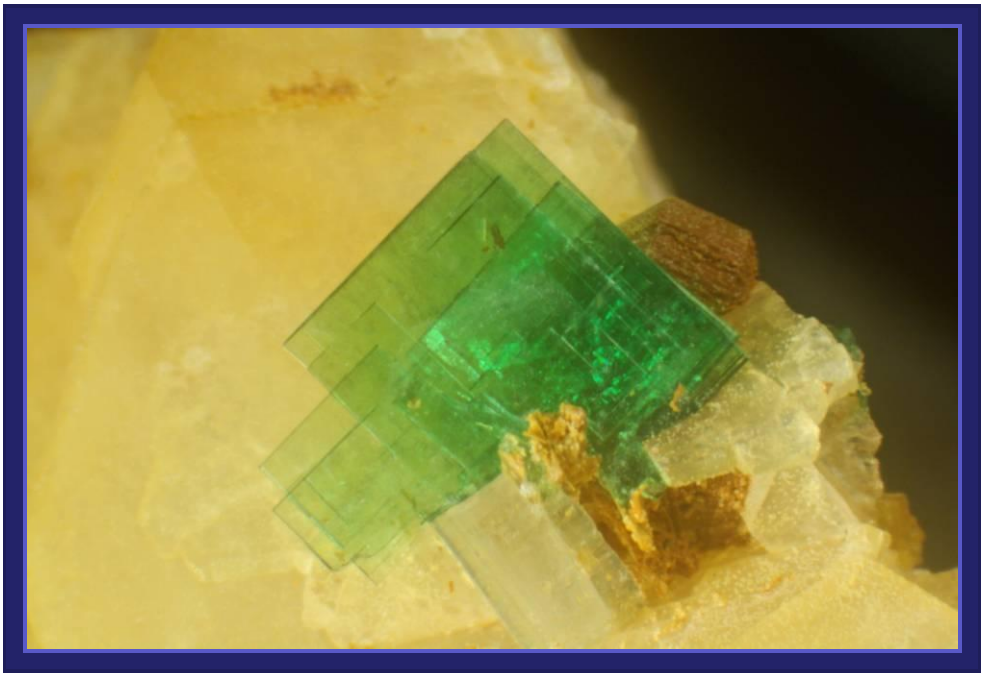
# The Mineralogical Society of Victoria
Incorporated
A0001471E

## Newsletter No. 201

## October 2009



Torbernite, Lake Boga, Vic
4.5mm field of view

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**Membership Details:**

| | | | |
|---|---|---|---|
| Joining Fee | $5.00 | | |
| City Adult Member | $25.00 | Country Adult member | $20.00 |
| City Family membership | | Country Family Membership | |
| (2 adults & children under 18) | $35.00 | (2 adults & children under 18) | $30.00 |
| Student Member (full time) | $15.00 | Newsletter only | $15.00 |

(N.B. - Country membership - more than 50 km from Melbourne G.P.O.)

Applications for membership can be obtained by writing to:-
The Secretary, Ms. Lia Bronstijn,
P.O. Box 12162,
A'Beckett Street,
Melbourne, Vic, 8006.

General meetings are held on the 2nd Monday of each month (except January) commencing at 8.00 pm at the Royal Society of Victoria, 8 Latrobe St. Melbourne.
Visitors are most welcome.

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## FORWARD DIARY

**PLEASE NOTE:-** General Meetings of the Society are now held on the second Monday of each month, 8:00pm at the Royal Society Building.

Oct 12 General Meeting: John Haupt. Topic: Rare Earth Minerals

Oct Mineral Appreciation Group – No meeting due to NDLC Exhibition.

Oct Micro Group Meeting – No meeting.

Nov 9 General Meeting: Professor Peter Williams, University of Western Sydney.
Topic: To be advised.

Nov 15 Micro Group Meeting – At Nunawading Lapidary Club Rooms, Silver Grove, Nunawading.
Topic: Minerals forming in granitic rocks (combined meeting with MAGroup)

Nov 15 Mineral Appreciation Group – At Nunawading Lapidary Club Rooms, Silver Grove, Nunawading.
Topic: Minerals forming in granitic rocks (combined meeting with Micro Group).

Dec 6 Excursion – MinSoc BBQ. Venue to be advised.

Dec 14 General Meeting: Assoc. Prof. Stephen Gallagher, University of Melbourne.
Topic: Eighty million years of climate change in Victoria.

Dec Mineral Appreciation Group – No meeting due to Christmas.

## MINERAL RELATED EVENTS

Oct 17 – 18 NDLC Annual Exhibition 2009. Blackburn High School, Cnr Williams and Springfield Roads, Blackburn North

Jun 12 – 14 2010 33rd Joint Mineralogical Societies of Australasia Seminar, The Royal Society Rooms, Adelaide. Hosted by The Mineralogical Society of South Australia.

## NEXT ISSUE

**PLEASE NOTE:-** Material for the October Newsletter to be with Michael Hirst by **December 2nd.**

## FROM THE COMMITTEE

As our Newsletter is now in colour, we will always be looking for interesting photos of specimens, fieldtrips or general interest items to include.

We are currently finalising the venue for the annual BBQ to be held on Sunday 6th December. After a few years at suburban locations, we are looking to return to the countryside again. However, a few alternative suggestions have been raised, including having a lunch at a pub / country venue instead of a BBQ? If members have any suggestions, preferences or vehement dislike of any option, please let a committee member know as soon as possible.

As the next newsletter (December) is likely to be published fairly close to the date of the BBQ, details will be provided at the November General Meeting, on the Society website or by contacting one of committee closer to the date.

The Mineralogical Society will have a stand at the Nunawading Lapidary Club exhibition, October 17-18, and we will need members to help both days, and particularly on the Sunday. If you can spare even half an hour (you can sit down!) it will help promote MinSoc.
Alex Blount
President

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Special thanks to Jon Mommers (www.earthstones.com.au) for providing the printing services and allowing us to present the Newsletter in colour.

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## EXCURSIONS
### Forward Diary

Pending the appointment of a new Excursions Officer, the committee is looking at some localities and in preliminary planning for the next 12 months. Potential future trips may include a return to Broken Hill, Phillip Island, other areas of NSW and some new localities in eastern Victoria.

December 6th – Sunday

MinSoc Annual BBQ – Venue to be confirmed. Please see the “From the Committee” section, we welcome Members comments and suggestions for venues.

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## PUBLICITY
### Micro Group Report

The August topic was minerals of the Middleback Ranges, S.A., principally Iron Monarch mine, but including other mines such as Iron Knob and Iron Princess. We had the Minsoc reference collection there, prepared by Glyn Francis some years ago and available for loan to members.

Type locality specimens tabled were francisite, gatehouseite and kleemanite. Phosphate minerals were well represented by: apatite-(CaF), dufrenite, faustite, kidwellite, libethenite, millisite, mitridatite montgomeryite, paravauxite, strengite, triploidite, turquoise, variscite, and wavellite. Minerals containing vanadium, not very common in Australia, were represented by pyrobelonite, namibite, and mottramite. Carbonates included aragonite, calcite, and rhodochrosite. Others were barite, bismutite and beyerite, silver, chlorargyrite, iodargyrite, phillipsite, chalcophanite, connellite, goethite, lepidocrocite, paratacamite, romanechite, shigaite, seamanite, and sussexite. Some aesthetic specimens noted were variscite (red) with wavellite, wavellite on hematite crystals, and tiny wavellite crystals on strengite. This list covers most of the species we saw and we felt it was a nice sample of the very diverse range of minerals that have been identified from this rich locality.

We all look forward to seeing the coming book on the minerals of the Middleback ranges. Meanwhile we had a very good day and found comparing specimens was really helpful. As usual, lots of chat about minerals and recourse to photos on Judy's computer, as well as frequent trips to the kitchen for coffee and cakes.

In September we met to look at Pseudomorphs. We found this topic testing: when is it a pseudomorph and when is it a perimorph – and what's the difference? An article by John S. White in Rocks & Minerals, Vol. 78, September/October 2003 explained it.

"A classic definition (*of a pseudomorph)* goes something like this: the replacement of one mineral by another in which the form of the original mineral is preserved. There are two main types: paramorphism, wherein one polymorph changes to another (e.g., calcite after aragonite), and pseudomorphism, which involves a chemical change wherein components of the original mineral have been partly or completely replaced by others (e.g. native copper after cuprite and goethite after pyrite). In both cases, the crystal form of the original minerals is retained. The pseudomorph has the same shape and size as the mineral it used to be".

There are also specimens that are not, strictly speaking, pseudomorphs: "a perimorph is an example of one mineral forming a crust over another, usually requiring the subsequent dissolution of the original mineral so that the crust is a hollow shell or cavity that replicates the original mineral's external form only… Good examples of perimorphs are relatively common. (e.g.) … quartz after anhydrite…(*and*) prehnite after laumontite."

Minerals tabled included a hand specimen of santabarbaraite from Wannon Falls, very fine, where the original vivianite crystal forms could be clearly seen. Other notable pieces included cotunnite coating vanadinite after pyromorphite, Morocco; hinsdalite ps. pyromorphite, Sylvester Mine, Tasmania; bismite ps. emplectite, Black Forest, Germany; hematite ps. marcasite, Hungary; and magnetite ps. andradite, Kara Mine, Tasmania (demonstrated to be magnetic).

We also saw meyerhofferite ps. inyoite, Death Valley, California; quartz var. agate ps. aragonite, Utah; senarmontite ps. stibnite, Costerfield; hematite ps. garnet, Utah; rutile ps. anatase. Brazil (a paramorph); crandallite ps. fluellite, and ps. wavellite, Tom's quarry, S.A.; goethite ps. wulfenite, Whim Creek, W.A.; malachite ps. copper, Mt. Malvern Mine, S.A.; and a 3.5 cm. cube of limonite ps. pyrite from Kirkeek's Treasure mine, S.A. There were more, and we discussed most of them which meant a lot of interest in the topic. A few we had to take on faith, many others such as the rutile ps. anatase could be clearly seen to be alterations. We really enjoyed the day.

The Group welcomes new members. Our meetings are informal and tea, coffee and cake are provided. It's only necessary to bring your lunch, microscope and any minerals you may have for the day's topic.

No minerals? No problem – come anyway as many minerals will be tabled for all to see, but if you haven't attended one of these meetings before, do let the host of the day know you are coming so that there will be enough seats for everyone.

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## Mineral Appreciation Group Report

To make amends for the confusion of topics at the July meeting (or possibly to cause further chaos), we re-studied the concept of lustre (or luster) at the August meeting.

Being a physical property of the appearance of a mineral specimen it can certainly be quite subjective, with different people having different opinions about the same specimen. The lustre of any given species can also vary significantly from specimen to specimen, and thus it is difficult to find consistent information within reference books or on the internet. Whilst some minerals may only even show one type of lustre, other minerals may produce examples in several different lustres on the same specimen. One of the old 'classic' mineral properties from before the days of XRD and Raman spectroscopy, lustre has an element of nostalgia associated with old geology text books but it still an interesting a useful property to consider.

Minerals exhibiting a vitreous lustre (reportedly accounting for around 70% of mineral species), which were presented at the meeting included calcite from Tennessee (USA) and from various localities in China, beryls, fluorite, spodumene, an array of different quartzes, benitoite, apatite, topaz, and axinite from France.

Some pearly lustre species included baryte, the 'endlichite' variety of vanadinite, siderite, anhydrite, apophyllite, orthoclase form Harts Range, brucite from Mount Keith, torbernite, and muscovite. Of the adamantine lustre minerals we saw specimens of diamond, crocoites, anglesite, wulfenite and cassiterite.

Due to a technological difficulty (he got the date wrong), the convener was absent from the September meeting. Mysteriously though, this was the second attempt at the "mica" topic which he had missed, so there is some suspicion he may suffer an allergy to this particular group of minerals.

A varied range of mica group minerals was on display. Brian had specimens from various Australian localities including the Harts Ranges and Western Australia. Val Hannah, who is still not well enough to attend, had sent some of her notes and specimens along with Brian to show the rest of us. Among these was a sheet of clear transparent muscovite of roughly 10 x 8 cm with inclusions, probably of manganese. Ian of course had another small but tantalising array of specimens, mainly from Sichuan province in China, where the mica mineral accompanied a variety of other species.

John Haupt also had several interesting specimens, including a 'zinnwaldite' from the type locality Zinnwald in the Czech Republic which looked quite attractive, even though zinnwaldite is strictly speaking no longer recognised as a species on its own. Bernie and Margaret as usual brought a fine range from their collection and Robert and Mary presented an interesting variety, including some larger specimens such as lepidolite, muscovite and biotite, some of which they had collected themselves during their travels.

Mary also gave us a very interesting lecture on the construction of mica minerals. Mica consists of several layers of $SiO_2$ tetrahedra with a layer of eg. $Al_2O_3$ sandwiched between them. The $SiO_2$ layers have a negative charge, and are bonded by positively charged cations such as Al or K to balance out the negative charge. The bonds form at the O positions, ie. at the six corners of the hexagon, and can be formed by either 2 trivalent cations or by 3 divalent cations, hence the subdivision of mica minerals into trioctahedral and dioctahedral species. There is more to mica than you would think!

[Note – photos may not actually be from the recent meeting on mica minerals. Obtained from National Archives of Australia.]

The meetings are an open show and discussion format and all society members are welcome to attend. Meetings typically aim for people to arrive around 10:00am for a 10:30am start, allowing time for people to unpack specimens. If you wish to attend, have any questions or have suggestions for topics you would like to see covered then please catch up with Alex Blount.

## RESOURCES, NEW PUBLICATIONS & REFERENCES OF INTEREST

If any Society members become aware of new publications relevant to mineralogy or existing items that they feel would be of benefit to members, please feel free to let a committee member know. Where appropriate, the Society can look to obtain copies for inclusion within the library.

New journals, publications and newsletters received include:

ExtraLapis English – Volume 11 – Garnets

**SOCIETY MICRO-MINERAL COLLECTIONS**
Broken Hill Collection – Alex Blount
Iron Monarch Collection – Alex Blount
Victorian Collection – Alex Blount
Western Australia – Coming Soon!!

Calcite (“ferroan”) and analcime, Bundoora Quarry, Vic – Photo Volker Hoppe.

The collections currently contain over 600 micro-mineral specimens from their respective regions. We are always looking for new donations of specimens (preferably mounted but not essential), especially from new or recent finds, but updates or multiples of existing species are also appreciated.

The collections are available to all members to borrow on a monthly basis and they provide an excellent way to compare your own material from field-trips with ‘already identified’ reference specimens. If anyone wishes to borrow the collections or peruse a copy of the catalogue, please catch up with the curators listed above.

## WANTED

Mineralogical Record Back Issues Vol 2 No 2 & Vol 2 No 5 for the **MinSoc Library**.

Please contact any committee member if you can assist with these.

**INTERNET LINKS & RESOURCES**

The Mineralogy Society of Hong Kong held its third annual Mineral Fair on 25th July 2009. We had a record number of visitors, at just under 400, and 20 exhibitors, as well as tables for the society. The quality of exhibits has improved year on year, with a wide range of minerals and fossils for everyone. We had dealers from Beijing, Guangdong and Taiwan, as well as Hong Kong, and two newcomers to our fair, Ms Wei and Ms Li from Changsha, Hunan.

This year we concentrated particularly on encouraging young collectors, with a simple mineral identification game using specimens on loan from the Stephen Hui Museum at the University of Hong Kong. Every participant received a free rock sample, and there were plenty more inexpensive pieces on the Society Sales table to start a simple collection.

We had visitors from Europe too. George Liu, who is based in Germany, came along to sign copies of his beautiful book "Fine Minerals of China" and Ida Chau of mindat.org took a table to tell people about that wonderful website and their new auction site being developed. Another book on sale was the society's first publication, "A Handbook of Chinese Minerals".

We are a young but enthusiastic society, and we would welcome a visit from any of the members of the Mineralogical Society of Victoria who happened to be visiting Hong Kong. Details of our upcoming meetings can be found on our website at www.minsochk.org

Best wishes,
Anthea Strickland
The Mineralogy Society of Hong Kong

## FIELD NATURALISTS CLUB OF VICTORIA

*GEOLOGY SPECIAL INTEREST GROUP*

Meetings take place at 8pm at the FNCV Clubrooms at 1 Gardenia Street, Blackburn, 3130 (Melway 47 K10) Further information on the talks and excursions is available from Rob Hamson, 9557 5215 AH, *robhamson1949@hotmail.com*, Clem Earp 9885 1548 AH or Noel Schleiger 9435 8408 AH.

Details of field trips appear in the issue of the *Field Nat News* published the month before the date of the excursion. As a voluntary organisation funded entirely by our members' subscriptions, we welcome visitors but there is a charge of $2 per non-member for each meeting and $5 per excursion attended to help cover our costs. Members of affiliated clubs pay $2.50 for excursions.

Membership: Joint/Family $85, Single $65, Concession $50, Student $25. Further details from FNCV Office 9877 9860.

**GEOLOGY CALENDAR**

Contact Ruth Robertson 03 9386 5521 rutherob@hotmail.com

## THE MINSOC TRADING POST

Society members can submit brief descriptions of specimens, equipment or other mineral related items that they wish to sell, swap or give away.

At General Meetings there are often some minerals for sale after the meeting.

This is open to all – feel free to bring your minerals along.

# MINERALOGICAL TRAVELS IN EUROPE

## Part 11: Cornwall, England

*By John Haupt*

Whilst in England, we naturally had to visit Cornwall and were fortunate to have our friend Chris Jewson show us around. Some members would remember Chris from his time with us on the Society's Tasmanian excursion in 2006. Chris has an excellent knowledge of most of the Cornish mines and minerals. With only a few days in Cornwall, we briefly visited some of the historic mining sites. This article only outlines some of the notable Cornish mines and minerals and the reader is referred to the excellent publication, Minerals of Cornwall & Devon for further information, a copy of which is available in the Society's library.

**Mining History**

Cornish mining history extends back over 2,000 years, with the mining of tin ore from the cliffs and streams being used to produce bronze (an alloy of copper & tin) tools and weapons and later during the Roman period, pewter (an alloy of lead & tin). Mining recommenced in the middle ages, with the mining of stream (alluvial) tin and copper from near surface workings. The introduction of water power in the 1700s and later steam engines allowed mining at deeper levels, which led to a rapid growth in mining from numerous mines. Copper production reached a peak in 1856, with 13,000 tons, 40% of the world's supply. The opening of rich copper deposits in America and Australia resulted in a large drop in copper prices and mine closures, with many miners leaving Cornwall for America and Australia. Tin production continued to be profitable, with production peaking in 1871 at 11,000 tons, half the world's supply. Another slump in metal prices in the 1890s led to the closure of most mines and once again many miners left for overseas. More efficient machinery and mining methods enabled the few remaining mines to continue into the 1900s. The East Pool mine at Camborne closed in 1947, leaving the Geevor and South Crofty as the only major mines. The South Crofty was the last mine to close in 1998.

The surface mines were called *bals* in the 17$^{th}$ century, (hence the term bal maidens - women ore sorters). The name was later changed to *huel* and in the mid 18$^{th}$ century became *wheal*, which meant a hole. Many mines were then named with the title Wheal (Bancroft & Weller, 1993).

**Some Famous Mines**

**St Agnes - Perranporth**

One of the numerous mines along this coastal area, the Cligga workings consist of adits driven into the cliff-face to mine small veins of greisen. It is the type locality for ferrokersterite and recently nice specimens of botallackite were collected from a boulder in the sea at the base of the cliffs (Merry & Weiss, 2007). In the mid 1800s, the Wheal Kind at St Agnes was a source of excellent vivianite crystals, some over 2 inches long and ¾" across. It is probably the type locality. Weekly sales were held at the mine, and specimens were eagerly bought by collectors and dealers. One only wishes that today's mines would be so enlightened to do the same.

**St Day - Gwennap**

Several of the mines around St Day, such as the Wheal Unity and Wheal Gorland are famous mineral localities. The Wheal Gorland, which produced amazing crystals of the rare mineral liroconite, no longer exists - its dumps were removed in the 1970s and the area is now a sporting field. The Wheal Gorland is the type locality for chenevixite, clinoclase, connellite, cornwallite, liroconite and olivenite. In addition to these, fine specimens of chalcophyllite, and spangolite also occurred in these mines. In the 1990s, the dumps of the Ting Tang mine produced a range of micro-minerals to local collectors (Bruce & Aubrey-Jones, 1998). The Wheal Jane, the type locality for ludlamite, has produced many other fine minerals, including large specimens of fluorite. Access to these mines was through the tidal port of Devoran on the south coast. Once a hive of activity, the inlet is now silted up and the old inns from the mining period are now a popular haunt of the younger set.

**St Just - Pendeen**
The mineralized lodes along the coast are the oldest mining area in Cornwall. In the 1600s, miners worked these lodes by tunnels into the cliffs just above sea level. Shafts were later sunk onto the lodes for ventilation and access, with steam beam pumps installed to pump out water. Several mines extended well out under the sea. The Levant mine was a major producer of copper and tin, with copper being mined until 1910 and was the last of the great Cornish copper mines. Later tin became the major ore which was mined to a depth of 2000 ft and for a mile out under the sea. A man engine was installed in 1857. In 1919 the man engine rods broke loose and dropped to the bottom, killing 31 men. The mine closed in 1930. The beam engine has been restored and is now a major tourist attraction. Nearby the picturesque Botallack mine is perched on the cliff-face with its derelict engine house just above the sea. Botallackite is named after this mine. Other famous mines in this area are the Wheal Cock and the Geevor. The latter being one of the last to close in 1985. The under the sea workings in the adjacent Levant mine under the sea were sealed off in 1969 to allow water to be pumped out of the lower workings. Mineralized veins along the cliff face at Roscommon have produced childrenite, stokesite and nice axinite crystals.

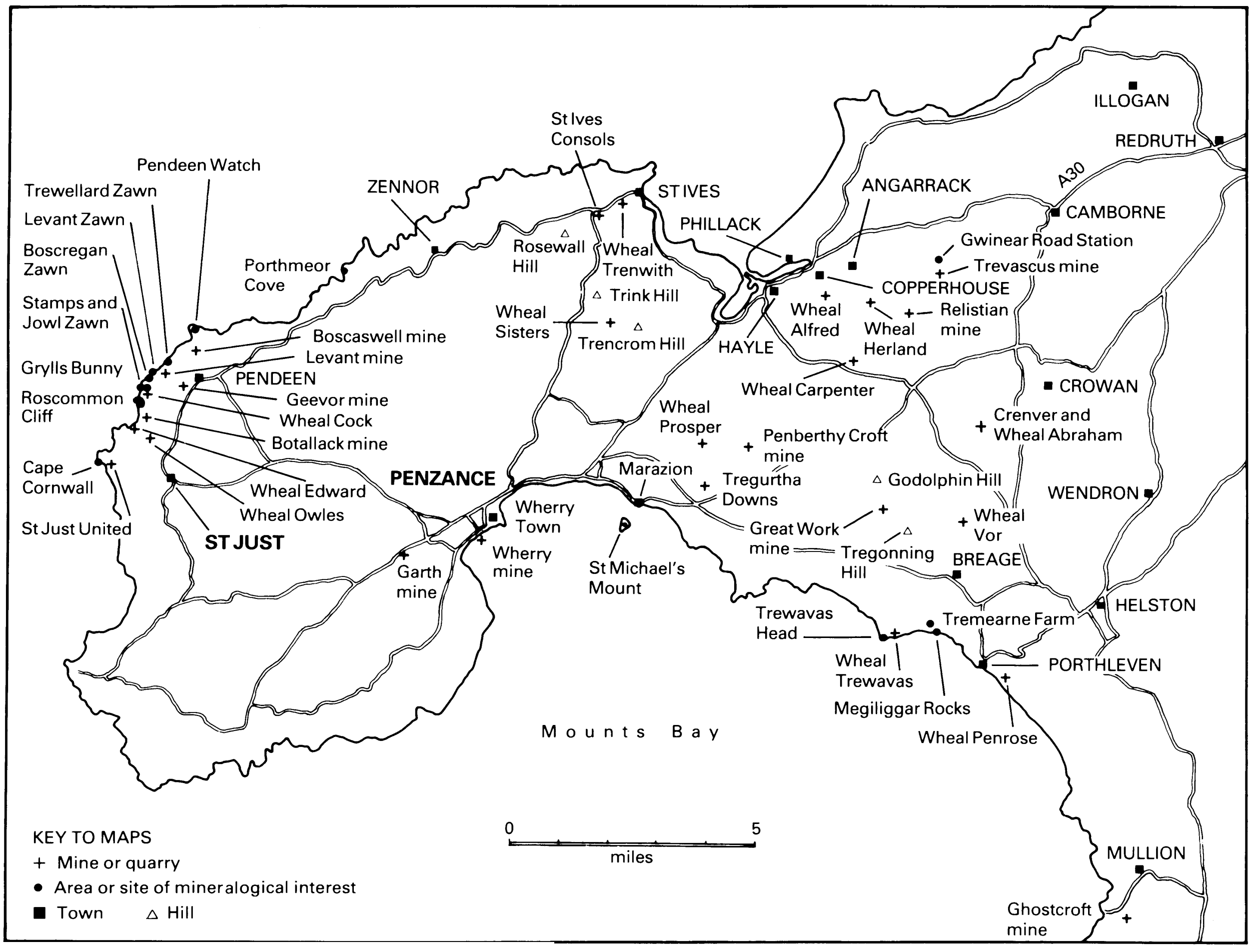
**Redruth - Camborne**
This region is regarded as the heart of Cornish mining, with 100 or more mines operating at the same time. One of the largest mines, the Wheal Basset, contained uranium, which yielded specimens of torbernite and a new mineral, bassetite. From its opening in the 1720s, the Dolcoath mine worked rich copper lodes in the upper levels. Rich tin ore occurred at the lower levels. In 1864 it had 10 steam engines operating and employed 1200 people. The Dolcoath mine ceased operating in the 1920's. The South Crofty mine at Camborne covers an area of nearly 2 square miles and includes scores of ancient mine setts, which like the Dolcoath, Carn Brea, Cooks Kitchen, Tincroft & East Pool, were large and important mines. The South Crofty was the last Cornish mine to close in 1998. The mine is currently being dewatered and some drives cleaned out in preparation for the recommencement of mining. We were fortunate to go underground in the South Crofty, and walked along old drives and into stopes in the upper levels of the mine, which were worked in the 1600s.

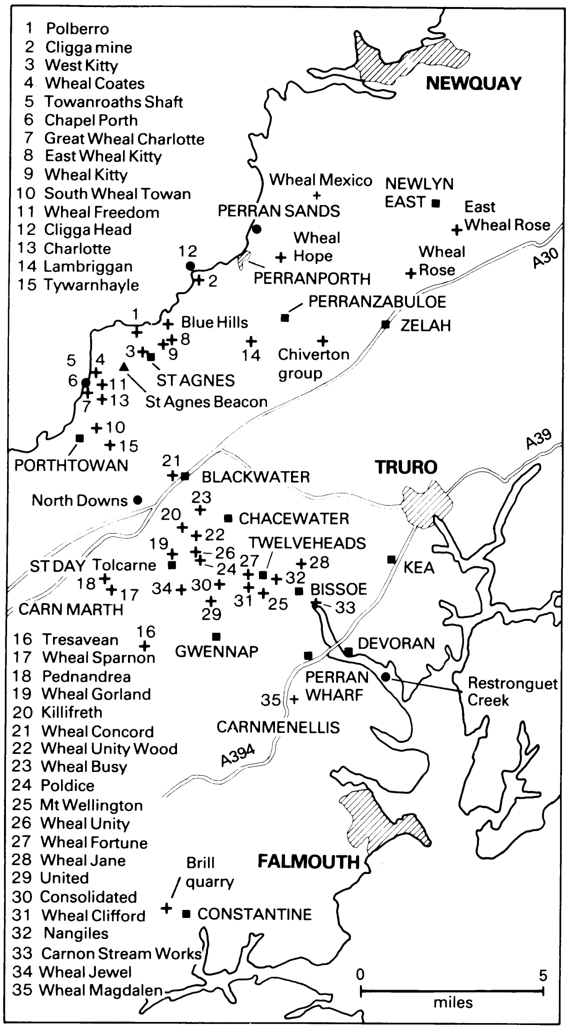
**St Hilary**
The Penberthy Croft mine is one of many old copper & tin mines at St Hilary that were worked in the 17$^{th}$ & 18$^{th}$ centuries and were abandoned in the early 1900s. Local collectors have found 90 different minerals on the old dumps of this mine, most are micro-minerals of arsenates, sulphates and phosphates. Many species are in common with those from Broken Hill, including carminite and segnitite. The first occurrence of bayldonite, in 1865, is attributed to this mine.

**The China Clay Pits**
A large mining industry in Cornwall, the mining of kaolin started in 1770 and in 1858, 92 pits were working near St Austell, producing 65,000 tons of kaolin a year. It is mostly used as a filler and coating in the paper industry, with a lesser amount used in the production of white china & porcelain ceramics. In 1994 it was estimated that a total of 100 million tons had been produced. The kaolin is formed from the breakdown of feldspar in the granitic rocks by acidic groundwater. The China Clay Pits near St Austell have produced a range of interesting minerals. Probably the most famous was the Gunheath pit with its nice specimens of 'apatite', cyrilovite, chalcosiderite, dufrenite, leucophosphite and turquoise. Also interesting are the pseudomorphs of fine grained muscovite after orthoclase, known as 'pigs eggs', that occur in kaolin.

**Liskeard**
Located south of Bodmin Moor, the Herodsfoot mine is world famous for the exceptional crystals of the sulphosalt mineral, bournonite. Only a small deposit, it was mined for argentiferous galena in the mid 1800s. Specimens of bournonite were collected around 1860 by the English mineral dealer Richard Talling, and sold to museums and collectors. Bournonite was first found at Wheal Boys in Endillion and initially named 'endillion', but later named bournonite after its discoverer, the French Mineralogist Count de Bourbon.

*To be continued*




Above & Left: Maps showing some of the Cornish mines (After Embrey & Symes).

Below: Newspaper advertisement by the Wheal Kind mine in 1818, offering minerals for sale to collectors. How enlightened!

## TO MINERALOGISTS.

SEVERAL fine SPECIMENS of the PHOSPHAT and CARBONAT of IRON, found in England, in WHEAL KIND MINE, at St. Agnes, in Cornwall, only, are now for SALE at that Mine. Attendance will be given on Thursday in every week for Sale of the same, from Ten in the Morning to three in the Afternoon, until the whole have been disposed of.

Letters may be addressed, free of postage, to Capt. HENRY PETERS, at St. Agnes aforesaid.

Dated 14th September, 1818.

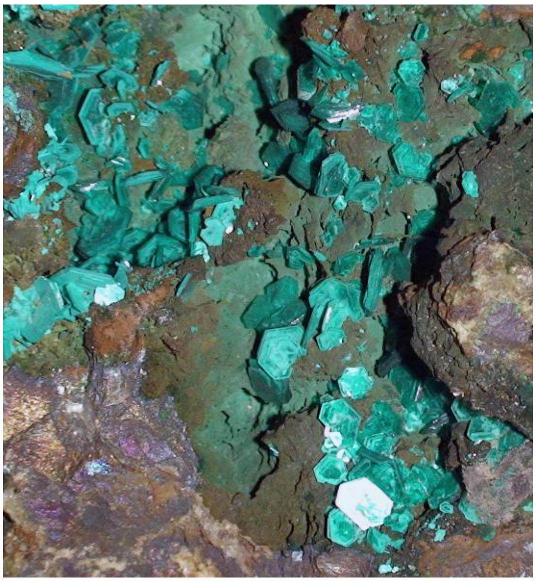
Left: Cligga mine Perranporth.

Robinson’s shaft, South Crofty mine, Camborne.

Below: Old workings in the South Crofty mine, Camborne.

Above: Levant mine, Pendeen.

Below: Botallack mine, Pendeen.



Above left: Site of the Wheal Gorland mine, St Day.

Above right: Liroconite from the Wheal Gorland mine, St Day. Deep blue crystals approx. 2 cm across. Specimen: British Museum.

Left: Chalcophyllite from the Wheal Unity Mine, St Day. Hexagonal crystals 5mm across. Specimen: British Museum.

Below: Main Street, Pendeen.

# The Danas, Father and Son, and some Dana localities in Australia

*by Ruth Coulsell*

Photographs by David Vince.

Reprinted from *Australian Gem & Treasure Hunter, April, 1985*

*James Dwight Dana and Edward Salisbury Dana, father and son, between them covered almost one hundred years of very great developments in mineralogy during the nineteenth century. Beginning with the publication* of *J. D. Dana's System* of ***Mineralogy*** *in 1837, the efforts of the two men reached their peak of achievement in E. S: Dana's complete revision of his father's original work which appeared in 1892. This was the famous Sixth Edition* of *the System* of ***Mineralogy,*** *and it provided the firm foundation on which twentieth century developments in the science were based.*

*In describing various minerals, ES. Dana in particular, invariably quoted localities where fine examples of each species occurred. These become known to collectors as `Dana localities' and material from them became valued, at least in part, for the Dana association.*

**INTRODUCTION**

In Australia today there are literally hundreds of people for whom mineral collecting represents the ultimate in satisfying pastimes.

Apart from the fun experienced in actively searching for specimens, minerals can excite both wonder and aesthetic appreciation through their beauty of form, texture and colour. To many ardent collectors it is this aesthetic appeal that is the main attraction, but there are also many who find intense satisfaction in learning to understand something of those precisely ordered structures, both chemically and physically, which all minerals possess.

It is not long before the new enthusiast seeks answers to some of the many questions which minerals provoke. What is a particular mineral's composition? What is the name given to that crystal's shape? Why does one mineral break cleanly and easily, yet another does not? What is that play of colours across the face of a specimen as it is moved from side to side? And so on.

Quite frequently books will provide answers to such questions, so the collector of minerals in turn becomes a collector of books about minerals. When this stage has been reached the name Dana soon becomes familiar, and it is probably only a matter of time before one of the Dana books on mineralogy will be purchased by the mineral-collecting addict to become a well thumbed, much loved mineralogical friend and guide for the rest of that collector's days. It does not matter whether the chosen reference book is the *Manual of Mineralogy,* the *Textbook of Mineralogy,* or one of the three currently available volumes of the Seventh Edition of the *System of Mineralogy*, its owner will almost invariably refer to it simply as `Dana'. Such is the reputation of the Dana textbooks amongst mineral collectors, that each one has the standing of definitive accounts of minerals and the science of mineralogy. To many enthusiasts, especially amateur enthusiasts, Dana is still the ultimate mineral authority.

**THE DANA BOOKS**

Who then is this Dana whose writings are as holy writ to so many mineral collectors?

Actually there were two Danas: James Dwight Dana, the father, and Edward Salisbury Dana, the son. Between them their writings covered a century of tremendous development in the science of mineralogy. What may be described as the Dana era began in 18 37 with the publication of James Dwight Dana's first edition of the *System of Mineralogy*, and came to an end in1935 with the death of Edward Salisbury Dana.

The Dana textbooks still in print today if at times difficult to obtain, are, however, no longer the original editions, for with the astonishing advances made in mineralogy especially in this century, they have been completely revised, re-written and greatly enlarged. J.D. Dana's *Manual of Mineralogy* is now in its nineteenth edition, the latest revision having been made by Cornelius S. Hurlbut, Jr. and Cornelis Klein. Edward Dana's *Textbook of Mineralogy*, now in its fourth edition, if you can get it, is the revised and enlarged edition prepared by William E. Ford, whilst the major revision of James Dana's initial *System of Mineralogy* was first published by the son as the splendid Sixth Edition of 1892.

This was the keystone of the work of both Danas in mineralogy, establishing as it did, the systematic classification of minerals known in their day, on a firm basis related to the chemistry of each species.

**James Dwight Dana.**

In the preface to this famous Edition, Edward Dana outlined the successive changes which developments in the science of mineralogy had brought about since his father's book had first appeared in 1837, and the 1892 edition was indeed far removed from the original system, both in approach and the number of mineral species described.

By 1915 however, Edward Dana was aware that a Seventh Edition was necessary to keep up with the steady and continuous advances still being made in mineralogy. Aware too, that the task was physically beyond him, he asked Professor William E. Ford of Yale to undertake the work, relinquishing all rights in the book to Professor Ford soon afterwards. In turn Ford realised the magnitude of the work involved, and enlisted the skilled assistance of a number of such able men as Professors Palache and Larsen from Harvard, Dr. J. F. Schairer, Dr. Michael Fleischer, Dr. Clifford Frondel and Dr. Henry Berman, whose names are familiar to many mineral enthusiasts today. An outline of the difficulties and delays encountered by these men, including the complete suspension of any work at all during the years of the Second World War, may be read in the preface to the first volume of the Seventh Edition of the *System of Mineralogy* which appeared in 1944.

Three volumes of the Seventh Edition are currently in print. They are –

Volume 1. Elements, Sulphides, Sulphosalts and Oxides by Charles Palache, Henry Berman and Clifford Frondel, dated 1944.

Volume 2. Halides, Nitrates, Borates, Carbonates, Sulphates, and so on by the same three men, dated 1951.

Volume 3. Silica Minerals by Clifford Frondel, the only one of the three writers still living, which appeared in 1962.

Whether a volume, or volumes, on silicate minerals will ever be written to complete the Seventh Edition remains to be seen.

The costs of producing the Seventh Edition were enormous. Many scientific organisations and the two great American Universities gave financial assistance, as did also the publishers, John Wiley and Sons, who now hold the copyright.

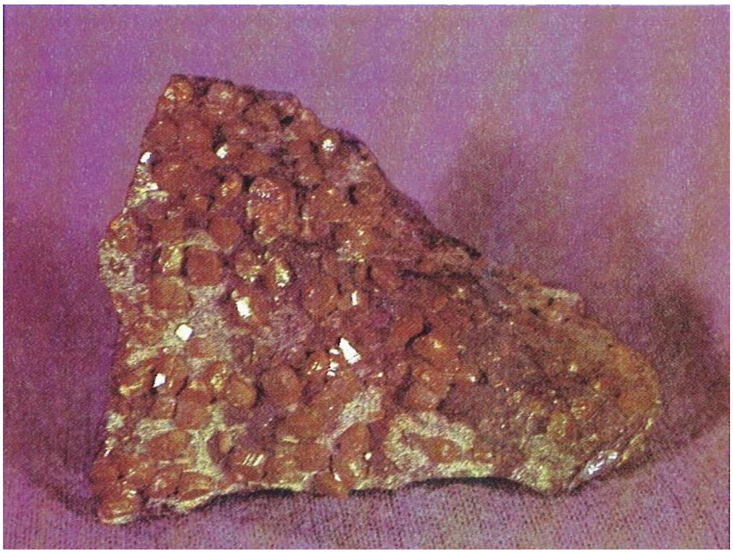
**JAMES DWIGHT DANA**

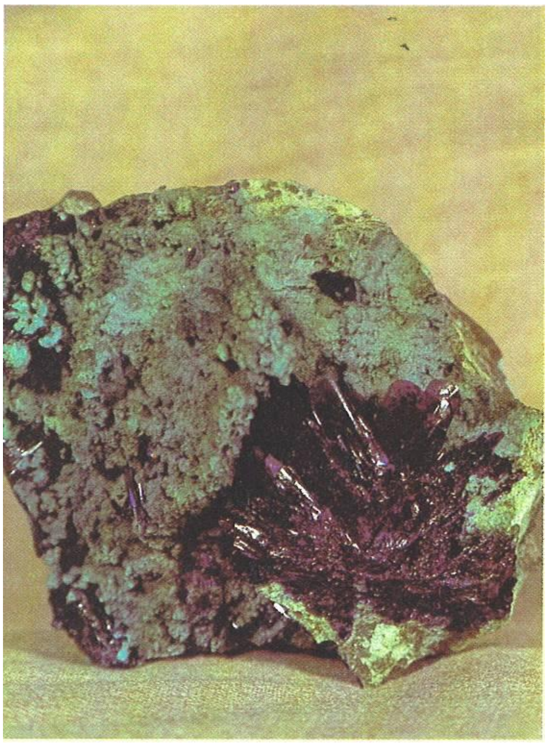
James Dwight Dana was born in Utica in New York State in February 1813. As a boy he showed an early interest in science particularly chemistry, and by the age of twelve had already become an ardent collector of minerals in his own state of New York, and in the adjacent small state of Vermont.

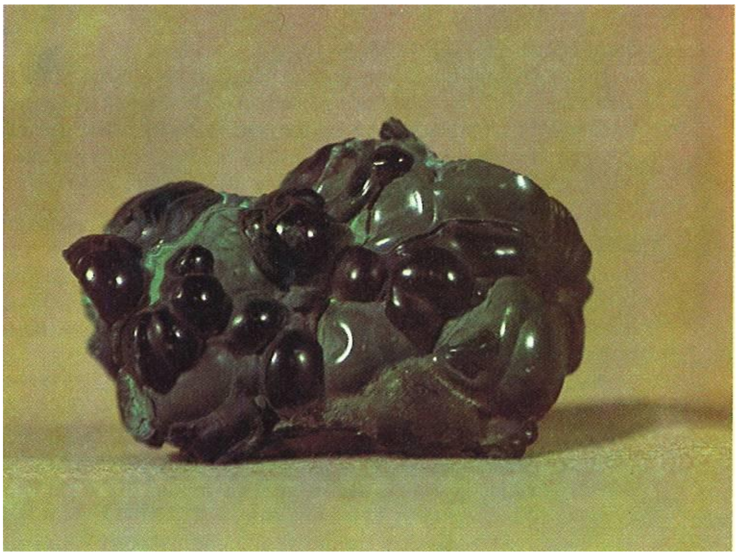
In 1833 young James Dana entered Yale College where he soon attained distinction in mathematics and where he continued to make progress in his favourite science of mineralogy, despite the fact that so much time had to be given to the accepted classical studies of the day, even by those whose special talents were quite markedly scientific.

Shortly before his graduation Dana was able to make a cruise of the Mediterranean as a mathematics instructor in the U.S. Navy, and it was during this period that he worked out a number of complicated mathematical problems in crystallography, the results of which he was to use to great advantage in the study of mineral crystallography at a later date.

On his return to America the young man worked with Professor Silliman of Yale as the latter's assistant in chemistry, and it was during this period that Dana published his first important contribution to science, namely a *System of Mineralogy.* This appeared in 1837 when he was twenty-two years







Above: Azurite and malachite, Burra Burra, S.A. R. Coulsell specimen. Size 7 x 5cm.

Above Left: Stolzite, Proprietary mine, Broken Hill, N.S.W. R. Coulsell specimen. Size 3 x 2cm matrix

Left: Botryoidal malachite, Burra Burra, S.A. R. Coulsell specimen. 5cm across.

old.

In 1838 Dana again went abroad, this time as geologist and mineralogist on an American expedition to the Pacific and Southern Oceans. During this period he was actually in the Colony of New South Wales for a time, and at a later stage during the same expedition he visited the Sacramento Valley in California. Here, six years before the great California gold discoveries, he noted that the geological features of the area indicated the probable presence of gold, but the report was not followed further.

Although much of the material gathered on this long expedition was lost in the wreck of one of the ships on the South American coast, James Dana published a number of reports on his return, including an excellent paper on the origin of Pacific coral islands.

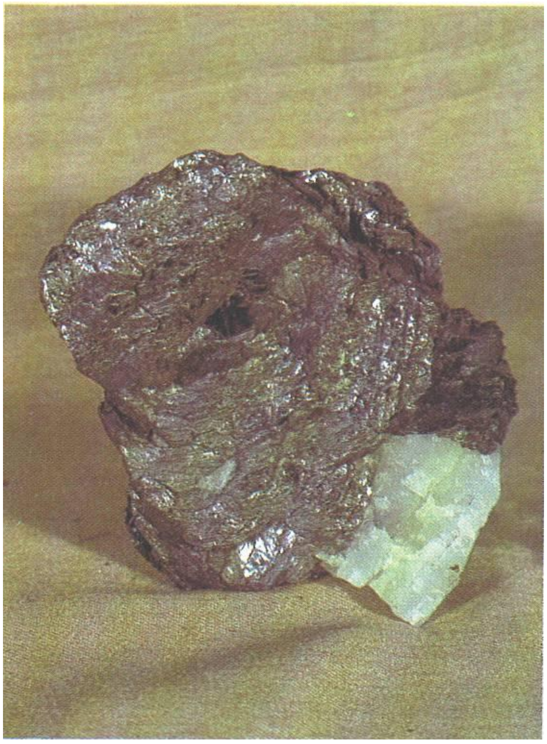
During the next thirteen years his scientific writings included three editions, in 1844,1850 and 1854, of the original *System of Mineralogy* which had proved to be enormously popular. He also produced in 1848, and 1857, two editions of a *Manual of Mineralogy* representing in all, a prodigious amount of work.

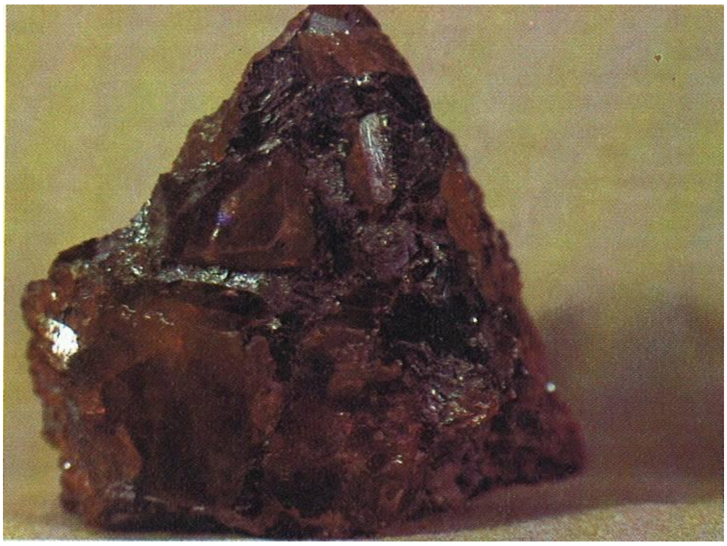
The constant and intense activity of this period caused a serious breakdown in health from which he never fully recovered, although in fact James Dana lived to the considerable age of eighty-two. Those last years were by no means either inactive or unproductive, but the intensity of his efforts had always to be limited and kept within the bounds of his strength.

**EDWARD SALISBURY DANA**

James Dana's son was born in November 1849 and after the normal schooling of his time, he entered his father's college of Yale to undertake studies in the science then known as Natural Philosophy.

Although this son, Edward Salisbury Dana, was to build on, and further develop the systematic approach to the classification of minerals begun by his father, the younger man's professional life at Yale was devoted almost entirely to physical





Above: Molybdenite and quartz, Kingsgate, N.S.W. R. Coulsell specimen. Size 9.5 x 5.5cm.

Above Right: Gmelinite and natrolite in basalt, Flinders, Vic. R. Coulsell specimen. Size 10cm overall.

Right: Rhodonite crystals on galena, Zinc corporation Mine, Broken Hill, N.S.W. R. Coulsell specimen. 7 x 8cm.

science. He became Assistant Professor of Natural Philosophy in 1870, and Professor of Physics in 1890, holding that Chair until his retirement in 1917.

As a boy young Edward Dana showed a much greater interest in ferns and lichens than in minerals, but as he grew up his interest in minerals became as great as that of his father. In consequence of this, by 1870 he was engaged in serious research and study in mineralogy, all of which was superimposed on his normal teaching obligations in physical science, and his administrative duties at Yale.

As a result of these intensive activities, history ultimately repeated itself, and the son's health became impaired by overwork just as had that of his father. To the end the life patterns of father and son were curiously similar, and Edward Dana in spite of ill-health, also lived into his eighties.

For Edward Dana the years between 1880 and 1893 were, as far as mineralogy was concerned, the most productive of his life. In that period he wrote and published forty-seven papers devoted to minerals and prepared a number of textbooks. He achieved especially important work in crystallography, but his crowning achievement and the one that caused Yale to become one of the greatest centres of mineralogical science in the world, was the publication of his *Textbook of Mineralogy* in 1877. This is still an authoritative text. For his book the younger Dana prepared not only detailed and very accurate descriptions of the minerals known at that time, but he also included important chapters on crystallography (at which he excelled), the optical properties of minerals, and practical methods for the chemical testing of minerals. Almost overnight the book became the most important textbook on mineralogy written in English at that time.

Nevertheless, in spite of the very great importance of the 1877 textbook, many would claim that Edward Dana's most significant achievement was the revision of his father's *System of Mineralogy.* This was the famous Sixth Edition of 1892 in which the son consolidated his father's gradual approach to a systematic classification of minerals based on their chemistry, and even though since that time knowledge of the structure of minerals has continued to make tremendous advances, present day systematic studies in mineralogy are still firmly rooted in that great work. Edward Dana's fame must rest firmly there for many years to come. The book itself, with the Appendices which followed in 1899, 1909 and 1915 may still be seen occasionally, but it is today a rare and valuable collector's item.

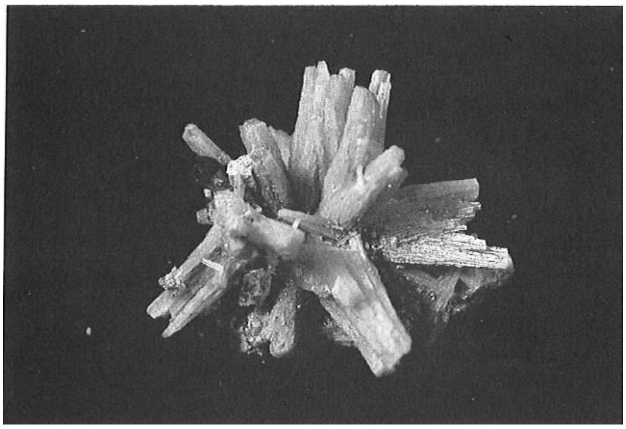
The preparation of the material for the Sixth Edition took Edward Dana ten years to complete and his accuracy was quite extraordinary. The appendices already mentioned included numerous new listings of American mineral localities together with general supplementary mineral data, and for many years almost every mineralogist had a copy of this splendid work at hand, most copies showing evidence of hard usage.

**DANA LOCALITIES IN AUSTRALIA**

The descriptive sections of the 1892 publication included extensive and carefully verified locality details as part of the account of each mineral species noted. Generally speaking many of these produced either spectacular or remarkably perfect specimens. Other localities earned a listing because of the rarity of the minerals found there, or because of some other special feature, though in appearance the mineral might have little to commend it. To the student in mineralogy, to the mineral collector, and often to the professional mineralogist such localities came to be known as `Dana' localities, the term conferring almost an accolade on the particular mineral species found there. Dana localities are still regarded with reverence by collectors in general, and there are some enthusiasts who painstakingly build up collections of minerals drawn exclusively from such areas, though this is not an easy task and could moreover for a variety of reasons, perhaps prove a narrow approach.

Australia is well endowed with localities where fine or rare minerals have been produced and duly noted in the Dana textbooks. Localities such as Broken Hill and the New England Tableland in New South Wales, the north-western coastal region in Tasmania and the copper belt of South Australia are quite familiar to present day collectors.

There are also many Australian mineral localities which are not nearly so well-known also noted in one or other of Dana publications, and a little research can produce such surprises as the recording of a deposit of amblygonite to the south of Darwin, certainly a fact not generally known. Surprising

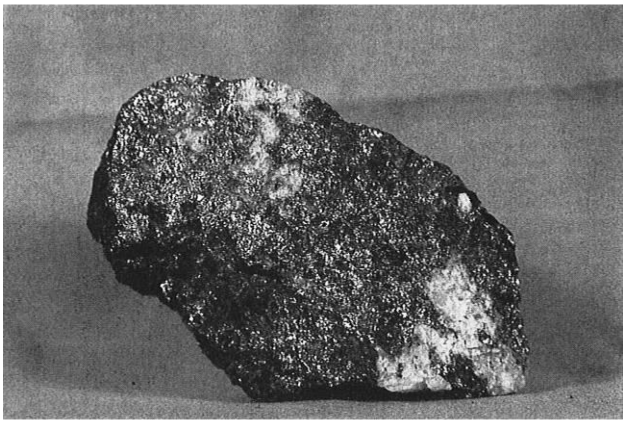


Cerussite, Open Cut, South Mine, Broken Hill, N.S.W. R. Coulsell specimen. Size 5cm across.

omissions will also be realised, but where such instances come to mind, the deposits will, in all probability, postdate the Dana era in their discovery and ultimate working.

Even Victoria, not especially well-endowed with mineral deposits of great interest now that so much of the gold has been worked out, can boast of five major Dana localities. These are, of course, the unique maldonite from Maldon, the fine blue vivianite crystals from the **Wannon River Falls** in the Western District, the outstanding zeolite suite found in the Older Basalt of Simmons Bay near Flinders, the zeolites from the Newer Basalt of the inner Melbourne suburbs of **Richmond, Clifton Hill and Collingwood,** and the strange group of guano-type phosphates which include newberyite and struvite, and which come from lava caves on Mt. Widderin near **Skipton.** There are, however, at least another five Victorian localities mentioned in the Dana texts if one looks for them, and there are unexpected aspects of some of these. For instance cervantite is noted from Costerfield but not the stibnite from which it was derived; there are some strange but notable mineral components in the **Beaconsfield and Cranbourne** meteorites, and there is mention of the molybdenite pipes in the Everton district of the NorthEast.

Outstanding areas noted by Dana in New South Wales include the great lode at **Broken Hill** from which several minerals have been recorded. These include native silver, native copper and native antimony, dyscrasite, stromeyerite, tetrahedrite, galena both fine grained and coarsely crystallised, willyamite now given status as an acceptable species, cuprite, cerussite, smithsonite, anglesite, brochantite, linarite, azurite, pyromorphite both yellow and brown, several rare halides including embolite, miersite and marshite as well as the famous dimorphic tungstate minerals stolzite and



Massive chalcopyrite and quartz, Mount Lyell, Tasmania.
R. Coulsell specimen. Size 10 x 7cm.

raspite. Reference to the lovely silicate gangue mineral rhodonite must be sought for in the *Textbook*, but it will be found there.

Many of these species are no longer obtainable, having been removed or covered up in the stopes for one reason or another, as the shafts moved down through the upper oxidised zone. Even if found, some would be hard to see in the hand specimen, being finely disseminated in the ore body, but on the other hand the odd classic specimen from Broken Hill still appears at intervals, as early collections are broken up. Moreover this great deposit still actually yields beautiful specimens, to the delight of the mineral collecting fraternity both in this country and overseas.

From New South Wales Dana also notes the fine copper minerals which came from Cobar, especially azurite, malachite and cuprite, as well as azurite from Condobolin. Mudgee and Bingara are mentioned for their yield of small, hard, lustrous diamonds, now largely worked out; **Hill End** is one of the famous gold producing centres mentioned, whilst the fine scheelite and stibnite, once plentiful in the mines of the Hillgrove region, are also noted.

Probably little if any of these minerals remain, although patient work at the old mining sites may sometimes be rewarded with a prize, and the occasional fine specimen appears as material from past collections comes on the market.

Of particular interest is the Dana listing of the sulpho-salt, polybasite, from **Yerranderie** where other minerals have recently been found, and of the alunite deposit at **Bulladellah** near Port Stevens. This latter area has provided collectors with specimens for years, though none of the material available could ever have been rated as handsome.

The strange glendonites from parts of the coast of New South Wales also rate a mention, and these siderite pseudomorphs after glauberite may still be found today.

Dana also mentions a number of species from the highly mineralised New England Tableland which is not surprising, for the region has yielded many beautiful specimens for years. He notes the `elephant's ears' of molybdenite associated with native bismuth from Kingsgate and Deepwater, the rare cosalite from Kingsgate, fine topaz and sapphire, as well as bladed wolfram and excellent cassiterite crystals from the general area.

As all collectors of Australian minerals are well aware, South Australia can be regarded as the copper State. Indeed it was the rich carbonate ores of **Kapunda and Burra Burra** which saved the young colony from bankruptcy in its early days. So much of South Australia suffers from deficient, unreliable rainfall, that mineral resources are very important to that State's economic well-being. The great copper deposits of Burra discovered in 1845 and opened up in the same year, proved to be a vast pod of oxidised ore with little remaining of the original primary ore. Kapunda was similar in structure, and when the surface ores were exhausted, the mines themselves soon closed in the absence of any reserves of supporting sulphides to keep them in production. The magnificent Burra cuprite, native copper, malachite and azurite, all mentioned by Dana, are now legendary, so that surviving specimens from the early period of mining are much cherished by their owners. Today colourful nodules of azurite, massive patches of cuprite, bright, but earthy, chrysocolla, and specimens of banded malachite are still found by collectors, but all are, alas, in quality, a far cry from the magnificent pieces which came from the workings, or even from along the bullock dray tracks to the coast where desperate drivers had lightened loads on the long, rough, haul south.

Dana also mentions the rare mineral sulvanite as coming from the Burra area, but he does not name the Edelweiss Mine in which this unusual species is actually found.

The Eyre Peninsula copper ore deposits which include the Dana localities of Wallaroo and Moonta are of interest partly because there were no tell-tale green or blue surface outcrops to indicate the presence of copper in the area. The old rocks which contain the ore are entirely covered by much younger Mallee type limestones. Tradition assigns green flames in camp-fires as playing a part in their initial discovery. Although present day mining exploration deals readily with hidden ores in tracing their extent and potential, in their day the fact that the Wallaroo-Moonta ore bodies had to be mapped from borings was regarded as quite unusual.

Unlike the copper deposits at Kapunda and Burra, the mines at Wallaroo and Moonta worked extensive primary ores as well as the richer oxidised zone, so that their working lives were considerably longer than those of the mines further north.

Wallaroo yielded an extensive range of minerals including fine barite, calcite, molybdenite and fluorite, but the Dana cachet is reserved for outstanding long dark-green crystals of atacamite which were amongst the finest examples of that mineral ever found, as well as spectacular masses of native copper. Moonta produced very fine chalcopyrite as well as excellent specimens of other oxidised minerals.

The mines of both areas are now closed, but the Wallaroo dumps can be rewarding, and many of the descendants of the old mining population still possess outstanding pieces from the original workings.

South Australia holds one other well-known Dana locality tucked away in the rugged north Flinders Ranges at Mt. **Painter.** Uranophane, torbernite and spectacular yellow autunite came from the No. 6 workings of the Mt. Painter uranium deposits where the primary source of the bright secondary minerals was uraninite, disseminated through the ancient host rocks.

The mineral deposit at **Radium Hill,** much further to the south beyond the main railway line from Broken Hill to Port Pirie is also noted in Dana for carnotite, another radioactive mineral. In this case though, the primary source is davidite, a species named to honour the Australian geologist, mineralogist and explorer, Sir Edgeworth David.

The small island of Tasmania contains numerous Dana localities most of which are situated in the ancient rocks of the wet and rugged north-west corner of the State. Pride of place must go to the superb crocoite from the mines around **Dundas.** Although these mines are no longer worked for their ores, many are still held on private leases and are painstakingly worked for the recovery of specimen material. Associated with the crocoite are fine specimens of gibbsite, dundasite and pyromorphite, all duly recorded.

The great ore deposit at Mt. Lyell holds a Dana rating for bornite, stromeyerite, chalcopyrite and gold, the latter now recovered chiefly as part of the smelting process, rather than as the free metal. Mt. **Bischoff** is listed for topaz and cassiterite, **Whyte River** for the green nickel mineral, zaratite, and Mt. Zeehan for stannite.

The **Heazlewood** serpentine belt yields a local mineral called heazlewoodite which is also noted, as well as pyrostilpnite, a rare sulphosalt, zaratite and cervantite.

**Colebrook Hill near Rosebery** is yet another Dana location in Tasmania. From here come beautiful, sharp crystals of axinite associated with calcite, arsenopyrite and datolite which are still relatively plentiful. Finally returning again to the Dundas area, are Dana listings given for bismite, the lilac-coloured mineral stichtite and the very similar barbertonite with which it is closely associated, as well as tetrahedrite and the much less familiar mineral dufrenoysite.

Dana localities in the vast States of Queensland and Western Australia appear to be relatively few in number when compared with the listings for the smaller States, and they are certainly much more widely scattered.

Most of Queensland's mineral deposits are situated either in the highly complex rock formations of the eastern dividing range, or in outcrops of ancient mineral-rich rocks where these are exposed above the much younger rocks which cover so much of the State's inland areas.

As for so many other parts of Australia it was the search for gold which triggered off subsequent mineral discoveries in Queensland. The long coastline with the parallel river valleys which drained into it from the mountains provided points of entry to the inland goldfields and ultimately formed the major lines of communication throughout the huge State. Several of the major eastern goldfields are noted in Dana, the most important being **Mt. Morgan, Gympie and Charters Towers,** although little free gold remains in any of those places today.

The inland **Chillagoe and Mungana** areas are also Dana localities. Both produced quite a range of minerals in the heyday of mining, but the long haulage involved to even local markets made the mines short-lived unless some special factor caused a rise in metal prices. From Chillagoe Dana lists wulfenite and native bismuth as well as the now discredited species chillagite, whilst azurite in fine crystals is noted from Mungana.

Finally from Queensland the **Herberton** district, another area of extensive mineralisation, is noted by Dana as producer of fine cassiterite and wolfram.

Western Australia which occupies about half the entire Australian continent, fares rather better than Queensland in the listing of Dana localities. Much of the State is made up of huge expanses of very ancient rocks which are usually highly mineralised in any part of the world where they are found. This general characterisation applies also in Western Australia which, in all probability, has the greatest mining potential of any part of the continent.

Several notable mineral occurrences are mentioned in the Dana books, but the **Kalgoorlie** area must surely be considered as outstanding. With mines that have been worked almost continuously since Paddy Hannan picked up his famous nugget in the winter of 1893, the area has yielded a huge amount of gold. In spite of the richness of these yields however, the mineralogical glory of Kalgoorlie has to be its group of rare telluride minerals. At least eight of these are noted in Dana. They include calaverite, sylvanite, coloradoite, krennerite, hessite, rickardite, altaite and petzite, together with the uncommon native element tellurium.

Certainly nothing much to look at, at first unrecognised for what they were, and unceremoniously dumped, even being used in construction of some of the rough, local roads, the tellurides are now an established source of both gold and silver. These unique ores, so rich that they invited risks to be taken in smuggling pieces out of the mines, have fostered stories that have a secure place in Australian literature emanating from the old mining days, Gavin Casey's "Rich Stew" being perhaps one of the most enjoyable of these.

Dana does not list any of the nickel minerals which are almost cheek by jowl with Kalgoorlie gold deposits. Although some of the ores would almost certainly have been seen earlier, the nickel discoveries date from the 1960s, but a future edition of the *System of Mineralogy,* should it ever be written, could well include some of the dull-looking but interesting nickel minerals now found in the upper sections of the nickel workings.

Other Western Australian Dana occurrences are the fine variscite from the **Ninghamboun Hills,** minyulite from the caves at Dandaragan, pseudomalachite from **Collier Bay**, cervantite and stibiconite from **Wiluna,** amblygonite from **Ravensthorpe** and the cassiterite, associated with tantalite from **Greenbushes.** The Western Australian listings also include a number of uncommon minerals found in the pegmatites at **Wodgina** in the far north of the State. These include columbite, tantalite, stibiotantalite and cassiterite, as well as the phosphate mineral lithiophyllite, which in the weathering process breaks down to form a number of subsidiary phosphates including purpurite and sicklerite. All three minerals are rare in Australia as far as is known.

Most Australian collectors own a few specimens from the Dana localities of their country and these are much prized, at least in part, for the Dana association. Probably the fullest representation comes from Broken Hill, Tasmania or New England, and many of the specimens from these notable areas are superb either in colour, form, or in both these desirable attributes.

Nevertheless, whatever the specimen, and whether it is beautiful in appearance or not, a mineral from a Dana locality ranks as a mineral classic, its existence having been duly recorded in one or other of the famous books written by two gifted men whose achievements in the field of mineralogy must leave collectors grateful for a long time to come.

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