THE MINERALOGICAL RECORD

JULY–AUGUST 2006 VOLUME 37 NUMBER 4

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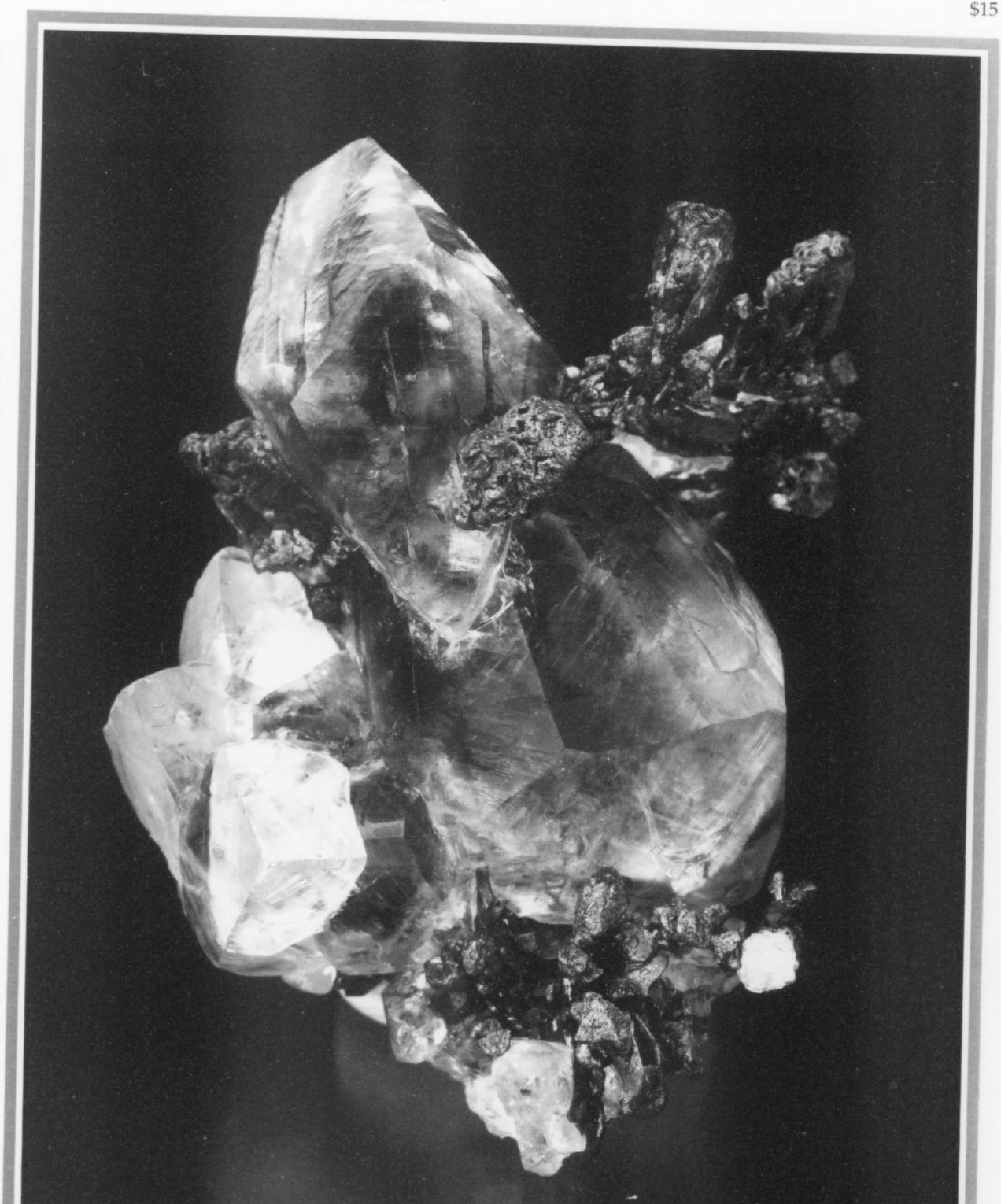

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THE MINERALOGICAL RECORD

July–August 2006 Volume Thirty-seven, Number Four

Articles

Columns

COVER: COPPER and CUPRITE in CALCITE, 5.2 cm, from the Onganja mine near Seeis, Namibia. Mike Bergmann specimen, now in the Carolyn Manchester collection; Jeff Scovil photo.

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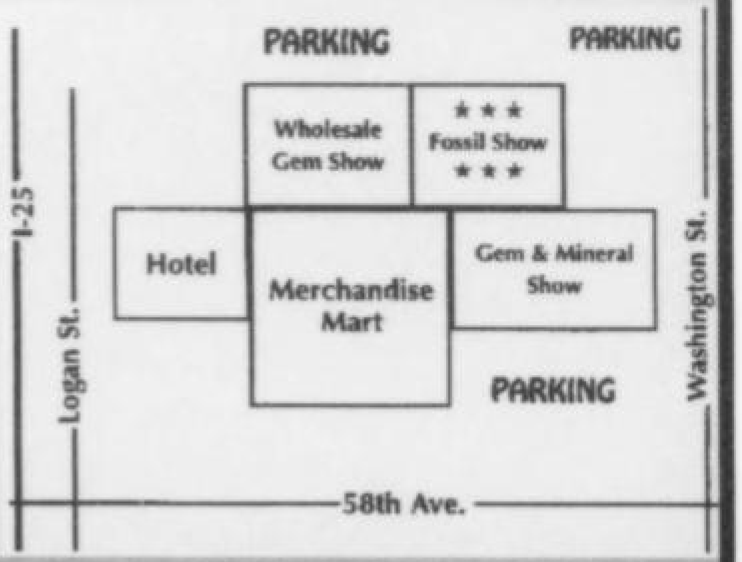
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The Ben Frankenberg Collection of Bisbee Minerals

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Bisbee, Arizona, "the Queen of the Copper Camps," was a fabulous storehouse of mineral wealth. Countless tons of specimen-grade material must surely have gone to the crusher, but many fine examples also were saved, collected and traded by Bisbee miners, mine executives, shop owners, and businessmen. One such friend of mineralogy was Benjamin Frankenberg, who ran a department store in Bisbee from 1898 to 1928, and built an extraordinary collection recently presented to the Natural History Museum of Los Angeles County by his children.

A century ago Bisbee, Arizona was a boom town. This was the heyday of mining, when Bisbee was the world's largest producer of copper and became known as the "Queen of the Copper Camps." This was also a period during which tons of beautiful specimens of azurite, malachite and other copper minerals were mined, only to end up smelted as ore.

Fortunately, some individuals with keen perception of natural beauty (and some expendable income) recognized the extraordinary nature of the "ores" and sought to preserve the finest examples. Among these enlightened individuals was Ben Frankenberg, who for three decades purchased fine specimens from miners who frequented his store in Bisbee. He even grubstaked some of them to go out and dig specimens for him. He built a diverse collection of twelve dozen mineral specimens from the mines of Bisbee, a collection which serves to document the most important period of mineral production at one of the world's most famous producers of exceptional mineral specimens.

Benjamin Isaac Frankenberg was born December 1, 1872 in Cincinnati, Ohio, the son of Isaac and Barbara Meyer Frankenberg. Isaac (born ca. 1827) had come to the U.S. from Hannover, Germany in 1857 and settled in Cincinnati, where he met and married Barbara "Babette" Meyer in 1859. He worked as a merchant, a butcher, and even a cattle drover during the following years, in which time he and Barbara had seven children: Meyer (born 1859), Amelia (born ca. 1861), Henriett (Hattie; born ca. 1868), Alexander (born ca. 1869), Fanny (born ca. 1870), Bejanmin (Ben) and Samuel (Sam; born ca. 1873). Isaac died ca. 1885, and Barbara probably died sometime between 1891 and 1900.

In 1892 Ben, age 20, decided to travel West in search of adventure and opportunity. He gave up a budding career in the

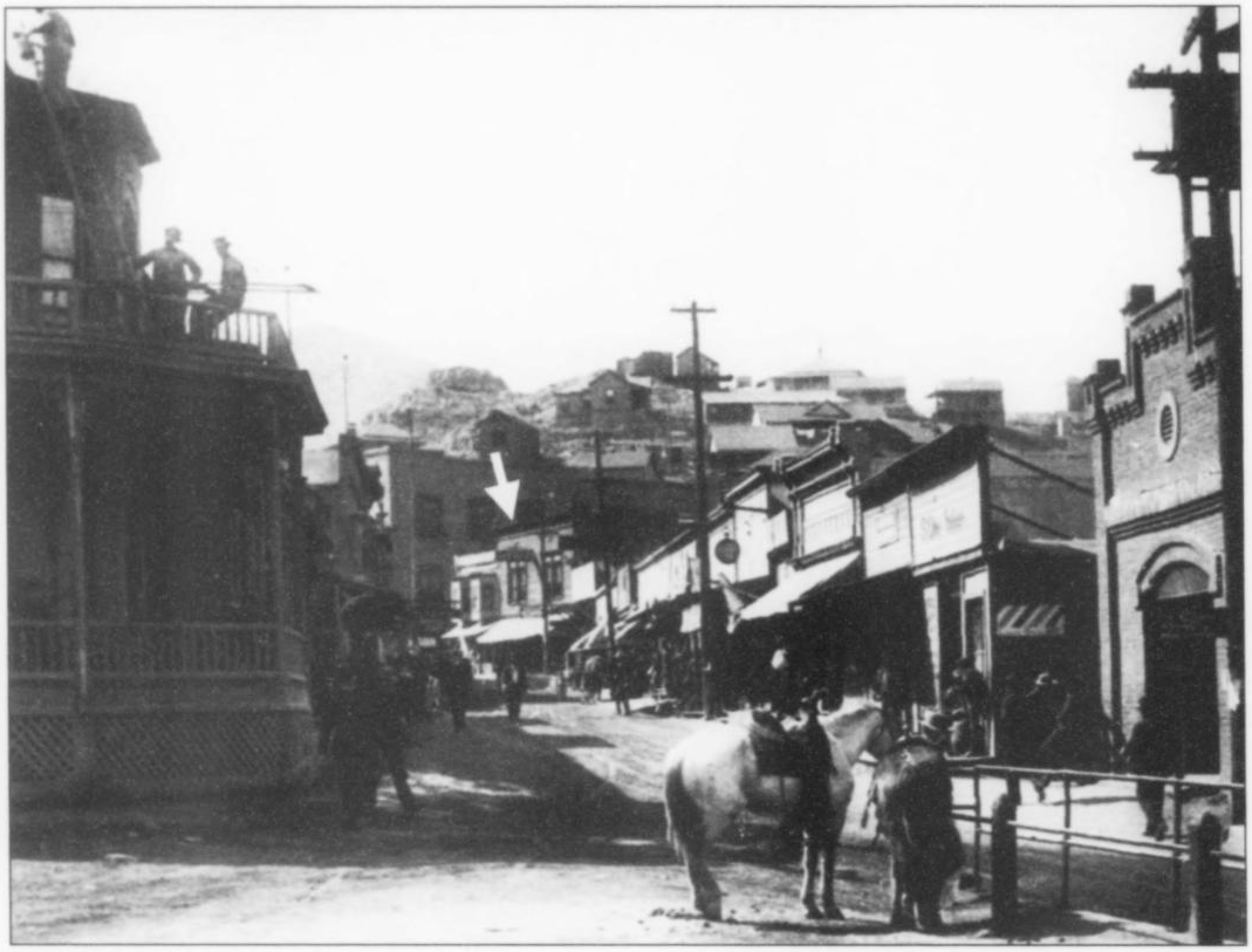


Figure 1. **Main Street in Bisbee, Arizona, 1903; Frankenberg's department store, "The Fair" (*arrow*) is at center. Photo courtesy of the Bisbee Mining and Historical Museum archives.**

Figure 2. **Benjamin I. Frankenberg (1872–1964) assembled his Bisbee collection between 1898 and 1928. Photo courtesy of Bobbe Frankenberg.**

"The Fair"

FRANKENBERG BROS & NEWMAN

Fall Goods Arriving Daily for Each Department

An Early Visit Will Prove Interesting and Beneficial

New Autumn Dress Fabrics

Now on Display

Newest Weaves and

Prevailing New Colors

1.25

85c

1.25

1.25

New Fall Millinery

Complete Showing

Now On Exhibition

TRIMMED HATS

$8.50

READY-TO WEAR HATS

$5.00

NOW ON DISPLAY

Ultra Fashionable Fall Models

In STEIN-BLOCH CLOTHES

The Fall Suits

$15.00 and up to $35.00

The New Top Coats

$12.50 and up to $27.50

Figure 3. **Newspaper ad (1906) for Ben Frankenberg's store in Bisbee. Photo courtesy of the Bisbee Mining and Historical Museum archives.**

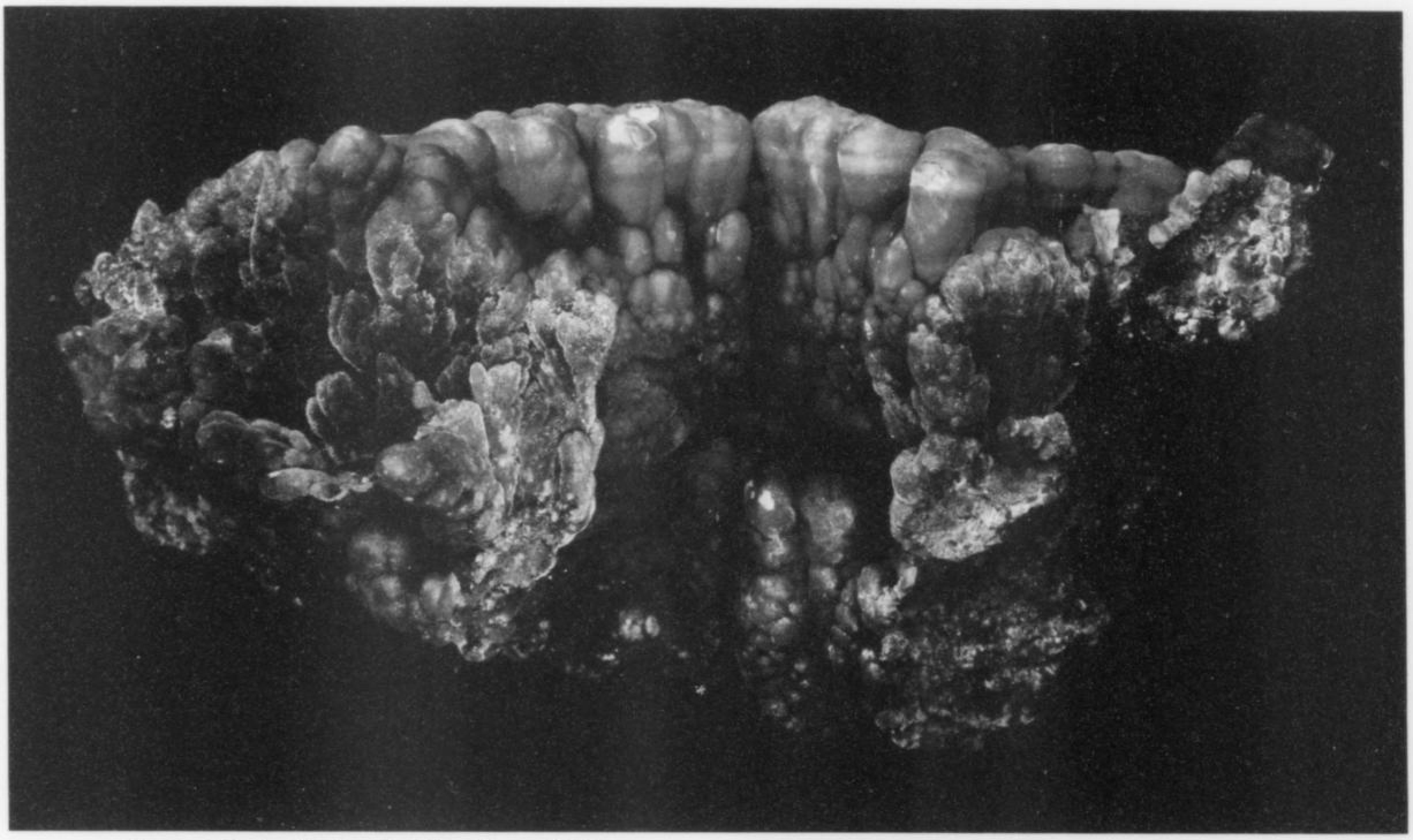


Figure 4. **Botryoidal malachite, 14 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

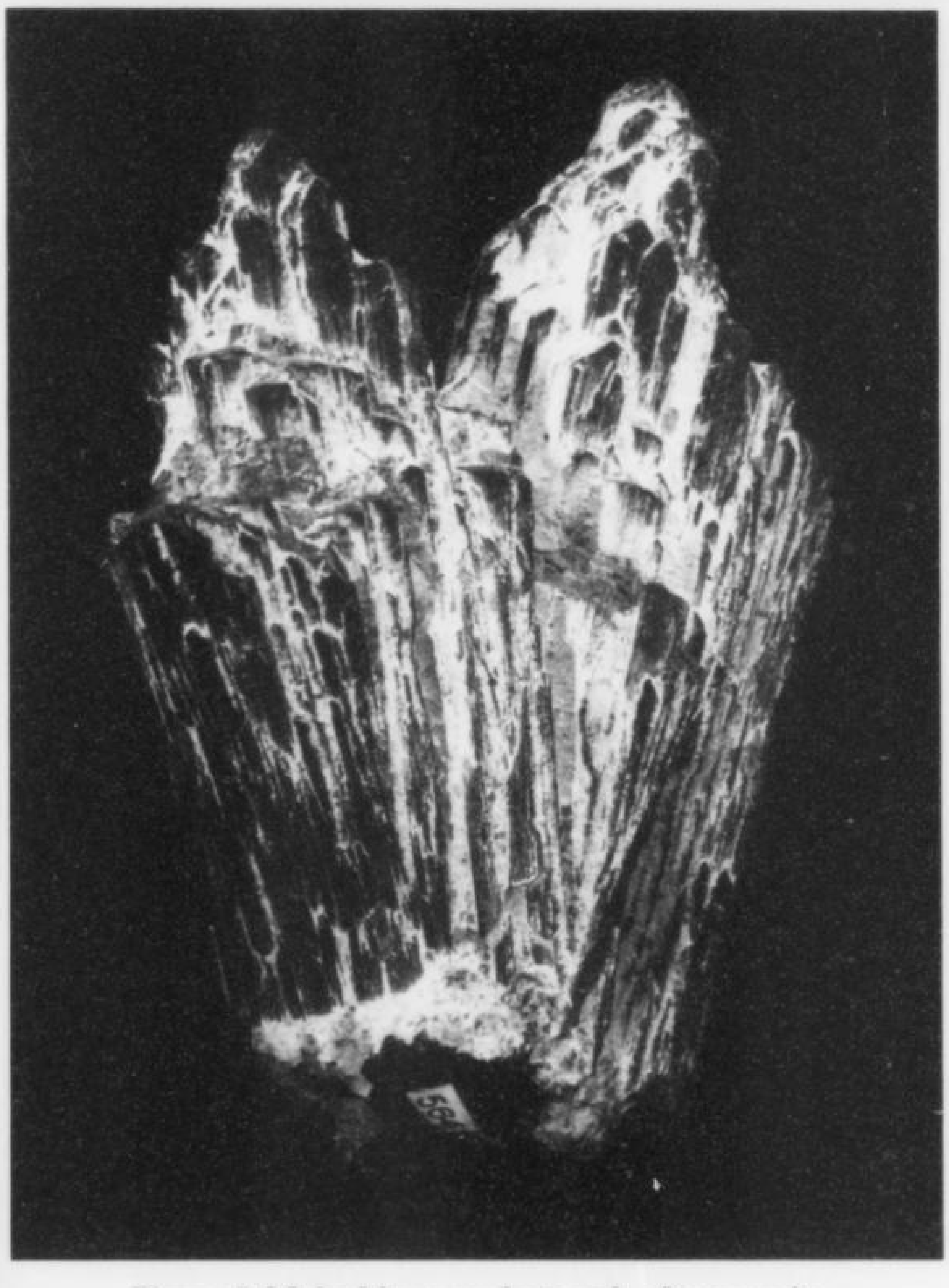


Figure 5. **Malachite pseudomorph after azurite crystals, 6.4 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

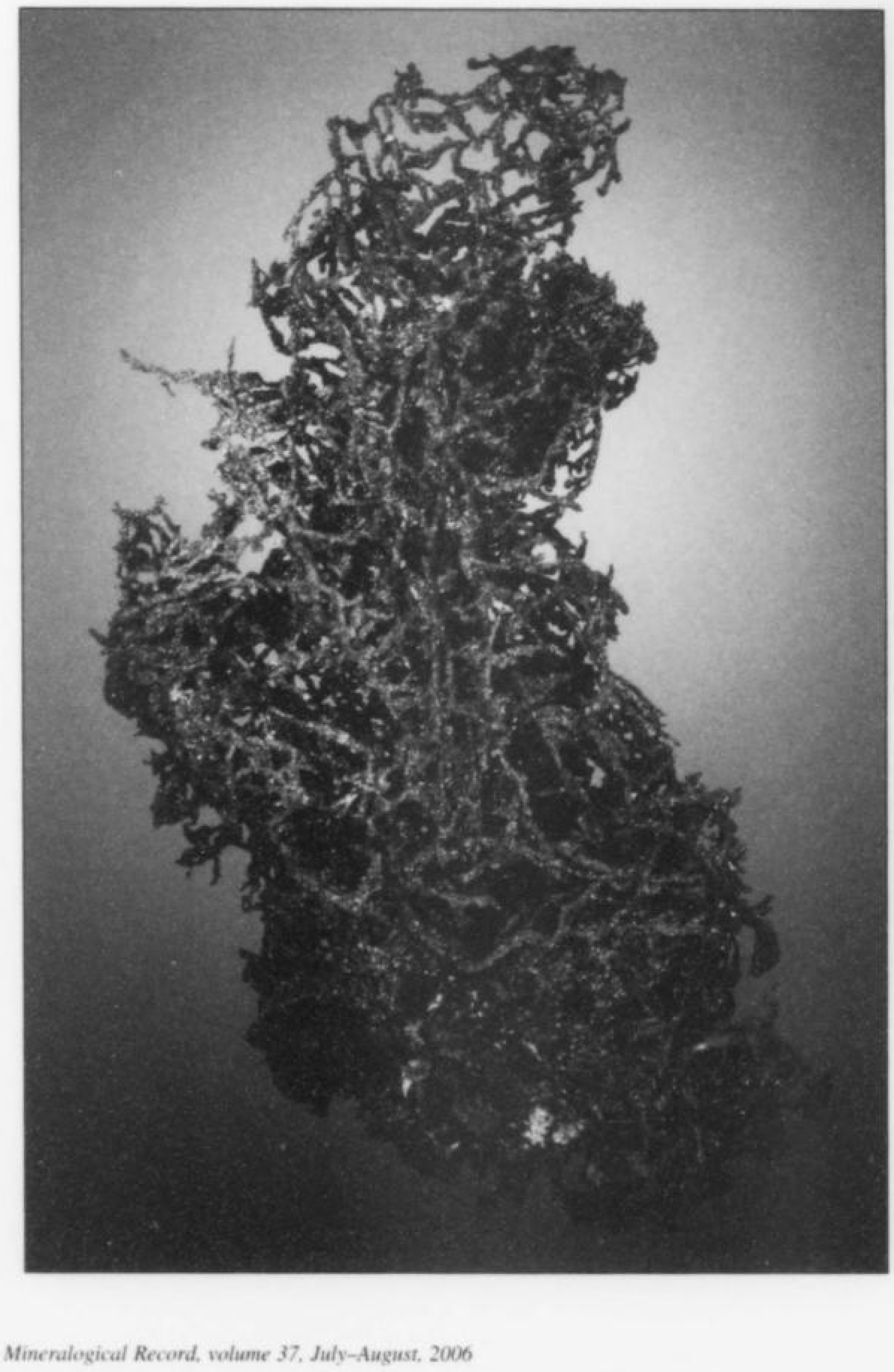


Figure 6. **Native copper with cuprite, 16 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

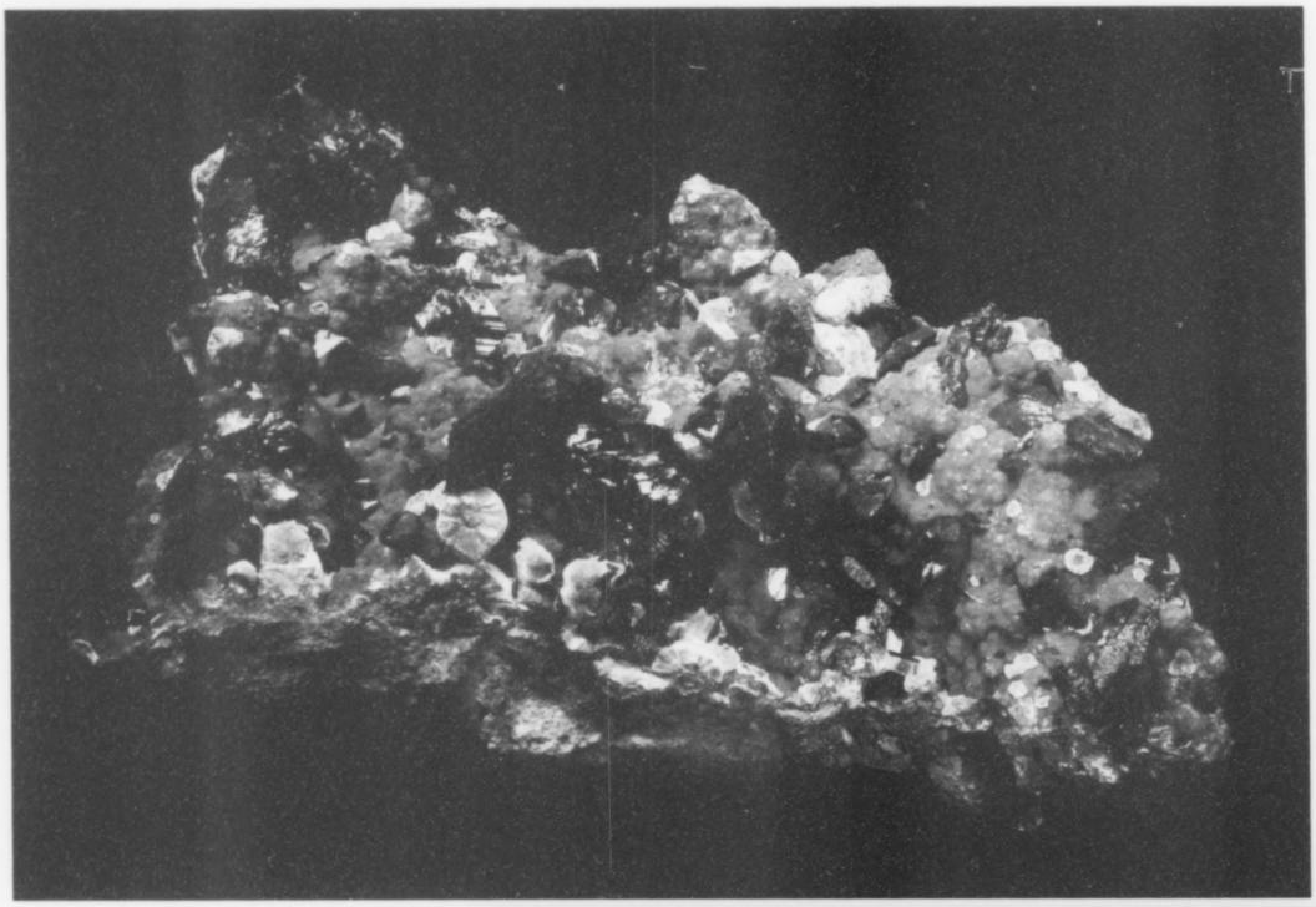


Figure 7. **Azurite crystals on matrix, 18 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

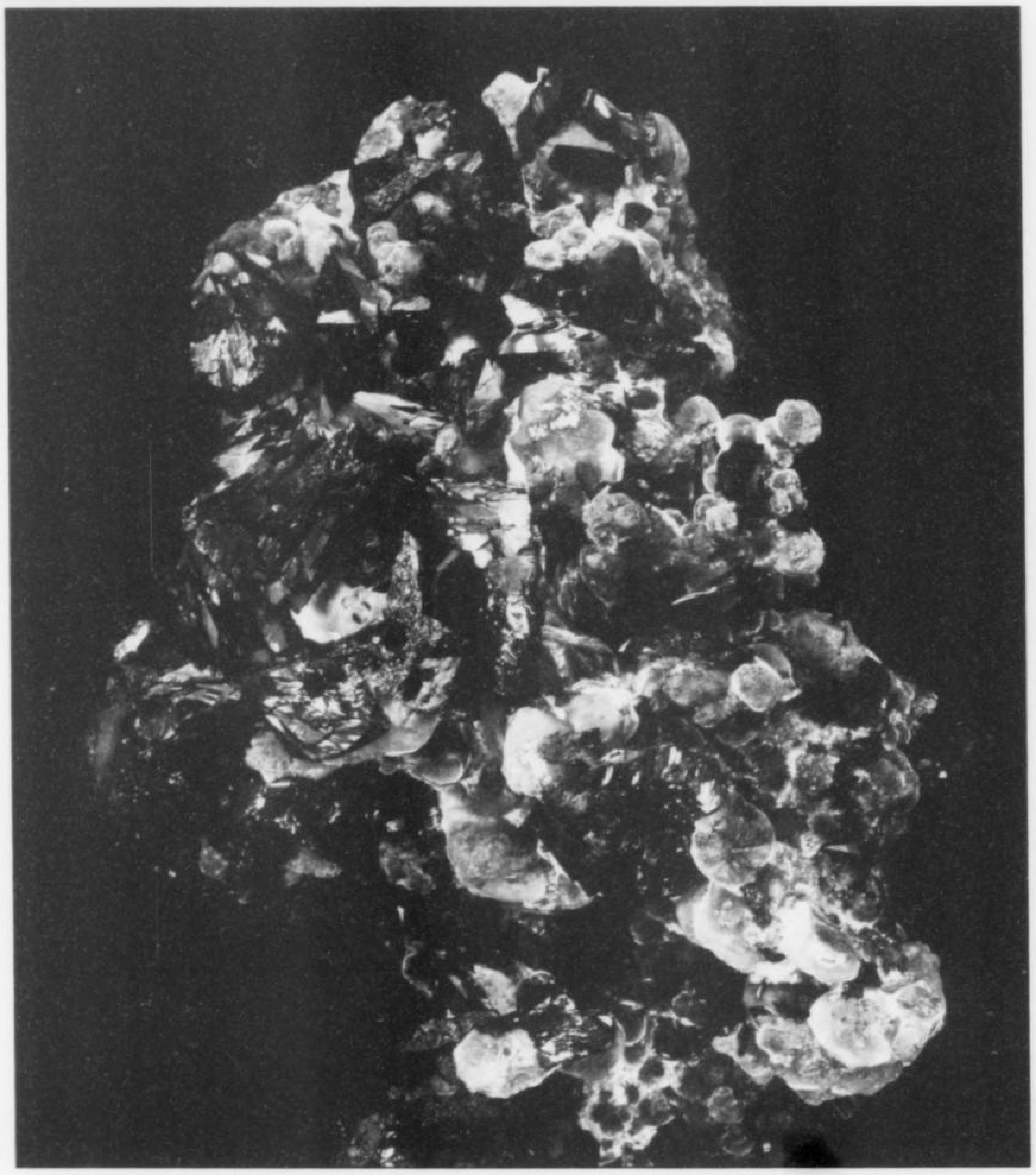
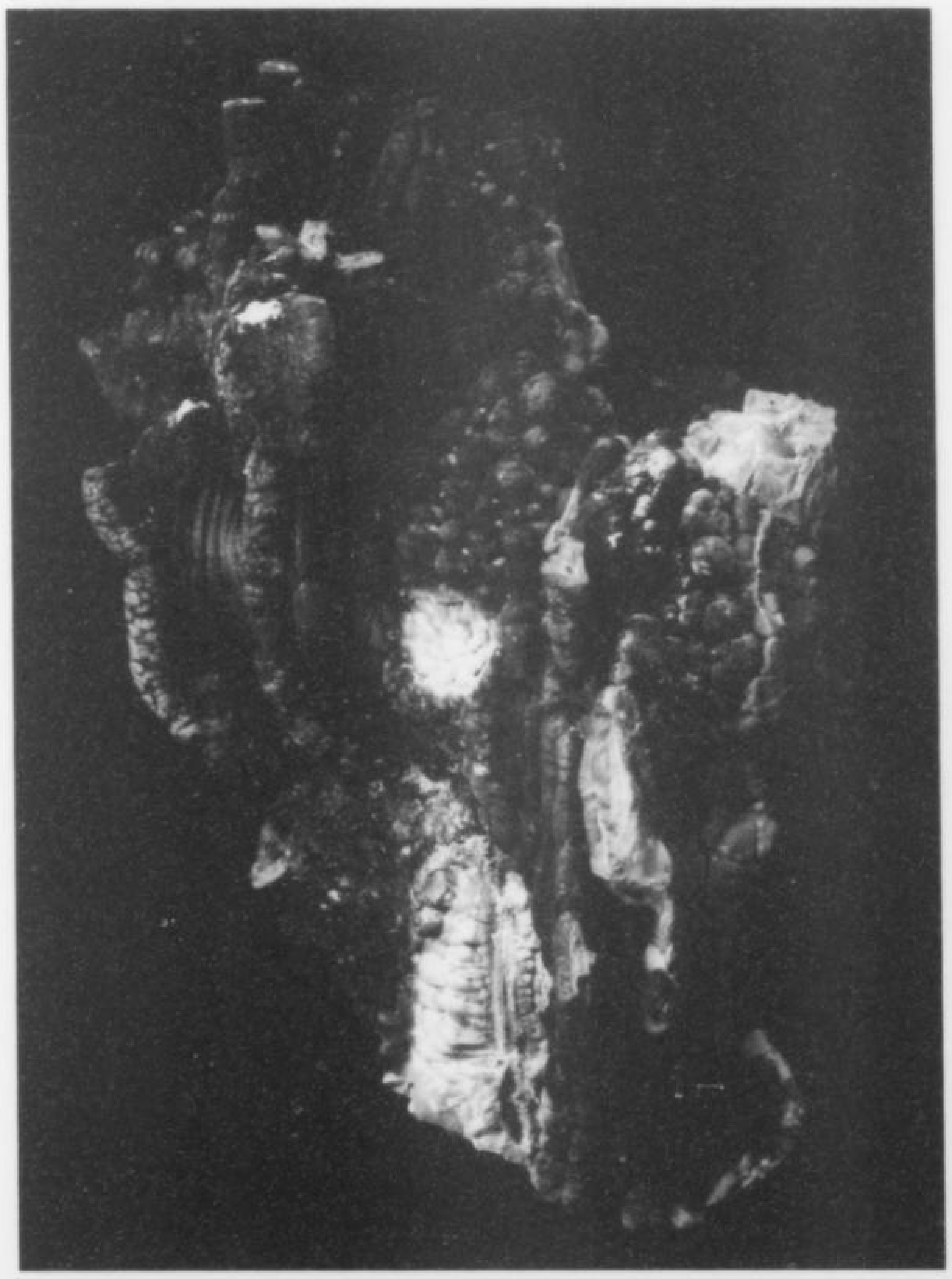


Figure 8. **Azurite crystals on matrix, 15 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**



dress goods business in Chicago where he had been employed in the famous Marshall, Field & Company department store. Upon moving west, Ben's first job was as an advertising agent for a New Mexico company, and he then served as representative for a Chicago store. In 1898, he arrived in Bisbee. A Frankenberg family story relates that upon his arrival in Bisbee for the first time, he witnessed the hanging of several cattle rustlers. His immediate reaction was that this must be a law-abiding town and he decided to settle there and open a dry goods store.

He called his store "The Fair," perhaps after a large department store with that name in Chicago. His first store occupied a 15 by

Figure 9. **Botryoidal malachite on limonite, 16 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

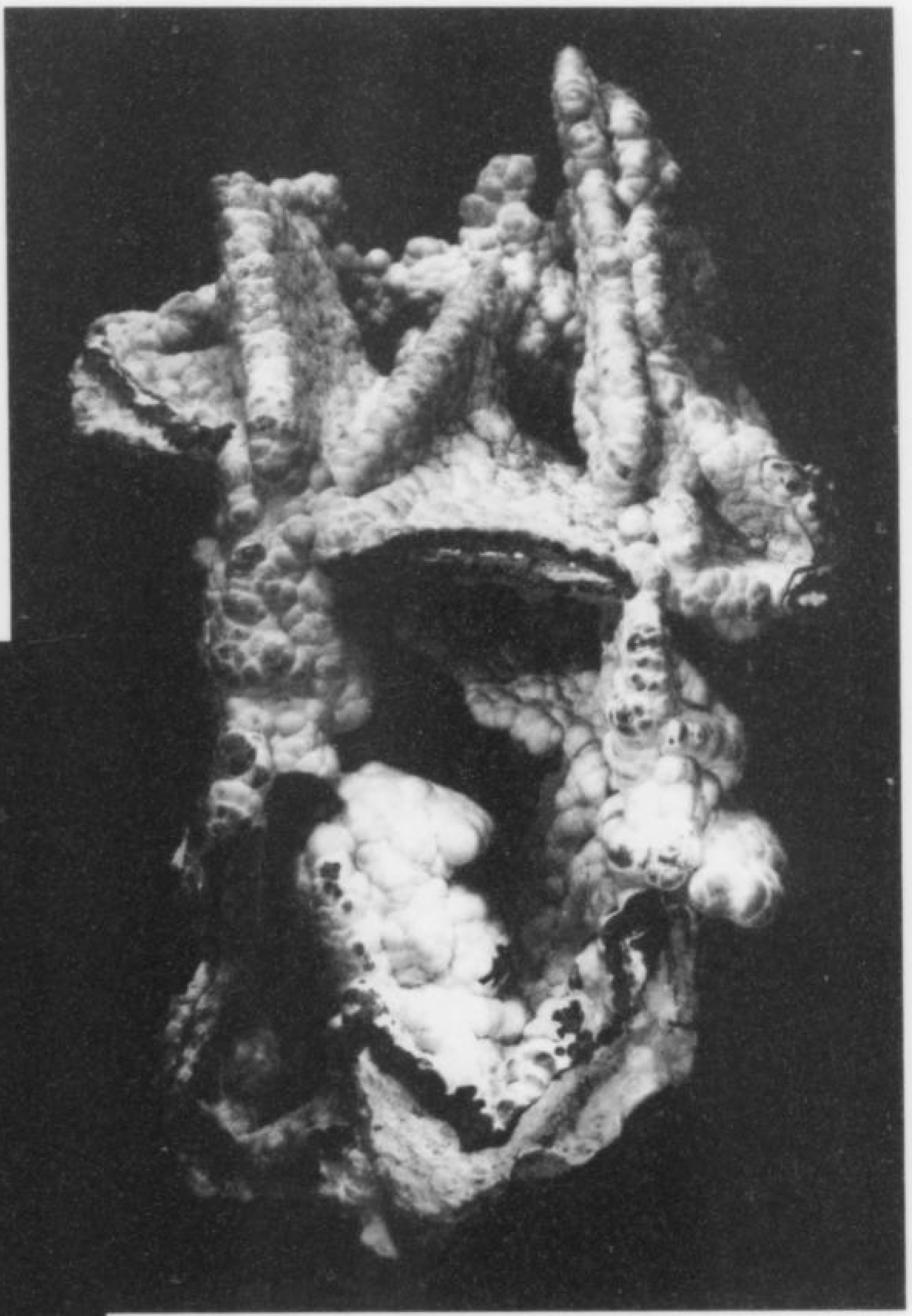


Figure 10. **Botryoidal azurite crystals on matrix, 14.5 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

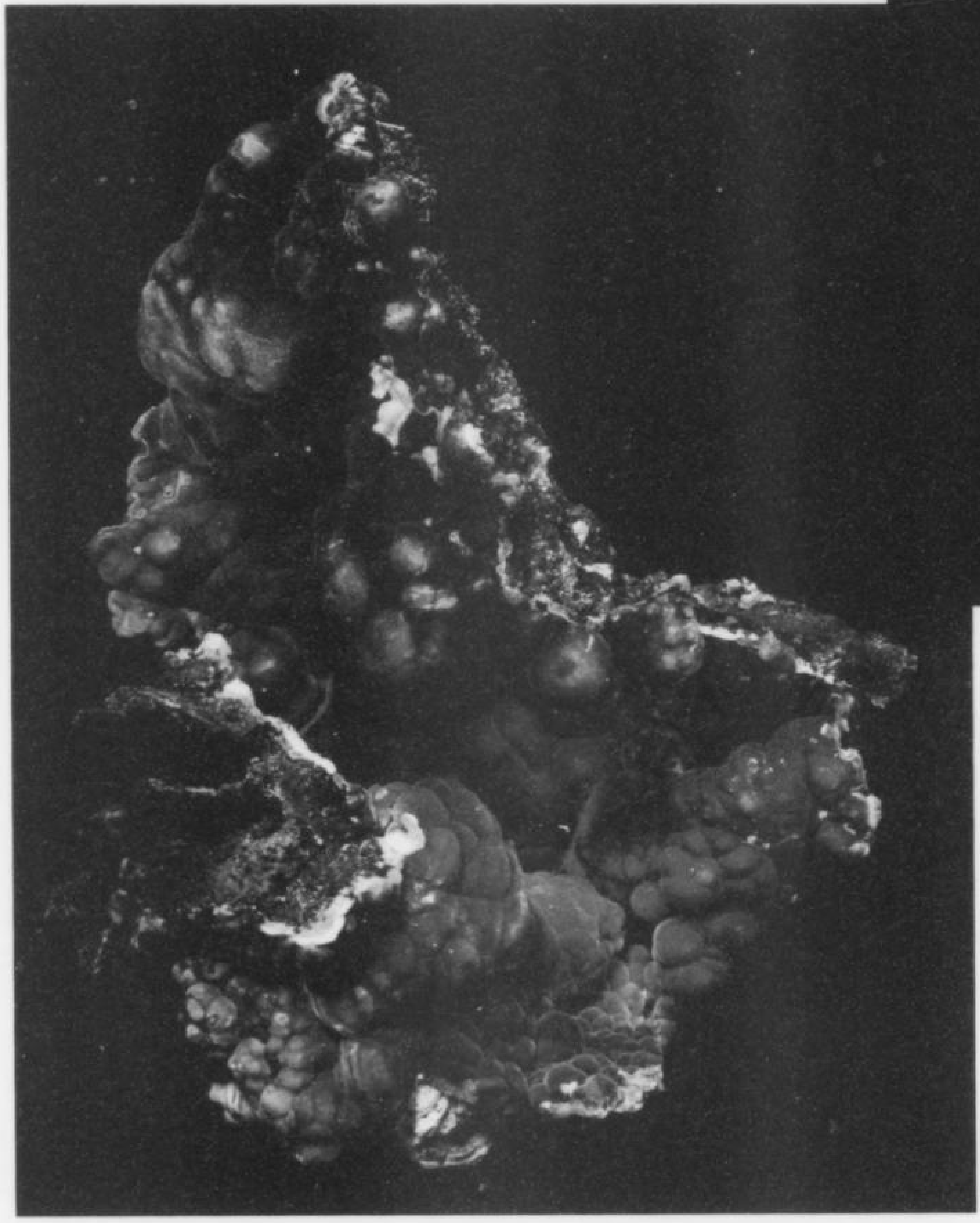


Figure 11. **Botryoidal malachite, 17 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

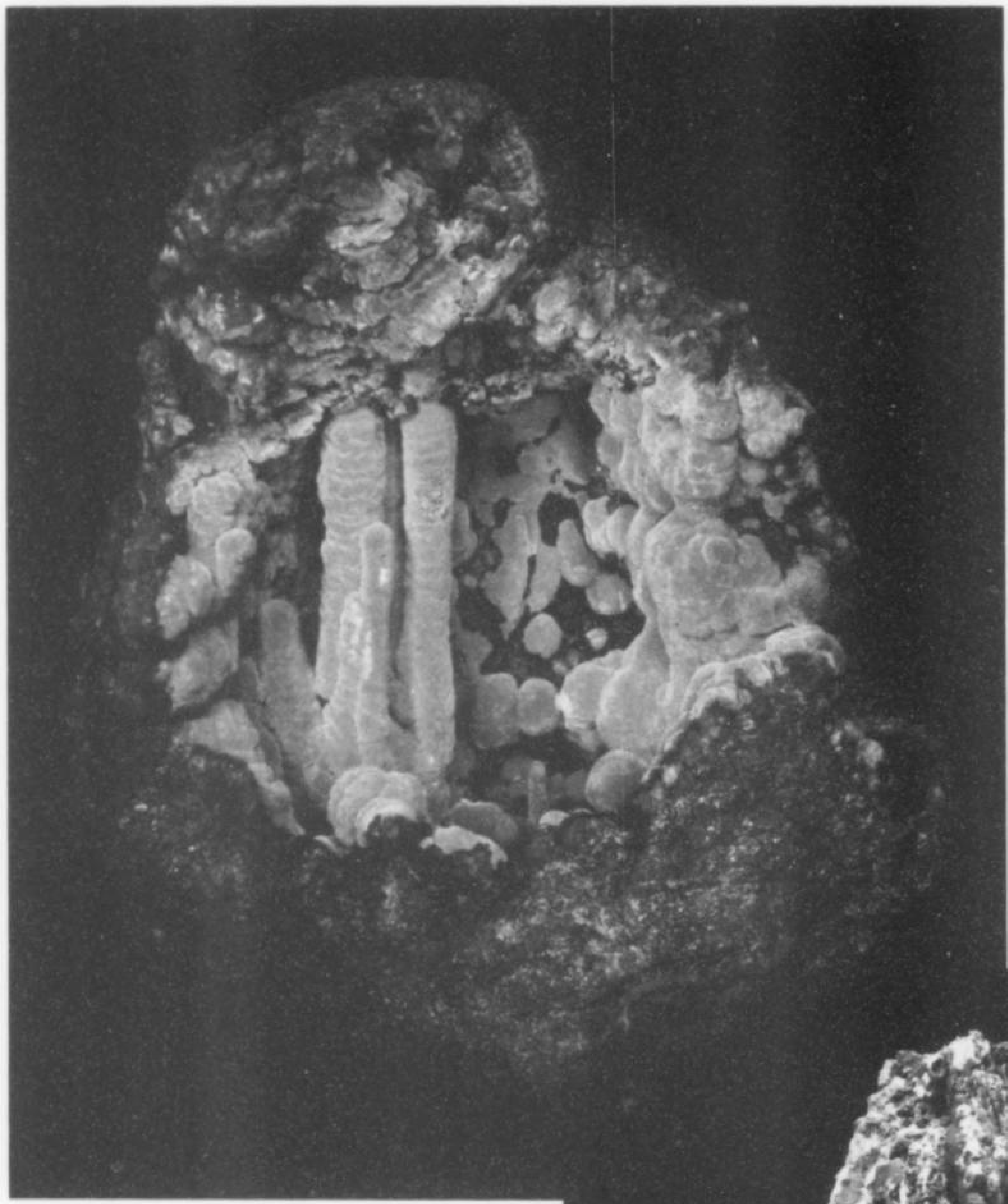


Figure 12. **Malachite vug in limonite, 17 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

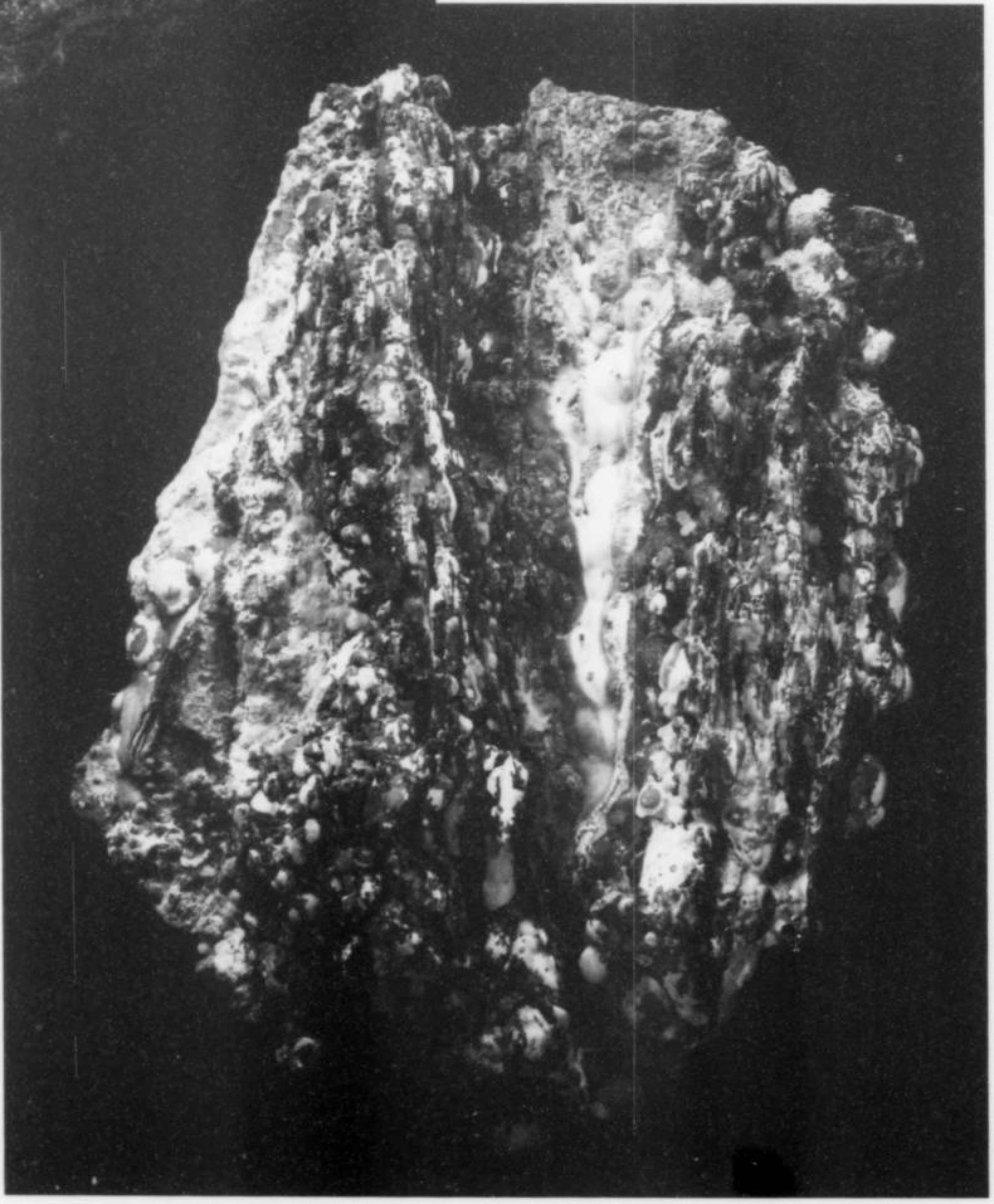


Figure 13. **Botryoidal malachite and azurite on matrix, 14 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

Figure 14. **Azurite crystals on limonite matrix, 8 cm, Bisbee. Frankenberg collection; A. R. Kampf photo.**

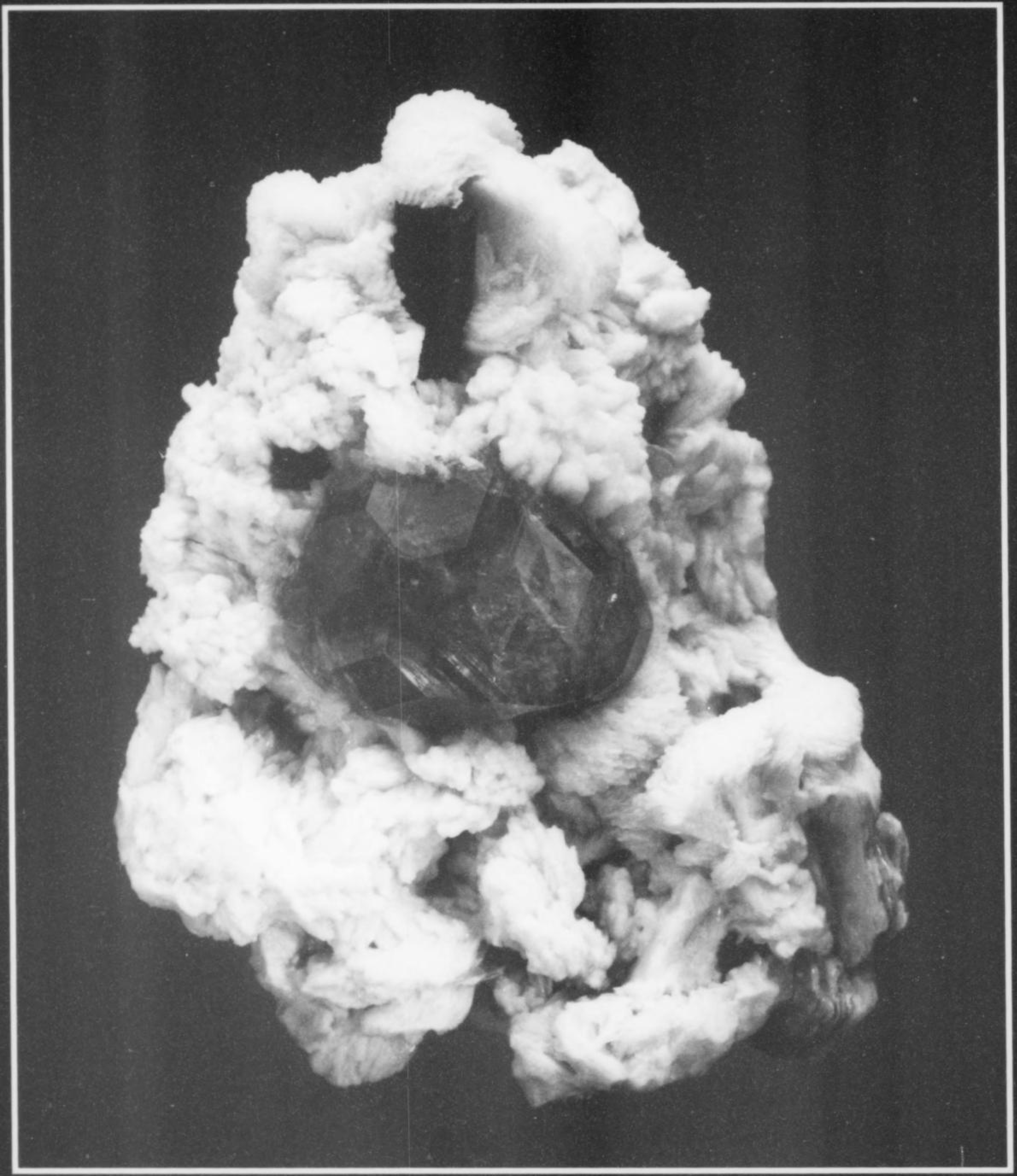
20-foot room on Brewery Gulch. In less than four months he replaced his original store with a larger one on Main Street. Before long, Ben's brother Sam joined the business, and then their brother-in-law, Moses Newman (the husband of their sister Hattie), became a partner in 1901.

A new two-story store built in 1902 had 12 employees and featured a variety of departments with the latest in fashions from New York and Paris. Following a fire in 1908, which destroyed many of the buildings on Main Street, a new store was opened in 1909. "The Fair" by this time had become the largest clothing store in Cochise County.

Ben made frequent trips back East to buy merchandise for the store. On one of these trips, he met Clara Kaufman, a family friend from Baltimore. In 1915 they were married in Hampton, Virginia and Clara headed back to Bisbee with Ben to raise a family. They had three children: Babbette (Bobbe), born May 16, 1916; Maynard (now Maynard Franklin), born March 9, 1919; and Benjamin, Jr., born January 31, 1924 and died February 28, 1973.

The Frankenberg brothers and Moses Newman sold their store in 1928. Today, "The Fair" is a museum operated by the Bisbee Restoration Society. In the years leading up to the sale of "The Fair," Ben began planning a move for his family to Beverly Hills, California. He commissioned a house to be built there, naturally with a large built-in display case for his mineral collection. His brother Sam retired to the Los Angeles area, too.

Ben Frankenberg died January 5, 1964 at the age of 92. His daughter Bobbe cherished her father's mineral collection and continued to maintain it in the family home. She became interested in the Natural History Museum of Los Angeles County and for a time in the early 1970's served as a museum docent. In March of 2006, Bobbe and her brother Maynard Franklin donated the remarkable mineral collection to the Museum in the memory of their parents, Ben and Clara. A selection of the finest specimens from the collection is on display in the museum's Hall of Gems and Minerals.



Spessartine Garnet with Schorl and Albite,
7.3 cm, from the Little Three mine, Ramona, California.
Obtained from Stuart Wilensky in December 2005;
Stuart had purchased it from Irv Brown.

Clara and Steve Smale
COLLECTORS

PHOTO BY JEFF SCOVIL

ZEOLITE OCCURRENCES *in the* CENTRAL METASEDIMENTARY BELT OF THE GRENVILLE PROVINCE, ONTARIO, QUEBEC AND NEW YORK STATE

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The Grenville Geological Province of southeastern Canada and upstate New York has long been known as a source for fine specimens of medium-grade to high-grade metamorphic and skarn minerals, but not zeolites. Recent re-examination of many well-known older localities as well as several new localities has resulted in the discovery of 21 species of zeolites, a number of which occur in collector-quality specimens.

INTRODUCTION

In spite of a long history of mining and mineral specimen production, there are relatively few reports of zeolites in Grenvillian rocks. Willimott (1884) reported chabazite and natrolite from the Haldane Mine and stilbite from the Moore (Seybold) Mine, Gatineau Co., Quebec. Spence (1920) noted the presence of stilbite and heulandite in fluorapatite-phlogopite skarn deposits, and Hoffman (1901) reported faujasite from the Daisy mine, Papineau Co., Quebec. Moyd (1949) mentioned zeolites associated with a band of nepheline-bearing rocks in the Bancroft, Ontario area, and Corriveau (1985) noted thomsonite in an alkalic syenite from Lac Rouge, Labelle Co., Quebec.

The present study was prompted by a serendipitous discovery of well-formed crystals of gismondine, chabazite-Ca and mesolite in a road cut near Laurel, Quebec, by Canadian Museum of Nature

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* deceased

** Research Associate, New York State Museum, Albany, NY

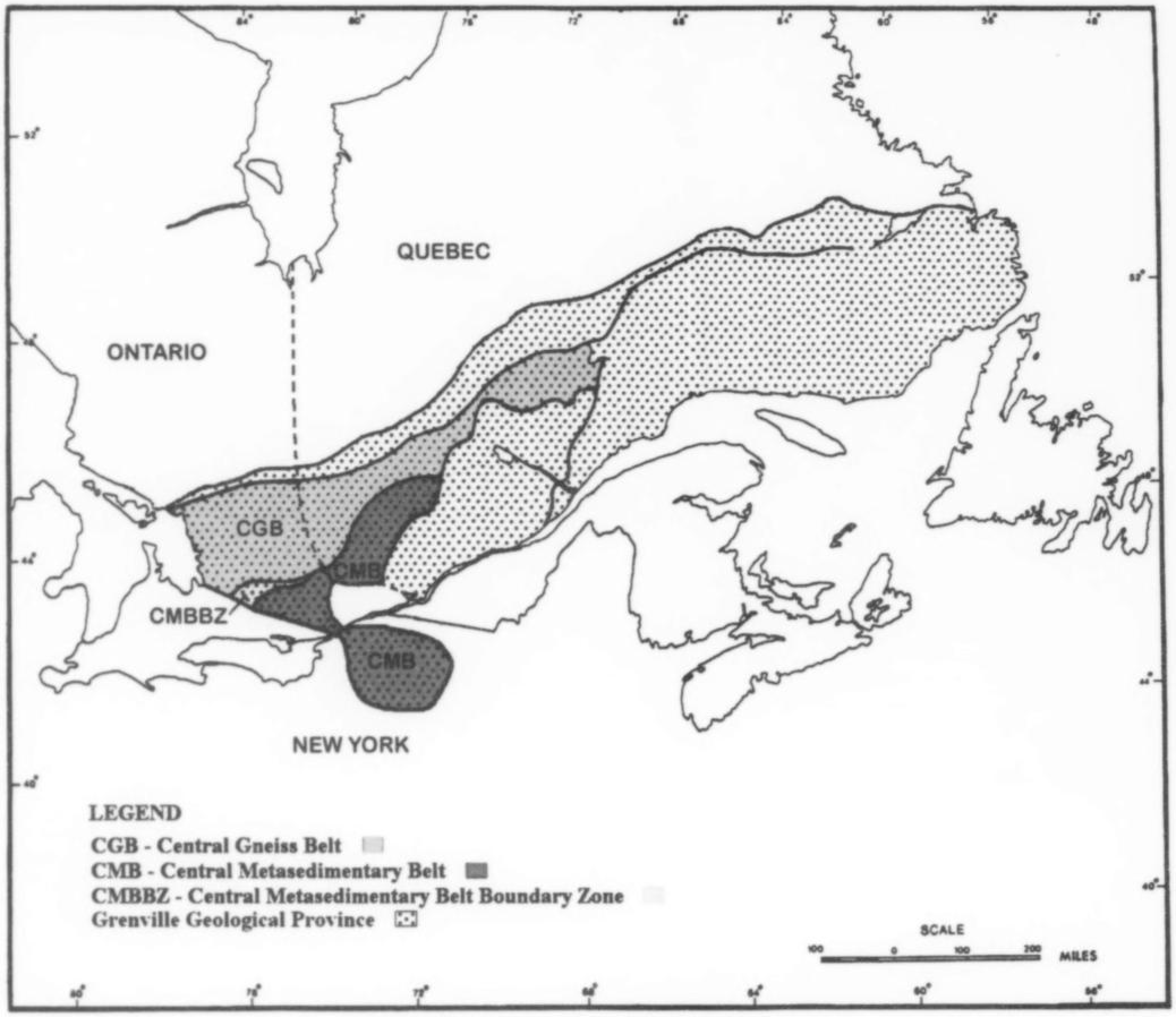

Figure 1. **Map showing location of the Grenville Province and its southern subdivisions; modified from Price and Douglas (1972) and Peck and Valley (2000).**

staff in 1983. Over the next decade, approximately 1000 road cuts, mines and test pits in the Central Metasedimentary Belt (CMB) and Central Metasedimentary Belt Boundary Zone (CMBBZ) of the Grenville across southern Quebec, southeastern Ontario and northwestern New York State were examined. In all, 101 occurrences containing zeolite mineralization were discovered, and 21 zeolite species were identified (Tables 1 and 2), including the third world occurrence of brewsterite-Ba and the rare species heulandite-Sr. The geochemically associated non-zeolite minerals prehnite, datolite and the apophyllite series were also noted at a number of localities.

A band of Fluorapatite-Phlogopite Skarn (FPS) deposits and related metasedimentary rocks located in the approximate geographical center of the CMB, and north of the Ottawa-Bonnechere Graben (OBG), hosts the majority of occurrences. However, we have also found zeolites in various granitic pegmatites, nepheline syenitic pegmatites, fractured diabase dikes, calc-silicate gneisses and fenites in the same area, and in agpaitic rocks and calc-silicate skarns in the CMBBZ. Interestingly, no zeolites have been found in any of the above-mentioned lithologies located south of the OBG.

The zeolite nomenclature used in this paper corresponds to that recommended by the International Mineralogical Association (IMA) (Coombs *et al.*, 1997).

GEOLOGIC SETTING

A comprehensive overview of Grenville geology and mineralogy is well beyond the scope of this study, and is best gained from a large number of other sources (e.g., Shaw *et al.*, 1963; Wynne-Edwards, 1972; Davidson *et al.*, 1979; Davidson *et al.*, 1990; Moore *et al.*, 1986; Robinson and Chamberlain, 1982; Windley, 1988; Rivers *et al.*, 1989; Sabina, 1986). The majority of zeolite occurrences described here are in rocks within or adjacent to the Central Metasedimentary Belt (CMB) of the Grenville Province, probably an ancient island arc, composed largely of Precambrian marbles, gneisses, amphibolites, granites, syenites, etc., formed by tectonic and plutonic mountain-building events (Grenville orogeny) at ~950–1080 Ma, during which amphibolite-to-granulite facies conditions were attained. The Central Metasedimentary Belt Boundary Zone (CMBBZ) separates the CMB from the Central Gneiss Belt (CGB) to the west; its eastern border is defined by the Carthage-Colton mylonite zone and Labelle shear zone. The CMBBZ is characterized by brecciated carbonate metasediments, and is host to intrusions of nepheline syenite along its length. Other igneous intrusions paralleling the CMBBZ and north of the Ottawa-Bonnechere Graben (Kumarapeli and Saull, 1966) include the Cawood nepheline syenite complex (Currie, 1976), the St. Veronique and Lac Rouge K-rich to shoshonitic plutons (Corriveau, 1984,

Figure 2. **Locality 48 road cut near Laurel, Québec, showing fractured scapolite skarn mineralized by zeolites. George Robinson photo.**

1985), nepheline syenite intrusions near the Cabonga Reservoir (Brunet and Martignole, 1994), and the Wakefield batholith (Hogarth, 1970).

During the Paleozoic, much of the southern portion of the study area was covered by sediments (sandstones, sandy dolostones, shales and limestones) to a depth of 2–3 km (Sanford, 1993). Minor igneous activity is recorded by the Onslow Syenite and Buckingham Latite (575 Ma) and the Buckingham peridotite (275 Ma). Hydrothermal mineralization along reactivated faults and fractures at 186.6 Ma resulted in a number of Rossie-type galena-calcite and related gash vein deposits (Robinson *et al.*, 2001). The passage of a "hot spot" during Cretaceous time resulted in the alkaline Monteregian intrusives to the east, and may have thermally affected areas in the Gatineau terrain. The Blackburn carbonatite within the field area is similar in age to the Oka carbonatite complex, 110 km to the east (Hogarth *et al.*, 1988).

Younger rocks are unknown in the region; if they were once present they were probably eroded by Pleistocene glaciation, the last remnants of which receded approximately 12,000 years ago. Current isostatic rebound in the area is estimated to be at a rate of about 3 mm per annum (Andrews, 1970), with seismic activity evident, particularly in the Ottawa area.

MINERALOGY

X-ray diffraction and electron microprobe analyses were used to identify all minerals. Chemical analyses were obtained from a JEOL 733 electron microprobe in wavelength-dispersion (WDS) mode using Tracor Northern 5500 and 5600 automation. Operating conditions were 15 kV accelerating voltage, 20 nanoampere beam current and a 30 micron beam diameter to minimize volatilization and decomposition during analysis. A conventional ZAF routine in the Tracor Northern TASK series of programs was used to correct

Table 1. **Modes of occurrence of zeolites in the Central Metasedimentary Belt.**

Species	*Mode of Occurrence**
1) Analcime	1, 2, 4, 5
2) Brewsterite-Ba	8
3) Chabazite series	1, 2, 3, 9, 10
4) Clinoptilolite-Ca	1
5) Cowlesite	2
6) Erionite series	2
7) Faujasite-Na	1
8) Garronite	5
9) Gismondine	2
10) Gonnardite	5
11) Harmotome	4
12) Heulandite-Ca	1, 2, 3
13) Heulandite-Sr	4
14) Laumontite	2, 3
15) Levyne	2
16) Mesolite	1, 2, 3
17) Natrolite	5
18) Scolecite	6
19) Stellerite	1, 2, 3, 4, 7
20) Stilbite-Ca	1, 2, 3
21) Thomsonite	1, 2

* Modes of Occurrence: 1) fluorapatite-phlogopite skarn deposit, 2) calc-silicate skarn or gneiss, 3) syenitic-to-gabbroic pegmatitic segregations in skarn or gneiss, 4) granitic pegmatite, 5) nepheline syenite, 6) fenite, 7) fracture filling in diabase, 8) prehnite veins in wollastonite skarn, 9) calcite-prehnite vein in amphibolite gneiss, 10) fracture filling in granitic gneiss.

Table 2. **Zeolite localities in the central metasedimentary belt*.**

Locality	*Name*	*Host***	*UTM(N)*	*UTM(E)*	*Map*	*Township*	*County*	*Species***
Quebec Segment								
1	Haldane	1	5300	3440	31G12	Lapeche	Gatineau	16
2	Comet	1	5393	3615	—	—	—	3, 12
3	road cut	2	5540	3535	—	—	—	3, 12, 16
4	road cut	4	4670	3603	—	—	—	3, 12
5	Horseshoe	1	5230	3360	—	—	—	1, 3, 12, 20, 21
6	prospect	1	5540	3230	—	—	—	3, 12, 19, 20
7	Nellie Blanch	1	4195	3880	—	Hull	—	3, 12, 16, 20
8	Featherstone	1	4235	3850	—	—	—	3
9	Dacey	1	4980	3688	—	—	—	3, 12, 16
10	Thom	1	4950	3775	—	—	—	3
11	Blackburn	1	4480	3815	—	—	—	3
12	Dibbley	7	3295	3975	31G5	—	—	3, 12, 20
13	outcrop	2	5075	3055	31G12	—	—	3, 12, 16
14	road cut	2	4840	3457	—	—	—	3, 12, 16
15	road cut	2	4653	3265	—	—	—	3, 12, 16, 20
16	road cut	3	4235	3695	—	—	—	3, 12, 16, 20
17	road cut	2	4110	3952	—	—	—	3, 12
18	prospect	1	4685	3455	—	—	—	3
19	Haycock	6	4360	4210	—	—	—	18
20	road cut	3			31K8	D'Angoumos	—	20
21	road cut	3			—	—	—	3, 12, 20
22	road cut	2	Series of road cuts on Highway 819 in vicinity of UTM 4550N and 0870 – 1030E		—	—	—	3, 12, 20
23	road cut	2			—	—	—	3, 12, 20
24	road cut	2			—	—	—	3, 12, 20
25	road cut	2			—	—	—	3, 12, 20
26	road cut	2			—	—	—	3, 16, 19, 20
27	road cut	2			—	—	—	3, 20
28	road cut	7	8570	0280	31F16	Clapham	—	20
29	road cut	2	9190	2760	—	Hincks	—	3, 14
30	road cut	2, 7	8820	2545	—	—	—	3, 4, 12, 14, 19, 20
31	prospect	1	4515	2440	—	Egan	—	3, 12
32	road cut	2	5275	2250	—	—	—	3, 12, 20
33	Chaibee	1	9878	2125	—	Wright	—	3, 12, 16, 20
34	road cut	2	3275	2460	—	Maniwaki	—	3, 12, 16, 20
35	road cut	2	3920	2450	—	—	—	3, 12, 16, 20
36	road cut	2	7175	2100	—	Lytton	—	3, 12, 16, 20
37	road cut	2	5120	3952	31K9	—	—	3, 12, 16, 20
38	road cut	2	7250	2025	—	—	—	3, 12, 16, 20
39	Bain	2	6510	1150	31F9	Masham	—	3
40	road cut	2	5530	2690	31G12	—	—	3, 12, 16
41	Yates	2	9100	8045	31F15	Huddersfield	Pontiac	3, 12, 20
42	Giroux	2	7680	8130	—	Litchfield	—	3, 12, 20
43	road cut	2	6895	8040	—	—	—	3, 12
44	road cut	2	6895	8150	—	—	—	1, 14
45	road cut	3	6970	8140	—	Thorne	—	3, 12
46	road cut	4	3790	0330	31N05	—	—	3, 12, 13, 20
47	road cut	2	8427	3125	31G15	Harrington	Argentieul	3, 12.16, 21
48	road cut	2	7780	4250	31G16	Wentworth	—	3, 4, 5, 6, 9, 12, 15, 16, 21
49	Seybold	1	5533	3755	31G12	Val des Mont	Papineau	3, 12, 20
50	Gemmil	1	5920	4030	—	—	—	3, 12, 20
51	road cut	2	6430	4415	—	—	—	22
52	Breckin	1	5645	4530	—	—	—	3, 12, 16, 20
53	Jackson Rae	1	5130	5295	—	Templeton	—	3, 12, 16, 20
54	Post	1	5240	5325	—	—	—	3, 12, 20
55	Murphy	1	5125	5130	—	—	—	3, 12, 20
56	King Edward	1	5810	5455	—	—	—	3, 4, 12, 16, 20
57	road cut	2	4813	4763	—	—	—	3, 12

Table 2 (continued). **Zeolite localities in the central metasedimentary belt*.**

Locality	*Name*	*Host***	*UTM(N)*	*UTM(E)*	*Map*	*Township*	*County*	*Species***
58	Laurin	1	5510	4625	—	—	—	3, 12, 20
59	Millar	1	5320	5100	—	—	—	3, 12, 16
60	Briggs	1	5830	4670	—	Templeton (Gore)	—	3, 12, 16, 20
61	Washington	1	6130	6285	31G11	—	—	3, 12
62	Emerald	1	5985	6180	—	—	—	3, 12, 16, 20
63	Aetna	1	5975	6185	—	—	—	3, 12, 16, 20
64	Penaud	4	6020	6442	—	—	—	3
65	New York	4	5494	5799	—	—	—	11
66	Terror Lake	1	6405	4970	31G12	Portland West	—	18
67	Crown Hill	1	7350	4950	31G13	—	—	3, 16, 20
68	High Rock	1, 4	7045	5110	—	—	—	1, 3, 12, 16, 20
69	High Rock	1, 4	7110	5095	—	—	—	3, 20
70	Allan	1	6565	4870	—	—	—	3
71	Cameron	1	7200	5815	—	Portland East	—	3, 12
72	France	1	6530	6145	—	—	—	3, 12, 20
73	Watts Rapids	1	5970	6140	—	—	—	3, 12, 16, 20
74	road cut	3	6915	7880	31G14	Mulgrave	—	3, 20
75	Daisy	1	6250	6410	31G11	Derry	—	3, 7
76	Lac Rouge	5	4200	7000	31JGW	Kiamika	Labelle	17, 21
Ontario Segment								
77	road cut	2	1735	3795	31F6	Griffith	Renfrew	3, 12, 20
78	road cut	2	1750	3810	—	—	—	3, 12, 20
79	road cut	2	1960	4040	—	Brougham	—	3, 12, 20
80	Hunt	2	1865	5070	31F7	—	—	3
81	Klondike	5	1840	9520	31F5	Raglan	—	3
82	road cut	2	3100	0680	31F6	Brudenell	—	3, 12, 20
83	Gutz Farm	5	2580	0690	—	—	—	1, 8, 10
84	Wolfe	5	2300	1760	—	Lyndoch	—	1, 12
85	Princess	5	9485	7916	31F4	Dungannon	Hastings	1, 17
86	Davis Hill	5	9408	7915	—	—	—	1, 8, 17
87	Egan Chute	5	9465	8470	—	—	—	1
88	Golding-Keene	5	9408	8477	—	—	—	17
89	Vardy	5	9510	7935	—	—	—	1
90	Faraday	3, 4	8910	6965	—	—	—	3
91	Burgess	5	1550	8850	—	Carlow	—	1, 17
92	Monteagle	5	0265	8637	—	Monteagle	—	17
93	prospect	1	0320	7520	—	—	—	3, 17
94	road cut	2	0020	7460	—	—	—	3, 12
95	Gill	5	7563	1040	31D16	Glamorgan	Haliburton	1, 17
96	Fraser	5	7487	0884	—	—	—	1
97	Blue Mountain	5	5100	6620	—	Methuen	Peterborough	1, 17
New York Segment								
98	Valentine	8	N44°07′	W75°22′	Lake Bonaparte	Diana	Lewis	2
99	road cut	9	N44°26′	W75°11′	Russell	Russell	St. Lawrence	3
100	Scott Farm	3	N44°13′	W75°05′	Oswegatchie	Fine	—	3, 12, 19, 20
101	Benson Mines	10	N44°10′	W75°00′	Oswegatchie	Clifton	—	3

*The data in this table were accumulated by the senior author (deceased) and have not been verified. They are presented here as a starting point for the benefit of those wishing to visit some of these occurrences.

**As given in Table 1.

raw data for absorption, fluorescence and atomic number effects, and water was calculated by stoichiometry. Results for selected samples are presented in Table 3.

X-ray powder diffraction patterns were obtained using a 114.6 mm diameter Debye-Sherrer camera with Ni-filtered $Cu_K\alpha$ radiation on a Phillips 811801 X-ray generator operated at 44 kV and 22 mA. Refined unit cell dimensions were derived utilizing the computer program CELREF (Appleman and Evans, 1973). Results for selected samples are presented in Table 4.

Analcime $Na[AlSi_2O_6]\cdot H_2O$

Analcime has been found in calc-silicate skarn at FPS and other contact skarn deposits, as well as in granitic pegmatite and nepheline (± corundum) syenite. At locality 5 (FPS deposit) it

Table 3. **Electron microprobe analyses for selected samples.**

	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
SiO_2	55.29	47.80	41.79	54.20	54.03	63.93	50.93	45.61	45.66	59.55	35.78	35.59	36.78
TiO_2				0.08									
P_2O_5		0.10	0.14				0.07				0.08	0.06	0.08
Al_2O_3	21.75	19.51	29.43	15.60	16.68	12.79	21.71	26.12	25.94	18.19	30.25	30.11	29.32
CaO		8.59	15.56		3.06	4.54	11.61		0.05	8.63	12.92	11.30	11.62
SrO		0.35	0.20		6.20	0.54					1.05	3.01	2.08
BaO		0.21		22.80	4.42	0.13							
MgO						1.15	0.21						
FeO							0.40						
Na_2O	13.93		0.78	0.09	0.05			16.29	16.41	0.94	3.73	3.75	4.15
K_2O	0.30	0.32	0.05	0.08	1.51	0.88	0.31			0.51			
H_2O	0.30	20.99	25.88	16.32	14.71	13.15	17.28	9.19	9.18	18.86	12.89	12.77	12.86
Sum	99.40	97.87	113.83*	109.17	100.66	97.12	102.52	97.21	97.24	106.68*	96.70	96.59	96.91
Si^{4+}	2.04	3.41	4.36	11.95	26.43	29.14	15.91	2.98	2.98	26.51	5.00	5.01	5.14
Ti^{4+}				0.01									
P^{5+}		0.01	0.01				0.02				0.01	0.01	0.01
Al^{3+}	0.95	1.64	3.62	4.05	9.62	6.87	7.99	2.01	2.00	9.54	4.98	5.00	4.83
Ca^{2+}		0.66	1.74		1.60	2.22	3.89		0.003	4.12	1.93	1.71	1.74
Sr^{2+}		0.01	0.01		1.76	0.14					0.09	0.25	0.17
Ba^{2+}		0.01		1.97	0.85	0.02							
Mg^{2+}						0.78	0.10						
Fe^{2+}							0.10						
Na^{1+}	0.99		0.16	0.04	0.05			2.06	2.08	0.81	1.01	1.02	1.12
K^{1+}	0.01	0.03	0.01	0.02	0.94	0.51	0.12			0.29			
$N(H_2O)$	1.00	5.00	9.00	12.00	24.00	20.00	18.00	2.00	2.00	28.00	6.00	6.00	6.00
# O^{2-}	7.00	15.00	25.00	44.00	92.00	92.00	66.00	12.00	12.00	100.00	26.00	26.00	26.00

* high sum probably due to decomposition during analysis

1: analcime, locality #5; 2: cowlesite, locality # 48; 3: gismondine, locality 48; 4: harmotome, locality # 65; 5: heulandite-Sr, locality 46; 6: clinoptilolite-Ca, locality 30; 7: laumontite, locality 30; 8: natrolite, locality 86; 9: natrolite, locality 97; 10: stilbite-Ca, locality 42: 11: thomsonite, locality 5; 12: thomsonite, locality 47; 13: thomsonite, locality 48.

Table 4. **X-ray data for selected samples.**

Locality	*Species*	*Cell Parameters (in Å) and References*
5	analcime	*a* = 13.710(2) (cubic cell)
48	cowlesite	*a* 11.653(2), *b* 15.509(1), *c* 12.538(2) based on orthorhombic cell of Wise and Tschernich (1975)
48	gismondine	*a* 10.024(2), *b* 10.614(2), *c* 9.48(2), β 92.28°
65	harmotome	*a* 9.806(2), *b* 14.191(3), *c* 8.697(2), β 124.39° based on monoclinic cell of Sahama and Lehtinen (1967)
46	heulandite-Sr	*a* 17.733(3), *b* 17.744(2), *c* 7.415(3), β 116.20° based on JCPDS 24-469 (Cerny and Povondra, 1969)
30	laumontite	*a* 14.935(3), *b* 13.047, *c* 7.510(2), β 111.58°

occurs as 0.5-mm colorless, translucent to transparent trapezohedral crystals and shells in cavities in heavily etched meionite. While morphologically cubic, lower symmetry is apparent optically in these crystals, with sector zoning and weak anisotropy evident. The paragenetic sequence of the zeolite mineralization at this locality is calcite(I) → chabazite → thomsonite → mesolite → analcime → calcite(II) → illite.

At locality 44, pseudomorphs of albite after trapezohedral analcime crystals up to 1 cm were found in fine-grained, massive laumontite associated with meionite, titanite, fluorapatite and rare zircon. At locality 68, analcime forms translucent, white, trapezohedral crystals to 0.5 mm associated with an apophyllite series mineral in a microcline-albite-quartz-calcite pegmatite, and at locality 86 it occurs as a white, powdery, surface alteration on nepheline.

Brewsterite-Ba $(Ba,Sr)_2[Al_4Si_{12}O_{32}]\cdot 10H_2O$

Barium-dominant brewsterite occurs in cavities in prehnite at locality 97, where it forms pale yellow to colorless pinacoidal crystals and aggregates to 1 mm associated with prehnite, quartz, diopside, calcite, wollastonite and microcline. For a complete description, see Robinson and Grice (1993) and Chamberlain *et al.* (1999). Other than harmotome, brewsterite-Ba is the only barium-dominant zeolite known from the Grenville Province. This occurrence is the third known in the world for the mineral.

Chabazite-Ca $(Ca_{0.5},K,Na)_4[Al_4Si_8O_{24}]\cdot 12H_2O$

Chabazite-Ca is clearly the predominant chabazite species found in the Grenville. At most localities it forms transparent to translucent, colorless to white rhombohedral crystals with or without modifying {021} faces. Crystals rarely exceed 5 mm, though a few exceptional crystals measuring 1 to 1.5 cm are known from

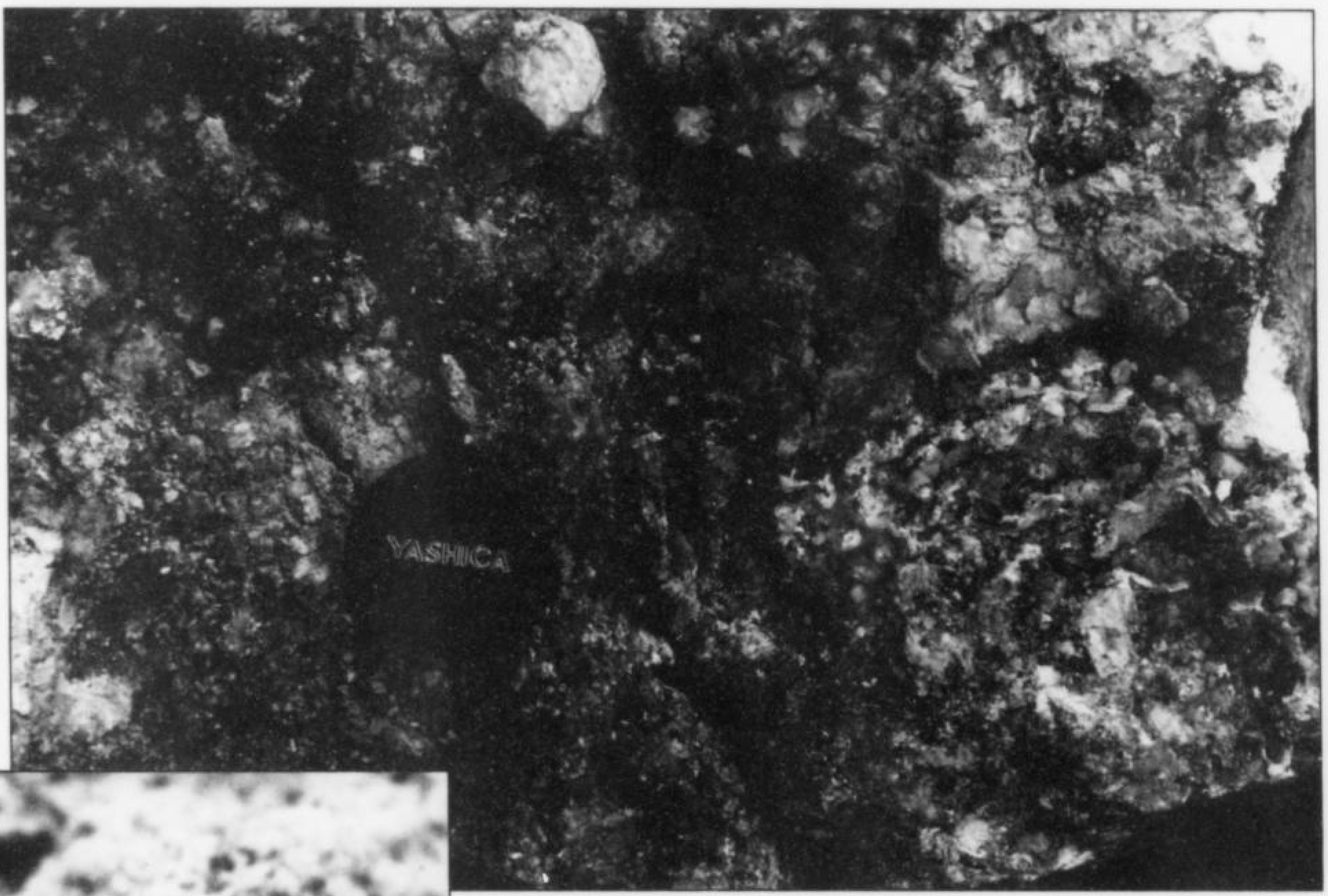

***Figure 3.* A large block of scapolite-rich skarn coated with mesolite and chabazite-Ca; locality 48 road cut near Laurel, Québec. Michel Picard photo.**

***Figure 4.* Twinned crystal of chabazite-Ca, 7 mm across, from the Faraday (Madawaska) mine, 450 level, 338 drift, Bancroft, Hastings County, Ontario, Canada (locality 90). Canadian Museum of Nature specimen (Cat. No. 47771); Jeff Scovil photo.**

localities 47 and 48. Occasionally, pale yellow (locality 35) to deep orange (locality 27) crystals are encountered. Simple penetration twins are common, and yellow to orange "phacolite-habit" twins occur at localities 7 and 90. Microprobe analyses of chabazite samples from thirty-seven localities show that most (thirty-two analyses) contain Ca>K>Sr>Ba, but some (eleven analyses) show Ca>Sr>K>Ba. While Ba and Na are low in all the analyses, the Na content of chabazites from pegmatites is higher than from other modes of occurrence. Otherwise, specific chemical correla-

***Figure 5.* Crystals of chabazite-Ca to 5 mm with heulandite-Ca, from Highway 819 road cut (locality series 20–27), near Maniwaki, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83826); Jeff Scovil photo.**

tions for specimens from the different modes of occurrence are not evident, suggesting that lithology may have played only a limited role in the formation of chabazite-Ca.

One analysis (locality 6, an FPS deposit) yielded a composition with virtually equal Ca and K contents, suggesting the possible occurrence of chabazite-K in the CMB. This sample, which is physically indistinguishable from other chabazite-Ca specimens, consists of colorless, 1 to 2-mm rhombohedral crystals associated with heulandite-Ca and meionite. The sample also has the highest Mg content of all samples analyzed (0.34 *apfu*).

Cowlesite $Ca[Al_2Si_3O_{10}]\cdot 5.3H_2O$

Cowlesite has been identified from a single occurrence (locality 48), where it forms lustrous white, silky, radiating crystal aggregates to 0.3 mm on a thin overgrowth of albite on a meionite crystal. Associated species include altered pyrite, allanite-(Ce) and intergrowths of levyne and erionite. The meionite crystal hosting the cowlesite was found loose in soil filling the bottom of a 2 × 1.5 × 1-meter solution cavity in brecciated calc-silicate skarn. Interestingly, identical meionite crystals attached to the cavity walls or enclosed in calcite were frequently covered with mesolite, but only crystals found in the soil contained the cowlesite-erionite-levyne assemblage.

Compared to other cowlesite, that from locality 48 contains more Sr and Ba, but has a similar Si:Al ratio (Nawas, 1984; Gottardi *et al.*, 1985; Wise and Tschernich, 1975; Tschernich, 1992; Vezzalini *et al.*, 1992).

Erionite Series $(K,Na,Ca_{0.5})_{10}[Al_{10}Si_{26}O_{72}]\cdot \sim 30H_2O$
Levyne Series $(Ca_{0.5},Na,K)_6[Al_6Si_{12}O_{36}]\cdot \sim 17H_2O$

An erionite-series mineral intimately intergrown with levyne forms lustrous white to gray, silky, asbestiform, radial crystal aggregates to 0.3 mm on meionite at locality 48 (see cowlesite description above). Both species were identified by X-ray diffraction. Because of the paucity of sample, no other determinative techniques were applied. The occurrence of these minerals on meionite in soil may represent a new genetic mode, as they have previously been reported only from basalt and tuffaceous rhyolite beds (Gottardi *et al.*, 1985).

Faujasite-Na $(Na,Ca_{0.5}Mg_{0.5}K)_{3\text{-}4}[Al_{3\text{-}4}Si_{9\text{-}8}O_{24}]\cdot 16H_2O$

Milky white octahedral crystals of faujasite-Na have been described from locality 75 (Hoffman, 1901), but its occurrence there remains unconfirmed. Associated species reported include fluorite, datolite, quartz, barite, chabazite, calcite, pyroxene, phlogopite, pyrite and pyrrhotite. Hoffman (1901) gives the analysis SiO_2 48.7, Al_2O_3 17.0, CaO 4.6, Na_2O 3.2, H_2O 26.0, sum 99.5 weight %, which yields a reasonably good empirical formula for faujasite-Na (based on 40 anions): $(Na_{1.11}Ca_{0.88})S_{1.99}[Al_{3.56}Si_{8.69}O_{24.22}]\cdot 15.78H_2O$. In the National Mineral Collection of Canada there are three specimens labeled "faujasite" from this locality matching the description given by Hoffman (1901). Each was analyzed by X-ray diffraction and microprobe and found to be a mixture of fluorite and datolite. Such a mixture could not have yielded the analysis found by Hoffman, and while we have no reason to doubt his identification of faujasite-Na from locality 75, neither can we confirm it.

Garronite $NaCa_{2.5}[Al_6Si_{10}]O_{32}\cdot 14H_2O$

Garronite has been identified by X-ray powder diffraction from locality 86, where it forms a white powder on nepheline crystals.

Gismondine $Ca[Al_2Si_2O_8]\cdot 4.5H_2O$

Gismondine occurs with chabazite-Ca and prehnite in solution cavities developed in skarn at locality 48. The mineral occurs both as euhedral, pseudotetragonal, bipyramidal, colorless to white, opaque crystals up to 5 mm, and as elongated anhedral growths replacing meionite fibers parallel to the *c* axis of the meionite.

Harmotome $(Ba_{0.5},Ca_{0.5},K,Na)_5[Al_5Si_{11}O_{32}]\cdot 12H_2O$

At locality 65 harmotome occurs as equant to long-prismatic, colorless to white, twinned euhedral crystals and divergent aggregates to 2 mm associated with fibrous white spherules of allanite-(Ce), fluorite, calcite, pyrite and montmorillonite in voids in brecciated feldspar. The feldspar is noticeably etched, and slickensided surfaces are evident on some specimens. Morvenite, Perier

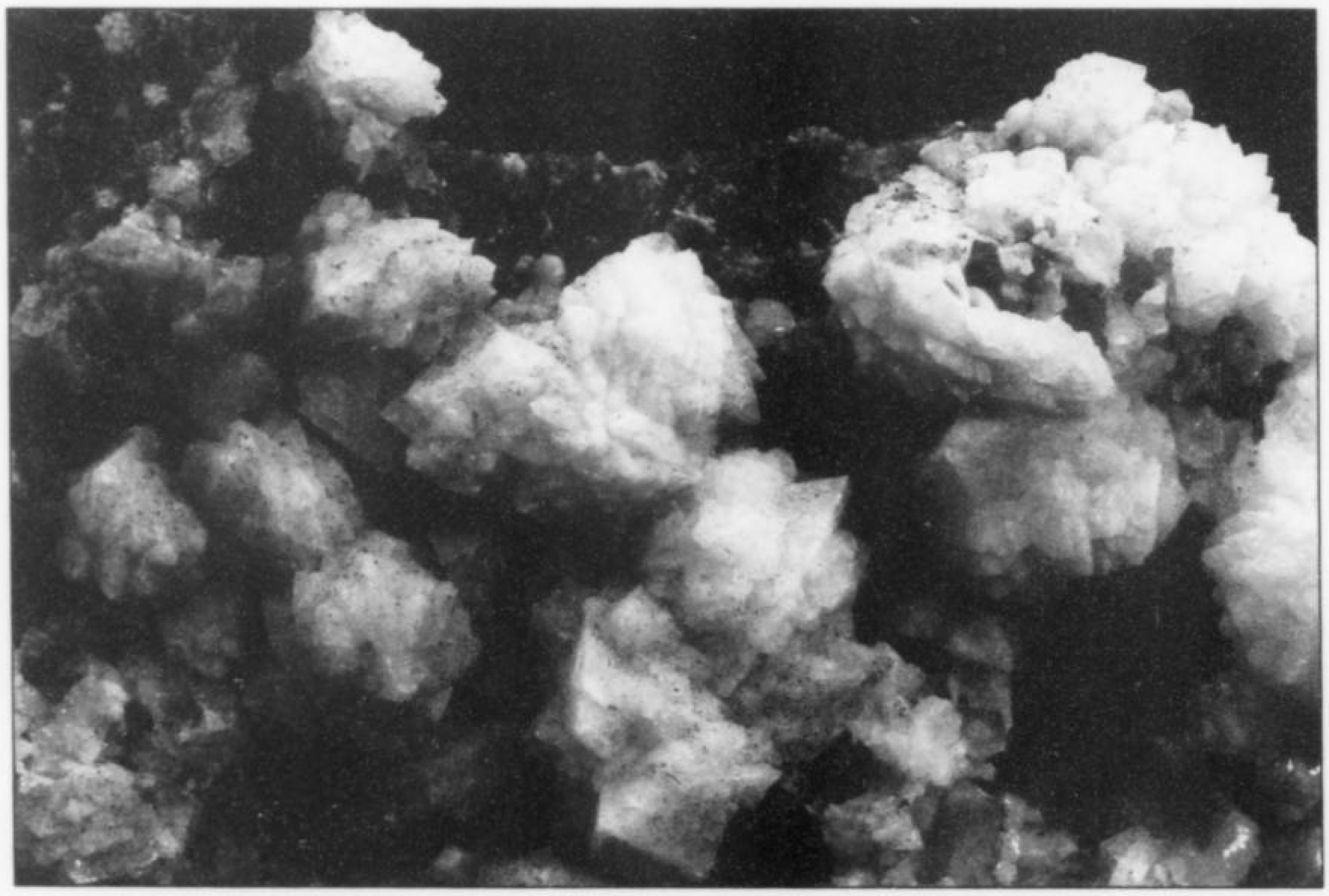

Figure 6. **Gismondine crystals on skarn, 3.5 cm-wide field of view, from road cut near Laurel, Wentworth Township, Argenteuil County, Québec, Canada (locality 48). Canadian Museum of Nature specimen (Cat. No. 49242); Jeff Scovil photo.**

and cruciform twins are common; predominant forms include {100}, {010}, {001} and {110}. A source for the barium required to form harmotome is not evident. Microprobe analyses of both the feldspar and the muscovite from this locality found no detectable Ba, nor were any barite or other Ba-bearing minerals observed. Nine different barite veins cutting carbonate or siliceous metasediments within a 130-km distance were examined, but none was found to contain harmotome or any other zeolite mineral.

Heulandite Series

$(Ca_{0.5},Sr_{0.5},Ba_{0.5},Mg_{0.5},Na,K)_9[Al_9Si_{27}O_{72}]\cdot{\sim}24H_2O$

Clinoptilolite Series

$(Na,K,Ca_{0.5},Sr_{0.5},Ba_{0.5},Mg_{0.5})_6[Al_6Si_{30}O_{72}]\cdot{\sim}20H_2O$

Heulandite-Ca, heulandite-Sr and clinoptilolite-Ca have been identified from the study area. Of these, heulandite-Ca is by far the most abundant, and heulandite-Sr the rarest, occurring only at locality 46. Heulandite-Ca forms pearly, transparent to translucent, colorless, yellow, orange or white single crystals and spherical aggregates to 1 cm at a number of localities (Table 2). Observed crystal forms include {100}, {010}, {101} and {011}. Microprobe analyses of heulandite-Ca samples from the CMB show that they typically contain more Sr and Ba and less Na and Fe than does heulandite-Ca from volcanic or sedimentary occurrences, and at locality 46, Sr is the dominant cation in zones of some crystals.

Heulandite-Sr is a rare mineral, and this occurrence may represent its third reported locality. The mineral occurs as white to colorless, 0.5-mm crystals in a fractured 30 cm-wide granitic pegmatite vein that vertically crosscuts calc-silicate gneiss. The crystals are visually indistinguishable from heulandite-Ca, and show the forms {100}, {010}, {101} and {011}. Chabazite-Ca and stilbite-Ca are associated. A microprobe analysis of one Sr-dominant zone is given in Table 3, and unit cell dimensions refined from X-ray powder data for this sample are given in Table 4. The Ba content in this heulandite is also unusually high in comparison to those from other Grenville occurrences.

Figure 7. **A 1-cm spray of mesolite on chabazite-Ca, from Highway 819 road cut (locality 26), near Maniwaki, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83821); Jeff Scovil photo.**

Clinoptilolite-Ca has been identified from three localities (30, 48 and 56) in contact zones in calc-silicate skarn or gneiss. At locality 30 this mineral was found as translucent white crystals up to 1 mm on altered meionite, microcline and other minerals in a 50 × 20 × 15-cm pocket in a sheared pegmatitic rock in contact with a diopside-carbonate metasediment.

Laumontite $Ca_4[Al_8Si_{16}O_{48}]\cdot 18H_2O$

At locality 44 laumontite has been identified as a compact, massive white vein-filling with albite pseudomorphs after analcime in carbonate metasediments. At locality 30 it occurs in an altered calc-silicate band in garnet-sillimanite gneiss as simple, white to red, prismatic crystals to 2 mm displaying forms {110} and {201}; as pseudomorphs after anhedral feldspar (?) crystals; and as tightly packed, radiating, pinkish white crystal aggregates with chabazite-Ca and clay minerals filling voids at the contact between the two rock types.

Mesolite $Na_{16}Ca_{16}[Al_{48}Si_{72}O_{240}]\cdot 64H_2O$

Mesolite is a relatively common zeolite in the CMB, often observed in voids in calc-silicate skarn deposits where it forms lustrous white, divergent tufts of acicular crystals. Common associates are chabazite-Ca, stilbite-series species, stellerite and heulandite-Ca. The mesolite may form early or late in the paragenetic sequence. At locality 26, fibrous mesolite forms overgrowths on

Figure 8. **A 1.4-cm spray of mesolite with chabazite-Ca on diopside, from Highway 819 road cut (locality 26), near Maniwaki, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83821); Jeff Scovil photo.**

Figure 9. **A 5-mm natrolite crystal on altered nepheline, from the International Minerals quarry at Blue Mountain, Lot 20, Concession II, Methuen Township, Peterborough County, Ontario, Canada. Canadian Museum of Nature specimen (Cat. No. 39035); Jeff Scovil photo.**

chabazite-Ca in cavities in diopside-meionite-phlogopite gneiss; at locality 47 it occurs as bundles of fibers associated with pumpellyite, chabazite-Ca, prehnite and thomsonite in voids in calcite and calc-silicate rock. At locality 52 it occurs as fibrous inclusions in phlogopite; at locality 21 it forms inclusions in heulandite-Ca; at locality 5 it appears as inclusions in chabazite-Ca; and at numerous localities it appears as overgrowths on and in cavities in meionite. Mesolite was identified by X-ray diffraction only, as its fibrous nature precluded its analysis by microprobe techniques.

Natrolite $Na_2[Al_2Si_3O_{10}]\cdot 2H_2O$
Scolecite $Ca[Al_2Si_3O_{10}]\cdot 3H_2O$

Natrolite is frequently encountered in the nepheline-bearing metasediments, pegmatitic segregations in nepheline gneiss and nepheline syenite deposits that parallel the CMBBZ. Much of the altered nepheline from these deposits that was formerly called "hydronephelite" is in fact natrolite (Edgar, 1965; Moyd, 1990). Well-formed pseudotetragonal prismatic crystals to 2 cm or longer occur at localities 86 and 97. Those from locality 86 display forms {010}, {110}, {120}, {111} and {331} and are often flattened on {010}, while those from locality 97 are typically simpler, showing only {110} and {111} faces. Microprobe analyses of samples from each locality are given in Table 3. Scolecite has been identified by petrographic means from locality 19 (Donald Hogarth, personal communication, 1993).

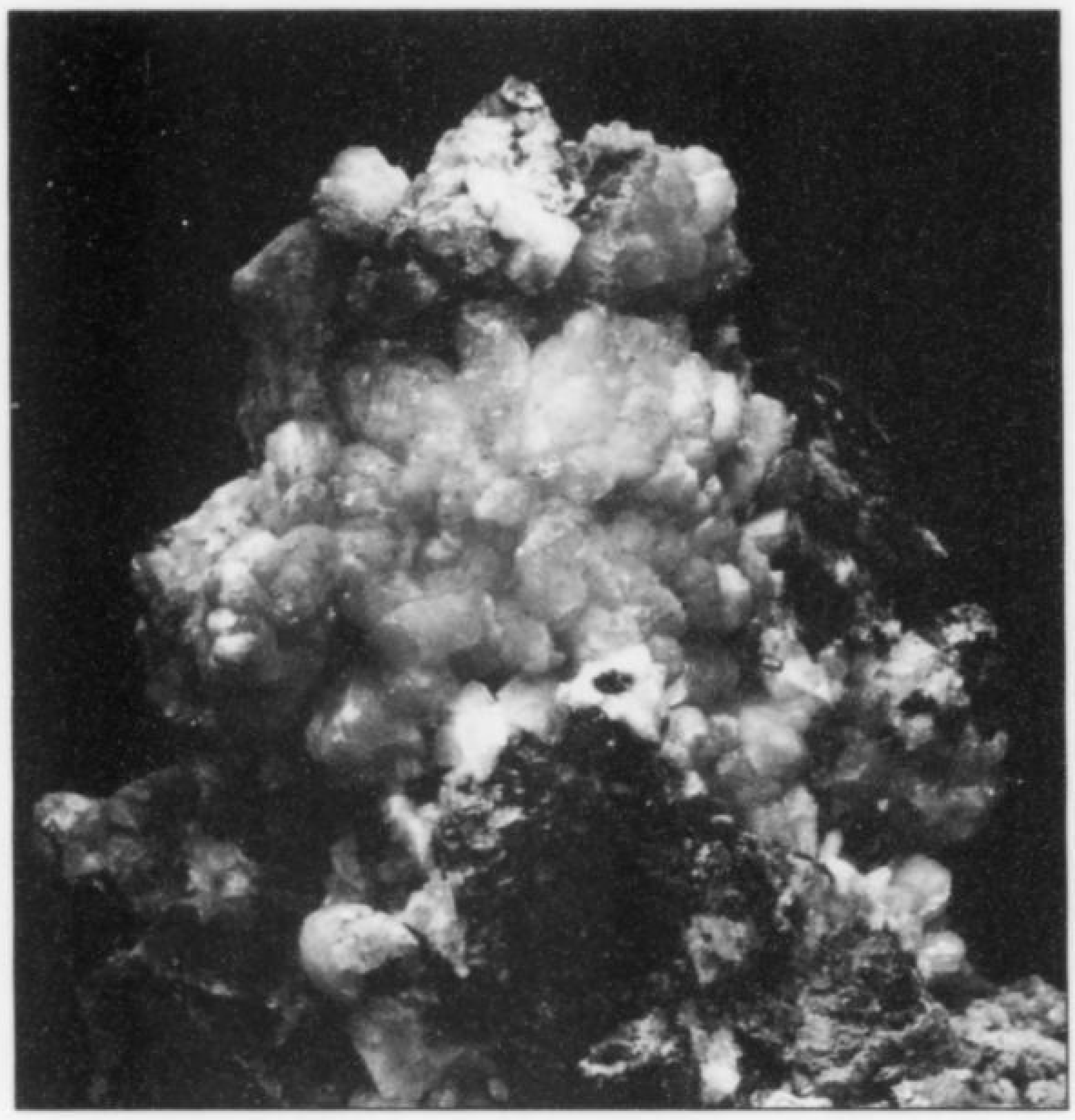

Figure 10. **Stilbite-Ca crystals on altered meionite-pyroxene skarn, 8 cm, from the Giroux mine property (locality 42), Leslie Lake, Litchfield Township, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83815); Jeff Scovil photo.**

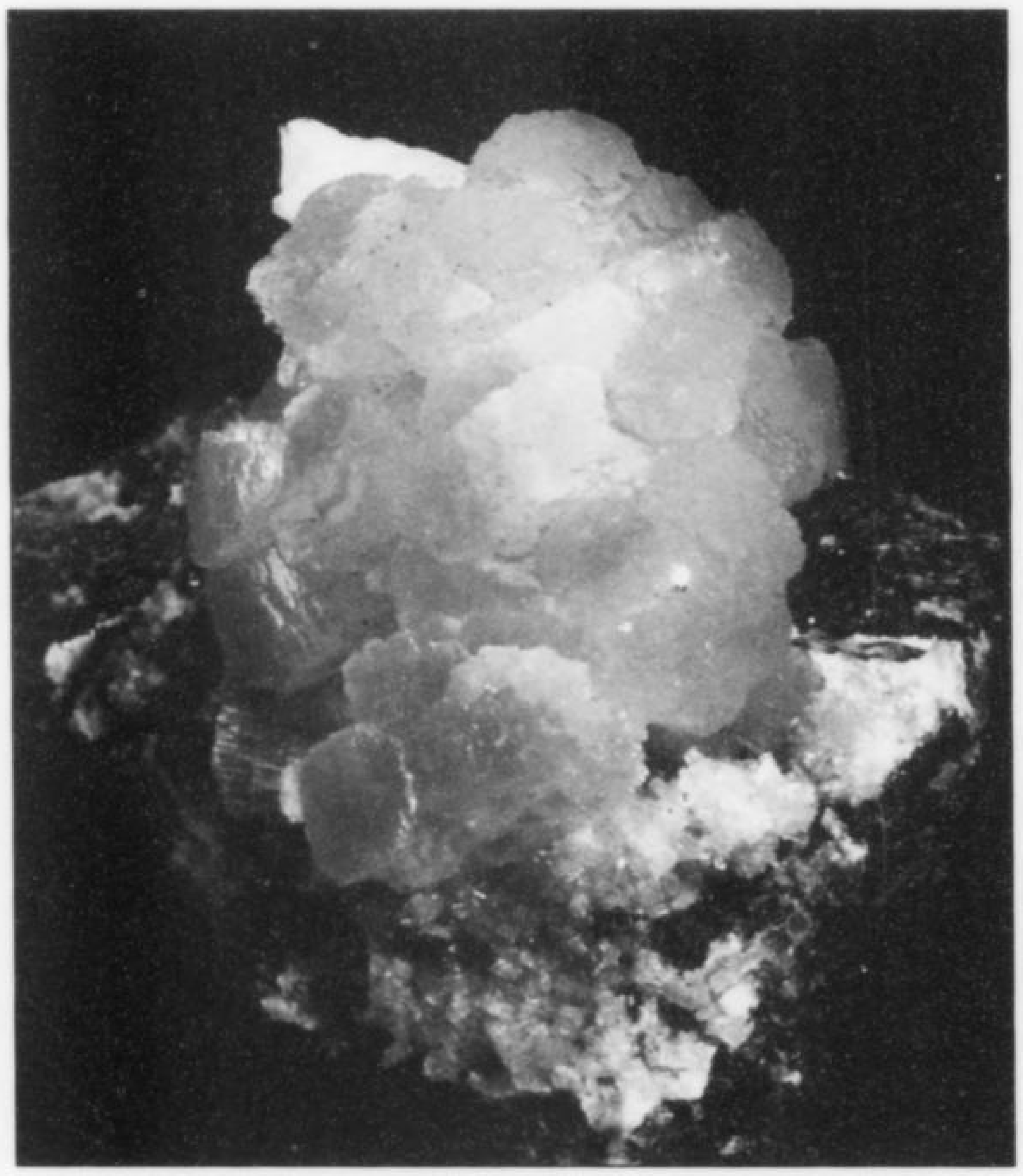

Figure 11. **Stilbite-Ca on pyroxene skarn, 4.3 cm wide, from road cut near Lac Mathilda, Harrington Township, Pontiac County, Québec, Canada (locality 47). Canadian Museum of Nature specimen (Cat. No. 83579); Jeff Scovil photo.**

Figure 12. **A 1.8-cm bowtie of stilbite-Ca with heulandite-Ca on skarn, from Highway 819 road cut (locality series 20–27), near Maniwaki, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83823); Jeff Scovil photo.**

Stilbite-Ca $(Ca_{0.5},Na,K)_9[Al_9Si_{27}O_{72}]\cdot 28H_2O$
Stellerite $Ca[Al_2Si_7O_{18}]\cdot 7H_2O$

Both stilbite-Ca and stellerite are found in the study area, though the former is far more abundant than the latter, occurring at nearly fifty localities. While stellerite has been confirmed from only five localities (6, 22, 26, 30 and 100), it may be more abundant than recognized, since not every stilbite-stellerite series mineral found was chemically analyzed. Furthermore, both species occur at localities 26 and 30, suggesting that some unanalyzed "stilbite" from those localities hosting stilbite-Ca may actually be stellerite.

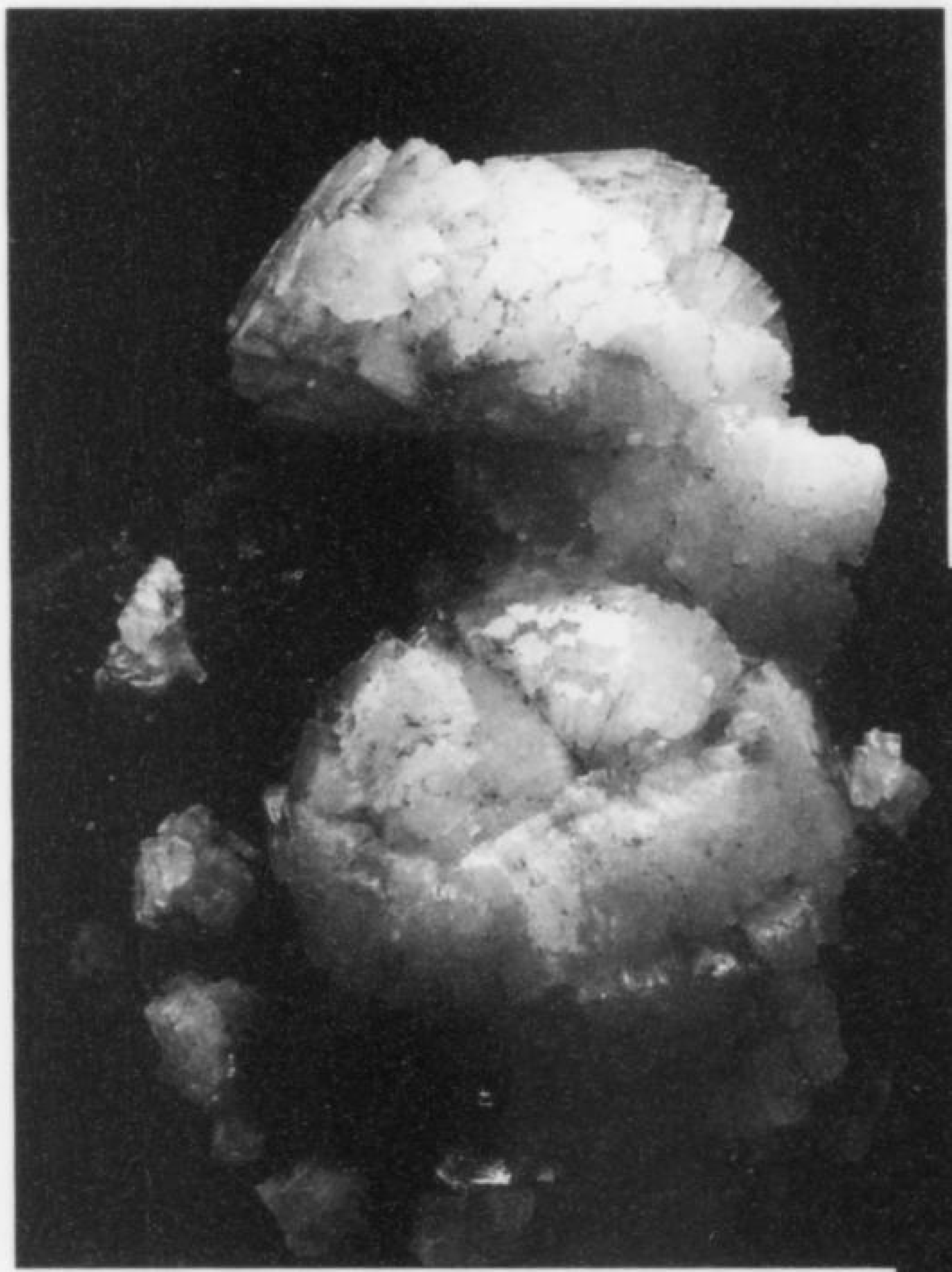

Figure 13. **Stilbite-Ca with heulandite-Ca on diopside, 4.2 cm, from Highway 819 road cut (locality series 20–27), near Maniwaki, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83824); Jeff Scovil photo.**

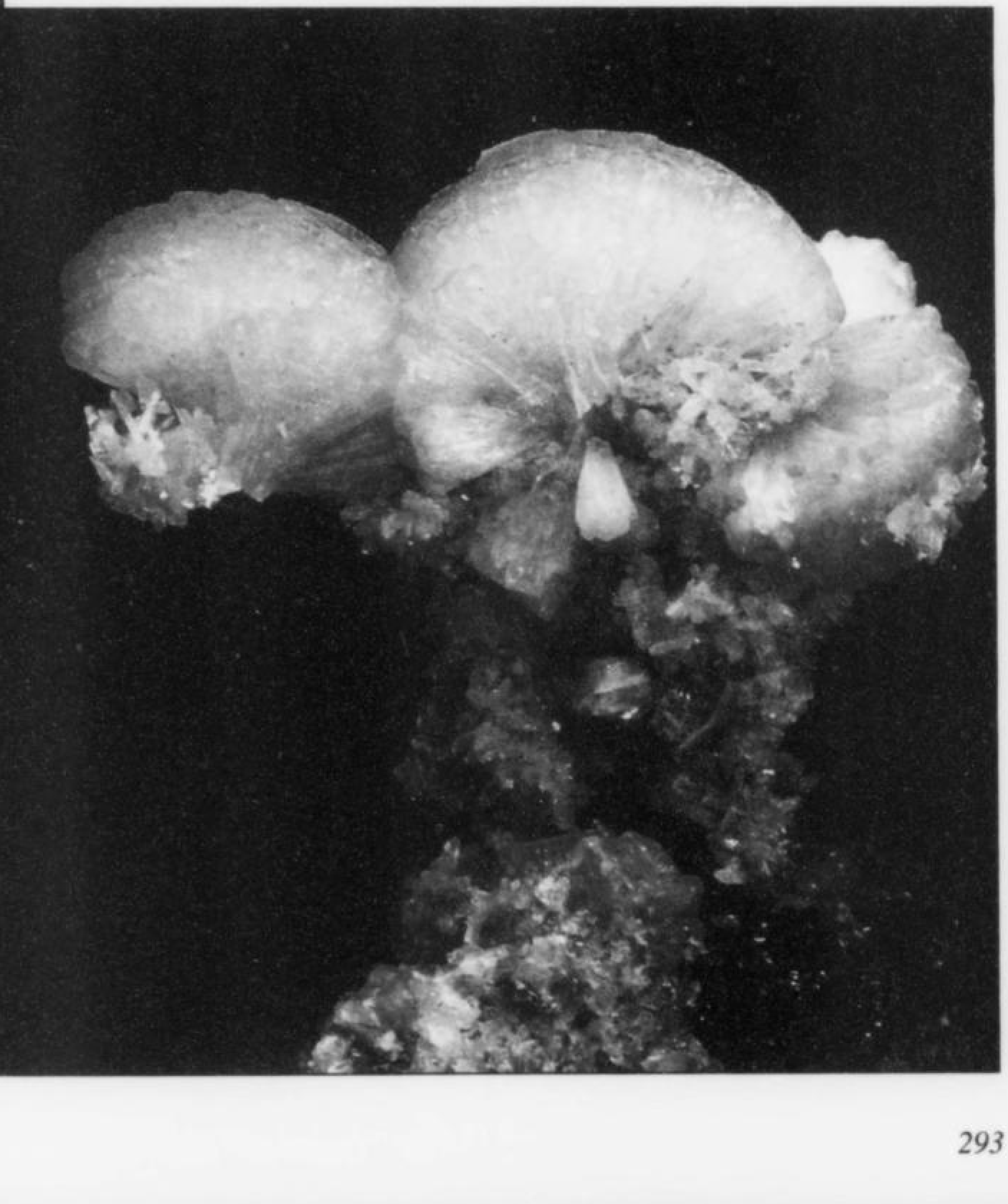

Figure 14. **A 3.9 cm-wide aggregate of stilbite-Ca with heulandite-Ca and orange chabazite-Ca on skarn, from Highway 819 road cut (locality series 20–27), near Maniwaki, Pontiac County, Québec, Canada. Canadian Museum of Nature specimen (Cat. No. 83816); Jeff Scovil photo.**

Figure 15. **An 8-mm aggregate of stilbite-Ca on diopside, from the Scott farm prospect (locality 100), Fine Township, St. Lawrence County, New York. Canadian Museum of Nature specimen (Cat. No. 83811); Jeff Scovil photo.**

Visually, both minerals display similar colors and pseudo-orthorhombic crystal morphologies, making sight identification unreliable. Crystals are commonly translucent white, pale to deep orange, or pale yellow; they display (monoclinic) forms {100}, {010}, {001} and {111}, and are typically flattened on {010}.

Microprobe analyses of these minerals show no distinguishing compositional differences between samples from different host rocks.

Thomsonite $Ca_2Na[Al_5Si_5O_{20}]\cdot 6H_2O$

Thomsonite occurs at localities 47 and 48 as bright white radiating tufts to 2 mm, porcelain-like growths on meionite exposed in cavities by the dissolution of calcite, or translucent tan spherical growths to 5 mm. Associated zeolites include gismondine, chabazite-Ca and mesolite. At locality 5, thomsonite is found as transparent to translucent, colorless to gray, elongated rectangular blades flattened on {001}, as cruciform twins, and as divergent crystal aggregates on altered meionite, diopside and fluorapatite crystals exposed in voids in FPS skarn. Observed forms include {100], {010}, {001}, and {110}.

DISCUSSION

Much has been written on the paragenesis of zeolites, but little on their occurrence in high-grade metamorphic terrains. In his summary of the genetic modes of occurrence of zeolites, Gottardi (1989) notes that zeolites form during diagenesis or very low grade metamorphism in soils and lakes, in hydrologically open and closed systems, in geo-autoclaves and in marine sediments. A hydrothermal origin is invoked for zeolites in geothermal fields, hydrothermal ore deposits, pegmatites and feldspathic rocks, but there is little information concerning rock-forming zeolites in veins and vugs in "massive rocks." Numerous studies address the role of glass in zeolite genesis in silicic volcanic rocks (e.g., Barth-Wirsching and Holler, 1989; Hawkins, 1981), or hydrothermal zeolite mineralization in basic volcanics (e.g., Kristmannsdottir and Tomasson, 1978). Interestingly, Zen (1961) suggested that "the marginal parts of some ancient fold-belts may have zeolitic assemblages preserved despite the ravages of erosion, but simply have not been discovered." Additional reviews of the formational conditions and geological settings for zeolites are given by Coombs *et al.* (1959) and Pecover (1987).

Zeolites are known to form at near-atmospheric conditions, often below 70°C (Barrer, 1982). Because zeolites are indicative of relatively low-temperature environments, their widespread occurrence in the high-grade metamorphic terrain of the Grenville may appear surprising, though thomsonite has been reported elsewhere from altered aplitic dykes, pegmatites and fractures in gneiss (Gottardi *et al.*, 1985; Tschernich, 1992), and in calc-silicate rocks (Cross and Shannon, 1927; Hogarth and Griffin, 1980).

While most silicates are slow to dissolve in aqueous solutions at atmospheric conditions, alkali elements may be preferentially leached from some silicates under these conditions (Casey and Bunker, 1990). In the Grenville, dissolution of calcite, Na- and K-feldspars, meionite, nepheline and other rock-forming minerals probably contributed to the development of zeolites. Of these, meionite is perhaps most significant, playing a role somewhat analogous to that of glass in zeolite genesis in volcanic rocks and sediments. At the New York pegmatite (locality 65), muscovite is altered to clays, and feldspars are noticeably etched. Here, harmotome crystals occur on brecciated, etched feldspar with calcite, fluorite, cerian epidote/allanite-(Ce), chlorite and pyrite. Nepheline in a mesocratic syenite at Lac Rouge, Quebec (locality 76) is replaced by cancrinite and sodalite, which are subsequently altered to natrolite and thomsonite (Corriveau, 1984). Likewise, altered feldspathoids in the nepheline syenites in the Bancroft, Ontario area (formerly called "hydronephelite" or "giesekite") are mixtures of natrolite and muscovite, ± analcime and other minor constituents.

In FPS and other skarn deposits, zeolites occur in cavities in coarse-grained calcite, in joints and fractures in calc-silicate skarn and syenitic xenoliths, or as free-standing crystals on earlier-formed crystals of meionite, diopside, feldspars, titanite, fluorapatite, and other minerals that occur in cavities resulting from the dissolution of calcite once in contact with the skarn minerals. At locality 47 one such void contained meionite partially replaced by albite, titanite partially altered to anatase, and the zeolite paragenesis mesolite → stilbite-Ca → heulandite-Ca → chabazite-Ca → thomsonite. At the same locality, crystals of chabazite-Ca to 1 cm were found growing on a bridge of etched calcite spanning the walls of a solution cavity hosting large crystals of meionite and diopside-hedenbergite, proving that the pocket, like many in the area, was once filled with calcite, and that the chabazite-Ca formed after its dissolution (probably by groundwater). Similar geological environments and mineralization were also observed at localities 21–27 and 48.

While the source of the water(s) responsible for calcite dissolution and zeolite mineralization is unknown, most was probably meteoric. The lack of fluid inclusions in the samples and difficulties associated with obtaining reliable stable isotope data from zeolites in general preclude securing definite information on the nature of the solution(s) responsible for zeolite mineralization. Likewise, the timing of zeolite mineralization remains unknown, though it clearly postdates the fracturing of the host rocks and the dissolution of calcite. There is no evidence in the geological record of hydrothermal activity in the area from 110 mA to present, unless the presence of these zeolites marks such an event. Earlier geological events that may have contributed to the mineralization include 1) a mantle plume such as that associated with the Monteregian Hills, 2) carbonatite emplacement in the Gatineau area (Hogarth *et al.*, 1988), 3) Rossie-type vein mineralization (Robinson *et al.*, 2001), 4) a thermal event associated with intrusions of Mesozoic dykes in southeastern Ontario (Barrett *et al.*, 1984), and perhaps others.

It is also interesting to speculate that at least some of the observed mineralization may be Recent, due to uplift and weathering after the retreat of Pleistocene glaciers. At locality 48, thomsonite, cowlesite, levyne, mesolite and prehnite were found on meionite crystals that had dissolved from calcite in a soil-filled solution cavity in skarn within a meter of the present-day surface. Also here, and at other localities, sharp, unabraded chabazite-Ca crystals are present on rock surfaces that were almost certainly exposed to glaciation, and it is difficult to envision how they could have survived erosion by ice and ground moraine. The idea of low-temperature environments for zeolite formation is not new. Nashar and Davies (1960) suggest chabazite may form by slow crystallization from meteoric water at only 5°C, and Capdecomme (1952) reported laumontite formed by the reaction between plagioclase and water from melting snow. Zeolites are also known to form at low temperatures (45–75°C) in springs and geothermal wells (Kristmannsdottir and Tomasson, 1978), and heulandite has been observed on colemanite in borax deposits thought to have formed at less than 60°C (Tschernich, 1992).

SUMMARY

Source materials, geochemical signatures, and the ages of their host rocks differentiate zeolites found in the Grenville from those in most other geological settings. Many zeolites from the CMB have relatively high Sr contents. Despite their diverse host lithologies, most of the zeolites in the CMB probably share a common, low-temperature hydrothermal origin that involves leaching and subsequent precipitation of Ca, Na, Al, Si and other elements from their host rocks by solutions migrating along faults, fractures, shear zones, vugs or other open spaces that behaved as both conduits and repositories. While most are probably meteoric, both the source and age of these solutions remain unknown. Further exploration in the area will almost certainly reveal additional occurrences.

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Early Mineral Dealers:

William Niven
(1850–1937)

Wendell E. Wilson
Mineralogical Record
4631 Paseo Tubutama
Tucson, Arizona 85750
minrec@earthlink.net

William Niven, a self-taught mineralogist, archeologist, prospector, miner, businessman, explorer, adventurer and raconteur, was a dedicated field collector who, for a time, was among the leading mineral dealers in New York City. He discovered the new minerals yttrialite and thorogummite (at Barringer Hill, Texas) and aguilarite (at Guanajuato, Mexico) and was the namesake for the mineral "nivenite"—now considered a variety of uraninite.

INTRODUCTION

William Niven, mineralogist, archeologist and mineral dealer, was born in Bellshill, Lanarkshire, Scotland, on October 6, 1850, the son of Sarah (Brown) Niven and William Niven, a railroad engineer. Details of his life are recounted in *Buried Cities, Forgotten Gods* (1999) by art historian Robert S. Wicks and Niven's grandson, Roland H. Harrison. The first third of the following account, and a few bits farther on, are abstracted from that interesting biography, which focuses primarily on Niven's archeological activities. The emphasis here will be on his involvement in mineralogy and mineral dealing, revealed primarily through his ads and articles in the collector journals of his day: *The Exchangers' Monthly, The Mineralogists' Monthly*, and *The Mineral Collector*.

Niven was an interesting and admirable character. As reviewer Randall Holdridge (1999) said of him:

> Niven intrepidly survived desert thirst, earthquake, bandit skirmishes, skull-packed caves, arrest in revolutionary Mexico, raging rivers and jungle fever. The God-fearing Scotsman managed to keep safe in a world of violence and intrigue by nothing more (nor less) than an ironclad sense of honor and sober industry.

Niven came from a large and close-knit family in Scotland. His parents were acquainted with the famous missionary and explorer David Livingstone, who regaled the young William with tales of his African adventures, inspiring in him an urge to explore remote and primitive lands. When his father was killed in a railroading accident in 1865, Niven dropped out of school and took a succession of clerking jobs to help support his family. In 1870 he took over the management of the Dalmarnock weaving mill in Glasgow, though he was only 19 at the time. Despite his success there, he decided in 1879 that it was time to leave Scotland and travel to America, as his younger brother James had done before him in 1874.

MINING LIFE OUT WEST

Niven arrived in New York City on April 15, after a ten-day crossing, and traveled on to Providence, Rhode Island where he lived for nine months with a cousin, Robert Niven. He was "so pleased with the country" that he decided to make the United States his permanent home. He first attempted to start a jewelry manufacturing business, but soon realized that it would not be profitable. He then moved to New York, where he worked for J. W. Cochrane


WM. NIVEN & CO.,

Manufacturing Jewelers,

32 ELM STREET,

PROVIDENCE. R. I.

Figure 1. **William Niven's first business card in America (1879–1880). Roland Harrison files.**

& Company as a traveling salesman, with only indifferent success. By 1880 he had nearly run out of money. Inspired by promotional brochures touting "mountains full of rich gold and silver ores, sulphurets, carbonates, chlorides and rich placers not yet prospected," Niven decided to seek his fortune out West. He pawned his last few possessions for enough money to buy a one-way ticket to the site of a booming silver rush: Leadville, Colorado.

Soon after arriving in Leadville he established a bakery with his cousin, John Niven, but when John took sick and had to return home, that business came to an end. Rescued from destitution by a check for £100 from his brother Alexander in India, he parlayed it into a $400 profit by selling "gent's furnishings," then set off for Las Vegas, New Mexico where he joined up with two partners to go prospecting. They found nothing that could be mined economically, but in the process Niven became an expert miner with pick and shovel. He then found work in a mine in Bernalillo for four months and saved his money, before setting out prospecting again with two new partners. They very nearly died of thirst before reaching the Gallinas range, ending up in the Red Cloud district of New Mexico where they finally achieved some measure of prospecting success.

Niven mined in the Red Cloud area for more than a year, and developed an interest and proficiency in the local mineralogy. He collected a number of minerals, including malachite, azurite, native gold and silver ores from the nearby White Oaks district.

In July and August of 1883, a major event took place in New Mexico: Santa Fe celebrated its Tertio-Millenial Exposition, commemorating 333 years of local history. Niven exhibited his collection of ore minerals, and was promptly chosen as Mining Commissioner for Lincoln County. He gave a lecture on the Red Cloud mining district, recounted in the *New Mexican Review* for August 1, 1883. He described about 50 claims there, the mineralogy consisting of "copper, silver, gold and iron in the form of sulphides, sulphurets, carbonates and oxides, in the usual gangue accompanying such ores." Regarding one particular claim, Niven recounted a discovery that was a mineral collector's dream:

> One of the most important discoveries was made a few weeks ago. While sinking on the Tenderfoot vein 100 feet from the surface, a chamber of remarkable beauty was exposed. The rich appearance and wonderful brilliancy of this subterranean palace—50 feet in length, 6 to 12 feet in width, grandly rising to a height of 60 feet—the walls and roof covered completely with the most gorgeous crystallizations, interspersed with beautiful malachite and azurite, long lines of stalactites and stalagmites of every imaginable shape and color—sparkling like a thousand gems, form a scene of rare grandeur, which baffles the power of description.

As part of the festivities, a fancy dress ball was held, reported as "the most elaborate society event this territory has ever known." There Niven met Nellie Purcell, daughter of a noted costumer from St. Louis who had been commisioned to provide fancy gowns for the evening. Dressed as Romeo and Juliet, William and Nellie danced the night away, and after Nellie's return to St. Louis they carried on a long-distance romance.

BECOM NERAL DEALER

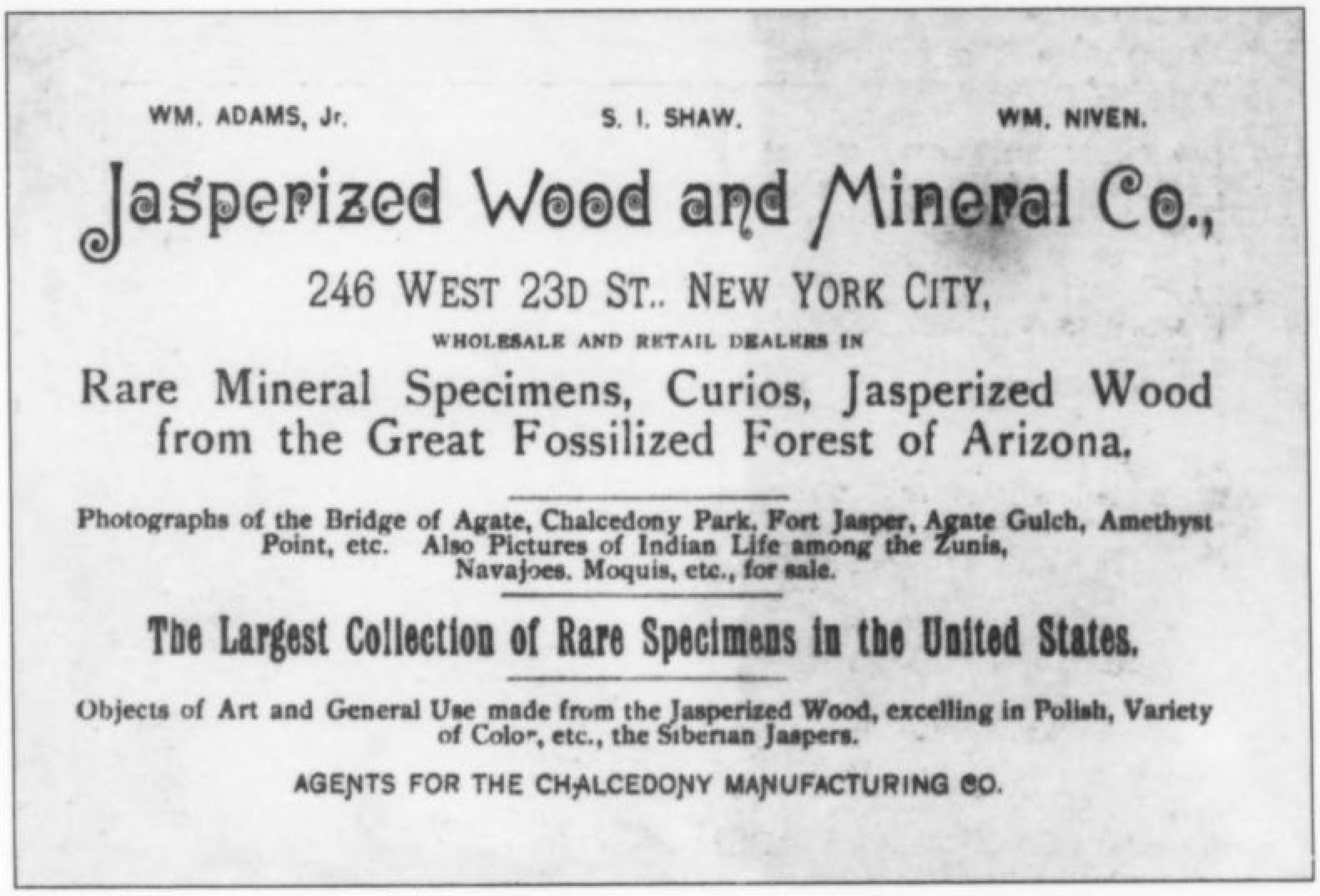
Niven's prospecting activity took him into Mexico in 1884 and then into Arizona Territory, where east of Tucson he found a rich 1-inch vein that was 50% solid gold and silver. He sold the claim for $1200 and purchased a half interest in a local hotel, the Benson House in Benson, Arizona. The hotel business went well, and Niven greatly enjoyed having a roof over his head and being in business for himself, but it was not to hold him for long. The collecting impulse drove him to take the money left over from the sale of his claim and buy up large numbers of specimens—a nine-ton carload of ore samples, in fact—mostly native gold and native silver that had been collected primarily from the mines of Tombstone and the Copper Queen mine at Bisbee. He also acquired some Arizona petrified wood samples and a variety of local plants and animals preserved in alcohol.

Niven was appointed Assistant Commissioner for Arizona Territory to the 1884–1885 World's Industrial and Cotton Centennial in New Orleans, the ideal place to exhibit his Arizona minerals and ores. He had everything shipped to New Orleans in a freight car, and installed his specimens in showcases in the Arizona section of the exhibit hall. He was located right next to the exhibit of William Adams and Seely Shaw, who had a government lease at that time on the Petrified Forest in northern Arizona and were mining it for petrified wood. They had plenty of time to talk during the exposition, and by the time of its closure in June of 1885 they had agreed to go into partnership together. They shipped their petrified wood and Niven's mineral specimens (over 20 tons all together) to New York City by boat, and opened a new business there called the *Jasperized Wood & Mineral Company* at 246 West 23rd Street. The company was short-lived, though, and the partnership was dissolved in 1886. Niven retained the shop and continued dealing in mineral specimens under his own name, but his rich ore specimens were not sufficiently attractive for New York mineral collectors, so he shipped the bulk of his nine tons to a smelter in Newark, New Jersey and received a check for $6,600—a huge sum in those days.

Shortly after moving to New York, Niven acquired an extraordinary specimen. He told the story himself in a lecture given in 1930; the following extract is from his handwritten lecture notes which have been preserved by his descendants:

> In 1885 [I moved] to New York City where, for a number of years, I carried on a regular mineral business, and my explorations in and around New York City kept me constantly and plentifully supplied with mineral specimens. Many very important discoveries of fine species and varieties were made. One of these was a huge garnet crystal, said to be the largest ever found, weighing nine pounds nine ounces and [measuring] six inches in diameter. It was unearthed by a laborer making an excavation at 35th Street near 3rd Avenue, eight feet below the surface, and thrown up on the dump where I happened to be passing along. After a careful cleaning it was found to be a perfect dodecahedron crystal of almandite garnet, and was placed in the window of my mineral store at 246 West 23rd Street in New York—for sale—the price marked $100. Next day it was bought by a well-known gem expert of Tiffany and Company, and is now on display in a

Figure 2. **Niven's mineral display representing Lincoln County, New Mexico at the Tertio-Millenial Exposition in Santa Fe (1885). Niven is at center (under the "Lincoln Co." sign); his friend Lee H. Rudisille is on his right; standing is Chief San Juan of the Mescalero Apache tribe; and at far left is agent W. H. H. Llewellyn. Roland Harrison files.**


WM. ADAMS, Jr. S. I. SHAW. WM. NIVEN.

Jasperized Wood and Mineral Co.,

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WHOLESALE AND RETAIL DEALERS IN

Rare Mineral Specimens, Curios, Jasperized Wood from the Great Fossilized Forest of Arizona.

Photographs of the Bridge of Agate, Chalcedony Park, Fort Jasper, Agate Gulch, Amethyst Point, etc. Also Pictures of Indian Life among the Zunis, Navajoes, Moquis, etc., for sale.

The Largest Collection of Rare Specimens in the United States.

Objects of Art and General Use made from the Jasperized Wood, excelling in Polish, Variety of Color, etc., the Siberian Jaspers.

AGENTS FOR THE CHALCEDONY MANUFACTURING CO.

Figure 3. **Business card for Niven's short-lived "Jasperized Wood & Mineral Company" (1885) in New York, with partners William Adams, Jr. and Seely I. Shaw. Roland Harrison files.**

loan gem exhibition of the Mineral Department of the American Museum of Natural History in New York City.

The Tiffany gem expert was none other than George F. Kunz, who described and figured the crystal in an article read before the New York Academy of Sciences on December 7, 1885, and May 30, 1886. Kunz mentions that the specimen came from a sewer excavation in August 1885, and states that "the laborer took it to Mr. J. J. King, from whom I received it." King was no doubt Niven's shop attendant, often left in charge during Niven's long absences. The specimen, which became known as "the Kunz garnet" (a drawing of it was incorporated into the crest of the New York Mineralogical Club), is still preserved in the American Museum of Natural History.

Incidentally, it was no accident that Niven happened to be passing by that excavation when the big garnet was uncovered. Just a few days before, Niven had been shown garnets found around there by fellow New York Mineralogical Club member Gilman Stanton. "I always wondered how you found it so soon after I showed you my specimens," wrote Stanton in a 1936 letter, insisting that the big 9-pound garnet must have come from near 7th Avenue rather that 3rd Avenue.

Niven married Nellie Purcell in St. Louis in 1886 and, after a short honeymoon, they returned to New York City. The following year Nellie gave birth to a son, William Albert Niven; ultimately they had a total of nine children. Niven, joining the local mineralogical fraternity for business purposes, soon developed his contacts

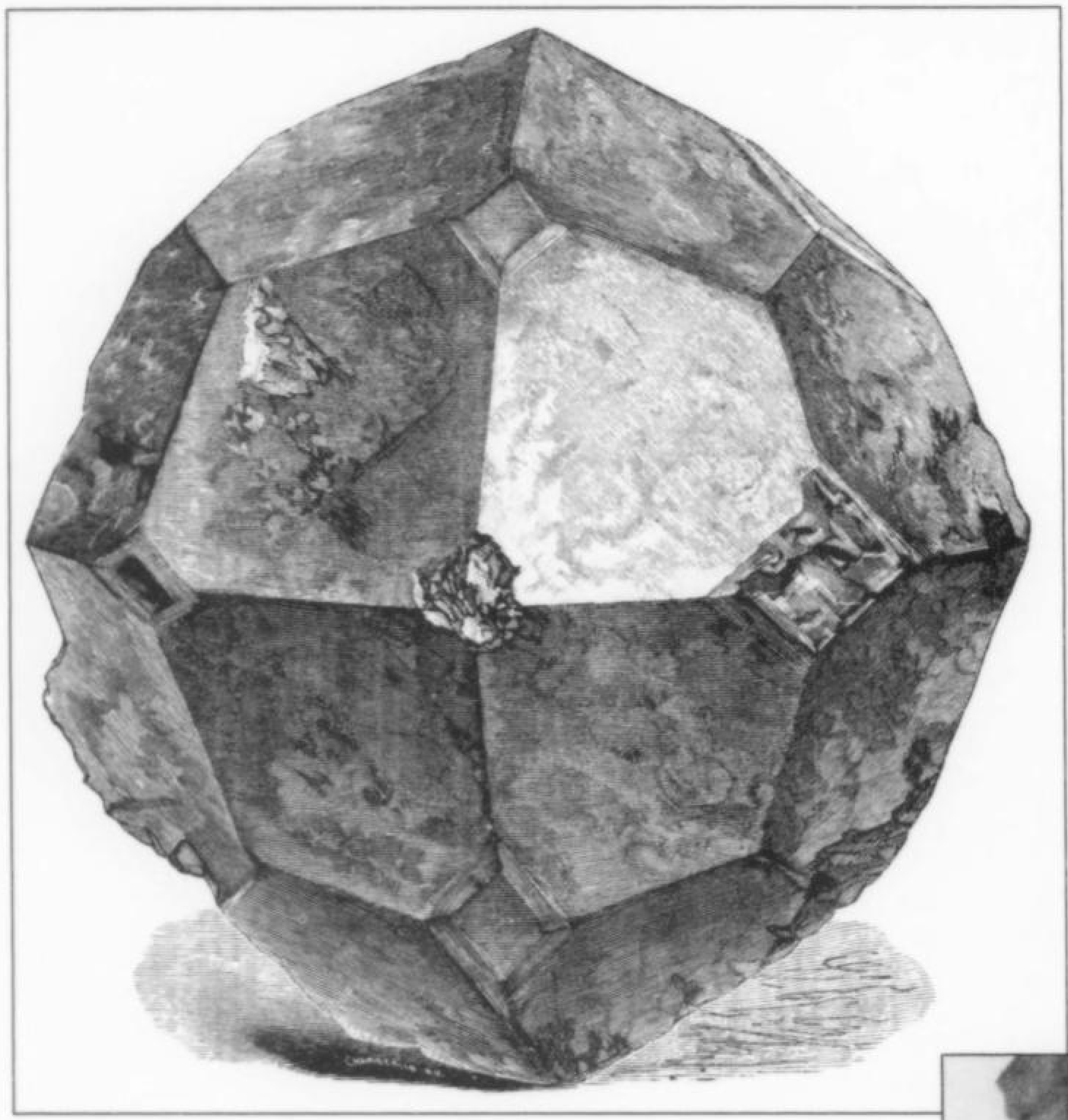


Figure 4. **The so-called "Kunz Garnet," a 6-inch almandine crystal retrieved by Niven from an excavation at 35th Street near 3rd Avenue in New York City and sold to George F. Kunz in 1885 for $100. Illustration from Kunz (1886); the crystal is now in the collection of the American Museum of Natural History in New York.**

with the American Museum of Natural History and with Kunz at Tiffany and Co., and was a co-founder of the New York Mineralogical Club.

Niven's 1886 ads in *The Exchangers' Monthly* proclaimed him a "dealer in fine mineral specimens" and lapidary *objets d'art* (including his specialty, Japanese crystal balls). He offered for sale a boxed collection of 12 specimens of Arizona Territory minerals (fluorite, native gold, chalcocite, malachite, chalcopyrite, smoky quartz, native copper, petrified wood, azurite crystals, cuprite, argentiferous galena, and "argentiferous quartz") for 50 cents. He sold these through *Exchangers' Monthly* publisher Arthur Chamberlain, who must have purchased his complete stock of sets, because he continued to market them for years afterward. In December 1886, Niven began advertising on his own, listing his address as 739 Broadway, New York. In November 1887 he advertised as a "wholesale and retail dealer in foreign and American minerals" and lapidary objects, and initiated monthly auction sales of mineral specimens in New York.

By May 1888 Niven had become successful enough to take out a full-page ad for his monthly auction sales of minerals, now also including Indian relics and other curios. He wrote:

> These sales are meeting with a good deal of favor both from the buyer and seller. Consignments of goods are received almost daily for these sales from all parts of this country and Europe. The place during Auction Week is a veritable museum and is thronged with persons wishing to add to their collections. By next fall it will be necessary to hold these sales twice a month if the interest in them continues to increase at the present rate.

Niven charged sellers 15% of the amount realized, plus $2 per page for space in his auction catalog.

Niven's 20th auction sale took place on November 16, 1888, conducted by Messrs. Bangs & Co., auctioneers, at Niven's

Figure 5. **William Niven in his mineral store at 739 Broadway in New York, ca, 1885. Roland Harrison collection.**

WILLIAM ♦ NIVEN

Successor to THE JASPERIZED WOOD AND MINERAL COMPANY,

739 Broadway, New York,

WHOLESALE AND RETAIL DEALER IN

Rare Mineral Specimens, Objects of Art and General Use
made from Jasperized Wood, Onyx, Carnelian and
Moss Agate, Crocidolite, Malachite,
Labradorite, Rhodonite, etc.,

— AND —

JAPANESE CRYSTAL BALLS.

Figure 6. **Business card for William Niven at his mineral shop in New York, 1885–1890. Roland Harrison files.**

THE EXCHANGERS' MONTHLY. 17

FRIDAY, NOVEMBER 16, 1888,
At 2.30 P. M.

Wm. Niven's
Twentieth Sale,
COMPRISING
A MINERALOGICAL STUDENT'S COLLECTION,
OF
500 MINERAL SPECIES,
COLLECTED BY A WELL-KNOWN MINERALOGIST,
INDIAN RELICS,
FOSSILS,
AND A CHOICE COLLECTION OF
JAPANESE BRONZES & CURIOS.

To be sold at Auction, without Reserve,
ON
Friday, November 16, 1888,
BY
MESSRS. BANGS & CO.,
739–741 Broadway, New York.
SALE BEGINS AT 2.30 P. M.

Buyers who cannot attend the Sale may have purchases made to their order by the Auctioneers.

Figure 7. **Ad in *The Exchangers' Monthly* (November 1888) for Niven's 20th monthly auction sale.**

expanded quarters at 739–741 Broadway.[1] The sale featured "a mineralogical student's collection of 500 mineral specimens collected by a well-known mineralogist" (perhaps George F. Kunz), "every specimen properly labeled," as well as Indian relics, fossils, curios, and a collection of Japanese bronzes. Many of the mineral specimens might sound quite interesting to collectors today; for example:

Beryl crystals to 4 inches from Connecticut, North Carolina and Massachusetts.
Crystallized **cinnabar** from Napa Valley, California.
Goshenite (colorless beryl) from Goshen, Massachusetts.
Very fine **pyromorphite** from Ems, Germany.
Botryoidal Russian **malachite**.
Fine crystals of Cornish **torbernite** on matrix, 2.5 inches.
Very fine **native silver** crystals from Batopilas, Mexico.
Native silver from Silver Islet, Lake Superior.
Petzite and **gold**, 2.5 inches, from Gold Hill, Colorado.
Cornish **vivianite** crystals, 3 inches;
Rutile and **emerald** crystals from Alexander County, North Carolina.
Very fine **proustite** crystals, 2 inches, from St. Andreasberg, Harz.
Manganite crystals, 4 inches, from Ilfeld, Harz.
Pyromorphite crystals from the Wheatley mine, Pennsylvania.
Very good **celestine** and **sulfur** crystal group, 3.5 inches, from Girgenti, Sicily.
Malachite and **azurite** crystals, very good, 5 inches, from the Burra Burra mine, Australia.
Very fine **native copper** crystals, 4 inches, from the Phoenix mine, Michigan.
Good crystals of "troostite" (**willemite**), 3 inches, from Franklin, New Jersey.

At the time Niven also had available for private (non-auction) sale a collection of 420 mineral specimens, 2 to 4 inches, for $80; a collection of minerals and rocks from New York Island, 250 specimens for $100; a large consignment of Alaskan garnet specimens up to 12 inches in size; the "Hix Collection" of fine wire gold, native and ruby silver, crystallized native copper, etc." (particulars on application); and an Egyptian mummy for $12!

On a trip to Hot Springs, Arkansas in 1888[2] Niven had noticed quartz crystals being uncovered by an excavation in the town's main street, right in front of the Arlington Hotel. He purchased the rights to the excavation for a day and did some blasting, uncovering a substantial pocket. One extraordinary cluster of clear quartz crystals to 3 or 4 inches in diameter was later sold to the American Museum of Natural History for $350, and was believed at that time to be the finest quartz cluster in the world.

Niven's 24th sale in February 1889 included minerals, stuffed birds, animals from the "Fraser Collection" and Indian relics from

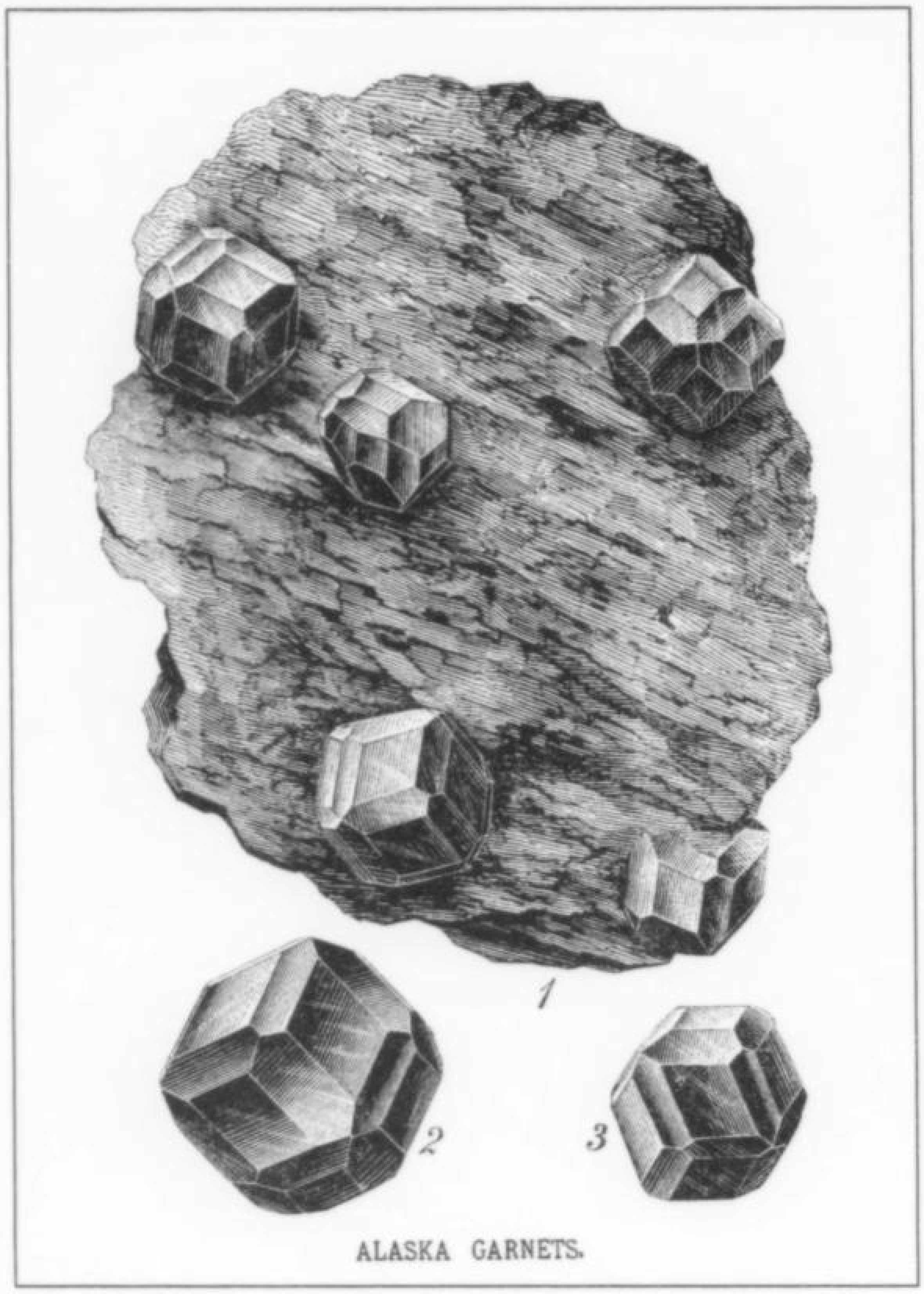
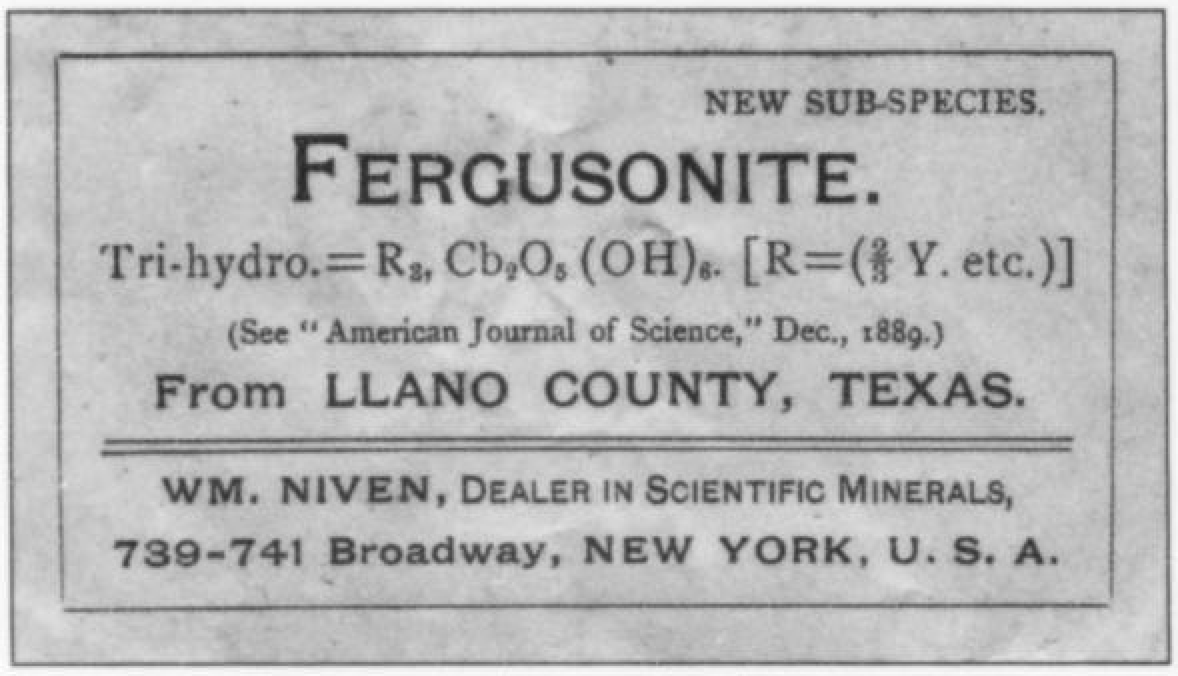


Figure 8. **Alaska garnet specimens (probably from the Stikine River area near Wrangell, Alaska) illustrated in Niven's 1888 catalog and reprinted in *The Exchangers' Monthly* (December 1888).**



NEW SUB-SPECIES.

FERGUSONITE.

Tri-hydro.=R_2, $Cb_2O_5(OH)_8$. [R=($\frac{2}{3}$ Y. etc.)]

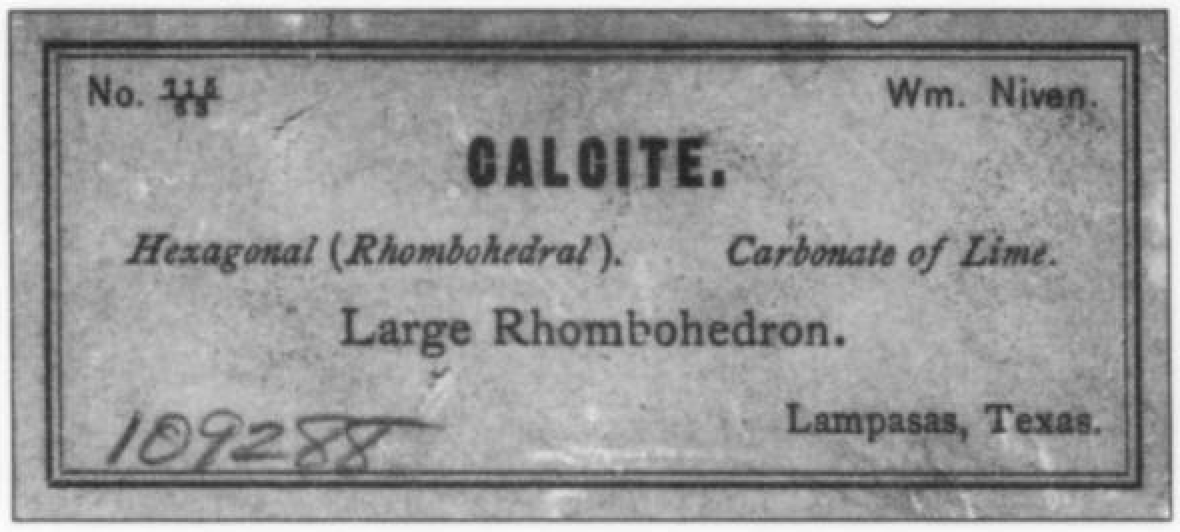
(See "American Journal of Science," Dec., 1889.)

From LLANO COUNTY, TEXAS.

WM. NIVEN, DEALER IN SCIENTIFIC MINERALS,

739-741 Broadway, NEW YORK, U. S. A.

Figure 9. **A Wm. Niven label for one of the fergusonite specimens he collected at Barringer Hill, Llano County, Texas. Mineralogical Record**



No. $\frac{115}{55}$ Wm. Niven.

CALCITE.

Hexagonal (*Rhombohedral*). *Carbonate of Lime.*

Large Rhombohedron.

109288

Lampasas, Texas.

Figure 10. **American Museum of Natural History label for a specimen of calcite from Lampasas, Texas collected by William Niven. Image courtesy of George Harlow, Curator.**

the "Spang Collection" (perhaps Charles Spang, 1809–1904). The catalog included 13 full-page plates illustrating minerals and other specimens in stock. He also acquired for resale a "private mineral collection" of 648 specimens averaging 3 × 3 inches and representing over 200 species, offered at $200.

In February of 1889 Niven embarked on a ten-week collecting trip through Texas, New Mexico, Arkansas, Missouri and other areas.[3] Writing in March,[4] he announced: "I have visited not only all the celebrated mineral localities, but some never before prospected; and have collected many hundred pounds of fine and rare specimens." Among his discoveries[5] were gadolinite and fergusonite from Barringer Hill, Llano County, Texas; quartz crystal groups, variscite, wavellite, perovskite and rutile from Arkansas; and sphalerite, galena, marcasite, dolomite and calcite crystals from Missouri.

The work at Barringer Hill had originally been inspired by newspaper reports in 1887 and 1888 describing rare yttrium-bearing minerals from an unnamed quarry in Burnet or Llano County. William E. Hidden, a New Jersey mineralogist and agent for Thomas Edison, commissioned Niven to locate the deposit and ship back specimens for Edison to experiment with in his search for a practical electric light filament. Arriving in Texas, Niven learned that a Dr. Westfall, President of the First National Bank of Burnet, was one of the chief owners of some of the local quarries. Westfall was very helpful, and directed Niven to the exact locality he was looking for, on the west side of the Colorado River about 5 miles south of Bluffton in Llano County. It proved to be a granite hill about 50 feet high, covered in quartz and transected by a pegmatite vein. It was owned by a man named John Barringer, who had located the deposit in 1886 and had noticed the unusual mineralization. Barringer had already shipped off 1000 pounds of gadolinite and other minerals to see if anyone could figure out what they were and whether they had any value, but was disappointed with the evaluation. He therefore was willing to let anyone take what they wanted, so Niven was able to arrange with Barringer to work the quarry for specimens. By the time Niven arrived, the place looked as if it had been scraped fairly clean (Niven, 1889), but . . .

> . . . To my great surprise, the first pick I put in the ground brought to the surface a huge crystal of gadolinite, and for a short time I enjoyed the most pleasant excitement, bringing out crystal after crystal from the decomposed feldspar, until the pile must have weighed 30 pounds.

He worked out the pocket and continued digging. On the fourth day he struck a pocket of crystals "the forms and appearance of which were all new to me." That evening he packed off samples to William E. Hidden for identification, and a short time later received a telegram saying "Congratulations; xenotime, fergusonite, cyrtolite, etc."

This good news spurred further searching which turned up large quantities of fluorite, muscovite, magnetite, menaccinite, molybdenite, graphite, columbite, allanite, several more pounds of fergusonite and ultimately over 200 pounds of gadolinite. (In 1895 Niven arranged the purchase of the Barringer Hill deposit from John Barringer, on behalf of Thomas Edison's Piedmont Mining Company, for $5,000 in gold coin. The mine was later acquired by

Figure 11. **William Niven ad in *The Exchangers' Monthly* (August 1889) offering Herkimer County, New York quartz crystals.**

THE EXCHANGERS' MONTHLY. 17

HERKIMER COUNTY
DOUBLE-TERMINATED
QUARTZ CRYSTALS.

Having just returned from a two weeks collecting trip to Middleville, Herkimer County, N. Y., where I secured almost 500 pounds of these beautiful crystals, I am enabled to offer my customers the finest and largest lot of these celebrated crystals ever sent to New York City.

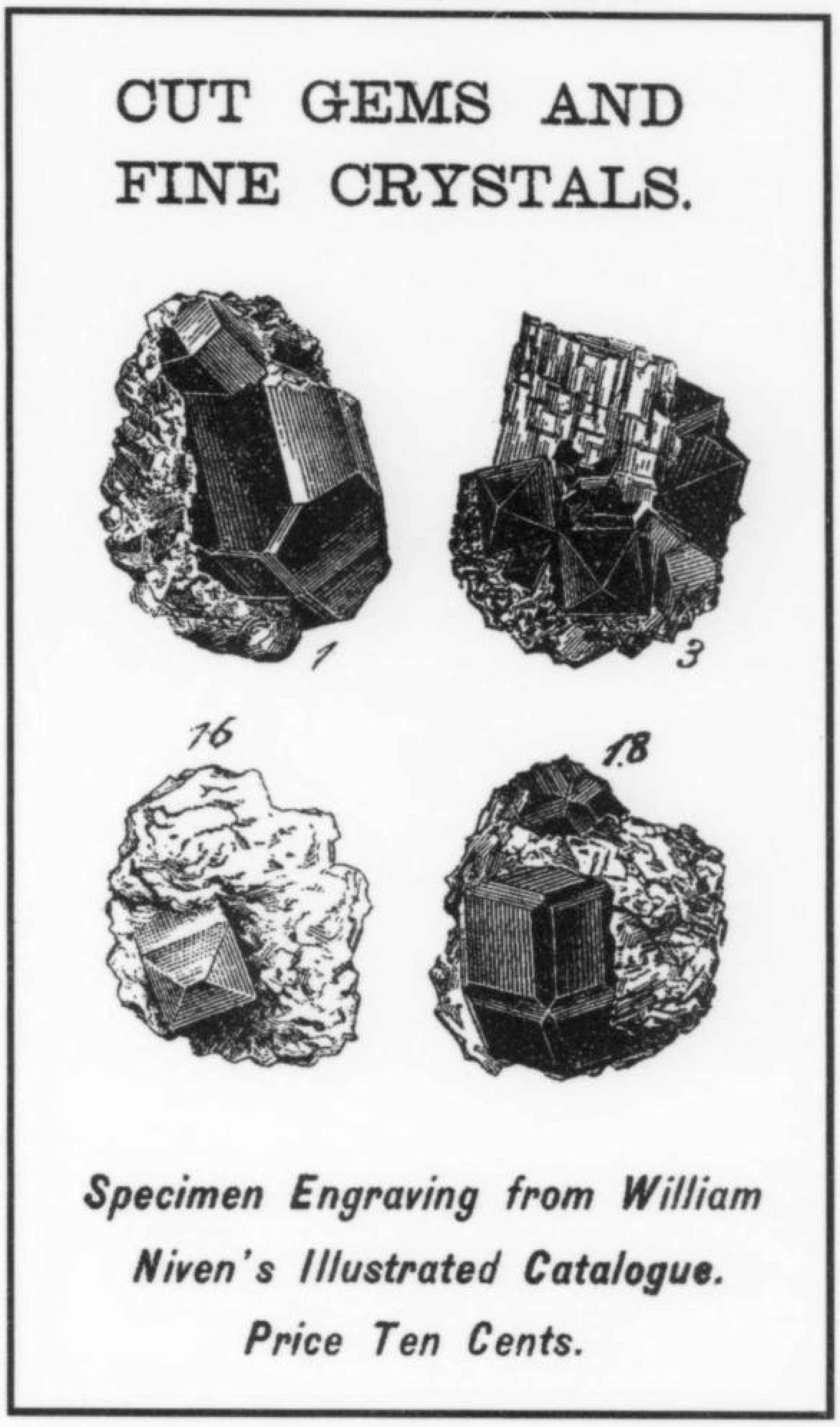
SINGLE CRYSTALS, 1c. to $5.00.
GROUPS, 25c. to $5.00.
WATER DROPS, 50c. to $5.00.
COLLECTIONS OF 25 ASSORTED CRYSTALS, 25c. to $10.00.

A FINE COLLECTION OF
STUFFED AND MOUNTED BIRDS.
CATALOGUE FOR STAMP.

JUST RECEIVED.
FOSSIL FISH FROM WYOMING,
25c. to $5.00 Each.

WILLIAM NIVEN,
739 & 741 Broadway, NEW YORK.

Figure 12. **Specimen illustrations from William Niven's 1889 catalog, reprinted in *The Exchangers' Monthly* (March 1889).**



CUT GEMS AND
FINE CRYSTALS.

Specimen Engraving from William
Niven's Illustrated Catalogue.
Price Ten Cents.

the Westinghouse Electric Corporation, which abandoned it in 1906.)

After this highly successful first trip of 1889 Niven wanted to return to the field as soon as possible. He planned a three-month tour of Texas and on into Mexico for late 1889, in preparation for which he decided to auction off his entire stock[6] of existing specimens in June. At this same time, however, he also acquired the huge collection of the late Chemistry and Geology Professor Charles Stewart Stone (1815–1889) of Cooper Union College in New York: 5,000 specimens of minerals, rocks, fossils, shells and zoological items.[7] It was, according to George F. Kunz, "unusually strong in the rare and expensive minerals such as wulfenite, crocoite, matlockite, vanadinite, and all the metallic minerals." That same June Niven made a quick two-week collecting trip to

FLUORITE AND CALCITE CRYSTALS.

Figure 13. **Fluorite and calcite specimen illustrations from William Niven's 1888 mineral catalog, reprinted in *The Exchangers' Monthly* (January 1889).**

Figure 14. **William Niven standing beside a stage boach in Zacatecas, Mexico (1889). Roland Harrison collection.**

Middleville, Herkimer County, New York, where he secured nearly 500 pounds of the famous "Herkimer diamond" quartz crystals, clusters and matrix specimens.[8]

Niven then embarked on his second major collecting trip of 1889. He returned in November,[9] after three months in the field, with substantial stocks of yellow and white topaz crystals from San Luis Potosi, Mexico; precious opal from Queretaro; amethyst specimens and snow-white calcite crystals from Guanajuato which he deemed "far surpassing in beauty, brilliancy, and variety of form the well known and much talked of Egremont [Cumberland, England] crystals." He had purchased several thousand specimens of the Guanajuato amethyst and calcite from the miners and overseers, and had worked three days packing them in 14 boxes of about 80 pounds each. He also got apophyllite and valencianite from Guanajuato, and had spent a week in Zacatecas[10] buying specimens of proustite, pyrargyrite, stephanite and native silver. Before entering Mexico Niven had also collected more brookite, perovskite, apatite and idocrase from Magnet Cove, Arkansas, and had acquired more uranothorianite, thorogummite, yttrialite, gadolinite, fergusonite, cyrtolite and allanite from Barringer Hill, Texas. One of his Texas discoveries was promptly named "nivenite" in his honor by William E. Hidden, in the December 1889 issue of the *American Journal of Science*.

In February 1890 Niven received "one of the best lots of minerals from Nova Scotia I have ever seen, comprising chabazite, gmelinite, analcite, stilbite and heulandite," and also offered for sale an intriguing specimen: "the finest, largest and best rhodonite specimen that doubtless has ever been found," priced very high (for the times) at $500. By this time Niven had also accumulated over 30,000 Indian relics, and even had a 3,500-pound Toltec stone god,[11] a double-headed serpent with tail, for sale at $5,000. A shipment also arrived from his contact in England, containing fine specimens of fluorite, celestine and barite. Niven's mineral business was flourishing; he had over 5,000 mineral specimens on exhibit in his New York shop, arranged in eight large showcases, two of them 15 feet long by 10 feet high.

IN PARTNERSHIP WITH GEORGE ENGLISH

In April of 1890 Niven announced[12] that he was entering into partnership with the Philadelphia mineral dealers George L. English and Edwin C. Atkinson. Business was to be conducted at their various premises as before, but under the name of "George L. English & Company." Offerings from Niven thenceforth appeared in the English ads, referred to as "our New York store."

On May 3rd Niven left his shop in the hands of a "competent assistant" and took off once again for Mexico and the Southwest.[13] Immediately he began shipping specimens back to English, first from Magnet Cove, Arkansas, then from a stay of several weeks at Barringer Hill in Texas, and then from the topaz locality in San Luis Potosi, Mexico. Some of the topaz crystals were nearly 2 inches long,[14] very perfect and brilliant, including a number of doubly terminated crystals and fine matrix specimens. He also returned to previously visited Mexican localities for more apophyllite, calcite, proustite, pyrargyrite and native silver.

In late 1890 Niven set out on another collecting trip to Mexico in search of specimens for his museum clients. He spent time at the San Carlos silver mine in Guanajuato, acquiring many silver specimens including a new silver selenide which, at his recommendation, was later named *aguilarite* by Frederick Genth in honor of the mine's superintendant, J. Aguilar, who had been so courteous to him during his visit. Moving on to Pachuca, he met with Francisco Landero of Landero & Company, owner of the Real del Monte

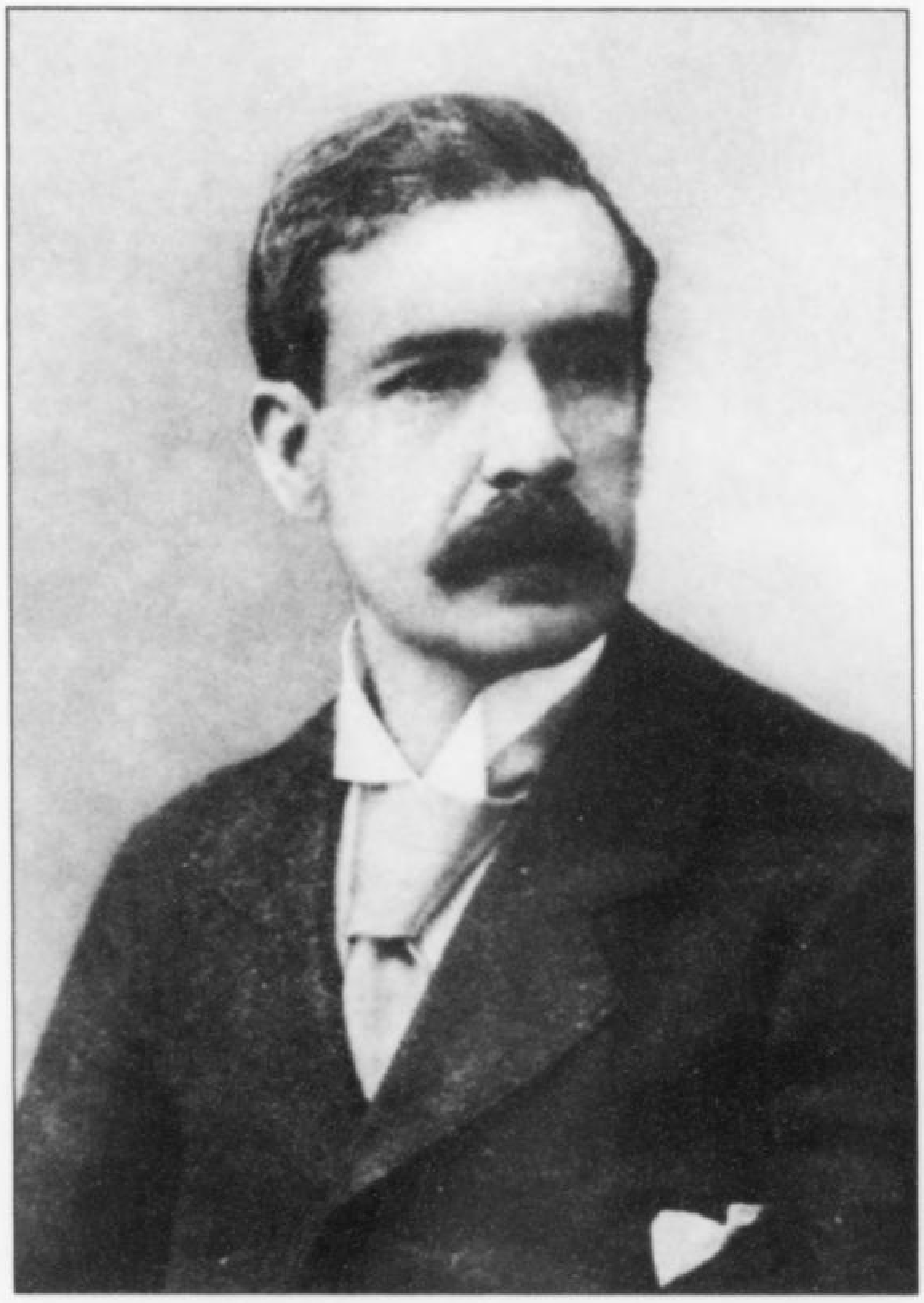


Figure 15. **William Niven. From a newspaper article in the Roland Harrison files.**

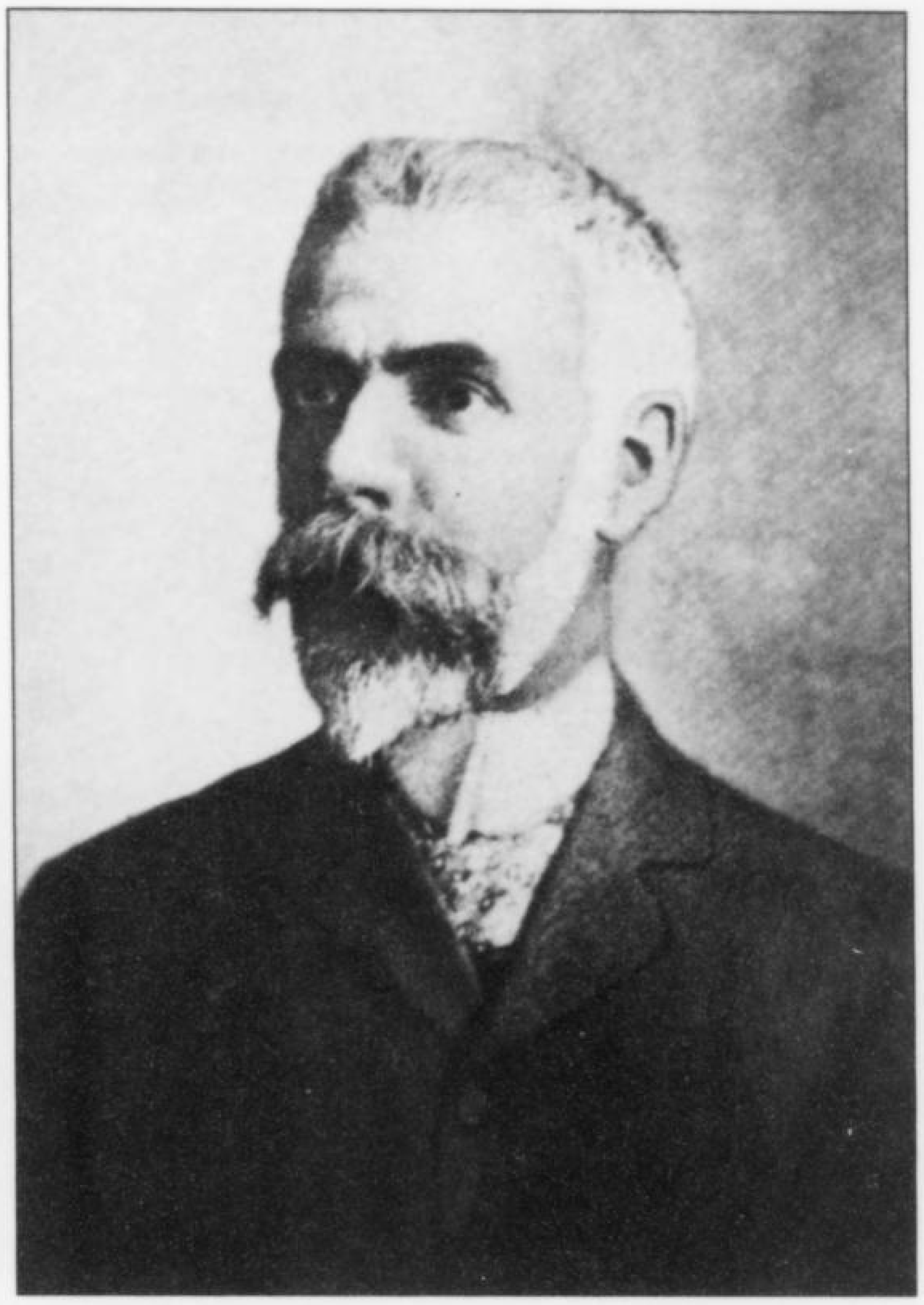
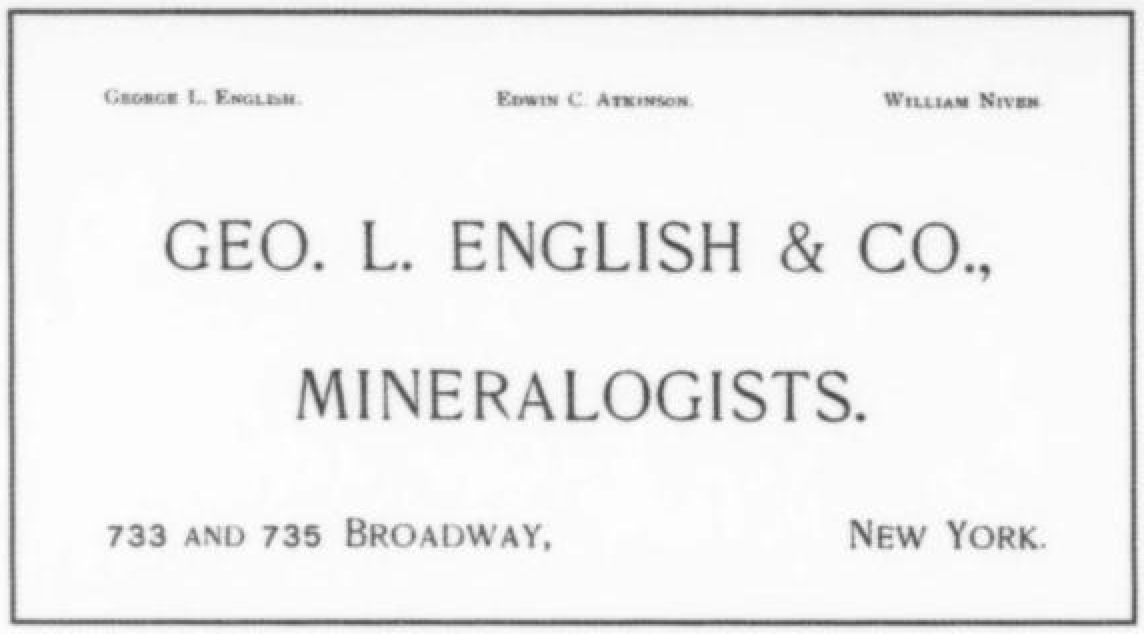


Figure 16. **George L. English (1864–1944), prominent Philadelphia mineral dealer and William Niven's partner from 1890 to 1892. Mineralogical Record Library.**



GEORGE L. ENGLISH. EDWIN C. ATKINSON. WILLIAM NIVEN

GEO. L. ENGLISH & CO.,

MINERALOGISTS.

733 AND 735 BROADWAY, NEW YORK.

Figure 17. **Business card for the partners George L. English, William Niven and Edwin C. Atkinson. Roland Harrison collection.**

mine, one of the richest silver mines in Mexico. Landero was also a dealer in mineral specimens, and had an extensive personal collection of Mexican minerals. This collection included specimens of a massive rose-colored grossular intermixed with yellow vesuvianite, a commodity which Niven had been seeking. Landero informed him that it came from a deposit at the small town of Xalostoc, near Cuautla in the state of Morelos. In January 1891 Niven visited the locality, where he was able to block out about 240,000 tons of the attractive ornamental stone, and arrange for samples to be shipped back to New York.

Niven continued to travel Mexico and the Southwest during the summer of 1891. In August his office reported "Mr. Niven's great find at Bisbee!" He had entered one of the cave areas that often overlie orebodies at Bisbee and had found the room decorated with green to sky-blue stalactites to 20 inches as well as a large amount of floss ferri and white aragonite crystal clusters, all of which he immediately harvested and shipped back to New York.[15]

In January 1892 Niven met with Mexican President Porfirio Diaz and obtained a temporary concession for the recovery of minerals and archeological artifacts in Guerrero.

Throughout the time Niven was in the field, his store in New York continued to acquire stock from other sources, including several in Europe, perhaps with the help of English. On March 1, 1892, the mineral collection of the prominent Swiss dealer Hoseus was put on sale at Niven's shop in New York,[16] while Niven was engaged directing the quarrying of the pink grossular rock in Mexico. Niven remained almost exclusively in the field while English took over the New York store and moved it to more spacious quarters at No. 64 East 12th Street.[17]

Niven returned to New York in April 1892, with a load of Mexican artifacts. Morris K. Jessup, a well-known banker and President of the American Museum of Natural History, purchased a Guerrero jade sculpture for the museum and agreed to fund another expedition to Guerrero for artifacts. Niven was made an honorary

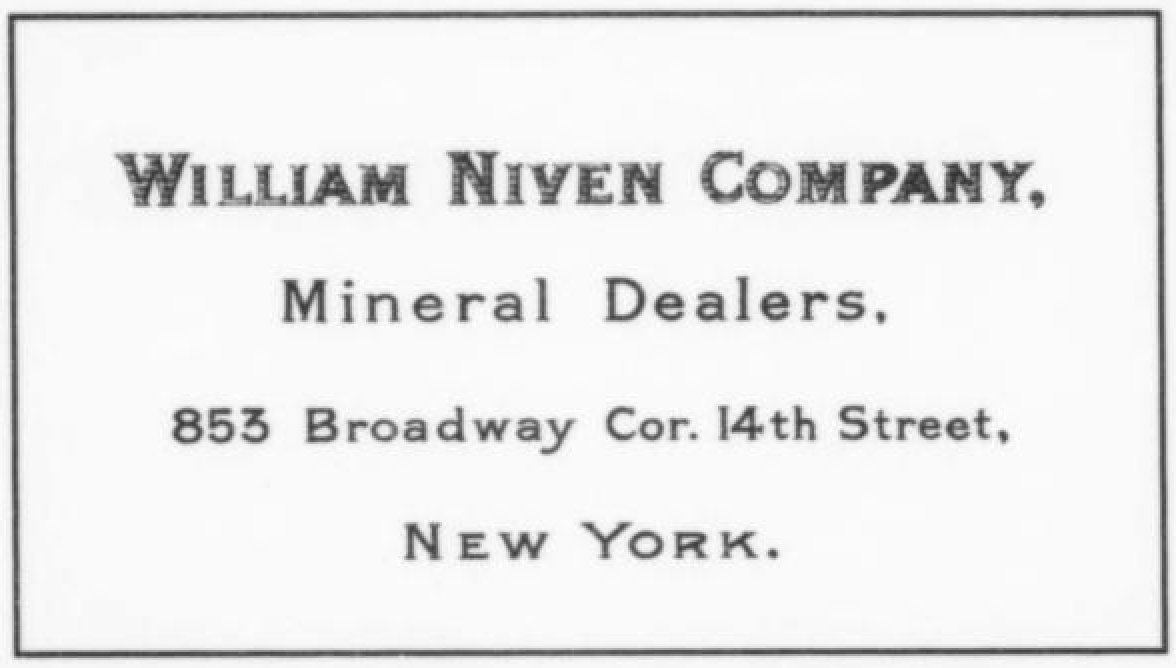
Figure 18. **William Niven at the Columbian Exposition in Chicago (1893), promoting his "rosolite" ornamental stone. Roland Harrison files.**

life member of the museum. Meanwhile, the pink grossular rock (which he named "rosolite") from Morelos was causing excitement, so Niven acquired the mineral rights to the deposit, in partnership with José de Landero, Director of the Real del Monte Mining Company, and thus the *American Rose Garnet Company, Inc.* was formed in April, 1892, with Niven as Vice President, Edwin Atkinson as President and George English as secretary. Tiffany & Company agreed to act as agent for any items manufactured from the stone. Niven and his family then returned to Mexico for the remainder of the year, setting up headquarters at the Hotel Iturbide in Mexico City.

In January 1893 a small part of the English ad in *The Mineralogists' Monthly* offered "Mexican minerals, secured by Mr. Niven during a recent visit to Guanajuato. Nine boxes of selected specimens of richly colored amethysts, beautiful groups and twins of calcite, fine apophyllites, and a few aguilarites." Niven continued sending periodic shipments, but the partnership with English was finally dissolved when English bought Niven's share in December 1892.[18]

ON HIS OWN AGAIN

After selling out to English, Niven started fresh in the mineral specimen business—not too difficult considering all of the contacts he had developed—and maintained a mineral shop in New York (as "the William Niven Company"). Meanwhile, quarrying of the rosolite rock continued, and in mid-February 1893 a shipment was sent to New York to be prepared for exhibit at the Columbian


WILLIAM NIVEN COMPANY,

Mineral Dealers,

853 Broadway Cor. 14th Street,

NEW YORK.

Figure 19. **Willliam Niven business card from his 853 Broadway address (1895–1896). Roland Harrison collection.**

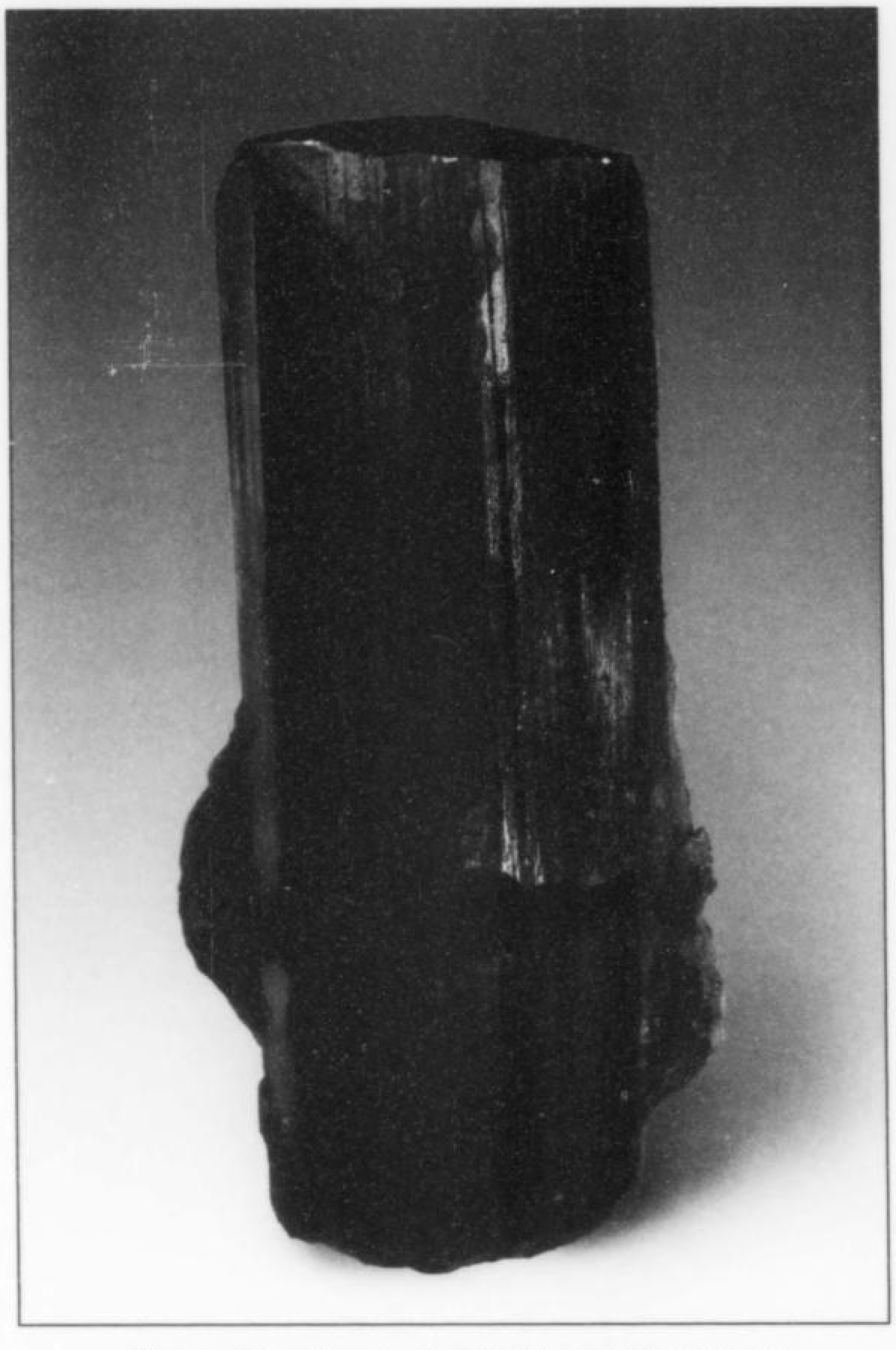


Figure 20. **The giant schorl crystal, 4 × 11 inches, originally on matrix and weighing about 60 pounds. It was found by Niven in an excavation on Washington Avenue in New York in October 1895 and sold to the American Museum of Natural History in 1896. A preparator around 50 years ago trimmed off the heavy quartz matrix and replaced a broken portion of the termination with plaster and black shoe polish. Photo courtesy of George Harlow, Curator.**

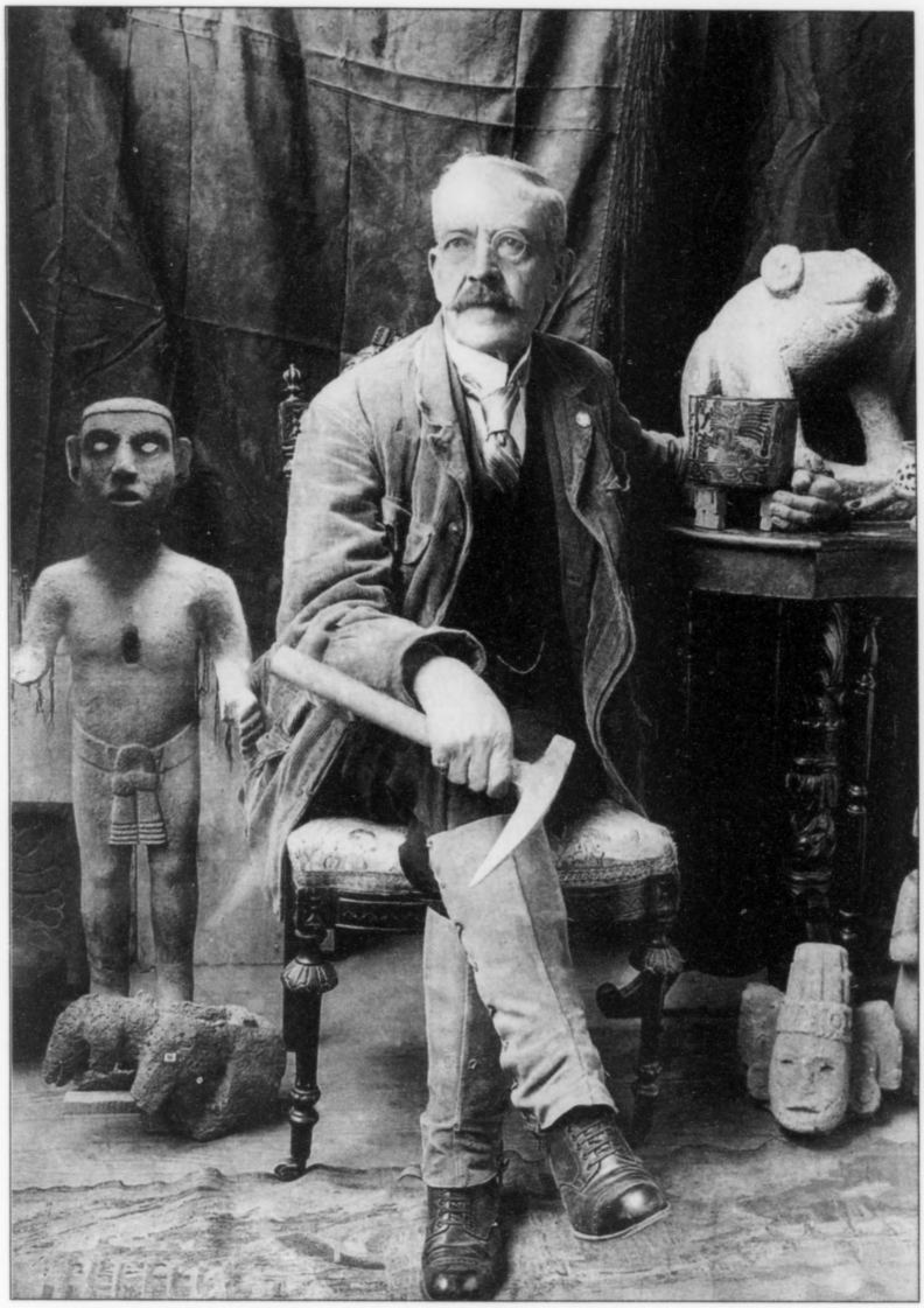
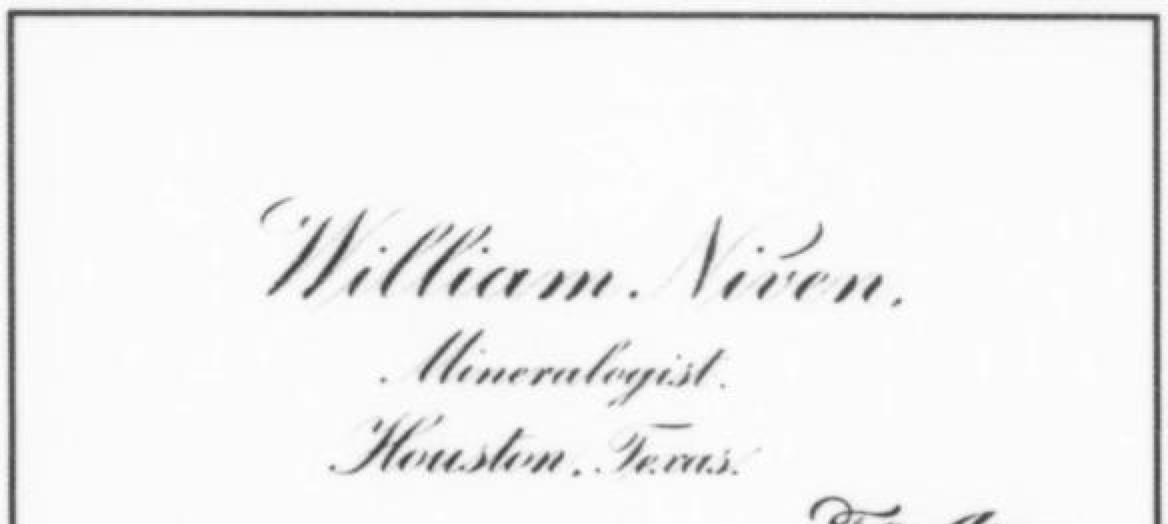


***Figure 21.* William Niven surrounded by some of his pre-Columbian Mexican artifacts; photo probably taken in his shop/museum in Mexico City in the late 1920's. Roland Harrison collection.**



William Niven.
Mineralogist.
Houston, Texas.

1817 Main Street

Feliz Ano
1930

***Figure 22.* William Niven business card from 1930, when he was living in retirement in Houston, Texas, where he served on the Board of Directors of the Houston Museum of Natural History. Roland Harrison collection.**

Exposition in Chicago, where it was greeted with considerable acclaim. Unfortunately, professional stone cutters found the rock impossible to cut without generating surface pits because of the difference in hardness between the various component minerals, and it also proved to weather quickly when exposed to the elements. Thus, despite its early promise, the rose garnet venture proved a failure.

In April 1894, the William Niven Company, "collectors and dealers in scientific minerals," announced in *The Mineral Collector* that:

> Our Mr. Niven, who has been absent so frequently from New York on extended collecting trips through the Southwest and Mexico during the past 5 years, will be glad to meet his old friends and customers at our Mineral Show Rooms, 644 First Avenue, New York, where a rare and beautiful collection of minerals, recently purchased from one of the oldest and best known mineralogists in New York City, is displayed. *No fancy prices.*"

Who this old mineralogist may have been is unknown, but apparently it was noteworthy that Niven was in New York and actually present in his own store. In June he was once again collecting in Mexico at his favorite localities, and sending shipments back to New York. Although Niven was no longer formally in partnership with George English, they maintained a cordial relationship and Niven sent shipments of specimens to English as well as to his own shop.[19]

On a prospecting tour for the American Museum of Natural History in 1894 Niven made an archeological discovery: prehis-

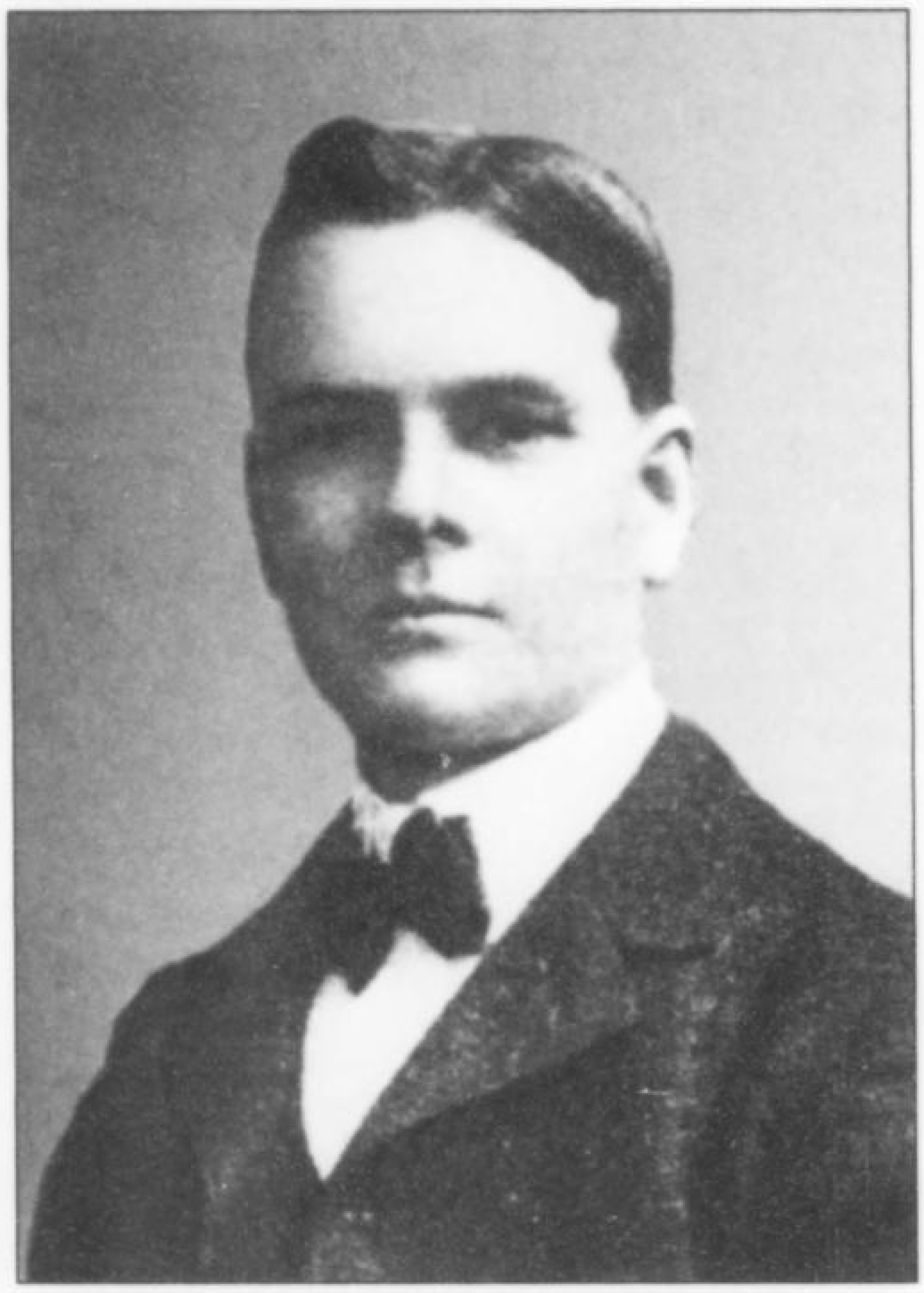
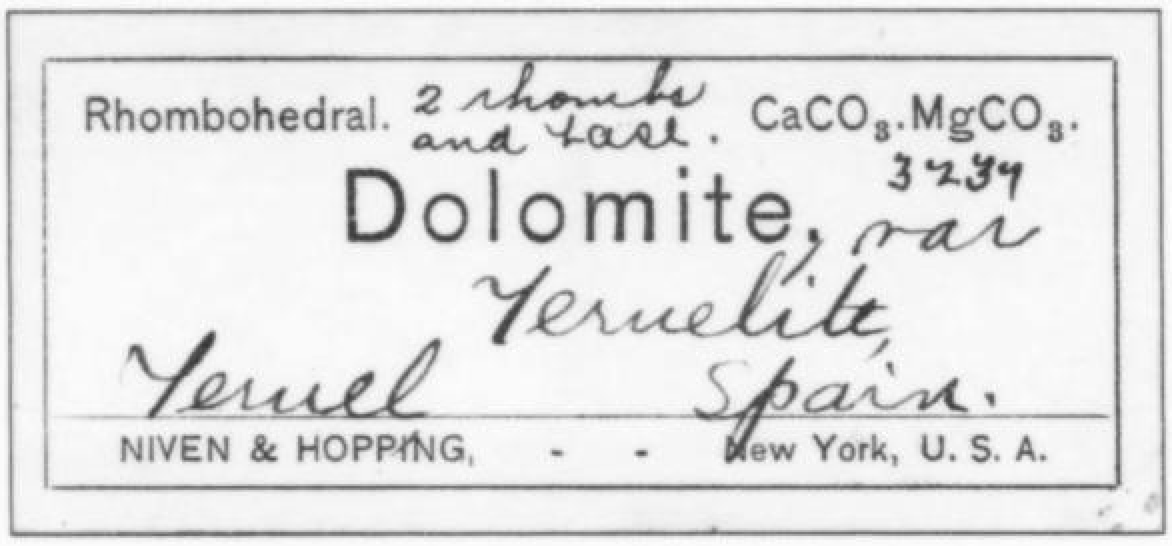


Figure 23. **Roy Hopping (1872–ca.1904), William Niven's junior partner in the firm of Niven & Hopping (1896). From *The Mineral Collector*, December 1902.**

toric ruins (later named Omitlán) northwest of Chilpancingo in the state of Guerrero. This was tremendously exciting to Niven, and he would later devote his full attention to the excavation of ancient ruins.

He also found attractive zeolites and associated minerals at West Paterson, New Jersey. In May of 1895 he announced his relocation to new quarters at 853 Broadway, and in August 1895 he acquired yet another collection for resale, this one consisting of over 500 specimens.

Niven prospected the New York City area thoroughly from 1886 to 1889 and did so again in 1895–1896, discovering an extraordinary mineral locality in the subway excavations along Washington Avenue from 165th to 181st Street.[20] There he collected thousands of xenotime crystals, yellow titanite crystals, brilliant monazite crystals, beryl, tourmaline and almandine. Always the professional, he first obtained official permission from the chief of New York's Board of Public Works, then hired laborers who worked the site with drills and dynamite. Among his many finds there was a schorl crystal[21] over 11 inches long and 4 inches wide, on a quartz crystal matrix, the whole specimen weighing about 60 pounds. Found in October 1895, it was purchased in 1896 by the American Museum of Natural History. The next morning the *New York Herald* published a picture of it with a story headlined "Largest Sale of Real Estate ever made on Manhattan Island." It went on to say "William Niven sells to the American Museum a specimen of rock from 181st Street with a Tourmaline Crystal, weighing 60 pounds for $250—said to be the largest crystal of that mineral in the world." The specimen (pictured here) is still in the American Museum collection, though most of the matrix was trimmed off about 50 years ago, and it had lost its provenance over the years. Curator George Harlow, who tracked it down and photographed it for this study, was pleased to be able to reclaim its history.



Rhombohedral. 2 rhombs and tail. $CaCO_3.MgCO_3$.
3234
Dolomite, var Teruelite,
Teruel Spain.
NIVEN & HOPPING, - - New York, U. S. A.

Figure 24. **Mineral label for Niven & Hopping (1896). Mineralogical Record Label Archive.**

Niven announced[22] that he would soon be off again on a collecting trip through Mexico in search of minerals and archeological specimens, and invited "his friends to call before he leaves." He then formally took on the 23-year-old Roy Hopping as his protégé for a year, doing business together[23] as "Niven & Hopping." Hopping had worked for George English, and it is very probable that he had also been working for Niven, as one of Niven's unnamed "competent assistants." In October of 1896 Niven sold his remaining interest in the business to Hopping.[24] During that year, Niven had obtained exclusive rights to the minerals from a quarry at Paterson, New Jersey, and began to get more shipments of minerals from his contact in Arizona. Hopping[25] benefitted from these acquisitions, but no more ads for Niven or his company appeared after 1896; he was out of the mineral specimen business for good.

ARCHEOLOGY TAKES OVER

Niven turned increasingly to Mexican archeology in his later years, funded in part by his prospecting for gold in Guerrero, where he filed hundreds of claims in remote areas. His greatest find was the La Lucha mine, where the ore ran $10,000 in gold to the ton. He also discovered the celebrated Placeres del Oro sepulcher in 1910. His curio shop in Mexico City became a popular gathering place for visiting collectors, archeologists, diplomats and American writers, such as Katherine Anne Porter, who called him "a charming old pot hunter." Excavating neglected archeological sites in the Valley of Mexico, Niven unearthed relics now in the collections of major museums worldwide. His collection of archeological artifacts from Guerrero is now distributed among the American Museum of Natural History, the Peabody Museum of Yale University, and elsewhere.

In 1911 Niven discovered ancient ruins buried beneath volcanic ash near Azcapotzalco just north of Mexico City. He devoted the next 20 years of his life to archeological exploration in the Valley of Mexico, and thanks to an arrangement with the Mexican government he was able to fund his digs through the sale of artifacts. Niven was so successful in his field work that he was able to establish a private museum in Mexico City containing more than 20,000 objects.

A great many interesting adventures befell Niven in Mexico; readers are urged to consult Wicks and Harrison's fascinating book, *Buried Cities, Forgotten Gods* for more on that portion of his life.

Niven had liked Texas when he worked at Barringer Hill, and so in 1929 he retired to the Houston area, where he made himself popular by donating a large number of Mexican artifacts to the new Houston Museum and Scientific Society, and serving on its board of trustees. He also served on the Board of Directors of the Houston Museum of Natural History in 1930. In 1931 he moved to Austin, Texas, where he remained until his death on June 2, 1937, at the age of 87.

A NOTE ON LABELS

William Niven mineral labels are, for some reason, quite rare. We would appreciate receiving color scans at 300 dpi of any such labels that collectors, dealers or curators may come across. We will then post them on the Label Archive portion of the Mineralogical Record website (www.MineralogicalRecord.com), with credit to the owner.

ACKNOWLEDGMENTS

My sincere thanks to Roland H. Harrison, William Niven's grandson, for access to the family photographs and letter files; and to Judith Keeling, Editor-in-Chief at Texas Tech Press, for permission to reproduce images from Wicks and Harrison (1999). Thanks also to George Harlow of the American Museum of Natural History for searching their collection records for Niven specimens and for locating and photographing the big schorl crystal. My special thanks to Richard Hauck for graciously allowing us to acquire his rare set of *The Exchangers' Monthly*, without which this article could not have been completed.

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WICKS, R. S., and HARRISON, R. H. (1999) *Buried Cities, Forgotten Gods*. Texas Tech University Press, 318 p.

NOTES

1. November 1888 ad in *Exchangers' Monthly* for his auction (p. 17), with partial catalog (p. 18–28); store ad (p. 29).

2. Handwritten lecture notes by Niven in the files of Roland Harrison.

3. February 1889 ad in *Exchangers' Monthly*, p. 17–19.

4. April 1889 ad in *Exchangers' Monthly*, "An open letter," telling where he's been, p. 19.

5. May 1889 ad in *Exchangers' Monthly*, p. 19, giving results of his trip.

6. June 1889 ad in *Exchangers' Monthly*, p. 17; his planned three-month collecting tour, and the sale of his entire stock.

7. June 1889 ad in *Exchangers' Monthly*, p. 18–19, on the Stone Collection (repeated in the following issue).

8. July 1889 ad in *Exchangers' Monthly*, p. 17, Herkimer collecting trip.

9. November 1889 ad in *Exchangers' Monthly,* p. 18–19.

10. Jan 1890 ad in *Exchangers' Monthly*, p. iii, Zacatecas silver minerals; also described in his handwritten notes in the Roland Harrison files.

11. Feb 1890 ad in *Exchangers'Monthly*, p. iii–vi, the Toltec stone god, also described in his handwritten notes.

12. April 1890 ad in *Exchangers' Monthly:* "A Card" announcing the merger on April 1st 1890, p. xii

13 May 1890 ad in *Exchangers' Monthly*, p. iii, announcing trip beginning May 1; store left in charge of "competent assistants." June 1890 ad in *Exchangers' Monthly*, p. iii; progress report on trip. July 1890 ad in *Exchangers' Monthly*; another progress report.

14. August 1890 ad in *Exchangers' Monthly*, p. iii, describing topaz crystals to 2 inches

15. August 1891 ad in *Mineralogists' Monthly*, p. xii, describing "Mr. Niven's great find at Bisbee! Now on sale!"

16. March 1892 ad in *Mineralogists' Monthly*, p. viii: Hoseus Collection sale.

17. December 1892 ad in *Mineralogists' Monthly*, p. viii: removal sale, new headquarters at 64 East 12th.

18. February 1893 ad in *Mineralogists' Monthly,* p. viii, announcing buyout by George English.

19. August 1894 ad in *Mineralogists' Monthly* by English, p. viii, noting a shipment of Mexican minerals from Niven's typical localities, presumably sent by Niven.

20. May 1895 ad in *The Mineral Collector*, p. ix; Niven's first announcement of xenotime, sphene, monazite, etc. "recently found" on Manhattan Island.

21. The story of the big schorl is told in Niven's handwritten lecture notes (Roland Harrison files); the ad for Niven & Hopping in the January 1896 issue of *The Mineral Collector*, p. vi, states that the schorl specimen, still available at $250, was found by Niven in October 1895.

22. August 1895 ad in *The Mineral Collector,* p. vii.

23. January 1896 ad in *The Mineral Collector,* p. vi: the first ad for Niven & Hopping. It also announced "We are exclusive agents for the Paterson (New Jersey) quarry, which is yielding the best zeolites the world has ever seen."

24. October 1896 ad in *The Mineral Collector,* p. 129: "Roy Hopping, successor to Niven & Hopping"

25. **Roy Degrasse Hopping** was born in Union, New Jersey on June 18, 1872, the son of George Washington Hopping and Laura Degrasse. Roy had been interested in mineralogy from an early age, and had apparently studied the subject in college because he advertised in the November 1895 issue of *The Mineral Collector* to sell his Zentmeyer's student microscope (giving two addresses: Bloomfield, N.J. and 64 East 12th Street, the address of George L. English's shop in New York City). An ad in the January 1896 issue of *The Mineral Collector* indicates that the 23-year-old Hopping had been taken on by William Niven as a junior partner, operating as "Niven and Hopping" from rooms 504–506, on the fifth floor of the Liberty Building at 123 Liberty Street in New York City. Hopping probably had learned the business working as English's shop assistant, and may also have helped Niven run his shop during his long absences in Mexico and the Southwest.

Unfortunately, Hopping seems to have suffered from chronic health problems, for the following month (February 1896) their ad announces apologetically that "Owing to the prolonged illness of Mr. Hopping, announcements and bulletins have been delayed, but we hope to have them ready very soon. Meanwhile Mr. Niven is daily attending to the wants of customers. . . ."

Hopping recovered, however, and having completed his apprenticeship under Niven, he took over the business in October of 1896, when his ads announced the company name as "Roy Hopping, successor to Niven & Hopping," at the same address. His ads continued through July 1897, then ceased until March 1898, when they resumed with Hopping at a new address, 5 & 7 Dey Street. Ads for this address continued until December 1899, when Hopping announced his relocation to 129 Fourth Avenue, near Union Square, in rooms 35 and 36 on the third floor of the recently constructed Hancock office building, where he enjoyed nearly twice the space he'd had at his Dey Street address. He published bulletins periodically, in Autumn 1899, February 1900 and September 1900. Judging by his detailed and enthusiastic full-page ads, he handled a large and varied worldwide stock, with fine minerals arriving regularly in shipments from his contacts throughout Europe and America. Hopping was a member of the New York Mineralogical Club, and published an educational booklet entitled

The Practical Study of Common Minerals.

Hopping's last regular ad appeared in the December 1902 issue, and editor Arthur Chamberlain must have known of his worsening health problems because he published a portrait photograph of Hopping (reproduced here) as the frontispiece to that issue. An ad placed by Hopping's father in the April 1903 issue sadly announced the closing of the business: "My son, Mr. Roy Hopping, being in such poor health as to be totally incapacitated for business, I have taken charge of his business and will close it out as rapidly as possible."

Oddly enough, Hopping married Belle Hedden Jarolamon (born 1880) in New Jersey on April 3, 1903. It may well have been a deathbed marriage, and he may not have lived much longer, though his precise death date is unknown. He did continue to publish his own short-lived magazine (only two issues known), *American Minerals*, from his address at 1 Grove Place in East Orange, New Jersey in September 1903, and then from 3459 Walnut Street in October 1903. Roy Hopping is not recorded on the 1910 Federal Census, but Belle appears, under her maiden name, living alone in a boarding house in San Francisco, and working as a public school teacher.

Labels can be dated as follows: "Niven and Hopping," 1896; "Roy Hopping," 1896–1903.

HOLFERTITE

A NEW HYDROXYL-HYDRATED URANIUM TITANATE
from
STARVATION CANYON, THOMAS RANGE, UTAH

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ABSTRACT

Holfertite is a new mineral from Starvation (formerly Searle) Canyon, Thomas Range, Utah. It occurs as a pneumatolitic phase in cavities and fractures in a rhyolite, together with hematite, bixbyite, fluorite, topaz and red beryl. It forms elongated prismatic crystals up to 1 × 5 mm, and these crystals are commonly hollow, consisting of a hexagonal outer surface with a hexagonal prismatic cavity in the interior of the crystal. Crystals are found perched on hematite or topaz, piercing hematite crystals, and as inclusions in red beryl. Holfertite is canary-yellow to orange-yellow with a pale yellow streak and adamantine luster. It is brittle, $H = 4$, $D_{obs} > 4.22$, and does not fluoresce in ultraviolet light. Holfertite has perfect cleavage on {110} and an uneven to conchoidal fracture. In transmitted plane-polarized light, holfertite is non-pleochroic, colorless, uniaxial positive, $\omega = 1.815 \pm 0.008$, $\varepsilon = 1.910 \pm 0.008$. Holfertite is hexagonal, space group $P3$, $a = 10.824(2)$, $c = 7.549(2)$ Å, $V = 765.94(9)$ Å^3, $Z = 3$. The strongest five X-ray diffraction lines in the powder pattern are [$d(I)(hkl)$]: 4.60(10)(020), 3.05(2)(112), 2.90(8)(022), 1.87(3)(004/050), 1.747(3)(024). Chemical analysis by a combination of electron microprobe and crystal-structure refinement gave UO_3 76.03, TiO_2 11.89, CaO 2.29, Fe_2O_3 0.44, K_2O 0.30, H_2O (by weight loss on heating) 8.09, sum 99.04 weight %. Because of the very disordered nature of the crystal structure of holfertite, there is some ambiguity as to the chemical formula, depending on whether or not (OH) is present in the structure. The following two formulae are possible:

(1) $U^{6+}_{1.74}(Ti^{4+}_{0.97}Fe^{3+}_{0.04})_{\Sigma 1.01}O_{7.5}(H_2O)_3Ca_{0.27}K_{0.04}$

In this case it is calculated on the basis of 10.5 O-atoms with (OH) = 0 and (H_2O) = 3 apfu ($D_{calc} = 4.22$ g/cm^3; H_2O 8.27 weight % by structure refinement).

(2) $U^{6+}_{1.74}(Ti^{4+}_{0.97}Fe^{3+}_{0.04})_{\Sigma 1.01}O_{7.17}(OH)_{0.67}(H_2O)_3Ca_{0.27}K_{0.04}$

In this case it is calculated on the basis of 10.84 O-atoms with (OH) = 0.67 and (H_2O) = 3 apfu ($D_{calc} = 4.26$ g/cm^3; H_2O 9.19 weight % by structure refinement).

The corresponding simplified formulae are:

(1) $(UO_2)_{1.75}TiO_4\{(H_2O)_3Ca_{0.25}\}$ and
(2) $(UO_2)_{1.75}TiO_{3.67}(OH)_{0.67}\{(H_2O)_3Ca_{0.25}\}$, respectively.

INTRODUCTION

During a 1998 trip to topaz occurrences in rhyolites of the Thomas Range, Utah, one of the authors (DB) visited one of John Holfert's claims at Starvation (formerly Searle) Canyon in the western part of the Thomas Range. A few very small, bright-yellow acicular crystals were found while collecting smoky topaz. John Holfert told us that he had previously noticed such crystals at this and a few other places in the Thomas Range, and also mentioned that the late Eugene Foord worked on this material as a possible new mineral, but did not finish this work because of his illness and death.

In 1998, we collected only a few crystals. We subsequently visited the locality again in 2000 and 2001. With the help of John Holfert, his

Figure 1. **Holfertite type locality at Starvation (formerly Searle) Canyon, Thomas Range, Utah; the senior author is sitting in the center of the photograph (for scale). Photograph by N. Pekova.**

wife Galina, Mikhail Generalov and Natalia Pekova, we spent four days collecting about 4 mg of material. Thanks to the bright yellow or orange color of the mineral, it is relatively easy to find individual needles. However, it was not possible to get much pure material because the average crystal size is 0.1 × 1.5 mm, most crystals are hollow, and many crystals contain inclusions of associated minerals; approximately a hundred such crystals weigh only about 1 mg. In 2002, Patrick Haynes collected 2 mg of crystals from Starvation Canyon at our request, and this allowed us to finish this study.

The yellow crystals proved to be a new mineral species. It is hereby named for John W. Holfert (born 1949), who has made significant contributions to the mineralogy, geology and mineral occurrences of the Thomas Range (Holfert *et al.*, 1996). The species and name were approved by the International Mineralogical Association Commission on New Minerals and Mineral Names (IMA 2003-009). Holotype material is deposited at the Fersman Mineralogical Museum (#91374), Russian Academy of Sciences, Moscow, Russia, and at the Smithsonian Institution.

THE THOMAS RANGE and STARVATION CANYON

According to John Holfert, Starvation (formerly Searle) Canyon (Fig. 1) has the most abundant concentration of the mineral. The material used in this study all came from this site, which is designated as the type locality. Holfert has also found crystals at the end of that canyon, at the Maynard Topaz mine (on the western slope of Topaz Valley at the southern end of Topaz Mountain), and at the pseudobrookite location 1 mile south of Pismir Wash (western part of the Thomas Range).

At the type locality (Fig. 2) the rocks consist primarily of rhyolites and other volcanic rocks forming five distinct lava flows a few hundred meters thick. Details of the mineralogy and geology of the Thomas Range are given by Holfert *et al.* (1996). The rhyolites contain numerous cavities (gas bubbles) ranging from a few millimeters to a few meters in size. The most common mineral in the cavities is hematite, occurring as thin plates and as flat pinacoidal-rhombohedral crystals up to 1 cm. Certain areas in these rhyolites are well-known for smoky topaz which can nearly completely fill the original cavities and is commonly intergrown with quartz and alkali feldspar, forming what are locally known as "clinkers." Smoky topaz crystals can be transparent and up to 10 cm in size. Topaz freed from the rock by weathering fades in the sunlight. They are easily seen in the morning sunlight when numerous faded topaz crystals sparkle on the mountain slopes, making it crystal clear how Topaz Mountain got its name.

The Thomas Range is also famous for black cubic crystals of bixbyite (up to 2 cm) and flattened hexagonal prisms of red beryl up to 1 cm. Also common are columnar crystals of pseudobrookite, niobian rutile, cristobalite, magnetite and cryptocrystalline cassiterite. Rare zircon and thorianite have also been reported. At the holfertite occurrence, we also found cerianite-(Ce). In most cases, the larger crystals occur in fractures in rhyolite which served as channels for percolating fluids.

PHYSICAL PROPERTIES

Holfertite occurs as elongated prismatic crystals up to 1 × 5 mm with an average size of 0.15 × 1.5 mm. These crystals are typically

Figure 2. **The holfertite pit, Starvation Canyon, Thomas Range, Utah. Photograph by N. Pekova.**

hollow, consisting of a hexagonal outer surface with a hexagonal prismatic cavity in the interior of the crystal, and occur as isolated crystals, parallel intergrowths and radial sprays of three or four crystals.

Holfertite is translucent to transparent, and canary-yellow to orange-yellow with a pale yellow streak. It is brittle, has a Mohs hardness of 4, $D_{obs} > 4.22$ (crystals sink slowly in concentrated Clerici solution), $D_{calc} = 4.22$; 4.26 g/cm^3 (calculated for different crystal-structure models based on analysis H(2), Table 1). It does not fluoresce in ultraviolet light. Holfertite has perfect cleavage on {110} and an uneven to conchoidal fracture. In transmitted plane-polarized light, holfertite is non-pleochroic, colorless, uniaxial positive, $\omega = 1.815 \pm 0.008$, $\varepsilon = 1.910 \pm 0.008$ ($\lambda = 590$ nm).

OCCURRENCE

Holfertite occurs on fracture surfaces in rhyolite, on topaz "clinkers" and in cavities. Very commonly, holfertite is intergrown with, or penetrates, hematite crystals. Holfertite needles also occur on topaz crystals, sometimes partly (but never completely) included in topaz. Holfertite does occur as inclusions in crystals of red beryl (Fig. 3), but only rarely penetrates the surface of the crystals. Holfertite can also be found intergrown with bixbyite and niobian rutile. In SEM images, small (5–10 mm) octahedral crystals of cerianite-(Ce) are commonly associated with, but never contact, holfertite (Fig. 4). Many holfertite crystals are covered by a crust of deep purple to colorless fluorite crystals (Fig. 5a) or secondary calcite, and their hollow nature is easily apparent (Figs. 5a, b). The spatial relations with other minerals indicate that holfertite crystallized after quartz and Na-K-feldspar, during and after crystallization of hematite, at the very last stage of and after topaz growth, and before red beryl, bixbyite, most hematite and fluorite. Calcite and (probably) fluorite are very late secondary minerals. The rest of the minerals are probably pneumatolitic in origin.

CHEMICAL COMPOSITION

Chemical data were obtained using a JXA-50 electron microprobe operating in EDS and WDS mode and an SEM with EDS at the Fersman Museum (RAS) and IGEM (RAS), respectively. Two chemical compositions are given in Table 1; composition 1 was determined on material used to define indices of refraction, density and H_2O content; composition 2 was determined on material used to obtain X-ray diffraction data. A special effort was made to determine Y and REEs, but neither were detected. The weight loss on heating was measured at the Faculty of Geology, Moscow State University, in a microthermocamera (built by A. E. Zadov) and using a sample of 1.483 mg. The total loss on heating was 8.09 weight %: 7.75 weight % was lost on heating to 300°C for 10 minutes and the rest (0.34 weight %) on heating to 500°C for 10 minutes. Further heating up to 900°C did not produce any additional weight loss. The infrared spectrum (Fig. 6) was recorded using a Specord-75 infrared-spectrometer, and shows the presence of uranyl groups (892 cm^{-1}), (H_2O) and (OH) groups (1626 and 3390 cm^{-1}) and overtone and fundamental stretching vibrations of $Ti\text{-}O_4$ (3420 cm^{-1}) and Ti-O (622 cm^{-1}). The lack of $(CO_3)^{2-}$ absorption bands in the infrared spectrum allow us to assign the total weight-loss on heating to H_2O: 8.09 weight %.

Sokolova *et al.* (2005) found that the structure of holfertite is very disordered, resulting in a significant degree of ambiguity in the formula of holfertite. Consequently, rather than a definitive formula, they produced two alternative formulae:

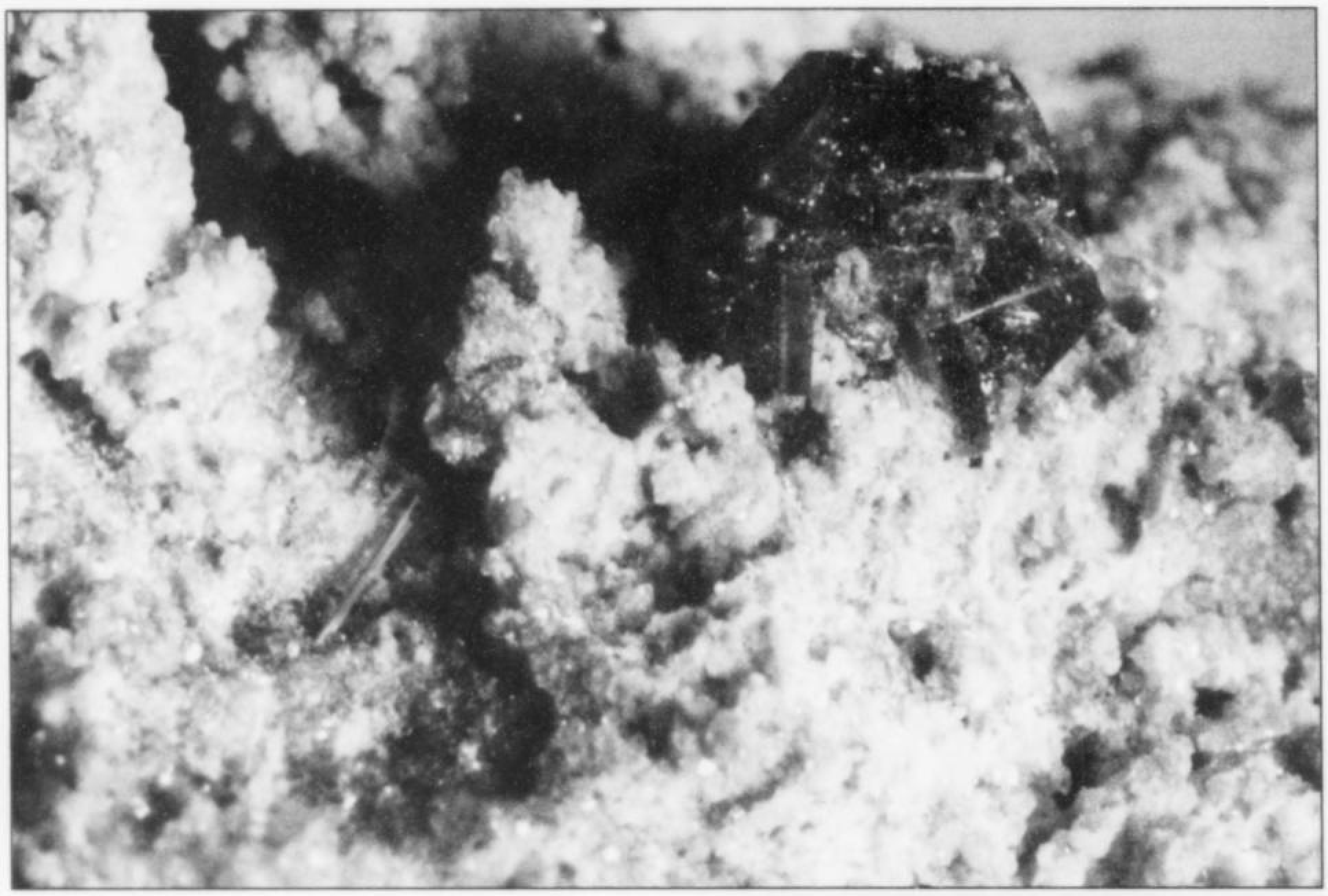

Figure 3. **Holfertite crystals on rhyolite and in red beryl; the beryl crystal is about 0.6 cm across.**

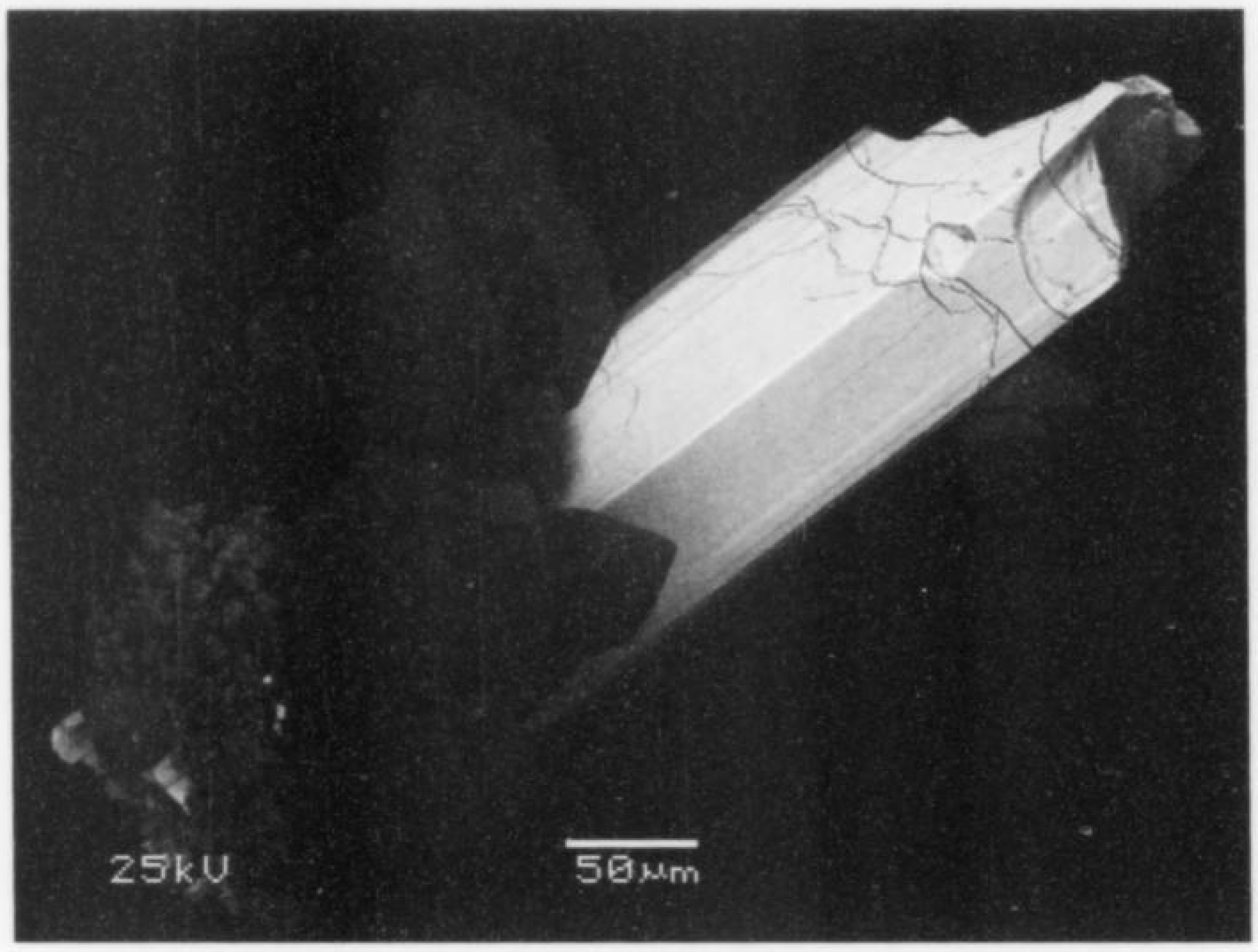

Figure 4. **A crystal of holfertite associated with quartz crystals (dark gray). At the lower left corner, there is a cuboctahedral crystal of bixbyite and an aggregate of Nb-rutile decorated with bright specks of cerianite-(Ce).**

(1) $U^{6+}_{1.74}(Ti^{4+}_{0.97}Fe^{3+}_{0.04})_{\Sigma 1.01}O_{7.5}(H_2O)_3Ca_{0.27}K_{0.04}$

This was calculated on the basis of 10.5 O-atoms with (OH) = 0 and (H_2O) = 3 apfu, D_{calc}=4.22 g/cm^3; (H_2O 8.27 weight % by structure refinement).

(2) $U^{6+}_{1.74}(Ti^{4+}_{0.97}Fe^{3+}_{0.04})_{\Sigma 1.01}O_{7.17}(OH)_{0.67}(H_2O)_3Ca_{0.27}K_{0.04}$

This was calculated on the basis of 10.84 O-atoms with (OH) = 0.67 and (H_2O) = 3 apfu, D_{calc} = 4.26 g/cm^3 (H_2O 9.19 weight % by structure refinement).

The corresponding simplified formulae are:

(1) $(UO_2)_{1.75}TiO_4[(H_2O)_3Ca_{0.25}]$ and
(2) $(UO_2)_{1.75}TiO_{3.67}(OH)_{0.67}[(H_2O)_3Ca_{0.25}]$.

The key issue here is whether or not holfertite contains significant (OH). The infrared spectrum (Fig. 6) is rather ambiguous in this regard. There is a very strong broad band centered on 3390 cm^{-1} and a strong sharper band at 1621 cm^{-1}, both attributable to (H_2O). The broad band centered on 3390 cm^{-1} has a broad subsidiary band at 3240 cm^{-1}. It is not clear if this band is due to disordered (OH), the disorder accounting for the unusual breadth of a band attributed to (OH), or another (H_2O) band. On the other hand, the amount of H_2O calculated in the chemical composition for each of these formulae (Table 1) shows closer agreement for the OH-free composition, with the amount of H_2O determined by weight loss on heating [8.09 weight %]. In our opinion, the evidence to distinguish between these two possible formulae for holfertite is not definitive, and hence we give both possibilities.

X-RAY AND ELECTRON-DIFFRACTION DATA

Table 3 gives X-ray powder-diffraction and microdiffraction data for holfertite. X-ray powder-diffraction data for holfertite were obtained on a Debye-Scherrer camera as the pattern obtained on an X-ray diffractometer exhibited strong preferred orientation and has only a small number of lines. The best result was obtained with a 57.3-mm (rather than with 114.6-mm) camera.

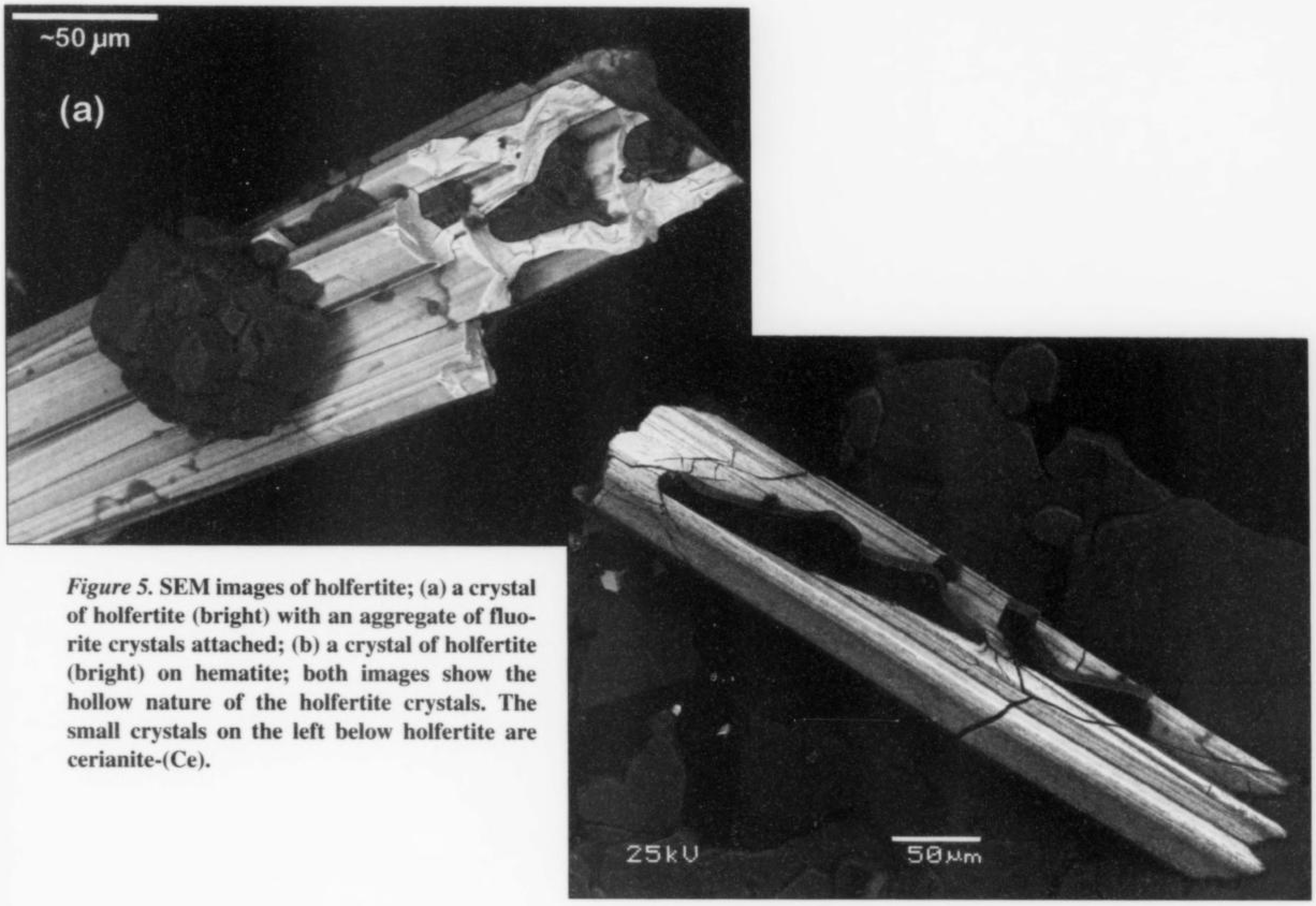

***Figure 5.* SEM images of holfertite; (a) a crystal of holfertite (bright) with an aggregate of fluorite crystals attached; (b) a crystal of holfertite (bright) on hematite; both images show the hollow nature of the holfertite crystals. The small crystals on the left below holfertite are cerianite-(Ce).**

***Table 1.* Chemical composition (weight %) of holfertite H(1,2)* and the Ti-U-Ca-HREE oxide, F, of Foord *et al.* (1995) and the formula (apfu) of holfertite.**

	H(1)	*H(2)*	*F*		*H(1)*	*H(2)*
UO_3	75.97	76.03	18.5	U	1.68	1.74
TiO_2	13.02	11.89	45.5	Ti	1.03	0.97
Fe_2O_3	0.47	0.44	n.d.	Fe^{3+}	0.04	0.04
CaO	3.01	2.29	3.25	Ca	0.34	0.27
Y_2O_3	n.d.	n.d.	3.1	K	0.04	0.04
RE_2O_3	n.d.	n.d.	6.93			
K_2O	0.31	0.30	n.d.	$O_{7.5}$	$(OH)_0$	$(H_2O)_3$
H_2O**	8.09	8.09	22.00			
Total	100.87	99.04	100.03***	$O_{7.17}$	$(OH)_{0.67}$	$(H_2O)_3$

H_2O from structure refinement for OH = O apfu: H(1) 8.56; H(2) 8.27 weight %

H_2O from structure refinement for OH = 0.67 apfu: H(1) 9.51; H(2) 9.19 weight %

* mean of 14 and 10 points respectively;

** H_2O by weight loss on heating;

*** Includes Na_2O 0.1, MgO 0.1, BaO 0.55 weight %; U as UO_3.

JXA-50 microprobe with Link EDS (Si-Li detector). U = 20kV, I = 2na. Beam diameter = 2 microns. K, U, Y and REE were measured using WDS U = 20kV, I = 20na. K was measured separately (PET crystal) using a slightly defocused beam. Standards: Ca—Diopside USNM 117733, U—Synthetic UO_2, Ti and Fe—Ilmenite USNM 96189, K—Microcline USNM 1439.

***Table 2.* Physical properties of holfertite in comparison with Ca-U-Ti-HREF mineral of Foord *et al.* (1995).**

	Our material	*Ca-U-Ti-HREF mineral of Foord et al. (1995)*
Color	yellow or orange yellow	Yellow or orange yellow sometimes white
Optical properties	unixial + parallel extinction $\omega = 1.815(8)$; $\varepsilon = 1.910(8)$	uniaxial – parallel extinction $\omega, \varepsilon < 1.7$
Density	observed > 4.22 g/cm^3 calculated 4.22–4.26 g/cm^3	2.64 for yellow 2.62 for white

Electron diffraction showed even single crystals of holfertite to be quite heterogeneous with respect to their diffraction behavior. For example, a holfertite crystal (1–2 microns long) gives very good spots at one point and rings in another part, indicating local violation of long-range order. The character of the disorder in holfertite, as indicted by the electron-diffraction results, is not clear. However, the single-crystal X-ray diffraction results (Sokolova *et al.*, 2005) indicate that crystals of holfertite have strong OD (Order-Disorder) character (Merlino, 1997) associated with translational disorder of uranyl-titanate chains in the *a*- and *b*-directions. The disorder indicated by electron diffraction may thus be the result of this chain disorder. It is difficult to decide if this chain disorder is the result of radiation damage, inasmuch as many minerals show OD behavior (Merlino, 1997), and yet are not associated with any radioactive materials.

Figure 3. **Holfertite crystals on rhyolite and in red beryl; the beryl crystal is about 0.6 cm across.**

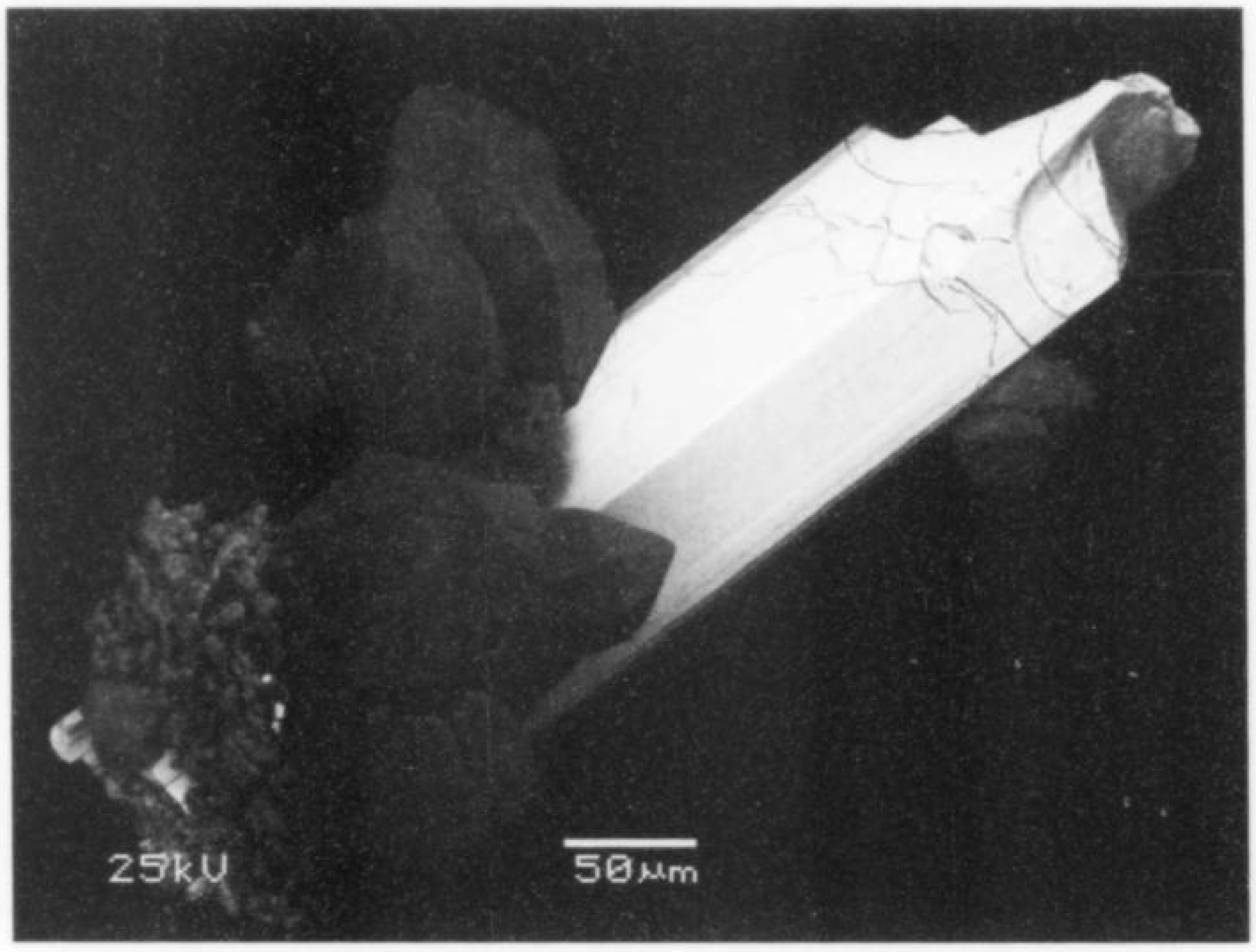

Figure 4. **A crystal of holfertite associated with quartz crystals (dark gray). At the lower left corner, there is a cuboctahedral crystal of bixbyite and an aggregate of Nb-rutile decorated with bright specks of cerianite-(Ce).**

$$\textbf{(1)}\ U^{6+}_{1.74}(Ti^{4+}_{0.97}Fe^{3+}_{0.04})_{\Sigma 1.01}O_{7.5}(H_2O)_3Ca_{0.27}K_{0.04}$$

This was calculated on the basis of 10.5 O-atoms with (OH) = 0 and (H_2O) = 3 apfu, D_{calc}=4.22 g/cm^3; (H_2O 8.27 weight % by structure refinement).

$$\textbf{(2)}\ U^{6+}_{1.74}(Ti^{4+}_{0.97}Fe^{3+}_{0.04})_{\Sigma 1.01}O_{7.17}(OH)_{0.67}(H_2O)_3Ca_{0.27}K_{0.04}$$

This was calculated on the basis of 10.84 O-atoms with (OH) = 0.67 and (H_2O) = 3 apfu, D_{calc} = 4.26 g/cm^3 (H_2O 9.19 weight % by structure refinement).

The corresponding simplified formulae are:

(1) $(UO_2)_{1.75}TiO_4[(H_2O)_3Ca_{0.25}]$ and
(2) $(UO_2)_{1.75}TiO_{3.67}(OH)_{0.67}[(H_2O)_3Ca_{0.25}]$.

The key issue here is whether or not holfertite contains significant (OH). The infrared spectrum (Fig. 6) is rather ambiguous in this regard. There is a very strong broad band centered on 3390 cm^{-1} and a strong sharper band at 1621 cm^{-1}, both attributable to (H_2O). The broad band centered on 3390 cm^{-1} has a broad subsidiary band at 3240 cm^{-1}. It is not clear if this band is due to disordered (OH), the disorder accounting for the unusual breadth of a band attributed to (OH), or another (H_2O) band. On the other hand, the amount of H_2O calculated in the chemical composition for each of these formulae (Table 1) shows closer agreement for the OH-free composition, with the amount of H_2O determined by weight loss on heating [8.09 weight %]. In our opinion, the evidence to distinguish between these two possible formulae for holfertite is not definitive, and hence we give both possibilities.

X-RAY AND ELECTRON-DIFFRACTION DATA

Table 3 gives X-ray powder-diffraction and microdiffraction data for holfertite. X-ray powder-diffraction data for holfertite were obtained on a Debye-Scherrer camera as the pattern obtained on an X-ray diffractometer exhibited strong preferred orientation and has only a small number of lines. The best result was obtained with a 57.3-mm (rather than with 114.6-mm) camera.

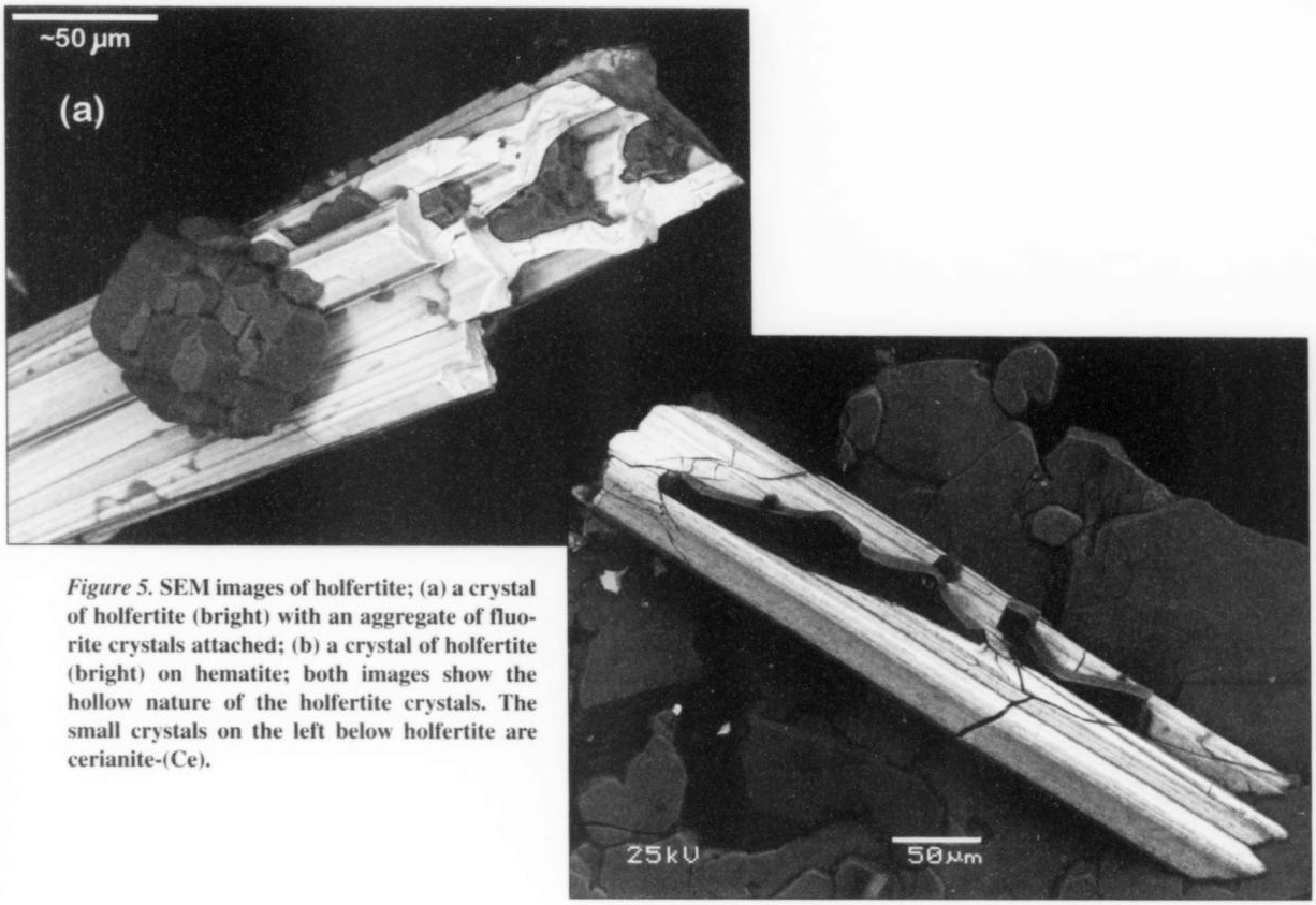

Figure 5. **SEM images of holfertite; (a) a crystal of holfertite (bright) with an aggregate of fluorite crystals attached; (b) a crystal of holfertite (bright) on hematite; both images show the hollow nature of the holfertite crystals. The small crystals on the left below holfertite are cerianite-(Ce).**

Table 1. **Chemical composition (weight %) of holfertite H(1,2)* and the Ti-U-Ca-HREE oxide, F, of Foord *et al.* (1995) and the formula (apfu) of holfertite.**

	H(1)	*H(2)*	*F*		*H(1)*	*H(2)*
UO_3	75.97	76.03	18.5	U	1.68	1.74
TiO_2	13.02	11.89	45.5	Ti	1.03	0.97
Fe_2O_3	0.47	0.44	n.d.	Fe^{3+}	0.04	0.04
CaO	3.01	2.29	3.25	Ca	0.34	0.27
Y_2O_3	n.d.	n.d.	3.1	K	0.04	0.04
RE_2O_3	n.d.	n.d.	6.93			
K_2O	0.31	0.30	n.d.	$O_{7.5}$	$(OH)_0$	$(H_2O)_3$
H_2O**	8.09	8.09	22.00			
Total	100.87	99.04	100.03***	$O_{7.17}$	$(OH)_{0.67}$	$(H_2O)_3$

H_2O from structure refinement for OH = O apfu: H(1) 8.56; H(2) 8.27 weight %

H_2O from structure refinement for OH = 0.67 apfu: H(1) 9.51; H(2) 9.19 weight %

* mean of 14 and 10 points respectively;

** H_2O by weight loss on heating;

*** Includes Na_2O 0.1, MgO 0.1, BaO 0.55 weight %; U as UO_3.

JXA-50 microprobe with Link EDS (Si-Li detector). U = 20kV, I = 2na. Beam diameter = 2 microns. K, U, Y and REE were measured using WDS U = 20kV, I = 20na. K was measured separately (PET crystal) using a slightly defocused beam. Standards: Ca—Diopside USNM 117733, U—Synthetic UO_2, Ti and Fe—Ilmenite USNM 96189, K—Microcline USNM 1439.

Table 2. **Physical properties of holfertite in comparison with Ca-U-Ti-HREF mineral of Foord *et al.* (1995).**

	Our material	*Ca-U-Ti-HREF mineral of Foord et al. (1995)*
Color	yellow or orange yellow	Yellow or orange yellow sometimes white
Optical properties	unixial + parallel extinction $\omega = 1.815(8)$; $\varepsilon = 1.910(8)$	uniaxial – parallel extinction $\omega, \varepsilon < 1.7$
Density	observed > 4.22 g/cm^3 calculated 4.22–4.26 g/cm^3	2.64 for yellow 2.62 for white

Electron diffraction showed even single crystals of holfertite to be quite heterogeneous with respect to their diffraction behavior. For example, a holfertite crystal (1–2 microns long) gives very good spots at one point and rings in another part, indicating local violation of long-range order. The character of the disorder in holfertite, as indicted by the electron-diffraction results, is not clear. However, the single-crystal X-ray diffraction results (Sokolova *et al.*, 2005) indicate that crystals of holfertite have strong OD (Order-Disorder) character (Merlino, 1997) associated with translational disorder of uranyl-titanate chains in the *a*- and *b*-directions. The disorder indicated by electron diffraction may thus be the result of this chain disorder. It is difficult to decide if this chain disorder is the result of radiation damage, inasmuch as many minerals show OD behavior (Merlino, 1997), and yet are not associated with any radioactive materials.

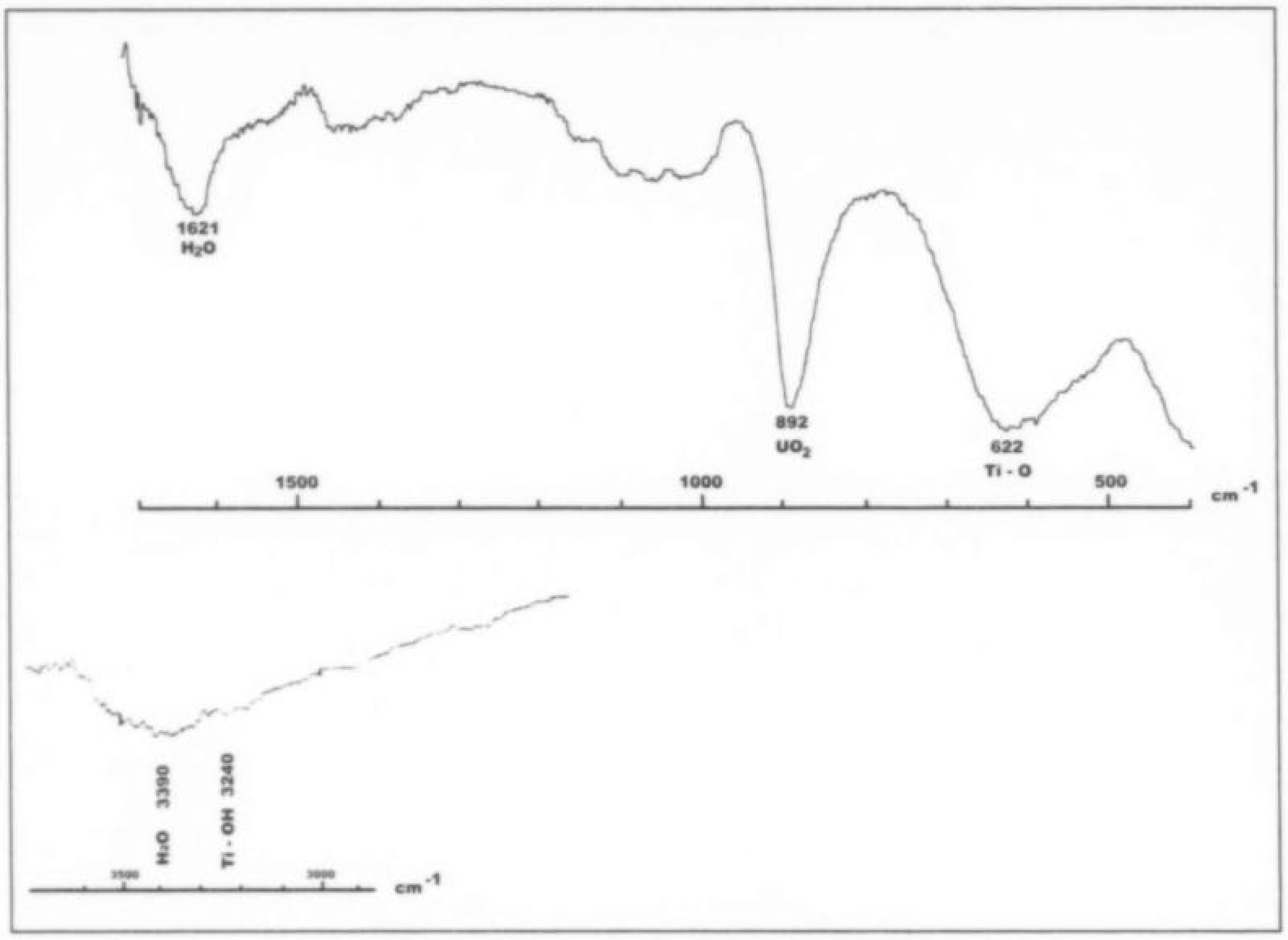

Figure 6. **Infrared spectrum of holfertite.**

Table 3. **X-ray data for U-Ti mineral.**

*Camera**		*Diffractometer***		*Electron diffraction****			*Ca-U-Ti-HREE mineral of Foord et al. (1995)*	
d (Å)	*I/Io*	*d (Å)*	*I/Io*	*d (Å)*	*d_{calc} (Å)*	*hkl*	*I/Io*	*d (Å)*
		9.456	50	9.7	9.37	010	S	9.40
4.60	10	4.660	100	4.6	4.687	020	S	4.70
3.77	1			3.8	3.774	002	W	3.74
3.38	1				3.501	012	Vw	3.52
3.05	2			3.05	3.096	112	W	3.05
2.90	8			2.85	2.940	022	S	2.92
2.61	1w				2.600	130		
2.35	1w				2.343	040	M	2.34
2.12	<1				2.151	230	Vw	2.15
					2.141	132		
1.99	<1				2.046	140	Vw	2.03
					1.991	042		
1.87	3				1.887	004	S	1.87
					1.875	050		
1.747	3				1.751	024	W	1.74
1.593	1				1.604	242		
					1.587	143		
1.531	2				1.538	152		
1.409	1w				1.437	025	W	1.435
					1.405	161		
1.246	1w				1.258	006		
1.211	3				1.229	262	Vw	1.225
					1.215	026		
1.047	1				1.054	182		

a = 10.824 a = 10.756
c = 7.549 Å c = 7.496 Å

* Debye-Scherrer camera 57.3 mm. FeKα (Mn-filtered) radiation, U = 20 kV, I = 25 mA, exposure 10 hours.

** Diffractometer DRON 2.0 U = 30kv, I = 30 mA. Scanning velocity 1 /min, sample had strong preferred orientation parallel to the cleavage.

*** TEM JEM-100C.

CRYSTAL STRUCTURE

The unit cell parameters for holfertite were determined with a Bruker P4 single-crystal diffractometer equipped with a CCD detector: hexagonal, a 10.824(2), c 7.549(2) Å. The crystal structure of holfertite, space group $P3$, $Z = 3$, was solved by direct methods and refined to R_1 21.1%; the high value of R_1 is due to the OD character of the structure. Full details are reported by Sokolova *et al.* (2005).

In the generalized structure model, chains of U and Ti polyhedra link through common vertices to form a framework with channels along [001]. The channels have a diameter of ~8 Å and contain eight sites which are partly occupied by Ca atoms and (H_2O) groups, giving the total channel constituents as $\{(H_2O)_{3.04}Ca_{0.25}\}$ apfu. In the crystal structure of holfertite, many of the 28 sites are only partly occupied. These partial occupancies are almost certainly related to the occurrence of vacancies at the *U* and *Ca* sites, and short-range coupling of these occupancies is almost certainly the cause of the OD nature of the structure.

COMPARISON WITH THE MATERIAL OF FOORD *et al.* (1995)

Several years ago, Foord *et al.* (1995) reported on a possible new mineral species from Topaz Valley, Utah. They described the geology and mineralogy of the Topaz Valley area, and partially characterized a novel hydrated oxide of U-Ti-Ca heavy rare-earth elements from a locality in Starvation Canyon (the locality was mentioned by Robinson, 1993; Robinson and King, 1993) and from a locality about half a mile from Pismir Knolls. The amount of material available was small and the crystals did not diffract well. Moreover, low totals from electron-microprobe analyses suggested an H_2O content of 22 weight % by difference, and a TGA study indicated a weight loss of 35 weight % up to 1000°C. Perhaps because of these difficulties, a formula was not proposed for this material.

The material described by Foord *et al.* (1995) strongly resembles holfertite, and at least some of the material collected by them came from the same small pit in Starvation Canyon (Fig. 2) where we collected holfertite (although the pit has deepened in the intervening years, and holfertite was collected approximately 10 feet deeper than the material of Foord *et al.*, 1995). The X-ray diffraction pattern and calculated cell-parameters reported by Foord *et al.* (1995) correspond to those reported here for holfertite. However, the chemical compositions, optical properties and densities of holfertite and the material of Foord *et al.* (1995) are completely different (Tables 1, 2). We analyzed a couple of dozen crystals and never found chemical compositions even close to the analysis given in Foord *et al.* (1995); indeed, all chemical compositions obtained by us are very similar to those reported in Table 1. Analysis of crystals provided to us by Forest Cureton (obtained by him from E. Foord) corresponds closely to the compositions obtained for type holfertite.

Comparison of the properties of holfertite and the Ca-U-Ti-HREE phase of Foord *et al.* (1995) (Table 1) provides us with a conundrum: (1) the color, habit, X-ray diffraction pattern, crystal class and cell dimensions are consistent with the two phases being identical; (2) on the other hand, the chemical composition, optical properties and density (reported by Foord *et al.*) indicate that the materials are completely different. It seems inconceivable that the differences in the two sets of data can be ascribed to errors in data measurement. Perhaps Foord *et al.* (1995) examined two completely different materials when measuring the properties that they report. In particular, Foord *et al.* (1995) report the Gandolfi pattern of their yellow crystals, and this is virtually identical to the pattern reported here for holfertite (Table 3). However, they also report the density of the yellow needles as 2.64 g/cm³ whereas we obtain >4.22 g/cm³ for holfertite (which is compatible with the refined crystal-structure, Sokolova *et al.*, 2005). The chemical, optical and density data are very different (*e.g.*, $UO_3 \approx 76$ and 19 weight %, respectively). Also it seems unlikely that the 9 weight % Y_2O_3 + REE_2O_3 in Foord's material is a mistake. However, no other Y-bearing or REE-bearing mineral was found at the location so far except cerianite-(Ce) reported above (which contains only Ce^{4+} and no other REE or Y). Foord *et al.* (1995) do report the presence of whitish crystals from the pit at Starvation Canyon, but we did not find any of this material. As noted above, our crystals came from a point 10 feet deeper on the pit than the material collected by Foord *et al.* (1995). Resolution of this conundrum must await rediscovery of the unknown white crystals and composite white-yellow crystals.

ACKNOWLEDGEMENTS

We thank John Holfert for his help with collecting the holfertite material and for consultations on the mineralogy, geology and geography of the Thomas Range, and his wife Galina, Michael Generalov, Natalia Pekova, Patrick Haynes and Jeffery Patterson for additional help with collection of the material. We thank Alexander Zadov, Irina Kiseleva and Lyubov' Ogorodova for the thermal study of the material, Nikita Chukanov for recording and interpretation of the infrared spectrum, Anatoli Sivtsov and Olga Doinikova for the electron-diffraction study, Forest Cureton for grains of the Ca-U-Ti-HREE material from the Eugene Foord collection, and Mark Cooper for his help in finding the best possible crystal for single-crystal X-ray diffraction. Financial support for this work was provided by Dmitriy Belakovskiy personally, and by the Natural Sciences and Engineering Research Council of Canada in the form of a Canada Research Chair in Crystallography and Mineralogy, and Discovery, Research Tools and Equipment, and Major Facilities Access grants, and by the Canada Foundation for Innovation in the form of an Innovation Grant to FCH.

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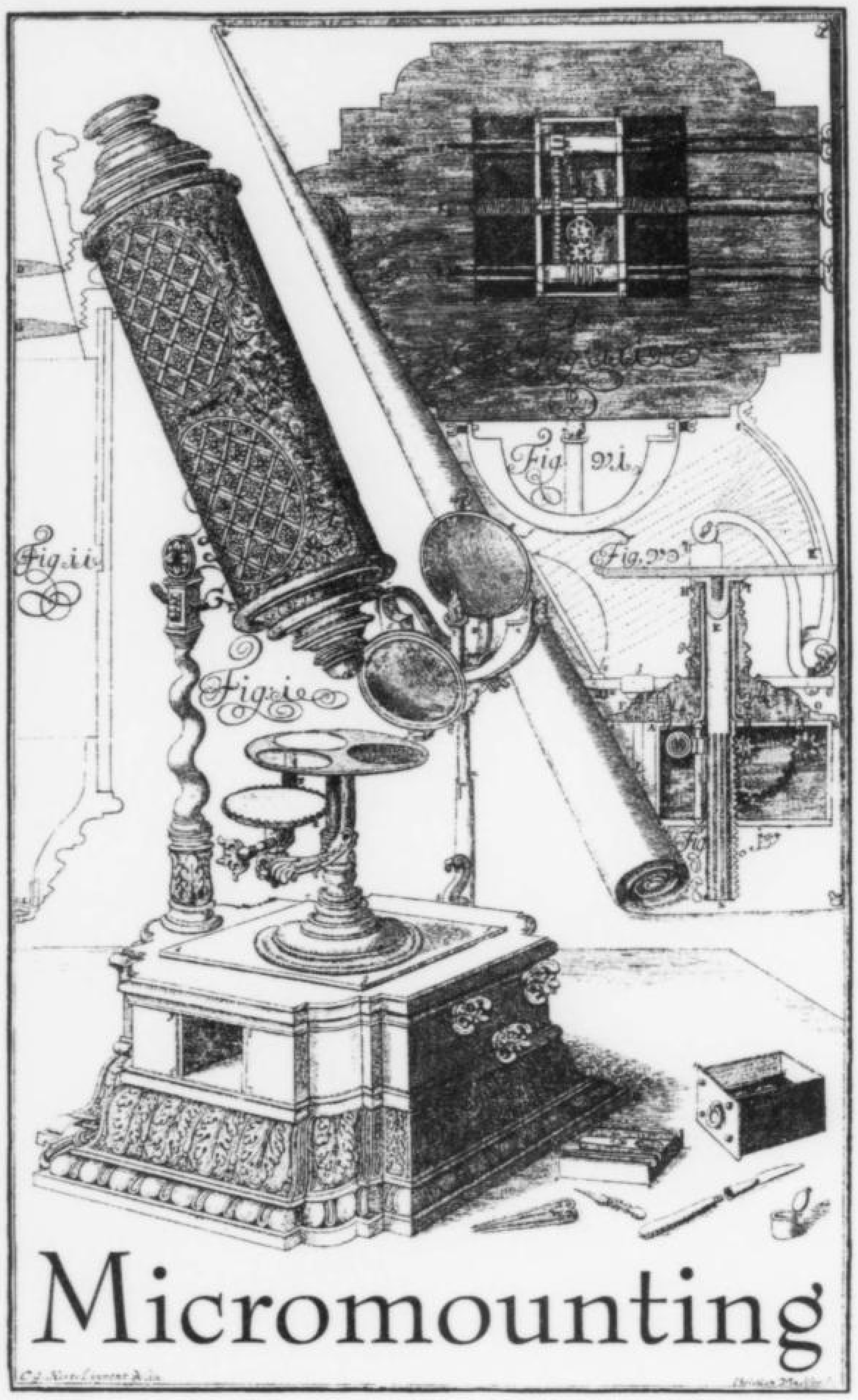

Micromounting

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Stalking the Wily Pedestal

It isn't a secret that I think a micromount isn't a micromount unless it is mounted permanently on a good, strong pedestal. There are exceptions, of course; a specimen that is the precise depth of the box itself may simply be glued in place with no further embellishments, while the box itself may be modified to accommodate a transparent specimen for special viewing. Nonetheless, in the general case, the pedestal makes the mount.

In the past, I have advocated the use of birch toothpicks for my preferred method of mounting through the bottom of the box. (I use that method because it is an easy way to guarantee that the pedestal is always the exact height required, and also because the small diameter of the toothpick makes the pedestal less obtrusive.) A recent trip through a local supermarket, however, made me change my mind. I found a package of 3-mm bamboo skewers.

Toothpicks tend to have diameters betwixt and between. That is, almost all of them require some modification (reaming) of the original hole drilled in the box to get a decent fit. On the other hand, a 3-mm skewer is just right for the hole made by a 3/32-inch drill. That may seem strange, for 3 mm should be closer to a 3/25-inch hole, but the 3/32-inch drill makes the right opening in the plastic for a snug fit. The 3-mm bamboo also makes a much stronger pedestal, which is a bonus.

A Picture's Worth a Thousand. . . .

Much has been written lately about the techniques of photomicrography, particularly that done using digital cameras. One has only to visit the web site of the AFM (Association Française de Microminéralogie) at www.micromineral.org to see the magnificent work of Robert Vernet, or to see that of Richard De Nul go to: http://www.micromineral.org/gito/Sclaigneaux/Sclaigneaux-uk.html.

The thing is that through photography at the local levels, micromounting is opening up to a much wider audience. People who have been wondering what it is that attracts micromounters can now see in sharp detail and brilliant color just what lies on the microscope stage. Slide film has shown some of that in the past, but digital cameras are making massive changes possible. One of the last obstacles to be overcome is depth of field. Digital cameras have the same problems with depth of field as film cameras, but digital cameras can be used in conjunction with computers to find a workaround that is very acceptable.

The basic concept is simple: take several standard shots having low depth of field, each at a different focus level, then combine them into one image that adds up all the in-focus slices and discards the out-of-focus portions. The results can be spectacular images with as much depth of field as one desires. Volker Betz published a fine article on just such a procedure in the *Mineralogical Record* (vol. 36, no. 4), July-August 2005, pages 365–369.

For the micromounter, there is a difficulty with this procedure, however. It is best to have an optical path that is precisely vertical with respect to the specimen (as Betz showed), that is, parallel to the direction of lens movement when the focus is changed. The standard stereomicroscope has a 14° separation of optical paths for the viewer's eyes. That puts the optical paths on each side at 7° off from the vertical axis along which the system is ratcheted up and down for focusing; this makes it much more difficult to keep the specimen in registration (i.e. to keep the same point on the specimen in the precise center of the field of view) as the focus is changed step by step. There is a lateral component to the shift in focus that must be taken into account. Fortunately, there is software to accommodate this difficulty. The application *CombineZ*, written by Alan Hadley, does a fine job of integrating photographic slices—and it is free! It can be downloaded from: http://www.hadleyweb.pwp.blueyonder.co.uk/CombineZ/combinez.htm.

Dr. David Green, Curator of Mineralogy and Petrology at Manchester Museum, University of Manchester, UK, has published an excellent article on the use of *CombineZ*, for photography through the microscope in issue no. 25 of the *UK Journal of Mines & Minerals* (2005). Using a Wild M10 microscope and Nikon Coolpix 4500 digital camera (the model most favored by photomicrographers) he demonstrates the capability of the ensemble in a step-by-step description, paying attention to the critical aspects of resolution and the calculation of depth of field. Some of his photomicrographs employing the *CombineZ* technique are reproduced here. The technique requires concentration and attention to detail, but the results are well worth the extra effort involved.

A difficulty for a lot of digital photographers wishing to use the bellows for photomicrographs is that their preferred camera, the Nikon Coolpix 4500, is optimized for microscope work and does

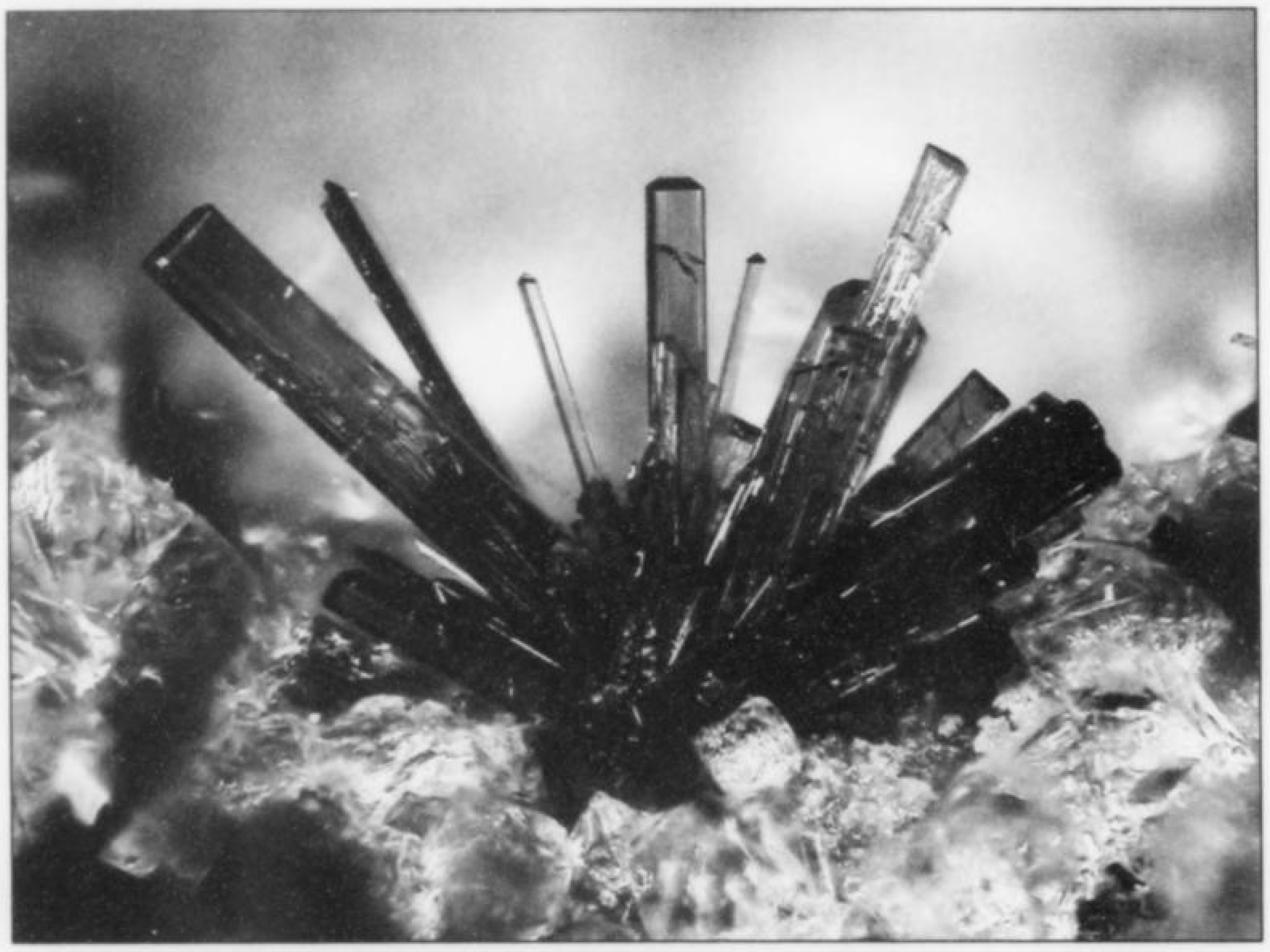
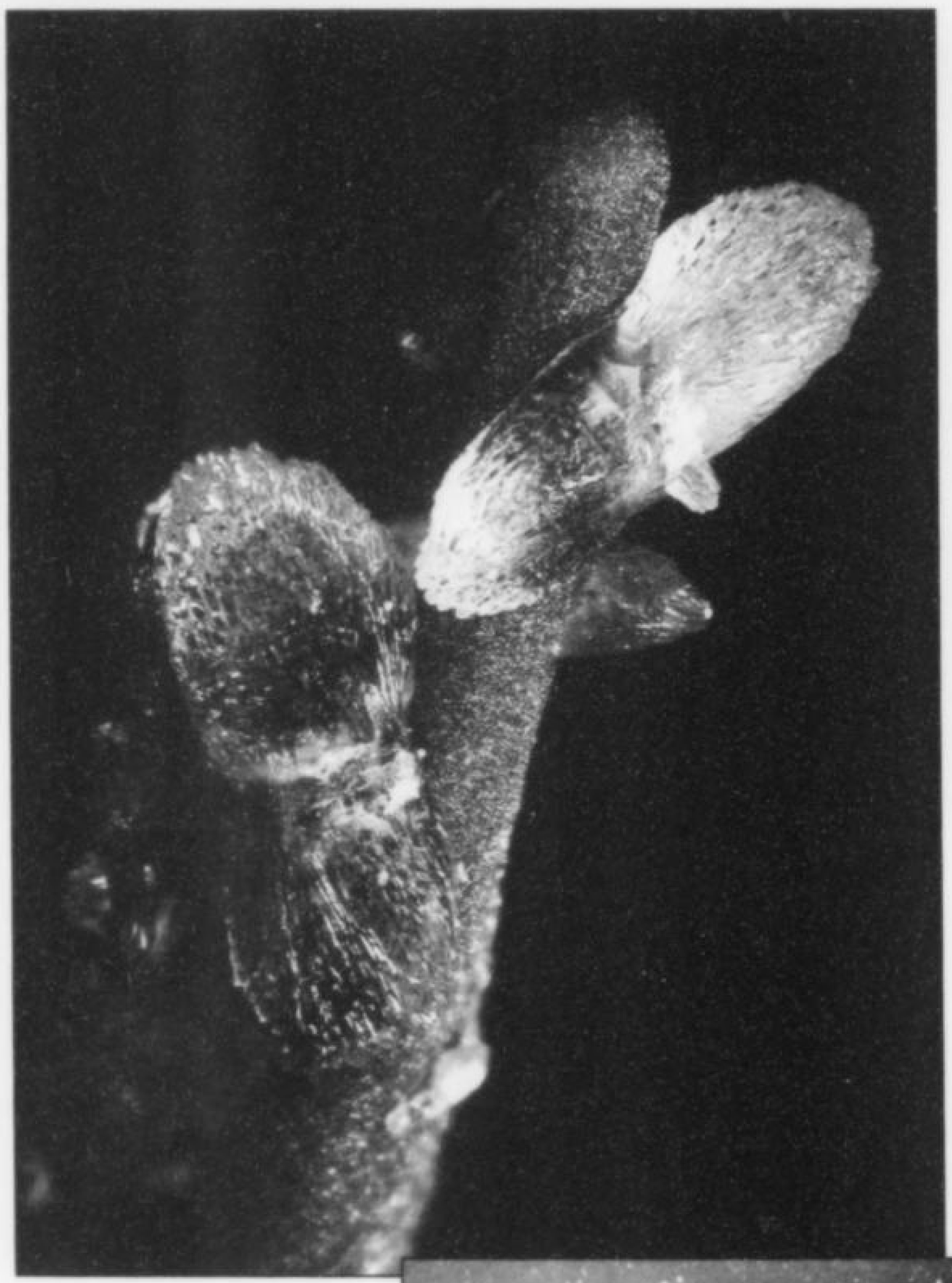


Figure 1. **Allanite crystal cluster, 1 mm, from Ardragh, County Galway, Ireland. Stephen Moreton collection and David Green photo.**



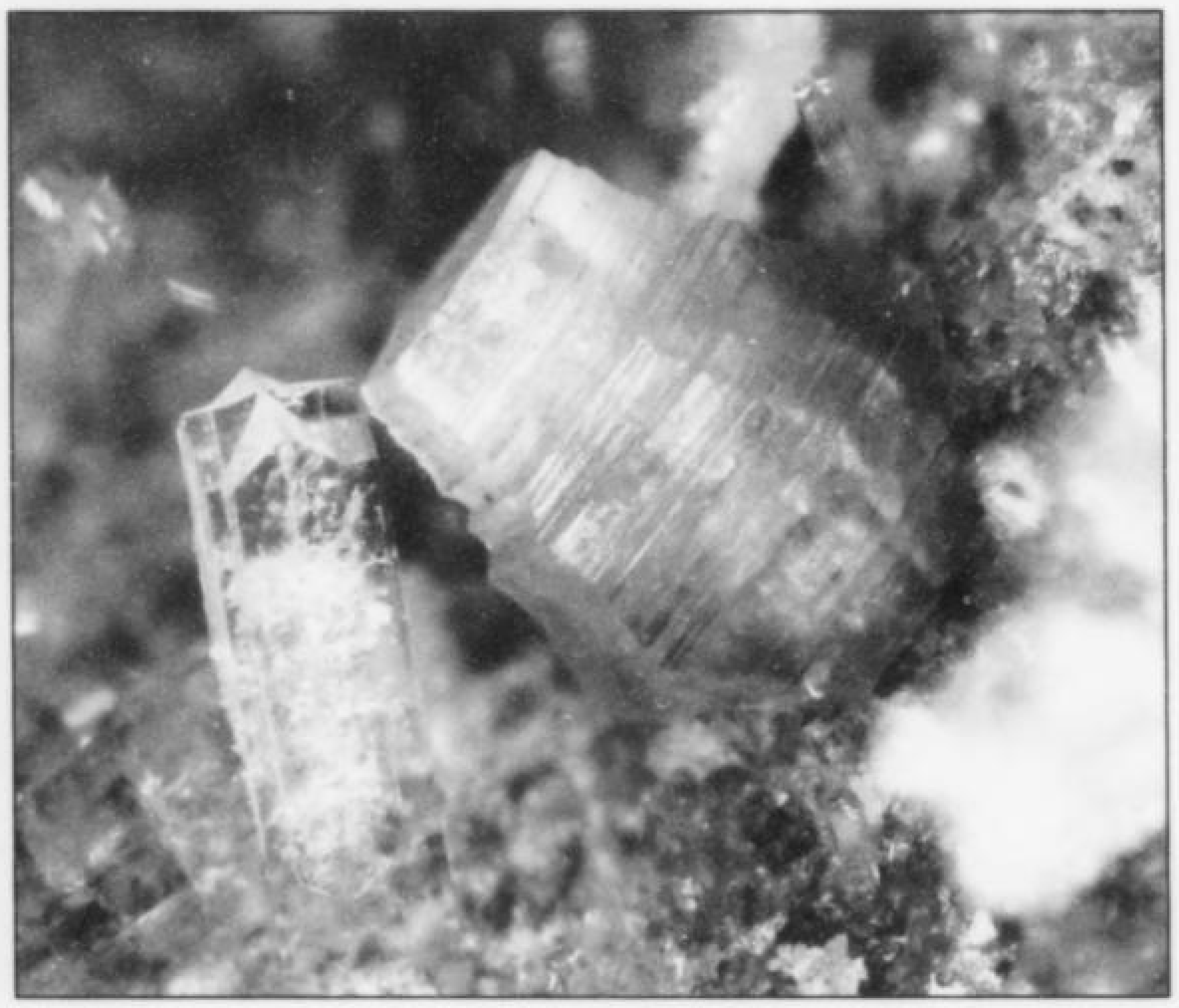


Figure 2. **Ewaldite crysyal (pale yellow), 2.5 mm, with harmotome, from the Dolyhir quarry, Wethel, Old Radnor, Powys, Wales. David Green collection and photo.**

Figure 3. **Smithsonite crystal aggregates to 2 mm, from the Kintore opencut, Broken Hill, New South Wales, Australia. David Green collection and photo.**

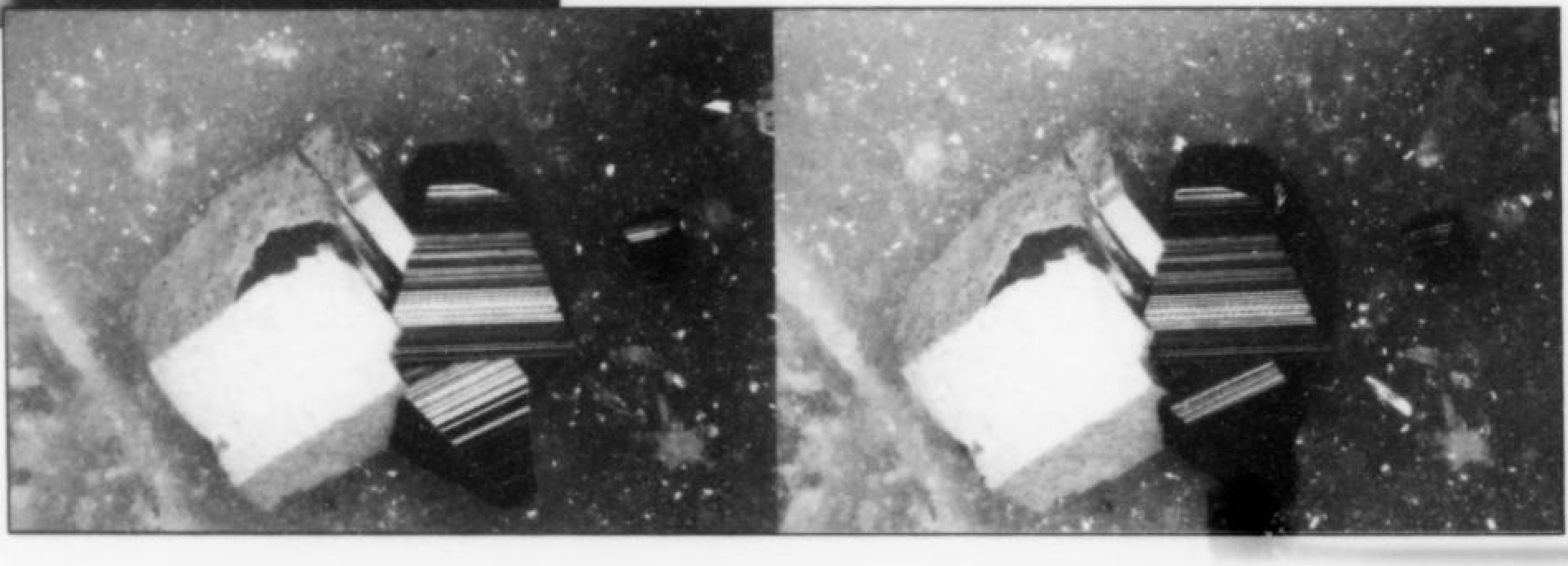


Figure 4. **Anatase crystal (black), 1.5 mm, with synchysite, from Blaenau Ffestiniog, Gwynedd, North Wales. David Green collection and photo.**

***Figure 6. (above)* Brewsterite crystal, 3 mm, from Strontian, Highland Region, Scotland. David Green collection and photo.**

***Figure 5. (above left)* Harmotome twin, 2 mm, from the Corrantee mine, Strontian, Highland Region, Scotland. David Green collection and photo.**

***Figure 7.* Synchysite crystal, 3 mm, from Blaenau Ffestiniog, Gwynedd, North Wales. David Green collection and photo.**

***Figure 8.* Calcite crystal, 5 mm, from the Whitesmith mine, Strontian, Highland Region, Scotland. David Green collection and photo.**

not fit a standard bellows well. Under those circumstances, one can either work up some sort of adapter to fit, or switch to a camera that will accept the bellows as a normal lens.

Three such cameras are the Nikon D70, Nikon D50, and Pentax *ist DS. All three will take a variety of lenses, all three are in the 6 mega-pixel range, and all three use the same Sony CCD sensor. They will also produce images in RAW (unprocessed) format if desired. In this case, although Nikon has the greatest hold on most photographers, my personal preference is for the Pentax. That is because the Pentax will perform an automatic exposure through

Figure 9. **Wulfenite crystal, 1.4 mm, from the Whim Creek mine, Western Australia. David Green collection and photo.**

just about any lens, but the Nikon cameras will not—they work only through dedicated lenses with electrical connections. I use an older Nikon bellows. It fits the D70 perfectly, but the D70 will not do an automatic exposure through it because it has no electrical connection. The Pentax, however, attached to the same bellows with a 30-year-old K-mount adapter, works well. That is not to say that the D70 or D50 cannot be used through a non-dedicated bellows. They can—but not automatically. One has to be prepared to bracket shots or to choose an exposure time, take the shot, examine it immediately (fortunately, digital cameras allow that), readjust as necessary, and shoot again until a satisfactory picture is obtained. The Pentax simply measures the light for itself, and takes the picture—usually right on target for exposure. With the Pentax, one can also lock the mirror up to avoid vibration, and use an infrared pulse to release the shutter without touching the camera.

I have looked at these three cameras only. It is entirely possible that those of another SLR manufacturer such as Canon or Olympus will also perform an automatic exposure with a non-dedicated lens. The point is not to denigrate one brand or push another; it is simply to point out that when buying a camera for a particular purpose, it is best to make certain that the camera will perform under the conditions required.

Making Light of it . . .

I have mentioned previously that I use a cylinder of artists' mylar to diffuse light when taking photographs. At the Rochester Mineralogical Symposium in April, 2005, George Hanna came up with a different approach. He said: "This is the method I use to photograph my minerals using a Nikon Coolpix 995, a Meiji RZ microscope, and a Techniquip fiber-optic light:

I keep my light to the right of the microscope with the fibers from the light box coming out (facing) toward the left. The fiber-optic light has two lines coming out I call "right" and "left." Both lights come with a light condenser. The left condenser I remove. This gives me the diffuse light, which I shine directly onto the specimen. The light on the right I turn sideways facing away from the specimen. I take a mirror and shine the condensed light off the mirror and angle it towards the specimen from the other direction. This gives me two separate types of light shining on the specimen—polarized and unpolarized light. I do not think the two types of light react with the specimen in the same way since the polarized light does not seem to make as many specular reflections off a crystal. Maybe part of the reason for less reflection is explained in F. D. Bloss's book *An Introduction to the Methods of Optical Crystallography*, where he writes that polarized light is not as intense as unpolarized light. Instead of the mirror, I also tried reflecting the light off a filter I bought as a book of 100 from Science Kit & Boreal Laboratories (Catalogue Number 30394-18). I also tried putting the filter in the front of the mirror to further mute the lighting for metallic, black on white, or other high contrast specimens."

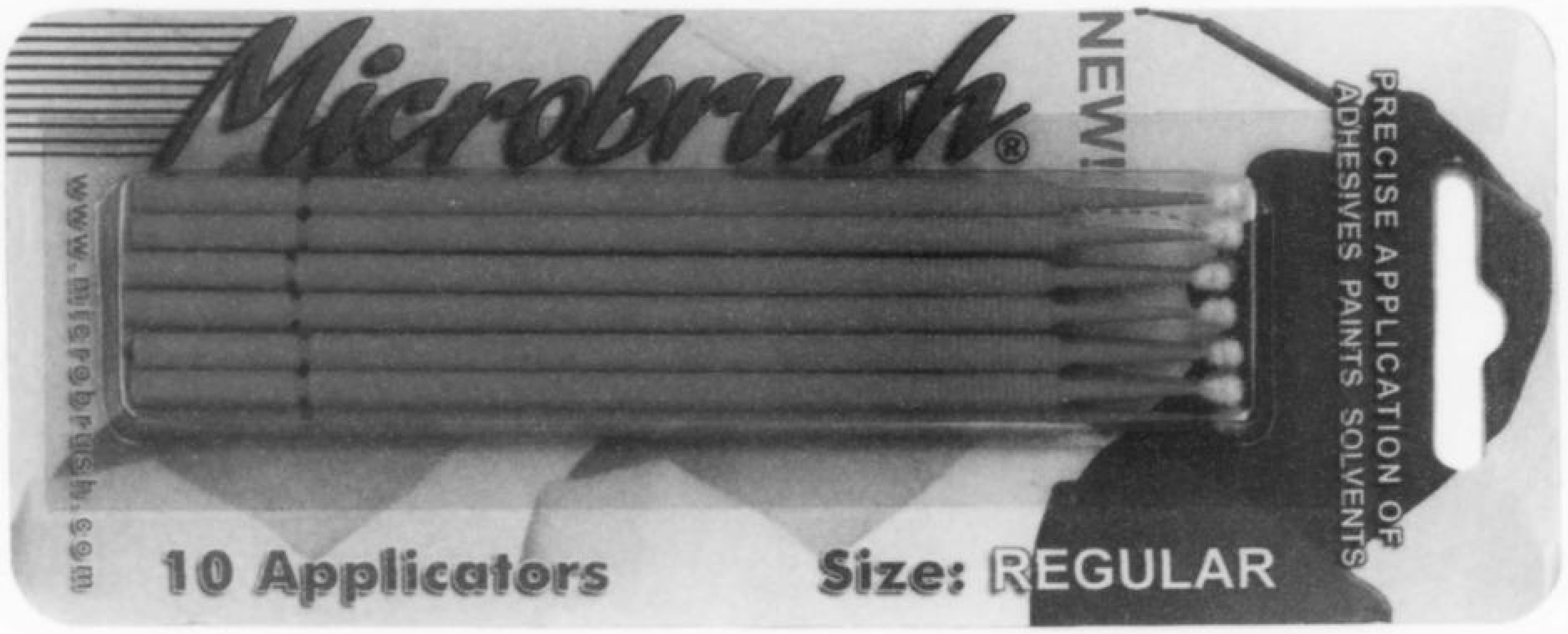
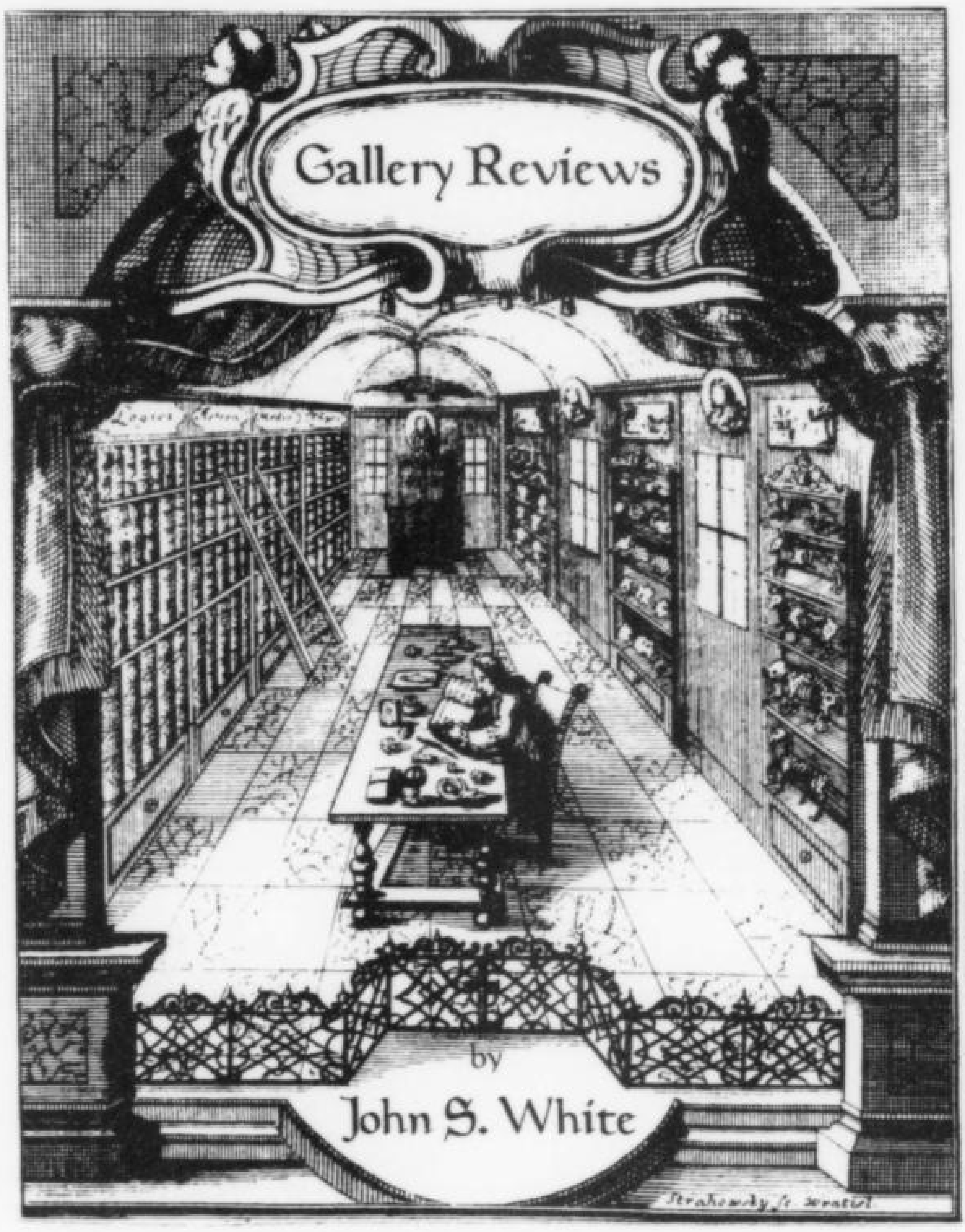


Figure 10. **"Puffbal" microbrushes for fine-scale work.**

The Brush-off—

Micromounters sometimes find that painted boxes can be frustrating. A slight twitch as one inserts the specimen can mar the painted finish. Patching scratches once the specimen is in place is extremely difficult. Ken Ewing, a micromounter from Kingston, Ontario, drew my attention to the products of the Microbrush Corporation of Grafton, WI, www.microbrush.com. These are applicators, 10 cm in length, and with a tiny fiber "puffball" at the tip, that are ideal for slipping into a narrow space to touch up defects in painted surfaces. They can also be used to apply glue reinforcement, or even solvent to remove glue and release a specimen. At ten to a package, they're cheap enough to use and toss, although they can be used several times. They are available in many hobby stores.



MINERAL MUSEUMS UPDATE

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What follows is a series of reports on the exhibit areas of various major mineral museums. Some represent revisits to galleries previously reviewed in this journal; others are comments on galleries or collections which range from alarming to encouraging. This survey is not intended to be comprehensive; there are many other galleries that deserve attention in this forum and will perhaps be reviewed in the future.

National Museum of Natural History, Smithsonian Institution, Washington D.C.

My impression of this mineral and gem display has not really changed since I reviewed it in 2000 (White, 2000). It remains the nearest thing to perfect that I have seen in an institutional mineral and gem gallery to date. This does not mean that it *is* perfect, however; far from it. The design elements that do not work are still there and cannot easily be changed without a major investment, and that is not likely to occur. In many of the cases there are serious gaps between glass plates so that dust is a constant problem. Dust can be seen seriously coating many specimens and covering many of the surfaces that the specimens rest on. Since label text has been screened onto these surfaces, rather than each specimen having its own individual label, there is a real problem where the type is breaking up and becoming difficult to read. These cannot be easily repaired without removing entire panels and rescreening all of the type that is on them: something not likely to be done anytime soon.

Lighting, overall, is good, and burned out lights can easily be replaced because they are not inside the cases containing minerals but are in separate compartments so they can be accessed by museum service personnel, assuming there are such. Unfortunately, however, it appears that this responsibility has been relegated to technicians in the mineral department.

Other deficiencies and errors on labels detailed in the 2000 review have not been addressed. The mistakes are still there and the deficiencies remain. For example, the label for a specimen containing several prominent minerals does not attempt to tell the viewer which of the various minerals the label refers to, the most grievous example being the charoite slab. The "New Acquisitions" case is totally underwhelming. It contains a small number of ho-hum specimens along with a large number of unimportant cut stones. I would be embarrassed to suggest that these specimens represent the best of what has recently been acquired by the museum. Mistakes on labels also remain. "Celestite" appears instead of the currently-accepted "celestine" on five labels, and I even found a new error this time: "gwendel" instead of "gwindel" (in four different places!).

In spite of these shortcomings the Smithsonian's mineral and gem gallery remains, in my opinion, the premier example of how best to display what one has. Overall, it is head and shoulders better than its nearest competitor.

Natural History Museum, London, England

When you first enter the *newer* mineral gallery (yes, there are two) your first impression is one of overwhelming darkness and gloom. It is almost like entering a tomb, a reaction heightened by the presence of a huge stone monolith at one end of the gallery, upon which are printed the names of all of the mineral species known at the time the gallery was opened (see Fig. 1). When I first reviewed this gallery (White, 1999) I thought that it was about as bad as it could possibly be. I have been back twice since and, believe it or not, it seems to have gotten worse with each visit. Each time one notices appalling things that were somehow missed before—presuming they are not entirely new. Apart from the depressing darkness, the thing that struck me most profoundly this time (March, 2006) was just how distracting the design elements are when one is trying to view the minerals. They compete disastrously with the minerals (Fig. 2). Instead of being presented in flattering light, the minerals and gems are largely hidden in shadows and sitting on cold and unfriendly surfaces, mostly metal in one form or another (rods, grates, screens, etc.). Labeling is beyond bizarre, making the visitor work hard in order to figure out which label accompanies which specimen. It helps if the visitor knows minerals because it would otherwise be very easy to match up the wrong set of labels with the numbers.

The lighting has not been improved since the gallery opened in 1998, and one might argue that it has even deteriorated beyond what it was then. Most cases are poorly lit, and far too many have their lights out altogether (Fig. 3). One gets the distinct impression that the staff of the museum has divorced itself entirely from this gallery, as there is no evidence that maintenance is occurring. Thick coatings of dust cover many specimens as well as case surfaces, and many of the large glass plates in some cases now have an ugly film over them.

Going from the "new" gallery to the old gallery is like gulping a breath of fresh air. Even though the old one relies almost entirely on daylight, it is wonderfully bright even on a cloudy day. It seems warm and friendly after climbing out of the monstrous mausoleum. It is open and spacious, and the minerals, in their almost flat-topped cases, can be easily seen and appreciated. The labeling, too,

Figure 1. **Trying to read mineral names on the monolithic slab in the new exhibit hall of the Natural History Museum, London.**

is user-friendly; there is actually a label next to almost every specimen. Remarkably, however, most if not all of the newer acquisitions lack labels. There are also numerous empty spaces where specimens have been removed, with no explanation as to where they have gone or why they were removed. Figure 4 shows specimens of deteriorated epsomite that probably should have been removed long ago.

It is interesting to contrast the displays of classic British minerals in the two galleries. In the "new" gallery the specimens are mired in gloom, poorly lit, abominably labeled and easy to overlook. The old gallery has about six cases featuring British minerals, and these cases appear to have recently been upgraded. The minerals sit on a plain light-colored panel which does not distract from them. They are very well illuminated by supplementary lighting. The labels are easy to read and are placed adjacent to the specimens they describe.

Throughout the exhibit of minerals, both new and old, neglect is everywhere evident. While the older gallery looks tidier at first,

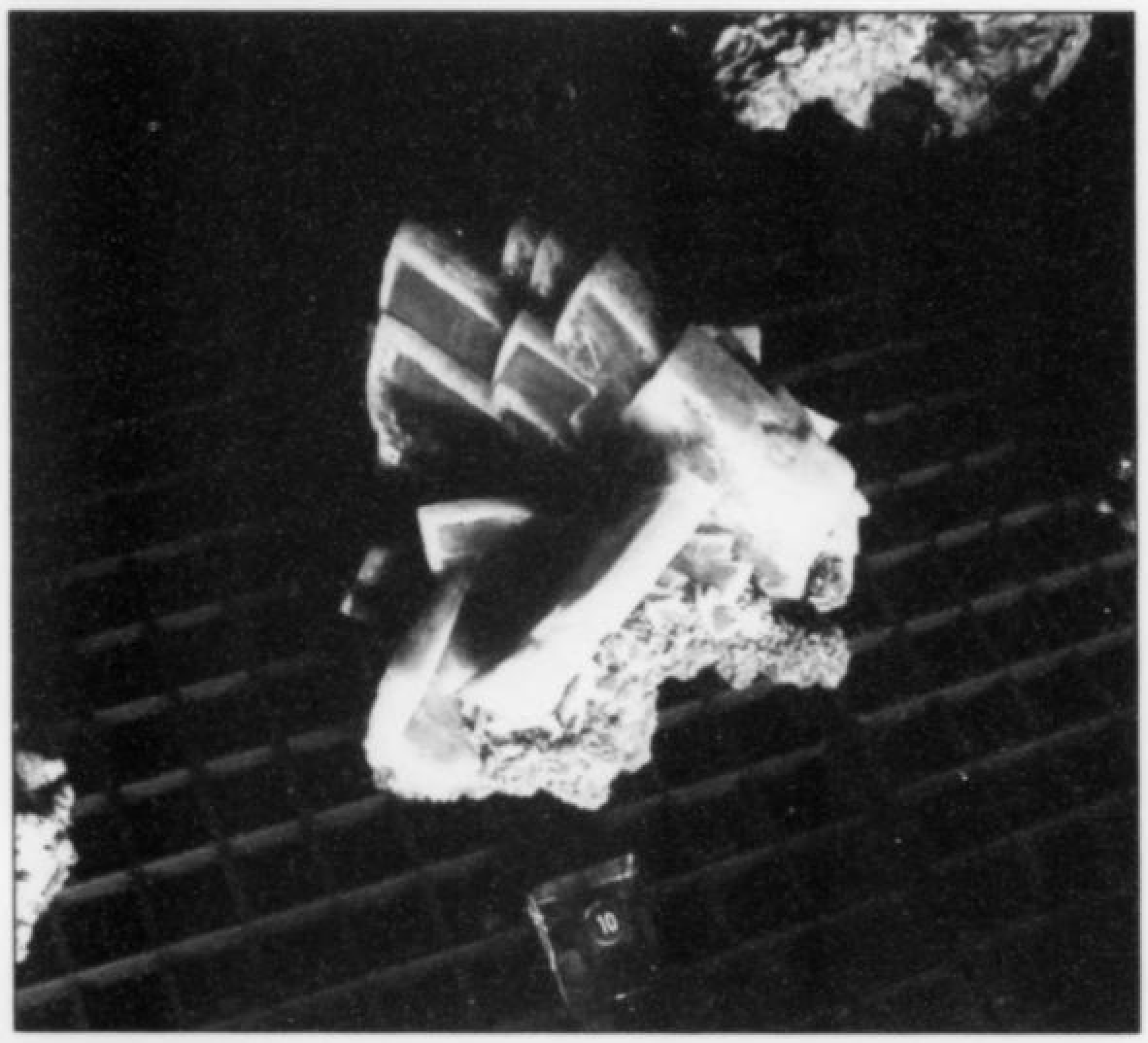

Figure 2. **A barite specimen sitting uncomfortably on a grate in the new exhibit hall of the Natural History Museum, London.**

Figure 3. **Using a penlight to examine poorly lit specimens in the new exhibit hall of the Natural History Museum, London.**

Figure 4. **Crumbling epsomite specimens on exhibit in the old mineral hall of the Natural History Museum. London.**

closer inspection reveals debris in the cases, especially in the redone "Minerals of Britain" displays. The "new" gallery is so dark and depressing that I suspect that no one wants to go in there and service it. How the lone guard on his stool manages to stay awake is anybody's guess. Of course, it is so dark in there that he could be napping and no one would be apt to notice.

Royal Museum of Scotland, Edinburgh

The following comments on this museum have been provided by Roy Starkey, who describes himself as "a keen British amateur mineralogist with a strong interest in Scottish mineralogy and localities":

> Almost 20 years ago, in July 1988, the first "Mineralogy and Museums" Conference was held at the Natural History Museum in London. Attracting over 100 delegates from 18 countries, this conference discussed the unprecedented and rapid change which many museums were experiencing at that time. Now, as we look ahead to the remainder of the 21st century, it seems that this pace of change will only accelerate.
>
> The original conception that the role of museums is to safeguard, and make accessible to the public, collections of natural objects and artifacts, has been supplanted by the idea that they are places of entertainment rather than study. The fundamental problem seems to be what the providers of funds expect to get for their buck. The apparent fixation on achieving wide-scale public engagement, rather than technical or educational excellence, has resulted in an immense dumbing down of museum exhibits over the past 20 years or so. If one looks at the Natural History Museum in London, the previously great displays in entomology, birds, dinosaurs etc. which existed when I was a boy have all but been replaced by computer graphics and animatronic models. The world famous Mineral Gallery, with its comprehensive systematic display, does still survive, thankfully, but for how long?
>
> The recent case of the Royal Museum of Scotland in Chambers Street, Edinburgh, illustrates the concern. First the good news: the Museum has secured some £16 million (nearly $30 million U.S.) of Heritage Lottery funding for a major redevelopmant as part of an initial phase in the implementation of the Royal Museum Master Plan—a 15-year program of renewal and redevelopment which (according to the Museum website) "will open up access to our collections by providing inspiring new displays and visitor facilities."
>
> Now for the "not so good" news: Two mineralogy galleries were closed in early spring of 2005 as part of the Royal Museum Master Plan. The plan allowed for the redevelopment of that part of the museum, including two new mineral exhibits. The proposed exhibits, Precious Planet and Mineral Treasures, formed part of the successful bid for "Lottery" funding for the redevelopment, but the Mineral Treasures exhibit was taken out of the first phase of redevelopment, and in December the Precious Planet exhibit also was cut from the first phase. This phase is scheduled to be completed by 2011. As yet no decision has been taken on whether Mineral Treasures will be part of Phase 2, and Precious Planet is currently not being considered as part of Phase 2. (Mineral Treasures was to be a small exhibit of attractive minerals with no educational messages, whilst Precious Planet was to be an exhibit on the use of minerals and their role in the development of civilization.)
>
> At present there is still one mineral gallery open to the public, but this too will be closed by the end of 2007. This means that after 2007 there will be no mineralogical exhibits until 2014 at the very earliest. Some minerals will be on display from 2011, but these will be merely as supporting objects for the major themes "Earth and Space" and "Earth Works." There will also be some mineral specimens on display as part of the "Menu Wall" now renamed "The Mosaic Wall." This "Wall" is supposed to give a flavor of the breadth of the museum's collections.
>
> The tragedy here, because of the likely new policy on displays, is that while a "flavor of what the Museum has" will be provided, we probably won't be able to see much of these holdings. It also seems likely that the displays will be strong on visual impact, but not provide much interpretation of the items on display.
>
> Readers can find some information on the National Museums of Scotland website, but the information is of only a very general nature.
>
> As part of the redevelopment program the Scottish mineral collection has been packed up and moved to new storage at a facility at West Granton on the north side of Edinburgh. The collection is not unpacked at the time of writing (April 2006), and there will be only limited access as the Staff gradually unpack it as needs require. The collection of non-Scottish minerals is scheduled to be packed and moved between March 2006 and August 2007. As yet no storage facilities to re-house this collection are available, and the likelihood is that none will become available before August 2007. This will mean that the specimens will have to be stored in some temporary

facility, such as a warehouse, and access to this collection will be, at best, severely curtailed.

Obviously, the stated objective of "displaying 100% more objects" will not apply to minerals if there are to be no specific mineral displays, and if minerals are reduced to mere supporting objects in other sorts of displays.

Given the undoubted "world class" status of the mineral collections, especially of the material from Leadhills and Wanlockhead, Strontian, and the many classic Scottish zeolite localities, it will be a tragedy if the new developments not only deprive visitors of the previous mineralogical exhibits but also fail to put Scottish minerals at the center of the new Natural History galleries and displays.

Mineralogy is, after all, a specimen-based science, and the need to see minerals ON DISPLAY, rather than graphics and interactive computer-based exhibits, is a fact that the museum authorities and the new Director and his team should take into account while developing future plans for the Museum. Perhaps, if this happens, there will be a change in emphasis, and the existing potential for a world-class mineralogy gallery and exhibit, providing the visiting public with an opportunity to view and wonder at Scottish minerals, will be realized.

The richness of Scotland's mineralogical heritage was amply showcased in Alec Livingstone's recent book *Minerals of Scotland*, and in the Hunterian Museum exhibit at the Tucson Show in February of this year. The Royal Museum Project is simply too good an opportunity to miss—let's hope that we do not have to wait another hundred years to put it right!

Royal Ontario Museum, Toronto, Canada

When I reviewed this museum in 2001 (White, 2001) the Mineral Hall display was less than two years old. Now it is gone. It was dismantled after only about four years (some sort of a modern-day record for short-lived exhibits, no doubt) and it is alleged to have cost some $4.25 million (I never was able to determine if this was in Canadian or U.S. dollars). The figure does not, I am sure, include the salaries of the museum staff for the thousands of hours spent in planning and installation—planning which extended over a period of 16 years! While I am not sorry to see the Mineral Hall gone, I am appalled at the waste of time, effort, talent and money that its short career represented. The reason given for the dismantling is not that the museum was unhappy with the gallery but that the space was needed for another exhibit that was too massive to be installed on an upper floor.

So, planning for a *new*-new gallery is under way and I am told that it is expected to open around mid-2007. Given that the *old*-new gallery was some 10 years late in opening, this projection may turn out to be optimistic. I am told that the new-new gallery will include:

> . . . a gem and gold room of comparable size to the old Perren Room, and a mineral hall that will feature five cases of systematic collections (approximately 1500 specimens) and five cases on the other side of the gallery dealing with localities. We will have a huge meteorite display . . . and a fluorescence/properties-of-minerals display. In total, we have a gallery that will be just over 7000 square feet with twice the number of minerals in it compared to the last time (roughly 3300 minerals/gems).

I am somewhat disappointed to learn that systematics apparently will dominate the display, as I am convinced that the systematic approach is ineffective in imparting useful information to visitors. I am very disappointed to learn that the museum intends to repeat the disastrous use of "paddleboards," which are laminated cards that slip into slots at the bases of some of the cases. These paddleboards are to contain information about the specimens so that the cases will be less crowded with labels. This may make some sense in theory (and is, at least, more easily correctable than the screened text backing the Smithsonian exhibit), but the reality is that visitors don't avail themselves of this feature.

Labeling overall in the recently closed gallery was abominable; let us hope that it is vastly improved when the new gallery opens.

Denver Museum of Nature & Science, Denver, Colorado

Here is one of the more alarming situations with respect to domestic museums. At the September 2003 Denver Gem and Mineral Show a rumor circulated that the mineral curator, Jack Murphy, was being let go by the Denver Museum, ostensibly as a cost-cutting measure. In response to my letter to the museum, its then-president and chief executive officer Raylene Decatur wrote that Jack was not being fired but was being "asked to stay on at the Museum working half time." What an insult to one of the best curators that I know. It is noteworthy that Raylene Decatur is no longer with the Denver Museum.

The administration was caught somewhat off guard by the public response to the news that Jack was to be demoted. In response to a chorus of disapproval from the museum's members, volunteers, and the general public, the administration attempted to explain why Jack and one other museum curator were selected to bear the department's mandated cost reduction. It was primarily because they were not also holding supervisory/managerial roles. In response to the repeated claim that Jack Murphy only holds one job versus the two or more duties held by other department personnel, consider these observations:

Jack Murphy has many duties and responsibilities affecting four different disciplines: minerals, gemstones, rocks and their geological relationships and, of course, the popular meteorites. He is responsible for the curation and stewardship of more than 48,000 individual specimens that have come to the museum over the last century, including the valuable gold collection, the rare Colorado diamonds, and the recently nationally recognized "rhodochrosite wall" (the reconstructed "Coors Pocket": see the Sweet Home Mine Issue of the *Mineralogical Record*, July-August 1998, p. 90–91), as well as the Alma King rhodochrosite specimen (same issue, p. 38), which he was instrumental in having donated to the museum. Constant new donations require his special attention. Among these is the Paul Seel micromount collection, comprising some 20,000 specimens including some 800 species and also including what is surely the best assembly anywhere of micromount-size diamond crystals, some 10,000 in number. Jack was an integral part of the amazonite and smoky quartz pocket reconstruction and diorama in the 1980's; construction of Coors Mineral Hall (now, I understand, to be deconstructed); and a specimen recovery venture at Gilman that yielded crystallized pyrite that is now part of the mine tunnel reconstruction at the Mining Museum in Leadville. He also co-authored the update to *Minerals of Colorado* (Eckel, *et al.*, 1997).

Jack has been the museum's most untiring and supportive representative to the public and scientific world. His vast knowledge and ongoing research result in frequent articles and public appearances. This is evidenced through the popular "building stones walking tour" books, his geology field trips, his research on newly arriving specimens and his research into the historical aspect of the collections. In Denver he is certainly one of the most familiar museum faces on television. He has been the curator of the mineral collection at Denver for 35 years, which may be something of a longevity record for a mineral curator in this country.

As far back as I can remember, Jack has always been an active member of the mineralogical community. He always attended and participated in the meetings of the mineral curators group. As a curator, Jack was accessible and interacted well with the local mineral community—a rare practice among today's mineral curators. In other words, he has been very much a model curator.

A visit to the Museum's website is enlightening. Paleontology claims four curators, a collection manager, a curator of paleoecology and a paleontology assistant preparator, seven bodies in all. Jack is not mentioned, and minerals, rocks and meteorites apparently have no representatives at all. Yet the website makes the true statement that "Colorado was founded on mining." The current emphasis at the museum would suggest instead that Colorado was founded on paleontology. Talk about being marginalized!

Harvard University Mineralogical Museum, Cambridge Massachusetts

At the Tucson Show in 2006 there were wild rumors circulating about dire threats to the mineral collection and exhibit at Harvard University. It would appear from the following comments from the curator, Dr. Carl Francis, that there was nothing to these rumors:

> For the University to be constantly pushing ahead the frontiers of knowledge, its schools and departments must evolve. They do this by hiring young professors who are working in the newest fields, rather than replacing retiring professors with younger people of the same ilk.
>
> When I arrived in 1977 there were professors of mineralogy, petrology and economic geology in the Department of Geological Sciences. They had responsibility for the various collections of minerals, rocks and ores (respectively). I was hired by Clifford Frondel to curate the minerals and meteorites. I hired William "Bill" Metropolis a couple of years later. Bill and I have been the only full-time collections staff. There has never been fulltime staff for rocks or ores, despite the size and significance of those collections. What little curation of those collections has occurred over the past 25 years was done by student assistants or by me.
>
> The department broadened its scope about 15 years ago and is now the Department of Earth and Planetary Sciences. All of the professors of mineralogy and petrology with responsibilities for collections have retired and been replaced by, for example, a biogeochemist, a structural geologist and a group that studies climate change. A senior appointment was made roughly in the area of petrology. Charles Langmuir studies ocean floor basalts, but calls himself a geochemist. So the extensive rock and mineral collections are no longer viewed by most of the faculty as relevant to their own research or integral to their teaching needs. Fortunately, Charlie does not feel that way and he is now the chair of the Department's collections committee.
>
> We've been given the mandate by Charlie, representing the faculty committee, of bringing the curation of the rocks up to 21st-century standards. There is to be no retreat on the care of the minerals. He wants the rocks, like the minerals, to be in an electronic database and online so that investigators and instructors here at Harvard and around the world will be able to search the collections for rocks as easily as library catalogues can be searched for books. This is perfectly reasonable. Unfortunately, Bill and I are the only staff available for this massive undertaking. We have hired a couple of students to help us, but much less of our time henceforth will be available for minerals.
>
> Charlie suggested that I not go to Tucson this year simply to save money. He's never been there and doesn't understand the scope or significance of the event. Neither Bill nor I anticipated the rumors that my remaining in Cambridge during the Show would spawn. The collections are not in peril, nor has our employment status changed, although new job descriptions are in the works. We fully expect to retire from Harvard on our normal retirement dates (2016 in my case).
>
> So it seems that in the future we shall be much more involved in serving the scientific and educational missions of the evolved department than just continuing to build the finest mineral collection we can. But the mineral exhibit is not threatened: I know of no plans to further renovate or change the mineral gallery.

Academy of Natural Sciences, Philadelphia, Pennsylvania

The sorriest story of all is what has been afoot at this venerable institution. Several years ago the word filtered out that the Academy was no longer interested in its exceedingly valuable and historic mineral collection, virtually none of which has been on exhibit for as long as anyone can remember. The Academy had the collection appraised, the appraiser put a ludicrously high number on it, and so, with visions of a great financial windfall, the Academy set out to sell major parts of the collection. This news generated a firestorm of criticism which the Academy deftly ignored by failing to respond to the flood of letters and appeals to rethink this potentially criminal act. I very much regret that much of what I am able to write about this situation is based on hearsay, because the Academy has stonewalled me totally in my efforts to gain information directly from its administration.

In any case, the game plan, apparently, is/was to deaccession (sell) the mineral collection, except for the Pennsylvania Collection (which had been given to the Academy by act of the state government), the Lewis and Clark Collection, and some of the gem collection that is currently on display. It has been suggested that they had hopes of this sale being made to another public institution; if so, the hope was completely irrational, as the number of such institutions that could even dream of coming up with the amount of money that the Academy had been led to believe the collection is worth could probably be counted on one finger. I have recently been told that the arrangement with the agent they hired to negotiate such a sale has now expired, so, with no news coming out of the administration, one can only fear the worst, namely the likelihood that the Academy is now prepared to break up the collection and sell it piecemeal.

The historical value of this great collection is probably unequaled by any other public or private collection in this country (Nikischer, 2004, Lininger, 2004). It is not an exaggeration to say that Philadelphia is unquestionably the cradle of American mineralogy, and the mineral collection at the Academy is a treasure-trove of artifacts reflecting that rich heritage. Familiar names associated with the collection include Lewis & Clark, Adam Seybert, Gerard Troost (troostite), Isaac Lea, Henry Seybert (seybertite; son of Adam and discoverer of fluorine and beryllium), Henry Darwin Rogers (first state geologist), Lewis White Williams (williamsite, since discredited as antigorite), Charles Moore Wheatley (owner of the Wheatley mine), William S. Vaux (donor of a 12,000-specimen world-class mineral collection, one of the finest ever formed in the United States), William W. Jefferis (jefferisite, since discredited as vermiculite), Charles Pennypacker, Frederick Genth (genthite, since discredited as népouite or pecoraite; Genth was the author of the first mineralogy of Pennsylvania), George S. Vaux (vauxite, metavauxite, paravauxite; nephew of William S.), Edgar T. Wherry (wherryite) and Samuel G. Gordon (gordonite; curator at the Academy and founder, along with Wherry, of the *American Mineralogist*).

Space here does not allow a detailed account of all that makes the mineral collection of the Academy so special, but readers are encouraged to visit the references cited in the previous paragraph. This is a collection and a heritage that should be celebrated, but what we see instead is an administration that has no interest in and possibly even disparages the treasure that it possesses. It is bad enough that the collection has gone uncurated for decades. I am told that specimens such as the type vauxite are crumbling, golds are missing and unaccounted for, the drawers and cabinets that the specimens are housed in are in serious disrepair and their deterioration is surely responsible for the damaged condition of so many of the specimens. It is evident that, had the Academy administration not been advised that the collection was worth in the neighborhood of five million dollars, they might very well have discarded it outright!

Administrators need to be reminded that they are only temporary custodians of museum collections, and therefore must *not* indulge themselves in throwing out whatever doesn't interest them personally. Such a policy would result, after enough administrators of varying interests had come and gone, in there being nothing left to curate! An old and valuable museum collection is a historic trust. The mineralogical community hopes that the Academy will eventually have a new administration that recognizes the importance of this formerly great mineral collection and does justice to its curation, preservation and display. And this needs to happen before one more specimen disintegrates, is damaged through mishandling, or is carried off in someone's pocket.

The University of Delaware Mineral Museum

For many years now I have believed that the mineral museum in Penny Hall, the geology building at the University of Delaware, is one of the best in this country from the perspective of showing off to advantage a reasonable number of very fine mineral specimens. The exhibit was the product of the efforts of its former curator, Dr. Peter B. Leavens, whose exquisite taste in specimens and talent for effective exhibiting made it, in terms of "bang for the bucks," a visual treat for anyone who appreciates great minerals beautifully displayed. Admittedly it is small by most museum standards, but it is a lovely gallery and it contains a remarkably high percentage of superb display pieces. For a very good account of what it used to be, and how the collection evolved from the core Irénée DuPont collection, most of which was acquired from George Kunz, I refer readers to Leavens (1983).

Things have changed, however, and not for the better. Dr. Leavens, although still associated with the University as an emeritus professor, is no longer in control of the gallery. Sad to say, this responsibility appears to have been transferred to one or more individuals who are clearly out of their element. Some years ago the gallery was emptied of its minerals so that the heating and air conditioning systems could be updated. The person who replaced the minerals and made substantive changes in the content of certain cases within the gallery should be looking for employment elsewhere because it is clear that he or she has absolutely no knowledge of minerals and how to display them. Out of the 750 or so specimens in the present exhibit, there are literally hundreds that have been placed in the display cases either upside down or backwards or just lying flat on a shelf so that the best features of the pieces cannot be seen. A very fine anglesite from Morocco is upside down and is actually sitting on the points of the best crystals (Fig. 5). The few that have been blessed with some sort of support, like the Swiss smoky quartz qwindel precariously sitting on a metal nut (Fig. 6), may be shown to advantage, but that is not a given. Many of these are still not oriented the way a knowledgeable curator would have positioned them and certainly are potentially subject to damage.

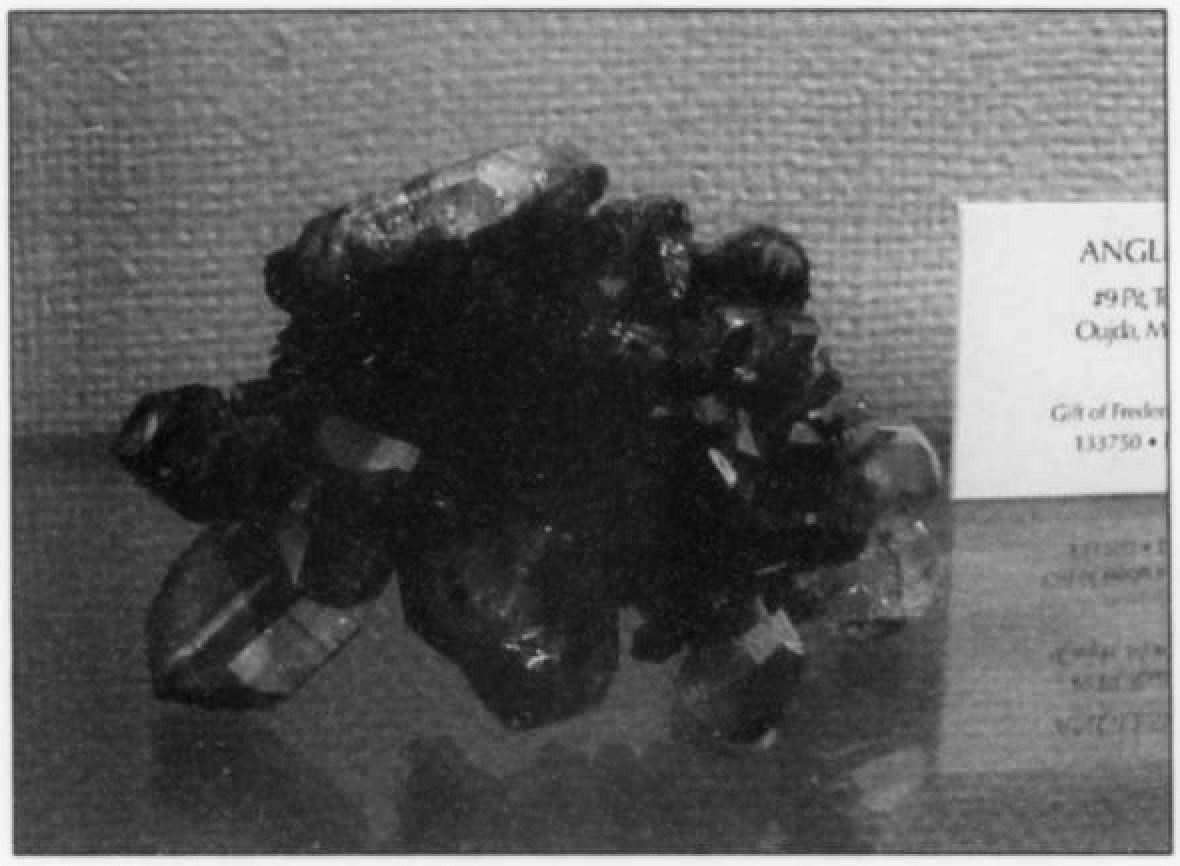

Figure 5. **Anglesite from Morocco, upside down; University of Delaware Mineral Museum.**

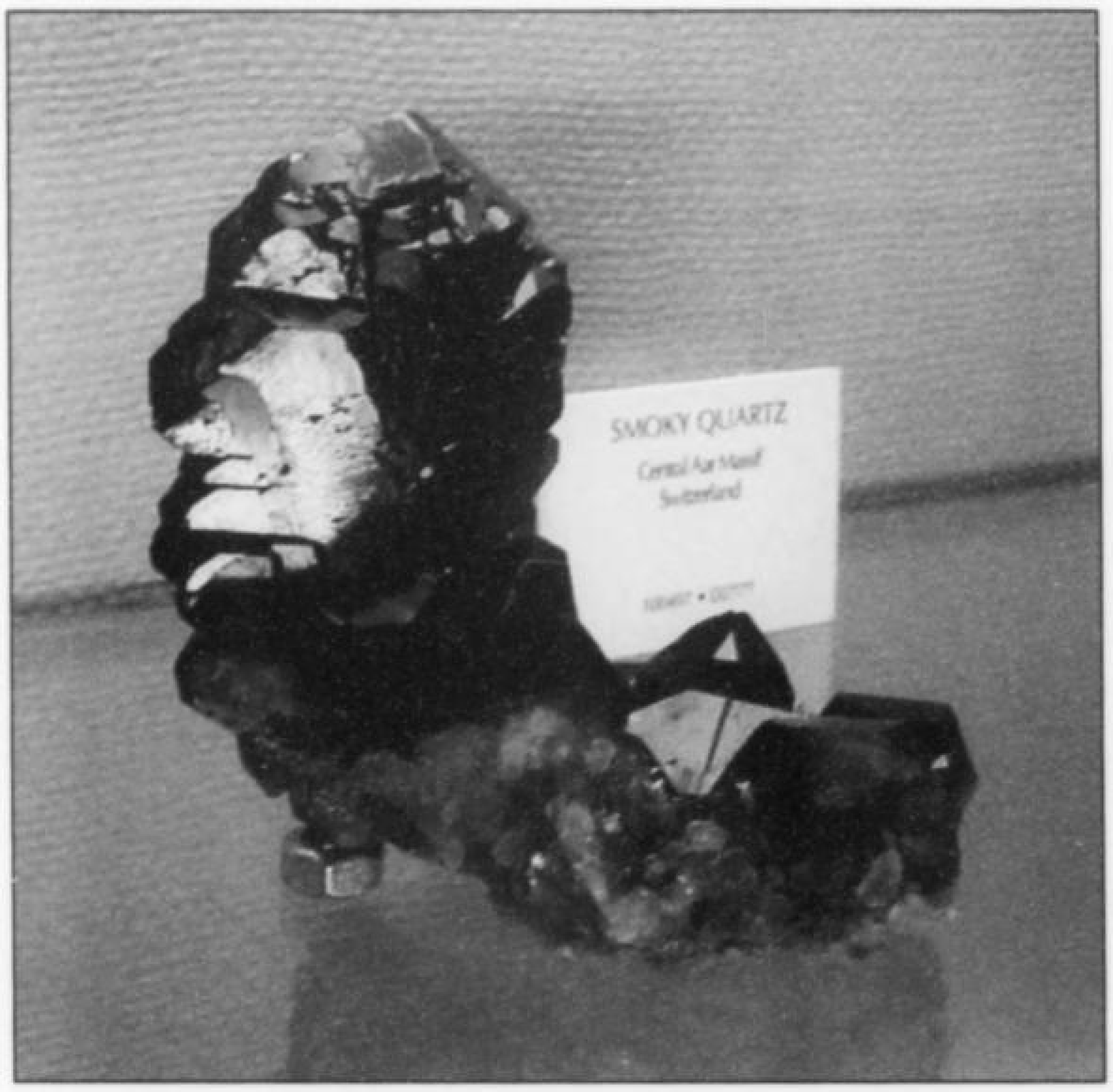

Figure 6. **Smoky quartz qwindel from Switzerland, supported by a metal nut; University of Delaware Mineral Museum.**

Major changes in two areas in the gallery can only be characterized as complete failures. The original gallery had two large freestanding cases near the entrance which featured gemstones, carvings and gem crystals. Today there is a meaningless case that is supposed to illustrate the phenomenon of pseudomorphism, but the specimen selection is so poor and the labels are so confused that it is a total disaster. At one end of the hall is a small alcove containing glass cases that once housed very fine miniatures. The shallow depth of the vertical cases meant that the viewer could put his or her nose within an inch or two of the specimens, all of them, and really check them out in detail. Today there is a strange mix of more or less indifferent and mostly uninteresting specimens, some large and some small, with no common thread, poorly lit, and abominably labeled.

I don't know what is going on behind the scenes, as I have not talked to anyone on the museum staff., but what has occurred at this museum is disgraceful, and it makes no sense. Dr. Leavens is still at the university and presumably available to lend his expertise to exhibiting the minerals, but the administration appears uninterested in availing itself of his skills. This, in itself, is condemnation enough. The university fully understands the value of the mineral collection because they recently had it appraised. In view of this awareness it is incomprehensible that they would entrust high-value specimens to someone who should not even have access to them, witness the anglesite upside down and resting on its crystal points. It is crystal-clear that the individual responsible for this and other bumblings in the museum should be forbidden from even touching another specimen until formally schooled in mineral handling and appreciation. Fortunately the specimens had all been properly catalogued and numbered by Dr. Leavens, otherwise one can easily imagine that specimens and labels would have been hopelessly scrambled by this same inept person. Go figure!

Weinman Mineral Museum, Cartersville, Georgia

If there is one bright spot in this litany of largely alarming and depressing reports, it has to be the Weinman Mineral Museum. This facility appears to be a dynamic, forward-looking enterprise that promises to celebrate minerals the way they deserve to be celebrated. It is still very much in the development process, but it seems to have the potential to become a standard-setter. Currently the museum is a 9,500-square foot facility, roughly half of which is devoted to exhibit space: 3,200 square feet for minerals, 900 for fossils, and 400 for a small temporary exhibit gallery. Its primary focus has been Georgia minerals, mining and geology, with an emphasis on educational programs serving some 16,000 students a year, including lectures and special events.

The museum is planning to expand its science focus into other physical sciences (mostly), but the mineral museum will play a key role in the new facility. The new museum, to be named TELLUS, the Northwest Georgia Sciences Museum, will measure over 100,000 square feet and will include a planetarium, a 200-seat theater, a space gallery, a hands-on science gallery and galleries for fossils and temporary exhibits. The largest gallery, to be named the Weinman Mineral Gallery, will more than double the current space for minerals to 7,000 square feet.

While the emphasis in the Weinman Mineral Gallery will remain Georgia mineralogy, worldwide minerals will be presented as well. It is certainly good news that the museum has hired a mineralogist as curator of the collection. According to José Santamaria, Executive Director of the museum:

> We also try to keep that fine line between making the exhibits accessible to the general public while not dumbing them down. I realize there are other mineralogical museums that are concerned about being 'absorbed' by broader institutions, but I am confident the integrity of the mineral collection will remain intact and in fact see only opportunities to improve it.

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The "Pioneer" Aquamarine, 13.7 cm, from the Pioneira mine, Brazil

What's New

in Minerals

Bologna Show 2006

by Renato Pagano

[March 10–12, 2006]

Bologna is, by itself, a worthwhile tourist destination. Located in northern Italy between the Po Valley and the northern Apennines, it was a fairly important settlement by at least the 9th century B.C. It became an Etruscan town in the 6th century B.C., and later was taken over by Rome.

The Romans built Via Emilia, a major road connecting Milan to Bologna and continuing on to the Adriatic Sea; this road guaranteed Bologna's strategic and cultural significance. The University of Bologna, established in 1088, is the oldest university in the world. Today, remains of the city's glorious past are still visible, and many tourists also visit to enjoy the famous, rich and tasty Bolognese cuisine.

The annual Bologna Mineral Show has reached its 37th edition. Its growth and success have been due to a careful selection of invited exhibitors, and to the fact that only dealers in minerals, fossils and gemstones are allowed—excluding the jewelry, gift items and other non-germane merchandise that makes some other shows less interesting to mineralogical true believers.

The show takes place in the *Palazzo dei Congressi*, a convention center well served by parking lots, hotels and restaurants, all within walking distance or easily reachable by public transportation. Foreign visitors and buyers who land at the Bologna airport often do not feel the need to rent a car—as was the case for John Veevaert, one of the most active web dealers, who visited the show this year for the first time.

The dealers are located in three adjacent areas of the convention center, totaling about 1100 square meters. There were about 250 dealers this year, of whom about half were foreigners from over 20 different countries.

EXHIBITS

Before diving into the melee of the show, let us have a look at the special exhibits, well presented in a dozen or so cases near the entrance to the convention center. The theme of the show for 2006 was "Mount Blanc—between mountain-climbing and mineralogy." Mont Blanc (*Monte Bianco* in Italian), straddling the border between Italy and France, is the highest peak in the Alps, with an elevation of 4,810 meters. Naturally, it is a highly challenging arena for mineral collectors, who must be accomplished climbers to reach the mineralized Alpine clefts in the more remote locations.

The Torino Regional Natural History Museum filled the first display case with historical specimens—one especially remarkable example is a large **red fluorite** crystal with no matrix from the Argentiére glacier, Montanvert, Chamonix valley, donated to the museum at some time between 1835 and 1840 by His Majesty Carlo Alberto, king of Piedmont and Sardinia from 1831 to 1849.

Figure 1. **The site of the Bologna Show, the Palazzo della Cultura e dei Congresso.**

***Figure 2.* The lobby area of the convention center in Bologna where some dealers were set up. John Veevaert photo.**

***Figure 3.* Another area of the convention center, filled with dealers. John Veevaert photo.**

***Figure 4.* Cyanotrichite, crystal sprays of about 3 mm on matrix, from Dachang, Guizhou, China. Lino Caserini specimen; Roberto Appiani photo.**

The specimens in the other cases were from several prominent Italian and French collections, and included, as might be expected, a stunning selection of **quartz** specimens, in particular gwindels and faden crystals, as well as pink fluorites and a few less common species such as a 5-cm **hyalophane** from Trou des Romains, Aosta Valley (R. Ferronato collection). The specimens that impressed me most were a 15-cm group of smoky quartz crystals capped by a small "scepter" of amethystine quartz from Les Droites (the north face of the Mont Blanc massif), Haute Savoie, in the Eric Asselborn collection, and, from the same collection, an exquisite pink fluorite crystal group on smoky quartz.

MINERAL DEALERS

After just one quick survey of the various dealers' materials I had made my choice of the most impressive specimen at the show: a giant blue-green **microcline ("amazonite")** crystal from near Macarani in the Brazilian state of Bahia. This remarkable single crystal measures about 20 × 35 × 45 cm, and reportedly weighs 64 kg; two of its faces are selectively covered by small schorl and topaz crystals. According to dealer Riccardo Prato of *Pregi Gemme* (pregigemme@iol.it), two even bigger specimens were collected at the same locality: they weigh respectively about 100 and 200 kg but, Riccardo says, they lack the aesthetic quality of the exceptional specimen shown at Bologna. The microcline crystal, displayed in a well-lighted pyramidal glass case, attracted so many visitors that the pressure and jostling of people began to threaten the stability of the case. Consequently, on Sunday Riccardo started packing his monster crystal well before the end of the show.

Dealer Giorgio Bogni (giorgiobogni@libero.it) had a nice selection of the oil-green hydroxylapatite in discoidal crystals on feldspar from Lavra do Sapo, Goiabeira, Minas Gerais, mentioned in Wendell Wilson's Munich Show report. See also the letter regarding the identification of this species by Federico Pezzotta published in the March-April 2006 issue.

Vesuvianite in large, lustrous brown crystals from the Han Dan area, Hebei province, China has been seen before at several shows, occasionally in well-formed single crystals with a tabular habit showing little or no tetragonal prism. Dealer Ennio Prato (ennioprato@tiscali.it) had several cabinet-size specimens of this mineral, some with garnet crystals, that were more attractive than most that we have seen so far.

Another prominent dealer on the Italian scene, Lino Caserini (linocase@tin.it), also had good Chinese material, in particular some very fine **cyanotrichite** specimens, with delicate sprays of acicular crystals up to 3 mm on matrix, from Dachang, Guizhou, China.

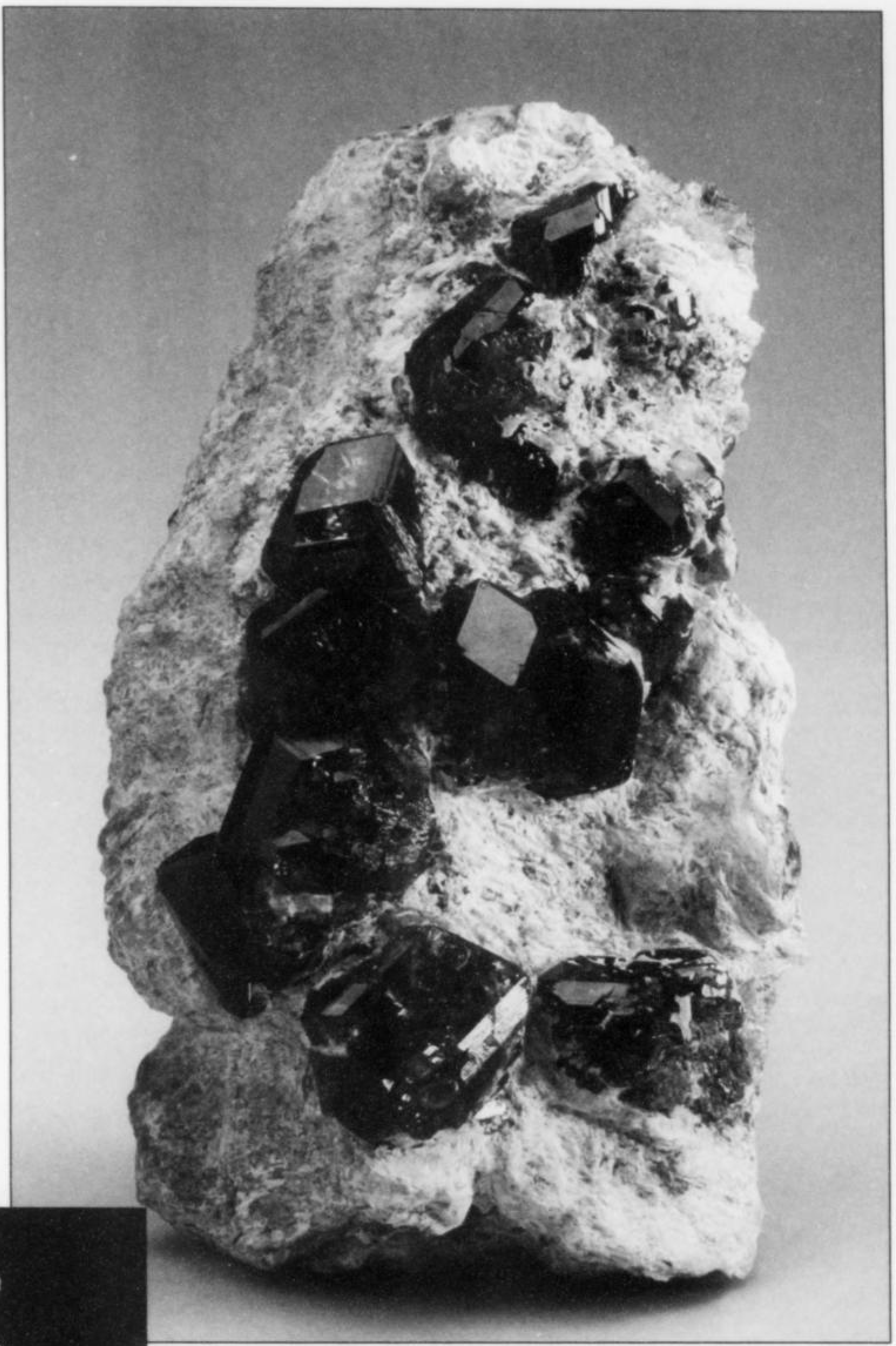

***Figure 5.* An old-time specimen of "demantoid," a green variety of andradite, in crystals up to 1.8 cm on a 5 × 8.5-cm matrix from Val Malenco, Sondrio, Italy. Emanuele Marini specimen; Roberto Appiani photo.**

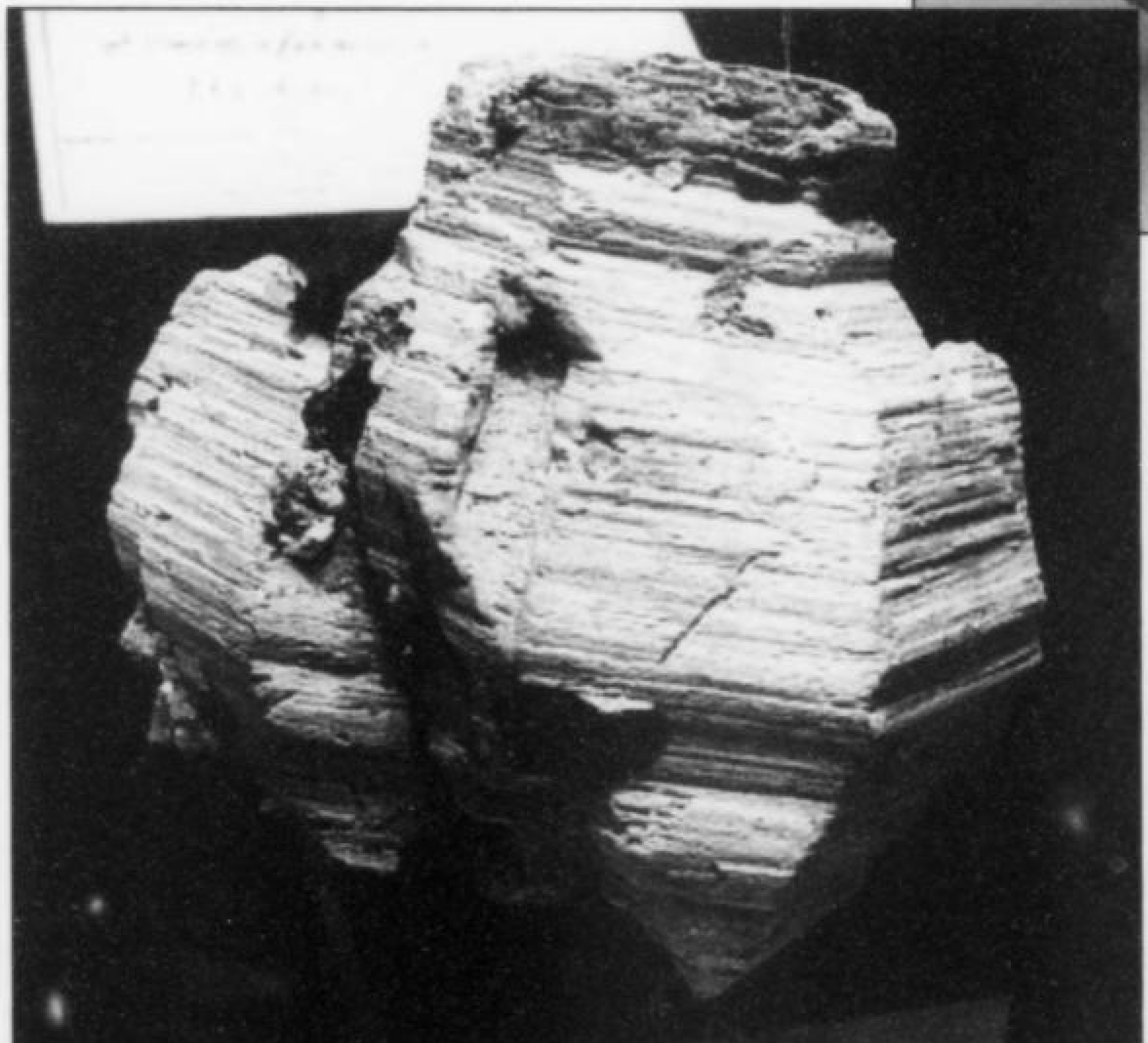

***Figure 6.* A 4-cm crystal of parisite from Mt. Malosa, Zomba district, Malawi. John Veevaert specimen and photo.**

Giovanni Nalin (Via Oberdan, 6 — I-20032 Cormano, Italy) is a very energetic field collector who lives in the Milano area, but grew up in the western Alps; not surprisingly, his main mineralogical love is Alpine minerals. At Bologna he had a wide selection of **grossular** garnets in sparkling red druses from the famous Val di Gava and Faiallo localities near Genoa, and of *demantoid*, the green variety of **andradite** which often occurs with asbestos in Val Malenco, Sondrio. The demantoid crystals and crystal clusters are fairly small, perhaps 3–4 mm across, but they cover the matrix almost completely. Their color is a paler green than that of the classic specimens found several decades ago, but still these are reasonably good cabinet specimens at affordable prices for collectors interested in garnet varieties.

Occasionally, some "old-time" Val Malenco demantoids appear on the scene, these specimens having been passed from dealer to dealer at increasing prices with the recycling of old collections. Emanuele Marini (e.marini@tin.it) had one such specimen, with deep green dodecahedral crystals to almost 2 cm on an 8.5-cm matrix. Emanuele, a new kid on the block and quickly becoming known as a dealer in fine minerals, had one of the best specimens

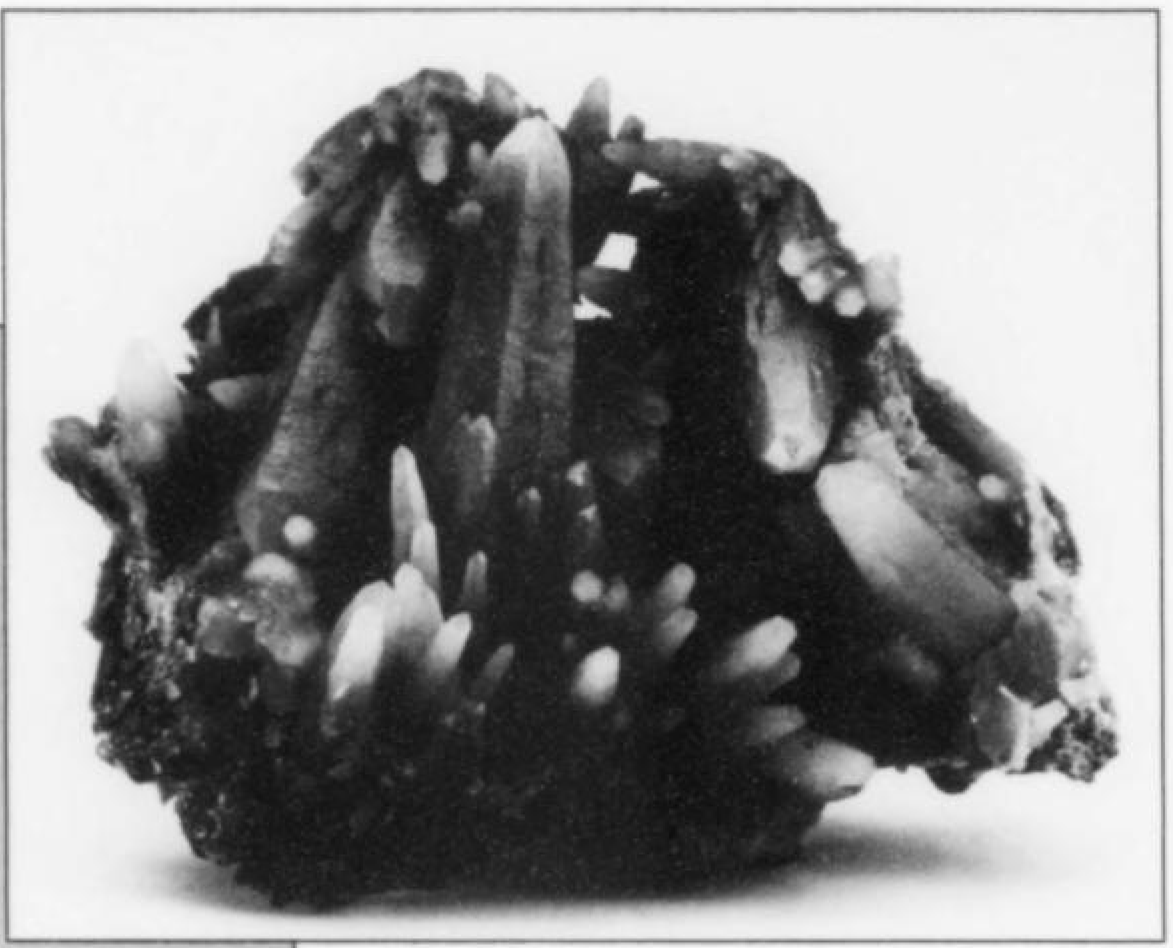

Figure 7. **A 10-cm cluster of green quartz crystals from a new find near Rio Marina, Elba, Italy. Maurizio Prati specimen; Roberto Appiani photo.**

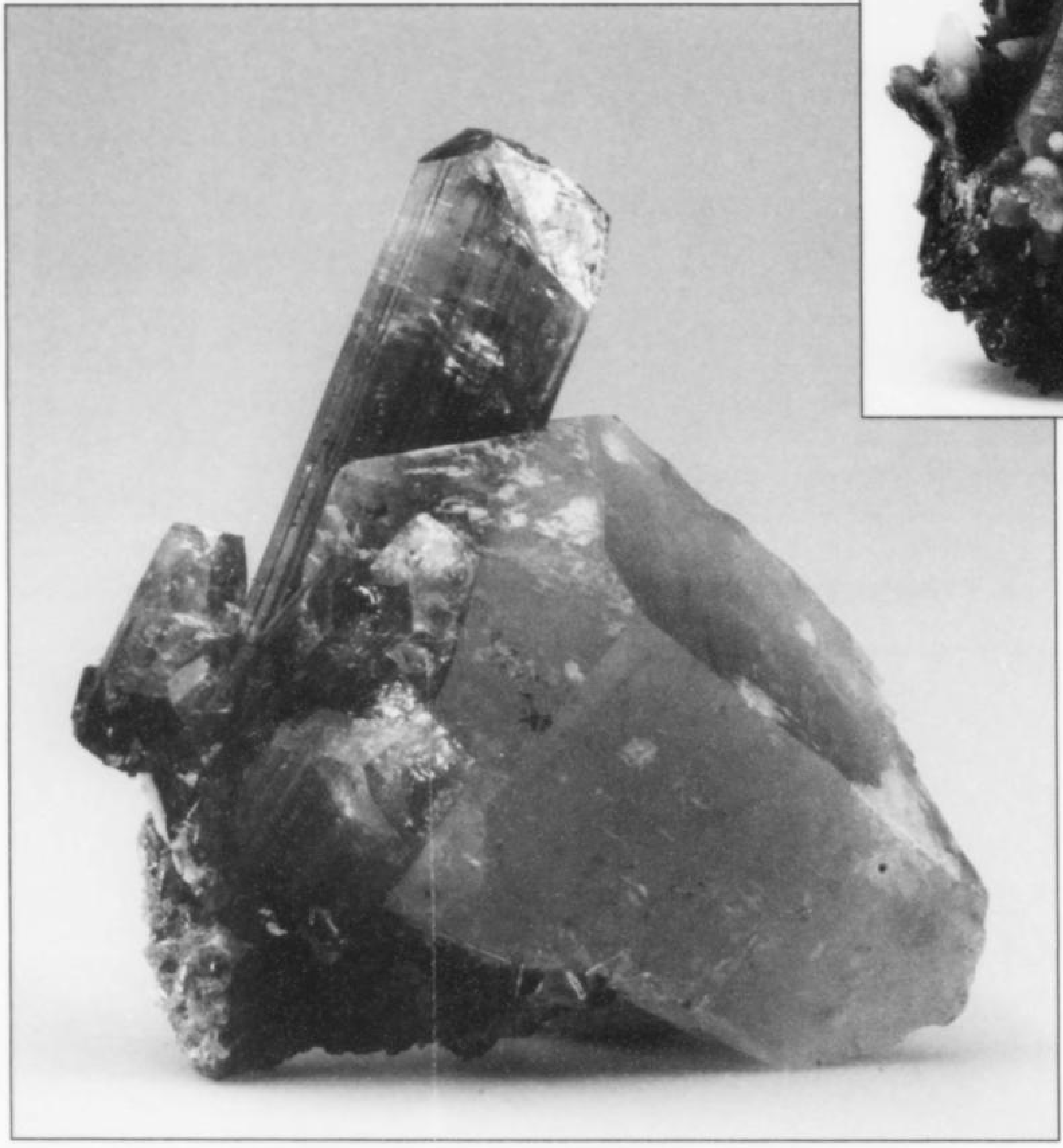

Figure 8. **Liddicoatite crystals to 4 cm on quartz, from the Sahatany Valley, Madagascar. Emanuele Marini specimen; Roberto Appiani photo.**

Figure 9. **Riccardo Prato (*Pregi Gemme*) with his remarkable microcline from Macarani, Bahia, Brazil. This 45-cm "amazonite" crystal weighs 64 kg (141 pounds!). Two of its faces are covered by small, black schorl crystals and topaz crystals. Roberto Appiani photo.**

at the show: a group of red **liddicoatite** crystals up to 4 cm on quartz from the Sahatany Valley in Madagascar. He also had some excellent specimens from Mount Malosa in Malawi: **parisite** in crystals to 3 or 4 cm, **epididymite** crystal groups, **aegirine** and others.

For some time Giuseppe Agozzino (giuseago@libero.it), a field collector and dealer from Genoa, has been working on a **fluorite** vein that has produced fine specimens with 2 to 4 cm (occasionally up to 8 cm) cubic crystals of a delicate bluish color, and at Bologna he had several good specimens. The locality? An obscure place in the Madonie Mountains southeast of Palermo, Sicily, where small fluorite and barite veins have been located. "Sicily—not only sulfur," appropriately read Giuseppe's advertising.

Another Italian field collector, Maurizio Prati (Via Piccard 18/Q — I-42100 Reggio Emilia, Italy), had nice clusters of **green quartz** crystals (colored, presumably, by inclusions of hedenbergite): a classic mineral from the skarns near Rio Marina, Island of Elba, and represented here by a new, limited find of specimens. The better pieces were quickly purchased by collectors and other dealers.

Ernesto Ossola (R.te Nationale 86, F-30210 Pouzilhac, France), well-known among collectors especially for his interesting stocks of minerals from Morocco, also had some unusual specimens of **aragonite** from Pantoja, Toledo, Spain: delicate sprays of pinkish to yellowish acicular crystals safely lodged in cavities in limestone matrix.

The fondness of many European collectors for rare or uncommon species was well reflected in the offerings of several dealers. One of them, Franco Vanini (francescovanini@virgilio.it), had a good selection of rare Alpine minerals, including **cafarsite** and **tilasite** from Monte Cervandone, Italy/Switzerland, and a complete suite of the minerals of Falotta, Grisons, Swiss Alps: **grishunite**, **cabalzirite**, **palenzonaite** and various others. Also, Franco had a few specimens of the rare scandium minerals **cascandite** and **thortveitite** from Baveno, Italy.

The offerings of German dealer Gunnar Färber (mineralien@online.de) included a number of mineral species, mostly small specimens in what looked like a million plastic boxes. The most interesting of them was probably **skorpionite**, a new IMA-approved mineral (IMA# 2005-10) from the Skorpion zinc mine near Rosh Pinah in the Lüderitz district, southern Namibia. This new phosphate has been found as small, colorless crystals with tarbuttite.

A new locality for **melanophlogite**, in small, colorless, cubic crystals to about 0.5 mm on matrix, was discovered at Case Montanini, near Parma, Italy. Christian Mavris (machu83@hotmail.com), a geology student who has been doing his thesis on that locality, had a selection of specimens: certainly not showy material, but this silica mineral has been reported from only five world localities, and thus a specimen is a good catch for micromounters and species collectors.

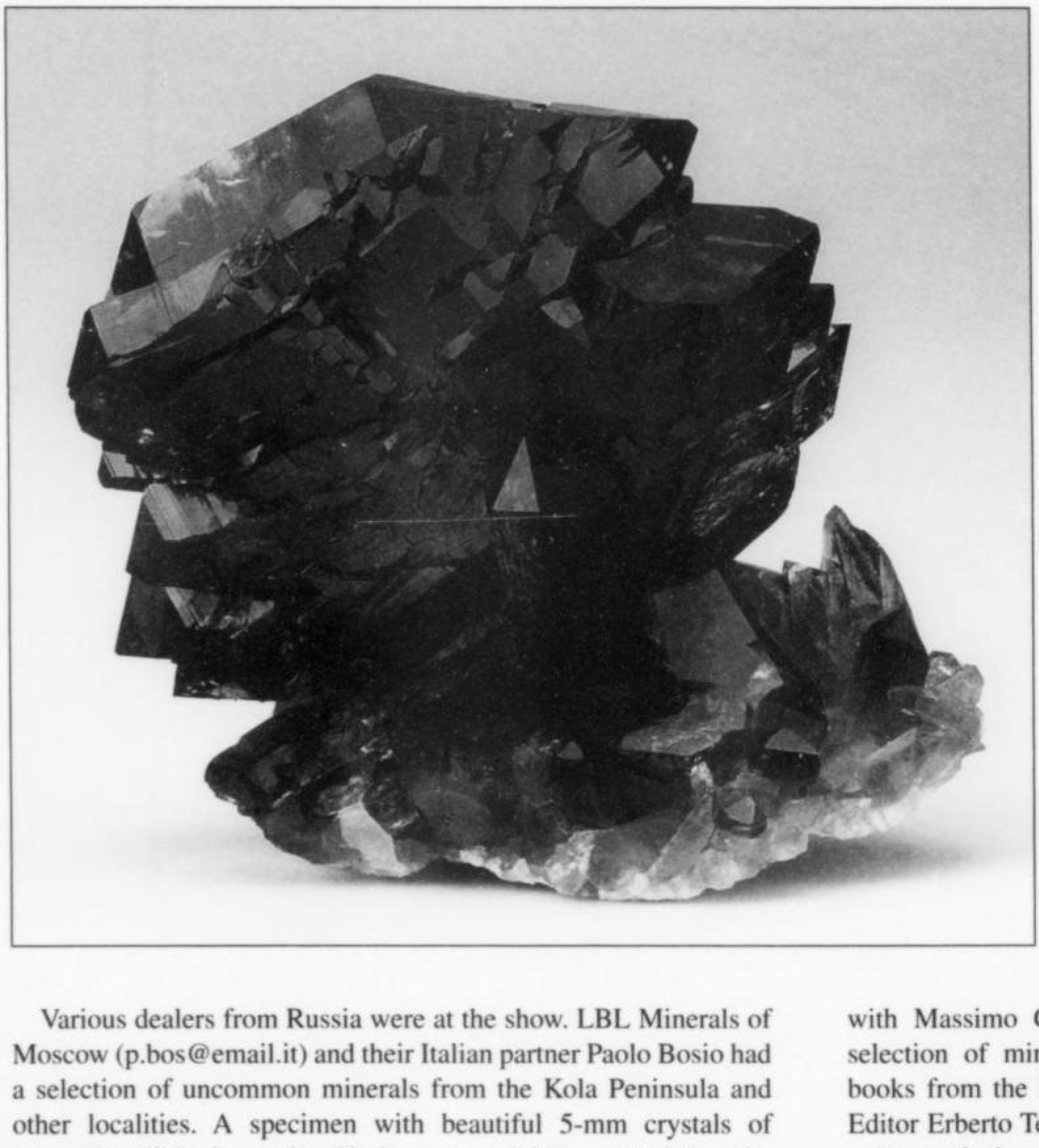

Figure 10. **A gwindel smoky quartz crystal, 6 × 7 cm, from the Trolet glacier, Val d'Aosta, Italy. David Caresio specimen; Roberto Appiani photo.**

Various dealers from Russia were at the show. LBL Minerals of Moscow (p.bos@email.it) and their Italian partner Paolo Bosio had a selection of uncommon minerals from the Kola Peninsula and other localities. A specimen with beautiful 5-mm crystals of **monazite-(Ce)** from the Urals was quickly spotted by the cognoscenti and disappeared at the beginning of the show.

Mikhail and Zulfia Murashko (murashko@peterstar.ru) had their usual selection of species for systematic collectors, some of them quite new, including **gjerdingenite-Ca**, **phospoinnellite** and many others. Most of the Murashko specimens are of micromount or small thumbnail size, but occasionally larger ones are available, such as specimens from the Tolbachik Volcano, one of Mikhail's specialties.

RARE BOOKS

All of us who love books have noticed with regret that antiquarian mineralogy books have almost disappeared from U.S. mineral shows. Not so in Bologna. I shall mention some of the dealers who had interesting books, but several more were there, offering old and not-so-old tomes.

Enrico Scrivanti (enrisc@libero.it) from Casale Monferrato deals in nothing but books, and had piles of publications on various branches of the earth sciences including paleontology (his own personal love), geology and mineralogy.

Christophe Dubois (Lithic2501@aol.com) from Lyon, France, along with his normal offering of good minerals, had some interesting titles, including a *Tableau méthodique des minéraux* (1801) by Louis J. M. Daubenton (1716–1800), Haüy's predecessor at the Natural History Museum in Paris. This is a rare work that quickly found a new home (mine). Christophe also had an interesting work on Derbyshire "Blue John" fluorite; an 1883 publication on mining safety lamps; and various ephemera including postcards, photographs and other memorabilia. Gianfranco Branchi (Via Sanarelli 11 — I-52100 Arezzo, Italy), who shares a large table with Massimo Galimberti from Arezzo, Tuscany, had a good selection of mineral-related plates and books, including some books from the library of the late *Rivista Mineralogica Italiana* Editor Erberto Tealdi (1934–1996).

In conclusion, Bologna 2006 was a good show, with not a great many really new things, but lots of good specimens and even books for everybody—most of them, to quote John Veevaert, at non-Tucson prices. So you may want to make a note on your calendar: in 2007 the Bologna Show will be held on March 9, 10 and 11. ⊠

BROOKITE, with Quartz, 4.1 cm, from Baluchistan, Pakistan. Jeff Scovil photo.

Letters

Woodend Mineral Diorama

I have been trying (up to now unsucessfully) to find information regarding a couple of dioramas assembled from mineralogical specimens by "F. W. Woodend," as denoted by the business card attached to the back of one of the dioramas. In my latest Google search, I finally turned up an article on your website in the Label Archive that actually names him and places him at the same address. Whoopee! The only other diorama similar to what I have I saw at a gem and mineralogical museum in Balboa Park in San Diego.

Steve Lang

Fedex Insurance Policy

As a collector of cabinet size mineral specimens, I have for many years been involved with the shipment of these specimens across the country. I have always taken solace in the fact that the mineral specimens that I shipped or received were fully insured by the carrier, so I believed myself to be financially protected, should loss or damage occur. This past November 2005, I received a large specimen valued and insured for $7200, using the Federal Express Corporation (FedEx). When the carton containing the mineral specimen arrived, the bottom corner of the carton was smashed inward and upon closer examination, it was obvious that the carton had been mishandled during its journey to me. When I tried to refuse the carton, the FedEx delivery agent stated that since no delivery signature was required to receive the carton, it would just be left at my address, whether I accepted delivery or not.

Once it was determined that the mineral specimen was damaged and a claim was filed, FedEx, without even retrieving the carton and mineral specimen for examination, sent out payment in the amount of $500. When questioned about the disparity between the $7200 declared value for the item and the $500 settlement payment, FedEx responded that they "do not insure items, but merely accept payment as additional freight charges to increase the declared value limitations of liability on higher valued items." This limit of liability does not exceed $500. In short what this means is that FedEx will take your money for whatever value you declare an item to be worth, however, should something happen to that item, they will only make payment up to $500.

The lesson to be learned for all mineral collectors is that if you are shipping high-priced specimens, make sure that a delivery signature is required and be aware that no matter what value you declare for the mineral specimen, FedEx will only pay out $500 should damage or loss occur. I have only had this unfortunate experience while using FedEx as a carrier, so I don't know what policy other carriers have. I would advise all mineral collectors to look into this in great detail before intrusting your valued specimens to any carrier. Better yet, arrange to carry your own shipping insurance.

Cliff Vermont
Brielle, New Jersey

That's good advice. And it always pays to read the fine print. FedEx prints their "Declared Value Limits" statement on the back of each airbill. It states that, except for shipments in a FedEx Envelope, FedEx Pak, or FedEx Sleeve (for which the maximum allowed declared value is $500), the highest declared value allowed is $50,000, "unless your package contains **items of extraordinary value**, *in which case the highest declared value allowed is $500." Mineral specimens definitely fall under the category of "items of extraordinary value," so would not be covered for more than $500. FedEx must have concluded that from information you supplied when making your claim. FedEx states that their liability "may not exceed the maximum allowable declared value. . . ." So you can declare any amount up to $50,000, and pay the proportional fee, even if that declared value is not "allowable"—FedEx will not attempt to determine, when accepting a shipment, whether you have exceeded the allowable declaration of value; they will only make this determination later, if a claim is filed.*

FedEx has made provision for customers to insure "items of extraordinary value" through Trans Global Insurance Corporation (1-800-245-4852). However, that insurance (charged at 1% of the declared value) covers only loss of the whole package or catastrophic damage (earthquake, flood, etc.), and not *negligence on the part of FedEx, so a damaged box and broken specimen would not be covered even by this means.* WEW

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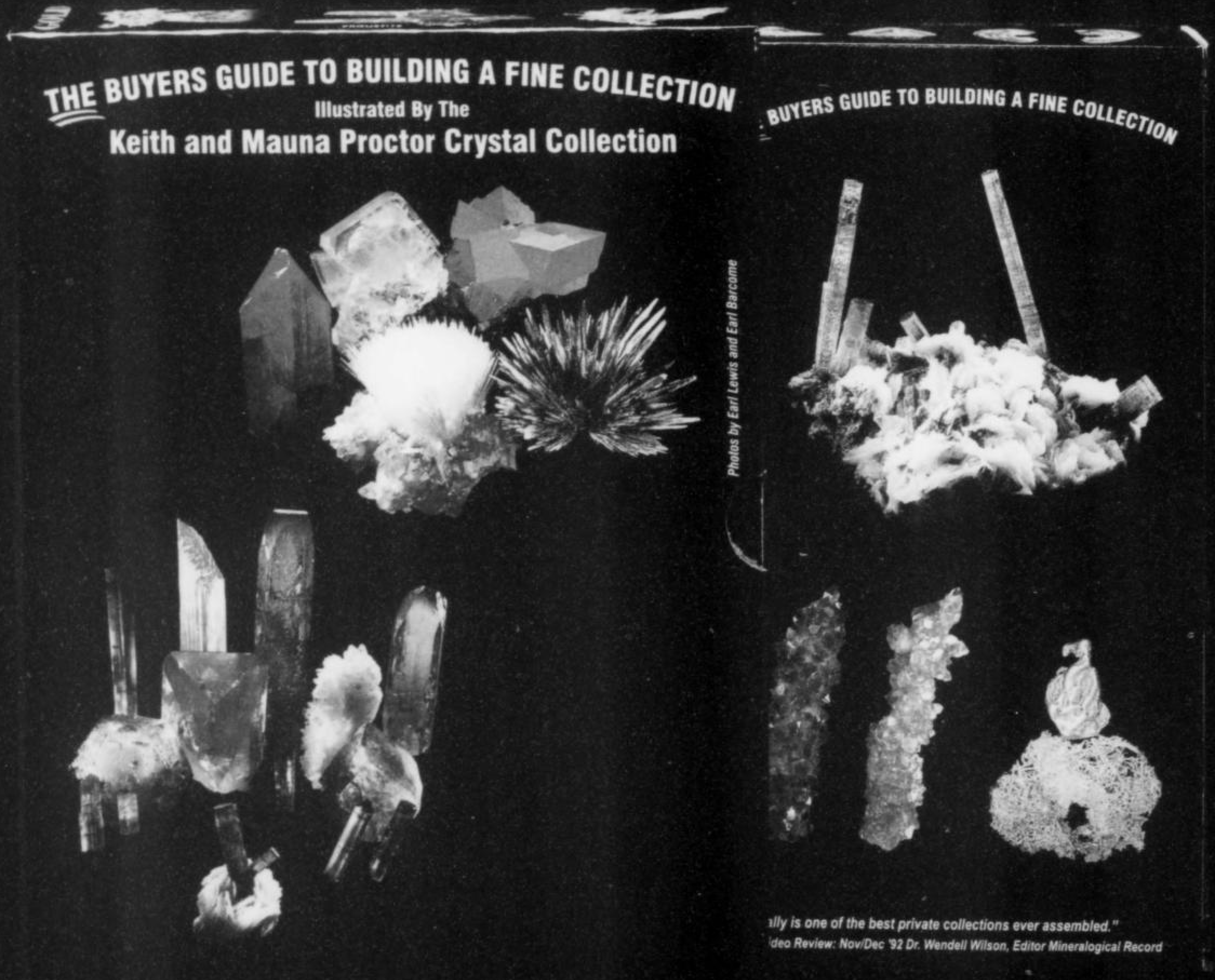

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I will be traveling around the country giving private showings of this unique collection. If you are at all interested please give me a call (or email) to arrange a showing when I am in your area. Of course, all of us occasionally like to "window-shop," so, in looking there is absolutely no obligation whatever to buy. Just meeting other people and seeing their collections is adequate reward for me.

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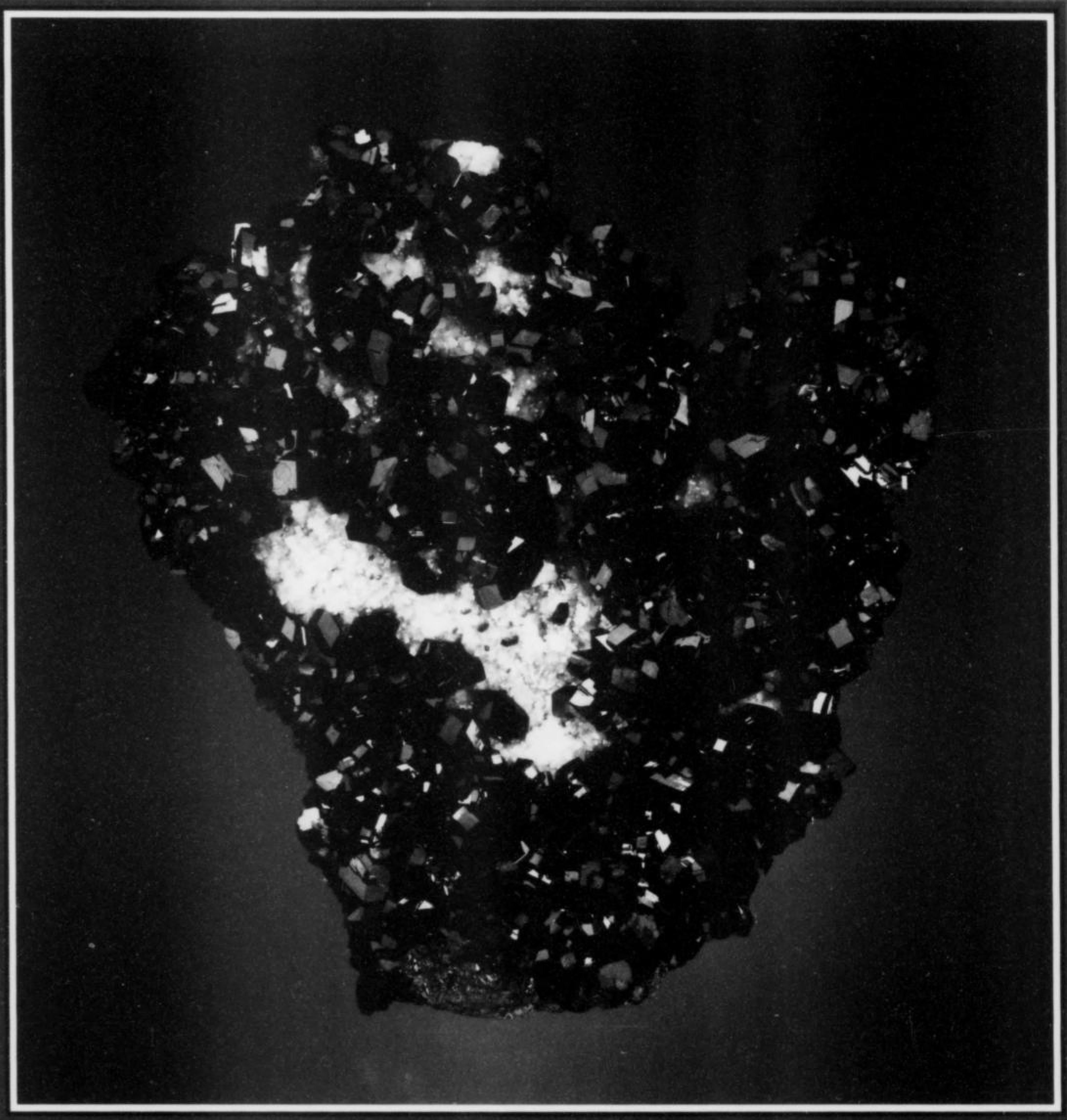
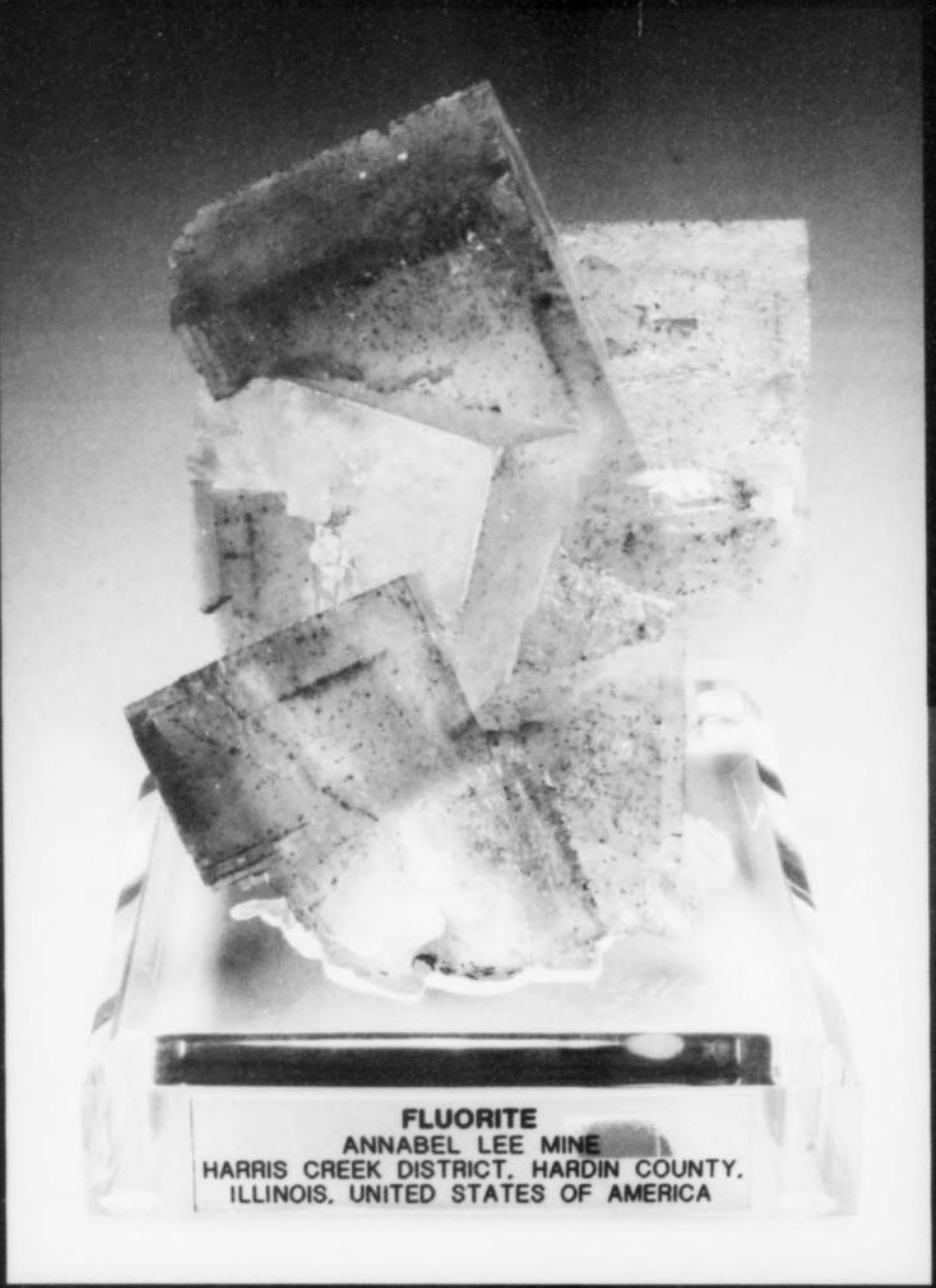


DIOPTASE *on* CALCITE

from Tsumeb, Namibia; 5.25 inches, with crystals to 0.75 inches.
Acquired from Stuart Wilensky in July 2005; originally
purchased by Julius Zweibel from a miner working on
Level 30 in the late 1970's

Photo by Jeff Scovil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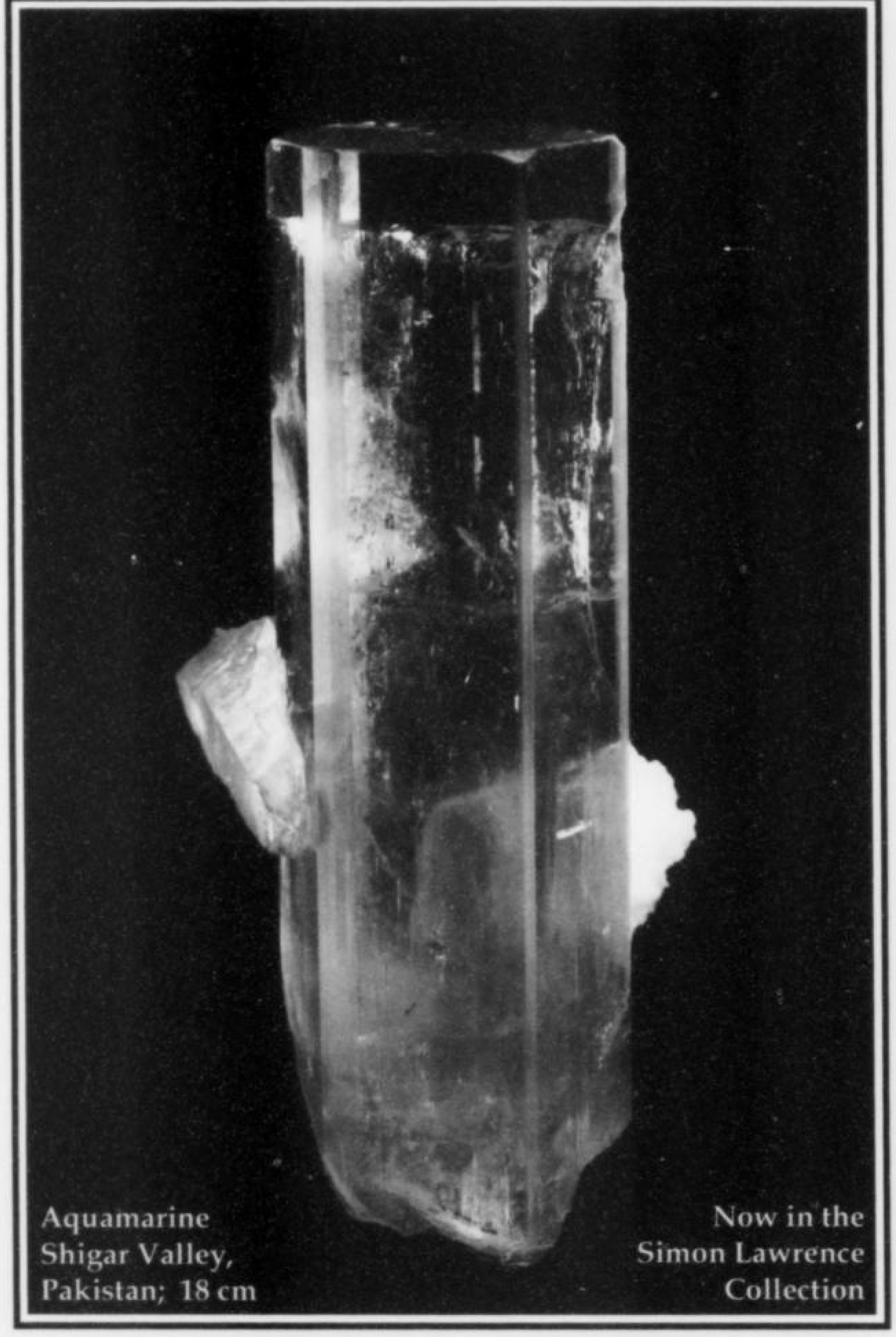

Aquamarine
Shigar Valley,
Pakistan; 18 cm

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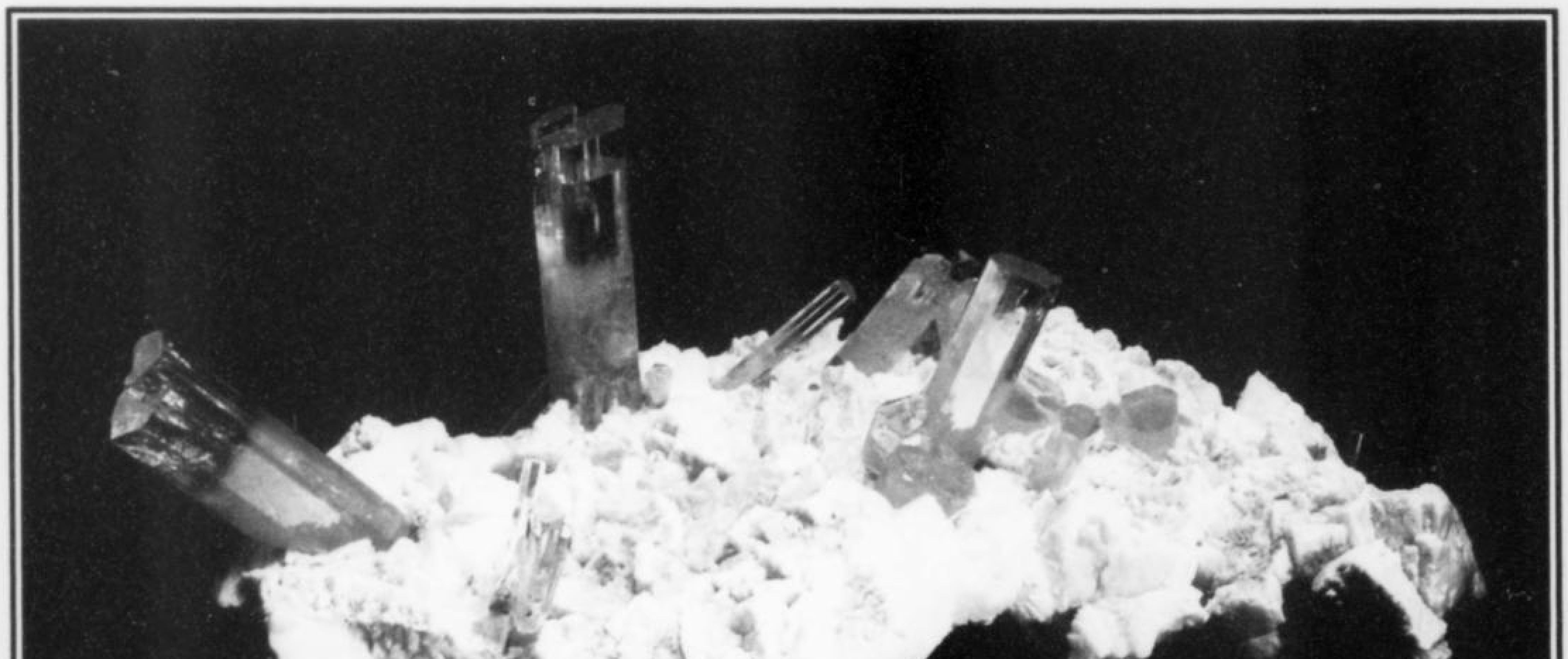

Aquamarine, Shigar Valley, Pakistan; 28.9 cm

Now in the Gail and James Spann Collection

Photos by Jeff Scovil

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

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Symposia: "Minerals of South America," October 20-22, 2006, Red Lion Hotel, Kelso-Longview, WA.

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Symposia: "Mines and Minerals," November 4–5, 2006, Delaware County Institute of Science, Media, PA.

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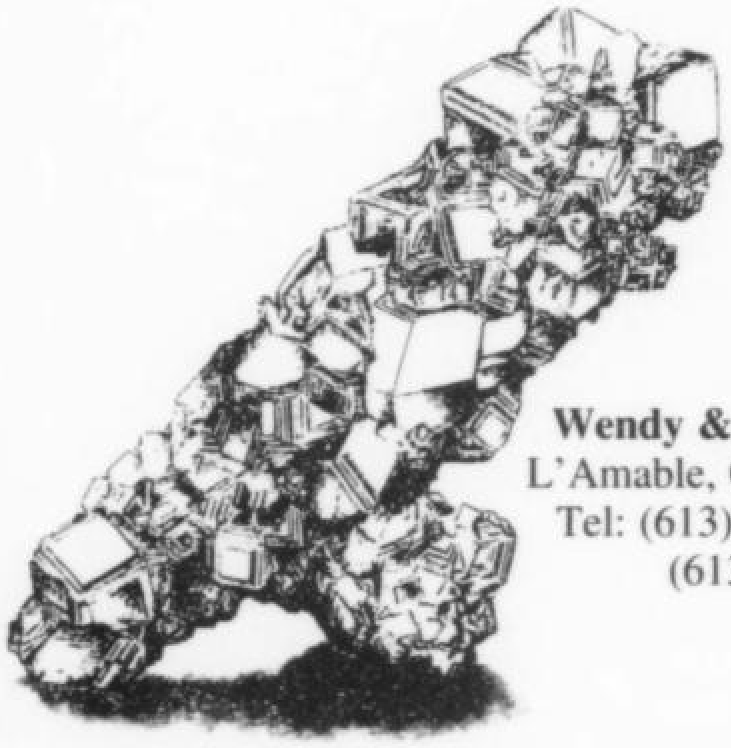

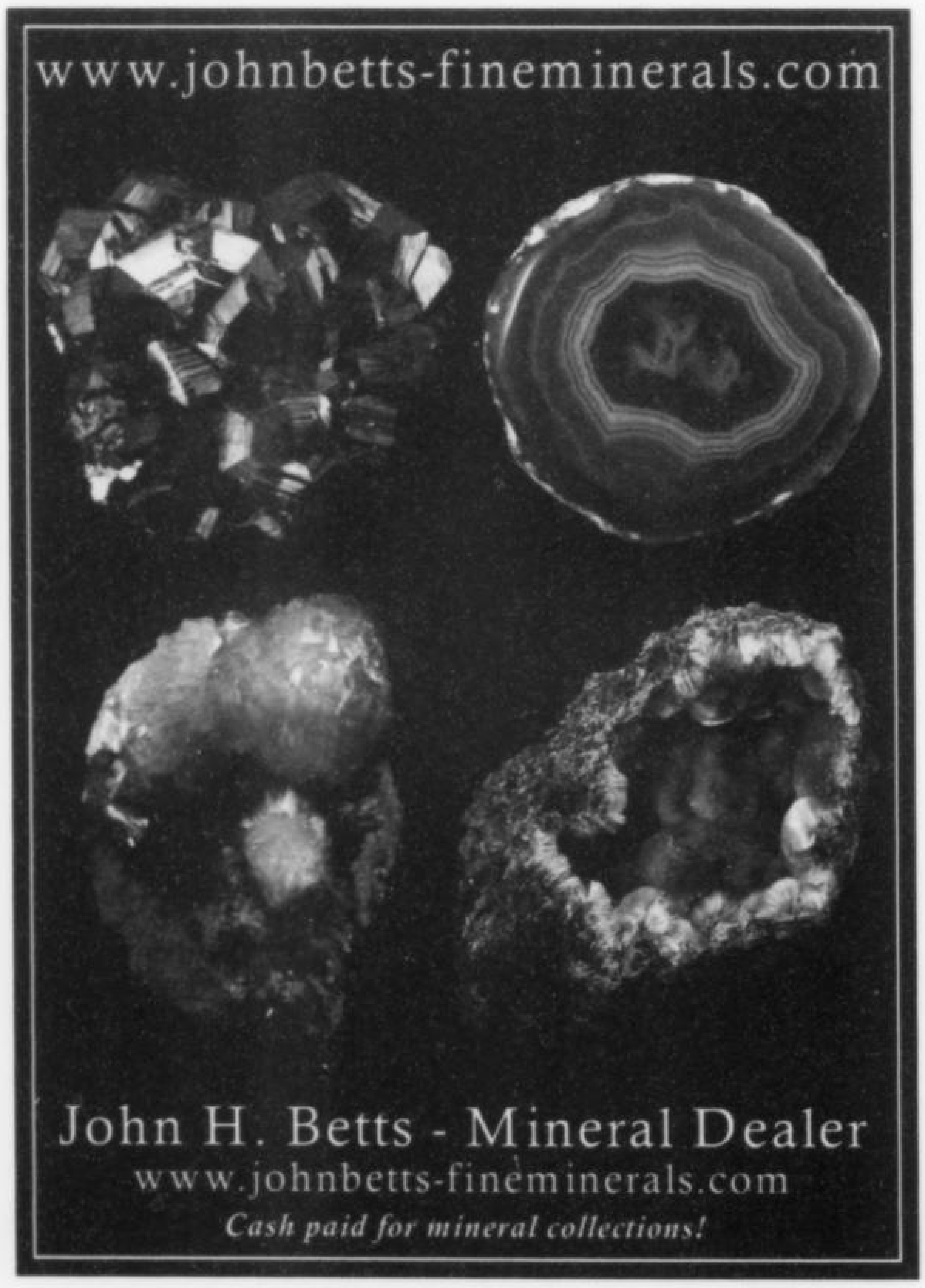

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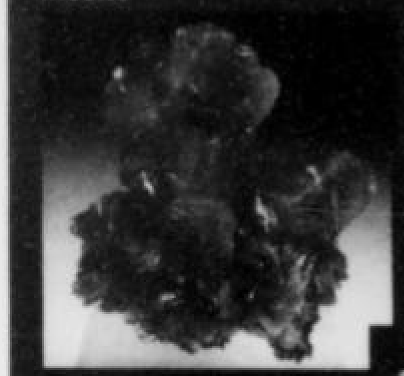

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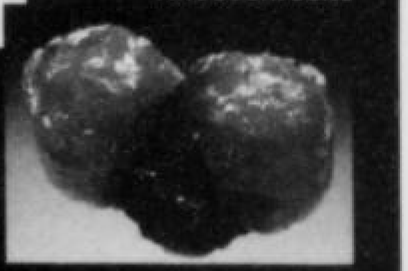

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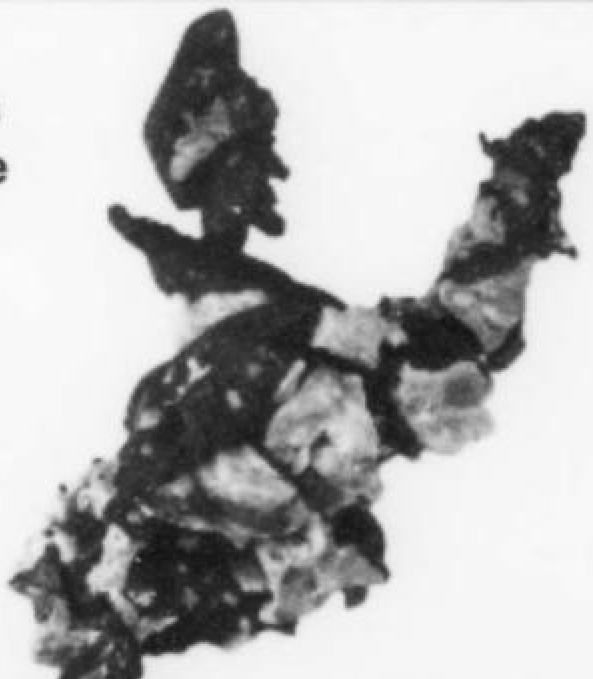

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