Minerals of the Chilean mineralogical expedition of 1938, Sam Gordon and the Academy of Natural Sciences of Philadelphia

Patrick E. Haynes

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PATRICK E. HAYNES
patrickhaynes407@yahoo.com

The 1938 Expedition to Chile

The following notes are taken from an eight-part series, "Results of the Chilean mineralogical expedition of 1938", written by Sam Gordon and published between 1940 to 1942 in *Notulae Naturae* (Gordon 1940-1942). The first paper, titled "Results of the Chilean mineralogical expedition of 1938. Part I – the identity of lapparenite with tamarugite", includes a Foreword with a few easily-overlooked paragraphs regarding the expedition!

Gordon first thanks the financiers of the expedition (the American Philosophical Society and Mr. Cadwalader, then President of the Academy of Natural Sciences of Philadelphia, ANSP). He gives a general description of the Atacama Desert of Chile, and notes "… more than ten thousand mines have been opened from prehistoric times to the present", and "It is a paradox that the minerals containing the most water (some up to 50%) are found in the driest deserts!" (Gordon 1940, p1).

Gordon left from New York on the S. S. Santa Maria, September 9, 1938 and returned to the same port on the S. S. Santa Clara, January 3, 1939. During the expedition he visited more than 100 mines and prospects, and stock piles of ores from hundreds of others were examined at shipping centers. Twenty-six boxes of mineral specimens were shipped to the Academy's mineralogical laboratory for study. While in Chile, some of his transportation was via a three-wheeled motorcycle that he had shipped from Pennsylvania. He spent just over $1,000 during those four months (Montgomery, 1975). One of the more notable discoveries was a new mineral, found on a mine dump at Cerro Pintados in Sierra Gorda, which he named cadwaladerite, after the President of the Academy (Gordon, 1941, p1-4).

The 2024 Donation

In November of 2024, Bryan Lees of Collector's Edge Minerals, Inc. donated 13 flats of Chilean minerals to the New Mexico Mineral Museum in Socorro, New Mexico (Haynes 2026). The flats were part of their purchase from the Academy of Natural Sciences of Philadelphia in 2006 and contained specimens collected by Samuel Gordon during his 1938 expedition to Chile; the donation includes many type locality specimens.

The Academy of Natural Sciences of Philadelphia was established in 1812. One of its earliest members was Thomas Jefferson, the lead author of the Declaration of Independence. By the time of the sale of its collection in 2006, the Academy had amassed over seventeen million items in its various collections (Montgomery 1975). In 2011, the Academy became affiliated with Drexel University and changed its name to the Academy of Natural Sciences of Drexel University.

When seeking information about the 1938 expedition, I contacted the Drexel University library where I spoke with Paul Roberts, the reference librarian. Roberts sent me 8 pages of Gordon's proposed "Project for a mineralogical survey of the Atacama Desert of Chile" (Gordon, 1938), which included details about the proposed expedition's logistics. Roberts also sent 14 pages of Gordon's "Meteorites Chile" (Gordon, undated), which gave descriptions of twenty Chilean meteorites, and a further 47 pages of some of the expedition's mineralogical descriptions that were published after

the expedition in *Notulae Naturae* (Gordon 1940-1942). Roberts also put me in contact with a Drexel associate, Ned Gilmore, the collection manager for vertebrate paleontology.

Gilmore was familiar with the geologic collections and provided me with a list of 463 specimens from Chile that had been accessioned into the Academy's collection commencing with silvers cataloged as early as 1877! Of the specimens donated by the Collector's Edge Minerals, Inc., twenty-three were on this list!

The donation included two full flats, each with a letter-sized sheet of paper that labelled the contents as "reference material" and "junk". The bottom of each sheet had the initials "A. M." The identity of "A. M." was unknown until the author noted the following in Gordon's tamarugite paper, where he thanks numerous people, including "…Professor James L. Crenshaw for permitting Mr. Adolph Meier to use the facilities of his chemical laboratory at Bryn Mawr College" (Gordon, 1940, p2). Adolph Meier may have been an ANSP employee who aided Gordon in the identification of minerals. Both of these flats contained numerous pseudoboleite specimens, from two different mines, the La Compañía mine and the "Mina Santiagina". The name "Mina Santiagina" was a mystery; I could find no mention of it in my literature and online search. Initiating a discussion on Mindat led to the conclusion that the current name of this mine is Bella Santiaguina, with Gordon's "Santiagina" being both a shortening and a miss-spelling. It is also noted that Gordon's "La Compañía mine" is now mindat's "La Compañia mine". Both of these mines are in Sierra Gorda, Antofagasta Province.

There are also specimens attributed to the "San Miguel mine" at Queténa. No reference to such a mine could be found and it is assumed that the locality intended is the Queténa mine, Toki Cu deposit, Chuquicamata District, Calama, El Loa Province, Antofagasta, especially given that the type locality for bandylite is the Queténa Mine, and four donated "bandylite" specimens (ANSP #22435) are labeled as being from the "San Miguel Mine, Queténa"; perhaps the mine changed its name. Unfortunately, however, these "bandylites" had been misidentified; one of them was X-rayed for this study and found to be atacamite.
Two specimens of "gold" were included in the donation, with matching catalog numbers on labels and specimens; however, no gold was present. Presumably they had been trimmed and the gold-bearing portions spirited away, leaving behind numbered specimens with no gold. Something similar may have happened to other specimens, where only post-trimming waste was left in the boxes.

A small bag contained fragments of cadwaladerite in halite from Cerro Pintado, Las Pintadas mining district, Tierra Amarilla, Copiapó Province, Atacama. Gordon had collected this material during the 1938 expedition, discovered a new mineral, and named it after Charles Cadwalader (1885-1959), President of the Academy between 1928 and 1951 (Gordon 1941).

It is clear that most of the donated specimens had been incompletely researched and curated. Some had no labels; others had labels with a locality but no mineral name. Some of the unlabeled species – such as clinoclase – were identifiable by their visual properties but, for the rarer minerals, identification was attempted in this study through a combination of powder X-ray diffraction (XRD), and searching Mindat for comparable material and further information. In some cases the Mindat comparisons were helpful, while in others they posed fresh questions. For example, many of Mindat's photos of gold from La Compañia mine show a matrix similar to that for "Mina Santiagina" specimens in the donation. Perhaps, these two mines have similar rock and mineral associations? Both are in Sierra Gorda, and are separated by only about ten miles.

The Minerals

The following table lists all of the minerals that were identified, visually or by X-ray diffraction, in the donation.

Table 1 - Minerals Identified in this study.

Alunogen	$Al_2(SO_4)_3 \cdot 11H_2O$	Gypsum	$CaSO_4 \cdot 2H_2O$
Antlerite	$Cu^{2+}{}_3(SO_4)(OH)_4$	Halite	NaCl
Aragonite	$CaCO_3$	Jarosite	$KFe^{3+}{}_3(SO_4)_2(OH)_6$
Atacamite	$Cu^{2+}{}_2Cl(OH)_3$	Kröhnkite	$Na_2Cu^{2+}(SO_4)_2(H_2O)_2$
Blödite	$Na_2Mg(SO_4)_2 \cdot 4H_2O$	Leightonite	$K_2Ca_2Cu^{2+}(SO_4)_4 \cdot 2H_2O$
Boleite	$KPb_{26}Ag_9Cu_{24}Cl_{62}(OH)_{48}$	Libethenite	$Cu^{2+}{}_2(PO_4)(OH)$
Botryogen	$MgFe^{3+}(SO_4)_2(OH) \cdot 7H_2O$	Lindgrenite	$Cu_3(MoO_4)_2(OH)_2$
Butlerite	$Fe^{3+}(SO_4)(OH) \cdot 2H_2O$	Meta-alunogen	$Al_4(SO_4)_6 \cdot 27H_2O$
Cadwaladerite	$Al_5(H_2O)_3(OH) \cdot (Cl,H_2O)$	Metasideronatrite	$Na_2Fe^{3+}(SO_4)_2(OH) \cdot H_2O$
Caracolite	$Na_2(Pb_2Na)(SO_4)$	Metavoltine	$K_2Na_6Fe^{2+}Fe^{3+}{}_6O_2(SO_4)_{12} \cdot 18H_2O$
Chalcanthite	$Cu^{2+}SO_4 \cdot$	Molybdenite-2H	MoS_2
Clinoatacamite	$Cu^{2+}{}_2(OH)_3Cl$	Natrochalcite	$NaCu_2(SO_4)_2[(H_2O)(OH)]$
Clinoclase	$Cu^{2+}{}_3(AsO_4)(OH)$	Natrojarosite	$NaFe^{3+}{}_3(SO_4)_2(OH)_6$
Cuprite	CuO	Paratacamite	$Cu^{2+}Cl(OH)$
Darapskite	$Na_3(SO_4)(NO_3) \cdot H_2O$	Pseudoboleite	$Pb_{31}Cu^{2+}{}_{24}Cl_{62}(OH)_{48}$
Dickite	$Al_2Si_2O_5(OH)$	Pyrite	FeS_2
Dioptase	$Cu_6Si_6O_{18} \cdot 6H_2O$	Quartz	SiO_2
Ferrinatrite	$Na_3Fe^{3+}(SO_4)_3 \cdot 3H_2O$	Siderotil	$Fe^{2+}(SO_4) \cdot 5H_2O$
Fluorwavellite	$Al_3(PO_4)_2(OH)_2F \cdot 5H_2O$	Thénardite	Na_2SO_4
Greenockite	CdS	Unknown	XRD similar to montetrisaite.

References

Gordon, S. G. 1938. Project for a mineralogical survey of the Atacama Desert of Chile. Unpublished Academy of Natural Sciences of Philadelphia paper [Expedition Proposal].

Gordon, S. G. 1940-1942. Results of the Chilean expedition of 1938. Parts I-VIII. Notulae Naturae (1940, Part I, Number 57; Part II, Number 64), (1941, Part III, Number 69; Part IV, Number 72; Part V, Number 80), (1942, Part VI, Number 97; Part VII, Number 101; Part VIII, Number 103).

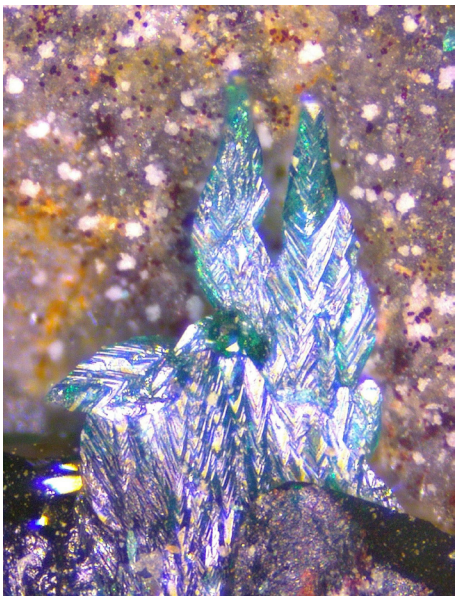

Figure 1- Atacamite from the Bella Santiaguina Mine, showing interesting growth striations. 1.5 mm field of view (FOV). Patrick Haynes photo.

Figure 2- Botryogen with butlerite from Chuquicamata(?). 1.1 cm FOV. Patrick Haynes photo.

Gordon, S. G. 1940. Results of the Chilean expedition of 1938. Part I.- the identity of lapparentite with tamarugite. Notulae Naturae 57:1-9.

Gordon, S. G. 1941. Results of the Chilean expedition of 1938. Part V.- cadwaladerite, a new aluminum mineral from Cerro Pintados Chile. Notulae Naturae 80:1-4.

Haynes, P.E. 2026. A donation of Chilean minerals collected by Samuel Gordon in 1938. Rocks & Minerals 101(1).

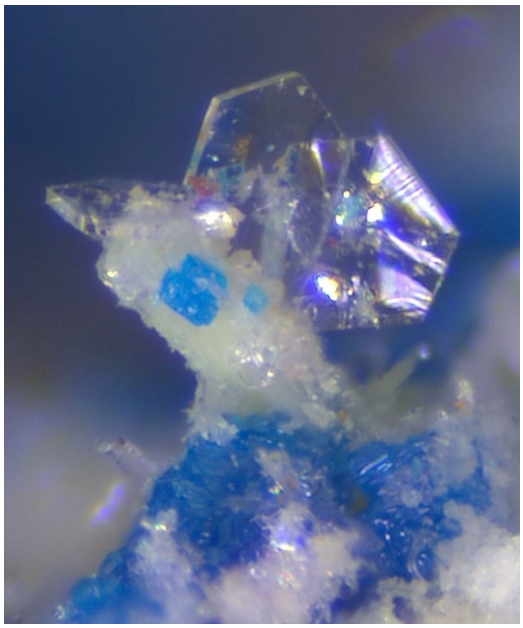

Figure 3- Caracolite with pseudoboleite from the Bella Santiaguina Mine. FOV = 0.3 mm. Patrick Haynes photo.

Figure 4- Kröhnkite with colorless blödite. From Chuquicamata. 10.9 cm wide. John Rakovan photo.

Figure 5- Leightonite with atacamite on ANSP specimen number 22392. The FOV = 3.5 mm. Patrick Haynes photo.

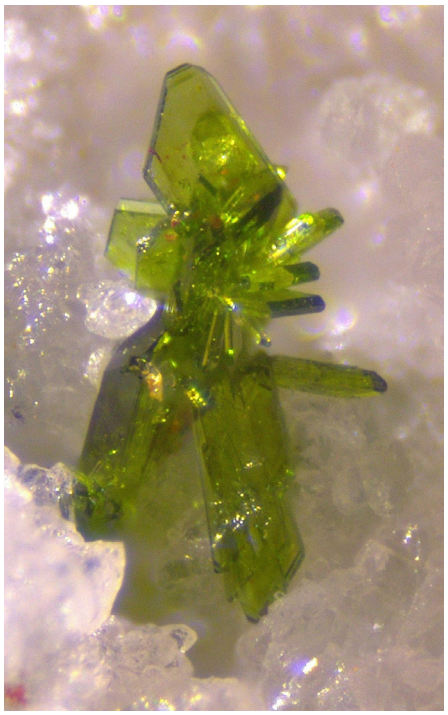

Figure 6- Lindgrenite from the type locale, Chuquicamata. A 1 mm long spray. Patrick Haynes photo.

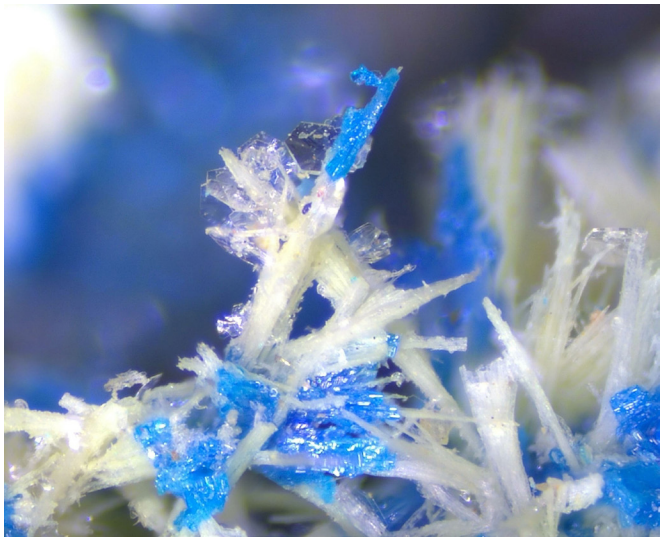

Figure 7- A white quartz spike with blue pseudoboleite and colorless caracolite. From the La Compañia Mine. 1.5 mm FOV. Patrick Haynes photo.

Figure 8- Pseudoboleite from the La Compañia Mine. 0.6 mm FOV. Patrick Haynes photo.