been mined out and the mine now stands abandoned.

The guest speakers this year were entertaining and informative. Rock Currier lectured on "How to dig 1000 pounds of amazonite in Colorado"; Nancy Koskie Millard lectured on "Collecting New England Minerals in the Field"; Jeff Scovil lectured on "Minerals of Hunan, China," and Phil Scalisi lectured on "Treasures of the Harvard Mineralogical Museum."

Never been to Harvard? Well, next year at the 2005 East Coast Show, some of the *Treasures of the Harvard Mineralogical Museum* will be on display. The Harvard repository certainly ranks among the richest and most historic minerals collections in the world. Many famous mineralogists and mining engineers were Harvard graduates who donated or sold their collections to their alma mater. In addition, for 200 or so years, geology and mineralogy students at the college have made field trips to places far and wide. Please do not miss the 2005 East Coast show! You might even want to make a side trip to Harvard to see the rest of the collection.

Denver Show 2004 — by Tom Moore

[September 14–19, 2004]

Some said that snow had already been spotted in some high places back in the mountains, but the days of the Denver Show were unseasonably hot down around the Holiday Inn and Denver Merchandise Mart, and the yellow/browning leaves on display in some of the trees looked lightly braised, not autumnal. Nevertheless the show offered that easeful, chilled-out experience it always does, reducing consciousness of Hurricane Ivan and even the presidential campaign to faint background statics; mineral people who made it to the show will all, I'm sure, Approve This Message.

The main item of Colorado news was being spread around by Bryan Lees: within a few weeks of this show all specimen-mining will have stopped at the Sweet Home mine, and the owner, Bryan himself, will have closed down the mine completely. As your Sweet Home Special Issue can tell you, this project was originally planned to run for only five years (1991–1996), but, of course, the project has fed happily on its own success for eight further years. Now, though, the Collector's Edge crew has other undertakings in hand, and mineral collectors meanwhile have picked up zillions more specimens of rhodochrosite (and fluorite, tetrahedrite, quartz, etc.) than we'd have dared to hope for in 1991. Good job.

The new items at this Denver Show (although many are from the western United States) for some reason bypass Colorado. Indeed the program opens in Arizona, with Evan Jones' and Jim Ricker's major strike, this past May and June, of **wulfenite** at the famous Rowley mine, near Theba, Maricopa County. Hundreds of specimens, from small thumbnails to one magnificent-looking crystal-lined open cavity in a 30-cm-wide matrix, emerged from a zone of pockets in the massive white barite that fills a fault gouge exposed in the mine. The wulfenite crystals reach 1.5 cm on edge, are uniformly very lustrous, and range in color from yellow-orange to rich medium orange. Some specimens consist of very thin, transparent wulfenite "windows" perching edgewise, alone or in dense glades, on the red-stained white barite, while in other specimens the wulfenite crystals are somewhat thicker and translucent, and form discrete, petite clusters on and off matrix. At the Main Show, Evan Jones (3520 N. Rose Circle Dr., Scottsdale, AZ 85251) kept snaring the attentions of passing Arizona collectors (especially) with his several flats of thumbnail, miniature and small cabinet specimens of these brand-new and very nice "Rowleys."

By way of a prompt follow-up to Curt Forrester's article in July/August 2004 describing his new strike of excellent **clintonite** crystals at the Crestmore quarry, Riverside, California, Cal Graeber at the Main Show was selling a very few (fewer than ten) small specimens showing clintonite crystals half-embedded in massive blue calcite. Just as in the pictures on pages 329 and 330 of that issue, the clintonite crystals are sharp, dark green, pseudohexagonal "books" reaching 2 cm across, and Cal's specimens are mostly small miniatures. They are only moderately attractive, but are, of course, superlative crystal examples of a rare species, and might quite possibly turn out to represent a one-time find.

Also not leading the pack in the dazzlement derby but also exemplifying a very rare species in nearly record-size crystals are the new specimens of **getchellite** ($AsSbS_3$) from the open pit of the Getchell mine, Humboldt County, Nevada; these were to be seen in the Holiday Inn room of *Great Basin Minerals* (3895 Lisa Ct., #C, Reno, NV 89503-1125). Here were about 50 specimens ranging in size from 2 x 2 to 5 x 8 cm—all of them, at first sight, mere lumps of massive red pararealgar, yellow orpiment, and black stibnite. But before I could ignorantly turn away, Scott Kleine pointed out the deep red, lustrous, striated getchellite crystals to 5 mm which lurked in crannies in all these pieces; on one specimen a sharp, relatively enormous getchellite crystal 1.4 cm across could be seen. The specimens, Scott said, were collected in 1990 from loose material lying around in the open pit of the Getchell mine, and they have been cleaned and examined only recently: hence the discovery of the getchellite crystals, and the first marketing of the specimens at this Denver Show.

Along similar lines, the Gold Bar mine in Eureka County, Nevada has very recently yielded good **orpiment** crystal specimens, and John Seibel had a few of these in his wholesaling booth at the Main Show. Fairly sharp, dull yellow, bladed orpiment crystals on these specimens reach 5 cm, and crystal groups can be impressive, although lacking the vivacious luster and sharpness of the great orpiments mined some years ago at the Twin Creeks mine, Humboldt County. In the Gold Bar mine specimens, the orpiment crystals occur on a matrix of gray/black carbonaceous shale; there are no realgar crystals, but in some specimens a massive realgar/orpiment mixture replaces clearly defined sections of a coral colony—in case anyone ever asks whether you've ever heard of arsenical fossils. Thirty to 40 flats of the orpiment crystal groups, in a range of specimen sizes, were collected at the Gold Bar, an active gold mine, in March and July, 2004.

The Sioux Ajax mine, Mammoth, Juab County, Utah has recently given up about 50 miniature to cabinet-size specimens of **aragonite**—very pretty ones too, with lustrous, white to colorless acicular crystals of aragonite in delicate sprays to 3 cm perched on pearly white botryoids of the same species. Some specimens show tiny, pale green, rice-grain crystals of smithsonite, hemimorphite microcrystals, and deep green spots of rosasite. Dave Bunk was offering a shelf-full of this material in his room at the Holiday Inn.

At the Denver Show of 2001 (see vol. 33, no. 1, p. 83), Lanny Ream came out with abundant specimens of **milky quartz pseudomorphous after apophyllite** from a locality in central Idaho then designated as Antelope Flats. Well, a better designation seems to be the Summer Storm claim, Custer County, Idaho, and this time it was the ever-industrious John Cornish (j&gcornish@tenforward.com) who was offering about 100 specimens of the same material which he (John) had quite recently extracted. The glittering white drusy quartz crusts do not disguise the sharp forms of the former tetragonal bipyramids of apophyllite; as before, the clusters reach cabinet size, with individual pseudocrystals to 4 cm.

Another ghost of a Denver past is the fine, Mexican-style **vanadinite** (think of the so-called "endlichite" from Los Lamentos) which Chris Tucker is still finding, and in increasingly finer quality too, in the North Home mine, Broadwater County, Montana. In 2003, Chris had about five flats of specimens of this very attractive material (see vol. 35, no. 2, p. 152), and this year there were five flats of thumbnails alone, plus several more of miniatures and a couple of glass shelves full of specimens measuring up to 12 cm across. These brilliantly lustrous, acicular vanadinite crystals and subparallel aggregates of crystals reach about 2 cm individually; specimens consist of dense, very delicate intergrowths, almost all without matrix. In general the color is yellowish brown, but some crystals have reddish zones near their tips, while others show silky, pale brown patinas on some surfaces. On some of the exceedingly delicate thumbnail specimens, the vanadinite crystals join at the ends at small angles, and the subparallel aggregates crisscross, making for curving or wavy, thin, tortured-looking little clusters. Chris collects these specimens underground in the old gold/silver mine (last worked for ore in 1896), and he has taken to naming the pockets, so this year he had, for example, selections from the Thanksgiving, Silver Medal, Double Owl and several other pockets, all found since Denver 2003. Also emerging in small numbers from the North Home mine are milky white sprays of **quartz pseudomorphous after hemimorphite** crystals, and for these, and for the vanadinite (which, by the way, is correctly called vanadinite and not "endlichite"), you may apply to *Chris Tucker Minerals* (P.O. Box 22575, Billings, MT 59104).

For the next item, from North Carolina's emerald country, we have what is so far only a news flash (my thanks to Russ Behnke of Connecticut), and no marketed specimens yet, though all campers must, of course, hope that will change. In December of 2003, a 2 x 2-meter pocket was opened at the Hill mine (formerly the Rist mine), in Hiddenite, North Carolina, and, besides a few of the emerald crystals which were the objects of the search, the workers found a few very dramatic **siderite** specimens, with sharp brown rhombohedral crystals to 5 cm associated with brilliant red-brown needle crystals of rutile and translucent white rhombohedral crystals of dolomite. About 200 specimens emerged, most of them without siderite—but the best of the pieces *with* siderite are said to be world-class examples of the species. Stay tuned for further bulletins.

The Roncari quarry near East Granby in north-central Connecticut has recently produced some very nice **calcite** specimens. This quarry is best known for its outstanding datolite and (rarely) babingtonite specimens, but these new white, translucent scalenohedrons and compound scalenohedrons of calcite, reaching 10 cm, are no poor sisters either. The crystals occur in jumbled groups enlivened around the edges by bright, transparent quartz crystals to a few millimeters, and specimens come in a wide range of sizes, up to one very fine "museum" cluster measuring 45 cm across. A couple of flats of these Connecticut calcites, plus the jumbo-size cluster, were brought to Denver by Rocko and Mandy Rosenblatt of *Rocko Minerals* (438 Southside Spur, Margaretville, NY 12455).

What is a what's-new report these days without something newly dug up by Gilles Haineault in the amazing quarries at Mont Saint-Hilaire, Quebec? At Denver, the Main Show stand of *Tyson's Minerals* was graced this time by some excellent specimens of **rhodochrosite** which Gilles collected last May: very sharp, typically flattened rhombs to 3 cm, as loners and as lightly attached in fragile clusters to 8 cm. This rhodochrosite shows sharp color-zoning, with deep brownish red triangular areas in the centers of crystals, and pale orange-pink zones around the rims. Clinging to a few of the rhodochrosite platelets are tiny white bladed crystals and sprays of the extremely rare mineral **behoite**. Also, Rod Tyson filled one of his glass shelves with about ten impressive thumbnail

and miniature specimens of **arfvedsonite**, collected by Gilles last February at Mont Saint-Hilaire. Razor-edged, canted, lightly striated, blocky crystals of highly lustrous black arfvedsonite reach 4 cm, and these are lightly perched, in some specimens, on isolated thin-prismatic crystals of aegirine. The contrast between the shining black, wedge-shaped arfvedsonite crystals (perhaps the best ever found for this species) and the supporting black aegirine columns of duller luster makes for striking aesthetics, even though we are talking about black-on-black.

For earlier scoops on the wonderful iridescent **stephanite** and **polybasite** crystals collected originally in the late 1970's from the Husky mine near Mayo, Yukon Territory, see my show reports from Tucson 1996 (vol. 27, no. 3, p. 216—and a photo on p. 214) and Denver 2002 (vol. 34, no. 1, p. 91). According to Rod Tyson, the little stash of these specimens which he offered in Denver this year is *truly* the last which is likely to become available, and although they are not large and not cheap they are quite attractive. The stephanite occurs as single prisms to 2.5 cm and as small-thumbnail spiky clusters; the polybasite arranges itself as rosettes of thin, platy crystals, the largest rosette at Rod's being nearly 3 cm across. The brilliant metallic luster of both species is beautified by very strong plays of iridescent colors, and despite the fact that the larger thumbnails were priced in four figures I'd wager that most of the pieces have moved, by now, to the homes of appreciative collectors.

The authors of the special Peru Issue (vol. 28, no. 4) report that the famous Huanzala mine, Dos de Mayo Province, Huanuco Department, Peru has been producing **galena** in lustrous to dull crystals, many of them partially resorbed and melted-looking, to 2.5 cm, with occasional spinel-law twins. This summary seems much too feeble to account for the spectacular specimens found last March at the Huanzala mine, and marketed in Denver by George Witters and Marshall Koval of *Silver Scepter Minerals* (P.O. Box 3025, Kirkland, WA 98083). Mirror-faced, blindingly lustrous, not at all edge-rounded, spinel-law twinned galena crystals reaching 3 cm rest, or stand straight up, on massive pyrite or (in two elite pieces I saw) on groups of bright, sharp, pyritohedral crystals of pyrite, themselves to 2 cm on edge; a little white calcite gets in there too. The galena spinel-law twins are flattened, of course, but only moderately, i.e. they are fairly fat, and are altogether commanding presences on these matrix specimens, which range in size from 4 x 4 to 8 x 8 cm. According to Marshall, fewer than 20 really fine pieces were found.

In my last Tucson report I mentioned the debut of specimens from a new **vivianite** occurrence in Bolivia—"near" the Canutillos mine, Potosí, Savedra. Alfredo Petrov explains the "near": these specimens are collected from outcrops of sandstone country rock a few hundred meters from the workings of the Canutillos mine, and thus it is that the vivianite crystals perch on matrix of fine-grained red sandstone and lack any associations of metallic or gangue minerals such as are typical for ore-vein occurrences. At this show, hundreds of excellent specimens in all sizes were to be seen in the Holiday Inn room of Gary Nagin's *Crystal Springs Mining Company and Gallery* (P.O. Box 6033, Hot Springs, AR 71902), and many hundreds more (mostly thumbnails and small miniatures) awaited the bargain hunter in the wholesale tent of Rock Currier's *Jewel Tunnel Imports*. Indeed, at the latter place a patient reconnaissance of the flats could discover truly fine thumbnails for around $15. The wedge-shaped vivianite crystals are of the best sea-green transparency, sharpness and luster, and a gratifying number of them, even among those seen in the wholesale tent-kingdom, are free of any damage; on a few of Nagin's cabinet-size specimens the compound vivianite crystals reach 8 cm long and nearly as thick. However, Alfredo Petrov warns, the bounty won't last: while currently many miners (and ex-miners?) are digging specimens from the sandstone beds, the water table will soon be reached, and there is neither equipment nor funding for serious specimen-mining below it.

Garimpieros were busy this past summer at the Pederneira mine, Minas Gerais, Brazil. I saw none of the fantastic, 30-cm groups of gemmy, color-zoned elbaite crystals which have come in a few recent waves from this famous mine, but at a few dealerships I did see great numbers of beautiful small specimens consisting of single **elbaite** crystals, and delicate flattened, girderwork groups of lightly attached ones, speckled with lilac **lepidolite** globules and brushy, subhedral crystal groups of lepidolite. In general the hue of the gemmy elbaite crystals is halfway between green and blue; some have black caps, others have subtle rose-pink interior zones, and still others terminate in whisks of parallel fibers. It was a delight to finger-pick through loose layers of thumbnail elbaite crystals and spindly groups in several flats in the room in the Best Western hotel (across the street from the Holiday Inn) where Chris Ehrlich (2675 W Hwy 89A #105, Sedona, AZ 86336) was holding court. Nor am even I so thumbnail-preoccupied as to have failed to notice Chris' cabinet-size masses of subhedral, translucent, purple lepidolite "books," or his prize single elbaite crystal from Pederneira, a gemmy blue-green prism 20 cm long.

The lone European what's-new is not truly new, but *is* truly venerated, especially by Europeans, each time it surfaces: I refer to rose-pink octahedral fluorite from Mont Blanc, above Chamonix, Haute-Savoie, France. Each of the past two summers has seen a significant pocket find of this distinctive and beautiful fluorite at Pointe Kurz, on Mont Blanc; about 15 fine specimens emerged in 2003, and about a dozen in 2004. The sharp fluorite octahedrons are lustrous, transparent, and such a deep pink as to appear virtually red at first glance, with thin, faint purple zones around the outside; the crystals reach 2.5 cm on edge. A few show very thin hexagonal plates of white calcite to 5 cm across, stacked in little tapering piles around the fluorite crystals. Although there were occasional strays to be seen at other dealerships, it was Kevin Dixon of *Alpine Mineral Company* (P.O. Box 1178, Lawrence, KS 66044) who had the best supply—about 12 miniature and small-cabinet pieces—in his Holiday Inn room.

At every Denver and Tucson hotel show, edification greets the seeker who goes to check out Russian exotica in the room of the *Fersman Mineralogical Museum* (Leninskiy prospect 18-2, Moscow, Russia 119071), Dmitriy Belakovskiy, Curator, presiding. One new find this time was **sulfur**, in lustrous yellow, translucent to transparent crystals and tight crystal groups to 10 cm, from the Vodino deposit near Samara (between Moscow and the Urals), Russia. The sharpest of the sulfur crystals are the loose ones of thumbnail size (Dimitriy had about 30 of these), but the most interesting specimens were some of the matrix pieces showing sharp sulfur crystals lining cavities in limestone, the cavity walls and crystals still stained to different degrees by films or coatings of pitchy black "bitumen." It is this just-had-an-oil-change organic substance which enclosed and protected the sulfur crystals where they rested in dump material of the Vodino mine, where active mining ceased about ten years ago. The Russian collectors whom we have to thank for the mostly pristine-looking sulfur crystals quite recently turned the dumps over in search of them, then bathed their finds in gasoline to remove the "bitumen." Check that tire pressure for you too?

Another interesting what's-new in the Fersman Museum room (and, to lesser extents, in a couple of other "Russian" rooms) was a selection of pretty **grossular** specimens found in the autumn of 2003 in the enormous Bazhenovskoe deposit—the world's largest asbestos mine—near Asbest, Ural Mountains. Sharp, slightly modi-

fied dodecahedral grossular crystals to 2 cm line cavities in a rodingite vein; the orange-brown to honey-brown crystals cluster densely, in mounds, on mottled gray-green to tan matrix, in specimens from toenail to small-cabinet size. Although only a very few of the grossular crystals I saw are transparent, most of them are translucent, and all are highly lustrous. The specimens suggest, of course, those found in rodingite at the Jeffrey mine in Quebec, but the Russian grossular crystals are darker and not truly gemmy. Dr. Belakovskiy told me, though, that Jeffrey-like green and colorless grossular crystals have also been found in the Bazhenovskoe deposit.

Speaking of new garnet specimens out of ex-Soviet Asia, a quarry near the Sokolovskii-Sarbayskii mine near Kusteni, Kazakhstan is now producing lustrous, extremely handsome, black crystals of **andradite** (of the high-iron variety). Actually the crystals are very dark brown, but it takes strong backlighting to see this color glinting along occasional edges; the modified dodecahedrons present themselves as sleek, shining, and jet-black. Individual andradite crystals average 1 cm and exceptionally reach 8 cm, but most specimens are tight clusters of crystals which have been acid-etched free of enclosing calcite. The specimens, reportedly first found in spring 2004, range in size from thumbnail to 10 cm across. In Denver a few very fine examples were to be found at the Main Show with *Steve Perry Minerals* (P.O. Box 136, Davis, CA 95617), and many more, (including some excellent) ones, in the Holiday Inn room of Aleksey Vinogradov (zopkin@rambler.ru).

From India this time the main news is hardly more than a rumor, since only about six specimens so far are known, and in Steve Perry's booth at the Main Show I got to see only two . . . but who has ever heard before of **calcite with included cavansite** from the Wagholi quarry complex at Poona? Not even the beautiful golden transparent rhombohedral crystals of calcite from "the cavansite place" are particularly well known—but, sure enough, in Steve Perry's two specimens the simple 1-cm rhombs harbored distinct cavansite-blue crystals in their golden innards. Collectors should go on high alert for further appearances of such pieces.

The Tucson Show of 2004 saw a tentative trickle of lustrous, gemmy, pale purple crystals of **scapolite** (to which species of the scapolite group the material belongs is so far undetermined) from the Kokcha Valley, Badakhshan, Afghanistan; some labels further specify that the locality is near the village of Kiran. This Denver Show saw a considerable strengthening of the supplies of these lovely gem crystals, the best and the brightest of them being about a dozen offered at the Main Show by Dudley Blauwet of *Mountain Minerals International*. All of the scapolite crystals are loose, pale lilac in color and singly terminated; they range in size from 1 to 3.5 cm long and are lightly striated vertically, lustrous and totally transparent. Matrix specimens remain very rare, and when seen they should, of course, be examined carefully, under suspicion of glue-jobbery—not, according to Dudley, exactly an unheard-of phenomenon for gem crystals from the Himalayan regions.

Dudley Blauwet, Herb Obodda, and Scott Kleine (of *Miner's Lunchbox*) were among the several dealers at Denver who had **brookite** specimens from a new strike made a few months ago in Pakistan. Labels differed as to the locality, and not even Dudley or Herb could be authoritative, but the best designation seems to be "near Dalbundi," Baluchistan—note that this is *not* in the mountainous northern part of Pakistan, wherefrom come all Pakistani minerals we've seen so far, but in the desert southwest, near the Iranian border. The brookite crystals are very thin, sharp blades reaching 5 cm (!) and ranging from very dark brown and lustrous to pale brown and less lustrous. The crystals hide out in crevices in clusters of quartz crystals on a green, chlorite-coated matrix, and also may partly penetrate or be wholly included in the quartz crystals. In all, in various places at Denver, I saw about 50 specimens from this highly promising new brookite occurrence.

Also from Pakistan (back in the northern mountains) have recently come a few handfuls of small, brilliant specimens of **vesuvianite**, in highly lustrous, rich reddish brown, short-prismatic crystals to 1 cm or so in subparallel-growth crystal clusters of thumbnail to miniature size. These vivid little specimens were to be noted scattershot at a number of dealerships around the show. Yes, and *also* from Pakistan have recently come groups of colorless and transparent, lustrous, blocky crystals of **orthoclase**, each crystal distinctly showing a faden line; these specimens come from near Alchuri village in the Shigar Valley, a place already well-known for its fine apatite, epidote, titanite and gemmy zoisite crystals. The faden orthoclase specimens also were scattered about the show, though the best of them were probably Dudley Blauwet's several miniatures.

Two very new, very gemmy items from Myanmar (Burma) caused considerable buzzes around the show. First, there are the loose, very lustrous and totally gemmy *blue* crystals of fluorapatite, some with partial surface films of palygorskite, from Le U village, Mogok, in the ancient but still-active Mogok gem district. The fluorapatite crystals are singly terminated, slightly flattened thin-hexagonal prisms from less than 1 cm to fully 7 cm, all crystals being possessed of a charismatic color which might be called a pale to medium "electric" blue. The biggest swarm of these was in the Holiday Inn room of *Andy Seibel Minerals*, where Andy had a separate glass case devoted to showing off about 30 of these exciting crystals.

The second new Burmese (Myanmaroid?) item, reportedly from "near Mogok," was **phenakite**, in the jazziest, brightest, gemmiest crystals of this species that I have ever seen. They are loose, simple hexagonal prisms from under 1 cm to about 3 cm long—simple, that is, until you look at the terminations and notice the complex chevron patterns of re-entrant angles betraying "drill-bit" penetration twinning. The best of the phenakite crystals are, however, so lustrous and so colorless and so completely transparent that catching the re-entrant angles is mostly a matter of getting the right light reflections. Also, the angles vary in depth and obviousness, and some of the crystals are completely filled in where the re-entrant angle should be. Not all of these highly unusual phenakite crystals are dazzlingly bright and gemmy—only the best of them are—but all show at least fairly high luster, and all are sharp; a few have milky areas inside and/or slightly frosted terminal faces. The best lot of specimens was to be seen at the Main Show stand of *Graeber and Himes* (P.O. Box 2347, Fallbrook, CA 92088), but in the hotel room of the KARP dealership, Ivo Szegeny showed me the only two matrix specimens apparently in attendance at Denver, with phenakite crystals lying flat on grayish feldspar cleavage fragments.

The tour concludes with one exciting what's-new from China—although it seems almost shameful thus to ignore the plenitude of *other* Chinese minerals on hand at this show, as at almost all recent shows. This past July, while Martin Jensen was scouting around in China for *Collector's Edge*, a dealer in Changsha showed him a few dozen specimens of a then-unidentified, submetallic black mineral which had just been found in the great Yaogangxian tungsten mine in Hunan Province. The lustrous, very dark brown to black, platy hexagonal crystals (morphologically resembling sharp little mica "books") reach 1.7 cm across, and come as discrete little clusters and very sharp loners perched up on matrix. Scanning electron microscope and energy dispersive spectrometer testing by Martin has shown that the crystals are **wurtzite**, a species never before noted from the Yaogangxian mine. These are among the world's best specimens of the rare zinc sulfide (a dimorph of

sphalerite), having crystals quite different in form, and generally quite a bit more lustrous, than in most old Bolivian wurtzites. In the prettiest pieces, all of thumbnail and miniature size, the little wurtzite plates perch up smartly on complex, sparkling, hillocky matrix consisting largely of bright chalcopyrite crystals to 2 mm and milky white, lenticular calcite crystals to about the same size; however, Jensen reports that microcrystals of about ten other species are present in specimens which he examined, these other associations including quartz, muscovite, arsenopyrite, ferberite, sphalerite, galena and cassiterite. At the Denver show, the *Collector's Edge* dealership offered about five flats of small wurtzite specimens from Yaogangxian, the better ones with low to medium three-figure price tags. To quote Jensen,"whether more vugs containing crystallized wurtzite will be encountered at Yaogangxian remains to be seen." Indeed.

The Main Show scene was a busier one this year than the hotel show scene, as well as heavier on new mineral finds (some years, be it noted, the case is the other way around). On the show floor, Mr. Bones (the black-clad chap animating a 3-meter-tall walking dinosaur skeleton) had plenty of excited kids to jostle and generally schmooze with on opening day, and excited grownups were numerous too, tending especially to cluster in and around the beautifully decked-out rooms of major dealerships in the "tunnels." In one of these rooms, that of Rob Lavinsky's *Arkenstone*, a special attraction was a whole wall case full of terrific specimens, old and new, of pyromorphite from the Gary Hansen collection. Bad Ems (Germany), Phoenixville (Pennsylvania), the Bunker Hill mine (Idaho), the Les Farges mine (France) and other well-known localities were represented, and there was also a wonderful old pyromorphite specimen from someplace in Japan, and a lovely shining cluster of tan crystals from the ancient Ecton mine in Pennsylvania. Playing the which-one-would-you-take-if-you-could-only-take-one game here was especially fun.

The show theme was "Zeolites," and two exhibits of this thematic persuasion deserved special mention. First, facing visitors as they came in the main entrance, there was a large, busy case put in by the Rice Northwest Museum of Rocks and Minerals: "Zeolites of the Pacific Northwest," with enormous salmon-pink heulandites and a bull's-head-size open mordenite geode from the Rat's Nest claim, Challis, Idaho, ranged along the back row. Also here were tremendous, large, silky white or glittering pastel specimens of zeolites from places like Goble, Oregon; the Skookumchuk Dam, Washington; Ice River, British Columbia; and the Weyerheauser Lincoln Creek quarry, Doty, Washington. Having been raised on New Jersey zeolites, and having had my sensibility flooded in later times by Indian zeolites, I found this Pacific Northwest case a powerful mind-broadener.

Even more enlightening were two cases put in by the National Museum of Scotland, showing specimens of zeolites, most of which were collected during the past seven years on the Isle of Skye and in Strontian, Orkney, and the Midland Valley, according to Brian Jackson of the Scottish museum. This material, Brian said, almost never reaches the commercial market, but is being dug quite actively and respectfully by museum people and locals, with many specimens finding their ways to collectors in the British Isles. Examples of first-rate Scottish zeolites in the two cases included very large specimens of basalt plates and open tubes lined with lustrous white stilbite "bowties" to 5 cm, thick coverages of lustrous white and colorless chabazite rhombs to 3 cm on matrix, perfect glassy analcime trapezohedrons to 2.5 cm sitting straight up on white calcite druses over basalt, red heulandite and blocky white hydroxylapophyllite crystals in stately groups, and, of course, the classic harmotome from Strontian, in magnificent crystal clusters with individuals to 3 cm across.

Also fitting the show theme were cases on New Jersey and Virginia and Nova Scotia zeolites (Smithsonian); Indian zeolites (Los Angeles County Museum of Natural History; Keith and Mauna Proctor; Colorado School of Mines Geology Museum); zeolites of the North Carolina Piedmont (Colburn Gem and Mineral Museum); zeolites of Los Angeles and Ventura Counties, California (California State Mining and Mineral Museum); zeolites of North Table Mountain, Colorado (Dan and Dianne Kile); zeolites of northern New Jersey (American Museum of Natural History); and general zeolite cases by, among others, the Weinman Mineral Museum, Bill and Marge Hawes, and Bill and Carol Smith. Oh yes, and the Mineral Museum of Bonn contributed a part-technological exhibit on two surprisingly related, highly important topics: Zeolites and The Brewing of Beer.

Among other cases were the usual miscellany of very fine specimens put in by members of the Mineralogical Association of Dallas; Irv Brown's ten super-pieces (my favorite of which was a huge, doubly terminated, vividly colored Himalaya mine elbaite); "Mineral Mimicry" by whimsical Carolyn Manchester; two cases by Dudley Blauwet which more or less profiled his stock of Asian material, but in specimens stratospherically extraordinary; a case by Herb Obodda on Zagi Mountain, Pakistan, and open copies of recent articles in the *Mineralogical Record* and *ExtraLapis*, with pictures matching specimens; and finally there was a "teaser" case of native copper specimens from the Onganja mine, Namibia, from the Bill Birnie collection—Bill actually worked at the mine from 1970 to 1974, and will be offering most of his large hoard of exceptional Onganja coppers (like these) for sale in Tucson in 2005.

And that's how it is (was) at Denver this year: a solid and most satisfying show.

Munich Show 2004 — by Tom Moore

[October 29–31]

My visit to the 2004 Munich Show marked my first time in Germany since leaving that country in 1991 after 15 nearly continuous years of residency—so the reader will just have to bear with me here for a line or two, before we come to the minerals.

Of course, the German scene was different, and it was also the same, and the autumn colors seen everywhere in the city were blazons of old memories begging that I scuffle playfully and sadly through them, as feet through autumn leaves (bear in mind, too, that I had just emerged from the seemingly endless oven-like cactus patch of a Tucson summer). When I went one evening to the Marienplatz, the city's most beautiful public square, to wander about, eat *Jägerschnitzel*, and watch the street life come out into the evening lamplight, it was a private yet shameless, nostalgic binge. The sodden gray German skies and heavy air were the same—the much-employed, handy term is *nasskalt*—and the street sounds, voices, facades of Gothic churches splendidly illuminated at night, the coziness of the fringing streets of the *Theresienwiese* where the old Munich Show had been—all these were most satisfying to wander through. New, however, in my experience was the currency, "Euros," whose present high rate against the dollar every U.S. citizen was (understandably!) complaining of. And then there was the new (to me), distant site for the show, such that one rode a line of the *U-Bahn* to its final end at the far eastern edge of the city, then went up a long walkway along one wall of a complex of buildings, reaching at last the show entrance at A6, only the first of three giant *Halle* which the show filled to bursting. The vastness of each of the halls, each one jammed throughout its floor space and lined everywhere on its walls with dealers' stands, confused

my directional sense (normally equal to that of a drunken hamster anyway), and I'll admit that at some point I added my memories of the old site to the nostalgia album.

But what a creative, flamboyant Show was thrown—has always been thrown—by Munich Show maestro Johannes Keilmann! This year the show theme was China (as it will be for Tucson in 2005), and inside a "Special Exhibit" area enclosed by a high red wall decorated with Chinese characters and hung with lanterns of corrugated red paper a wonderful diversity of Chinese displays was offered. Most prominent were the Chinese fossils, including a Tyrannosaurus skull and the complete body of a *Dilophosaurus wetherelli* (a raptor-like carnivore, was my impression), as well as numerous smaller creatures and partial creatures. Here also were about 15 tall cases full of fine Chinese mineral specimens put in by many collectors and institutions (and one case, put in by Michel Jouty, with carvings); a display of artworks in jade and of jade antiquities and grave goods, put in by the Natural History Museum of Vienna; more cases of ancient jade objects and artworks from the G. Peitcher collection; and, in the midst of it all, the world's largest boulder of raw nephrite, a 5,000-kilogram (that's over 5 tons) "specimen," found in the summer of 2001 in British Columbia, with several areas polished to show its internal, uniformly deep and rich, greenness. Behind this boulder, a green, serene mini-environment with garden, fountain, footbridge and waterfall spread itself for visitors to stroll through. This major *Sonderschau China*, in Halle A6, was echoed in A4 by a smaller, more contemplative space: a Feng Shui garden, "Heaven and Earth," with miniature trees, seated Buddhas, a fountain, a Chinese archway, two giant quartz crystal specimens, discrete signs explicating the meanings of the Eight Compass Directions, and, as a cobbled circle under one's feet, a Yin/Yang sign made of pebbles of blue sodalite and colorless quartz covered by a motionless pool of water. Incense fragrance pervaded the little garden, and photography was not allowed.

As the Munich Show has never settled for just one major theme, there were also several other display-attractions (not even counting the several fine cases on various themes put in by private collectors). Berlin's *Naturkundemuseum* showed old specimens and contemporary photos to document the famous journey of Alexander von Humboldt to Siberia in 1829. The National Museum of Scotland brought several large cases-full of outstanding specimens of classic Scottish and English minerals: Leadhills lanarkite, leadhillite and anglesite; Cornish bournonite; Cumbrian calcite; and zeolites from the Isle of Skye were among the standouts. Munich's own *Museum Reich der Kristalle* showed great old specimens, mostly Russian, from the collection of Maximilian, Duke of Leuchtenberg (1817–1852). The illustrious *Bergakademie Freiberg* showed three specimens which had posed for the sumptuous pictures in a new 2005 calendar of minerals from Upper Saxony. My favorite, though, of the extra-Chinese mineral displays occupied a whole alcove, including an Alpine hostel-style table where beer and snacks were continually served, in A4. Centered on a quartz crystal cluster 2 meters tall, this alcove featured a series of cases of specimens from the Alpine clefts of the Rauristal (Austria) and Ahrntal (Italy), including three astonishing milarite specimens (one of them was pictured in "Alpine Milarite," Sept.-Oct. 2004); there were also magnificent specimens of quartz, titanite, fluorapatite, hematite, etc., including some taken out very recently by members of a *Strahler* youth group from Rauris. Some of the group's members hovered about, and surely these teenaged collector/mountaineers were among the proudest and most fired-up people anywhere on the show floor.

The roster of What's New In Minerals is rather short this time (for such a vast and important show), but it does contain some enticing items. German mineral people are fond of using the word *träumig*, "dreamy," to describe mineral specimens—and so here are a few of the things which this year's dreams were made on.

Sometime early in 2004, Enrique Kucera (www.naturakucera.com) collected about a thousand very nice specimens of **amethyst** from the region of Alpine-like clefts in gray andesite which surrounds the settlement of Las Vigas, in Veracruz state, Mexico. This occurrence is hardly "new" but is certainly famous for having produced, over the decades, some of the world's most beautiful and distinctive amethyst specimens (see the article in the Mexico-III Issue, Nov.-Dec. 2003). It was somewhat startling to see so many fine specimens of this material in Munich: Kucera's wide stand glittered brilliantly with them, and specimens were for sale at a few other stands too, including that of *Lapis* magazine. In Kucera's specimens, ranging from thumbnail size to matrix plates 20 cm wide, the amethyst crystals are color-zoned (typically, very pale purple to almost colorless on the bottom 2/3 of the prisms, deep purple near the tips), and uniformly of very high luster; individual crystals, including a few scepters and a few with enhydros, reach 15 cm long.

Beginning in early 2001, Matthias Jurgeit (www.matsminerals.com) has been seriously, if intermittently, working a prospect pit in Durango, Mexico which produces what surely are some of the world's finest butterfly-twinned **calcite** crystals. When I first noted the specimens of this material which Herr Jurgeit had brought to the Denver 2001 show (Jan.-Feb. 2002, p. 86), the locality was called "Rodeo," but now it is known as Jose Maria Patoni (see March-April 2004, p. 149), or simply "Patoni," after the nearest village. New pockets hit in March 2004 and September 2004 yielded the several dozen outstanding specimens, ranging in size from thumbnails to 25-cm crystal clusters, which Herr Jurgeit brought to Munich. The calcite occurs as transparent, palest gray to colorless butterfly twins attached loosely in groups of two or three, and piled on matrix. As the crystals *are* loosely attached, and the matrix consists essentially of just more, highly friable calcite, specimens are to be handled with care lest they fall apart. But these are very fine calcite specimens, with a bright, yet soft, silky luster: an article on the occurrence will probably be forthcoming in a future Mexico Issue.

An impressive new discovery of jumbo **quartz** crystals from somewhere near Capelinha, Minas Gerais, Brazil, was being marketed by J. J. Abello of *Cailloux* (jjabello@aol.com). Unearthed in the summer of 2004, the quartz comes as "cathedral" crystals, with complexly stepped, highly lustrous faces, to 60 cm tall; moreover, some individual faces are cavernous "fensters," and there is splotchy color-zoning, so that some of the transparent crystal areas are colorless, some are pale smoky, and some are amethystine. The material is locally called "amethyst jaquaret," meaning "crocodile amethyst," since, the Brazilians fancy, the multiform surfaces suggest crocodile skins (to me they just suggested very large, lustrous quartz crystal faces, but then where is my imagination?). About 25 enormous specimens were available.

Late in September 2004, Alfred Kugler (Badnerstrasse 3, 3032 Eichgraben, Austria) collected about 300 extremely bright little specimens of **meta-autunite/uranocircite** at the Asuncão mine, Serra da Estrella, Portugal, and he was offering many of them in Munich. This is a pegmatite which has been quarried for feldspar and quartz for more than 25 years, but never before Herr Kugler's discovery have significant specimens showing uranium mineralization been known from the place. The crystals are tabular and very thin, and reach 1 cm across, though on specimens I saw they average only about 3 mm. However, they are extremely lustrous, and with vivid colors suggesting where each one is on the compositional zoning continuum: bright apple-green means that

meta-autunite predominates, whereas grass-green means uranocircite. The little crystals form bright drusy carpets on gray quartz matrix pieces mostly between 3 and 10 cm wide.

Elsewhere in Iberia . . . the Emilia mine at Caravia, Asturias, Spain is one of the many localities in northern Spain for **fluorite** specimens, and these may be large and dramatic, but I was intrigued by some smaller pieces collected over the past five years by Michael Grimmel (Gewerbeschulstr. 36, 42289 Wuppertal, Germany). Absolutely colorless and transparent, cubic crystals of fluorite reach 2 cm, and they form lustrous groups of all sizes, but most that I saw in Munich are thumbnails and miniatures. Some of the fluorite crystals have starkly black, shardlike inclusions of organic "bitumen" deep within, and some have microcrystals of cinnabar on their surfaces. **Calcite**, as lustrous orange scalenohedrons to 2 cm, and **barite**, as parallel groups of colorless and transparent blades to 3 cm, have also come recently from the Emilia mine.

A few interesting German mineral discoveries of recent months were on view at Munich—none of them in a league with the great old classic occurrences, naturally, but then what's more "classic" than the Ilfeld, Harz Mountains locality which, long ago, produced the world's finest manganite crystal groups? Well, in late 2003 and early 2004, some old mine dumps near Ilfeld yielded about 250 fairly handsome, small specimens of **hausmannite pseudomorphs after manganite**, as jet-black prismatic crystals to 3 cm shot through, or protruding from, massive manganese oxide matrix. The specimens vary in size from 2.5 to 10 cm, and vary in luster from dull to brilliant; a handful was being offered at Munich by Wolfgang Wendel (wendel.mineralien@t-online.de). According to Wolfgang, the collectors who were digging these interesting pseudomorph specimens were nabbed by "forest rangers" (*Forstmeistern*), and had to pay a large fine; the occurrence may now be considered exhausted anyway.

Marcus Grossmann (info@the-mineral-web.com) had a considerable stash of the "black" **fluorite** which occasionally is found in one or another old mine around Annaberg, Obersachsen, Germany; these particular specimens came in 2003–2004 from a dump of the 10,000 Ritter Schacht (Ten Thousand Knights shaft) near the town of Frohnau, which is near the larger town of Annaberg. Sharp, lustrous fluorite cubes to 3 cm on edge occur in clusters to 15 cm; some surfaces are decorated with tiny white dolomite crystals and others carry small yellow barite crystals. The fluorite, of course, is not really black, but a very deep purple, the crystals having grown on a substrate of massive yellow fluorite. Especially when strongly backlit, this is highly attractive material.

Many dozens more specimens of deep purple and/or yellow fluorite from Frohnau joined hundreds of small specimens of dozens of species from many German localities old and new at the stand of Jörg Walther and Antje Heuer's *Sächsische Minerale* (ahe75@freenet.de) in A4. Here I had fun poking through flat after flat of (admittedly) modest specimens from famous eastern German places, and in the glass showcase was something considerably less modest: very fine miniature clusters of leafy to tabular, bright yellow-green crystals of **meta-autunite/uranocircite** from the Streuberg quarry, Bergen, Vogtland. These specimens are, at their best, of world-class quality for the species (competitive with the better known examples from Brazil and from the Daybreak mine in Washington). I had thought that discoveries at the Streuberg quarry had ceased forever sometime in the 1970's but, according to Jörg, about 50 very good new specimens were found four years ago in the quarry, as floater (*schwimmer*) groups in a clay layer. The biggest of the bright yellow-green crystal clusters to have come from the new find is 15 cm across.

Dr. Petr Zajicek was one of those lucky Czechs who, in 1979, helped recover and export the now very famous specimens of **dyscrasite** from Příbram, Bohemia, Czech Republic (then Czechoslovakia). More than two *tons* of specimens were unearthed from uranium workings in the old mines, but, as they represent easily the finest dyscrasite ever found anywhere, they were quickly snapped up by collectors, and are now hard to find. At Munich this year, Zajicek offered about 100 outstanding specimens of all sizes, saying that this stash, held back until now, would almost certainly be the last significant one to reach the market. The metallic gray or grayish white dyscrasite crystals are elongated and flattened—splintery-looking—and rise in jumbles from massive gray native arsenic matrix; in a few specimens they emerge from massive white calcite. Addressing the longstanding question of how to distinguish the dyscrasite from the silver pseudomorphs after dyscrasite, Petr said that the crystals with duller luster are silver pseudomorphs, and that these had been found enclosed in calcite; the crystals with brighter metallic luster are dyscrasite, and had been enclosed in arsenic (the latter is removed by soakings in H_2O_2 solution). Together with a few specimens of spongy **native silver** from Příbram, this spectacular array of dyscrasite specimens (the largest is a cluster measuring 35 cm across and sporting 5-cm crystals) rested incongruously among trilobites and amethyst geode sections at the stand of Zajicek's *Top Geo* (topgeo.gmbh@t-online.de).

Some nice new items found just weeks before the show in the polymetallic ore deposits of the Maramures district, Romania, were brought to Munich by René Triebl of *Top Minerals* (rene.triebel@chello.at). First, René's stand was littered with delicate specimens of **barite** from the place we have been calling the Turt mine, in the Satu Mare region: actually "Turt" is not the name of a mine but of a village; the productive mines there are the Socea, Penigher and Ghezuri mines, all lying within a few kilometers of Turt. The barite occurs as colorless, lustrous, transparent, very thin, bladed crystals in parallel growth, forming rounded, "picket fence" aggregates, from 3 to 10 cm across, perched lightly on sparkling medium-brown, fragile shells of **siderite** epimorphs (casts) after rhombohedral crystals of calcite and/or dolomite. And then, from the famous Boldut mine, Maramures, have very recently come a good number of lustrous groups of **milky quartz** in glassy white "pineapple" compound crystals to 25 cm high, in specimens from about 30 cm to almost 3 *meters* across; some of these great groups are enlivened by dustings of pyrite, chalcopyrite, and marcasite microcrystals.

In his most recent report from the Ste.-Marie-aux-Mines show, Bill Larson mentioned in passing some new, pretty, "feathery groups" of **acanthite** crystals recently found at the Imiter mine, near Tinghir, Morocco (also productive lately of some modest-but-promising wire silver and proustite specimens). At Munich I learned from Jean François Astier of *Astier Mineraux* (36D, rue des Vingt Toises, 38950 Saint-Martin-Le-Vinoux, France) that there has been, so far, only one small acanthite pocket hit in the mine, and that in February-March 2004 it yielded about 100 thumbnails, maybe 50 of which were on hand at Munich. Medium-gray, spiky acanthite crystals to 1 cm long and possessed of fairly bright metallic luster occur clustered in branching groups to 3.5 cm, none with matrix; the best of the specimens were priced at only €75.

A couple of other new Moroccan things were to be seen with one of the people you'd most expect: longtime Morroco hand Horst Burkard of *Burkard Mineralien & Fossilien* (burkardhorst@aol.com). From outcrops in the Imilchil area of the High Atlas Mountains, very bright, pistachio-green rosettes and bundles of **epidote** crystals are found, resting on a pale gray-green matrix containing much massive epidote and some magnetite; individually the bundles reach only a centimeter or so, but they cluster attractively in

upwelling groups on thumbnail and miniature specimens, and densely cover matrix to form glistening, colorful pieces to 15 cm wide. Also, a fluorite deposit near the town of Taourirt is now turning out very pretty, transparent, pale to deep purple, simple cubic crystals of **fluorite** to 2 cm on edge, in clusters to 12 cm.

Taking a break now from common species, consider a one-of-a-kind, indubitably-world's-best specimen of a very rare species, which Rob Lavinsky (doing the Munich Show for the first time) was proudly showing around: a loose, nearly complete, 3-cm crystal of **villiaumite** found very recently in the Aris Phonolite in Namibia. Unlike villiaumite crystals from the alkaline intrusives at Mont Saint-Hilaire and the Kola Peninsula of Russia, this crystal is (1) very large, and most certainly not a cleavage fragment, (2) rounded, equant, and morphologically complex, not a simple cube, and (3) deep *orange*, not maroon. Moreover, it is lustrous and totally transparent; indeed, according to Rob, a few other pieces from the discovery were sold as gem rough (!) by unnamed dealers. By all means, let us be watchful for more such villiaumite crystals from this exotic locality.

At Munich this year, Madagascar played a prominent role among mineral-rich countries which regularly produce new discoveries. First up are the fine new **calcite** specimens which have been being gathered for the past two years at Sambara, near Antsiranama in northern Madagascar; these were being sold in Munich by Laurent Thomas of *Polychrom France Sarl* (polychromfrance @aol.com). The highly lustrous, transparent, pale yellow-orange rhombohedral calcite crystals are multiply twinned and are vaguely tetrahedron-shaped or (in intergrowths) star-shaped, and they reach 12 cm across. Some crystal faces are coated by lustrous white druses of stilbite, with occasional stilbite blades to 5 mm. The locality is said to be a basalt flow, and there are also microcrystals of laumontite and apophyllite on a few specimens. These very unusual, vivacious calcite clusters range in size from 3 to 20 cm.

Laurent also had a couple of flats of specimens from a new find of blue **spinel** at Beronomo, Tulear Province, southern Madagascar. Lustrous, partially gemmy, deep blue (some are purplish blue) spinel crystals are here found as loose singles and clusters, and also in a scapolite-diopside-mica matrix, and, most surprisingly, the crystals are not octahedrons but dodecahedrons, a few of them ideally formed, most of them somewhat distorted. The best single crystal I saw was a simple, sharp, rich blue dodecahedron 3.5 cm in diameter.

And Lino Caserini (linocase@tin.it) had a tall case full of specimens of some truly elite Madagascar material, including a handful of wonderful miniature-size matrix specimens showing sharp, hexagonal-tabular, glowing pink crystals to 1.5 cm of the newly described **pezzottaite** (see Sept.-Oct. 2004), and equally luscious-looking, lustrous raspberry-red to purplish **corundum** in sharp hexagonal barrels to 4 cm in dark biotite schist matrix chunks to 12 cm, from Amborohy. Also mightily impressive were Lino's chowdery matrix specimens in which very sharp, lustrous, pale yellow dodecahedral crystals of a **rhodizite-like mineral** are half embedded. Lino explains that since this material has tested extremely high in rubidium, it may in fact be neither rhodizite nor londonite but a new species. Dr. Federico Pezzotta is now at work on the material, first found near Tetezantsio in July 2004.

Of the exciting and relatively new items on hand at Munich (I did mention the first few that were seen earlier at the Denver Show), probably the most widely distributed among the dealerships was the terrific new **brookite** from the Kharan district, Baluchistan, Pakistan. Pregi Gemmi, François Lietard, Marcus Budil, Marcus Grossmann and several Pakistanis were among the dealers who offered specimens by the dozens—and at all these stands there were many truly superlative pieces. The first (known) discovery of fine brookite in Pakistan took place about five years ago in Wana, Waziristan, where the crystals were found with the well-known faden quartz of the area; however, Kharan, Baluchistan is an Alpine-type cleft occurrence quite far away, and the first finds here date only to March 2004. The brookite crystals are very thin, wedge-terminated blades which reach 7 cm long, and they are very dark brown through root-beer-brown through reddish brown (resembling hübnerite), and quite gorgeously transparent, many of them showing black lines or black hourglass shapes as inclusions, like brookites from many a Swiss and Austrian cleft. Some specimens are loose, thumbnail-size blades and flaring clusters of blades, but the most dramatic are miniature to cabinet-size matrix pieces, with brookite crystals standing up singly and in forests of sharp blades on groups of quartz crystals (some of the quartz is chloritoid and greenish); respectable anatase and fluorapatite crystals are also to be espied on a very few of these specimens.

In the sumptuous booth of *Weerth Edelsteine & Mineralien* (Hochfeldstr. 37, D-83684 Tegernsee, Germany), affable Andreas Weerth toured me through his fine spread of specimens found recently at Zagi Mountain, Northwest Frontier Province, Pakistan (see the article in May-June 2004). Besides the predictably excellent **bastnäsite** crystals, there were lustrous black, platy **ilmenite** crystals to 6 cm; sharp, dark brown, incomplete tetrahedral crystals of **genthelvite** to 3 cm on edge; fine **rutile** as toenail-size, brilliant twins; and even a thumbnail crystal of the exceedingly rare **baotite** almost the equal, I'd say, of the one pictured in the article on Zagi Mountain. Not through yet, Andreas also showed me some quite spectacular **epidote** specimens found a year ago at Alchuri, Shigar Valley, with lustrous terminated prisms to 15 cm long, and some nice groups of pale **amethyst** in crystals to 10 cm from the same discovery. And he had elongated, mottled blue-white, somewhat distorted **corundum** crystals to 12 cm in gneissic matrix from a brand-new occurrence in the Pamir Mountains, on the Tajikistan-Afghanistan border.

Lastly from Pakistan, Zarmast Khan of *Azhar Gems & Minerals* (azhargems@yahoo.com) had a small handful of wondrously sharp, lustrous, dazzling trapezohedral crystals of **almandine-spessartine** newly taken from a pegmatite somewhere in the Shigar Valley. The garnet crystals reach 2.5 cm, and what makes them special (besides their lush red-brown color and sheer perfection of form) is that they rest on, or are girdled by, subhedral crystals of silvery muscovite.

Not for the first time, it was the dealership of *Miner K* (minerk@club-internet.fr) which had the most interesting specimens (and the biggest assortment of faceted gems) from the Mogok, Myanmar (Burma) gem fields. At this stand, Patrick de Koenigswarter showed me a glittering handful of the new gemmy, pale yellow to colorless, cyclically twinned **phenakite** prisms from Momeik—I reported on these from the Denver 2004 show but saw no others than Patrick's in Munich (so, hey, I figured I'd buy one: an excellent thumbnail crystal for €85). And quite brand-new, Patrick said, from the region are the pristine little crystals of colorless **beryl** found last summer at Sakahangyi, near Mogok: jewel-like, transparent, loose hexagonal prisms to 2.5 cm. About 50 of these crystals have been collected so far, and about 15 made it to Munich.

We come at last to China, theme-country of this show, of the Tucson Experience to come in 2005, and of the *Mineralogical Record*'s Special Issue which you now hold. By now it's a given that fine specimens of Chinese fluorite, calcite, barite, cinnabar, sphalerite, spessartine, etc., etc. are richly populating the mineral market, and that great tonnages of these are being brought out by Chinese as well as western dealers. Such was again the case in Munich, so I will confine my ravings here to one particularly elite, rare item, and one newly discovered Great Pocket.

The elite thing is the exotic Cu-Zn-Fe-Sn sulfide **këesterite**, unknown to all but "species" collectors until recently, when very sharp, green-filmed macrocrystals, at first called "pandaite," were found in the mine workings on Mount Xuebaoding, Sichuan. At Munich, Jordi Fabre informed me that about 50 very fine këesterite specimens were found in the Xuebaoding mines in 2003, and Jordi had about ten of them at the show: blocky, striated, intricate-looking crystals to 2 cm in loose thumbnail groups uniformly tinted pale green by coatings of mushistonite. On Dan Weinrich's website (three days after the show) I also find that there exist newly mined specimens whereon tight clusters of këesterite crystals to several cm across rest appealingly on matrix of beryl and muscovite crystals, in a few cases with cassiterite.

Stefan Stolte of *Mineralien-Fossilien-Galerie* (Min.Foss.Gal @web.de) offered six large (averaging 15 x 20 cm), spectacular specimens whereon tight clusters of tabular pink calcite crystals host delicate, free-standing sprays of very thin acicular crystals of **stibnite**, with individual sprays reaching 7 cm. A few hundred such specimens in all were found, Stefan said, last summer at the Nandan mine, Guangxi; there was some thought at first that the brilliant metallic black crystals might be bismuthinite, but Guanghua Liu assures us that they are stibnite. Hence we have a new entry on the growing list of distinctive Chinese stibnite occurrences.

Showgoers were dazzled by the contents of a new **stibnite** pocket hit in March 2004 at the Wuning (Wuling) mine, Guangxi. An article on this mine appeared in the March-April 2002 issue, describing some imagination-bending crystal groups that had been taken out late in 2000 and marketed by *Collector's Edge* the following year. Around ten specimens measuring perhaps 50 cm x 1 meter came from the March 2004 pocket, along with about 200 more of large cabinet to "museum" size; the largest individual stibnite crystals in the new lot reach about two and a half feet long, and most of the crystals are well terminated, too, in the characteristic chisel shape shown in the pictures in the 2002 article. Fifty percent of the specimens from the new pocket were found coated with an alteration product and had to be cleaned, and consequently they are not as brilliantly lustrous as the others—but 15 of the best of those "others" reposed at the Munich stand of the man who bought the whole pocket: Marcus Budil of *Fine Minerals International* (marcus@fine-minerals.com). Off to one side, Marcus displayed a solo specimen which I, like all the other tourists, stood back a meter or so and photographed: it is a flashing cluster-of-swords affair about the size and volume of my 36-inch-screen television.

I know it's a Great Show when I seriously worry about having left out, i.e. simply not seen, major numbers of major mineral discoveries, and getting feedback of the "why on earth didn't you mention . . .?" kind—and so matters stand now. But we can always catch up in Tucson, *nicht wahr*?

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Newsletter Editor
Andrew Sicree, Penn State University, 122 Steidle Building, University Park, PA 16802
Tel: 814-867-6263 or 814-865-6427
E-mail: sicree@geosc.psu.edu

National Organization Website: http://www.friendsofmineralogy.org

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The Friends of Mineralogy (FM), formed at Tucson, Arizona on February 13, 1970, operates on a national level and also through regional chapters. It is open to membership by all. FM's objectives are to promote, support, protect and expand the collection of mineral specimens and to further the recognition of the scientific, economic and aesthetic value of minerals and collecting mineral specimens.

FM has a long association with *The Mineralogical Record.* It helps produce locality indexes for specimen mineral localities published in *Rocks and Minerals,* and is co-sponsor, with the Tucson Gem & Mineral Society (TGMS) and the Mineralogical Society of America (MSA), of the annual Tucson Mineralogical Symposia. Among its activities it also sponsors awards for best articles each calendar year in *The Mineralogical Record, Rocks & Minerals* and *extraLapis English* and gives special recognition at the February Tucson Gem and Mineral Show for educational displays that help explain an aspect of mineralogy.

The Friends of Mineralogy is affiliated with the *American Geological Institute* and the *Mineralogical Society of America,* as well as with *Rocks & Minerals* and *The Mineralogical Record.* Both of these magazines provide FM space and publish news of its activities from time-to-time. FM in turn supports these magazines in various endeavors.

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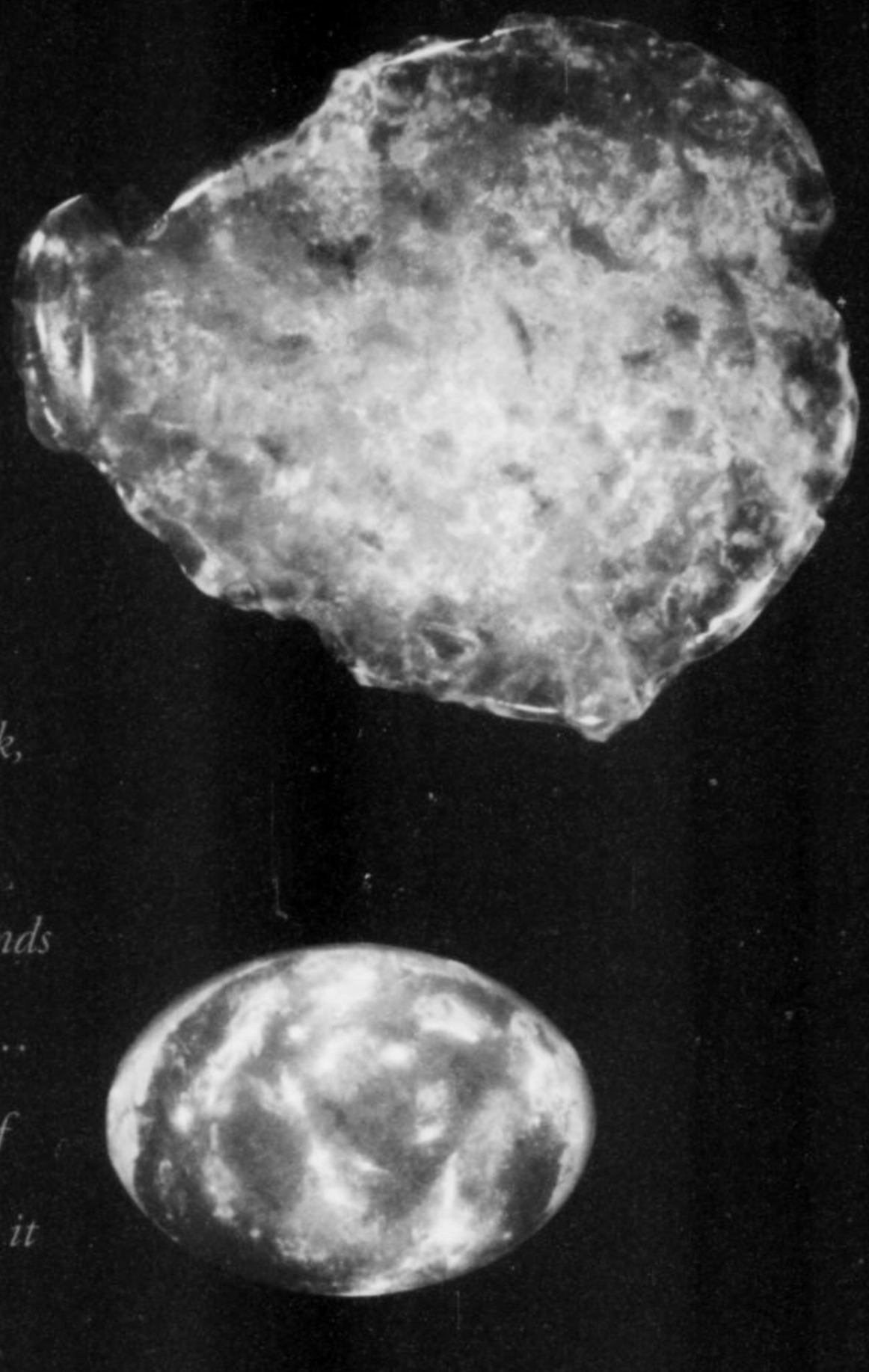

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– G.F. Kunz in Mexico

Mexican Opal

Photo: Harold & Erica Van Pelt