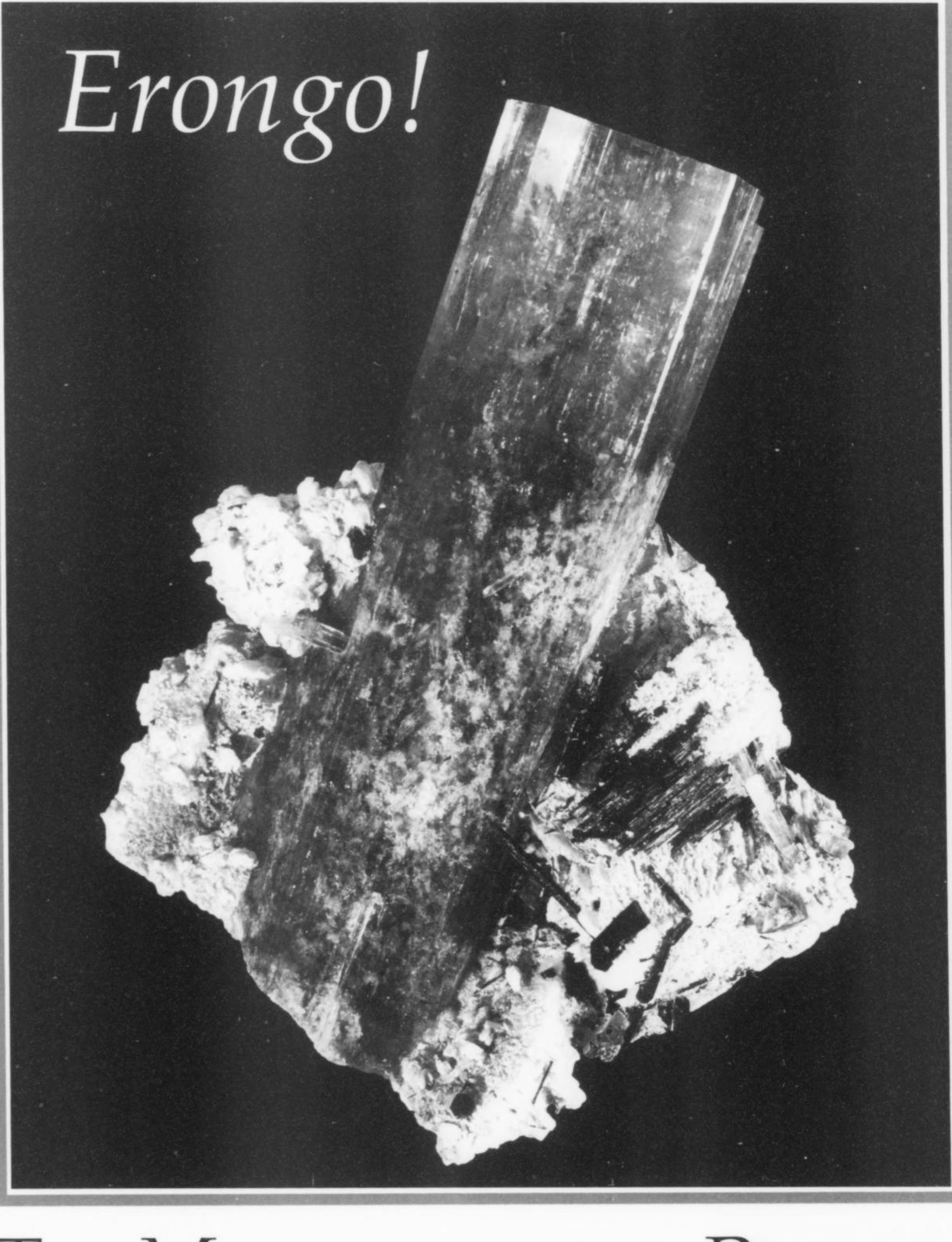

THE MINERALOGICAL RECORD

SEPTEMBER–OCTOBER 2006 VOLUME 37 NUMBER 5 $22


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THE MINERALOGICAL RECORD

September–October 2006 Volume Thirty-seven, Number Five

Articles

Columns

COVER: AQUAMARINE BERYL crystal, 9.5 cm, with schorl and feldspar, from the Erongo Mountains, Namibia. Desmond Sacco collection; Bruce Cairncross photo.

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Notes from the EDITORS

Thanks to Uli Bahmann . . .

We owe special thanks in this issue to Uli Bahmann, coauthor of the comprehensive article on the mineralogical treasures of the Erongo Mountains in Namibia. Uli's financial support made possible the inclusion of 342 figures—far more than we could normally have afforded to publish. Thanks to Uli's generosity, readers get to see an unprecedented selection of specimens from this interesting group of localities.

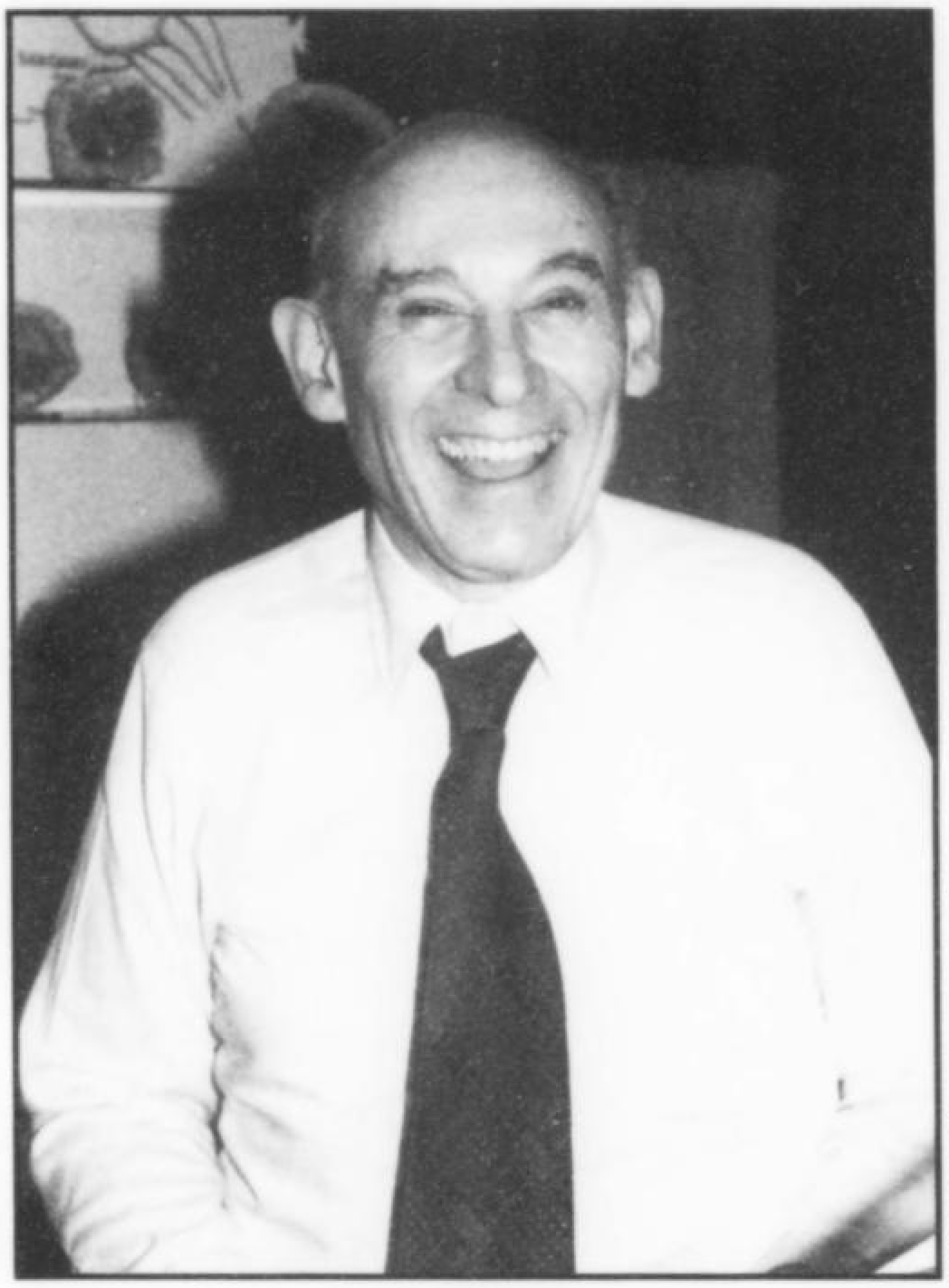
Died, Gilbert Gauthier, 81

Gilbert Joseph Gauthier was born December 24, 1924, in Belgium and trained as a geological engineer. He received strong mineralogical instruction while he was a student at the Catholic University of Louvain, Belgium. His primary mineralogical teacher was Jacques Thoreau (1886–1971), but he was also well acquainted with Henri Buttgenbach (1874–1964) and others of the older generation. (He did receive his certificate in gemology from the British Gemological Association about 20 years ago.) He began his career as a teacher at the University of Liége, but soon discovered that he could earn a better living as a mining geologist with the then robust mining company, Union Minére du Haut Katanga (UMHK). He worked as a drilling engineer and an overseer of drilling at sites throughout Katanga, including an important assignment at the Shinkolobwe uranium mine. His supervisor was Johannes Vaes (1902–1978).

Gilbert had been a mineral collector since an early age, but Katanga was a paradise for mineral collecting, especially if your work kept you close to the mine's working face. The technical staff of the UMHK lived in compounds apart from the miners and residents, but the close association meant that Gilbert was in close contact with the company's geologists, and few among them who were not also mineral collectors. (Gilbert, a particularly fastidious record keeper, kept in touch with his UMHK colleagues and over the years purchased nearly every one of their mineral collections, or at least sold many pieces for them on consignment.)

By the mid-1950's, Gilbert's collection had grown to the point that he decided to make vacation journeys to other great African mining districts including those in Southern Rhodesia (Zimbabwe) and Tsumeb, Southwest Africa (Namibia). He had a mini-van-like truck loaded with minerals and he traded Katanga minerals with everyone that he could. His extensive travels allowed him to become friends with a large population of mineral collectors, many of whom returned to Europe and continued their mineral collecting specialties. By the late 1950's, Gilbert became a consulting drilling authority and worked primarily with oil exploration and frequently worked for the United Nations, mostly in Africa's emerging oil fields. Gilbert never really retired from geological consulting and his field experiences continued well into the 1980's, although he was frequently an advising geologist rather than a working geologist.

Gilbert became a mineral dealer partly to sell some of his duplicate specimens, and he also acquired many duplicates from collections he bought to increase his collection. One of his earliest American collection sales was to Herman Bodson, of Ohio, a deal that took 35 years to complete. Gilbert was actively trading with



Gilbert J. Gauthier (1924–2006)

European museums in the late 1950's and he developed a specialty of dealing in antique specimens which thrilled his friends and customers.

To say that Gilbert was jovial is to diminish the word. Nelly Bariand said you could always find Gilbert at a show; you just had to follow the laughter. He was not particularly a joke teller, but he loved plays on words and was adept at "joking" in six or seven languages. Gilbert first turned up as a dealer at Tucson in the 1970's; he literally had hundreds of flats of antique mineral specimens, mostly stacked in cubic closest packing under his tables and there would always be a small army of enthusiastic shoppers sitting in lotus-like contortions trying to find some rarity from Elba, Iveland, or Ytterby.

Gilbert's stock was phenomenal. At one time, he simultaneously had storage sheds of minerals at Denver, Tucson, Rochester, and Pasadena. His European stashes can only be imagined. Collectors would always smile, particularly when they offered a credit card to pay for their purchases: "Oh no", he'd reply, "I am not a dealer, I am a collector." Often collectors would try to have a specimen shipped to them, but they also got the same reply: "I am not a dealer." As a collector, he was the most international dealer there has ever been. In the U.S., he traveled to shows in Tucson, Denver, Pasadena, Costa Mesa, Houston, Rochester, Franklin, Springfield, Detroit, and other cities. He was also a regular at the Tokyo Show in his later years. There is probably no European show, excepting small ones with very few dealers, where he had not sold minerals at least once.

Because Gilbert's booth was so full of really unusual specimens, collectors usually scampered over to see him as soon as a show opened. Likewise, dealers would hunt him down at the hotels where he stayed and demanded to be the "first" to see his stock and, for many years, many major dealers *were* the first at each show. However, each visitor was the first to see part of his stock. David New would see offerings in his own specialty or Wayne Leicht would see something in his, and Herb Obodda, again, a third selection, and so on. In the early 1990's, when he showed up at Denver with his fabulous cuprites from the Mashamba West mine, Gilbert only hinted to a few people of his treasures, and when his tiny cubicle finally opened for business, it proved to contain a dazzling array of cuprites.

Because Gilbert thoroughly loved people, he did make a special effort to find a treasure, sometimes only from a hint dropped years before, that would be first offered to a special person, and frequently these acts of thoughtfulness would make a dozen people happy at a particular show. The requests may have been made for relatively modest specimens, a rare book, or a fine cuprosklodowskite or torbernite. Of course, part of Gilbert's fame lay with his near monopoly on uranium minerals. Gilbert was able to purchase nearly every uranium mineral collection of essentially every UMHK geologist, as they were virtually all Belgian (as was Gilbert). Because of the pervasive French conversations at his booth, many naive visitors would comment on his being French, but he was usually quick to retort, "I am not French, I am Belgian." Recognizing this as the same trait as that of a famous character, Hercule Poirot, a detective of the popular fiction writer Agatha Christie, Tom Moore christened Gilbert "the Poirot of mineralogy."

Gilbert was particularly careful about his mineral identifications and was very generous to academic mineralogists who would need research samples of rare minerals. Gilbert recognized that they would be happy to return information on the very expensive minerals he would give to them and his interest in research led to the naming of a number of new species. Several species new to science, still unnamed, were provided by Gilbert to his friend, mineralogist Gene Foord. Gene had intended to name a new mineral in Gilbert's honor, but his research was cut short when he died in 1998, at the age of 51. Gilbert enjoyed particularly good relations with uranium specialist Michel Deliens, and there was hardly a major mineralogist who did not seek his advice about certain rare species they required.

With regard to price, one must acknowledge that he was not shy about "fully" pricing a specimen, but the specimens would actually sell for the price tag he assigned. He had little respect for dealers who had an advertised price and then the discount price: "They are not serious," he would complain. Nonetheless, particularly in recent years, he'd sometimes volunteer a 10% incentive. He would be generous to geology students, however, and they might get a particularly good deal if he recognized the spark of a love for minerals as they fretted among their peers about how they might leverage the purchase of a treasure.

Gilbert was also a gourmet. The mineral business was business and he would try to break even on any international trip, but that was frequently difficult when every evening of the show included an extended visit to a quality restaurant with friends. The wine bill alone was almost always of staggering proportions with $100 per person often achieved in a good night. Californian white wines were a favorite, although he did enjoy a few New York whites he'd discovered on tours through the Finger Lakes. Sometimes dealer and collector friends would try to bring an example of a wine from their local area as a treat, but quite often the gesture would be discovered to be a poor, "undrinkable" table wine frequently shared with less discriminating miners. When in a new town, he'd quickly ferret out the best restaurant with the best wine list and would make repeated visits, as there would be little likelihood of finding a second restaurant of such high caliber.

Gilbert was the exception to the rule: "Never ask a thin person where to eat." He was tall, about 6 feet, and relatively slender; hardly anyone can remember when he had a full head of hair. His charm was truly magnetic, always classically polite, and with boundless energy. Of course, he was not fatuous and he did not suffer fools easily, but he was never the first to be rude if the situation arose and his strength of character made him a formidable trading or selling partner, and a discussion that became an argument might become an event you could sell a ticket to. His notebooks, full of meticulously calligraphed messages, contact information, details of negotiations, etc., were certainly marvels of the diarist's arts. He insisted on using a fountain pen, when the ballpoint had nearly rendered it extinct by 40 years. He had no interest in computers, although it is a little known fact that he finally acquired a fax machine early in the 21st century.

One of Gilbert's tiny quirks included his spending an inordinate amount of time trying to find the absolutely perfect box for a specimen. When Gilbert prepared for a show, when he worked at Dick Bideaux's offices or at home, he would be surrounded, waist deep in his supply of what Dick called "the world's largest collection of odd-sized boxes."

In the 1960's, Gilbert and his wife invested in rare and high-quality antiques and Little Masters (paintings). His advisor was also a friend and they purchased seventeenth and eighteenth century fine furniture, Sèvre porcelain, etc. at favorable market prices, although they enjoyed them so much they never sold them. Gilbert's personal mineral collection was rather small and was kept in an equally small antique French glass cabinet. His collection in the last years of his life was down to only a few dozen specimens, so he really did sell from his collection at shows.

Gilbert died June 23, 2006. His life-long wife, Germaine, predeceased him, but he is survived by a sister and two sons, Axel and Cedric, now physicians in France, who several times in their youth served as his assistants at the Tucson Show. Such a rich lifetime and such a rich personality are difficult to capture in just a few pages. He was well-loved and the indelible impression of his personality will continue in living memory for a long time to come.

Vandall T. King

Biographies Added to the Label Archive

www.MineralogicalRecord.com

Harold Arndt
Peter Bancroft
Florian Cajori
Jean-Pierre Cand
Frederick Canfield
Allan Caplan
Fred W. Cassirer
Steven C. Chamberlain
Lawrence H. Conklin
Mahlon Dickerson
Martin Ehrmann
Russell Filer
John Frankenfield
Richard V. Gaines
Gilbert Gauthier
Cal Graeber
E. Mitchell Gunnell
Friedrich Kohl
Richard Kosnar
William Larson
Luis Leite
Harold D. Levey
Walt Lidstrom
Jesse "Jay" Lininger
Athos Locatelli
Tom Loomis
Orlando Lyman
Arthur Montgomery
Thomas P. Moore
George W. Robinson
Washington A. Roebling
Eugene Schlepp
St. Ignatius College
Edward Swoboda
Brad van Scriver (and family)
Herbert W. Werner
Robert W. Werner
John S. White
David P. Wilber
Joseph Willcox


Tourmaline on Quartz, 5.5 inches, from Santa Rosa, Minas Gerais, Brazil. Jeff Scovil Photo.

Famous Mineral Localities:

The ERONGO MOUNTAINS NAMIBIA

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Minerals have been collected in the Erongo Mountains of Namibia for nearly 90 years, culminating in the 1999 discovery of some of the finest Namibian aquamarine, schorl and jeremejevite ever seen. Other aesthetic species have also been recovered, including fluorite, quartz, goethite pseudomorphs after siderite, and other important species such as cassiterite, ferberite, metanováčekite, uranophane and metazeunerite. Erongo is also the type locality for brabantite, described in 1980.

INTRODUCTION

The 21st century began very well for Namibian minerals. From 1999 to 2006, some of the finest Namibian aquamarine, schorl and jeremejevite ever seen were collected in the Erongo Mountains, together with aesthetic fluorite, quartz, goethite pseudomorphs after siderite, and other important species such as cassiterite, ferberite and metazeunerite. These minerals made major impacts in the southern African collecting scene and at international mineral shows (Johnston, 2002; Gentry *et al.*, 2004). But this bounty was merely the culmination of almost 90 years of collecting in and around the Erongo Mountains; the first production of mineral

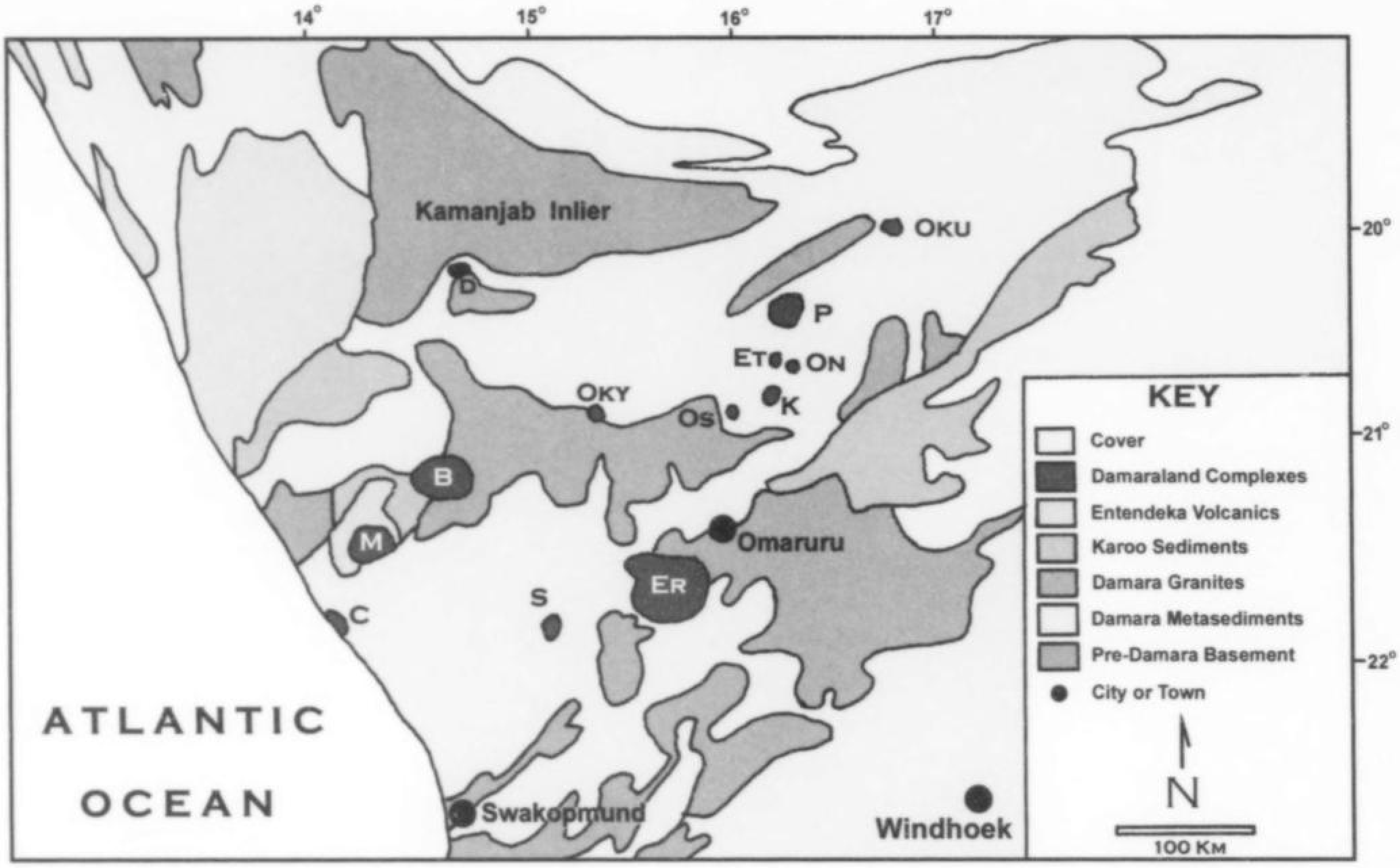


Figure 1. **Locality map showing the Erongo Mountains in central Namibia and other igneous complexes of similar age. "Er" = Erongo. Other well-known Namibian mineral-producing igneous complexes are, Brandberg ("B"), Okorusu ("Oku"), and Spitzkoppe ("S"); from Trumbull *et al.* (2000).**

There is a detailed 1:250,000 topographic map (Omaruru sheet 2114) of the Erongo Mountains, and the southwestern portion shows the locations of the various farms, defunct mines, mountain peaks, rivers and other physiographic features mentioned in this article. On-line satellite imagery of the Erongo Mountains is also freely available; in addition to Google Earth, NASA has excellent quality downloadable images of the region.

specimens from Erongo dates back to the early 20th century. The mineralogical future looks bright for this region, because there are still vast tracts of mountainous terrain that have yet to be explored—though exploration may be difficult in some areas, as much of the land is privately owned.

LOCATION AND ACCESS

The Erongo Mountains are a prominent semicircular terrain 30 kilometers in diameter, located in Damaraland, Erongo Province, Namibia, approximately 20 km north of Usakos and 25 km northwest of Karibib. The climate is semi-arid, with thornveld vegetation and an average annual rainfall of 100–200 mm per year (Mendelsohn *et al.*, 2003). The humidity ranges between 40% and 50% in the rainy season and 10% to 20% during the winter months. Although the mountains are close to the Namib Desert, the average annual temperature is a relatively constant 20 to 22° C, with minimums of 8 to 10° C and maximums of 32 to 36° C (Mendelsohn *et al.*, 2003). The highest peak, Hohenstein, is 2,319 meters above sea level and looms over the southwest section of the mountains, where most minerals are collected.

Road access to the peripheral parts of the Erongo Mountains is relatively easy. A dirt road runs around the entire circumference of the mountains, and specimens can be bought from the locals at Tubussis village in the northwest. Hiking trips into the mountains are more strenuous: it is advisable to bring water and some food, good hiking boots and a hat. However, much of the Erongo Mountains is either privately owned land or forms part of the Erongo Mountain Nature Conservancy. Mineral rights are state-owned in Namibia and prospecting permits must be obtained from the necessary authorities in Windhoek.

HISTORY

Cloos (1911) provided one of the earliest descriptions of the physiography and geology of the Erongo Mountains, as well as detailed descriptions of the rocks, accompanied by numerous field sketches and by the first published black and white photographs of the mountains. Eight years later the same author published the region's first geological map (Cloos, 1919). Meanwhile, the economic geology of the surrounding pegmatites was described by Wagner (1916). Wagner's map already shows economic tin workings at Ameib 60 and Davib Ost 61, on the southwestern periphery of the mountains. By 1928, there were several more working tin mines in this area, as indicated on map sheet 79, Karibib, South West Africa (Frommurze *et al.*, 1942).

A search of the mineral collection of the Natural History Museum in London revealed some Erongo Mountains specimens from the early 20th century. One is a cassiterite collected in 1915 and presented to the museum by Percy C. Tarbutt. The crudely formed specimen weighs 8.16 kg (18 pounds) and comes from the farm Davib (spelled "Dawib" on the label). It would be expected that similar historical specimens are in some museums in Germany, considering that the country was under German control at the time.

From the 1960's through the 1980's, a trickle of specimens came from Erongo. For example, the Desmond Sacco collection has a large half-"bowtie" schorl acquired in the late 1960's; the Natural History Museum in London has a plumbogummite from Krantzberg, purchased from well-known collector-dealer Charles Key in 1985; and one of us (BC) has a thumbnail schorl on granite matrix purchased in 1981 from *Carlton Gems & Minerals* in Johannesburg. Notwithstanding early discoveries like these, the heyday for Erongo came at the end of the 20th century. Gebhard (2002) provides an

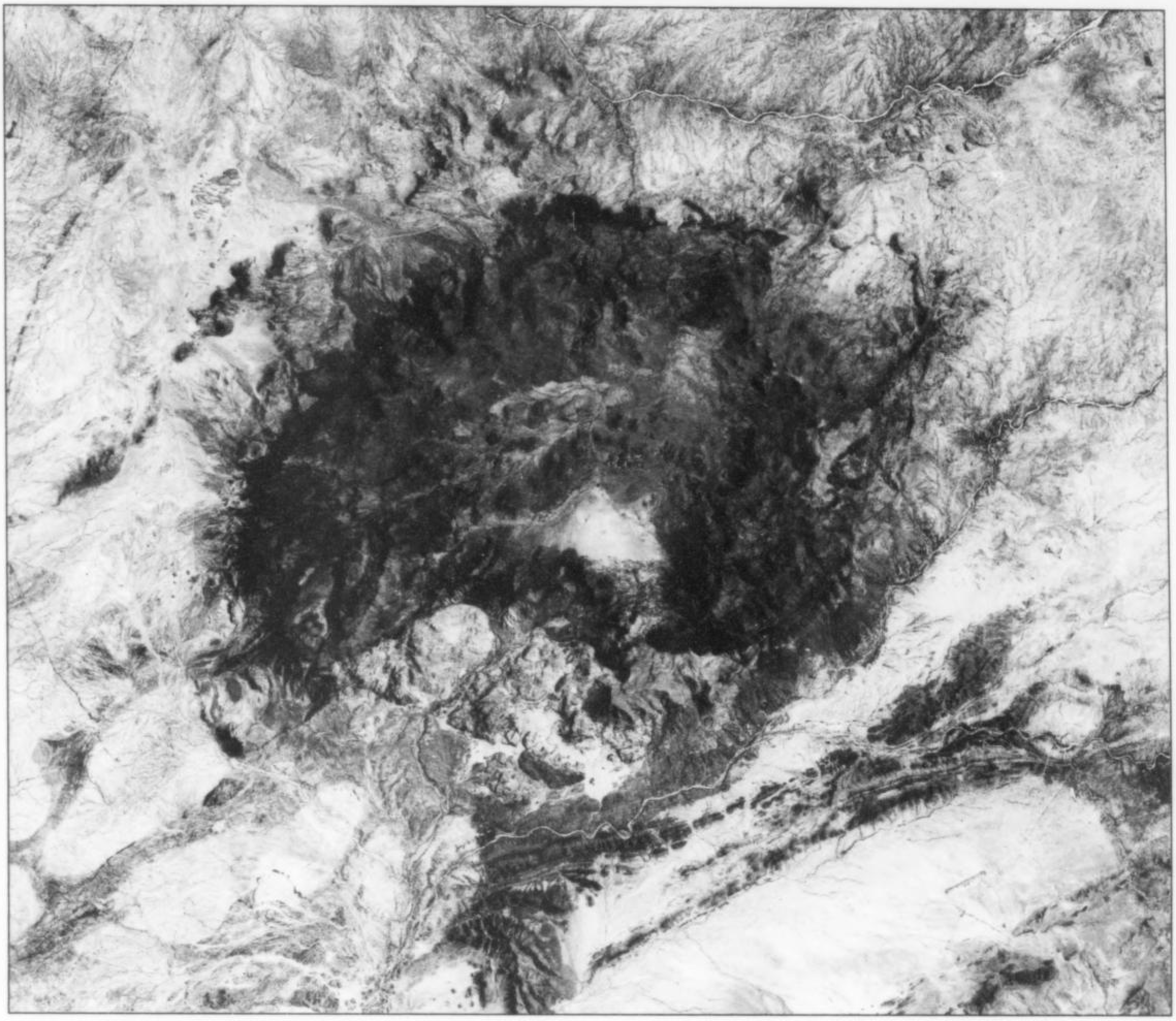


Figure 2. **Satellite image of the Erongo Mountains, seen as a dark green circular structure. The Omaruru River is clearly visible to the north and the Kahn River to the south. The Etiro River flows into the Khan River from the northeast. Krantzberg Mountain stands out as the brown peak to the northeast. The thin, black circular line to the west and north is the eruptive cone sheet (see geology section for details). Source: https://zulu.ssc.nasa.gov/mrsid/**

interesting overview for the period between late 1999 and 2001, and his records, together with information from our own collections, are briefly summarized in Table 1.

One of Erongo's most important mineralogical events occurred in April 2000 with the discovery of the first major pocket of aquamarine on the farm Bergsig 167 (Jahn, 2000; Jahn and Bahmann, 2000; Cairncross, 2001; Johnston, 2002). As a result of this "Easter Pocket" event, there was an intense resurgence in informal diggers' exploiting the mountains for mineral specimens (see the "What's new in minerals" column of the *Mineralogical Record*, November-December 1999, p. 471; January-February 2000, p. 99; March-April 2000, p. 193–194). For several weeks thereafter, more aquamarine was collected; some of the crystals are associated with schorl, fluorescent lime-green hyalite and complexly twinned orthoclase crystals displaying Carlsbad, Baveno and Manebach twins. The schorl is highly lustrous and commonly shows complex habits and terminations.

Pseudomorphs of goethite after siderite appeared later in 2000, associated with small struvite and/or ilmenorutile and pyrolusite crystals. In November 2000, one pocket yielded an interlocking network of pale blue beryl crystals, and some matrix specimens measure over 1 meter. In 2001, yellow beryl, gemmy monazite and Japan-law twinned quartz were added to the list of desirable collector's items from Erongo. In April-May of that year, schorl crystals up to 20 cm long in groups to 50 cm, the crystals displaying perfect trigonal symmetry, were collected. In March 2001, jeremejevite crystals were collected *in situ* and from weathered alluvium. Since then, sporadic discoveries of more aquamarine, schorl, quartz, siderite and some micromount material have been made. During mid-2005, beautiful emerald-green fluorite on white orthoclase was collected, adding to the growing list of aesthetic specimens. In January 2006, stalactitic fluorite, vermiform schorl and stellate groups of opaque white beryl were collected for the first time. In April-May 2006, more jeremejevite was discovered.

GEOLOGY

Three large alkaline igneous provinces are recognized in Namibia, and the Erongo Mountains are part of one of these, namely the Mesozoic-age Damaraland Alkaline Province (Pirajno, 1994). The other two are the Lüderitz Alkaline Province, of roughly the same

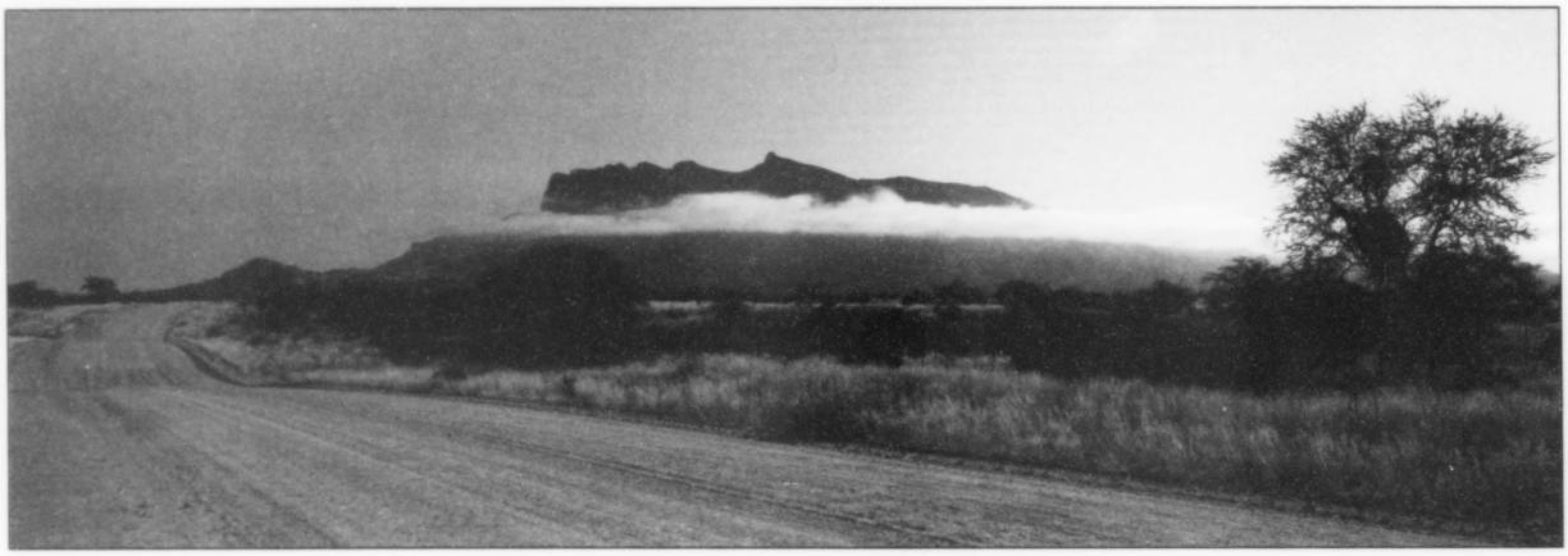


Figure 3. **A view of the southwestern section of the Erongo Mountains, seen from the Usakos-Tubussis road. The mountains are shrouded in early morning mist; Bruce Cairncross photo.**

age as the Damaraland Province, and the Kaboos-Bremen Province, approximately 550 million years old (Pirajno, 1990), located in southern Namibia and extending across the Orange River into South Africa. The rocks of the Mesozoic-age provinces contain economic deposits of hydrothermal tin-tungsten-fluorine and rare-earth element and niobium mineralization (Gevers and Frommurze, 1930; Haughton *et al.*, 1939; Frommurze *et al.*, 1942; Gevers, 1969; Pirajno and Jacob, 1987; Pirajno, 1994).

Mineral collectors usually refer to the Erongo as a "granite" mountain, but there are, apart from granite, several different rock types. Geologists who have researched the region refer lithostratigraphically to the Erongo Volcanic Complex (Pirajno, 1990). Geological interest in the rocks and mineral deposits of the Erongo dates back to the time, over 90 years ago, when the territory was controlled by Germany. During this time, two comprehensive publications (Cloos, 1911 and 1919) provided descriptions, diagrams and maps of the Erongo Mountains and the surrounding geological terrain. A more recent geological investigation of the Erongo was published by Blümel *et al.* (1979), and the most comprehensive overview of the geology is that of Pirajno (1990).

Table 1. **Chronology of some significant discoveries at Erongo (Data from U. Bahmann collection and Gebhard, 2002).**

Date	*Description*
February-March 1999	First major pocket of schorl and large topaz crystals
May 1999	Schorl pocket with trigonal "Mercedes Benz" terminations
September 1999	First major pocket of green beryl
October 1999	"Cauliflower" schorl with siderite
November 1999	Quartz scepters
April 2000 (Easter)	First major aquamarine pocket of approx. 250–300 highgrade specimens
May 2000	Schorl, foitite and monazite-(Ce)
August 2000	First discovery of fluorapatite and first large pocket of colorless beryl
October 2000	Associations of quartz, fluorite and dolomite
November 2000	Network of interlocking aquamarines
January-February 2001	"Garnet-like," pseudo-isometric schorl
March 2001	Jeremejevites
May 2001	Yellow-green beryl, monazite and Japan-law twinned quartz
June 2001	Second discovery of yellow beryl and cassiterite
September 2001	Aquamarine "cotton-reel" habit and large siderite crystals
August 2002	Discovery of zinnwaldite crystals and ilmenite
May-June 2003	Cassiterite
July 2003	Pocket of hydroxyl-herderite
August 2003	Pseudomorphs of quartz after orthoclase and third major pocket of yellow beryl
September 2003	Metazeunerite, metanováčeckite and associated uranium species
October 2003	Gold
July 2004	Second pocket of cassiterite
August 2004	Goethite aggregates
July 2005	Major fluorite discovery associated with white orthoclase
August 2005	Another pocket of colorless beryl
January-February 2006	Stalactitic fluorite; orange-zoned beryl; stellate colorless beryl; vermiform schorl; elongate, twinned orthoclase, galena
April-May 2006	Jeremejevite

Figure 4. **Portion of the 1:250,000** ***Omaruru*** **topographic sheet showing the Erongo Mountains and various topographic features and farm names referred to in this article.**

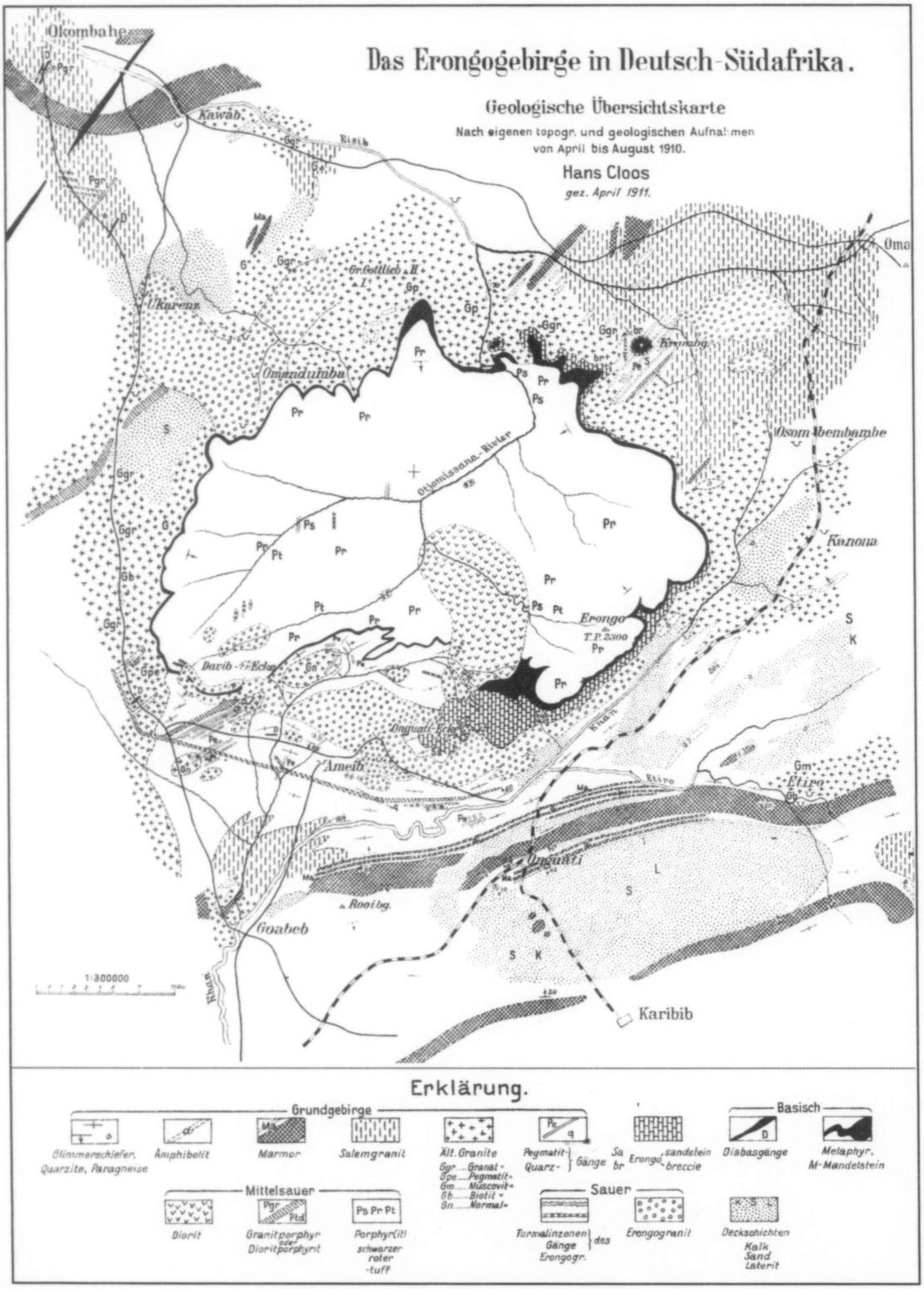


Figure 5. **The first geological map, dated 1911, of the Erongo Mountains, published in the early part of the 20th Century. Compare this with the satellite image in Figure 2. From Cloos (1911).**

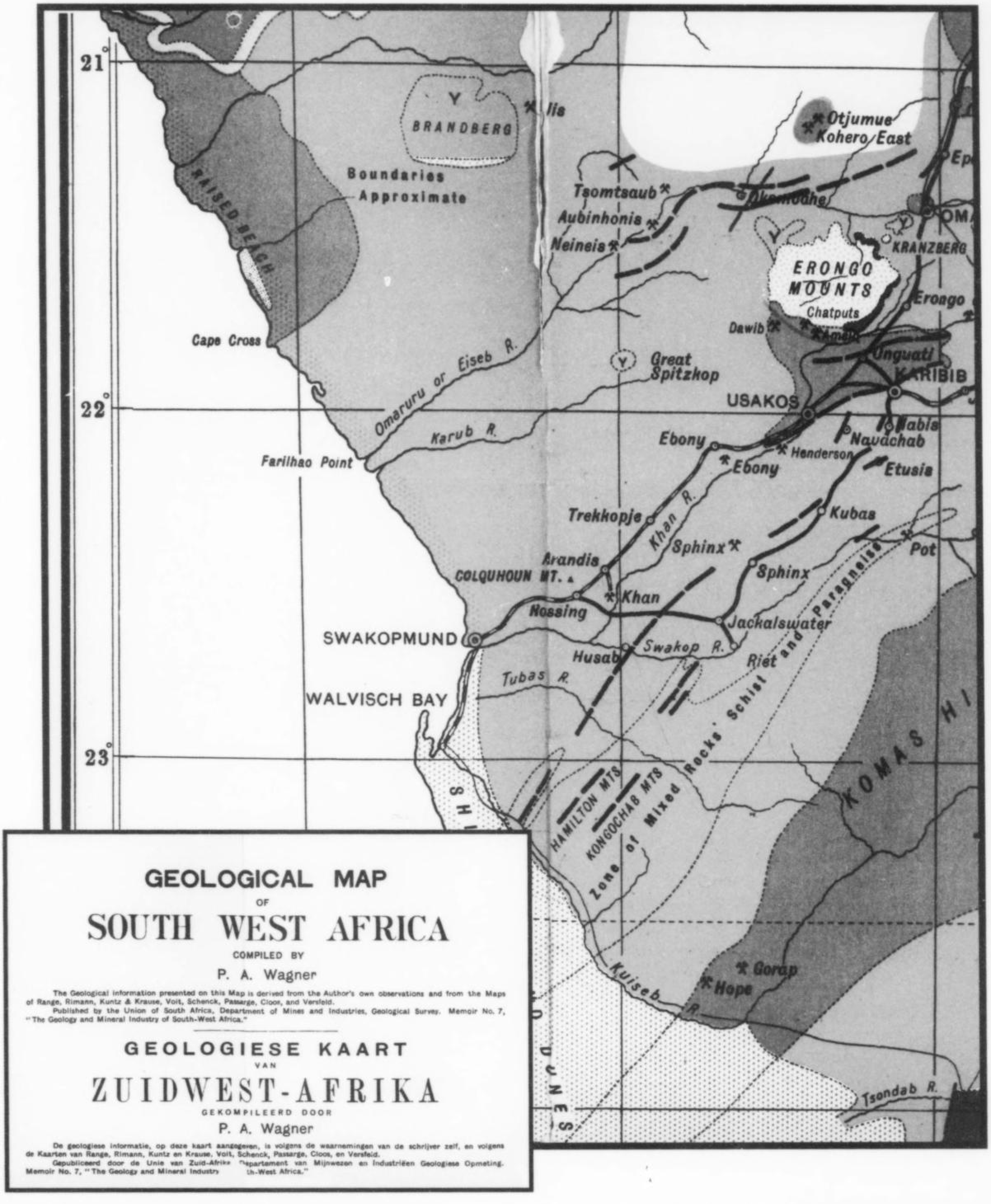


Figure 6. **Part of Wagner's (1916) Namibian geological map, showing the Erongo Mountains. Note the presence of tin mines at Dawib, Ameib and Chatputs, southwest of the mountains.**

The Erongo Mountains are a mixture of extrusive volcanic rocks (mafic and felsic lavas) and intrusive plutonic rocks (granites). The rock sequence formed during several geological events (Pirajno, 1990). An initial extrusive basalt phase was followed by an extrusion of felsic volcanic material (termed the Erongorus Event by Pirajno, 1990) in the form of ash flows interbedded with basalts. This sequence was intruded by granodiorite while at the same time rhyodacitic ignimbrites were emplaced from a centrally located volcanic vent (this is termed the Ombu Event). The third and final phase was characterized by further eruptions of pyroclastic material, forming layers which were later intruded by lamprophyric dikes and mafic plugs, and the emplacement of the Erongo Granite:

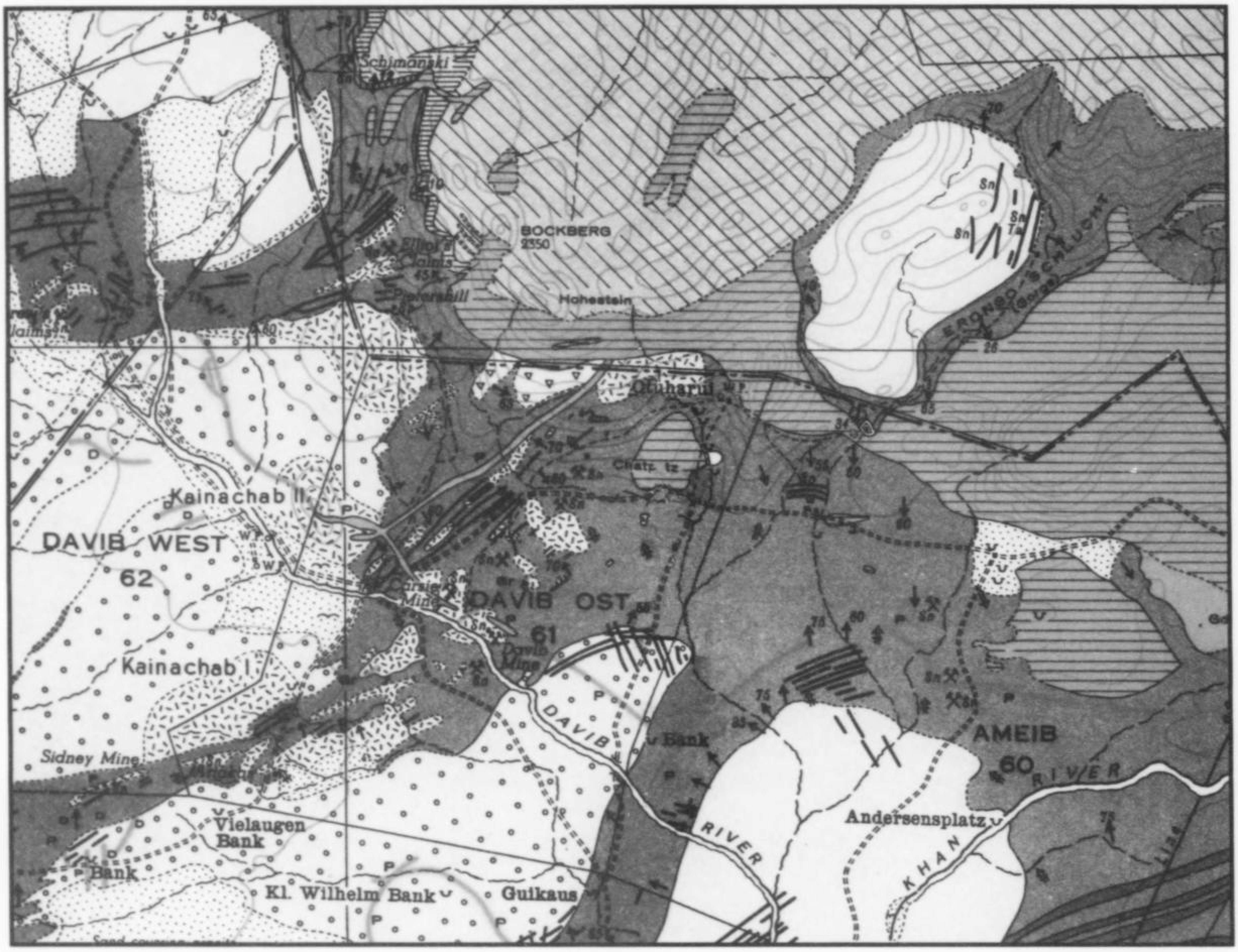


***Figure 7.* Part of geological map Sheet 79—*Karibib, South West Africa*, surveyed in 1928 by H. F. Frommurze and T. W. Gevers, revised by P. J. Rossouw in 1937, and printed in 1942 to accompany Frommurze *et al.* (1942). The map shows the mines operating at that time, as described in this article. Most are tin-bearing pegmatites in the foothills of the Erongo Mountains.**

an A-type (anhydrous, anorogenic, alkaline) granite (Collins *et al.*, 1982), enriched in boron and fluorine (Pirajno and Schlögl, 1987). The emplacement of the Erongo Granite was an important metallogenic event. It provided the heat and chemical components for alkali and boron metasomatism, for greisenization (as at Krantzberg), and for mineralization in the roof of the granite intrusion and in the surrounding country rocks. Pirajno *et al.* (2000) refer to the resulting crystal pockets as "nests":

> A prominent and important feature of the Erongo granite is the presence of quartz-tourmaline nests up to 30 cm diameter. They are disseminated throughout, but are locally extremely abundant and may coalesce, especially in the roof zones of the granite stocks. The nests have a leucocratic reaction halo containing quartz and K-feldspar with no biotite. In these nests, tourmaline and quartz have either replaced the feldspar and biotite of the original granitic mineral assemblage, or fill open spaces. In addition to tourmaline and quartz, the nests also contain accessory amounts of fluorite, apatite, topaz, and cassiterite, with relict feldspar and biotite. Tourmaline veins, breccias, and dyke-like bodies as well as more pervasive tourmaline replacements are widespread in all rocks around the Erongo granite up to several hundred meters from its contacts, both vertically and horizontally.

The Erongo Volcanic Complex consists mainly of a central caldera, 30 km in diameter, composed of ash-flow tuffs overlying mafic basalts. The entire Erongo Volcanic Complex, including the olivine gabbro cone-sheet of its outer rim, measures 48 km east to west. Following caldera subsidence, the volcano was intruded by several plutons, including the Erongo Granite, which forms a ring-shaped dike-like body. The intruding granite took advantage of structurally weak zones around the periphery of the caldera (Schlögl, 1984). Recent U-Pb dating of zircons and step-heating of $^{40}Ar/^{39}Ar$ alkali feldspars indicate an eruption age of 132–135 Ma for the Complex (Pirajno *et al.*, 2000).

It is the Erongo Granite *per se* that hosts tungsten, fluorine, tin and beryllium mineralization, some low-grade uranium mineralization, and gold (Hirsch and Genis, 1992; Roesener and Schreuder, 1992). Also, the granite hosts the miarolitic cavities that have produced the collectible aquamarine, schorl and other interesting minerals. However, there are satellite pegmatites on the fringe of the Erongo Granite to the west, southwest and southeast which are also mineralized (Frommurze *et al.*, 1942)—see Table 2. These pegmatites are hosted by country-rock schist, not by the granite; some intrude into the metasedimentary rocks and granitoids. The pegmatites are stanniferous, and their genesis is related to the

Table 2. **Erongo Mountains Deposits and Associated Pegmatites.**

Pegmatite–Mine	*Farm Name*	*Economic Minerals*	*Accessory–Secondary Minerals*	*References*
Sandamap	Sandamap North 115	Cassiterite; ferrotantalite	Dark green elbaite; schorl; triplite; K-feldspar as large, euhedral crystals	Frommurze *et al.* (1942); Diehl (1992a); Gevers and Frommurze (1930).
Cameroon pegmatite	Goabeb 63	Cassiterite-equivalent to Sandamap	Schorl; triplite	Diehl (1992a)
Sidney pegmatite	Davib West 62 and northern boundary with Goabeb 63	Cassiterite; lepidolite	Schorl; grossular garnet; "huge feldspar crystals"; triplite	Frommurze *et al.* (1942); Diehl (1992a)
Borna pegmatite	Davib Ost 61	Cassiterite	Albite; schorl; triplite	Frommurze *et al.* (1942)
Carsie pegmatite	Davib Ost 61	Cassiterite; ferberite; columbite (Fe?); ferrotantalite; monazite; molybdenite	Muscovite as "large books"; schorl of "tremendous size"; nontronite	Frommurze *et al.* (1942)
Davib mine	Davib Ost 61	Cassiterite; ferrotantalite; ferberite; amblygonite; lepidolite	Schorl; green elbaite	Frommurze *et al.* (1942)
Tubussis pegmatites	Tubussis 22	Gem green andradite garnet	Aquamarine, diopside, calcite, epidote, magnesio-axinite, prehnite, quartz, vesuvianite	Grolig (2005); Niedermayr (2000)
Ameib pegmatites (several)	Ameib 60	Cassiterite	Large K-feldspar crystals; apple-green fluorapatite	Frommurze *et al.* (1942); Wagner (1916)
Drews pegmatite	Kudubis 19	Cassiterite (up to 50 kg aggregates)	Schorl; muscovite; triplite	Frommurze *et al.* (1942); Gevers and Frommurze (1930)
Brabant (also known as Erongo Schlucht, Van der Made pegmatite)	Brabant 68	Cassiterite; lepidolite; ferrotantalite	Schorl; zinnwaldite; garnet; fluorapatite; muscovite; pink albite in vugs; purple fluorite in vugs	Frommurze *et al.* (1942)
Pietershill	Erongorus 166	Cassiterite; ferrotantalite	Schorl; blue-black tourmaline	Frommurze *et al.* (1942)
Elliot claims	Erongorus 166	Cassiterite	Schorl; triplite; andradite; spessartine	Frommurze *et al.* (1942)
Schimanski's claims	Erongorus 166	Cassiterite	Schorl; andradite	Frommurze *et al.* (1942)
Wendroth's workings	Erongorus 166	Cassiterite	Muscovite; hematite nodules; schorl; dark-green elbaite	Frommurze *et al.* (1942)
Krantzberg (not the tungsten mine in the northwest)	Kranzberg 59 and Onguati 52	Cassiterite	Schorl; blue elbaite on Onguati 52	Frommurze *et al.* (1942)
Riverplaats	Riverplaats 97	Cassiterite	Brown, green pink, blue tourmaline; garnet	Frommurze *et al.* (1942)
Etiro pegmatite	Etiro 50	Beryl, muscovite, columbite-tantalite, K-feldspar, bismuth	Topaz, brazilianite, eosphorite	Miller (1969)
Kanona–Erongo workings	Erongo West 83 and Kanona West 84	Cassiterite (2.5 cm crystals) in southwest portion of Erongo West 83)	Schorl; garnet	Frommurze *et al.* (1942)
Krantzberg	Pistelwitz 128 and Omaruru Townlands 85	Ferberite; cassiterite	Fluorite; beryl (aquamarine); schorl	Frommurze *et al.* (1942); Schlögl (1984)
Giftkuppe	Boundary between Erongo Ost 82 and Kanona Ost 81	Rutile—in drusy fissures, lined with quartz, albite and Cr-muscovite. Rutile crystals up to 20 cm	Schorl; muscovite; K-feldspar; pyrite; pyrrhotite; chalcopyrite; marcasite	Frommurze *et al.* (1942)

Figure 8. **Typical granite outcrop on the farm Ameib 60. Photo by L. T. Nel, in Frommurze *et al*. (1942).**

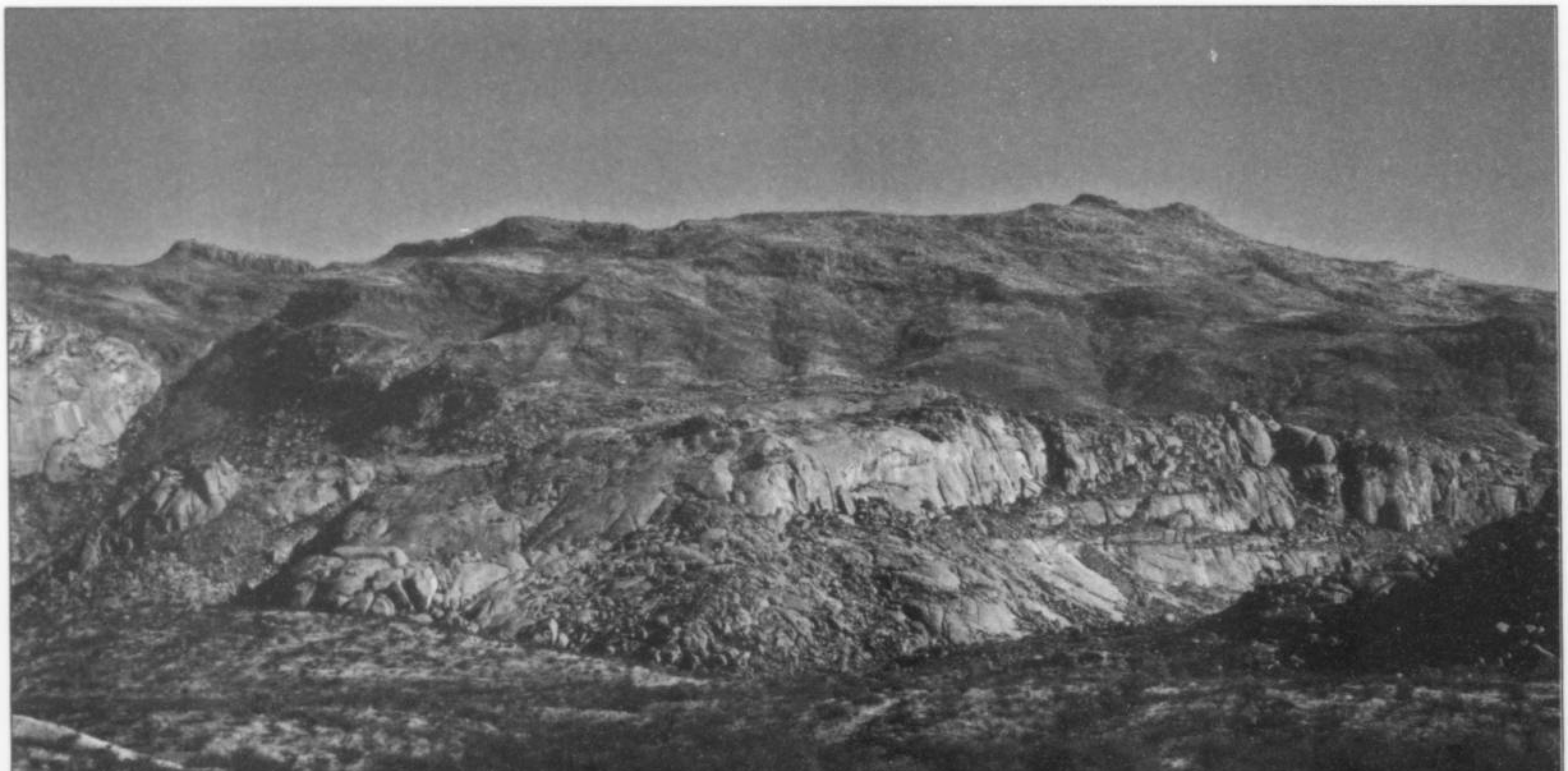
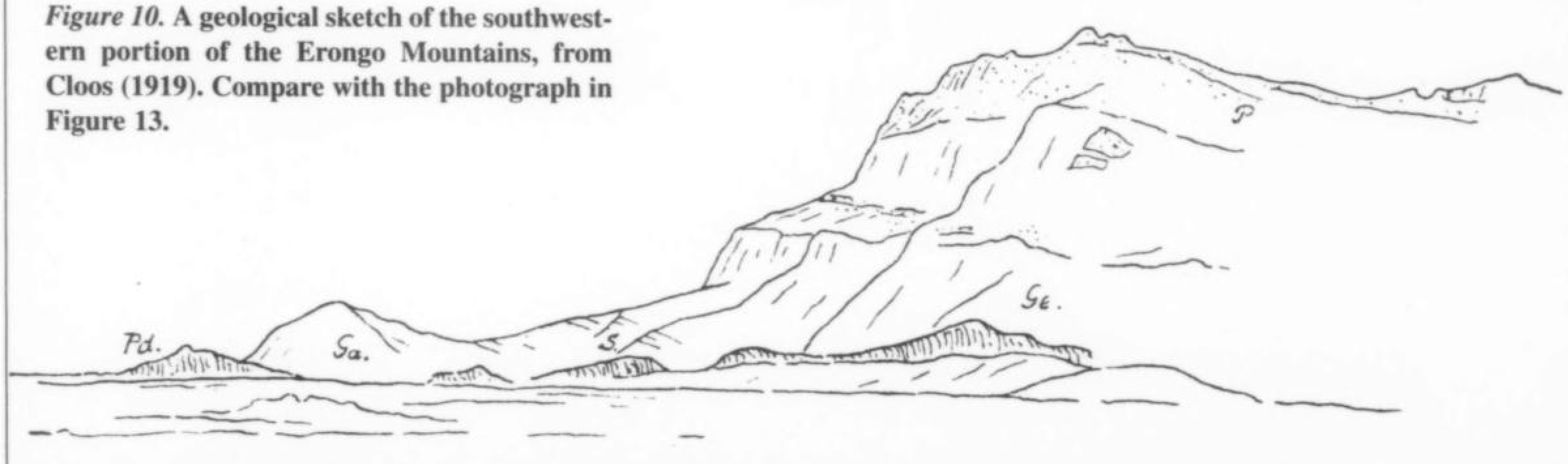


Figure 9. **A view of the Erongo Mountains on Ameib 60, looking northwest. The granite slope in the middle distance produced cassiterite specimens and jeremejevite. The Erongo Schlucht runs in front of this hill. Bruce Cairncross photo, August 2005.**

Figure 10. A geological sketch of the southwestern portion of the Erongo Mountains, from Cloos (1919). Compare with the photograph in Figure 13.



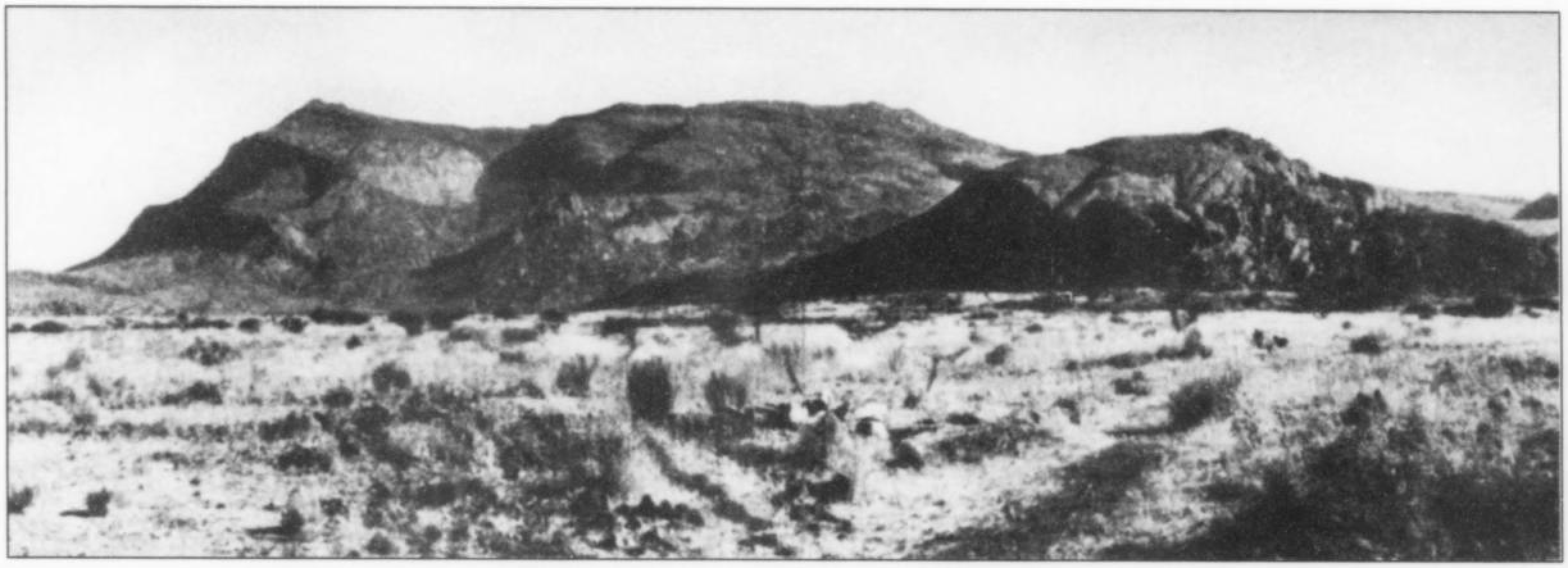


Figure 11. **A view looking north, at the southwestern part of the Erongo Mountains. The highest peak, Hohenstein, is on the left. Photo by P. J. Rossouw, in Frommurze *et al.* (1942).**

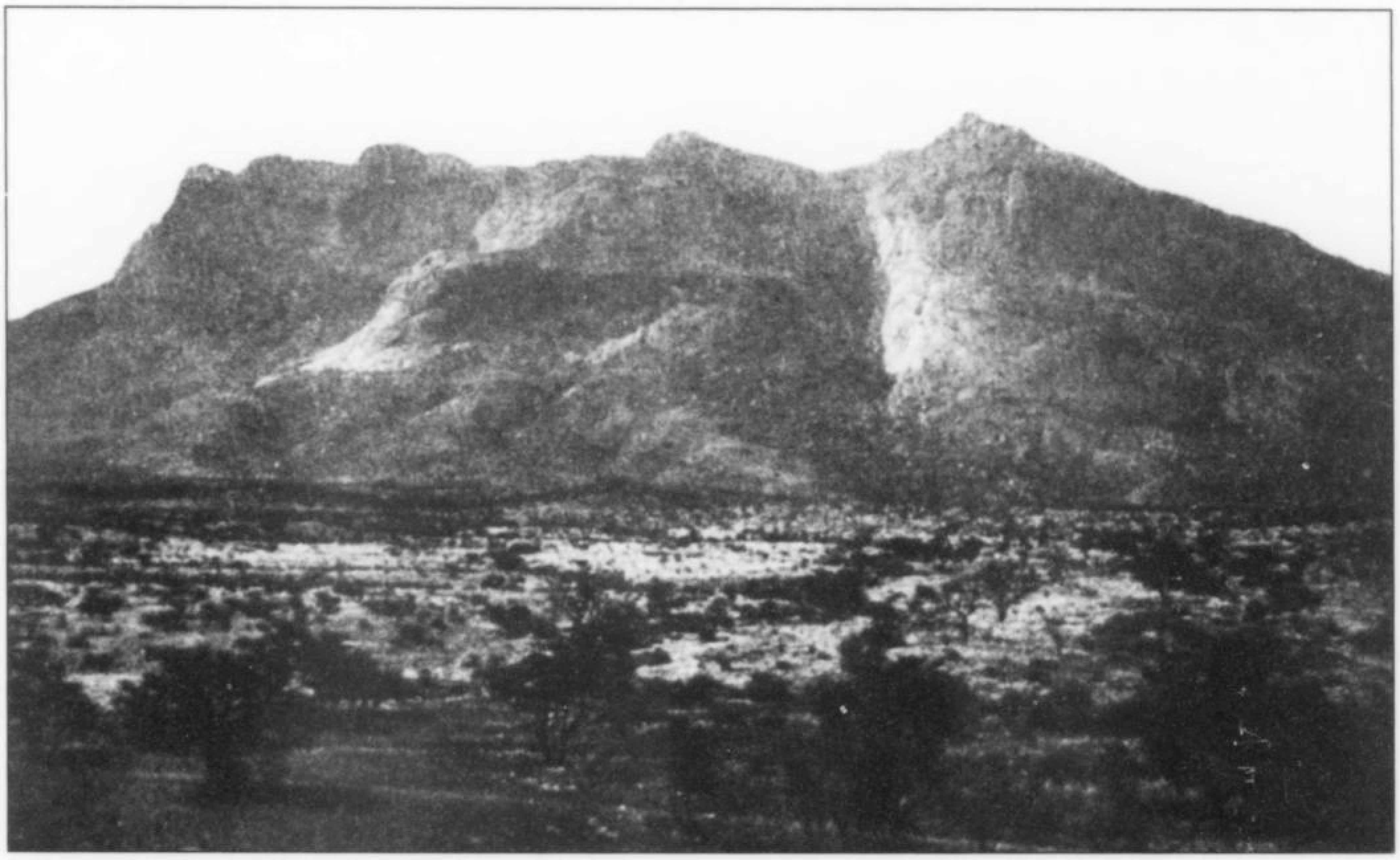


Figure 12. **A view of Hohenstein (peak on the right), looking towards the east. The gorge on the right side, whose rock face is exposed in the sunlight, is one of the localities that has produced specimens. From Cloos (1919).**

Figure 13. West-facing slope of the Erongo Mountains on the farm Bergsig 167. The rubble-strewn gorge provides access to the slopes on the right where miarolitic cavities have yielded minerals in recent years. Hohenstein, the highest peak, is in the center of the picture. Bruce Cairncross photo, August 2005.

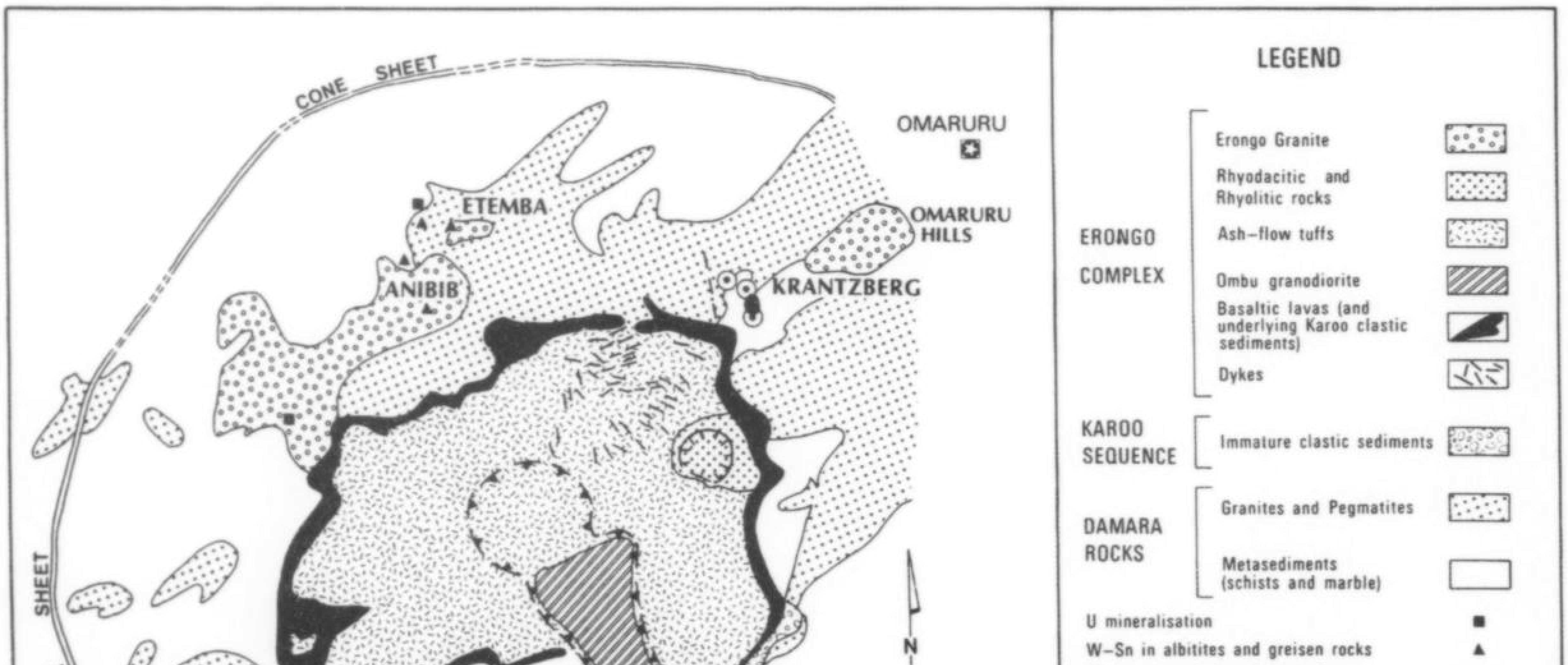


Figure 14. Simplified geology of the Erongo Mountains. Some of the economic tin-tungsten-uranium deposits are indicated. From Pirajno and Schlögl (1987).

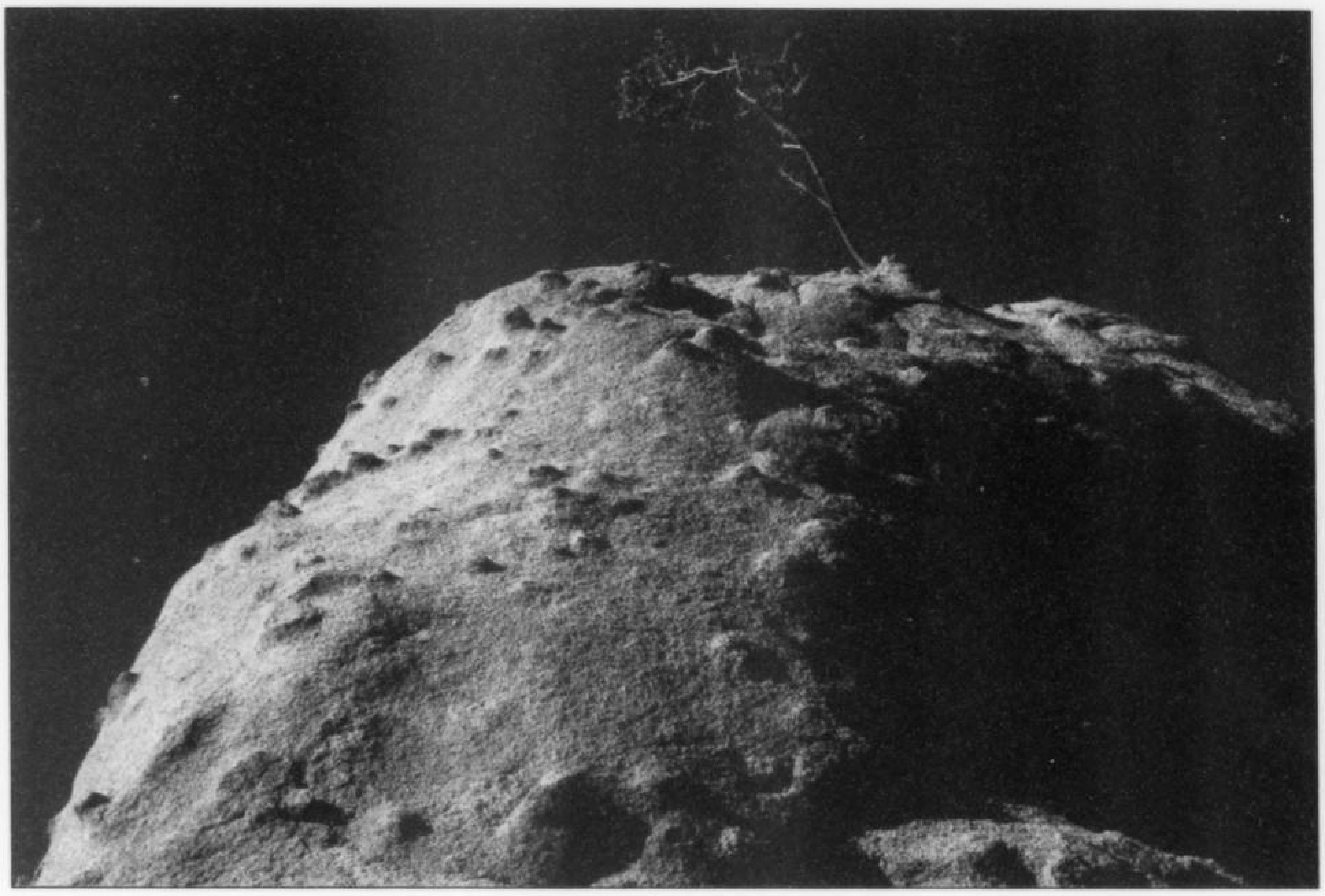


Figure 15. "Nests" of schorl-quartz aggregates in the Erongo granite. These are harder than the host rock and weather as positive relief features. The diggers randomly dig out these nests to search for minerals; Bruce Cairncross photo, August 2005.

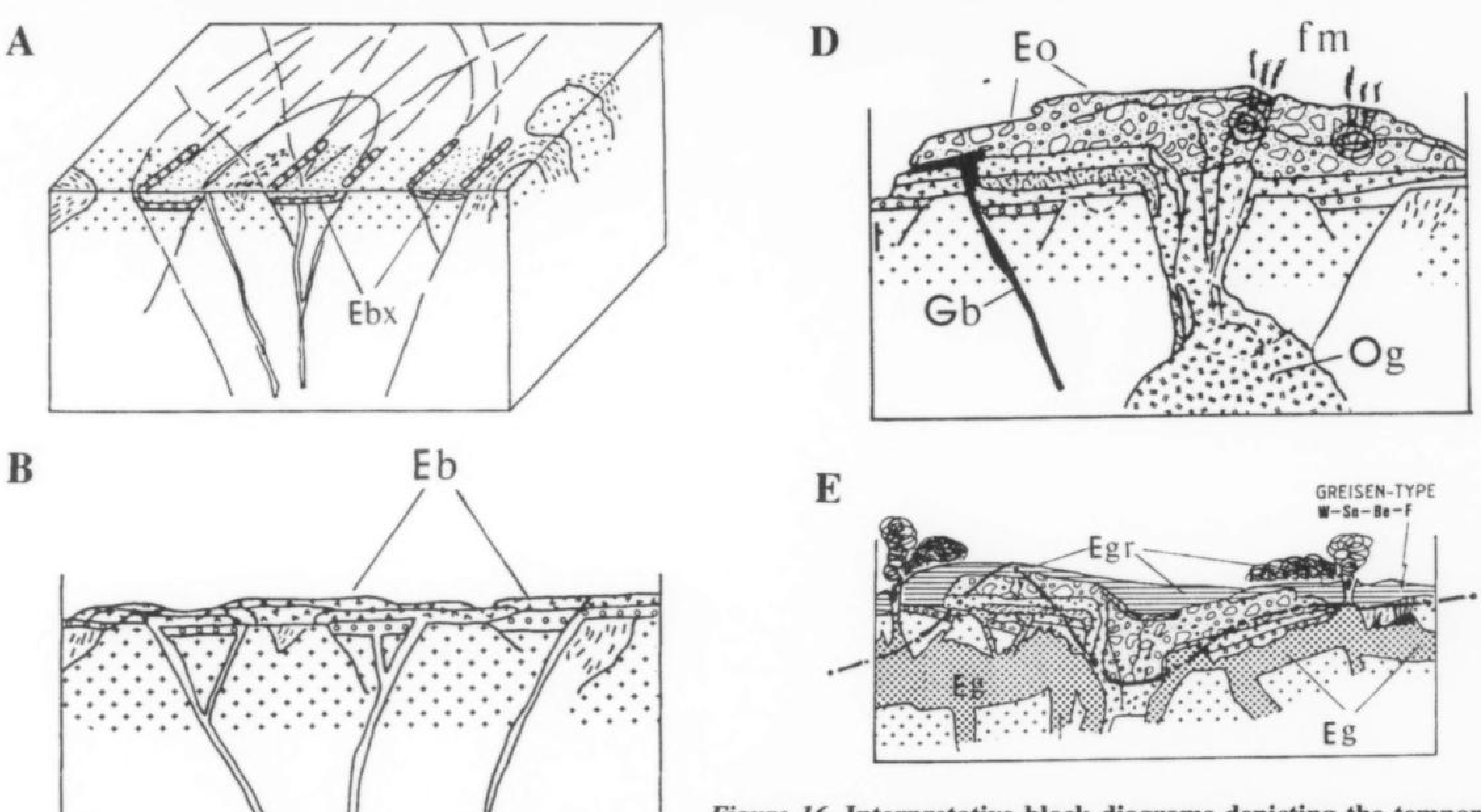


Figure 16. Interpretative block diagrams depicting the temporal development of the Erongo Volcanic Complex (From Pirajno, 1990). View is looking towards the north. (A). Faulting and structural fabric in the ancient rocks prior to the emplacement of the complex. (B) Eruption of the basalts (Eb). (C) The Erongorus event with the eruption of lavas and ash-flow tuffs (Ee1) overlain by more crystal-rich units (Ee2). (D) The Ombu event with the emplacement of the Ombu granodiorite (Og), ignimbrites (Eo), gabbros (Gb) and fumarolic activity (fm). (E) The Erongo event with the intrusion of the Erongo granite (Eg) around and below the volcanic sequence and possible venting of ash-flow tuffs (Egr), followed by the collapse and formation of a caldera-type structure. The dashed line through block E represents the present-day erosion level. From Pirajno (1994).

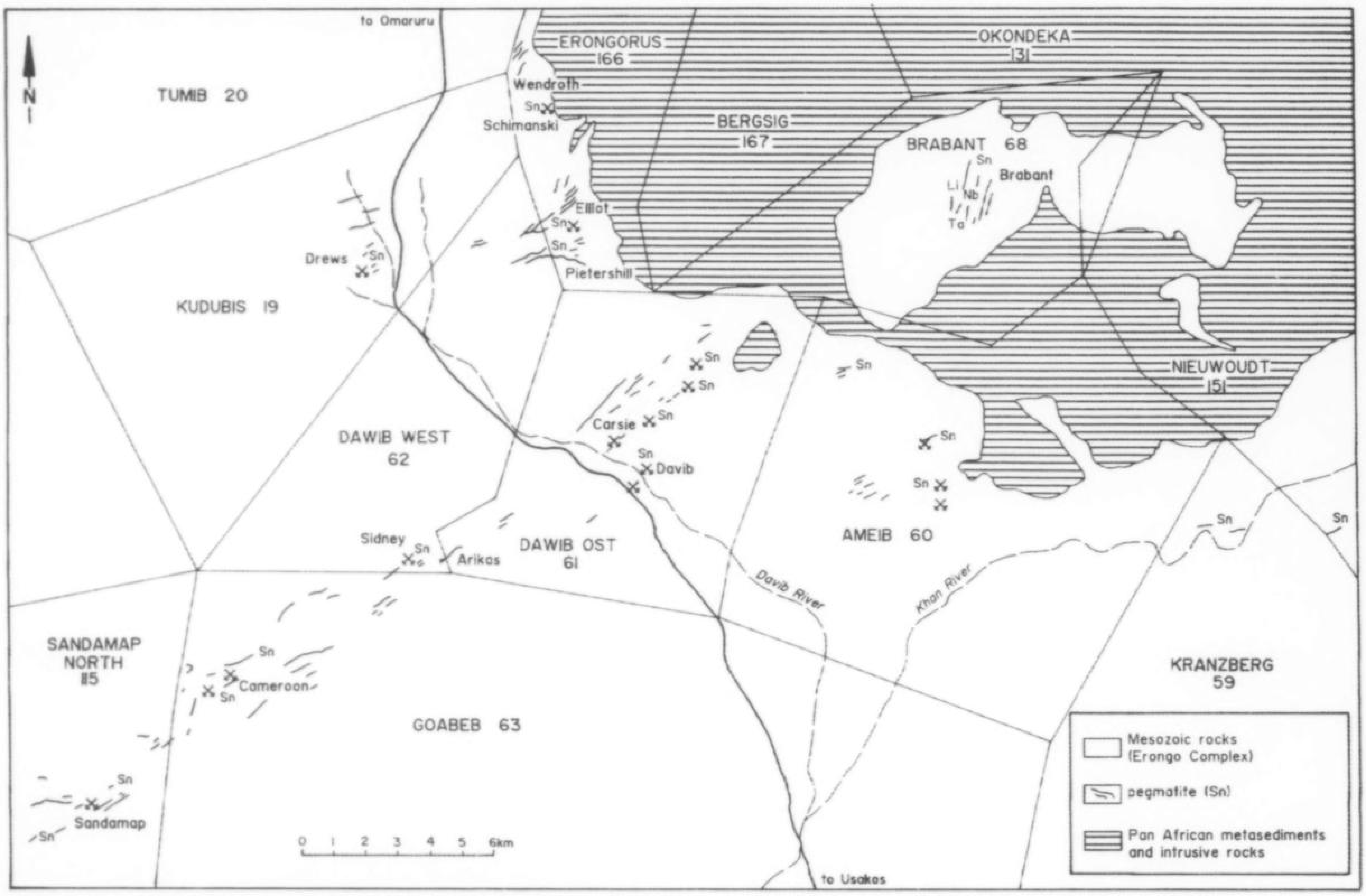


Figure 17. **Location of the known historic tin pegmatite workings in southwestern Erongo. The Brabant pegmatites located in Erongo Schlucht are the type locality for brabantite. From Diehl (1992a).**

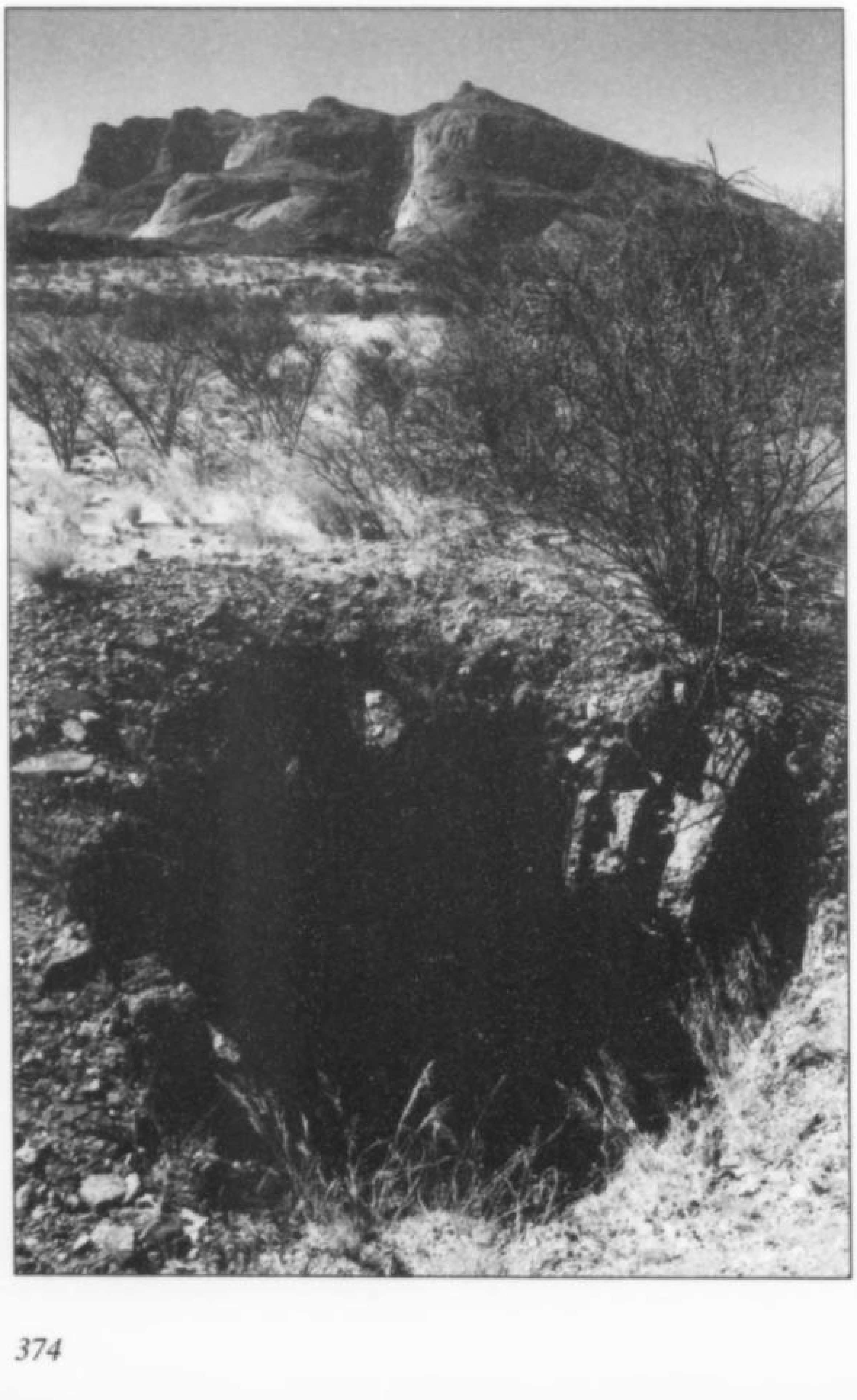


Figure 18. **An abandoned pegmatite digging on the farm Davib Ost 61, with the Erongo Mountains in the background. The highest peak, Hohenstein, is on the right. This quartz-muscovite pegmatite was worked for cassiterite. Bruce Cairncross photo, August 2005.**

intrusion of the Erongo Granite. Pegmatites from which the cassiterite has been commercially exploited are located on the farms Davib Ost 61, Sandamap, Ameib 60, Onguati 52 and Brabant 68; the latter three are closely related spatially to the Erongo Granite (Diehl, 1992a). The Brabant pegmatites in particular intruded into a pre-Erongo inlier of granite and schist which was later engulfed by the Erongo Granite (the Brabant pegmatite was referred to as the Erongo Schlucht pegmatite by Frommurze *et al*., 1942 and as Ameiber Tal by Cloos, 1919). The Erongo Schlucht is the valley leading up from Ameib 60 and Davib Ost 61 into the Erongo Mountains. Cassiterite mined there was associated with quartz, K-feldspar, muscovite, schorl and fluorapatite. Ferrotantalite occurs in one of the Brabant pegmatites associated with Li-mica, fluorapatite, topaz and albite.

Over 70 years ago, Gevers and Frommurze (1930) observed that black iron-rich tourmaline (schorl) "*frequently in large, well-formed crystals*" is characteristic only of the non-tin-bearing pegmatites, which explains why cassiterite has not typically been found associated with the minerals that have been collected over the past few years. The other suites of Li-Be pegmatites in the

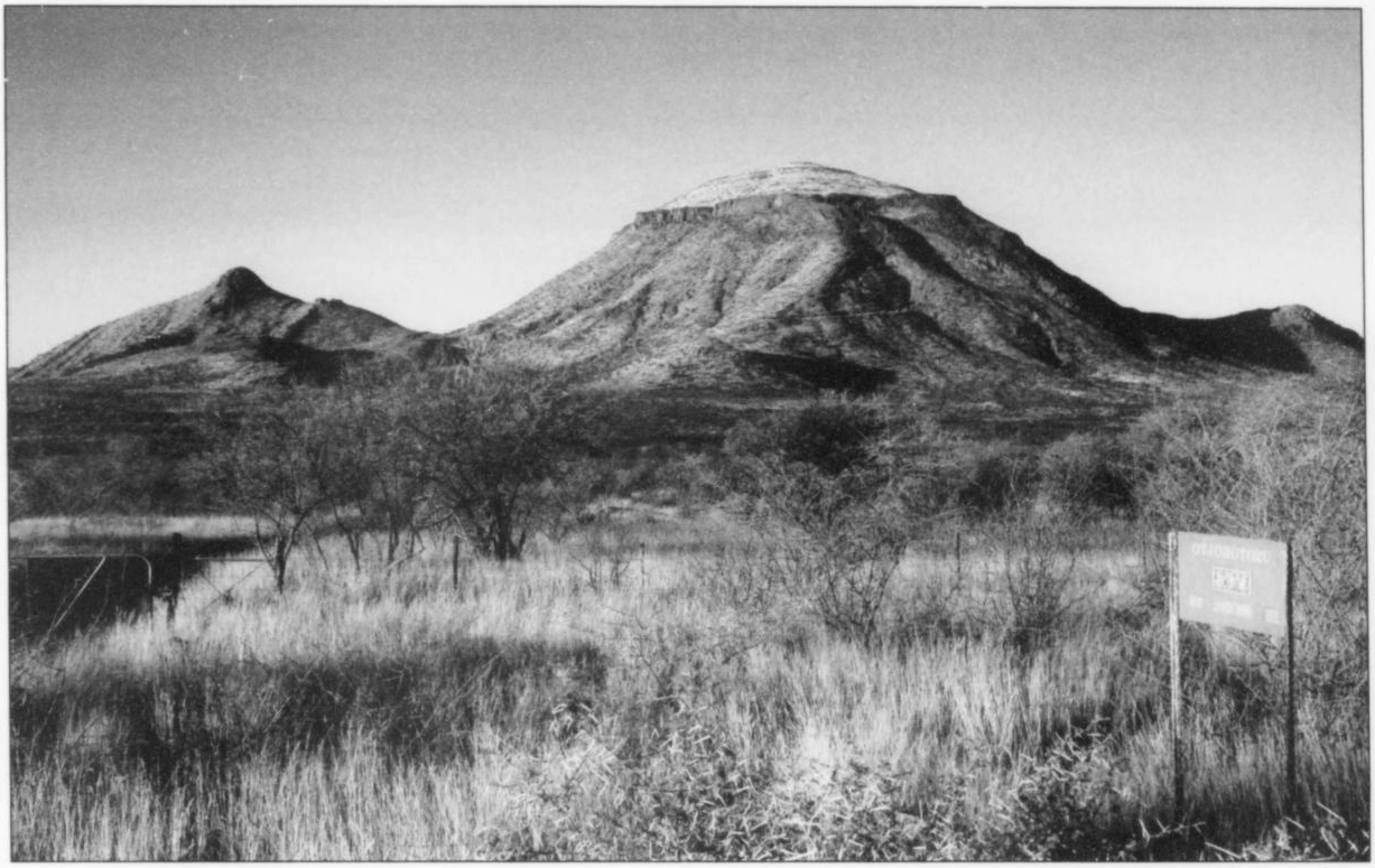


Figure 19. **Early morning view of the Krantzberg Mountain. Compare with Figure 25. Bruce Cairncross photo, August 2005.**

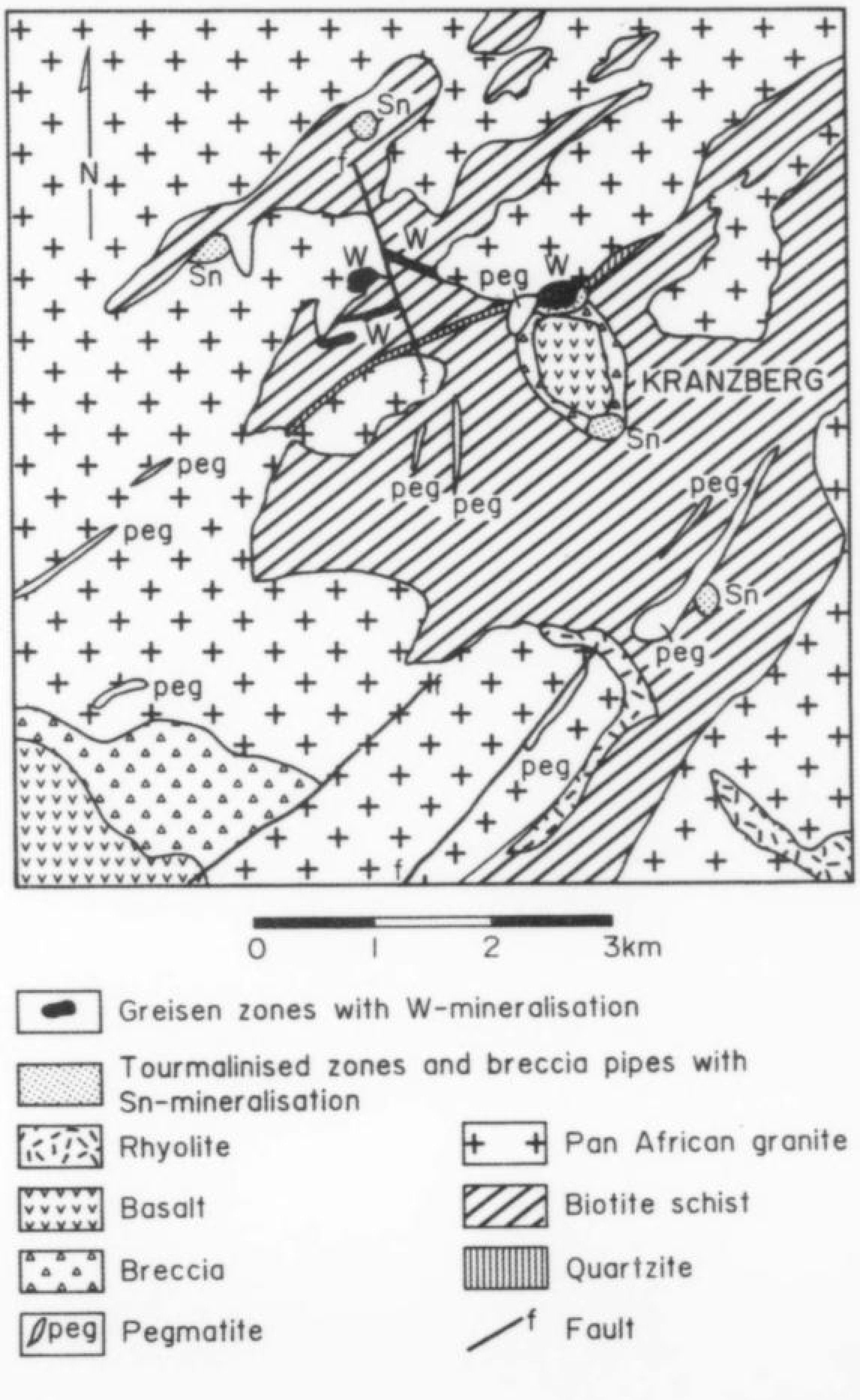


Figure 20. **Location of economic tin-tungsten deposits and pegmatites in the vicinity of Krantzberg Mountain. From Diehl (1992a).**

Karibib pegmatite area are genetically unrelated to the Erongo event and have been studied fairly extensively (Roering, 1961, 1963, 1964; Roering and Gevers, 1962; Steven, 1993; Keller *et al.*, 1999); they are not discussed further here.

KRANTZBERG MINE

One of the largest Erongo Mountains tungsten-tin mines was the Krantzberg mine, a major tungsten producer until it closed in 1979 (Schlögl, 1984; Pirajno and Schlögl, 1987; Diehl, 1992b). This was a polymetallic deposit with ferberite and minor cassiterite accompanied by fluorite, beryl and minor molybdenum, iron and copper sulfides. Some interesting and collectible minerals came from this mine. The defunct Krantzberg mine is one of the few mining operations in the region that has been well documented.

Location and History of Krantzberg

Krantzberg, an outlier of the Erongo Mountains, peaks at 1,714 meters above sea level. The hill is clearly visible from a distance, with its characteristic capping of vertical rock faces which give the appearance of a wreath atop the mountain, and hence its German name meaning "wreath mountain."

The Krantzberg tungsten mine is located on the northeastern flank of the Erongo Mountains, 18 km west-southwest of Omaruru. There are several ferberite, cassiterite, tantalite and beryl occurrences in the vicinity of the mine, but historical mining operations tended to focus on the tungsten deposits on Krantzberg hill (Schlögl, 1984).

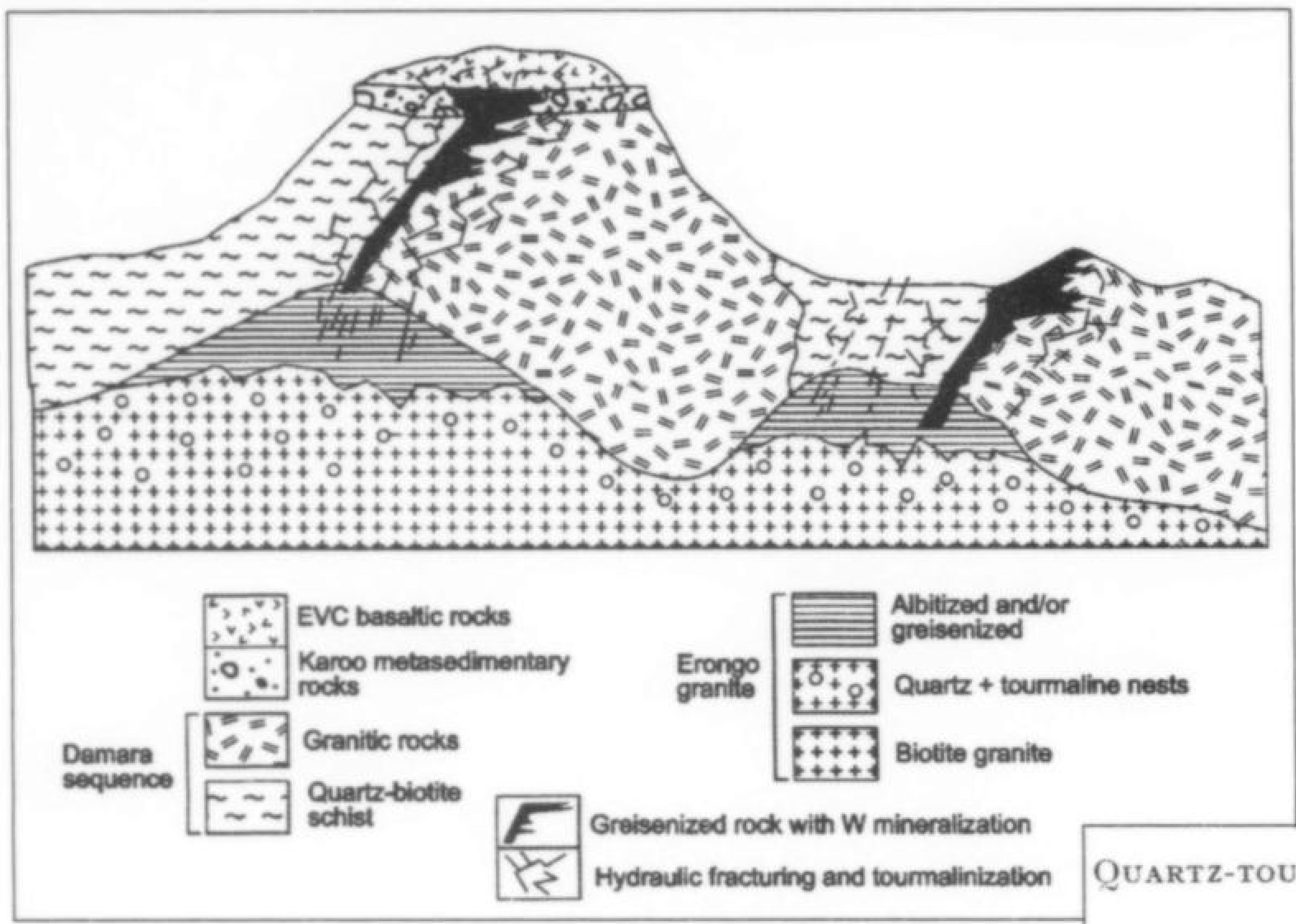


Figure 21. **Geological cross-section through Krantzberg Mountain. From Pirajno *et al.* (2000).**

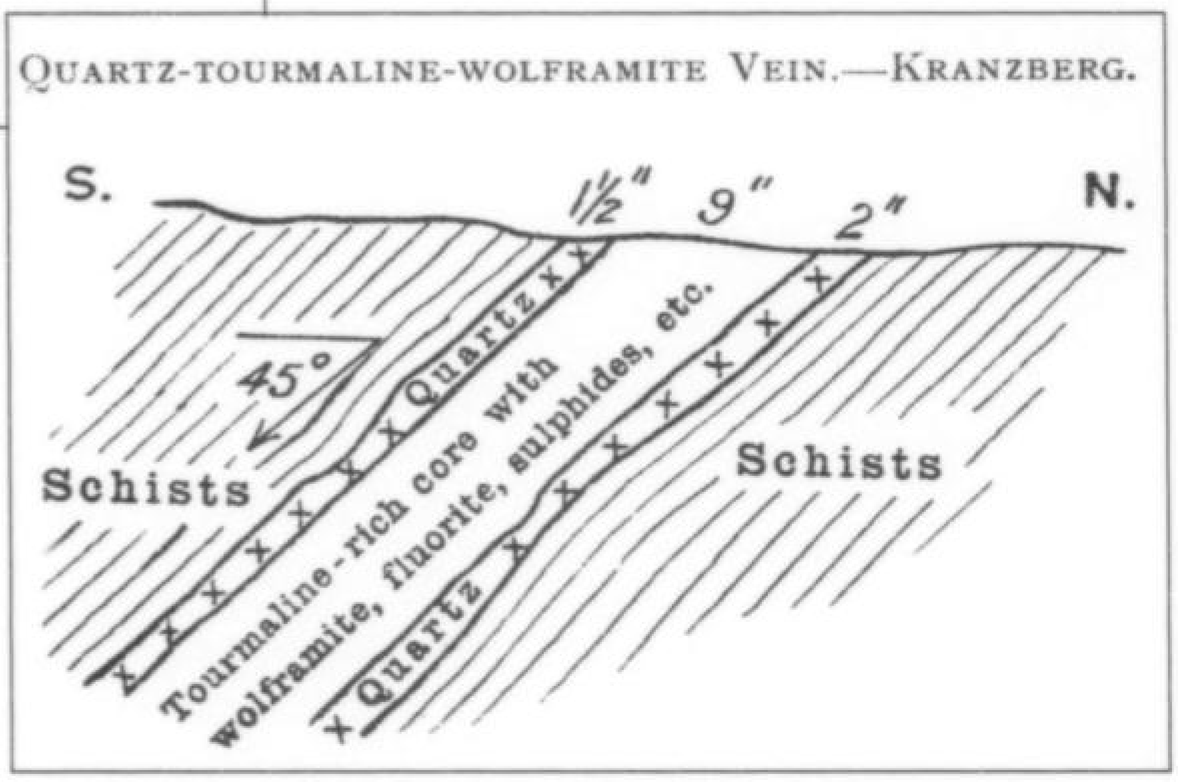


Figure 23. **Cross-section through a mineralized tungsten vein at Krantzberg. The ferberite ore is contained in the core of the vein and is associated with schorl and associated minerals. From Haughton *et al.* (1939).**

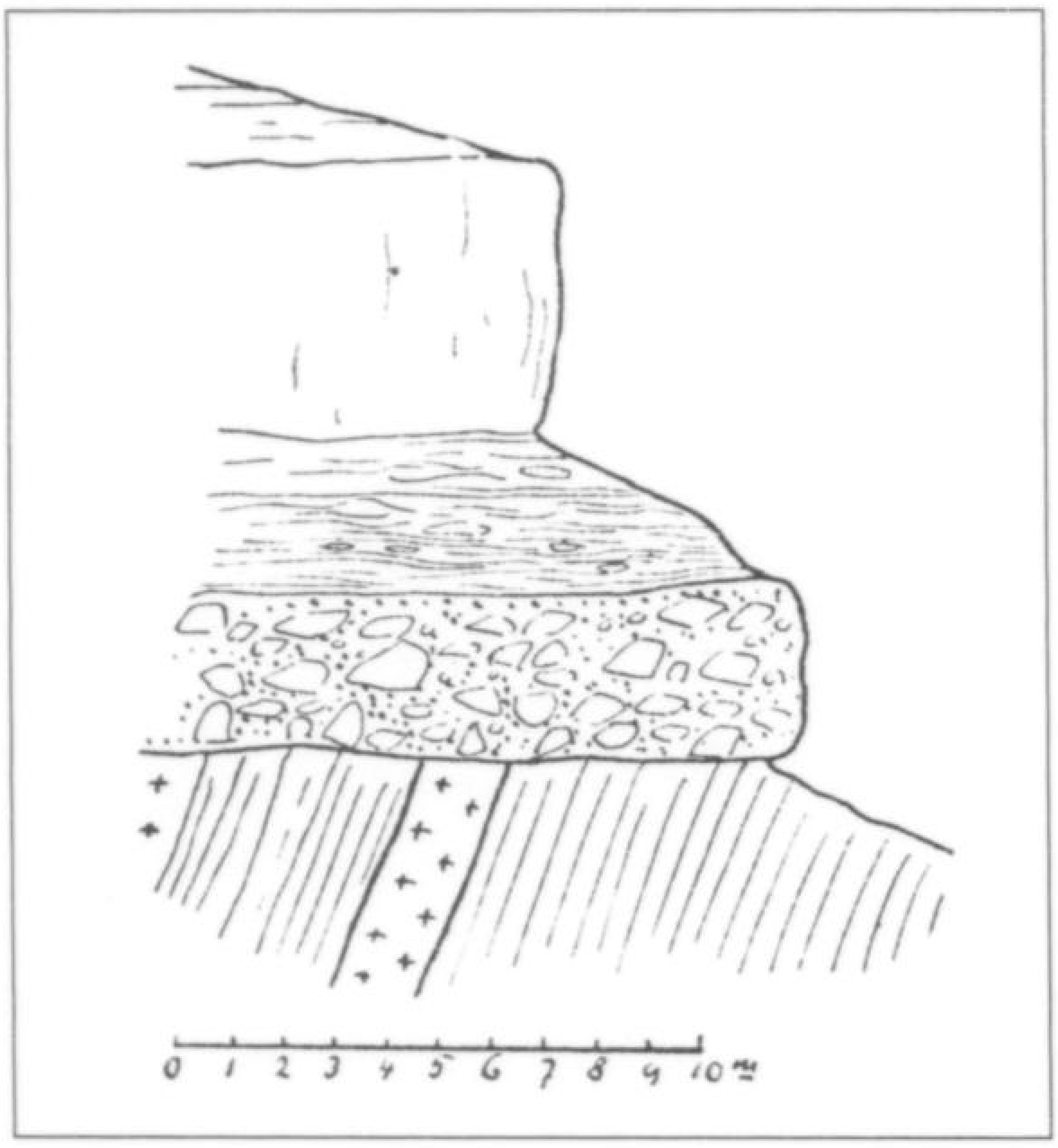


Figure 22. **Cloos' 1910 geological cross-section sketch of the geology of Krantzberg. The angular unconformity between the older basement schist and granite and overlying, younger horizontal strata is clearly illustrated. From Cloos (1919).**

Cassiterite and ferberite were discovered in alluvial gravels during the late 1920's. Initially and until 1938, most mining took place in excavations in highly mineralized parts of surface outcrops of greisen zones. Schlögl (1984) reports that ore grades published for the period 1933 to 1938 reveal that the WO_3 content ranged from 67% to 73% and that the old waste dumps still carry about 1% WO_3. During the 1950's, African Mining and Trust exploited the tungsten deposits (see sidebar). The company's operations produced approximately 1,000 tons of tungsten concentrate, making the deposit the richest in Namibia at the time. The mine fell dormant until 1968, when Nord Mining and Exploration, a subsidiary of Nord Resources of Albuquerque, New Mexico, acquired the mining rights for Krantzberg and adjacent areas. After extensive drilling and exploration, mining commenced in 1973; it continued until 1979, when the price of tungsten dropped and ore reserves had been seriously depleted. Nord then offered the property to Anglo-American Corporation of South Africa, which subsequently undertook an exhaustive exploration and drilling program without any major success. Since then, the mine has been idle.

Geology

The lower part of Krantzberg Mountain consists of late Proterozoic Kuiseb Formation schist and Salem (Damara) Granite, underlain by the Erongo Granite and overlain by younger Karoo-age sedimentary strata and basalts (Schlögl, 1984; Pirajno and Schlögl, 1987). The steep slopes and cliffs that form the upper parts of the mountain are sedimentary breccias, capped by Etendeka Formation tourmalinized basalt. The breccias are very immature clastic rocks containing clasts and fragments of schist, granite and pegmatite in a sugary quartz-feldspar matrix (Hegenberger, 1988). The breccia is extensively sericitized and tourmalinized, and the pebbles and boulders are cemented together by a hard groundmass of schorl. The pervasive and intense tourmalinization of the Erongo breccia, conglomerate and basalts is obvious and pervasive (Cloos, 1919);

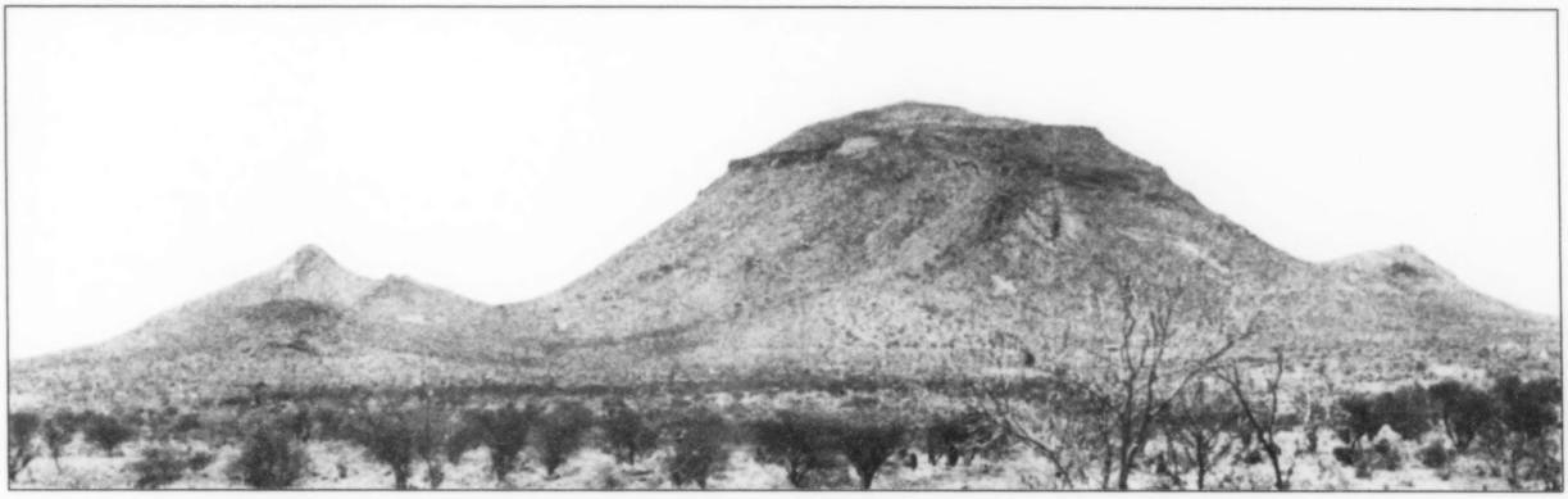
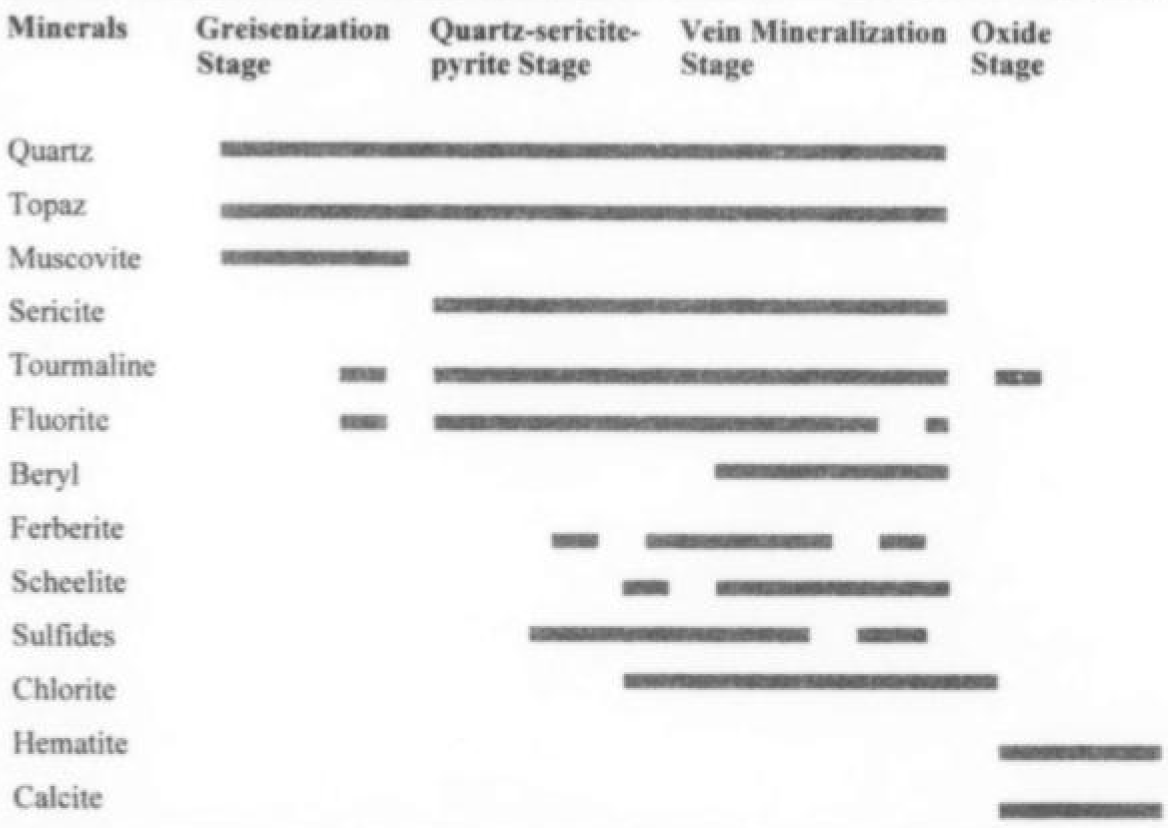


***Figure 24.* A view of Krantzberg Mountain seen from the north, in 1938. The small hill on the right is the Koppie zone orebody; the C-zone is located on the upper right flank of Krantzberg, and the hill on the left with the two pegmatite ridges is a cassiterite-rich tourmaline breccia pipe. Photo by C. M. Schwellnus in Haughton *et al.* (1939).**

***Table 3.* Minerals of Krantzberg (*pro parte* from Haughton *et al.*, 1939; Schlögl, 1984; von Bezing, 2006; and the authors' own observations).**

Albite	Ferberite	Muscovite
Arsenopyrite	Ferro-axinite	Opal variety hyalite
Azurite	Fluorapatite	Plumbogummite
Beryl	Fluorite	Pyrite
Biotite	Garnet (almandine?)	Quartz
Bismuth	Goethite	Rutile
Calcite	Goyazite	Scheelite
Cassiterite	Hematite	Schorl
Chalcopyrite	Malachite	Scorodite
Danburite	Molybdenite	Titanite
Dravite	Monazite	Topaz

***Table 4.* Tentative paragenesis of minerals at Krantzberg. After Pirajno and Schlögl (1987).**



there is also secondary tourmalinization in the older Late Proterozoic schist and granite, extending stratigraphically up to the base of the basalts that cap the Krantzberg. Cloos (1919) and later workers (Haughton *et al.*, 1939; Martin, 1965; Schlögl, 1984) have unanimously concurred that the source of the tourmalinization and mineralization was the underlying, intrusive Erongo Granite. Haughton *et al.* (1939) described amygdules and geodes in the capping basalts, containing axinite, calcite, danburite, datolite, fluorite, goethite, hematite, pyrite, quartz, schorl and specular hematite.

The tungsten mineralization originated from greisenization events associated with the Erongo Granite emplacement (Schlögl, 1984). During these alteration events, albitization and hydrogen ion metasomatism caused not only tungsten greisenization at Krantzberg but also uranium-tungsten-tin mineralization at Etemba 135 and tin-tungsten mineralization at Anibib 136, approximately 20 km west of Krantzberg (Pirajno and Schlögl, 1987). Greisen veins tend to be concentrated in the older schist, with a few in the younger Erongo strata. The gray-white to brown greisenized rock is composed of quartz and topaz, with fluorite, schorl, and sericitic muscovite. Accessory minerals are biotite, calcite, cassiterite, chalcopyrite, chlorite, ferberite, goethite, titanite, zircon, bismuth, powellite, scheelite and minor sulfides such as arsenopyrite, pyrite and molybdenite (Schlögl, 1984). Alteration was concentrated along major lithological and structural breaks.

Two main tungsten ore zones were exploited: the Koppie Zone on the south side of the hill and the C-Zone on the northeast slope. Collectible aquamarine came from the C-zone. The greisen veins are quartz-topaz and quartz-tourmaline with minor accessory minerals. Ferberite, scheelite and powellite (Schlögl, 1984) are erratically dispersed in the veins. Apart from these larger deposits, smaller mineralized greisen veins up to 6 cm wide occur in the older biotite schist. These are dark gray and consist of beryl, calcite, fluorite, goethite, quartz, schorl and topaz, with accessory ferberite, fluorapatite, muscovite, scheelite and serpentine (Diehl, 1992b). A list of the Krantzberg minerals is given in Table 3 and a tentative paragenesis is shown in Table 4.

Apart from the tungsten-tin deposits at Krantzberg, fluorite is associated with acicular schorl in vugs in an intrusive porphyritic dike 3.5 km southeast of Krantzberg Mountain (Schneider and Seeger, 1992a). Tin mineralization is also associated with quartz-topaz greisens at Krantzberg (Haughton *et al.*, 1939)—see under cassiterite below. Haughton *et al.* (1939) described samples of parts of the mineralized zones as follows:

> The material consists of cavity fillings, the cavities lined with beautifully formed minute crystals of quartz, tourmaline, fluorite and cassiterite . . . The minerals in the cavities have crystallized in the following order: tourmaline, beryl, cassiterite, quartz, fluorite.

KRANTZBERG MINE

One of South Africa's best known mineral collectors, Desmond Sacco, has historical links to mining at Krantzberg. African Mining and Trust, under the Chairmanship of Guido Sacco, Desmond's father, mined the deposit during the mid-20th century. One of us (BC) recalled hearing Des Sacco's story about his father and specimens from the mine, and this prompted an informal interview:

BC: *What was your family's involvement in mining at Krantzberg?*

DS: My father, Guido Sacco, was Chairman of African Mining & Trust, a company started in 1932, but they only began to mine the tungsten deposits at Krantzberg in the 1950's. The company mined the deposit from the 1950's until mid-1960. A mechanical engineer, Walter Parker, was dispatched to Krantzberg and he constructed a processing plant and other infrastructure to get the mine up and running. He also recruited miners.

All the mine personnel lived in nearby Omaruru. In fact, several years ago when I was in Namibia, I visited Omaruru and went to the hotel to have a drink. There was this old-timer sitting at the bar and we struck up a conversation. I said that I'd come to Omaruru just to see where my father had worked. He asked who my father was and I answered "Guido Sacco." The old guy replied: "What? That famous man!" He clearly recalled Guido's involvement at Krantzberg and even the presence of Walter Parker, the engineer. He then proceeded to take me to the Omaruru River to a spot where at the time of mining, my father's car got stuck in the river bed during a rain storm and they just managed to free it before the area was hit by a flash flood that would undoubtedly have washed them all away.

I remember that my father used to take three to four days to make the trip from Johannesburg to Omaruru by car – he traveled in a blue Buick Roadmaster, with the luggage tied to the roof of the car. He would spend several weeks at the mine before returning to South Africa. Even though he was Chairman of the company and of other companies, he loved going to the field; he spent a large part of his life in the Postmasburg and Kalahari manganese fields, that he was instrumental in discovering. He traveled to some other well-known South African deposits such as Palabora and the Consolidated Murchison mine. He also traveled extensively in Zimbabwe exploring for chromium.

BC: *What were early field conditions like at Krantzberg?*

DS: Conditions were very tough. Malaria was still prevalent in the region and black water fever was also sporadically contracted. But the grade of the ore at the mine was spectacular. My father said that he could not believe how rich the tungsten (ferberite) ore was. They would stope areas of solid ore and crush it and there was hardly any need to concentrate the ore because it was so pure. It was merely put into containers and shipped out.

BC: *What are your personal memories of specimen production from the mine?*

DS: Krantzberg was not a prolific specimen-producing mine and nobody really seriously collected minerals, like at Tsumeb, for example. But my father would occasionally bring back specimens. I remember that he once brought home two dinner-plate-sized ferberite crystals. They were impressively large, with well-developed crystal faces. This was in the early 1960's. A few years after this, I personally donated two ferberites to the Johannesburg Geology Museum, to the curator, Townsend. I remember that Townsend had a few other Krantzberg ferberite crystals in a small display case in his office, but I believe these have subsequently disappeared.[1]

BC: *What Krantzberg specimens do you have in your collection and how and when did you acquire them?*

DS: I have no ferberites in my collection, but I do have three Krantzberg cassiterites. One is a very large, brown crystal (see Fig. 99) that I got from my father. The other two are highly lustrous black crystals.

BC: *Did African Mining and Trust company donate specimens to any other local or overseas museums?*

DS: No. As I mentioned, the mine was not really known for producing masses of quality specimens. Apart from the few specimens I donated to the local Johannesburg museum, none were formally donated to other museums.[2]

[1] During research for this article, the current collection and inventory of the Johannesburg Geological Museum was searched for Krantzberg specimens, but none were found, corroborating the loss of these minerals from this institutional collection.

[2] Krantzberg did produce mineral specimens, and most appear to be in southern African collections. An acquaintance of Windhoek dealer-collector Herbert Nägele has searched a number of private and museum collections in Germany for Krantzberg specimens, but to no avail (Herbert Nägele personal communication, March 2006). The Nägele collection in Windhoek has a suite of Krantzberg specimens, as does the Ludi von Bezing collection in Kimberley. Von Bezing has an outstanding museum-size specimen of fluorite and quartz, which he acquired from the Nambian collector Gawie Cloete.

MINERALOGY

The minerals listed below are primarily from the Erongo Mountains miarolitic cavities. However, for completeness, interesting minerals from pegmatites are also mentioned, because some of these pegmatites, notably the ones located close to the south, southwest and western side of the Erongo Mountains, are thought to be geologically related to the Erongo geological "event" (Pirajno, 1990).

Albite $NaAlSi_3O_8$

Two generations of albite have been described from the Erongo Mountains' miarolitic cavities (Jahn and Bahmann, 2000): "Albite 1" consists of rare, several-centimeter-long but millimeter-thick acicular crystals. These tend to be epitactically grown on orthoclase. "Albite 2" consists of smaller crystals, up to 5 mm long, white to colorless; these are later, second-generation forms on previously crystallized minerals such as "albite 1," orthoclase, schorl and muscovite.

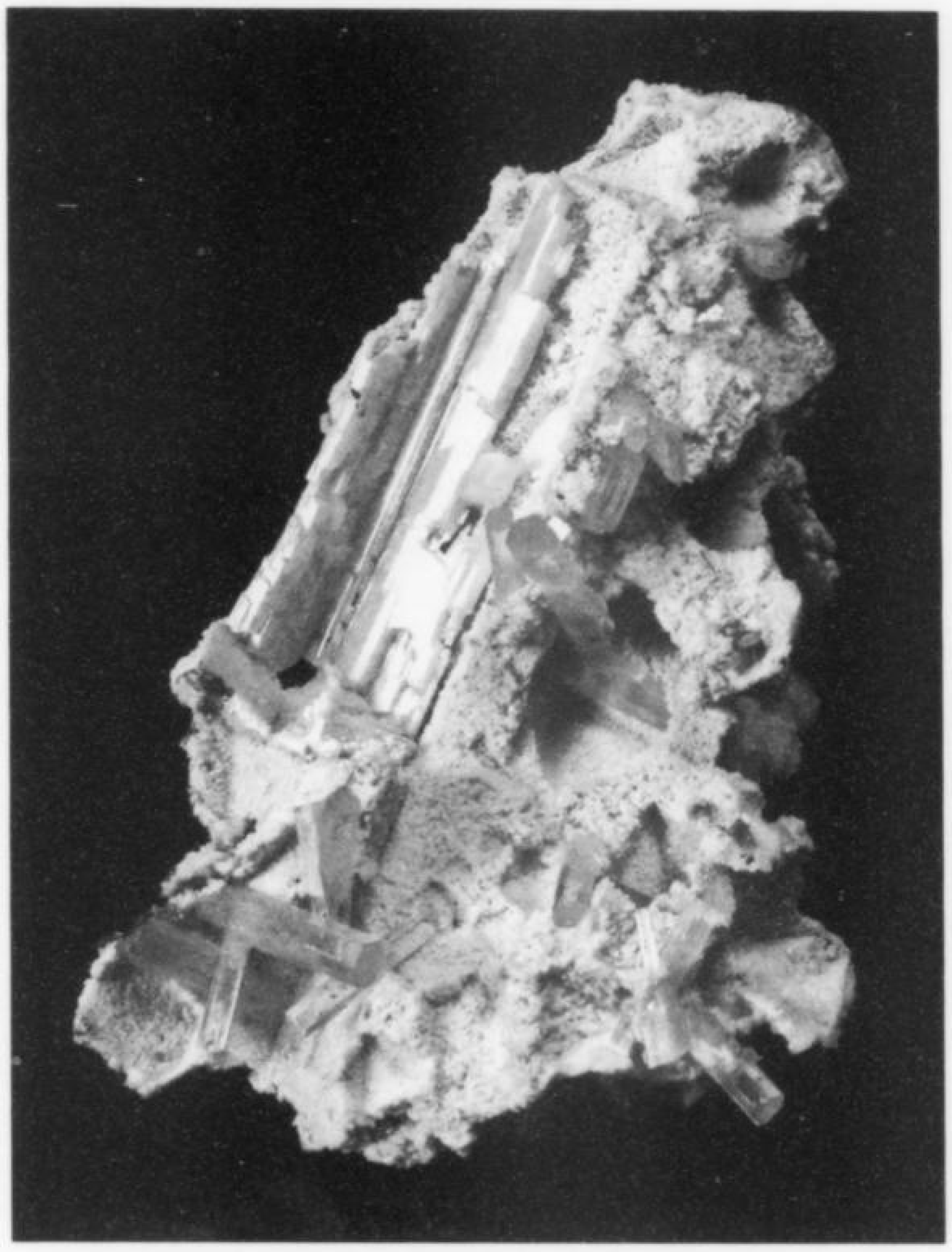


Figure 25. **Lustrous albite overgrown on orthoclase, with aquamarine, 7 cm, from the Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Albite has been found as cream-white, elongated crystals up to 2 cm on highly corroded epimorphic molds of orthoclase, associated with pale blue aquamarine and pale yellow, purple-tinged fluorite. The albite tends to be oriented along the orthoclase cleavage planes.

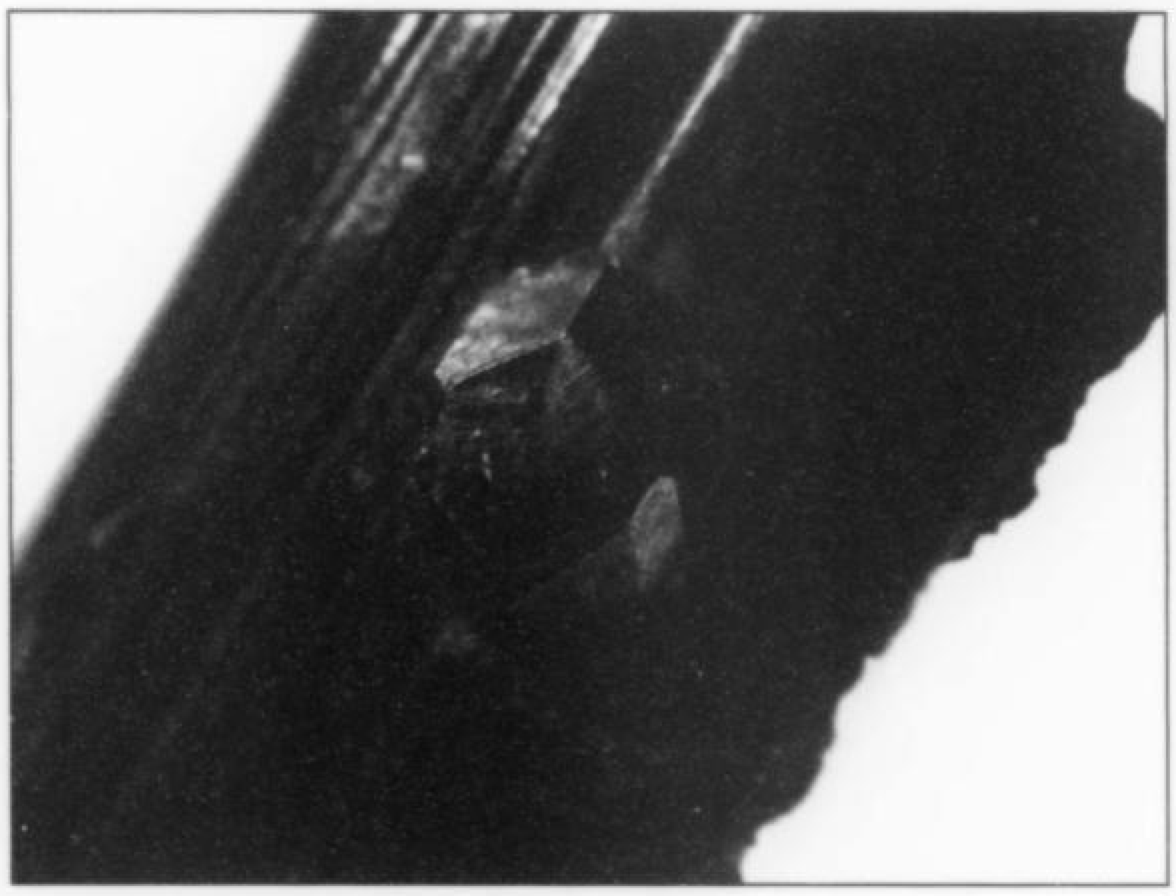
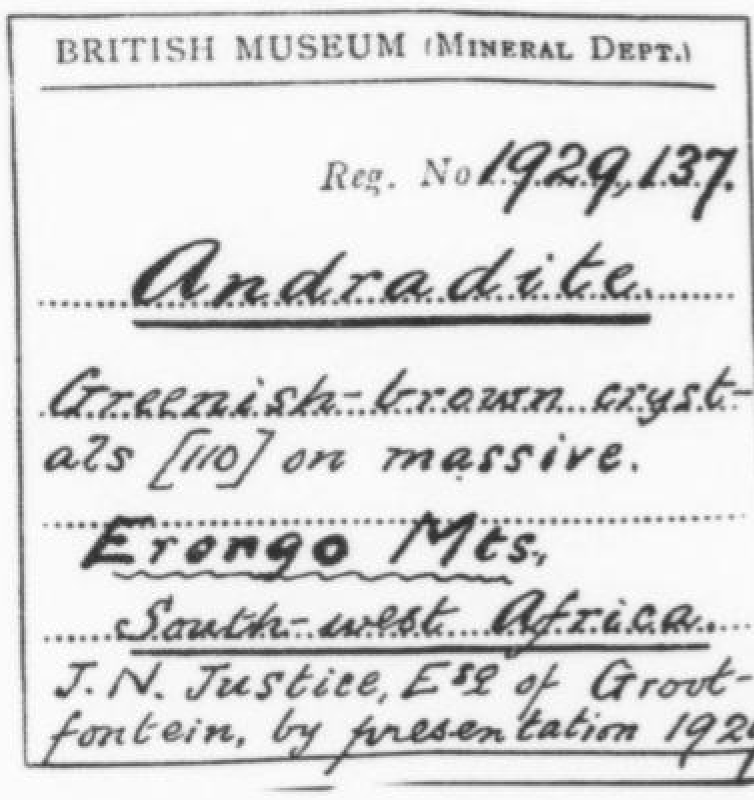


Figure 26. **Almandine crystal, 1 cm, on schorl; Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Almandine $Fe^{2+}_3Al_2(SiO_4)_3$

Almandine is found rarely as aesthetic specimens associated with the other minerals at Erongo. However, garnet (exact species not named) is reported from the following farms' pegmatites in the Erongo region: Brabant 68, Davib Ost 61, Davib West 62, Erongorus 166, Goabeb 63, Tsawisis 16 and Ukuib 116 (Schneider, 1992a). A well-formed almandine crystal on schorl is in the Nägele collection. Almandine-spessartine enclosed in triplite was described from the old Elliot claims, north of Pietershill below Hohenstein (Gevers and Frommurze, 1930).



BRITISH MUSEUM (MINERAL DEPT.)

Reg. No 1929,137.

Andradite.

Greenish-brown cryst-als [110] on massive.

Erongo Mts,

South-west Africa.

J. N. Justice, Esq of Grootfontein, by presentation 1929.

Figure 27. **Historical label for green andradite from the Erongo Mountains, dated 1929. Natural History Museum, London collection.**

Andradite $Ca_3Fe^{3+}_2(SiO_4)_3$

Andradite, like spessartine, is fairly common in many of the pegmatites in the Erongo-Omaruru area, particularly in the cassiterite pegmatites on the farms Brabant 68, Davib Ost 61, Davib West 62, Goabeb 63, Erongorus 166, and Erongo Schlucht (Schneider, 1992a; Schneider and Seeger, 1992b).

Green to tan-green andradite is mined from calcsilicate marble west of the Erongo Mountains at Tubussis 22 (Grolig, 2005). The garnets are embedded in the hard matrix. Faceting-grade gems have been mined, and specimen crystals measuring 1 to 2 cm have been found (Niedermayr, 2000).

An interesting green tin-bearing andradite was found in a calcsilicate layer hosted in schist on Davib Ost 61, approximately 1 km southwest of the main slopes of the Erongo Mountains (McIver and Mihálik, 1975); this "stannian garnet" was analyzed and found to contain up to 4.58% tin. The andradite was first noticed in the 1930's when attractive green single crystals and plates of crystals were collected from the weathered eluvium. In 1937, the pegmatite was trenched for 13 meters for specimen-grade and facetting-grade andradite (McIver and Mihálik, 1975). Specimens collected from this deposit 35 years later consist of 2 cm-thick encrustations of 5-mm dodecahedral crystals. These are concentrated along the contact zone between a layer of massive vesuvianite and cream-pink grossular. The stanniferous andradite lines drusy cavities in the vesuvianite layer and occurs as isolated crystals disseminated in cemented silcrete breccia associated with the pegmatite. Most of the Sn-andradite is green, but some crystals are green-brown and some are color-zoned; the greater the tin content, the greener the andradite (McIver and Mihálik, 1975). There has been some debate in local collecting circles regarding the exact locality for this stanniferous andradite, even though McIver and Mihálik (1975) state that it is found on Davib Ost 61. The reason for the debate is that the current production of green

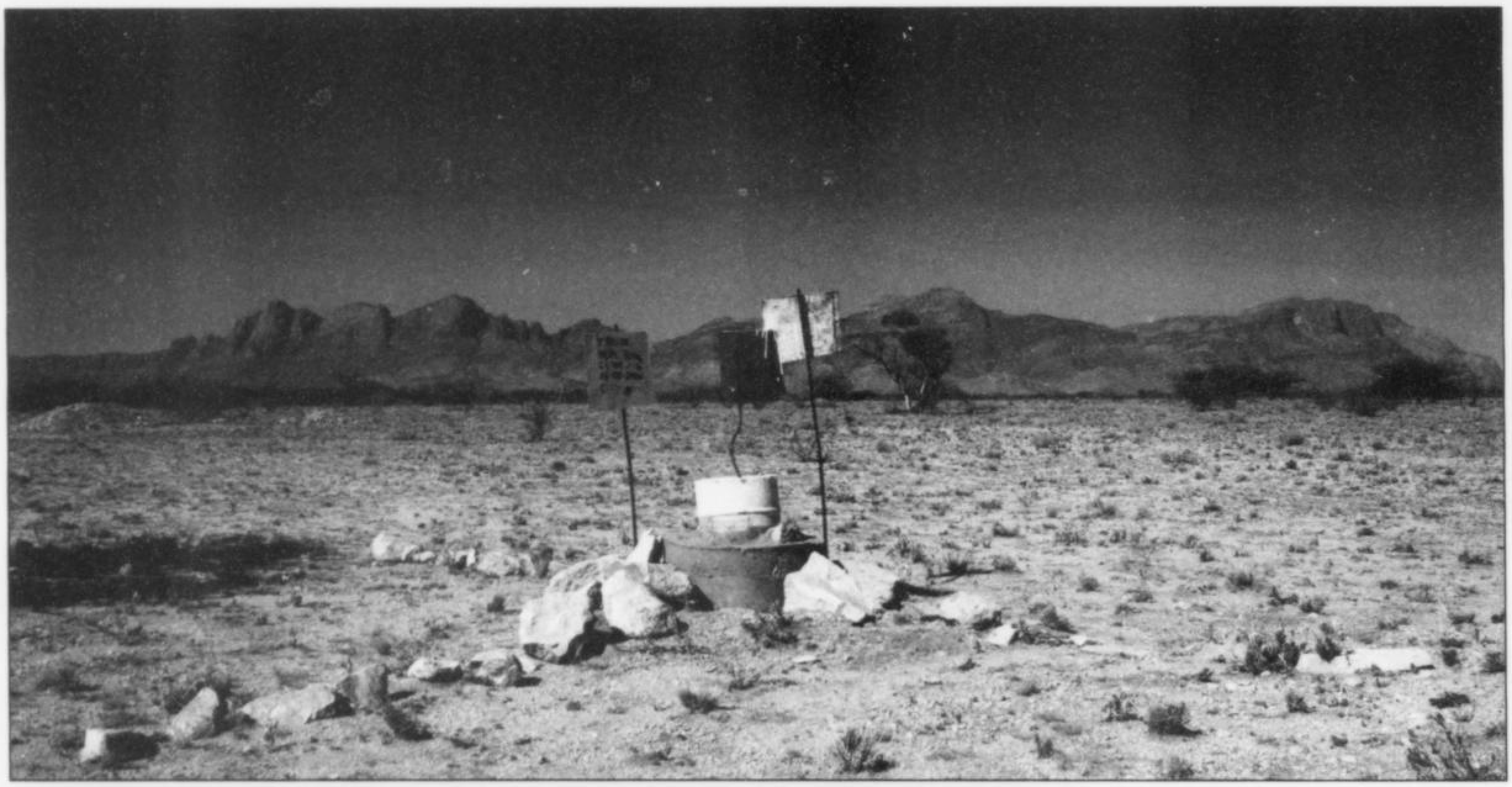


Figure 28. **View of claim beacons on Tubussis 22 close to the current diggings for green andradite. Bruce Cairncross photo, August 2005.**

Figure 29. **Andradite cluster, 2.9 cm, from Tubussis 22, Erongo Mountains. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

andradite from Tubussis 22 resembles the Davib Ost material from southeast of the Erongo Mountains. The pegmatites of the two localities are similar, and in both places the green garnet is found in calcsilicate rock.

Arsenopyrite FeAsS

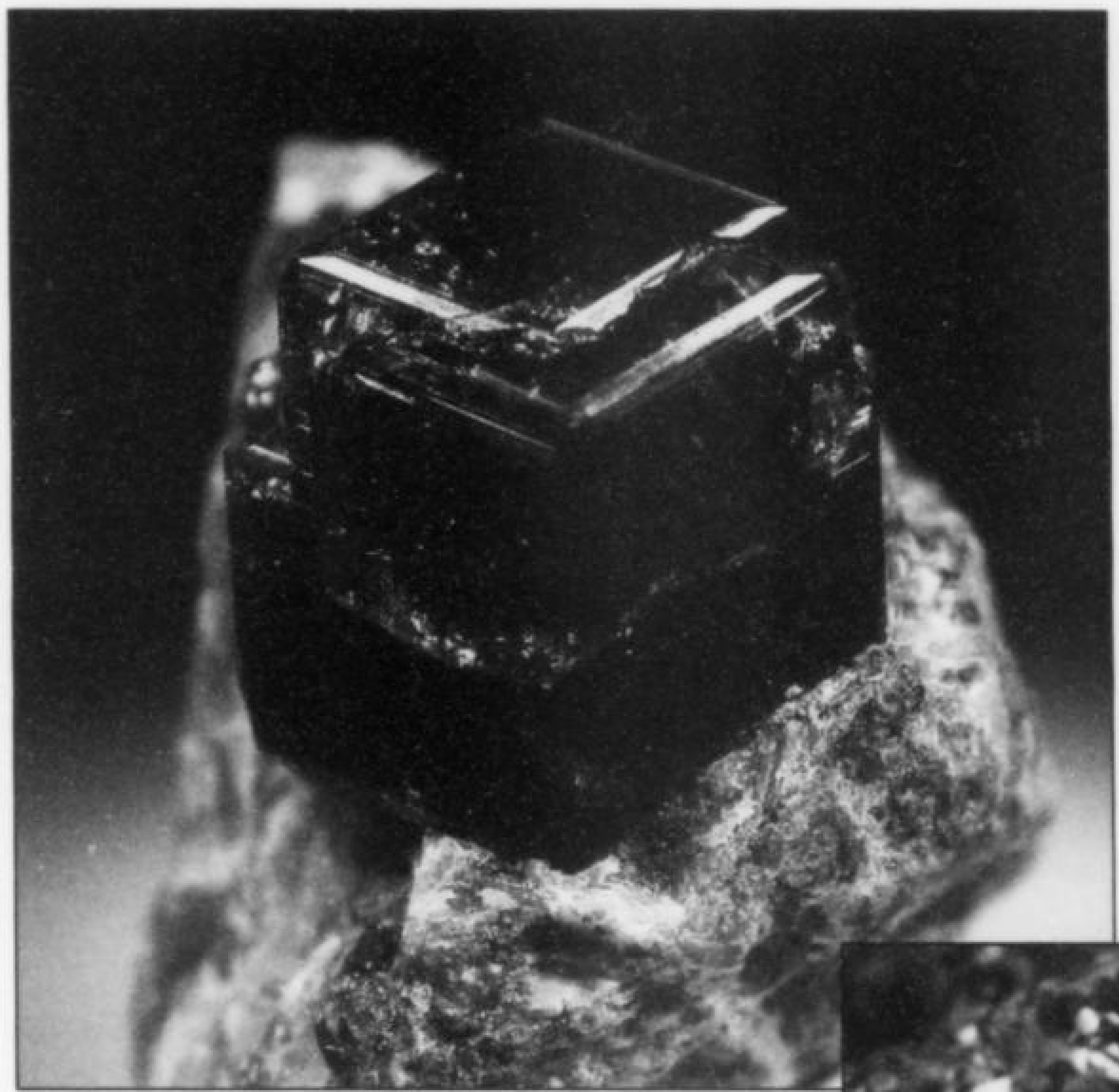
Sharp arsenopyrite crystals up to several millimeters were sporadically found at the Krantzberg mine. They occur in aggregates from thumbnail to cabinet size, associated with schorl.

Barite $BaSO_4$

A single thumbnail specimen showing pale brown prismatic barite crystals is currently known from the Erongo Mountains.

Beryl $Be_3Al_2Si_6O_{18}$

Beryl is well known from the Erongo Mountains (Jahn and Bahmann, 2000; Cairncross, 2001) and, together with schorl, has placed the locality firmly on the mineralogical map. Outstanding



specimens of aquamarine beryl, yellow and colorless beryl have all been found.

Beryl is one of the premier collectible minerals from the Erongo miarolitic cavities. Individual crystals typically have a variety of habits, from simple hexagonal prisms with basal pinacoids to complex combinations of pyramidal and pinacoidal faces. What makes the Erongo beryl interesting is the wide variety of colors and associated species. In fact, "common" opaque pale green and colorless beryl is very rare. Most crystals are translucent to transparent, although the degree of clarity in some cases varies within individual crystals; aquamarine beryl typifies this type. Some blue crystals are opaque at the bases and grade along the c-axes into translucent sections, to terminal zones which are transparent and facetable. This phenomenon typifies the April 2000 aquamarine discovery on the farm Bergsig 167 that made such a major impact on the collector market. Aquamarine specimens have since been collected from miarolitic cavities dug on Anibib 136,

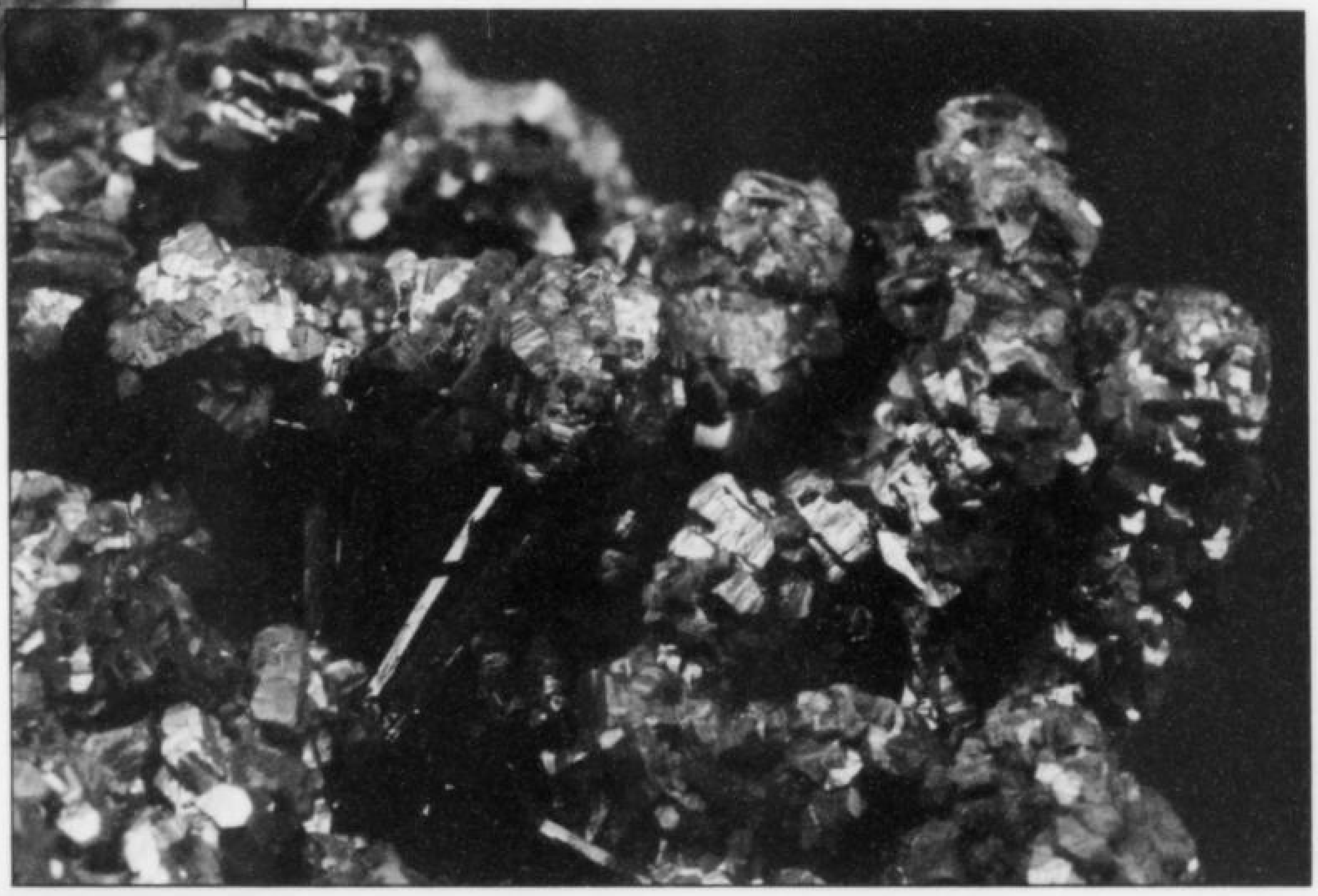
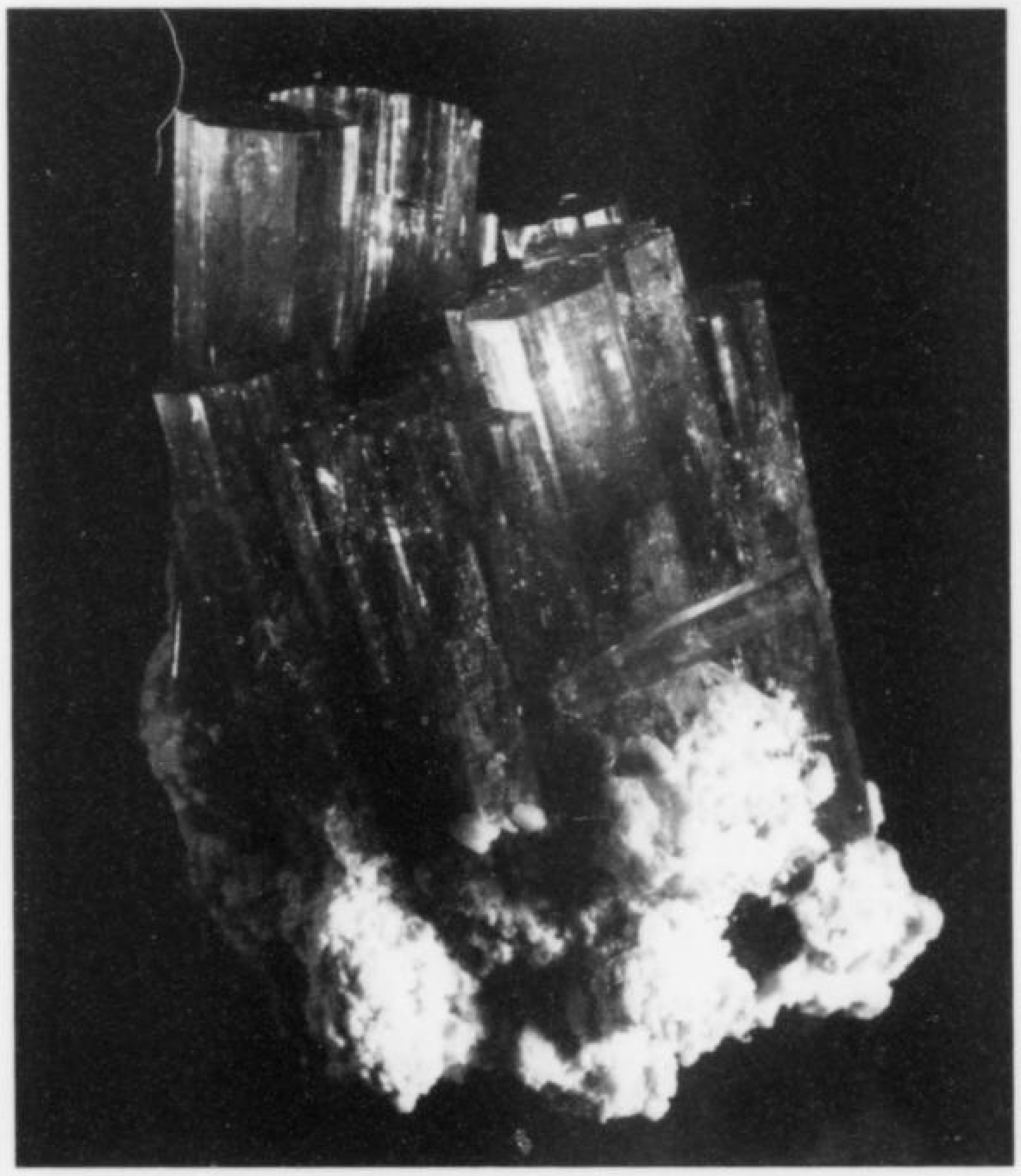


Figure 30. **Andradite crystal on matrix, 2.3 cm, from Tubussis 22, Erongo Mountains. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 31. **Drusy arsenopyrite with schorl, 5.2 cm, from the Krantzberg mine. Bruce Cairncross collection and photo.**

Figure 32. **Cluster of aquamarine crystals, 6.2 cm, collected in April 2000. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



Bergsig 167, Davib West 62, Erongorus 166 and Tubussis 22.

Jahn and Bahmann (2000) describe three different forms of beryl. One type consists of translucent aquamarine, with only about 5 to 10% of the crystals having transparent sections, particularly in the terminations. Most of the crystals have opaque blue sections that may or may not have inclusions of other minerals such as orthoclase and schorl. The crystals are hexagonal prisms $\{10\bar{1}0\}$ with basal pinacoids {0001}. Some of the crystals are vertically color zoned, parallel to the *c*-axis, from dark blue at the base to paler blue, transparent terminations. Color zonations also occur in cross section, perpendicular to the *c*-axis, with colorless cores surrounded by intense blue outer rims. The second variety of aquamarine consists of matrix specimens up to 20 × 20 cm, and the third variety consists of colorless, transparent beryl. Since Jahn and Bahmann's (2000) publication, several other types and associations of beryl have been found.

Some of the early discoveries in September 1999 were typified by transparent green, fluorescent crystals. Later pockets produced crystals showing various shades of blue. It is important to note that not all of the aquamarine crystals are color zoned; some are transparent throughout the length of the prisms while others are completely included and opaque. Aquamarine crystals up to 10 cm are common and larger crystals up to 30 cm have been reported (Gerd Bachran, personal communication, 2005).

The association of blue beryl with black, lustrous schorl and

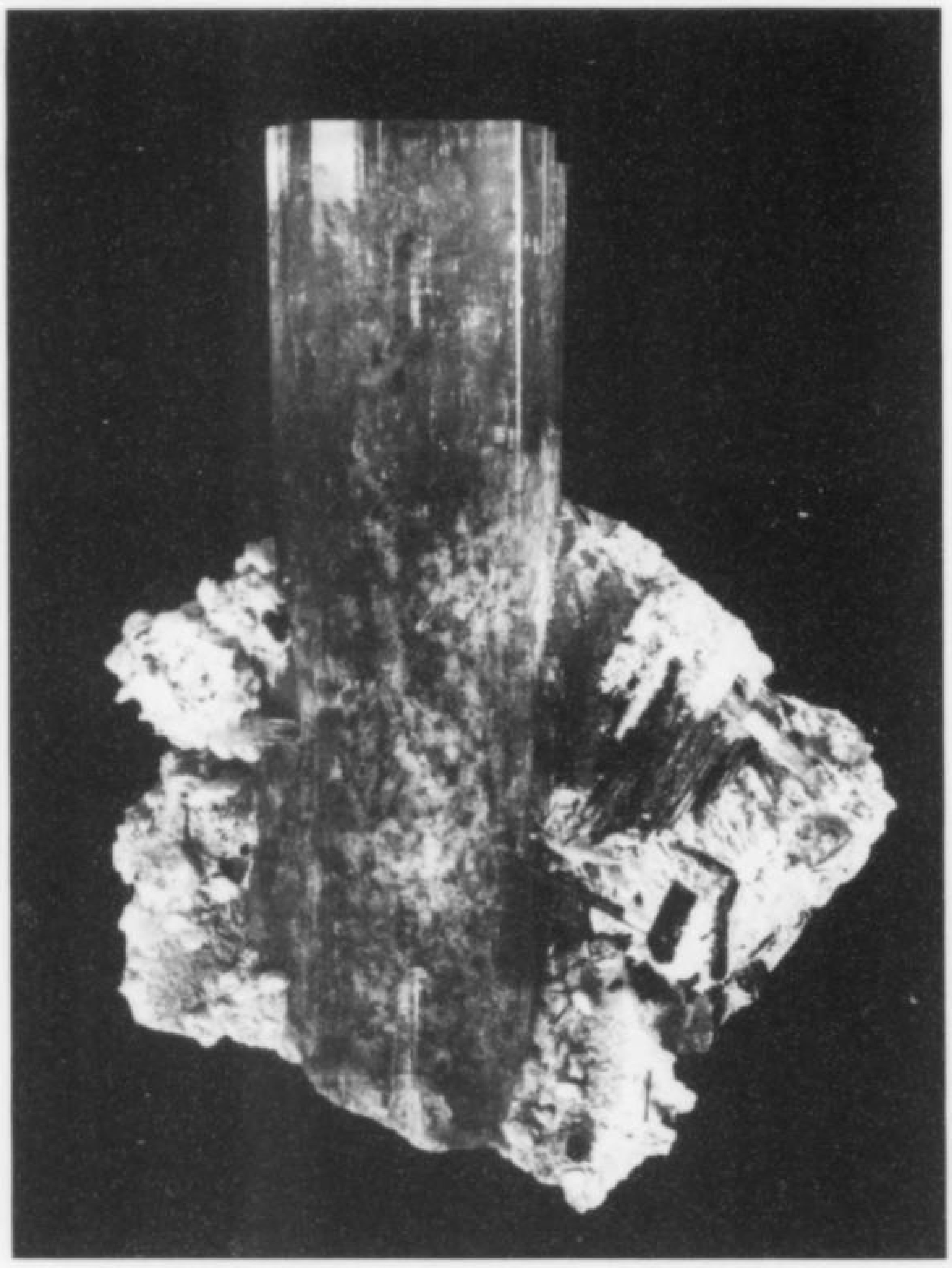


Figure 33. Aquamarine crystal, 9.5 cm, on orthoclase with schorl. Erongo Mountains, Namibia. Desmond Sacco collection; Bruce Cairncross photo.

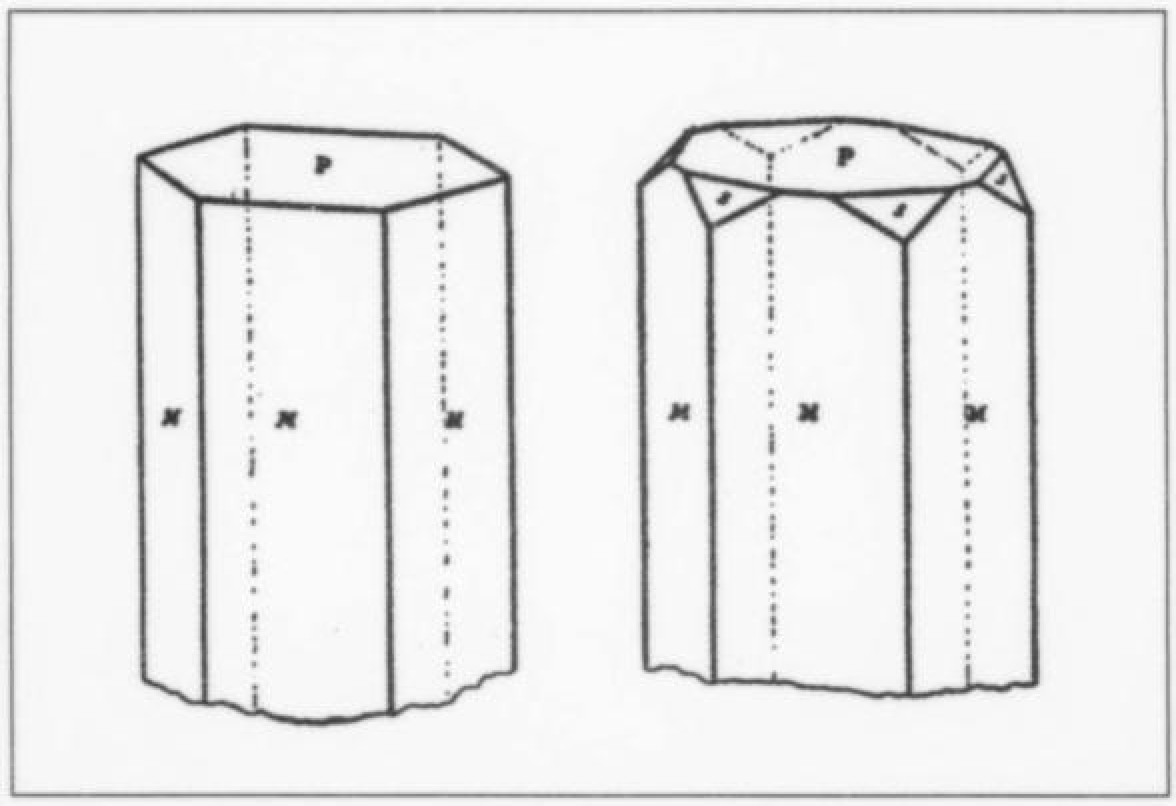


Figure 35. Drawings of Ural Mountains beryl crystals identical in habit to those from Erongo (Goldschmidt, 1913).

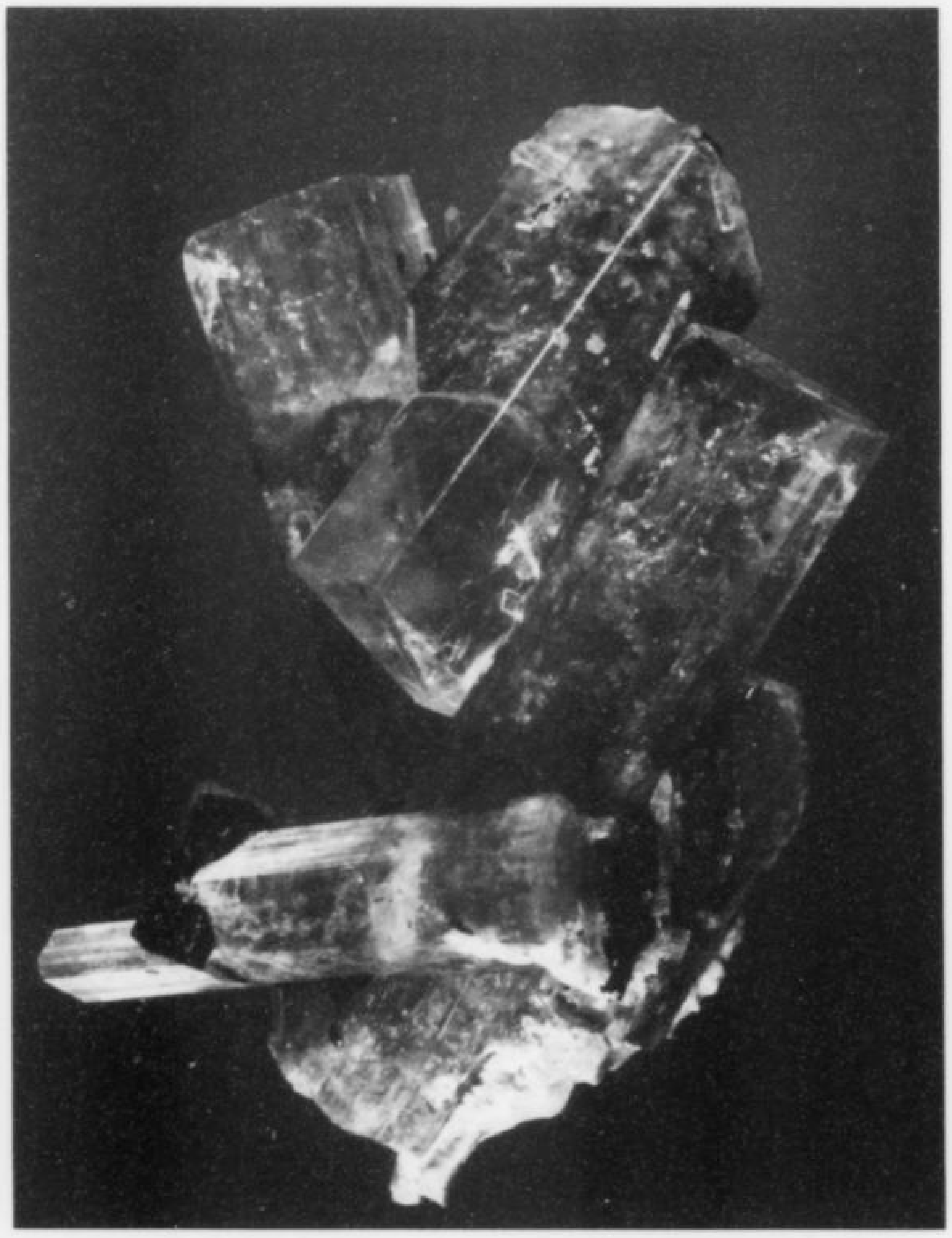


Figure 36. Cluster of aquamarine crystals on orthoclase, 9 cm. Erongo Mountains, Namibia. Desmond Sacco collection; Bruce Cairncross photo.

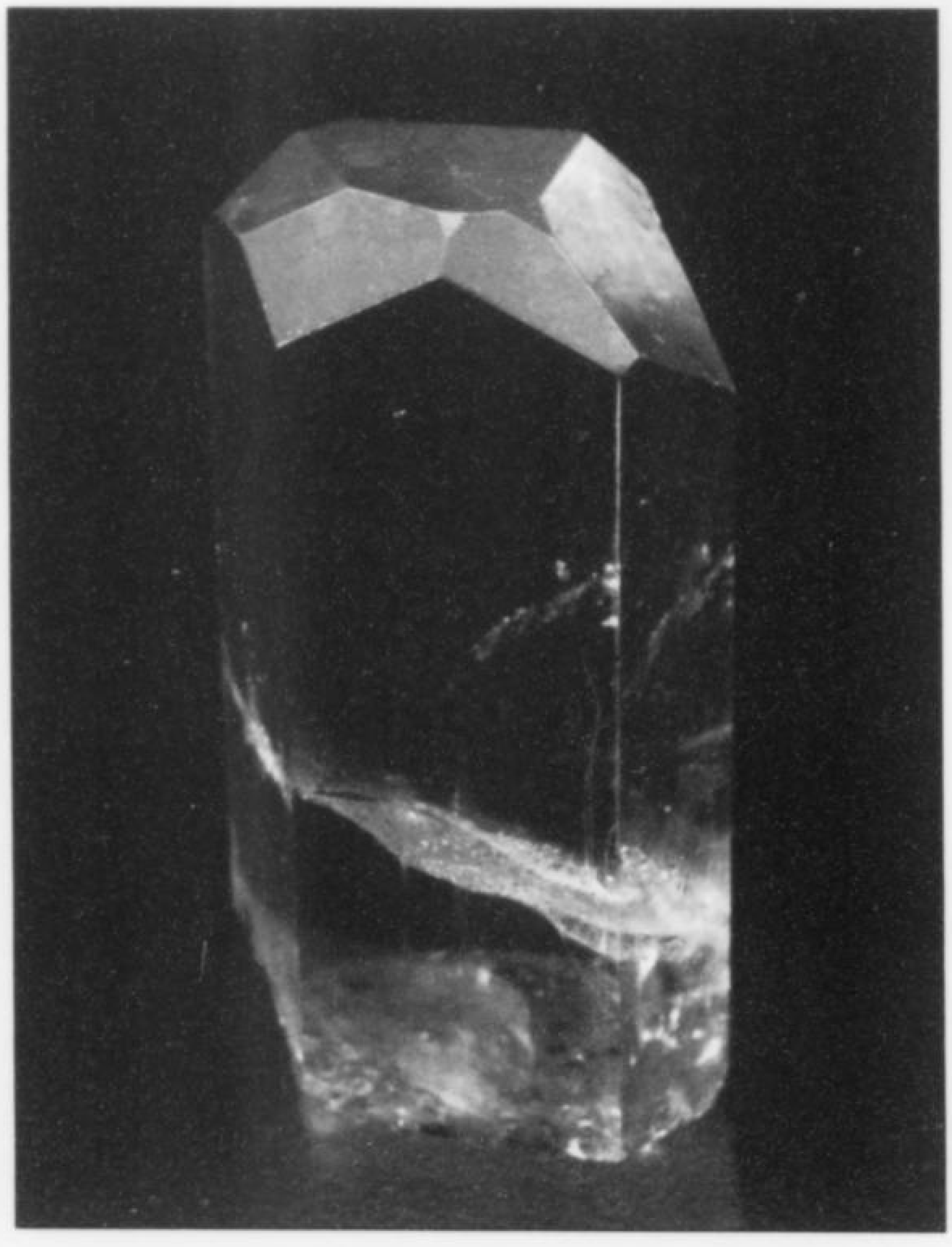


Figure 34. Gem-quality aquamarine crystal, 3.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

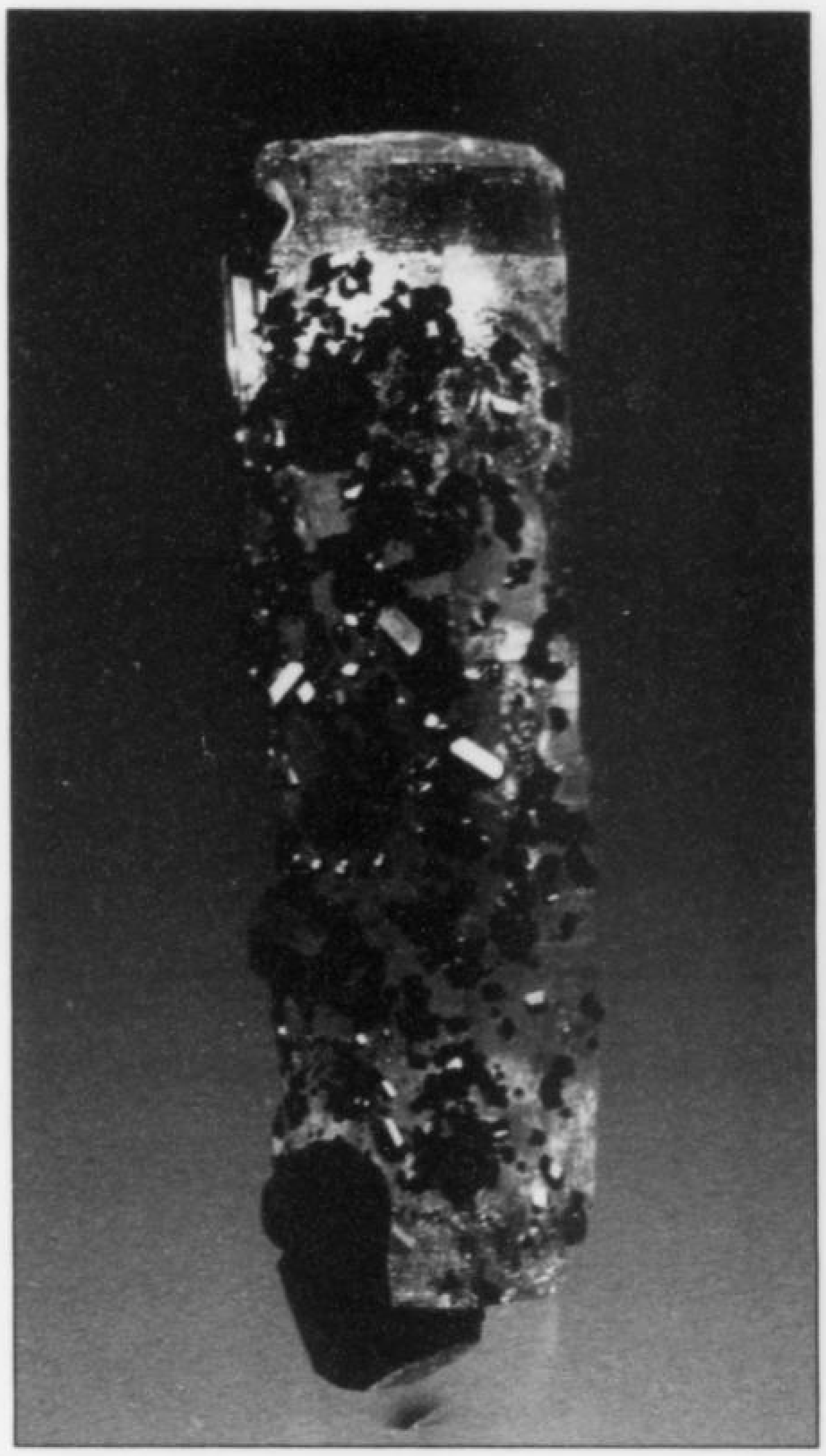


Figure 37. **Aquamarine crystal, 6.2 cm, studded with schorl. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

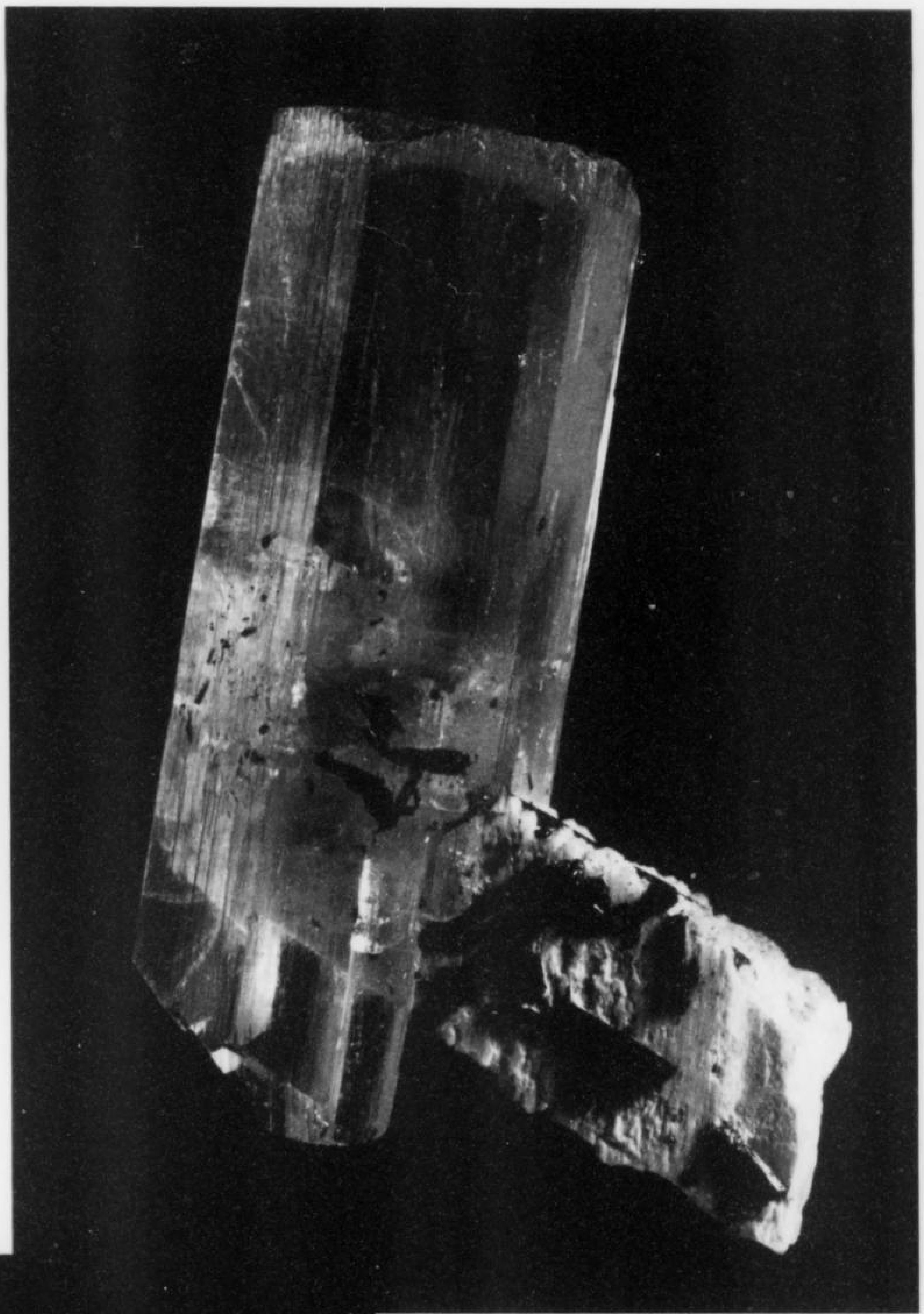


Figure 39. **Doubly terminated aquamarine overgrown on a Carlsbad-law twin of orthoclase, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

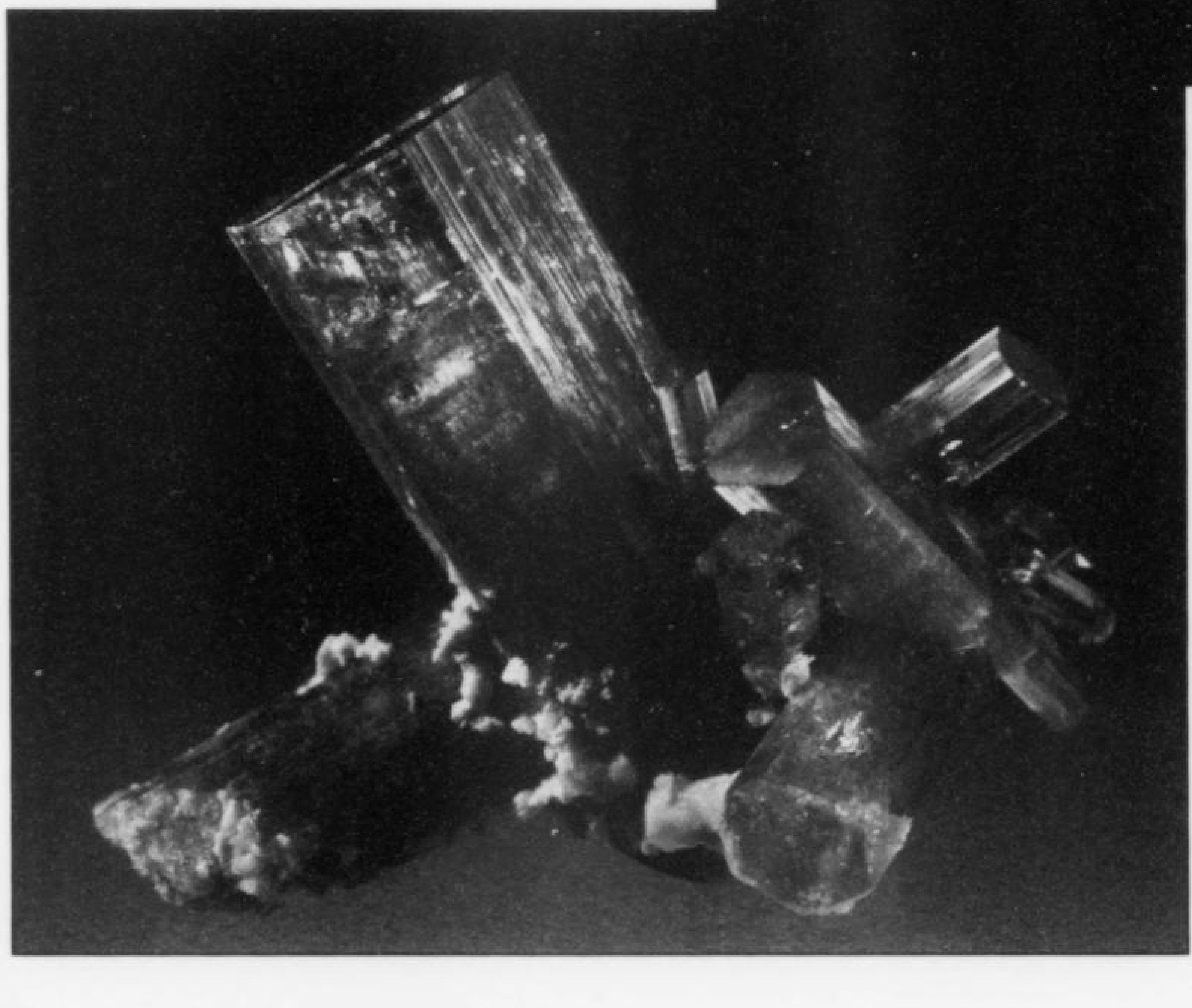


Figure 38. **Aquamarine cluster with minor orthoclase, 6.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

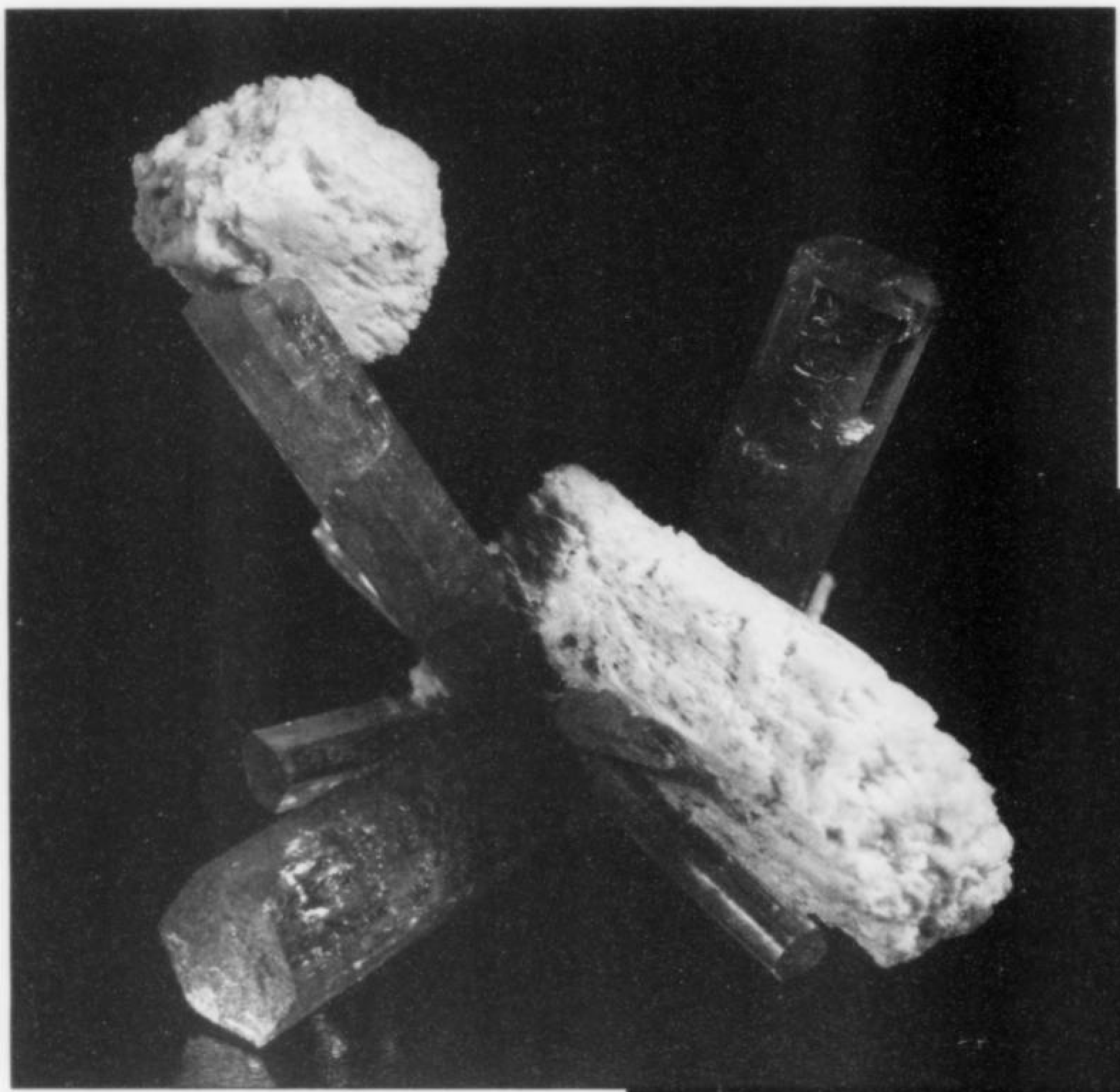


Figure 40. **Stellate cluster of aquamarine with randomly attached orthoclase, 5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

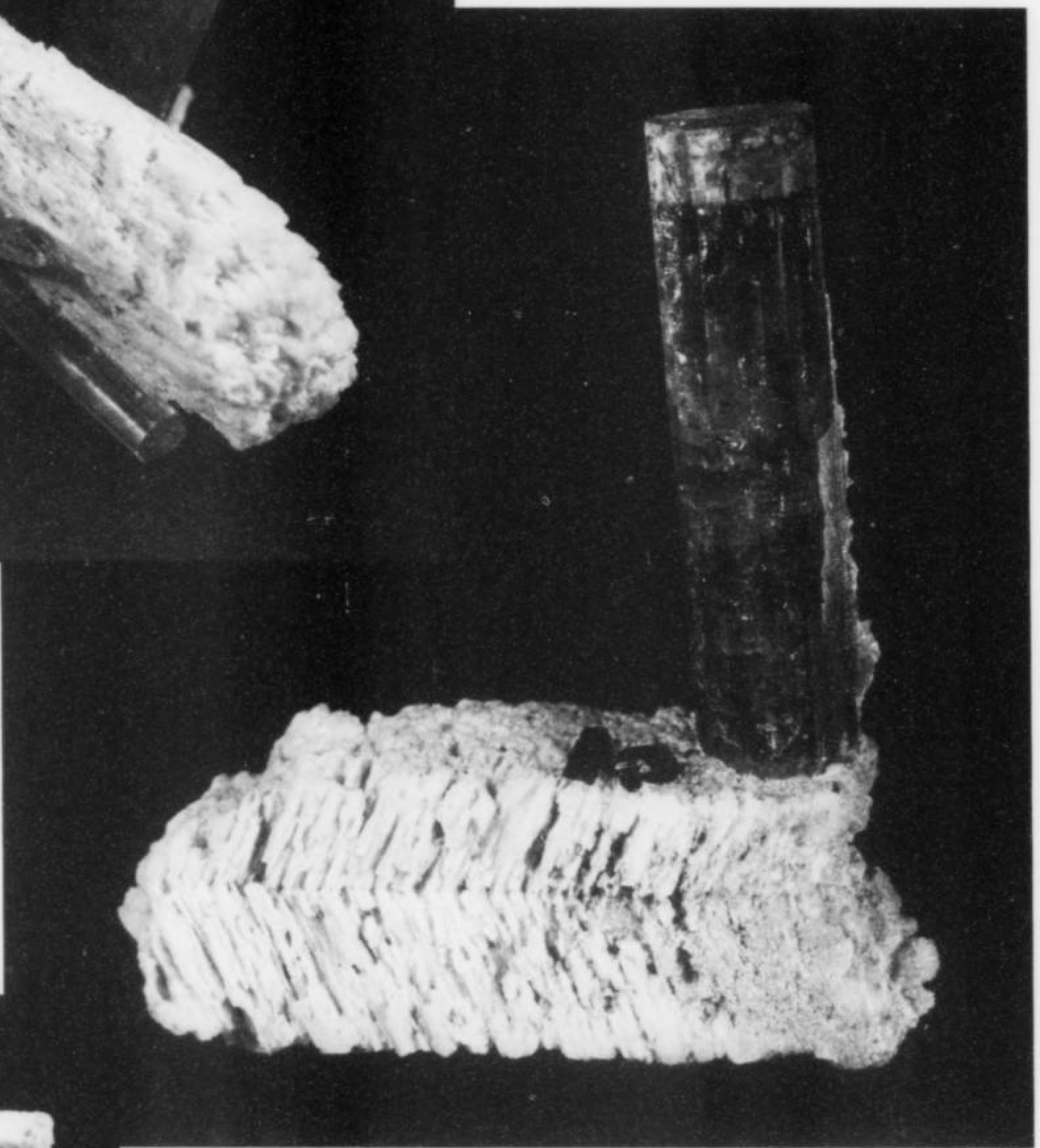
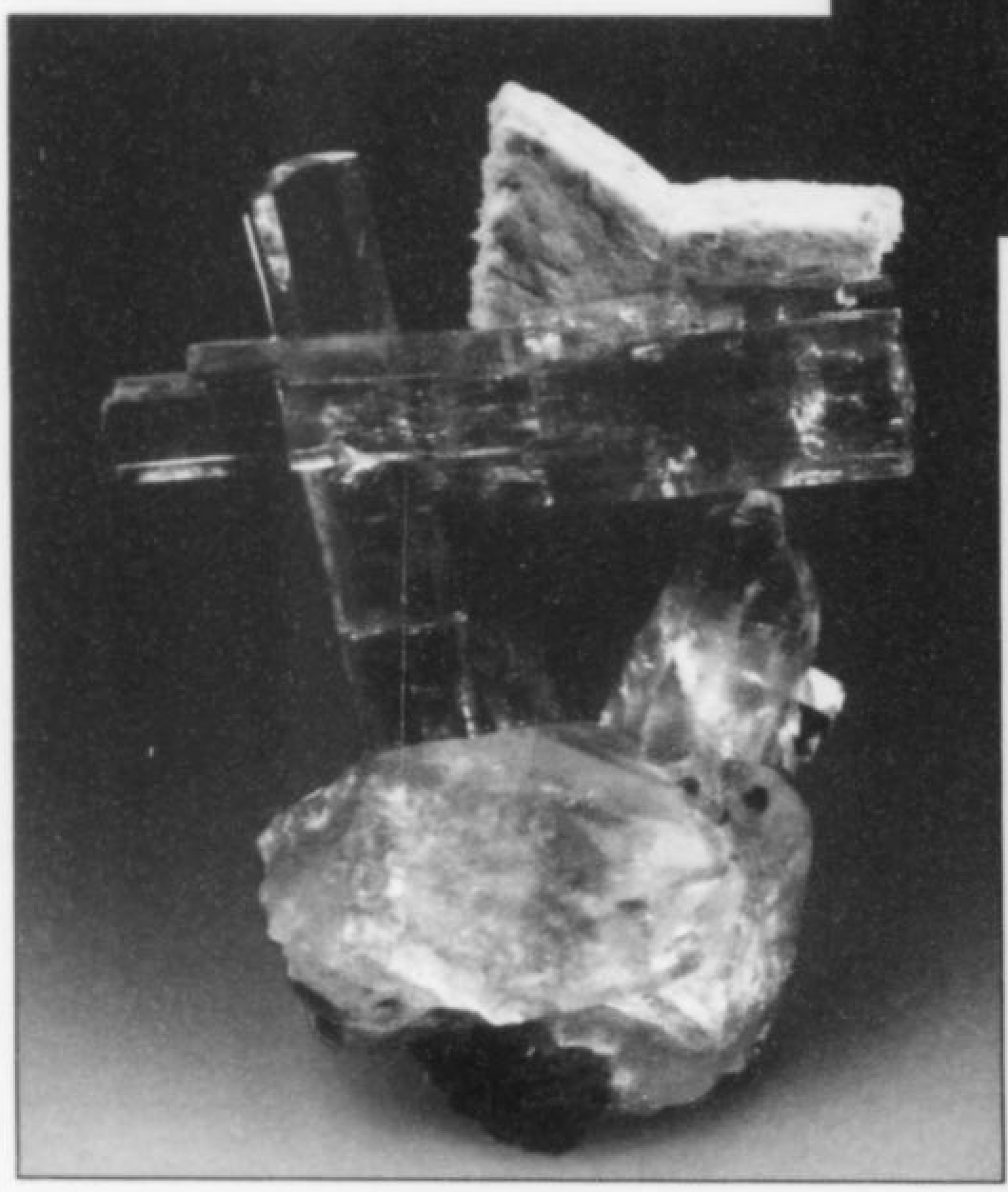


Figure 41. **Aquamarine crystal perched on Carlsbad-law twinned, corroded orthoclase, 4.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 42. **Cruciform aquamarine with quartz and Carlsbad-law twinned orthoclase, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



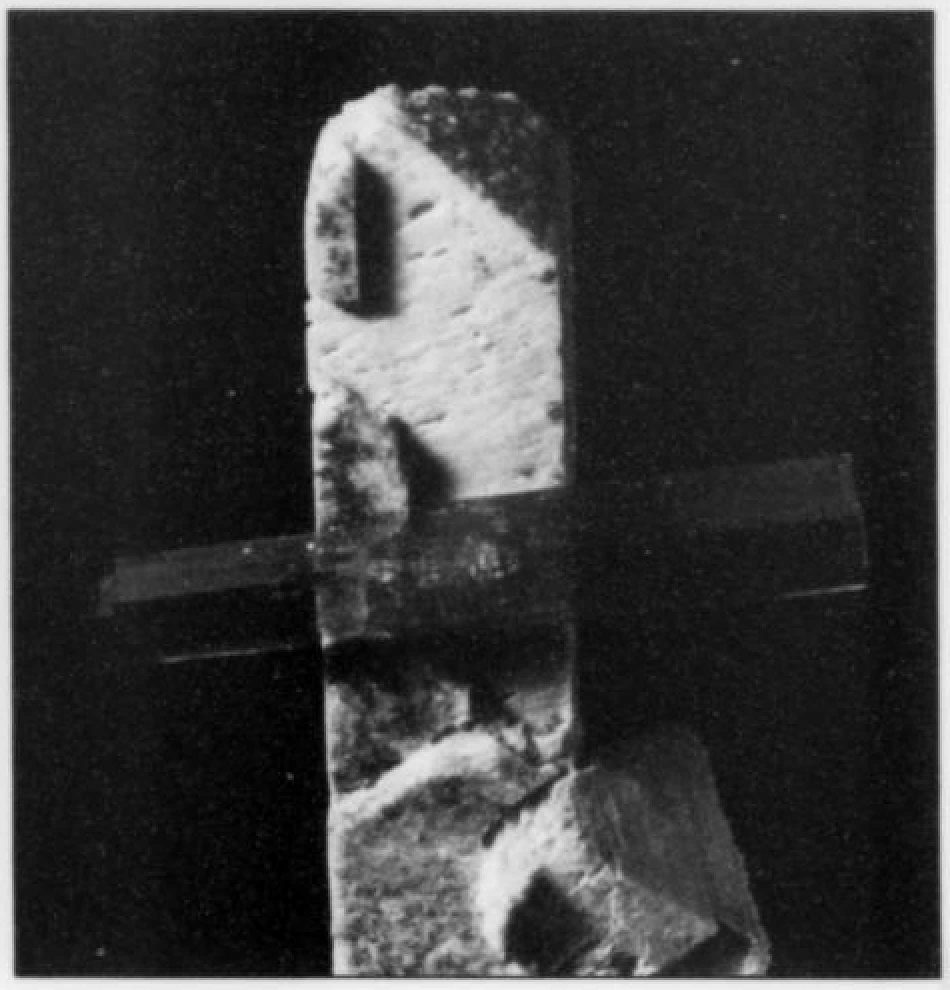


Figure 43. **Doubly terminated aquamarine attached to Manebach-law twinned orthoclase, 4.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

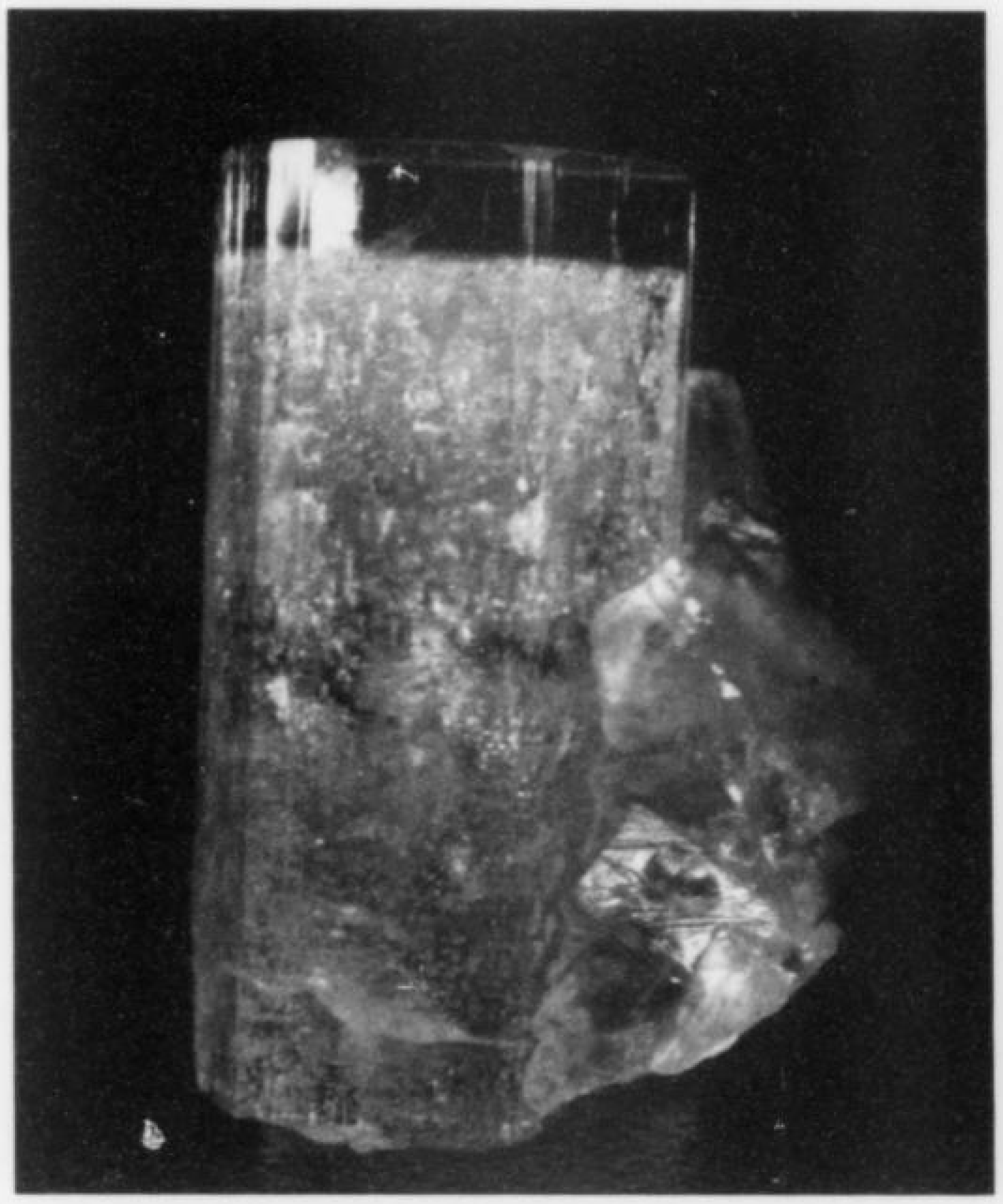


Figure 44. **Aquamarine with fluorite, 2.3 cm. Note the colorless, transparent termination, typical of many Erongo aquamarines. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**

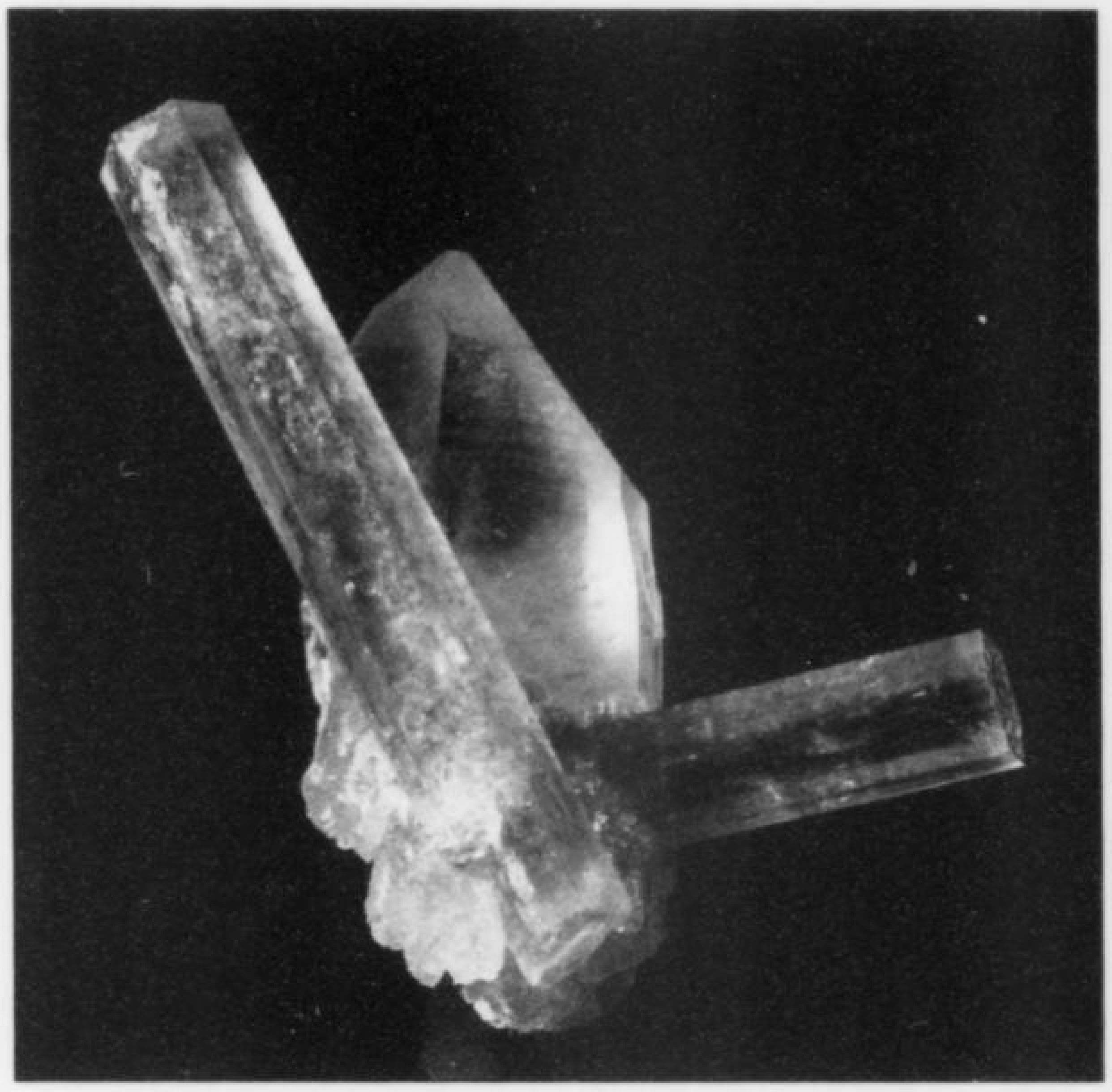
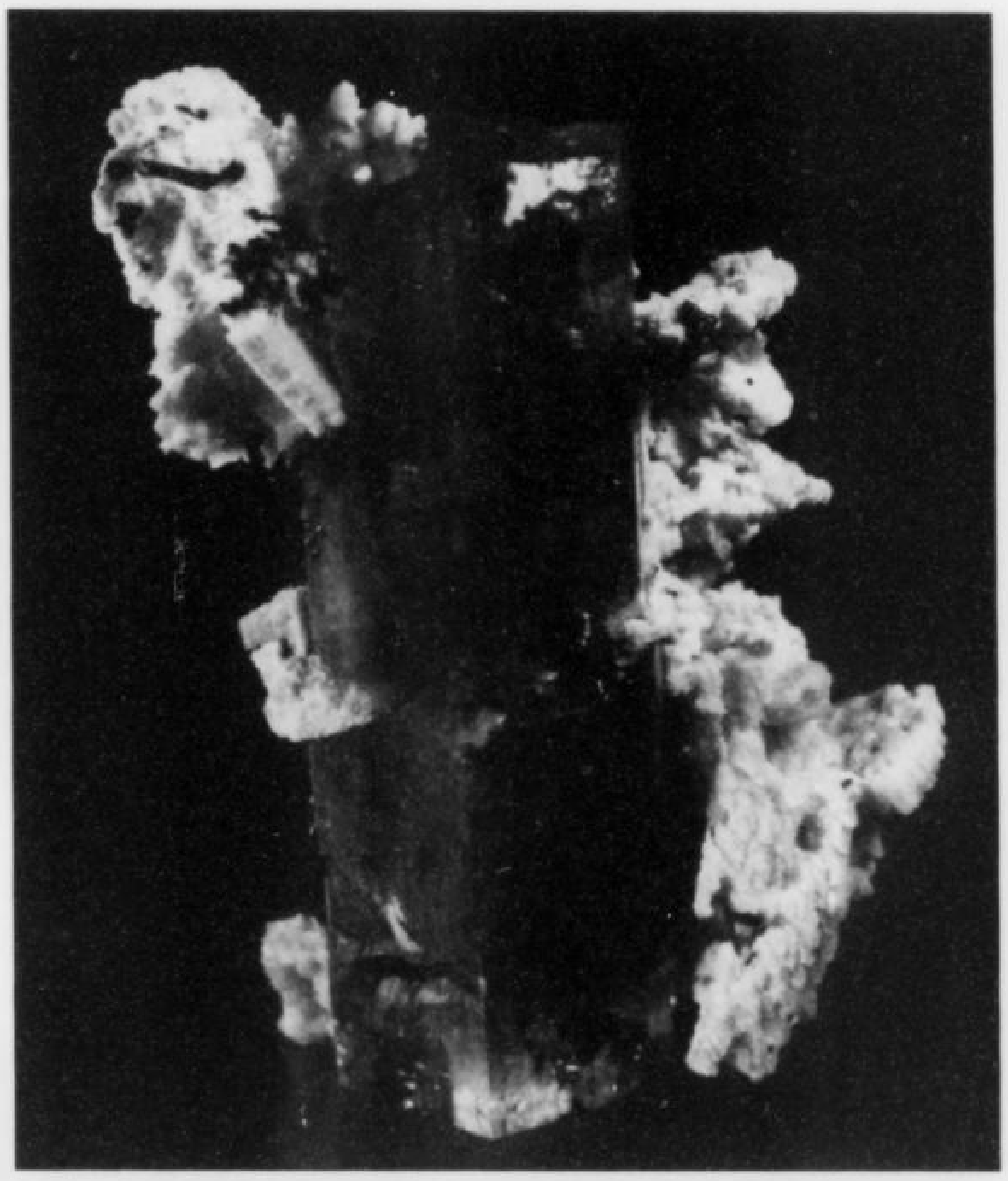


Figure 45. **Aquamarine crystals attached to quartz, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 46. **Aquamarine intergrown with orthoclase, 8.2 cm. Aquamarine crystal, 7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



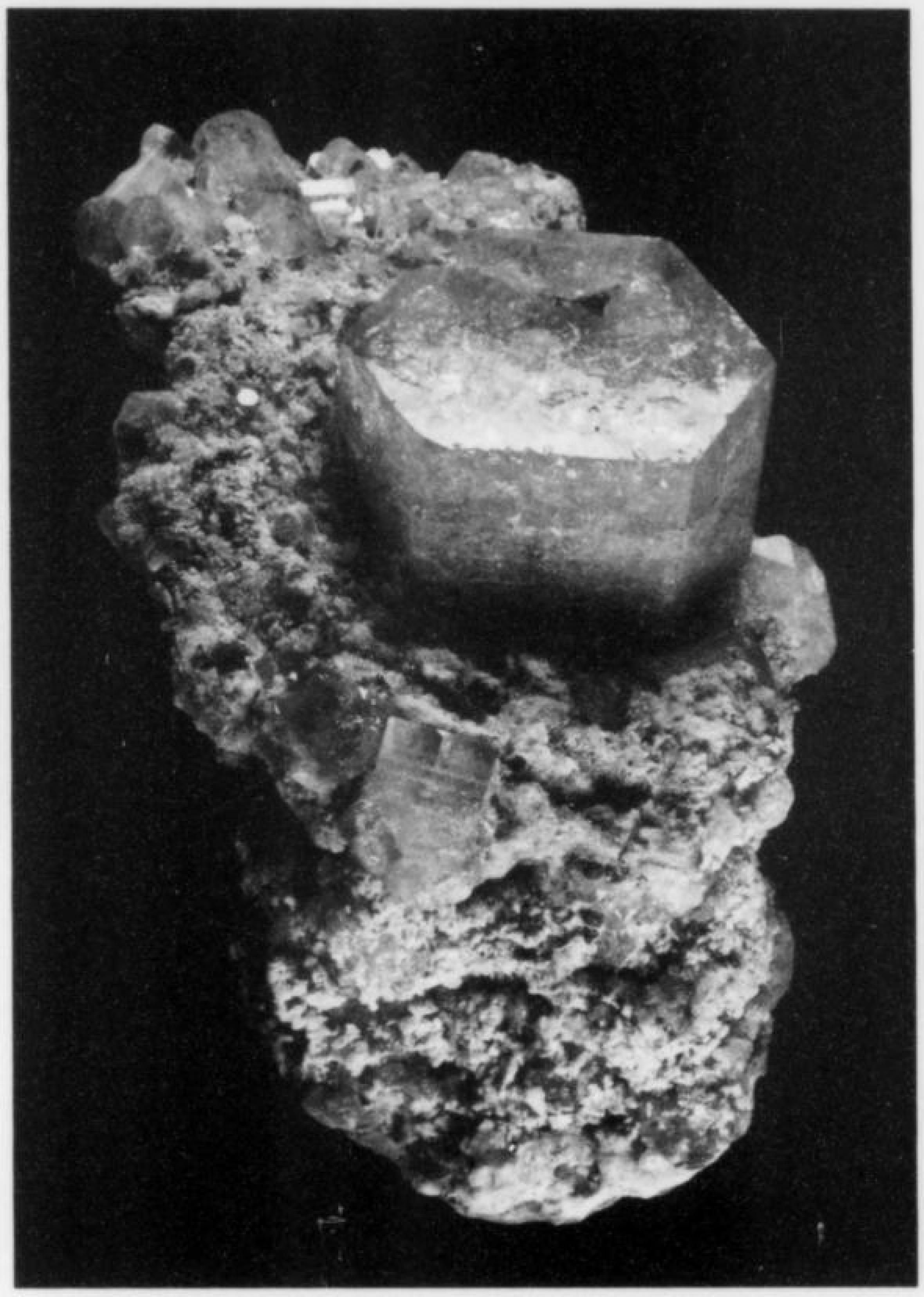


Figure 47. **Aquamarine on matrix, 13 cm. This was one of the first specimens collected in 1999. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

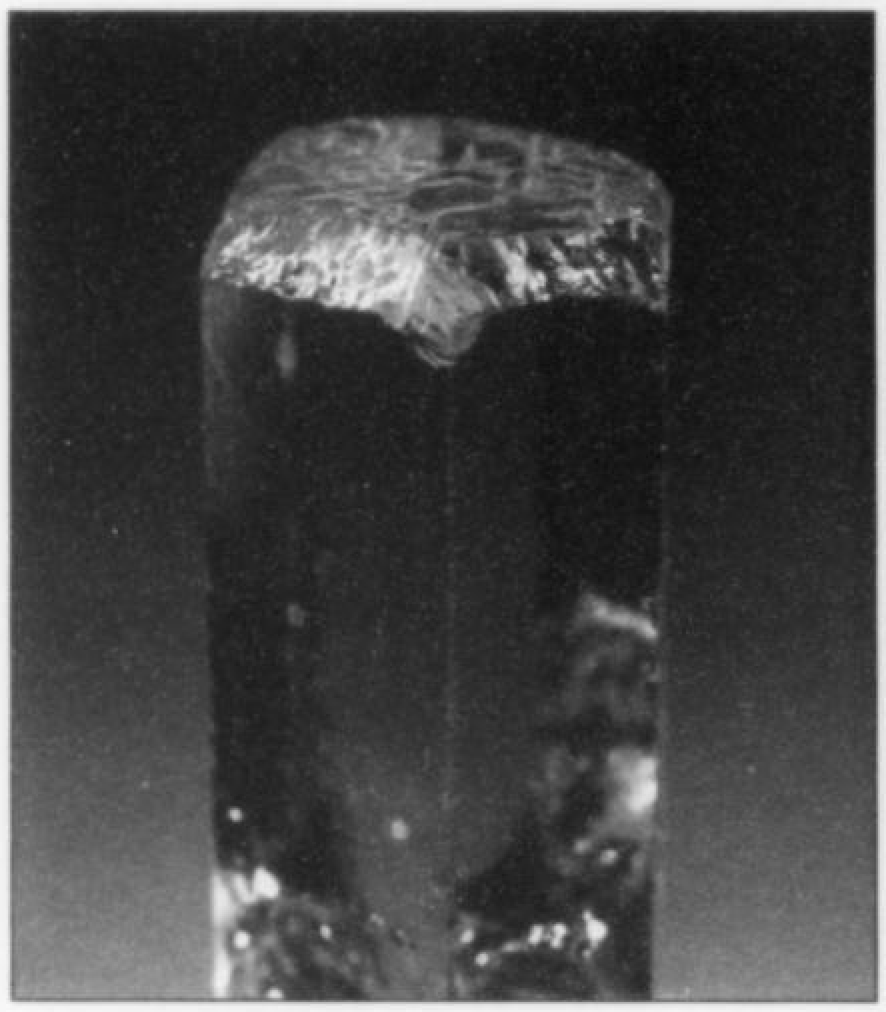


Figure 48. **Green aquamarine crystal, 3.2 cm, with complexly etched termination. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 51. **Aquamarine with schorl, 2.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

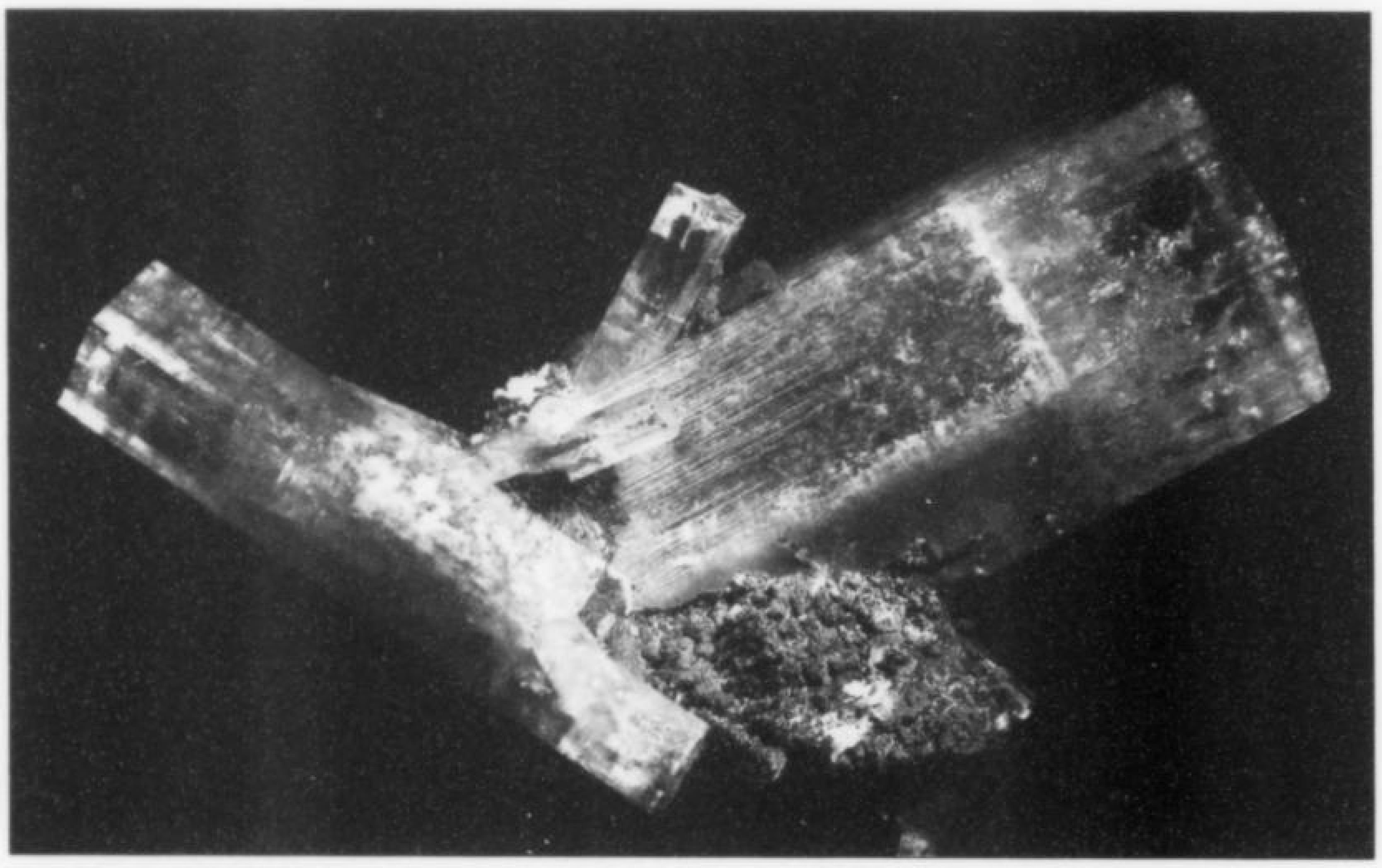


Figure 49. **Aquamarine crystals on orthoclase, 8.3 cm. Note the characteristic color zoning. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

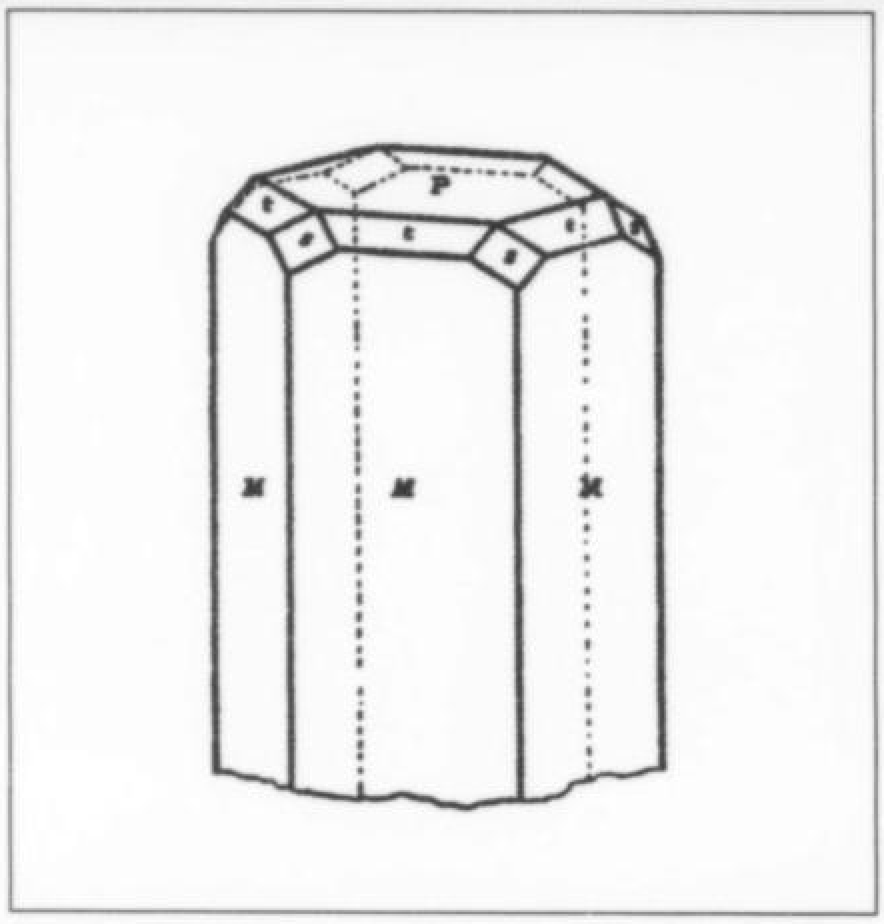


Figure 50. **Drawing of a Ural Mountains beryl crystal identical in habit to those from Erongo (Goldschmidt, 1913).**

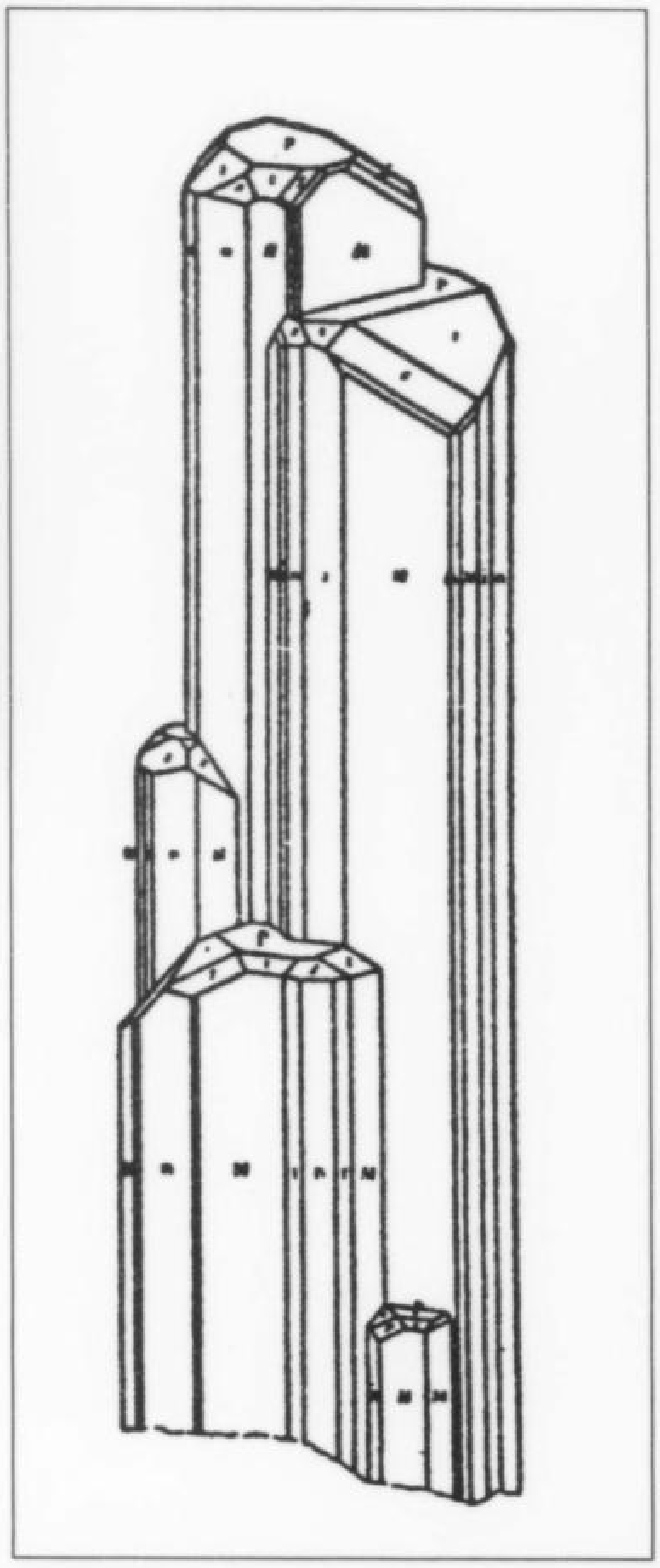
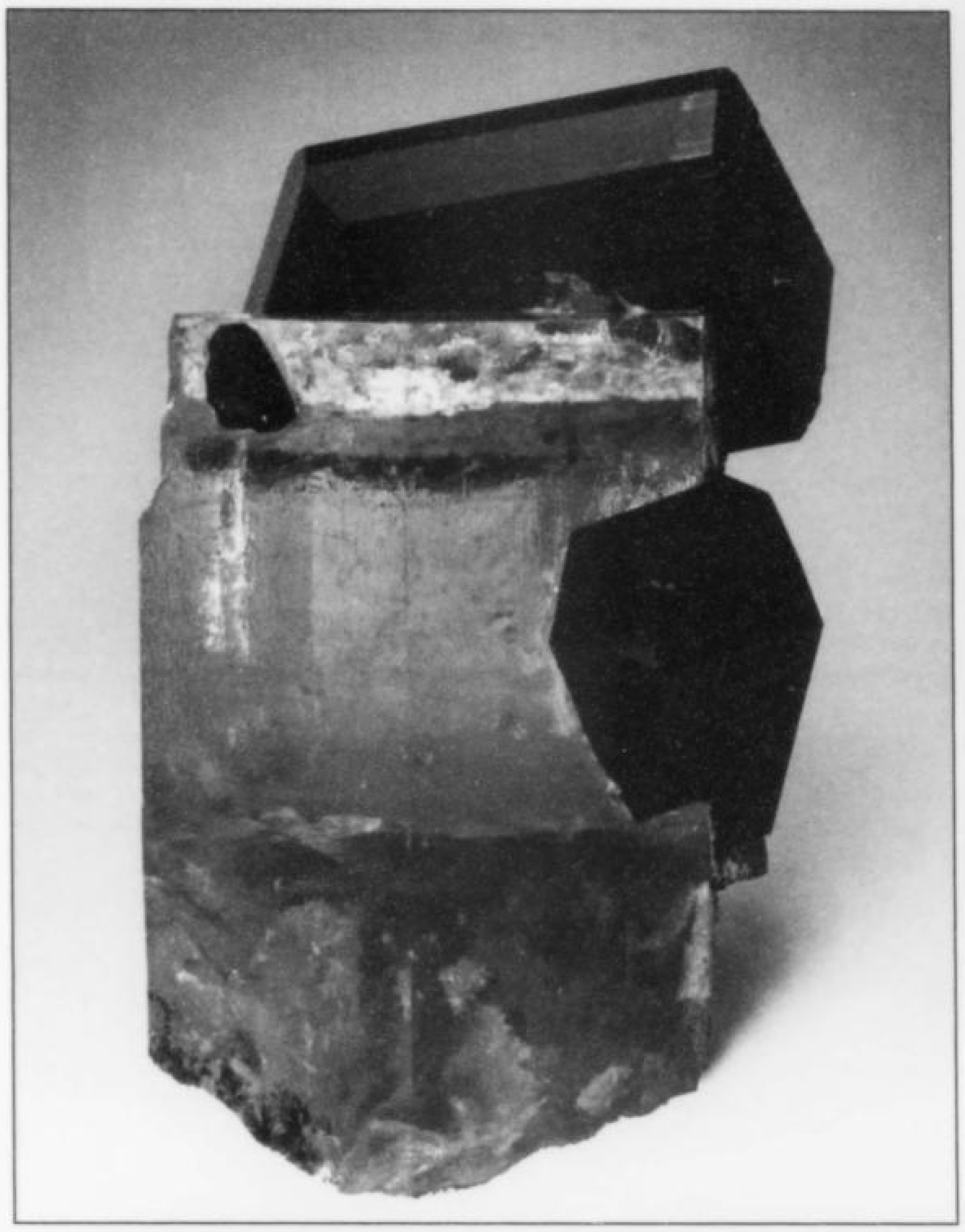


Figure 52. **A drawing of Mursinka beryl crystals similar in habit to those from Erongo (Goldschmidt, 1913).**

Figure 53. **Aquamarine and schorl, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



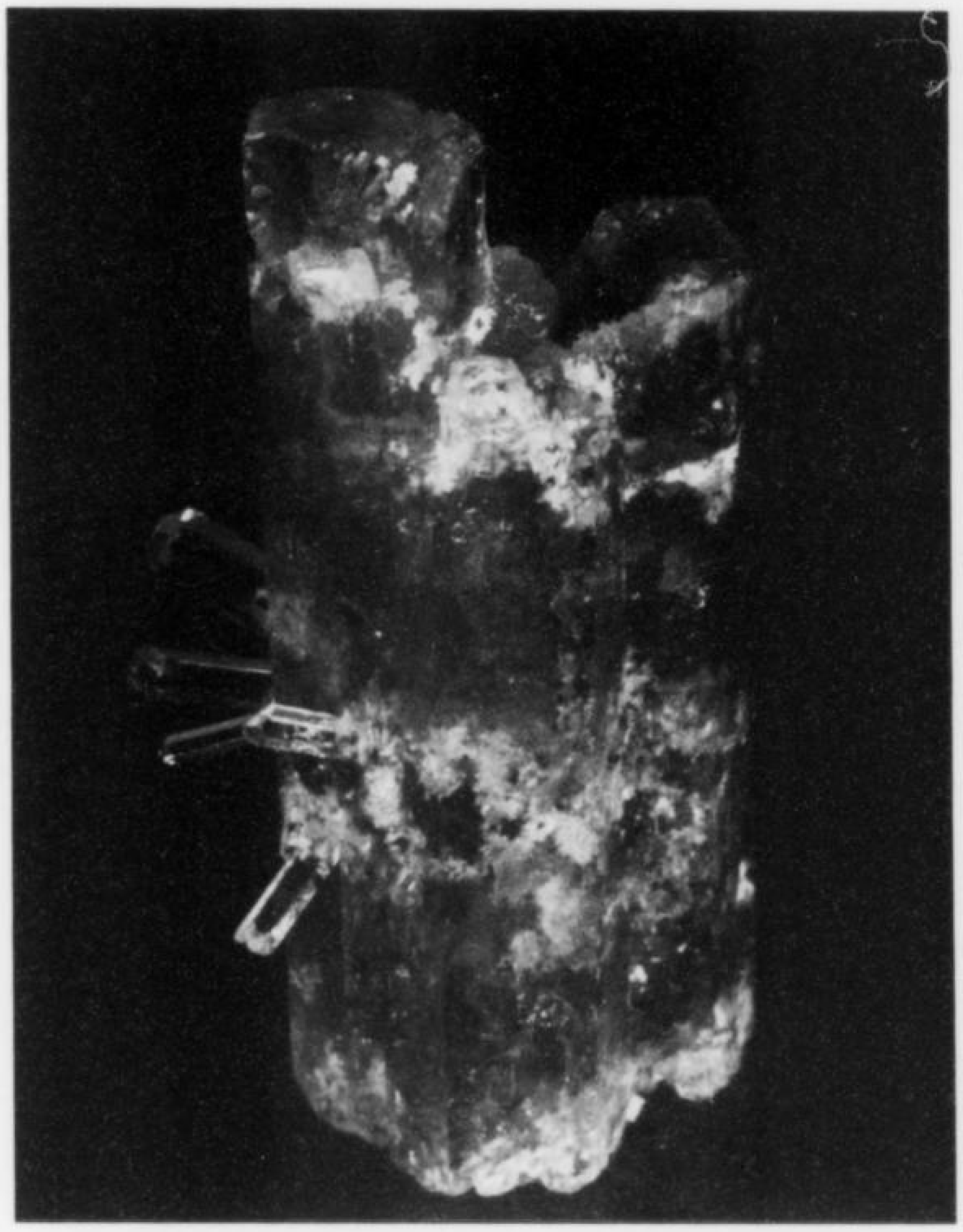
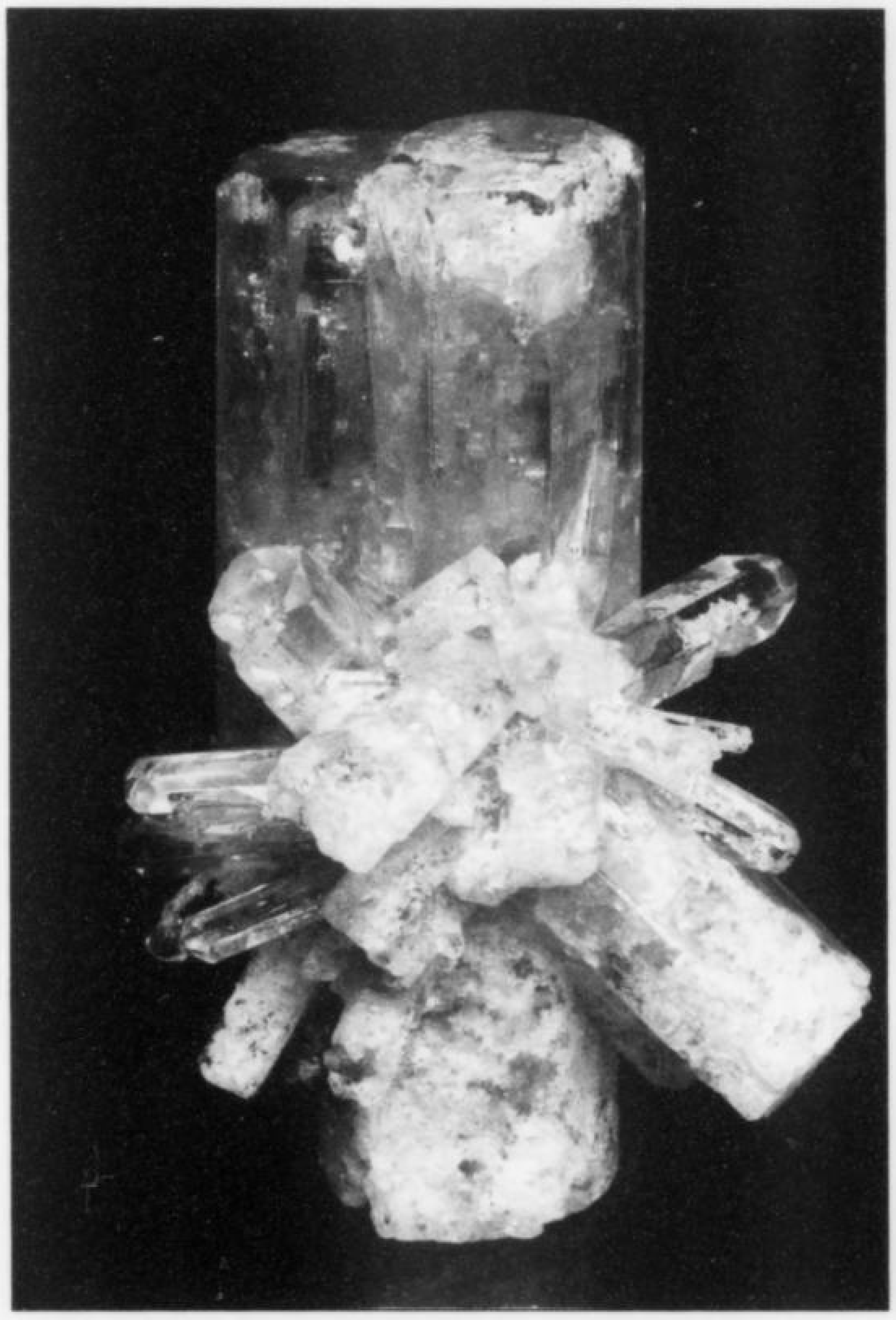


Figure 55. **Aquamarine, 7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



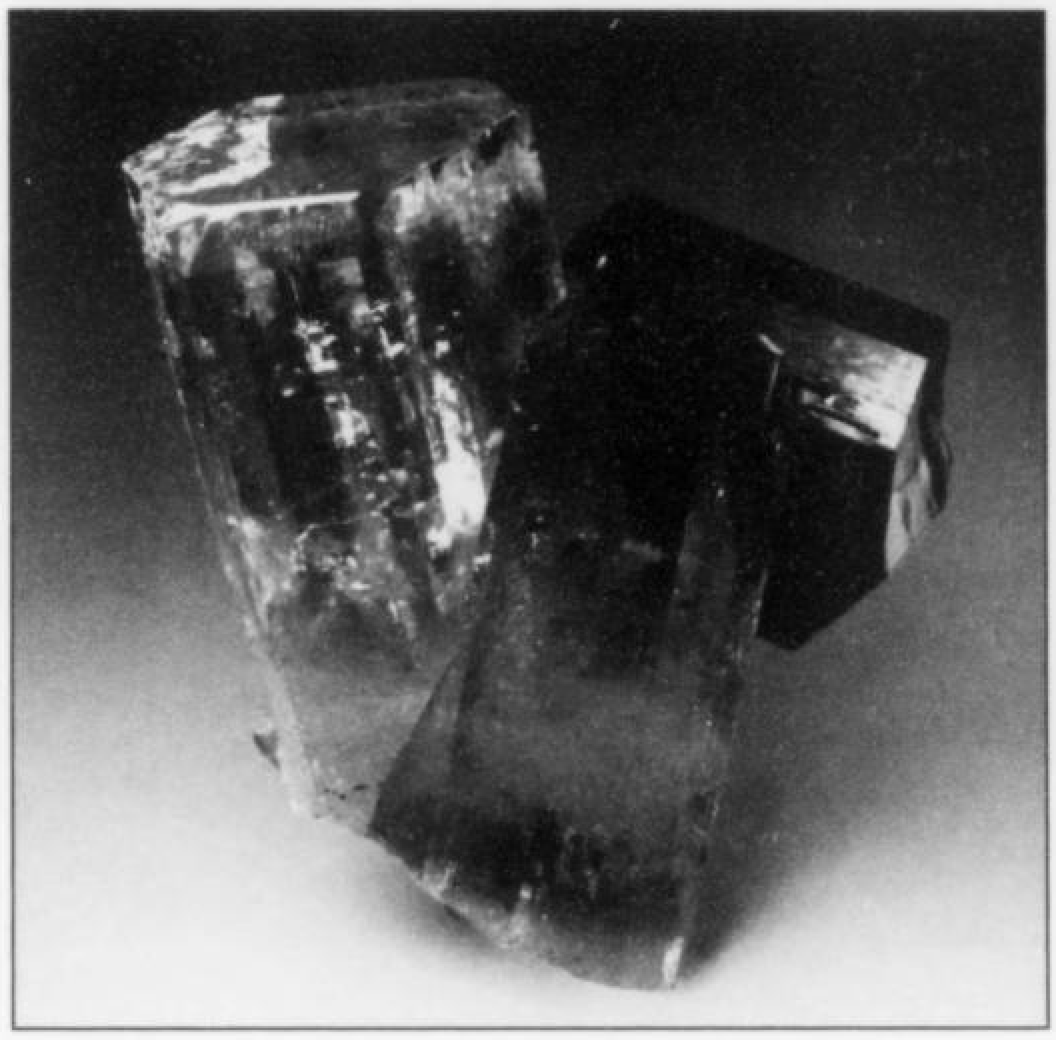


Figure 56. **Gem-quality aquamarine with schorl, 3.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 54. **Aquamarine, 7.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

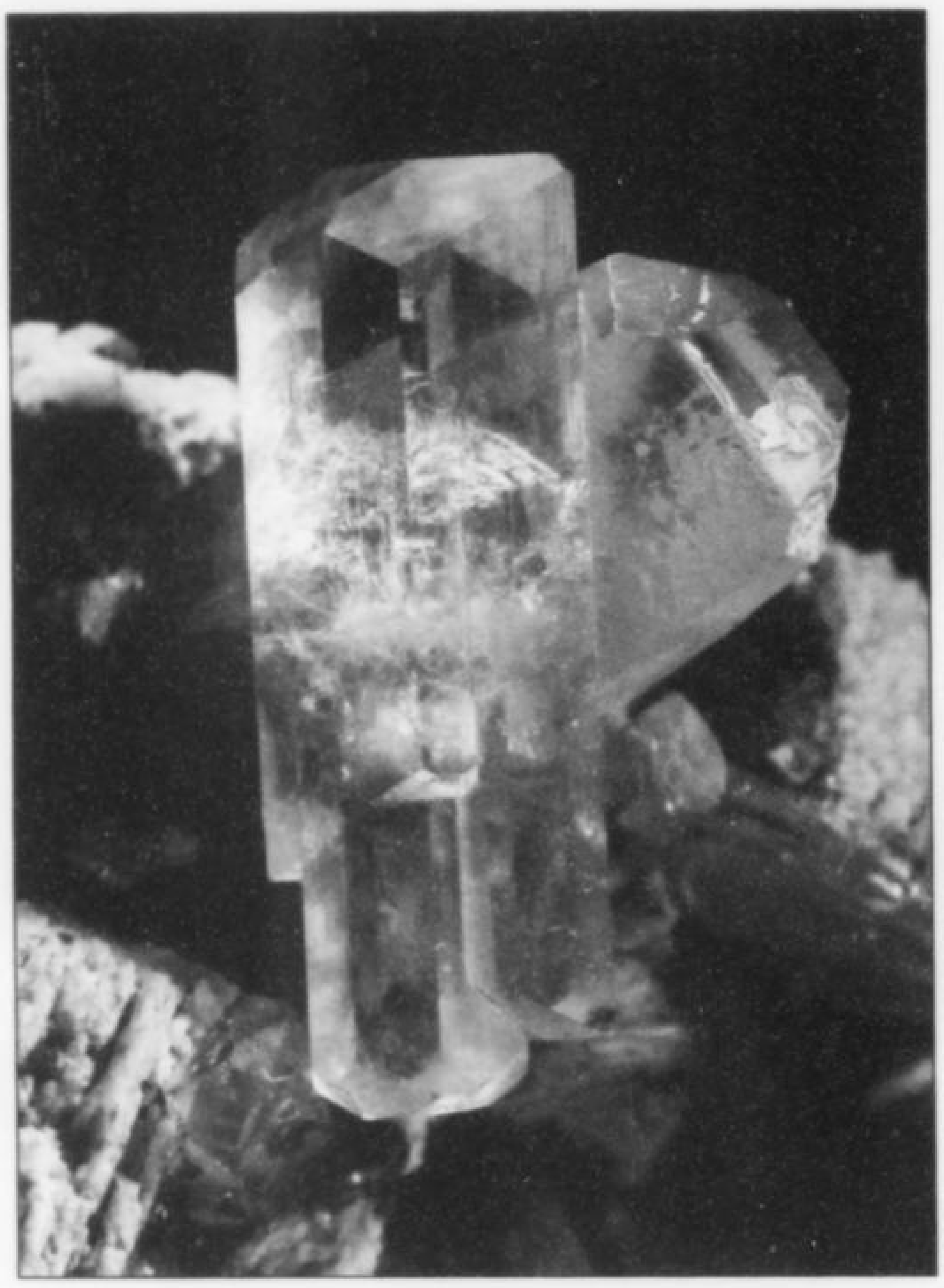
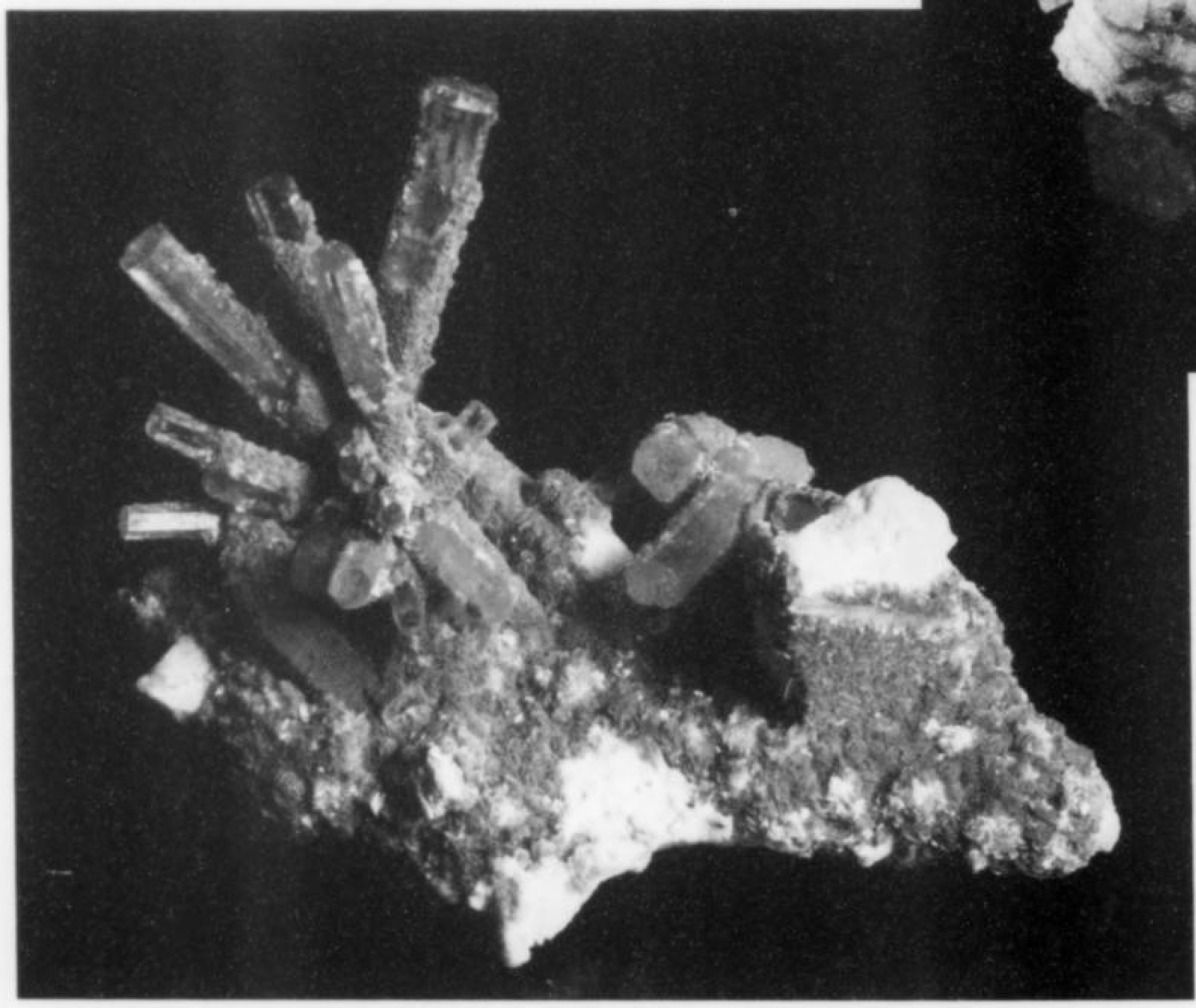


Figure 57. Aquamarine with quartz and orthoclase, 3.4 cm. Erongo Mountains, Namibia. Private collection; Ernst A. Schnaitmann photo.

Figure 59. Aquamarine crystal, 2.8 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 58. Cluster of aquamarine associated with muscovite and quartz, 6.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



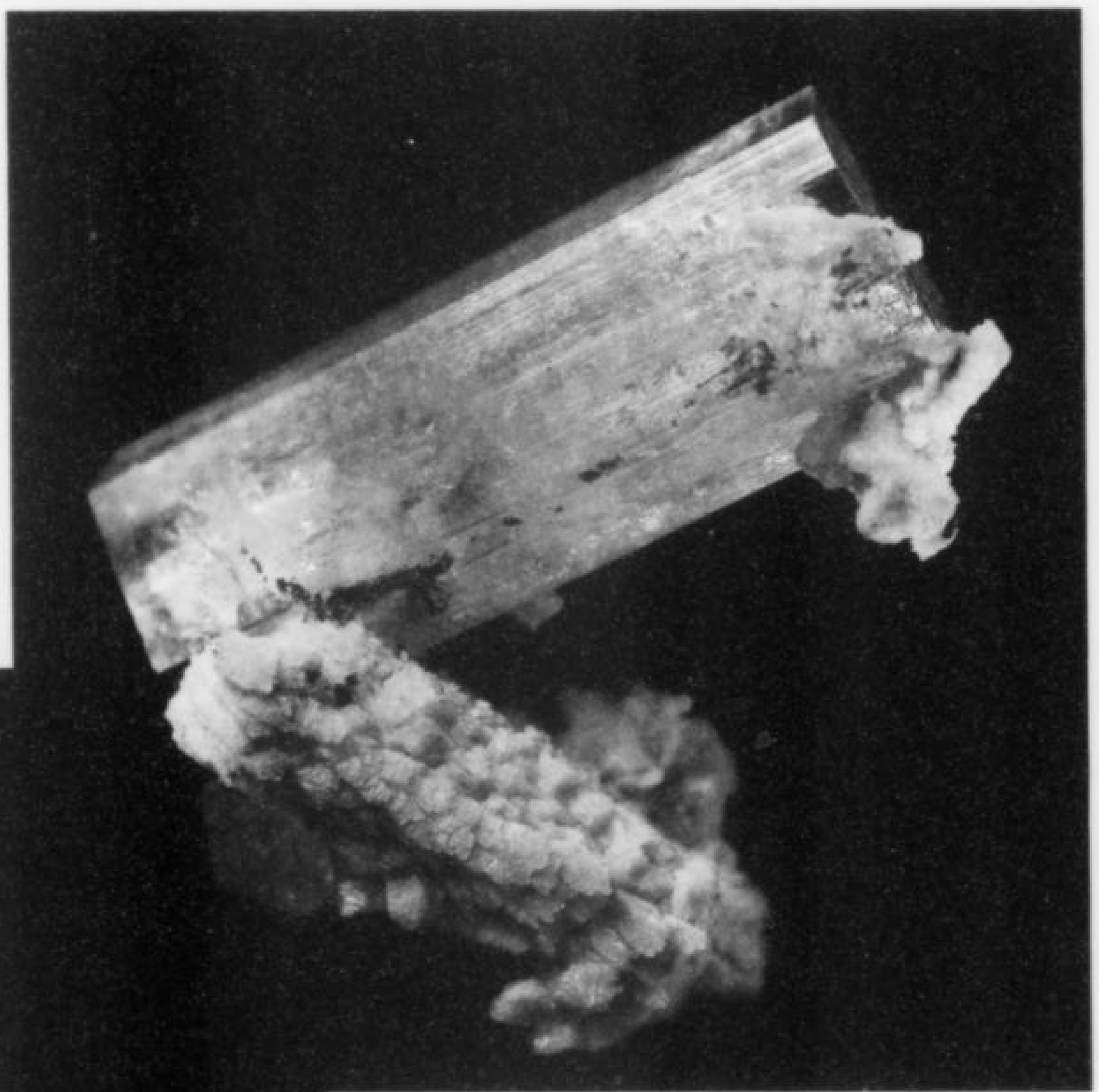


Figure 60. Doubly terminated, zoned aquamarine on orthoclase, 3.5 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

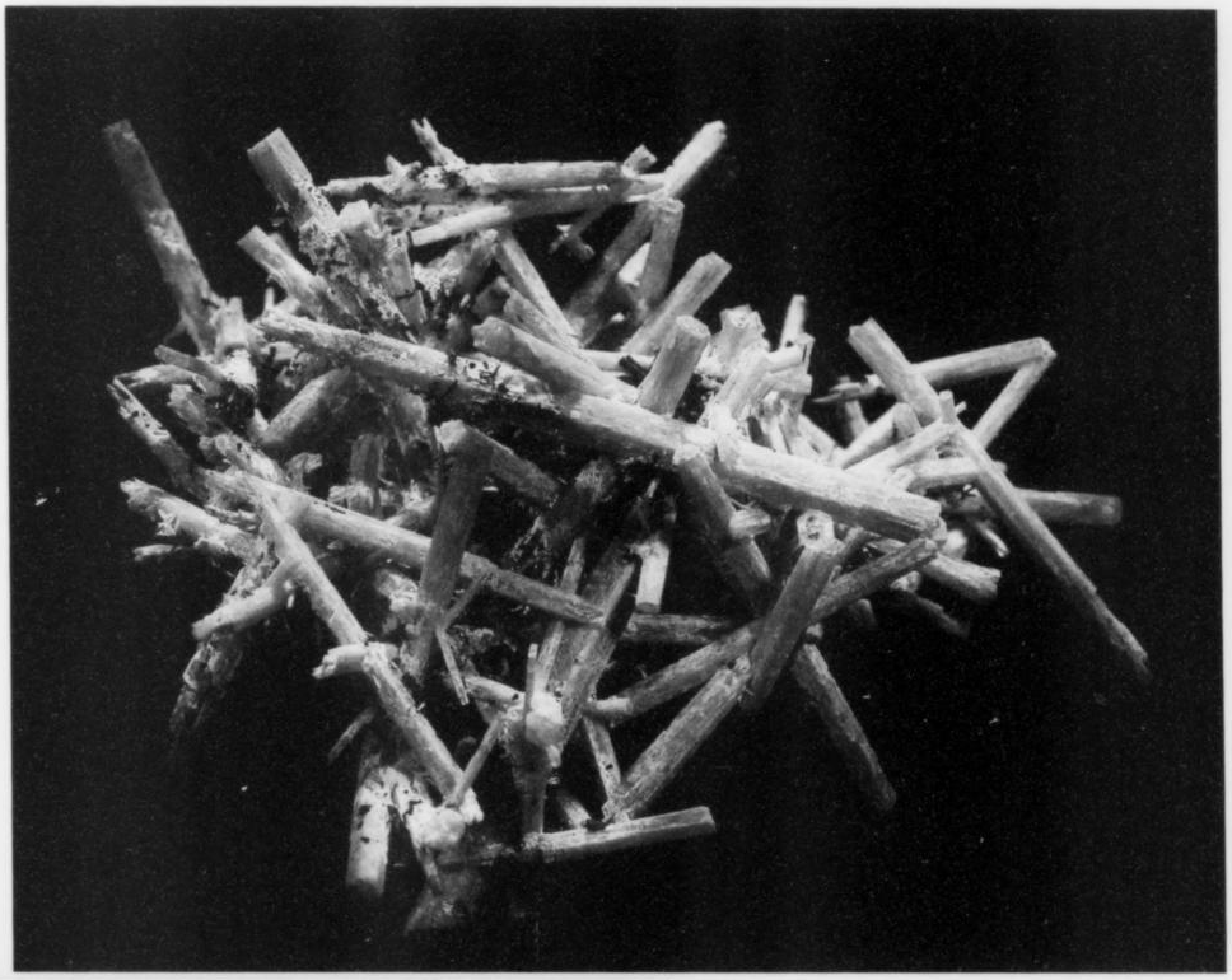


Figure 61. A network of intergrown aquamarine crystals, 9 cm, with orthoclase inclusions. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 62. An intergrown network of color-zoned aquamarine and yellow beryl, 8.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

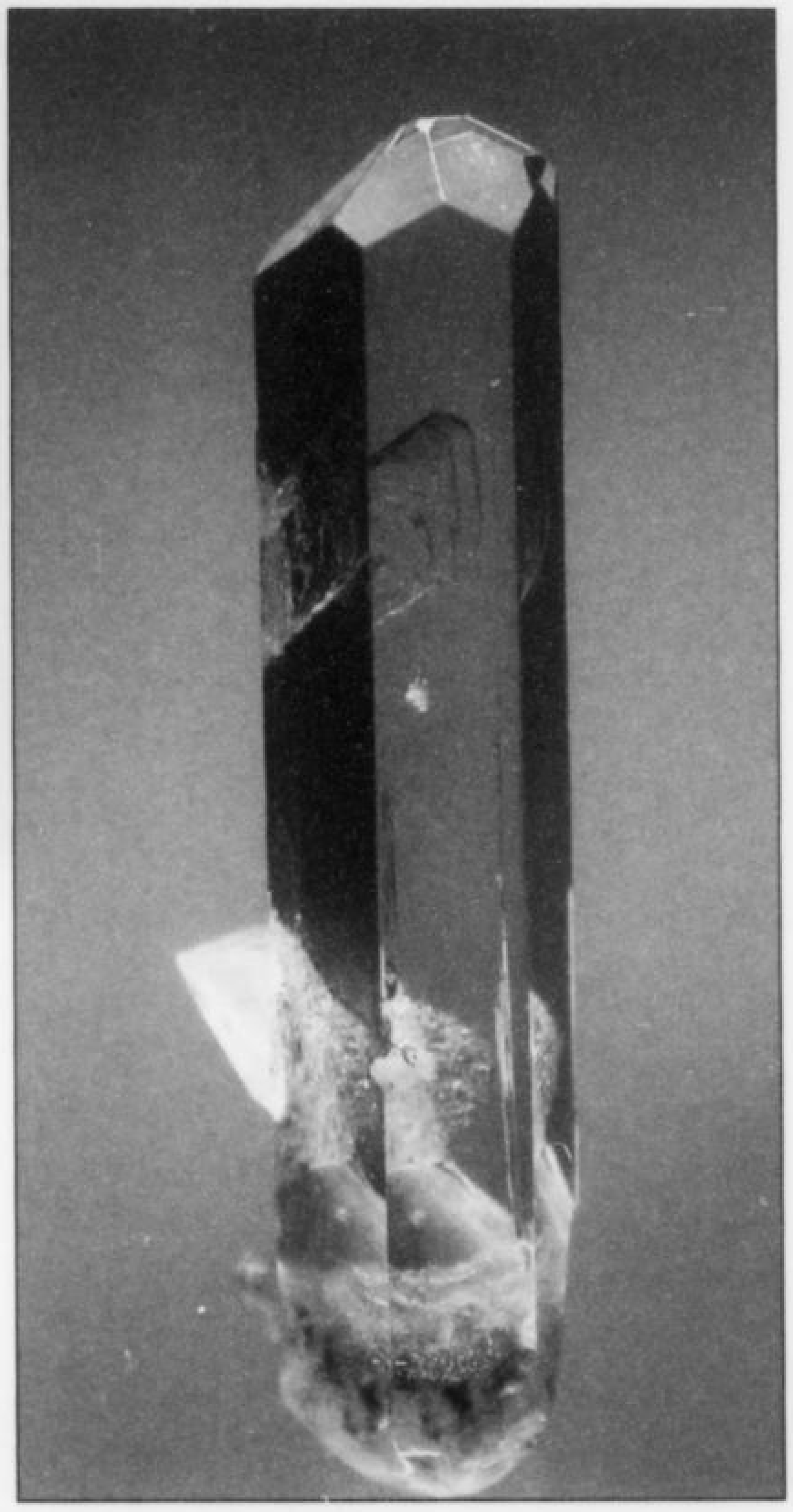


Figure 63. Aquamarine, 2.4 cm. Erongo Mountains, Namibia. Private collection; Ernst A. Schnaitmann photo.

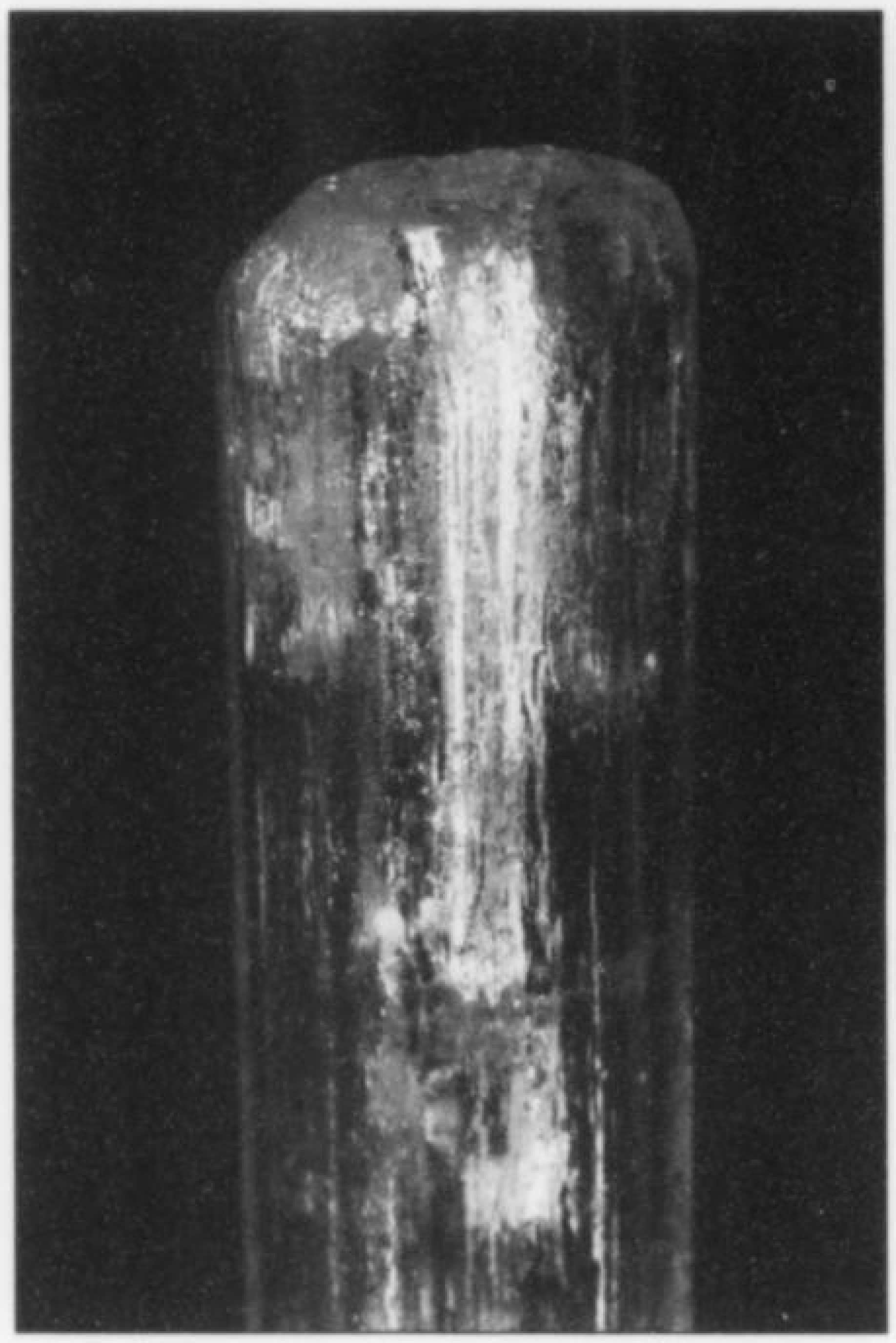


Figure 64. A colorless beryl crystal with a hollow tube running down the center of the crystal, 4.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

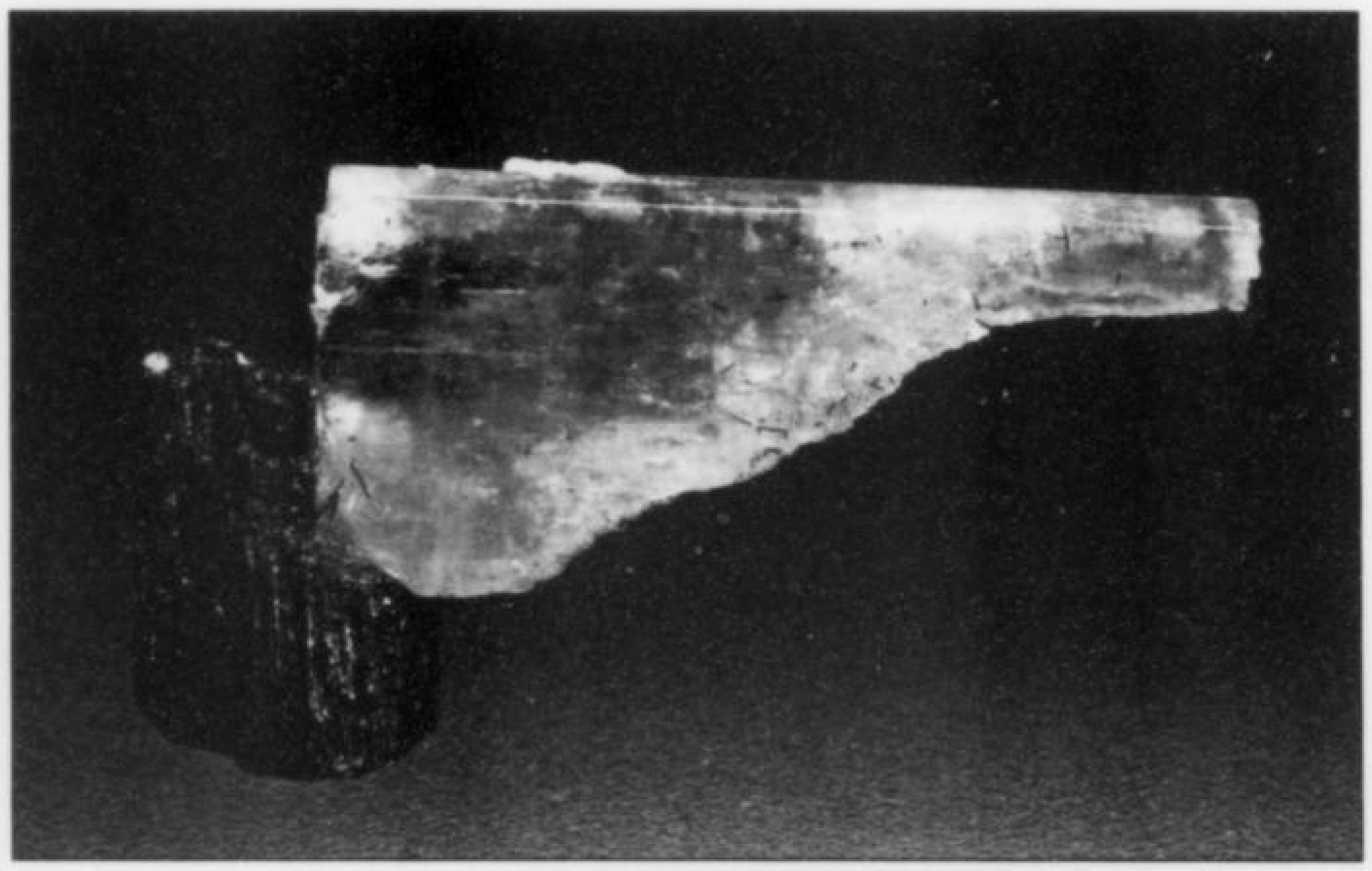
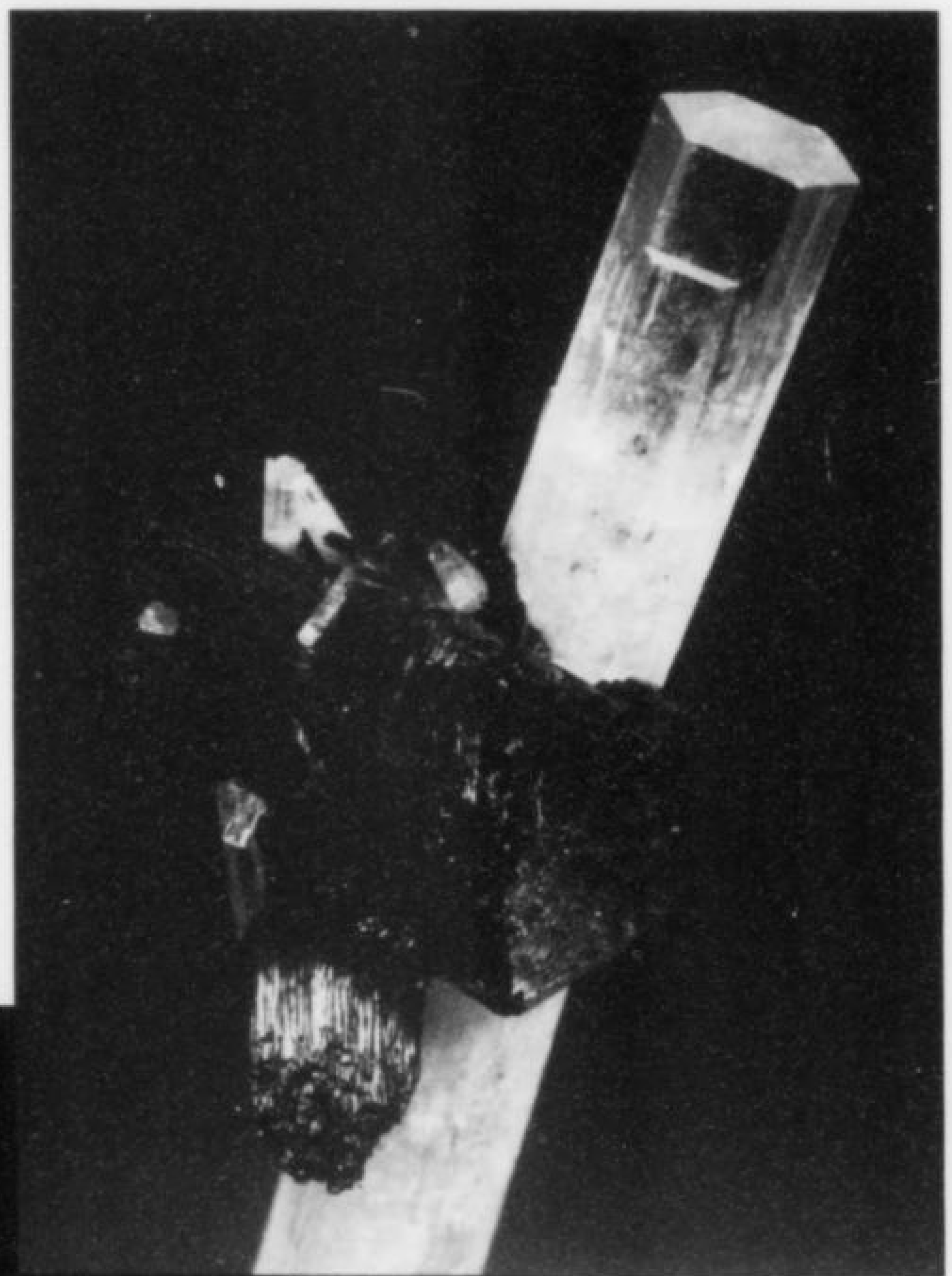


Figure 66. Aquamarine embedded in schorl, 5.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce

Figure 65. Aquamarine and yellow beryl spray on schorl on quartz, 6.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



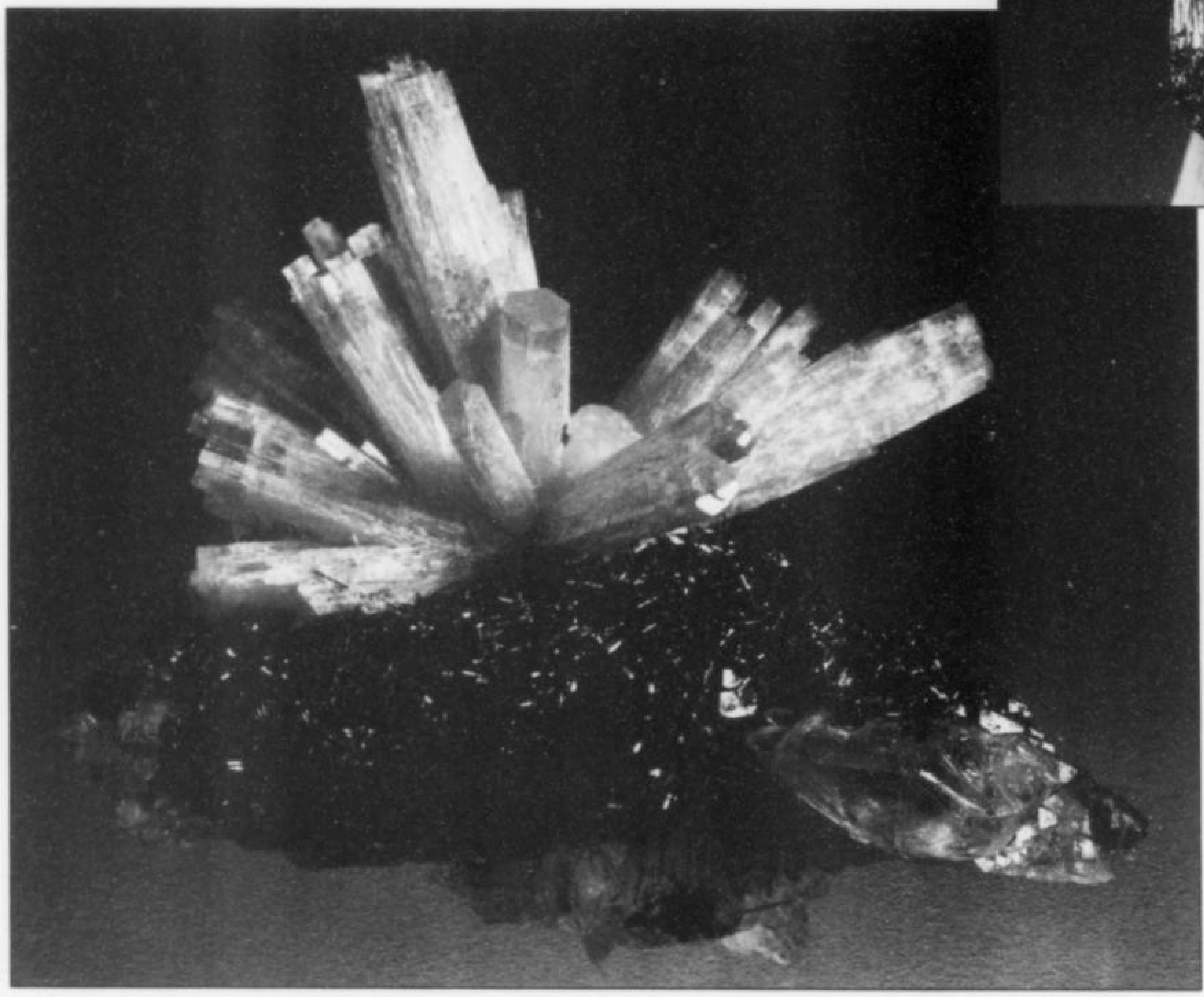


Figure 67. Slender doubly terminated aquamarine with schorl attached, 5.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

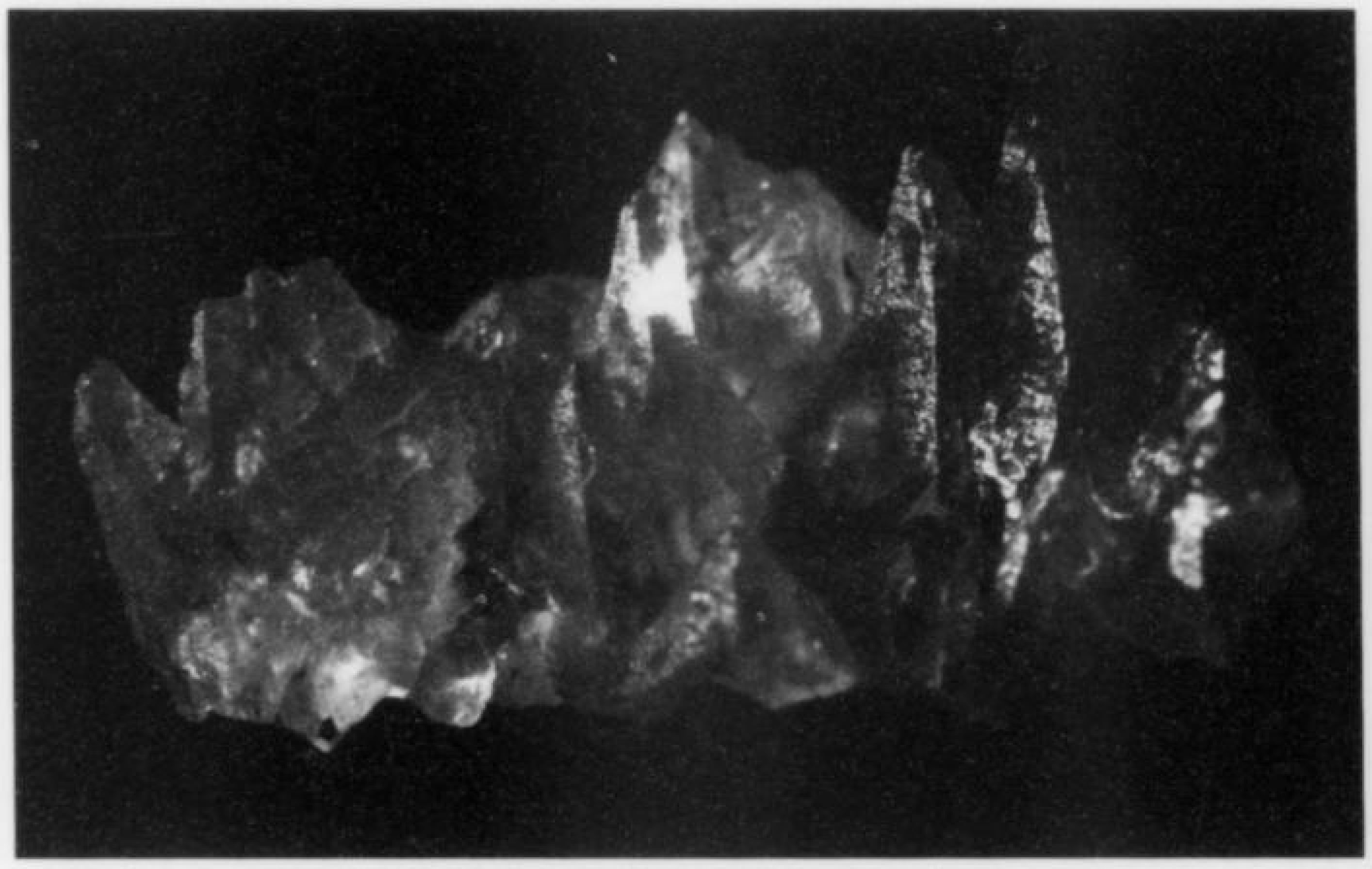
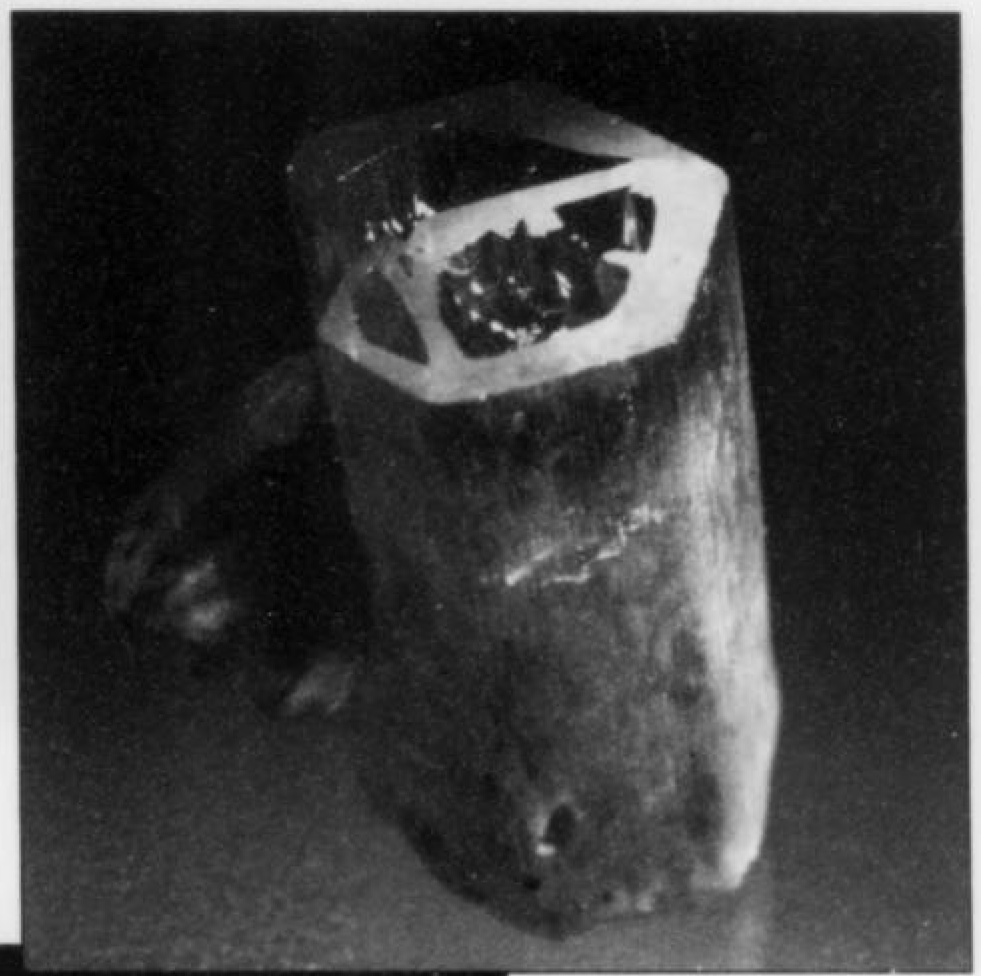


Figure 68. Multiply terminated aquamarine, 4.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 71. Semi-hollow aquamarine with quartz, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



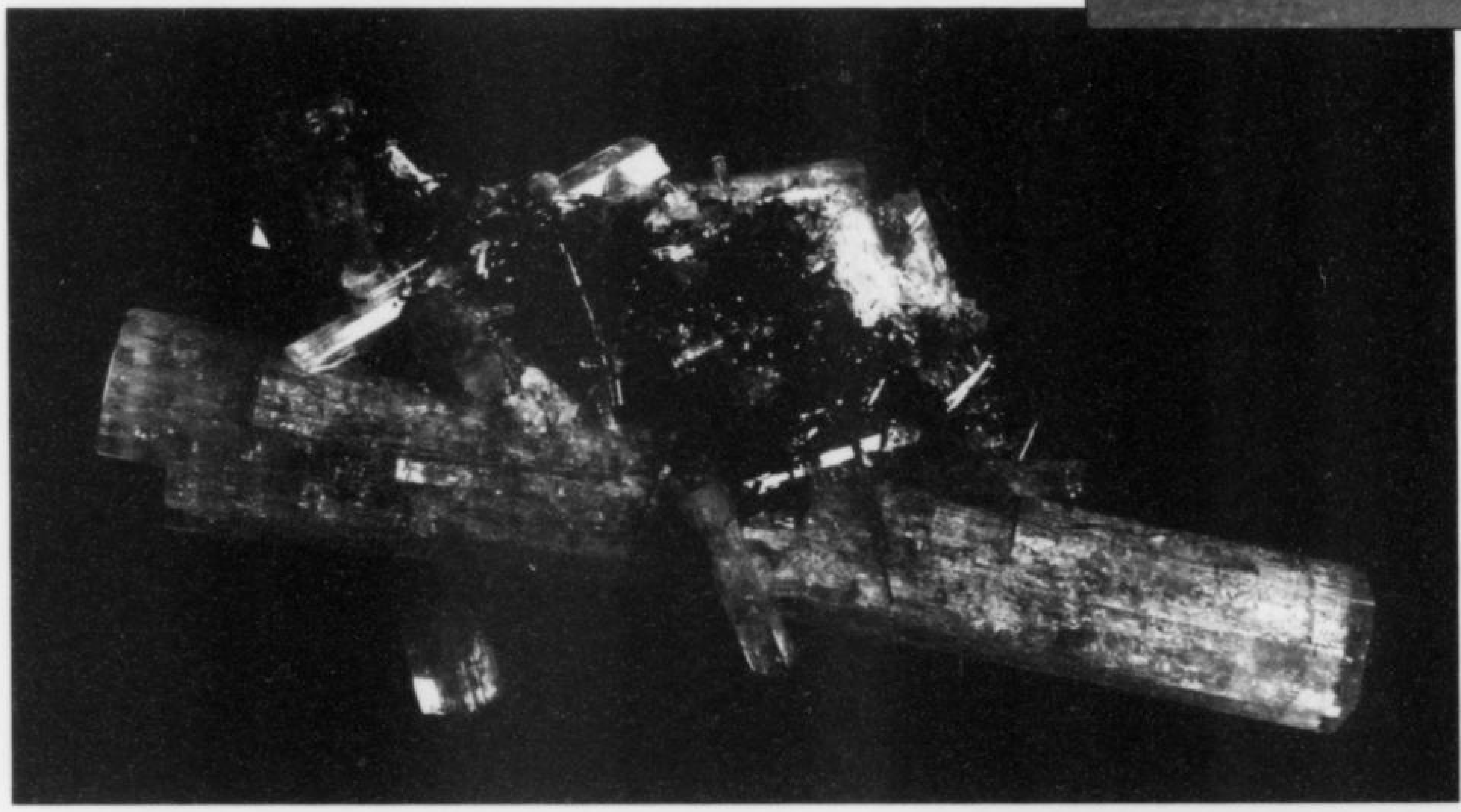


Figure 69. Cluster of doubly terminated aquamarine with schorl, 10.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

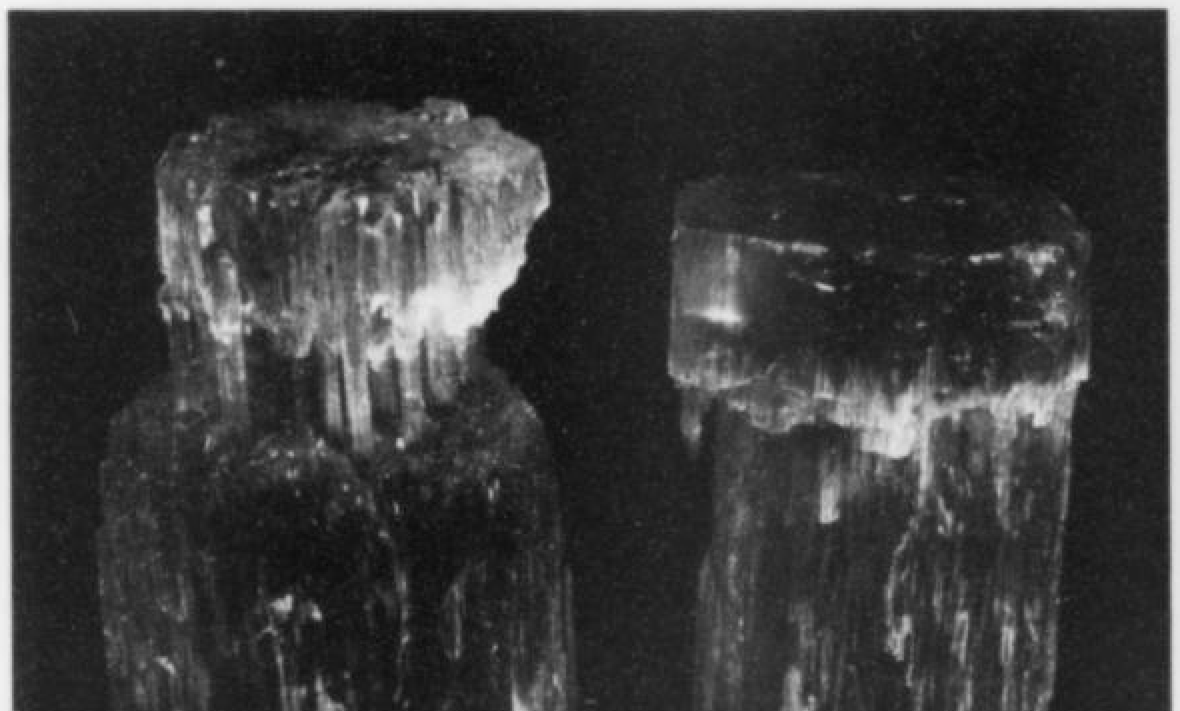


Figure 70. Two etched aquamarine crystals (left is 5.7 cm, right is 5 cm). Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

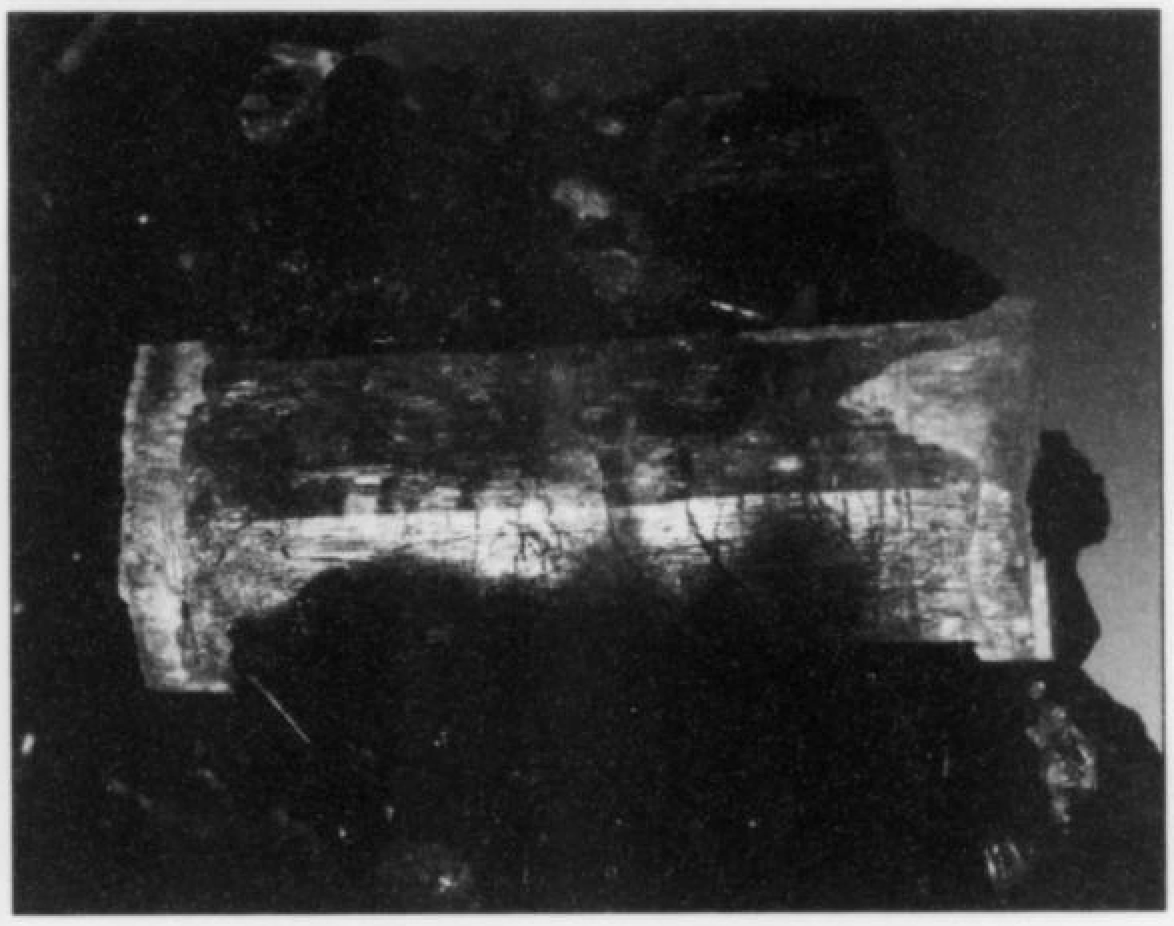


Figure 72. "Cotton reel" aquamarine with sceptered overgrowths on both terminations, 4.3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

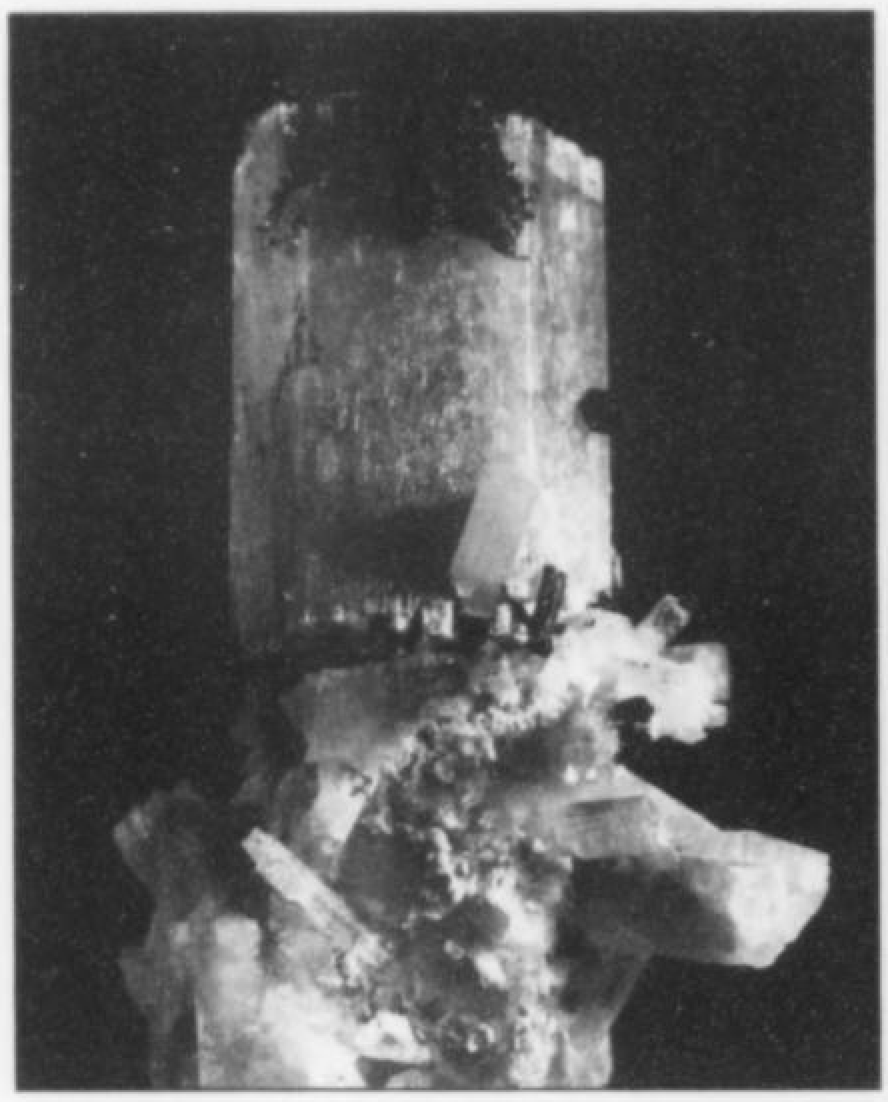


Figure 73. **A healed aquamarine crystal lightly attached to a base of chaotically crystallized colorless beryl, 5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

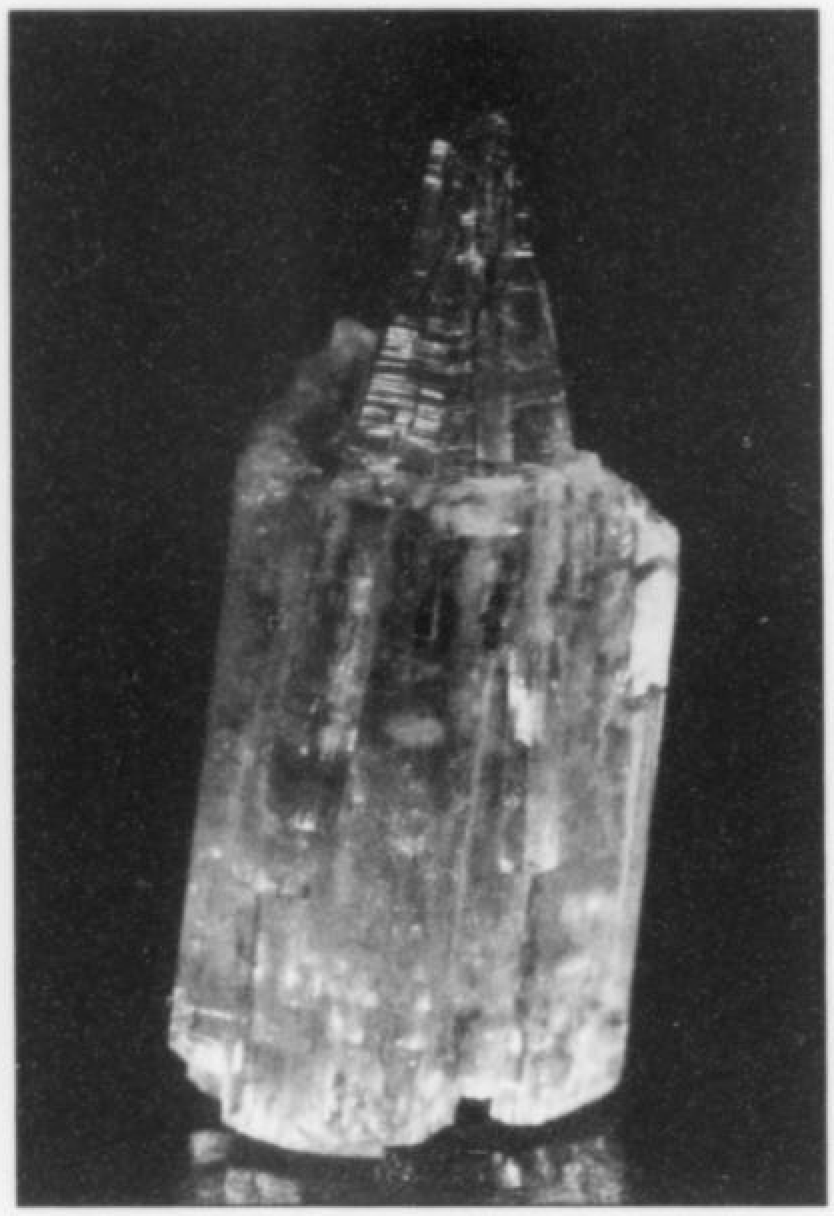


Figure 75. **Aquamarine crystal, 2.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

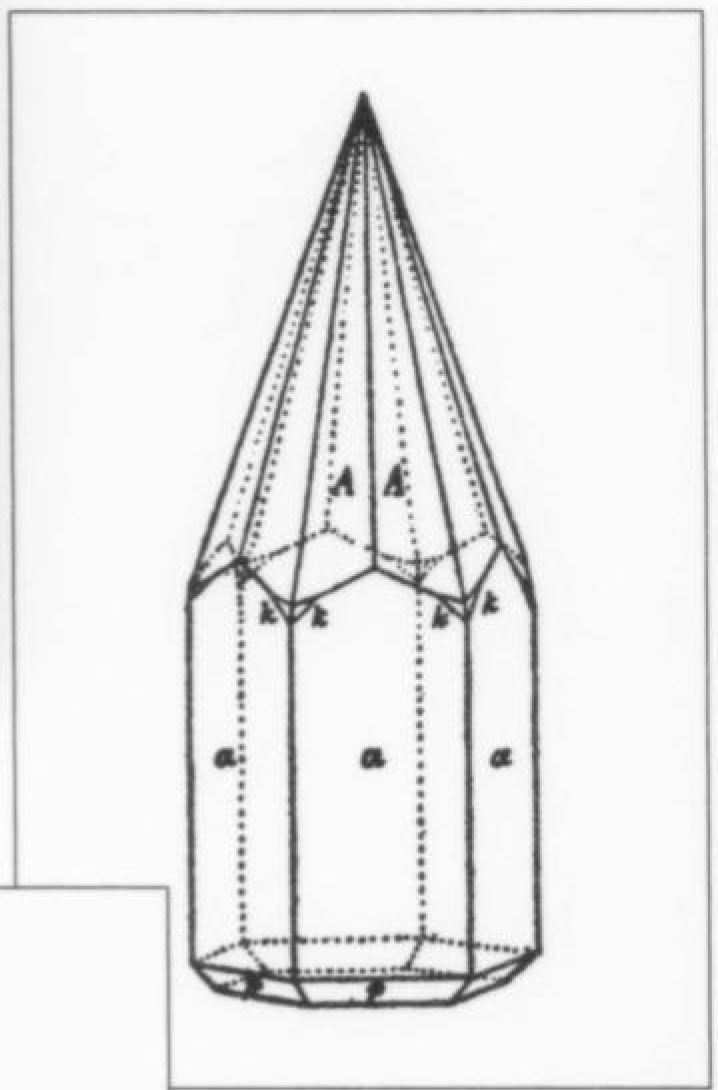


Figure 76. **Drawing of a beryl crystal from Banffshire, Scotland identical in habit to those from Erongo (Goldschmidt, 1913).**

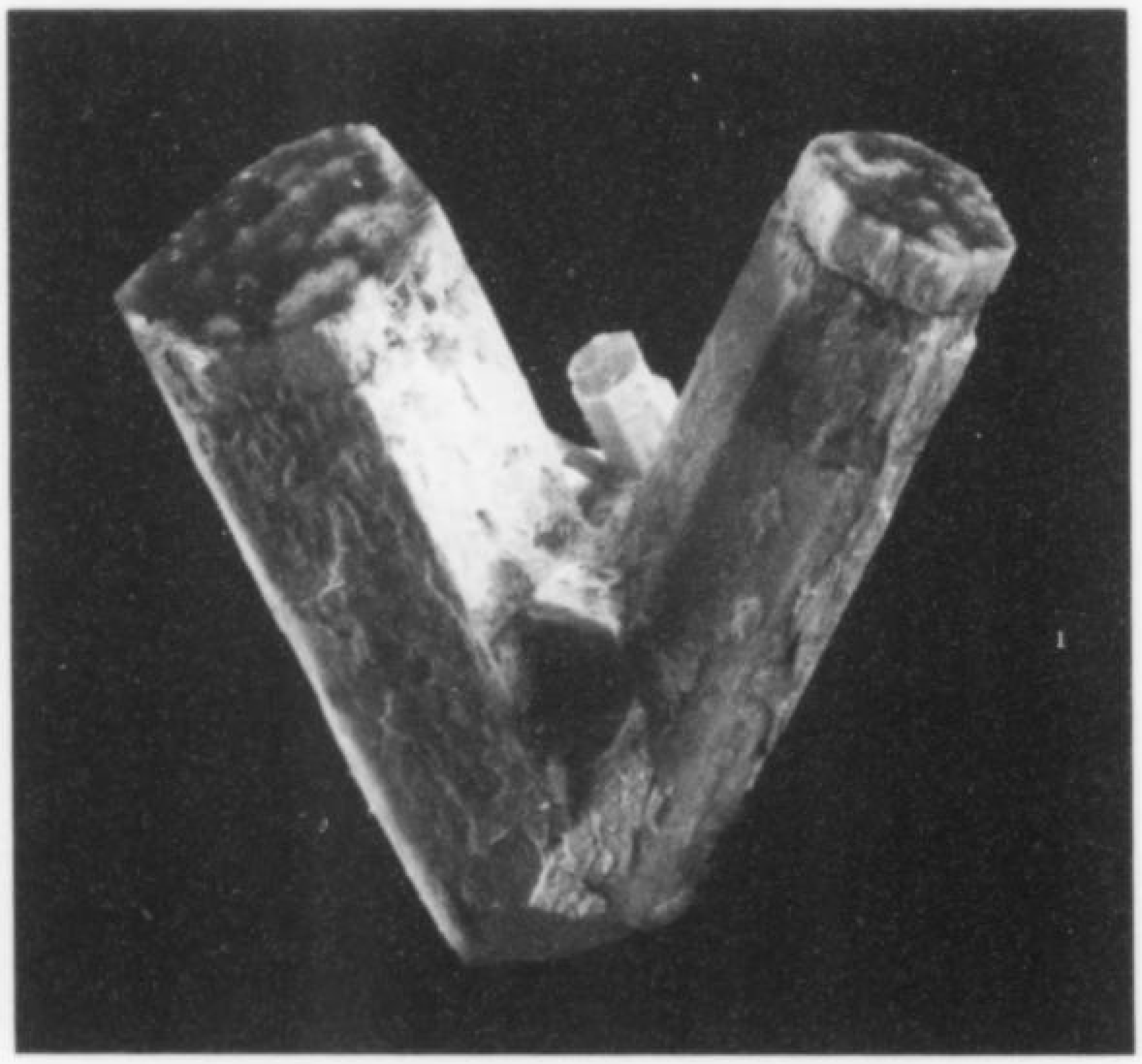


Figure 74. **Opaque beryl, 5.9 cm. The crystals are triple color-zoned: two thirds of the crystals are opaque blue, followed by a green zone and finally overgrowth of mottled green aquamarine that has partially vacant gaps at the contact. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

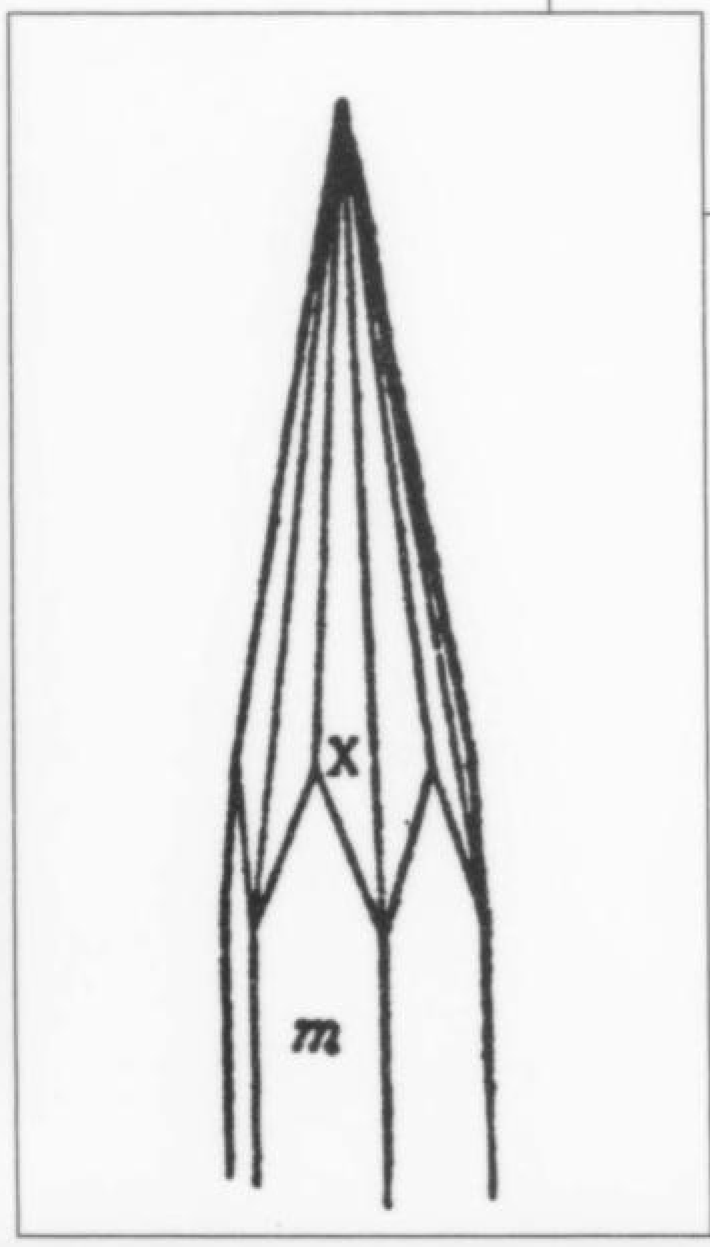


Figure 77. **Drawing of a beryl crystal from Mount Antero, Colorado identical in habit to those from Erongo (Goldschmidt, 1913).**

Figure 78. **Yellow beryl, 7 mm, capping aquamarine. The yellow beryl is attached by a thin overgrowth rim. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

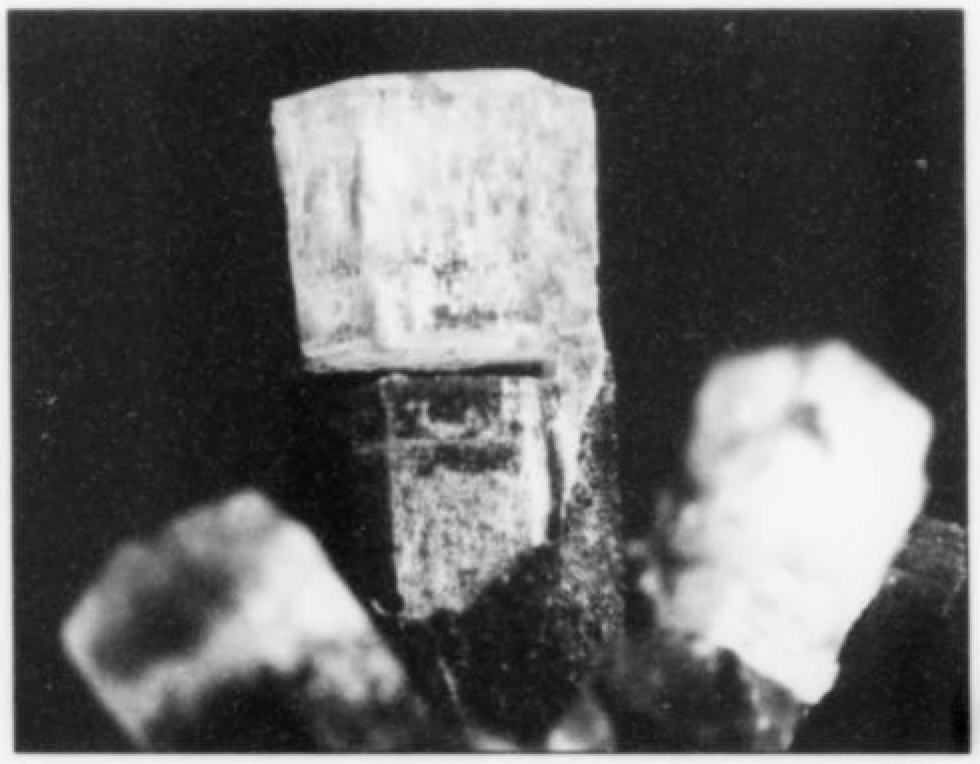
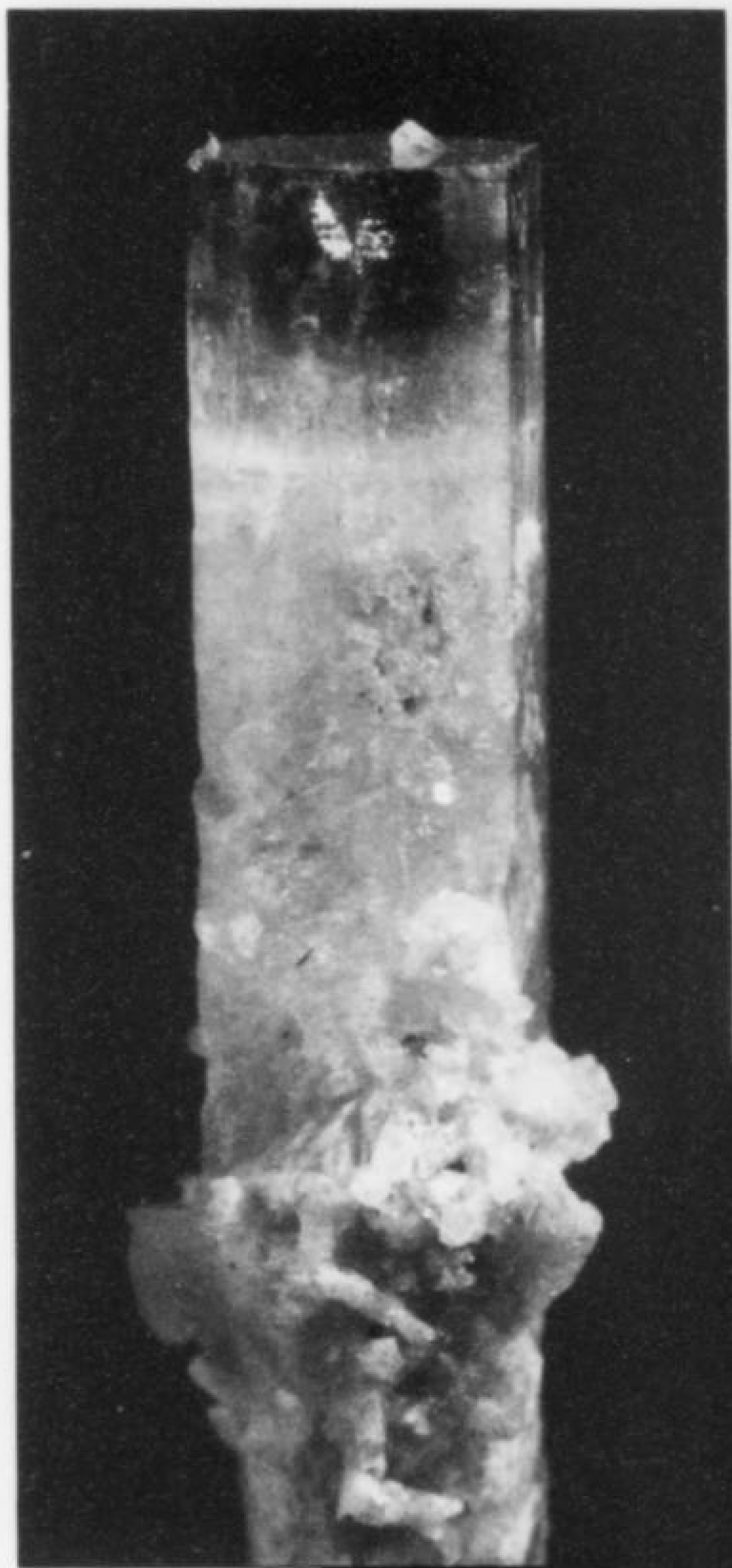


Figure 79. **Yellow beryl with orthoclase inclusions, 2.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 80. **Cluster of yellow beryl crystals, some with overgrowths on the terminations, 4.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



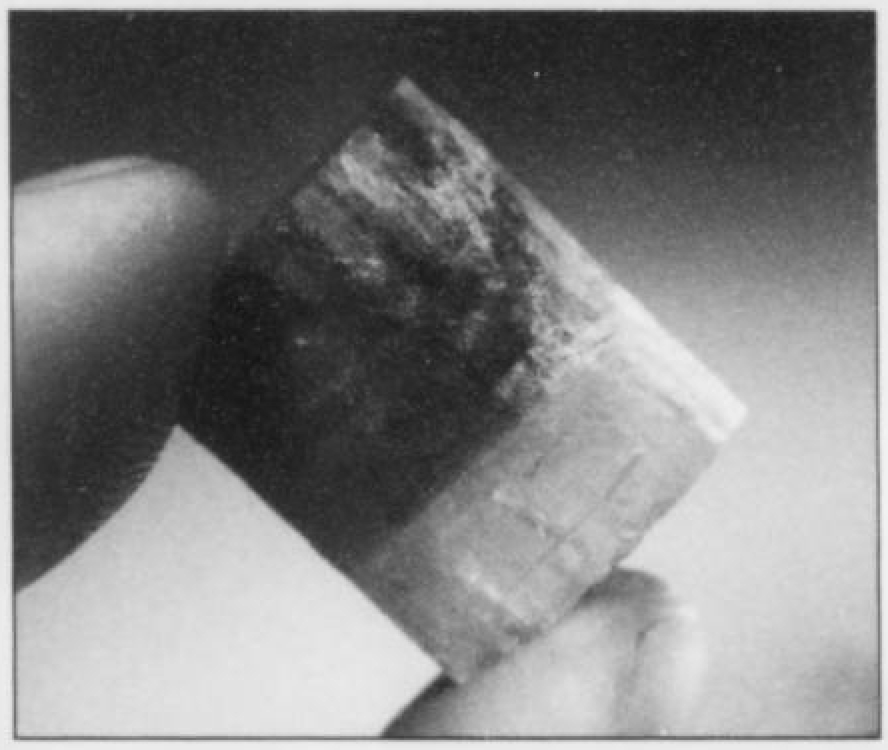
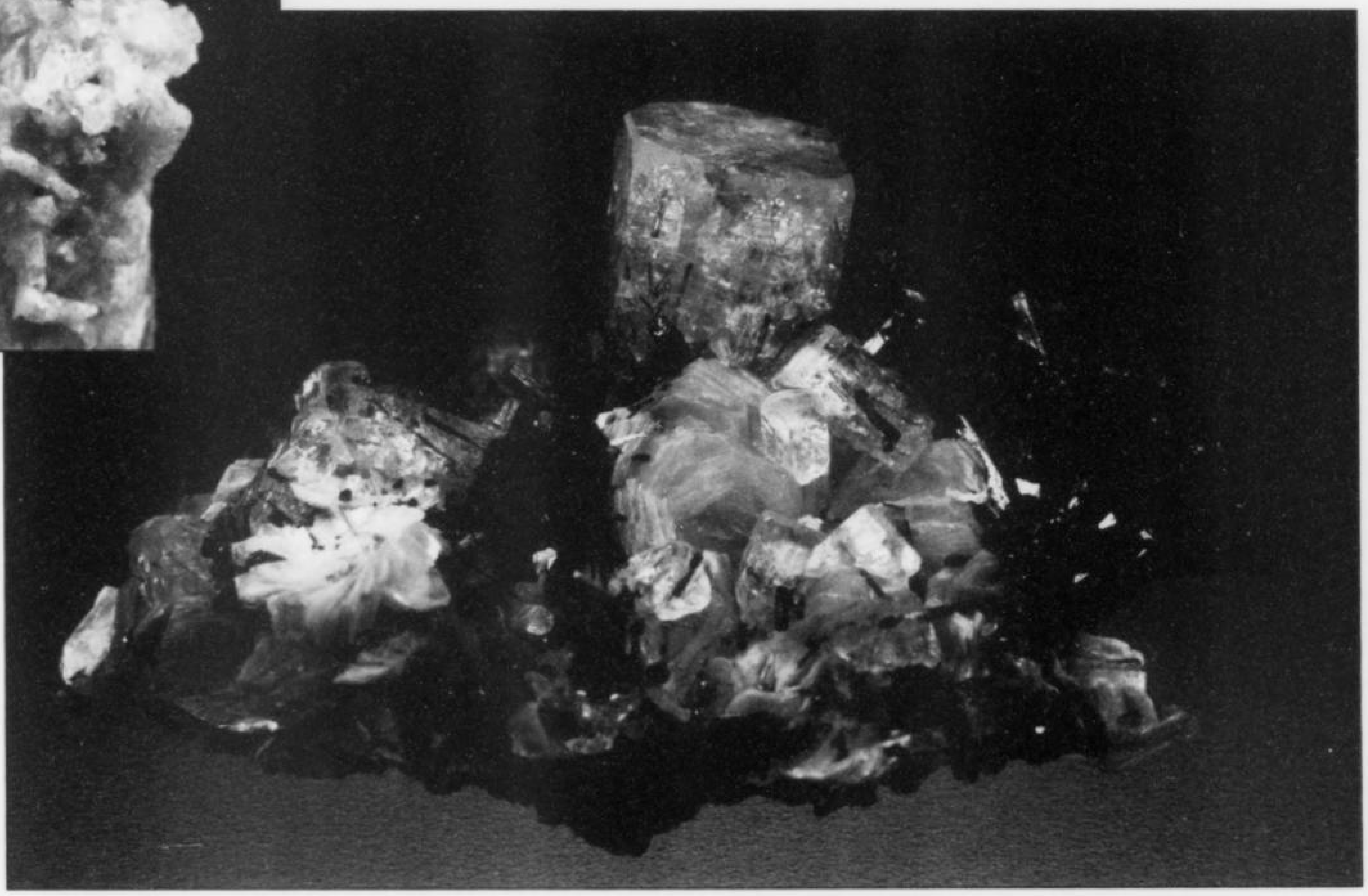


Figure 81. **Distinctly color-zoned aquamarine and orange beryl, 1.9 cm. A small pocket of these crystals was collected; they tend to cleave very easily along the color contact. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 82. **Yellow beryl, colorless beryl, muscovite and schorl, 6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



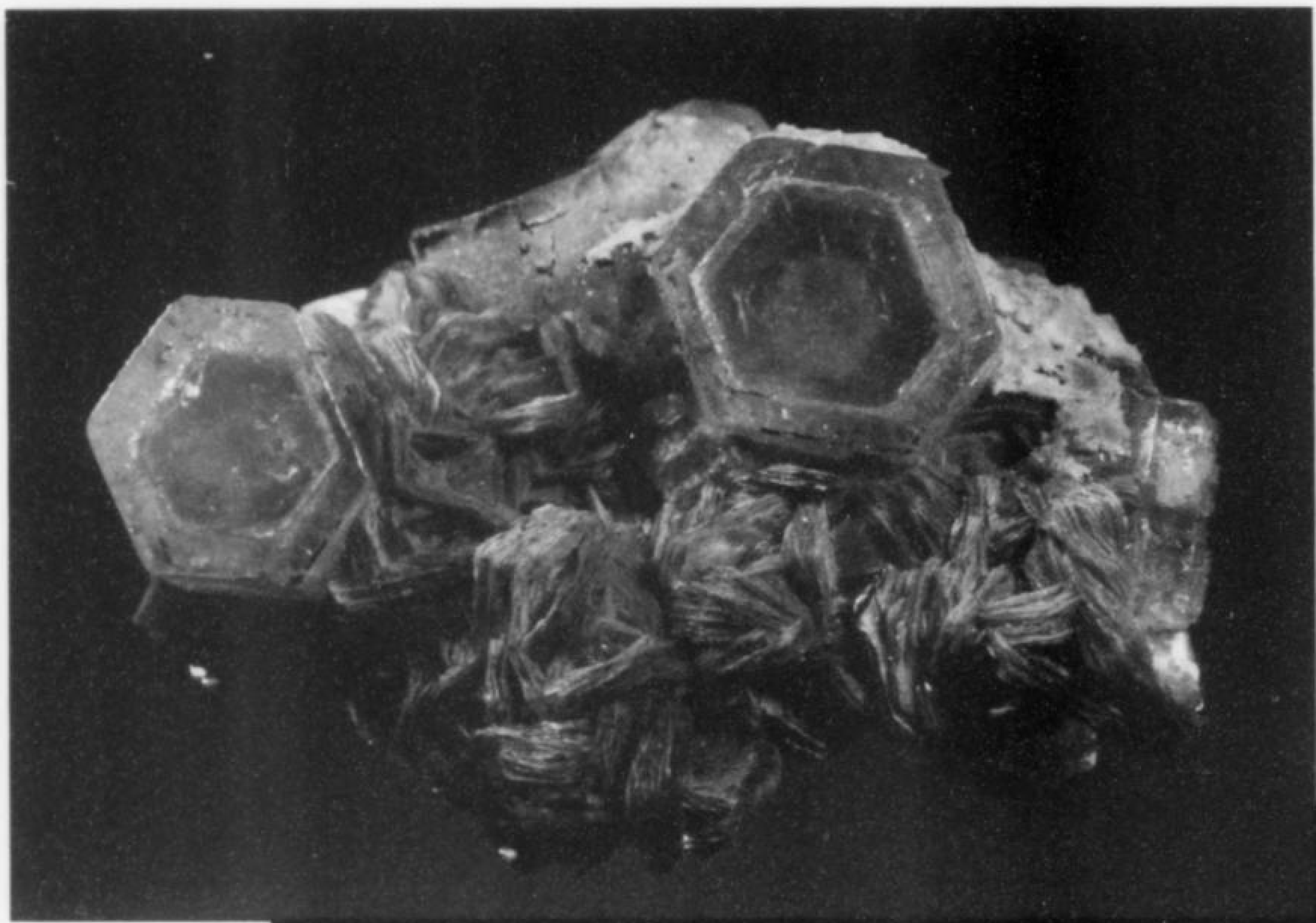
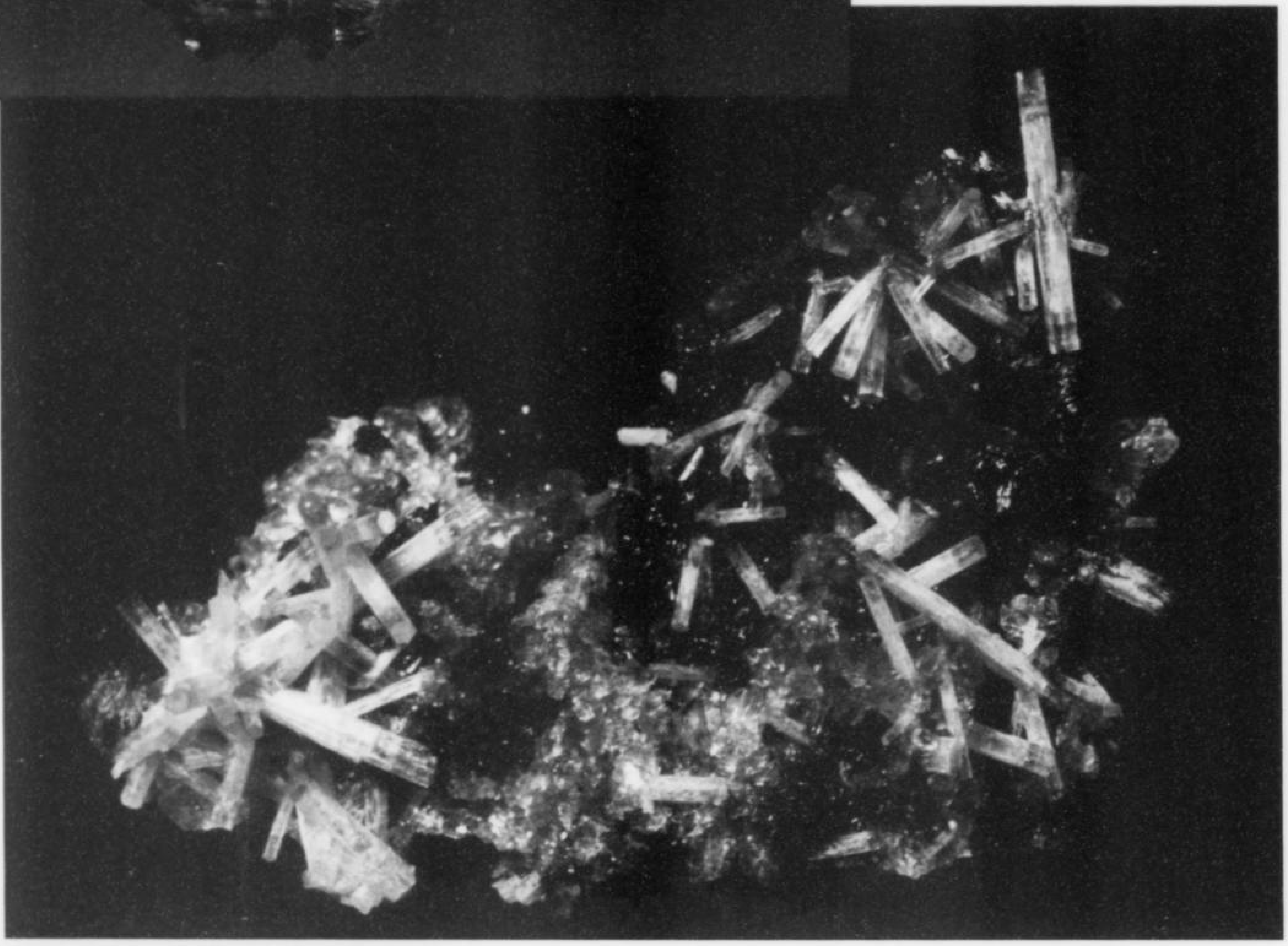


Figure 83. **Colorless/yellow beryl zoned perpendicular to the *c* axis, with muscovite, 5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 84. **Doubly terminated and double color-zoned beryl crystals associated with schorl and hyaline opal, 9.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



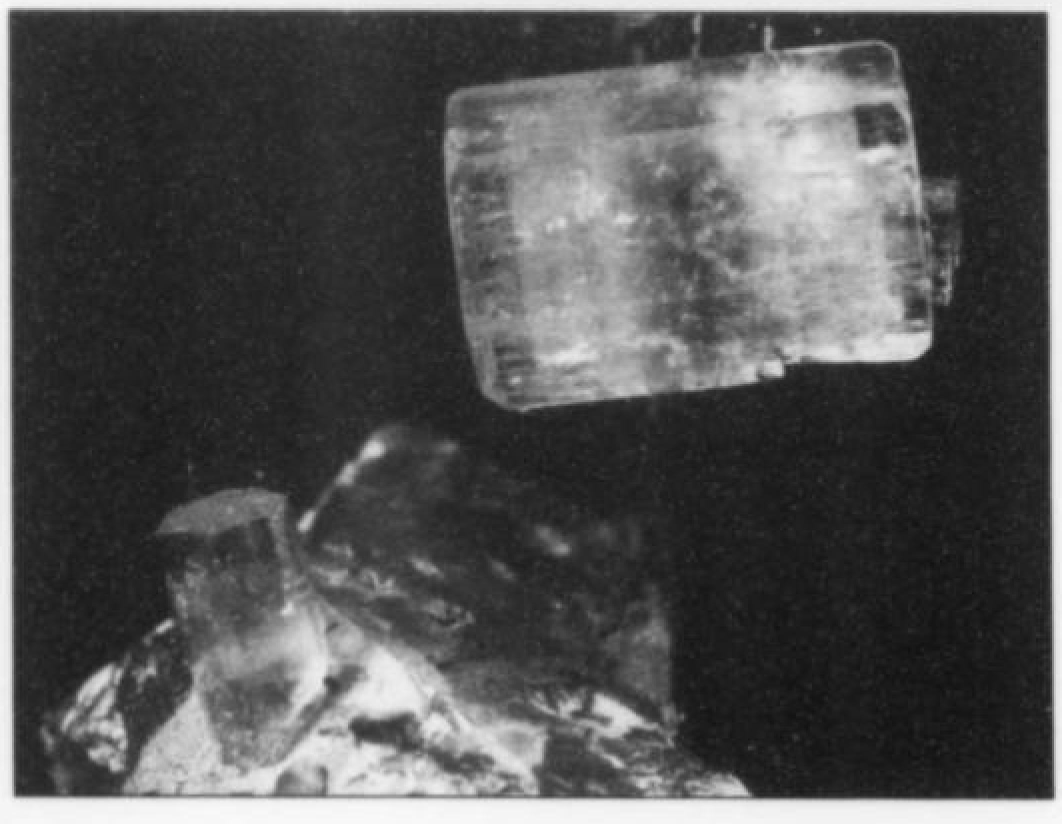


Figure 85. **Colorless beryl crystals to 1.8 cm on schorl and quartz; 5.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

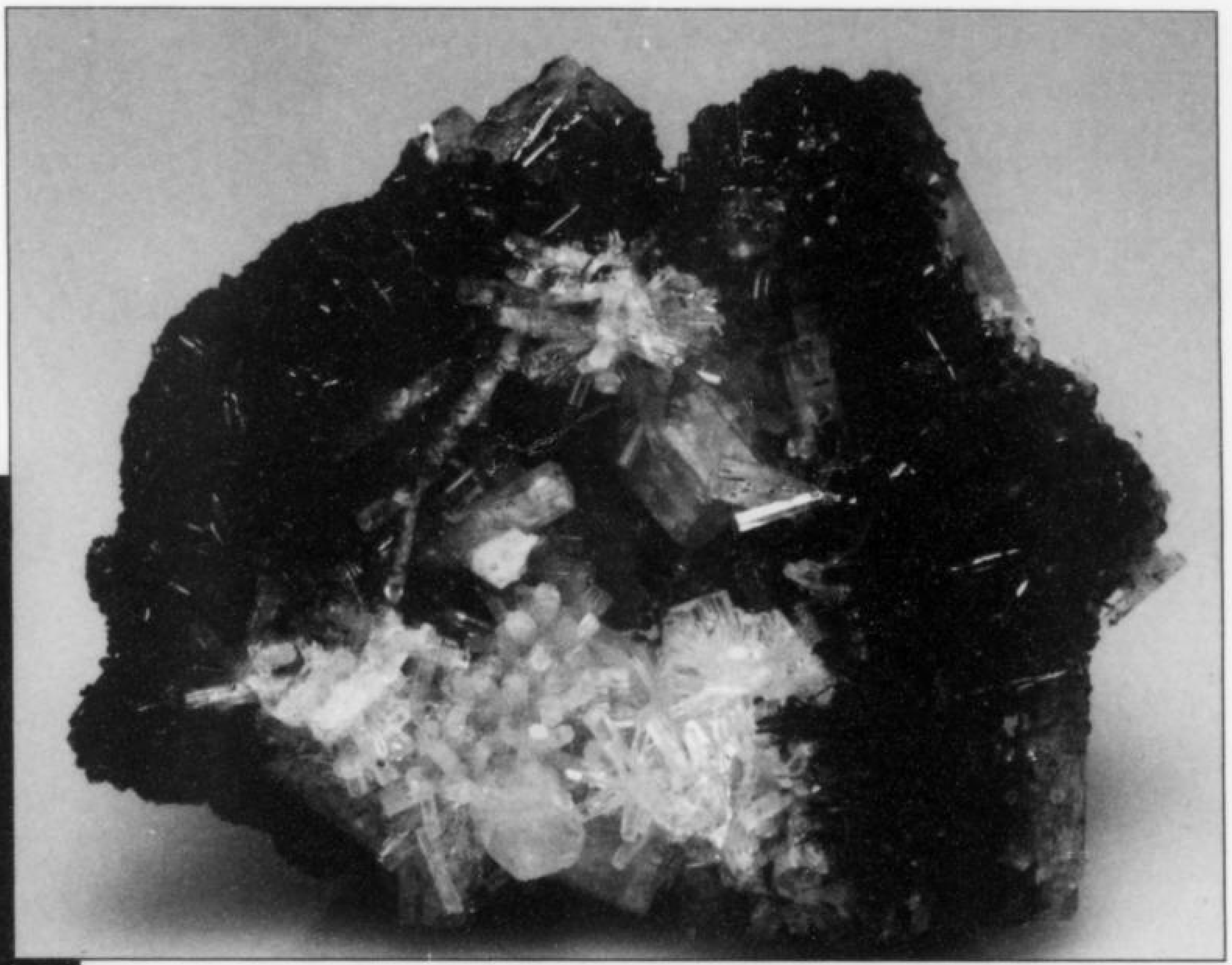


Figure 86. A vug of schorl filled with colorless beryl crystals, 7.7 cm, and aquamarine attached at the back. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

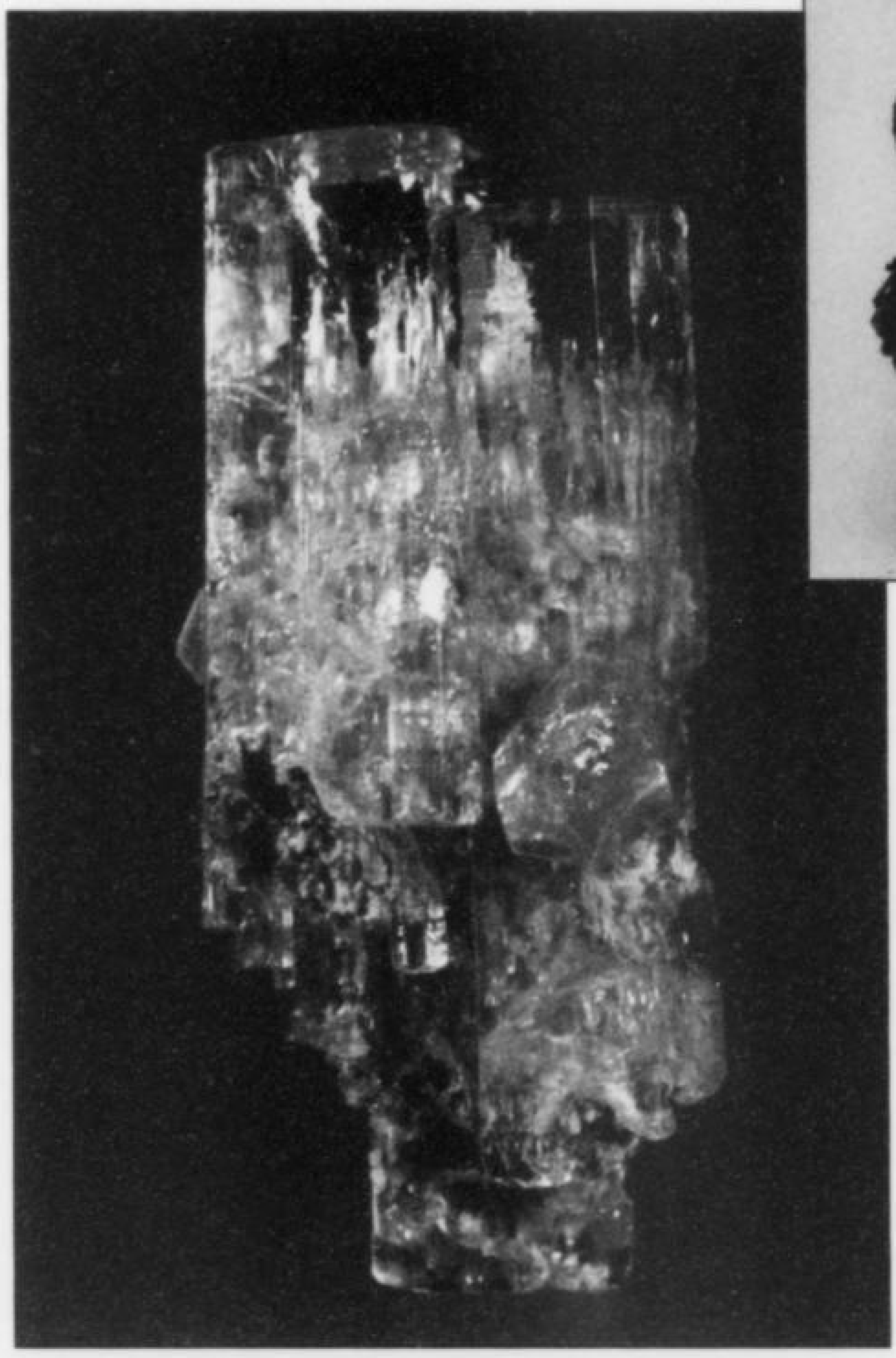
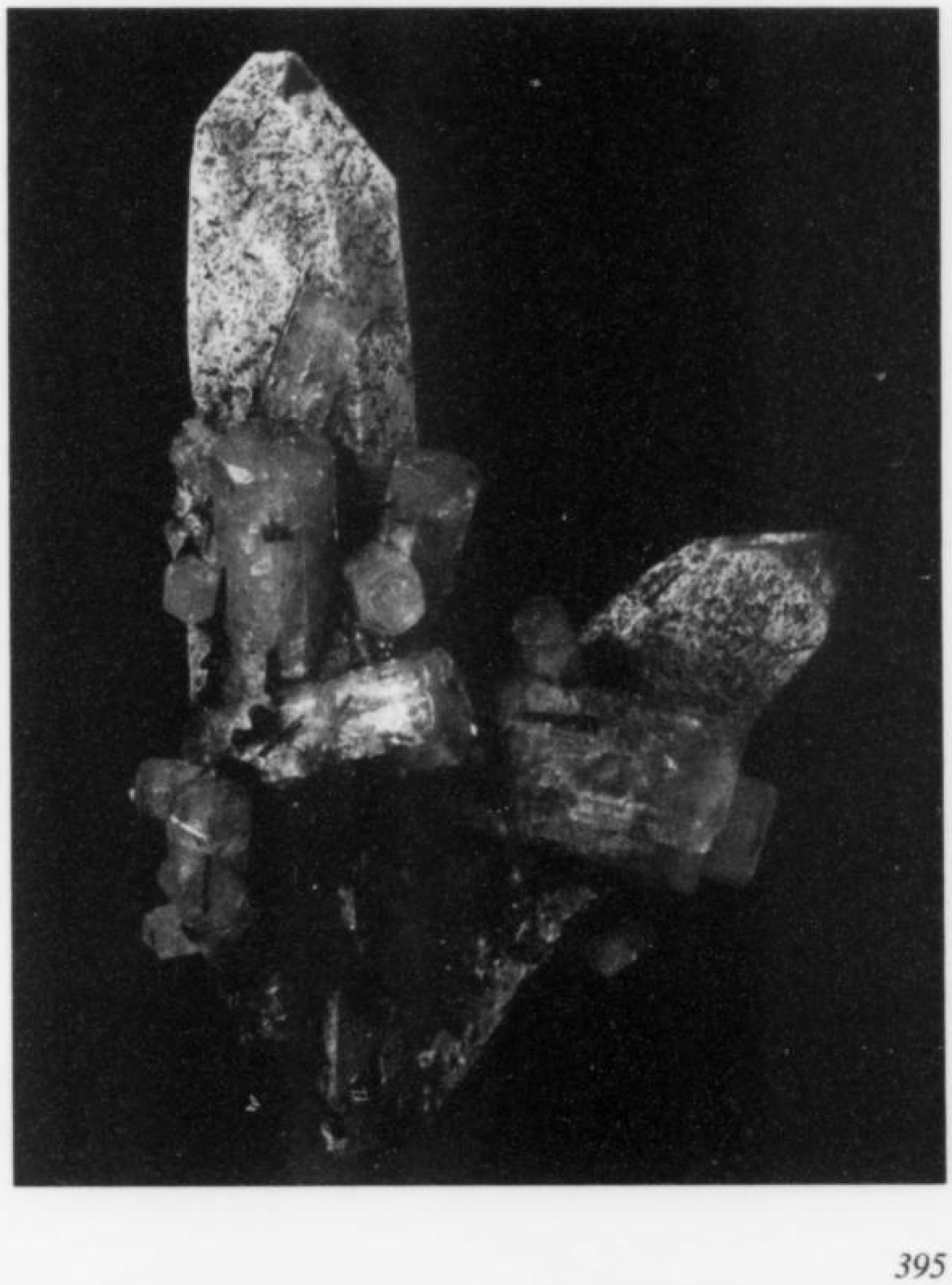


Figure 87. Colorless beryl crystals, 4.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 89. Colorless beryl on quartz with schorl, 7.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



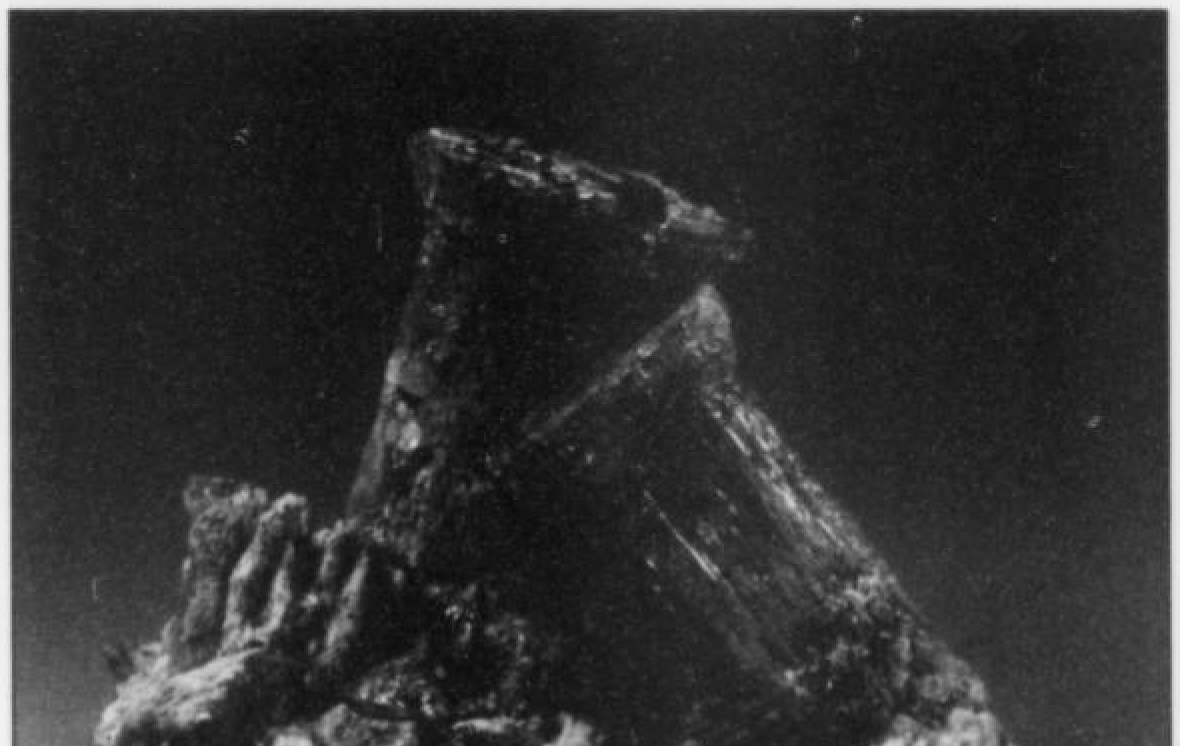


Figure 88. Capped (sceptered) beryl crystals associated with schorl, 5.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

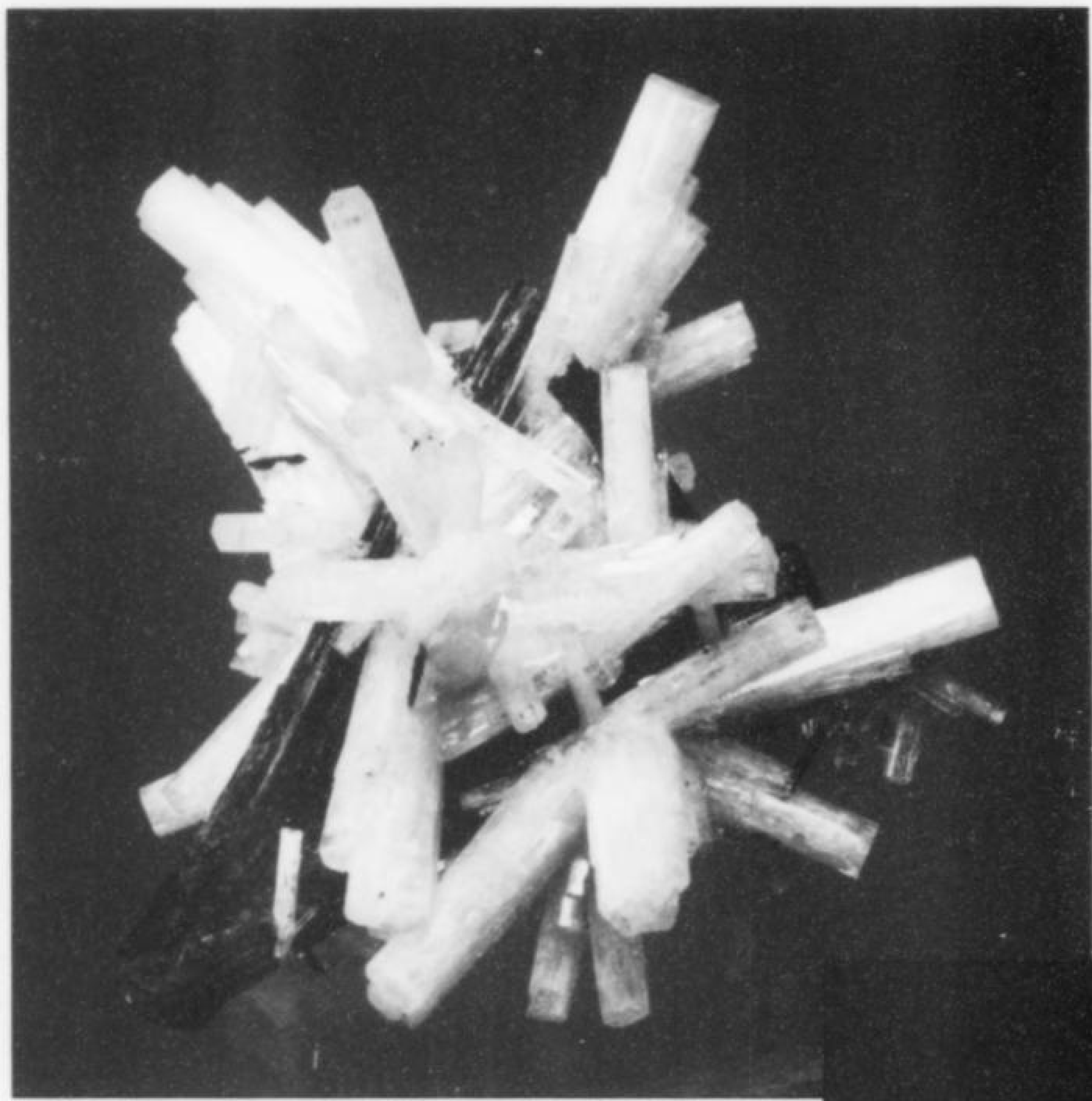
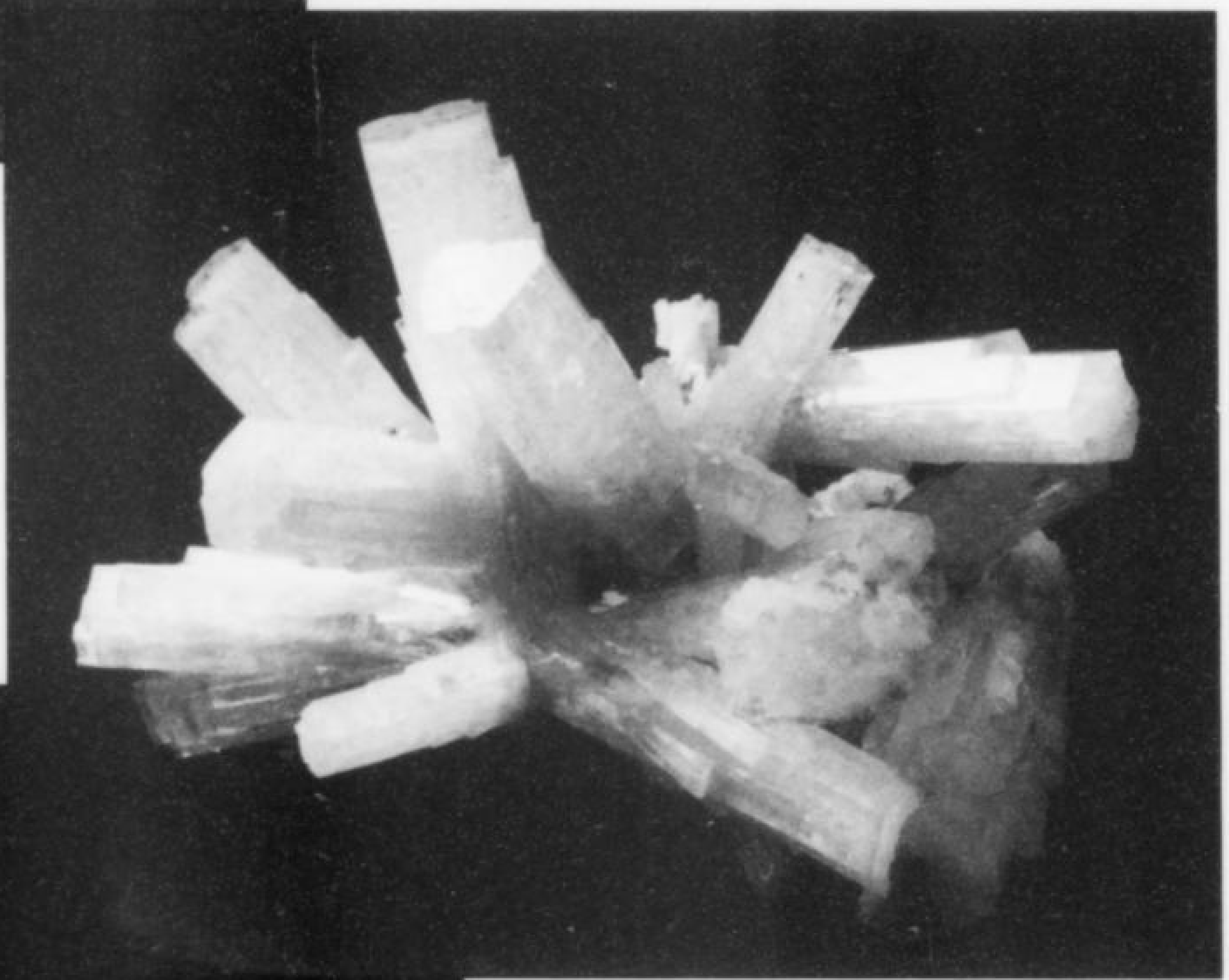


Figure 90. **Colorless beryl and schorl, 7.3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 91. **Colorless beryl, 6.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



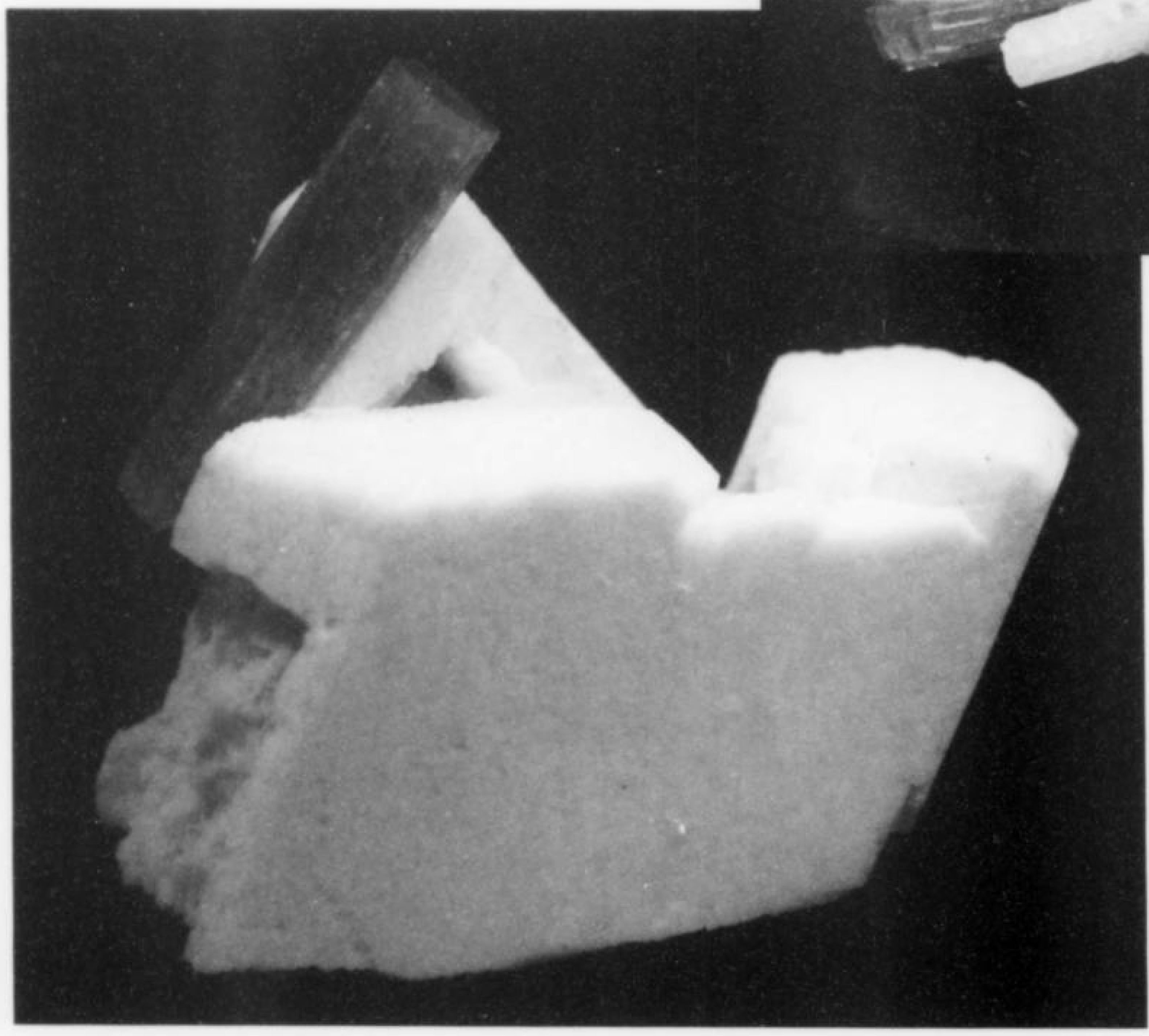


Figure 92. **Colorless beryl and twinned orthoclase, 4.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

white orthoclase makes for stunning specimens. Other paragenetic associations run the gamut of the Erongo mineral assemblages—variously colored fluorites, orthoclase, smoky quartz, white and opaque quartz, topaz, and goethite pseudomorphs after siderite. Some aquamarine crystals show naturally etched prism faces, while others have smooth faces with faint vertical striations. Some specimens are doubly terminated, single floater crystals. Crystals in clusters may form stellate groups, radiating from a common center. Specimens of this last type, with Manebach-twinned orthoclase crystals randomly attached to some of the aquamarine crystals, are typical of one particular pocket.

Erongo aquamarine frequently contains inclusions of other minerals. A discovery in July-August 2005 produced specimens showing small greenish yellow fluorite cubes included within gemmy aquamarine crystals. Finely disseminated orthoclase gives a milky white to milky blue appearance to some aquamarine, while acicular schorl imparts a dark gray to black overtone.

An unusual aquamarine habit is shown by crystals associated with schorl found in May 2001. The habit is informally called "cotton-reel," as both terminations of each crystal have narrow tabular rims of blue-white beryl projecting beyond the edges of the prisms. Most of these are loose crystals, but some were collected as matrix specimens on schorl. In a variant of this habit, natural etching removed the rims, not the centers, of the prisms, producing tapering cone-shaped terminations. Even more bizarre are aquamarine crystals showing two stages of growth, one preserved in a tapering prism, the other in overgrowths of deeply striated, complex hexagonal prisms. The terminations of still other crystals have scalloped surfaces resulting from renewed growth of tiny crystals on the terminal faces. In November 2000, one cavity yielded an interlocking network ("jackstraw" cluster) of opaque cornflower-blue aquamarine. These crystals are all of similar size, form and color—hexagonal prisms a few millimeters thick and up to several centimeters long, with some included orthoclase. Small schorl crystals are associated with these interlocking meshes of blue aquamarine crystals.

In May and June 2001 and August 2003, yellow beryl was collected. The crystals are yellow throughout, not merely coated on the outer surfaces by yellow goethite staining. The May 2001 pocket also produced intense green beryl. The yellow beryl sometimes caps blue aquamarine, in some instances following interrupted growth between the two types. This interrupted crystal growth is seen on specimens that have a narrow gap immediately below the attachment point of the capping yellow beryl (Fig. 78). In early 2006, distinctly bicolored beryl crystals were collected; these have lower yellow-green sections capped by unusual *orange* upper sections. There is a very sharp contact between the two differently colored zones, and the crystals tend to break very easily along this contact.

In August 2000, August 2005 and January 2006, colorless beryl crystals were collected on Erongorus 166. Most of these are simple doubly terminated water-clear crystals up to 10 cm, commonly included by other minerals such as orthoclase and yellow muscovite in their middle sections. A few of the crystals are parallel groups rather than simple individuals. The August 2005 find produced matrix specimens showing either single colorless crystals or clusters of crystals up to 2 cm partially embedded in muscovite-rich matrix. Some crystals have pristine glassy faces; others are naturally etched and highly corroded. The most recent 2006 specimens are stellate clusters of white, opaque, highly lustrous beryl crystals up to cabinet-size.

Some Erongo aquamarine specimens have been featured subjects of local Namibian artists (Robinson, 2004).

At the Krantzberg mine, common beryl and aquamarine are associated with some ferberite-cassiterite veins, as noted by Haughton *et al*. (1939):

> Small cavities of beryl and wolframite (ferberite) occur in drusy cavities in a vein 400 yards due north of the beacon on Krantzberg. Beryl crystals are very slender, have a maximum length of three inches, are light and faint green in colour, and are mounted on top of quartz crystals.

A greisenized albite-rich pegmatite located 2.2 km northwest of the Krantzberg Mountain beacon contains well-developed beryl crystals up to 10 cm long and 3.5 cm in diameter. There are also drusy vugs scattered along the contact between the surrounding Kuiseb Formation schist and the overlying sedimentary breccia of the Erongo Formation. Here, attractive pale green beryl crystals occur together with fluorite, quartz and ferberite. A thumbnail specimen of pale green aquamarine from the Koppie Zone at Krantzberg is in the collection of the Natural History Museum (London): it is specimen number 36116, donated by P.G. Linzell in 1978. A pair of similar small crystals are owned by Herbert Nägele in Windhoek.

Biotite $K(Mg,Fe^{2+})_3(Al,Fe^{3+})Si_3O_{10}(OH,F)_2$

Biotite is a minor constituent in some of the miarolitic cavities (von Bezing, 2006).

Brabantite $Ca_{0.5}Th_{0.5}(PO_4)$

Brabantite is a member of the monazite group; the type locality is the van der Made-Brabant pegmatite in the Erongo Schlucht on the farm Brabant 68 (Rose, 1980). The species was named after the farm. It occurs as gray-brown to red-brown to pale yellow-gray, dull to greasy-lustered, elongated crystals, aggregates and fragments up to 1.5 cm. It is radioactive and is associated with accessory hematite, muscovite and uraninite.

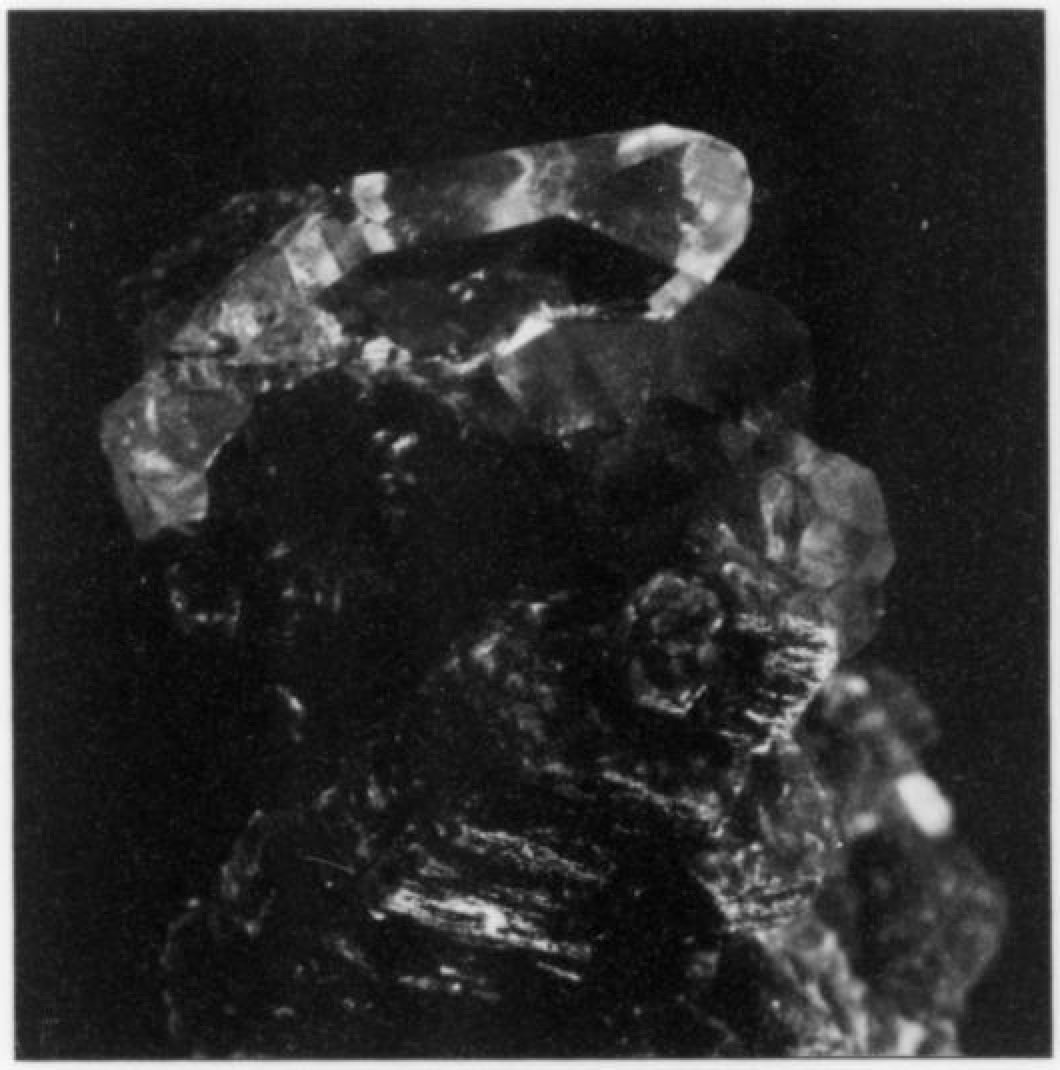


Figure 93. **Calcite with fluorite and muscovite, 3.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Calcite $CaCO_3$

Calcite is exceedingly rare from Erongo, and only a few specimens are known. Small, complex, transparent and colorless crystals are associated with fluorite and muscovite.

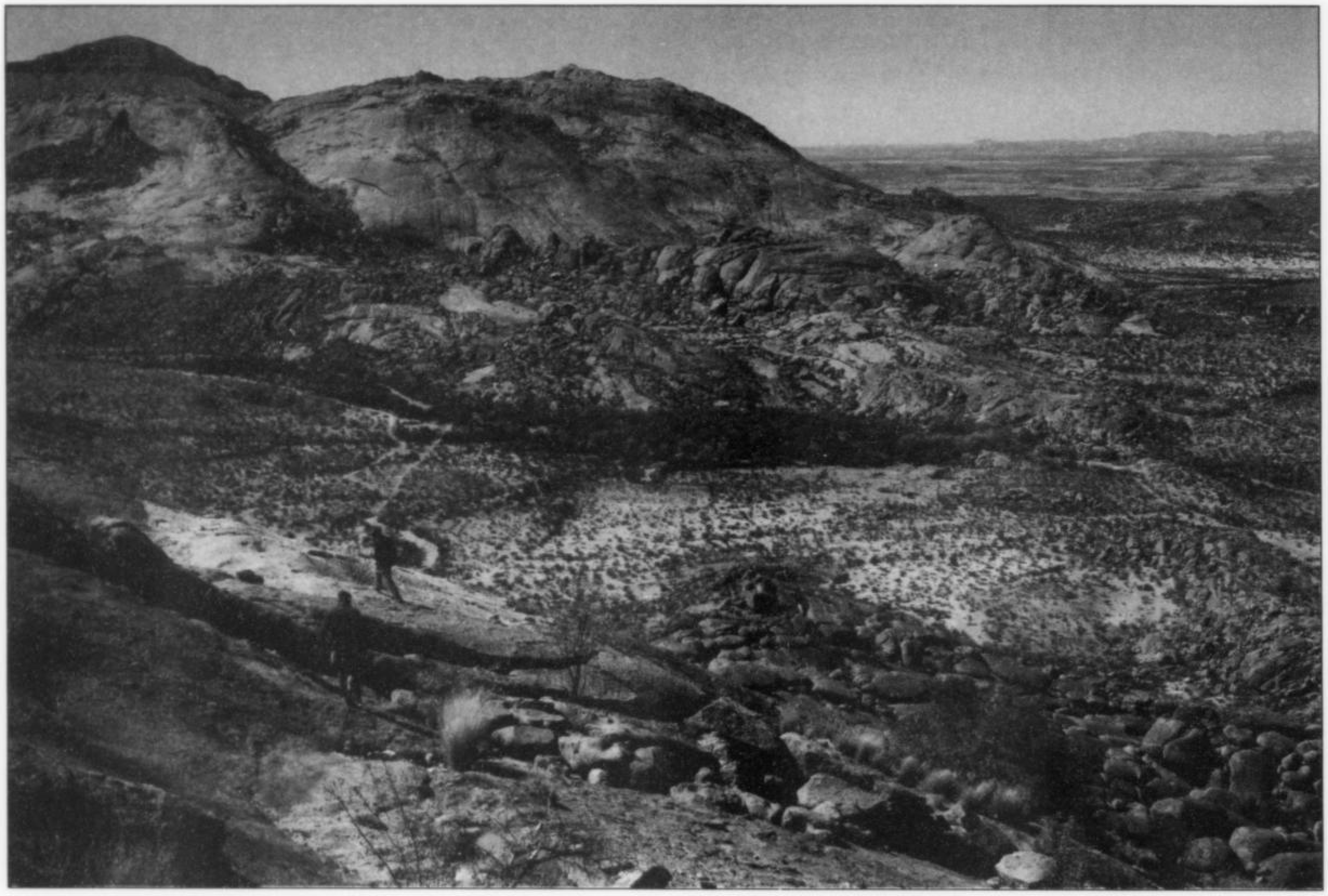


***Figure 94.* View looking southeast toward farm Ameib 60. The excavation in the left foreground yielded the cassiterite crystals featured here. Bruce Cairncross photo, August, 2005.**

***Figure 95.* One of the oldest known Erongo specimens housed in the collection of the Natural History Museum, London. The cassiterite numbered 1915,90 was acquired in 1915 and is from the mine located at the farm Davib Ost 61.**

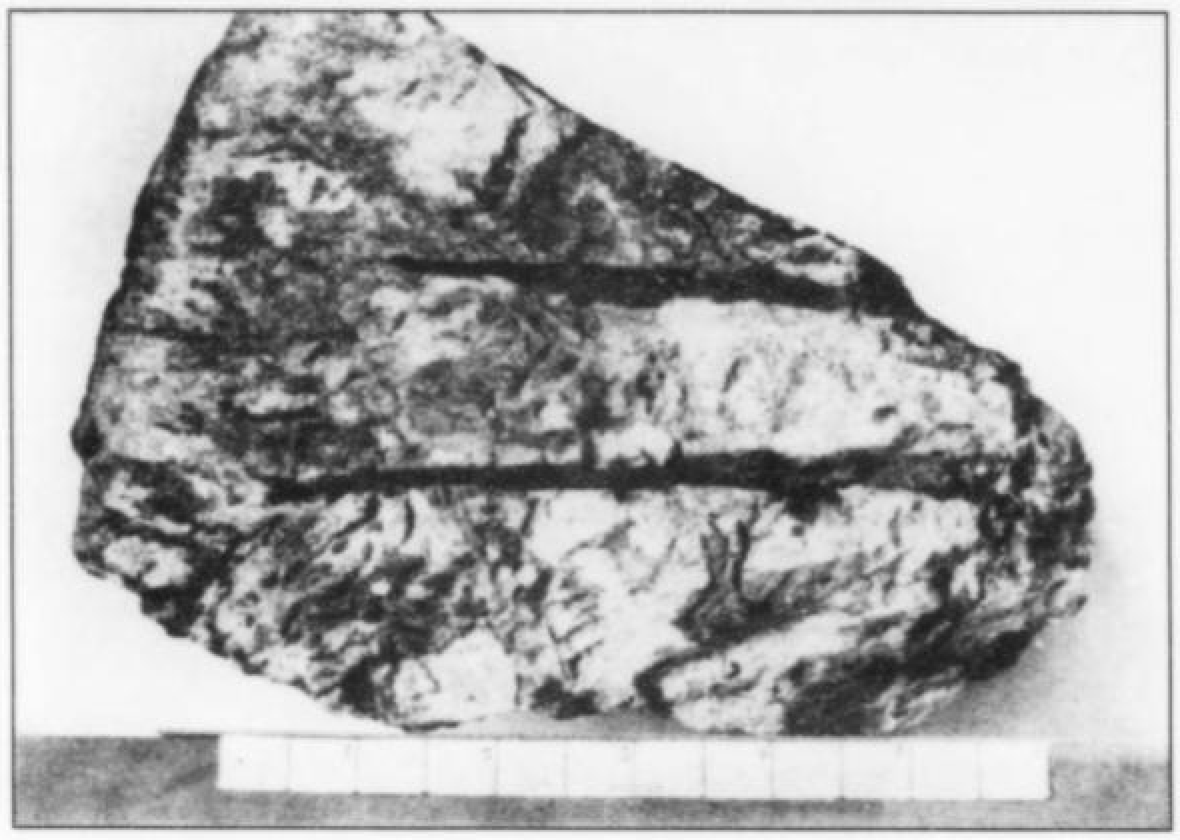


***Figure 96.* Cassiterite laths 24 cm long in micaceous pegmatite from Schimanski's claims on Erongorus 166. T. W. Gevers photo in Frommurze *et al*. (1942).**

Cassiterite SnO_2

The first discoveries of cassiterite in Namibia (then South West Africa) were made in 1910 at Ameib 60 in the vicinity of Erongo (Wagner, 1916). Shortly thereafter, more tin deposits were found. All of these consisted of cassiterite mineralization dispersed in veins and lenticular pegmatites (Diehl, 1992a). The pegmatites are coarse-grained and the cassiterite, in most cases, is scattered throughout the pegmatite bodies as individual grains and crystalline masses. Wagner (1916) describes one such occurrence at Davib Ost that yielded a solid 227-kg (500-lb) mass; some cassiterite is described as "ruby tin" and "a beautiful brown, transparent" cassiterite.

Black, complex, highly lustrous cassiterite crystals came from a miarolitic cavity on the farm Ameib 60, and von Bezing (2006) described 1-cm cassiterite crystals on schorl from Erongorus-Bergsig. However, matrix specimens are rare. The complexly intergrown cassiterite crystals measure to 4 to 6 cm (Jahn, 2003). Specimens of orange ilmenite have small tabular cassiterite crys-

Figure 97. **Large cassiterite, 8.6 cm. Krantzberg mine, Erongo Mountains, Namibia. Desmond Sacco collection; Bruce Cairncross photo.**

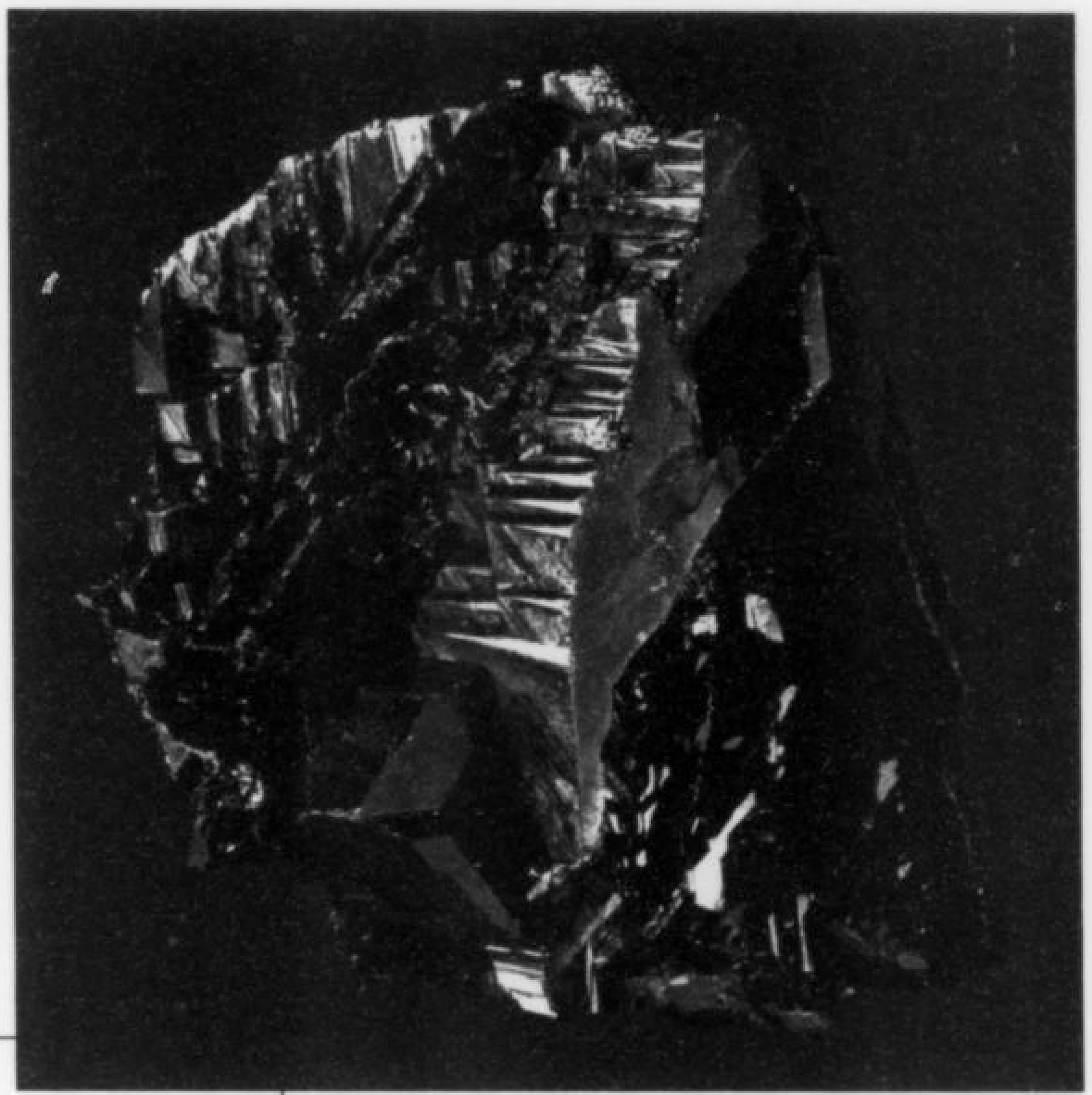


Figure 99. **Complex cassiterite crystal, 4.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 98. **Cassiterite with quartz, 3.8 cm. Erongo Mountains, Namibia. Private collection; Ernst A. Schnaitmann photo.**

tals scattered over their surfaces. A second pocket was discovered in July 2004, with cassiterite of a similarly complex habit. Good descriptions of the cassiterite pegmatites located west, southwest and south of the Erongo Mountains are given in Frommurze *et al.* (1942) and summarized in Diehl (1992a).

Cassiterite crystals found in miarolitic cavities differ markedly in habit from other cassiterites found in the adjacent stanniferous, zoned pegmatites and in the Krantzberg mine (see Table 2). The latter types show more typical simple forms and are brown to black with variable luster. At Krantzberg, some large specimens were collected (see Fig. 97). Here, the tin mineralization occurs in greisen veins, concentrated on the northern slope of the mountain and in a volcanic vent on the southeast slope. Highly mineralized zones are scattered around the periphery of the pipe. Some crystals are "coarsely crystalline ruby-red" (Haughton *et al.*, 1939). These authors give details on every cassiterite occurrence in and around Krantzberg Mountain. The main Erongo region cassiterite occurrences are listed in Table 2.

Clinozoisite $Ca_2Al_3(SiO_4)_3(OH)$

Pale pink clinozoisite crystals to 1 cm are found intergrown with prehnite at the andradite locality at Tubussis 22 (Niedermayr, 2000).

Collinsite $Ca_2(Mg,Fe^{2+})(PO_4)\cdot 2H_2O$

Hexagonal, orange-brown crystals of collinsite to 2 mm were quantitatively identified (Gebhard, 2002). The collinsite is scattered over the surfaces of foitite crystals, the latter showing strong pink-green dichroism.

Diopside $CaMgSi_2O_6$

The pyroxene-group species diopside has been found at the Tubussis andradite locality as radiating aggregates of small columnar crystals associated with tan-colored garnet.

Dolomite $CaMg(CO_3)_2$

Clusters of typically curved, saddle-shaped dolomite crystals attached to quartz were discovered in October 2000. Individual dolomite crystals are generally 1 to 2 cm and most are matte gray;

Figure 100. **Diopside with pale brown garnet, 2.3 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

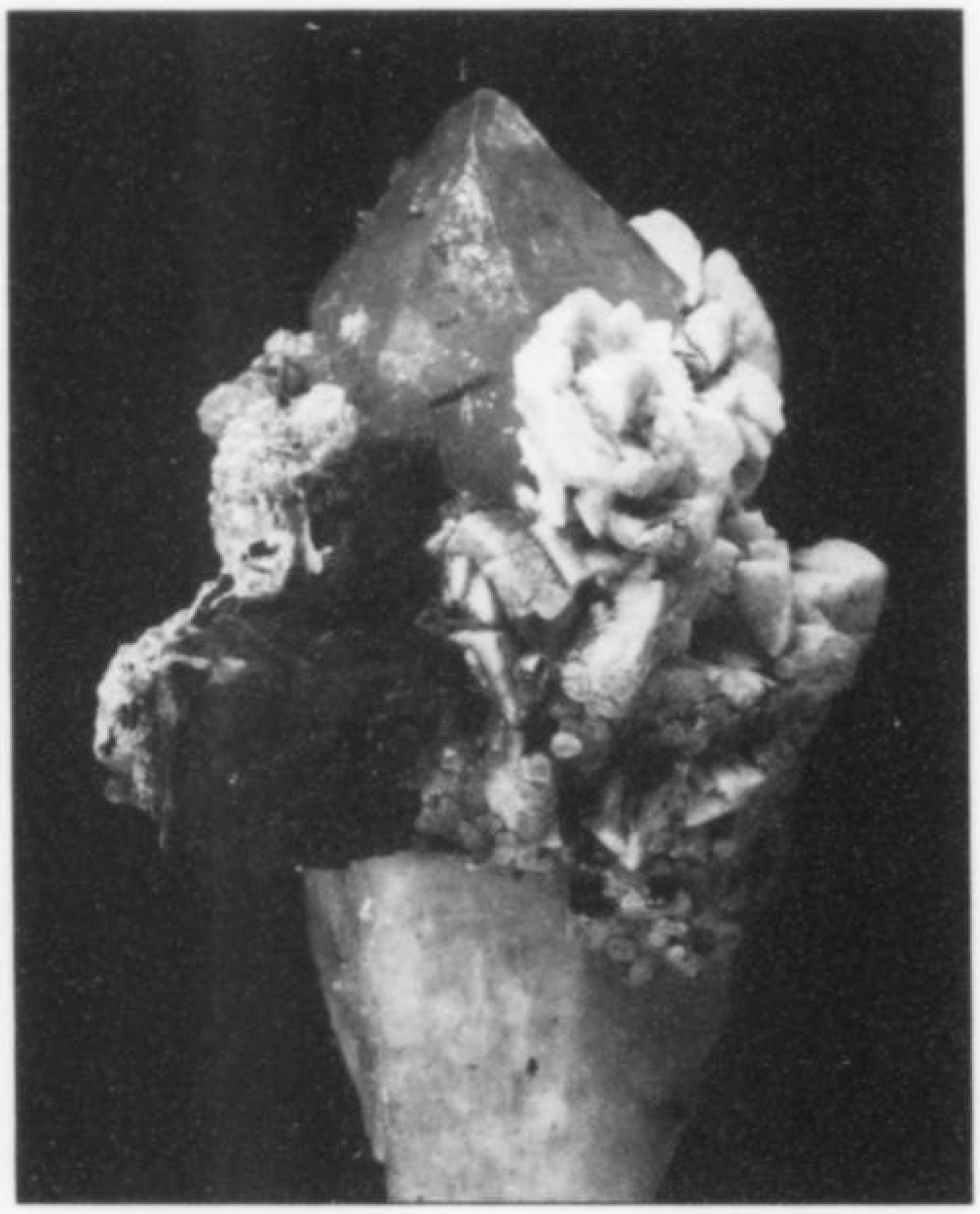


Figure 101. **Dolomite on quartz, 10.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

some are stained by secondary iron oxides. The dolomite-studded quartz varies from single crystals to multiple crystal clusters. The largest single quartz crystal is 15 cm long. The dolomite is characteristically attached to the pyramidal quartz faces but some is attached to the prism faces. Minor white fluorite, blue tourmaline crystals to 1 mm, schorl and hyaline opal complete the mineral assemblage from this unique dolomite-bearing miarolitic cavity.

Dumortierite $Al_7(BO_3)(SiO_4)O_3$

Schneider and Seeger (1992b) report bright deep blue dumortierite from a pegmatite on the farm Etemba 135, close to the northern boundary of the Erongo Mountains. This deposit was mined for ornamental stone, and yielded seven tons of material in 1957. Of historical interest is a bowl and obelisk made from this Etemba 135 dumortierite which were on display in the German Geological Survey in Berlin prior to the outbreak of World War II (Silberstein, 1933; *South African Mining & Engineering Journal*, 1947).

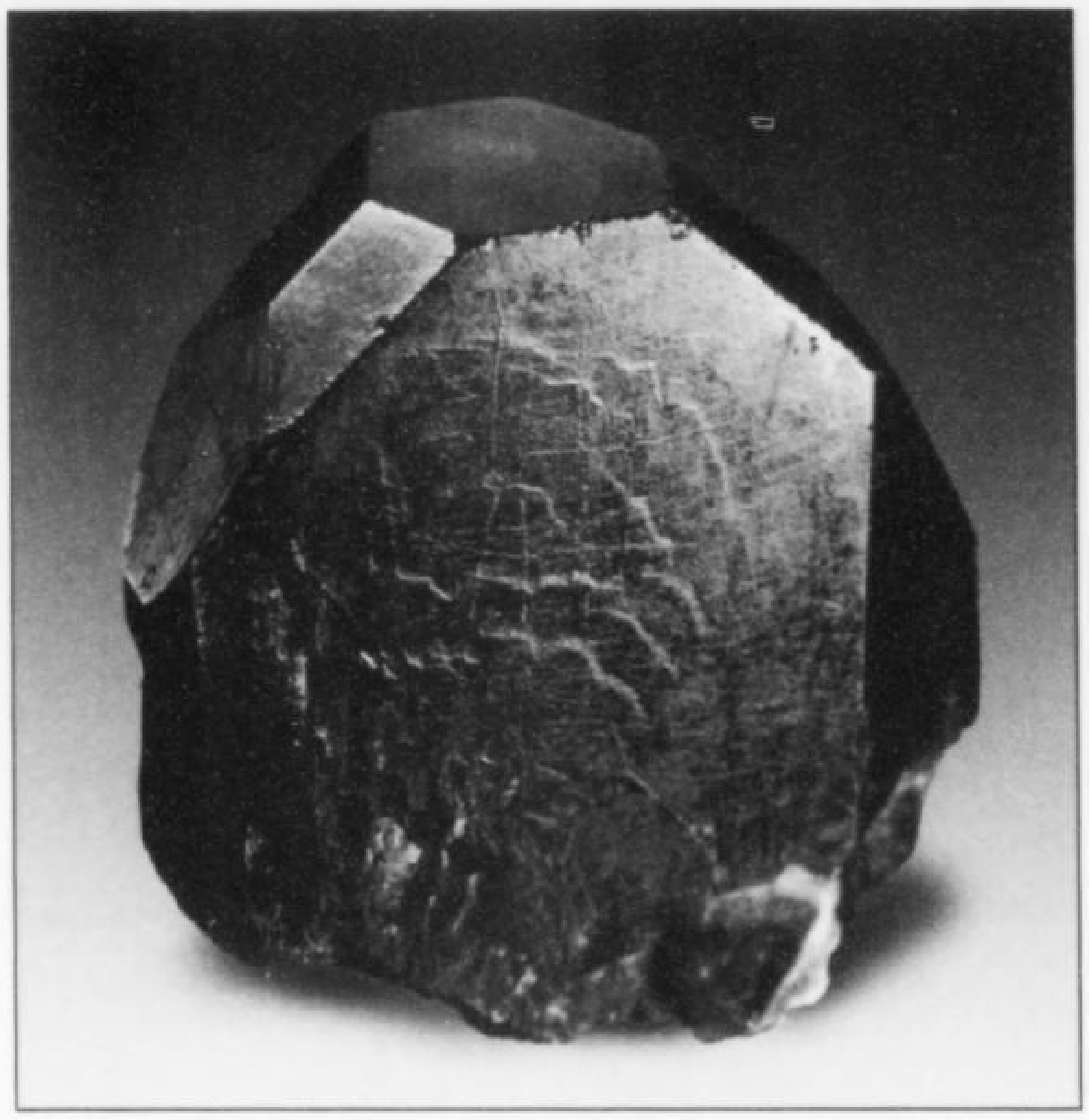


Figure 102. **Ferberite, 3.7 cm. Krantzberg mine. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 103. **Ferberite crystal, 1.3 cm, on fluorite (repaired). Erongo Mountains, Namibia.** ***Namibia Minerals*** **specimen; Ernst A. Schnaitmann photo.**

Ferberite $Fe^{2+}WO_4$

Ferberite was mined from the pegmatites on Kudubis 19, Goabeb 63, Davib Ost 61 and Ameib 60 (Diehl, 1992b). Attractive, euhedral, steel-gray crystals have been found on rare occasions. The main tungsten deposit in the region was at Krantzberg (Haughton *et al.*, 1939). Quartz veins in the Kuiseb schist contain ferberite associated with drusy fluorite and accessory bismuth and chalcopyrite. Well-formed ferberite crystals to about 5 cm occur sparingly with white and purple fluorite in a mineralized ferberite-schorl-fluorite vein 200 meters due north of the Krantzberg Mountain beacon. Ferberite crystals of similar size were discov-

Figure 104. **Ferberite crystal, 2 cm, on fluorite. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

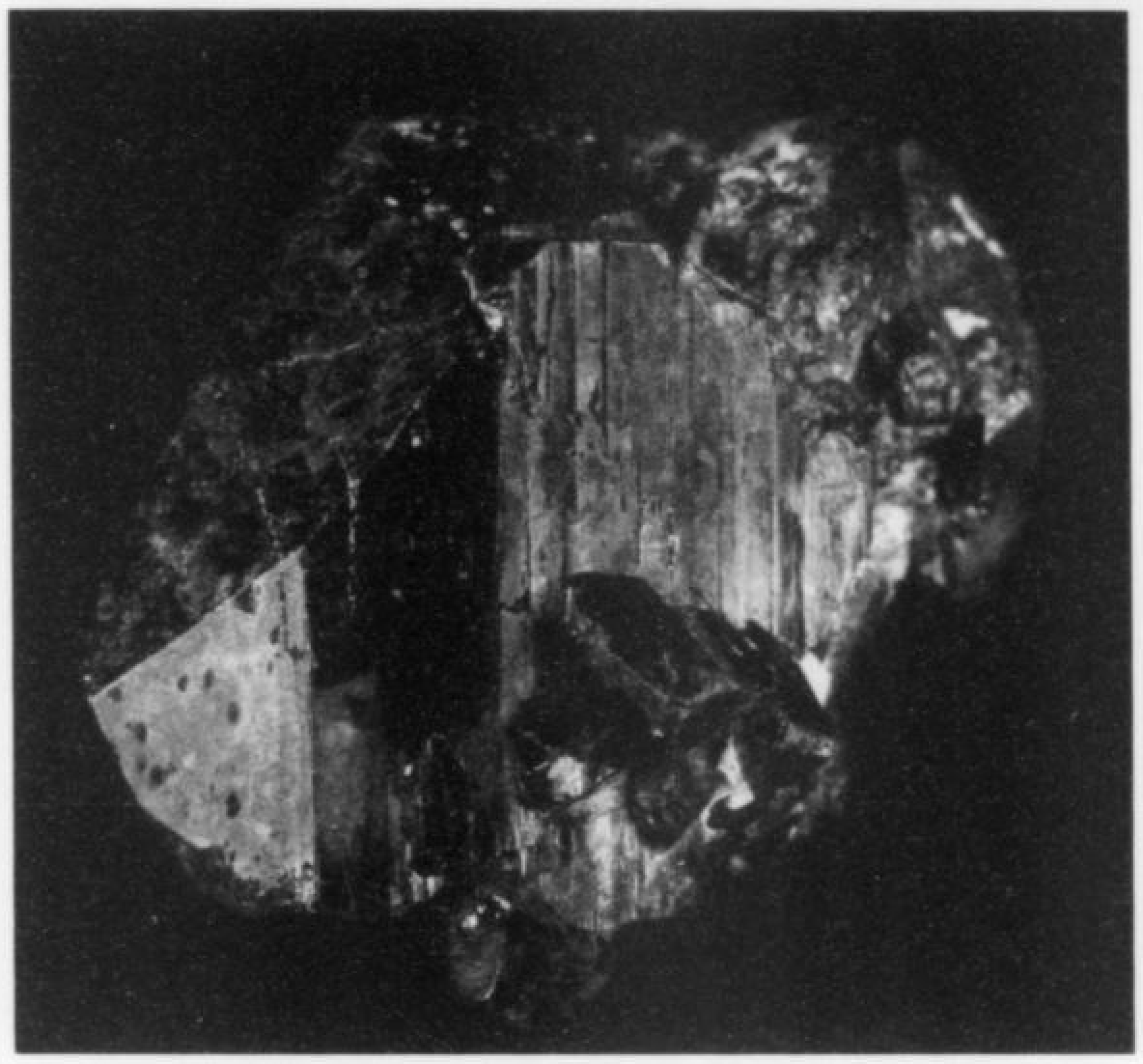
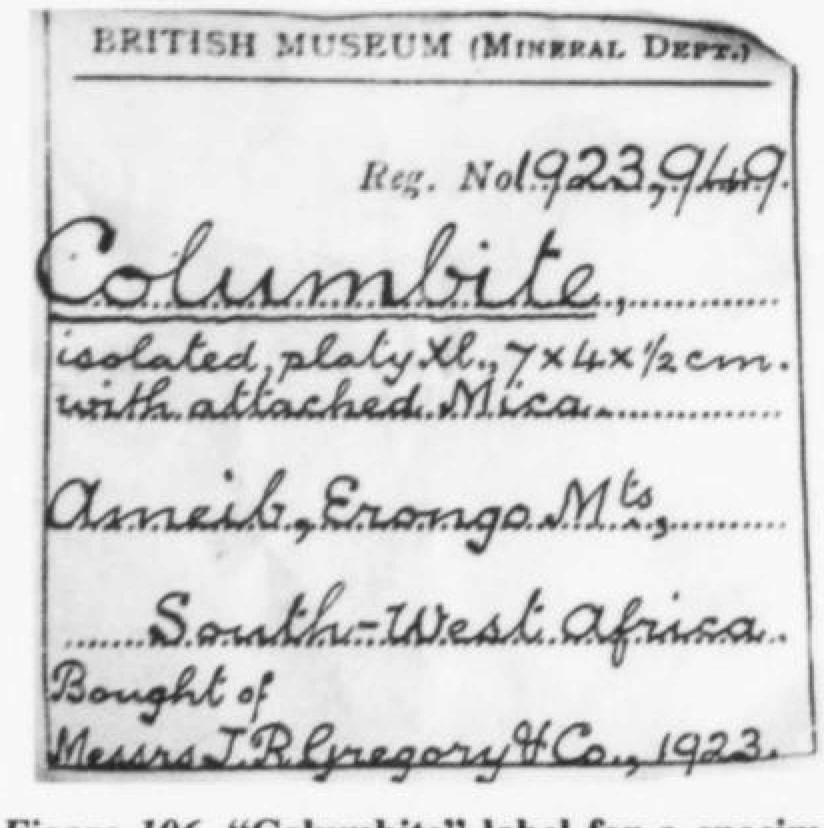


Figure 105. **Ferberite, 2.8 cm. Krantzberg mine, Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



BRITISH MUSEUM (MINERAL DEPT.)

Reg. No 1923,949

Columbite,

isolated, platy Xl., 7×4×½ cm. with attached Mica

Ameib, Erongo Mts.,

South-West Africa.

Bought of Messrs J. R. Gregory & Co., 1923.

Figore 106. **"Columbite" label for a specimen collected in 1929 on the farm Ameib 60. Natural History Museum, London collection.**

ered in another quartz-topaz greisen vein 2 km northwest of the Krantzberg beacon.

Windhoek collectors Herbert Nägele and Ernst Schnaitmann regularly make field trips to the Erongo Mountains for specimens and confirm that Erongo ferberites are rare. The ferberite that may be found by local diggers is usually misidentified as "tantalite" and is erroneously sold locally as an ore of tantalum.

Ferrocolumbite $Fe^{2+}Nb_2O_6$ and
Ferrotantalite $Fe^{2+}Ta_2O_6$

"Columbite-tantalite" has been reported by Jahn and Bahmann (2000) as crystal cleavages up to 6 cm, but these have not been quantitatively analyzed to determine their specific species. A specimen of tantalite-columbite from the Van der Made (= Erongo Schlucht) pegmatite was acquired in 1977 by the Johannesburg Geological Museum collection. One of the earliest recorded "columbite" crystals is a 0.5 × 4 × 7-cm specimen from Ameib 60, Erongo Mountains. The Natural History Museum in London bought this crystal in 1923 from James R. Gregory & Co.

Florencite-(Ce) $LaAl_3(PO_4)_2(OH,H_2O)_6$

Recently, florencite-(Ce) was positively identified from Erongo. It occurs as dark red microcrystals on Carlsbad-law twinned, corroded orthoclase, together with schorl and topaz. The minute crystals look rather nondescript and could easily be overlooked.

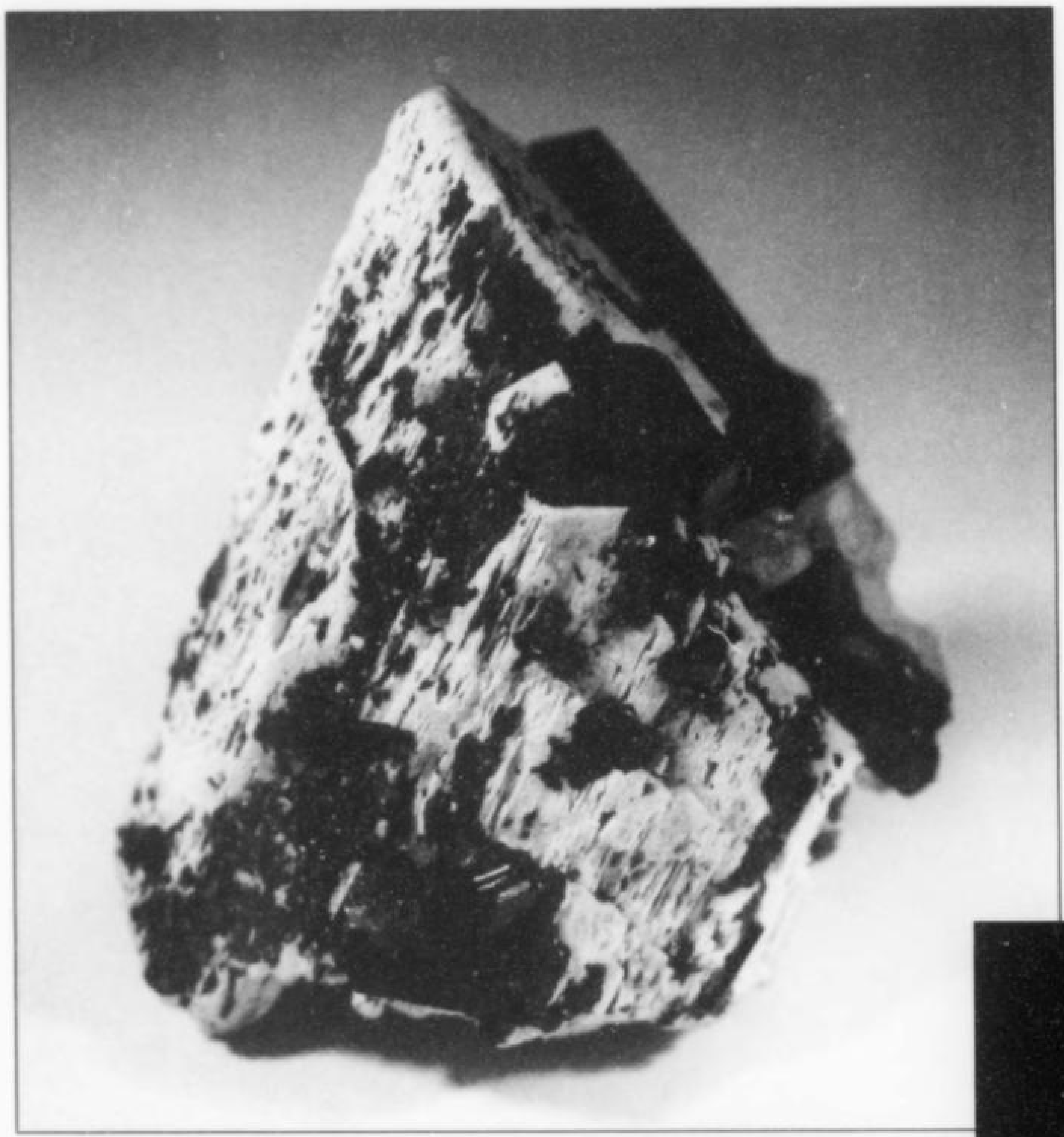
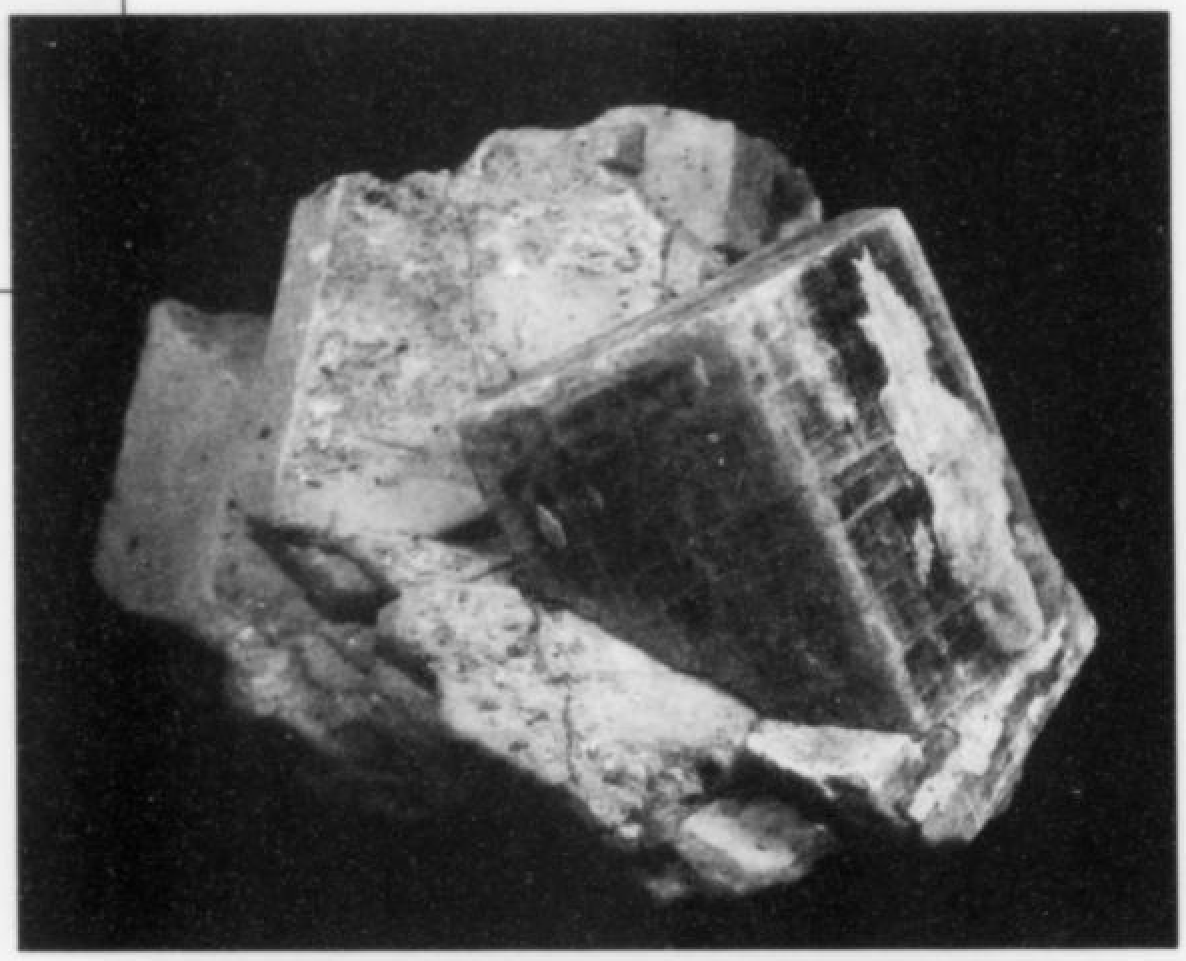


Figure 107. **Microcrystals of florencite-(Ce) on twinned orthoclase, associated with schorl and topaz, 3.4 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 109. **Fluorapatite on orthoclase, 5.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**



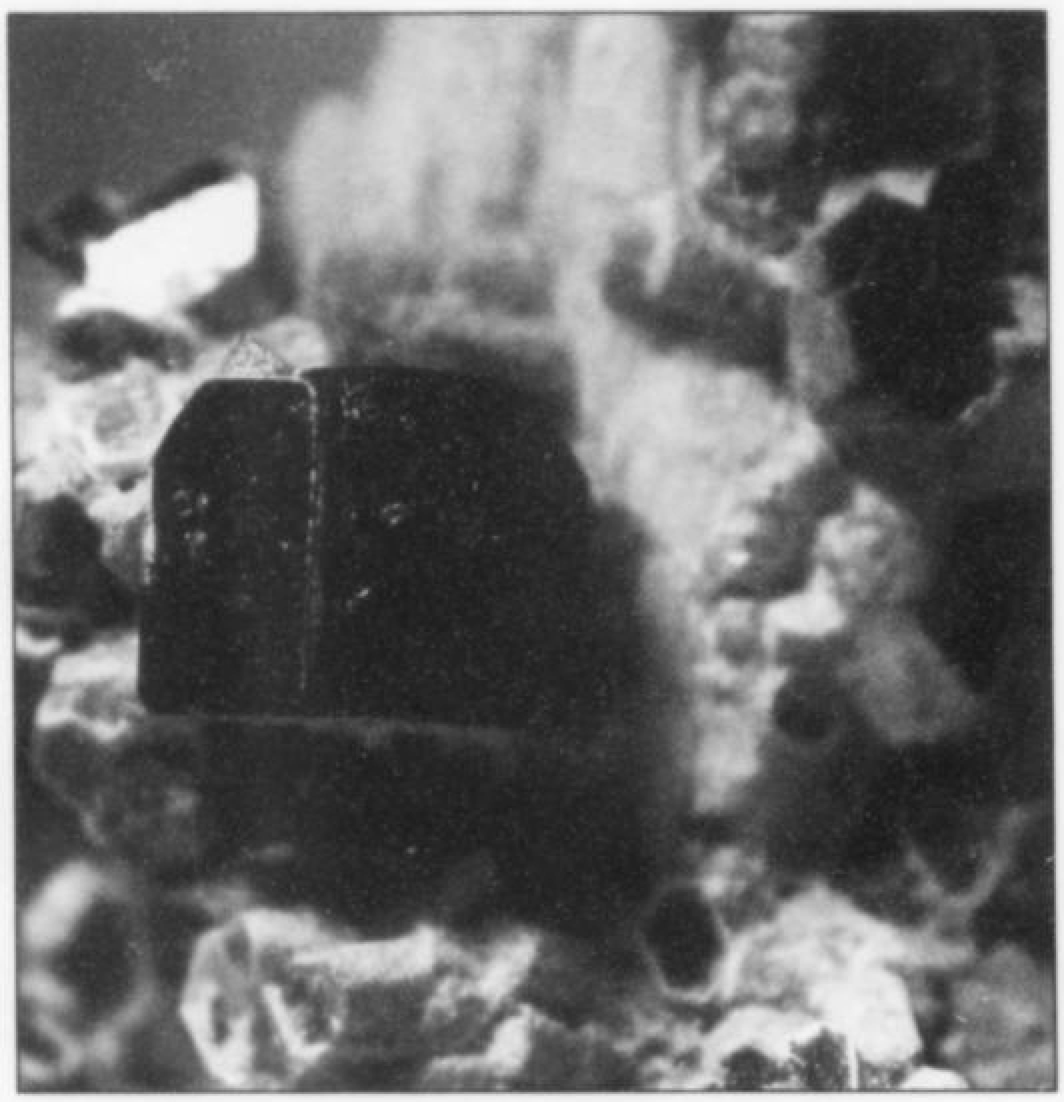


Figure 108. **Fluorapatite crystal, 5 mm, associated with orthoclase and muscovite. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Fluorapatite $Ca_5(PO_4)_3(F,OH,Cl)$

Fluorapatite is rare from the Erongo miarolitic cavities; some specimens thought to be fluorapatite turned out to be beryl. However, Jahn and Bahmann (2000) describe pale blue-gray crystals to 2 cm, but usually less than 1 cm, on gray milky quartz and schorl. The fluorapatite is characteristically deeply etched. The Brabant pegmatites in Erongo Schlucht contain fluorapatite, and von Bezing (2006) describes its occurrence from Bergsig 167 and Erongorus 166.

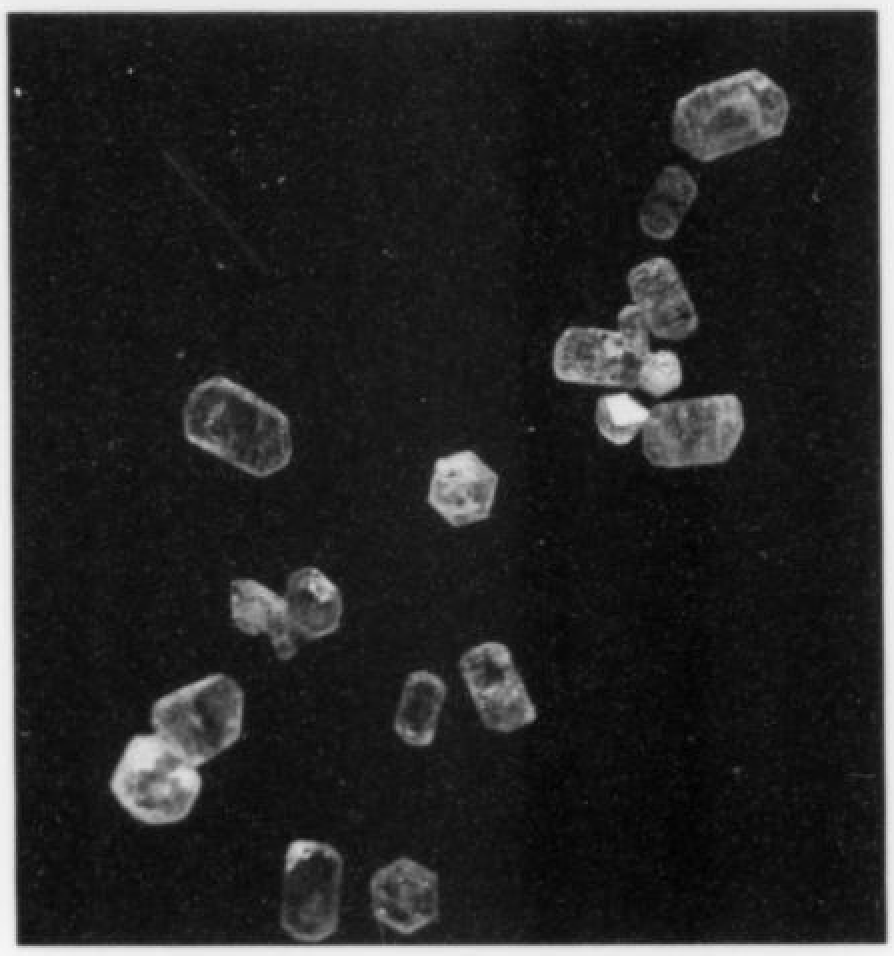


Figure 110. **Fluorapatite crystals, up to 2.5 mm, on schorl. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

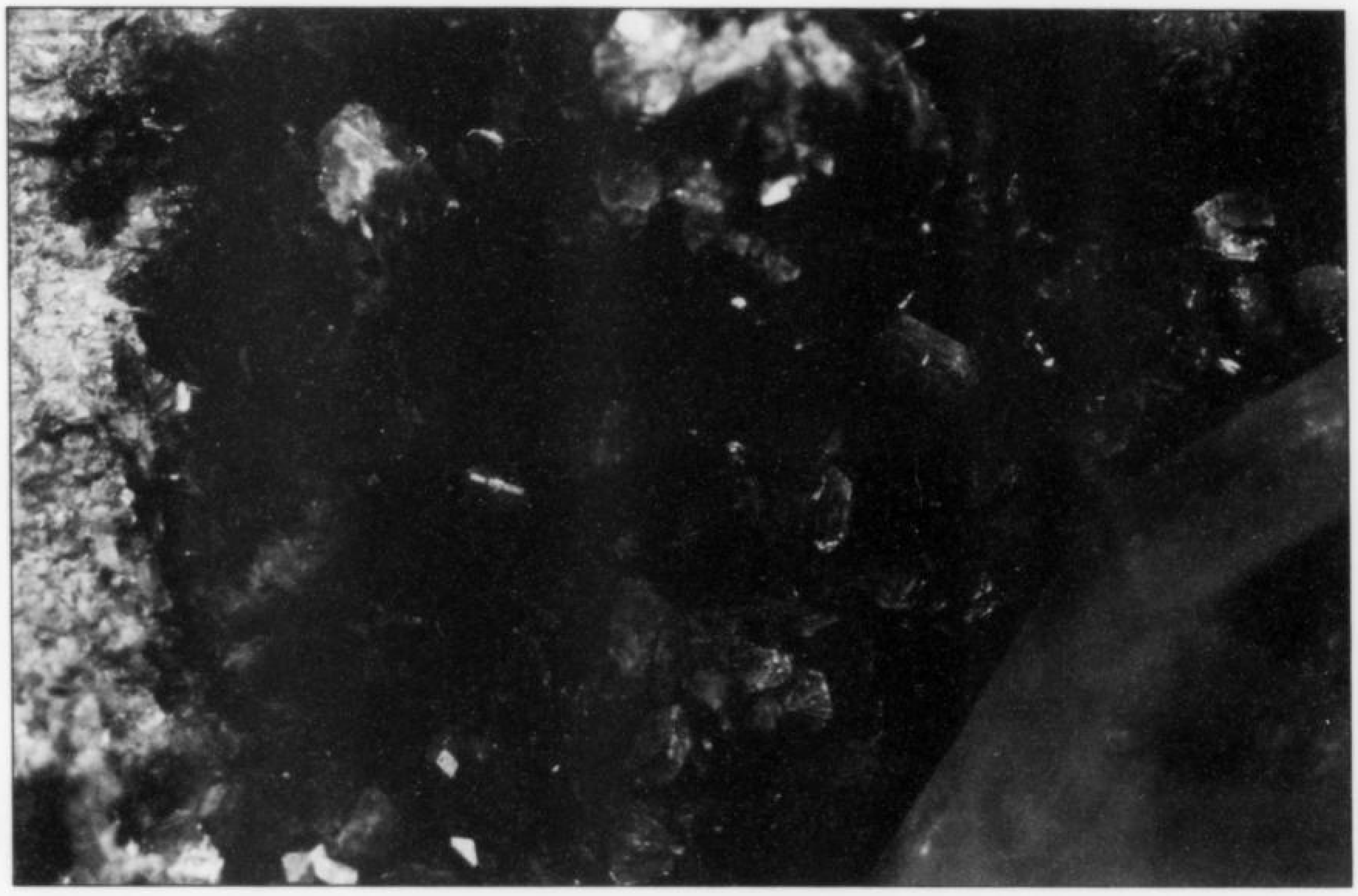


Figure 111. **Blue fluorapatite crystals to 3 mm, on muscovite, with quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

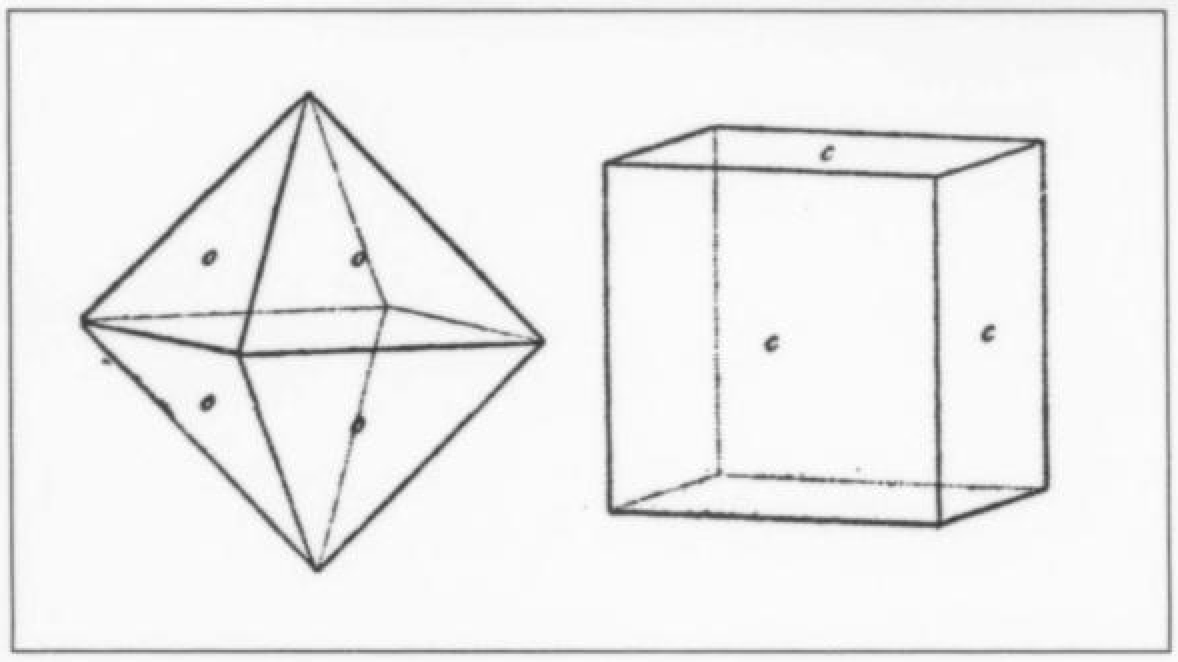


Figure 112. **Octahedron and cube crystal drawings typical of Erongo fluorite, from Goldschmidt (1918).**

Fluorite CaF_2

The miarolitic cavities on Davib West 62, Davib Ost 61, Bergsig 167 and Erongorus 166 have produced fluorite crystals of various colors and habits. The largest crystals are 10-cm cubes. Some of the earlier discoveries on Tubussis 22 produced pale green crystals with a semi-rounded appearance caused by etching and resorption. Notable pockets were unearthed in October 2000 and particularly in July 2005. The latter discovery was on the farm Bergsig 167, where diggers excavated pockets on the precipitous mountain slopes. Most of these fluorite crystals are simple cubes of a vivid, bright emerald-green color on a matrix of white orthoclase. Some of the cubes have dark purple corners. Dodecahedral and cuboctahedral fluorite crystals have also been found; some are deeply etched and display curvilinear crystal edges. Rare crystals display elongated growth patterns and serrated, colorless, transparent edges surrounding a dark green "faden" core running parallel to the elongation. Some transparent white crystals have globular purple cores. In some specimens, complex, dark purple-green fluorite crystals are scattered on matrix of coarsely crystalline, yellow hexagonal muscovite rosettes.

Most specimens are miniature to small cabinet-size, but rare plates of apple-green fluorite to 20 cm across have been recovered. Fluorite is associated with orthoclase crystals (single and twinned), topaz, quartz, aquamarine and muscovite. In rare cases, quartz crystals enclose small (less than 1 cm) fluorite crystals. In July 2005, unusual thumbnail to miniature specimens were collected which show transparent aquamarine crystals containing inclusions of yellow-green fluorite. Some fluorite is also attached to the outside surfaces of the aquamarine. Unusual specimens of purple-blue fluorite display a curvilinear habit, with crystal surfaces made up of a myriad of small crystal domains. Rare black octahedral crystals were once found and these resemble the yttrium fluorite from neighboring Klein Spitzkoppe (Cairncross, 2005).

In January 2006, specimens of stalactitic fluorite were recovered from one pocket. The "stalactites," which taper to points, consist of drusy green and dark purple fluorite, with associated colorless beryl and minor schorl.

The Brabant pegmatite on the farm Brabant 168, Erongo Schlucht, contained vugs in pegmatitic quartz that were lined with purple miarolitic cavity fluids.

Figure 113. **Fluorite crystal, 1.3 cm, on orthoclase. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

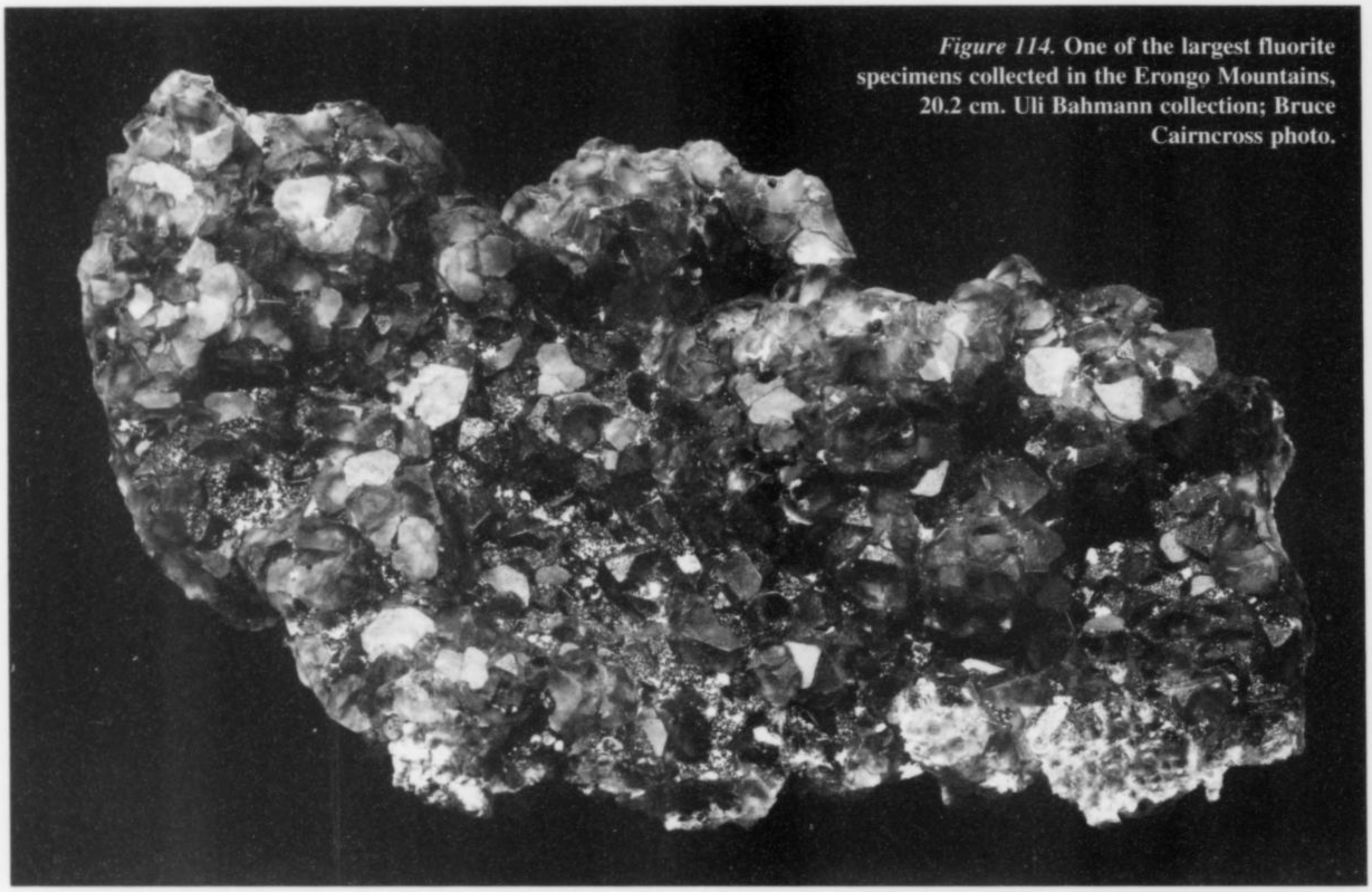


Figure 114. One of the largest fluorite specimens collected in the Erongo Mountains, 20.2 cm. Uli Bahmann collection; Bruce Cairncross photo.

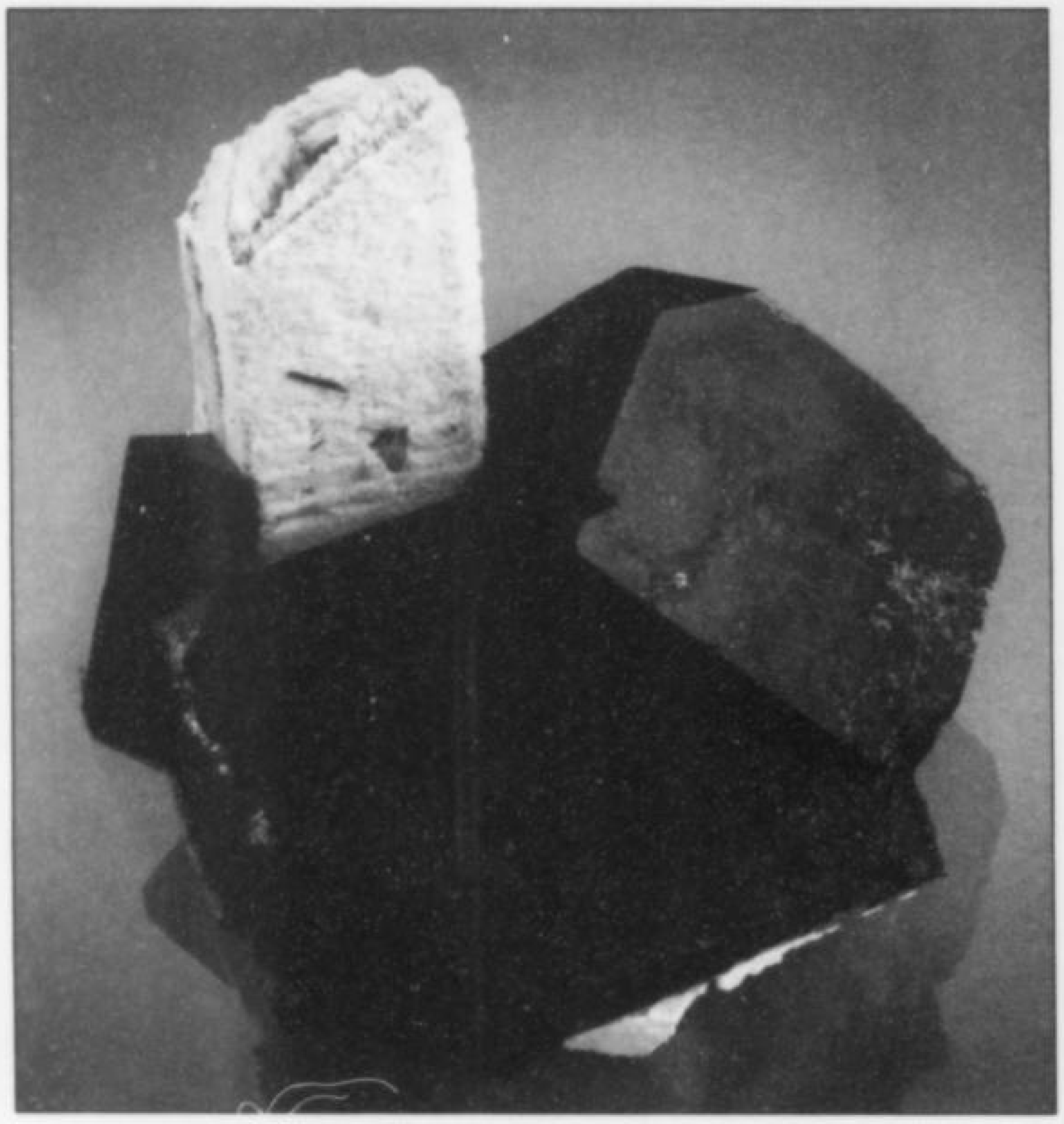


Figure 115. Fluorite and Carlsbad-law twinned orthoclase, 10.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 116. Fluorite on doubly terminated quartz and Carlsbad-law twinned orthoclase, 6.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

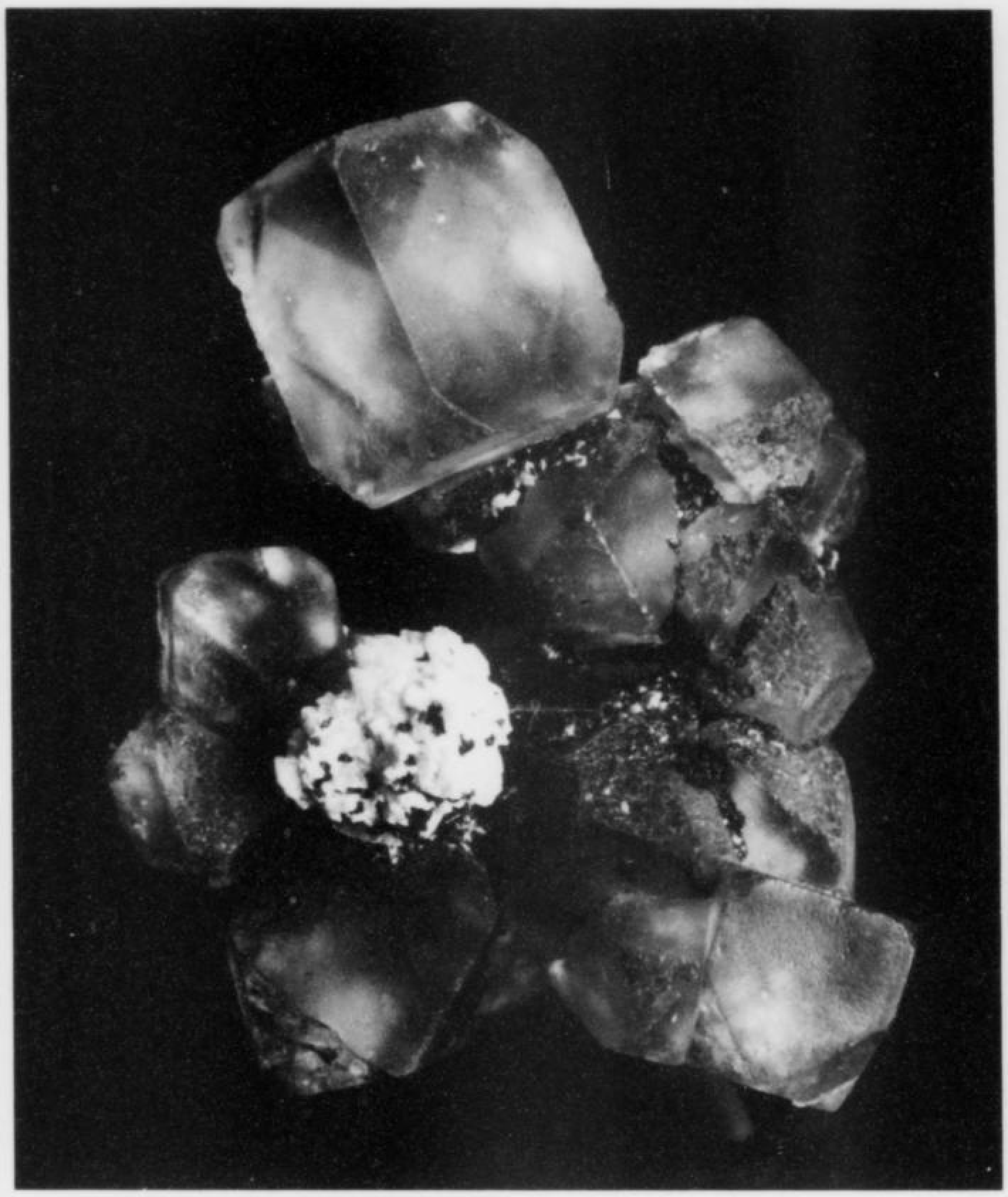


Figure 117. **Cluster of cubic fluorite, modified by {111} octahedral faces, 4.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

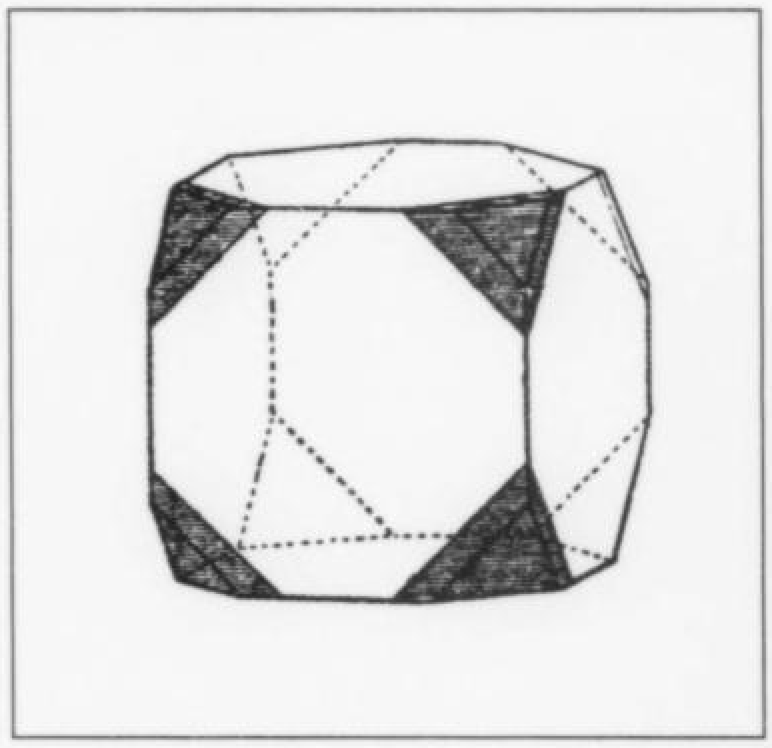


Figure 118. **Another cuboctahedral fluorite crystal drawing typical of Erongo, from Goldschmidt (1918).**

Figure 120. **Fluorite with quartz and muscovite, 6.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

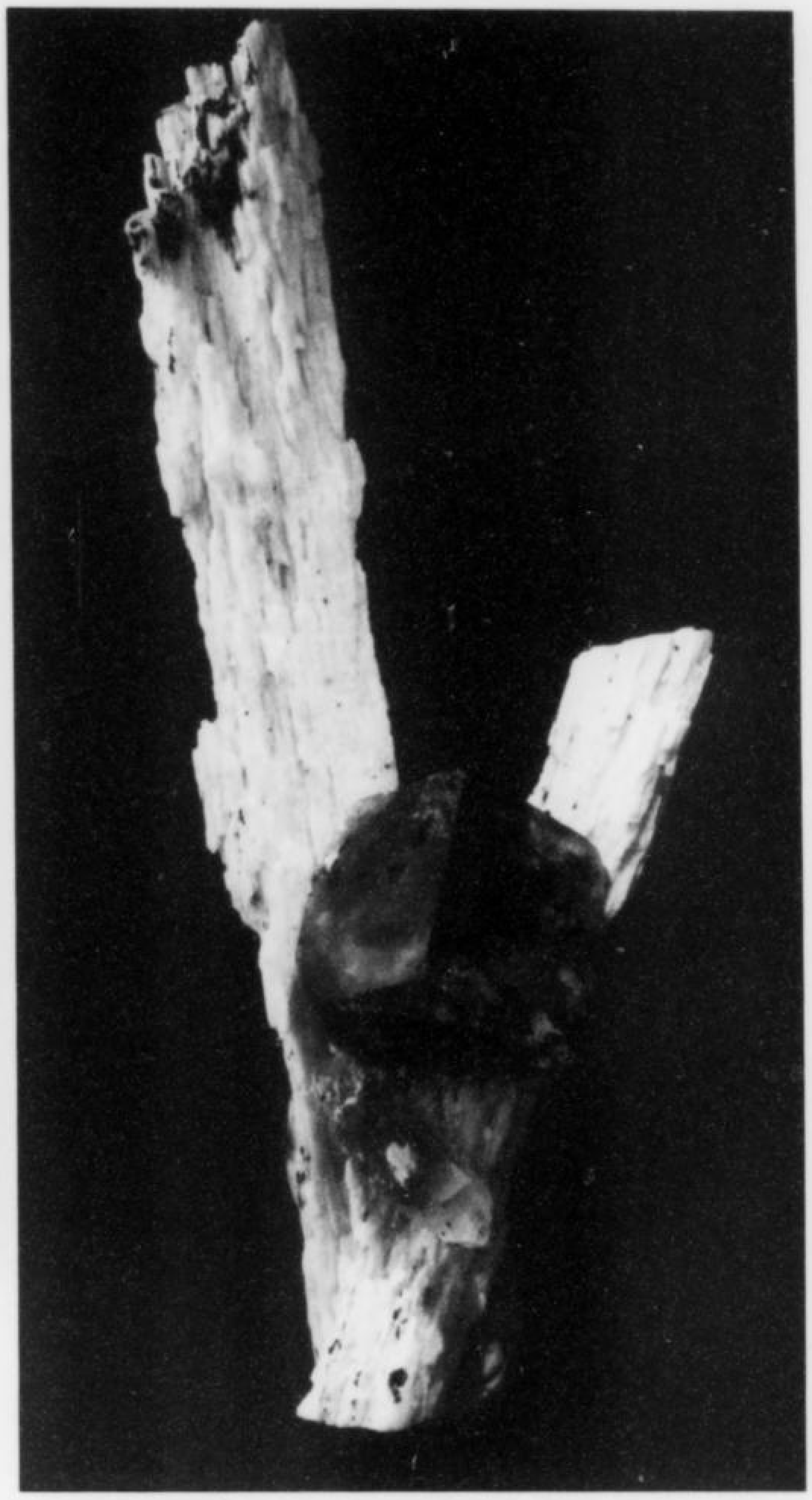
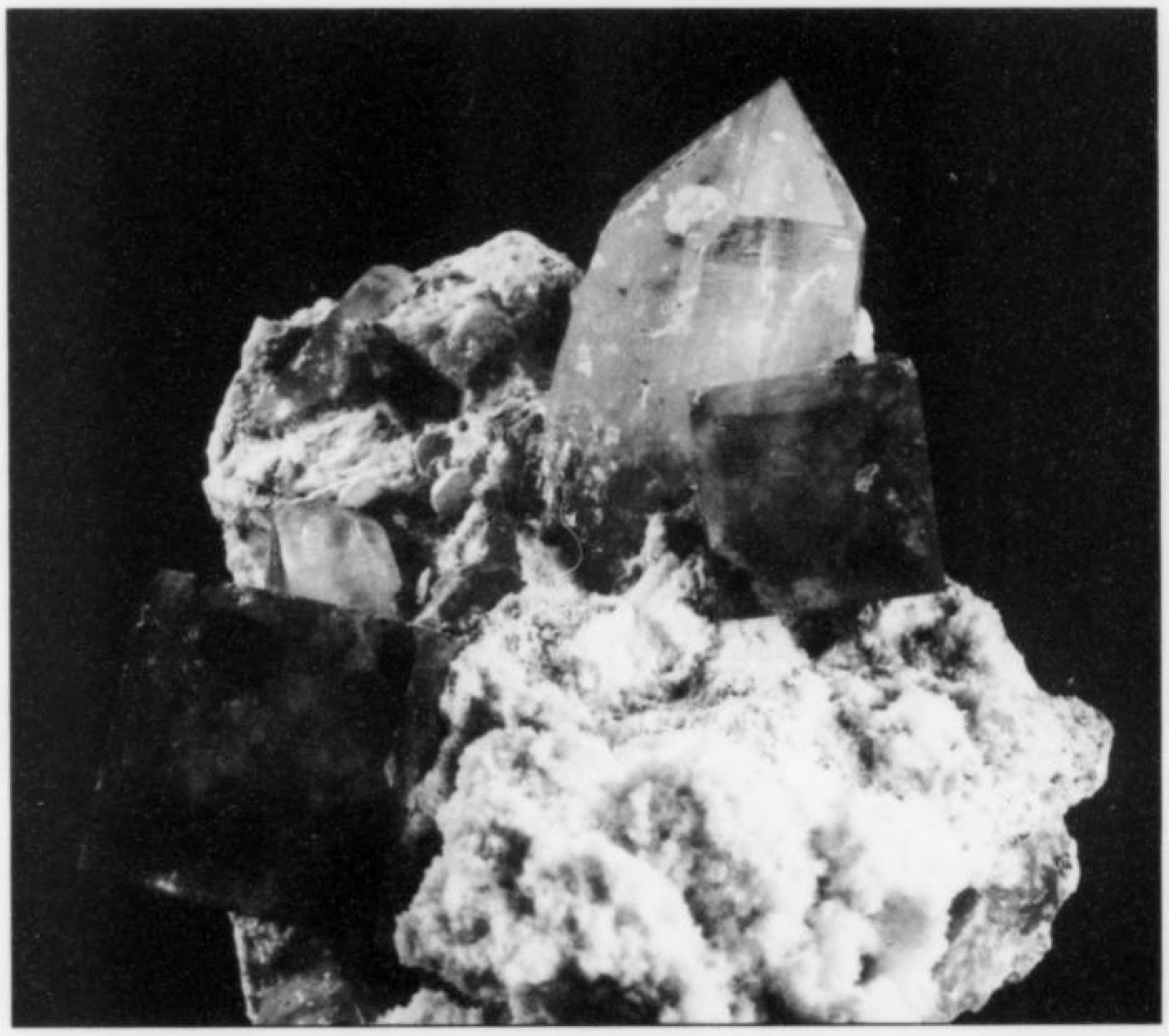


Figure 119. **Fluorite on orthoclase with quartz, 6.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



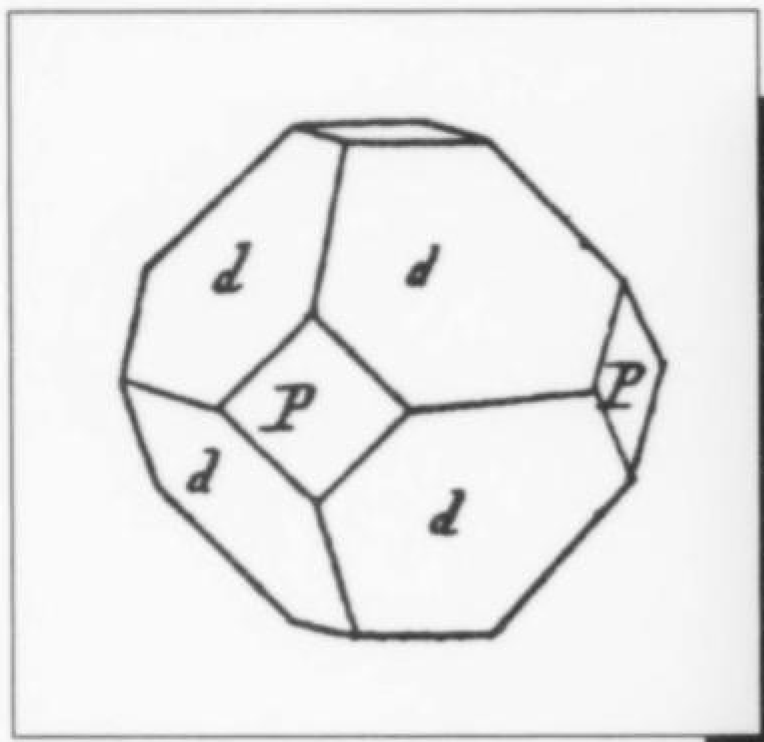


Figure 121. Cuboctahedron crystal drawing typical of Erongo fluorite, from Goldschmidt (1918).

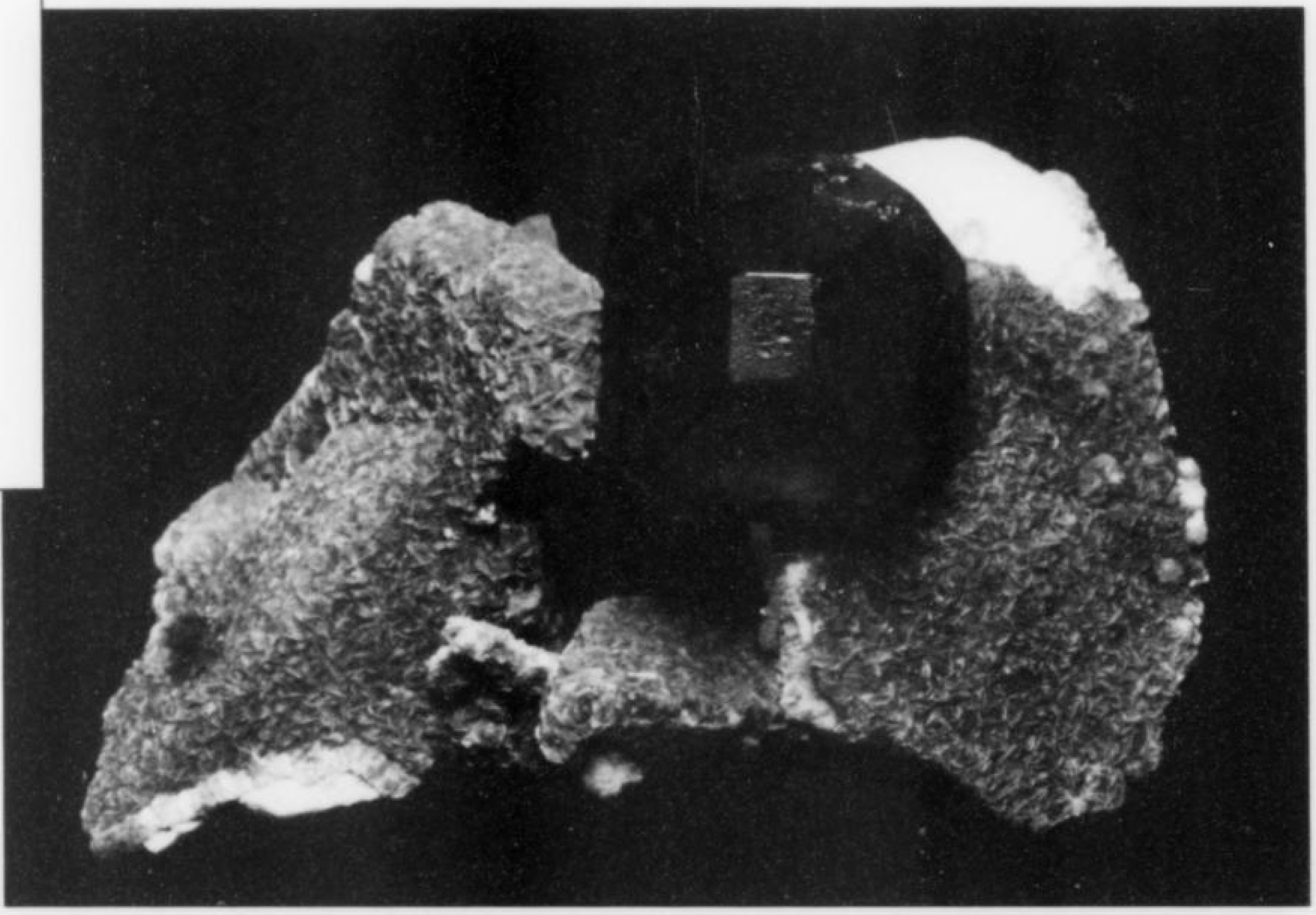


Figure 122. Fluorite crystal, 1.6 cm, on muscovite, on orthoclase. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

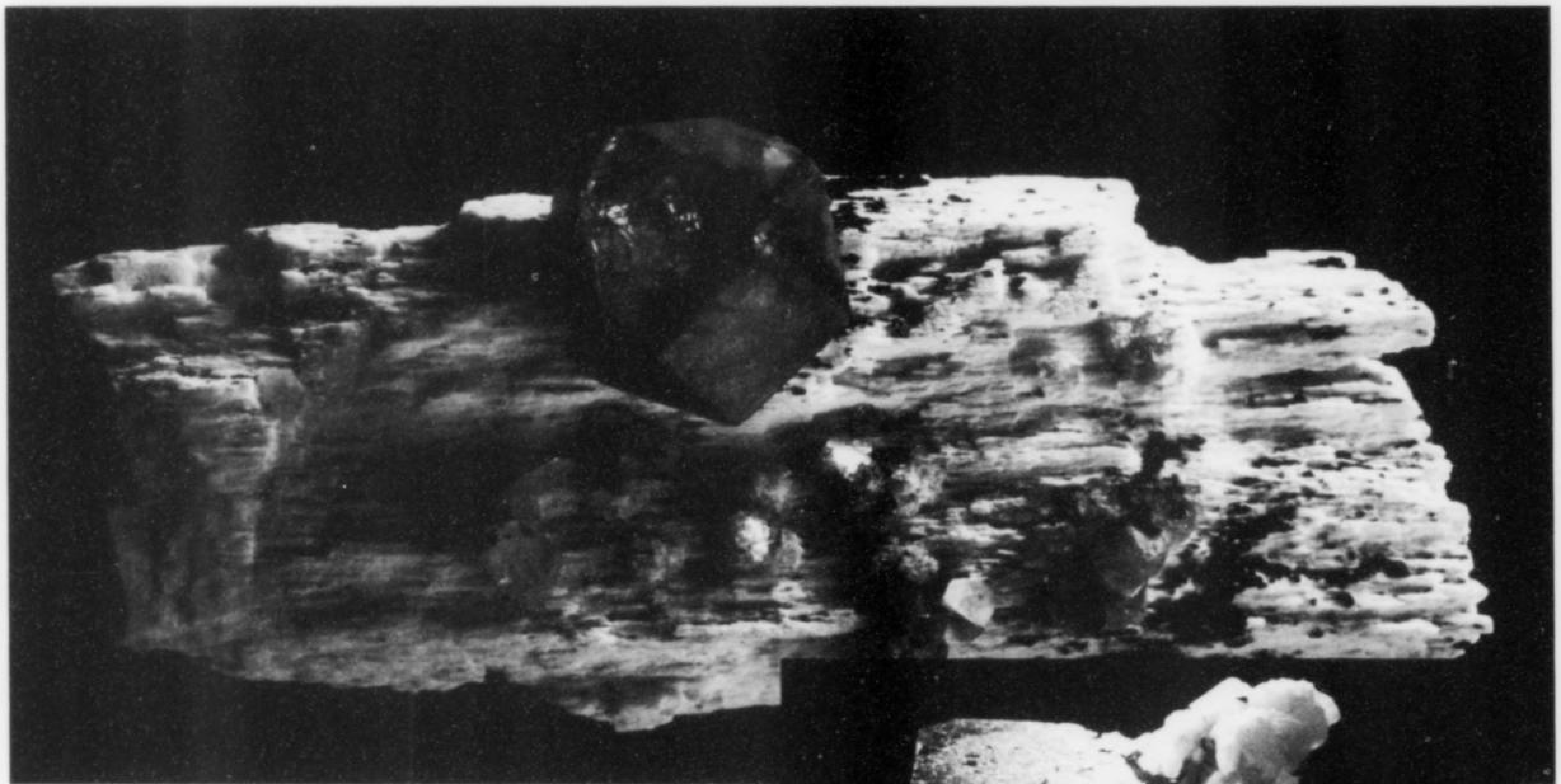


Figure 123. Fluorite on corroded orthoclase, 8.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

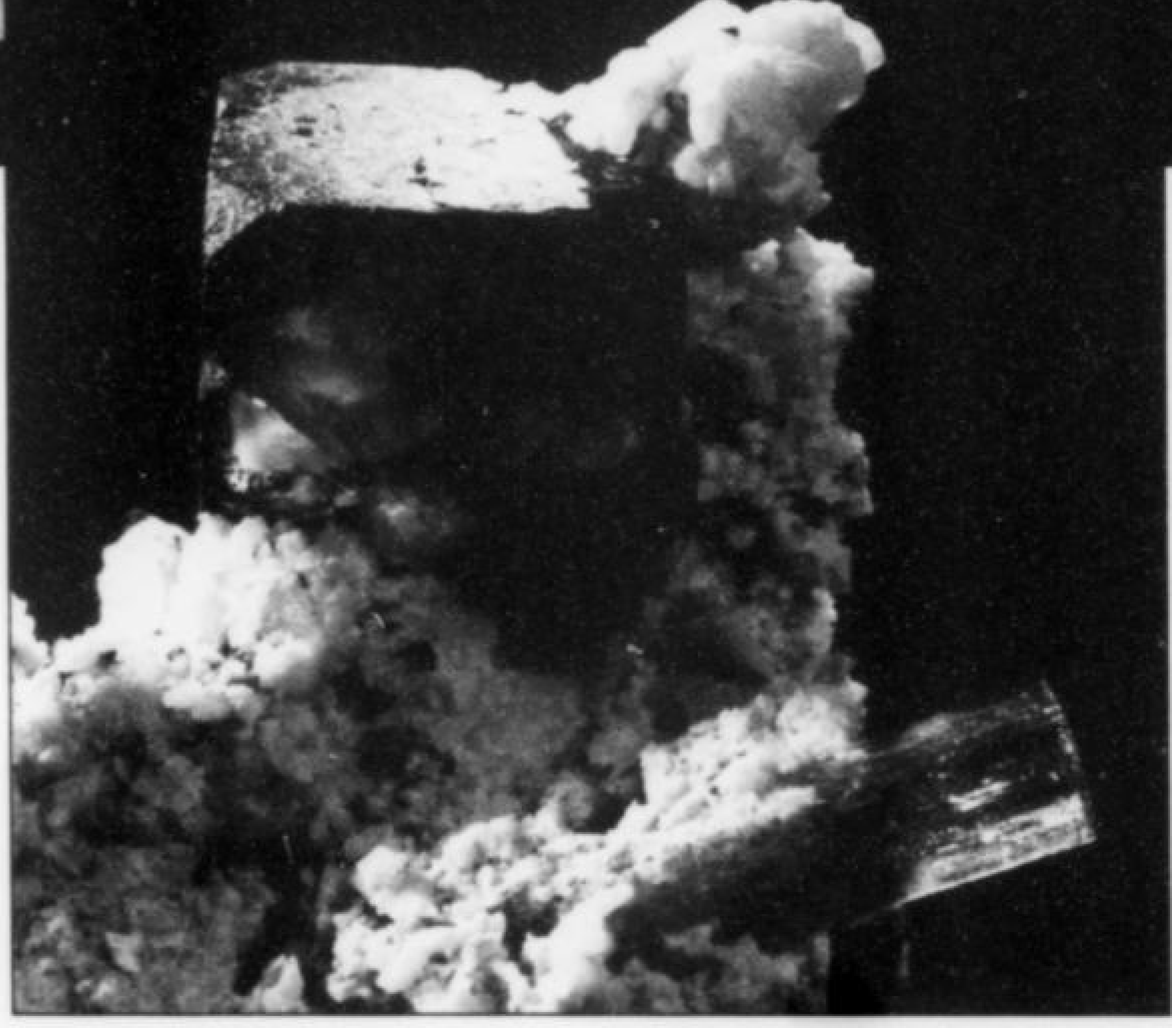


Figure 124. Color-zoned cubic fluorite on orthoclase with aquamarine, 4.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

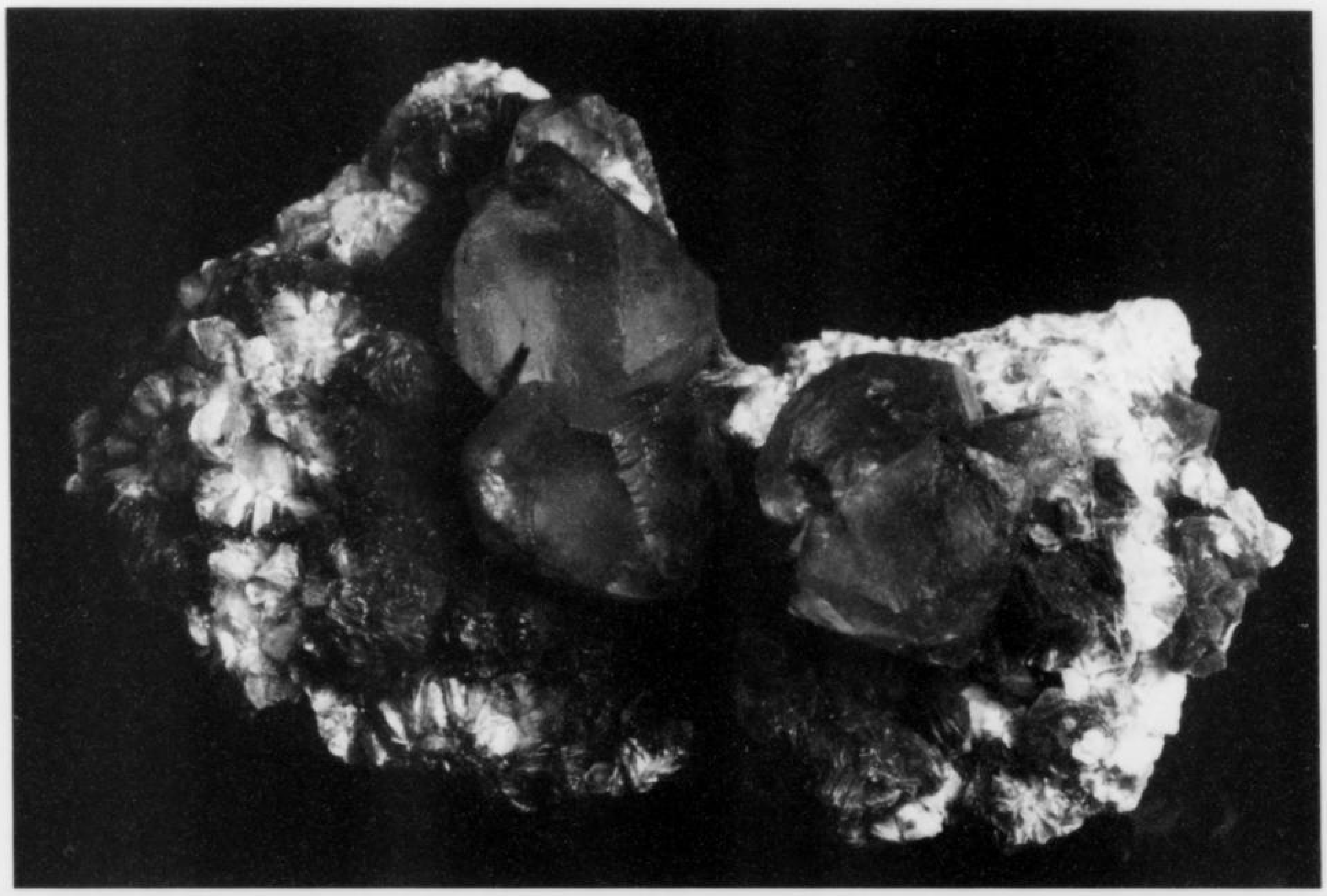


Figure 125. **Fluorite with muscovite and orthoclase, 7.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

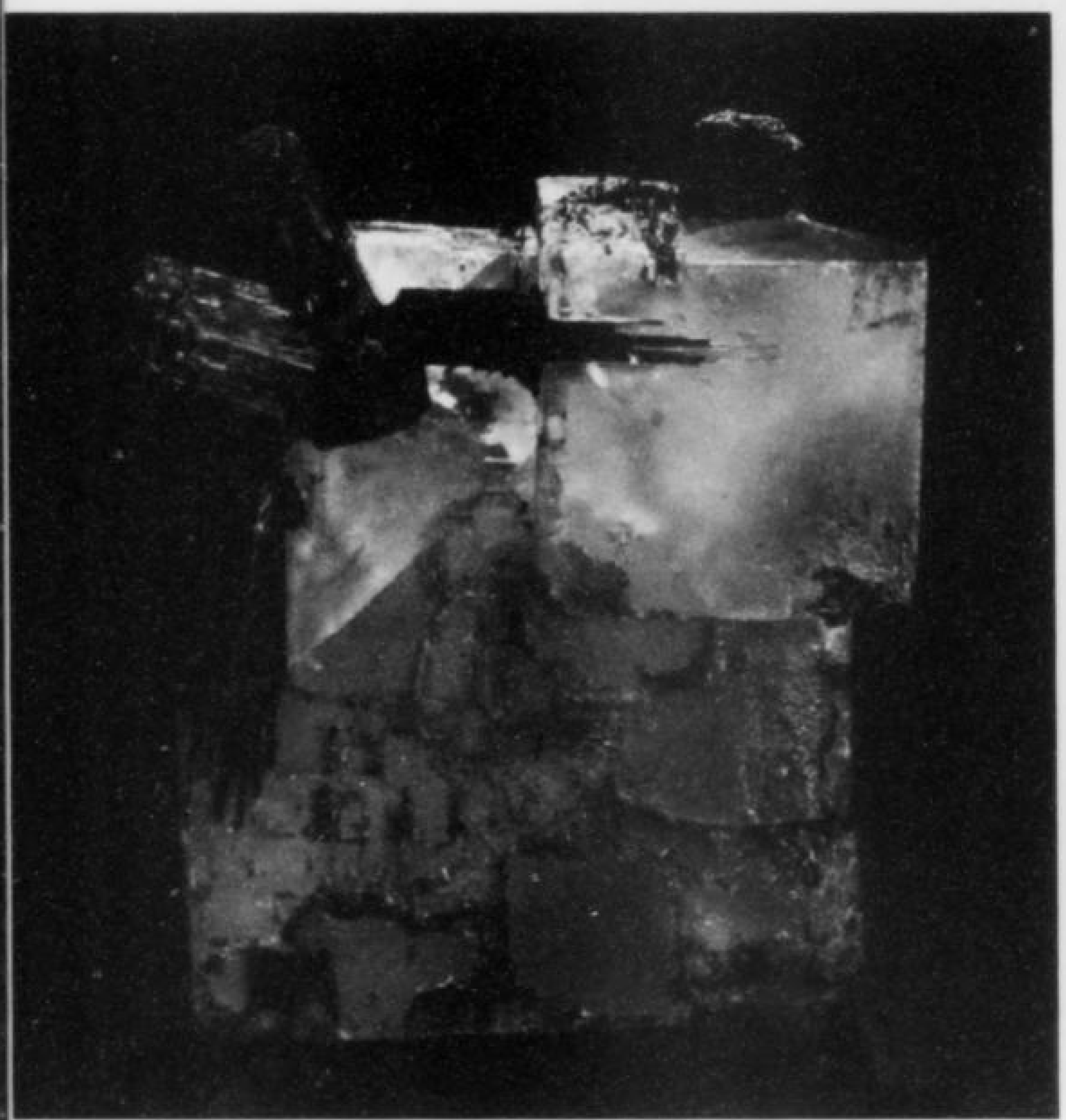


Figure 126. **Composite color-zoned fluorite with schorl, 2.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

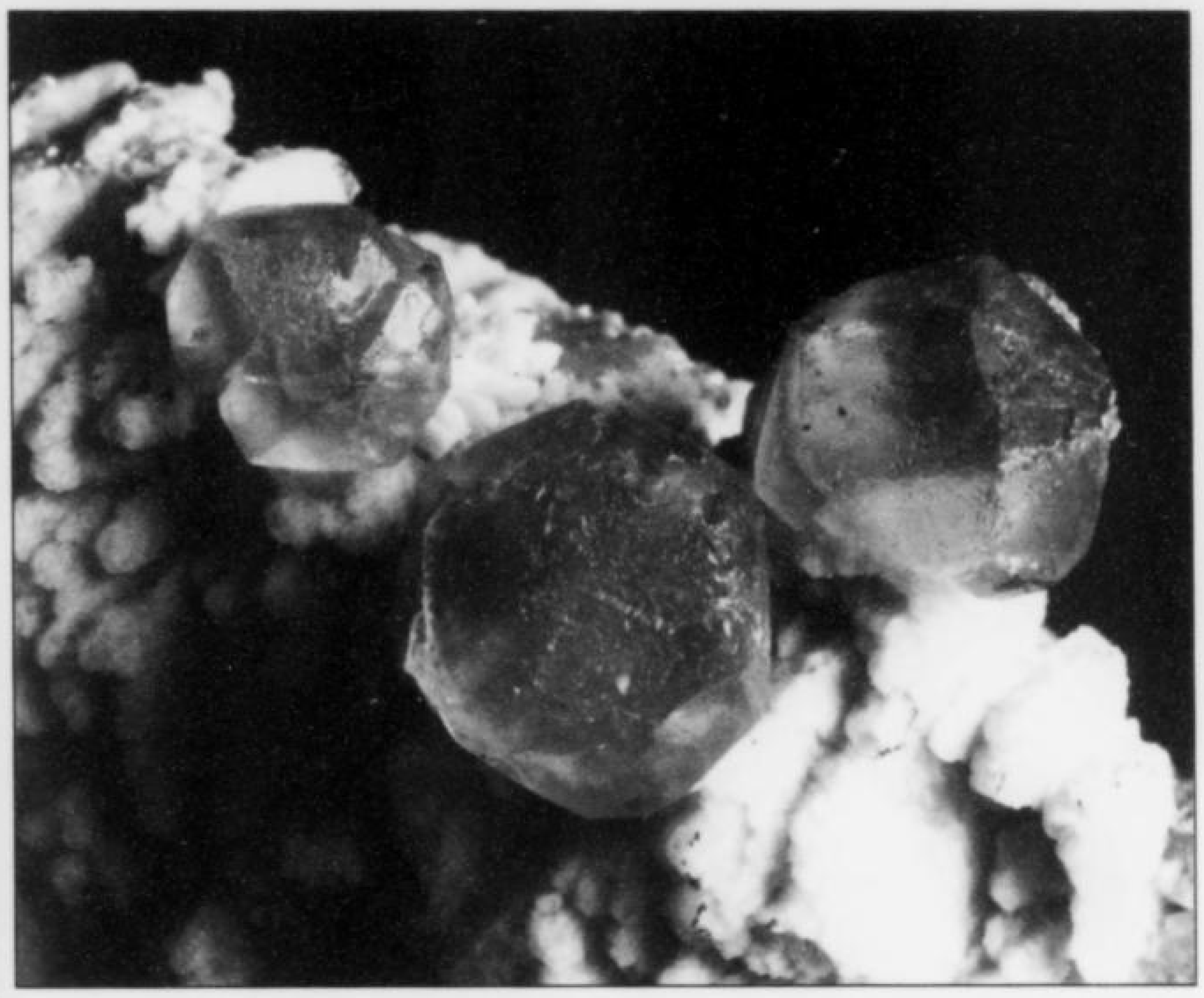


Figure 127. **Cuboctahedral fluorite on orthoclase, 6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 128. **Fluorite with ferberite, 4.6 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

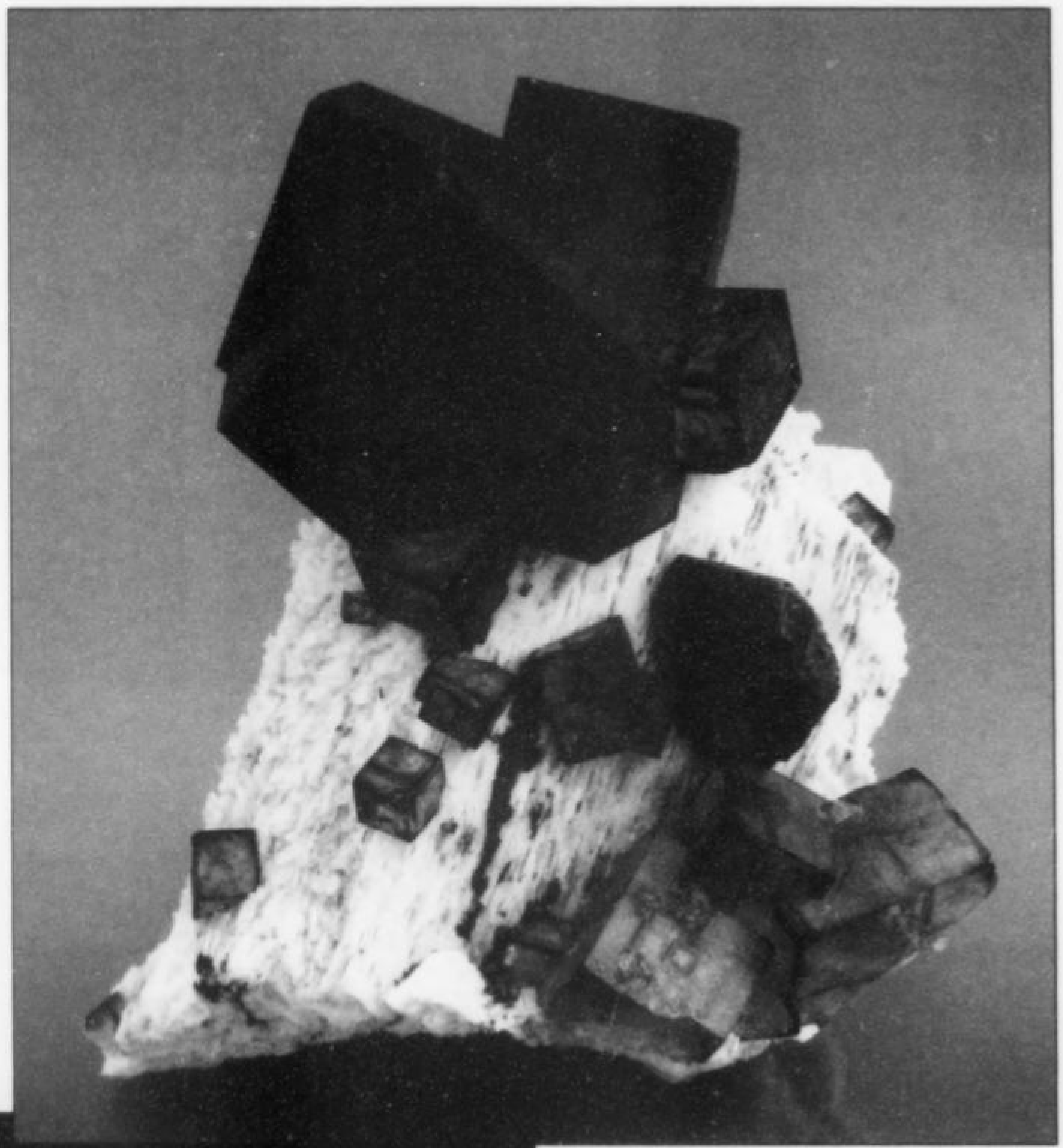


Figure 129. **Association of color-zoned fluorite, Carlsbad-law twinned orthoclase and goethite pseudomorph after siderite, 4.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

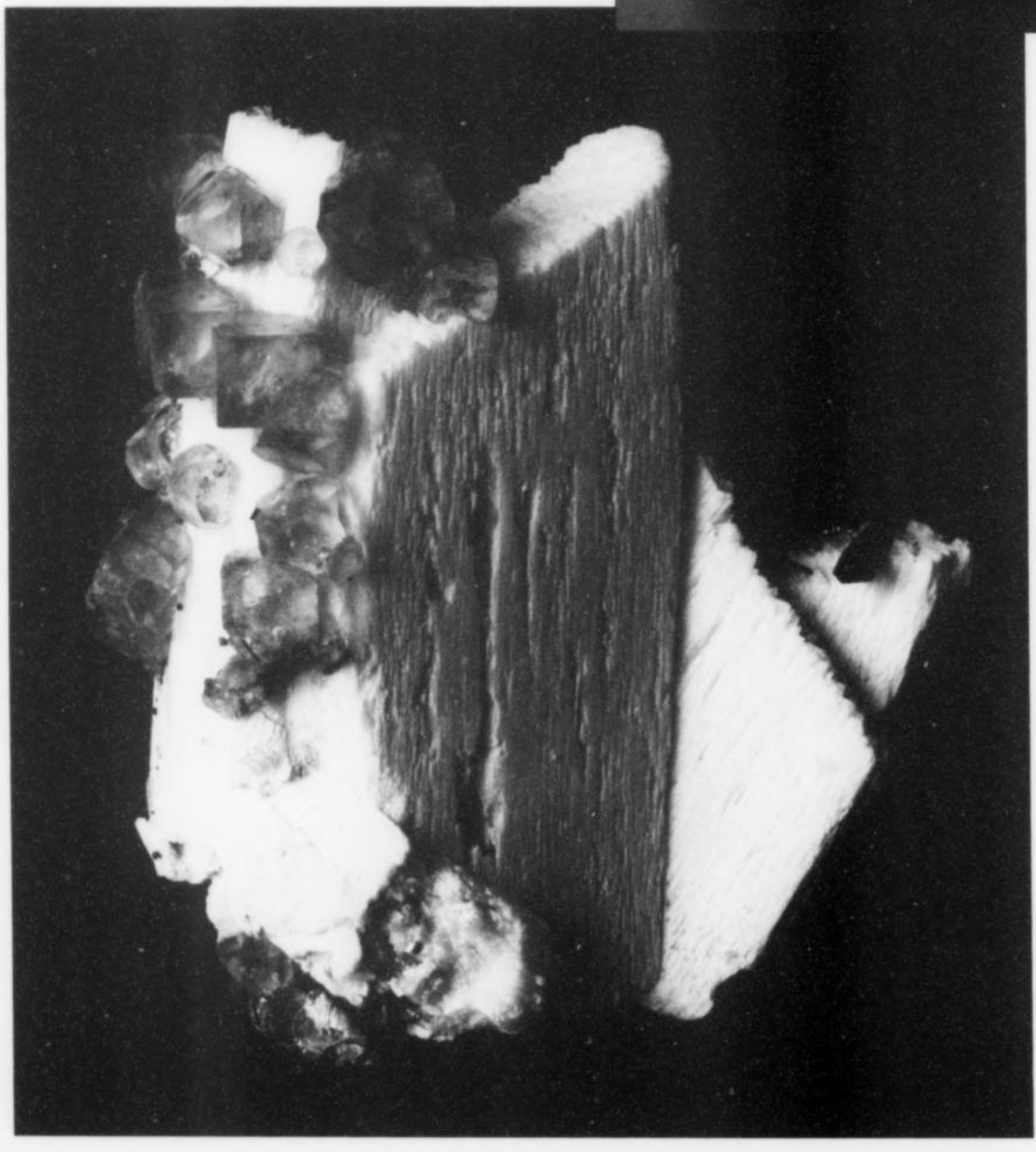


Figure 130. **Fluorite on Carlsbad-law twinned orthoclase, 4.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 131. (below) Fluorite with quartz, attached to orthoclase, 4.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

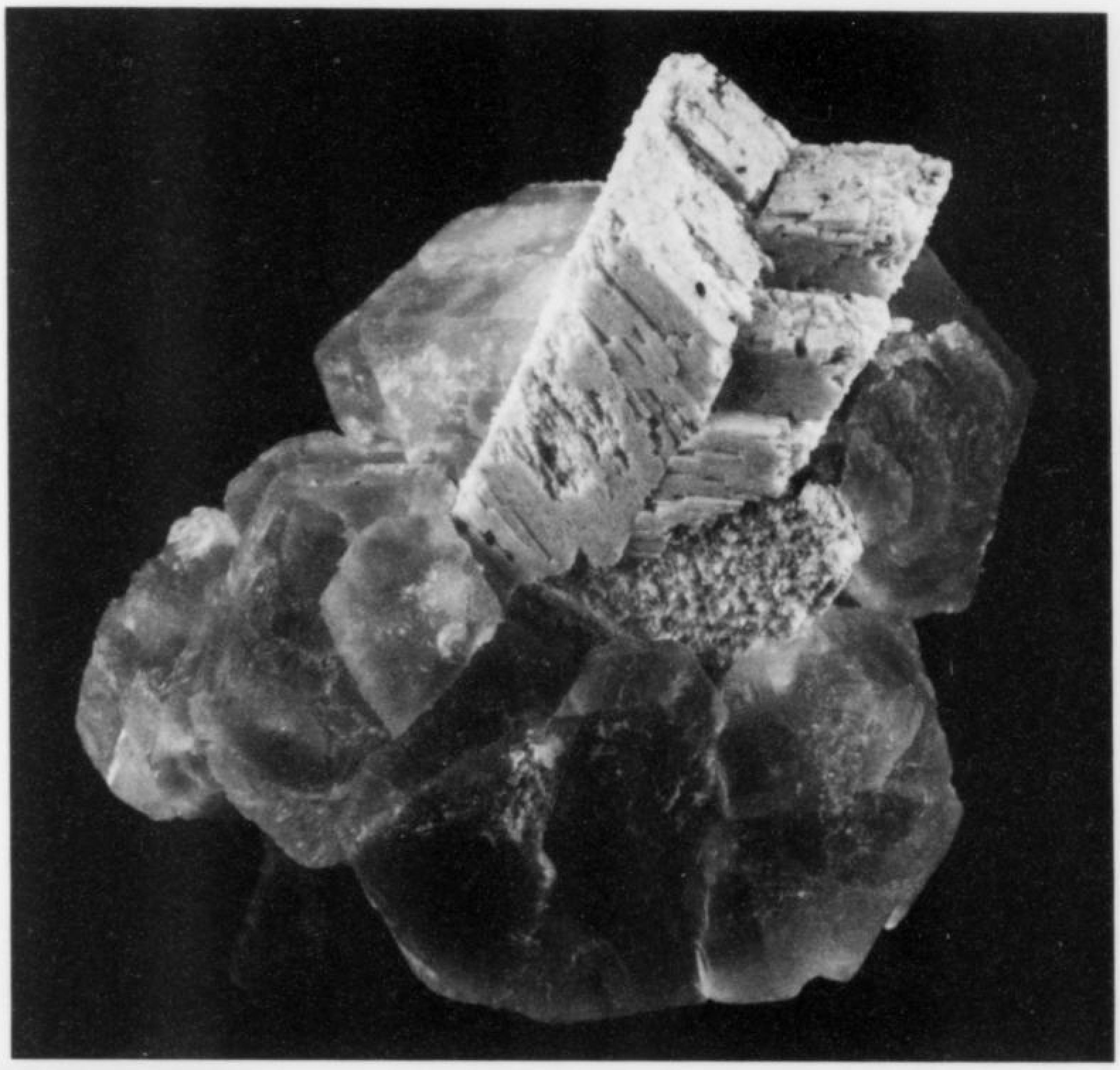
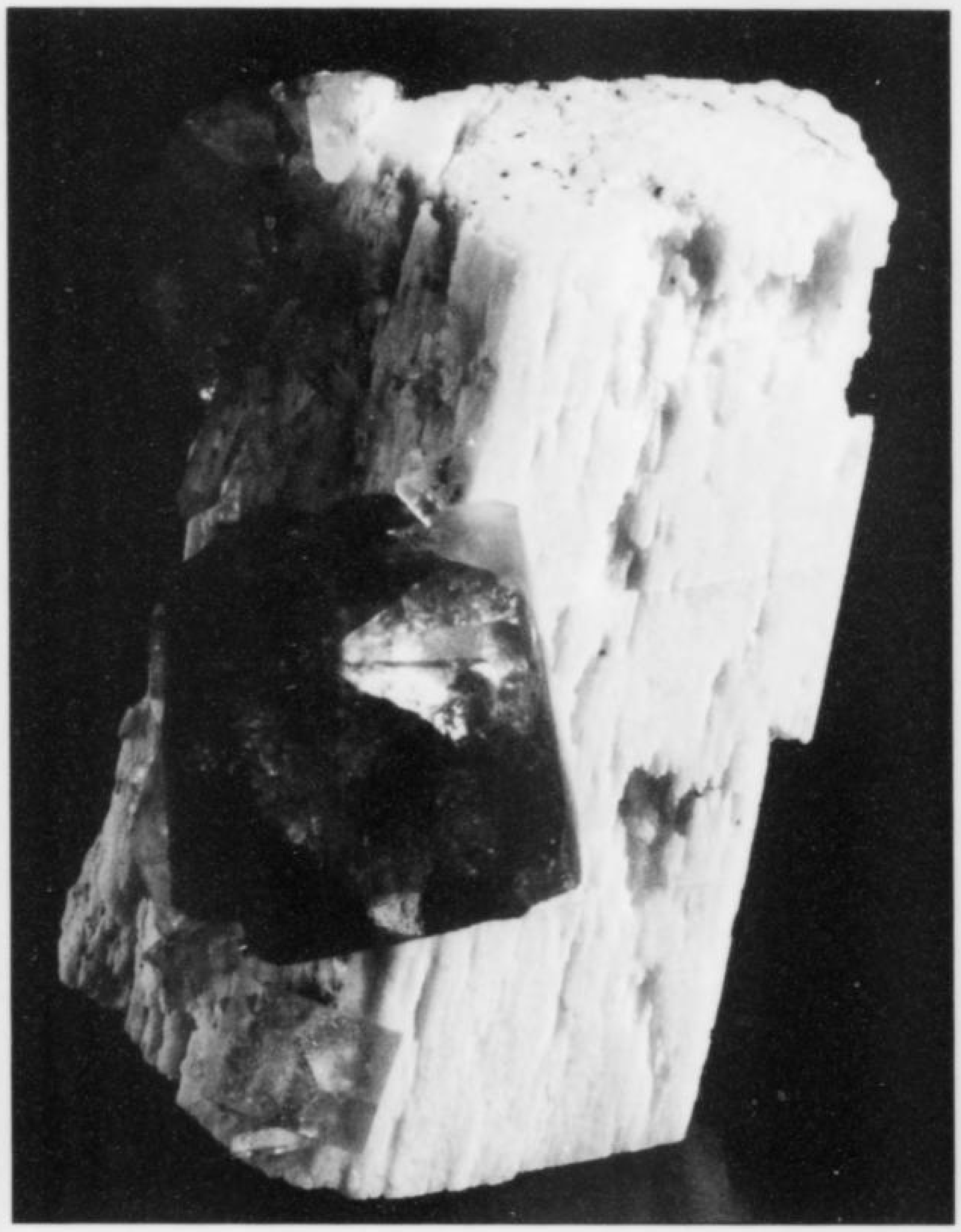


Figure 133. Etched Carlsbad-law twinned orthoclase surrounded by cuboctahedral fluorite, 4.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



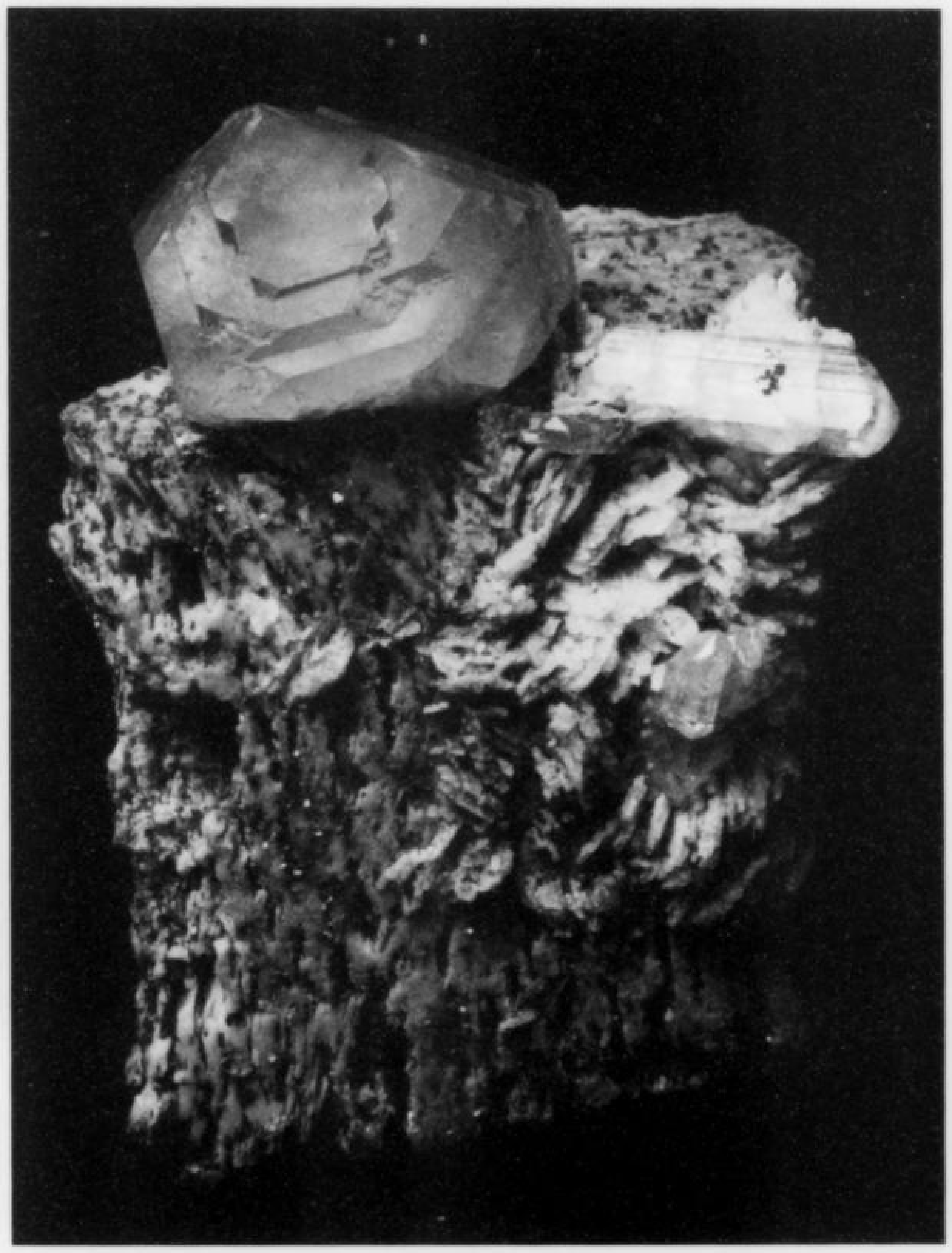


Figure 132. (right) Fluorite on orthoclase with topaz on albite, 5.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

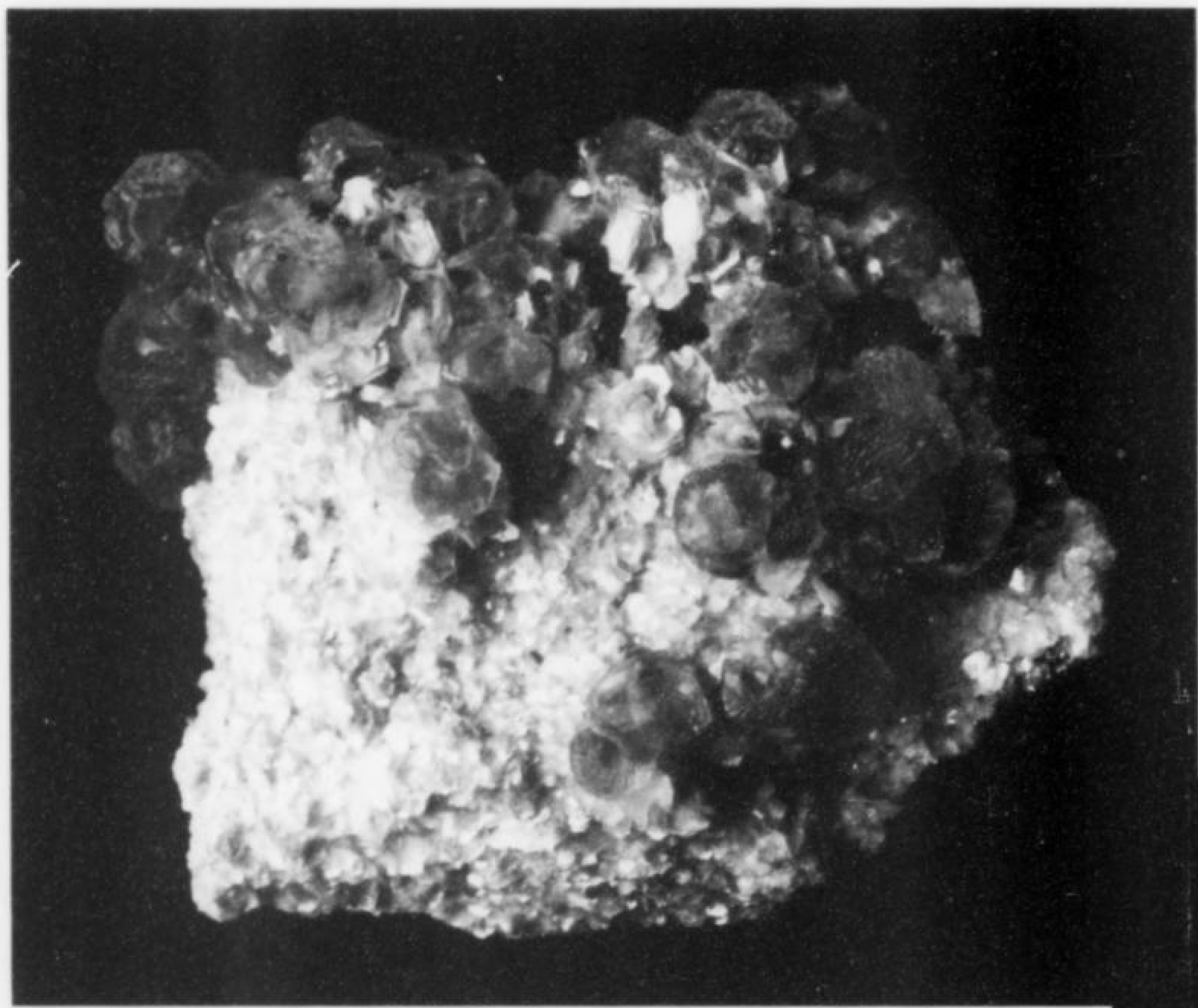


Figure 134. **Fluorite on yellow muscovite with minor schorl, 8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 136. **Unusual yellow fluorite, 4.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

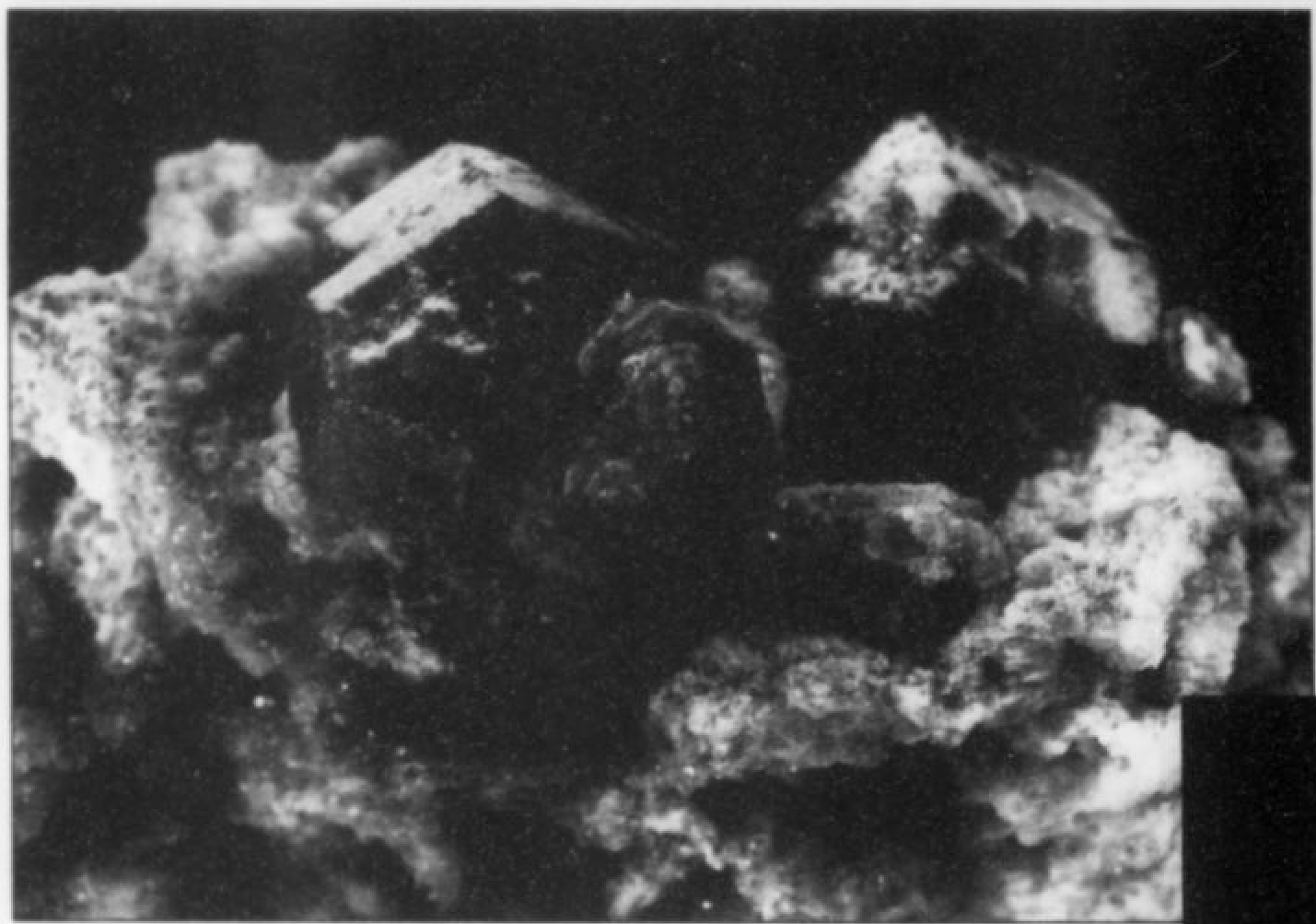


Figure 135. **Black fluorite on drusy purple fluorite, 5.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

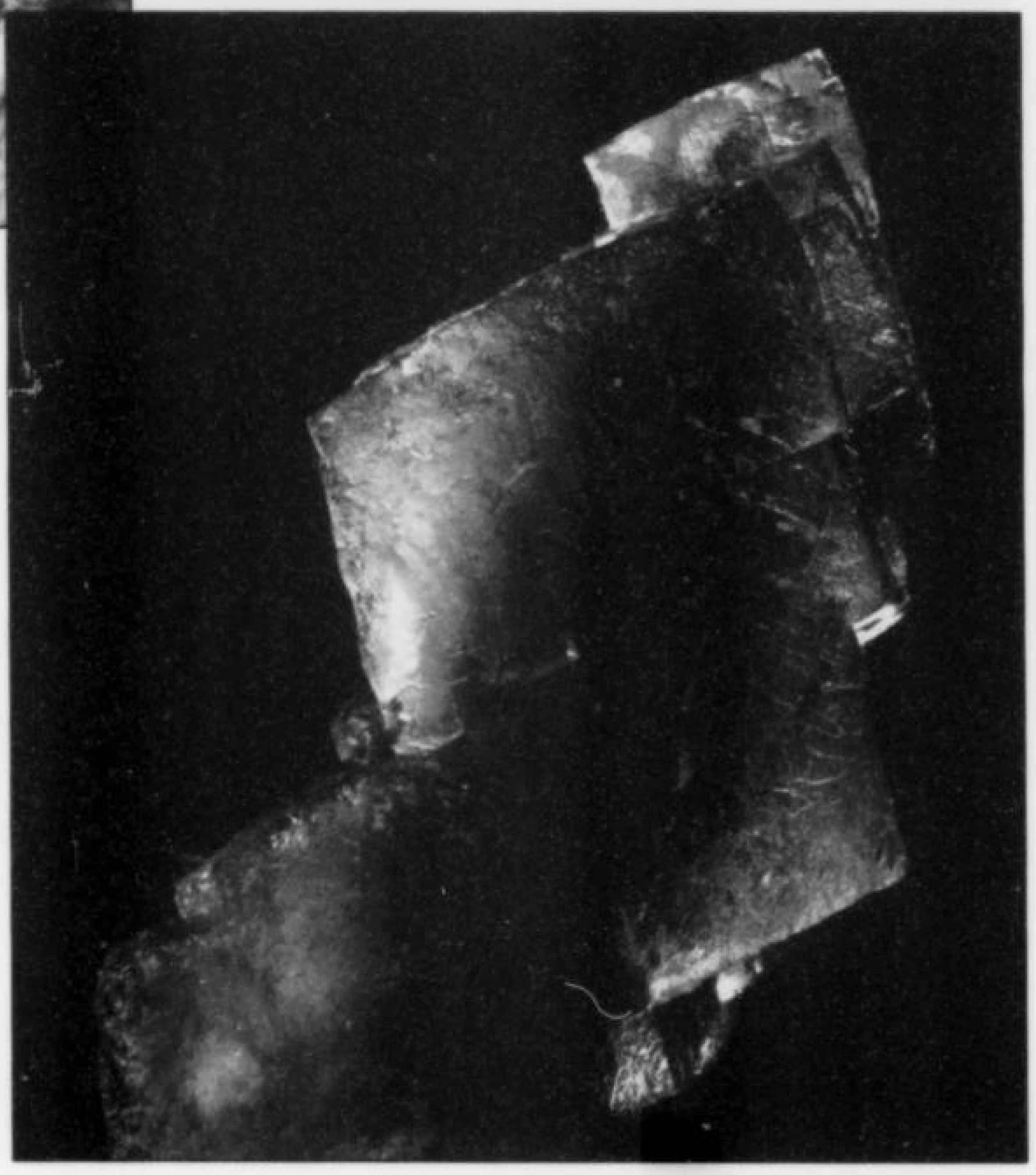


Figure 137. **Elongated fluorite with a green "faden" core, 6.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 138. **Fluorite and quartz, 25 cm. Krantzberg Mine, Erongo Mountains, Namibia. Ludi von Bezing collection and photo.**

Figure 139. **Fluorite associated with color-zoned beryl, muscovite and schorl, 4 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

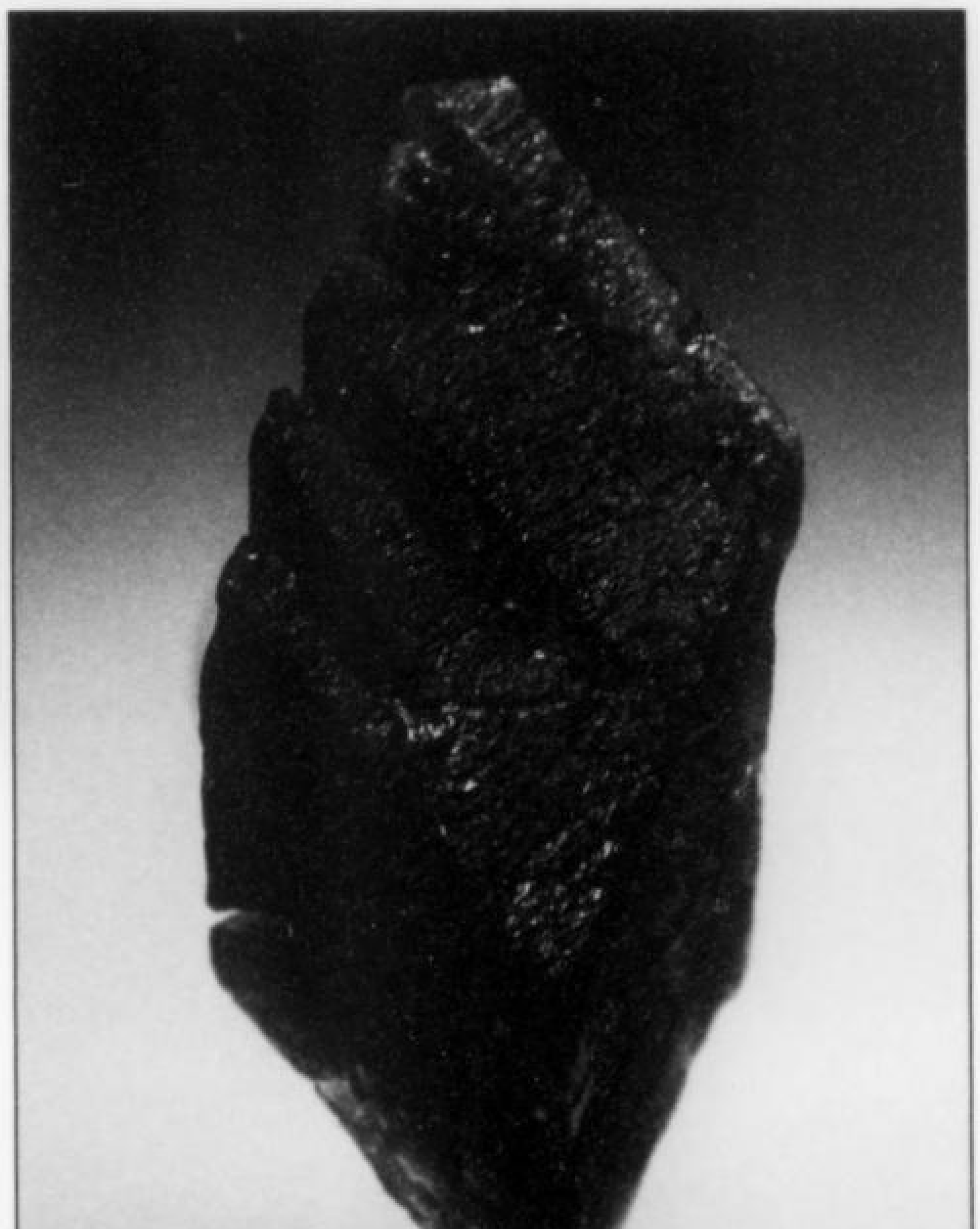


Figure 140. **Floater fluorite crystal, 3.5 cm. Erongo Mountains, Namibia. Private collection; Ernst A. Schnaitmann photo.**

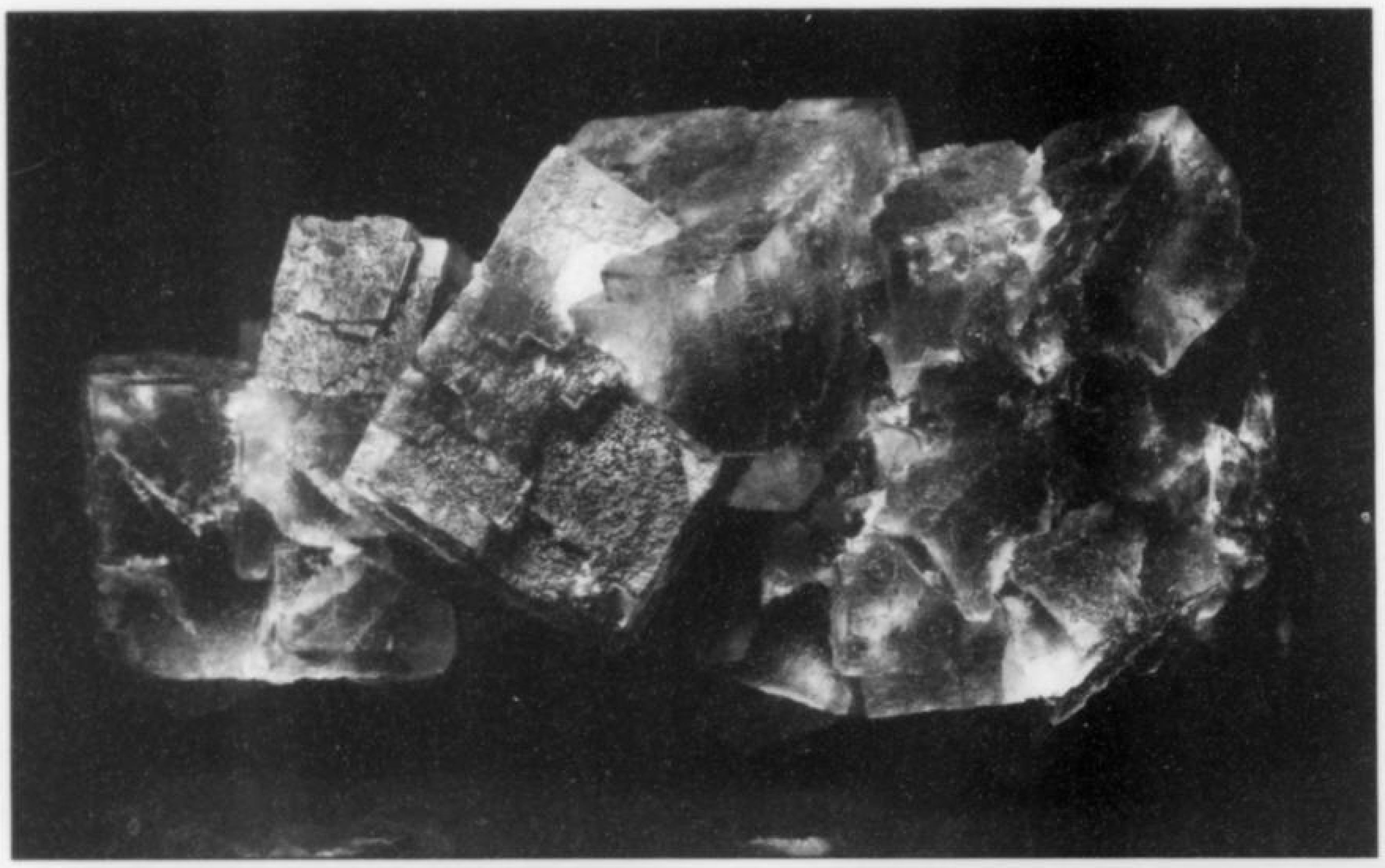
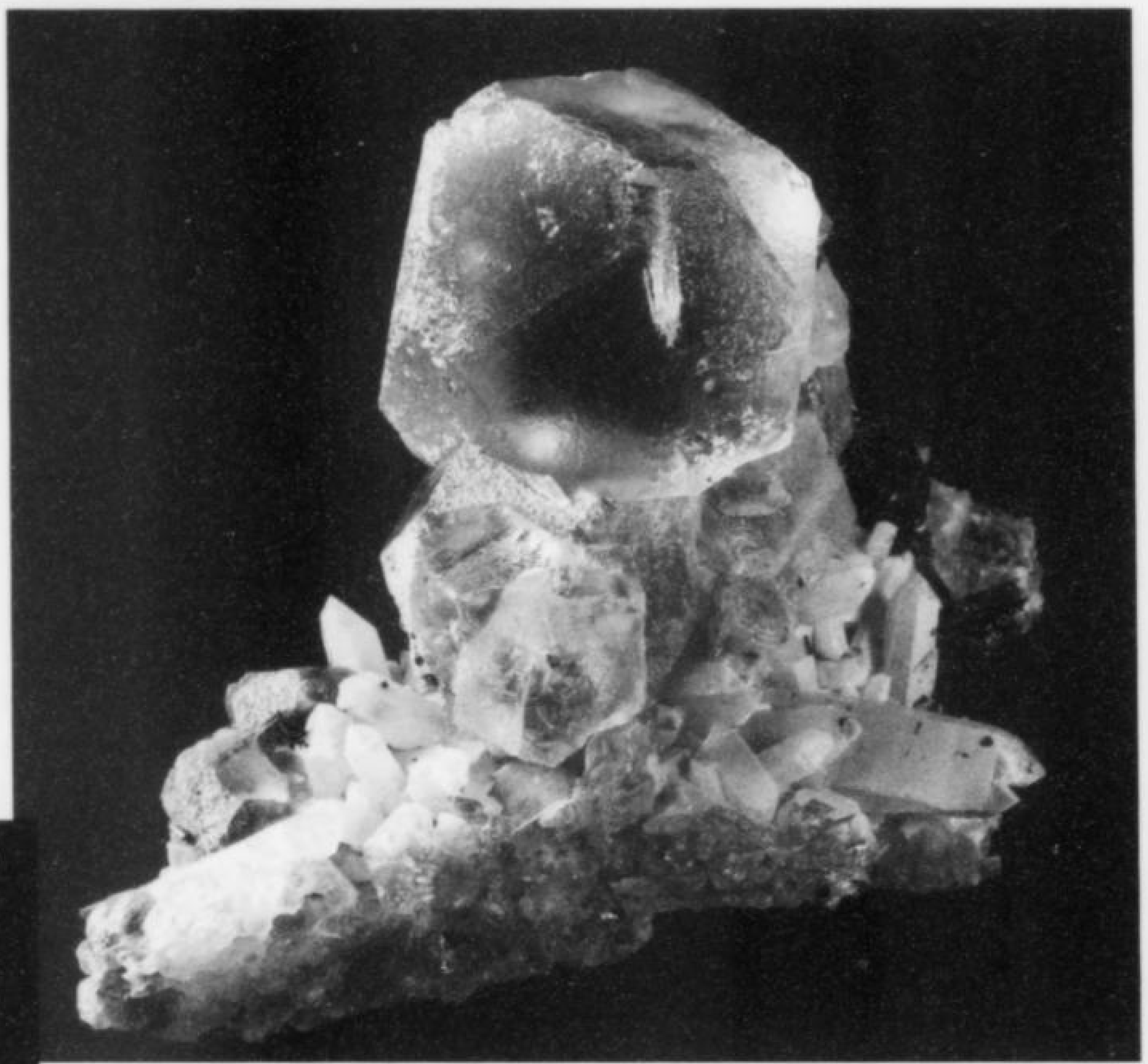


Figure 141. **Fluorite cluster, 6.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 144. **White cuboctahedral fluorite with included green fluorite cube on quartz with schorl, 8.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 142. **Etched fluorite crystal, 2.6 cm. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**



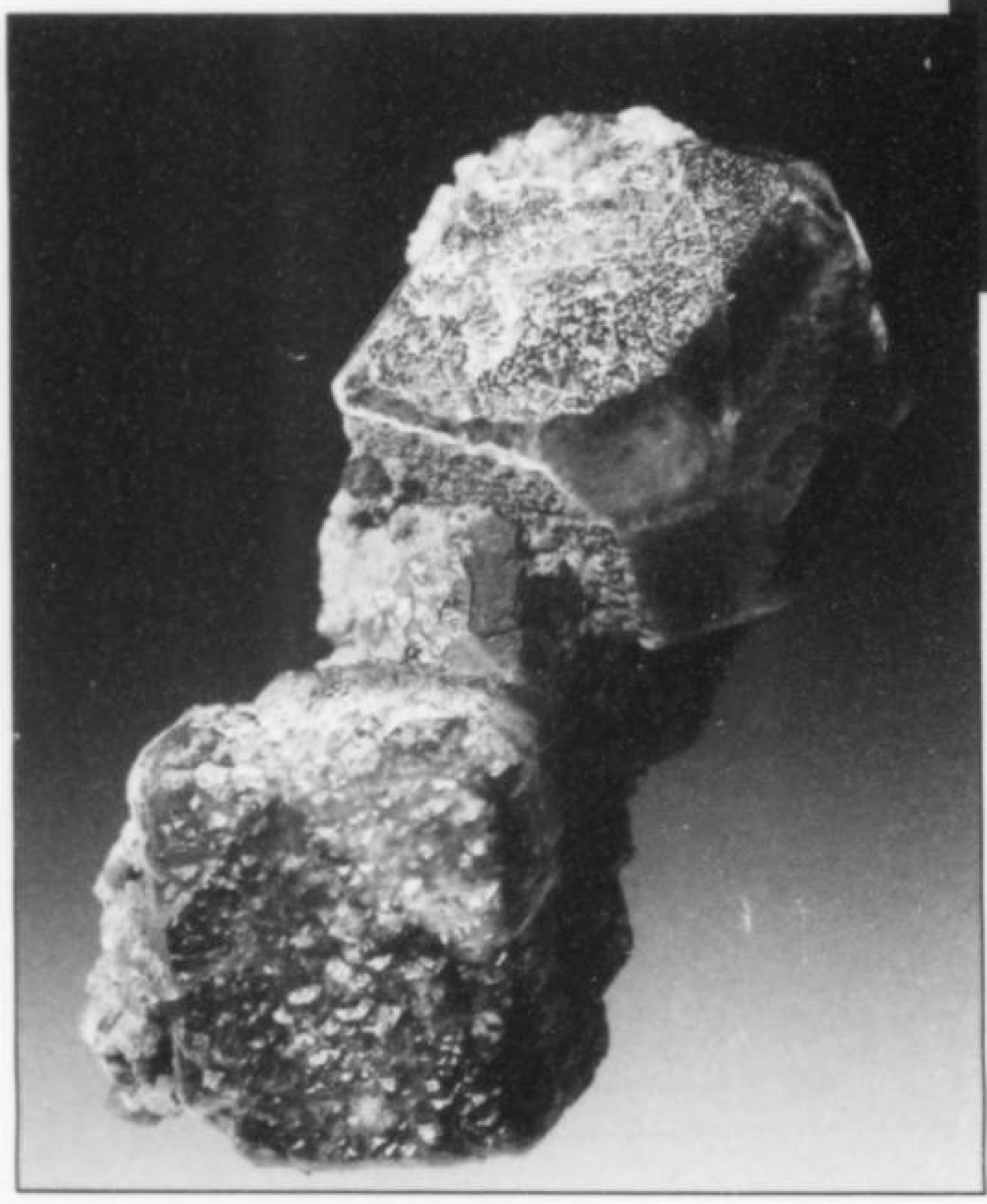


Figure 143. **Fluorite with minor topaz, 3.7 cm. Krantzberg mine, Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

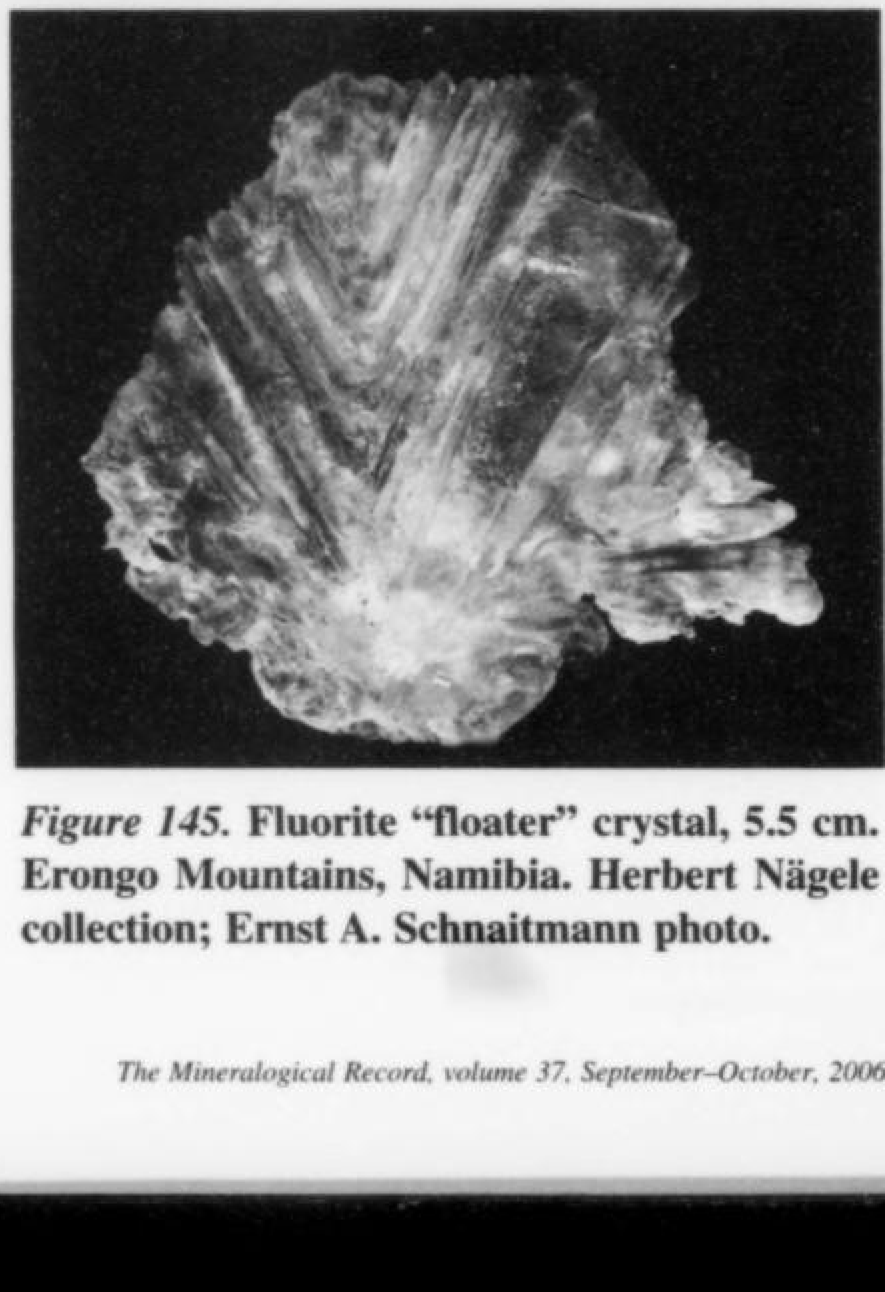


Figure 145. **Fluorite "floater" crystal, 5.5 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 146. Fluorite, quartz, minor topaz and schorl, 10.8 cm. Krantzberg mine, Erongo Mountains, Namibia. Geological Survey of Namibia collection, ex-Volker Berges collection; Ernst A. Schnaitmann photo.

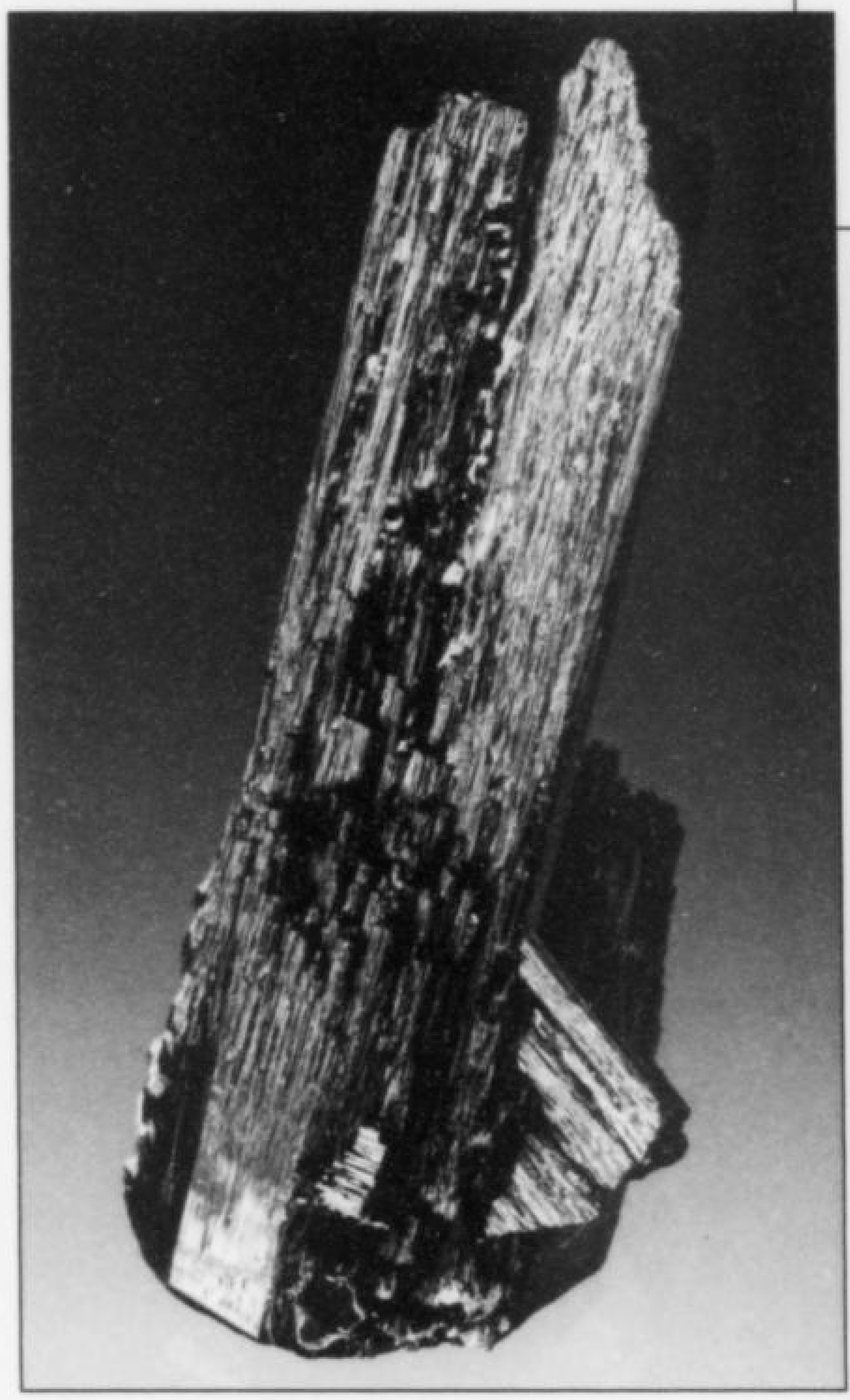


Figure 147. Extremely elongated trigonal foitite, 4.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

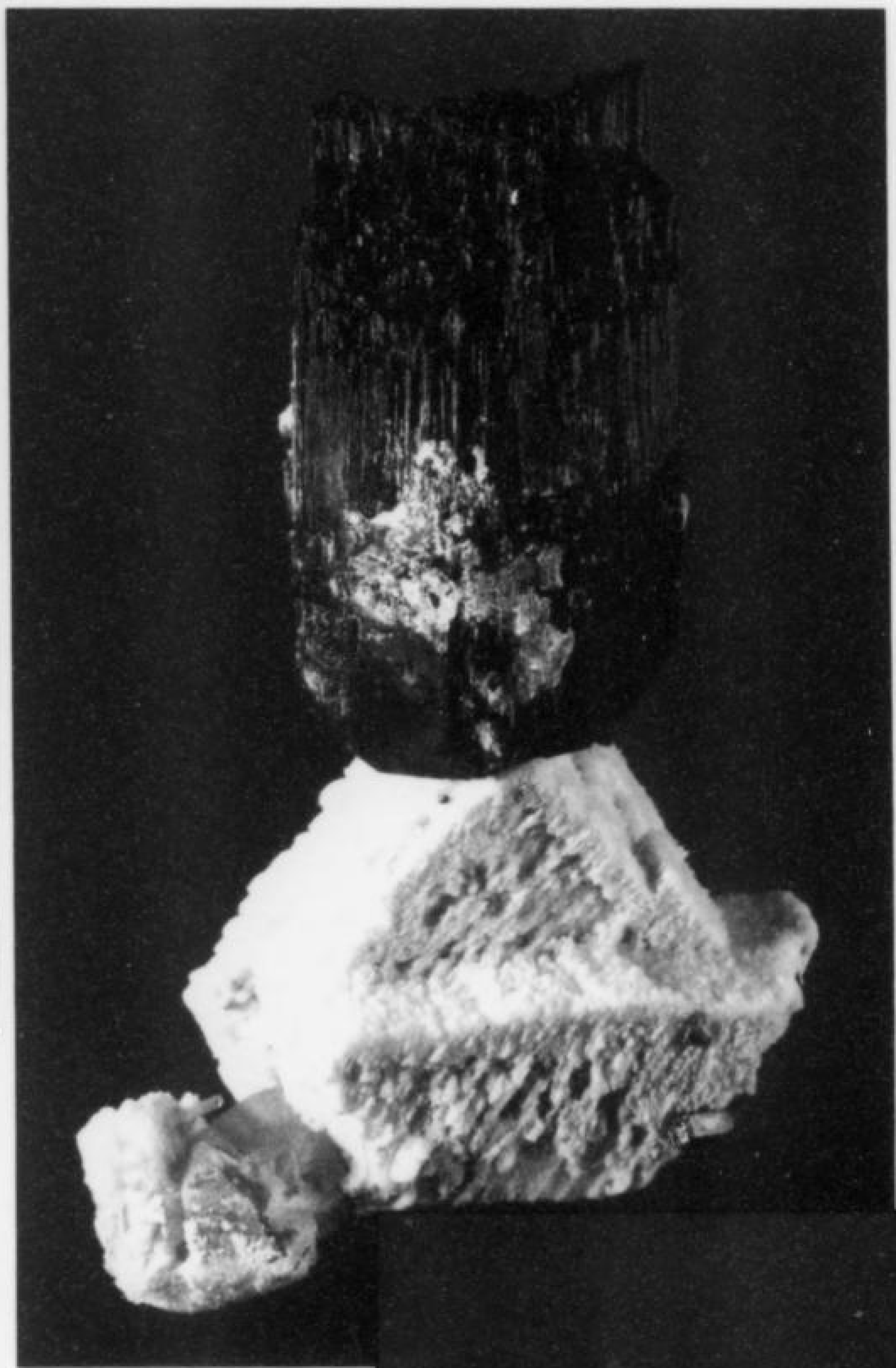


Figure 148. Doubly terminated foitite on twinned orthoclase, 8.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 149. Doubly terminated foitite embedded in quartz, 11.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Interesting green and pink fluorite cubes modified by {111} octahedral faces were collected in the past from the Krantzberg tungsten mine. Specimens of these are in the Nägele collection in Windhoek and the von Bezing collection in Kimberley; the latter collection contains an outstanding cabinet-size specimen of fluorite associated with quartz. Krantzberg fluorite is colorless and pale blue with purple patches. Fluorite also partially filled and lined cavities in the orebodies.

Foitite $[Fe^{2+}_2(Al, Fe^{3+})]Al_6Si_6O_{18}(BO)_3(OH)_4$

Tourmaline is classified, according to X-site chemistry, into three groups: alkali, calcic and X-site-vacant groups. The tourmaline species foitite falls into the last of these (MacDonald *et al.*, 1993; Hawthorne and Henry, 1999). The classification is well summarized by Simmons (2002b). Foitite is now considered a "very common tourmaline species" (King, 2002, page 8) and has been identified from the Erongo Mountains (Gebhard, 2002; Simmons, 2002a). Foitite, together with schorl, is presently the subject of a separate paper and detailed chemical analyses of these species is beyond the scope of this article[3].

In May 1999 a pocket of black tourmaline with unusual crystal habits was discovered at Erongo. The crystals measure up to 10 cm and have distinctive hemimorphic habits, with one end of the hexagonal prism terminated by either $\{10\bar{1}2\}$ or $\{02\bar{2}1\}$ pyramidal faces, the other termination exhibiting bundles of elongated acicular crystals, resembling an extended trigonal "Mercedes Benz" emblem. This form is caused by the rapid growth of the $\{10\bar{1}1\}$ pyramidal faces relative to the slower growth of the adjacent $\{02\bar{2}1\}$ pyramidal faces (Rustemeyer and Deyer, 2003). In some instances, the growth of the $\{10\bar{1}2\}$ faces is extreme and these three faces project several centimeters out as trigonal "wings." Many of the crystals are partly or wholly coated by hyaline opal. One termination is frequently attached to orthoclase, quartz or beryl, while the opposite "rocket wing" projects outwards. Some of the small foitite crystals are greenish black (von Bezing, 2006).

Foitite appears to be rare from the Erongo Mountains: detailed analyses of Erongo tourmalines in the Harvard collection have shown that most are schorl and only a few are foitite (F. Hawthorne, personal communication, 2005).

Galena PbS

One specimen of galena was collected in January 2006. It is a crudely formed cuboctahedron encrusted by a mixture of drusy orthoclase and goethite. The underside of the crystal is fractured and well cleaved metallic galena surfaces are visible.

Goethite α-$Fe^{3+}O(OH)$

Goethite occurs in a variety of guises in the Erongo cavities. In some cases it pseudomorphically replaces rhombohedral and semi-rounded, disc-shaped crystals (siderite?), octahedral and cuboctahedral crystals (magnetite?) and precursor forms that resemble trigonal ilmenite. A few rare hematite "iron roses" have also been altered to goethite. Determining the original mineral that was replaced by the goethite is difficult, as only the remnant crystal shape remains. Goethite also exists as a common oxidation product associated with most of the minerals found at Erongo.

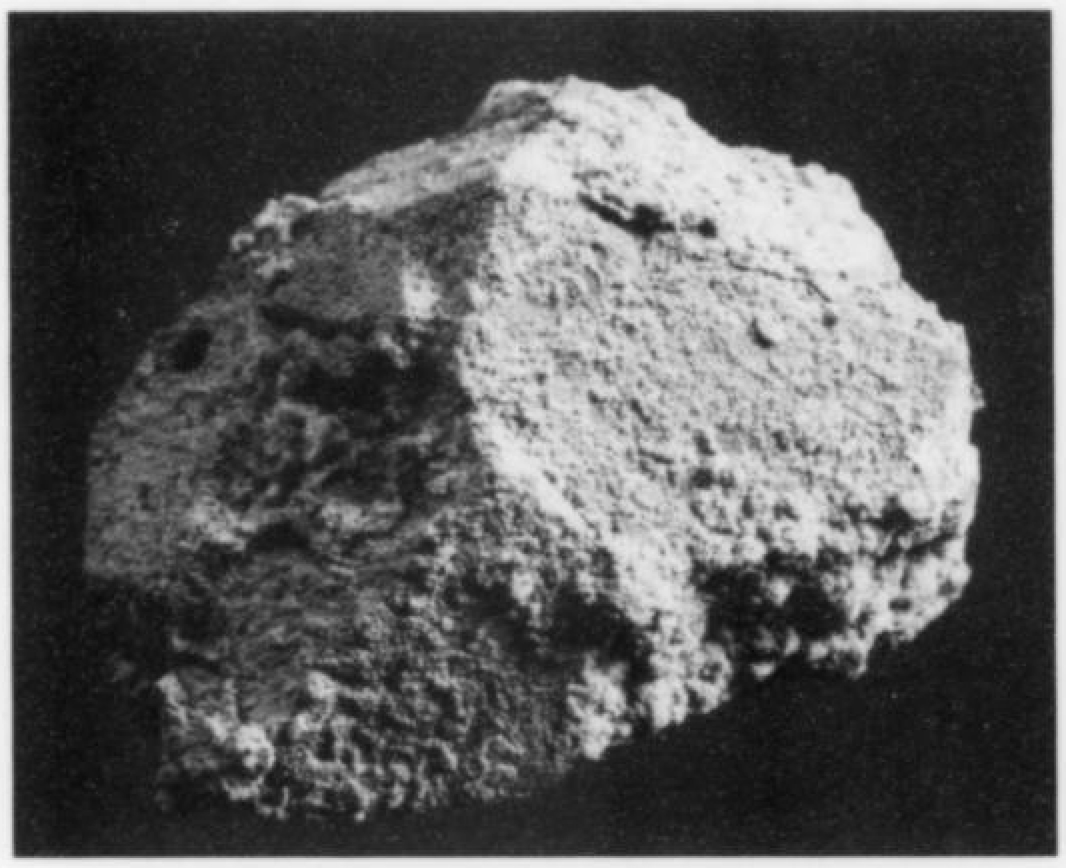


Figure 150. **Goethite-coated galena, 3.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

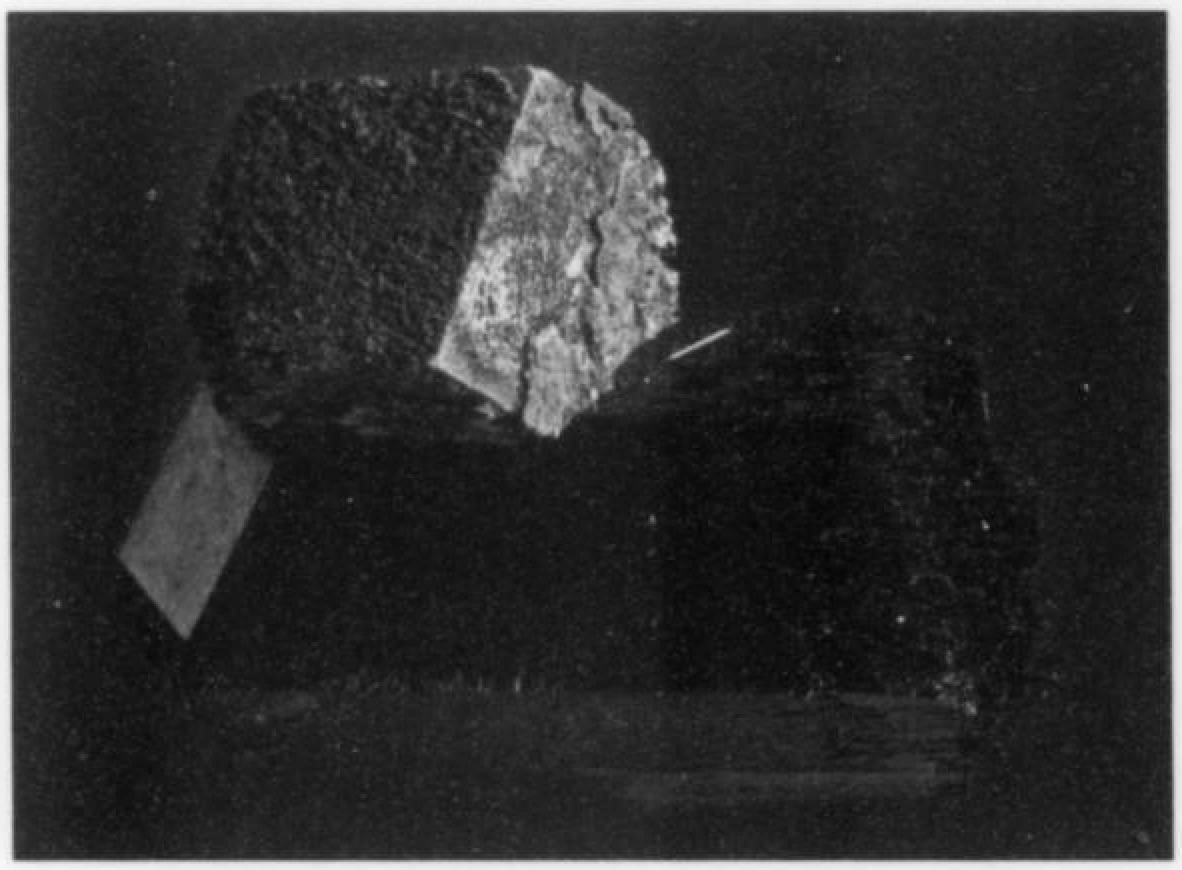


Figure 151. **Goethite after siderite attached to foitite, 5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

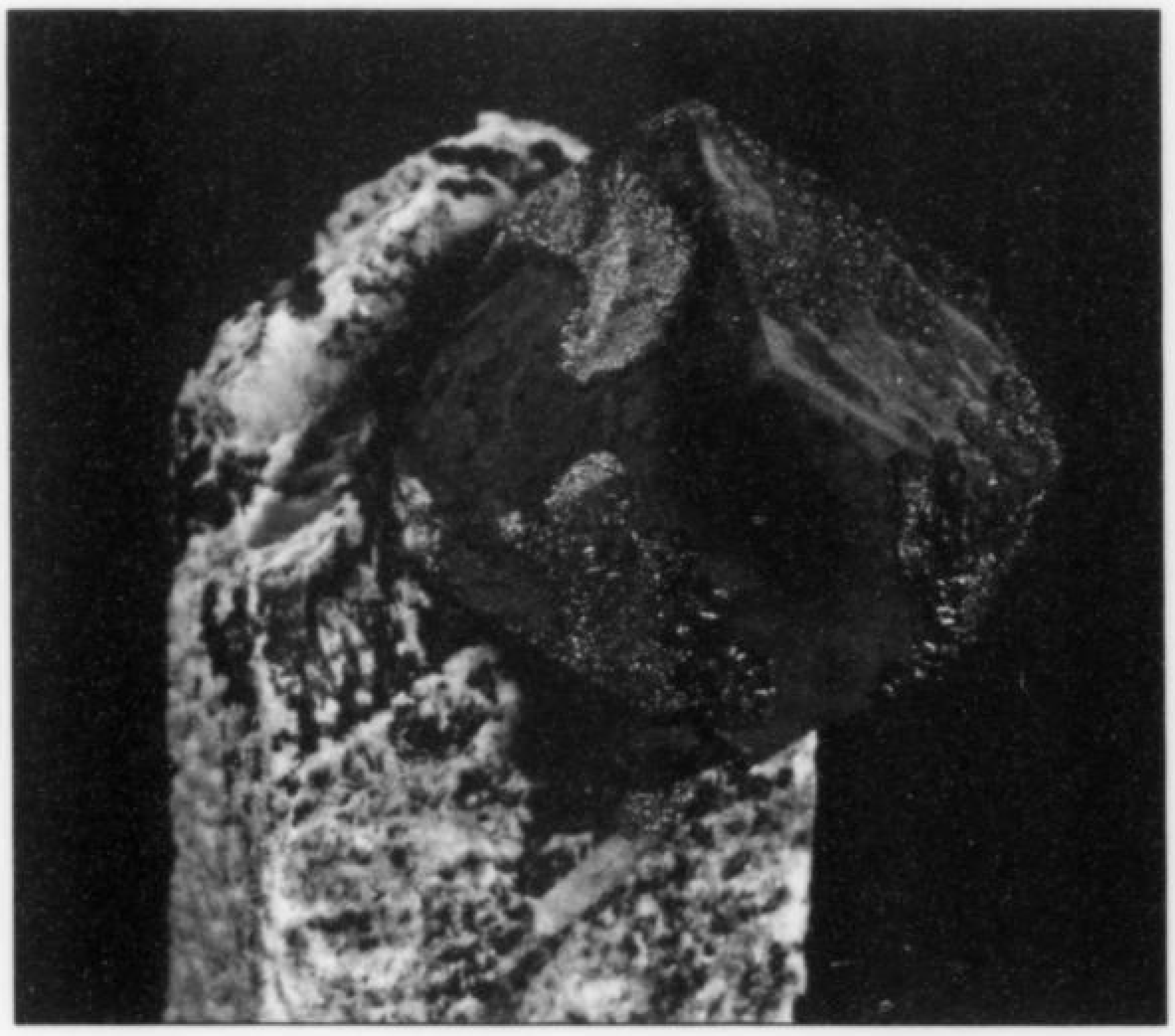


Figure 152. **Goethite after siderite crystal, 2.5 cm, overgrown with secondary goethite and pyrolusite on Carlsbad-law twinned orthoclase. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

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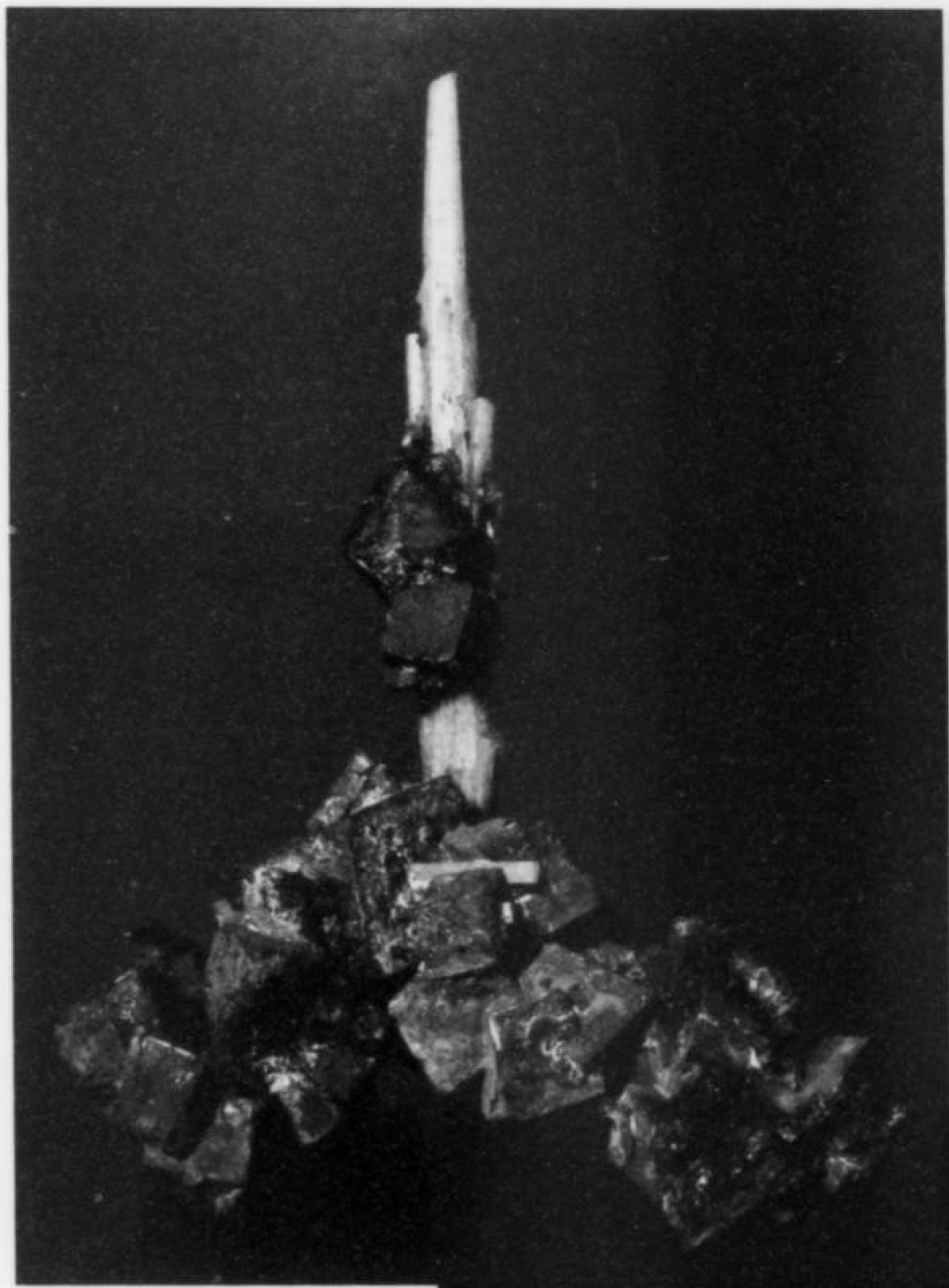
[3] The Erongo tourmalines are currently under investigation to determine which species occur at this locality (Frank Hawthorne, personal communication, 2005). For the purpose of this article, specimens that have been identified as foitite are described here; all others are described under schorl.



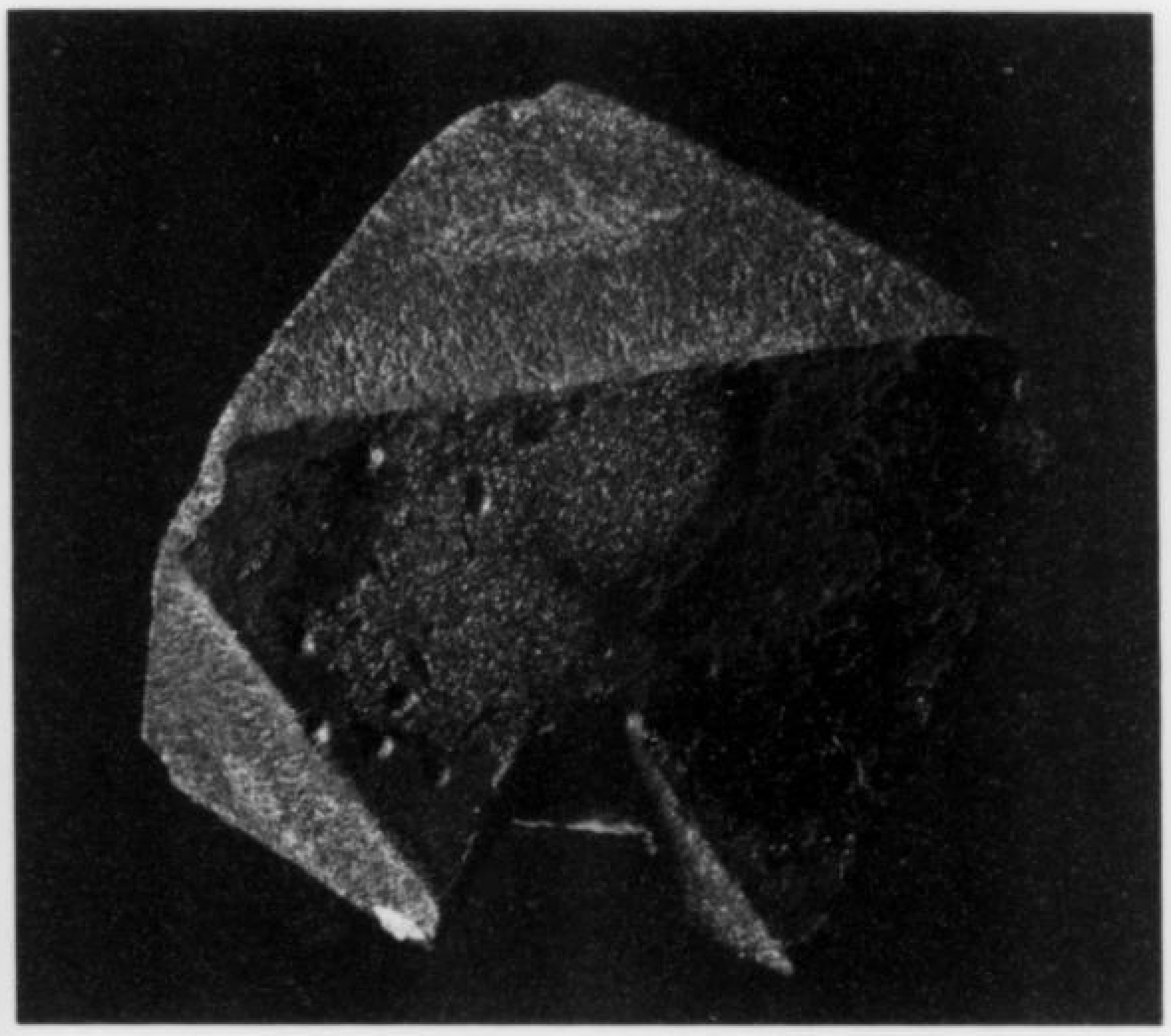


Figure 156. **Sharp goethite after siderite, 3.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 153. **Goethite after siderite crystals attached to aquamarine, 4.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

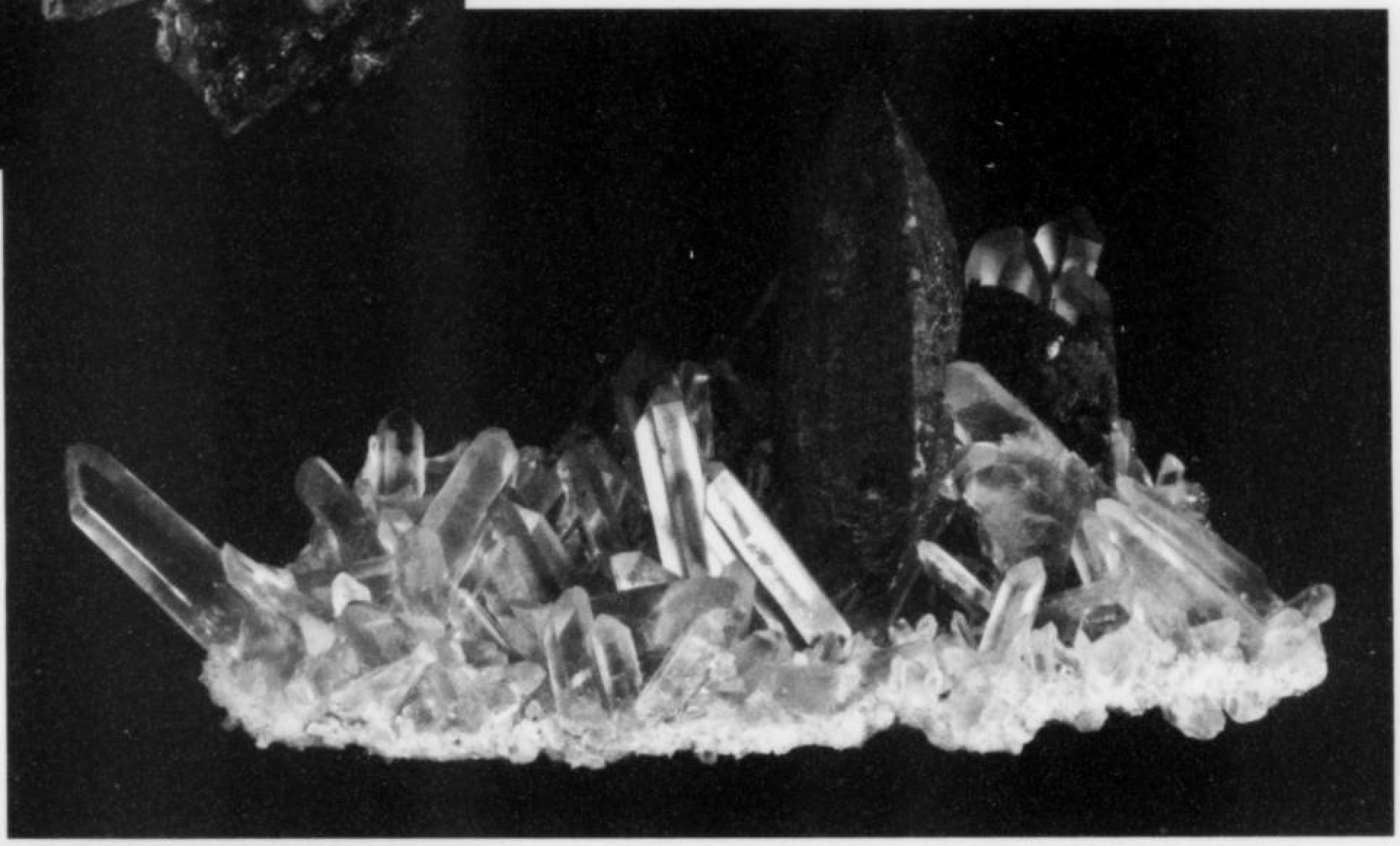


Figure 154. **End-on view of goethite after siderite with quartz, 8.3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 155. **Goethite pseudomorph after ilmenite with quartz, 8.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

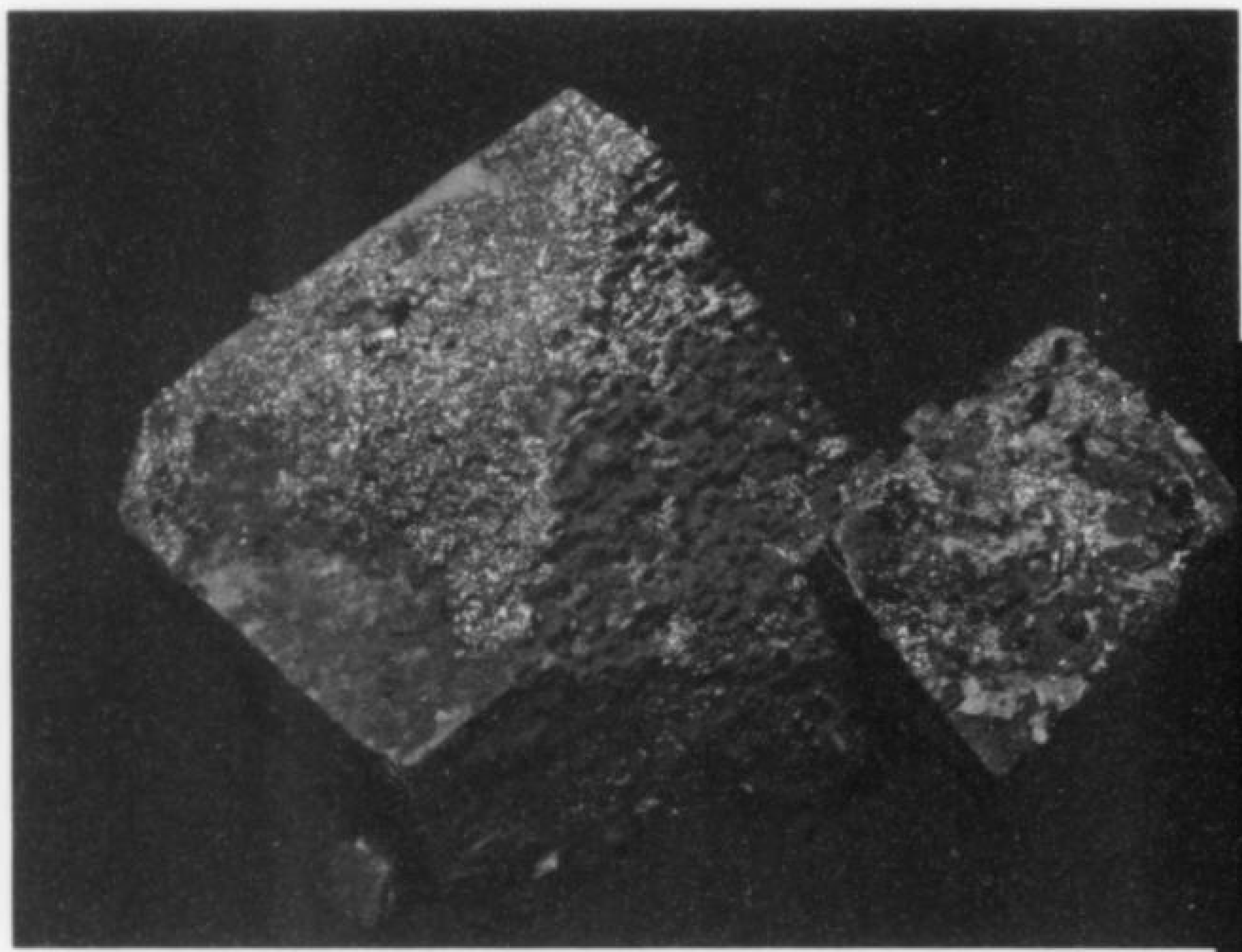
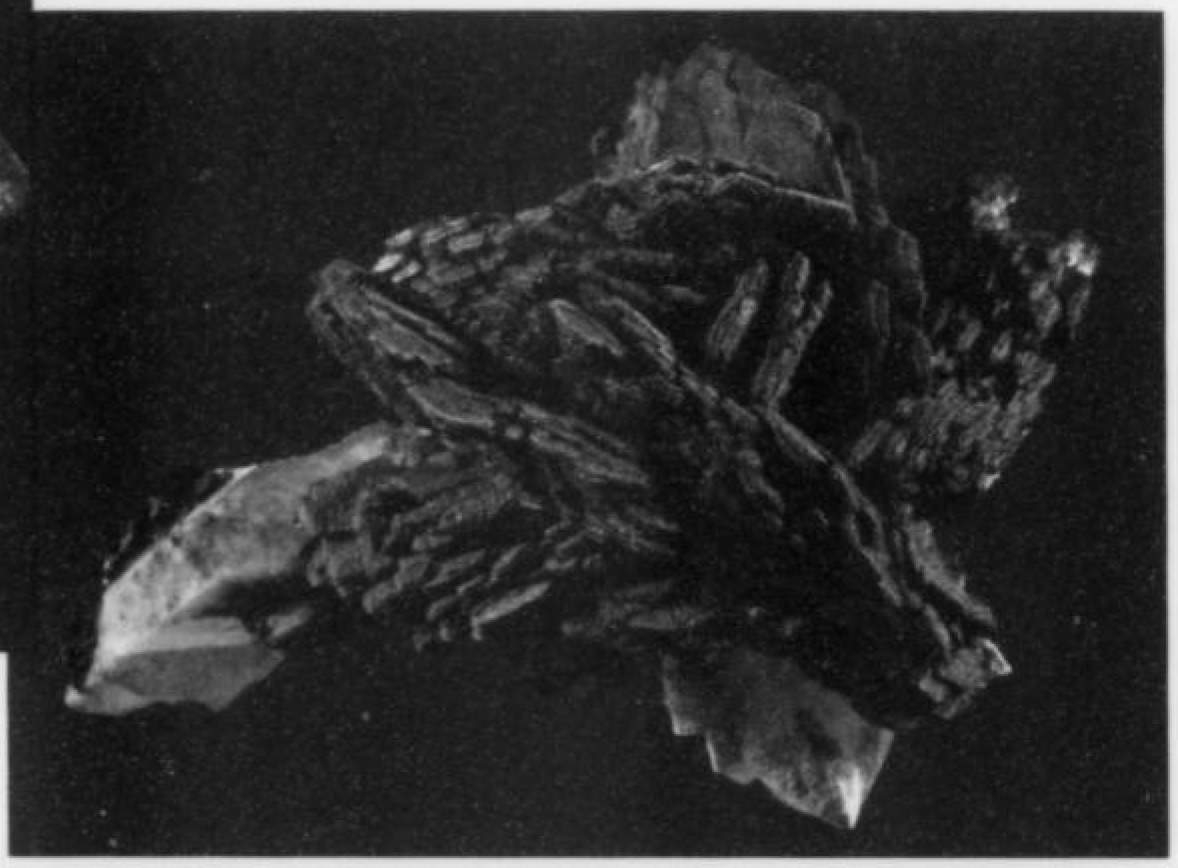


Figure 157. Goethite after siderite with pyrolusite, 10.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 160. Rosette of goethite after siderite on quartz, 9.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



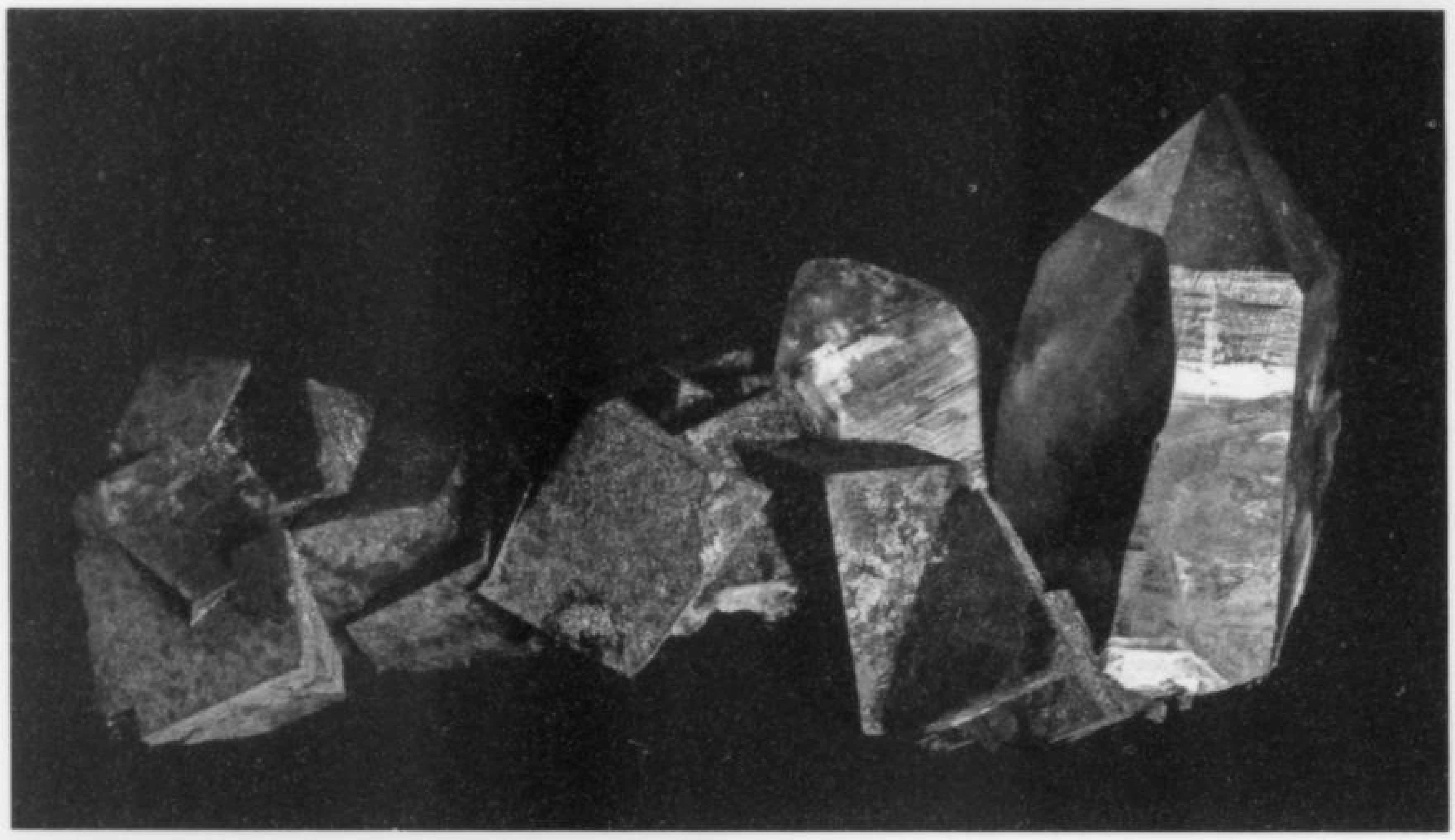


Figure 158. Cluster of goethite after siderite crystals partially coated by pyrolusite, 8.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

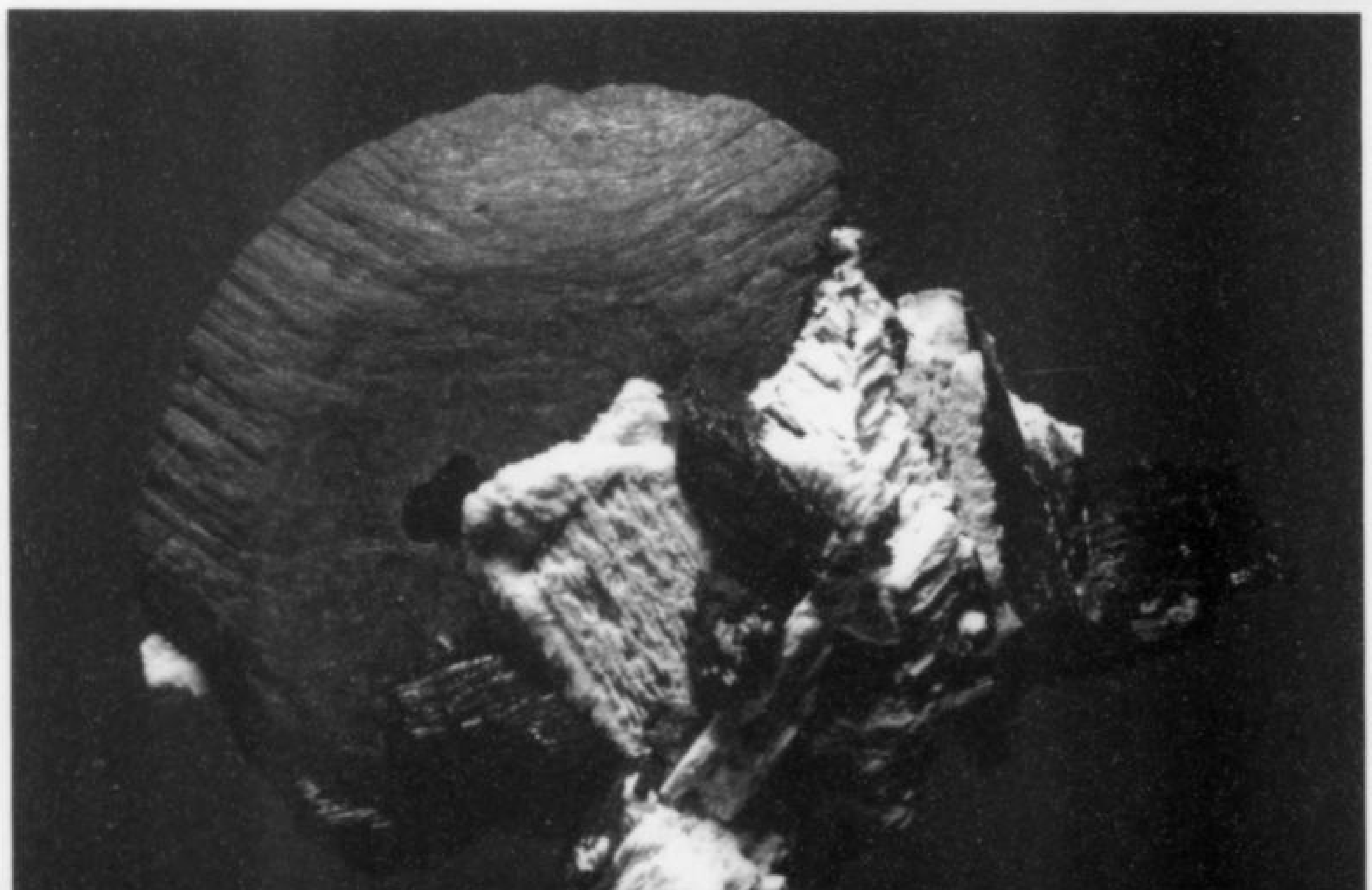


Figure 159. Flattened hollow goethite after siderite with schorl and Carlsbad-law twinned orthoclase, 8.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

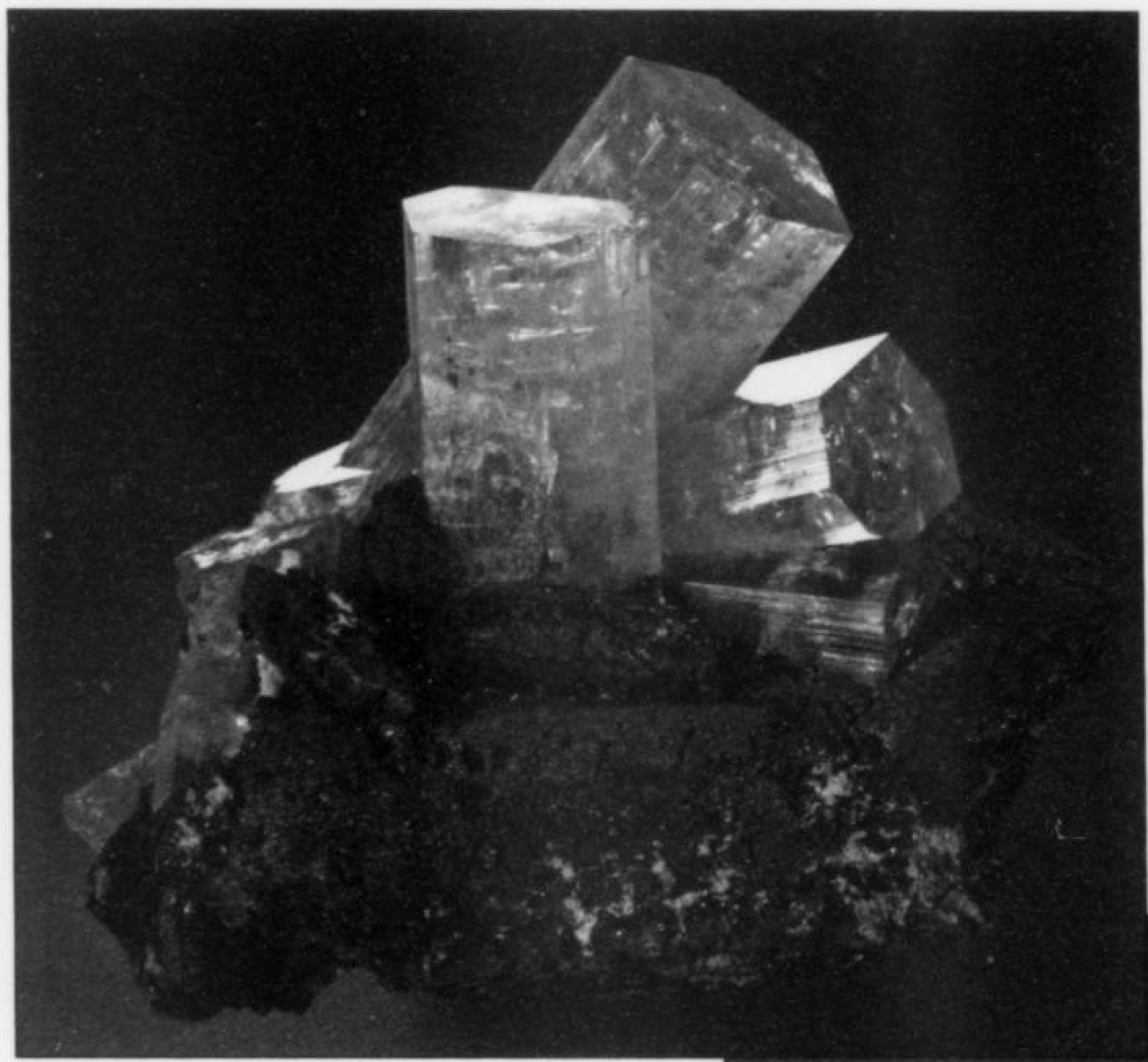
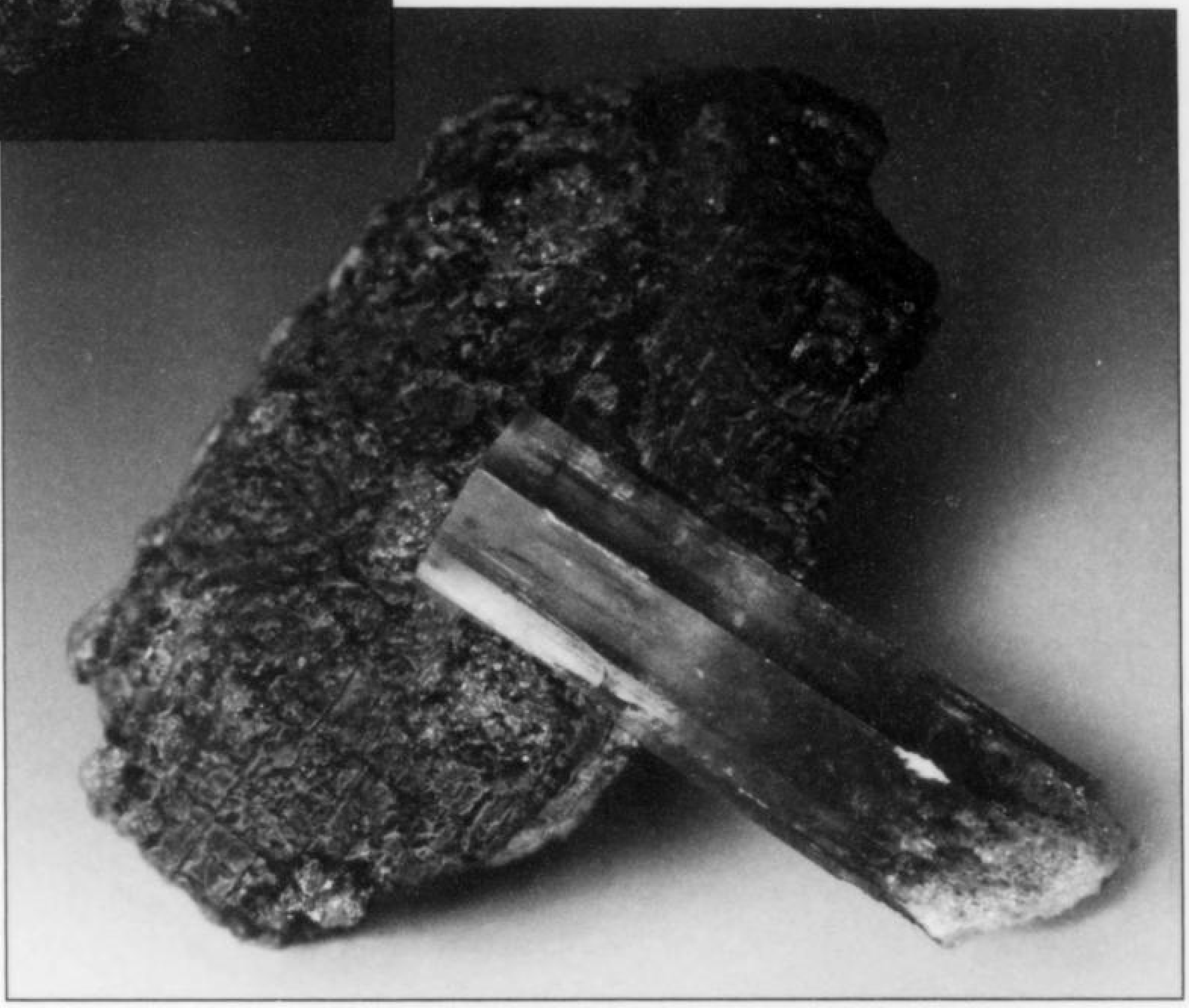


Figure 162. **Aquamarine crystal overgrown on goethite after siderite, 2.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 161. **Aquamarine on goethite after siderite, 4.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**



Gold Au

Gold is present in the Erongo caldera and in some of the adjacent rocks and alluvium (Hirsch and Genis, 1992; Steven, 1993). It is reported in small amounts from farms in the northern, western and southwestern Erongo Mountains, including Pistelwitz 128 (where the Krantzberg tungsten mine is located), Omaruru Townlands 85, Eleen 164, Ekuta 129, Hoogenoeg 170, Ombu 130, Koedoeberg 169, and Niewoudt 151 and 156.

Alluvial gold has been panned from Ameib 60 and Chatzpütz on Davib Ost 61. South of the Krantzberg mine, gold was found in some of the alluvial tin deposits (Haughton *et al*., 1939). Wagner (1916) describes "small nuggets of gold . . . in the stanniferous gravels and 'floats' of the Erongo tinfield."

Hedenbergite $CaFe^{2+}[Si_2O_6]$

Von Bezing (2006) reports platy yellow hedenbergite crystals in calcsilicate marble from the Tubussis 22 andradite locality west of the Erongo Mountains.

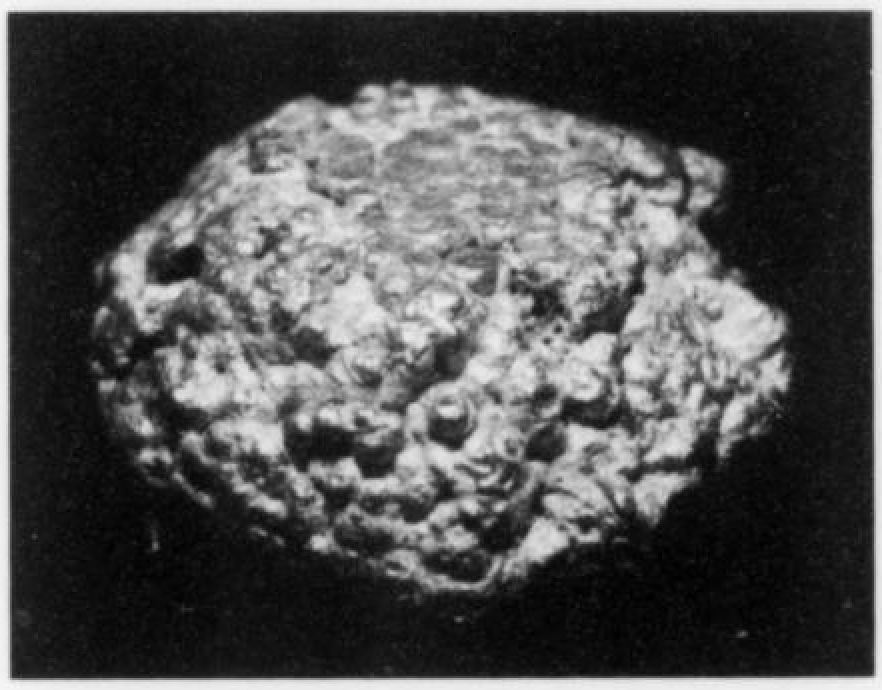


Figure 163. **Alluvial gold nugget, 8 mm. Erongo Mountains, Namibia. Private collection; Bruce Cairncross photo.**

Hematite α-Fe_2O_3

One discovery produced sceptered crystals of quartz with hematite staining, giving these specimens a pleasing red tinge. Very small crystals occur as crusts on goethite pseudomorphs after siderite (Jahn and Bahmann, 2000); however, recent observations suggest that this bright silver mineral is in fact pyrolusite and not hematite.

Hydroxylapatite $Ca_5(PO_4)_3(OH)$

Jahn (2003) describes hydroxylapatite associated with orthoclase. The 2 to 3-mm colorless crystals are prismatic with pyramidal terminations and superficially resemble quartz except that the prism faces lack the striations typically observed in quartz. Some of the hydroxylapatite is coated or partially coated by a thin 1-mm film of fibrous fluorite.

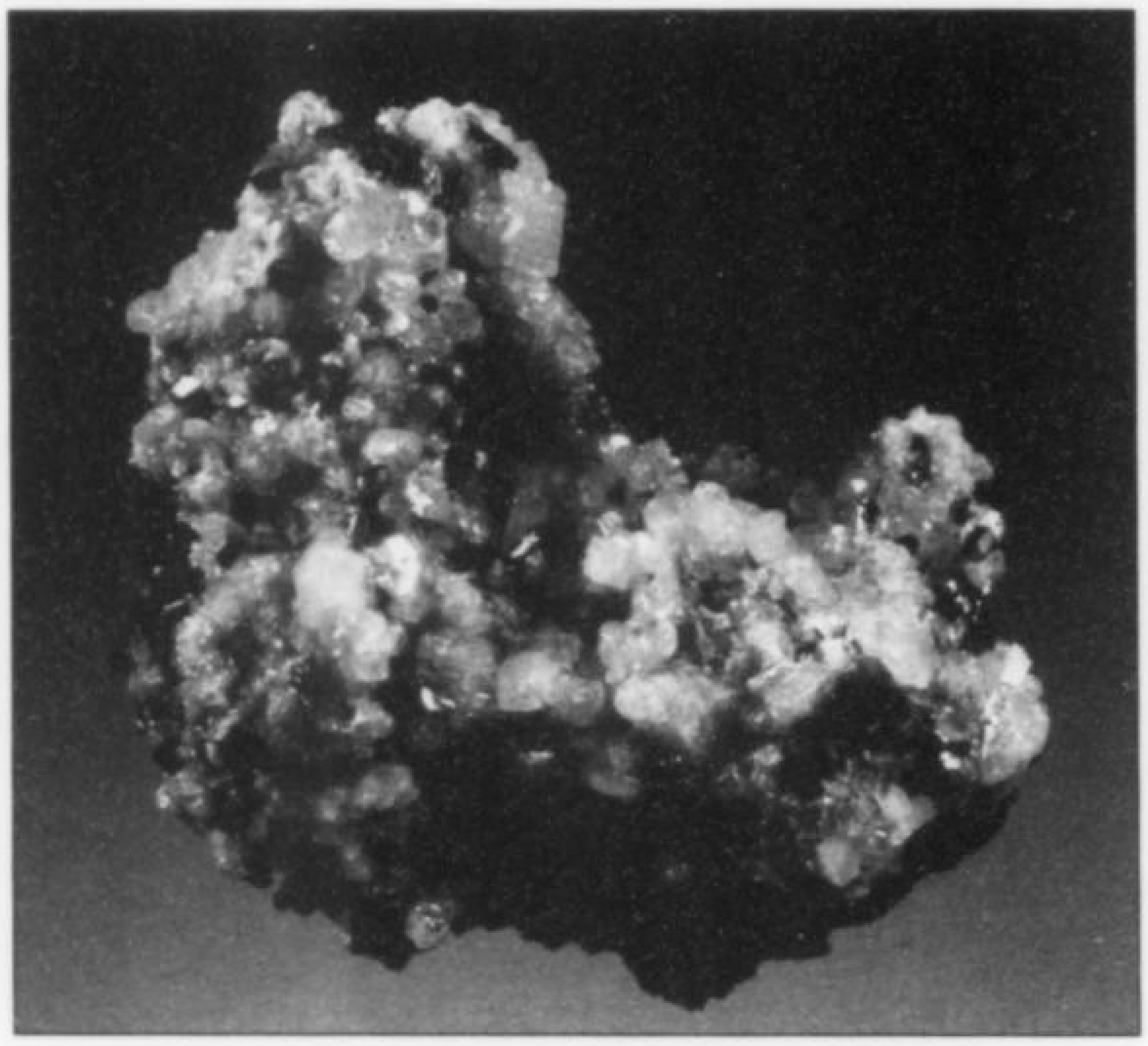


Figure 164. **Hydroxyl-herderite with schorl, 5.9 cm. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**

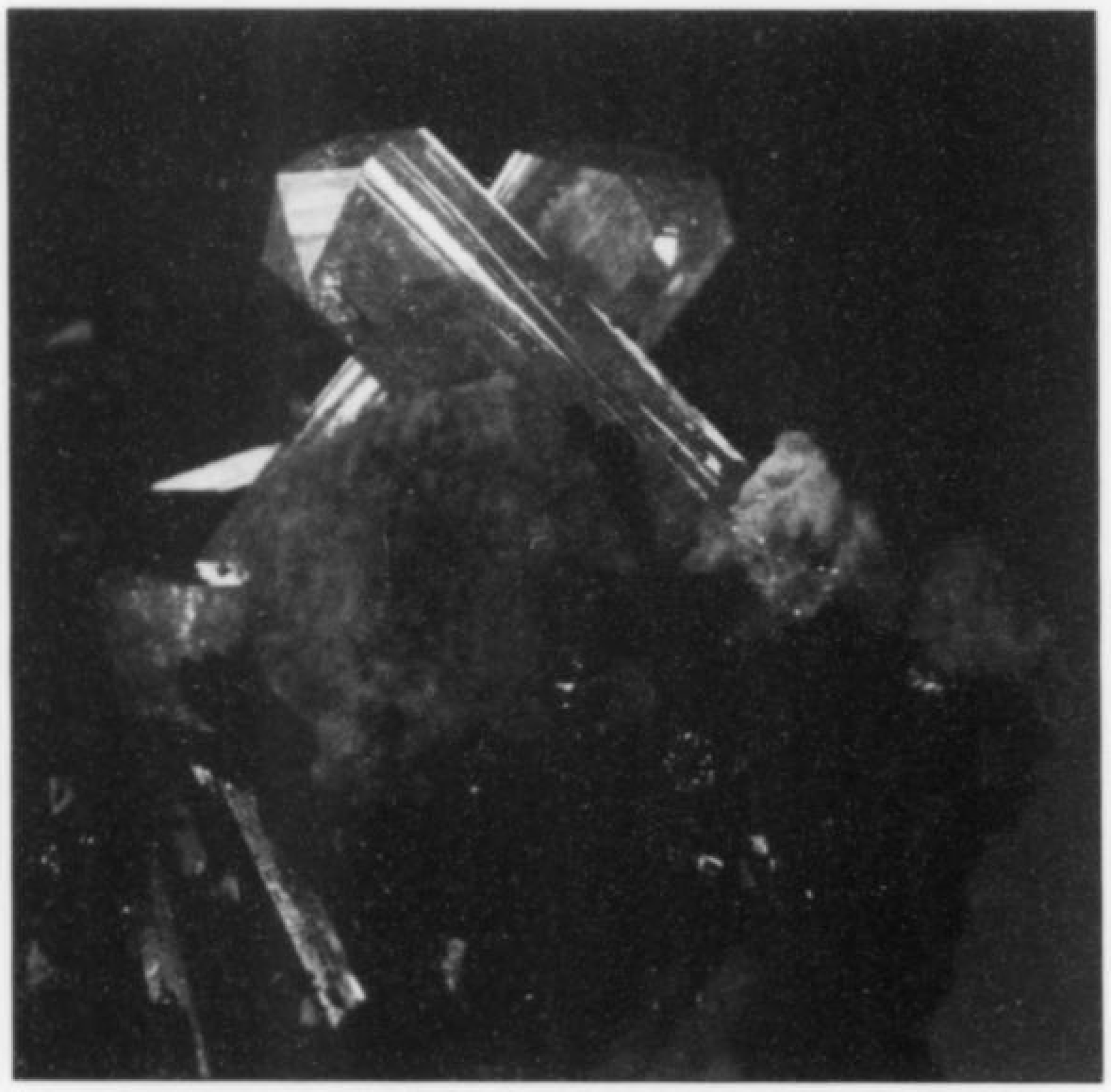


Figure 165. **Hydroxyl-herderite crystals, 2 cm, on fluorite with schorl. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**

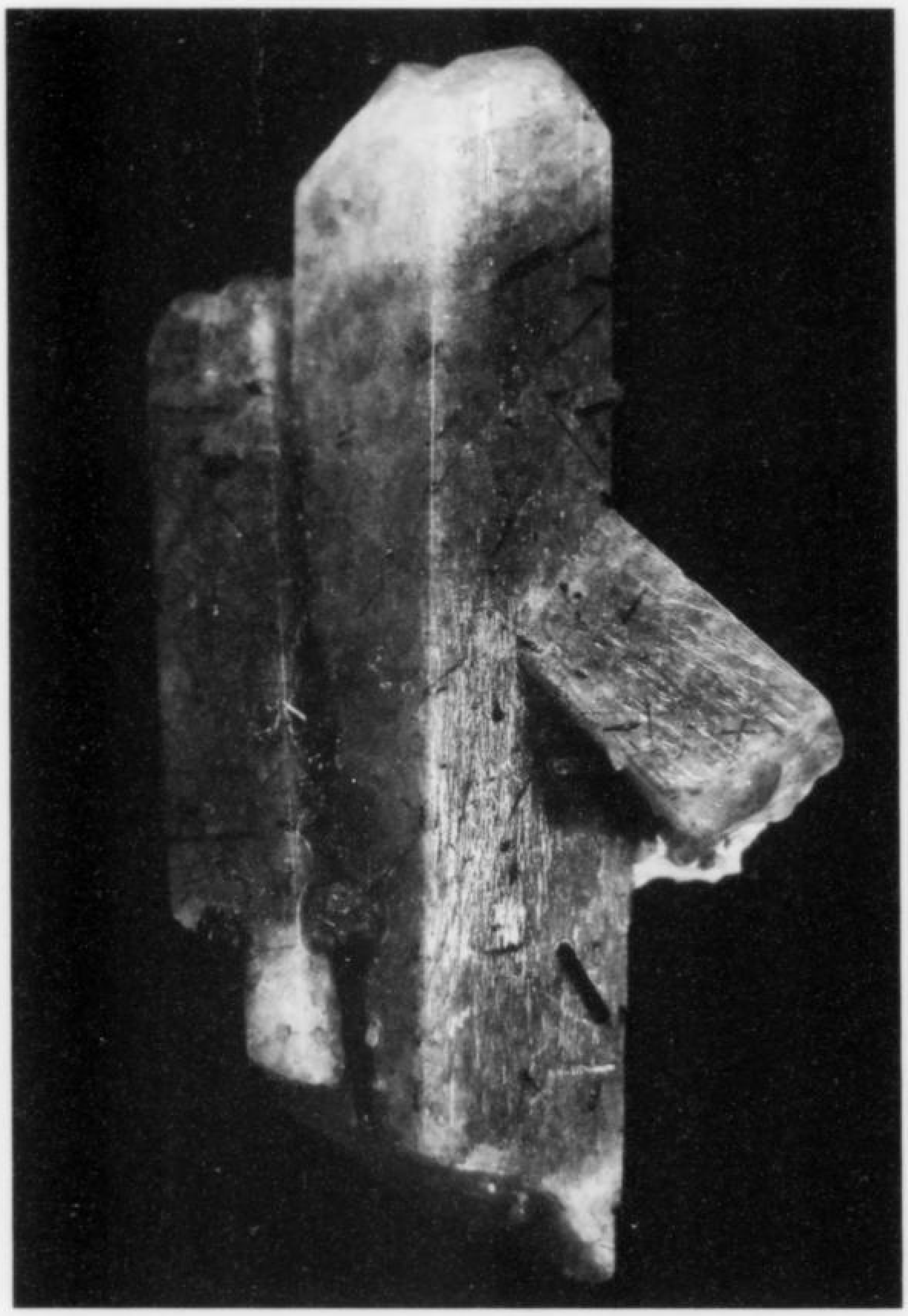


Figure 166. **Hydroxyl-herderite with fluorite and schorl, 4.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 167. **The largest hydroxyl-herderite crystal found to date, studded with schorl, 6.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 168. **Cluster of hydroxyl-herderite crystals, 4.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

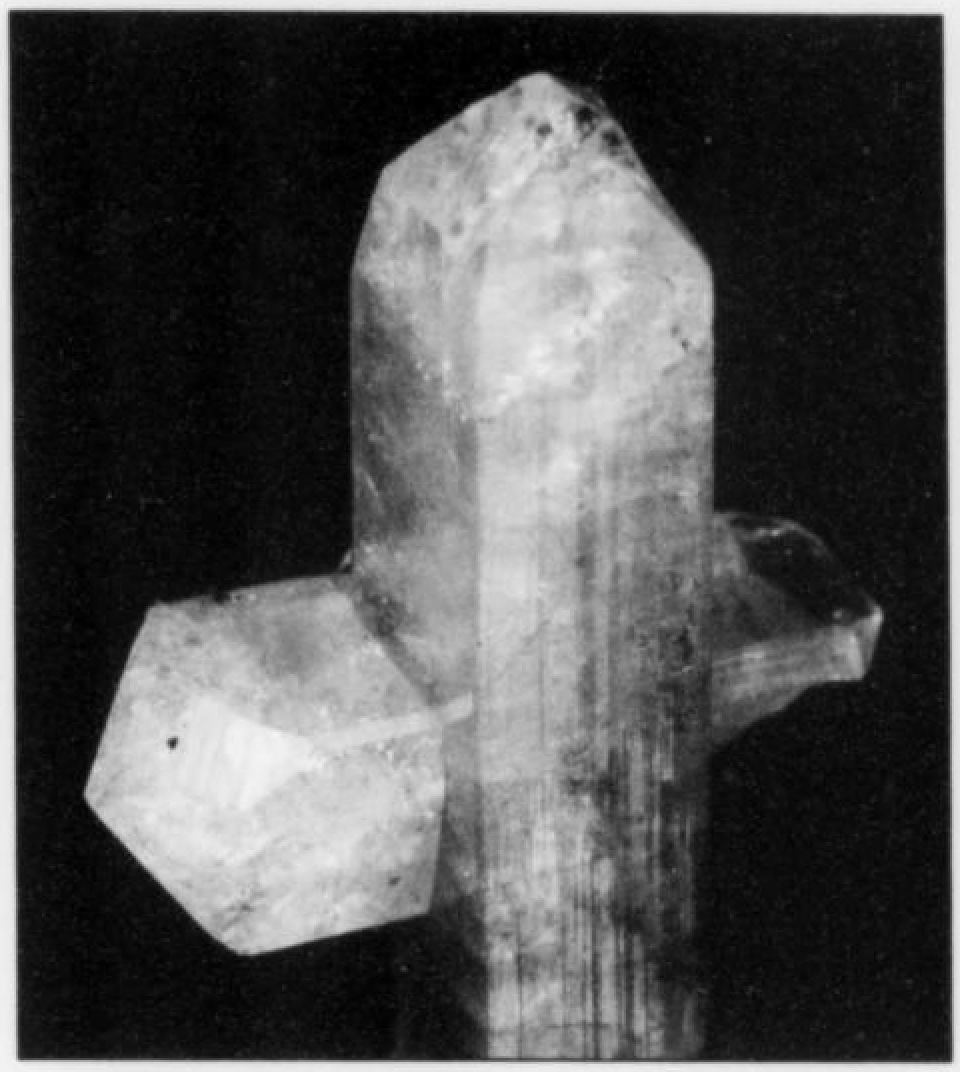


Figure 170. **Cruciform green hydroxyl-herderite, 2.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 169. **Striated green hydroxyl-herderite, 1.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

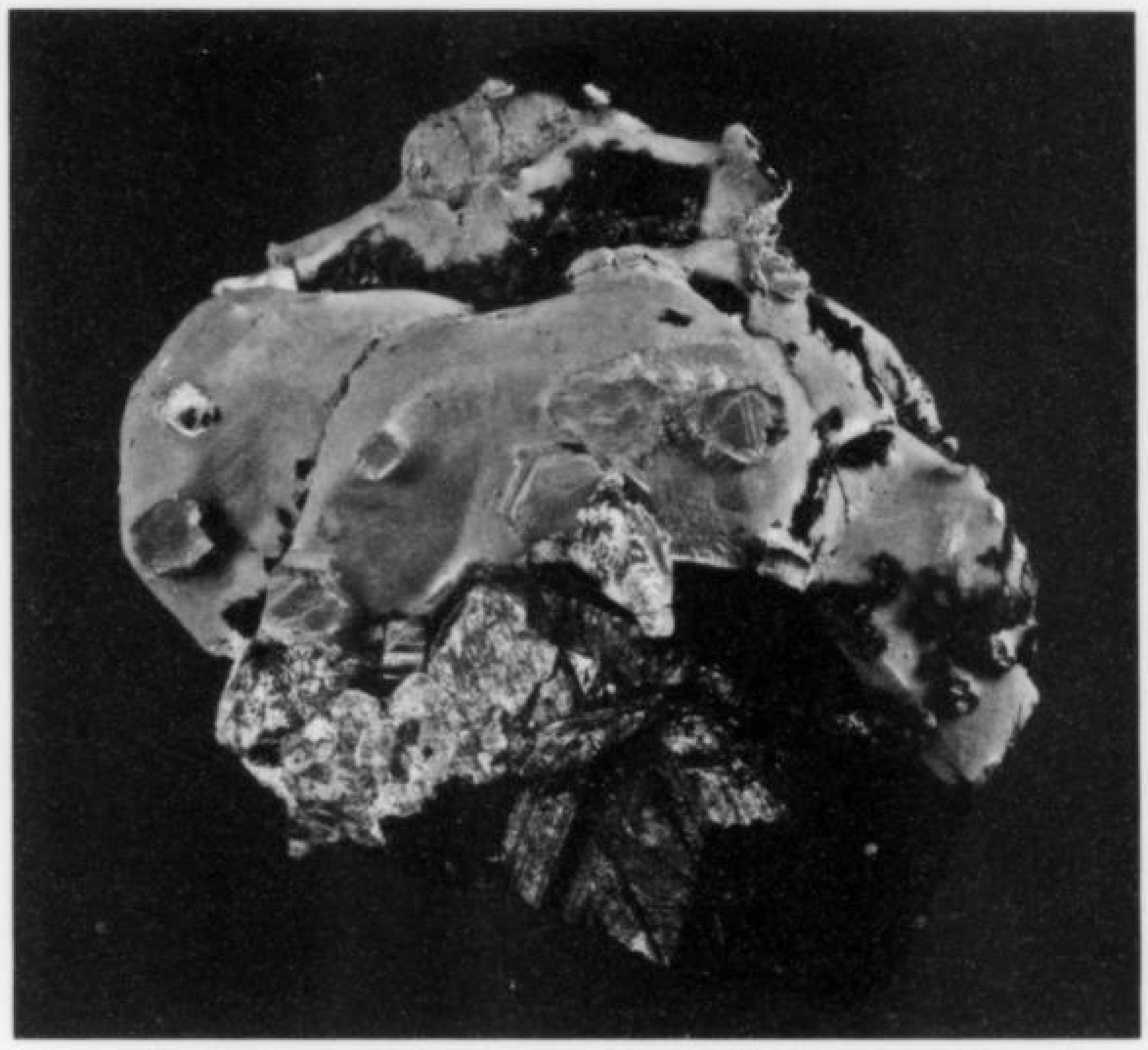


Figure 171. **Ilmenite on schorl and quartz with several cassiterite crystals attached, 7.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Hydroxyl-herderite $CaBe(PO_4)(OH)$

Hydroxyl-herderite is the second beryllium species (the other being beryl) to be found in the Erongo Mountains miarolitic cavities. Hydroxyl-herderite is associated with small (less than 2 cm) schorl crystals, muscovite and orthoclase. A single pocket opened in July 2003 yielded a small amount of this material. Most specimens are thumbnail to small-cabinet-size clusters composed of individual crystals measuring less than 1 cm. The largest crystal found thus far measures 6.2 cm and is studded by small schorl crystals.

Two different colors of hydroxyl-herderite exist at Erongo: pale green and off-white. X-ray diffraction analysis of crystals of both colors at the University of Johannesburg's SPECTRAU analytical facility revealed that they are the same species; the cause of the color difference is not known.

Ilmenite $Fe^{2+}TiO_3$

Ilmenite occurs as simple and complex crystals to 7.4 cm with slightly radioactive orange-yellow coatings. The ilmenite was quantitatively identified by the Geological Survey in Windhoek, Namibia and by X-ray diffraction at the University of Johannesburg. Ilmenite is associated with schorl, quartz and cassiterite, and some specimens contain microscopic intergrowths of rutile and ilmenite (Jahn *et al.*, 2003).

Ilmenorutile $(Ti,Nb,Fe^{3+})_3O_6$

Gebhard (2002) describes small, bright, silvery metallic ilmenorutile crystals on goethite pseudomorphs after siderite(?) and magnetite(?). These tiny crystals are difficult to distinguish visually from the pyrolusite.

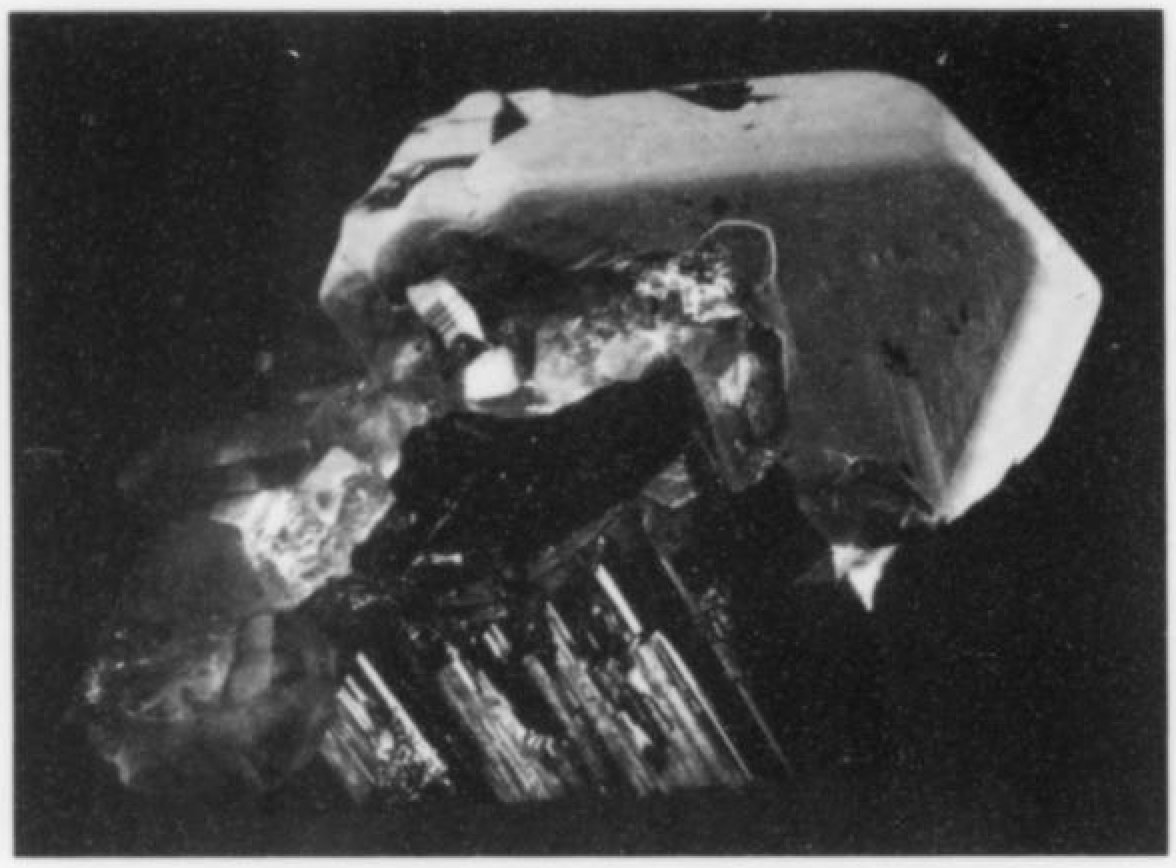


Figure 172. **Ilmenite crystal, 5.6 cm, on quartz and schorl. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

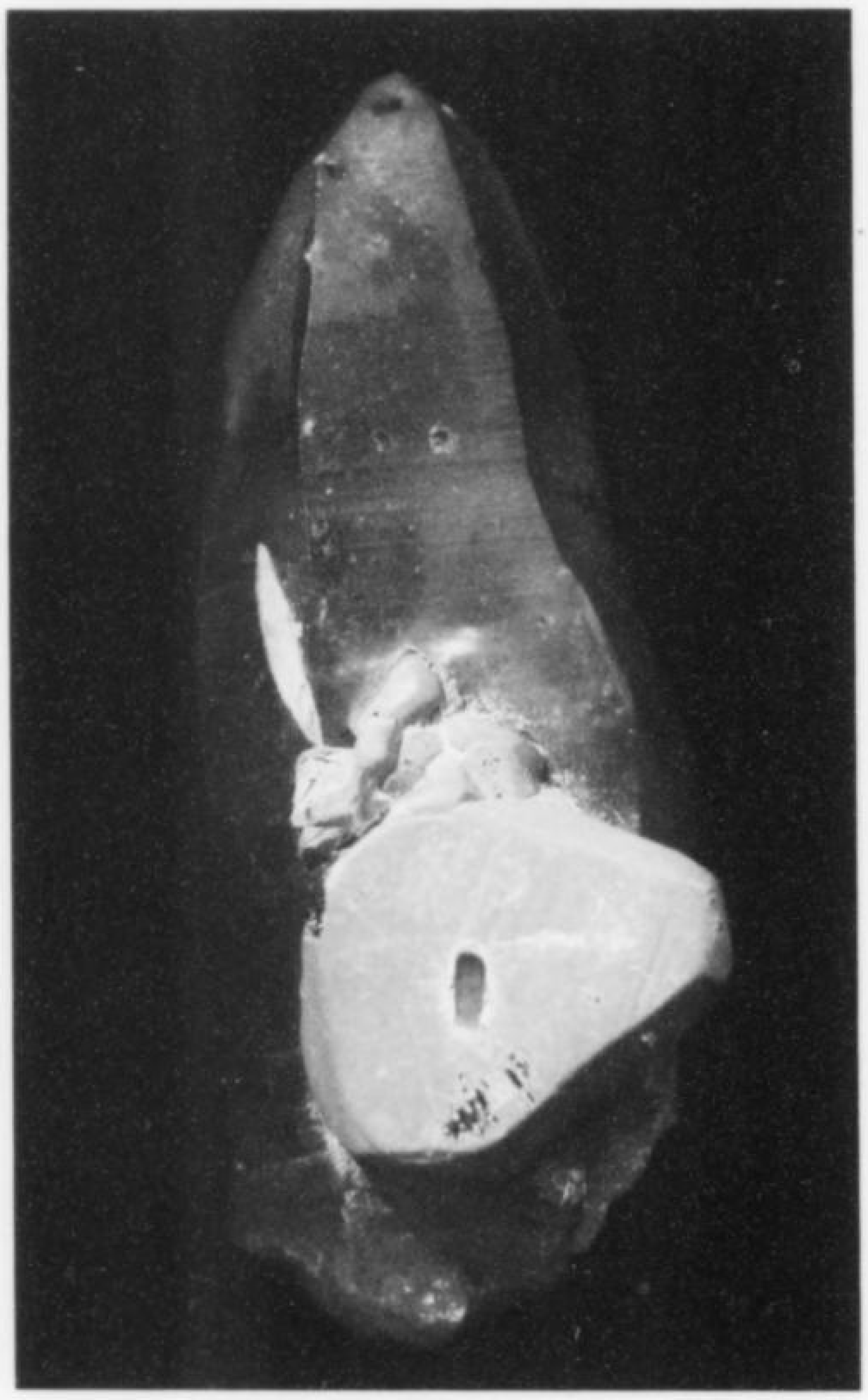


Figure 173. **Ilmenite on smoky quartz, 5.6 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

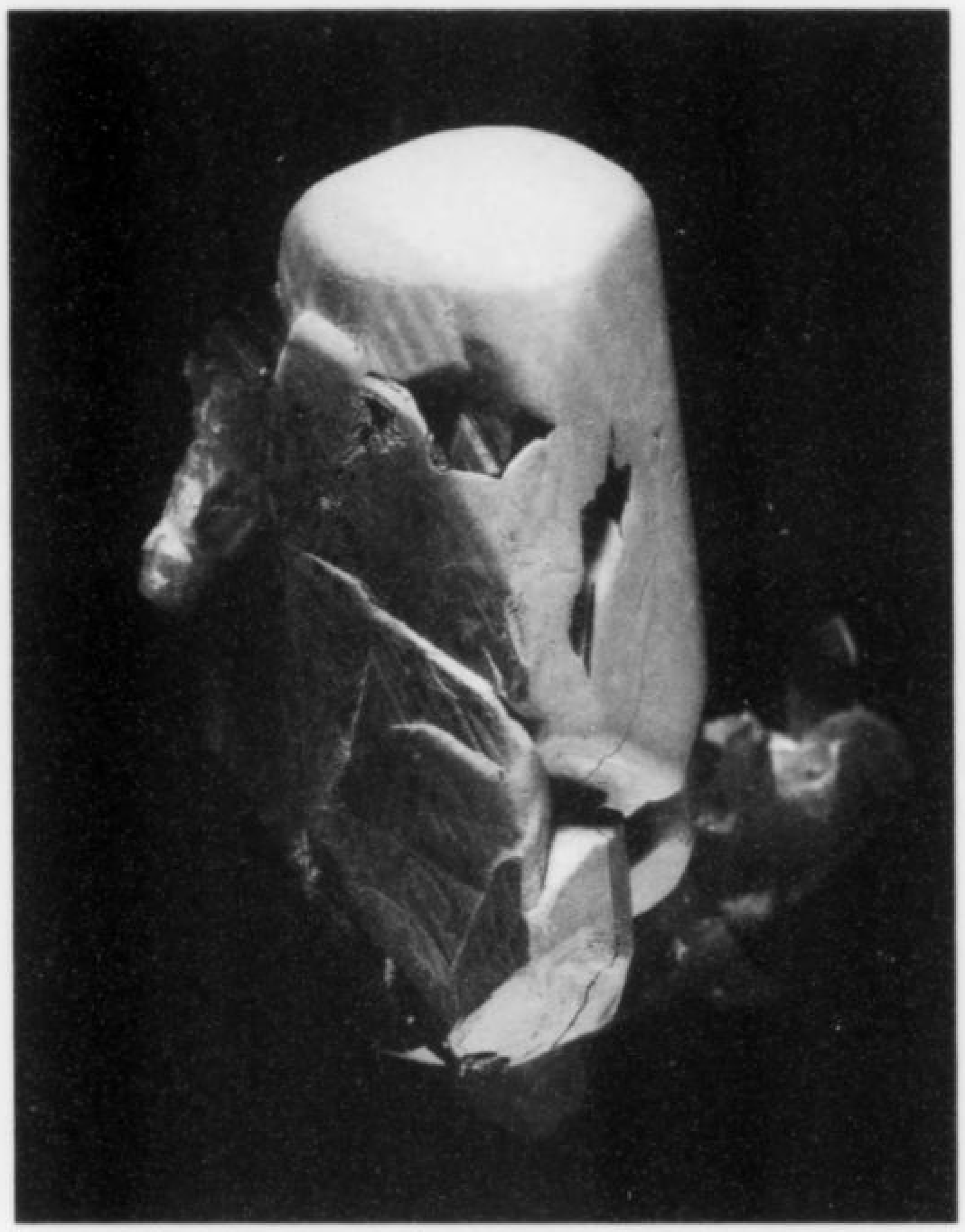


Figure 174. **Ilmenite crystal with quartz, 5.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Jeremejevite $Al_6B_5O_{15}(F,OH)_3$

Jeremejevite is a rare mineral, but was abundant from Erongo for a short period. It was first discovered in eastern Siberia in 1883, when a handful of pale yellow crystals were found. Ninety years later, in 1973, a second discovery was made at Mile 72, on the Atlantic seaboard north of Swakopmund, Namibia (Herting and Strunz, 1978; Wilson *et al*., 2002). Local mineral dealer Sid Pieters worked this deposit, and in 1976 he was rewarded with a small pocket that yielded some of the finest jeremejevite crystals known (see Wilson *et al*., 2002). In total, a few hundred specimens were removed during the 1970's. In 1999, a collaborative Namibian-American company, Khan River Mining (Pty) Ltd., reopened the deposit in the hope of finding more of the famous blue crystals, but they had only limited success. Three years later, in March 2001, jeremejevite was discovered in the Erongo Mountains (Gebhard, 2002; Wilson *et al*., 2002; Jahn, 2003). Several miarolitic cavities were excavated in the granite on the farm Ameib 60, almost at the border with the neighboring farms Davib Ost 61 and Brabant 68. At first, the blue prismatic crystals were thought to be aquamarine but analysis proved otherwise.

It is estimated that during the exploitation of these pockets a few thousand specimens were collected, including crystals that were dug from weathered alluvium. At the time, some dealers had small plastic bags filled with loose, pale yellow to colorless needle-like crystals without matrix. The vast majority of these are less than 1 cm long and 2 mm thick; larger crystals to 5 cm were found but are rare. Von Bezing (2006) states that the largest crystal is 6 cm. Matrix specimens of jeremejevite, either on smoky quartz or more rarely on orthoclase, attest to the simple mineralogy of these particular pockets. Large crystals typically taper toward the termination, and the bases of the crystals are bluer than the terminations. Furthermore, some crystals have stripes of blue-white color zoning that run the length of the crystal. Blue crystals exhibit a striking pleochroism from colorless to "cornflower" blue, an optical attribute used to great effect by gem cutters.

A visit to the discovery site on the farm Ameib 60 in August 2005 revealed several small worked-out cavities clustered together on one southeast-facing granite face. Most are less than 1 meter in diameter, and there is evidence of drilling having taken place. In 2005 the area was deserted, in contrast to 2001 when several hundred diggers were (illegally) excavating jeremejevite (Wilson *et al.,* 2002).

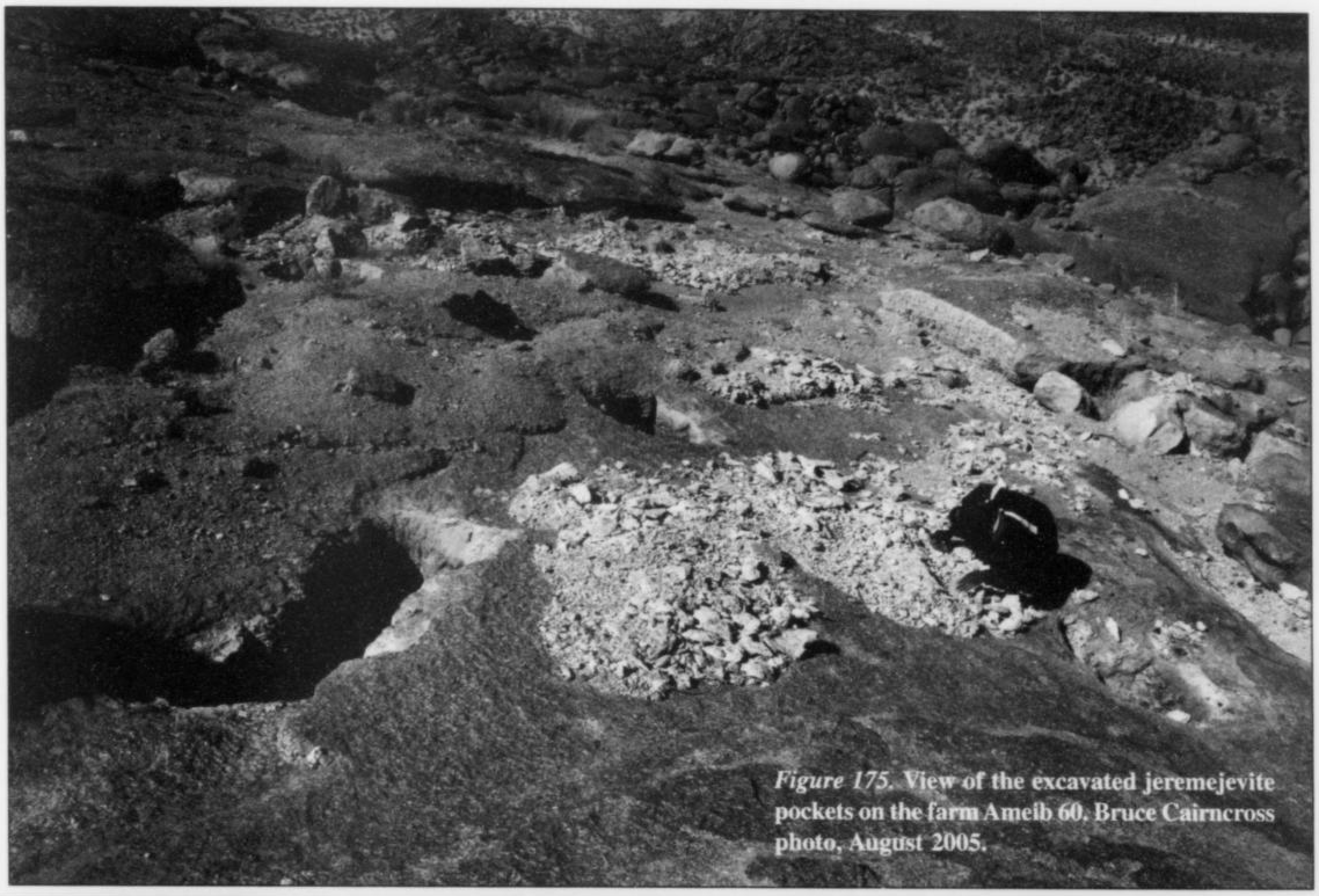


Figure 175. View of the excavated jeremejevite pockets on the farm Ameib 60. Bruce Cairncross photo, August 2005.

Figure 176. **A handful of gemmy jeremejevite crystals. The largest one is 3.1 cm. Erongo Mountains, Namibia. Desmond Sacco collection; Bruce Cairncross photo.**

Figure 177. **Jeremejevite crystal, 1.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

In April-May 2006, another discovery of jeremejevite was made in the Erongo Mountains, not at the previous site on Ameib 60 but at a site whose exact whereabouts have not yet been divulged. The crystals are similar in size to the previous ones from Ameib 60, but apparently fewer have been found. They have very good blue color but are opaque, and they are not clean, equant prisms but are somewhat distorted and misshapen.

Jeremejevite was recently discovered in Madagascar. In 2004, a 7.88-carat faceted stone was purchased in Madagascar as colorless "achroite" tourmaline. Quantitative analysis showed the stone to be jeremejevite (Mocquet and Lulzac, 2004). To date, it appears to be the only jeremejevite sample known from Madagascar.

Magnetite $Fe^{2+}Fe_2^{3+}O_4$

Unaltered magnetite crystals are rare at Erongo. Goethite forms

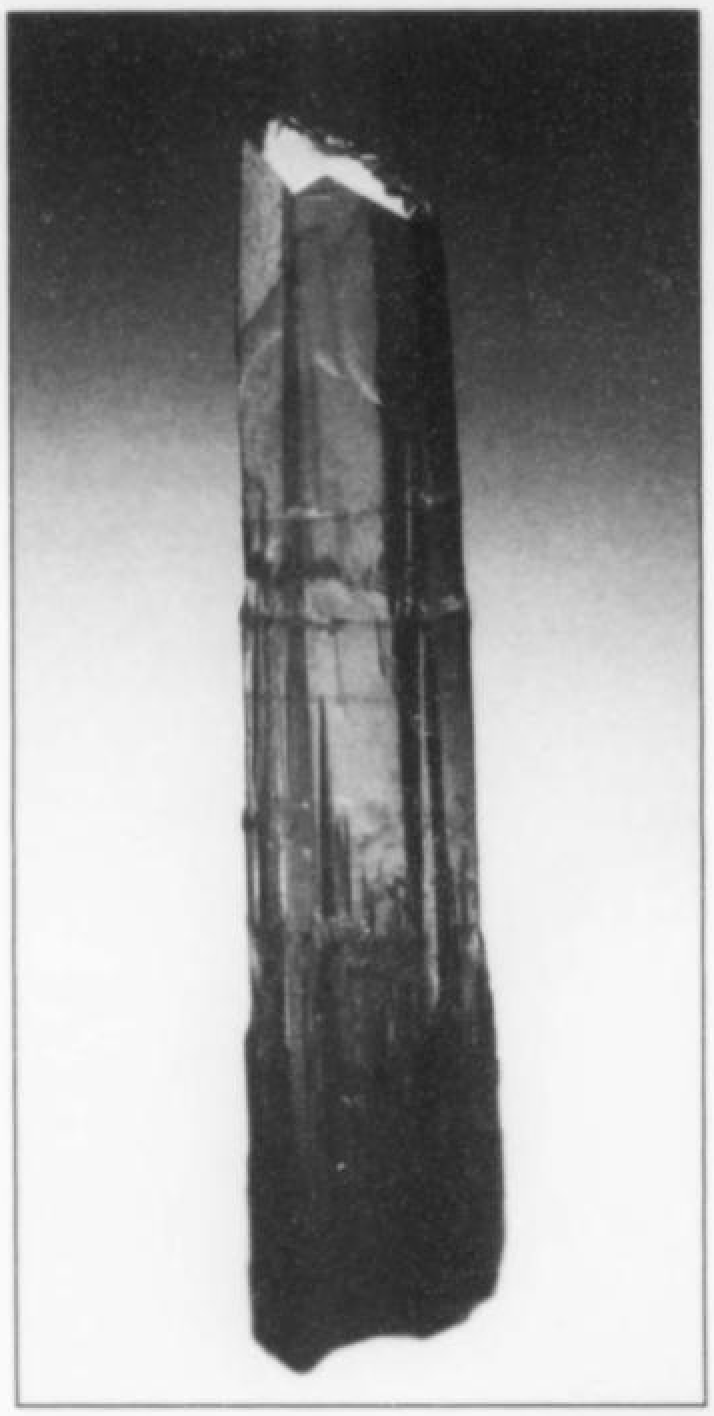


Figure 178. **Jeremejevite crystal, 1.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

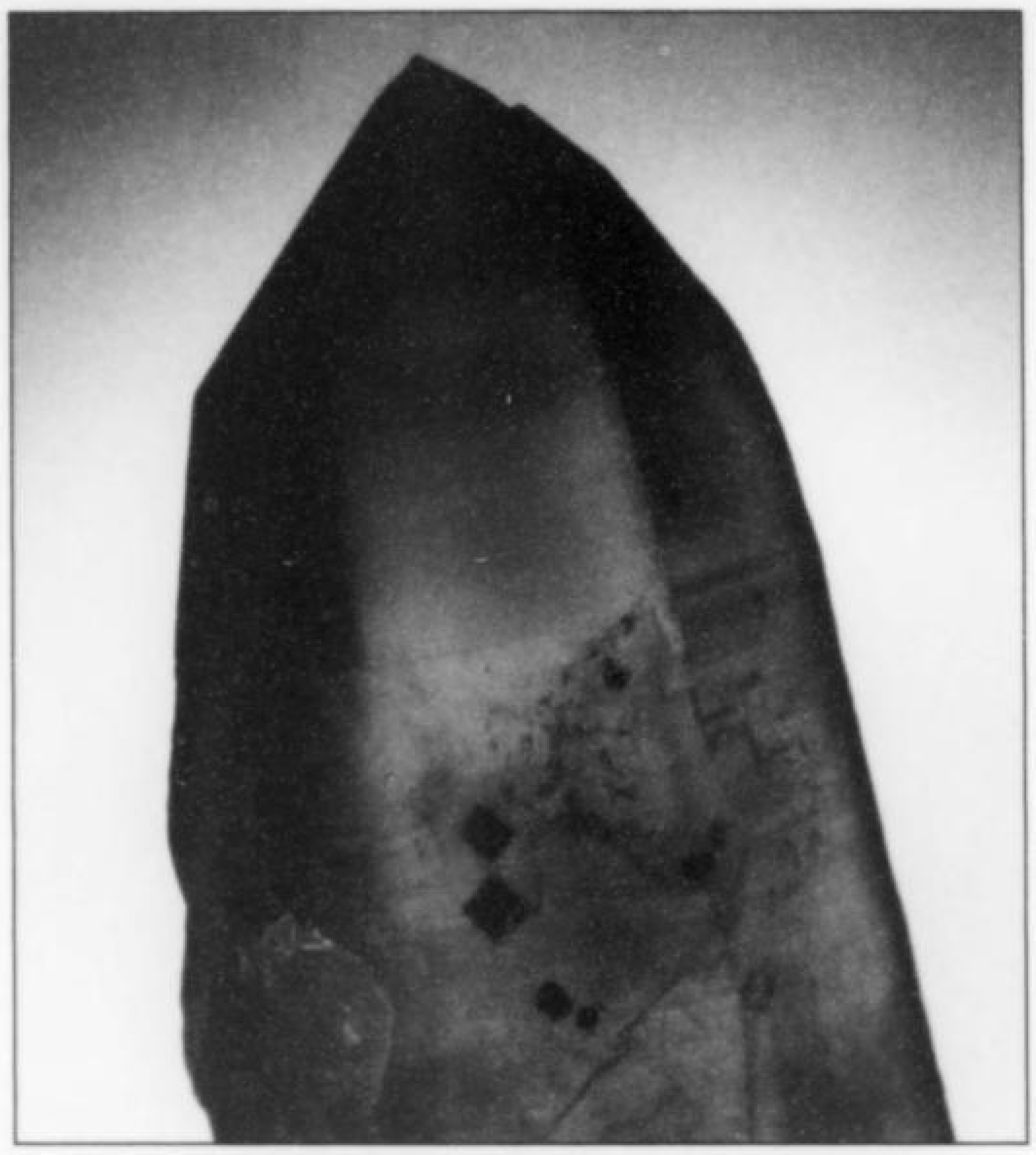


Figure 180. **Octahedral magnetite crystals included in smoky quartz, 3 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 179. **Metanováčekite, 4.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

pseudomorphs after octahedral crystals which are assumed to have been magnetite. Tiny magnetite octahedrons are sometimes included in smoky quartz, and loose, black, metallic octahedral crystals are sometimes found.

Metanováčekite $Mg(UO_2)_2(AsO_4)_2 \cdot 4\text{–}8H_2O$

In September 2003 a small uranium-rich miarolitic cavity was discovered on the farm Tubussis 22. It yielded a few uranium species, including metanováčekite, metazeunerite and uranophane. Uranium anomalies were previously known from airborne exploration just north of Erongo on the farm Omandumba West 137, at the common boundary with the adjacent Anibib 136 (Roesener and Schreuder, 1992). The mineralization is structurally controlled by fractures in the Erongo Granite. Another area of supergene uranium mineralization occurs in pegmatites on Etemba 135, bordering northwest Erongo, at Omandumba West 137 and on southwestern portions of Brabant 68 (Pirajno, 1990).

Metazeunerite $Cu(UO_2)_2(AsO_4)_2 \cdot 8H_2O$

Single crystals and crystal groups of metazeunerite were col-

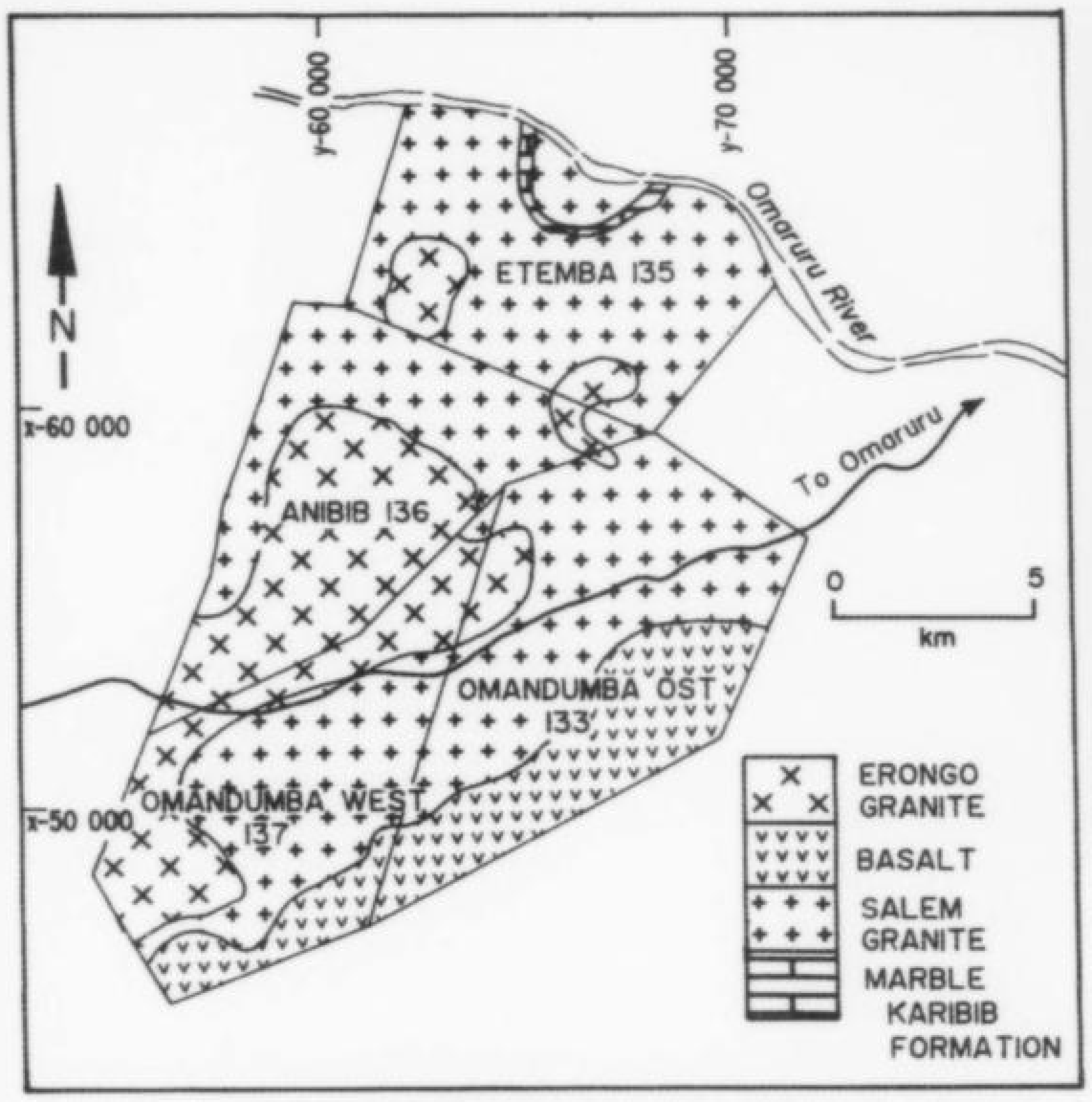


Figure 181. **Geological map of uranium occurrence in the Erongo granite on the farms Anibib 136 and Omandumba 137. From Roesener and Schreuder (1992).**

Figure 182. **Metazeunerite crystal, 1.3 cm on matrix. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 183. **Zeunerite crystal cluster, 1.6 cm, on matrix, shortly after being excavated from the pocket. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

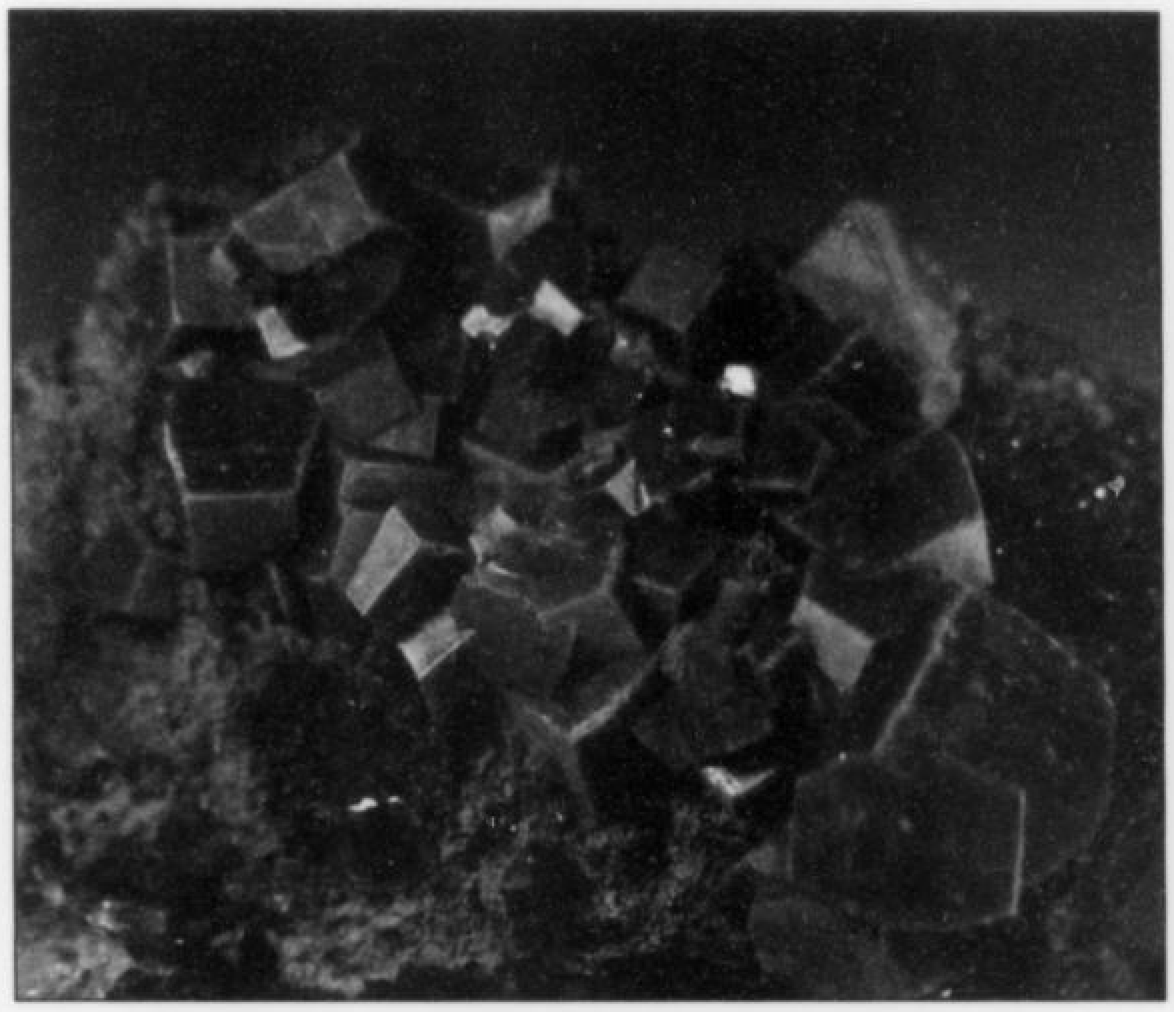


Figure 184. **Metazeunerite. The same specimen as in Figure 183, but one month later, having dehydrated. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 185. **Metazeunerite crystal, 9 mm, on quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

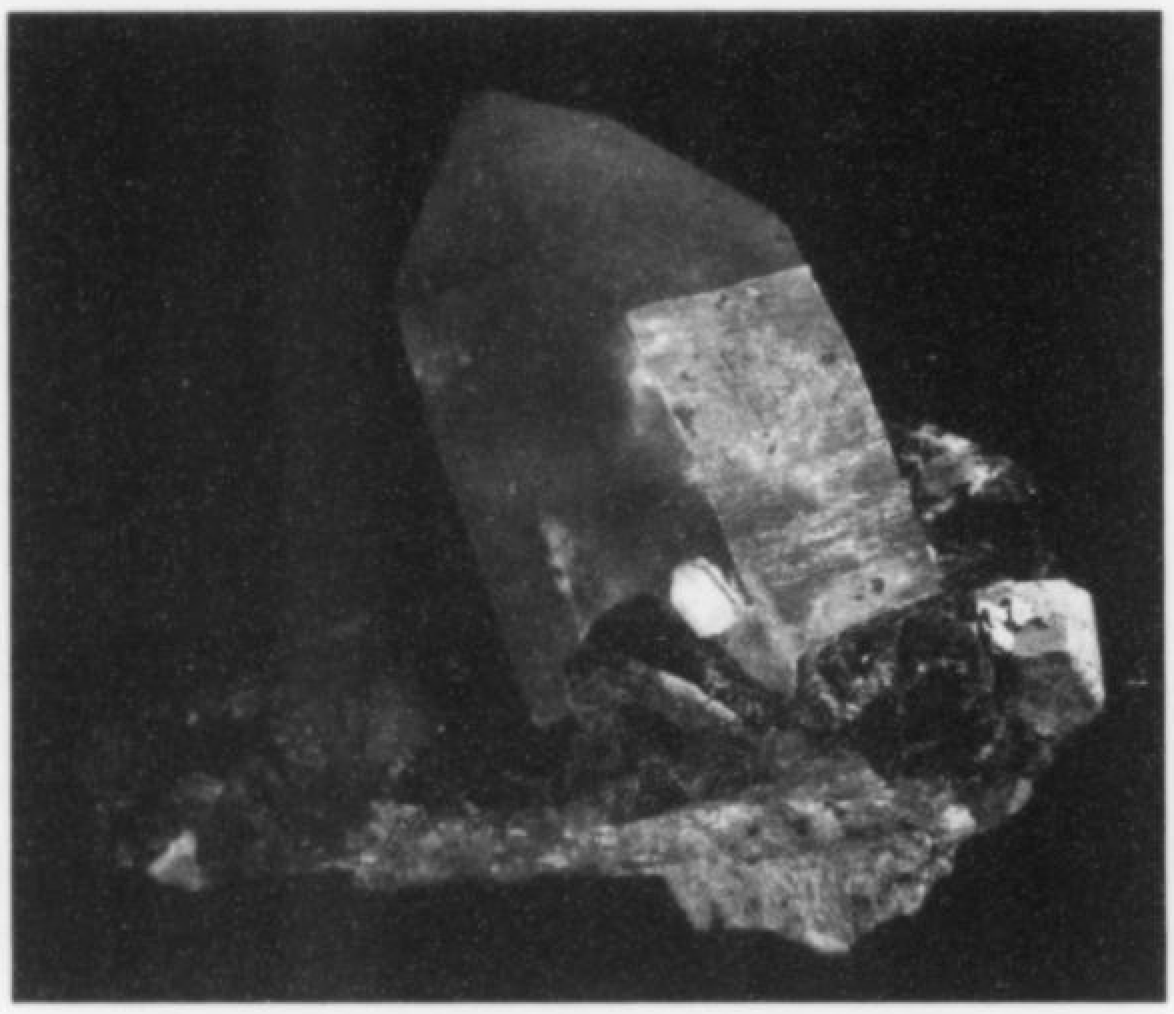


Figure 186. **Metazeunerite with quartz and schorl, 4.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

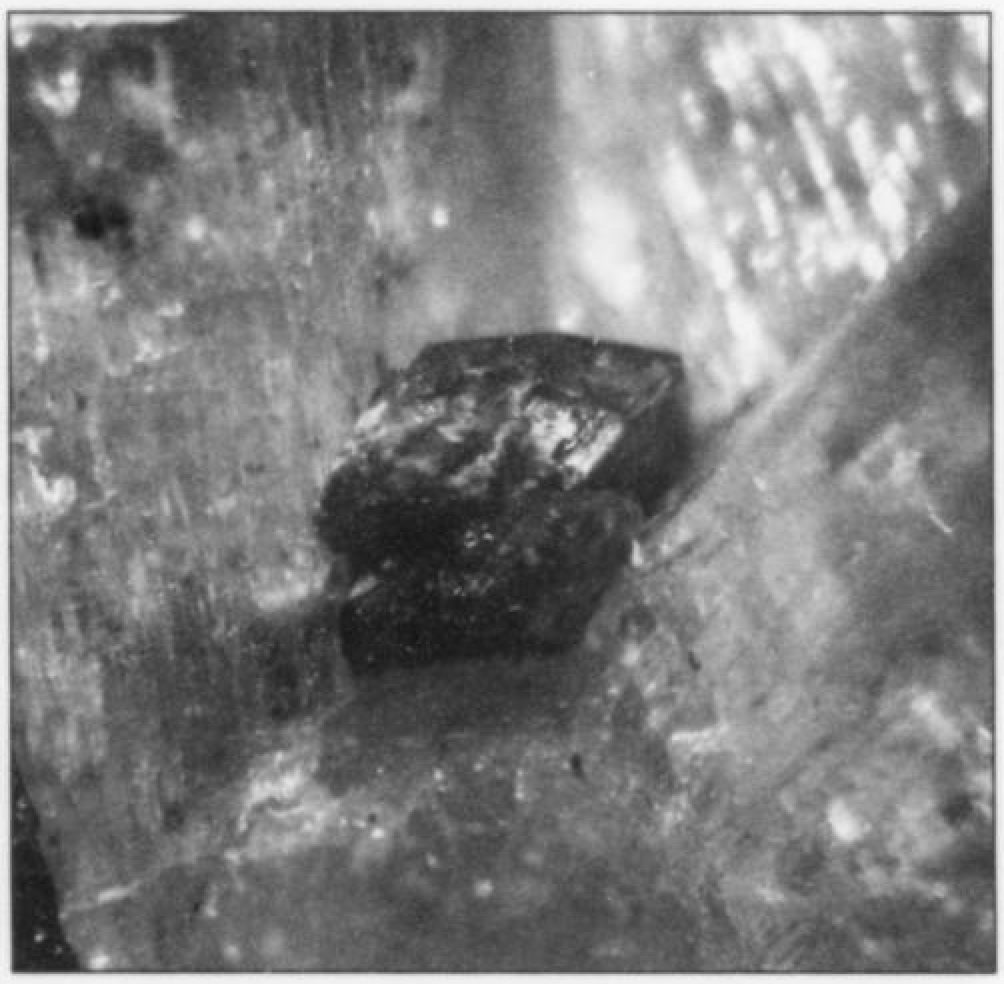


Figure 188. **Monazite crystal, 6 mm, on beryl with schorl. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 187. **Molybdenite on quartz, 3.4 cm. Erongo Mountains, Namibia. Georg Reif collection; Ernst A. Schnaitmann photo.**

Figure 189. **Monazite crystal, 5 mm, on muscovite with fluorite and metazeunerite. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

lected in the uranium pocket described above. Crystals are typically less than 1 cm and are rare. They are associated with purple fluorite, quartz and schorl.

Molybdenite MoS_2

In October 2005 a small cavity yielded the first specimens of Erongo molybdenite; only about ten specimens were collected. Associated minerals are quartz, muscovite and beryl (Herbert Nägele, personal communication 2006).

Monazite-group $(Ce,La,Nd)PO_4$

Monazite occurs as orange-brown tabular crystals, some associated with muscovite, others with pale green beryl. In May-June 2001, green to yellow beryl crystals to 8 cm associated with brown-yellow monazite crystals to 2 cm were found (Gebhard, 2002). One of the largest monazite crystals found measures 2.5 cm (Jahn and Bahmann, 2006).

Muscovite $KAl_2(Si_3Al)O_{10}(OH,F)_2$

Three different types of Erongo mica are described in the literature: muscovite, lithium-muscovite and zinnwaldite (Frommurze *et al.*, 1942; von Bezing, 2006). Jahn and Bahmann (2000) describe muscovite as 1 × 1-cm silver-green crystals but state that the identification of this mica was done visually and not quantitatively. The color of the muscovite is variable from silver-white to off-white, gray-green, pale green, pale yellow and pale orange-yellow. Small, stacked hexagonal "books" of muscovite, some flattened and other tapering, are common. Muscovite is associated with cuboctahedral fluorite, colorless beryl, schorl and topaz, and muscovite crystals commonly stud crystals of schorl, orthoclase and other species. One of the most attractive associations is 1 to 2-cm rosettes of honey-yellow muscovite providing the matrix for crystals of green fluorite and colorless beryl.

Opal $SiO_2 \cdot nH_2O$

Hyaline opal is relatively common in the miarolitic cavities and in some of the metallic deposits such as the one at Krantzberg. The

Figure 190. **Muscovite with albite, 3 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

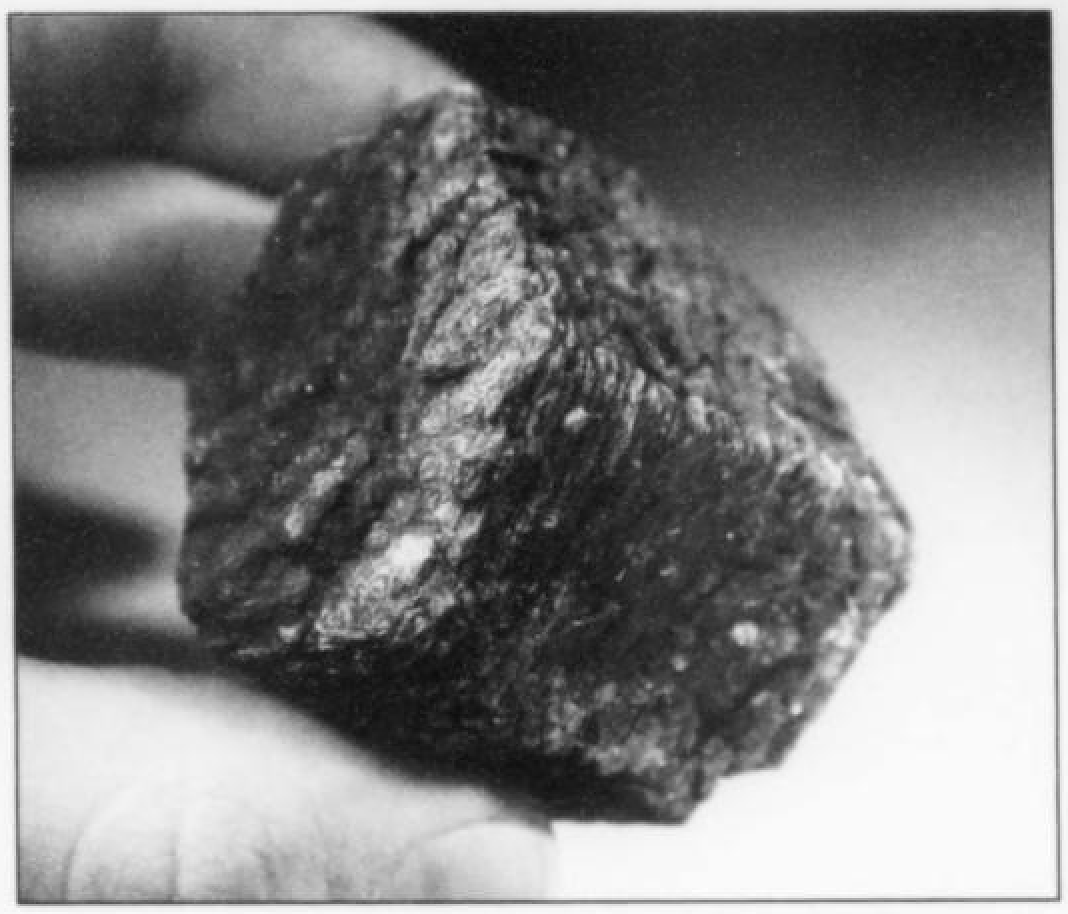


Figure 191. **Muscovite with topaz and orthoclase, 6 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

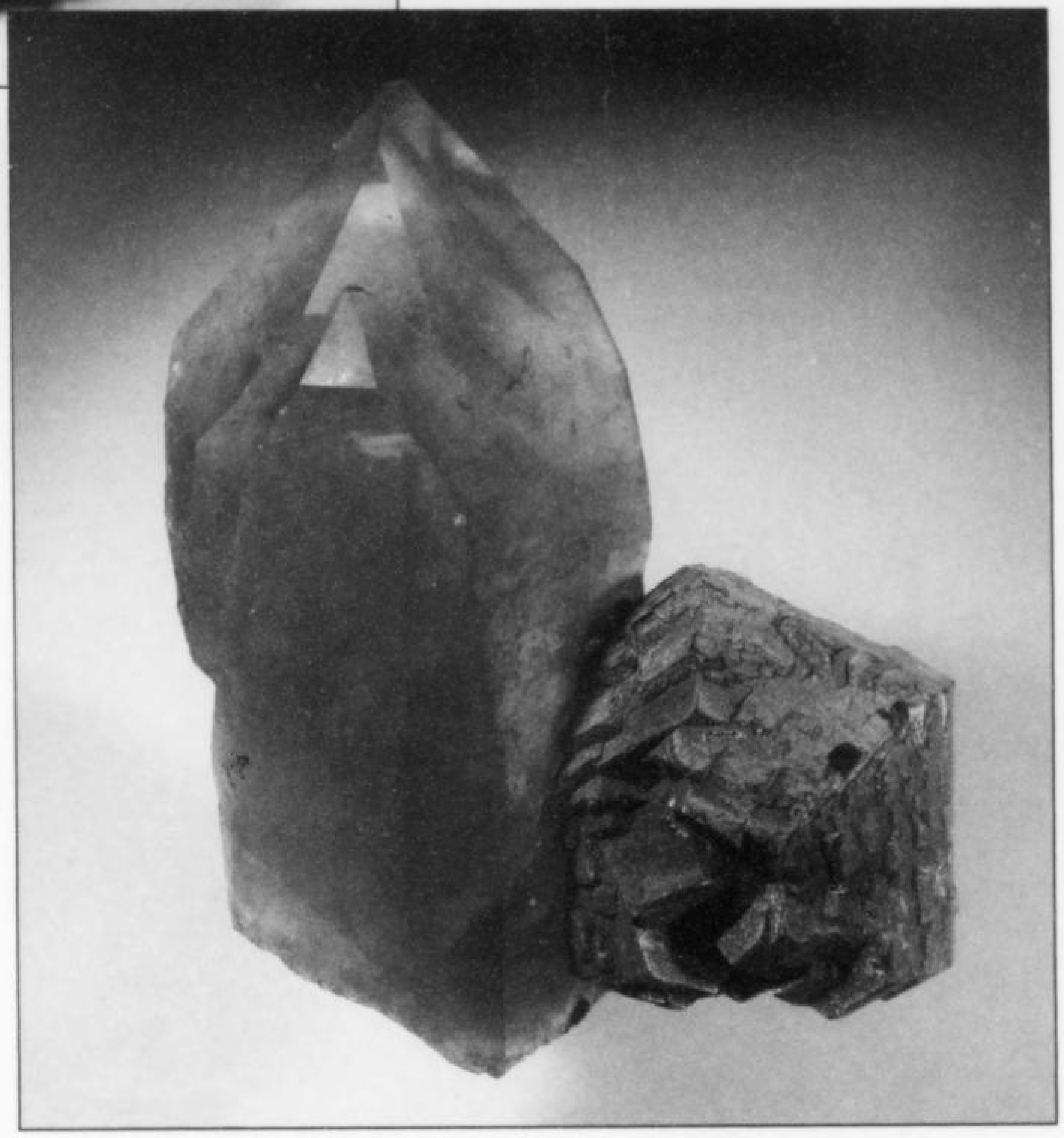


Figure 192. **Goethite-stained muscovite attached to quartz, 7.4 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

opal, being the last mineral phase to have formed in the Erongo paragenesis, occurs on all other species. This can be a blessing and a curse because the opal is tenacious and very difficult to remove from schorl, quartz and other minerals. On the other hand, some (not all) opal fluoresces a vivid, intense yellow-green, sometimes even in daylight, adding to the aesthetics of specimens.

The opal occurs in various habits. Glassy, transparent, botryoidal coatings are relatively common. White ice cream cone-like sprays are sometimes seen perched on fluorite and very commonly on orthoclase feldspar. These sprays have a divergent habit, very similar to Don King's hairstyle!

At the Krantzberg tungsten deposit, hyaline opal coats most minerals. It occurs as botryoidal layers, some stained green by secondary copper minerals or black by hematite.

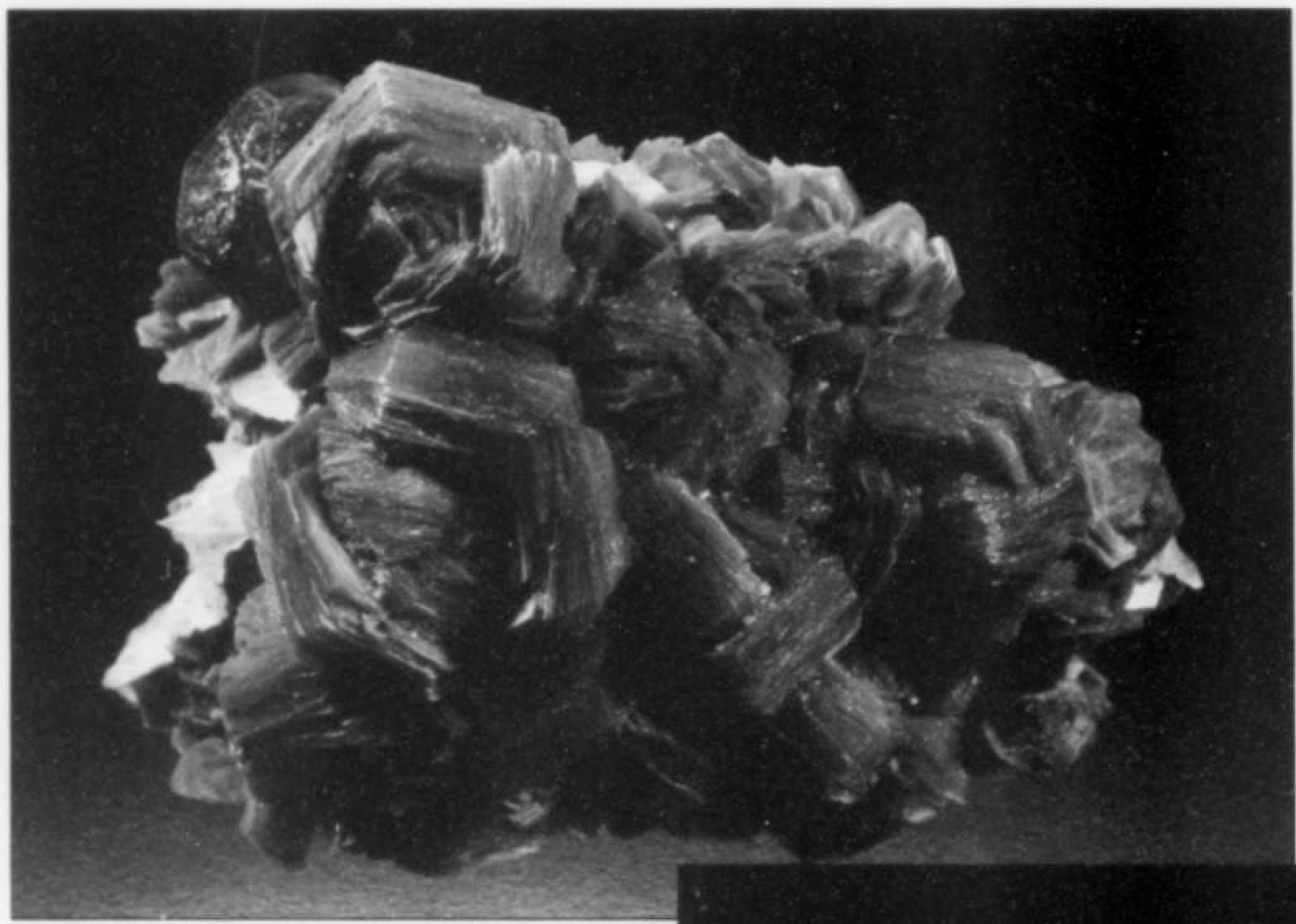


Figure 193. **Muscovite, fluorite and quartz, 5.9 cm. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**

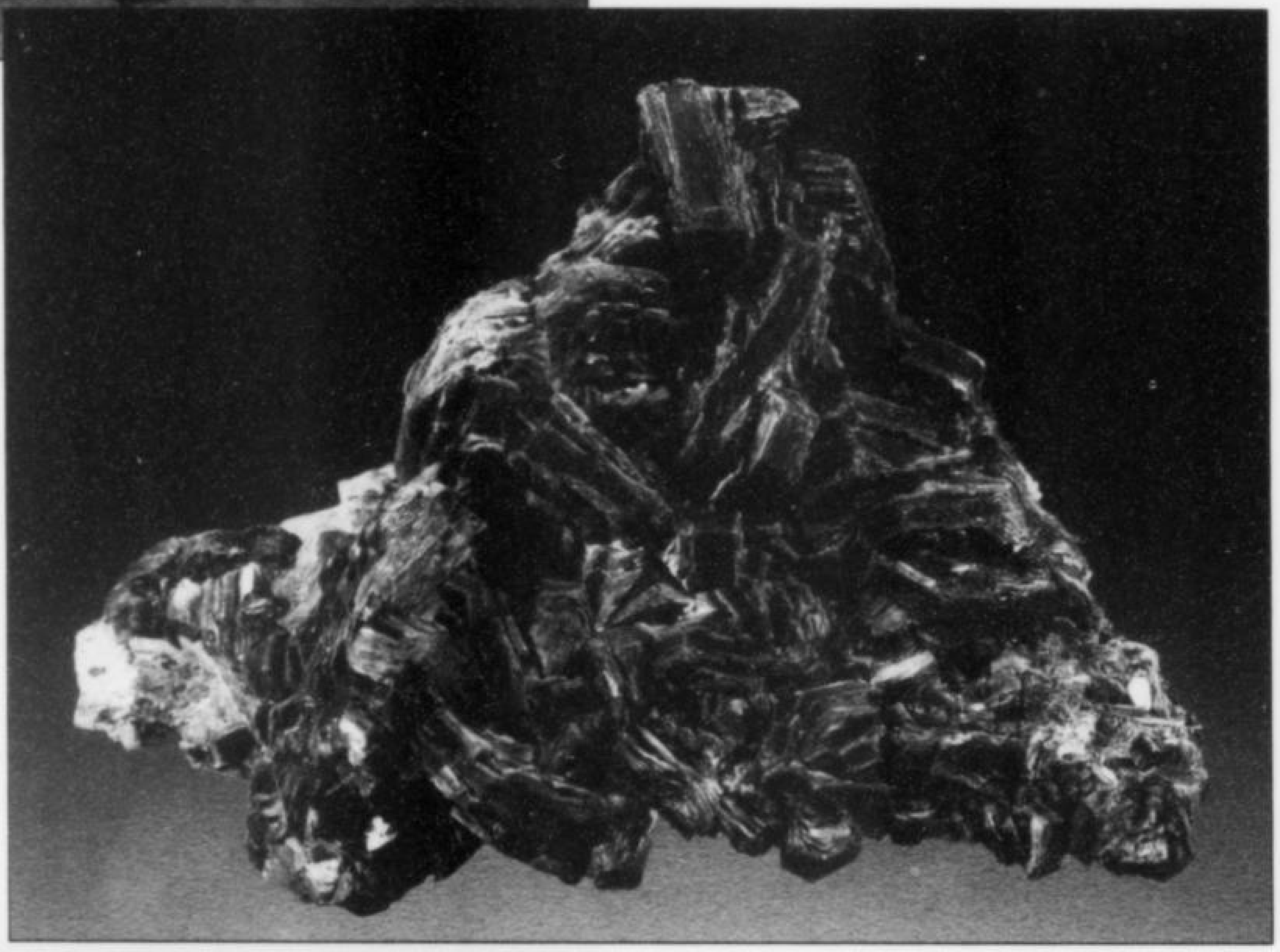


Figure 194. **Muscovite on orthoclase, 8.4 cm. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**

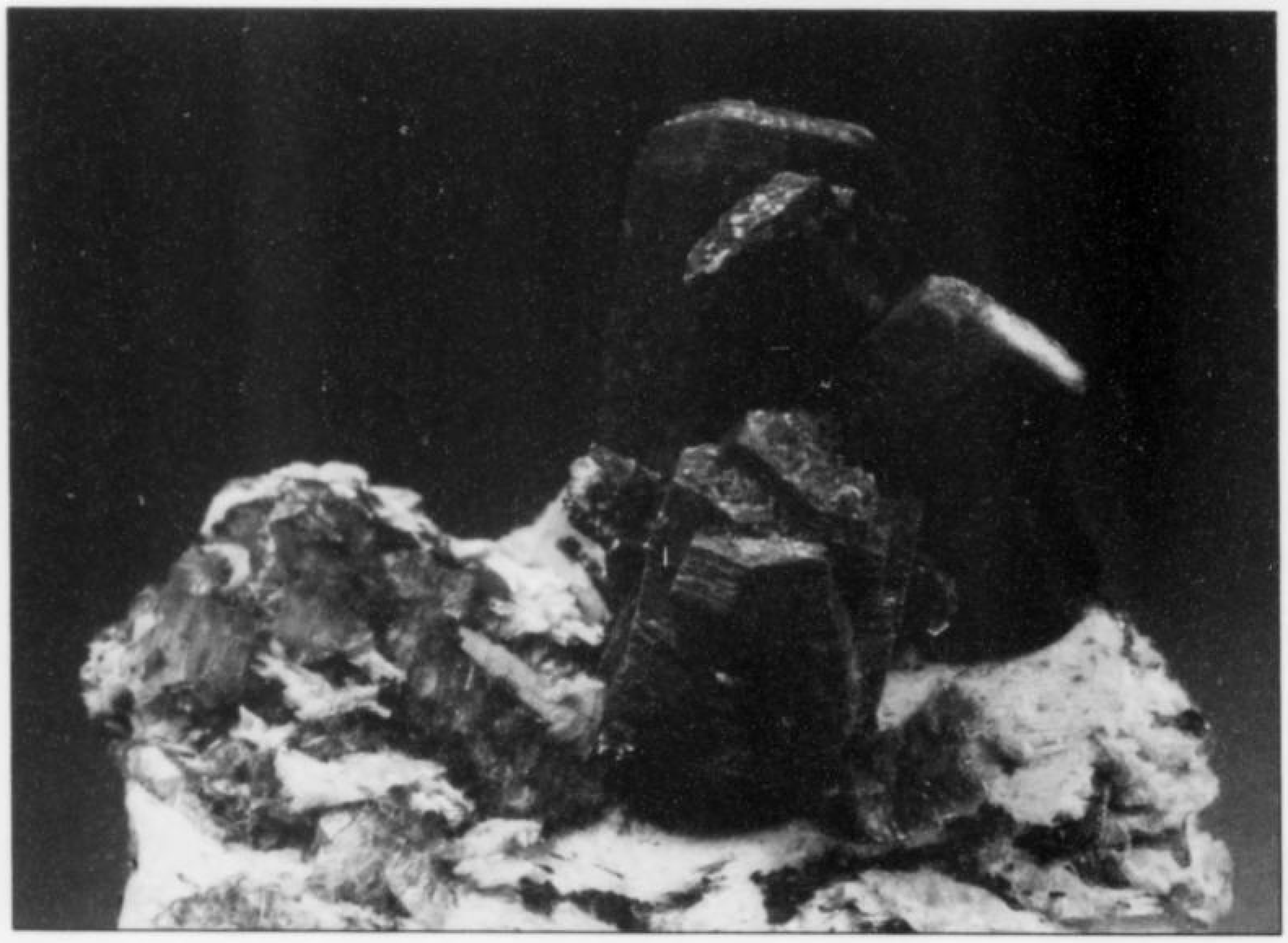


Figure 195. **Muscovite on orthoclase with fluorite, 4.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 196. Hyaline opal, 1.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

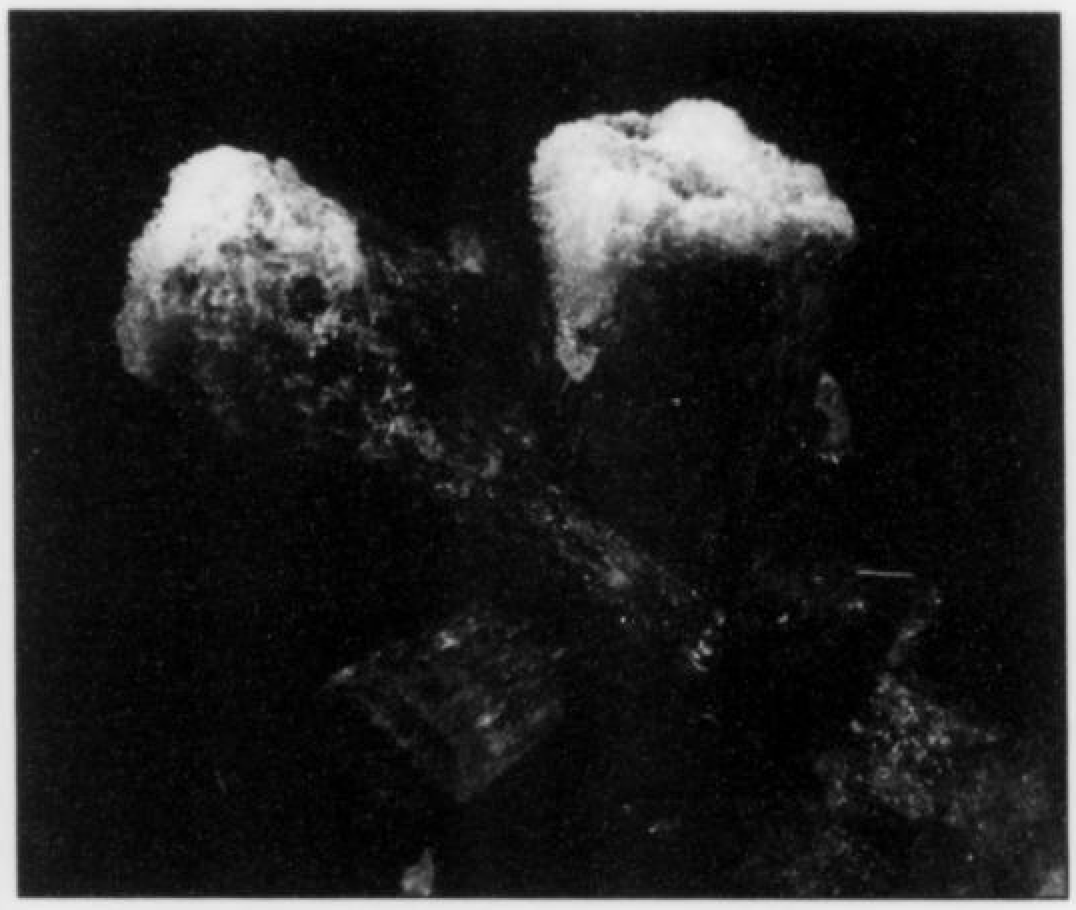


Figure 197. Hyaline opal on schorl, 9.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

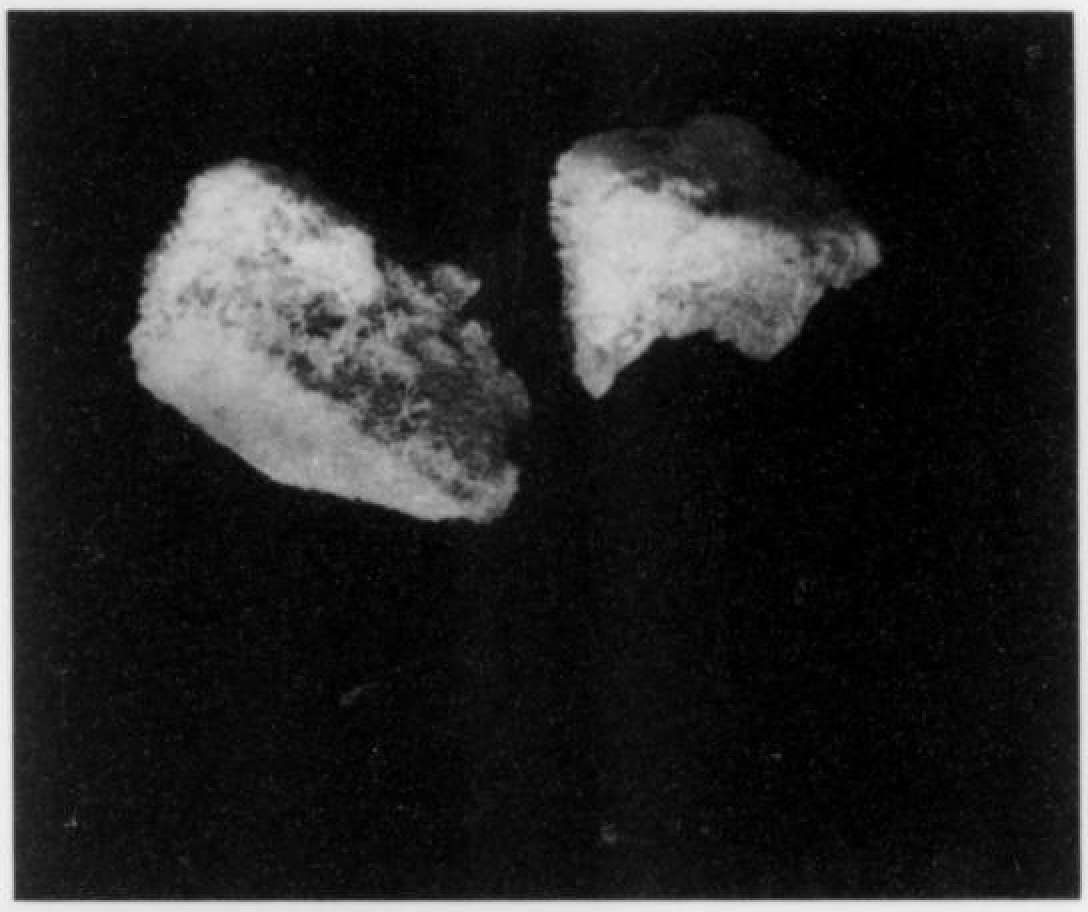
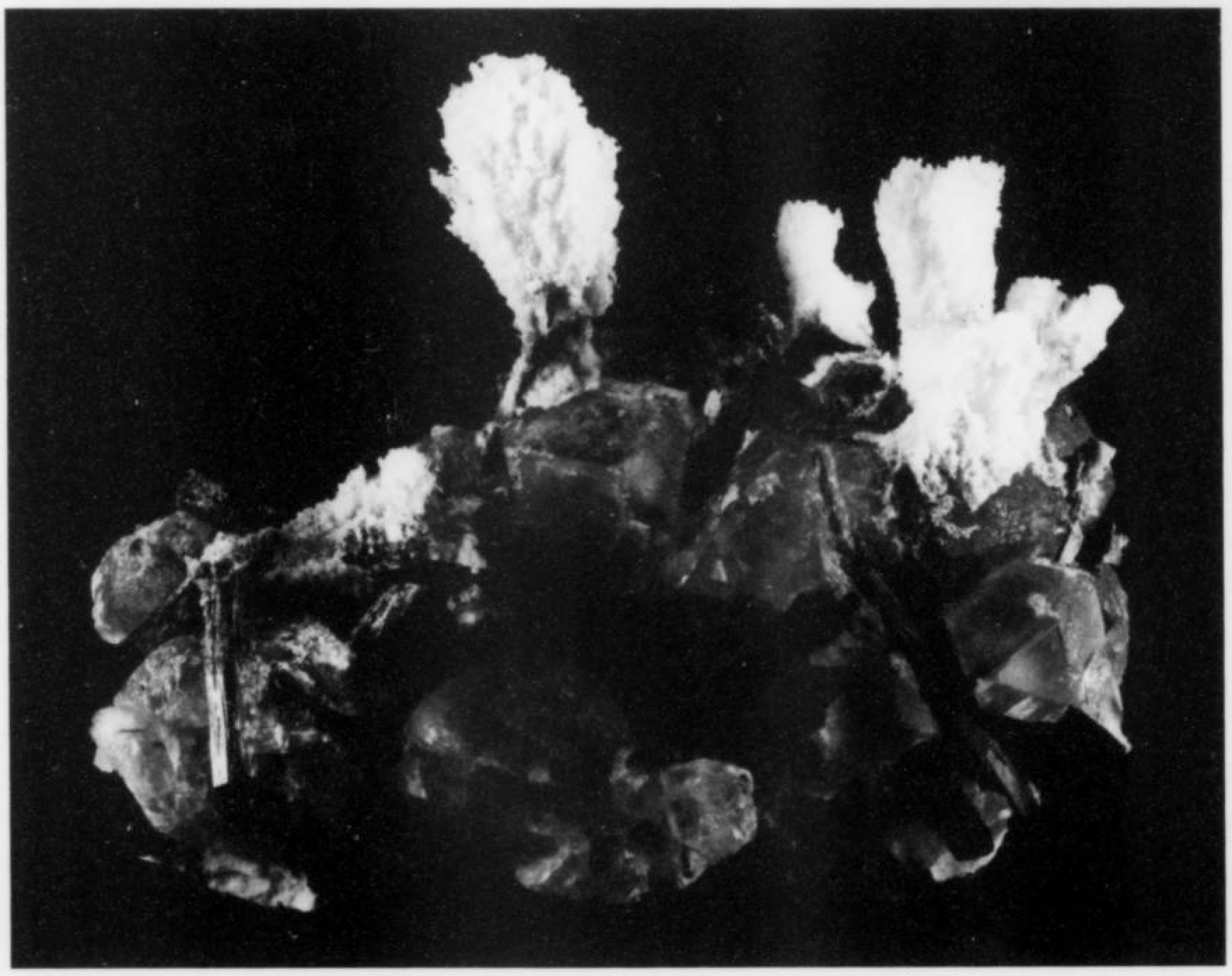
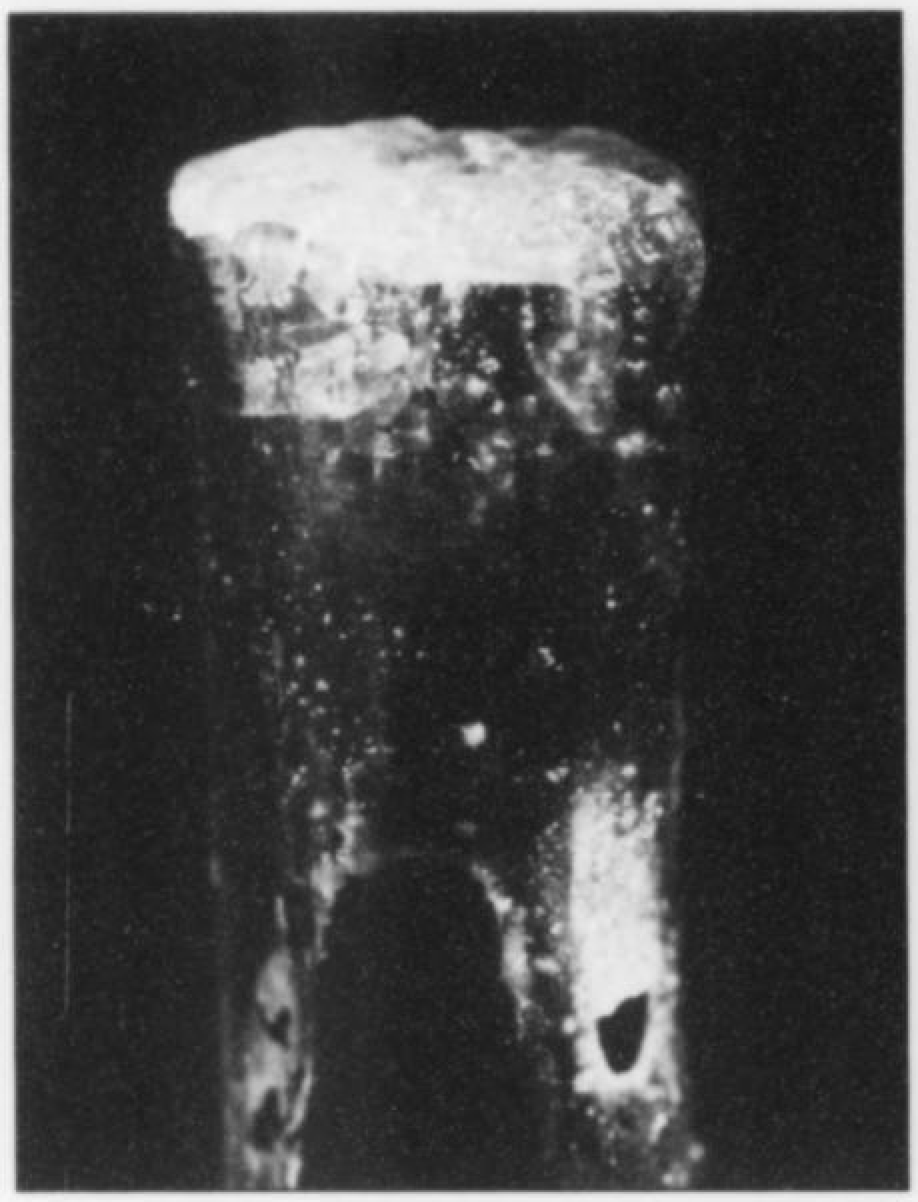


Figure 199. The same specimen as in Figure 197 under ultraviolet light.

Figure 198. Hyaline opal on fluorite and schorl, 7.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.





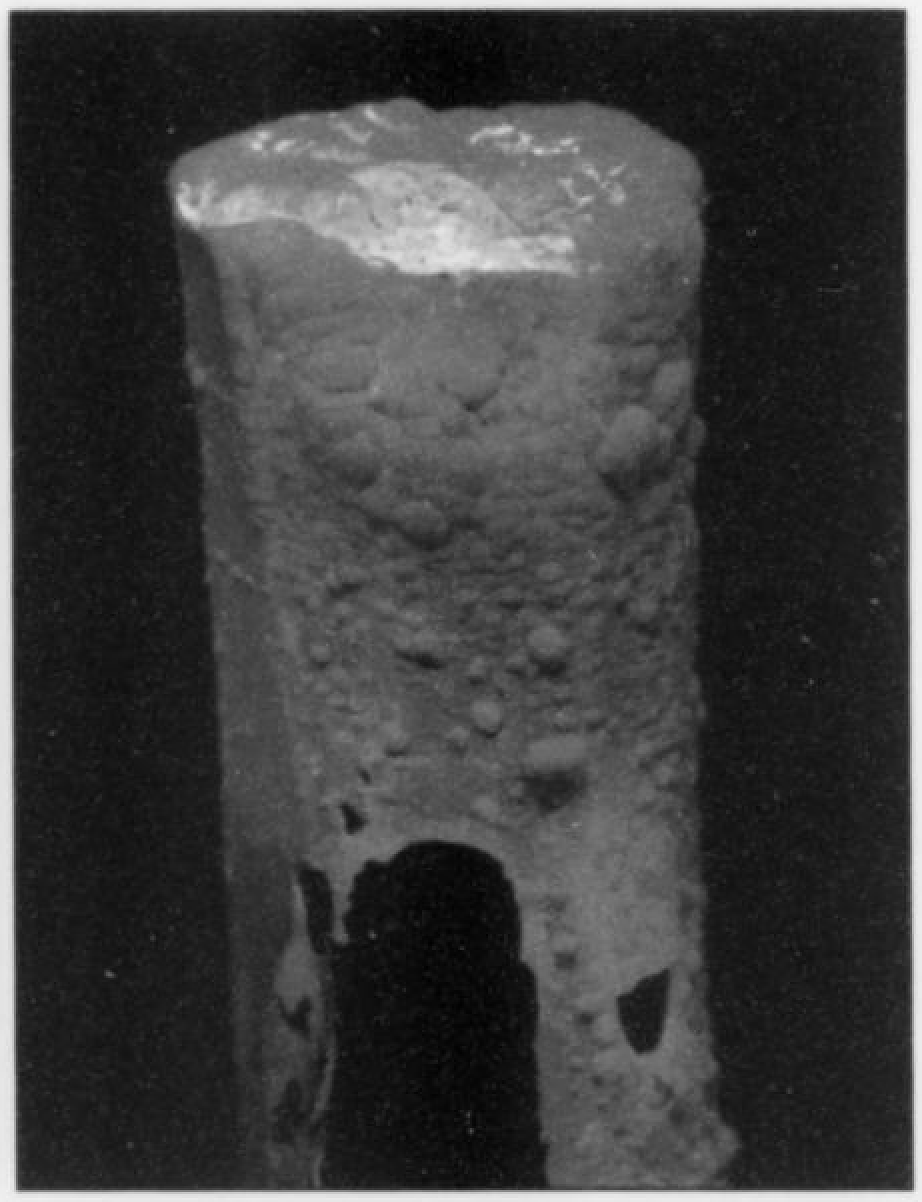


Figure 201. **The same specimen as in Figure 200 under ultraviolet light.**

Figure 200. **Glassy hyaline opal partially coating schorl, 3.3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

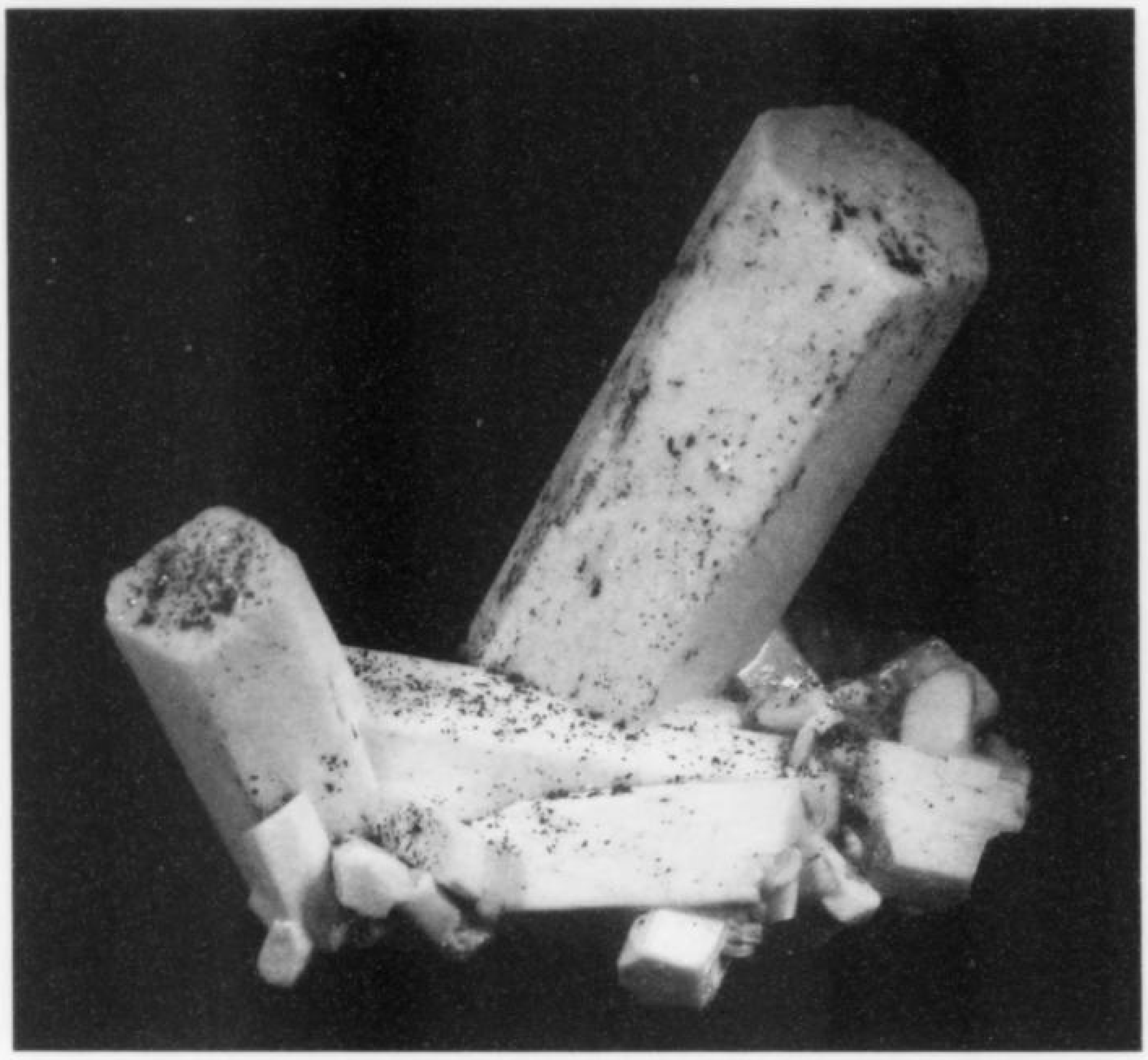


Figure 202. **Orthoclase with minor goethite staining, 4.5 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Orthoclase $KAlSi_3O_8$

Alkali feldspars are abundant in the miarolitic cavities at Erongo (Jahn and Bahmann, 2000). Orthoclase and microcline have the same chemical composition, but different crystal structures. Some microcline of the amazonite variety has been said to occur at Erongo, but the specimens most likely came from the nearby Klein Spitzkoppe, where microcline is locally abundant (Cairncross, 2004).

Most of the Erongo Mountains alkali feldspar is considered to be orthoclase. This conclusion is based partly on the abundance of excellent Baveno, Carlsbad and Manebach twins typical of orthoclase. Furthermore, thin sections were made from 15 randomly selected feldspar samples. These were microscopically examined under transmitted polarized light to determine whether any diagnostic "tartan twinning" could be observed that would be indicative of microcline rather than orthoclase, and no such twinning was found. The twinning of the Erongo orthoclase is very diagnostic and spectacular. Combinations of contact (Baveno) and penetration (Carlsbad) twins are pervasive, and multiple and complex twins are common.

Orthoclase usually forms the matrix for later-stage aquamarine, and the combination of perfectly twinned feldspar with blue-green aquamarine produces beautiful and unusual specimens (bright green fluorite perched on white orthoclase is equally appealing.) In some cases the aquamarine is aligned parallel to the orthoclase twin planes, particularly for the Carlsbad twins.

The state of alteration of orthoclase in Erongo specimens is variable. Fresh, unaltered crystals with smooth faces rarely occur. Most specimens show orthoclase crystals with etched, corroded faces, while extreme alteration and replacement of orthoclase is evident in other specimens showing epimorphic molds, some partially or wholly replaced by secondary minerals such as quartz (see pseudomorphs).

Figure 203. **Baveno-law twinned orthoclase, 8.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

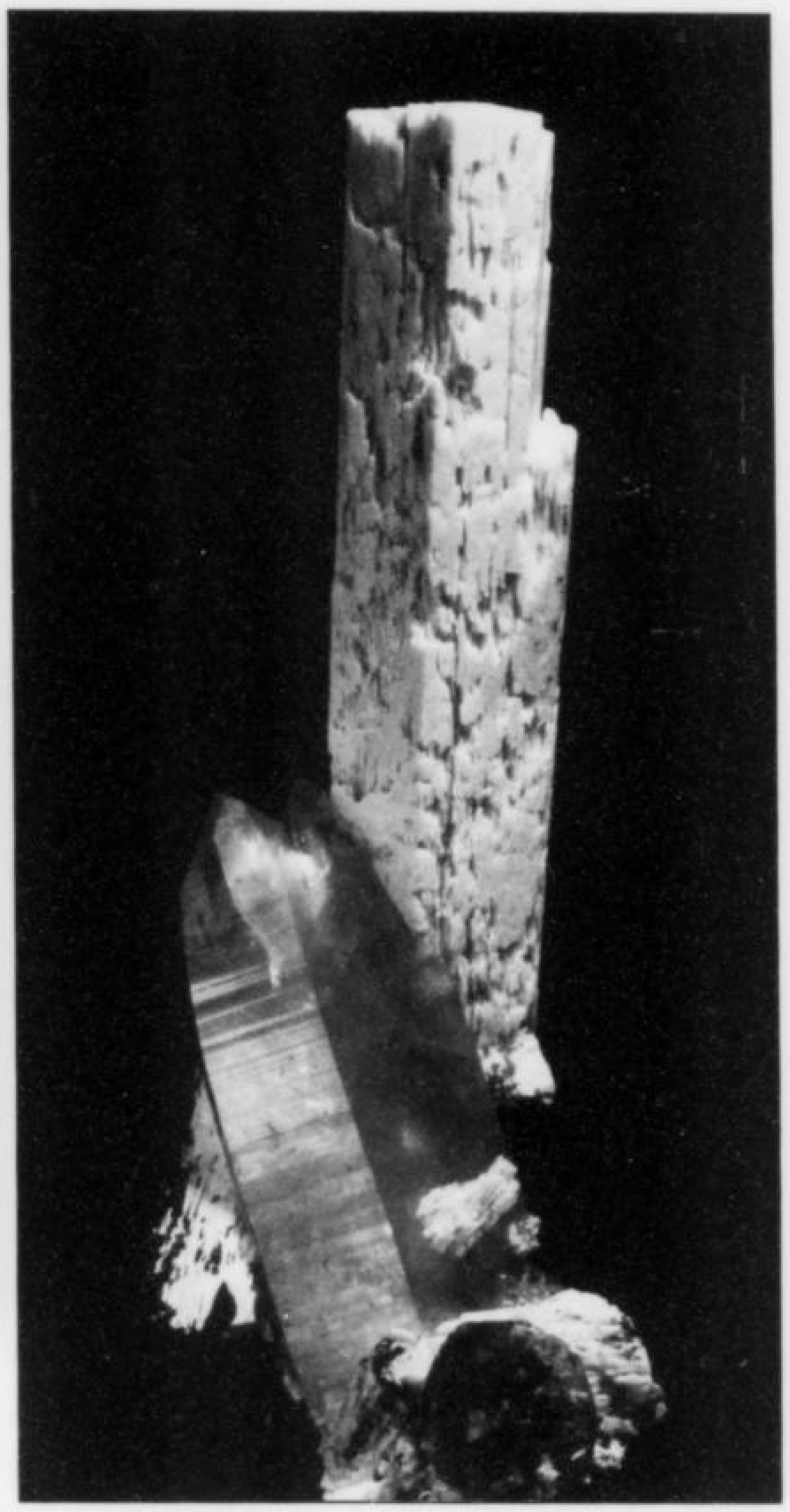


Figure 206. **Partially etched orthoclase crystal, 16.8 cm, associated with quartz and fluorite. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

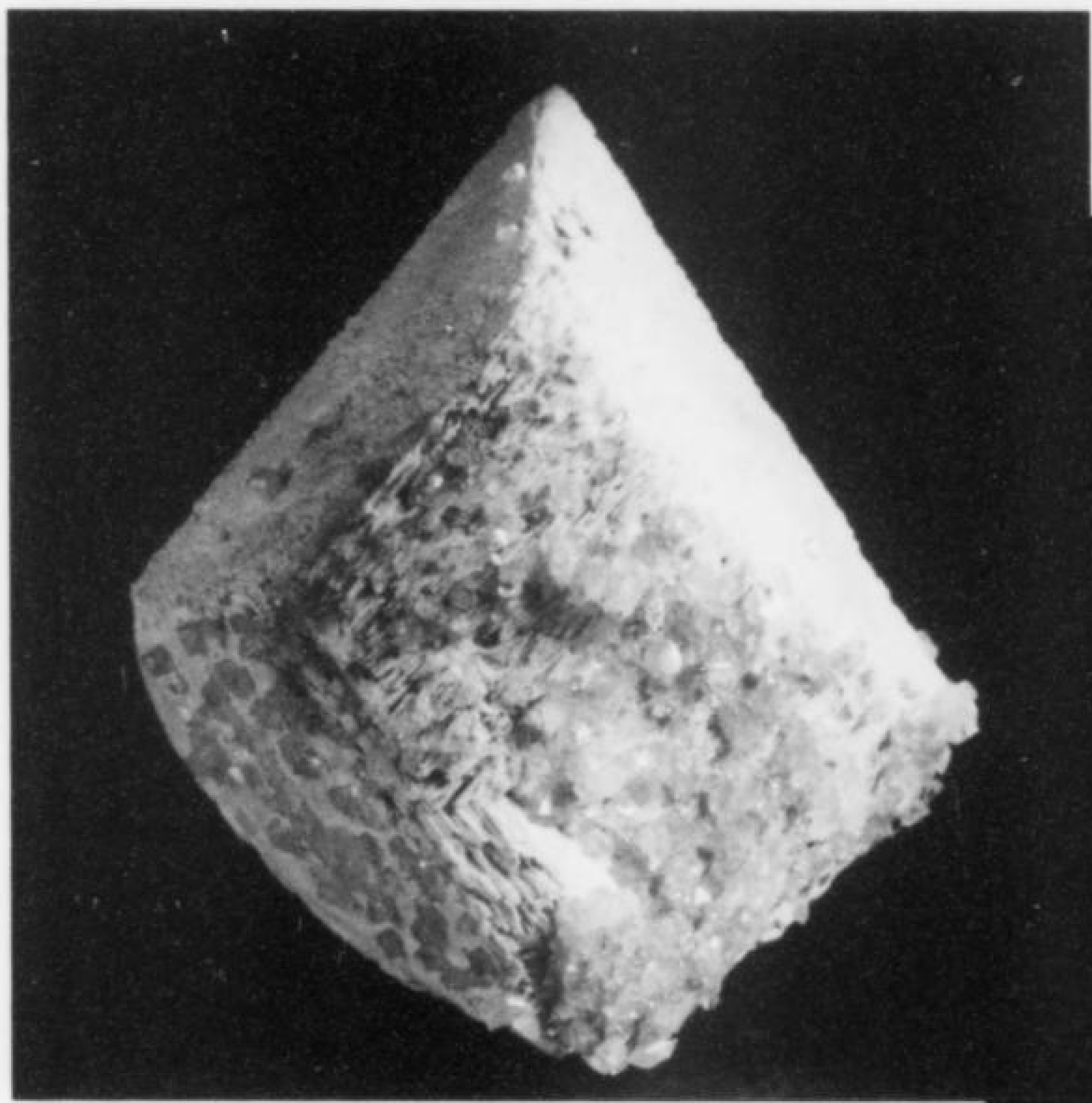


Figure 204. **Twinned orthoclase studded with small topaz crystals, 6.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

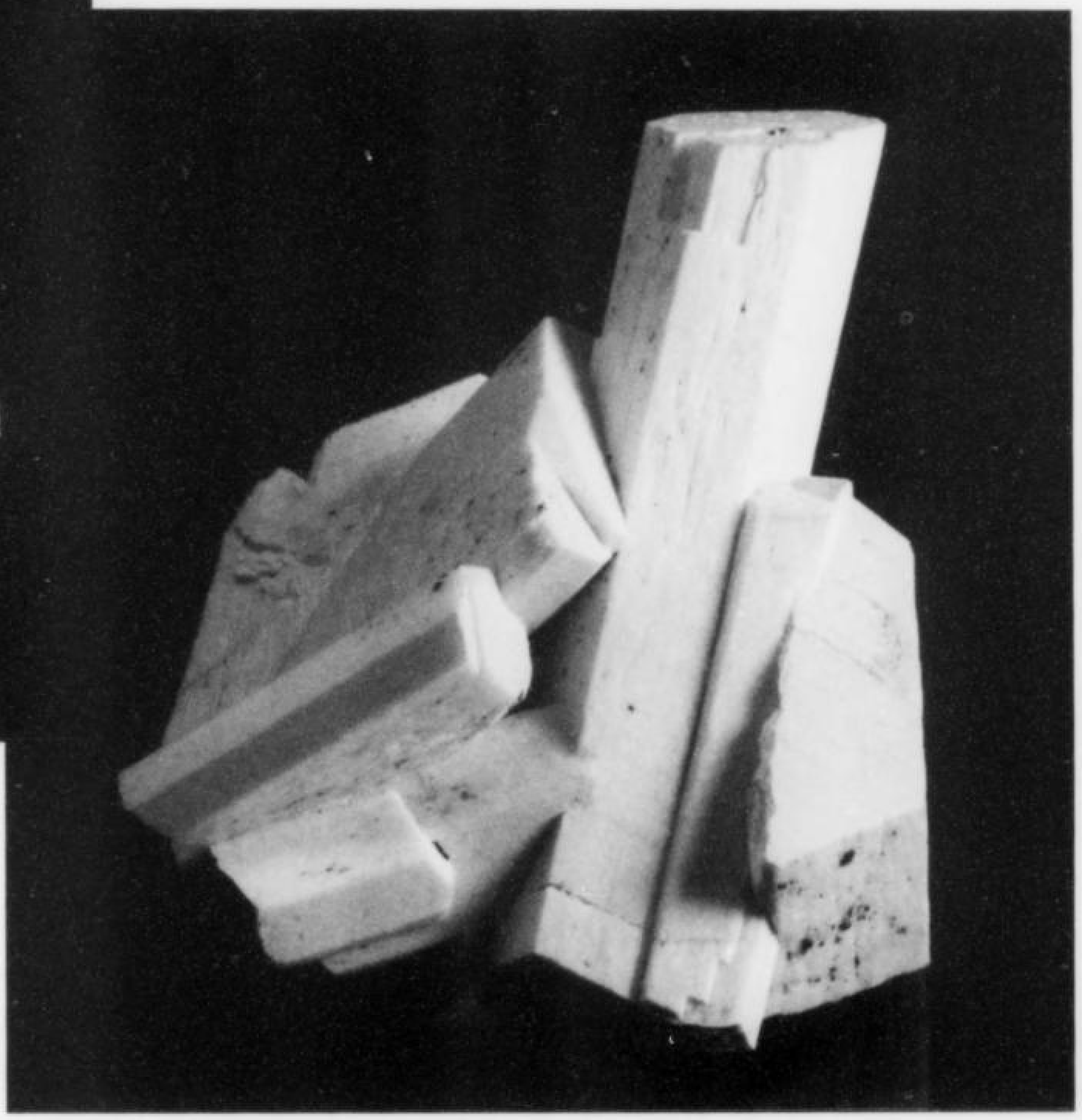


Figure 205. **Cluster of twinned orthoclase crystals, 6.7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

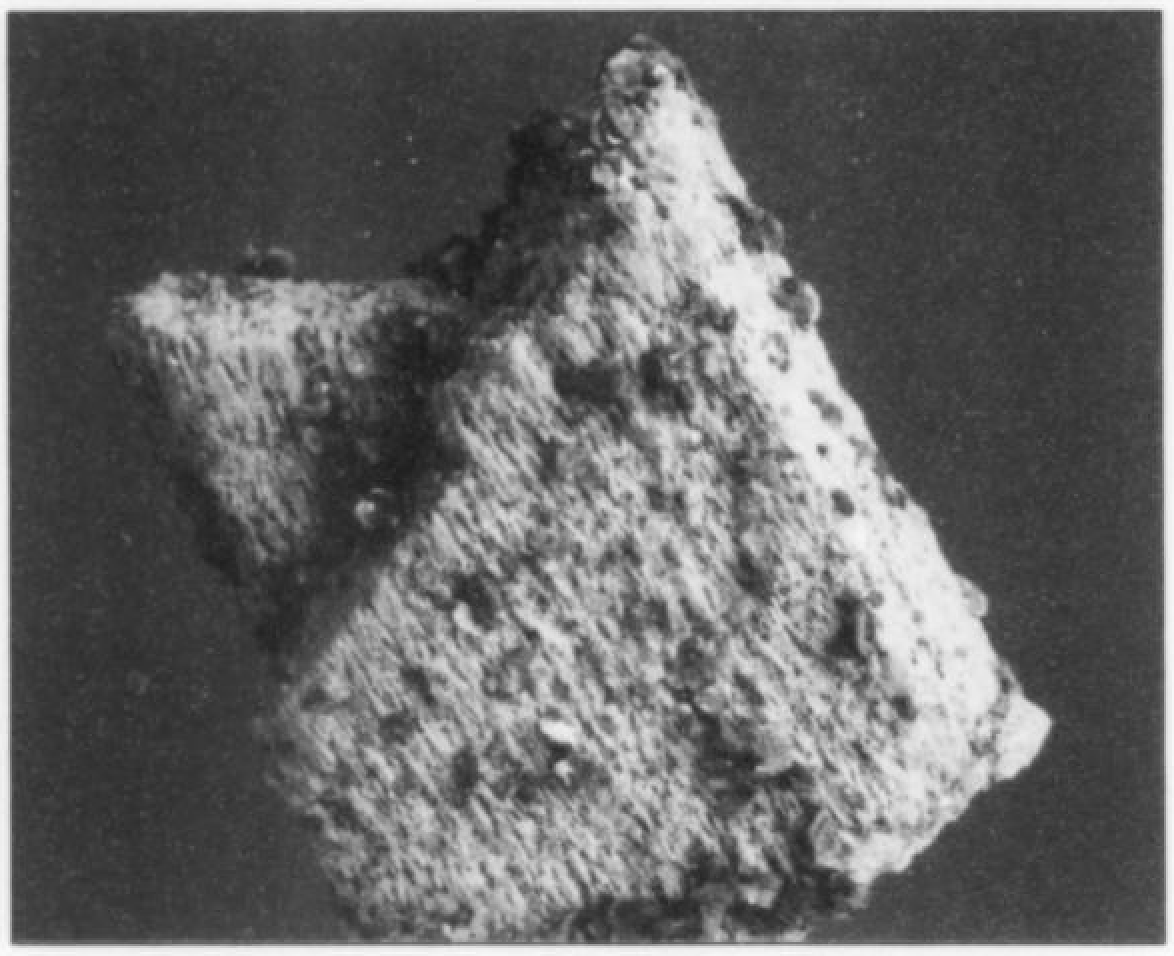


Figure 207. **Carlsbad-law twinned orthoclase, 6 cm, with muscovite. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

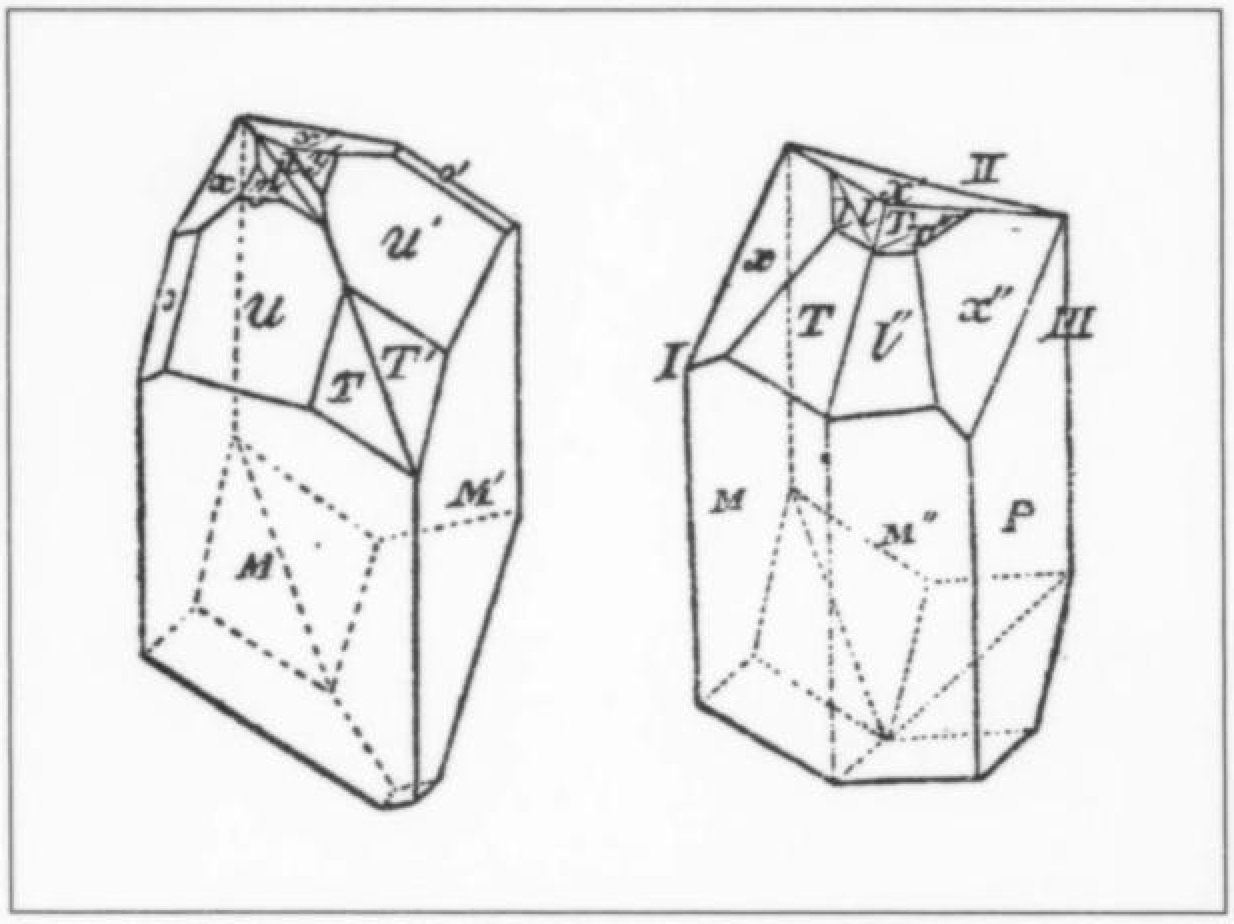


Figure 211. **Crystal drawings of orthoclase (locality unspecified) showing twin habit like that of Erongo orthoclase (Goldschmidt, 1920).**

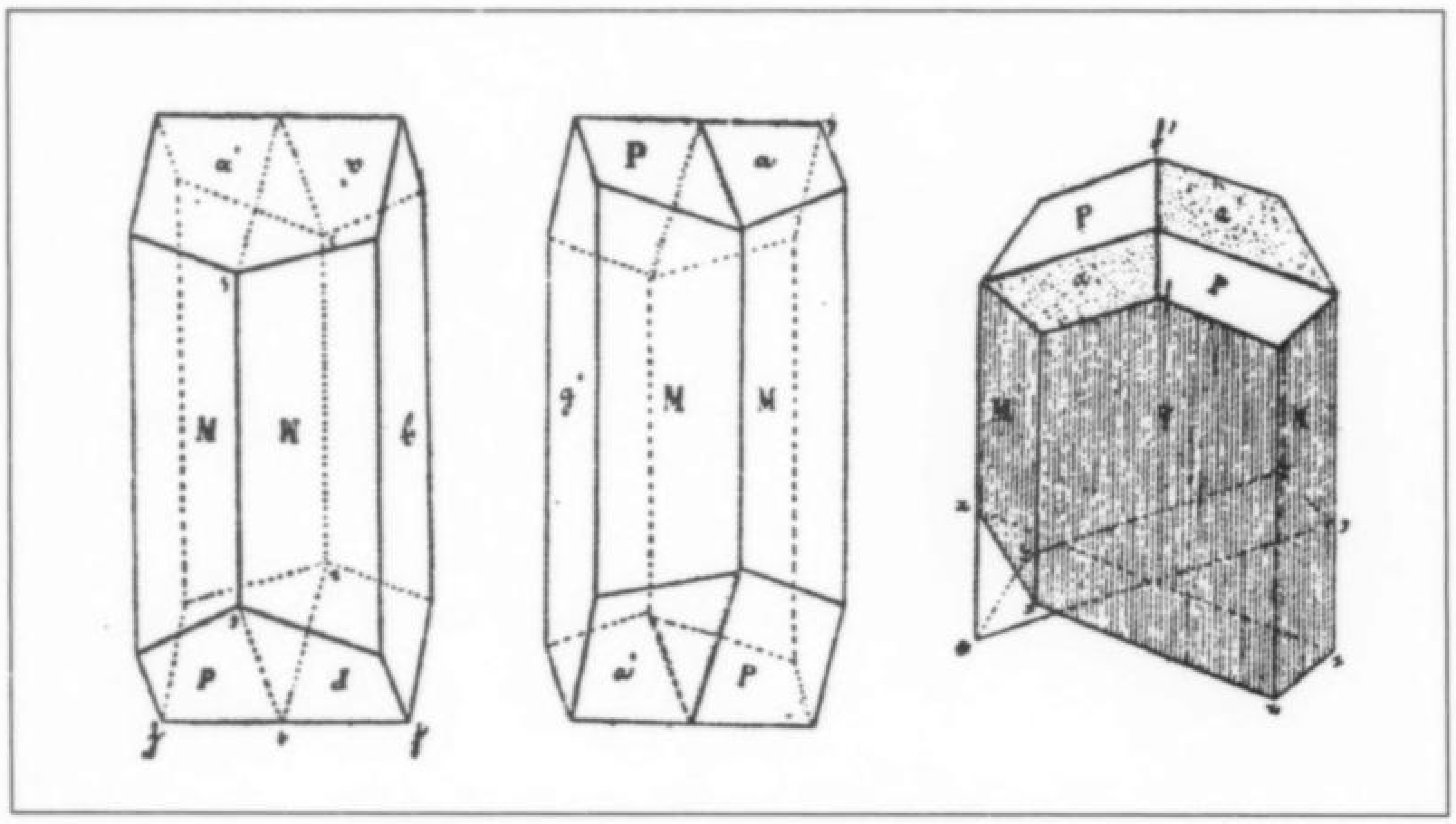


Figure 208. **Crystal drawings of orthoclase from Baveno, Italy showing twin habit like that of Erongo orthoclase (Goldschmidt, 1920).**

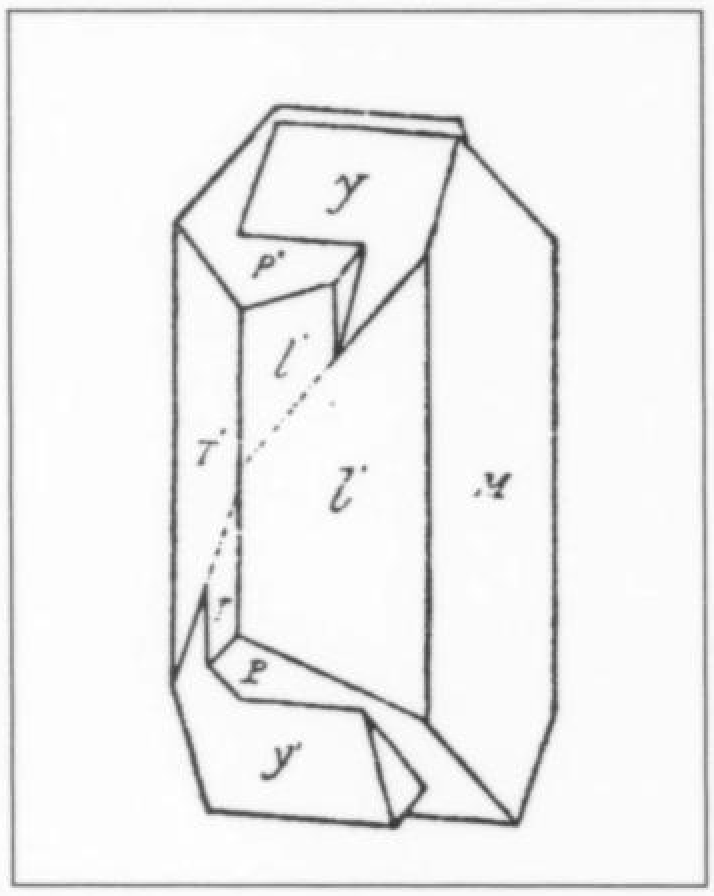


Figure 212. **Crystal drawing of orthoclase from Elbogen, Bohemia showing twin habit like that of Erongo orthoclase (Goldschmidt, 1920).**

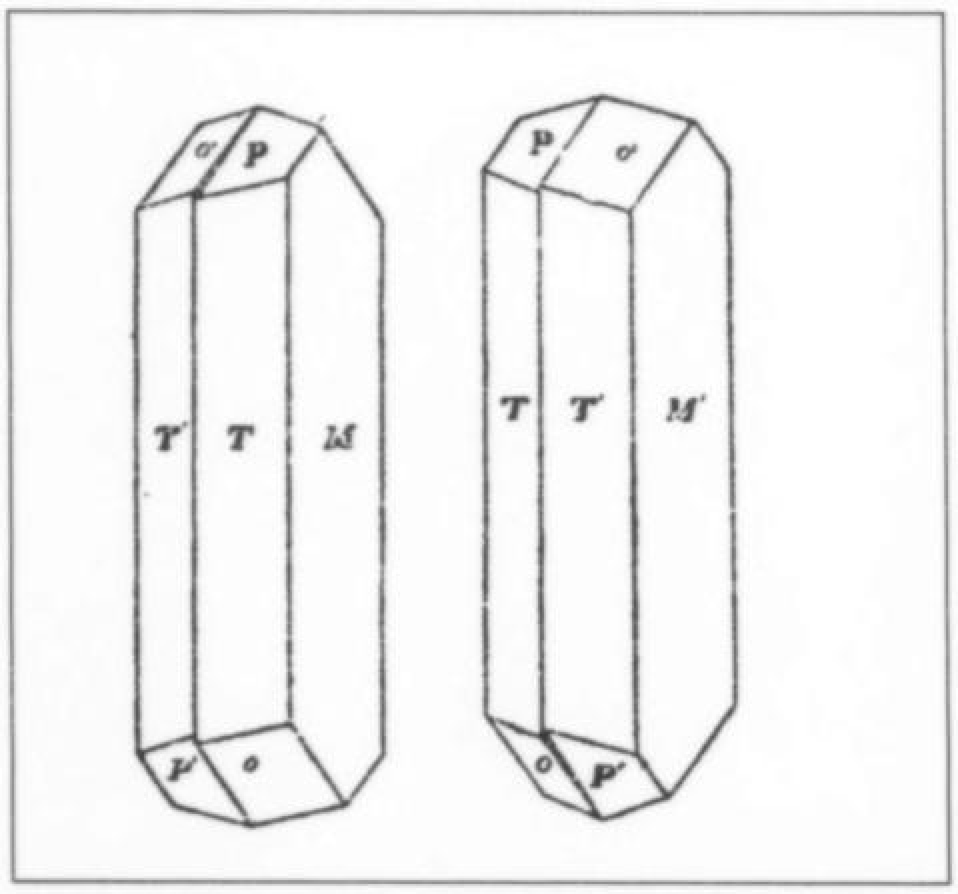


Figure 209. **Crystal drawings of orthoclase from Mount Vesuvius showing a twin habit like that of Erongo orthoclase (Goldschmidt, 1920).**

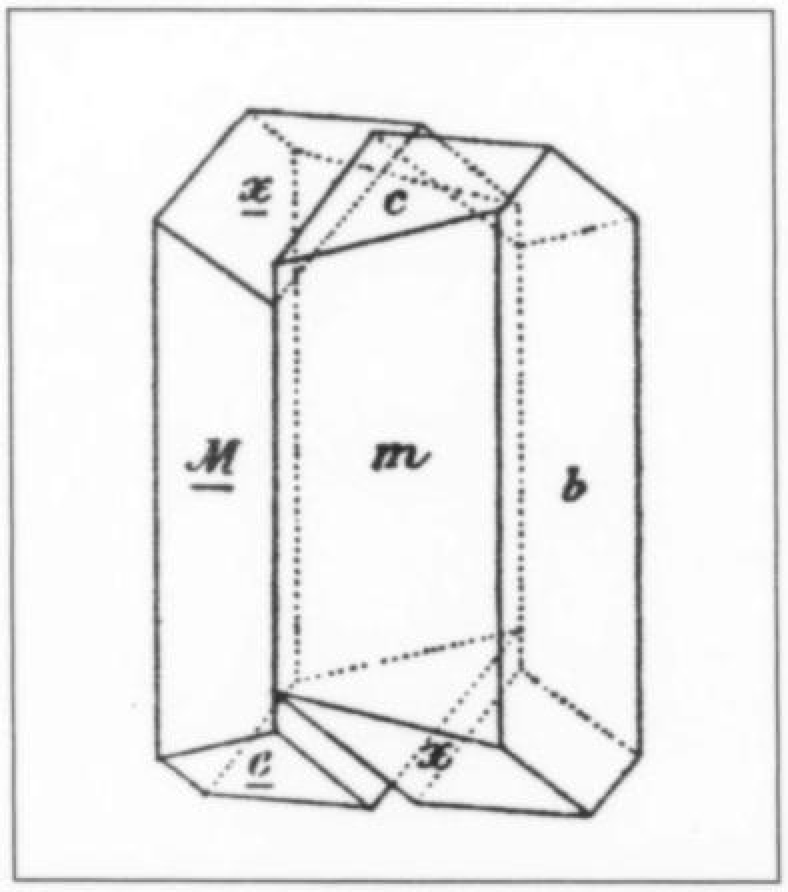


Figure 210. **Orthoclase from Ivigtut, Greenland showing twin habit like that of Erongo orthoclase (Goldschmidt, 1920).**

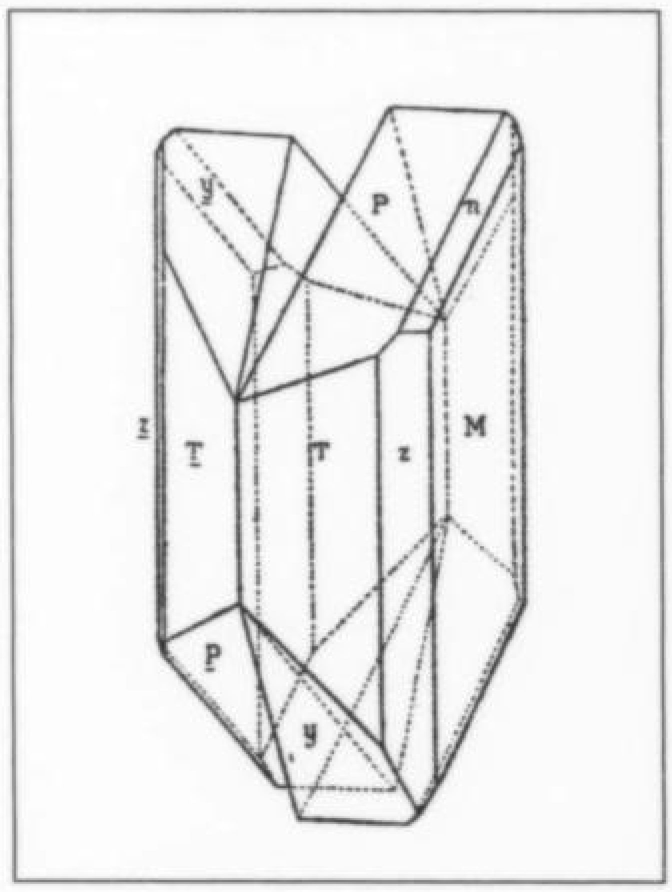


Figure 213. **Orthoclase from Neubau, Fichtelgebirge, Germany showing twin habit like that of Erongo orthoclase (Goldschmidt, 1920).**

In early 2006, twinned orthoclase was collected from one cavity. The crystals are relatively unaltered, with smooth white faces and minor goethite staining. They occur either as single crystals to 20 cm or in composite groups. Most are highly elongated parallel to the *c* axis.

Phlogopite $KMg_3Si_3AlO_{10}(F,OH)_2$

Phlogopite occurs as a minor species (von Bezing, 2006).

Prehnite $Ca_2Al_2Si_3O_{10}(OH)_2$

Prehnite occurs intergrown with clinozoisite in the calcsilicate-marble andradite locality at Tubussis 22 (Niedermayr, 2000).

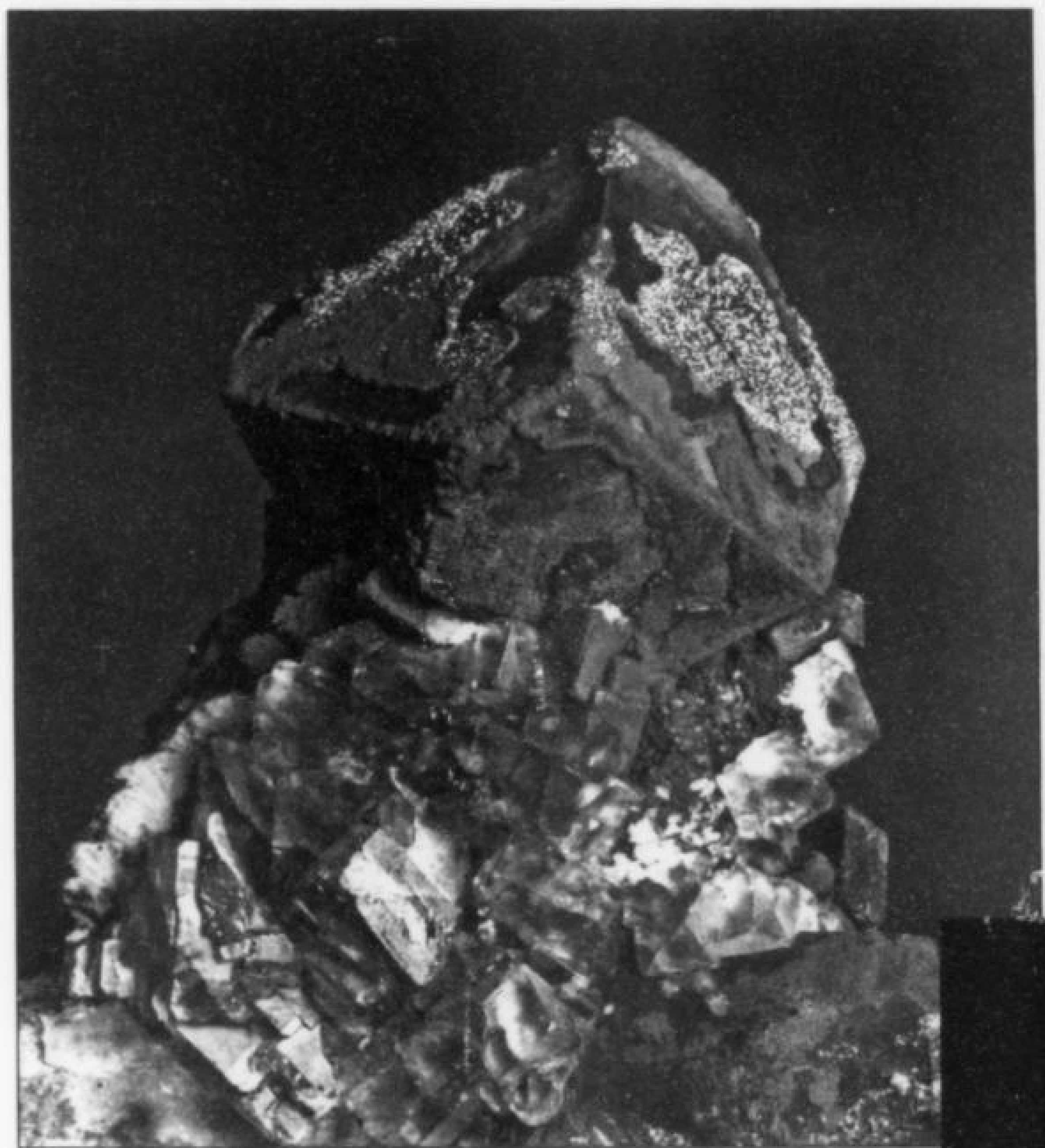


Figure 214. **Silvery pyrolusite crystals on goethite pseudomorph after siderite with fluorite, on quartz, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 216. **Black smoky quartz crystal on schorl, 9.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

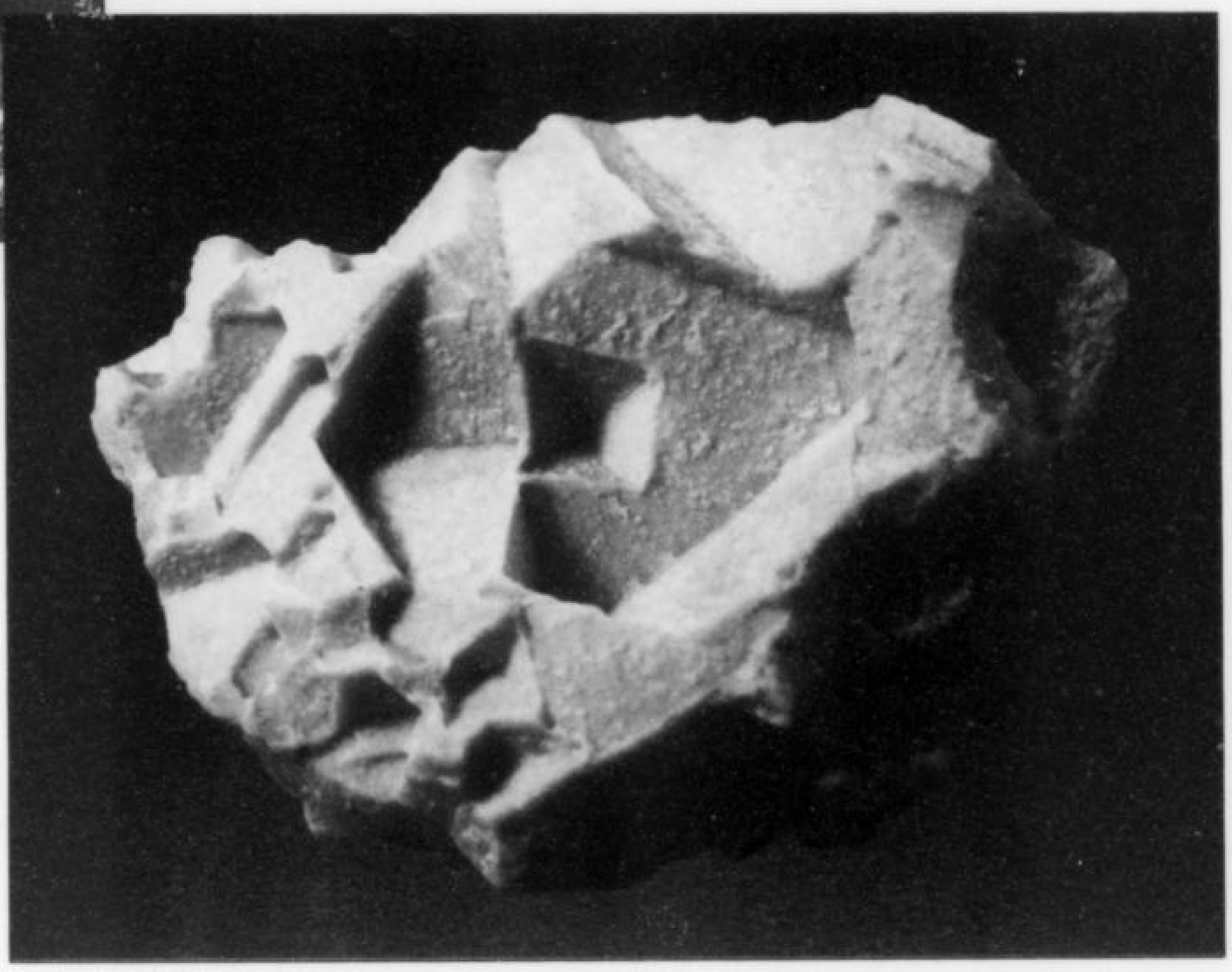


Figure 215. **Drusy quartz mold over fluorite, 4.2 cm. Bruce Cairncross collection and photo.**

Pyrolusite $Mn^{4+}O_2$

Small, lustrous, silvery-metallic, spindle-shaped pyrolusite crystals occur associated with goethite pseudomorphs after siderite(?). Some similar-looking crystals have been identified as ilmenorutile (Gebhard, 2002).

Quartz SiO_2

Several types of quartz exist in the miarolitic cavities, including transparent crystals, smoky quartz, milky quartz and amethystine quartz, some with inclusions. The largest quartz crystals reach 50 cm.

In August 2003, a pocket yielded epimorphs of quartz after elongated orthoclase crystals. The quartz forming the epimorphic shell is aligned parallel to the cleavage of the feldspar. Some specimens still have vestiges of the feldspar while in others the feldspar is completely gone, leaving only a hollow shell composed of an interlocking network of quartz crystal domains. The quartz is commonly coated and included by chlorite. The quartz mold can superficially resemble Japan-law twins, but in fact the intercrystal angle is an artifact inherited by the quartz crystallizing in a preferential orientation and alignment along the orthoclase struc-

Figure 217. Quartz, 4.6 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 219. (right) Agate, 9.7 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 218. Smoky quartz, 10.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

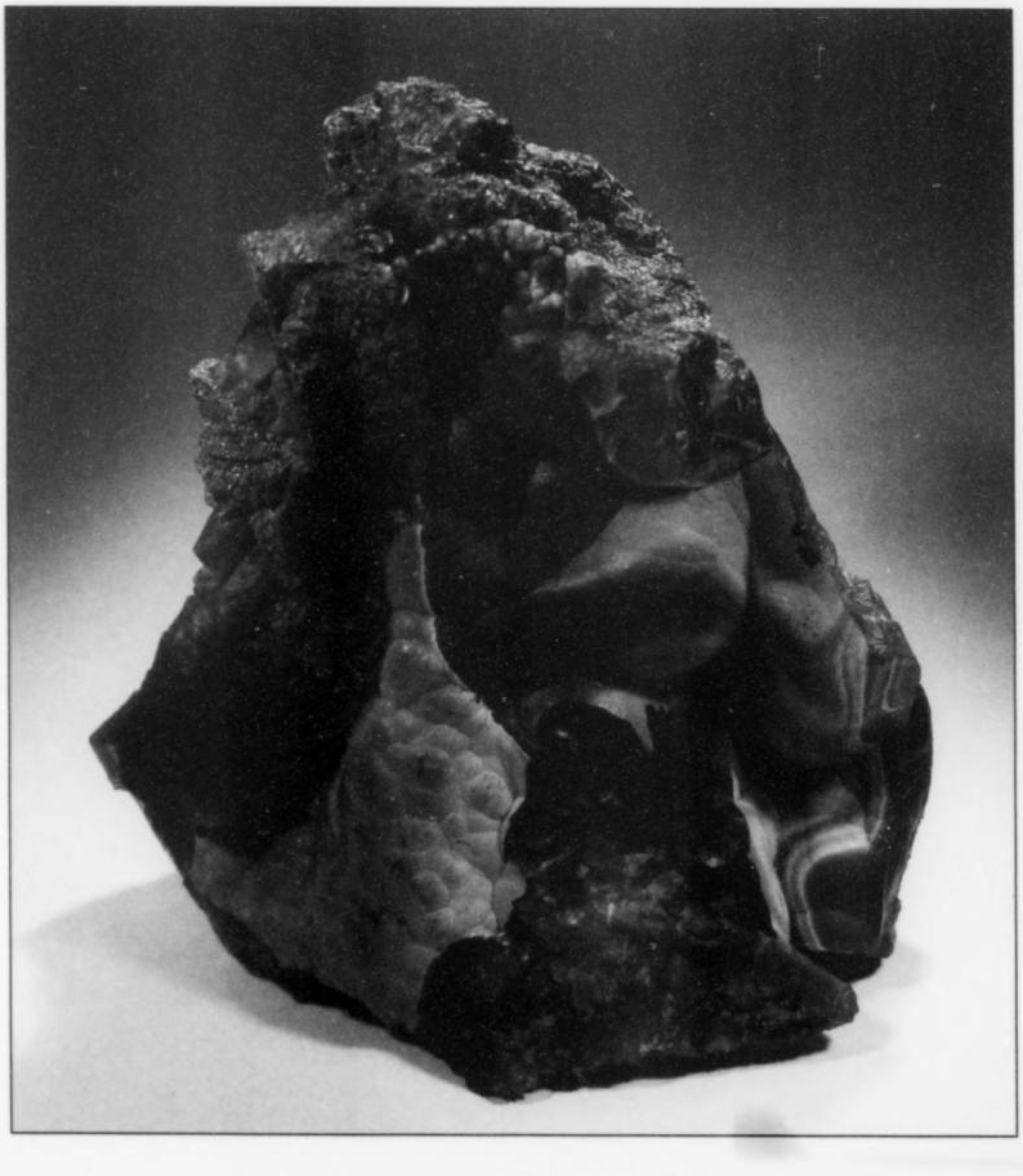


Figure 220. **Doubly terminated quartz with minor schorl, 9.3 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

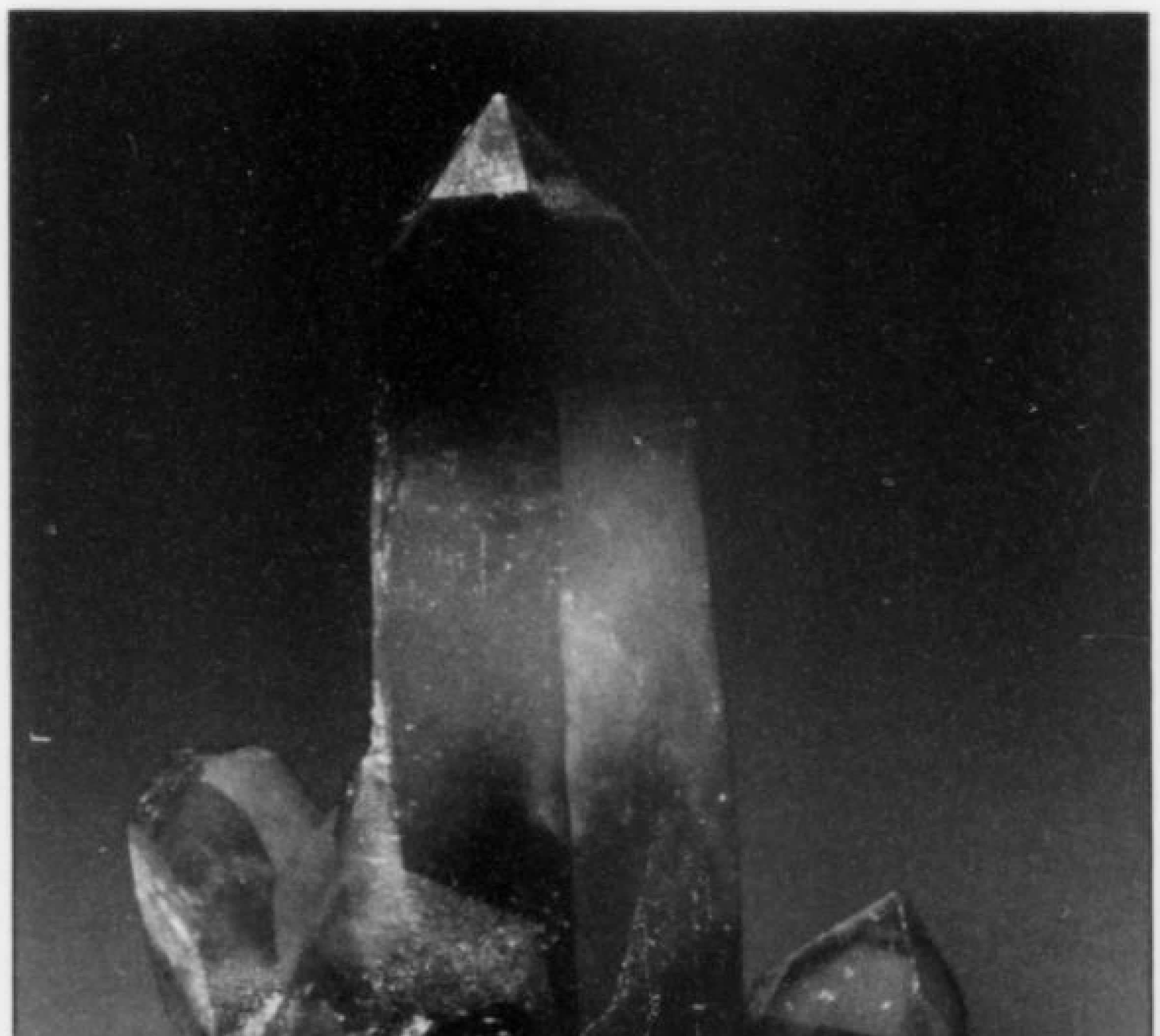


Figure 221. **Quartz with black smoky terminations, 8.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

ture. However, some rare Japan-law twins have been collected. These are typically small, flattened, transparent crystals.

Amethystine quartz is not common. The sceptered terminations of a few dozen specimens collected from a single pocket in November 1999 have partly amethystine tips, and are also stained red by hematite. One specimen is matte black throughout. These are the best Erongo specimens of sceptered quartz known to date; the largest crystal measures 20 cm.

A few rare quartz specimens display the "artichoke" habit (White, 2004). These were collected at Tubussis 22, associated with pale green fluorite. Colorless, transparent, highly lustrous quartz crystals to 2 cm were collected in 2004. These are perched on and intergrown with brilliant black acicular schorl in composite specimens to 15 cm. Quartz containing inclusions of acicular schorl is relatively common; some quartz crystals are blackened by these inclusions.

In April-May 2006 another pocket of "artichoke" quartz was unearthed. The specimens consist of transparent quartz coated by a layer of opaque milky quartz with amethystine terminations. The largest specimen measures approximately 40 × 40 cm. Some sceptered quartz crystals associated with schorl were also collected.

Chalcedonic quartz is rare, and only a few aesthetic specimens are known from the Erongo pockets. Like hyaline opal, the

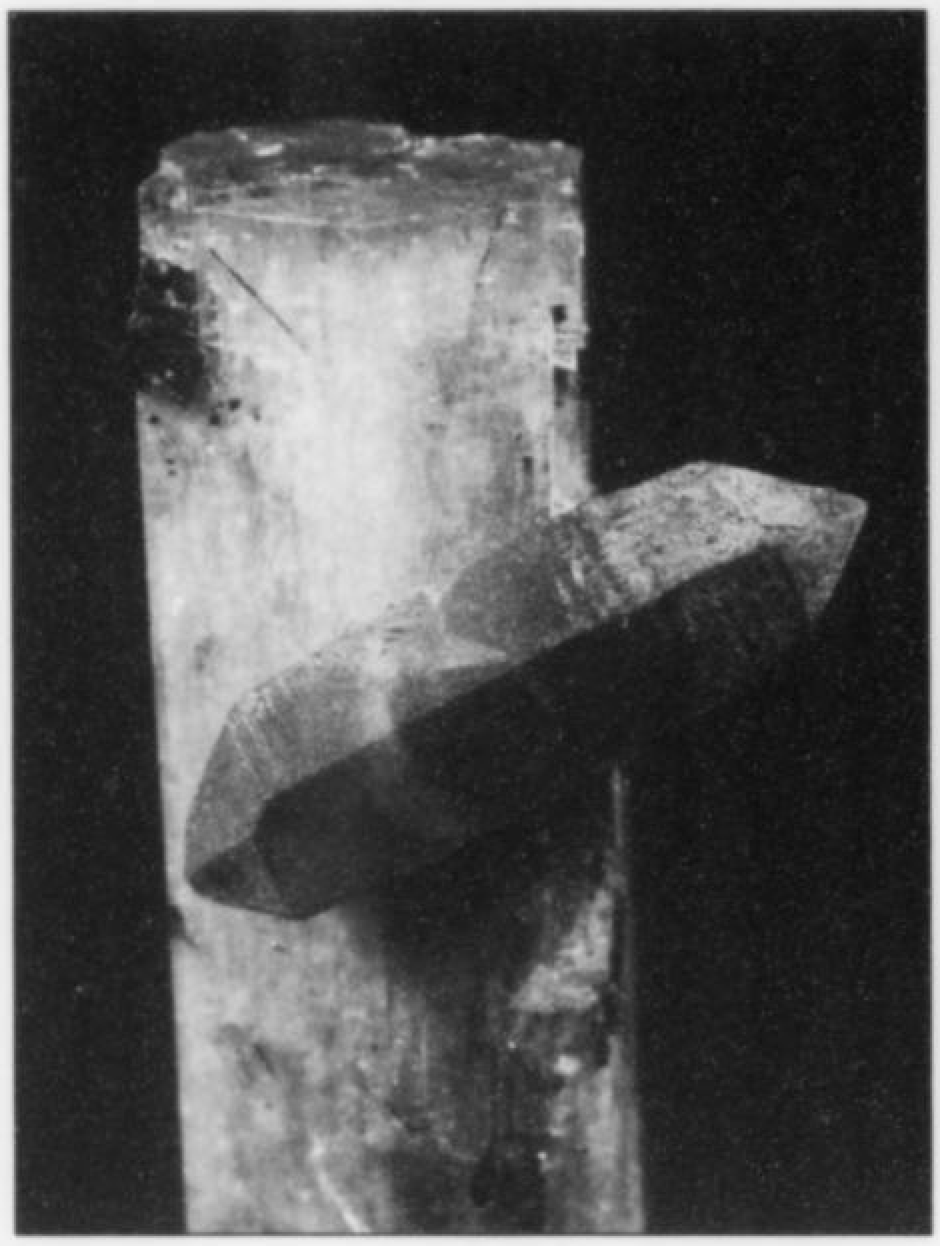


Figure 222. Doubly terminated quartz attached to aquamarine with minor schorl, 4.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

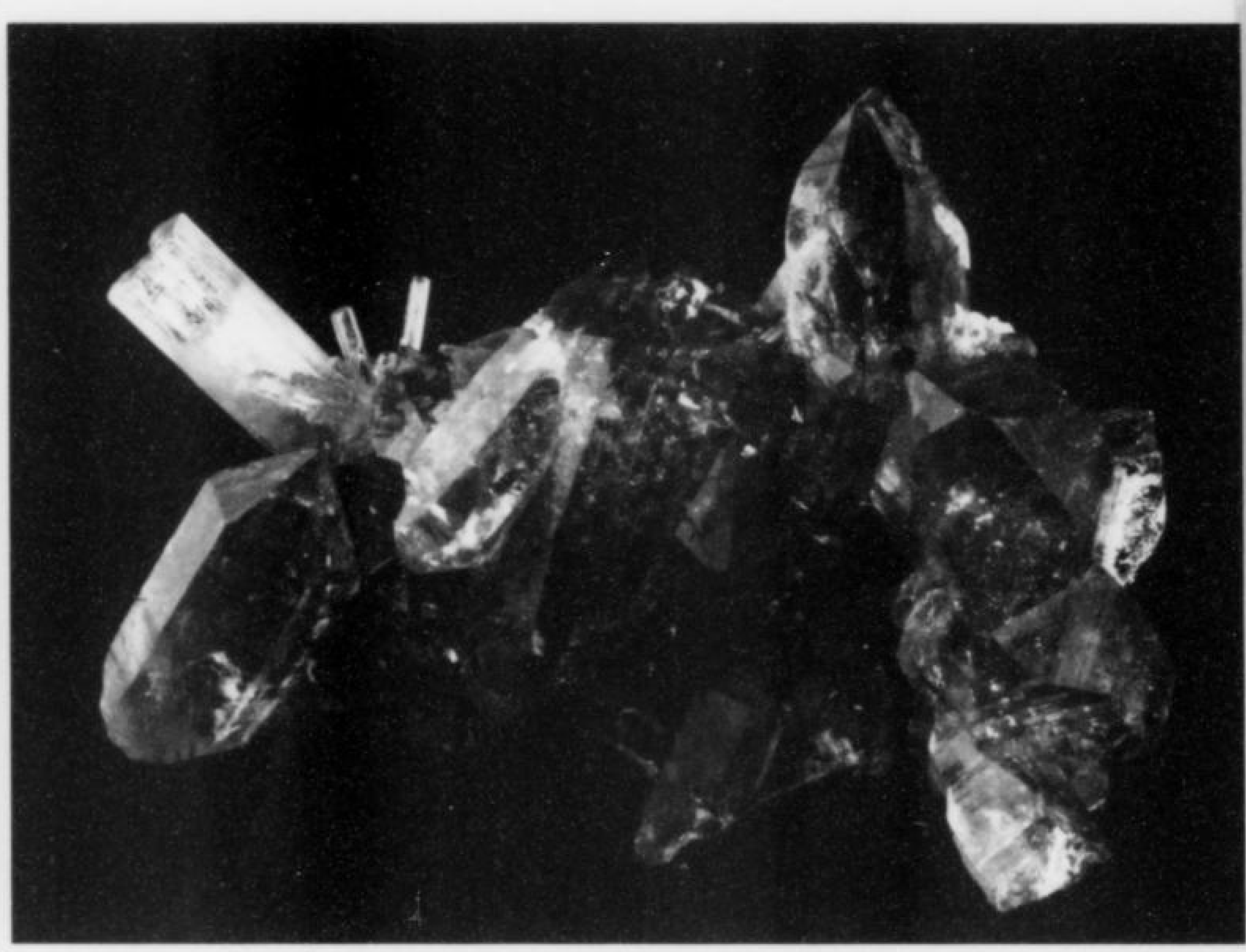
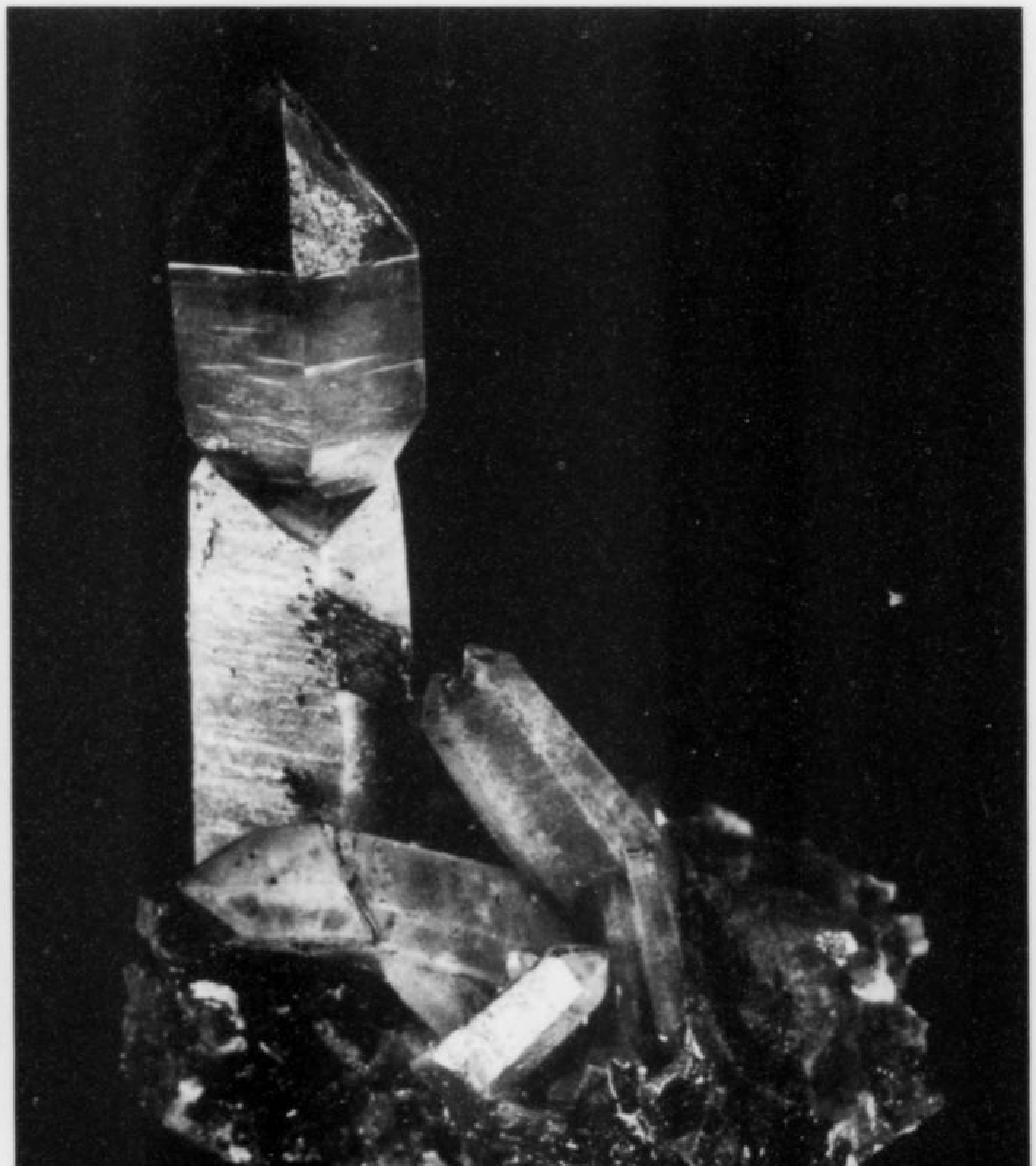
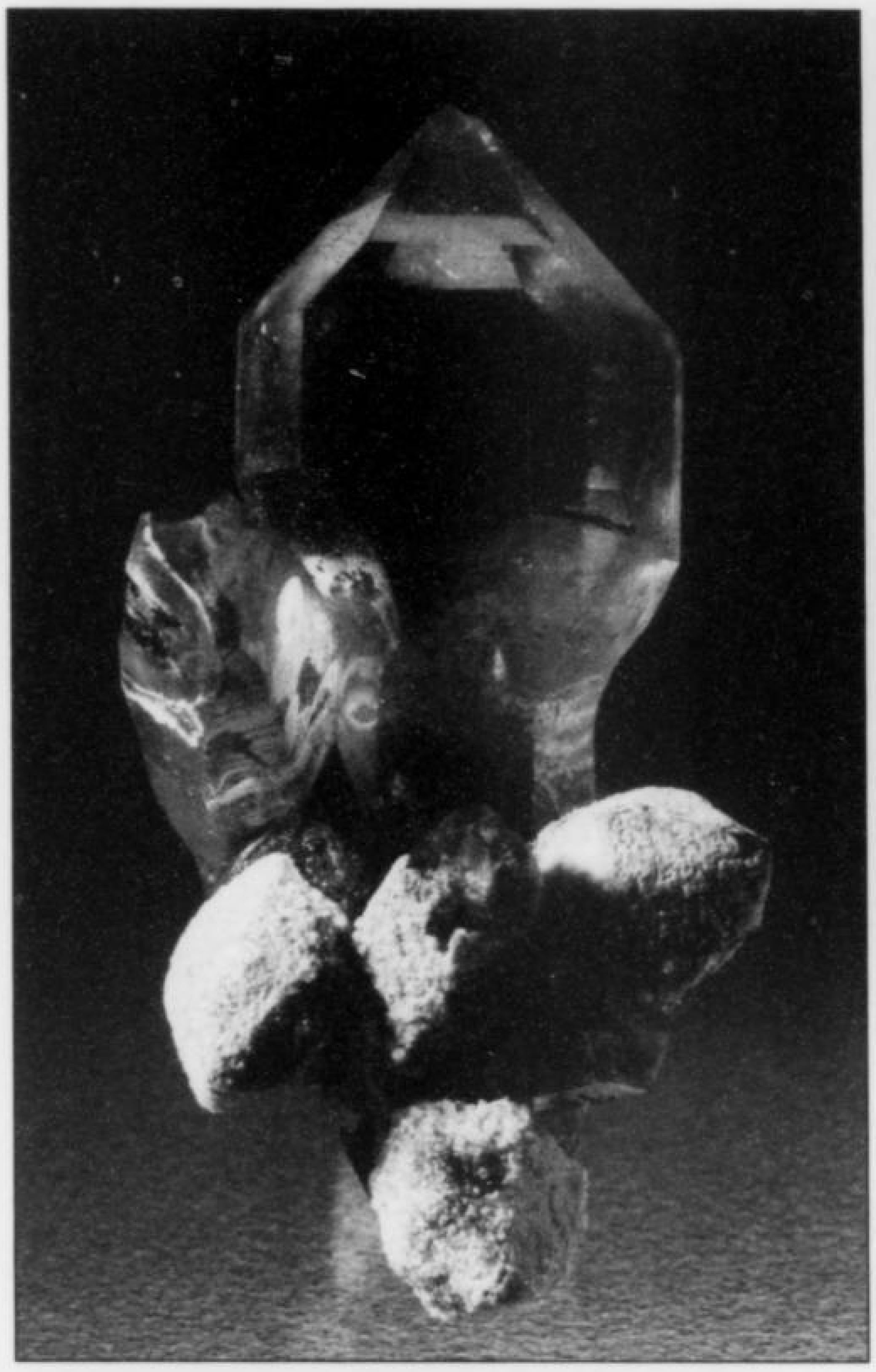


Figure 224. Glassy smoky-citrine quartz with aquamarine, 6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 223. Two doubly terminated quartz crystals attached at right angles to one another, 17.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 225. Doubly terminated quartz scepter with minor schorl, 5.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.





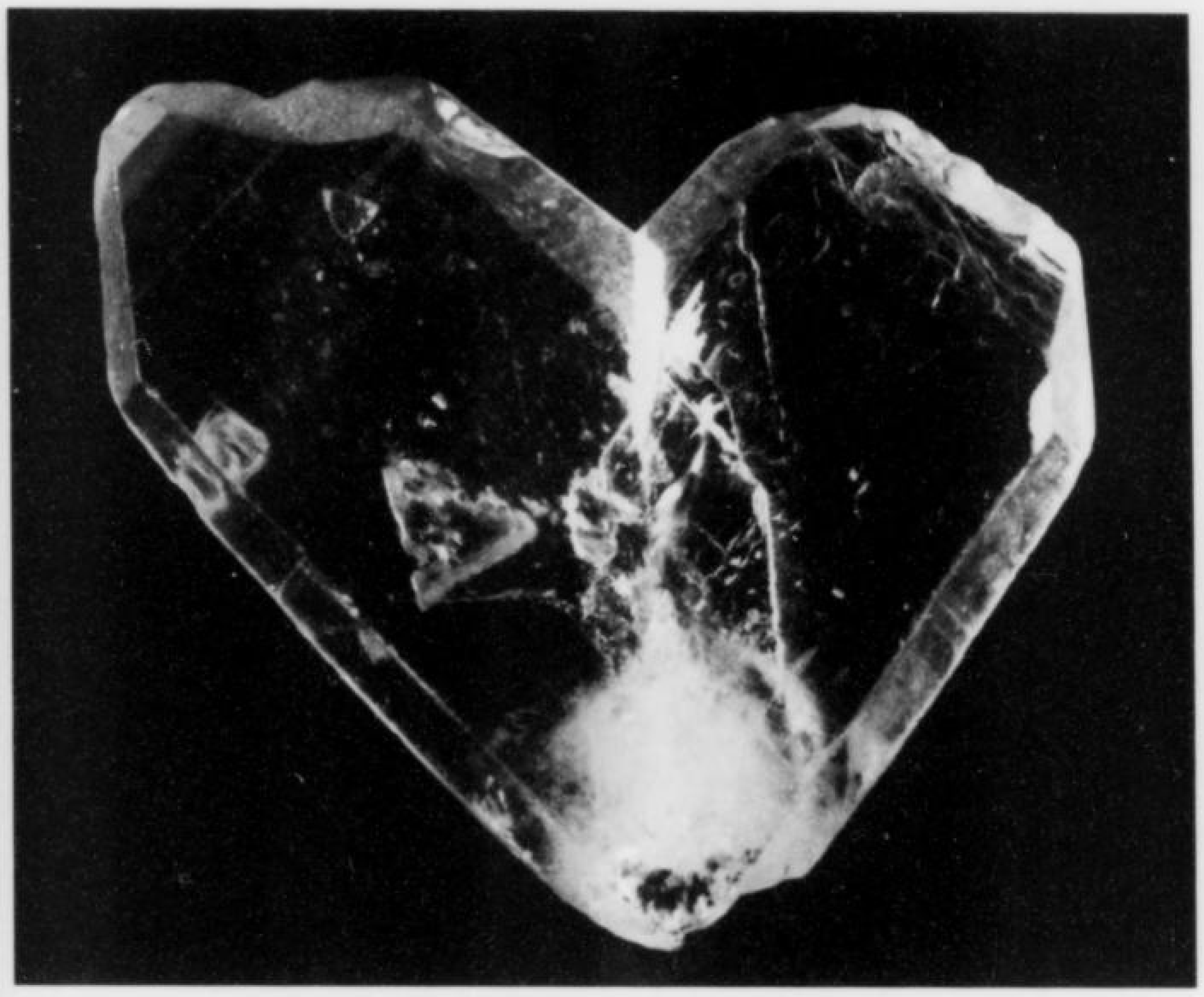


Figure 228. **Japan-law twinned quartz, 1.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 226. **Quartz scepter on opal-coated quartz, 4.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 229. **Quartz with schorl inclusions; the front crystal is 15.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 227. **Cluster of quartz crystals, 5.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

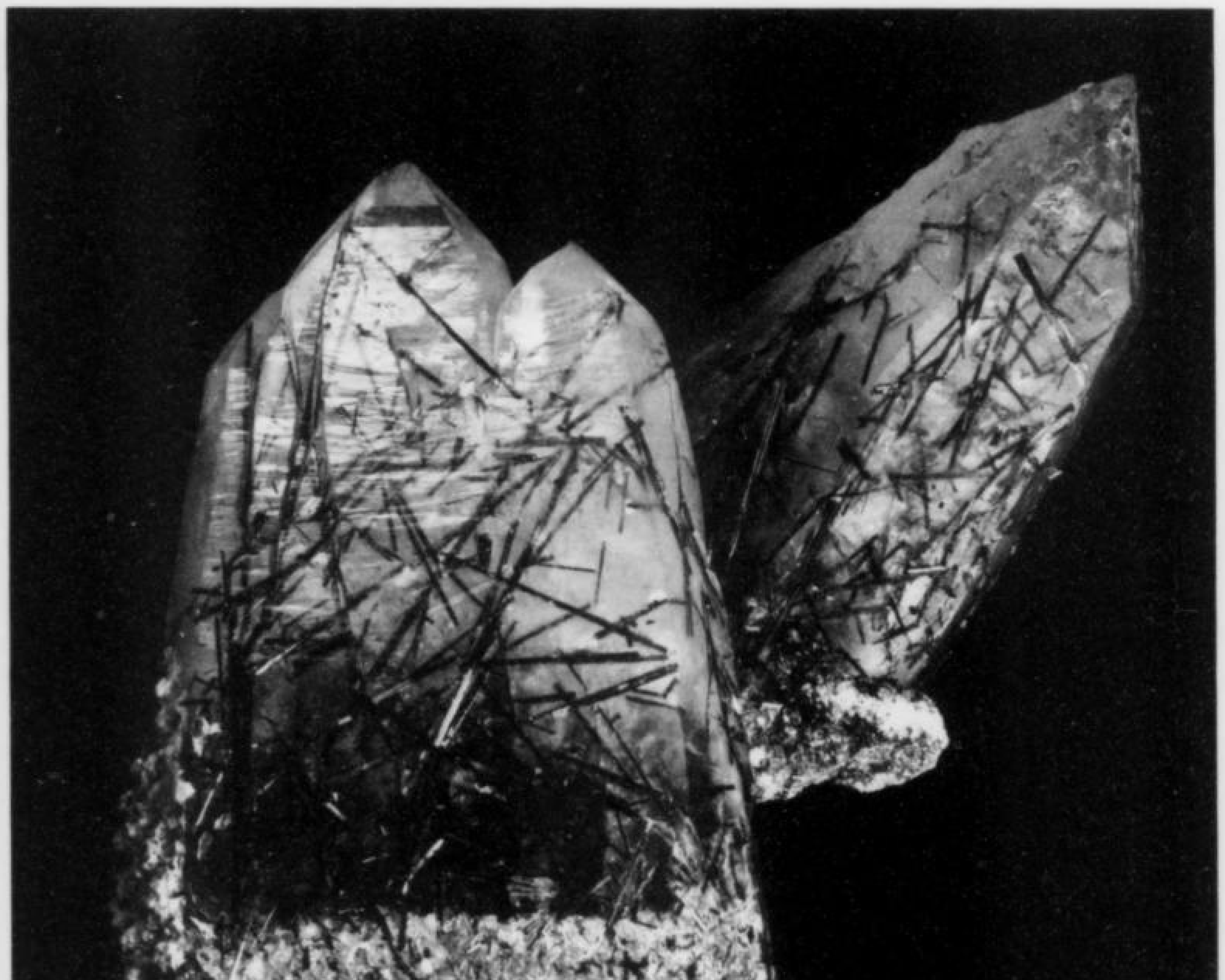


Figure 230. **Amethyst sceptered quartz, 2.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

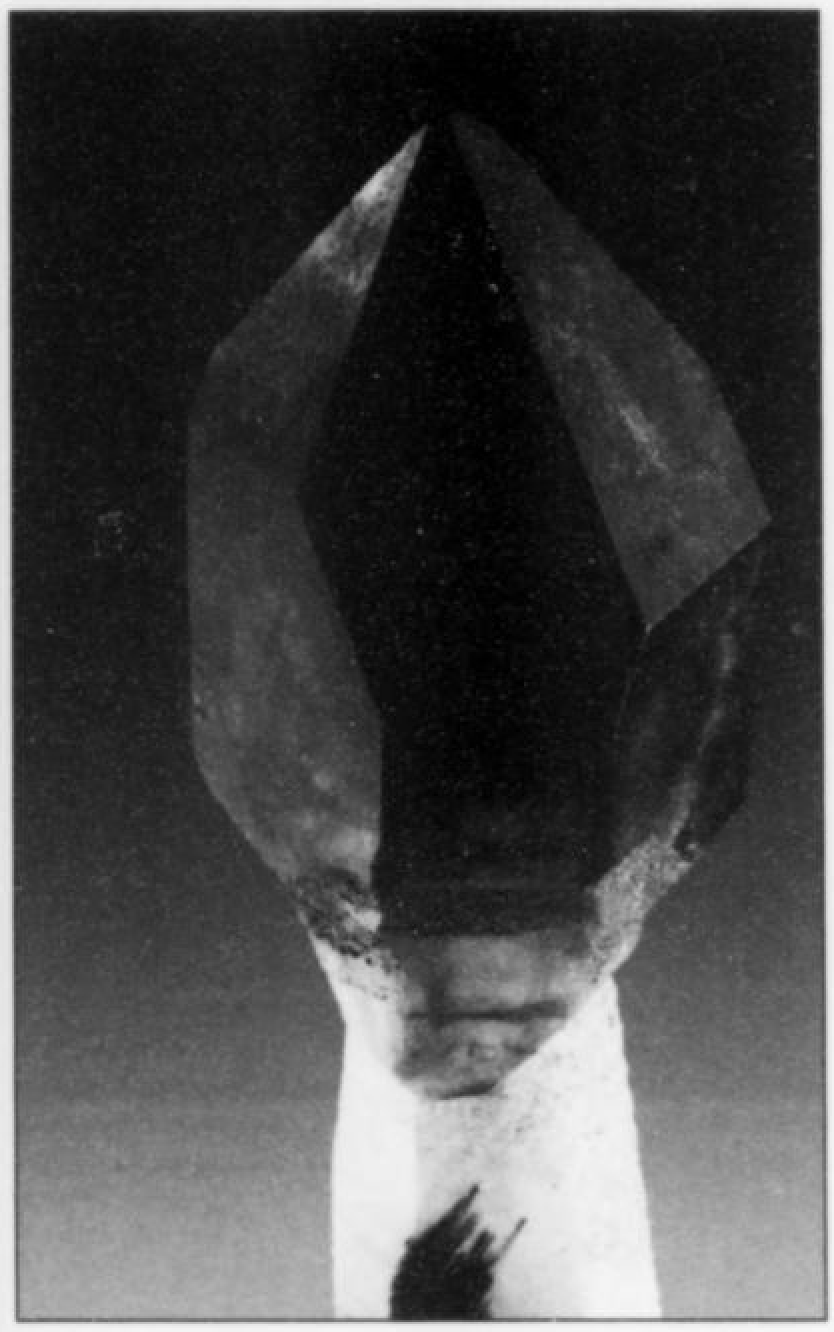


Figure 231. **Doubly terminated amethystine-smoky quartz scepter on milky quartz prism, 8.9 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 232. **An old specimen of chalcedony purchased from the well known Munich dealer Wilhelm Maucher (1879–1930) in 1927. Natural History Museum, London collection.**

chalcedony is a late-stage mineral in the paragenesis and usually coats previously formed minerals. Chalcedony and jasper-lined vugs in quartz-schorl veins are located approximately 9 km west of Krantzberg Mountain. Doubly terminated quartz crystals were once found in mineralized vugs at Krantzberg.

Rhodochrosite $Mn^{2+}CO_3$

A specimen of a single, rhombohedral Erongo rhodochrosite crystal is in the Nägele collection in Windhoek. The crystal is pink and was quantitatively identified as rhodochrosite. This find is not too surprising, considering that manganese was present in the miarolitic cavity fluids.

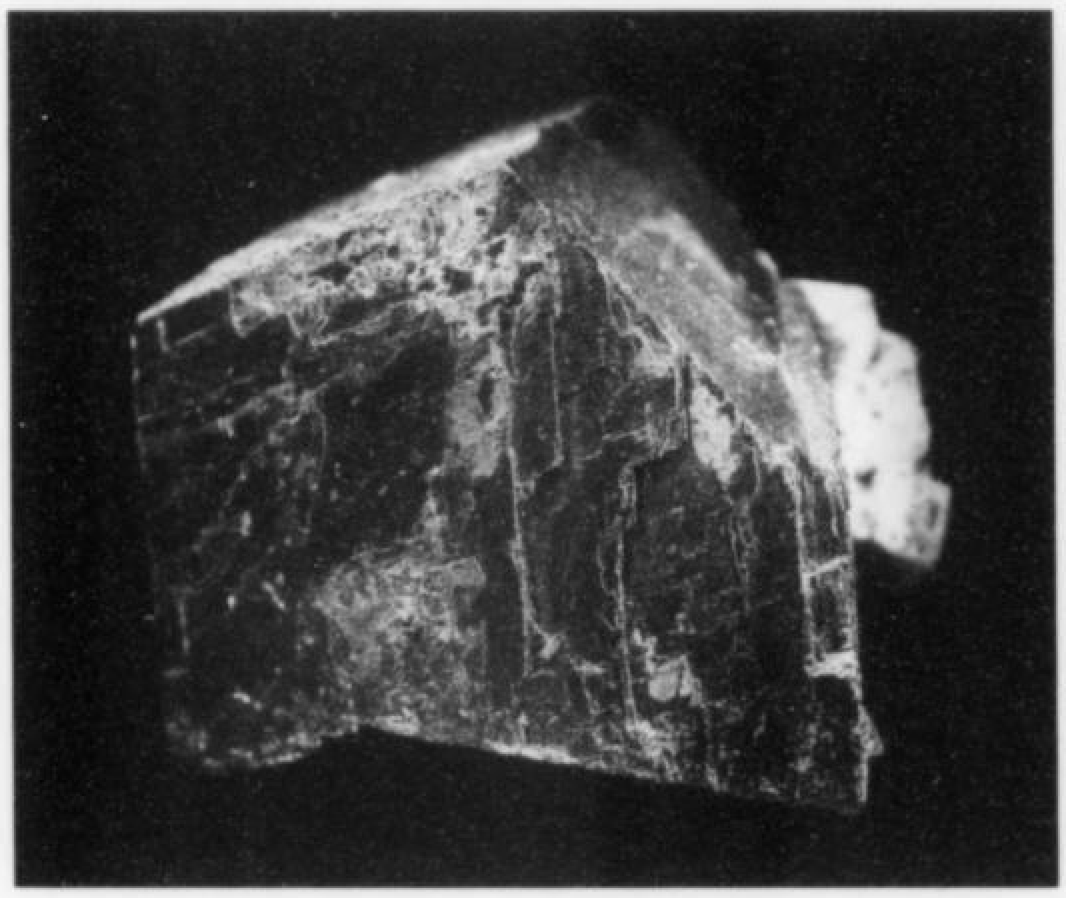


Figure 233. **A unique rhodochrosite crystal, 5.9 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Romanèchite $(Ba,H_2O)_2(Mn^{4+},Mn^{3+})_5O_{10}$ and
Cryptomelane $K(Mn^{4+},Mn^{3+})_8O_{16}$

Botryoidal aggregates and masses of black, amorphous material have been described as "psilomelane." This is no longer a valid species (Mandarino and Back, 2004), but it has not been possible to chemically analyze whether the Erongo specimens are romanèchite or cryptomelane. Aesthetic specimens of black and silver metallic botryoidal aggregates and radiating acicular sprays, in some cases associated with schorl, occur at Erongo.

Rutile TiO_2

Rutile occurs as reticulated intergrowths of tiny crystals with ilmenite. Small (2 mm) red rutile crystals are found rarely on the serrated terminations of schorl, producing a pleasant red-black color combination (Jahn *et al.*, 2003).

A famous deposit of rutile is found 10 km by road from Kanona siding on the railway line between Omaruru and Usakos, at the boundary between Erongo Ost 82 and Kanona Ost 81 (Schneider, 1992b). The rutile is hosted in albitized granite partially intruded by pegmatites. Here, rutile occurs as drusy crystals lining fissures, with quartz, albite and Cr-muscovite. Rutile crystals up to 20 cm are still found today at the locality but are embedded in the host rock. The deposit was commercially mined as a source of titanium in 1936 and 1937, when 71.3 tons of hand-sorted 95%-pure rutile concentrate was recovered (Schneider, 1992b).

Scheelite $CaWO_4$

Very rare orange microcrystals of scheelite from Erongo are known from a specimen in the Bahmann collection. The mineral is associated with goethite pseudomorphous after siderite(?), ilmenorutile-pyrolusite and quartz. Scheelite is one of the accessory ore minerals at Krantzberg (Haughton *et al.*, 1939).

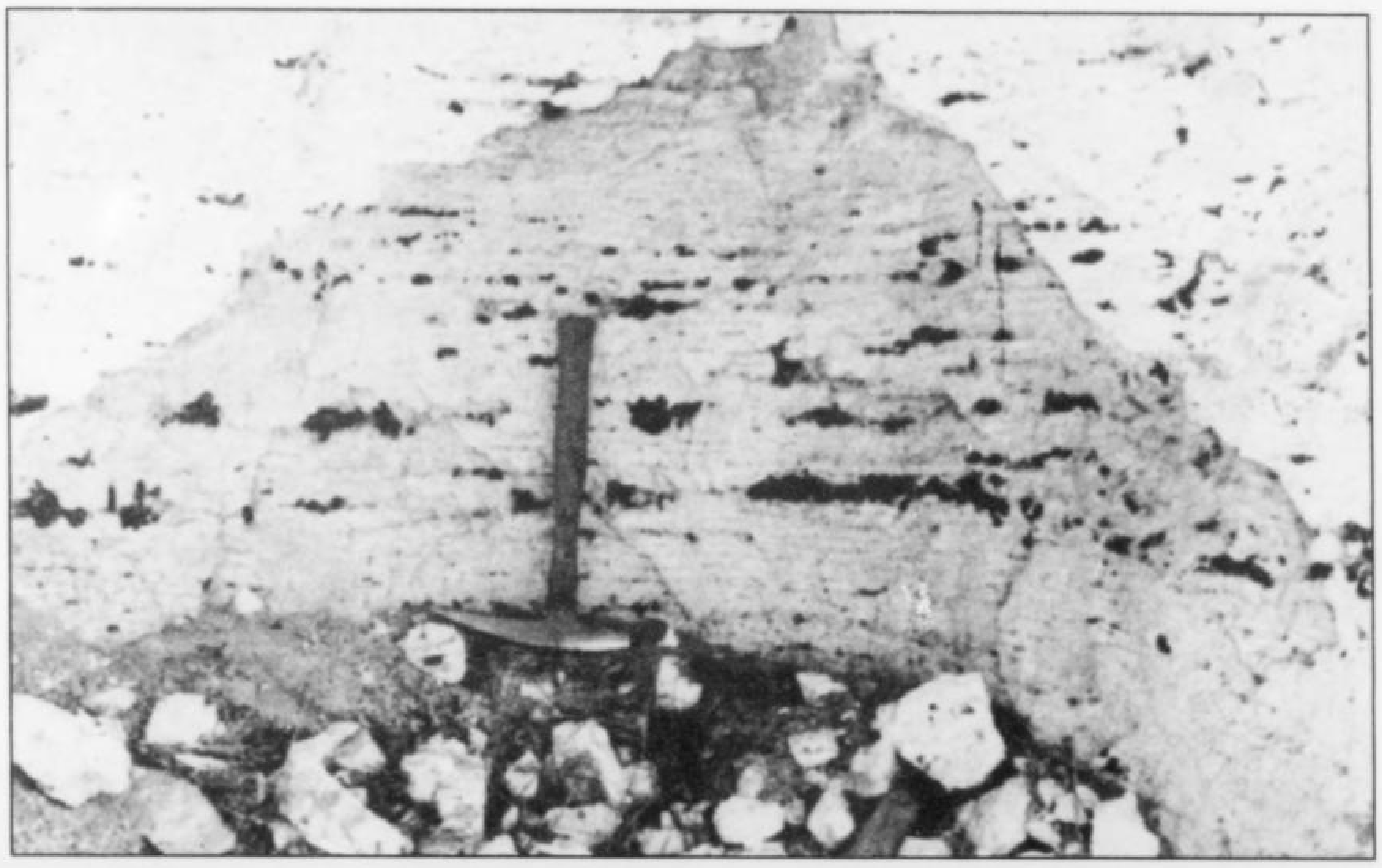


Figure 234. **Stringers of rutile in quartz-albite host rock at Giftkuppe. P. J. Rossouw photo in Frommurze *et al.* (1942).**

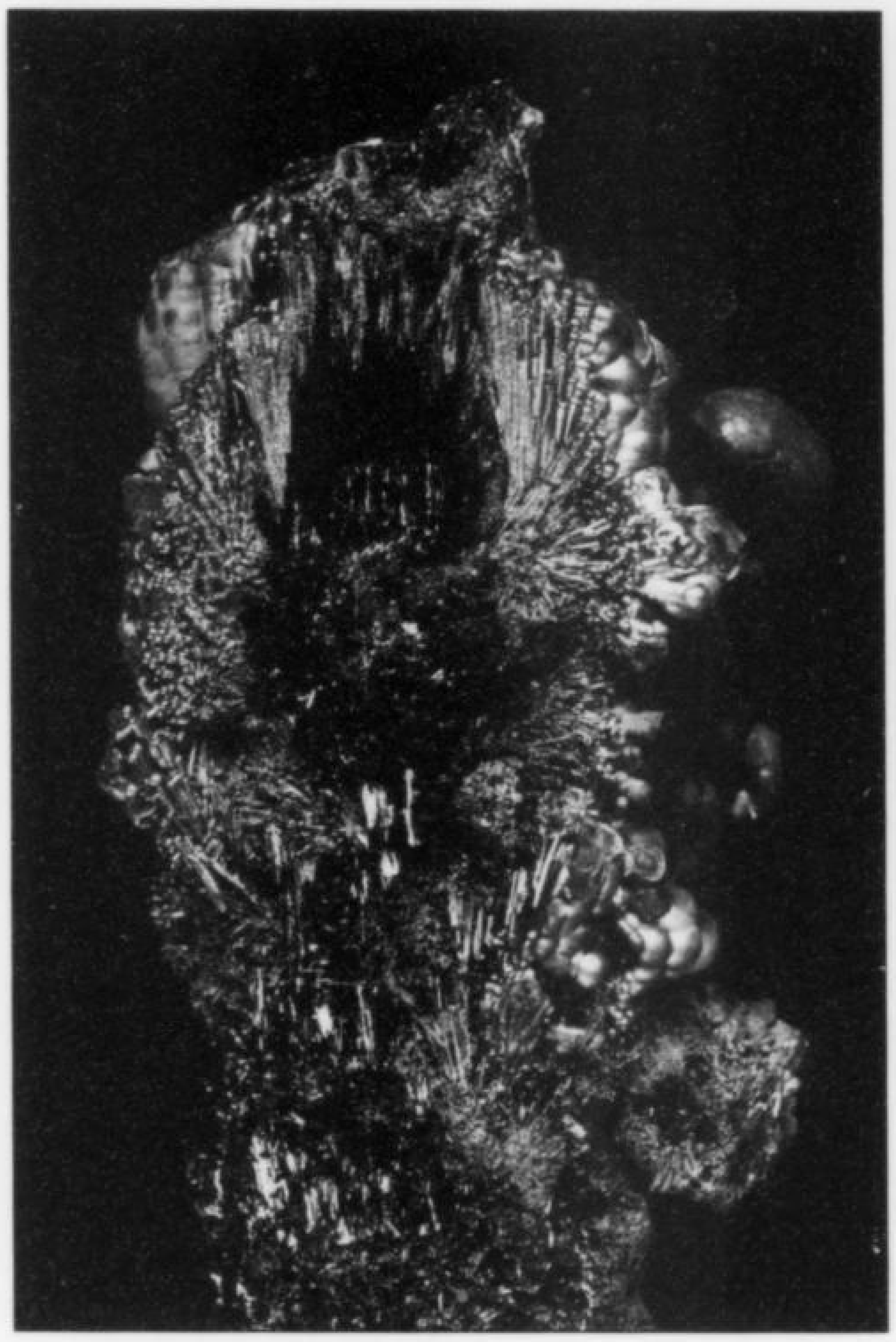


Figure 235. **"Psilomelane" (romanèchite-cryptomelane?) aggregate, 7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

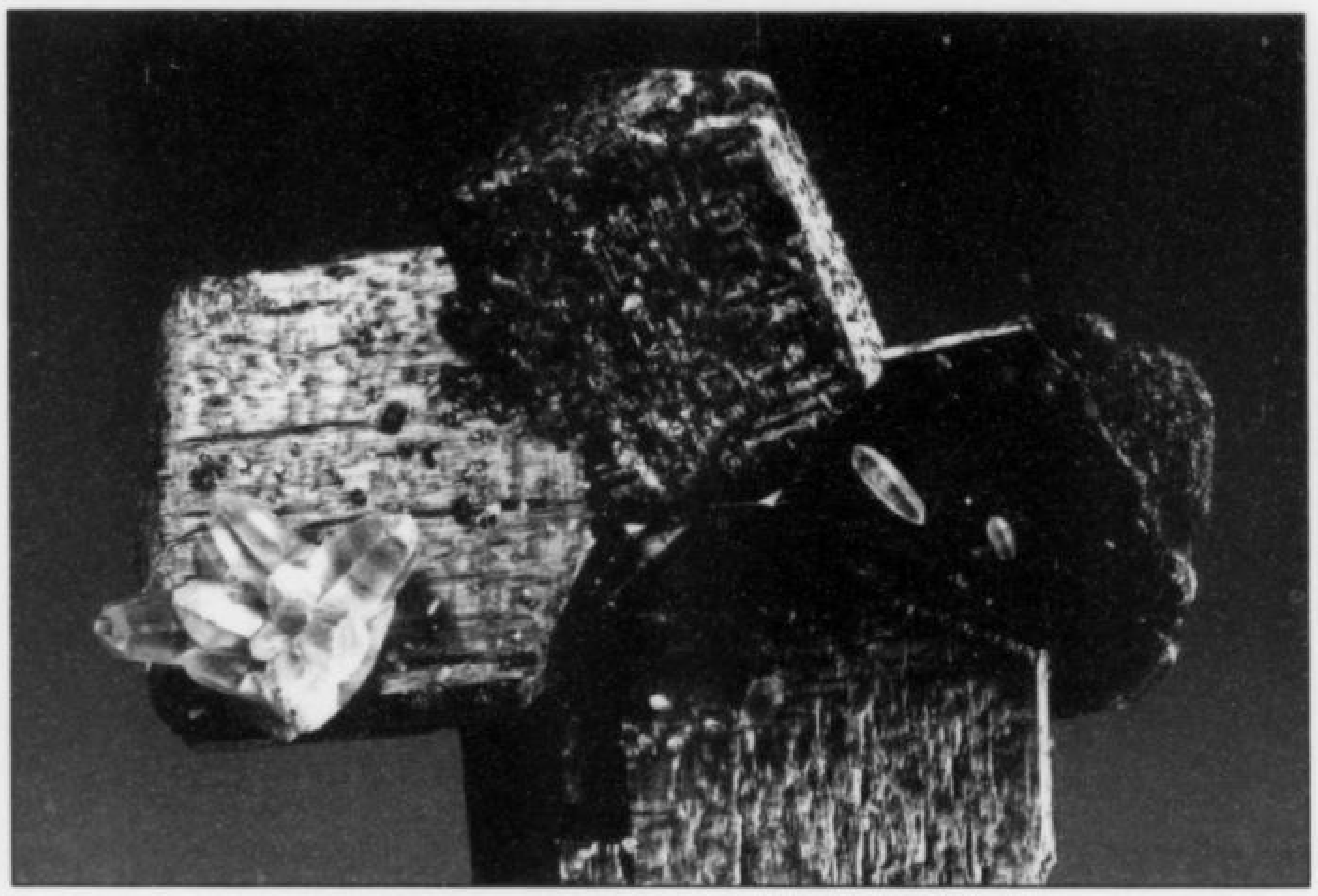


Figure 236. **Schorl with attached quartz, 8.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Schorl $NaFe^{2+}_3Al_6(BO_3)_3Si_6O_{18}(OH)_4$

Schorl from the Erongo Mountains has set a high quality standard for this species worldwide. Erongo schorl specimens are certainly the best in the southern African region and most likely Africa as a whole. The attractive associations, the great variety of crystal habits, the large crystal size and the brilliant luster of the larger schorl crystals, combine to make Erongo one of the world's most significant occurrences of the species.

Schorl is the most common species in the miarolitic cavities. Scattered crystals and fragments are strewn around the mountainous area (Jahn and Bode, 2003); most of these have naturally weathered from the outcrop but some are rejected specimens left behind by the diggers. Some schorl eroded from the granite has been transported and deposited as alluvial crystals on the surrounding plains. With time, these crystals become embedded and cemented into calcrete, producing "secondary" matrix specimens. The schorl occurs as individual crystals up to 15 cm, and in large museum-sized plates with associated minerals. Much Erongo schorl is characterized by smooth crystal faces with extremely high luster; other crystals have more of a matte luster, with highly striated prism faces. Many specimens are floaters, either as single crystals or as clusters. Not all schorl appears as pristine crystals. Some specimens are highly corroded, etched and resorbed, and some crystal faces are studded by acicular gray quartz, muscovite and orthoclase. In some cases schorl has pseudomorphically replaced orthoclase.

Schorl belongs to the ditrigonal pyramidal class of the hexagonal system, and many complex habits are found at Erongo. The crystals very commonly display distinct hemimorphic habits, having pyramidal terminations on one end while splaying out into multiple terminations on the opposite end. These terminations (termed "rockets" by Gebhard, 2002) consist of three flattened trigonal surfaces. The "Mercedes Benz" forms $\{10\bar{1}\}$ and $\{101\}$ show some extreme variations. Perfect trigonal crystals exist and some specimens have "frayed" terminations or may consist of a mosaic of intergrown subcrystals.

Figure 237. **Schorl, 14.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

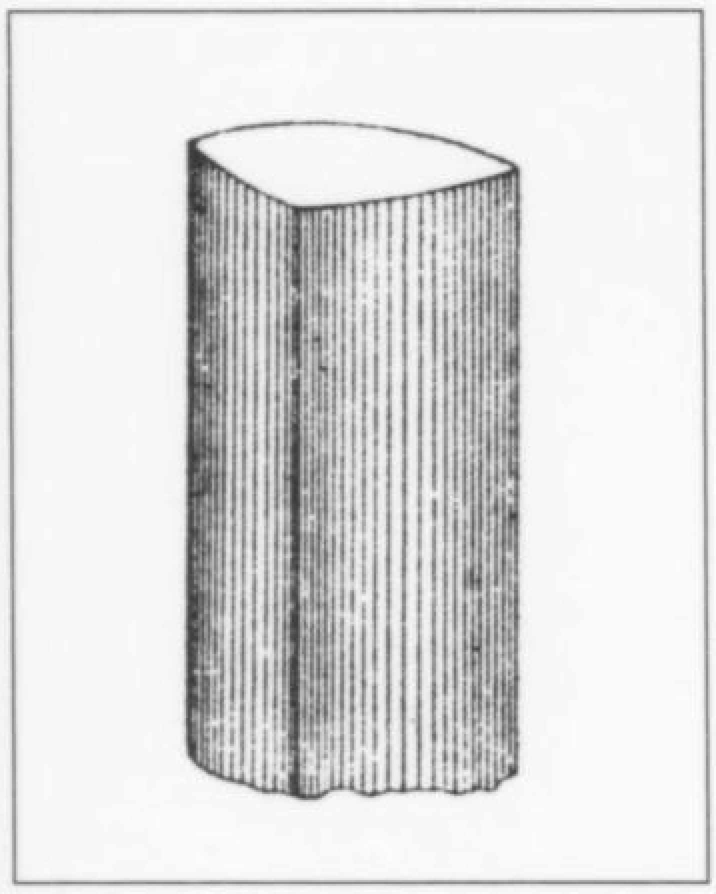


Figure 239. **Crystal drawing of tourmaline from the Ural Mountains similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

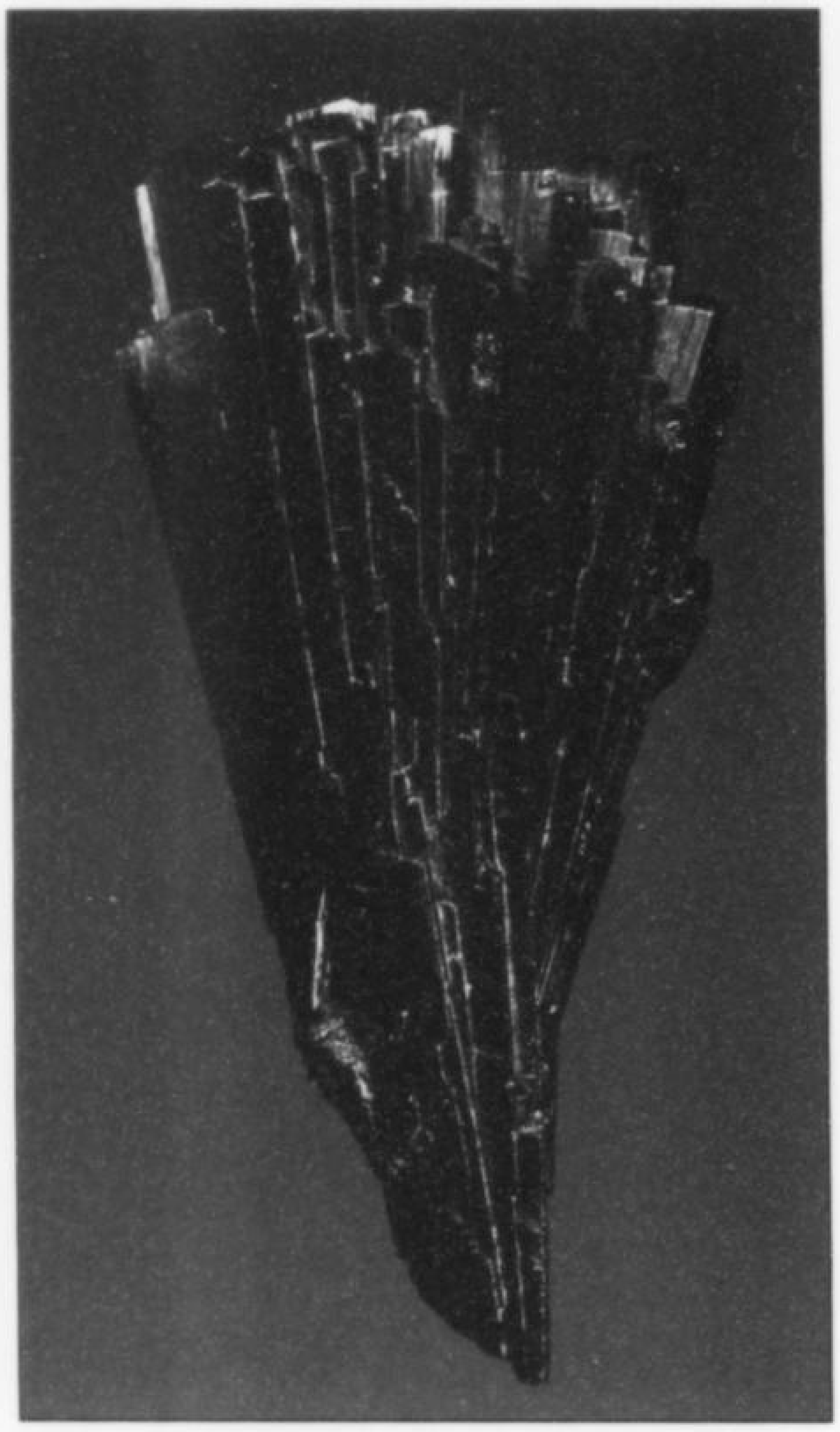


Figure 238. **Half of a large "bowtie" schorl, 15.2 cm., collected in the late 1960's. Desmond Sacco collection; Bruce Cairncross photo.**

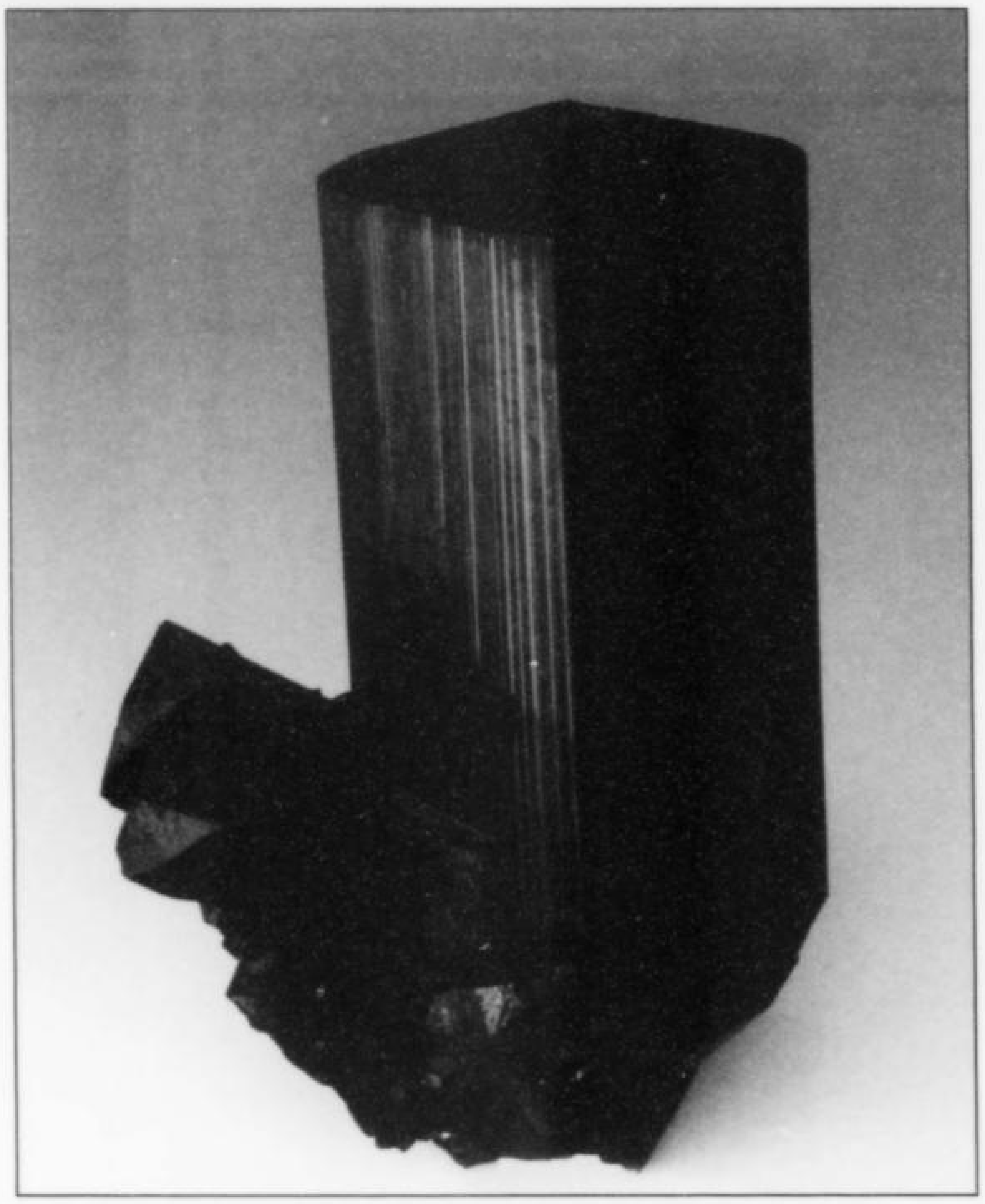


Figure 240. **Schorl, 12.3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce**

Some terminations are cavernous, arena-like hollows produced by preferential growth of sections of the outer prism faces, accompanied by less rapid crystal growth towards the center of the termination. Later-stage muscovite and fluorite commonly crystallize in these hollow terminations. Another interesting paragenetic process occurs when parts of the thin crystal rims are naturally fractured and collapse into the hollows; these then become cemented together as a network of crystal shards by continued crystallization of the schorl.

Some specimens are coated by fluorescent and non-fluorescent hyaline opal. Not all schorl is black—some crystals are very dark green or deep red. These tourmalines require further investigation to determine whether they are in fact schorl. One pocket produced crystals from thumbnail size to 6 or 7 cm in diameter that have an equant, pseudo-isometric habit, resembling black garnets. These

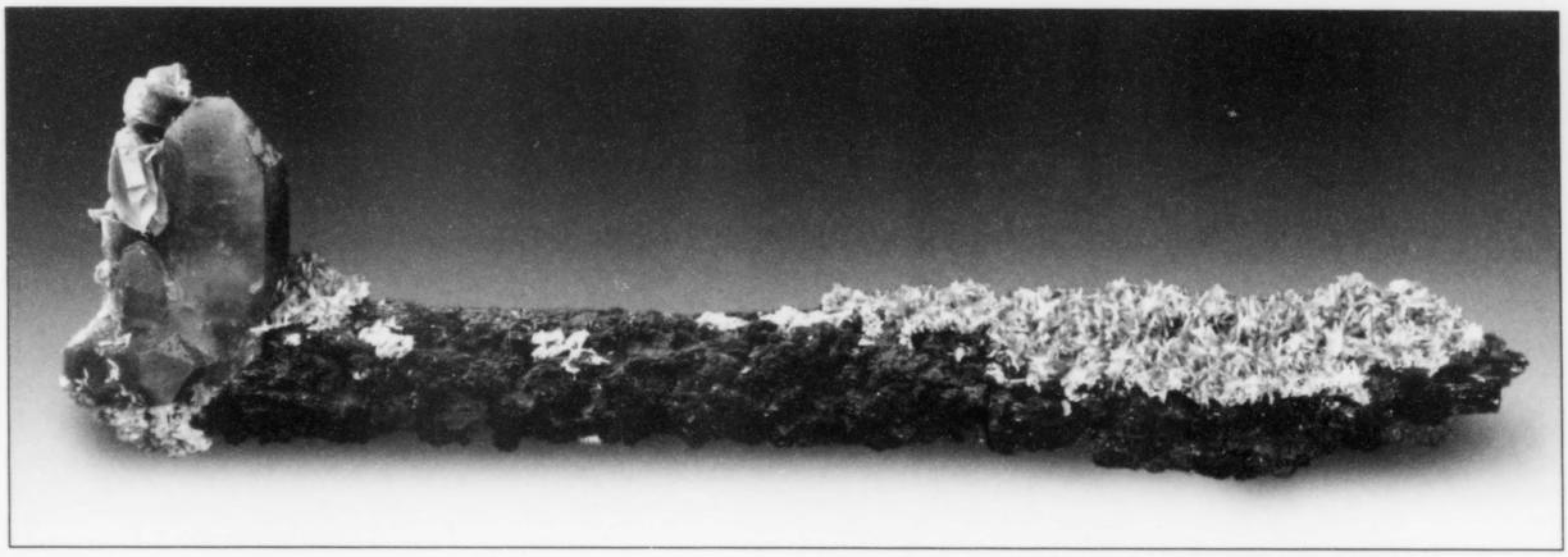


Figure 241. **A highly corroded schorl crystal, 20.2 cm, partially coated by quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 242. **Trigonal schorl with acicular crystals making up the prism faces, 9.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

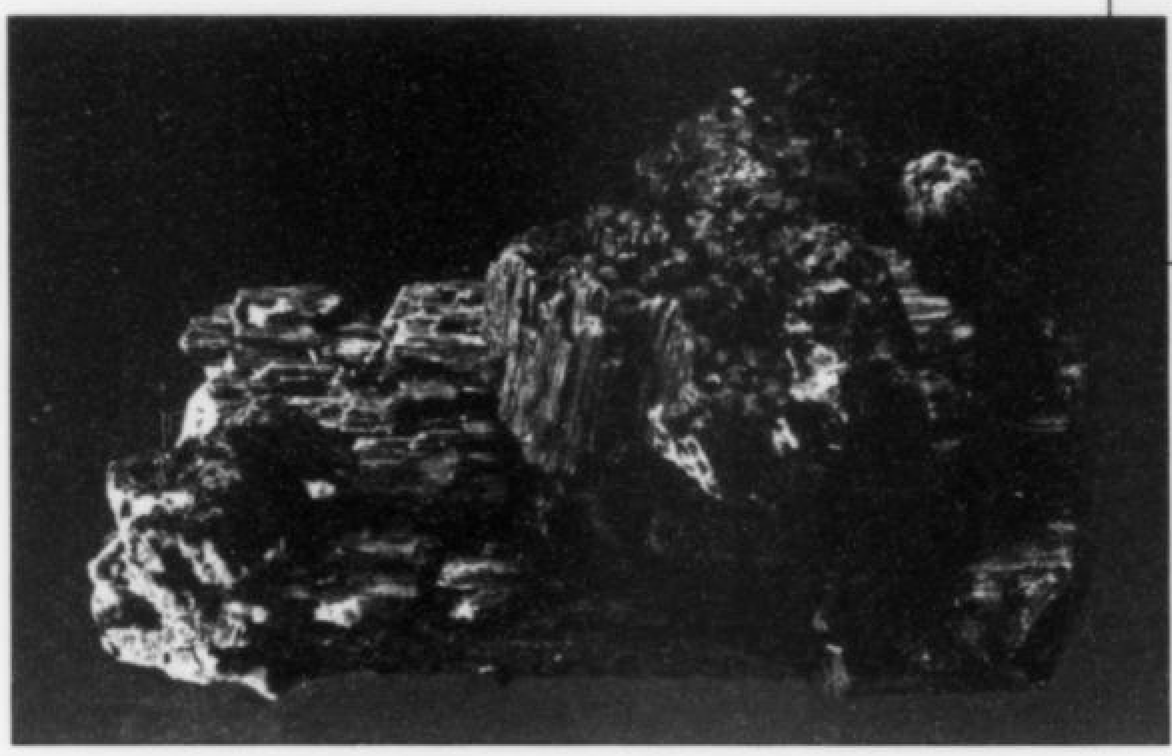


Figure 243. **Composite cluster of schorl with minor muscovite, 10.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

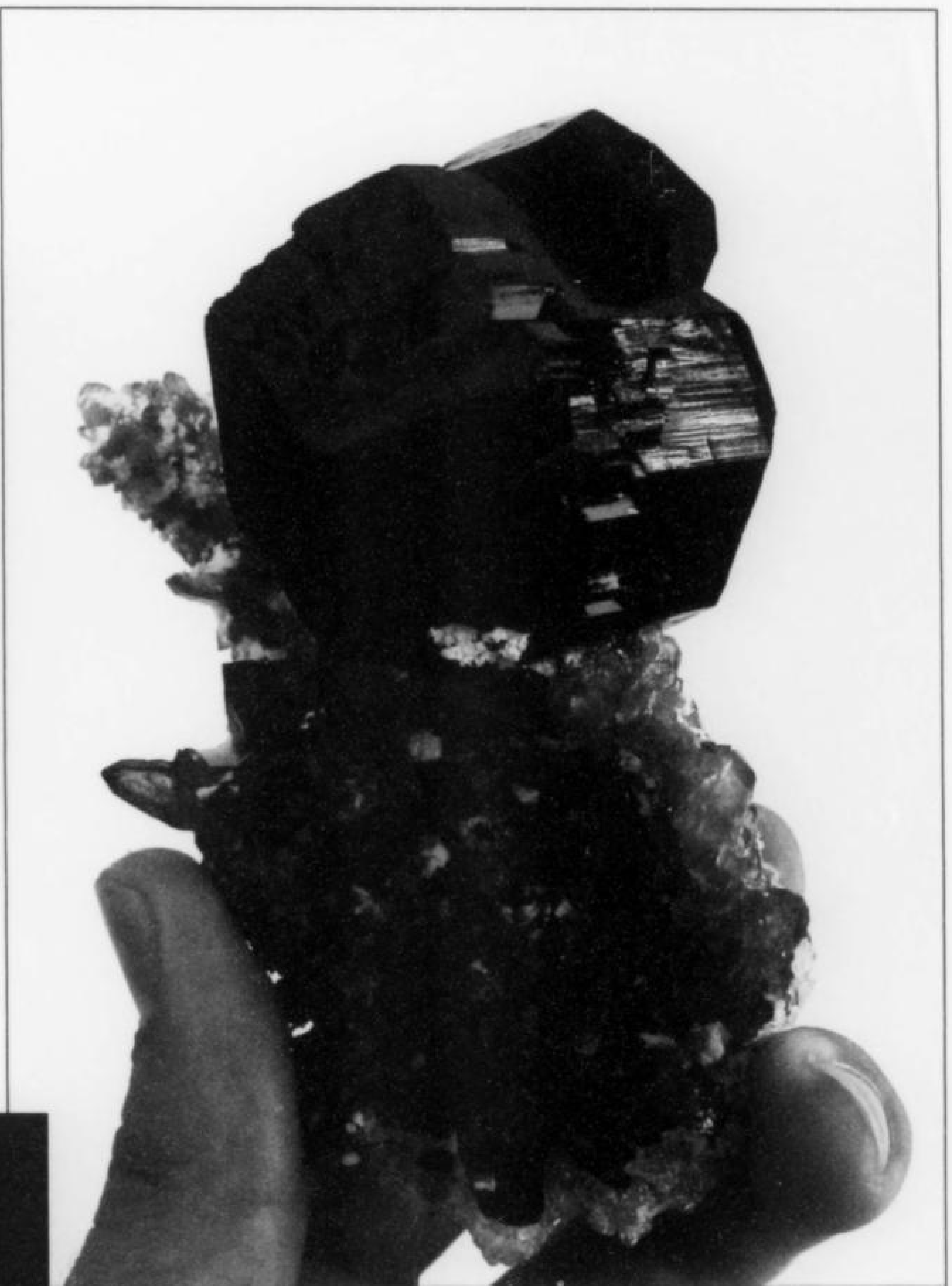


Figure 244. **Schorl on quartz with minor orthoclase and hyaline opal, 10.5 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

are either individual floater crystals or aggregates. Associated species include aquamarine, hyaline opal, muscovite, orthoclase and quartz. A handful of specimens of a unique vermiform schorl was collected during January 2006; they are miniatures consisting of contorted finger-like groups of crystals. Most of the farms located in the southwestern, western and northwestern Erongo Mountains have yielded outstanding schorls during the past 5 years.

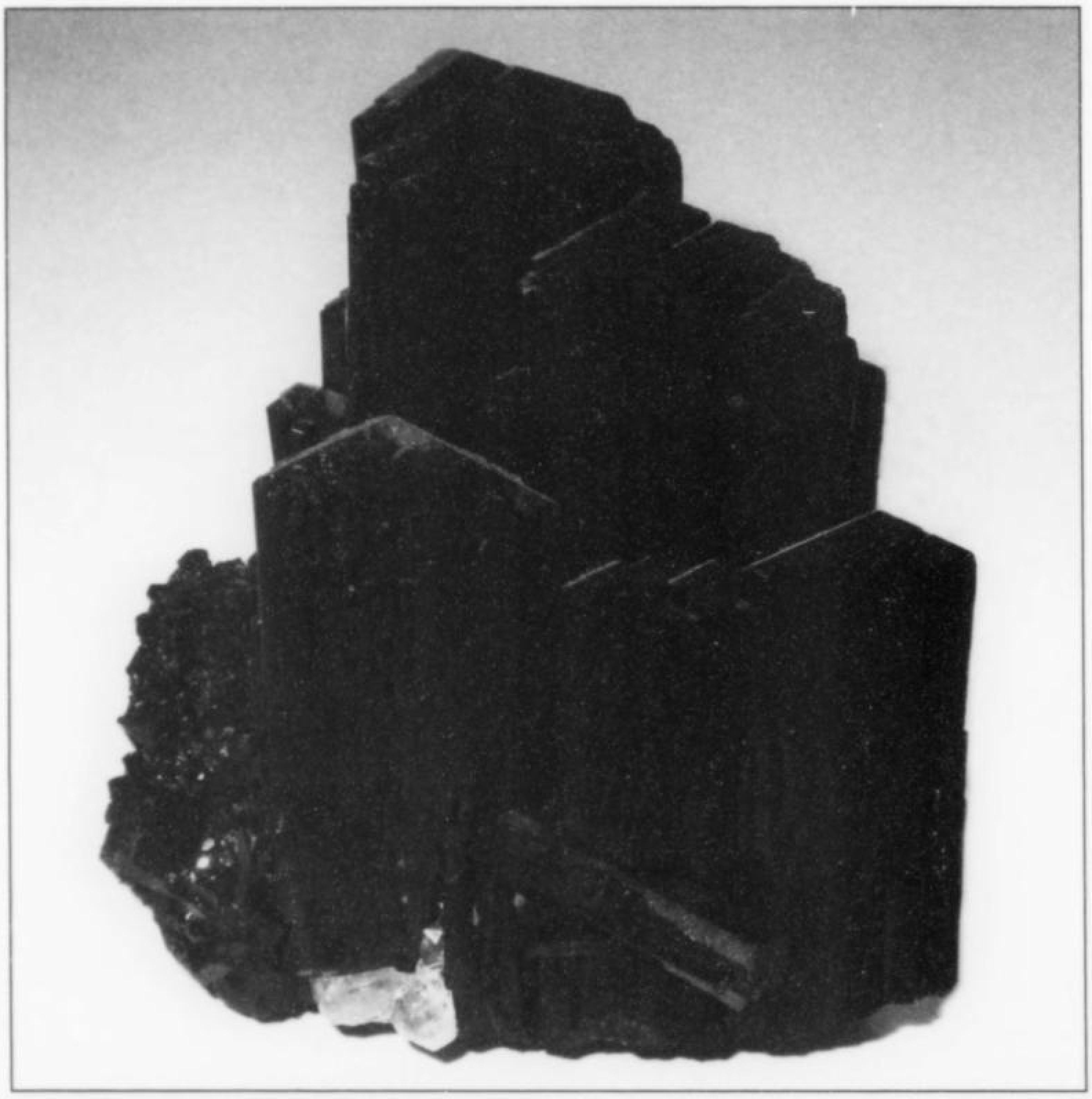


Figure 245. **Schorl, 9.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 247. **An 18-cm cluster of schorl crystals. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 246. **Slightly curved, corroded schorl, 16.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

One interesting aspect of the Erongo tourmalines is the internal color zonation that is revealed when very thin sections are sliced, either perpendicular or parallel to the *c* axis of crystals (Rustemeyer and Deyer, 2003); perpendicular sections tend to reveal blue colors while the parallel slices are mostly red-brown. Multiple colored zones that are either trigonal or pseudohexagonal in shape occur in the crystals. These are reminiscent of the the spectacular color-zoning in the famous Madagascar liddicoatite crystals, and colors

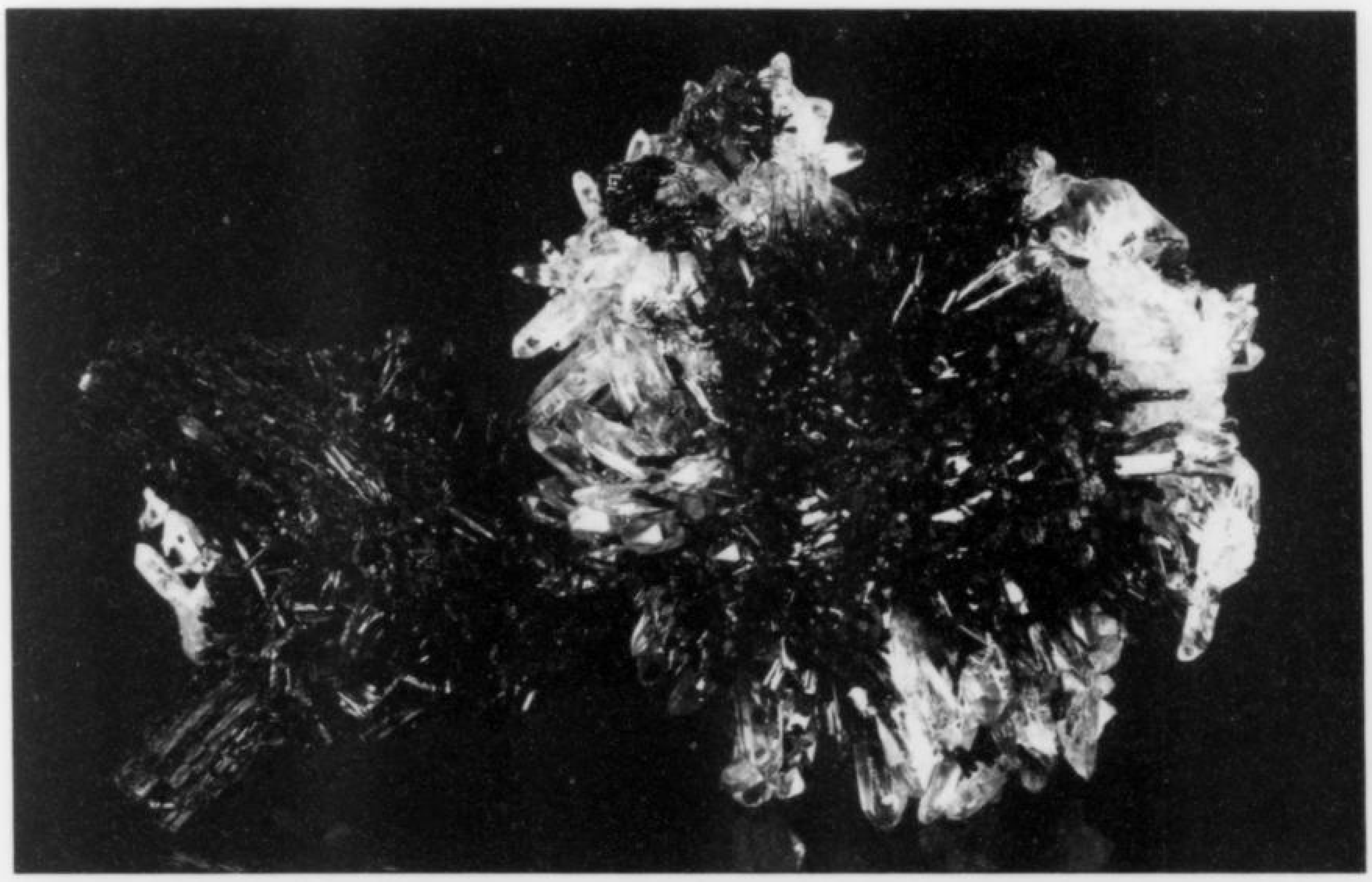


Figure 248. **Slender schorl crystals and quartz, 7.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

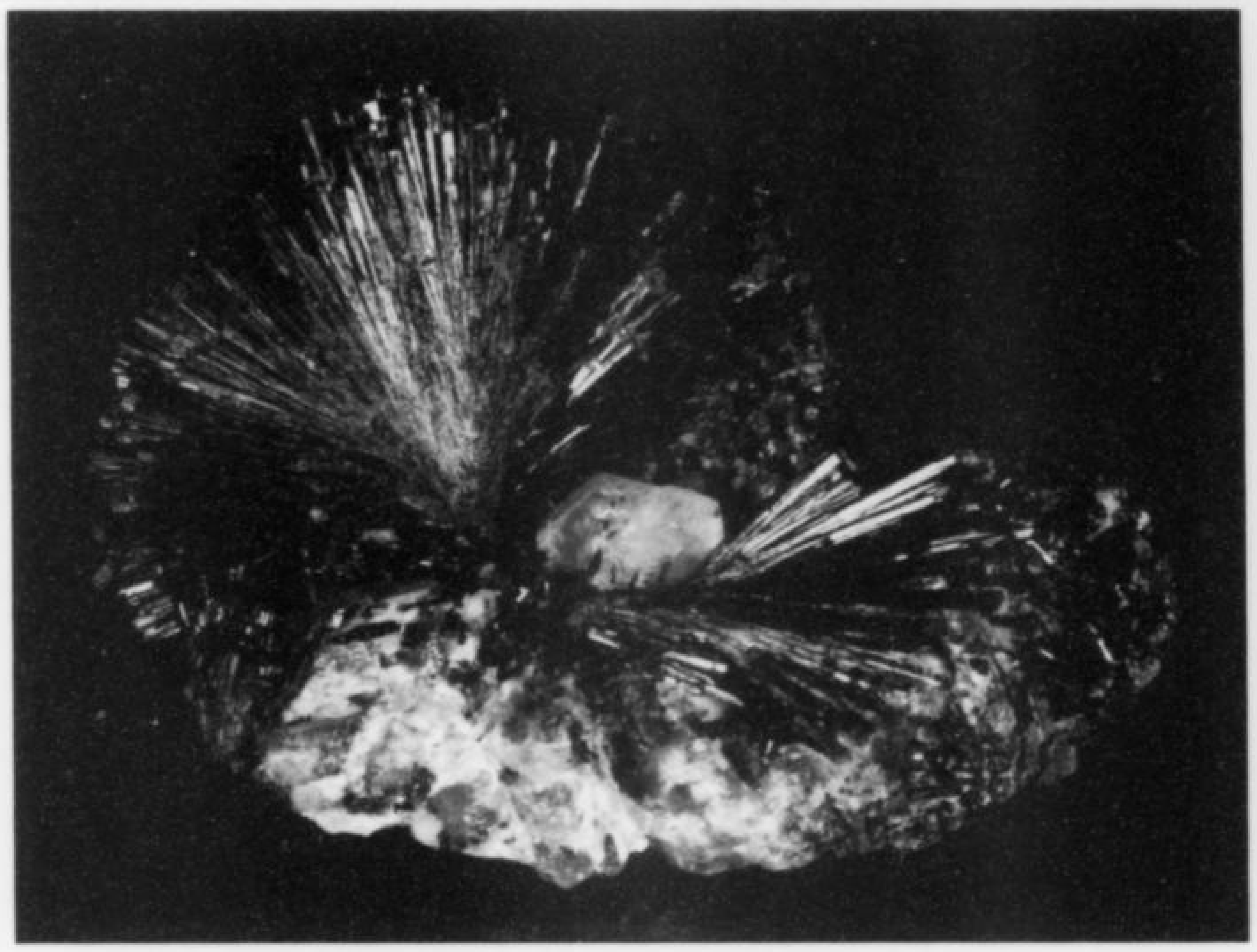


Figure 249. **Radiating fan of schorl crystals with quartz, 6.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

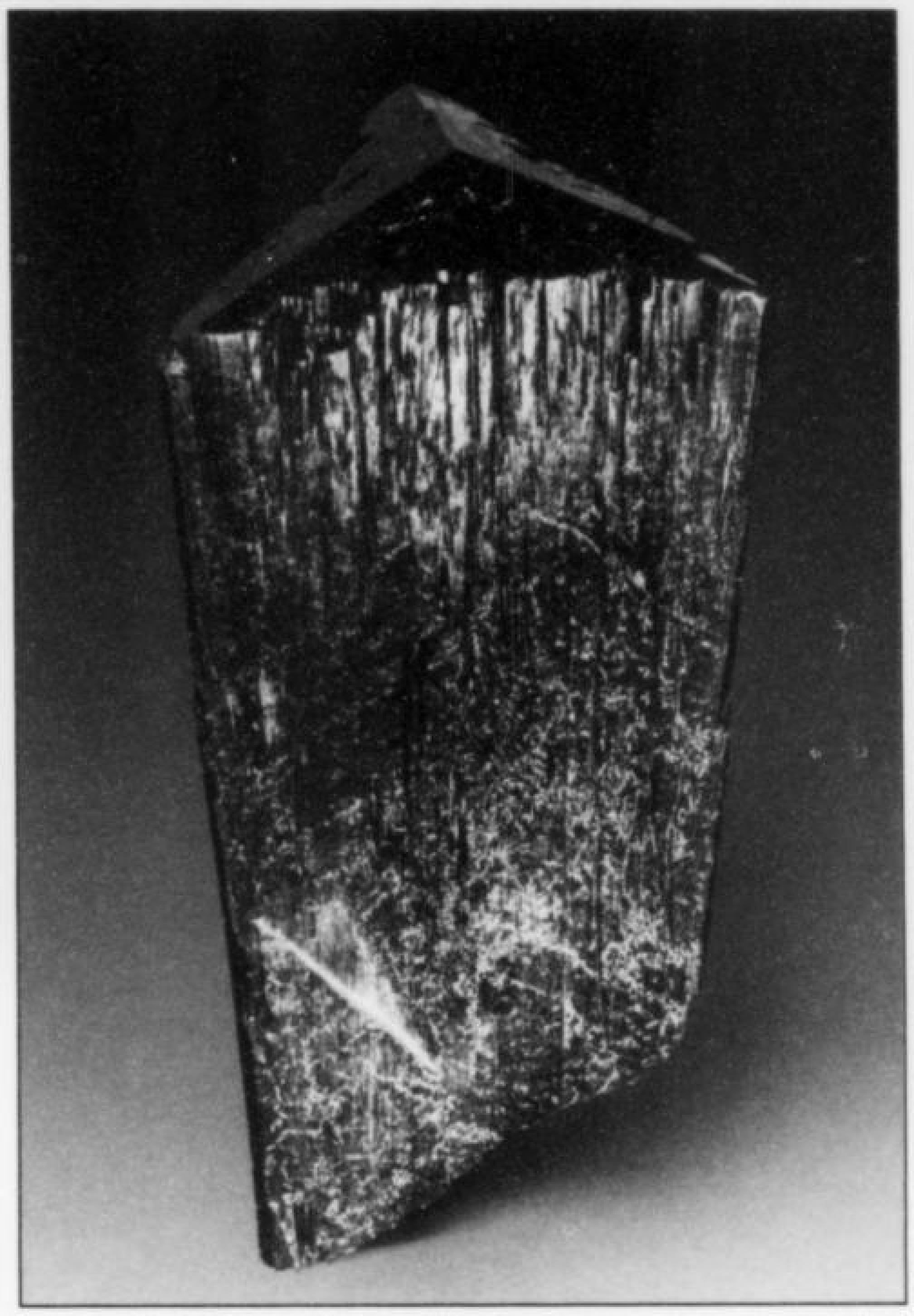


Figure 250. **Trigonal schorl crystal, 9.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

include yellow, orange, blue and green. Some zones form mosaic patterns that change in shape and color from the base to the termination of the crystal. Hemimorphic schorl, in particular, displays various stages of crystal growth that are reflected by different episodes of color contrast—orange-brown in the prism sections of the crystal, violet-red at one end, and dark brown on the opposite termination (Rustmeyer and Deyer, 2003). However, black tourmaline, and schorl in particular, typically displays varying colors when viewed as thin sections in transmitted light (Zang and Fonseca-Zang, 2002), so this phenomenon is not confined to the Erongo schorls.

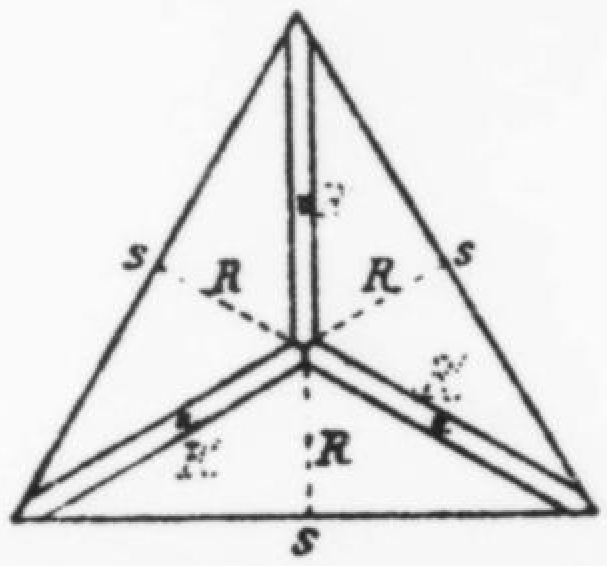


Figure 251. **Crystal drawing of tourmaline from Ceylon similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

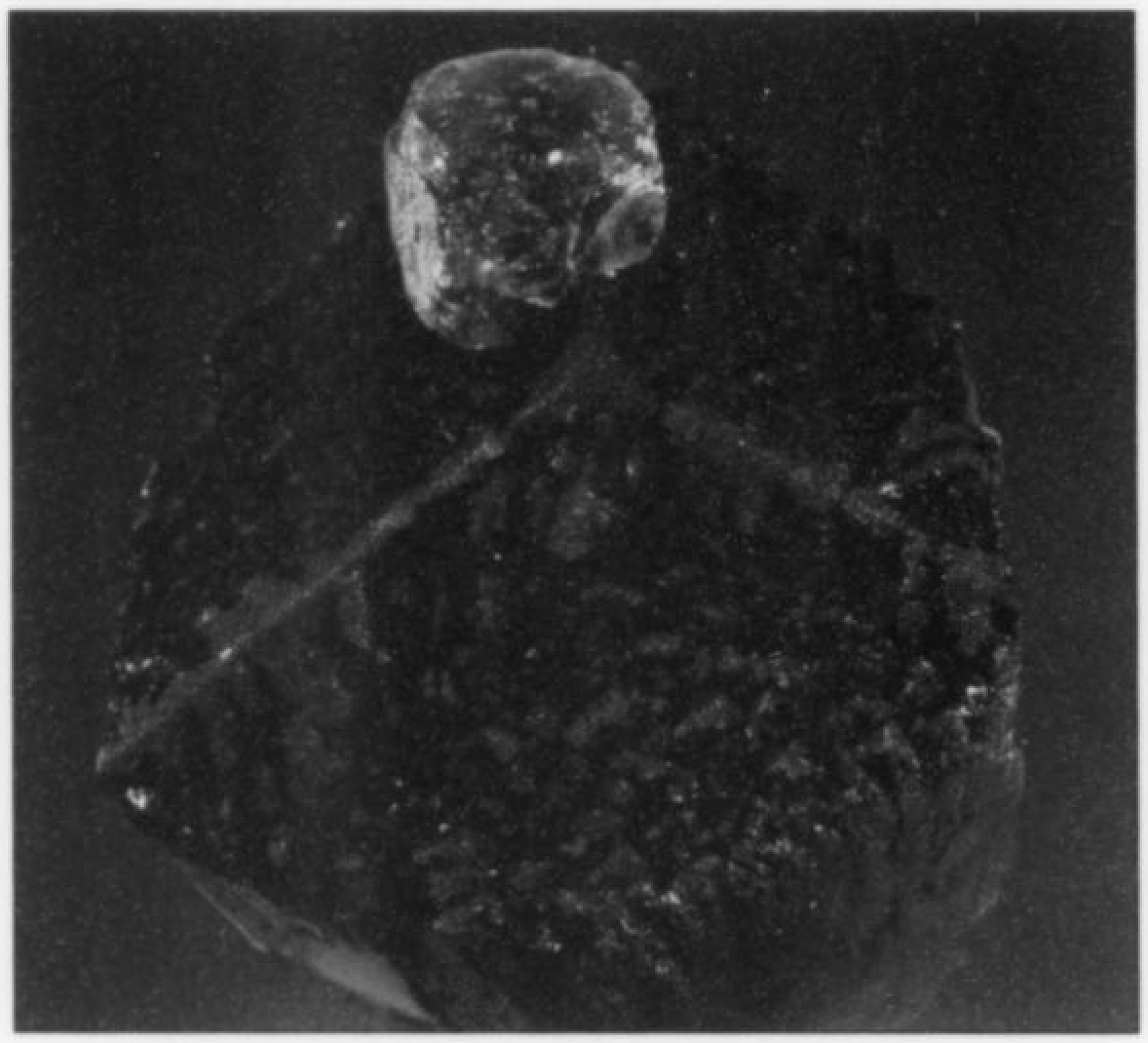


Figure 252. **Fluorite perched on schorl, 4.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

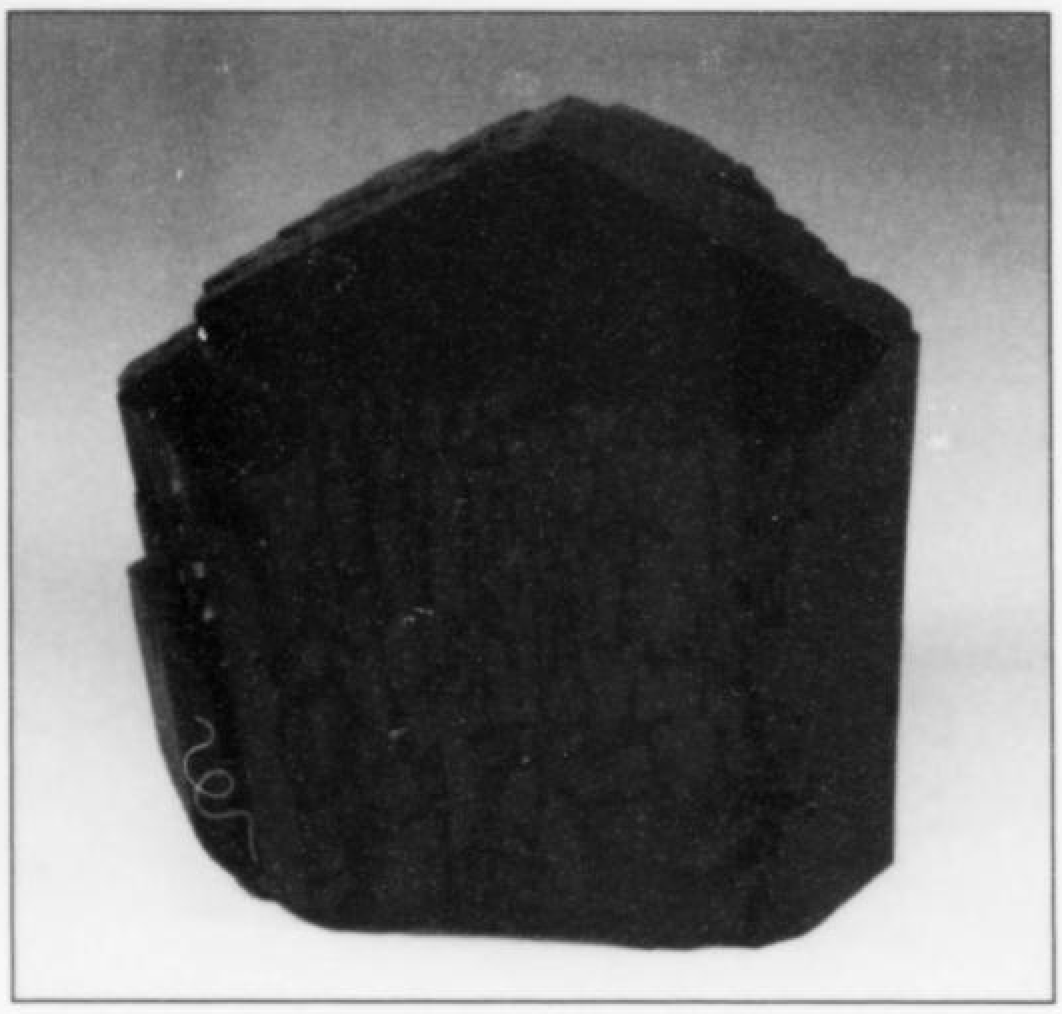


Figure 254. **A 14.3-cm (3.56-kg), highly lustrous schorl crystal. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

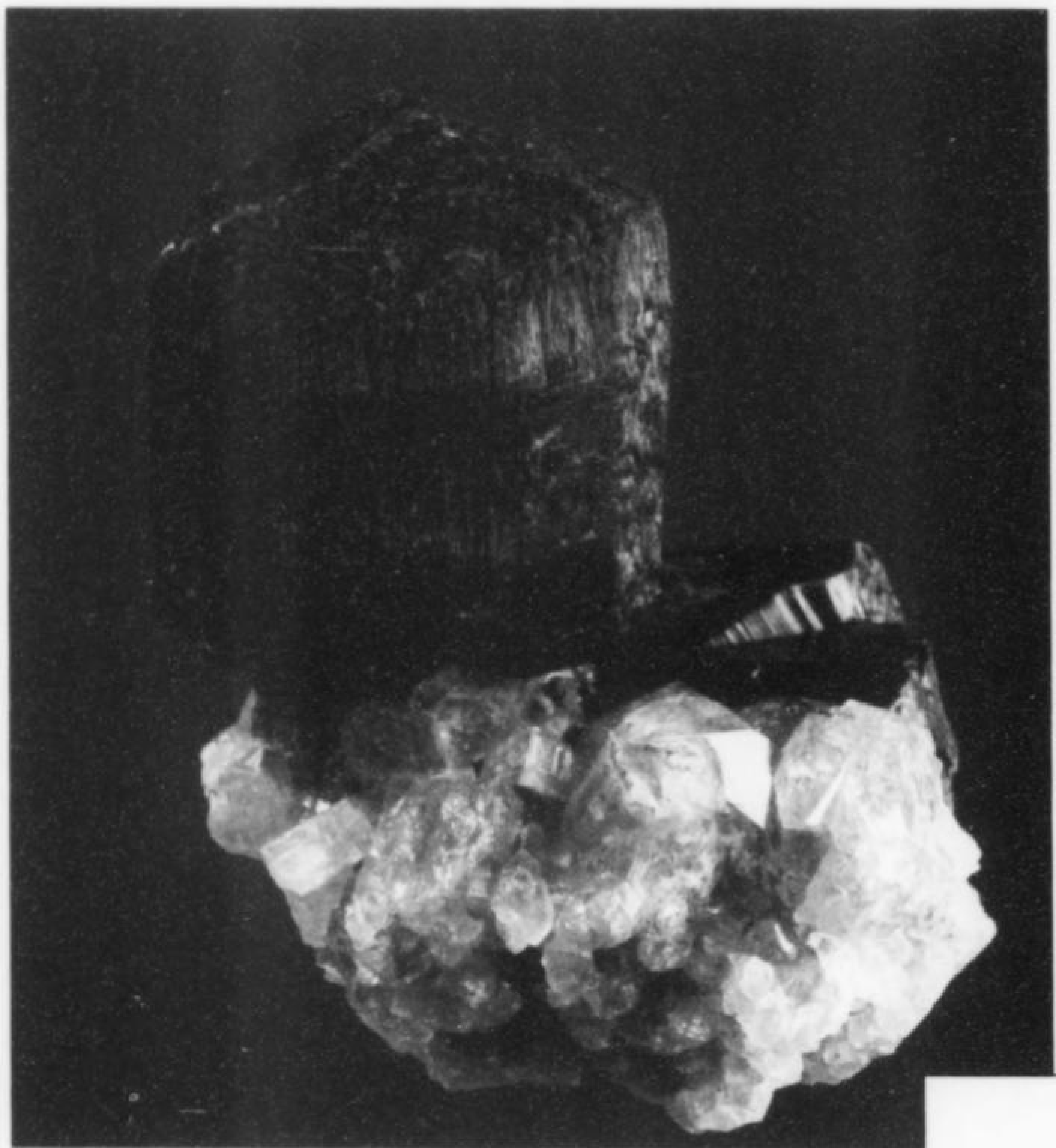
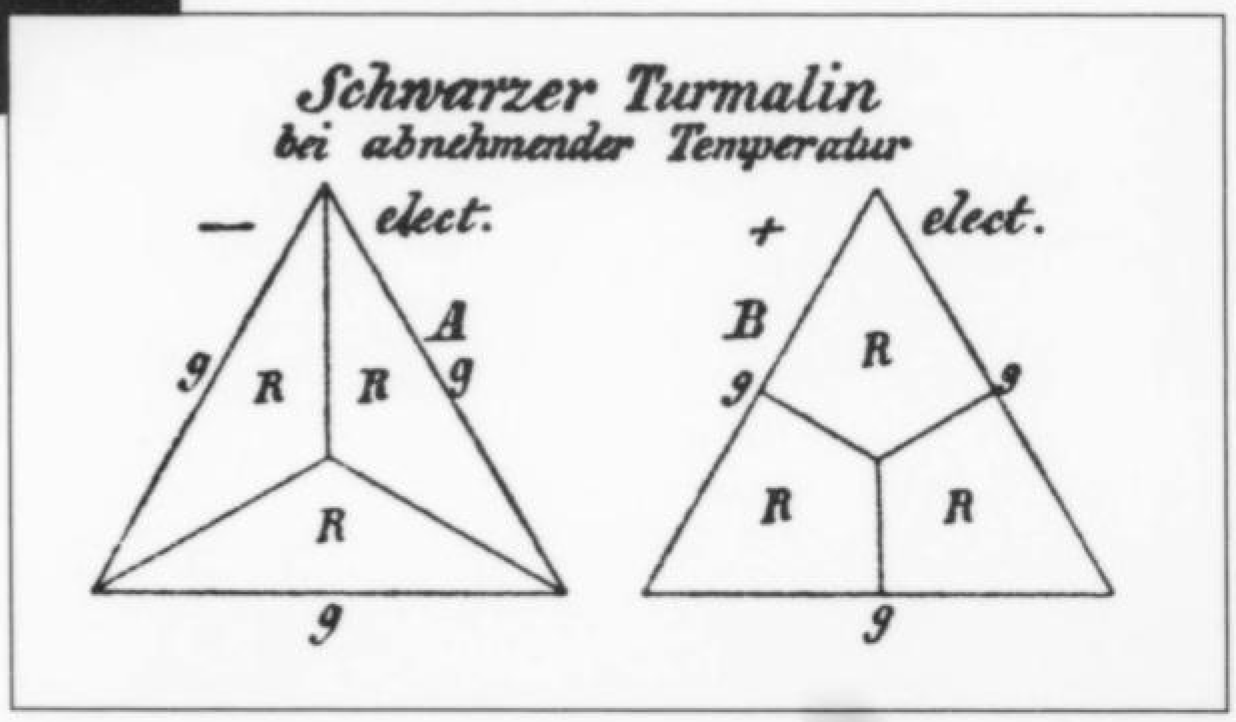


Figure 253. **Doubly terminated schorl perched on quartz, 5.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 255. **Crystal drawing of "black tourmaline" from Ceylon similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**



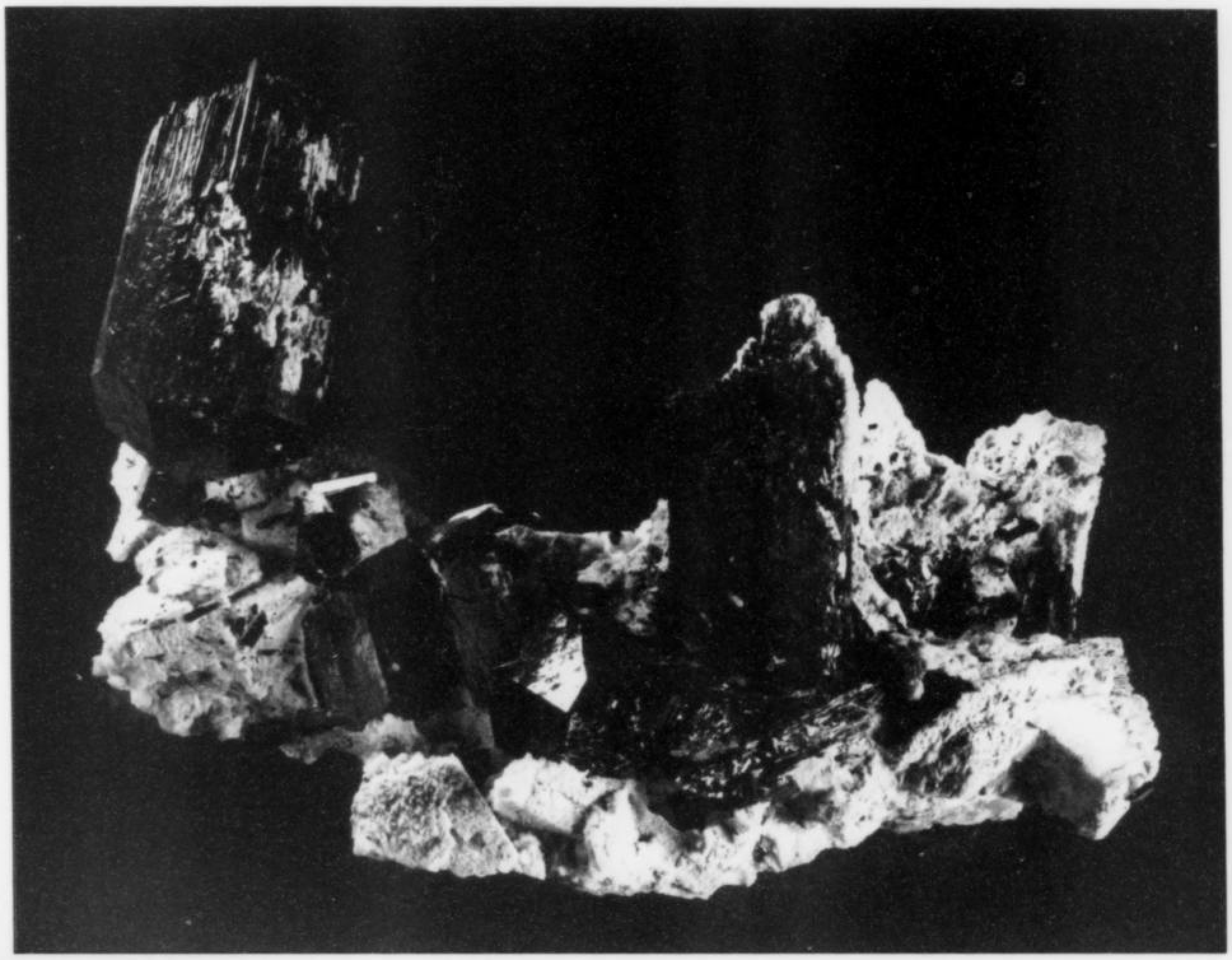


Figure 256. **Doubly terminated schorl (foitite?) on orthoclase, 15.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

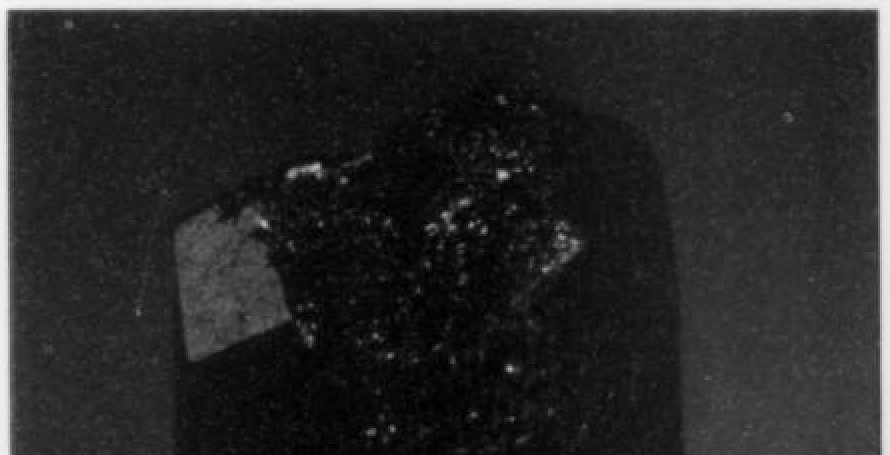
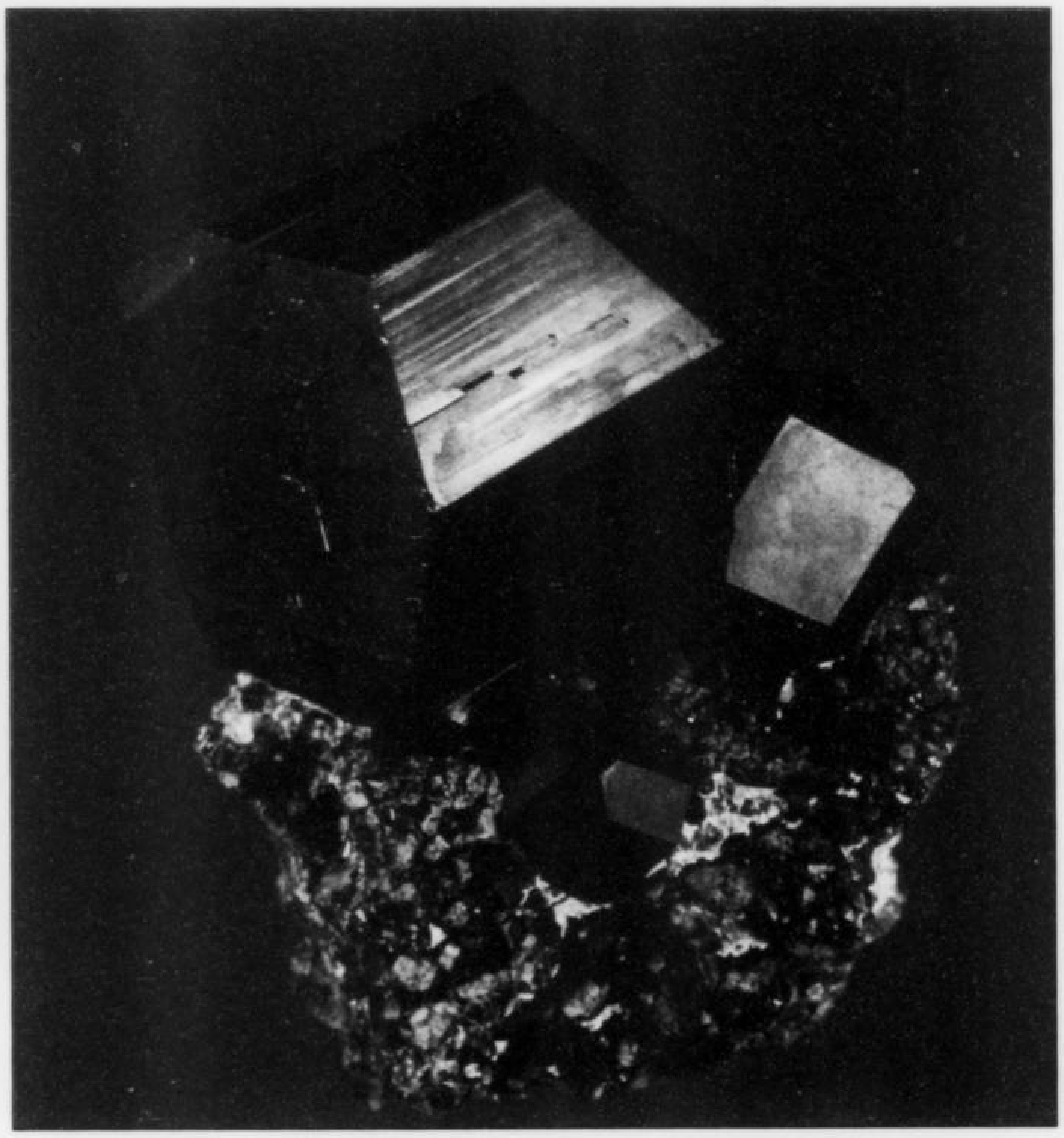
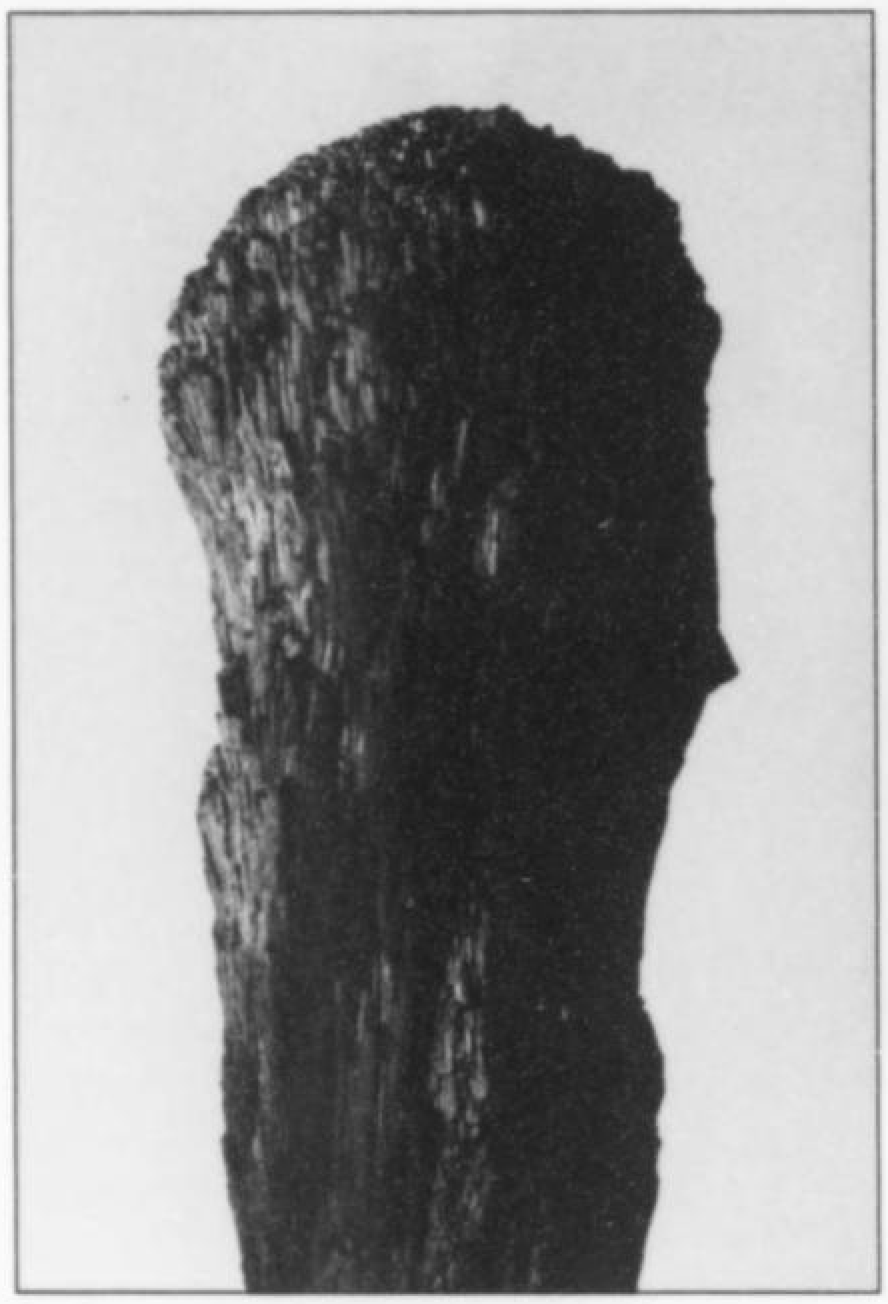


Figure 257. **Doubly terminated schorl on aquamarine, 7.3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 258. **Pseudocubic schorl crystal, 6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**





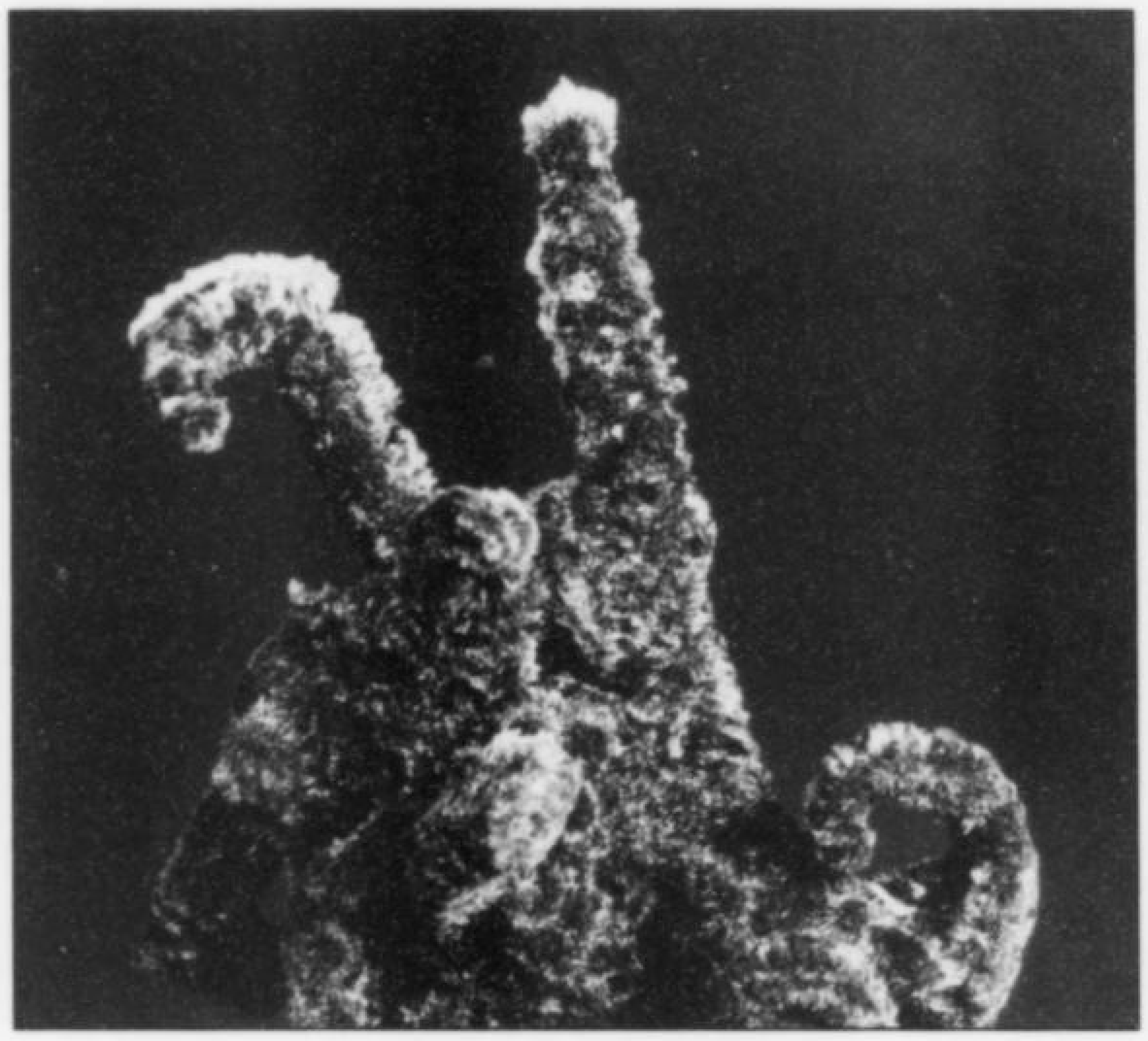


Figure 260. **Vermiform schorl with hyaline opal, 6.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 259. **Multiply terminated schorl, 13.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 261. **Divergent sprays of schorl, 14.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 262. **Clusters of acicular schorl with smoky quartz, 11.6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

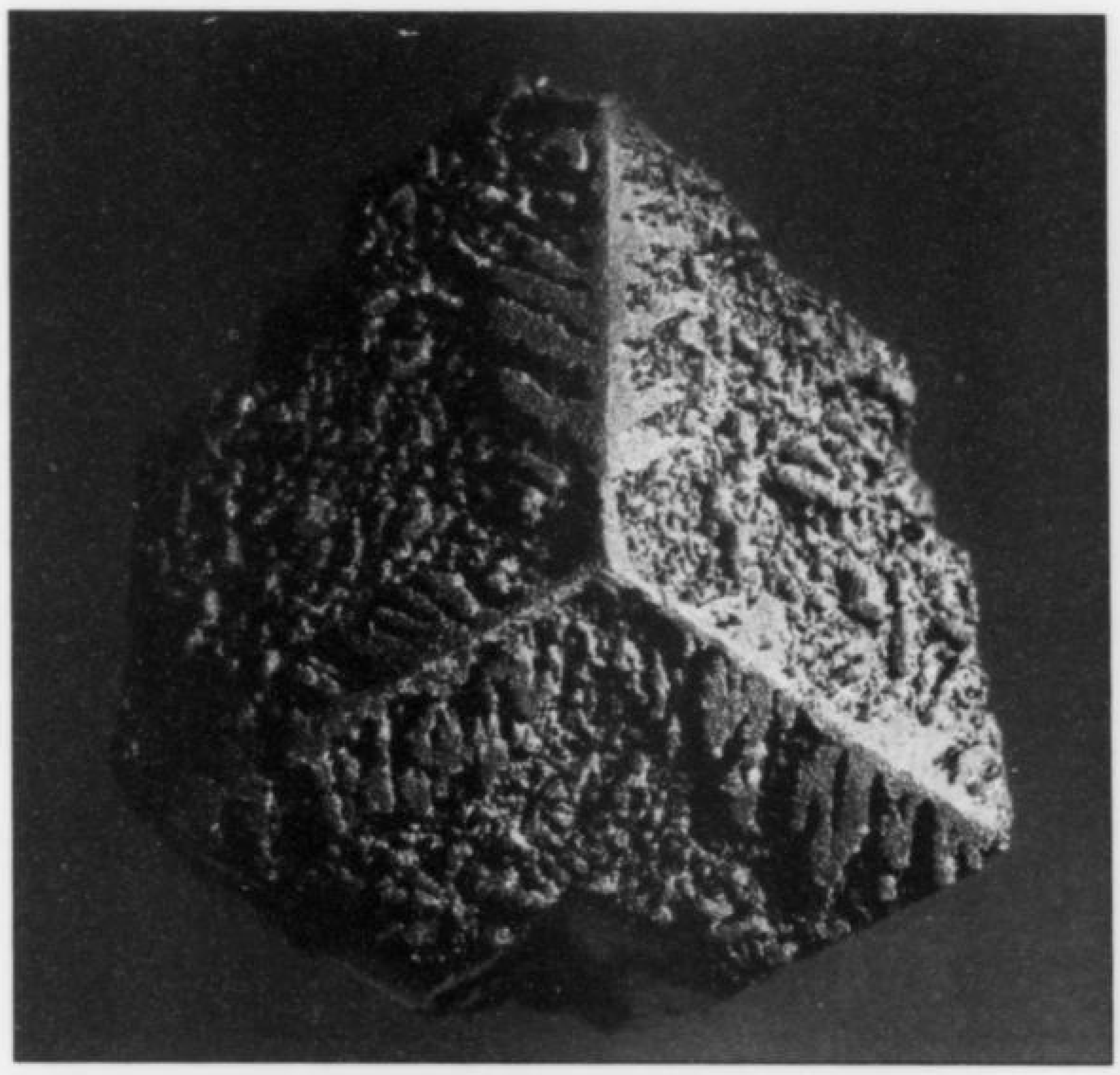


Figure 263. **Trigonal termination on schorl, 5.5 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

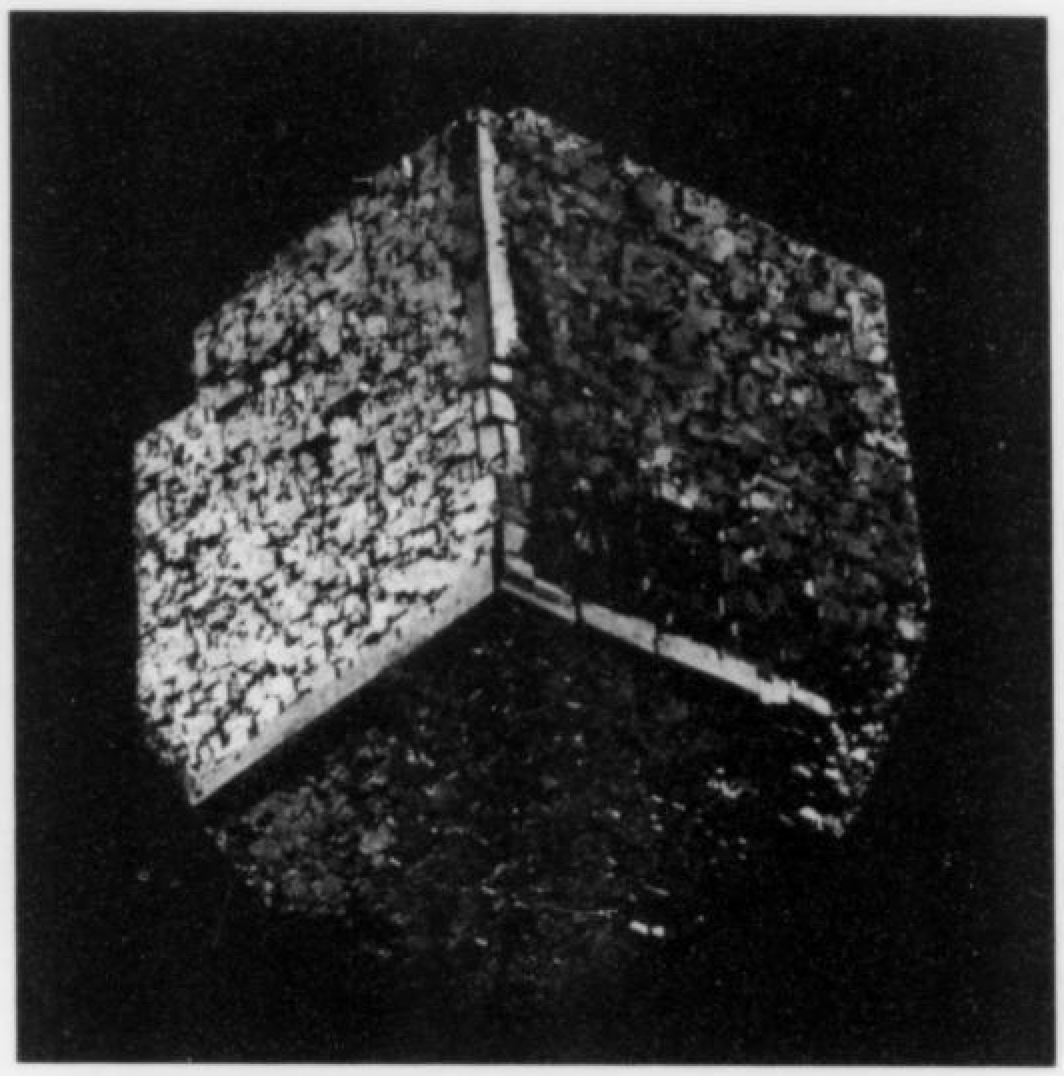


Figure 266. **Complexly terminated schorl crystal, 3.6 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 264. **Complexly terminated schorl crystal (possibly a regrown fracture surface), 3.7 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

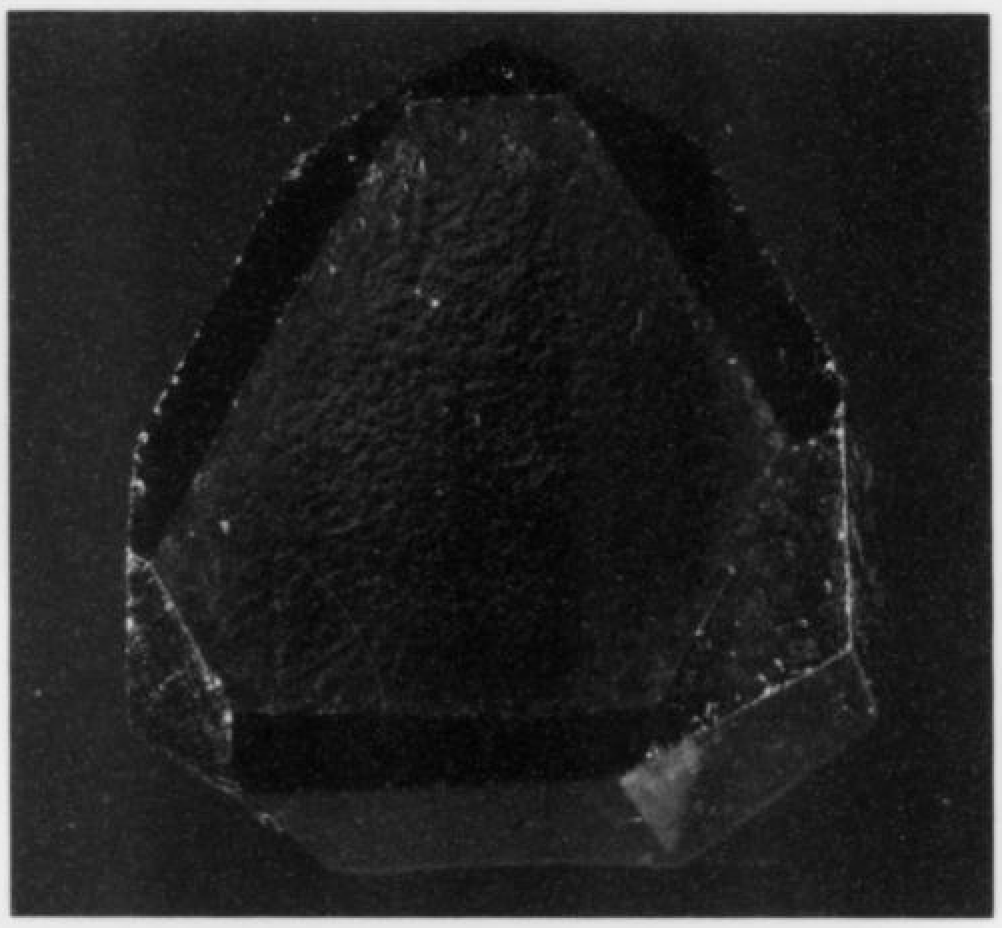


Figure 267. **Dimpled schorl termination, 2.8 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

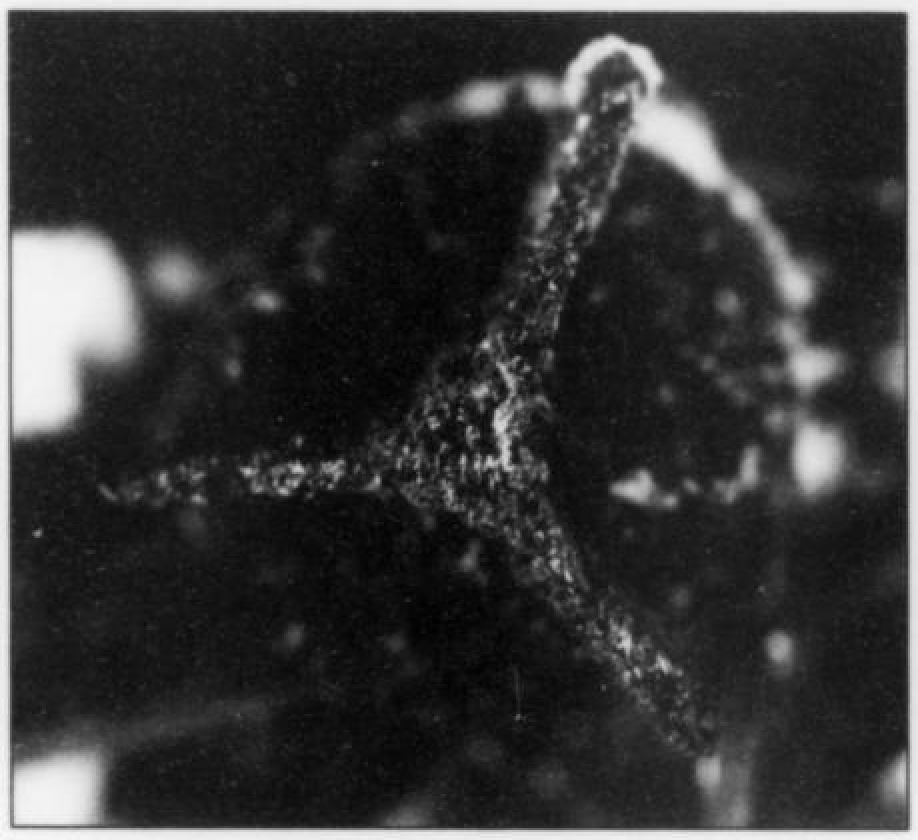


Figure 265. **Close-up of extreme trigonal development on schorl termination, 2.1 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 268. **Schorl crystal termination, 7.9 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

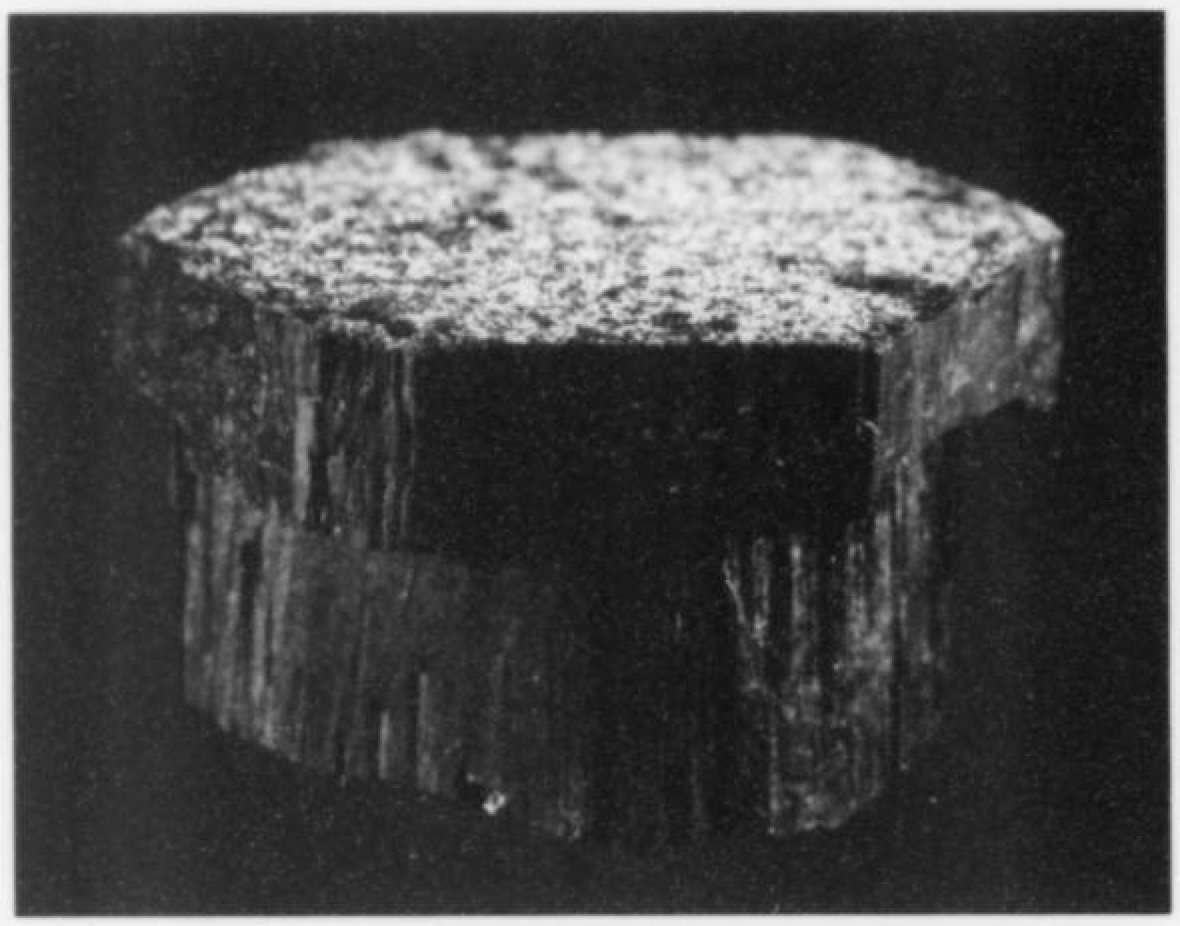


Figure 269. Table-like overgrowth termination on schorl, 4.2 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 271. Radiating aggregate of schorl, 6.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

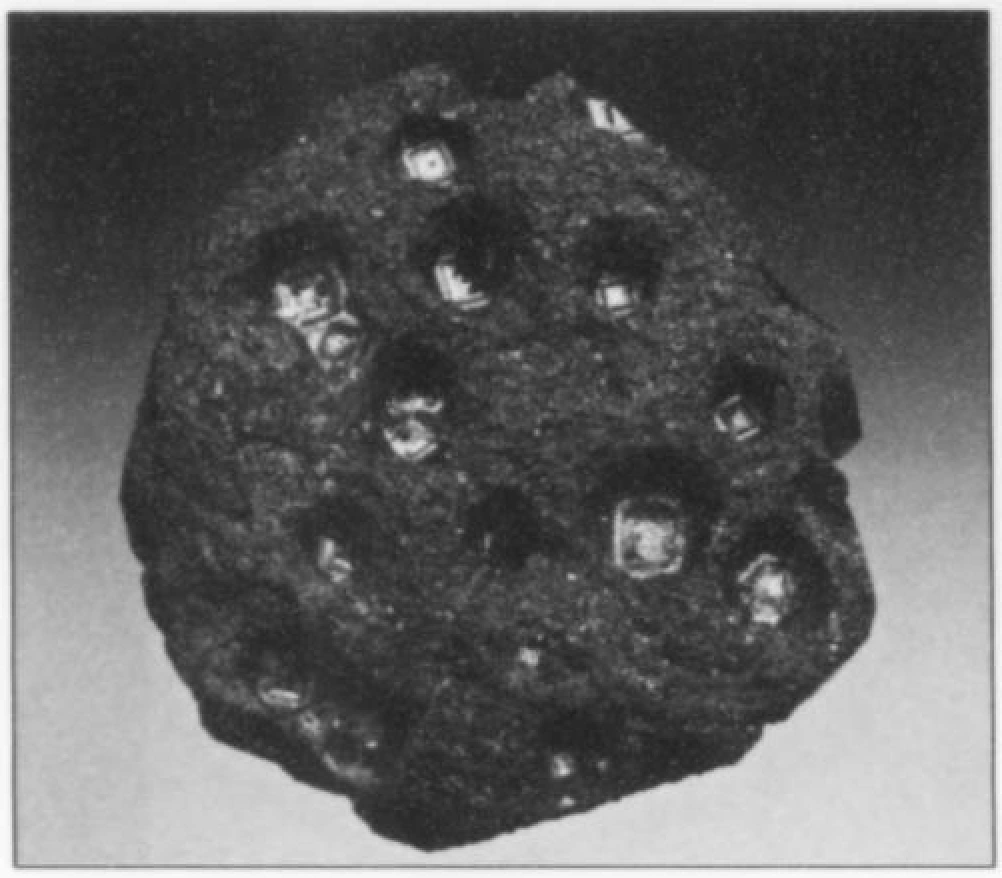


Figure 270. View down the *c* axis of a schorl termination, 6.8 cm diameter. The pedion face is marked by several pits showing the imprints of crystals that have been removed. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

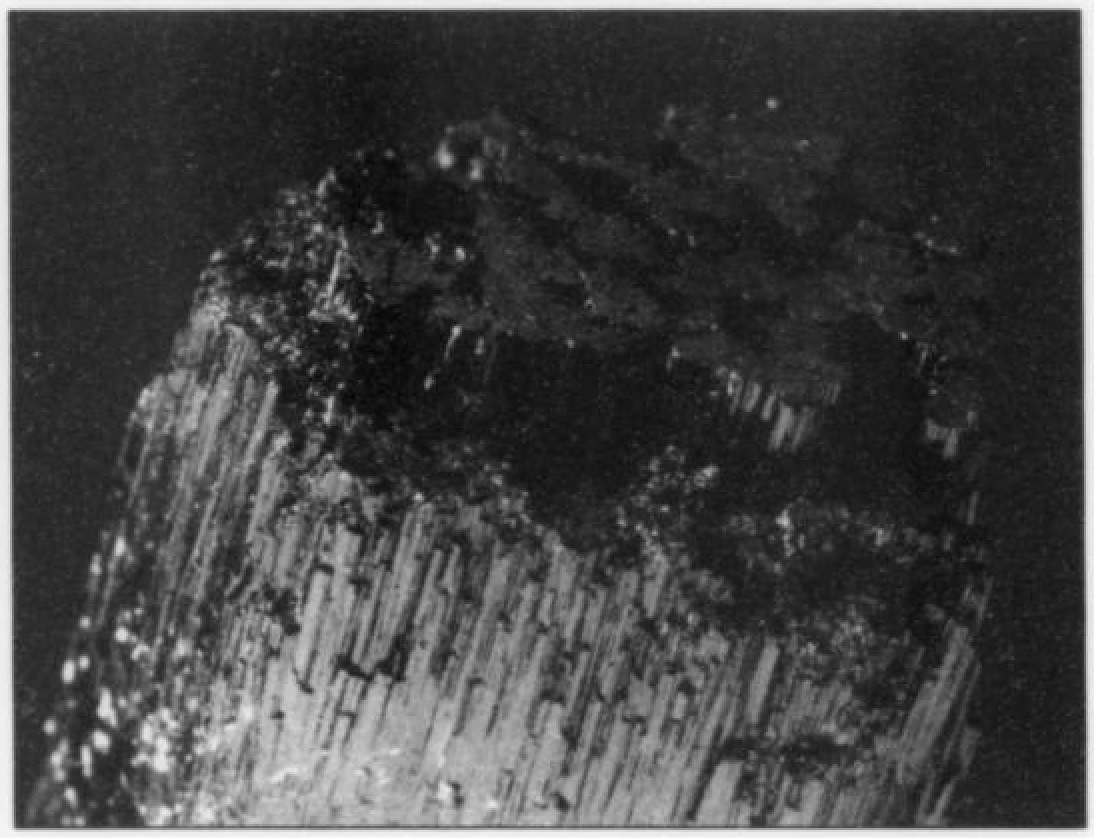


Figure 272. Schorl showing selective continued growth of the pinacoid face, 3.8 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

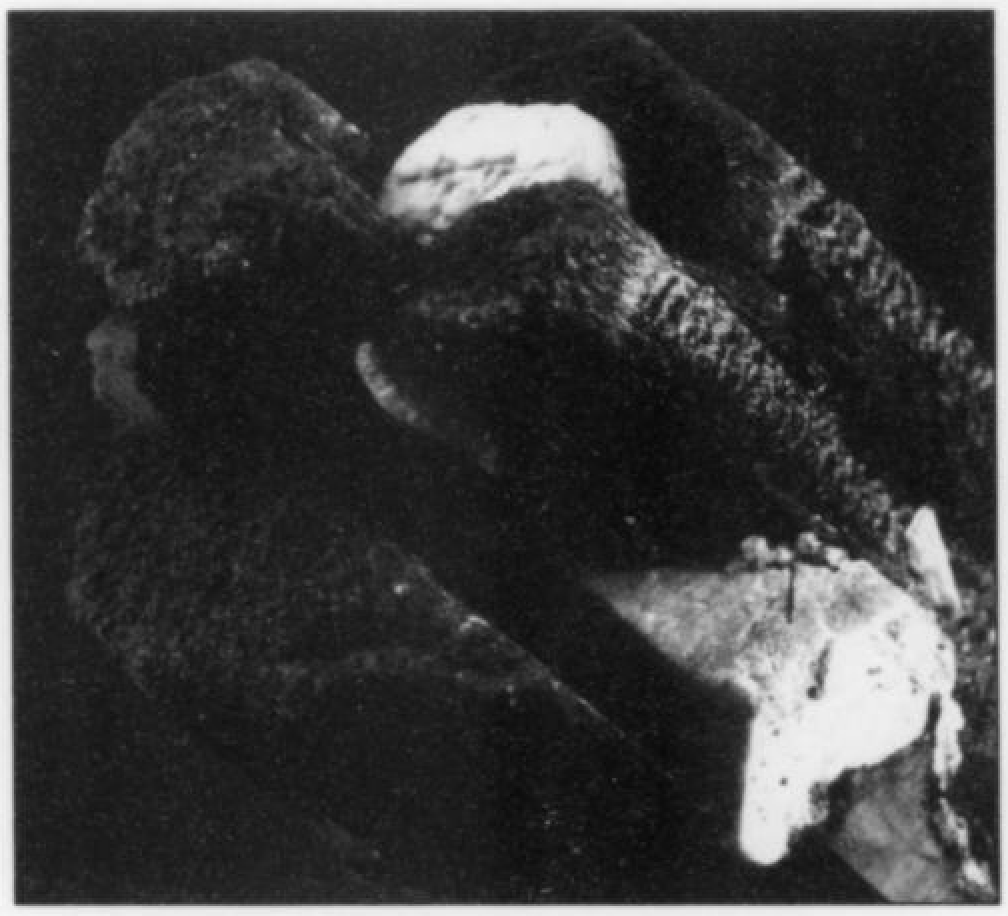
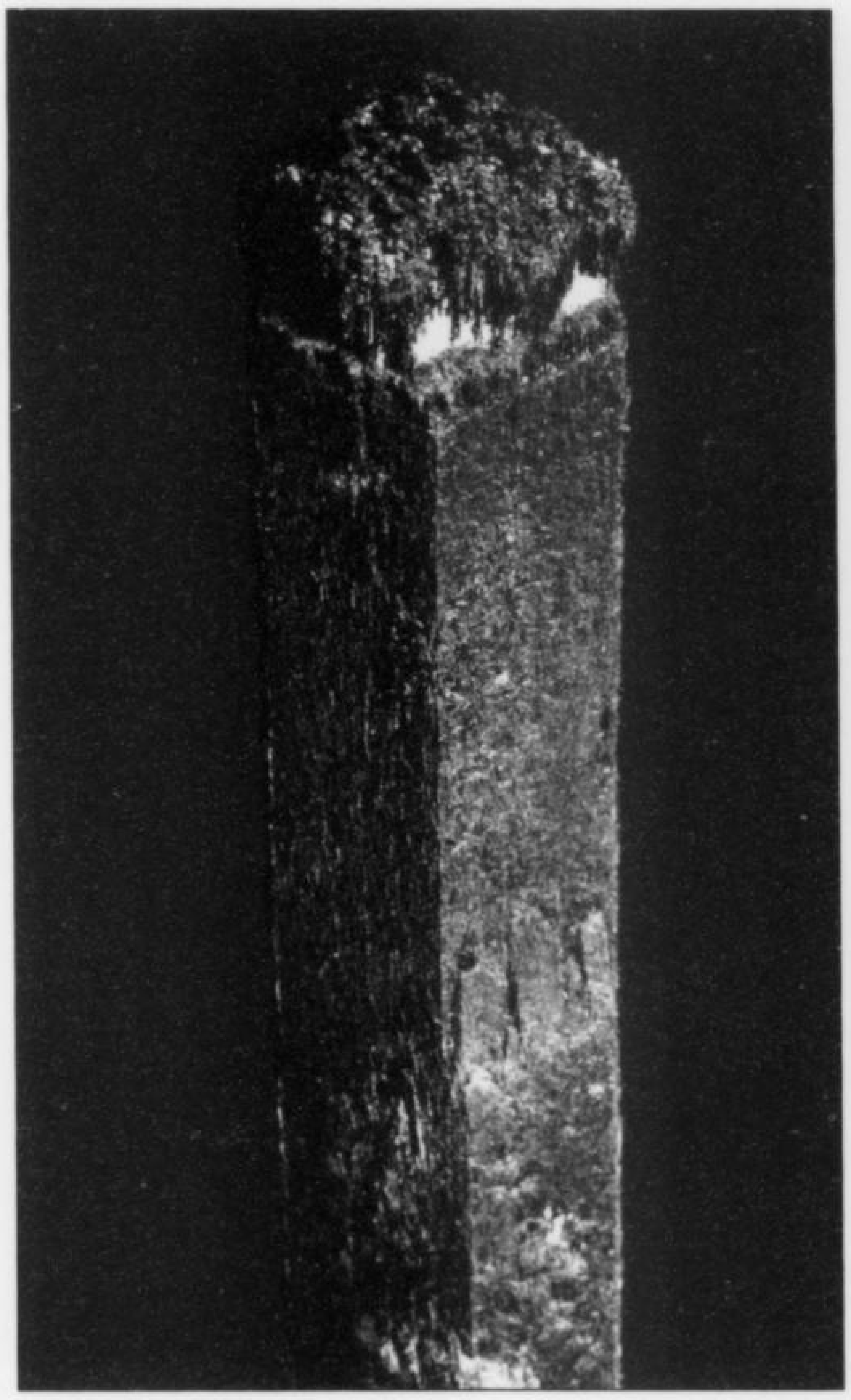


Figure 273. Schorl intergrown with muscovite, 4.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 274. Schorl with an embedded quartz crystal, 4 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



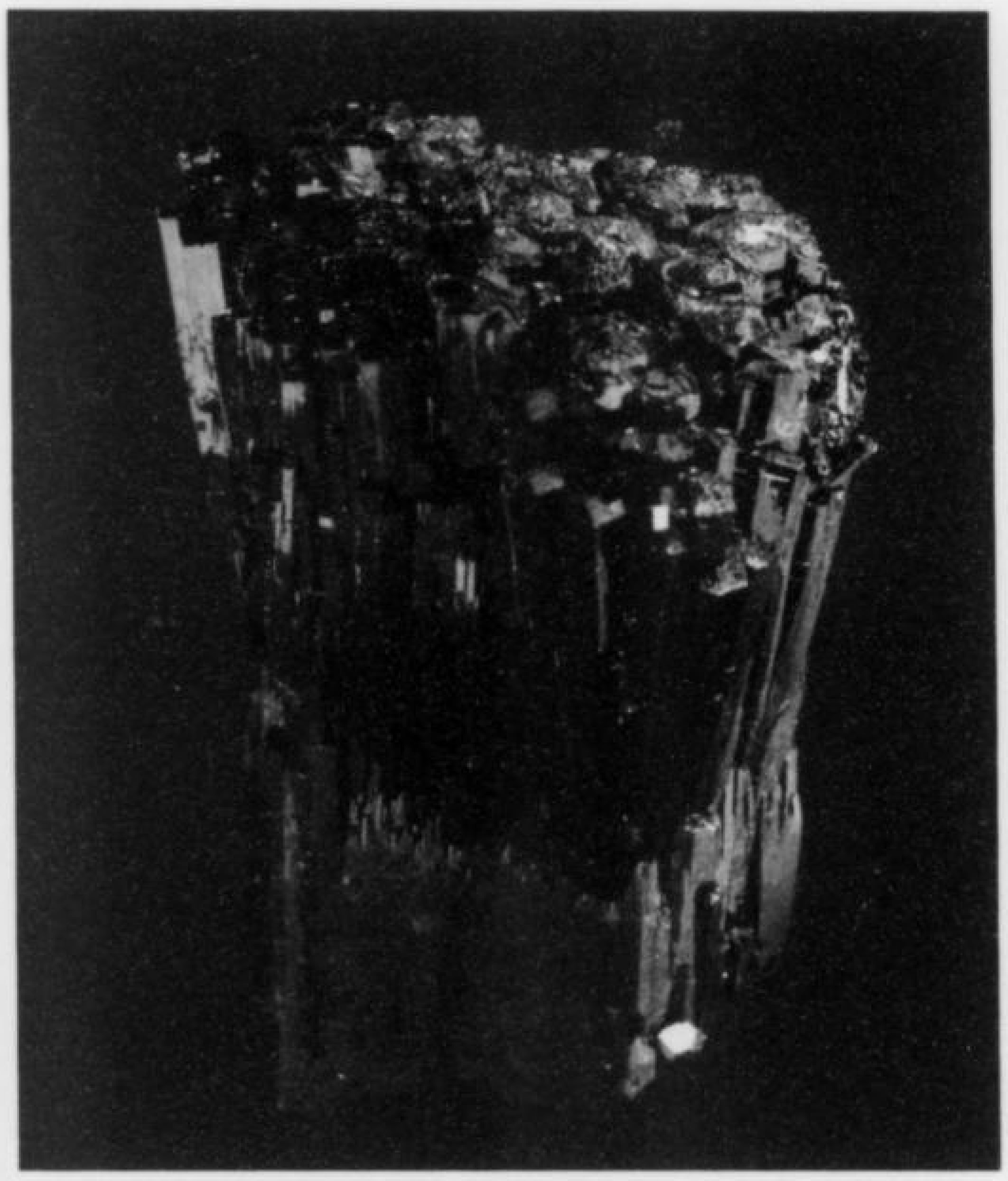


Figure 277. Schorl crystal fanning out into multiple terminations, 4.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 275. Prismatic schorl terminated by bundles of acicular schorl crystals, 11.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

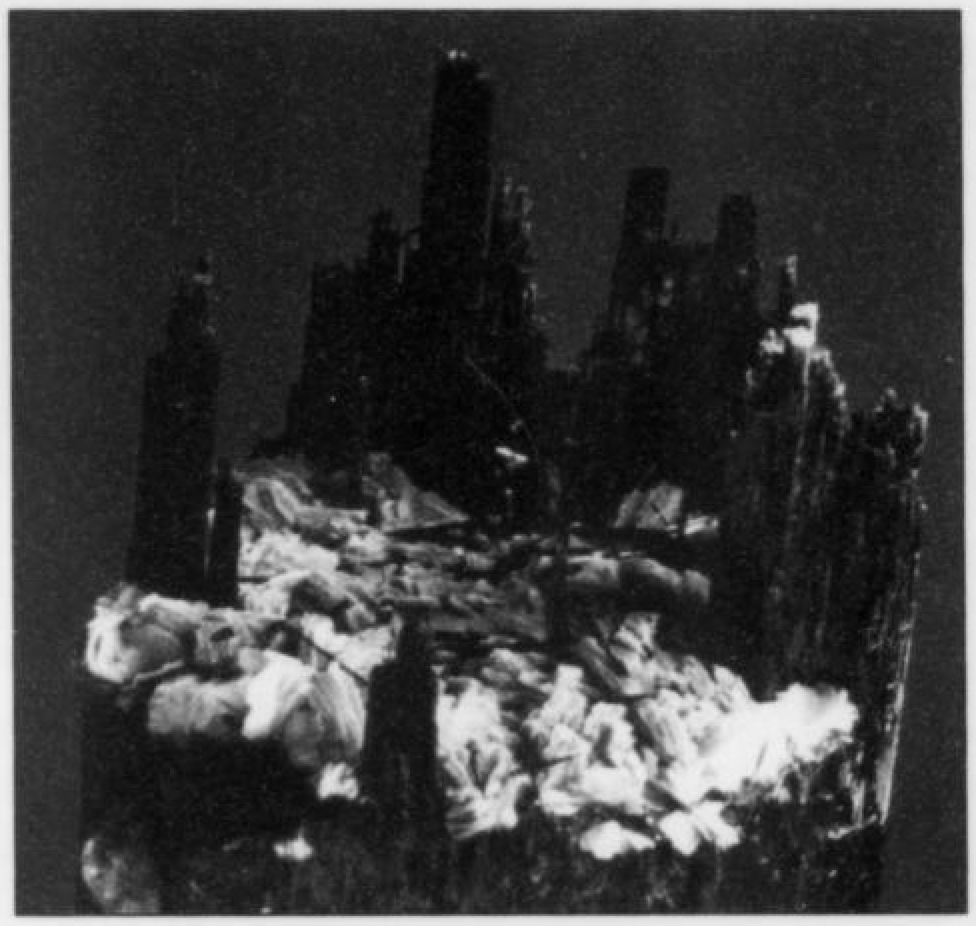


Figure 278. Schorl crystal termination (possibly a fracture surface) partially covered by muscovite, with areas showing additional crystal growth, 3.6 cm diameter. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 276. Cavernous schorl termination, 3.8 cm diameter. The outer section of the prism grew more rapidly than the middle section, then broke off and fell into the central hollow. These fragments subsequently were cemented together in a network by continued crystal growth. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

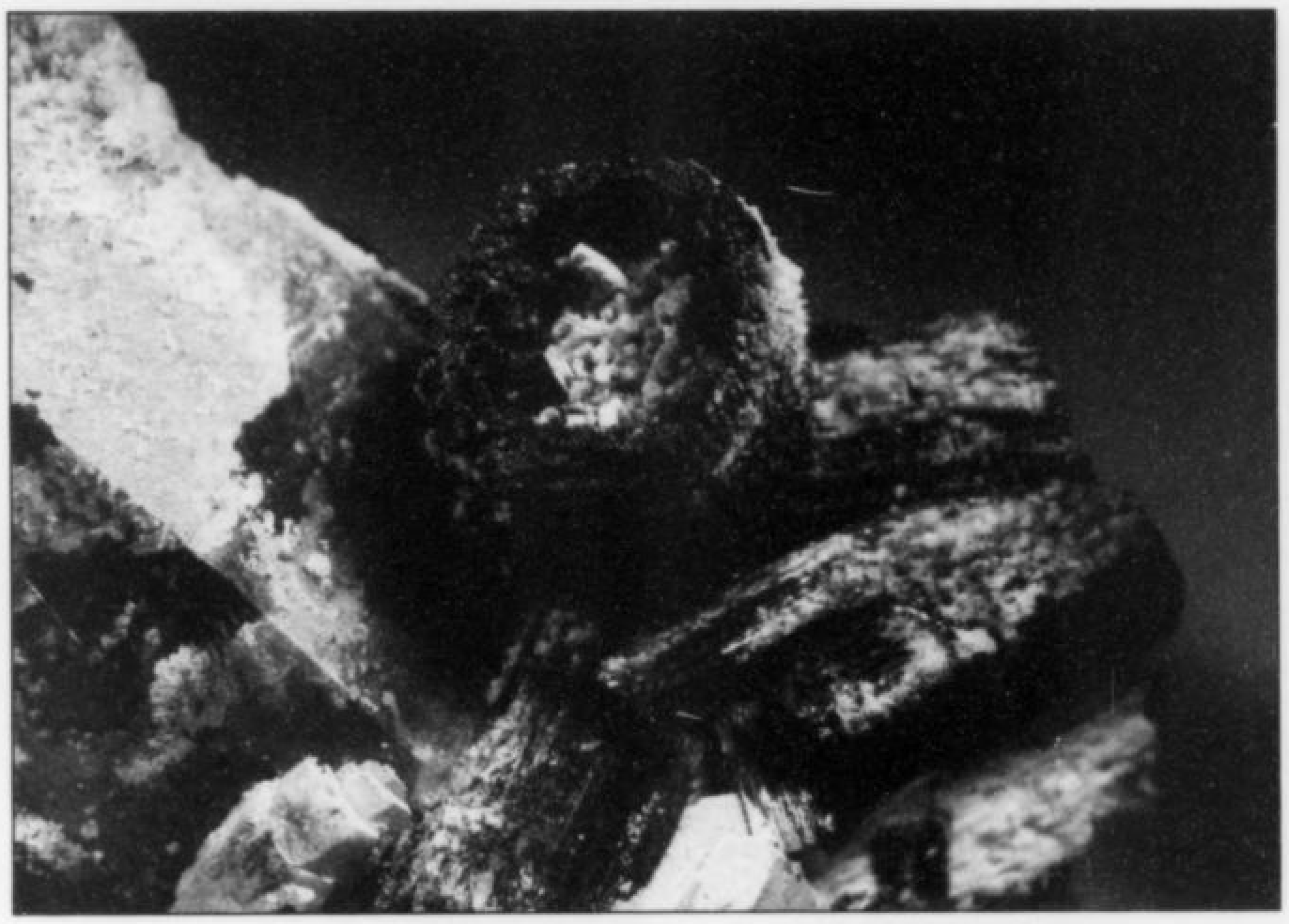


Figure 279. Hollow schorl partially filled with muscovite and minor topaz, 6.4 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

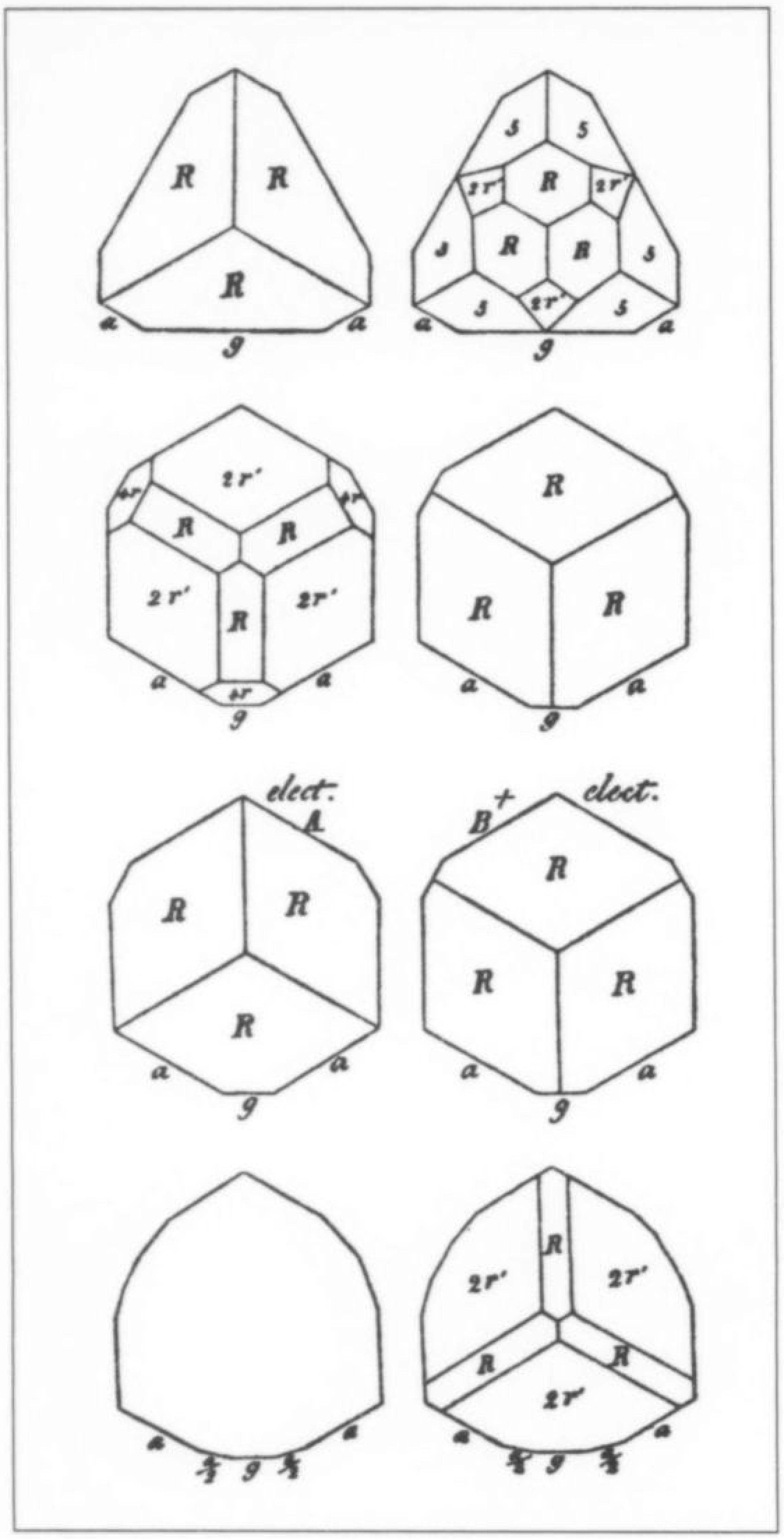


Figure 280. **Crystal drawing of tourmaline from Norway, Greenland and Germany similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

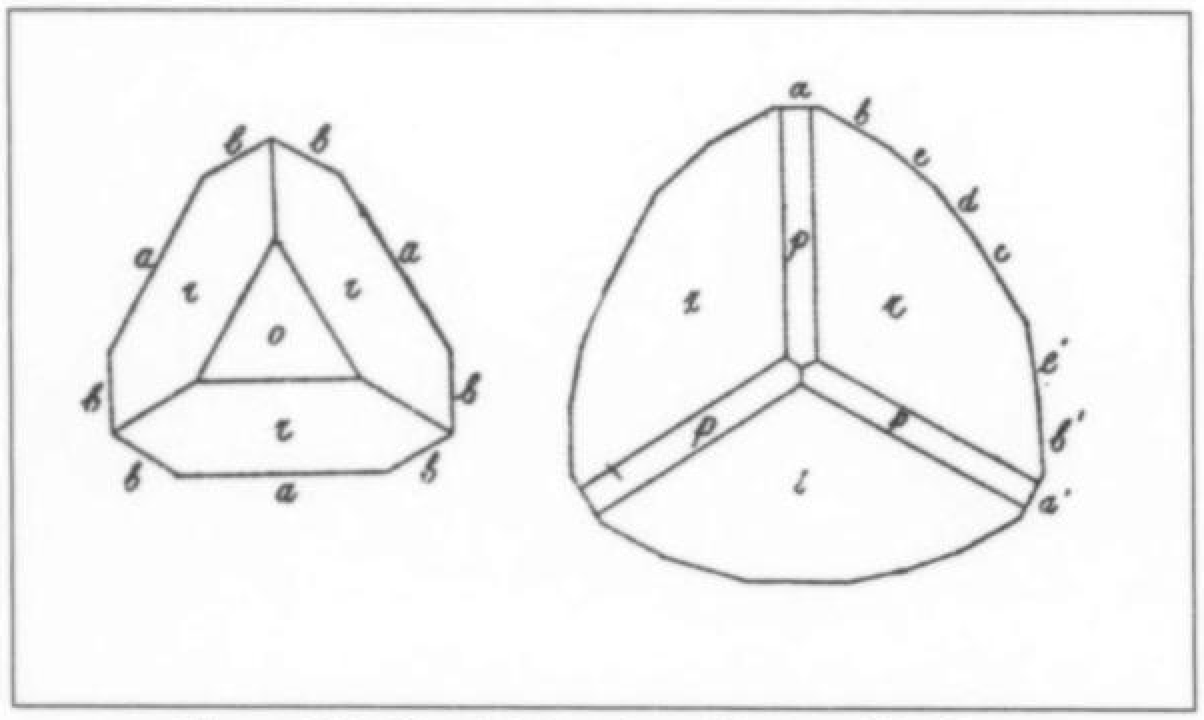


Figure 281. **Crystal drawing of tourmaline from the Ural Mountains similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

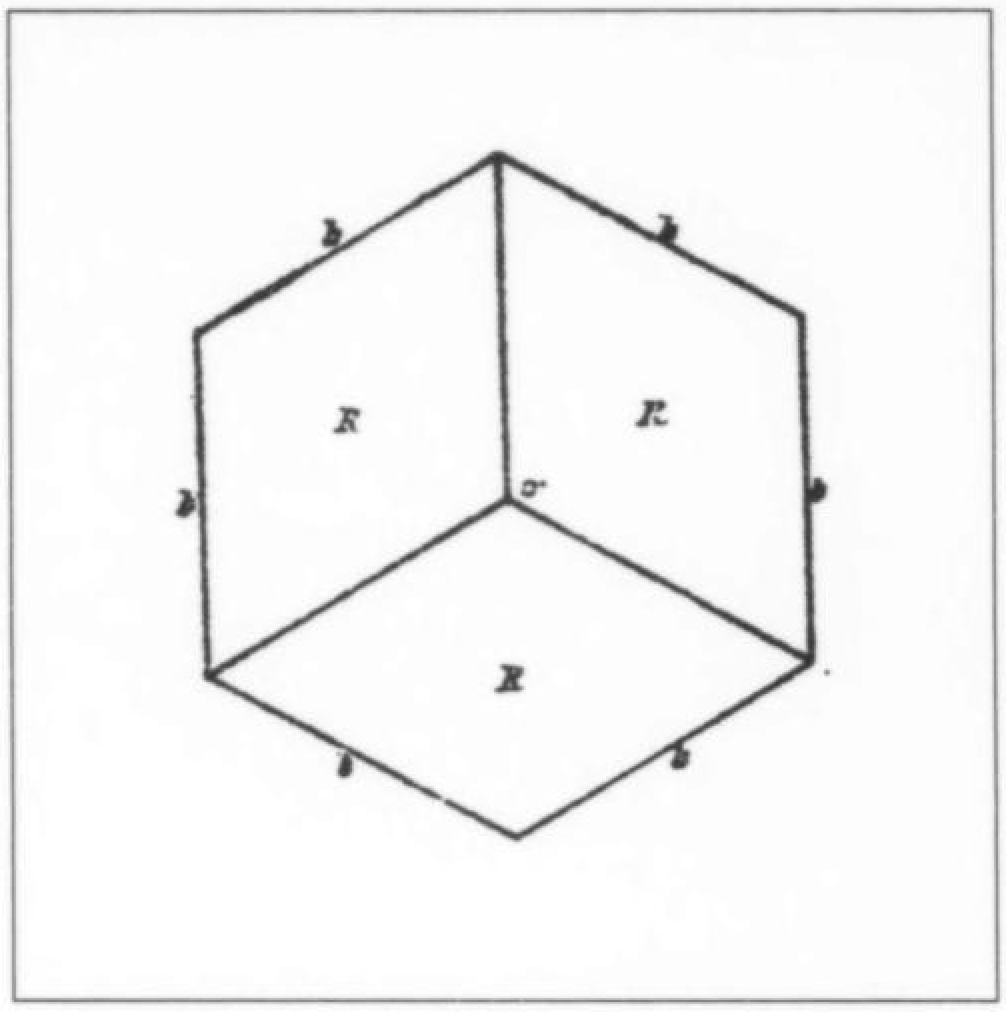


Figure 282. **Crystal drawing of tourmaline from Paris, Maine similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

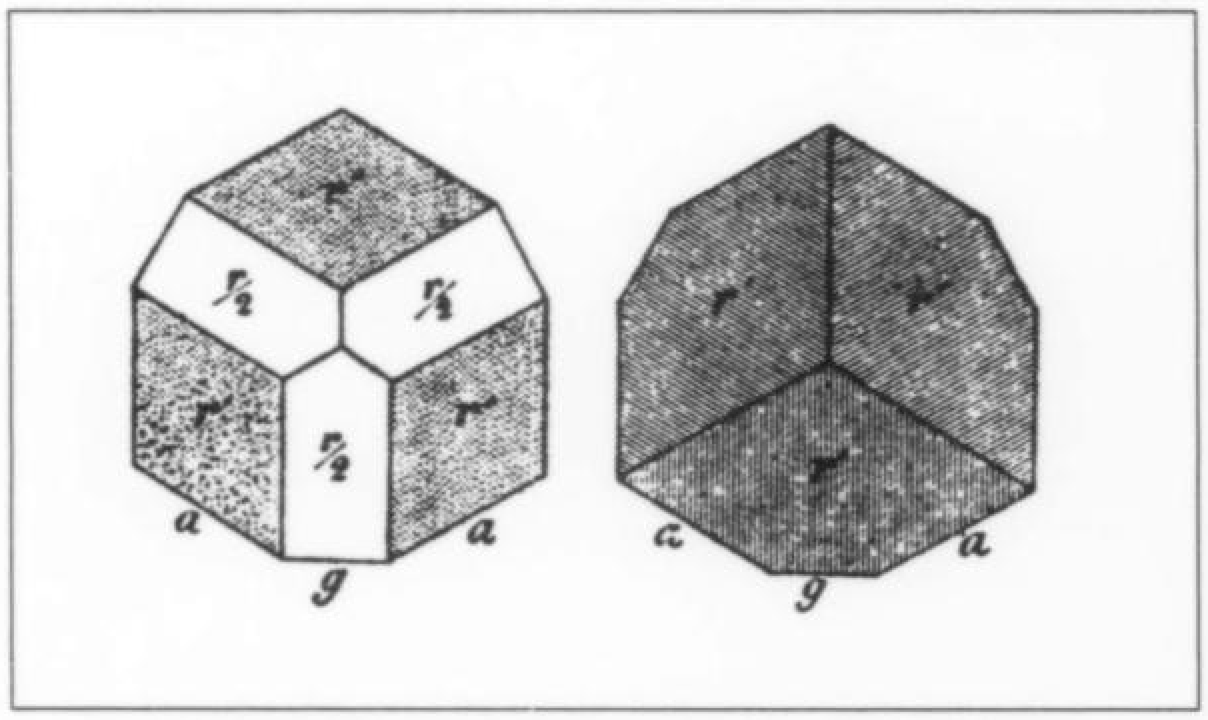


Figure 283. **Crystal drawing of tourmaline from Saxony similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

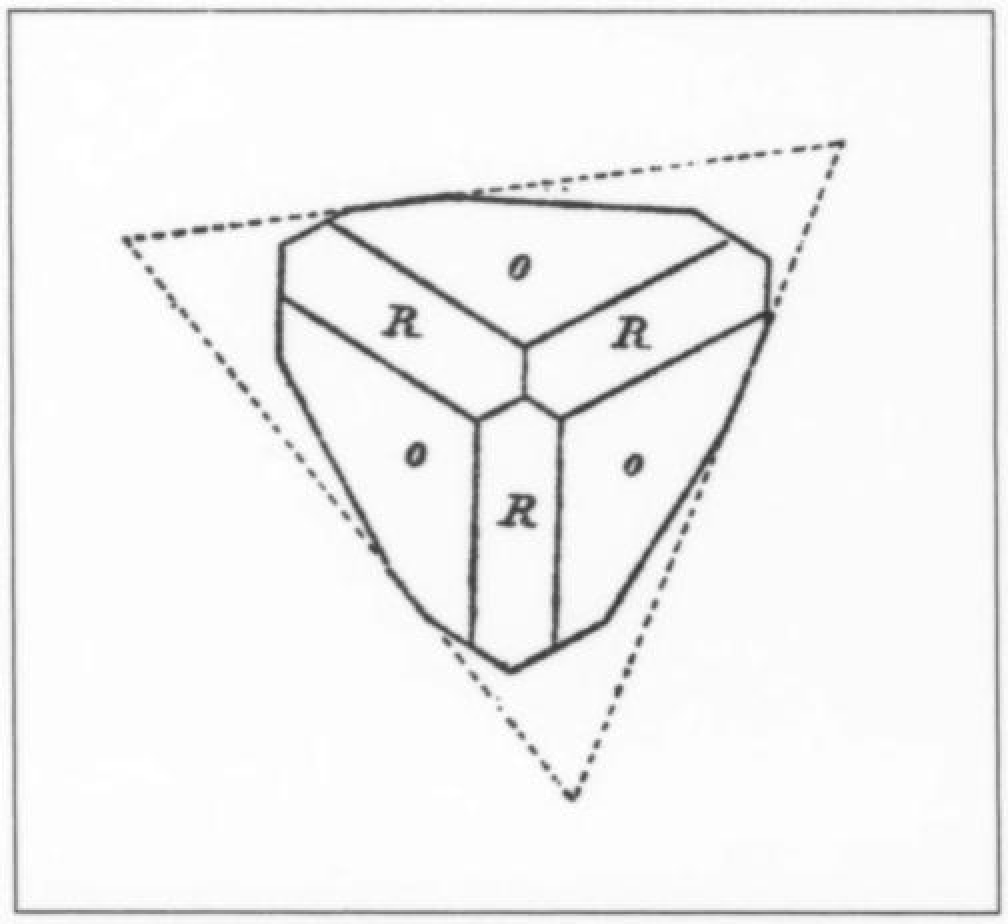


Figure 284. **Crystal drawing of tourmaline from Norway similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

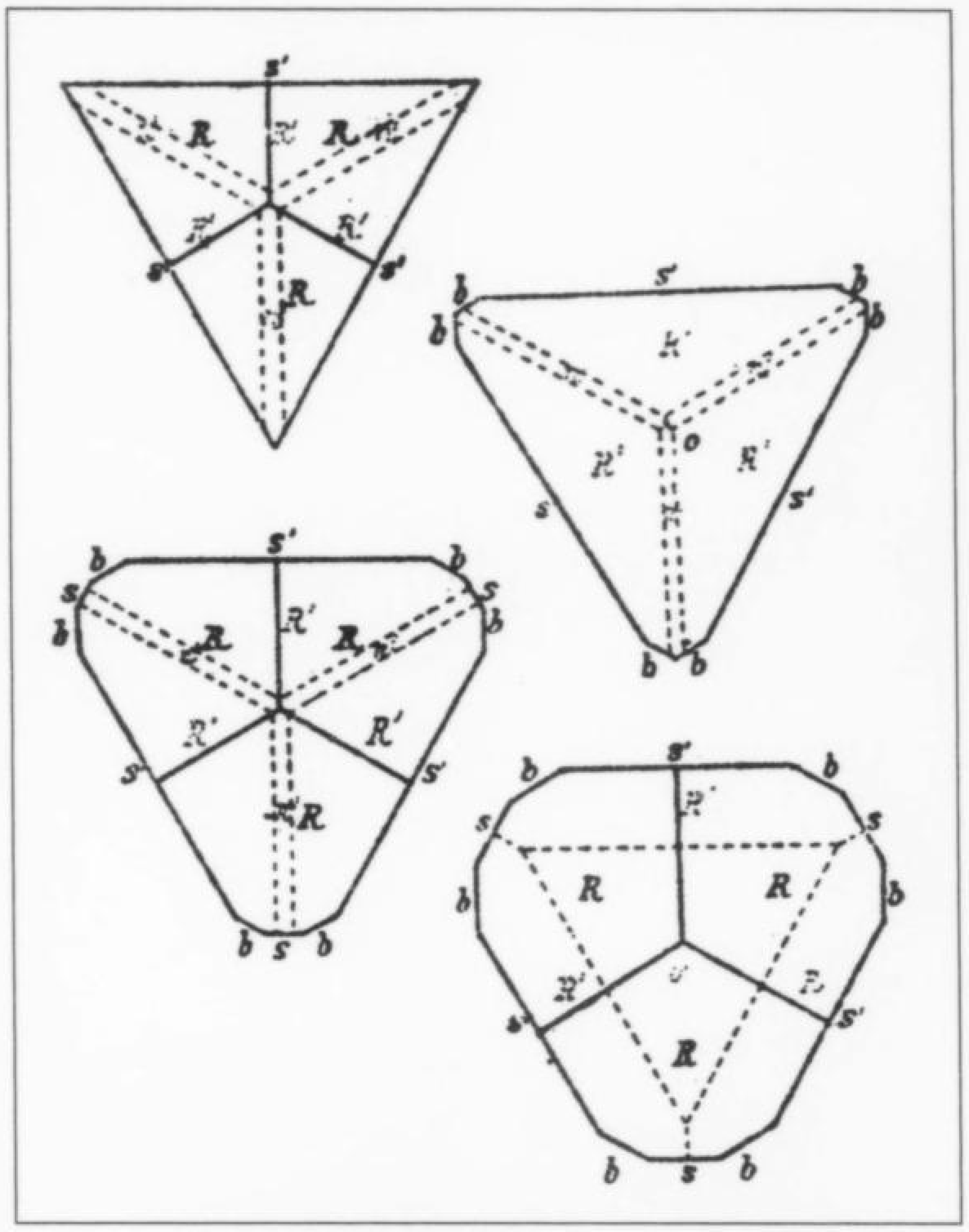


Figure 285. **Crystal drawing of tourmaline from Ceylon similar in habit to that of schorl from the Erongo Mountains (Goldschmidt, 1922).**

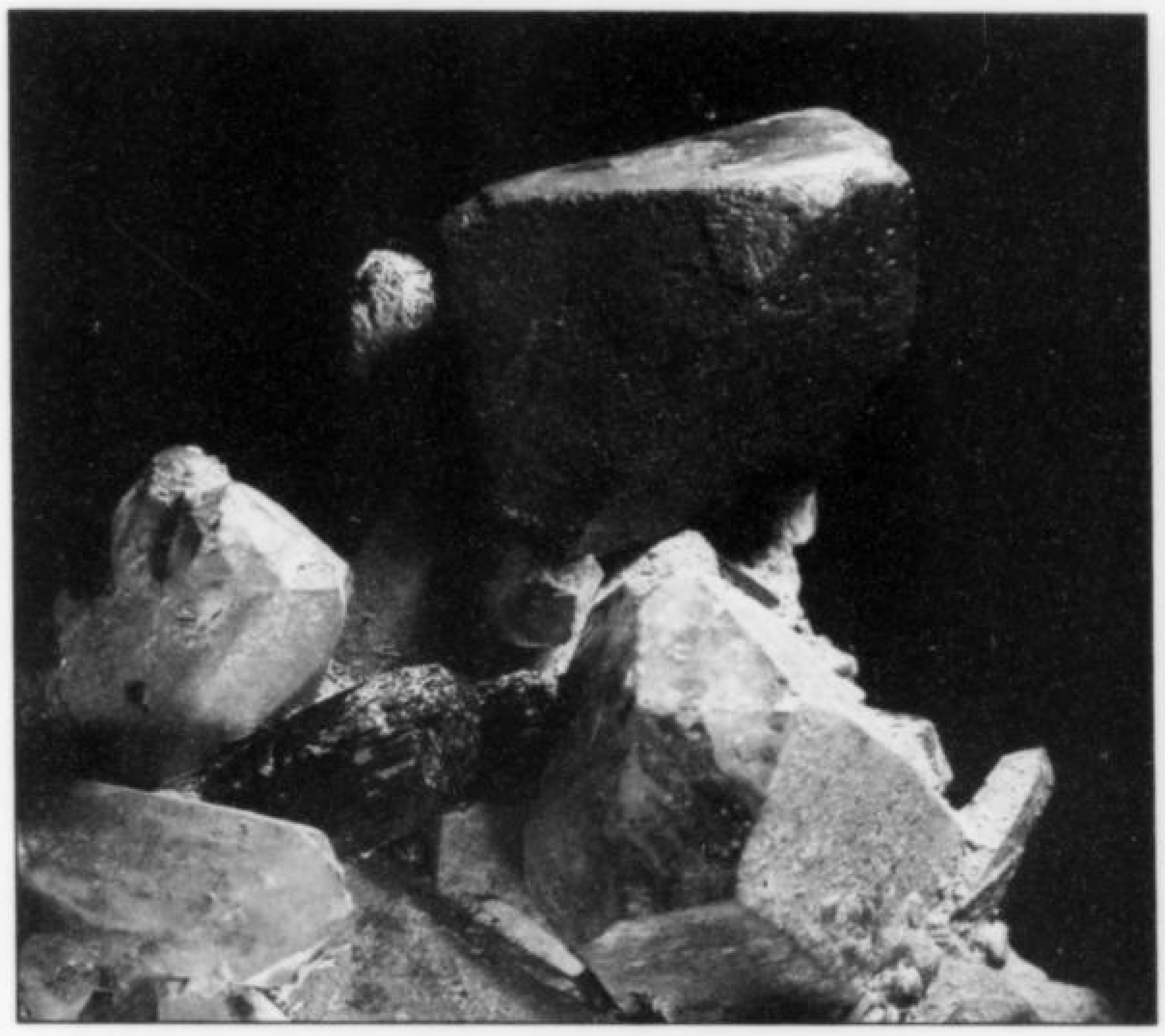


Figure 286. **Siderite on quartz with schorl, 4.5 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 287. **Siderite crystal partially altered to goethite, 27 cm, 9.4 kg, associated with minor garnet and schorl. This is the largest known siderite from the Erongo Mountains. Uli Bahmann collection; Bruce Cairncross photo.**

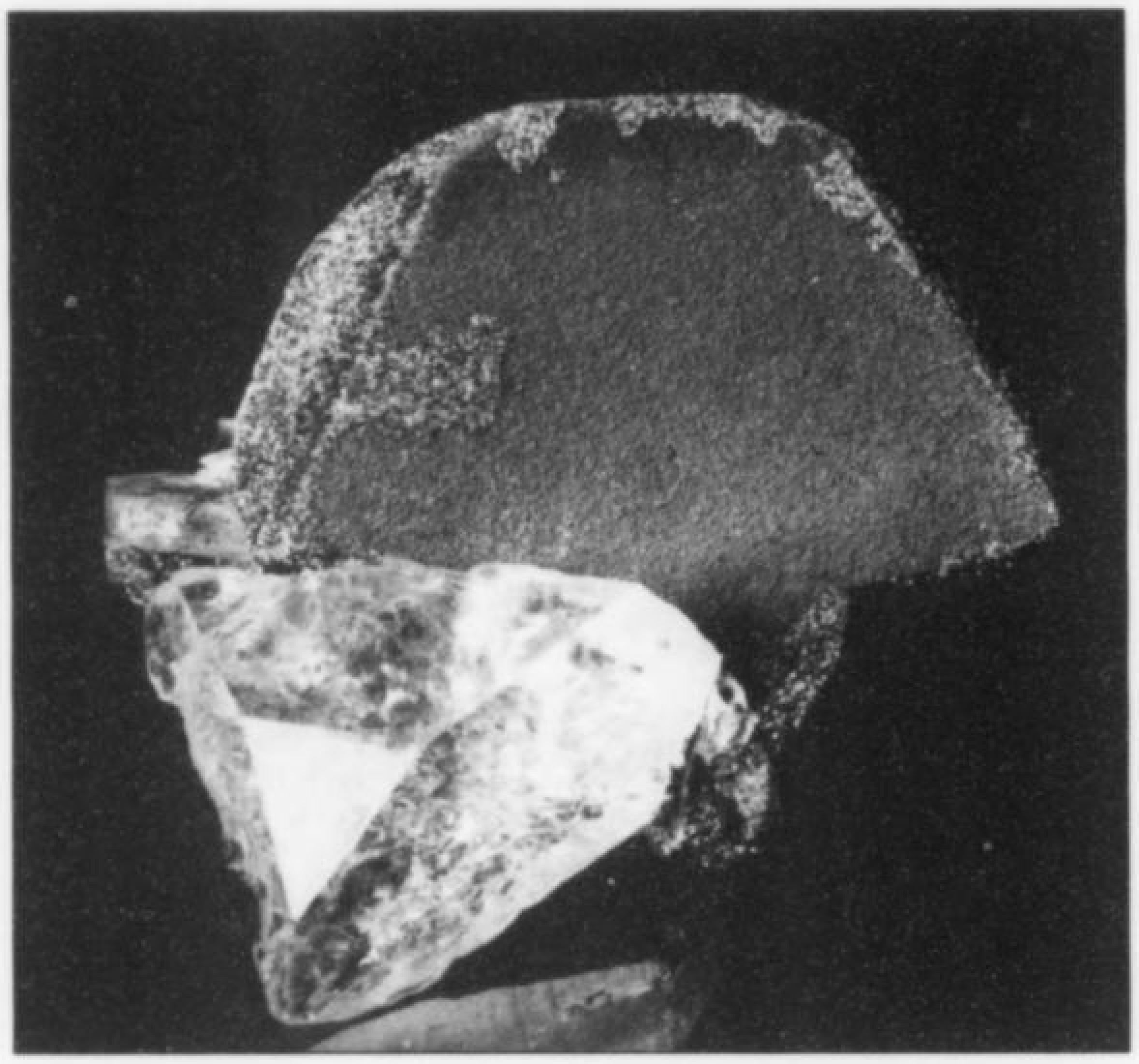


Figure 288. **Siderite with pyrolusite on quartz, 5.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

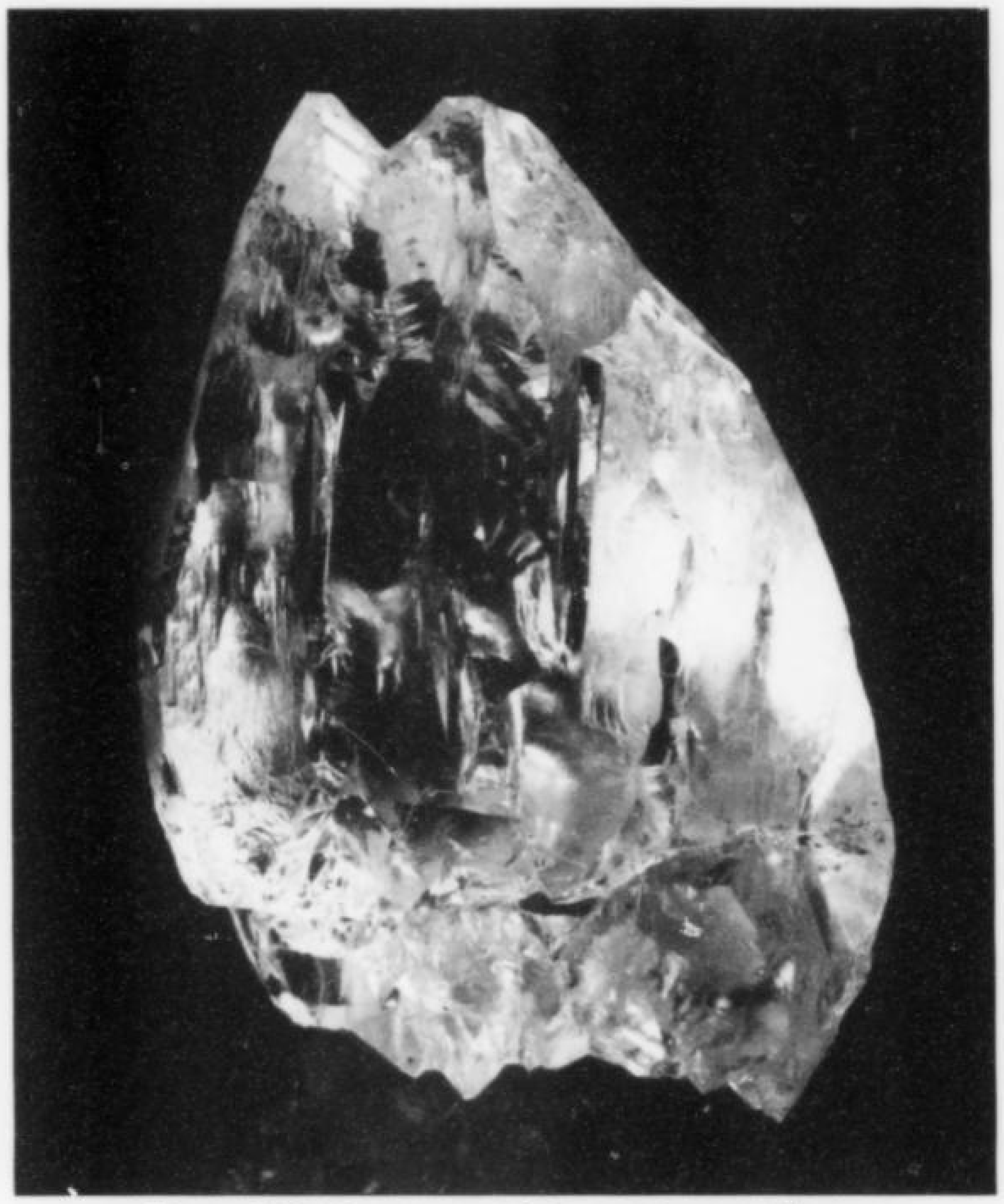


Figure 290. **Topaz crystal, 3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Siderite $Fe^{2+}CO_3$

Pristine, unaltered siderite is virtually unknown at Erongo. There is, however, a large specimen in the Nägele collection composed of unaltered siderite with interlayerings of rhodochrosite. Goethite pseudomorphs after siderite are very common, the rhombohedral crystals of the original siderite being now partially or wholly replaced by goethite. These specimens have periodically been collected from the diggings on the western and southwestern sides of the Erongo Mountains. In September 2001, some excellent examples of these pseudomorphs were collected; the most notable one is a single 27-cm crystal weighing 9.4 kg (in the Bahmann collection).

Figure 291. **Topaz studded with schorl, 3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 289. **Stolzite crystal, 3 cm. Uli Bahmann collection; Bruce Cairncross photo.**

Stolzite $PbWO_4$

Rare stolzite microcrystals have been found. They are pale orange and occur on orthoclase. In May 2006, two large, pale gray stolzite crystals were collected. One is tabular, euhedral and looks superficially like wulfenite. The other specimen has no distinct crystal faces but is composed of smooth, curved surfaces suggesting partial resorption.

Topaz $Al_2SiO_4(F,OH)_2$

Erongo topaz is characteristically partly etched, with relatively well-developed crystal faces. It is typically colorless but can be pale green or pale blue, ranging from partly translucent to transparent. Associated species are quartz, orthoclase, fluorite and schorl. The largest known crystal measures 20 cm. The crystals occur

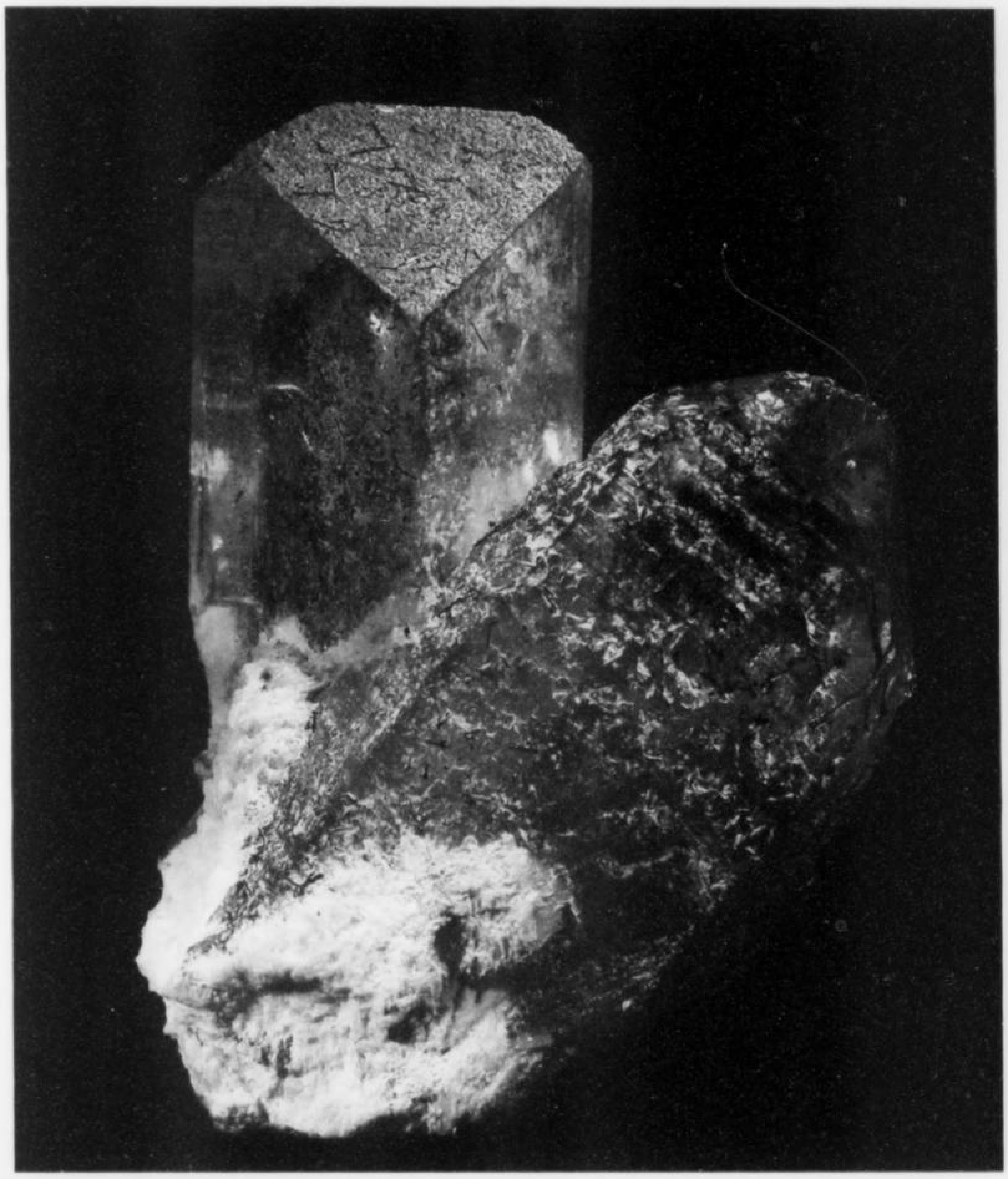
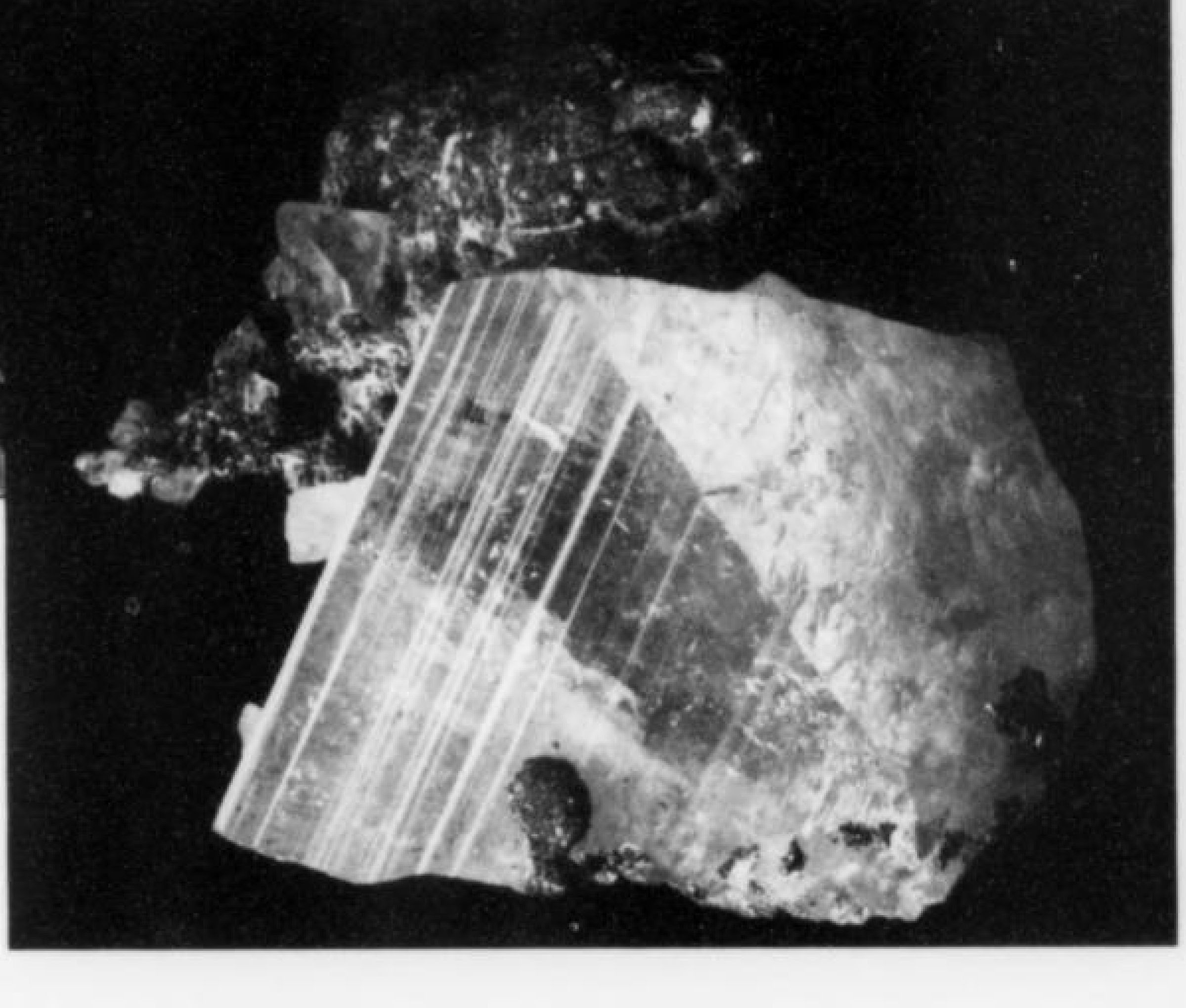


Figure 292. Topaz on quartz, 7.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 293. Pale blue topaz on quartz, 4 cm. Erongo Mountains, Namibia. Private collection; Ernst A. Schnaitmann photo.

Figure 294. Topaz with muscovite-coated orthoclase, 6.4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.



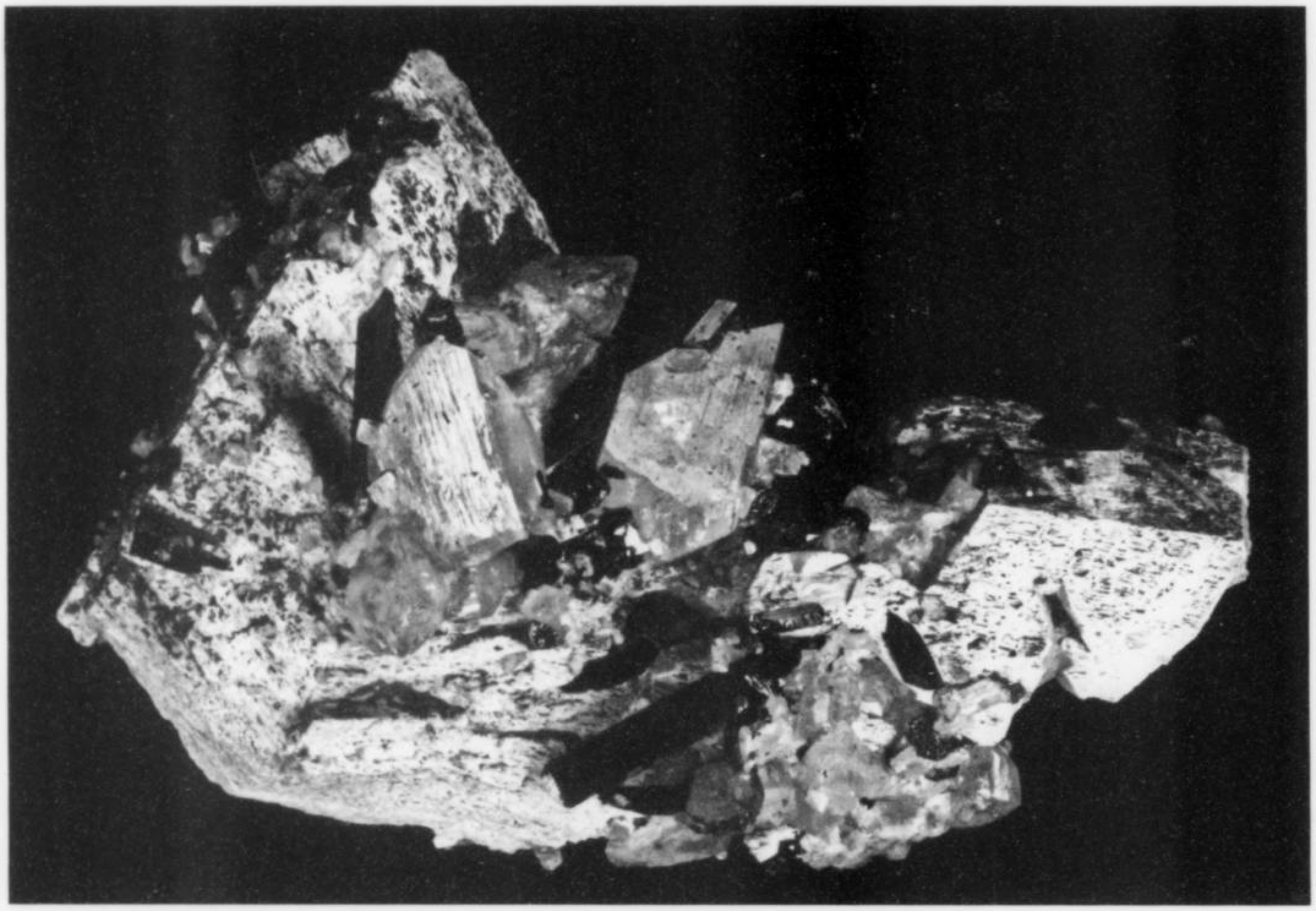


Figure 295. Topaz, schorl and orthoclase, 14.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

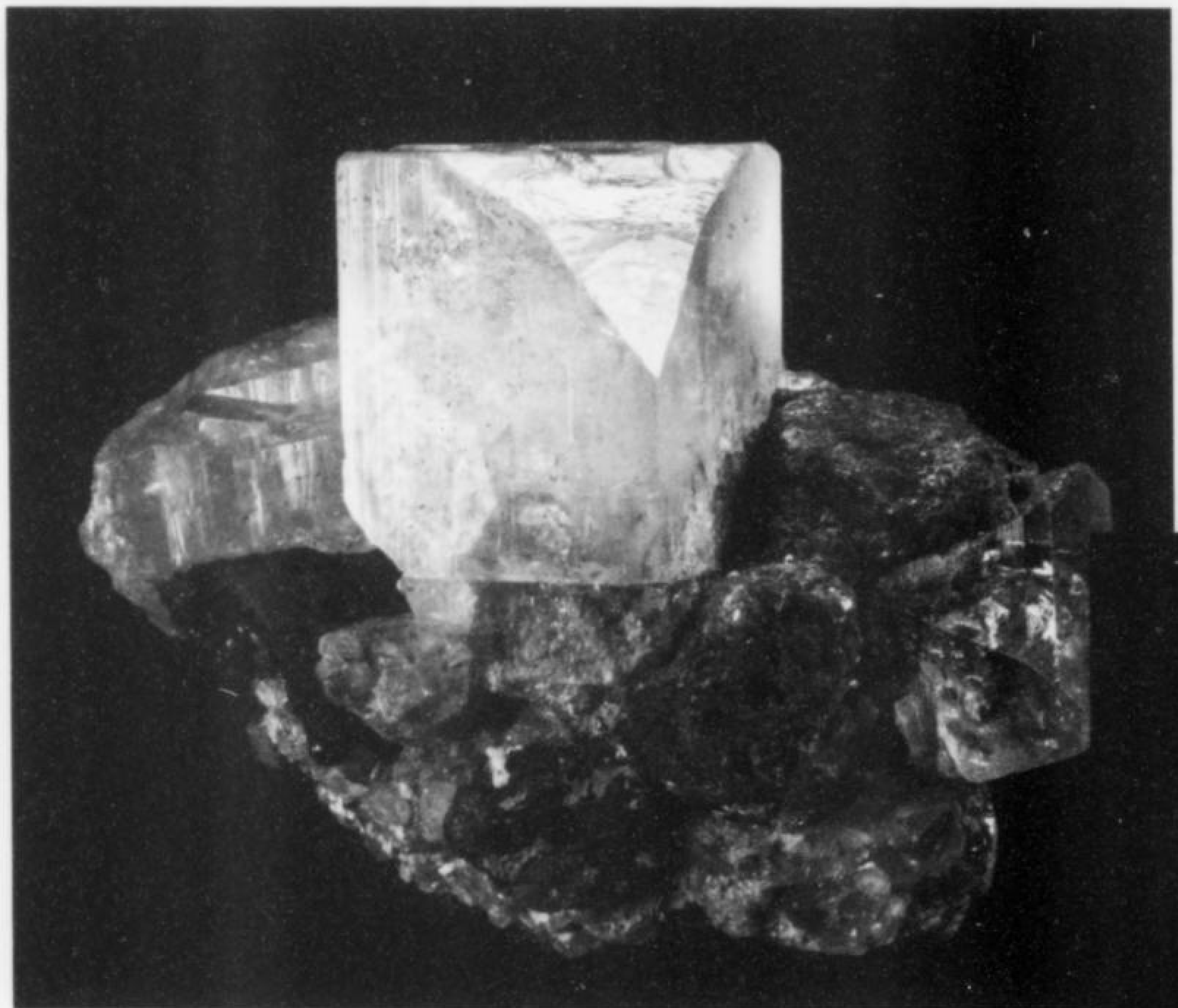


Figure 296. Topaz, quartz and minor schorl, 7.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 297. Topaz with quartz and schorl, 4.2 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

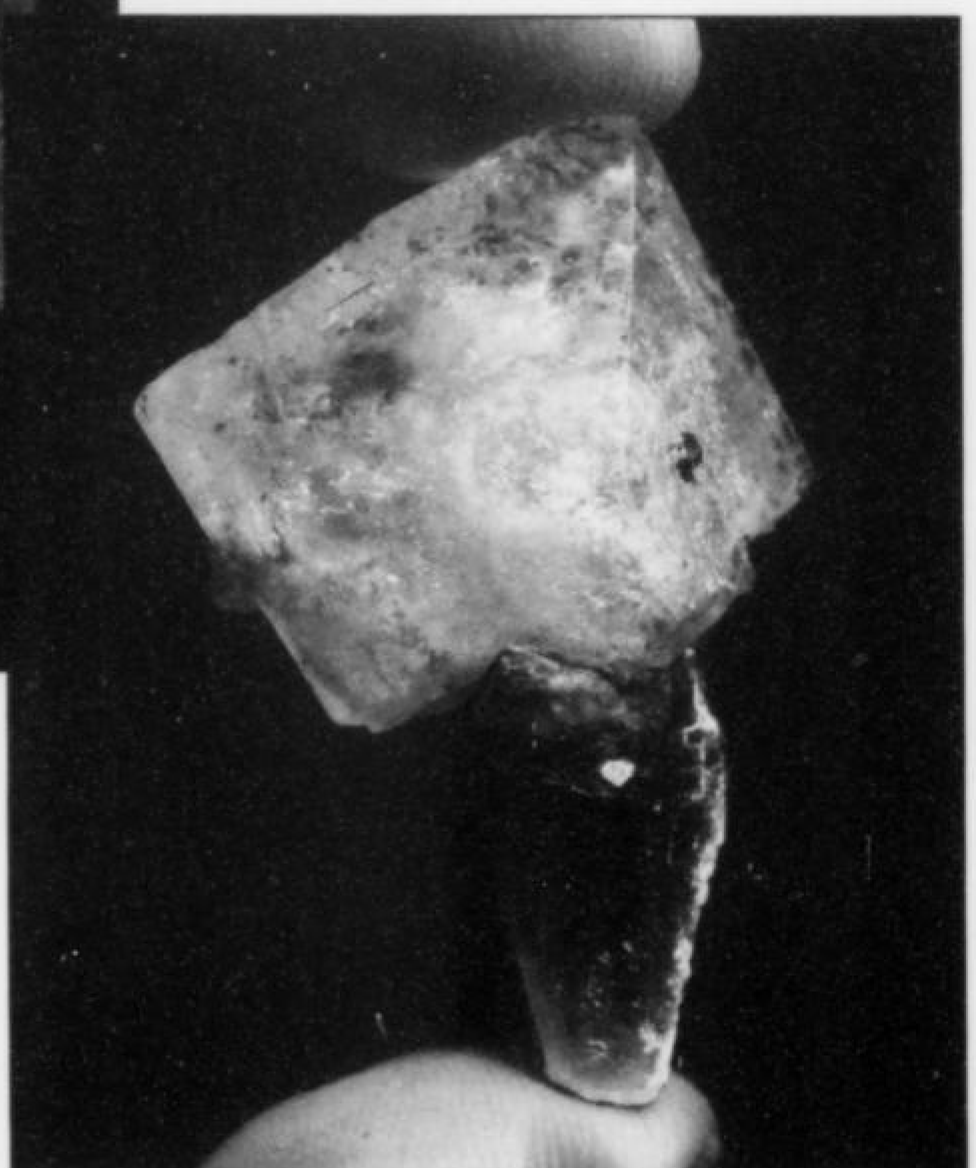


Figure 298. **Doubly terminated topaz with schorl, 20 cm. This is the largest known topaz from the Erongo Mountains. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

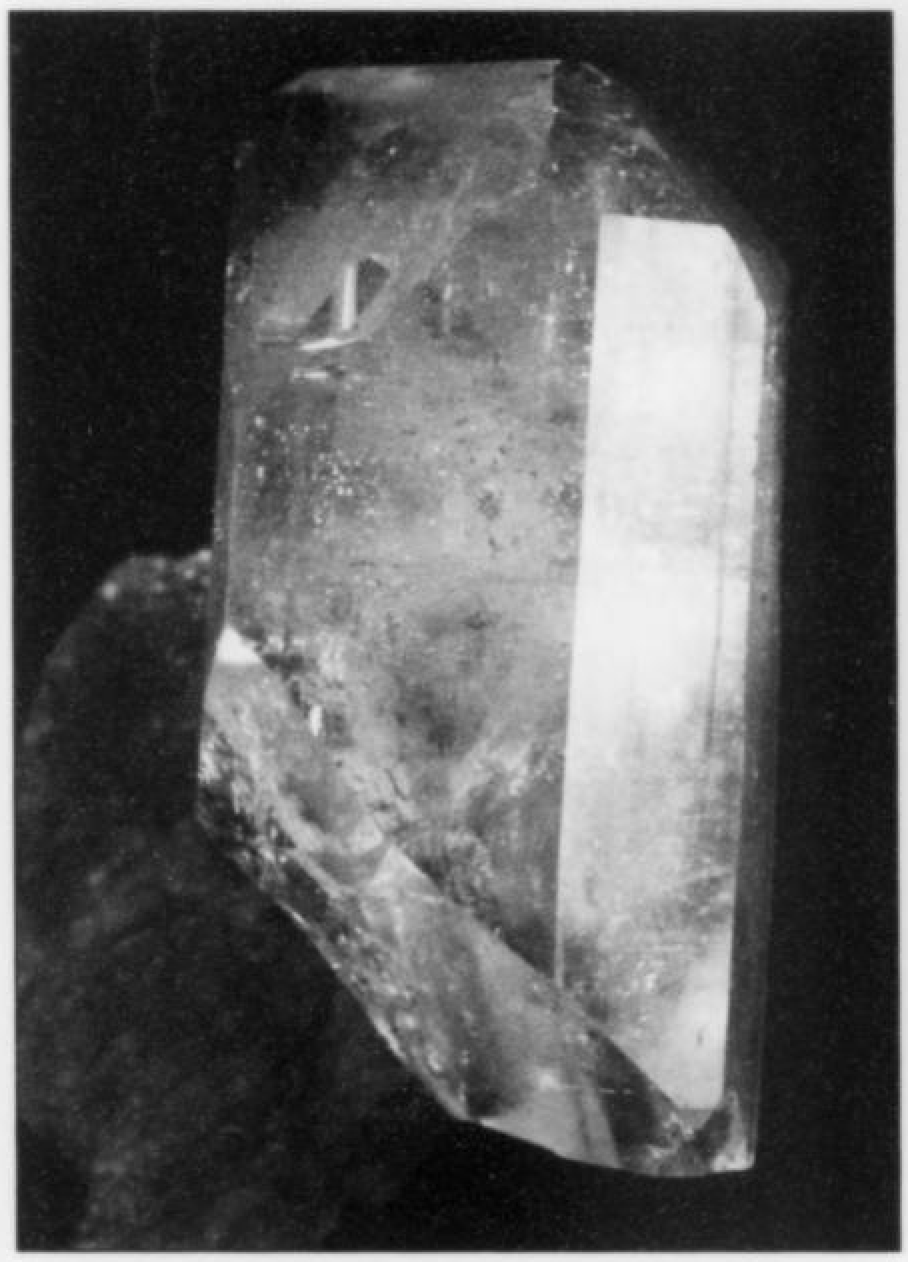


Figure 299. **Tabular topaz crystal, 2.4 cm, on quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

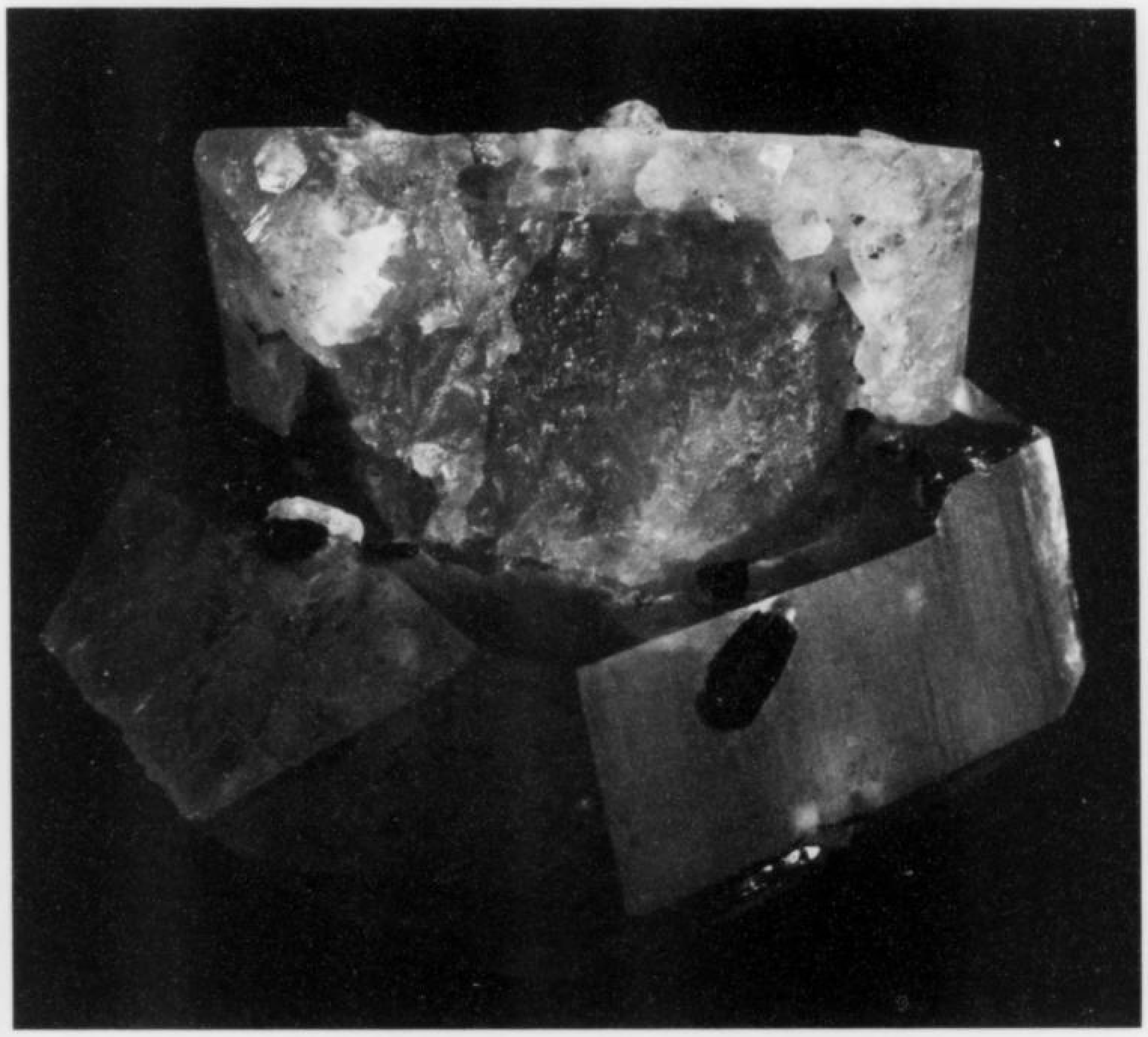


Figure 300. **Pale green topaz, partially overgrown by second generation yellow topaz, then enveloped by quartz with minor schorl attached, 6.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

singly, with no matrix, or in small clusters. Small schorl crystals are occasionally found included in topaz.

Tridymite SiO_2

Tridymite has been reported from the Erongo Volcanic Complex (Pirajno, 1990).

Uranophane $Ca(UO_2)_2[(SiO_3(OH)]_2 \cdot 5H_2O$

Stellate groups of uranophane microcrystals associated with botryoidal hyaline opal, muscovite, topaz and orthoclase came from the uranium pocket (see under metanováčekite for details). Some of the clusters of acicular yellow uranophane crystals are coated by opal that masks the uranophane's habit and color. Amorphous yellow uranophane aggregates from the Brabant (van der Made) pegmatites are described by Roering (1963).

Figure 301. **Uranophane, 9 mm, with quartz, albite and hyaline opal. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Walpurgite $(BiO)_4(UO_2)(AsO_4)_2 \cdot 2H_2O$

Walpurgite, a rare bismuth uranium arsenate, occurs together with violet fluorite, topaz and quartz, as small (maximum 1 mm), flat, tabular amber-brown to yellow crystals. Jahn (2003) speculates on the source of the bismuth, and comments on its absence (to date) in the miarolitic cavities. However, Krantzberg contains sporadic bismuth mineralization and the nearby Etiro pegmatite is famous for its massive and crystalline native bismuth (Miller, 1969; Cairncross, 2004).

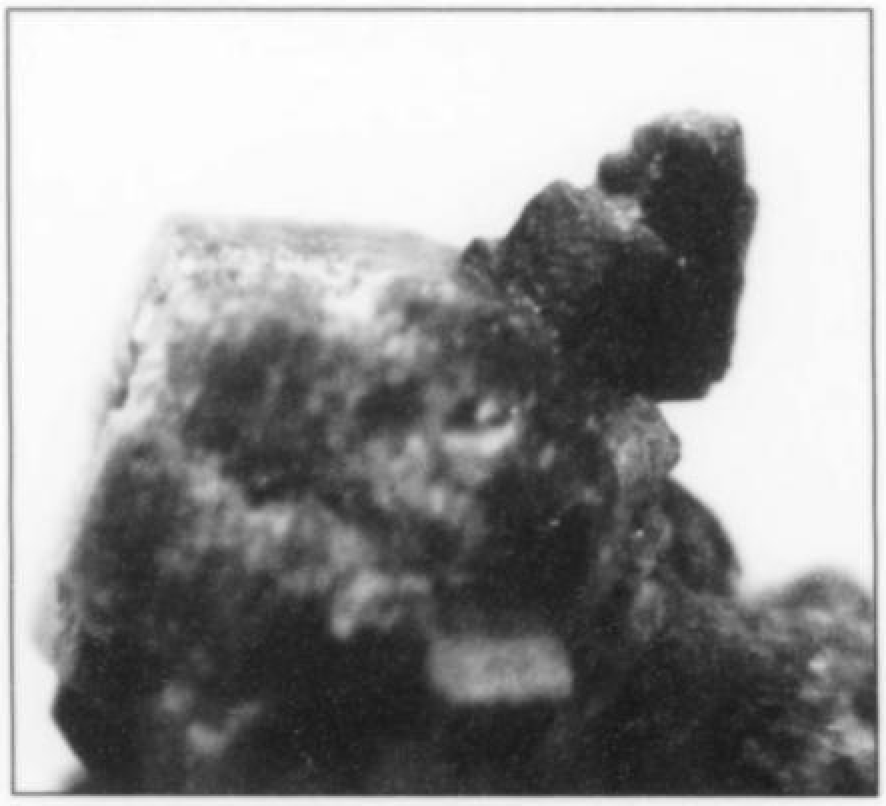


Figure 302. **Xenotime-(Y) crystal, 1.1 mm, on metazeunerite. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Xenotime-(Y) YPO_4

Small, yellow xenotime crystals are associated with aquamarine, fluorite and quartz (von Bezing, 2006). The xenotime-(Y) has a typical oily-resinous luster. Small crystals have been found perched on metazeunerite from the uranium pocket. The Erongo crystals contains up to 4% Dy and 3% Gd (Jahn, 2003).

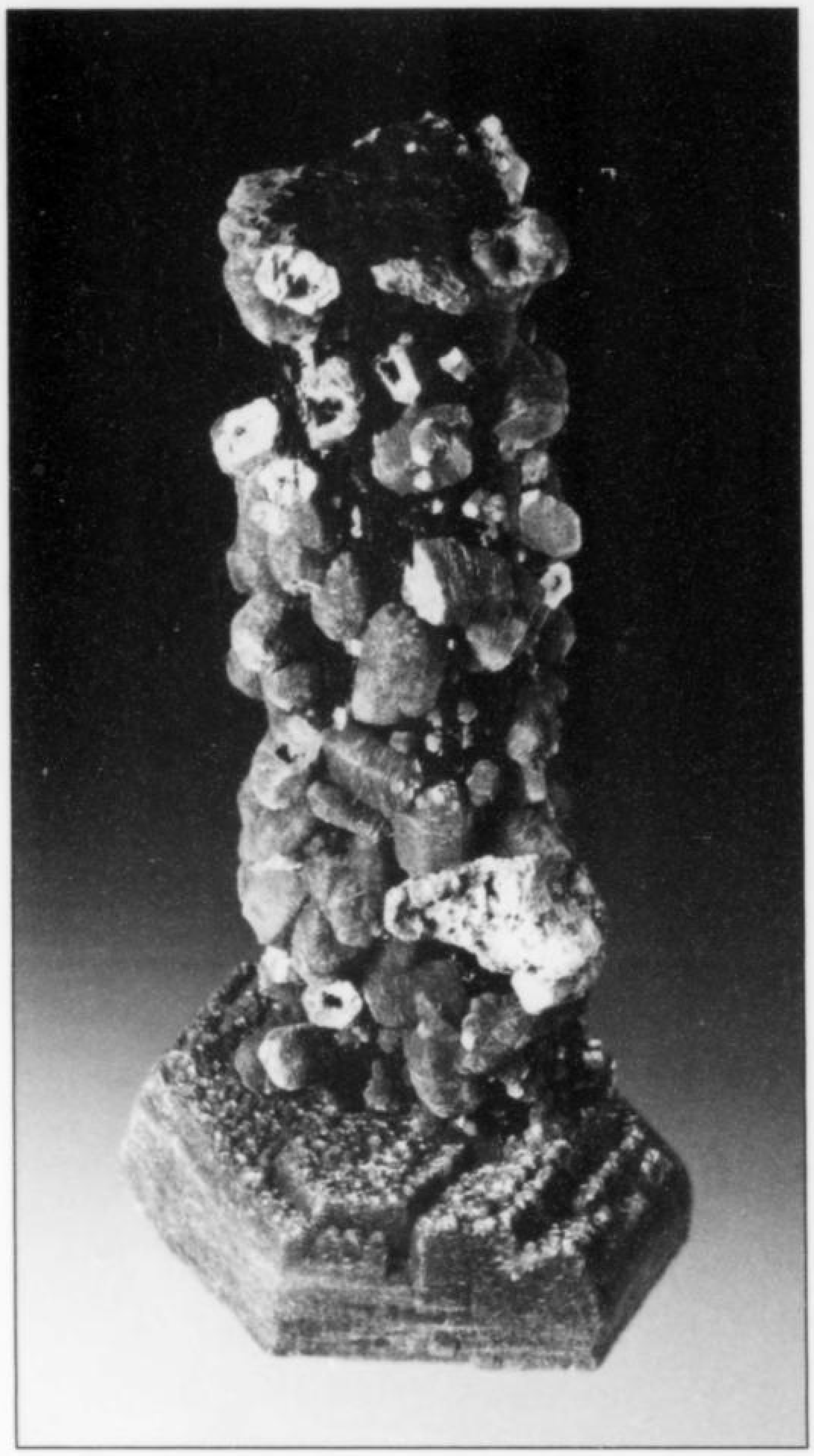


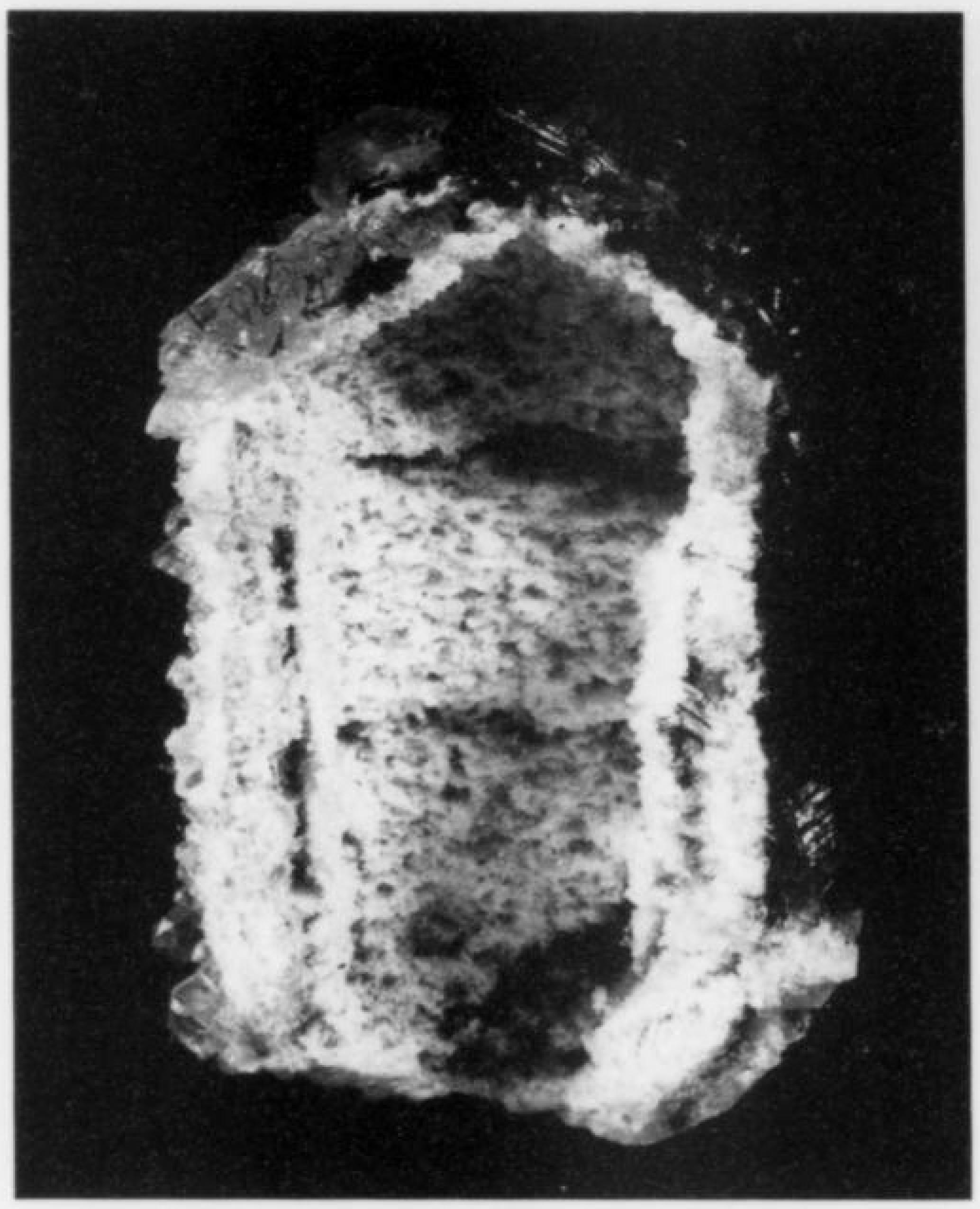
Figure 303. **Zinnwaldite (?) partially covering schorl, 14.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Zinnwaldite $KLiFe^{2+}Al(AlSi_3)O_{10}(F,OH)_2$

There is some confusion regarding the existence of zinnwaldite in the Erongo miarolitic cavities and surrounding pegmatites. Frommurze *et al.* (1942) provide optical and chemical analytical evidence for gray-green zinnwaldite from the Erongo Schlucht pegmatites, and it has been elsewhere reported from the Erongo Mountains (Charles Key, personal communication, 2003). However, later studies of the same deposit (Roering, 1963) found only lithian muscovite. Small rosettes of gray-green zinnwaldite from miarolitic cavities in the Erongo Mountains are reportedly in the Harvard collection (von Bezing, 2006).

Pseudomorphs

Several interesting pseudomorphs have been found in the Erongo miarolitic cavities. Some of the most unusual, collected in August 2003, are **quartz after orthoclase**. They are either single crystals measuring several centimeters or groups of crystals to 30 cm. Various stages of pseudomorphic replacement are evident, from quartz coatings (epimorphs), to partial or complete replacements of feldspar by quartz. Some of the quartz is oriented epitactically on the orthoclase. The latter specimens usually have a hollow framework shell of quartz, the inner part of the hollow cavity being lined by drusy schorl and small quartz crystals. The replacement quartz



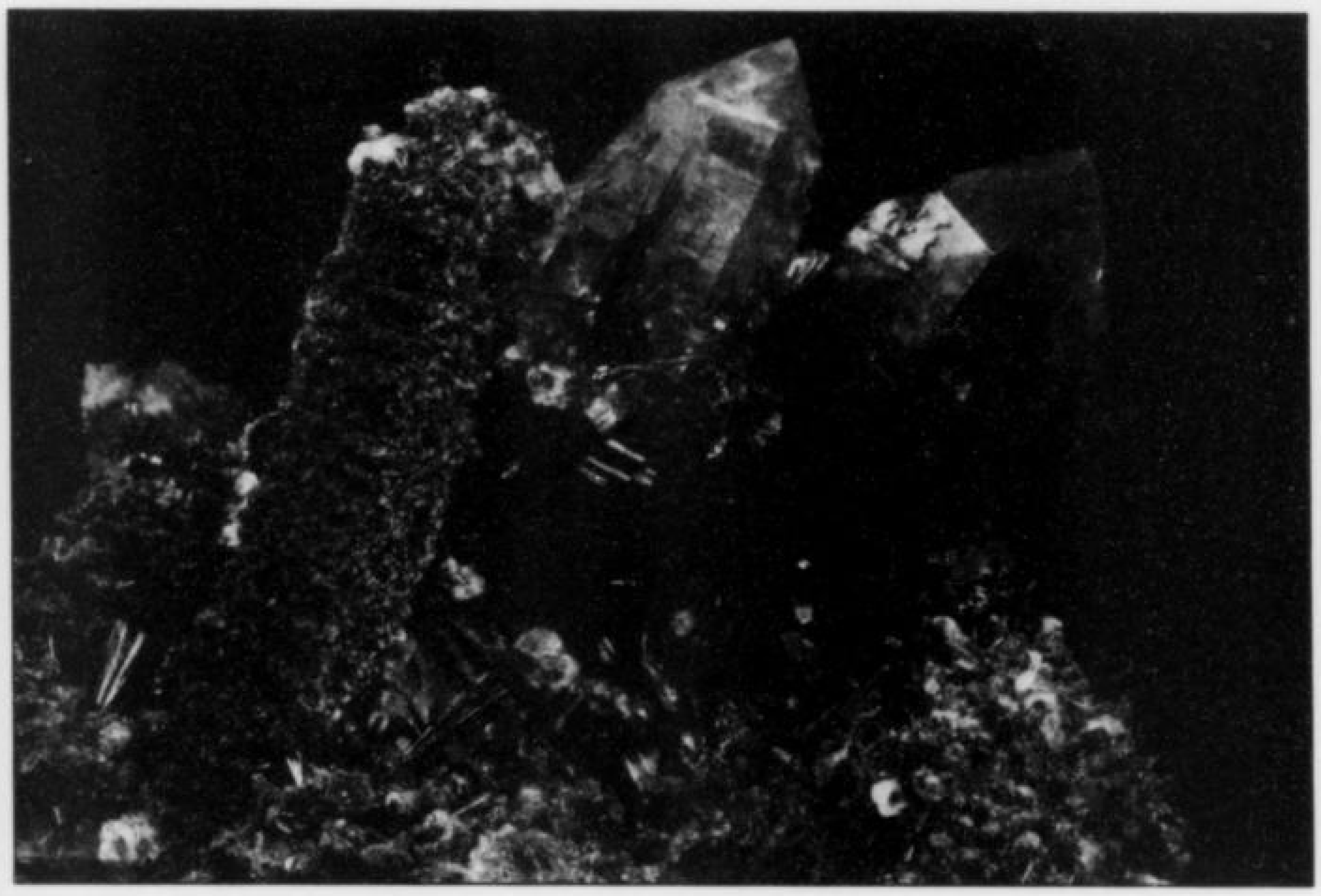


Figure 307. Orthoclase (left), 6 cm, replaced by acicular schorl, associated with smoky quartz and schorl. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 304. Hollow orthoclase mold with epimorphic schorl and quartz, 5.2 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

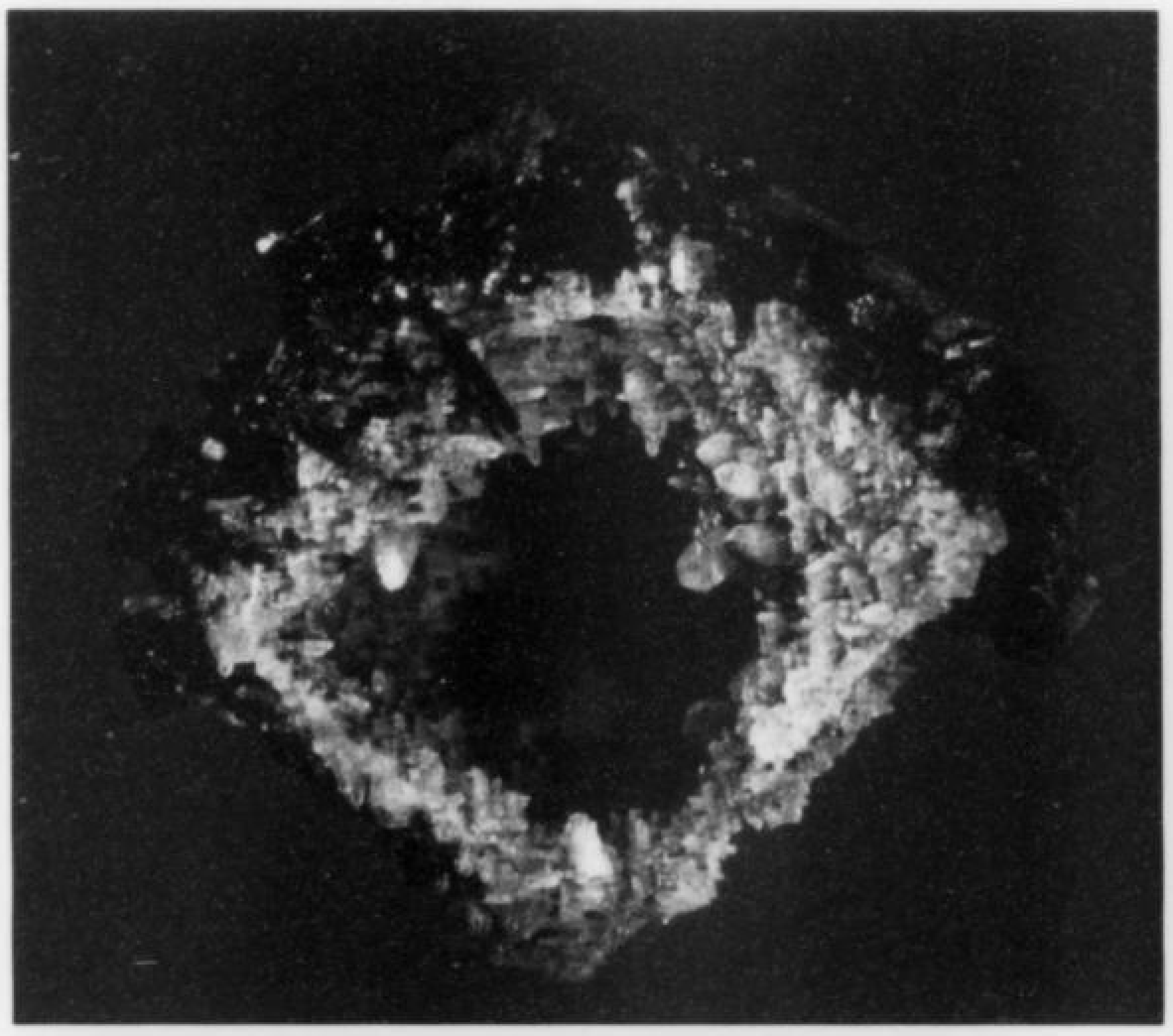


Figure 305. Cross-section perpendicular to the *c* axis through a hollow orthoclase crystal pseudomorphically replaced by quartz and coated by schorl, 5.1 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

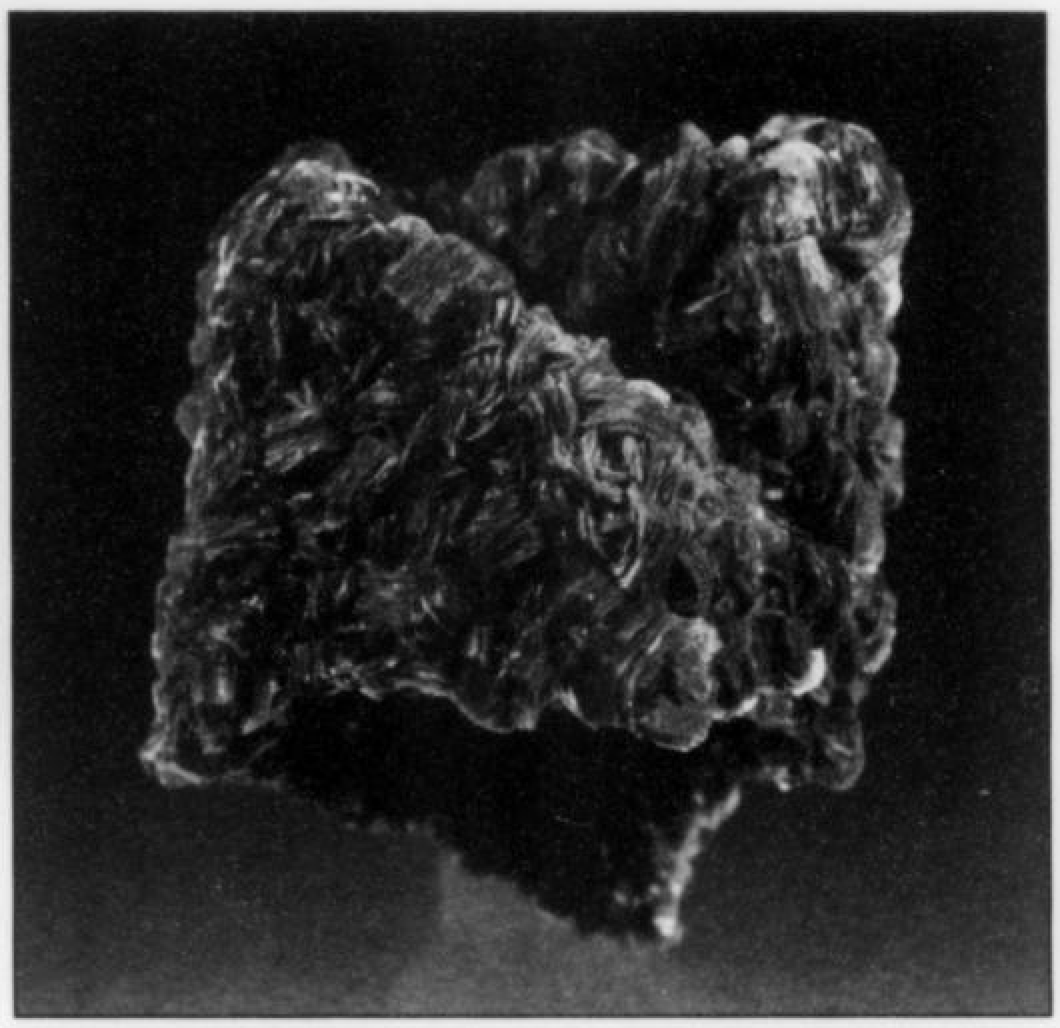


Figure 308. Muscovite pseudomorph after Carlsbad-law twinned orthoclase, 4 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

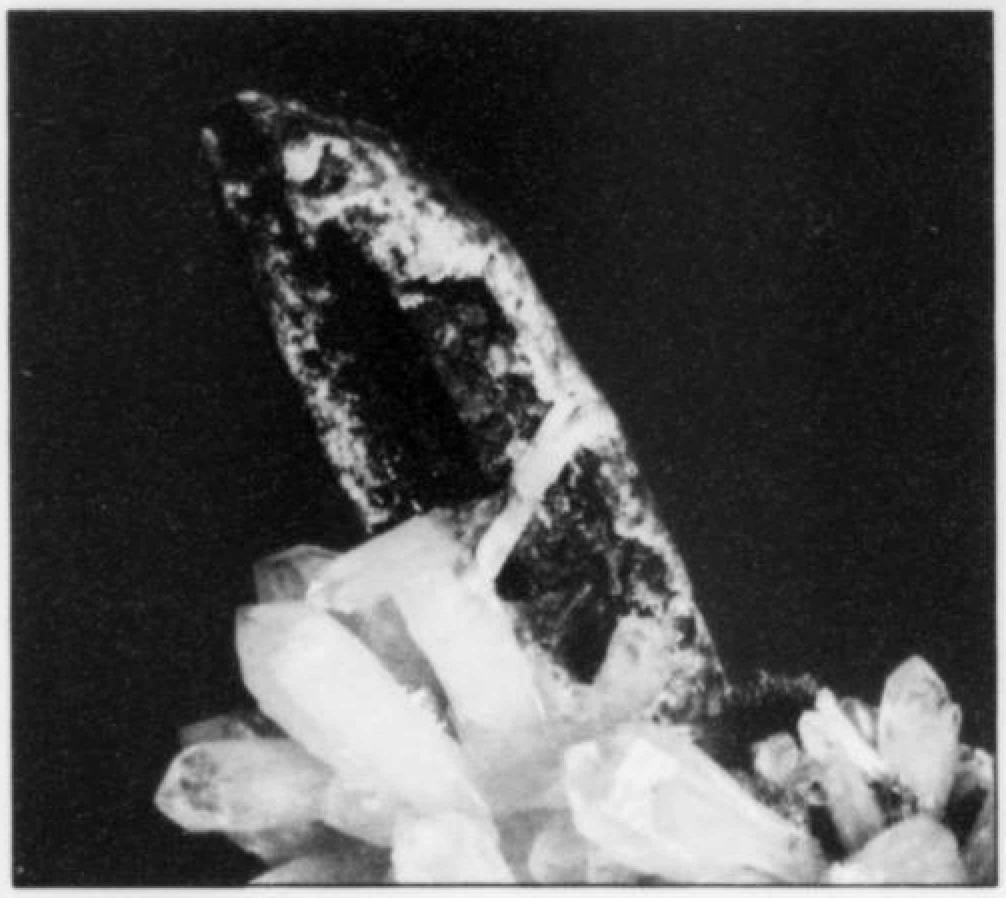


Figure 306. Schorl crystal, 3.8 cm, epimorphically coated by fluorite on quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

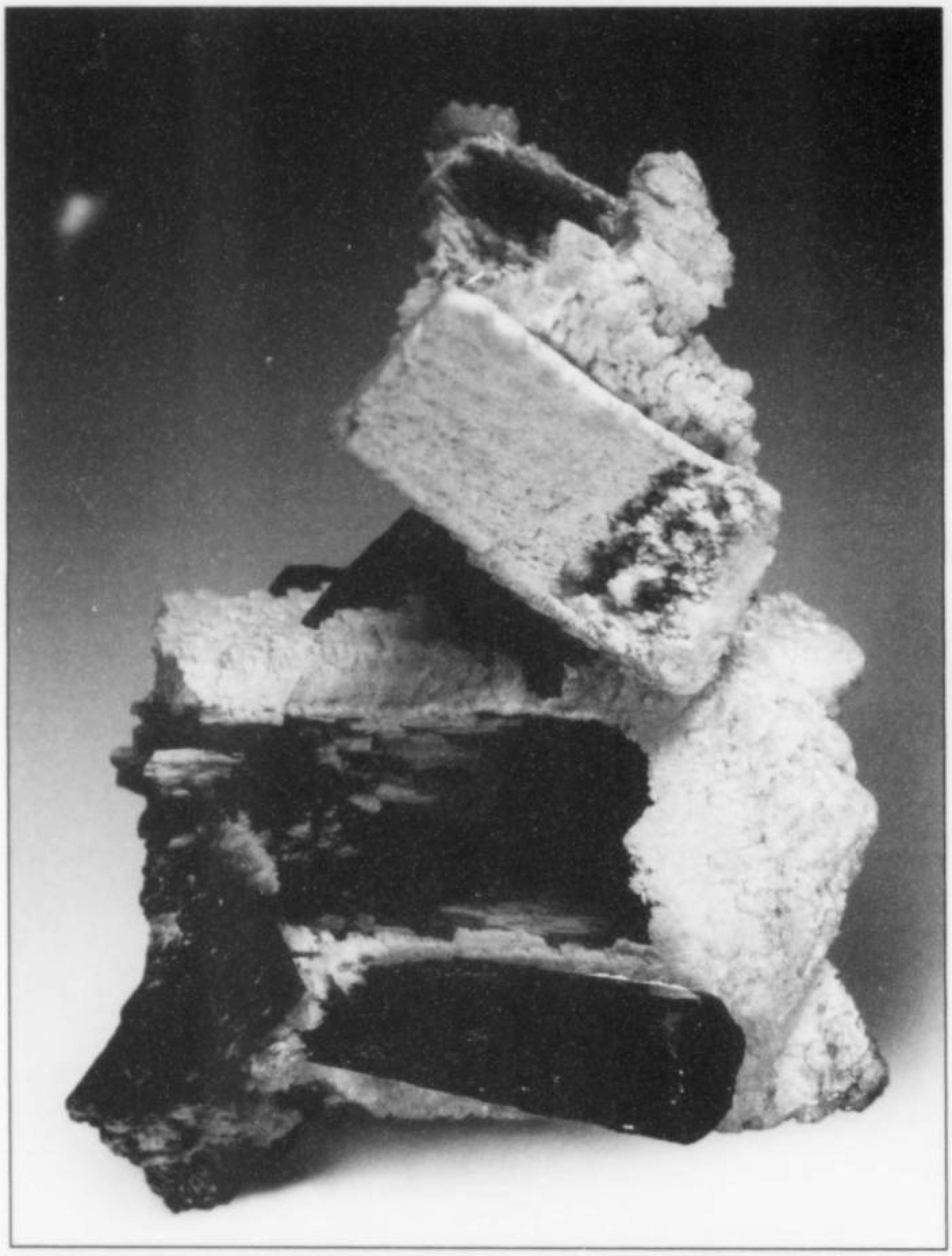


Figure 311. Hollow schorl, 1.9 cm diameter. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 309. Carlsbad-law twinned orthoclase pseudomorph partially lined by schorl, 4.7 cm. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.

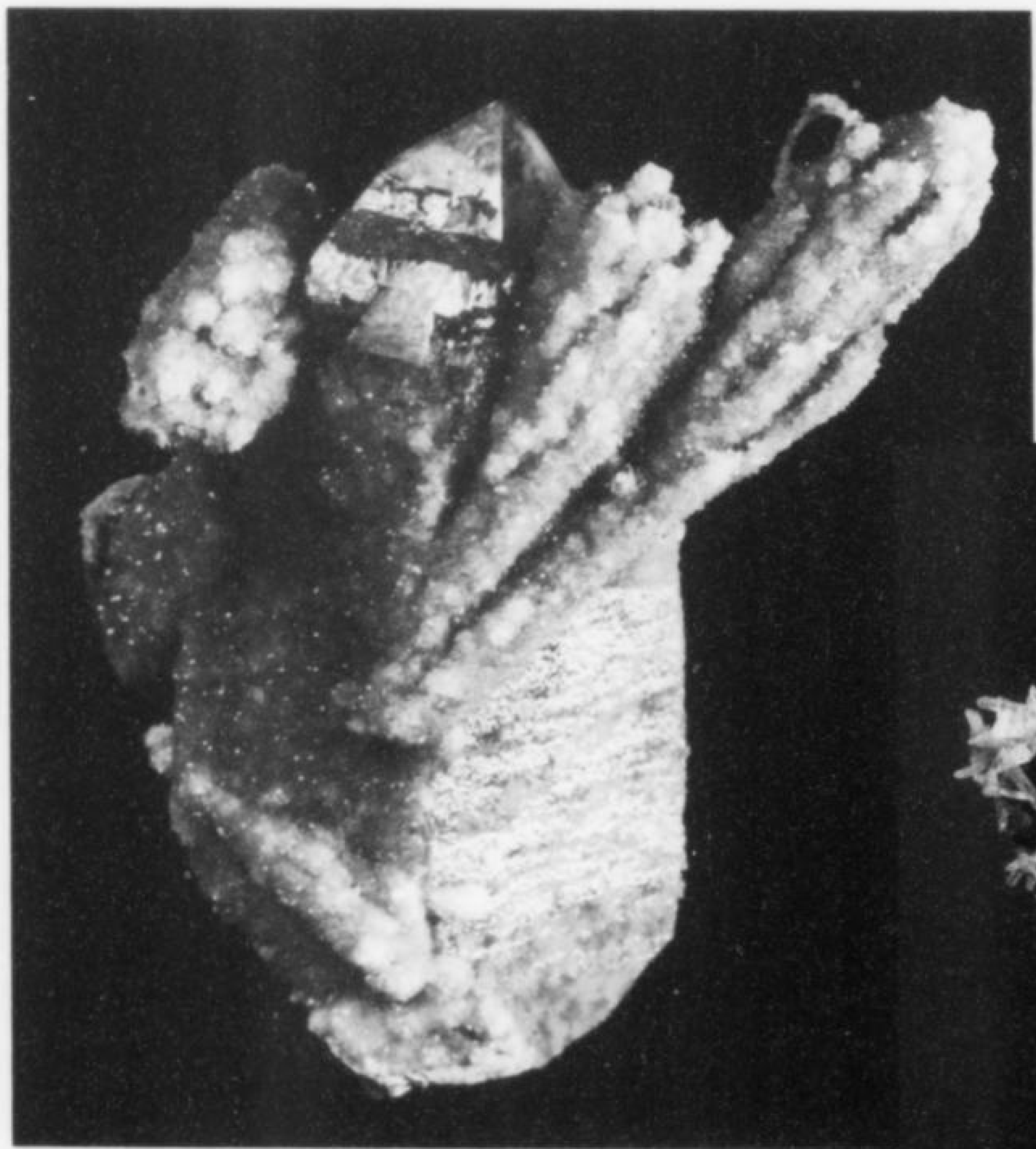


Figure 310. Schorl encrusted by quartz, attached to prismatic quartz, 7.5 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

Figure 312. Quartz epimorphically attached to highly altered schorl, 6 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

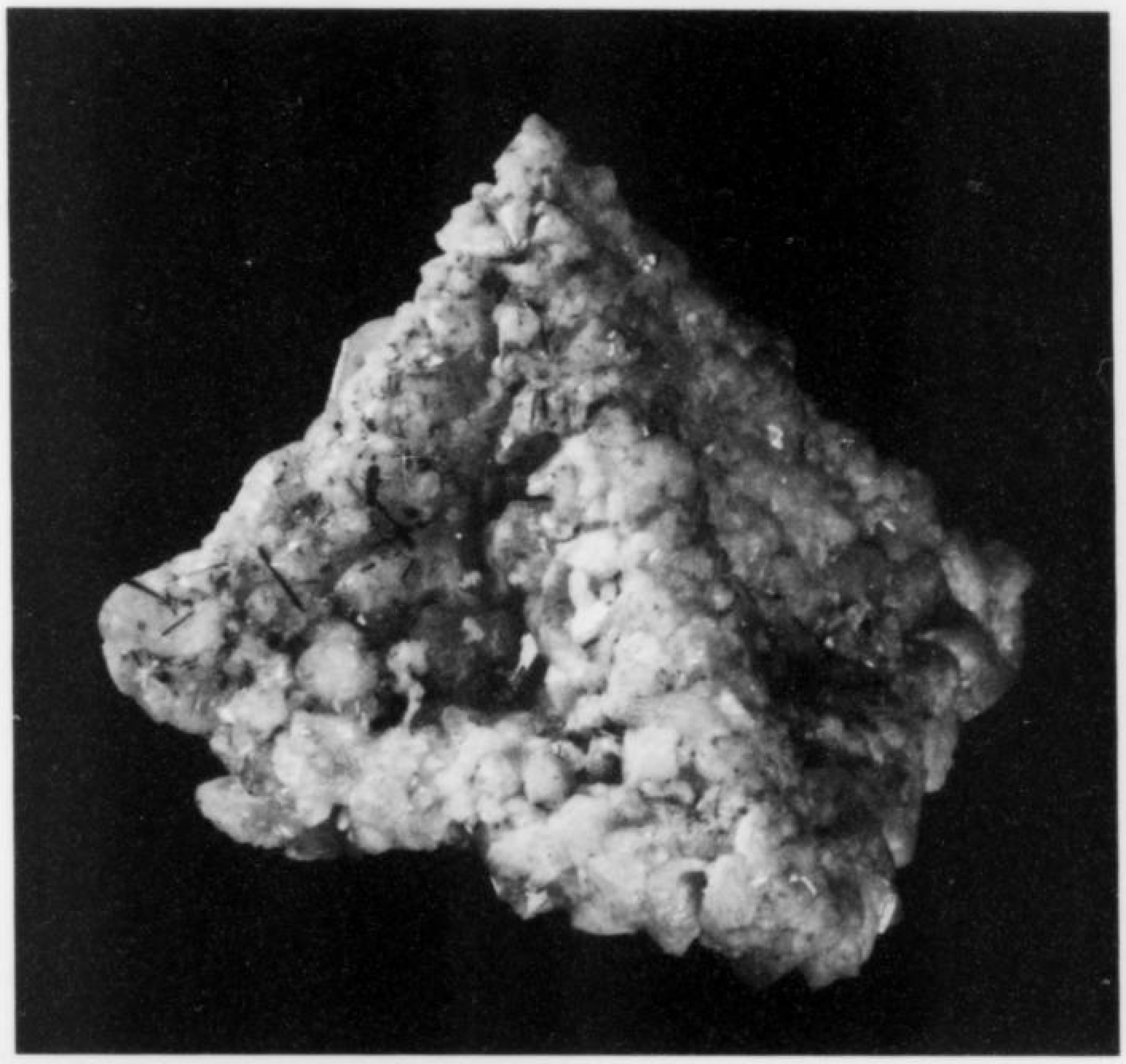


Figure 313. **Topaz pseudomorph after (?), 7 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

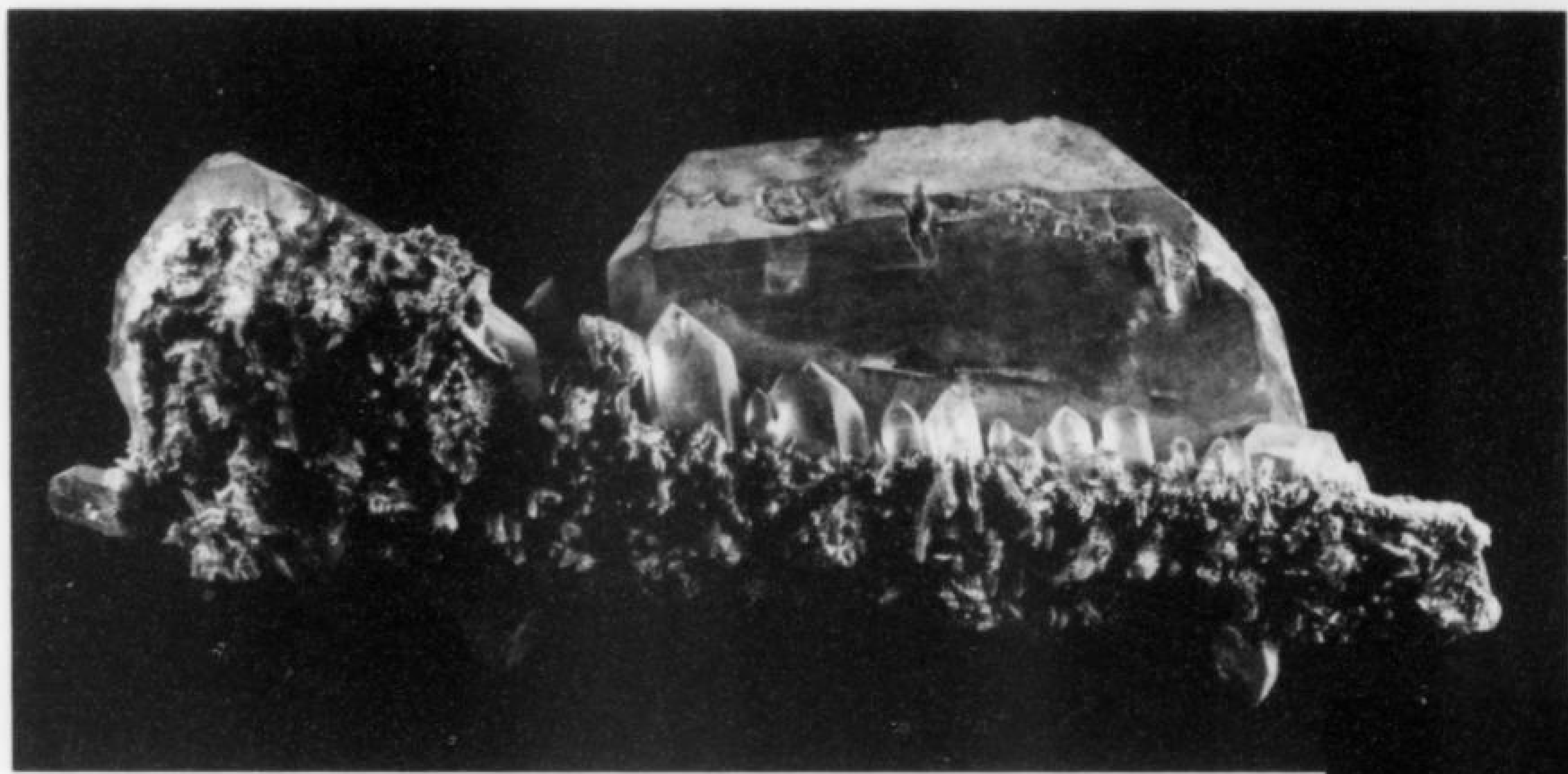


Figure 314. **Quartz pseudomorph after orthoclase with second-generation quartz crystallized on the pseudomorph, 9.1 cm. Erongo Mountains, Namibia. Bruce Cairncross collection and photo.**

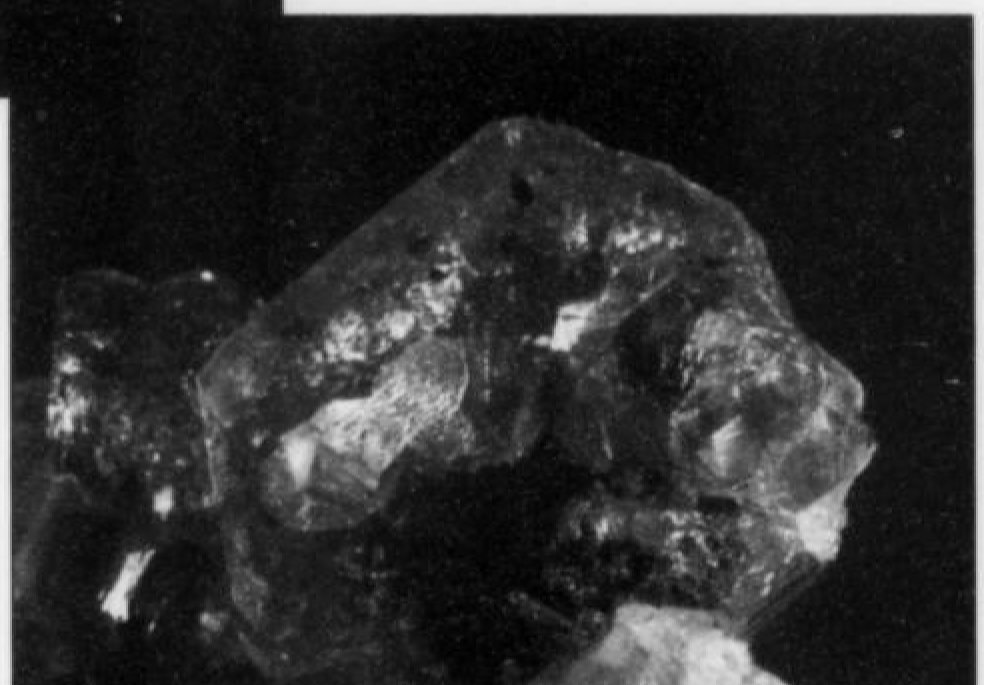


Figure 315. **Fluorite included in aquamarine, 3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

consists of flattened plates of variably aligned, short quartz crystals that superficially resemble Japan-law twins (Jahn *et al.*, 2003).

Several examples of goethite pseudomorphing other species are known. The best of these are rhombohedral, brown to rust-red **goethite after siderite(?)**, **goethite after octahedral magnetite(?)** and **goethite after trigonal ilmenite**. These goethite pseudomorphs have scattered drusy crystals of pyrolusite, ilmenorutile and romanèchite-cryptomelane on the altered crystal surfaces.

Muscovite after orthoclase crystals has also been found. Excellent examples of these pseudomorphs are seen where the fine-grained muscovite has completely replaced Carlsbad-law twinned crystals. Pseudomorphs of aquamarine **beryl after twinned orthoclase** are described and illustrated by Gebhard (2002).

Inclusions

Some of the Erongo minerals, notably quartz, aquamarine and fluorite, have interesting included minerals. These are listed in Table 5.

Unknowns

Several species from Erongo have yet to be identified and are awaiting analysis. Most have been found as microcrystals.

Table 5. **Mineral inclusions**

Species	*Included Minerals*
Aquamarine	Fluorite, orthoclase, schorl
Fluorite	Aquamarine, schorl
Colorless Beryl	Orthoclase, schorl
Quartz	Fluorite, magnetite, orthoclase, schorl
Topaz	Orthoclase, schorl

Figure 316. Floater fluorite crystal, 1.9 cm, with schorl, fluorite and vapor and fluid inclusions. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

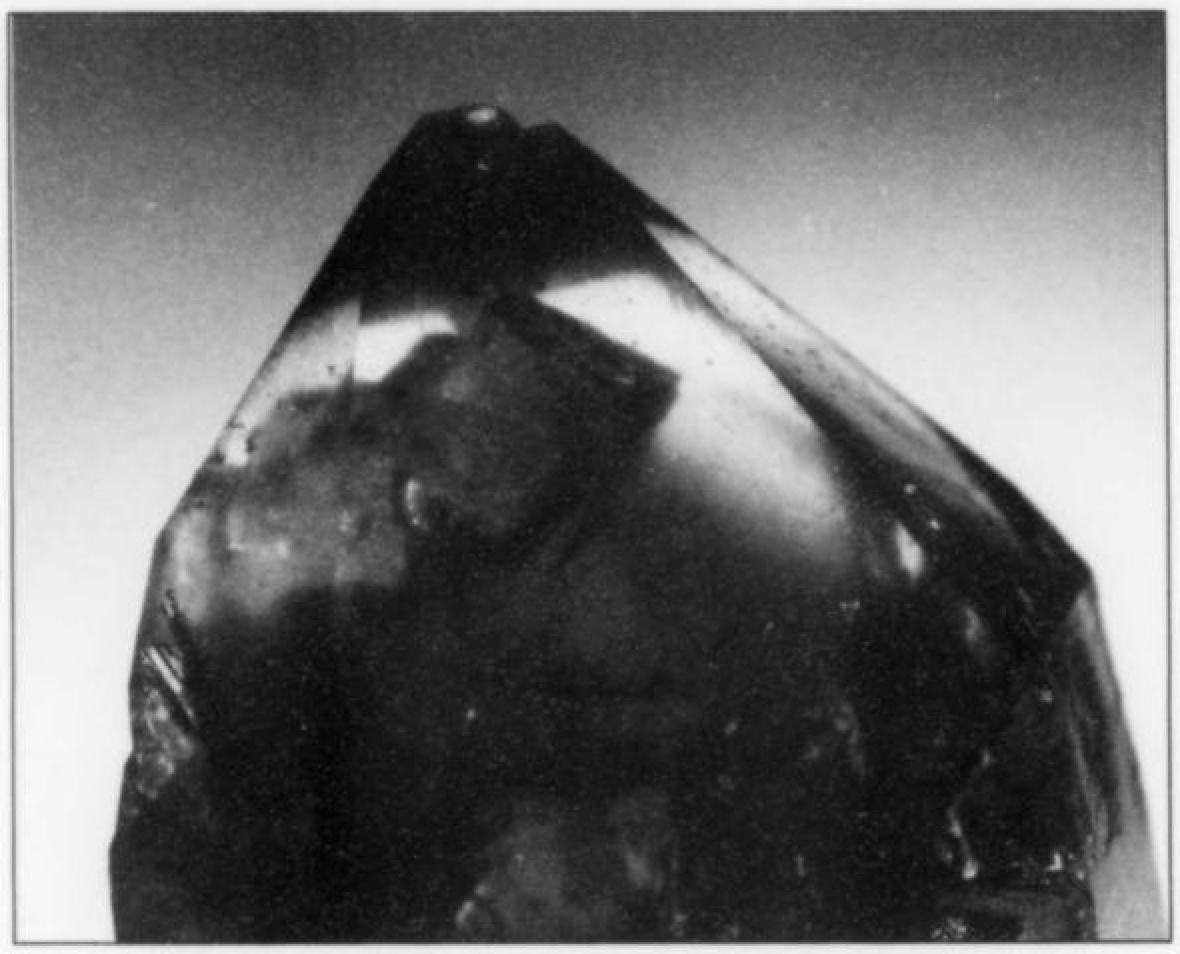


Figure 319. Smoky quartz crystal with schorl inclusions and a large crystal inclusion of an unknown mineral, 3.3 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

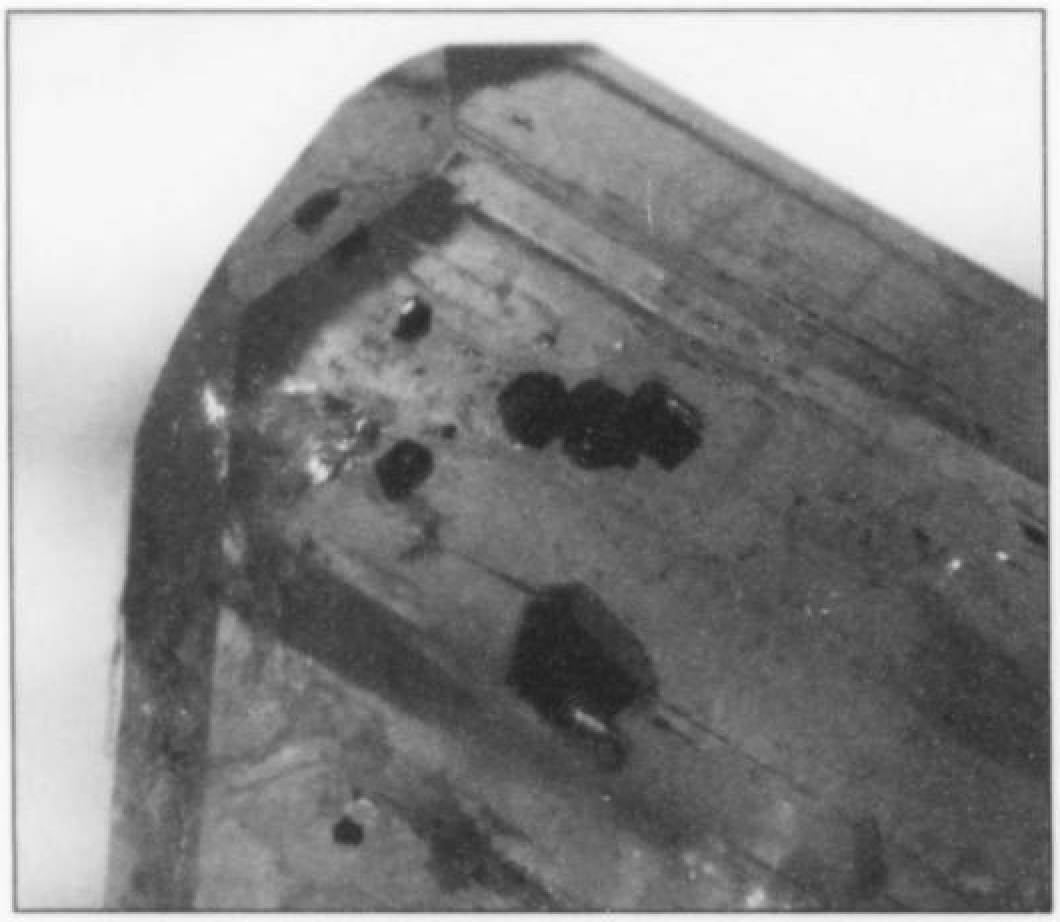


Figure 317. Schorl included in aquamarine, 2.7 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 320. Quartz with a subrounded inclusion (phantom), 2.9 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

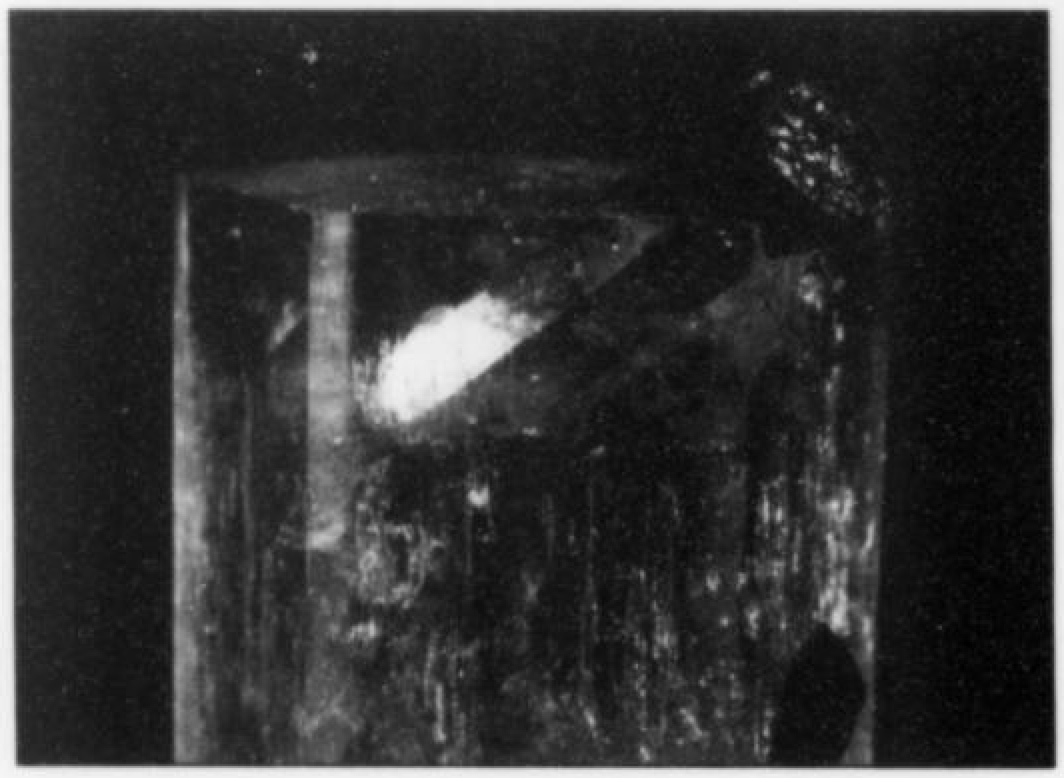


Figure 318. Aquamarine partially enclosing schorl, 2.8 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.

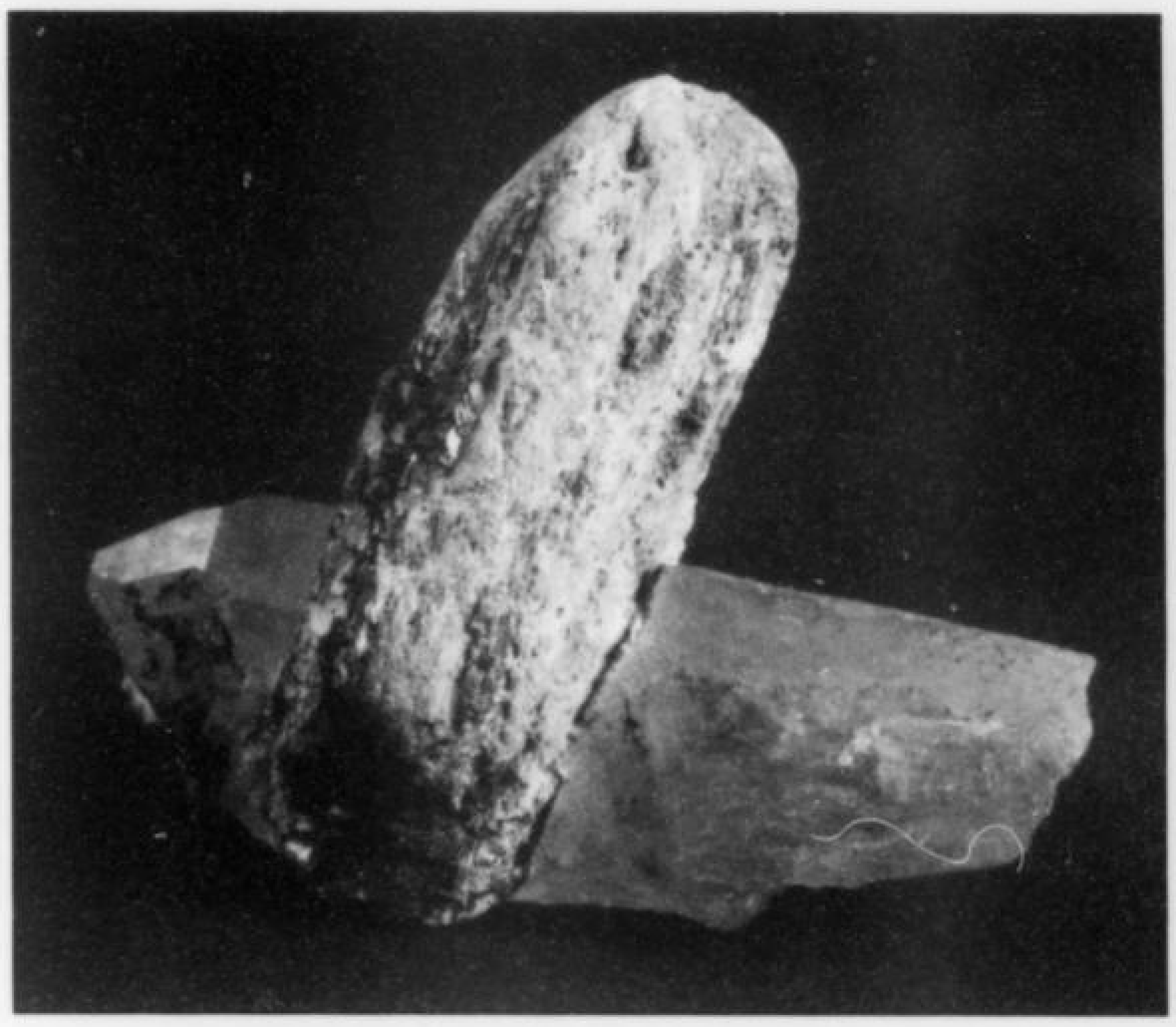


Figure 321. **Unidentified pink encrustation covering schorl, 4.2 cm, on quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

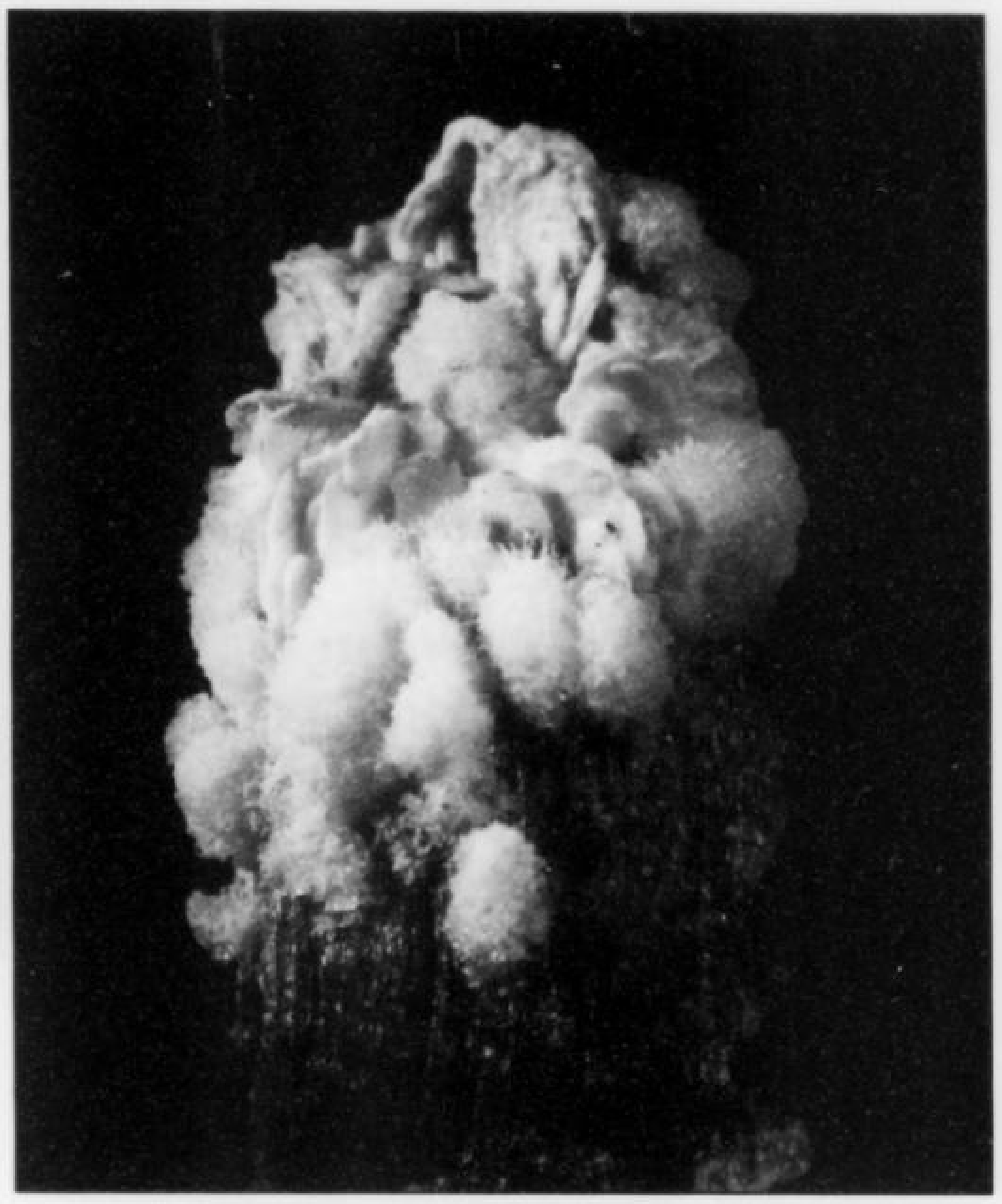


Figure 324. **Unidentified tabular yellow crystals on hyaline opal and schorl, 3 cm. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 322. **Unidentified orange crystals, 7 mm, on quartz. Erongo Mountains, Namibia. Uli Bahmann collection; Bruce Cairncross photo.**

Figure 325. **Unidentified fibrous white crystals with goethite and hyaline opal, 1.2 cm field of view. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

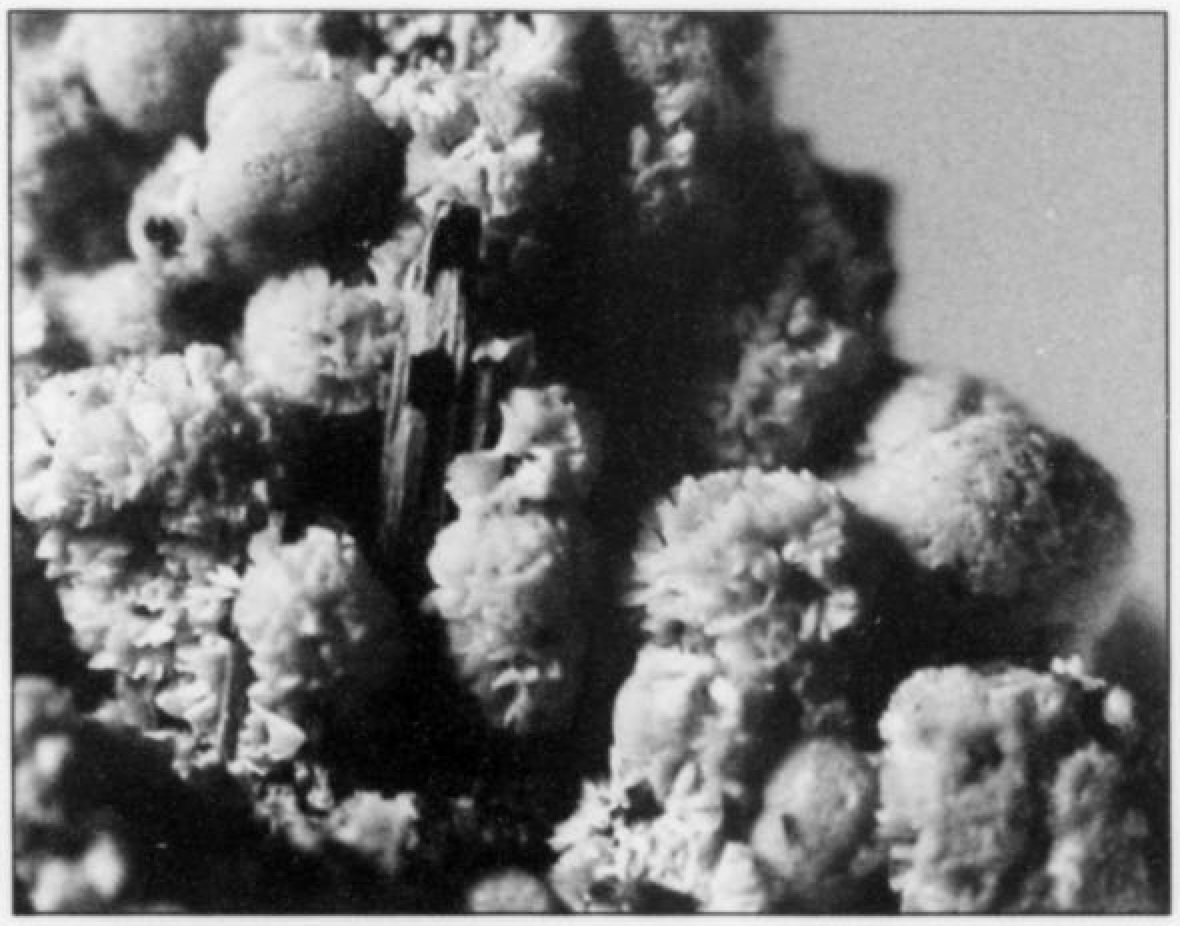


Figure 323. **Clusters of unidentified cream-white crystals with schorl, 1 cm field of view. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.**

Figure 328. Unidentified white crystals on schorl with hyaline opal, 8 mm field of view. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 326. Unidentified semicircular crystal on orthoclase, 3.4 cm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

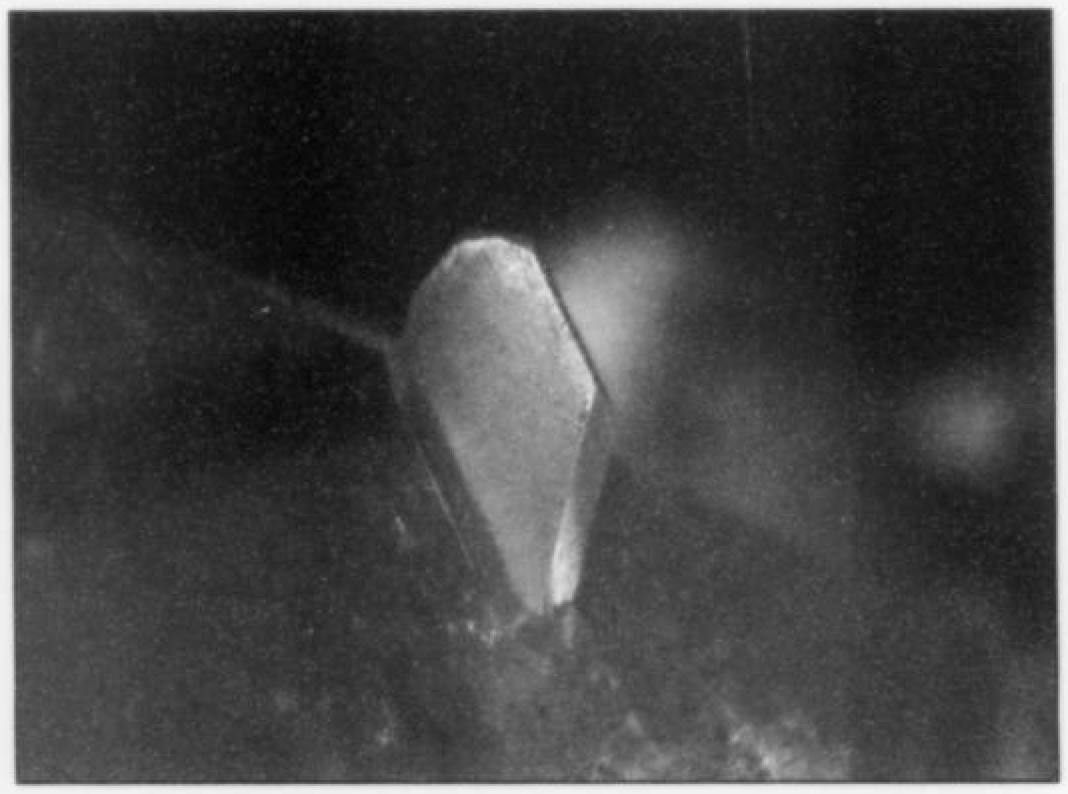


Figure 329. Unidentified tabular yellow crystal on quartz, 1.1 cm field of view. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 327. Unidentified white crystals with quartz and hyaline opal, 4 mm. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

Figure 330. Unidentified yellow crystals, 2 mm, on schorl. Erongo Mountains, Namibia. Herbert Nägele collection; Ernst A. Schnaitmann photo.

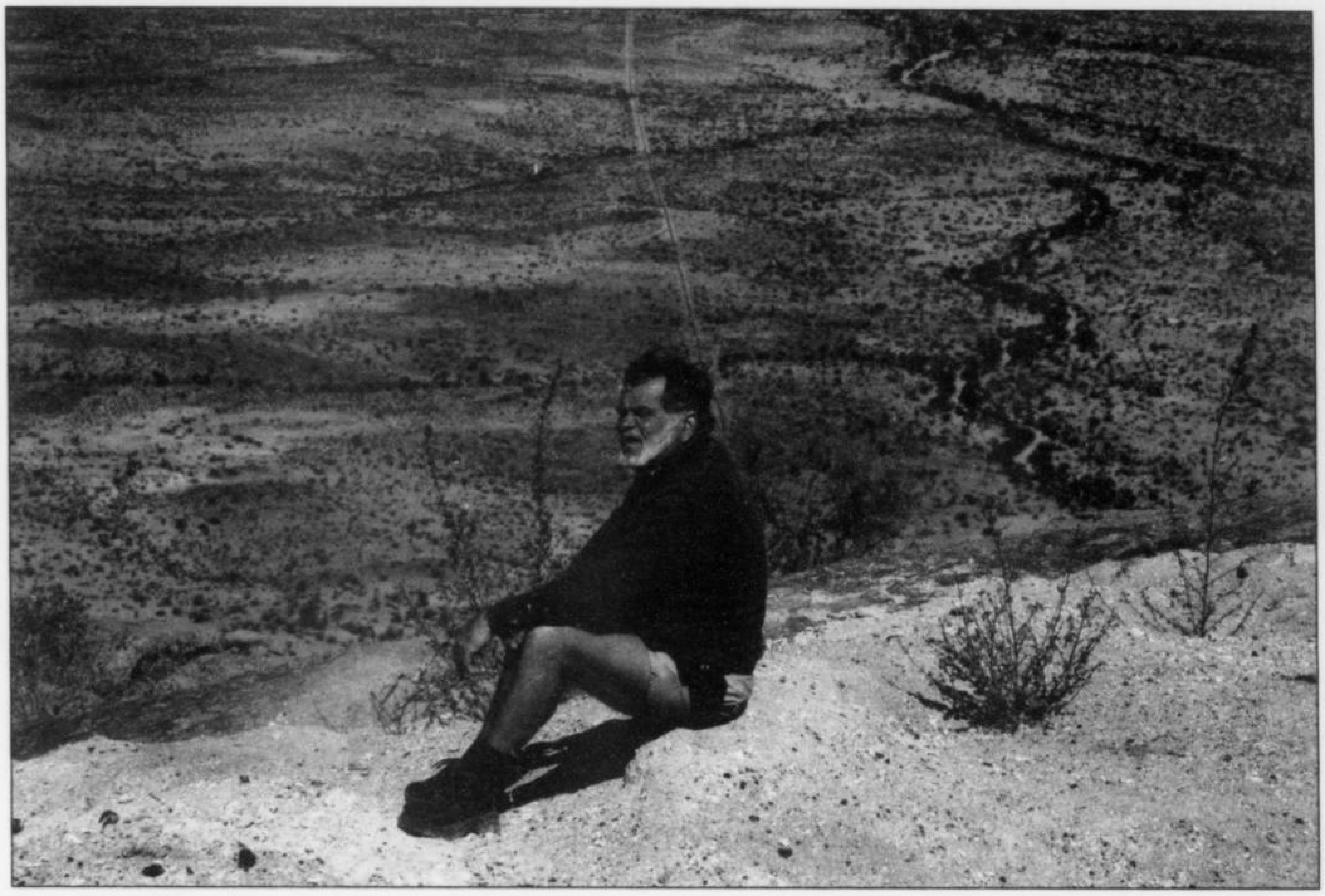


Figure 331. **Gerd Bachran sitting on one of the waste dumps on the Erongo Mountain. The fence boundary between the farms Ameib 60 and Davib Ost 61 can be seen in the valley below. Bruce Cairncross photo, August, 2005.**

AUGUST 2005 FIELD TRIP TO THE ERONGO MOUNTAINS

During August 2005, we spent several days on a fact-finding mission in the Erongo Mountains. The trip was undertaken to obtain up-to-date information for this article, to get photographs of the site, and to interview some of the people in Namibia who have been instrumental in collecting Erongo specimens. One of us (UB) set up a number of meetings and contacts with the local experts so that we could view their collections and also be guided in the field to some of the famous pockets that had produced specimens during the previous five years.

Windhoek is a two-hour flight from Johannesburg International Airport, and I (BC) flew up on Saturday August 6, 2005; Uli had already made the trip by road a few days before. The quickest way to drive to Namibia from South Africa is via the Trans Kalahari Highway that transects west-central Botswana. This trip takes approximately 12 hours, depending on time taken at the border crossings into Botswana from South Africa and into Namibia from Botswana. We spent Sunday in the company of Windhoek dealers and collectors Herbert Nägele and Ernst Schnaitmann, who have been collecting Erongo specimens since late 1999. They have a systematic collection of most species from Erongo, and some of their specimens are illustrated in this article. This visit was followed by an afternoon trip to see Andreas Palfi, a local dealer who is in partnership with Ralf Wartha. After viewing their stock of specimens (not only from Erongo, but from many other Namibian localities too) we decided to turn in for the evening, as we had an early start the next morning. After a long day of looking at minerals, "Joe's Beer Garden" in Windhoek provided a welcome respite. No visit to Windhoek would be complete without a meal at this famous watering hole.

On Monday morning, we left our bed-and-breakfast at 6:00 sharp, as we had an appointment to meet Gerd Bachran at 9:00 at the Erongo Mountains. The trip from Windhoek is via the main paved road that ultimately ends at the coastal town of Swakopmund. Driving from Windhoek, one passes through Okahandja and then on to the village of Karibib, then, 40 km further on, Usakos. These two towns are well-known for being in the heart of the Usakos-Karibib pegmatite belt that has produced excellent tourmalines and other mineral specimens. The journey westwards leads through progressively more arid regions, with thornveld and white-bleached grass slowly giving way to rocky and sandy terrain. This region of Namibia is traditionally dry, but absence of seasonal rains made it even more so in 2005[4].

In Usakos, a dirt road leads northwestward, skirting the western extremity of the mountains. This particular morning, there was an eerie fog blanketing the whole region—this is commonplace along the Namibian Atlantic coast, particularly at Swakopmund, where the cold Atlantic Benguela current causes early morning mist that can extend some distance inland. It was unusual to see it that far from the coast, and the morning was chilly. The Erongo Mountains could be seen looming off in the distance in this foggy mist. As we approached the southwestern part of the mountains, the fog began to lift, providing unusual views of the mountain peaks jutting through the mist. The road

[4] In January-February 2006, the highest rainfall in decades produced waist-high grasslands throughout the region.

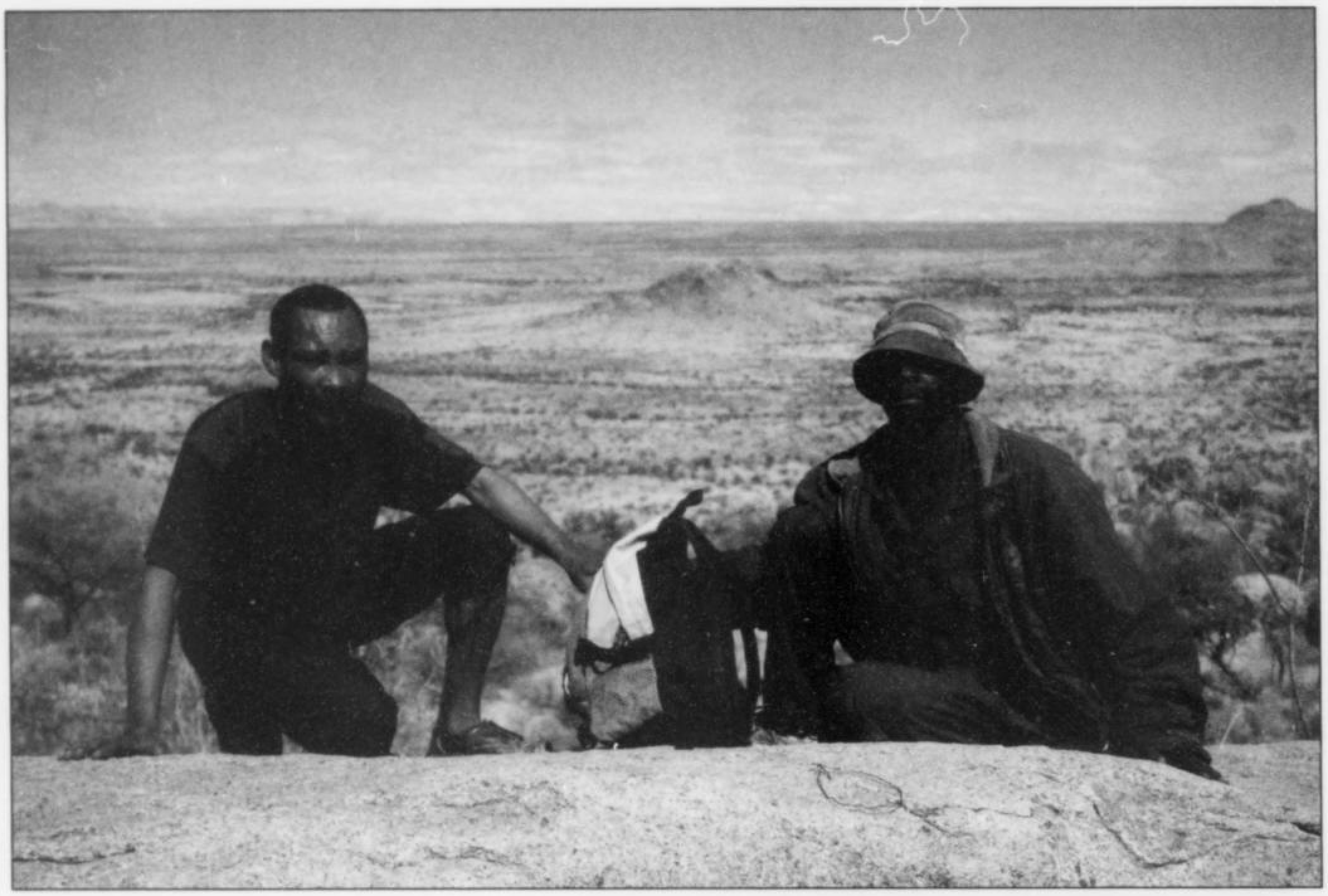
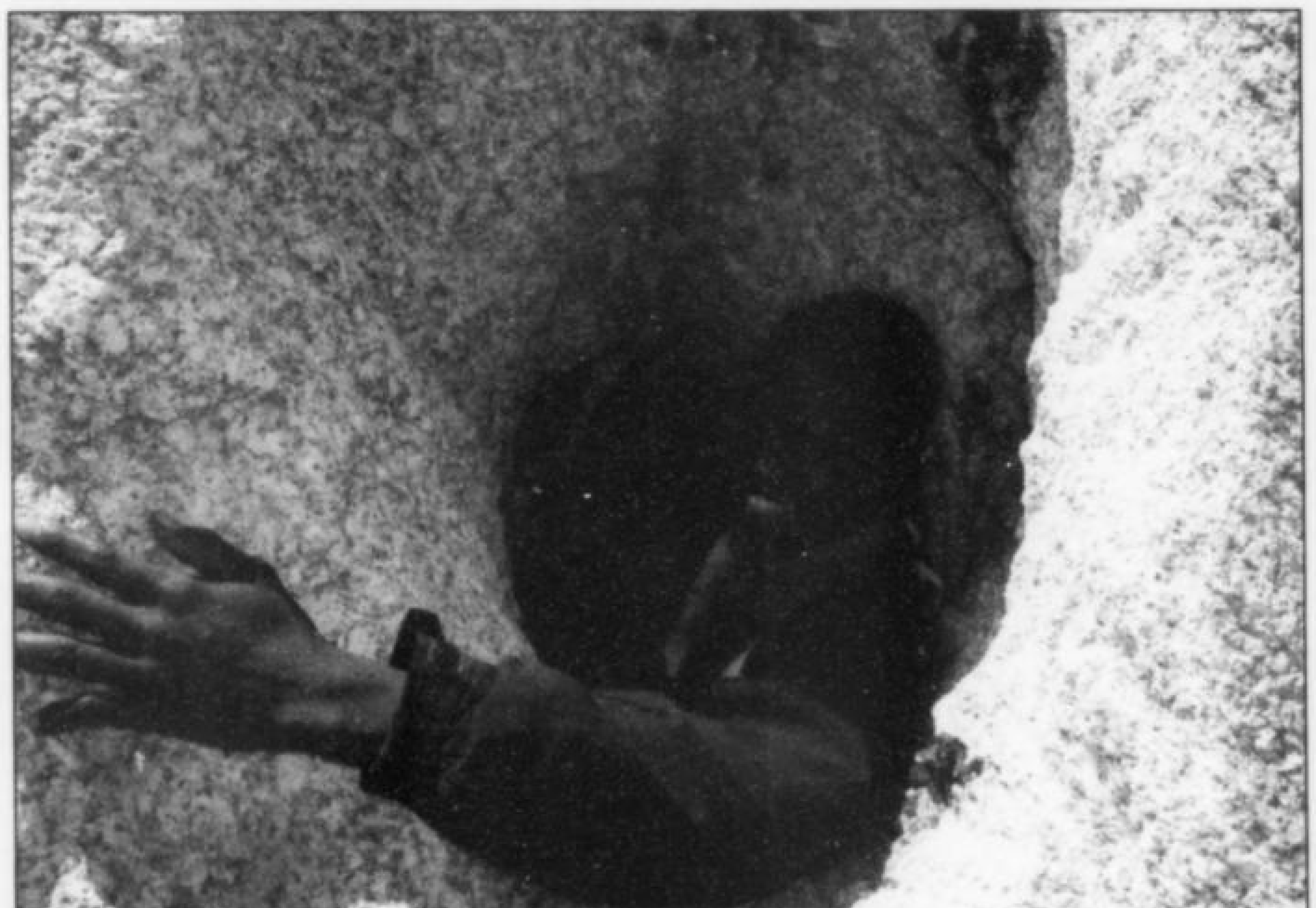


Figure 332. **Two of the local diggers, Ricardo (left) and Ferdinand (right), posing for a photo on the mountain. View is towards the west. Bruce Cairncross photo, August, 2005.**

Figure 333. **One of the local youngsters inside an excavated tubular miarolitic cavity. Bruce Cairncross photo, August, 2005.**



we were on continued to the settlement of Tubussis, but we turned off to enter the farm Bergsig, where the Hohenstein Lodge is located. We were met on arrival at the lodge by our host for the next few days, Gerd Bachran. He lives in Swakopmund and knows the area and the local Damara who dig for minerals. He had arranged for one of the locals, David, to guide us up into the mountains to view the diggings. The tracks that lead up to the foothills of the mountain are rugged and ideally require a four-wheel-drive vehicle. We parked at the bottom of the mountain and prepared to hike up. The first part of the hike is along a well-worn path that winds through the undergrowth between granite boulder scree that has weathered and rolled down the mountain over the years. Even at this low-lying section, the potential for minerals is evident: "nests" of black schorl tourmaline within coarse quartz protrude out of many of the boulders. These are more resistant than the granite host rock, so they give a distinct knobby appearance to the rock faces.

Our hike was aimed at a valley, or "Schlucht," as this provides the easiest access to the collecting areas. Otherwise one has to negotiate nearly vertical granite cliff faces. In some sections of the mountains, the local diggers rely on ropes to pull themselves up the steep slopes, sometimes with dire consequences. Shortly before our visit, one of the diggers was killed while making the climb: he had been carrying a jack-hammer on his back, and while he was pulling himself up, one of the

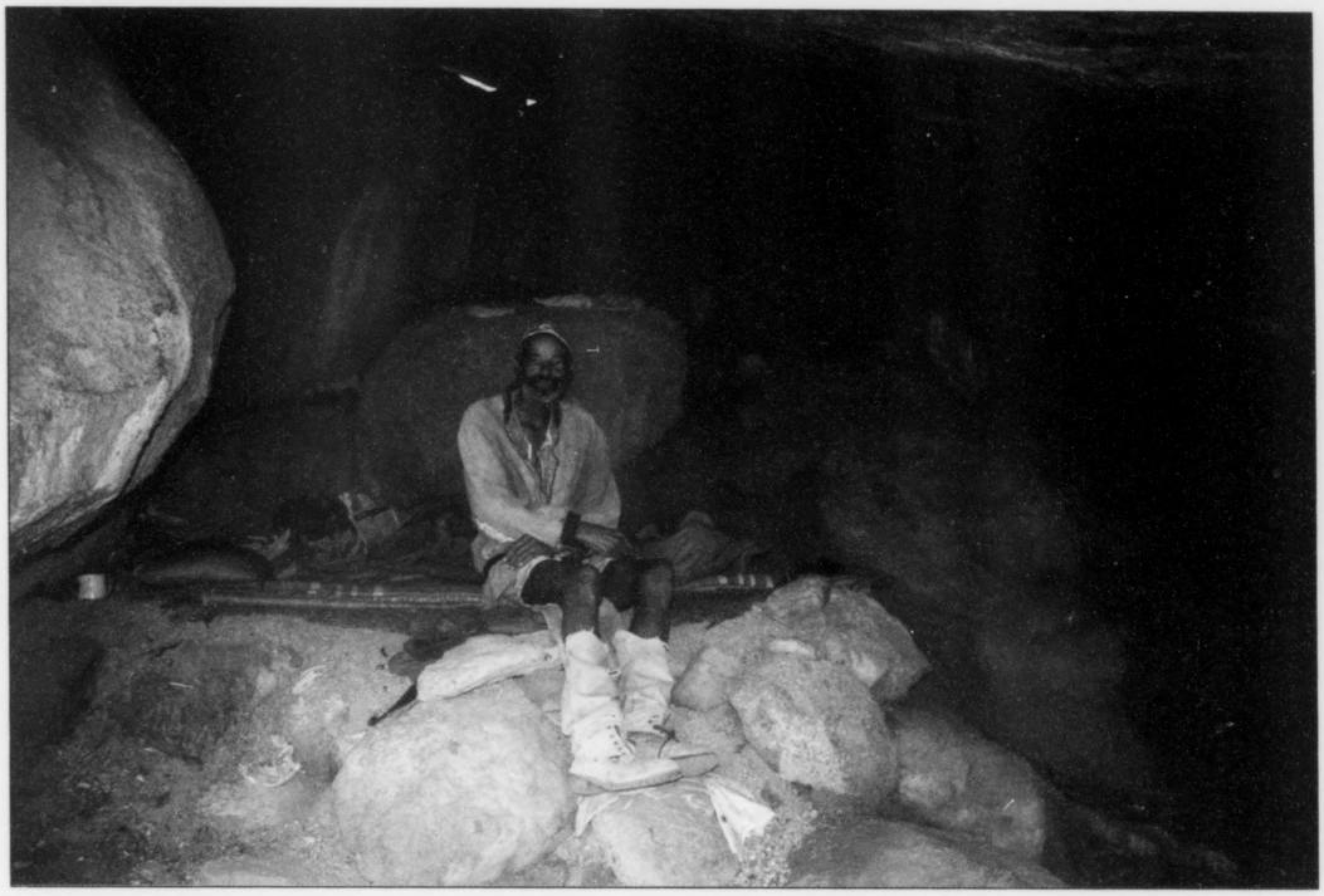


Figure 334. **Japie in his make-shift home on the mountain. The massive granite boulders provide adequate protection from the elements. Some diggers live temporarily on the mountain to avoid climbing up and down every day. Bruce Cairncross photo, August, 2005.**

ropes snapped and he tumbled to his death. Having this information passed on to us just before our ascent was rather sobering!

The granite is very coarse-grained, composed of coarse quartz and interlocking feldspar laths up to 5 cm. This rock texture is advantageous for climbing up the steeply dipping rock faces because the rough surface provides a firm grip for rubber-soled hiking boots. Nevertheless, "walking" up 40°–60° slopes takes some getting used to. It goes without saying that our nimble guides were hopping up and down the outcrop with casual abandon! Early on in the climb, we heard a voice from on high shouting down, and when we looked up the rock face we could see one of the diggers in a crevice about 100 meters up, waving down to us—that was where we were heading.

Upon reaching some of the old excavated holes, we met up with another group of local diggers. After posing for the obligatory photographs (some with the subjects very seriously posed and staring off pensively into the distance) we proceeded upwards. We soon came to the zone where many specimens had been collected (GPS location S: 21°45′6.4″; E: 15°31′50.2″). All of the productive sites are now empty cavities in the granite, some with small tailings of waste material filtering down the slope from the mouths of the openings. The cavities vary in size; some are small, less than 10 cm in diameter and as deep, whereas others are tubular, 50 to 80 cm wide, and winding down to over 2 meters depth.

The diggers randomly select pockets to excavate, identifying them from the telltale "nests" of schorl and quartz. Not all yield prize specimens and some are merely clay-filled and barren. There is not much to be self-collected from the odd tailings that remain. Because the climb up and down the mountain is arduous, even for the nimble-footed, the local diggers have set up semi-permanent camps in areas where fallen rocks provide shelter. Some have built rudimentary tents and lean-to shelters while others use natural caves formed by huge granite boulders. Water can be a problem, as it does not rain often, but at this particular locality in Bergsig, one of the larger pockets had previously filled with rainwater and this provided a supply that David said would last for months.

We photographed several of the pockets while David explained what minerals had been taken from each pocket. While we were there in August, some excellent green fluorite was being excavated.

In the afternoon, we returned to the Tubussis road and then turned off heading west to visit the well-known green andradite operation several kilometers to the west of the Erongo. When we arrived at the workings, which are fenced in, we were faced with a locked gate and greeted by an amicable machine-gun-carrying security guard. We asked permission to enter and take some photographs but this was politely denied. No mining was taking place on the day of our visit, so we decided not to waste any time and drove on to the farm Tubussis 22, in the northwestern part of the Erongo Mountains, where the original, major discovery of schorl had been made in 1999. Gerd Bachran had been instrumental in the that discovery.

After obtaining the key to the farm gate, we proceeded to the pocket where large (greater than 10-cm) orthoclase feldspar crystals had been excavated, together with schorl and yellow hyaline opal. This was another pipe-like cavity about 2 meters deep and 60 to 70 cm in diameter (GPS location S: 21°34′28.4″;

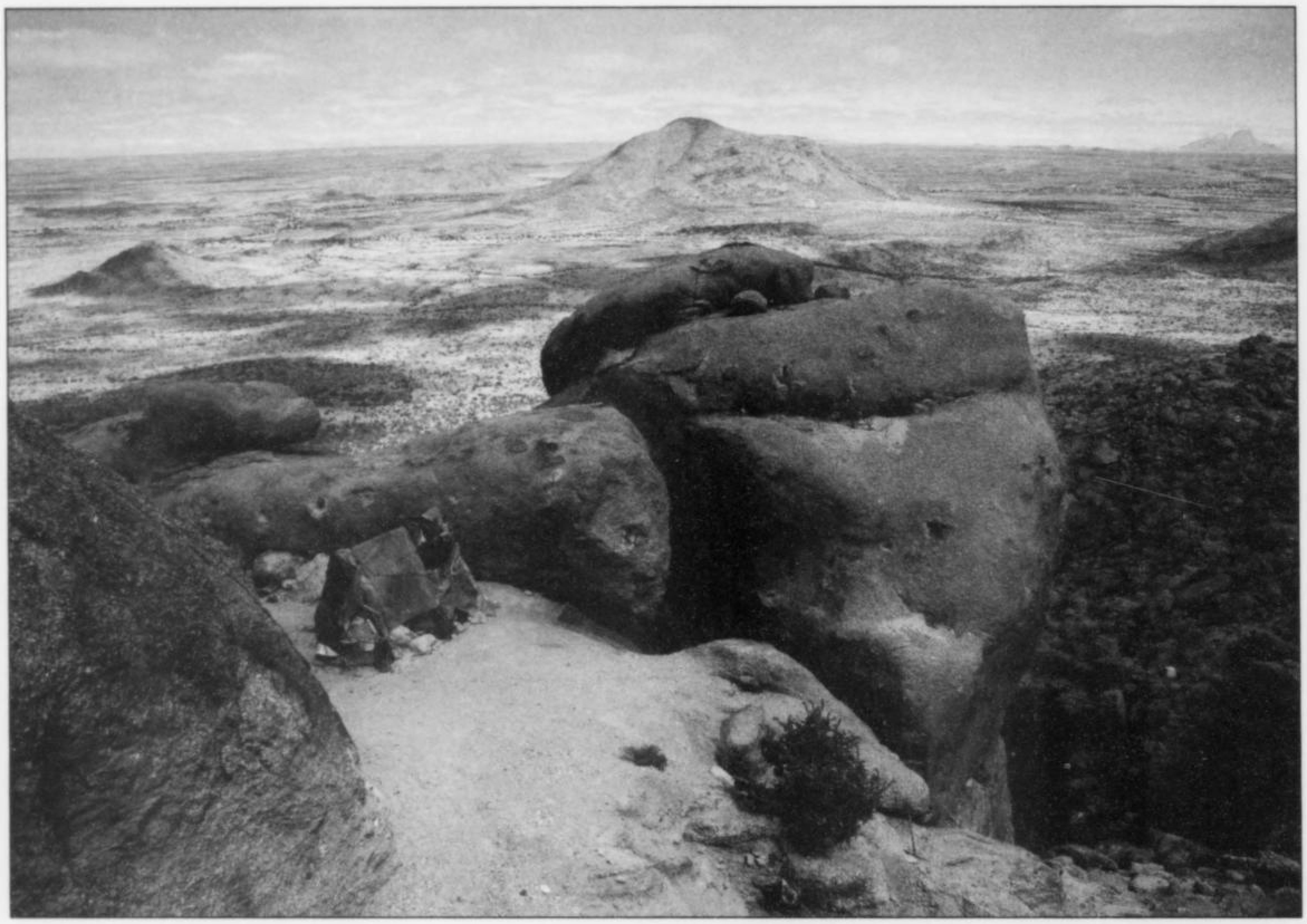


Figure 335. **Spectacular view towards the west from Erongo Mountain. The Gross Spitzkoppe can be seen at the top left. One of the diggers' makeshift tents is in the foreground, made of tree branches and plastic sheeting. Note the empty miarolitic cavities that have been dug from the rock around the tent. Bruce Cairncross photo, August, 2005.**

Figure 336. **Bushman paintings, approximately 20 cm tall, on granite on the farm Tubussis 22. Uli Bahmann photo, August 2005.**

E: 15°31′4.5″). On a nearby rock face, several Bushman paintings could clearly be seen in the late afternoon sun. These depict various antelope, notably kudu and eland, as well as giraffes and several caricatured humans.

We spent that Monday evening at the Ameib Ranch, located on the farm Ameib 60, adjoining Davib Ost 61, the other privately owned farm from which Erongo minerals have been (illegally) collected. On Tuesday morning, we returned to the Hohenstein Ranch on Davib Ost 61, but this time drove on farther to the southeast of the mountain range. The purpose of this morning's trip was to visit the 2001 excavations that had produced the jeremejevite. Some of these crystals had been collected from alluvium while others had been removed from *in situ* pockets in the granite.

Tuesday was somewhat warmer than the previous couple of days had been, and our climb up the granite this time was far more arduous because the slopes are steeper and one had to be careful not to lose footing and tumble down the rock face. The ascent was made more comfortable by zigzagging up the slope, again with David leading the way. We climbed up from the farm Davib Ost 61, but then began to move southeastwards towards the boundary fence with the neighboring Ameib 60 farm—the

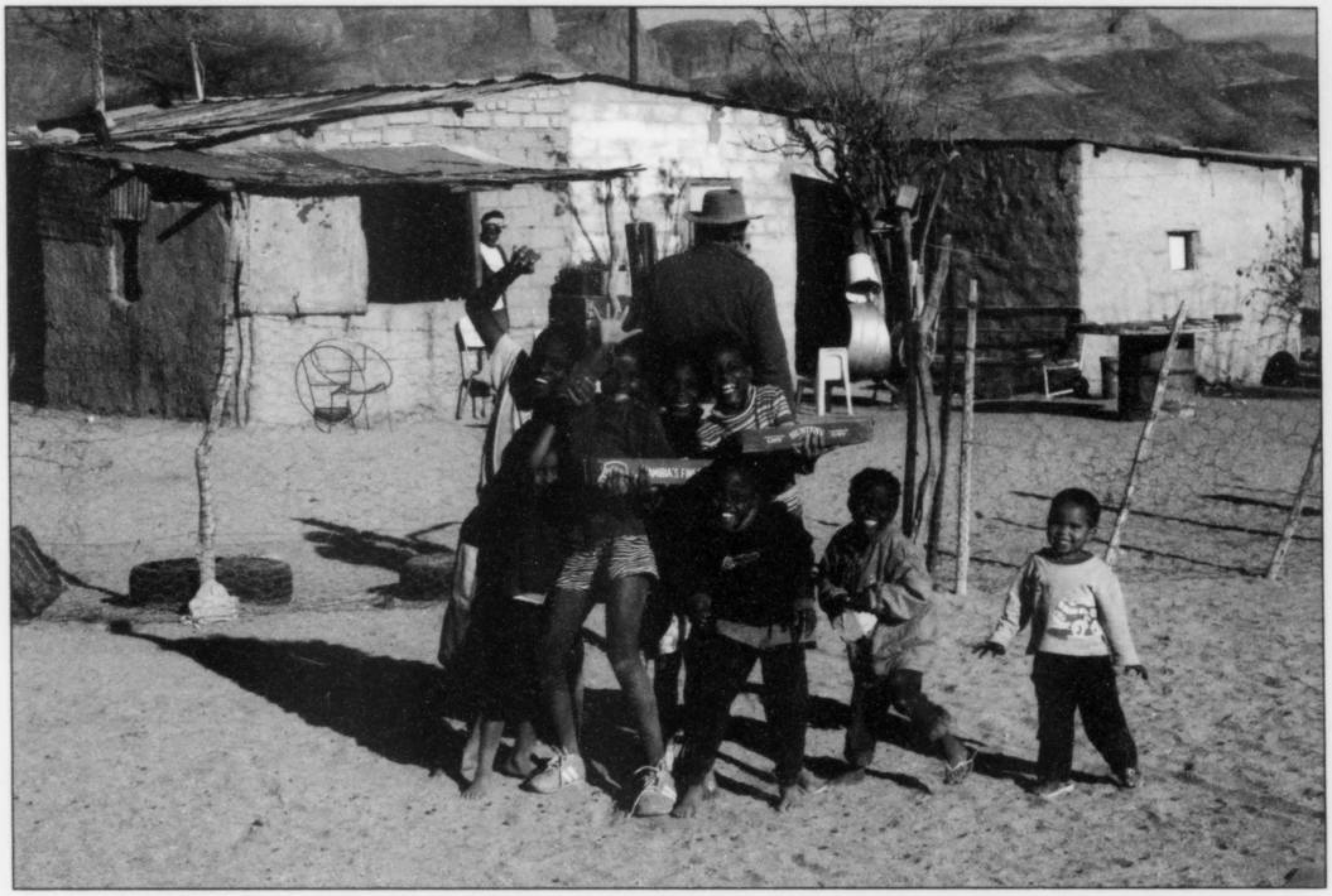


Figure 337. **In the village of Tubussis, local children are more than happy to sell minerals (in the ubiquitous beer flats) to passers-by. The Erongo Mountains are in the background. Bruce Cairncross photo, August, 2005.**

Figure 338. **One of us (BC) with backpack climbing the mountain. The local guide David (orange pants) looks on in amusement. Uli Bahmann photo, August 2005.**

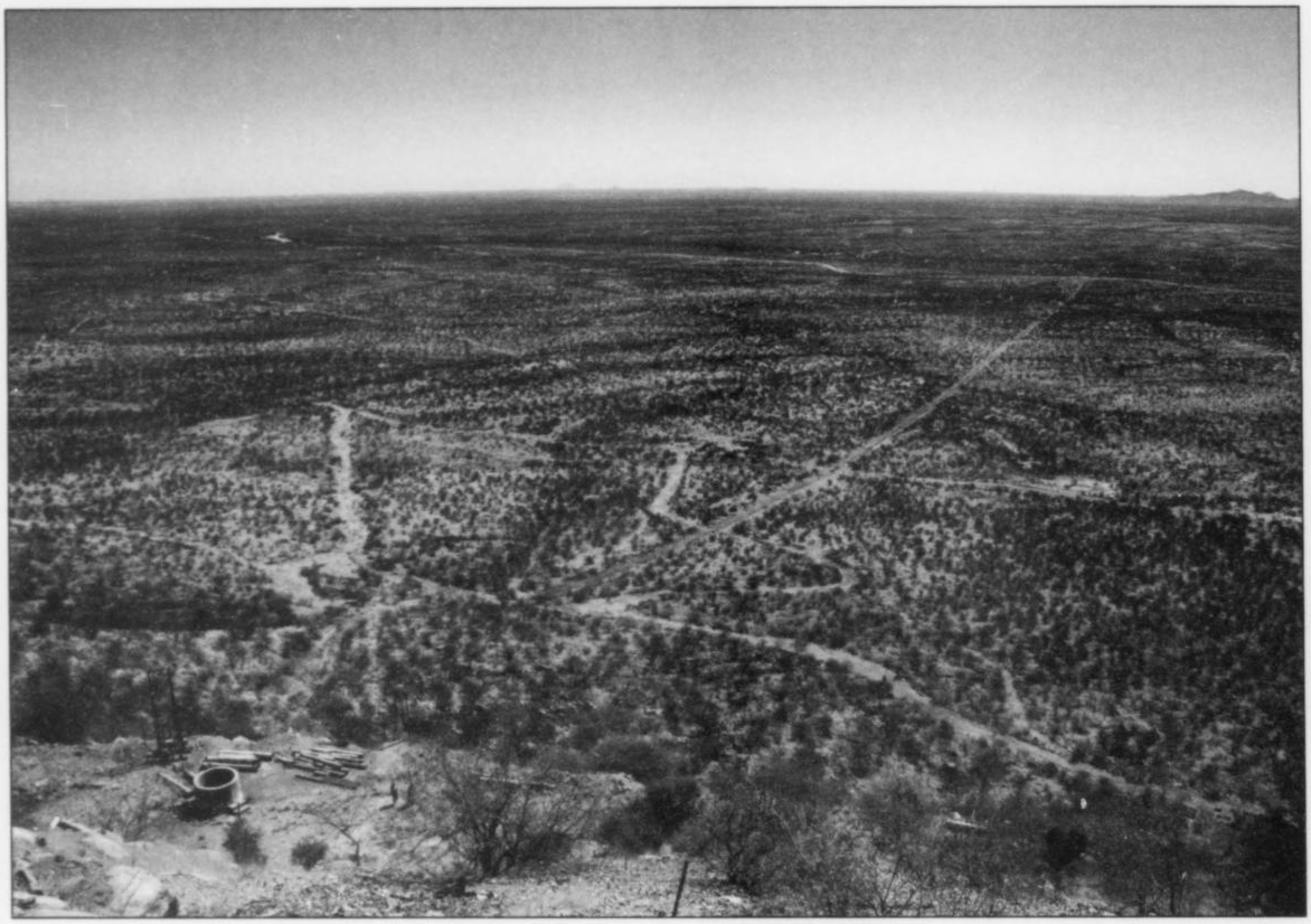


Figure 339. **Panoramic view looking north from Krantzberg Mountain. Some of the old mine apparatus is in the foreground. The Omaruru River is in the distance. Bruce Cairncross photo, August, 2005.**

jeremejevite came from close to the junction point between these two farms. En route, we passed several excavations that had yielded schorl, quartz and aquamarine (GPS location S: 21°45′20.4″; E: 15°34′47.6″).

We had to traverse around the front lobe of the granite mountain in order to get a route across to the jeremejevite diggings. Some of the cavities that we observed are large, a few meters across and a couple of meters deep. As at the Bergsig diggings, there was evidence of diggers occupying boulder overhangs in the mountains and using these for shelter.

We then stopped at an excavation that had the largest "tailings dump" we'd so far encountered. This material had been removed from a substantial pocket about 5 to 6 meters wide and 4 to 5 meters deep. Apart from aquamarine, smoky quartz and opal, David explained, this particular pocket had yielded the highly lustrous, complex cassiterite crystals in July 2004. Scratching around in the residue, it was easy to find smoky gray to black quartz crystals up to 6 cm and some highly fluorescent lime-green, botryoidal hyaline opal (GPS locality S: 21°45′26.1″; E: 15°35′0.4″). Most of the single quartz crystals display an interesting tapering of the prism faces towards the termination.

Standing at this cassiterite cavity, one looked downslope towards the southeast, and a few hundred meters away the empty jeremejevite pockets and rubble were clearly visible. We clambered down to this area, which is pockmarked with small excavations, most less than a meter across and a meter deep, although a few are larger. There has been some systematic work carried out here, as indicated by the cavities left behind by jackhammers. The exact locality of the jeremejevite discovery is GPS location 21°45′26.4″; E: 15°35′2.7″.

We scratched around in the tailings for anything of interest, but only found one tiny chip of blue jeremejevite in feldspar—the diggers do not leave much behind. The view from the top of this granite koppie is breathtaking, however. One can clearly see the Gross Spitzkoppe to the northwest and the vast, flat plain leading away from the Erongo foothills. The dry Khan River snakes off into the distance, and one of the old cassiterite pegmatites on the plains farm Ameib 60 can also be seen.

That concluded our trip to the western and southwestern fringes of the Erongo Mountains. Our next goal was to visit the northeastern section, where the Krantzberg mine had operated. This mine is now closed but was worked for tungsten and cassiterite intermittently between the 1920's and 1979. It is located on the upper slopes of Krantzberg Mountain, a prominent feature that has a circular "wreath" of sedimentary rocks

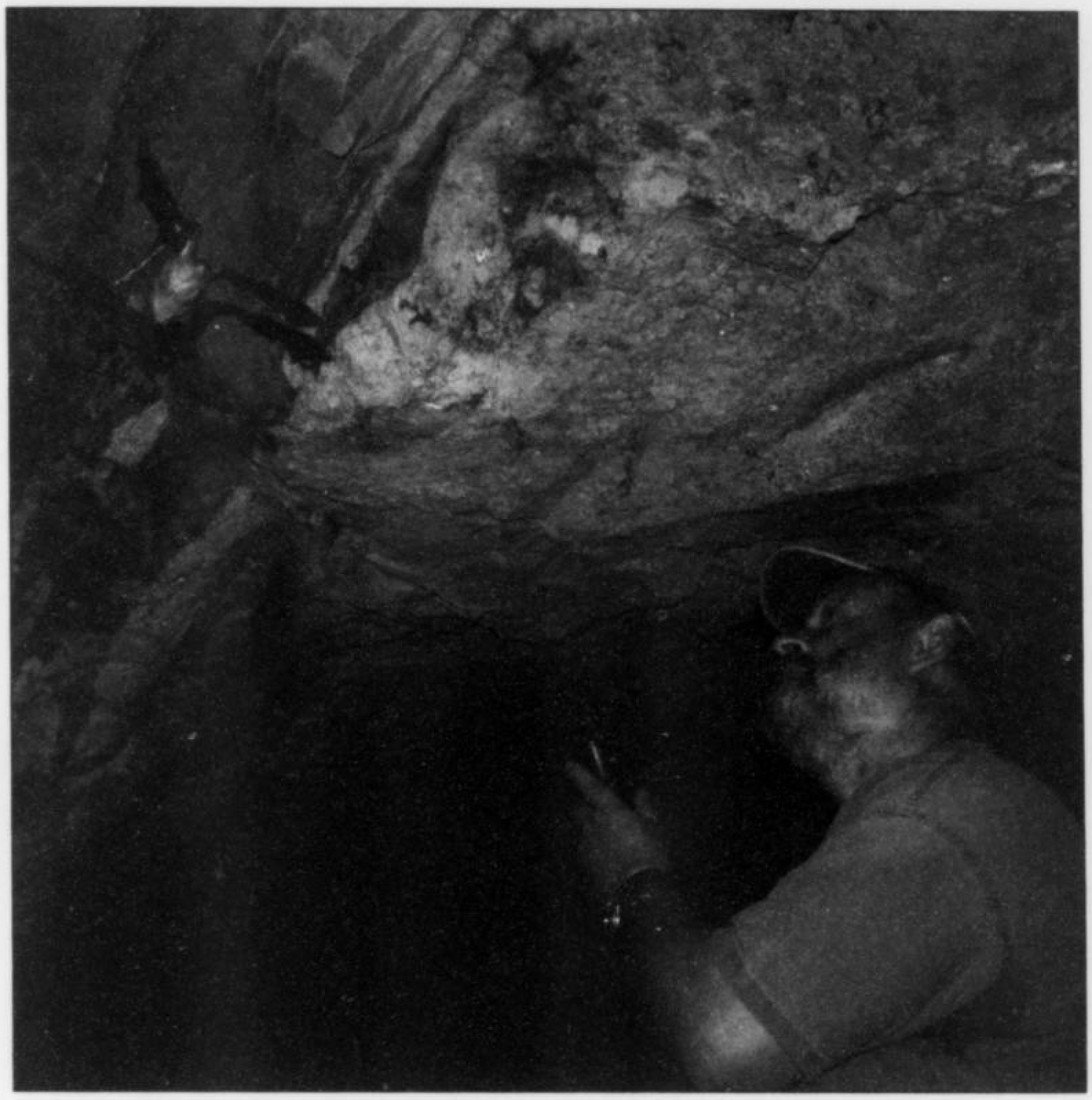


Figure 340. **One of us (UB) examining the underground exposures at the Krantzberg mine. Note the bat for scale. Bruce Cairncross photo, August, 2005.**

near the crest of the mountain: hence its German name, Krantzberg or "wreath mountain."

The mine is on private farmland, and at first it was not easy to get permission to access the mine. The problem was that the mine workings fall on the boundary between two neighboring farms, and on one of these the farmer was entertaining a hunting party, so he was reluctant to allow us on the property. We did not like the idea of getting shot, so we tried to contact the adjacent farmer, Herr Decker. He happened to be away in Germany, but his resident manager was happy to allow us in to see the mine. In fact, he even drove us up to the locality in his four-wheel-drive vehicle. The old track leads up to what appeared to be an adit in the side of the mountain where some old mining equipment was lying around. We soon noticed that it was in fact not an adit but a loading area where ore had been dropped from an upper level and then trucked away.

The view from Krantzberg is magnificent. Looking up the precipitous slope, we could see that the access adit was in fact higher up the hill. There are some old concrete steps that obviously had been used to communicate between these two levels. Uli and the farm manager's assistant, Nelson, climbed up, pulling themselves up over the last 20 or 30 meters on an old telephone cable tethered to an iron pole anchored in the ground. The memory of the fatality at Bergsig a few weeks earlier was still fresh in my mind, so I passed on that option; instead, I used the old access road to reach the adit on the upper level.

This adit had been driven horizontally into the mountain. We explored the underground mine for a distance of a few hundred meters into the old workings. The air is very fresh because several openings where rock had caved in from higher levels had broken through to the surface, admitting light and fresh air. Further into the mine the air becomes foul, exacerbated, no doubt, by the many bats we found dangling off various old cables and rock hangings. We also found leopard droppings and spoor (tracks), but the owner of these was thankfully not home at the time! We found evidence of some drusy cassiterite and blue-green secondary copper staining, but no sulfides, ferberite or fluorite.

That concluded our excursion to the Erongo Mountains. We capped off our Namibian trip by spending two days driving to Swakopmund via Uis and the Goboboseb Mountains. In the old tin mining village of Uis we met with mineral dealer and adventure tour leader Monty van der Smit, who showed us some of his recent acquisitions from the Erongo region and environs. We also visited several dealers in Swakopmund, which is now the main focal point for Namibia's mineral shops. However, there was nothing really exciting to be seen, neither in their stock nor in the collection of the Swakopmund Museum, located on the beachfront. This museum has a suite of Erongo minerals, but nothing extraordinary.

On the road back from Swakopmund to Windhoek, one drives by the turnoff to Henties Bay, and this road passes close by the Klein Spitzkoppe. About two dozen or so local diggers who have set up tables at this intersection offer a variety of mineral specimens from numerous Namibian localities. We stopped for a while and found some interesting Erongo specimens, including small jeremejevite crystals on orthoclase matrix, unusual orange hyaline opal that we had not seen before, thumbnail specimens of fluorite included in aquamarine and an assortment of other specimens such as colorless beryl on yellow muscovite, schorl and quartz.

Figure 341. **Sunset at the Erongo. Uli Bahmann photo, August 2005.**

CONCLUSION

The Erongo Mountains offer huge potential for minerals in the future, as vast areas are still unexplored. Much of the northern, central and western parts of the Erongo Mountains form part of the Erongo Mountain Nature Conservancy, a protected wilderness area where private landowners take a dim view of any trespassers and especially iterant mineral collectors. There are other private farms in areas outside of the Nature Conservancy as well, so one would be well advised to seek permission from the owners before embarking on any mineral collecting expeditions. The same applies to Ameib 60, Davib Ost 61 and Bersig 167, on all of which specimens have been collected. This is also privately owned land. Furthermore, it is illegal to remove any mineral, gemstone or geological specimens from Namibia without the necessary official export documents. These can be obtained from the Geological Survey offices in Windhoek.

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We are grateful to the individuals and institutions who assisted us in various ways to help bring this article to the light of day. Gerd Bachran of Swakopmund gave assistance in the field and mineralogical information on the various pockets, and donated jeremejevites for analyses. David from Tubussis was our guide for a few days in the Erongo Mountains. Andreas Palfi and Ralf Wartha of "Namibia Minerals," Windhoek, shared their knowledge and showed us their recent Erongo specimen acquisitions. Monty van der Smit of "Adventure Tours & Minerals," based in Uis, granted us access to his stock of Erongo minerals. Frau Kögel, the owner of Ameib Ranch where we stayed, allowed access to her farm and property. Herr Decker of the farm Otjohotozu provided transport and granted permission to visit the Krantzberg mine. Desmond Sacco provided historical information on the Krantzberg mine and permitted photography of his specimens. Dr. Ludi von Bezing provided pictures of his Krantzberg specimens. Peter Tandy, Curator of Minerals (Curation & Mineral Systematics) at the Natural History Museum, London, assisted BC in examining historic Erongo specimens in the Natural History Museum's collection. Rob Smith provided aquamarine specimens for analyses. Ellen de Kock searched the Museum Africa's Geological Museum collection database for Erongo specimens. Last but not least we thank Anka Bahmann for sustenance during the August 2005 field trip to the Erongo Mountains. Notwithstanding all this collaboration, we are responsible for the final content of this article.

We are particularly grateful to Herbert Nägele and Ernst Schnaitmann of Windhoek's "House of Gems." Ernst photographed specimens from their Erongo collection and further provided up-to-date information on Erongo and its minerals.

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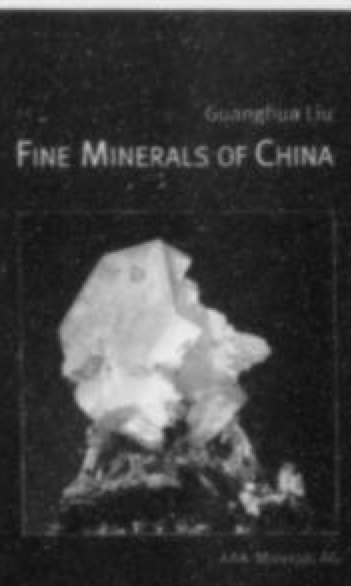

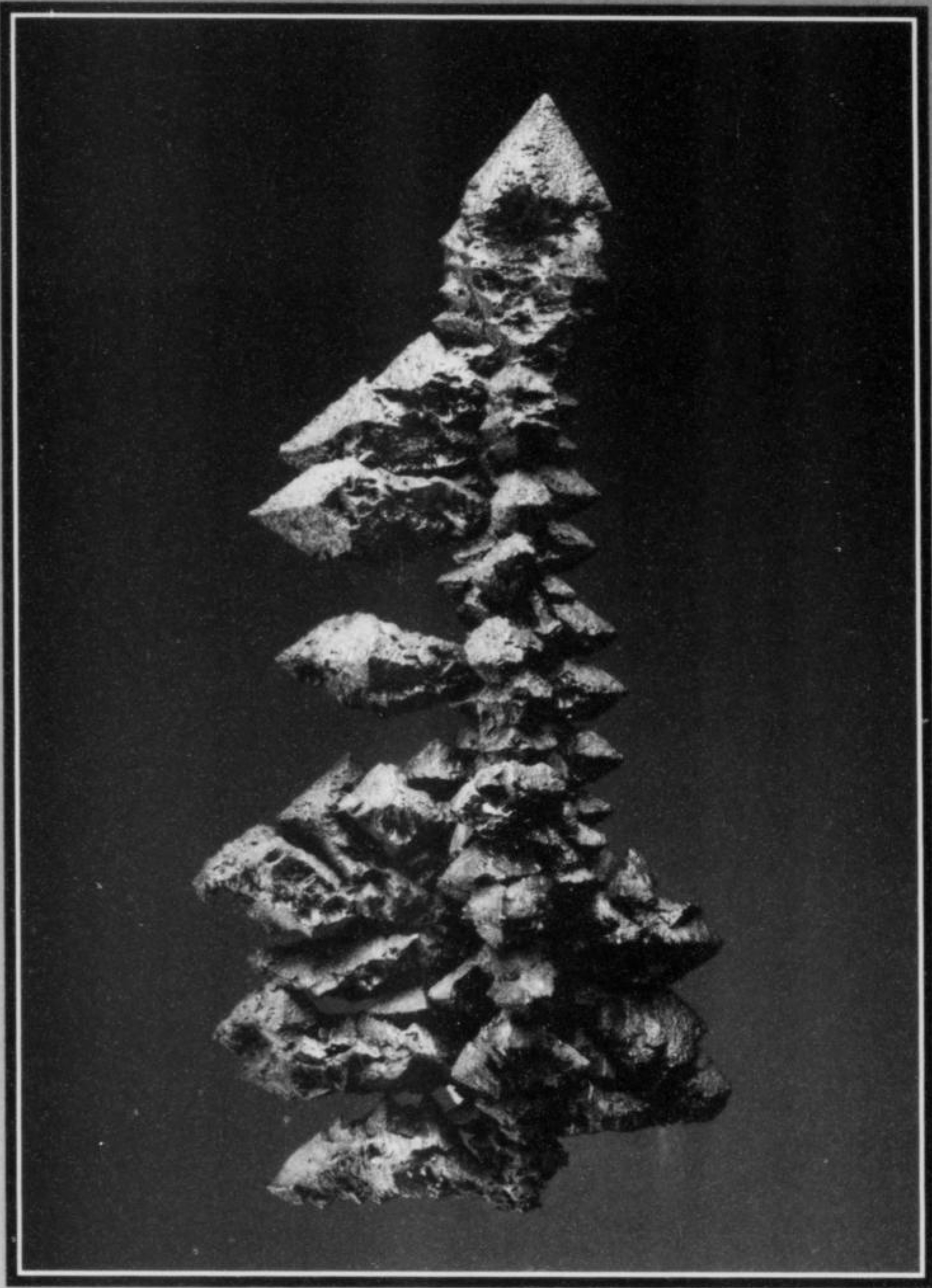

ACANTHITE, 10.5 cm, Imiter, Morocco. Jeff Scovil photo.


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What's New in Minerals

Ste.-Marie-aux-Mines Show 2006 by Tom Moore

[June 22–June 25]

At the end of June 2006 in central Europe, World Cup frenzy ruled (with cheering and beering natives, bare skins and Mohawk hairdos painted in various national colors, filling the streets of towns); the weather was hot and sunny; and from a surprising number of shop windows the Ste.-Marie-aux-Mines Show poster, showing the famous "dragon" gold specimen from California, looked out on passersby. For me, though, the theme-of-the-week was Nostalgia, for I'd come to Europe to check in again on people, places and things from my former life there (1976–1991). When my old friend Gary Kissick (accomplished poet and novelist) came down from his home in England to join me and my wife at the Ste.-Marie Show, we revisited a nostalgic site: the very first column of mine published in the *Mineralogical Record* (Nov.-Dec 1986 issue) was a report on the 1986 Ste.-Marie Show, including Gary's photo of me standing outside the theater building which was (and still is) the center of show action. Gary restaged the photo, with a result *not* shown here, inasmuch as the building, you see, looks too much, too unacceptably, older.

The density of the crowds this year at the show routinely approached World Cup-festivity levels, the sun was hot, and we won't even speak of the parking problems in town—but being there was entirely delightful. Predictably, the show in 2006 was at least twice as big as it was the last time I'd seen it, in 1991. The ground plan published with Bill Larson's 2001 show report (vol. 32 no. 6, p. 488) displays what is still the general layout, but whereas there were 550 dealer/exhibitors in 2001 there were more than 900 in 2006. To the 2001 geographic plan there has since been added a whole new area of dealers' tents (on the right of the diagram), as well as two large, connected enclosures which were new this year. Called the "Val d'Argent Expo," these brand-new halls have been fashioned out of an old industrial complex measuring 2500 square meters in area: "Val Expo I" chiefly holds mineral dealers while "Val Expo II" holds mineral club stands, seminar areas, and fossil, micromount and miscellany dealers. Establishing these "Val d'Argent" venues apparently saved the show from having had to be moved from Ste.-Marie-aux-Mines to some larger nearby town (Colmar had been suggested): To quote from a handout:

> The safety- and security-related constraints made it difficult to maintain the exhibition under the current conditions. Following a large movement of support by the citizens, the local officials, and particularly the municipality, took the opportunity to acquire [the] industrial complex in order to renovate it.

Those who have developed a fondness for this slope-streeted, flowery old town, headquarters for silver mining which ended in the 18th century, may thank its citizens for having acted thus to retain the show. The name "The Colmar Show" simply wouldn't have the historical-mineralogical cachet of "The Ste.-Marie-aux-Mines Show."

Some visitors, especially collectors from America, went about as usual saying that there was "nothing new" at the show, and yet my notes are copious enough to be organized into a Tucson show report-style "world tour" of interesting (if not all championship-level) mineral discoveries on hand. Since it seems only sporting to start with the host country, consider first some excellent French **fluorite** specimens. French fluorite is not widely marketed in the U.S., and hence is under-appreciated by Americans, so it's worth noting that these specimens from the Mine du Burg (or Burc—as it's sometimes written, in imitation of a local dialect), in the Albigeois fluorite-mining district, Department of Tarn, south-central France, are quite attractive. Serious fluorite mining here began in the early 1970's, but the Montroc mines closed in July 2005, the Moulinal mine closed in November 2005, and the district's best source of specimen-quality fluorite, the Mine du Burg [Burc] is just now closing. I received this information from two French dealers, Alain Martaud and Michel Cabrol, both of whom had stands in the theater building with modest numbers of fine fluorite specimens from the Mine du Burg, some from old hoards now being sold off, and some that were found very recently in the process of closing the mine. These specimens show lustrous, transparent, pale baby-blue to deep blue, cubic fluorite crystals to 3 cm on edge, in loose clusters or strewn among sparkling crusts of milky white, 5-mm quartz "points." In some specimens the limpid blue fluorite crystals show prominent phantoms; others have partial coatings of drusy pyrite. In all they are quite beautiful. Alain Martaud (33 rue Compans, 75019 Paris, France) had about ten miniatures of Mine du Burg fluorite, all recently collected, plus a few spectacular big pieces in a display case. Claudette and Michel Cabrol (michel_cabrol@yahoo.com) offered 35 specimens ranging in size from toenails to one gorgeous plate measuring 20×35 cm.

Nor was this the show's only appearance of French **fluorite**. On the upper level of the theater building, Lino Caserini (Via Don Giuseppe del Como 1, 20132 Milano, Italy) had about 40 fluorite specimens found in March 2006 in the Le Piboul mine, Department of Lozere (northeast of Tarn and just south of Haute-Loire). In these miniature and small cabinet-size specimens, cubic, transparent, medium-orange fluorite crystals to 3 cm form loose platy groups, or rest on salt-and-pepper matrix of weathered granite which is densely veined with purple fluorite of an earlier generation. For more information on French fluorite see the recent special "Hors Série XI" publication of *Le Règne Minéral*, on the marvelous fluorites of the Departments of Haute-Loire and Puy-de-Dôme, north-northeast of Tarn.

The old Salsigné gold mine in the Department of Aude, 18 km north of Carcassonne in southern France, was closed in 2000, but two large hoards of dramatic **aragonite** specimens collected there in 1970 and 1980 were being offered by a French dealership (whose name I unfortunately failed to record) in one of the Val Expo areas at Ste.-Marie. The 1980 lot, collected in the "Rameles Grotto" on the Salsigné mine's 337 level, consists of about 100 specimens of pure bright white coralloidal aragonite, each one a flamboyant fantasy of rounded stalks, acicular sprays, and delicate frostlike growths; these specimens *average* about 20 × 20 cm in size, a couple of them reaching 45 cm across. The specimens from 1970, which their handlers were calling "aragonites excentriques," are loose, twisted, rounded white stalks, some ramifying into dendritic formations, many topped by sparkling sprays of transparent, colorless, acicular crystals: these eccentrics reach 15 cm long. None of the aragonite specimens shows associated species; some have areas stained brown by iron oxides.

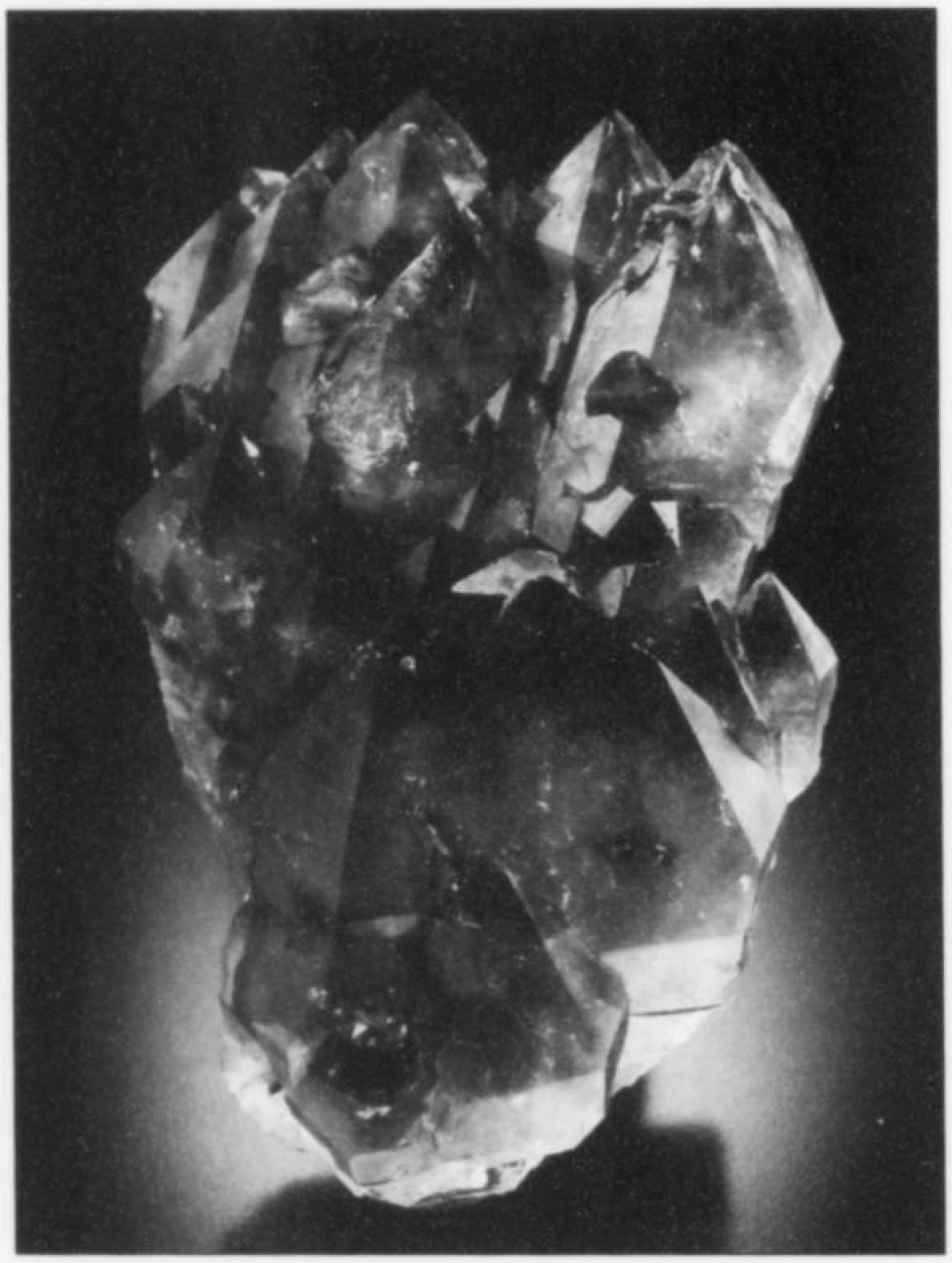


***Figure 1.* Amethyst crystal cluster, 10.7 cm, from Sils, La Selva, Girona, Spain. Jordi Fabre specimen; Jeff Scovil photo.**

Coming in through one of the two entrances to the main lower-level part of the theater building, one saw the diverse offerings of Jordi Fabre (www.fabreminerals.com) ranged down half a wall's worth of space. A new Spanish item here was a group of about 50 good specimens of scepter **amethyst** collected over the last two years from two sandstone quarries, one of them called the Massabé quarry, near the village of Sils, La Silva, Girona, Spain. The specimens range from single, loose, toenail-size milky quartz stalks topped by wide, deep purple amethyst scepters, to groups of sceptered prisms rising from matrix plates to 25 cm across. The luster is not of the highest, but the amethyst scepters are richly colored, and translucent to transparent.

In the June installment of "what's new in the mineral world," my online column on the *Mineralogical Record* website (www .MineralogicalRecord.com), I described the exciting October 2005 discovery of superb **autunite** specimens in a uraniferous pegmatite worked by the Nossa Senhora do Assunçao mine, near Ferreira de Aves, Viseu, Portugal—and the picture accompanying the report shows that these new autunites rival even the best of the old ones from the Daybreak mine, Washington and the Streuberg quarry, Germany. It was good to find out at Ste.-Marie that some top specimens from this discovery are still available on the market. About ten of them were on hand, brought in by the Portuguese dealership *Geofil* (geofil@geofil.com). Curved, bulging fans of parallel-growing, thin-tabular autunite crystals form brilliant yellow-green encrustations on matrix; individual fans reach 1.5 cm, and matrix pieces range from 3 to 12 cm.

The very rare zeolite species **ferrierite** (well, actually, ferrierite-K and ferrierite-Mg are different species, and it's not yet known which of these the new find represents) is found in attractive specimens pretty much exclusively at the Monastir roadfill quarry on Monte Olladri, near Cagliari, Sardinia, Italy. What must be the world's best ferrierite specimens were dug in the quarry in March and April 2006, and about 100 of them were being offered at Ste.-Marie by Giovanni Signorelli of *Webminerals s.a.s.* (www .webmineralshop.com). Bright orange to red-orange, smooth-surfaced, radial-aggregate spheres of ferrierite crystals with a medium to dull luster reach 2.5 cm in diameter; the spheres line seams in basalt, associated with microcrystals of heulandite and mordenite. Some matrix pieces have up to eight partly intergrown ferrierite spheres while others sport large single spheres, but in either case these are unusual and oddly appealing miniature-size specimens.

While not strictly "new," the six magnificent cabinet-size clusters of orange **barite** crystals from the Pöhla mine, Obersachsen, Germany cry out for mention: at any rate they cried out pretty loudly to *me* from the stand of *Marcus Grossmann Minerals* (www.The-Mineral-Web.com) on the theater's lower level. Consisting of solid, flashing clusters of transparent, mostly doubly terminated barite crystals to 3.5 cm, these specimens are leftovers from the great finds at the Pöhla mine in the 1980's. Also well-known by now—see the report from the 2006 Tucson Show—are the very spectacular groups of razor-sharp, brilliant red, prismatic **realgar** crystals found in December 2005 in one of the ancient mines at Baia Sprie, Maramures, Romania: a major selection of these, ranging from thumbnail to small-cabinet size, was being offered in the theater lobby by Luis Miguel Fernández Burillo's *Minerales* dealership (lmburillo@navegalia.com).

Morocco contributed four intriguing new things this time around. In May 2001, one of the many unusual skarn outcrops around the remote village of Imilchil produced several handfuls of loose, opaque beige to gray-white crystals of **oligoclase**, a member of the plagioclase series which only very rarely is found as euhedrons. The compound, blocky, elaborately grooved, thumbnail-size oligoclase crystals resemble slightly chewed-on artists' erasers, but nevertheless they were moving briskly to customers in the tent of *Daniel Gol Minéraux* (danielgol@free.fr). Secondly, Jordi Fabre and a couple of dealers in "Val Expo" had nice miniature specimens of **chabazite** very recently found near Imilchil, with sharp, shining, pinkish orange rhombohedral crystals to 1 cm forming cavity linings and making little heaps on matrix. And thirdly, in the tiny Iourirn gold mine near Tata, Morocco, Pierre Clavel and his wife Martine personally collected about 200 **siderite** specimens, the best of them very fine, in May 2006—just in time to bring them to Ste.-Marie and offer them at their stand, *Pierre Clavel, Mineralogie & Prospection* (min.pro@wanadoo.fr), on the theater's lower level. Lustrous, sharp, chocolate-brown rhombohedral crystals of siderite to 5 cm make parallel stacks, some with faden and chloritoid crystals of **quartz**, others with sharp white **dolomite** rhombs to 3 cm. According to Pierre, the paragenesis seen in the

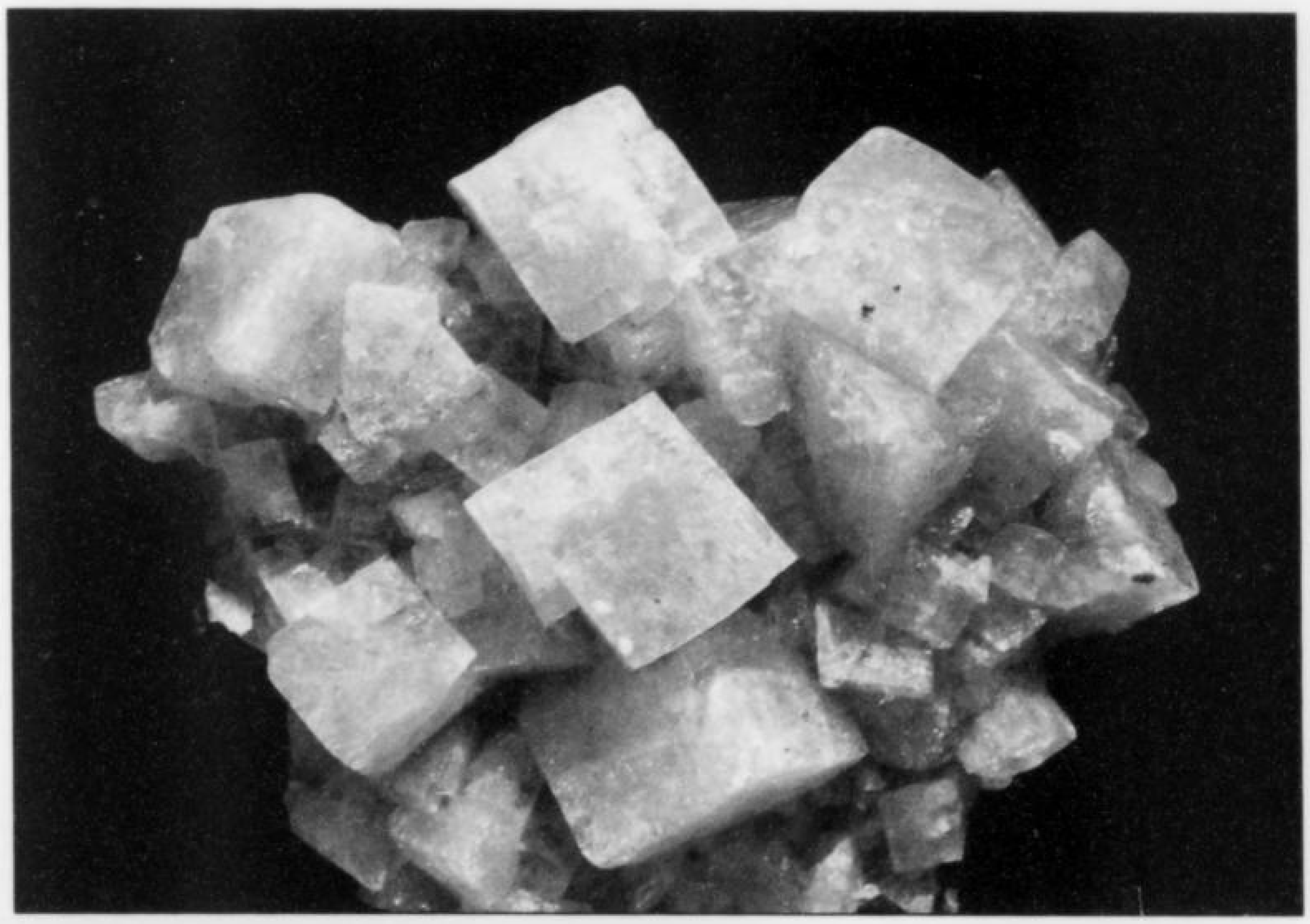
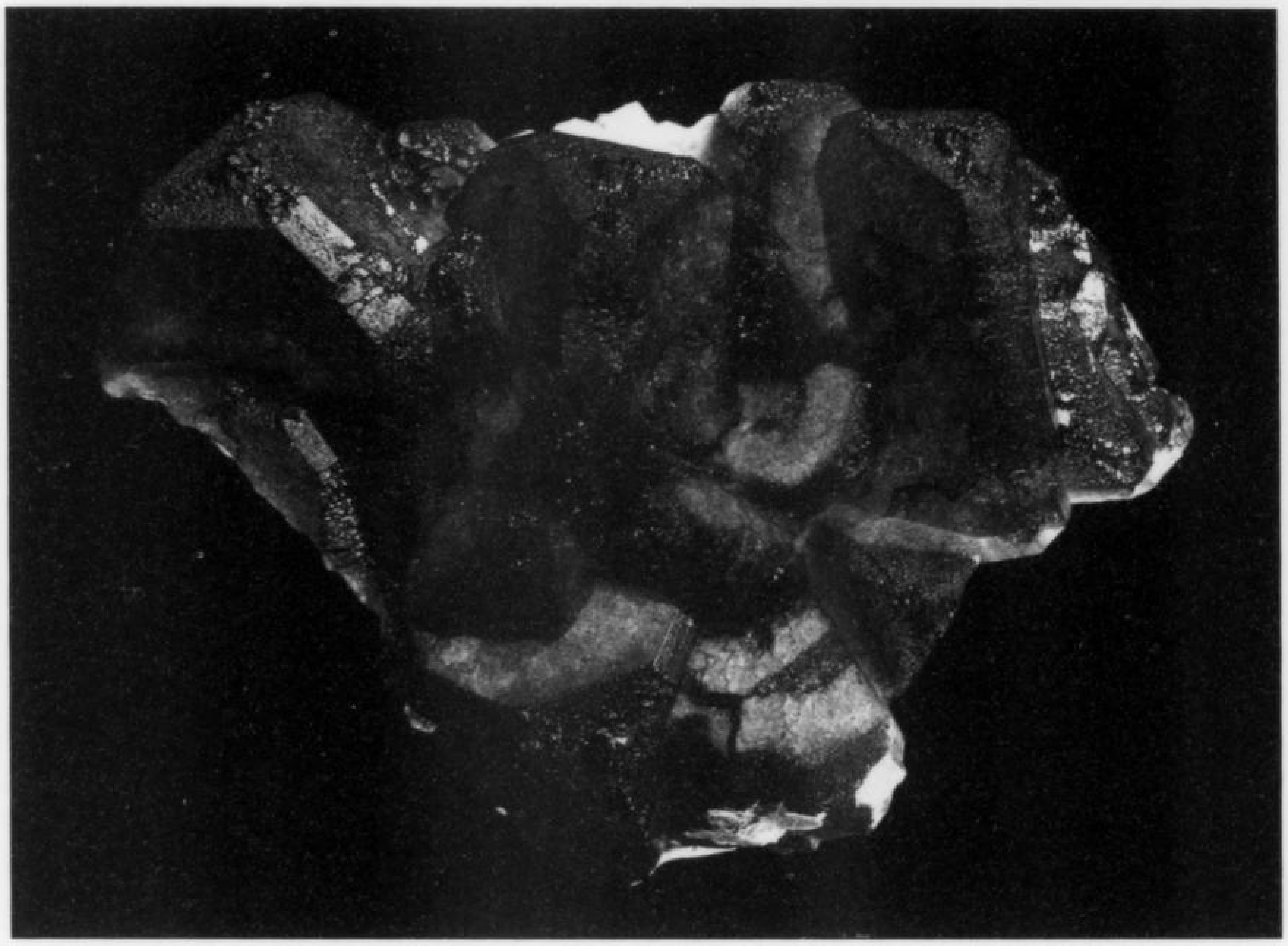


Figure 2. **Chabazite crystal cluster, with crystals to 1 cm, from Imilchil, Morocco. Jordi Fabre specimen; Jeff Scovil photo.**

Figure 3. **Fluorite crystal cluster, 7 cm, from near Tounfit, Boumia, Morocco. Jordi Fabre specimen; Jeff Scovil photo.**



Iourirn mine is the same as the one in the well known Morro Velho gold mine in Brazil; however, the siderite/quartz specimens very strongly resemble classic old pieces from Allevard, Isère, France.

The fourth new Moroccan entry is represented by a group of specimens picked up by Jordi Fabre during the show. Early in 2006 an old mine 1700 meters high in a mountain near the village of Tounfit, Boumia, Morocco gave up these lovely new specimens of **fluorite**, as lustrous, transparent crystals to 3 cm intergrown in cavity linings on massive fluorite. Some specimens show only simple cubic crystals of fluorite of a lush, very deep purple color. In other specimens, two generations of fluorite crystals are present, with shining deep purple octahedrons overlain by cuboctahedrons which are medium-purple with milky white zones; the points of the earlier crystals project slightly from the faces of the later crystals. These very attractive fluorite specimens range between 5 and 12 cm across.

Various skarn outcrops in the sub-Saharan scrublands of Kayes province, in western Mali, have been known for quite a few years now for their productions, sometimes very prolific, of grossular, epidote and prehnite specimens. The several flats of newly collected **grossular** crystals I found at this Ste.-Marie show may be unsurpassed for grossular crystals from Mali. The sharp, in most cases lustrous, dodecahedral crystals reach 25 cm across (very satisfying to heft in the hand), and some razor-sharp, perfectly formed, entirely complete crystals reach 14 cm. Most of the garnets are a rich, very dark brownish green; some are a paler green, but all are said to be grossular, not andradite, and not compositionally zoned, either. Thousands of the jumbo crystals were found sometime last year at the collecting site, which the handlers would only call "Kayes region." From the same site have come loose brushy groups, to 15 cm across, of very dark green, lustrous, compound crystals of **epidote**, and a few aggregates of intergrown **prehnite** spheres in the same size range. The specimens were collected by engineer Jean-Claude Villeneuve of Dakar, Senegal, with whom I

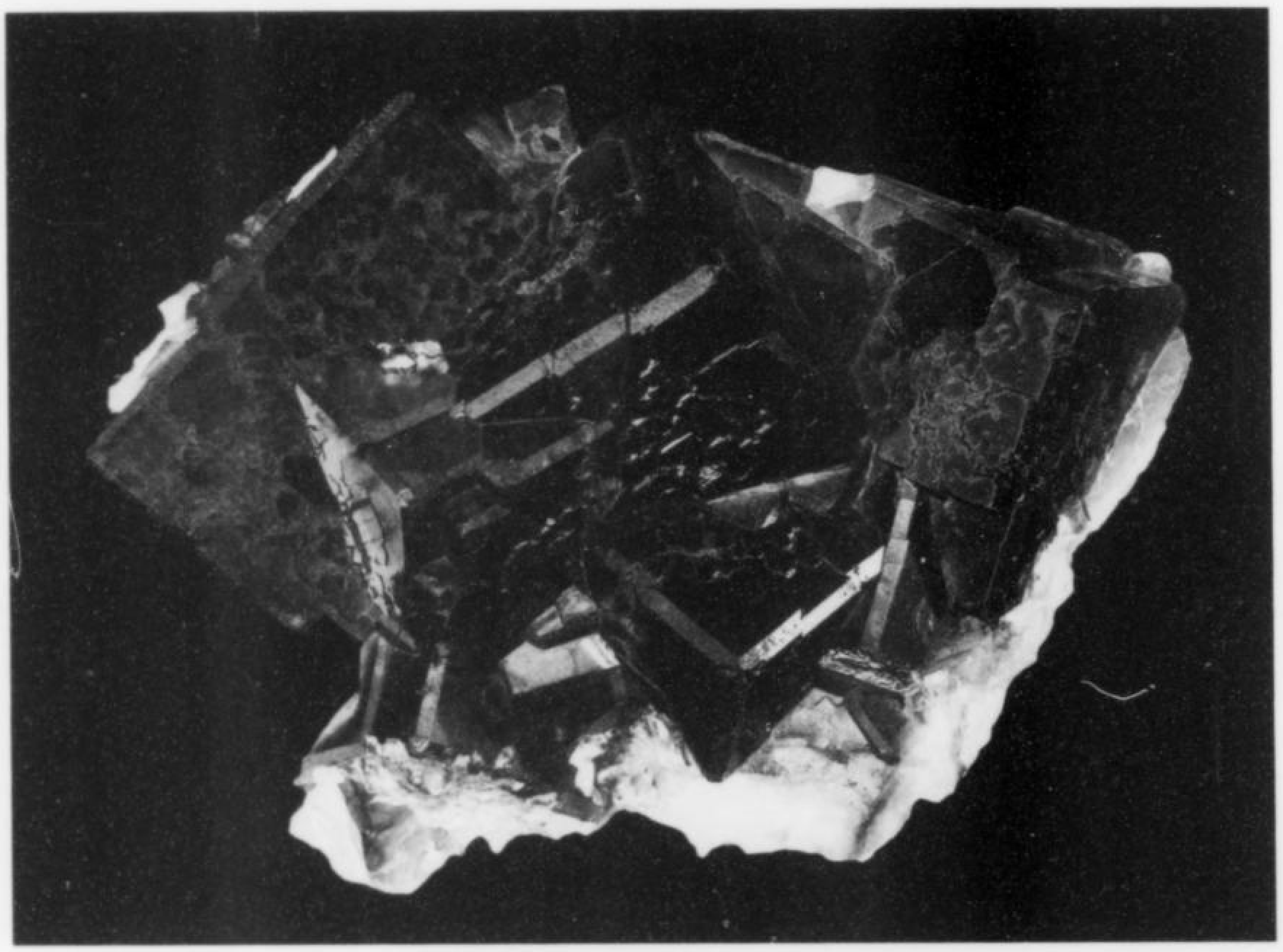
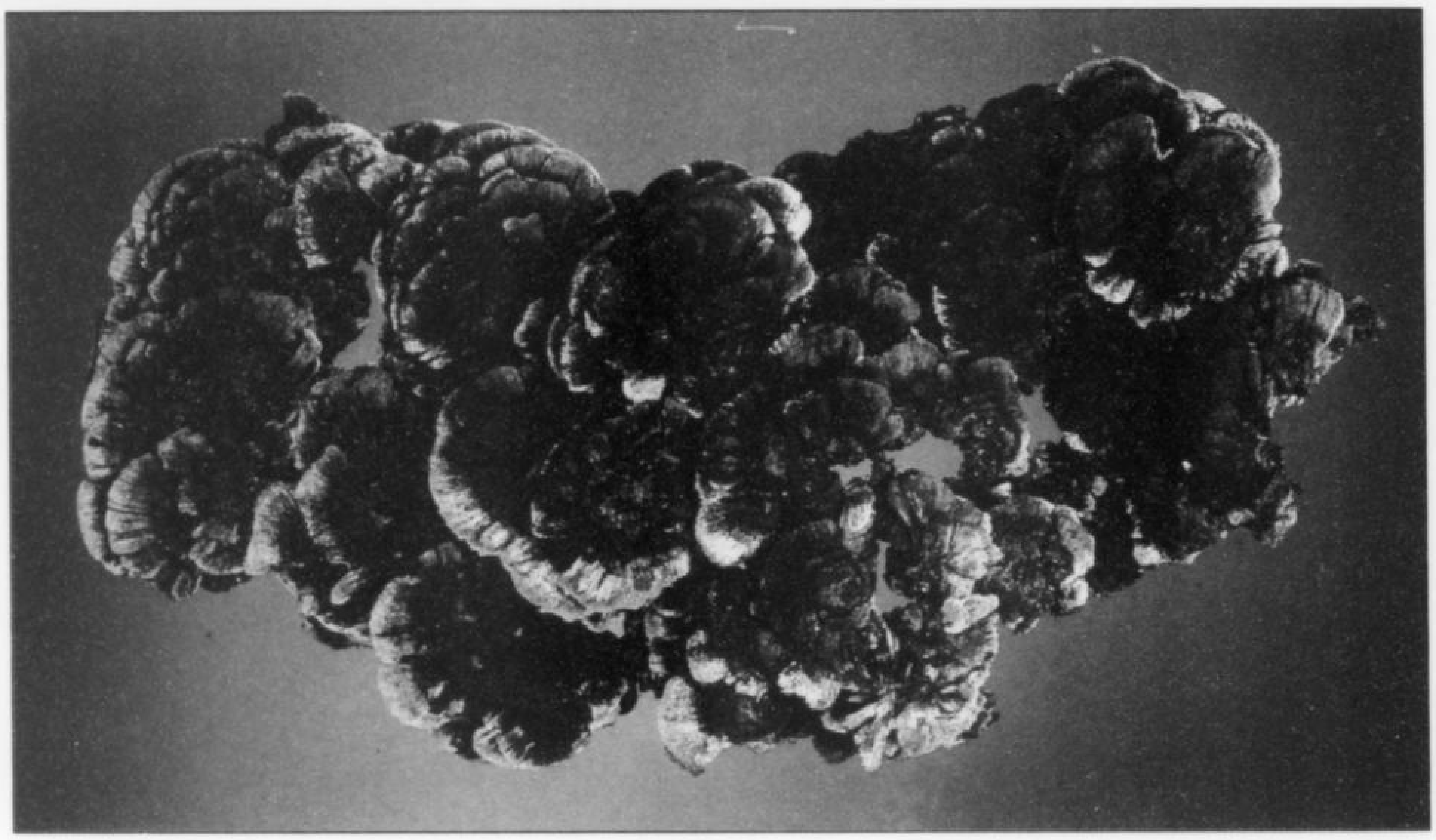


Figure 4. **Fluorite crystal cluster, 6 cm, from near Tounfit, Boumia, Morocco. Jordi Fabre specimen; Jeff Scovil photo.**

Figure 5. **Malachite, 22.9 cm, from the Luishia mine, Democratic Republic of the Congo. Gobin specimen; Jeff Scovil photo.**



could only converse with difficulty since we did not share a language; I did just a bit better in talking with Nicole Carré (Lusignan Grand, 47450 Saint Hilaire, France), who was handling the grossular specimens in one of the show's myriad little white "outside" tents.

Recently there has been a new strike of beautiful **malachite** specimens in the Luishia mine in the Congo Republic: glowing green, chatoyant sunburst aggregates forming flat-lying parallel clusters to many centimeters across. Reportedly only about a dozen specimens have emerged, and at Ste.-Marie just a few were scattered, as loners, at different dealerships. This, then, is a first alert—but Jeff Scovil's photo ought to demonstrate why we should keep an eye out for more of these spectacular things.

Last fall's Munich Show (I'm told) saw the first appearance of specimens from a new discovery of very sharp **orthoclase** crystals "somewhere north of Usakos" (actually the Erongo Mountains), Namibia, and about 50 of these came to Ste.-Marie in 2006 with the Austrian dealership *Kaiser* (kaiser.mineralien@inode.at). Single untwinned Carlsbad-law twins and small clusters, with individual crystals (all somewhat elongated) from 4 to 20 cm, are a clean chalk-white. Some surfaces show iron-oxide staining, and commonly there are adhering patches of warty white hyalite. In the same tent, Herb Kaiser showed me a nice selection of specimens of the now well known green andradite ("demantoid") crystals found embedded in chowdery quartz/feldspar/calcite matrix near Usakos, Namibia: the lustrous, part-gemmy, brownish green dodecahedral crystals in this lot reach 2 cm. The *Kaiser* specimens came out a few years ago, but according to Herb the mine is now starting to work again after a dormant period, and might soon yield plenty more crystals for gem cutters and mineral collectors to contend over.

Not for the first time, Laurent Thomas of *Polychrom France* (polychromfrance@aol.com) brought in a very beautiful, very hot new item from one of his several development projects in Madagascar. About a year ago, a small zone of pockets in igneous rocks

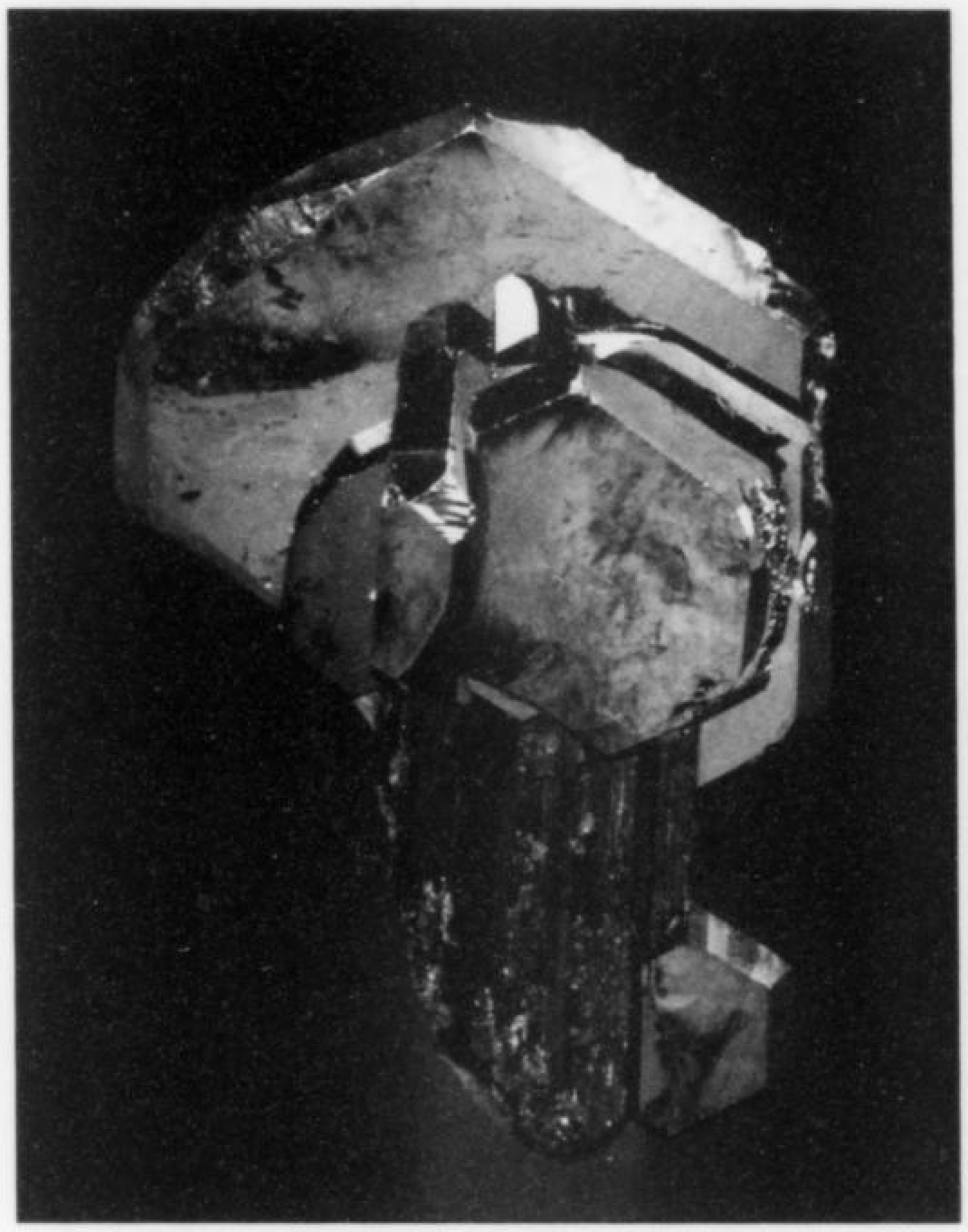


***Figure 6.* Hematite crystals on rutile, 2.4 cm, from Tetikenana, Ambatofinandro, Madagascar. Spirifer specimen; Jeff Scovil photo.**

near the village of Tetikana, near the larger town of Ambatofinandrahana in south-central Madagascar, yielded about 50 specimens of epitactic **hematite** overgrowths on **rutile**; the brilliant prismatic rutile crystals are mostly thumbnail size, but the largest so far found is 9 cm long. The hematite crystals, also highly lustrous, are jet-black plates with hexagonal outlines; some are found as floaters in pockets, but the superstar specimens are those in which the hematite crystals are lightly attached in series to the rutile prisms. At Ste.-Marie, Laurent had only a handful of representatives of the find, mostly thumbnails, stashed under his table. He is still working on pricing them, as well as continuing (naturally) to explore for more pockets at the locality. Meanwhile, however, he *was* selling about 20 superb crystal clusters, miniature to small-cabinet size, of shining, transparent blue **celestine** from the Katsepy mine, Majunga, Madagascar, with geode linings sporting individual celestine crystals to 10 cm. Madagascar celestine is nothing new, you say, but wait: the habit of these crystals is quite different from the stout, wedge-terminated shapes we are used to seeing from the famous Sakoany mine. The new crystals are elongated and tapered, with very steep pyramid faces coming almost to points, and thus the groups look distinctly odd, even at a first glance, for Madagascar celestine. Laurent says that the geodes with the tapered crystals were dug in mid-February 2006.

Having gotten down into the bottom of Africa we will now leapfrog to South America. Jordi Fabre (see earlier under amethyst) had some nice **sphalerite** and **galena** specimens found earlier in 2006 in the Santa Rita mine, Morococha district, Yauli province, Lima department, Peru. In the special Peru Issue of July-August 1997 the authors write "Sphalerite from Santa Rita is frequently gemmy, with a bright luster and a yellowish green color. Crystals may exceed 2 cm. Microcrystalline, pale pink rhodochrosite is the matrix"—and that describes these new pieces, except that the gemmy 2.5-cm sphalerite crystals are more honey-brown than yellow. The new Santa Rita mine galena occurs as lustrous, crested groups of parallel-growth crystals, the crests to 3 cm across, in cabinet-size matrix coverages.

Besides the Pöhla mine barites already mentioned, Marcus Grossmann had an even more exciting item: four loose, gemmy butterfly twins, large thumbnails and small toenails, of **phosphophyllite** from Cerro Rico de Potosí, Bolivia (*the* phosphyphyllite locality). The crystals show some chipping and are not maximally lustrous, but still are very impressive, especially considering that they are leftovers from a significant pocket discovered, according to Marcus, not 40 or 50 but just 5 years ago.

***Figure 7.* Red variscite on felspar, 1.8 cm, wide, from the Boa Vista mine, Galiléia, Minas Gerais, Brazil. Jordi Fabre specimen and photo.**

Jordi Fabre (again) had two promising new Brazilian discoveries from early in 2006. From the Boa Vista mine (a phosphate pegmatite) in Galiléia, Minas Gerais comes **variscite** as bright *red* druses of microcrystals colorfully resting on a matrix of purple strengite and other rare phosphates. And from a place called Berilandia, Quixeramobim, in Ceará state on the eastern bulge of Brazil, come very pretty specimens showing green/red color-zoned crystals of **elbaite** to 6 cm girdled by sharp, pale lilac "books" of lepidolite—only a tiny number of these have emerged so far.

And so to Asia, from which came some of this show's best new discoveries of all. Occupying a modest tablespace over in one of the Val Expo areas I found an Indian dealer new to me. Suresh Pande, proprietor of *Spark Minerals India* (sparkminerals@yahoo.com), told me that he hasn't yet attended the Tucson or Denver shows. If he does so in future, I hope he brings more of the new crystals of **powellite** which he had in France; these were found, he says, in early 2006 in a well-digging at Jamner, near Jalgaon, in India's zeolite-bearing Deccan Plateau. The powellite crystals are loose, complete floaters, with white sprigs of scolecite protruding a millimeter or so here and there, and they are razor-sharp, textbook examples of tetragonal bipyramids, with *c* axes about 1.25 times as long as *a* and *b*. The crystals are lustrous and lightly striated, and come in hefty sizes from about 2 to almost 5 cm along *c*. The only comparative shortcoming is that they are not yellow-orange and gemmy as might be wished, but milky white and translucent. Nevertheless these are excellent powellite specimens, ideal for the "single crystal" collectors.

Andreas Weerth (www.weerth-mineralien.de) had samples from a new **titanite/epidote** discovery made in April 2006 somewhere

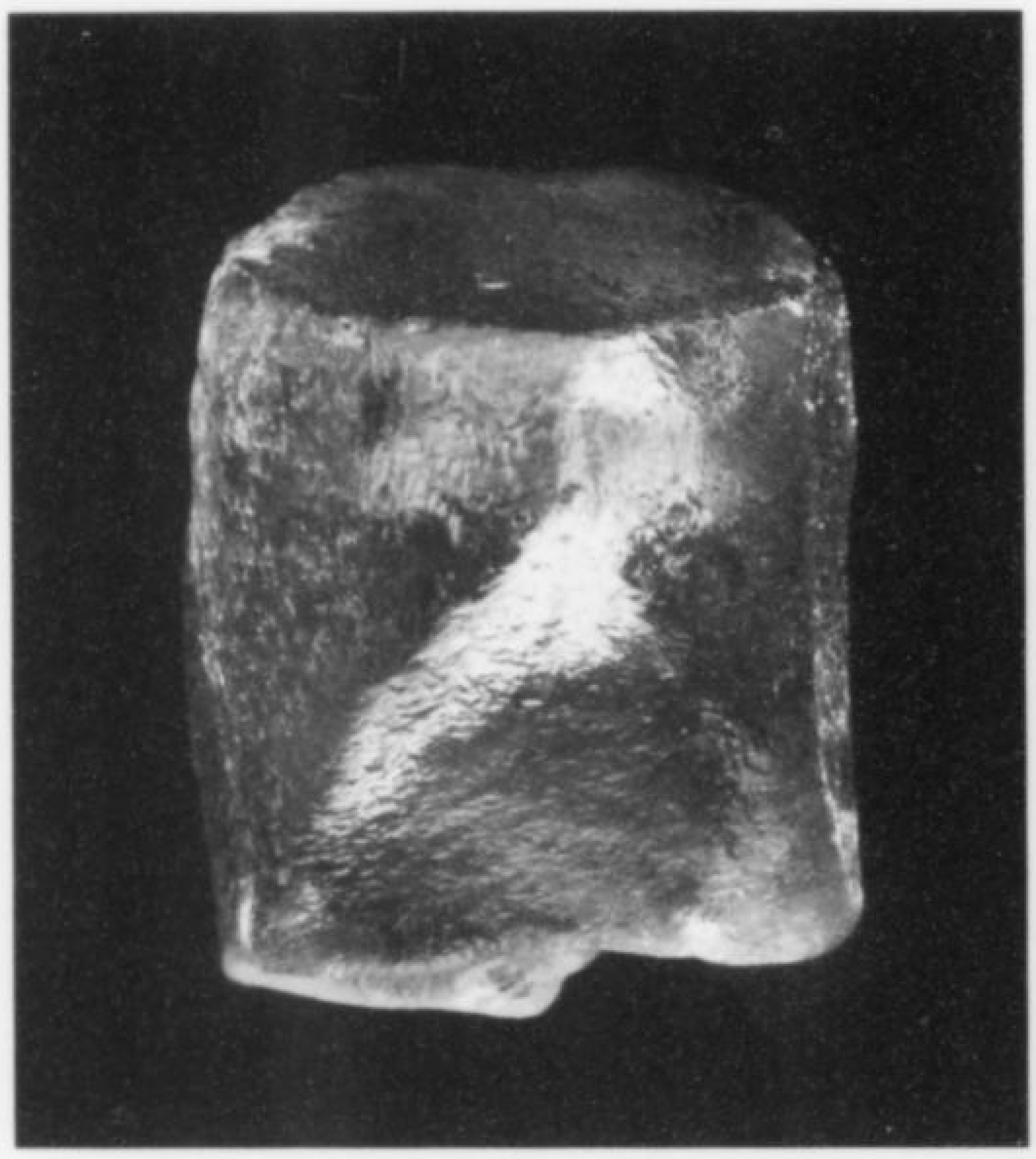
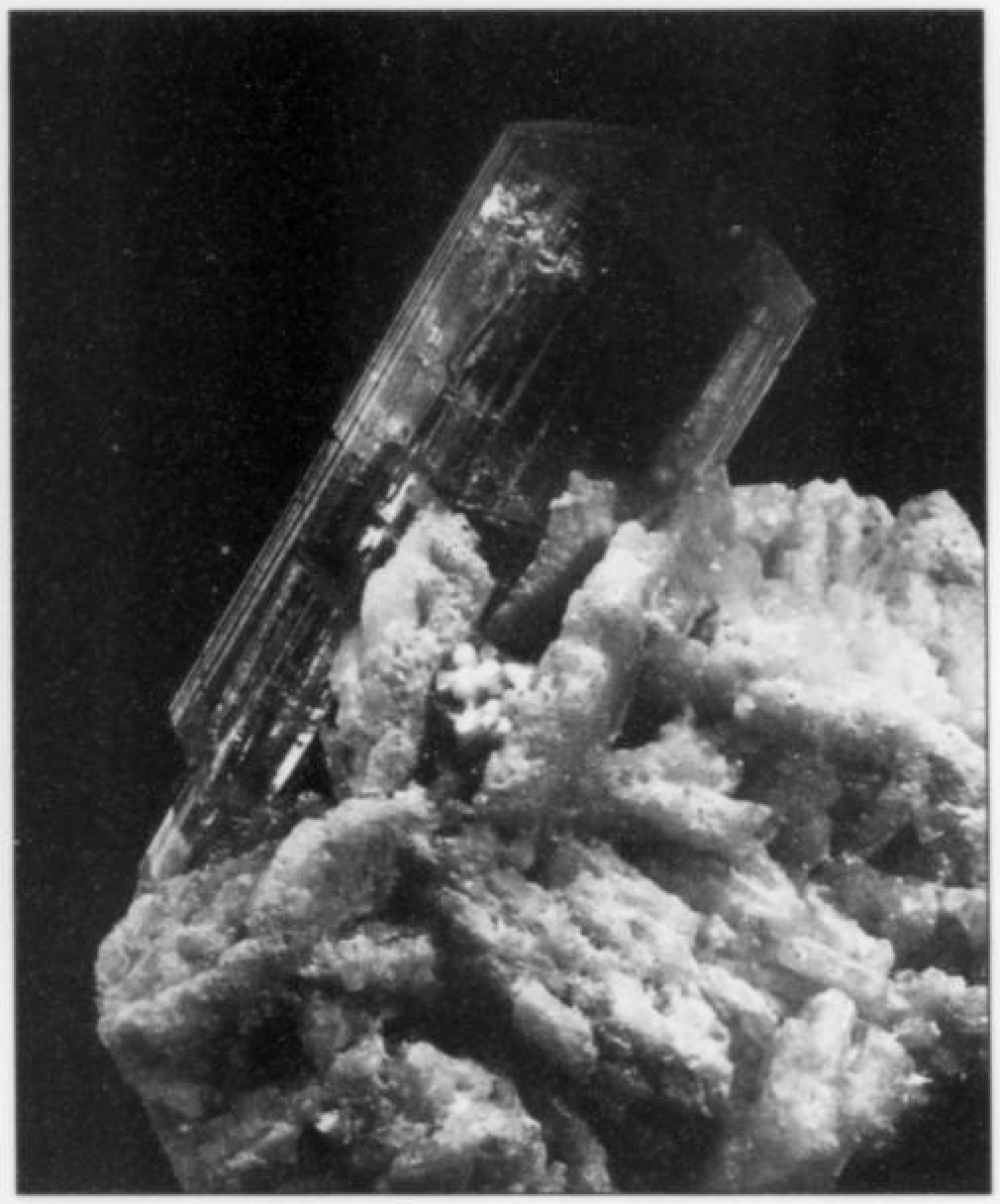


Figure 8. **Orthoclase crystal, 3.8 cm, from Benono, Madagascar. Spirifer specimen; Jeff Scovil photo.**

Figure 9. **Elbaite (in a rare aquamarine-blue color) on lepidolite, 6.1 cm wide, from Pech, Kunar, Afghanistan. François Lietard specimen; Jeff Scovil photo.**



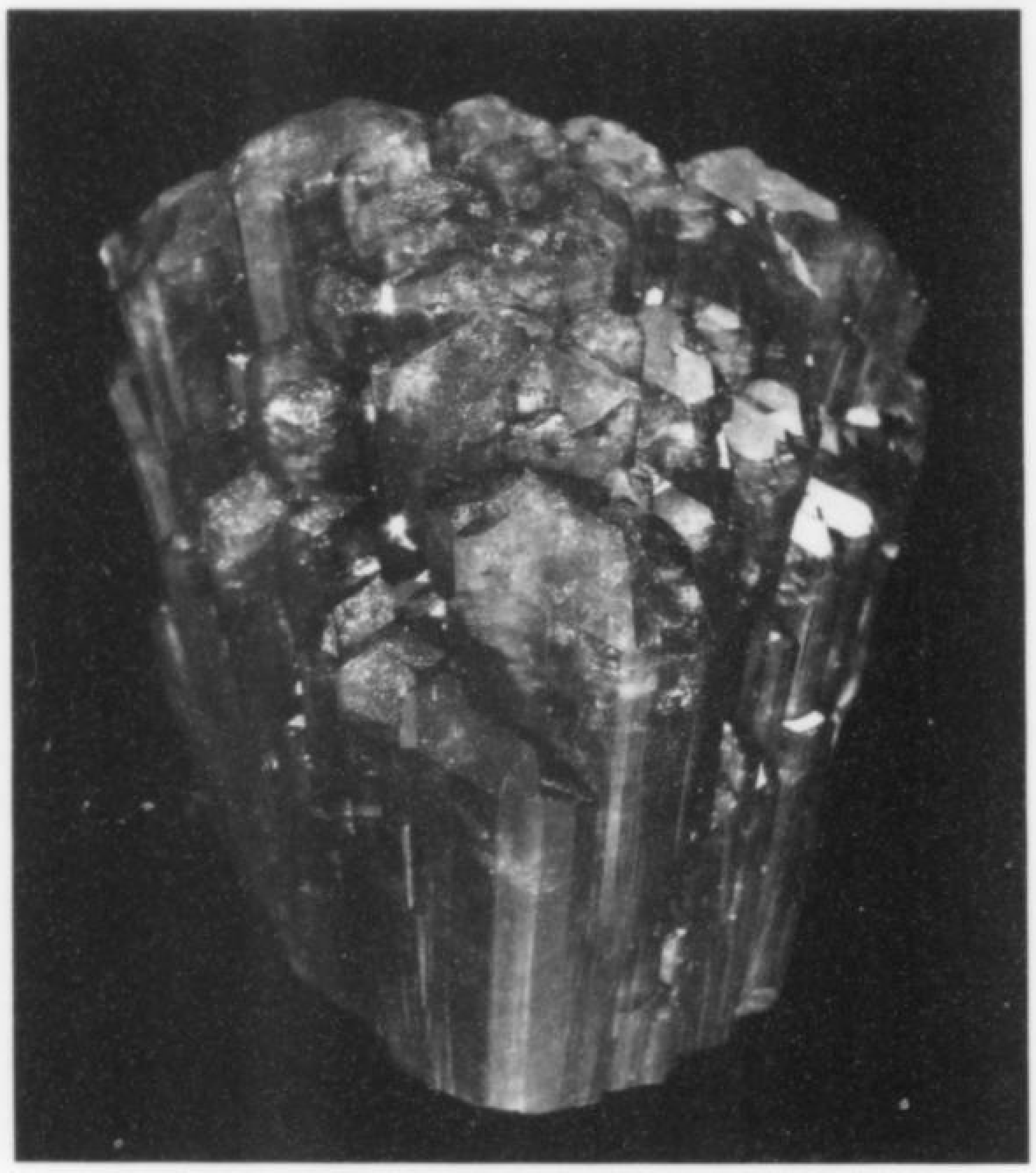


Figure 10. **Liddicoatite sub-parallel crystal cluster, 7 cm, from the Minh Tien pegmatite, Luc Yen district, Yenbai Province, Vietnam. Jordi Fabre specimen and photo.**

near Warsak in the Khyber Agency, Pakistan. What was obviously an Alpine cleft-type occurrence produced long-prismatic epidote crystals along whose sides have formed dense stacks of discoidal titanite crystals in parallel growth. The titanite crystals are pale brown, translucent and lustrous, and individuals reach 3 cm across. Andreas had only one 10-cm specimen left, having sold the few others he'd had before I got to his stand in the theater's lower level.

Even more beautiful were some miniature specimens of **almandine-spessartine on schorl**, both species performing brilliantly: the garnets are flashing, deep red, part-gemmy trapezohedrons to 2.5 cm, and the schorl crystals on whose prism faces they rest are bright black (however, one or both ends of most of the schorls are broken off). About 50 lush red/black specimens of this kind were collected three years ago from a pegmatite somewhere near Skardu, Northern Areas, Pakistan, and by the time of the 2006 Ste.-Marie Show only six pieces remained to be ogled in the *Barras-Gautier Minéraux* booth (BGM3@wanadoo.fr).

Plenty of mineral folks are excited about the new world-class specimens of **liddicoatite** tourmaline (some crystals with elbaite cores) from the Minh Tien pegmatite, Luc Yen district, Yenbai province, Vietnam. In an article in the May-June 2006 issue, Dudley Blauwet describes his visit to this remote region of northernmost Vietnam, and you can see a picture of a fine Minh Tien liddicoatite specimen in the June installment of the "what's new in the mineral world" online column. At Ste.-Marie, about 20 magnificent specimens were being offered on the theater's lower level by Frédéric Escaut (frederic.escaut1@libertysurf.f); the largest of them measures 14 × 14 × 14 cm. This lot of specimens (and the big specimen pictured on the website) is co-owned by Frédéric Escaut and Dan Weinrich. The near-parallel, slightly divergent bundles of brilliant red, highly lustrous, prismatic liddicoatite crystals have roughly trigonal composite outlines. All but one of the 20 or so pieces Frédéric had are lone bundles free of matrix, but in the other piece a 12-cm bundle rests on a bed of shining bluish white muscovite. Word is that the August 2005 discovery from which these specimens came gave up 73 major liddicoatites, 45 of which were taken out without damage. Probably it is now fair to say that the little Minh Tien pegmatite produces the world's finest display specimens of this rare tourmaline species, surpassing the superficially dark, thick, typically broken-off single crystals from Madagascar that only display well when slabbed.

I will conclude this report with China, as is my custom. This Ste.-Marie Show, like every other big mineral show for about the

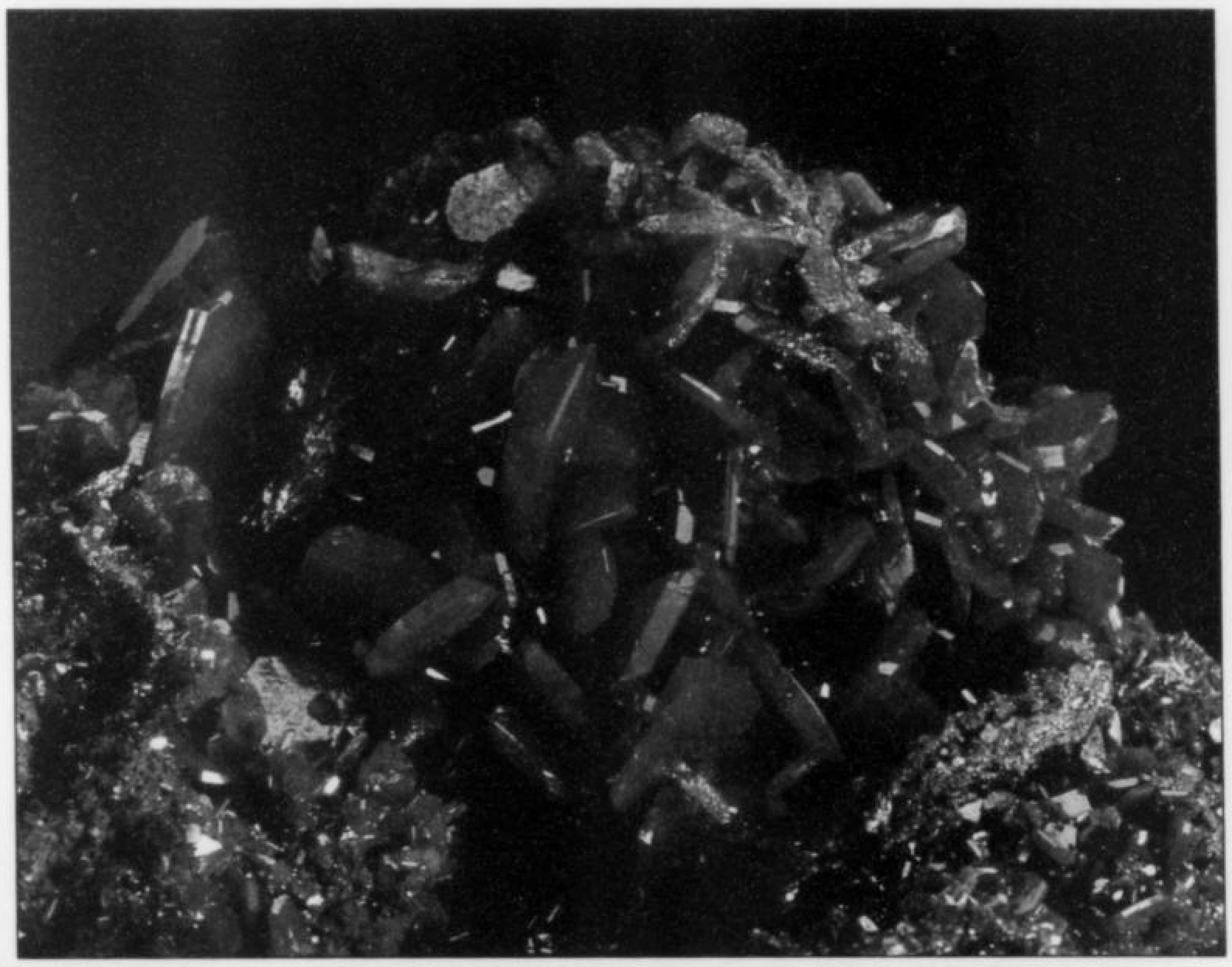
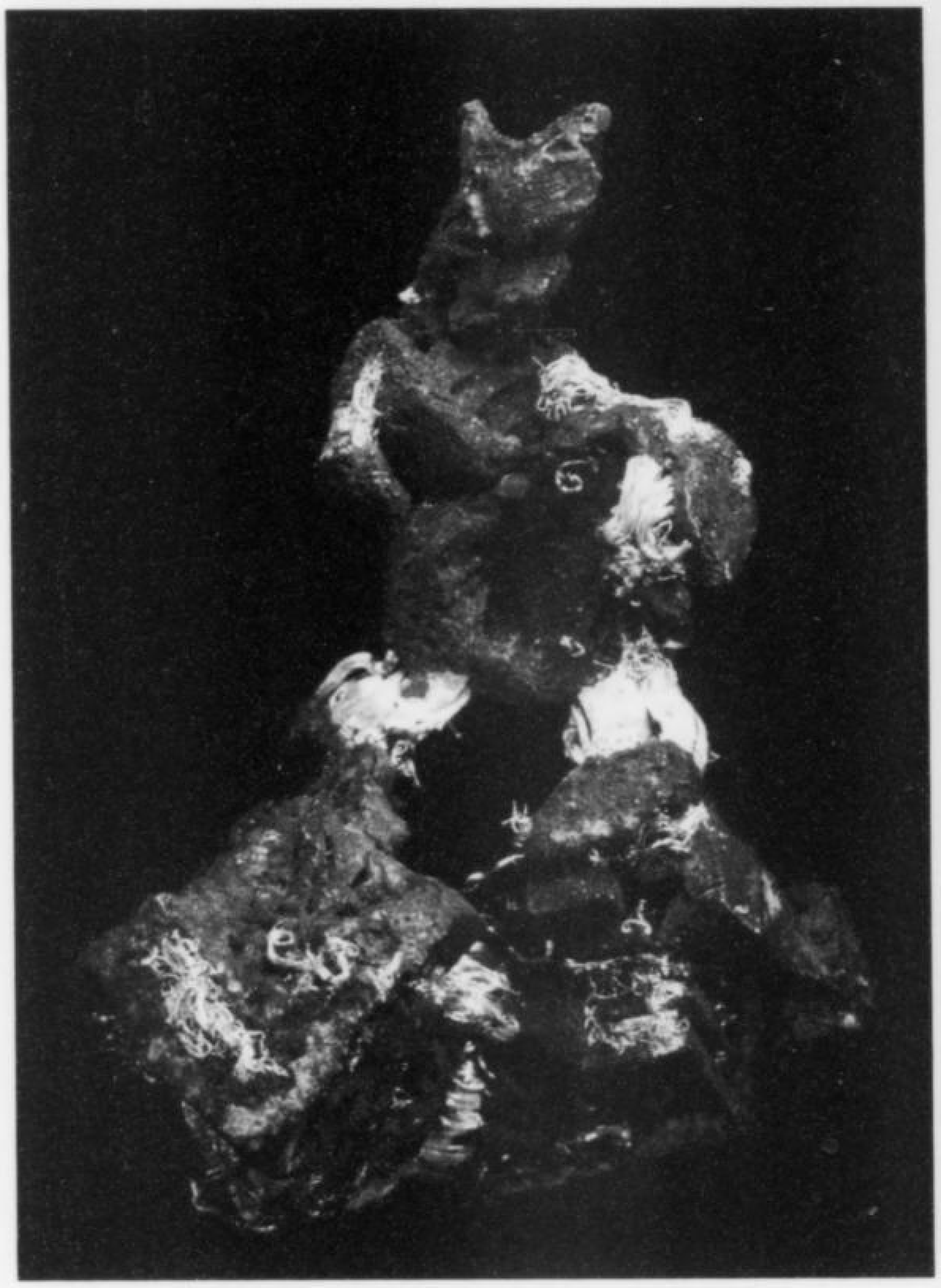


Figure 11. **Red wulfenite crystal to 1 cm, from Guangxi Province, China. Miner's Lunchbox specimen; Jeff Scovil photo.**

Figure 12. **Wire silver on acanthite, 7.3 cm, from the Hongda mine near Quguo, Lingqui County, Shangxi Province, China. Frederic Escaut specimen; Jeff Scovil photo.**



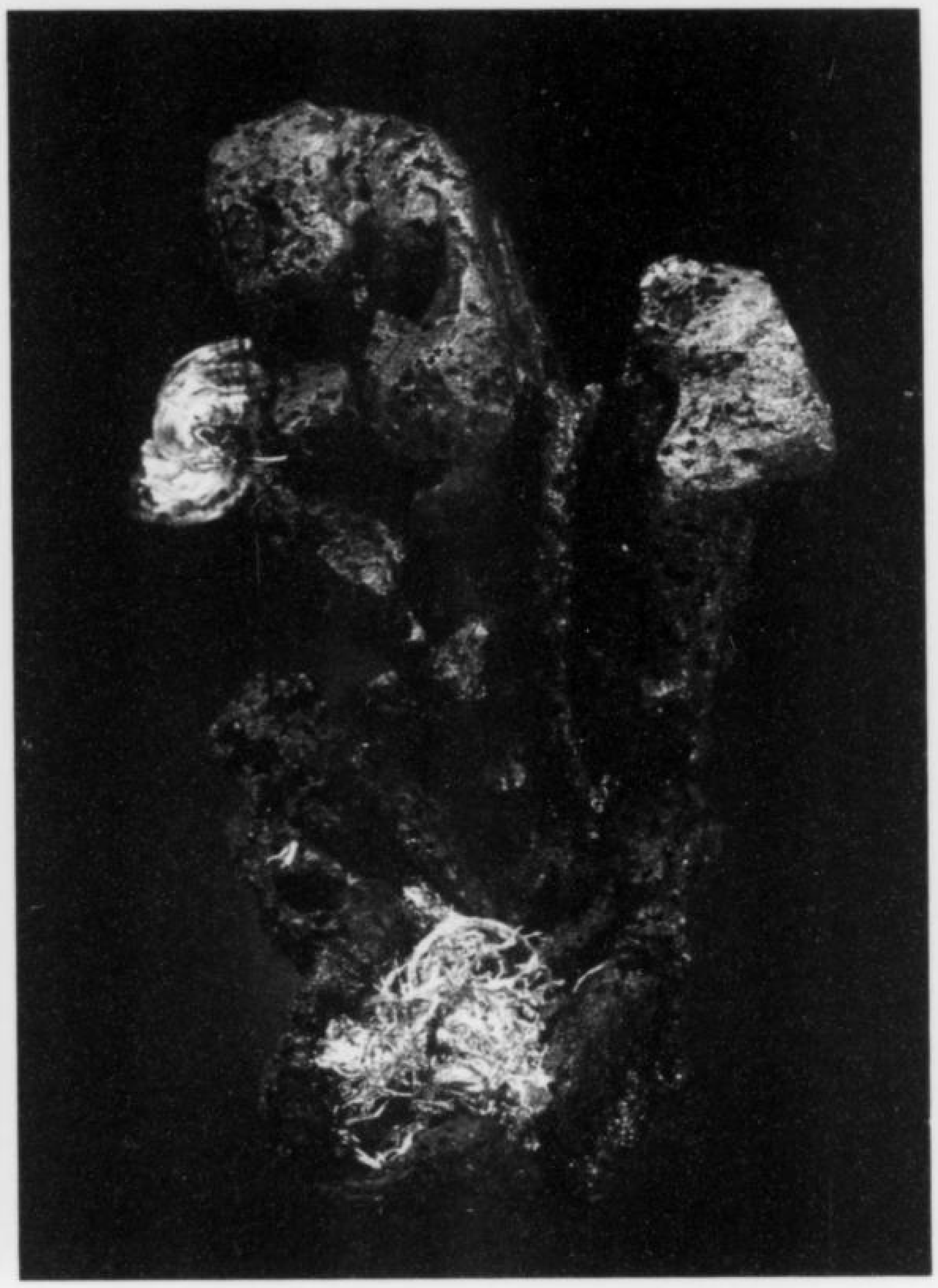


Figure 13. **Wire silver on acanthite crystals, 3.7 cm, from the Hongda mine near Quguo, Lingqui County, Shangxi Province, China.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**

past 15 years, had many things from China, familiar and new, to offer. I will spend most of the rest of my space here on just one of the many dealers simply because he had the most interesting new Chinese things (besides which, he bought me a beer). In the cool, fluted shade inside his white tent, René Daulon (daulonrene@aol.fr) showed me flats full of fine specimens of familiar things (hematoid quartz from Jinkouhe, cassiterite and aquamarine from Mt. Xuebaoding, fluorite from Xianghuapu, etc.), interspersed with exotica such as a miniature matrix specimen from the Xianghualing mine from which rises a dull white, 1.5-cm euhedron of the very rare **hsianghualite**, and a winning thumbnail consisting of two intergrown, sharp, hexagonal plates of brilliant metallic **molybdenite** from near the town of Dayu, Jiangxi province.

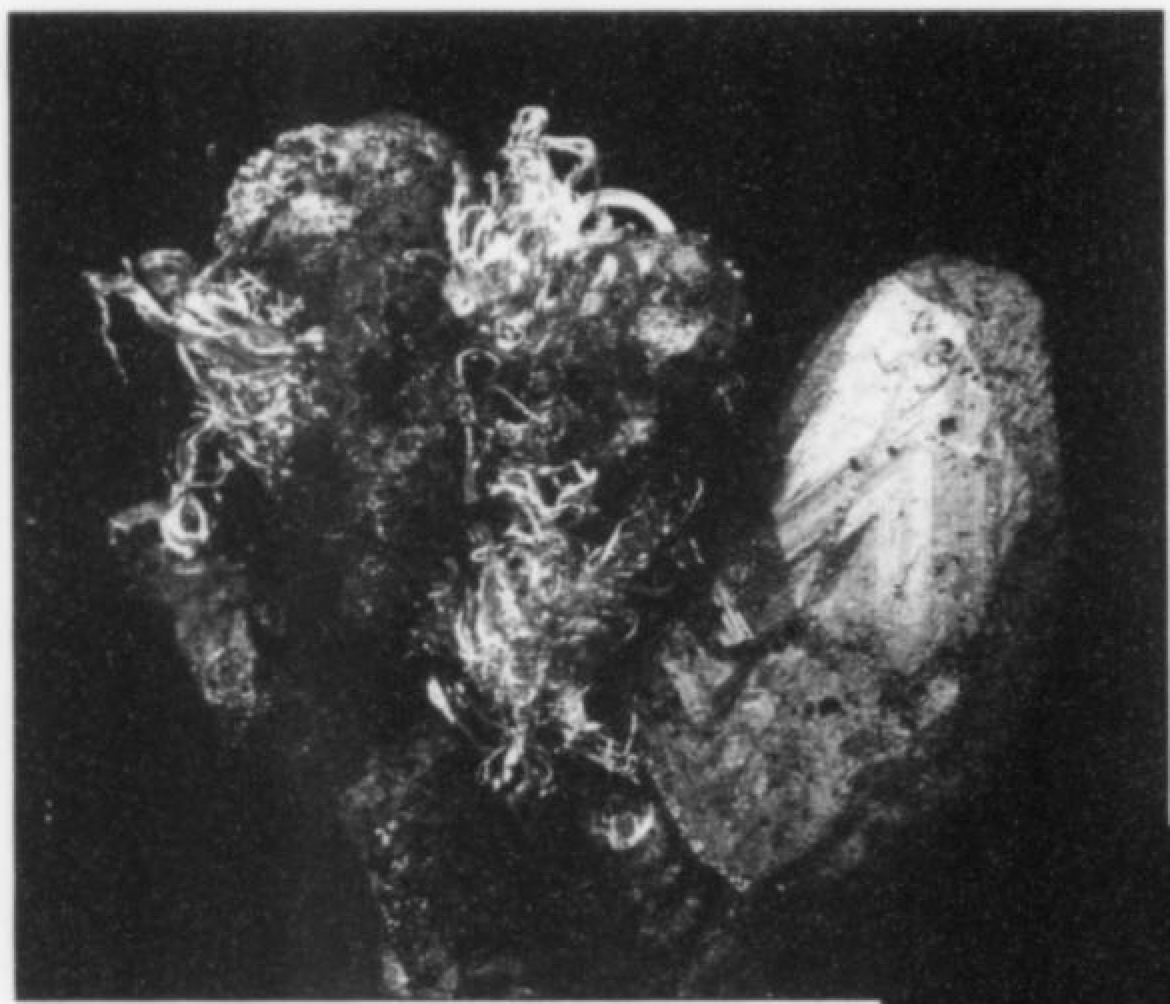


Figure 14. **Wire silver on acanthite crystals, 3.5 cm, from the Hongda mine near Quguo, Lingqui County, Shangxi Province, China.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**

but a small number of them are milky white, and all are sleekly lustrous—and so we have here *another* major Chinese scheelite locality to add to Mt. Xuebaoding (with its gemmy orange scheelites), and we have something more to look forward to from the Xianghualing mine than just fluorite and calcite.

Finally, René Daulon had a major stash, piled up on a table against his tent's inside wall, of ten or so flats full of outstanding specimens of **babingtonite** from the outcrop occurrence at Meigu, Sichuan province. The matrix plates, from miniature to large-cabinet size, are blanketed by flashing black crystals to 5 cm. As is well known by now, babingtonite crystals from Meigu resemble enargite crystals in form, i.e. they are columnar, with flat terminations, and lightly striated. Like the old babingtonites from the Lane quarry, Massachusetts and the Roncari quarry, Connecticut, those

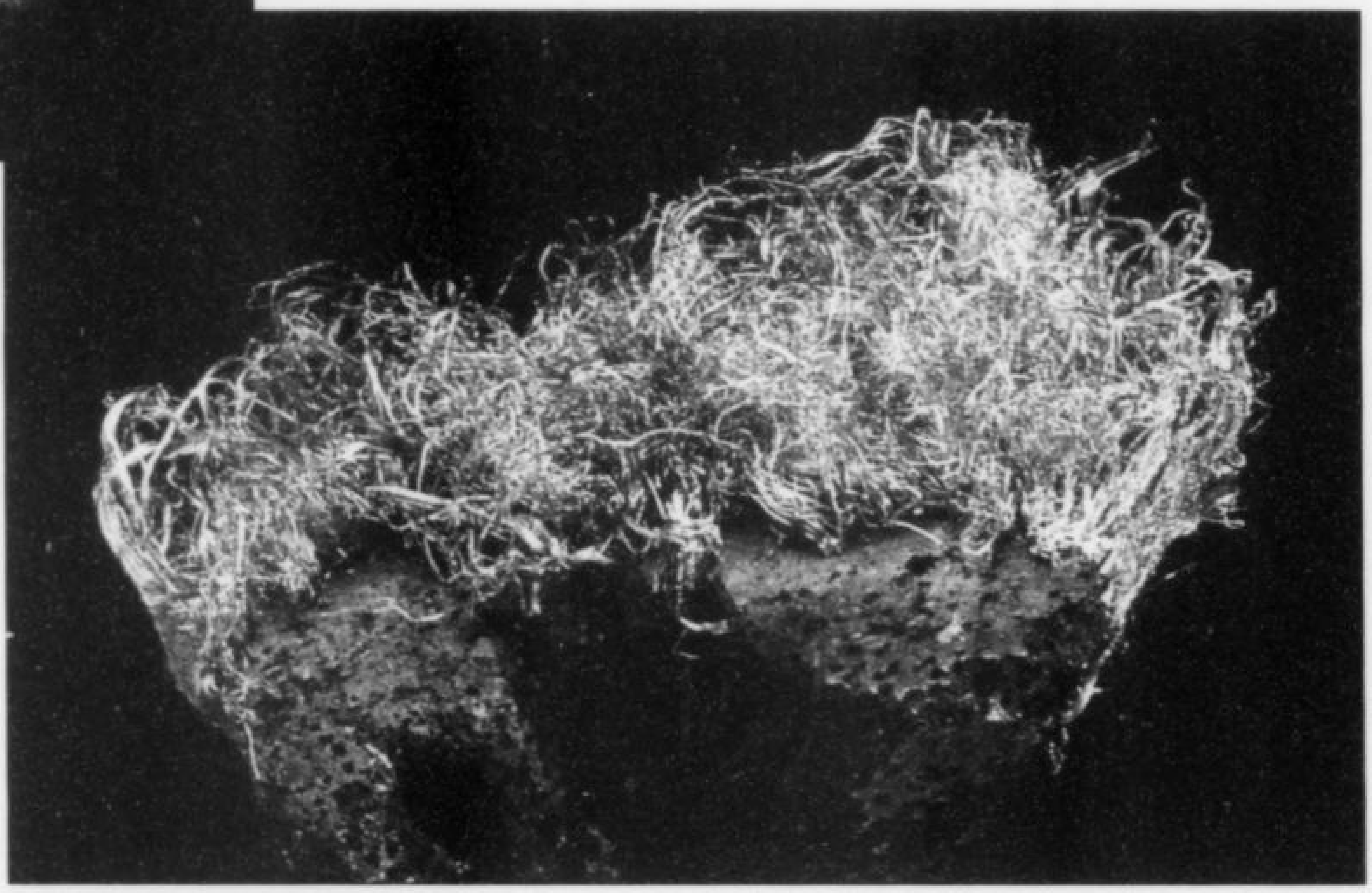


Figure 15. **Wire silver on acanthite crystals, 5 cm, from the Hongda mine near Quguo, Lingqui County, Shangxi Province, China.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**

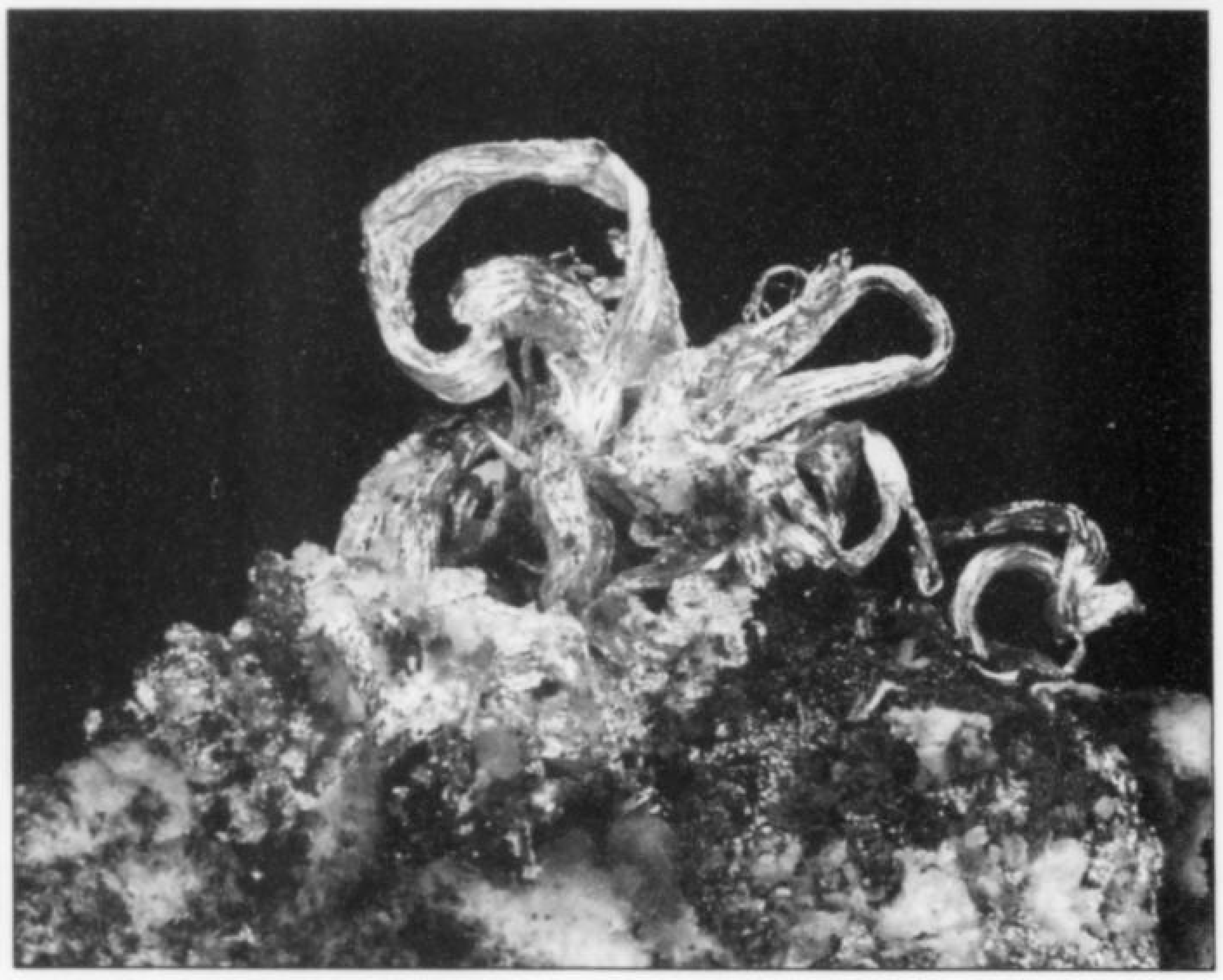


Figure 16. **Wire silver on acanthite crystals, 7 cm, from the Hongda mine near Quguo, Lingqui County, Shangxi Province, China.** ***Collector's Edge*** **specimen; Jeff Scovil photo.**

As far as I could see, René was one of only two dealers at the show (the other was Bert Ottens' *Ottens Mineralien*, ottensmineralien @t.online.de) having superb loose crystals of **scheelite** from a discovery made in early 2006 at the Xianghualing fluorite mine near Chenzhou, Hunan. These are loose, extremely sharp pseudo-octahedrons of scheelite in sizes from thumbnail to more than 5 cm. Most of the crystals are colored an unusual purplish brown,

from Meigu are associated with apple-green prehnite, commonly forming pretty spheres, and with colorless prisms of quartz. René's supply was both lavish—there were hundreds of specimens—and of a very high quality. He spoke also of a few super-specimens from the same recent find, with individual babingtonite crystals reaching 7.5 cm.

An exciting occurrence of **wire silver on acanthite** also turned up at the show. These are from a new Chinese locality in Shanxi province, called the Hongda manganese mine (*Hong Da Meng Kuang*) near the village of Quguo in Lingqui County. The mining operation is fairly large, employing over 1,000 miners working on four major levels. Silver was discovered in the area in 1987, and the deposit has also proved rich in manganese (currently the principal ore), lead and zinc. Frederic Escaut had good specimens at the show; Bryan Lees of *Collector's Edge Minerals* back in Golden, Colorado has also obtained a substantial lot of close to 2,000 specimens. Most of these are of rather low quality, but Bryan did manage to cull out about five flats of very nice pieces in the 3 to 5-cm range. The silver wires range from rather thin to nearly a centimeter in diameter and 7–8 cm long (if they were to be unrolled). The associated acanthite is typically rather corroded-looking (probably the result of heat-induced breakdown which spawned the silver wires), though some crystals have lustrous portions of faces remaining. Bright galena crystals 1–4 cm also occur there, but are not considered valuable by the miners.

So *au revoir*, *wiedersehen*, *bon soir*, *glück auf*, and *all* that sort of thing from Ste.-Marie-aux-Mines. Yes, it's a long way to come for U.S. collectors, gasoline for rental cars is shockingly expensive, and the Euro-dollar exchange rate was a handicap for Americans this year. But any serious collector owes himself/herself the experience of this heady show. Your Amstel Lager is waiting for you in the first big refreshment tent ahead as you round the theater to your right.

Letters

Ed McDole Remembered

Some mineral collectors are as interesting as the minerals they collect. One such person was Ed McDole. Around 1949 I received a cigar box wrapped in paper bearing the return address "Ed McDole, Lincoln Hotel, Butte, Mont." Inside the box were some nice pyrite crystal specimens from Butte, with a note saying he had seen my ad, and would I please pay him what I thought they were worth. Evidently he was satisfied with the amount I paid him, as he continued to send me more nice crystal specimens from Butte, including rhodochrosite, enargite, digenite and covellite.

In 1946 I started making mineral collecting trips to Mexico, visiting Los Lamentos, Naica, Pachuca, Parral, Guanajuato, and other localities. I made many trips to Los Lamentos. Besides personally collecting wulfenite there, I also made arrangements with a Mr. Holcomb (who was operating the mine for lead ore) to mine wulfenite specimens for me. Soon after I returned from one of these trips a mystery buyer appeared at my shop. He drove a big black Lincoln sedan and parked in front of the rock shop that my father, J. C. Filer, and I operated next door to my father's motel on Highway 99 west of Redlands, California. The driver was smoking a cigar and wearing a white shirt with the top two or three buttons unbuttoned, black trousers and black shoes. Without introducing himself he proceeded to pick out a number of miniature-size mineral specimens, putting them in a partitioned wooden specimen box that he had brought with him. He paid for these specimens in cash, got in his sedan and drove off. A few days later I learned from another dealer that this mysterious buyer was, in fact, my Butte supplier, Ed McDole.

McDole returned to our store several times after that, usually mysteriously appearing soon after I had returned from a collecting trip. On one occasion I had just returned from Mexico with a new load of Los Lamentos wulfenites and other minerals. He carefully went over all of my specimens and picked out the best ones. By this time we knew each other well enough that he was calling me an "old bounder," which apparently was his way of saying he liked someone.

Ed said he was color-blind, and would often ask what color a mineral was. I was never sure just how color-blind he was, though, as he would usually select the most colorful specimens from a lot.

In 1955, after I had returned from a mineral buying trip in Europe, Ed made one of his surprise visits. I did him the courtesy of showing him some of the specimens I had acquired for my personal collection. Ed expressed a desire to own one of them, but I repeated that it was a specimen which I had specifically bought for my own collection and it was not for sale. When I wouldn't sell it to him he, he abruptly walked out without saying a word. I figured I would probably never see him again, but a few months later he came back and was once again calling me an "old bounder," so I knew I was back in his good graces. He was still dressed in his white unbuttoned shirt, black trousers and black shoes—I never saw him dressed any other way, rain or shine, hot or cold.

After Alexandra and I were married in 1956 we moved to a new store we'd had built for us on Alabama Street west of Redlands. Ed McDole visited us there many times. He was at his best when he had some nice mineral specimens laid out before him, and he would puff on his Antonio y Cleopatria cigar and regale us with his life stories and collecting experiences. We remember vividly a couple of them. One was about the time he was working as a "sand

R. W. THOMSSEN PHOTO.

Ed McDole (only known photo)

hog" on a tunnel under a river near New York City. He said he'd gotten the bends and was taken to a hospital where, because of his Irish surname, he was given last rites by a Catholic priest. Fortunately Ed survived.

Another story he told was about working in the "Mother Lode" country of California. While driving a drift he spotted a wonderful vug of gold crystals, but he couldn't take them out of the mine because all miners were searched as they exited. He noticed a diamond drill hole that had been drilled from the surface and had intersected a nearby drift. Back at the engineering office he examined the maps and found where that particular hole had been drilled from on the surface. He made a narrow canvas sack which he lowered down the hole on a rope. Then, at the end of his shift, he found the sack protruding from the bottom of the hole. He filled it with crystallized gold, exited the mine, walked to the top of the hole and pulled the sack up to the surface. He repeated this operation several times until he had cleaned out the pocket.

All of his cigar-smoke-clouded stories were interesting, but we were never certain which ones to believe. Ed was an entertaining story teller.

Once Ed called us from Nevada and asked if we could use some stibnite. I said we could, and to our amazement he showed up later with 1,000 pounds of stibnite loaded in the trunk and on the floor of his Lincoln.

Ed had a remarkable ability to ferret out good mineral specimens, whether collecting them himself from a mine or acquiring them from someone else who had them. Such was the case one time in 1957 when Ed showed up at our store with two of the largest scheelite crystals we had ever seen, one about 6 inches tall and the other a little smaller. They were from the Dos Cabezas mine in Arizona. We paid about $50 for the larger one and a little less for the smaller one. He was very pleased with himself because the crystals had been set aside for mineral dealer Scott Williams, but Ed had persuaded the owner to sell the crystals to him instead. This little victory over a fellow dealer seemed to please Ed more than the mere acquisition of the scheelite crystals themselves.

Today we and others have only the memories of Ed's stories. Perhaps a lucky few of us also have one of his fine Butte specimens. Ed McDole has gone on to that great Mother Lode in the sky, but if there are any good minerals up there we can be sure that Ed will find them.

Russell Filer
Yucaipa, California

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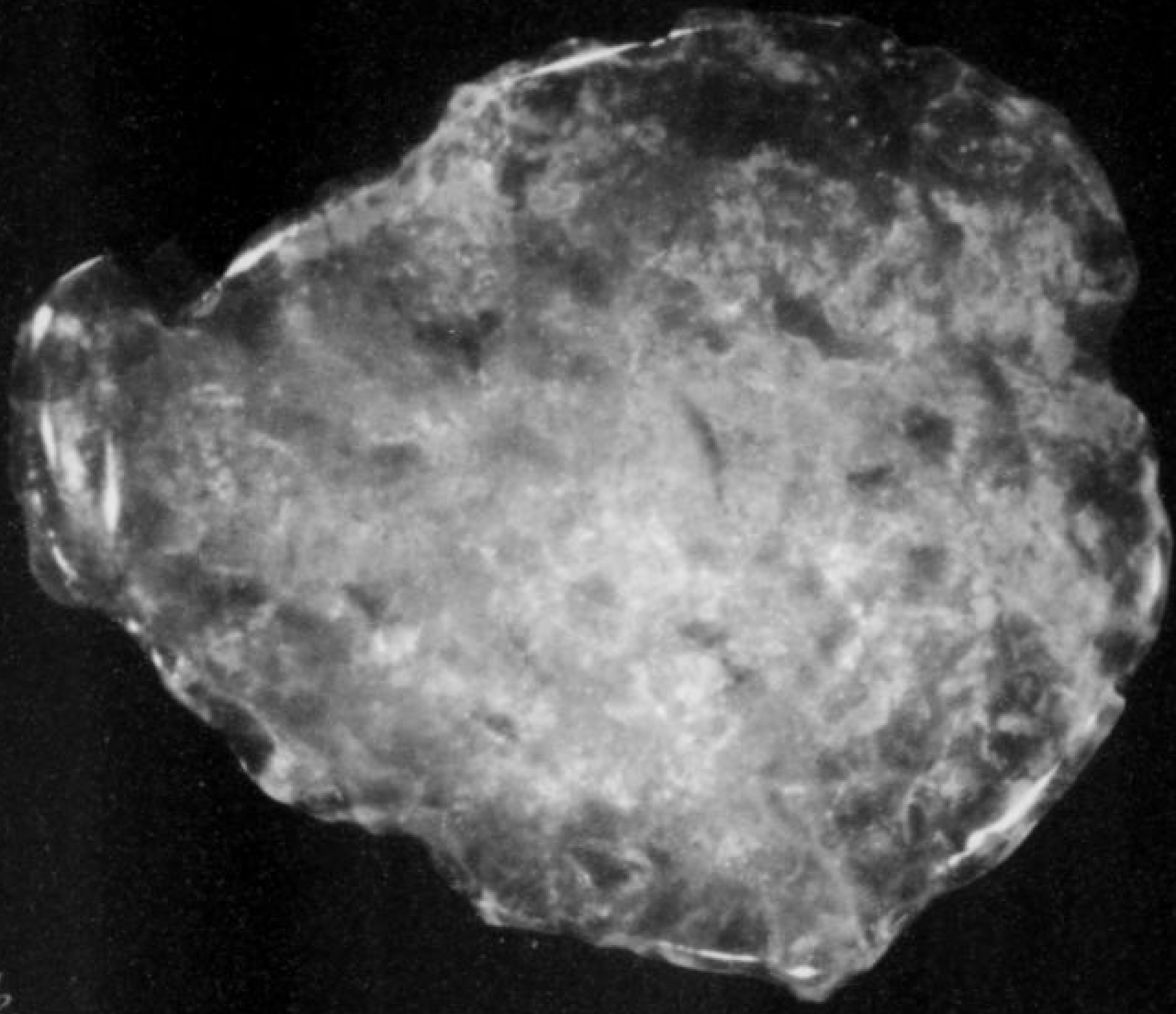

As we looked up the height of rock, there, peering and winking at us like myriads of curious eyes, shone thousands upon thousands of these bright opals... At the mine I went over the hoards of opals, each one a miniature sunset as it lies in your palm, like a shower of fireworks as they pour from your fingers.

– G.F. Kunz in Mexico

Mexican Opal

Photo: Harold & Erica Van Pelt