# TURNING RED LEAD INTO GOLD

## THE STORY OF CROCOITE AND OTHER LEAD MINERALS OF TASMANIA

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**"With their superb colour, high lustre, and remarkably perfect crystallisation, they are the most beautiful natural objects, scarcely surpassed by crystals of any other known mineral."**

**W.F. Petterd (quoting R.G. Van Name) on Crocoite**

**alchemy** *n*, medieval form of chemistry, seeking to turn other metals into gold, **alchemist** *n*.

# 1. THE ALCHEMIST'S DREAM

For many centuries, early scientists, known as alchemists, had a dream of turning lead into gold. It was the essential process of evolution of metals toward gold that the alchemists accelerated with the product of their labour, the *Lapis Philosophorum*, the Philosopher's Stone, the red powder that transmutes base metal into purest gold.

That dream of the alchemists has finally come true, at least for a small number of mineral specimen miners in western Tasmania.

## HISTORY OF LEAD AND LEAD MINING

Lead has been known from very early times and is mentioned many times in the Bible. Wilson (1994) documents what is probably the earliest known "collecting" of a lead mineral, that of a group of specimens found buried at the foot of an inscribed rock wall at Cap Blanc, France. The group includes samples of chalcedony, galena, rock quartz, and pebbles, and has been dated to about 17,000 years ago.

There was no exact distinction made between the metals lead and tin during the time of the Israelites, but Pliny distinguishes between them, giving the name *plumbum nigrum* to lead, and *plumbum candidum* to tin. Lead was also known to the ancient Egyptians, with lead plates having been found in the Temple of Rameses III, and the Romans worked the lead mines of Britain as early as the first century A.D.

Lead was the first metal mined in Australia. It was mined in the Glen Osmond hills on the outskirts of Adelaide, South Australia, in 1841, and was followed by the discovery of lead in the bed of the Murchison River, Western Australia. The earliest recorded discovery of a lead mineral in Tasmania, was of the sulphide, galena, at Norfolk Plains in 1849, and "in mountain limestone at Franklin River" in 1851. These were apparently unimportant discoveries, and it wasn't until about 1870, that the first practical mining for silver-lead occurred at Penguin on the north coast. Other discoveries followed, at Waratah by the Bischoff Silver-Lead Company in 1876, near Scamander in 1880, and then the most important discovery of all, made by Frank Long at Zeehan in 1882.

Exploration of the West Coast of Tasmania intensified resulting in important discoveries of other metal mines; Mount Lyell, gold and copper, in 1886; tin at Renison in 1890; and then copper, lead and zinc at Rosebery in 1893. More recent times have seen the discovery of other base metal sulphide deposits, Que River (1974) and Hellyer (1983). Lead minerals are known to occur in many other localities around the state, and details have been included in the descriptions of the minerals.

## TURNING RED LEAD INTO GOLD

Each of the seven metals known to the Ancients were supposed to be connected in some way with the seven heavenly bodies known to belong to our solar system. Among these alchemists, dull and heavy lead was apportioned to Saturn and astrologically connected with the planet.

Crocoite, known also as "red lead", although heavy, can certainly not be called dull. It is the lustrous orange and red prismatic crystals of this rare mineral that have helped mineral specimen miners to achieve the alchemist's dream, that of turning lead into "gold". The Dundas region of western Tasmania has produced, and continues to produce, the world's best crocoite specimens.

As well as crocoite, there are around sixty other lead-bearing minerals that have been reported from Tasmania. Some are rare, such as native lead, teallite, and franckeite, some are beautiful, like snow-white dundasite and the yellow, so-called “chrome” cerussite, some are downright ugly. Early descriptions of many of these minerals have often been “lost” over time. For this reason, many of those important early descriptions have been included in this publication.

"Alchemy therefore is a science teaching how to make and compound a certain medicine, which is called Elixir, the which when it is cast upon metals or imperfect bodies, does fully perfect them in the very projection."

Roger Bacon

## 2. WILLIAM FREDERICK PETTERD

William Frederick Petterd was a Tasmanian scientist noted especially for his contributions to our knowledge of the natural history of Tasmania, particularly mineralogy.

He had amongst his friends notable people such as William Harper Twelvetrees, the Government Geologist, W.F. Ward, the Government Chemist, William Robert Bell, "prospector and mining speculator", and James 'Philosopher' Smith, discoverer of the Mt. Bischoff tin lode.

He named new species, some of which are still valid today, namely Dundasite, Heazlewoodite and Stichtite. His efforts were often a driving force in the development of the Tasmanian silver-lead mining fields and he was the Chairman of Directors of the Magnet Silver Mining Company, a position he held from it's inception in 1895 up until the time of his death in 1910.

Crocoite was an important and very special mineral for Petterd. In his article "The Minerals of Tasmania" he tells us of welcome additions to the cabinet of the collector:

> "...the mineral which has rendered this State famous among collectors in all parts of the world is the inimitable crocoisite, especially that obtained some few years back at the Adelaide Mine, Dundas. Its intensely-bright hyacinth red colour, prismatic habit, and adamantine lustre render it one of the most attractive objects in the mineral world, and it has, consequently, been most eagerly sought after by all who admire Nature's handiwork."

The standard reference for collectors of Tasmanian minerals has, since its publication, been Petterd's Catalogue of the Minerals of Tasmania, first published just after his death in 1910, and revised by the Tasmania Department of Mines in 1969. Over the last few years, updates containing details of minerals new to the state, new data, and amendments, have been published in the Journal of the Mineralogical Society of Tasmania. A new revision of the Catalogue is currently being undertaken.

Petterd's first Catalogue of the Minerals Known to Occur in Tasmania, With Notes on their Distribution, was published in the Papers and Proceedings of the Royal Society of Tasmania for 1893. His introduction to the Catalogue gives us an insight into his special interest with, and approach to, the collection and identification of minerals, especially those from Tasmania. That introduction follows:

> "The following Catalogue of the Minerals known to occur and recorded from this Island is mainly prepared from specimens contained in my own collection, and in the majority of instances I have verified the identifications by careful qualitative analysis. It cannot claim any originality of research, or even accuracy of detail, but as the material has been so rapidly accumulating during the past few years I have thought it well to place on record the result of my personal observation and collecting, which, with information gleaned from authentic sources, may, I trust, at least pave the way for a more elaborate compilation by a more capable authority. I have purposely curtailed my remarks on the various species so as to make them as concise as possible, and to reduce the bulk of the matter. As an amateur I think I may fairly claim the indulgence of the professional or other critics, for I feel sure that my task has been very inadequately performed in proportion to the importance of the subject - one not only fraught with a deep scientific interest on account of the multitude of questions arising from the occurrence and deposition of the minerals themselves, but also from the great economic results of our growing

mining industry. My object has been more to give some information on this subject to the general student of nature, - to point out the large and varied field of observation open to him, - than to instruct the more advanced mineralogist.

Our minerals present a somewhat remarkable and interesting admixture of species, many of which are usually looked upon by mineralogists as restricted to certain well known and recorded localities, such as Crocoisite and Vauquelinite, which have until recently been considered as almost peculiar to the mining districts of Siberia ; two of our comparatively common forms - Zaratite and Huastolite - have scarcely been recorded outside their original localities in North America, while Matlockite and Leadhillite are well known British minerals, and Pleonaste and Zircon are abundant in Ceylon. This association of species would appear to some extent to confirm the existence of areas of great economic value containing the same metallic and other minerals that are characteristic of the older and better known mining countries. A comparison of the number of mineral species herein enumerated, with the catalogues that have been compiled of those known to occur in the various Australasian colonies, may be of some interest, as illustrating in a forcible degree the mineral wealth of this island, notwithstanding its restricted area and the paucity of investigators in this special department of science.

It will be found in New South Wales about 185 species have been discovered (Liversidge, "Minerals of New South Wales," and "Report of the Second Meeting of the Australasian Association for the Advancement of Science, 1890") ; South Australia about 100 ("Report of the Second Meeting of the Australasian Association for the Advancement of Science, 1890") ; Queensland about 101 (*loc. cit.*) ; and New Zealand about 172 (*loc. cit.*)

The Report of the Association is not as yet completed, as it does not contain a census[1] of those known to occur in either Victoria or Western Australia : the former may reasonably be expected to enumerate about 100 species. From a somewhat careful examination of the various catalogues that have been published, it may be fairly concluded that this island contains as many mineral forms as have been discovered throughout the whole of the mainland of Australia. Of the minerals that have been discovered here about 40 kinds have not been recorded as occurring in Australia. It will be found that the catalogue not only includes a large majority of the world's economic minerals, such as representatives of the Gold, Silver, Iron, Nickel, Cobalt, Wolfram, Bismuth, Titanium, Lead, Copper, and Platinoid groups, but also many species of considerable scientific interest, one or two of which are apparently new chemical compounds[2]. So far no members of the Selenium, Tellurium, or Uranium groups have been discovered, but there is apparently no reason why they should not exist; their discovery may therefore be reasonably expected as the work of the prospector progresses.

I have to thank my esteemed friends Messrs. James Smith and W.R. Bell - both well known names in mineral discovery - for much kindly help and valuable information regarding the occurrence of many of the minerals here enumerated, and to Mr. A. Morton[3] I am under great obligation for assistance in many ways."

[1] The Mineral Census of Australasia did not contain the Census of Victorian, Western Australian, or Tasmanian Minerals
[2] In reference to dundasite
[3] Mr. Alex Morton was the Secretary of the Royal Society of Tasmania at this time.

That Petterd was able to correctly identify many of the minerals in his catalogue is testimony to his great skills, particularly when you consider that he was a (gifted) self-taught amateur, that many of the minerals are of similar composition and appearance (the sulphosalt minerals alone make up around one third of this current list), and the fact that he didn't have access to many of the "tools" of modern day mineralogists.

Petterd bequeathed his collection of some 2,500 mineral specimens to the Royal Society of Tasmania, who loaned it to the Trustees of the (then) Tasmanian Museum and Botanical Gardens, for a period of 999 years. His collection not only forms the basis of the collection of minerals in the Tasmanian Museum, Hobart, but it is an important, and in some cases, it is the only link, with the minerals that were produced during the peak period of mining activity in this State. It is the Petterd Collection that has provided us with the foundation of our knowledge of Tasmanian minerals, and although it has not always been treated with appropriate care and respect (some specimens have either "gone missing" or have been accidentally destroyed), it must be properly protected into the future.

William Frederick Petterd, with his Catalogue, his Collection, and his keen interest and scientific curiosity, was truly the father of mineralogy in this state.

“Just as all life evolves toward Divine Perfection, so too do metals evolve toward gold.”

Joseph Caezza

# 3. LEAD MINERALS IN TASMANIA

Much of western Tasmania was traversed by famous early explorers such as Hellyer, Frankland, and James Sprent, but they were not searching for minerals. It wasn't until the late 1850's that Charles Gould, son of John Gould, the renowned naturalist, began the first of three trips to the west. The primary objective of Gould, as the Government Geologist, his party, and indeed, the Government of the Day, was to find payable gold and other mineral wealth, to try to stem the tide of Tasmanian men leaving for the Victorian gold rushes. His first trip resulted in no gold being found, but certainly added to the overall knowledge of the geography of the West Coast. His second and third trips resulted in Gould finding traces of copper, lead and gold, but not in payable quantities. The West Coast was essentially ignored as far as further official exploration was concerned, at least until James 'Philosopher' Smith discovered the great tin deposit at Mt. Bischoff, Waratah in 1871.

Smith's discovery sparked a resurgence in mineral exploration in the west with fields such as Heemskirk (tin), Zeehan (silver-lead), and Lyell (copper and gold) being opened up.

Even though lead minerals occur in many parts of the island, they are most abundant on the West Coast. They occur in silver-lead deposits such as those at Zeehan and Dundas, massive sulphide ore bodies such as Que River, Hellyer and Rosebery, in skarns, hydrothermal vein systems, and around the perimeter of granitic intrusions.

One of the most famous mining districts in Tasmania is that of the Zeehan-Dundas region. We are lucky to have a rich mining history in Tasmania, particularly in areas such as this.

The following section contains a brief history of both Zeehan and Dundas. Included are two extracts from early editions of the *Zeehan and Dundas Herald*, the region's newspaper for around twenty-five years. I am indebted to Carl Bjorklund of Hobart for much of the other information. Carl carried out research from this region for the 1995 Joint Mineralogical Societies Seminar, hosted by the Mineralogical Society of Tasmania.

The Zeehan-Dundas mineral field is justly famous for producing the world's best crocoite. Found at most of the Dundas mines, the most notable specimens having originated from the Adelaide, Red Lead and West Comet mines. Minor producers included the Kapi, Platt/Kosminsky Prospects, and the Dundas Extended mine.

Of the seven mineral species first described from Tasmania, four are from this region:

- Stichtite (a magnesium and chromium carbonate) - first found in Tasmania in 1891, recognised by A.S. Wesley, and described by Petterd as a new species in 1910. It was named after Robert Carl Sticht who was a former mine manager of the Mt Lyell Mining and Railway Co., and was famous for pioneering the application of pyritic smelting of copper ores. Major deposits of stichtite occurred south of the Adelaide mine at Dundas on Stichtite Hill (the type locality) and in a quarry just below the summit of Serpentine ("Tunnel") Hill, south of Renison Bell.
- Dundasite (a lead and aluminium carbonate) - named after the township of Dundas and found mainly at the Adelaide mine (the type locality), and the Kapi mine, North-East Dundas.
- Philipsbornite (a lead aluminium arsenate) - described as a new species by Walenta, Zweiner and Dunn in 1982, the type locality possibly being the Adelaide mine.
- Shandite (a lead and nickel sulphide) - first identified as a new species by Ramdohr in 1949 from a nickel prospect at Trial Harbour.

#### ZEEHAN DISTRICT

In the late 1880's and early 1900's, the region was an important producer, firstly of silver, then of lead. Frank Long pegged off the first section of the Zeehan field at his new discovery of galena, up what is now known as “Peasoup Creek”, during December, 1882. The ores of the Zeehan field are usually argentiferous with Long’s ore samples assaying 75% lead and 80 ounces of silver to the ton.

During the silver boom period, Zeehan boasted it’s own stock exchange, a number of hotels, it’s own newspaper, the *Zeehan and Dundas Herald*, the School of Mines, now a museum, and two theatres. Dame Nellie Melba once performed at one of these, the Gaiety, which is still standing today. The old Zeehan School of Mines building houses, apart from much memorabilia, an excellent mineral collection. In particular, it contains the “Mihajlowits Collection”, which includes some of the finest crocoite specimens produced in recent times.

Little work was carried out on this field until 1893, after the opening of the railway from the nearby port town of Strahan. Smelting works were put up on a large scale by a German company in 1899 and for some years, they treated large quantities of ore. On the rocks by 1907, the company was given Government assistance of £20,000[4], but this was to no avail, as they finally closed in 1913. The total production to 1926 was about 5,000,000 tonnes of argentiferous galena from around 300 mines and prospects. Principal producing mines were the Silver Queen, Western (the richest mine on the field), Zeehan-Western (deepest mine at about 300 metres), Oceana, Oonah, Montana, Florence, and Comstock. Many of the mines were shallow, with the richest being mined by simply driving horizontal adits into the hillside. The varied mineralogy includes a number of sulphosalts, silver chlorides, and stannite, amongst others.

Mr. G.D. Gibson, a special mining correspondent, provided an introduction to the region in the *Zeehan and Dundas Herald*, Tuesday, October 14, 1890. Although this and subsequent articles were probably written with a view to attracting much needed investment, the information contained in them is historically important, and unavailable elsewhere:

> “That the West Coast Silver fields of Zeehan and Dundas constitute the most important mineral area that has recently been discovered in any part of Australasia, the Barrier silverfield alone excepted, must be admitted by all who have had an opportunity, or are competent, to form a reliable opinion. This being the case it is with very great pleasure and no small feeling of responsibility that I now undertake the duty of presenting to the world, through the columns of “*The Herald*,” accurate accounts of the condition and progress of the various mines and the prospects of the field generally. In doing so it may be necessary to go over a good deal of ground in the way of furnishing details that may not locally be considered as “news,” but it must be remembered that the mining matter is compiled with the express view of imparting information to readers at a distance, so that those who have not an opportunity of visiting the field may be enabled to form correct ideas as to the merits of the different mines and of the field as a whole. This is a very important matter, because for the speedy and proper development of the mineral resources of the district, the introduction of foreign capital is very necessary, and investors and speculators in the Australian cities, as well as in Tasmania, look for regular and faithful reports from the seat of the action. These have not hitherto been readily obtainable, consequently but little is known about the field at a distance, however, by doing my best in the interest of my employers, I trust that I shall at the same time be doing a service for the benefit of all connected with the West Coast mineral fields. Of the ultimate great success of the Zeehan and Dundas silverfield, I have not the slightest doubt, and the recent discoveries in the latter portion of the field help to bring the whole into prominence, as owing, to the mountainous character of that

[4] Equivalent to $40,000 at that time, however realistic conversion to today’s value is not practical.

district, works of development can be pushed on in a great number of the mines without the necessity of obtaining machinery to cope with the water. Had it not been for the extreme difficulty in conveying heavy machinery to the spot, the Zeehan portion of the field would long ere now have asserted its importance in a more pronounced manner. I was surprised to see how much had already been accomplished in the way of permanent work on many of the mines, and consider that it speaks well for the courage and enterprise of the directors and shareholders in these companies. The introduction of English capital will do a great deal for the development of mining in Tasmania and in this the Zeehan portion of the field is so far fortunate in having two powerful English companies presently carrying on mining operations in a systematic manner with a view to permanent development. A glance at the works being carried out on the Mt. Zeehan (Tasmania) Silver Mines Co's properties will show that business is intended, and in due course I shall have the pleasure of furnishing your readers with a full and detailed account of these. At the Tasmanian S. M. Co's Mine, usually known as McLean's (the other English Company referred to) matters are not so far advanced, but plans have been prepared for the permanent working of the property, a commencement to sink a main shaft having been made. In connection with the Grubb S. M. Co., the important work of constructing a tramway three miles[5] in length, through some very heavy country, to connect with the Government line to Macquarie Harbour has been begun, while at the Silver King and the Silver Queen mines permanent works are being proceeded with in the way of the erection of pumping and winding machinery, besides some important prospecting work on the latter. On the Mount Zeehan mine underground developmental and prospecting works are being steadily carried on, as also at the Silver Bell, the Comstock and other mines. At Balstrup's Manganese Hill, the Manganese Hill and the Manganese Hill East, the work of tunneling is being vigorously prosecuted, with a view to testing the existence of large bodies of ore, or otherwise, underneath the immense capping of manganic iron from which the properties derive their names - I say "the existence or otherwise," because, although from the indications already obtained I have little or no fear of disappointing results, but the fact of large deposits of ore existing has yet to be proved. However, on another occasion I shall take an opportunity of discussing the merits of this line of country which possesses peculiarities of its own distinct from any other in the district.

Although the number of lodes traceable on the surface is "legion" to say nothing of those the existence of which is altogether unknown, there can be traced at least four distinct parallels coursing roughly speaking, North West, South East. Between these are found quite a network of lodes running at a variety of angles and underlying in different directions. That these form cross lodes I do not think likely, it is more probable that in depth they will be found to merge and form a lesser number conforming generally with the prevailing strike. That silver-lead, commonly called galena, will be the class of ore forming the main stay of the district there can be little doubt, although in the case of the Silver Queen oxidised formations, Balstrup's and other instances, where the ground is high, carbonate ore may be found to predominate. The galena of the district is most unusually high in silver as also is the carbonate

[5] 1 mile = 1.61 kilometres (km)

and oxidised ores, although it is a remarkable fact both at Zeehan and Dundas that silver in any visible form, such as native, or as chloride is but rarely seen.

In another article I shall deal more fully with the Dundas portion of the field which promises to be a very extensive, rich and extremely interesting one. If the Government could be prevailed on to push ahead at once with a continuation of the Zeehan railway to Dundas, there would soon be profitable occupation in that district for ten times the number of men now employed. In a word I have not the slightest doubt but that the West Coast silverfields will do as much for Tasmania as the Barrier has done for Australia. In fact, in proportion to the population, a very great deal more. I do not for a moment anticipate that any one mine will be found to equal the great Broken Hill mine in extent, but it is clear to be seen that the good things of nature are more widely and more equally distributed, and thus calculated to promote a larger amount of general welfare.

Coming to Tasmania as a stranger I cannot but congratulate the prospectors of this field and the investors in West Coast stock on the persevering manner in which the mineral resources of the district have been opened up in the face of almost overwhelming difficulties, and in spite of heedless neglect on the part of the Government."

**DUNDAS DISTRICT**

The Dundas township was smaller than Zeehan, and today only ruins remain. It is situated some 12 kilometres east of Zeehan in the western foothills of Mt Dundas.

Mining activity in the Dundas district began soon after Frank Long's discovery at Zeehan. From Zeehan, prospectors spread out into the surrounding countryside, searching every hill and valley for silver-lead ore. Some of them reached Dundas and soon found silver-bearing ironstone cappings of lead ore deposits. Nearly all of the known ore bodies in the area were discovered by the early prospectors and some were explored at depth by way of shaft and adit.

The first lease was pegged in this district by G. Lambie in 1887, with the first galena being discovered on New Year's Day, 1889 by Lambie and J. Davies. When Montgomery, the Government Geologist, visited the field in 1889, a large area had already been pegged out but very little development had taken place.

Dundas was linked to Zeehan by road not long after, and over the next few years, a branch line was constructed from the Zeehan-Strahan railway. This served the Adelaide, West Comet, and Comet Maestries mines, and was later extended by tramway to the Great South Comet mine.

Details of some of the Dundas mines follow.

**THE COMET-MAESTRIES MINE**

Situated about 1.6 kilometres east of the town of Dundas, the Comet leases were first pegged in 1888 by W. Johnstone and J. Carnahan respectively. Early in 1889, J. Maestri and P. Bear found "canary ore" (mainly cerussite), and pegged two leases to the east of the Comet claim. The orebody that they found, contained an oxidised zone that extended to a depth of 120 metres. The secondary minerals mainly cerussite, crocoite, and with large concentrations of silver chloride, are remarkable for their beauty. In 1895, the Maestri leases were let on tribute, and sold outright in 1900 to the Comet Silver Mining Company. They, in turn, ceased operations in 1904, but the mine was worked for several more years by tributors. From 1905 until 1913, the mine was worked mainly by open cut for the ferro-manganese gossan which was used as a flux by the Tasmanian Smelting Company at Zeehan.

**WEST COMET MINE**
Other than Comet-Maestries, the West Comet produced more silver and lead than any other mine in the Dundas field. Formerly known as the Mt Dundas mine (or the Dundas Prospecting Association) and the Central Dundas mine, in 1896, the two companies amalgamated to form the West Comet mine. The main lode was found to be 16-22 metres in width, and over 180 metres in length and appears to be a continuation of the Adelaide mine and Anderson's Prospect. Crocoite was the main secondary mineral that outcropped, and rich shoots of silver chloride and galena occurred within the lode. By 1903, only the richest ore (galena) was marketable. Subsequently, this mine too was operated for flux for the smelters.

**KOSMINSKY MINE**[6]
The Kosminsky mine is situated between the Comet Maestries and the South Comet mines. First pegged in 1890 by James Davis, it was taken over by Abraham Kosminsky later that same year. Two parallel orebodies, composed of galena, sphalerite, quartz, siderite, pyrite and minor chalcopyrite, commence at South Comet Creek, which marks the northern end of the Great South Comet lode, and are a probable faulted continuation of that lode. Despite having no less than eleven lessees, operating over a fifty year period, being opened by adits on three levels and followed by a shaft, the total output is estimated at only twenty tonnes containing 480 ounces of silver and ten tonnes of lead.

**ADELAIDE MINE**
Situated about 2.5 kilometres south-east of the Dundas township, this area was taken up by T. Anderson in 1890 and acquired the following year by the Adelaide Proprietary Silver Mining Co. By 1893, a good deal of tunneling had been done, without much result. In 1895, the mine closed down. From 1897, the mine passed through successive hands until, in 1908, a third level was opened. There was some ore production up until 1915, when the mine again closed. Since 1957, the Adelaide mine has been worked primarily for specimen material.

The Adelaide lodes show prominent surface gossan and oxidation extends over one hundred metres below the surface. They resemble the Comet and Maestries lodes except for the development of large masses of crocoite due to the proximity of an ultrabasic intrusion. In the upper part of the ferro-manganese gossan, crocoite is the chief component, but cerussite, dundasite, phosgenite, minium and bindheimite are not uncommon. Below the zone of oxidation, the ore consists of galena, sphalerite, pyrite and jamesonite in a gangue of Mn-siderite, dolomite and serpentine.

**ANDERSON MINE**
This mine lies between the West Comet and Adelaide mines and is situated on a continuation of the Adelaide lode. At the surface, the orebody consists of gossan, manganese oxides and quartz, and is encased in serpentine. Dump material reveals the presence of crocoite which, according to reports, occurs in considerable abundance at a depth of 15 metres. In 1911, the mine was purchased by the then owners of the adjoining Adelaide mine.

**RED LEAD MINE**
Situated on the south side of Adelaide Hill, adits have been driven on a ferro-manganese lode containing crocoite and minium. No rich bodies of ore were discovered in these exploratory works, and the cost of mining and transport were too great to allow for profitable operation. Since the late 1960's, the Red Lead mine has been worked for crocoite specimen material.

**PLATT PROSPECT**
This property is situated at the eastern boundary of the West Comet and south of the Comet mine. In 1925, it was held under prospector's license by Charles Platt. The lode consists of galena, sphalerite, jamesonite, crocoite, and cerussite in ferro-manganese gossan and quartz. It contains a fair proportion of crocoite and some bindheimite, rich in silver. In recent years, small scale specimen mining has produced attractive crocoite and pyromorphite associations.

[6] In early reports in the Zeehan and Dundas Herald, this mine was also known as the Koyminsky or Kozminsky

**GREAT SOUTH COMET MINE**
This property is situated south of the adjoining Kosminsky lease, about 5 kilometres from the Dundas township. The area was first leased in 1911 and held by various interests over the next twenty years. The lodes consist essentially of galena and sphalerite, with minor amounts of jamesonite, pyrite and chalcopyrite. The galena and sphalerite occur in distinct bands with no intergrowth. A floatation plant was constructed in 1927 to recover lead and zinc, but was not operated successfully. In 1948, the Cuni Mining Co. commenced construction of an access road and concentrating mill. Some ore was produced in 1949, but the lease was again abandoned in 1950. The mine was operated in the 1980's by Mintek Pty Ltd, and the bridge over Comet Creek rebuilt and the road upgraded. During this time, ore was trucked to the EZ Pasminco plant at Rosebery for processing.

Mr. G.D. Gibson's second major article appeared in the *Zeehan and Dundas Herald*, Friday, October 17, 1890, and provided an early description of the Mount Dundas District, where he again displays his irritation with the Government of the day:

> "In your first issue I confined my introductory remarks to the existing condition of the Zeehan portion of the field, which it was shown, is making steady progress of a substantial kind, in the face of the many difficulties that have to be contended with. It was also shown that recent discoveries clearly indicated the necessity for a more thorough system of prospecting on many of the properties now lying idle, a subject on which the special reports following in this issue, have a special bearing.
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> It cannot be denied that, but for the very important discoveries made at Mount Dundas, very much less vitality would have been manifested on the field generally than at present exists. However sterling or solid, may be the merits of the silver-lead mines of Zeehan, they lack, as a rule, that romantic fascination appertaining to great possibilities such as the Australian public so dearly love, and which seem to lend an indescribable zest to mining speculation. It may be objected that the speculative element is not desirable, I venture to say that if mining business was wholly bereft of such a potent stimulant, then the industry would languish, public interest would decay. The prospector would no longer find an incentive to undergo the voluntary hardships which he imposes on himself, and much of the mineral wealth of the world, in which Australasia has so largely participated, would still remain concealed in nature's treasure house.
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> The Mount Dundas district literally teems with possibilities, and offers most tempting attractions to the prospector, the speculator, and the investor alike. Nor does this state of matters exist without reason. The pessimist may declare that he fails to see anything to warrant placing so much reliance on the prospective value of the great ironstone outcrops, which form the leading characteristic of the district, but substantial indications are not awanting of the great mineral wealth contained below. Take for instance Demaestrie's. Beyond the ironstone cropping no surface indication of silver or lead were to be found. It was only on panning off the wash in the creek that the attention of the prospectors was arrested by the crystals of carbonate of lead remaining in the dish. This induced them to drive into the hill on the ironstone, which almost immediately led to the discovery of an important ore body, consisting of an oxidised ore, carbonate of lead, galena, and pecos. The existence of the same lode has been proved in the Comet ground, but unfortunately where struck, the ore body does not rise much above the water level, as governed by the creek. To the south similar indications on other lines of lodes are to be

found, notably the south section of the Comet, the Koyminsky sections, the Melbourne Proprietary, (Wright's) and others. To the north favourable indications are likewise to be found, and likewise to the east and to the west parallel lodes have been discovered bearing equally promising characteristics.

There is a large extent of country both to the north and to the south, which as yet I have not had opportunities of visiting, but of which good accounts are being daily received, and I hope soon to be able to personally inspect and report on the merits of these localities. Some very rich samples of silver glance (sulphuret of silver) and antimonial silver ore have recently been brought in from the northern district. From these sensationally high assay returns have been obtained, and naturally caused quite a rush of prospectors to the finds. Large tracts of new country have been taken up, but owing to its present inaccessibility, it will be some time before it can be opened up. In this matter, the Government are sadly behind, there is now no prospecting vote in Tasmania, but really the Government ought to do something more for the assistance of prospectors who are expending their time and labour in opening up the country. These are the men who are helping to develop the mineral resources of the country from which the state derives a substantial benefit, as every additional block of ground that is taken up adds so much to the revenue. But while prospectors are enduring all sorts of hardships and privations for the enrichment of the country at large, is it right that the state should do nothing for them? The roads of the district are in a disgraceful condition. I would strongly urge on the public that pressure be brought to bear on the Government, so as to have the formation of the track from Zeehan to Dundas pushed on with a little more speed. It is badly required and the opening up of the district is being shamefully handicapped and retarded on account of the delay in the completion of the track. After all it will only be a make-shift, the corduroy being in only 10 feet[7] lengths and consequently not wide enough to allow of two carts passing, however on the principle that "half a loaf is better than no bread" we would accept the track, such as it is, only the cry is "do let us have it without delay.""

**CORINNA - WARATAH DISTRICT**

Apart from the Zeehan-Dundas area, the only other verified occurrences of crocoite in Tasmania are from the Heazlewood, Whyte River, and Magnet mines located along the Corinna to Waratah road.

The Heazlewood mine is the "type locality"[8] for crocoite in Tasmania, and was first described from this mine around 1890. The Heazlewood mine was rediscovered by members of the Mineralogical Society of Tasmania in January, 1999, and a few specimens containing crocoite were found on the dumps.

The Magnet mine is situated some 7km west of Waratah, Discovered in 1891 by W.R. Bell, who also took out the first lease, it was in operation through to 1940. At its peak between 1910 and 1920, the Magnet mine was rated as the third largest mine in Tasmania, behind Mt. Bischoff (the "Mountain of Tin") and the great Mt. Lyell. At this time, the Magnet township supported a population of around 700, but now, like Dundas and so many other mining townships, little remains. Crocoite reportedly occurred as slender prismatic deep red crystals to 5cm in length. It can still be found as small red or

[7] 1 foot (ft) = 0.305 metres (m)
[8] A term used to signify the locality of the first recorded occurrence of a mineral.

orange crystals up to about 1cm long in gossan, although is becoming increasingly more difficult to locate. The Magnet mine is currently designated as a fossicking reserve.

### OTHER LOCALITIES

Lead minerals can be found in many parts of the State. Most of the important areas are in the north and west and include the Mt. Read volcanic belt, (which houses the Hercules, Hellyer, Que River, Rosebery, and Farrell/Tullah mines), and the central north region (Penguin, Hampshire, and Moina). In the north-east, silver-lead deposits occur in the Scamander area, although they are generally small, and many of the tin-bearing mines also host lead minerals. In the south of the State, galena and cerussite occur as minor constituents in gold mines in the Cygnet district.

“All true philosophers agree that the First Matter of metals is a moist vapor, raised by the action of the central fire in the bowels of the earth, which, circulating through its pores, meets with the crude air, and is coagulated by it into an unctuous water, adhering to the earth, which serves it for a receptacle, where it is joined to a sulphur more or less pure, and a salt more or less fixing, which it attracts from the air, and, receiving a certain degree of concoction from the central and solar heat, is formed into stones and rocks, minerals, and metals. These were all formed of the same moist vapor originally, but are thus varied from the different impregnations of the sperm, the quality of salt and sulphur with which it is fixed, and the purity of the earth which serves it for a matrix; for whatever portion of this moist vapor is taking along its impurities, is soon deprived of heat, both solar and central, and the grosser parts, forming a mucilaginous substance, furnish the matter of common rocks and stones. But when this moist vapor is sublimed, very slowly, through a fine earth, not partaking of a sulphureous unctuously, pebbles are formed; for the sperm of these beautiful, variegated stones, with marbles, alabasters, etc., separates this depurated vapor, both for their first formation and continual growth. Gems are in like manner formed of this moist vapor when it meets with pure salt water, with which it is fixed in a cold place. But if it is sublimed leisurely through places which are hot and pure, where the fatness of sulphur adheres to it, this vapor, which the philosophers call their Mercury, is joined to that fatness and becomes an unctuous matter, which coming afterwards to other places, cleansed by the afore-named vapors, where the earth is subtle, pure, and moist, fills the pores of it, and so gold is made.

But if the unctuous matter comes into places cold and impure, lead, or Saturn, is produced; if the earth be cold and pure, mixed with sulphur, the result is copper. Silver also is formed of this vapor, where it abounds in purity, but mixed with a lesser degree of sulphur and not sufficiently concocted. In tin, or Jupiter, as it is called, it abounds, but in less purity. In Mars, or iron, it is in a lesser proportion impure, and mixed with an adjust sulphur.”

A.E. Waite

# 4. Brief Geology

The ore bodies of the Zeehan and Dundas areas are quite similar. Why then, does crocoite occur in so much abundance at Dundas and not nearby Zeehan?

To find the answer, we must first of all travel back in time more than 500 million years, to the period known as the Cambrian. This period of time, named for the Roman name for Wales (Cambria), was, at the time, the oldest system of rocks in which fossils could be used for dating and correlation. The period commenced around 600 million years ago with a duration of about 100 million years.

During the Cambrian period in Tasmania, sedimentary rocks, derived from the erosion of earlier formed Pre-Cambrian rocks, were deposited over a long period of time. Many of these rocks were formed in marine environments, a fact indicated by the traces of marine fossils such as trilobites, brachiopods, sponges, and other organisms. Igneous rocks (that is, rocks that have melted, and then solidified by cooling) also formed during the Cambrian. Some of these rocks, such as serpentines, and the Mount Read volcanics, are important hosts for economic minerals.

The serpentines are also known as ultrabasic rocks (rocks that are comprised predominantly of ferromagnesian minerals), and may contain chromite, nickel sulphides, or “osmiridium” and other platinum group minerals. These serpentines outcrop in a number of areas in Tasmania, including Dundas, Heazlewood, Adamsfield, Ulverstone, and Beaconsfield. Only in the first two areas however, does the chromium in the serpentine combine with the other necessary ingredient, lead, that has allowed that spectacular mineral crocoite to form.

We must now move forward in time to somewhere around 350 million years ago. This was the latter part of the Devonian period (named after the English county of Devon, where the first rocks of this age were found), and a time when large masses of granitic rocks were being pushed up into Pre-Cambrian to early Devonian rocks in Tasmania.

The granites brought with them many elements which were either deposited in the granites themselves, or in the surrounding sedimentary rocks. In Tasmania, important silver-lead, tin and tungsten, and gold deposits were formed in many parts of the State during this episode of igneous activity.

The final phase of the story took place much more recently. Oxidation and hydration of older mineral deposits have produced oxidised zones where colourful and spectacular minerals can be found. Many of these minerals form in gossans, referred to as “Nature’s Alchemist” by Petterd, the leached and oxidised near-surface part of a vein or other orebody that contained sulphide minerals.

For crocoite to form, veins containing primary lead sulphide, in the form of galena, have been oxidised by the chrome-bearing solutions derived from the decaying serpentines. Where the conditions are right and space permits, crocoite forms orange or red, lustrous single crystals or interlocking groups that we know so well.

"If ever there is a natural thing on earth, it is the Preparation and Magisterium of the Philosopher's Stone, natural and not of man's making, but wholly the work of Nature, for the Artist addeth nothing thereto."

Anon.

# 5. CROCOITE!!!

**$PbCrO_4$**

Tasmania has been justly world famous for its specimens of crocoite for more than 100 years, although mainly only among mineralogists and geologists. All this was to change however when an important announcement was made at the 1997 Australian Gemboree and National Gem and Mineral Show in Launceston. The Hon. John Beswick, then Minister for Mines, announced to the world that crocoite was to take pride of place as Tasmania's mineral emblem.

"Crocoite has been chosen because Tasmania is one of the few places in the world, apart from Russia, where it is found. In addition, nowhere in the world are such beautiful specimens found" Mr Beswick said. Local newspaper headlines proclaimed "the Red Rock of Tassie", and a large crocoite specimen was presented to the Government by Frank Mihajlowits, the operator of the Adelaide mine.

Crocoite, a lead chromate, was first described by F.S. Beudant in 1832 from material found in the Beresov district, Siberia. It is rare on a world scale, and has been found at only a few localities. These include the Urals, Brazil, Romania, the Phillippines, Germany, South Africa, and at others, as very minor occurrences.

In Australia, crocoite was reported by Marsh (1897) from Broken Hill, New South Wales, although the identification is considered doubtful, and has been found at the Wadnaminga gold mines in the Olary Province of South Australia, and at a few mines in Western Australia near Coolgardie. Most of these occurrences were very minor, but, at the Happy Jack gold mine, crocoite formed in veins up to 4cm thick, often accompanied by coarse free gold.

However, it is in Tasmania that Nature has excelled in its formation of crocoite. Here it is locally abundant, particularly in the Dundas region. So much so, that for many years, it was used as a flux in the Zeehan Smelters. Fortunately, specimen mining over the last 30 years has provided both mineral collectors and scientific institutions with a wealth of material.

The chronological history of the discovery of crocoite in Tasmania is best told in the words of Petterd:

> "The first discovery of the mineral was made about the year 1890[9] by Messrs. Smith and Bell[10] at the Heazlewood Silver-Lead Mine. It there occurs in bright shining, hyacinth-red crystals, small as we now know them from other portions of the island, arranged in acicular bunches, penetrating and attached to a very friable clayey gossan, intermixed with a little cerussite, and more rarely pyromorphite. They then occurred at the Whyte River Mine more plentifully, and often intermixed with the soft country-rock on both walls of the lode as well as in its capping. The crystals often coated the fractures and cleavages. Patches of the doubly-terminated monoclinic crystals of small size, but perfect form, have been repeatedly obtained. Some of the specimens were of an unusually pale colour, and perceptibly faded upon exposure, a characteristic not noticeable in the Dundas occurrence. At the Magnet Mine this mineral is plentiful in the oxidised lode capping, sometimes in the form of entangled masses of fine prisms, 2 to 3 inches[11] in length, and less frequently in loose, perfectly terminated crystals of small size. In vughs, coated occasionally with black manganese oxide, the crocoisite[12] crystals were intimately associated with yellow cerussite and other salts of lead. At the

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[9] The 1910 Catalogue shows 1896 as the first year in which crocoite was found, however, this is probably a mis-print.
[10] James "Philosopher" Smith, the discoverer of the Mount Bischoff Tin Mine and William Bell, Discoverer of the Magnet Mine.
[11] 1 inch (in) = 25.4 millimetres (mm)
[12] An early name for crocoite.

> Adelaide Mine at Dundas an enormous quantity was passed through and partially mined. It was of good colour, and freely attached to and intermixed with cerussite of a pale-yellow colour and local habit. Psilomelane and massicot were often companions, which tended to add variation to the beauty of the specimens. At times patches of the rare and local dundasite were peppered over with exquisitely beautiful little crystals of the chromate. The most important find of all, both as regards quantity and quality, occurred at the Dundas Extended[13] and the West Comet Mines. Here it was obtained in the greatest profusion, many of the enormous crystals reaching the unparalleled length of 10 to 12 centimeters (*sic*), with perfect terminations. These naturally caused a mild sensation when available to mineralogists in all parts of the world. They were extremely brilliant, of an intense scarlet colour, and translucent to almost transparent. The varied crystal forms have been studied and described by Palache, Van Name, Anderson, and others. The crystals have been known to have various types of terminations from a single face to as many as six or seven terminal planes. The lode outcrop of the Central Dundas Mine was of considerable height above the natural surface, and through its ferruginous mass large isolated crystals of crocoisite were found. They were often intimately mixed with masses of chalcophanite and manganese oxides. This wonderful find is now practically exhausted, and it would need much exploratory work to attempt to discover another patch. The species has only been reported to occur, and then in extremely limited quantity, at the Colonel North and Silver Queen Mines on the Zeehan field."

Since Petterd's 1910 catalogue, crocoite has been reported from the sides of old adits in the Dundas and Zeehan fields where they have apparently been formed by post-mine leaching, as well as a doubtful report from Ranga on Flinders Island.

Soon after the initial discoveries, mineral collectors and mineralogists were able to acquire specimens through the Foote Mineral Company in Philadelphia. Efforts to obtain crocoite specimens from the Adelaide mine are described in the following excerpt from an undated Foote Catalogue issued around 1899:

> "The discovery of new forms of this wonderful mineral is the result of over a year's work of our collector, in which the old Siberian specimens were totally outclassed. The various Tasmanian mines yielding the chromate of lead have been abandoned for some years and offered no hope of specimens in the future, the water in the levels having ruined all the specimens in the porous rock. The surface indications at the Adelaide appeared to warrant operations, and a tunnel was driven into the hill above. After much expensive labour a number of fine, rich coloured crystals on dark gangue were found, and a good supply of pure massive Crocoite saved. Further on, however, in a clayey deposit, our collector was fortunate to strike a patch of loose prisms 3 to 9 cm long, superbly terminated, and of a most gorgeous translucent to transparent scarlet-red. The planes are exceptionally brilliant, and the angles of ideal sharpness and perfection. . . . Only a few perfect crystals were saved as compared with the number of broken, but otherwise choice crystals. Following this great strike, several months of fruitless and expensive tunneling forced an abandonment of the work, at a depth of 232 feet, closing the most extensive mining ever done solely for scientific mineral specimens."

[13] This is not the same mine currently known as the Dundas Extended Mine, but is probably a part of what is now known as the Red Lead Mine.

A superb specimen, collected from the Adelaide mine in the 1920's, is pictured in "The World's Finest Minerals and Crystals" (Bancroft, 1973). It is one of four Australian specimens out of seventy-eight of what were judged to be the finest groups of minerals and gems ever photographed. The other Australian specimens included cerussite and stolzite (both lead minerals) from Broken Hill, New South Wales, and a spectacular crystallised gold specimen from Victoria.

The Adelaide mine has continued to produce spectacular specimens. In the early 1970's, a cavity measuring 2 by 2.5 metres was found, containing thousands of brilliant terminated crystals of crocoite to 8cm, in singles and clusters, to dazzle the collectors of the time. Some even larger single crystals were stolen during a break-in at the Zeehan School of Mines museum in the late 1970's.

During the late 1980's and early 1990's, open cut operations at the nearby Red Lead mine produced a lot of crocoite specimens for the collector market. A large proportion of the material mined was low grade, forming in thin veins or growing in fracture planes. Higher grade material was found as interlocking crystals in friable gossan, or as sprays of brilliant, transparent, terminated crystals up to 16cm in length, in pods within the friable gossan. One of the most spectacular finds was in 1991 when a large vein of black ferro-manganese gossan was intersected in new workings. This held a vein of crocoite, at times up to 10cm wide, exposed over a length of approximately 50 metres, with randomly spread pods throughout its length. The crocoite occurred as gemmy crystals sitting on black gossan or as high quality "floaters" in masses of loose crystals.

The 1990's have also been good for the Adelaide mine with a rich seam of crocoite, partially coated with black manganese oxides, having been found. The best specimens have been recovered from below the water level in the mine as these are clean and lustrous orange to red specimens. However, the mine only has an estimated life of perhaps two more years.

These days, crocoite can still be found as small crystals in friable gossan at the Magnet mine near Waratah, and at a number of mines in the Dundas region, including the Adelaide, Dundas Extended, Kapi, Platt, and Red Lead mines. Specimen mining is carried out on most of the Dundas leases.

"The philosopher takes pleasure in the contemplation of the nature of these compounds while the miner takes pleasure in the profit and use he obtains from the metals he extracts from them."

Georgius Agricola.

# 6. MINERS, MIDDLEMEN AND MANIACS

Crocoite comes in various grades. Prices start very low and range up to many tens of thousands of dollars per specimen. The low-grade material, sometimes referred to as "market fodder", usually consists of specimens containing interlocking crystals of crocoite, with rare terminated crystals. Sometimes, even lower grade material is pushed on to the market. Pieces of dirty gossan with orange smudges and broken crystals were often offered as "rare crocoite" at rock swaps and at some mainland Australian shows in the late 1980s. Not until I relocated to Tasmania did I find that "real" crocoite specimens were available. Tasmanian collectors are at a definite advantage being in the same region that the mineral is mined. Moving down to Tasmania has also pushed me towards the realm of the maniacs.

> "It has been said that in the world there are ten unprofitable mines to one profitable ; so let no one take the trouble to dive into the above considerations until he really believes that there is 'payable stuff' to be dug out of his 'claim' ; let him avoid the habit of reckoning the value of a property from a few picked specimens."

So said J.W. Anderson. Are the Dundas mines profitable for their operators, the crocoite miners? Are they in fact able to perform some sort of alchemy and turn their red lead into "gold"?

Mike and Eleanor Phelan have worked the Dundas Extended mine as a "hobby mine" for about 10 years. Operating it as a hobby mine keeps the cost down, and this, coupled with the fact that the specimens from here are quite different to other crocoite producing mines in the region, makes it a profitable venture.

The mine was located by Mike based on information in a Mines Department Report by Montgomery in the 1890s (possibly the Report on the Zeehan-Dundas Mineral Fields, 1896). It was originally a tunnel only, with apparently no production.

Mike has also operated other mines in the past, including the Red Lead and the Kapi. He worked the Red Lead for about 5 or 6 years and was able to produce around $1,000 worth of crocoite a week. He still has some of the specimens mined during this period in his collection. He was the first to take out a lease on the Kapi and worked it with a Standard Eight and a wheelbarrow! How the Standard Eight made it out to the mine is a mystery.

Others still working the Dundas mines for crocoite are Frank Mihajlowits (Adelaide mine), and Shane Dohnt (Red Lead mine). They too, may have had their share of fortune and luck turning red lead into "gold", but it is never a foregone conclusion.

"**middleman** n. trader handling a commodity between producer and consumer."

Some crocoite miners have, over the years, taken their treasures directly to the marketplace, to places such as the annual Tucson mineral show in Arizona. However, most of the crocoite that now appears on to the market, does so via middlemen. Some of these people such as Ambros Kissling, are dealer-collectors, people who help to feed their own habit, that is, enhance their mineral collections, through trading or selling crocoite and other minerals. Others are purely dealers, intent on only making money.

Ambros was born in Switzerland. He started mineral and gemstone collecting while working in India during 1954-56. Arriving in Tasmania in 1956, he saw crocoite for the first time and a keen interest in mineralogy followed. Ambros has had an interest in the Dundas mineral field for over 30 years, specialising in minerals of the Adelaide mine. Together with his wife Ann, with the help of trading and dealing, they financed their own collection, concentrating mainly on Tasmanian and Tsumeb (Namibia) specimens.

The first time that Ambros collected crocoite was in 1961 at the Adelaide mine, which was accessed by walking along the old tramway. Ambros still has some of the specimens collected that day in his collection. Crocoite can do that to you.

A few years later, Ambros got to know Frank Mihajlowits who goes by the tag of the "Crocoite King", and who has operated the Adelaide mine for many years (and still does).

His first sale was made in Switzerland. Crocoite purchased for $250 was sold as one lot for $750. It wasn't always this good though. After the spectacular find in 1971 at the Adelaide, there was a long lean period. Frank and Ambros had something of a monopoly on mineral specimens from the west coast for many years (Frank was able to source mineral specimens from many of the west coast mines, including Renison, Rosebery, the Kapi, and Mount Bischoff) until others came along in the 1980s.

Ambros still has his contacts. A recent purchase revealed specimens of crocoite, cerussite and pyromorphite, that had been stored for many years in a shed. The crocoite specimens, from the West Comet mine, were found wrapped in 1905 newspaper, and may have been stored that way for almost a century.

Crocoite has also found its way into the homes of famous people. A bronze crucifix, with a crocoite specimen at its base, was presented by the schoolchildren of the township of Richmond, to the Pope on his visit to Tasmania. Ambros supplied the crocoite.

Ambros also provided singer Frankie Lane with a crocoite specimen. Frankie Lane, who was in Hobart to perform at the Wrest Point Casino, had been asked by his wife to obtain a crocoite specimen while he was in Tasmania, and he spent some considerable time at the home of Ann and Ambros. They were subsequently guests at one of his performances.

Ann and Ambros have made many such contacts and friends over the years.

"**mania** n. extreme enthusiasm for something. **maniac** n. person with a mania."

This is the end of the Supply Chain. Our maniacs are those lucky mineral collectors that are close to the source. Some of the specimens can be obtained directly from the miners, but often are procured through the middlemen.

Carl Bjorklund became interested in collecting minerals at the age of eight and joined the Lapidary Club of Tasmania in Hobart in 1963. Involvement with mineral collecting and lapidary has continued since then. His main area of interest is in collecting minerals from the West Coast of Tasmania. Carl also runs a mineral and gemstone stall at the famous Salamanca Market in Hobart.

Mark Hallam, the second of our maniacs, was born in Hobart in 1958. He developed a keen interest in minerals from an early age, enhanced by numerous visits to Queenstown with his grandmother who was born there. His first glimpse of crocoite was of a specimen given to him during a trip to the West Coast with his father in the early seventies. This particular crocoite specimen was worth only around $10 to $12, but to Mark, it was worth much more.

After a long absence, he resumed collecting in 1989. Crocoite was the mineral that regenerated his interest. It was also the mineral that provided the means for him to further his collection, through trading with other collectors around the world. Trading also helped Mark learn about other minerals, particularly about those minerals not found in Tasmania, or not seen at the few gem or mineral shows that he has attended.

When you ask Mark what it is about crocoite that appeals to him, he will tell you that it has a certain mystique, particularly as it is so rare, and so uniquely Tasmanian, and besides, he's always loved the colour red. Seeing crocoite *in situ* at a number of Dundas mines has also been a dream come true. He has benefited from being close to the source, and considers himself fortunate to have been able to go underground at the Adelaide, Red Lead, Platt, Kapi, and other crocoite mines in the Dundas area.

Today Mark has, as you would expect from a crocoite maniac, a "few" crocoite specimens in his collection. Many of these are thumbnail specimens of unusual habits and odd forms. His favourite specimen in his own collection is one that came out of the last good pocket at the Red Lead mine. There are crocoite specimens in other collections that Mark considers as "stand out" specimens. The first to come to mind being one from the Adelaide mine extracted in the early 1970s and now on display at the Zeehan Museum.

Mark very much regrets having given up collecting, and particularly having given up his early collection, even though it was "nothing special". He also wonders what he may have missed out on during those years. Mark never really lost interest, he just couldn't find someone to share his interest with. Those times are long past. Over the last few years, he has more than made up for what he may have missed out on, and is now able to share his interest and knowledge with other like-minded crocoite maniacs.

It wouldn't be fair to finish this chapter without declaring myself as a crocoite maniac. My own collection not only includes specimens from many of the Dundas mines, but also from the Magnet mine near Waratah, and the Heazlewood mine further west (where crocoite was first discovered in Tasmania). I also have specimens from Western Australia, South Africa, France, Germany, Russia, and China, although none of these can compare with the beauty of the Tasmanian crocoite.

“Such being our motives, we can no longer be silent concerning the seed of metals, but declare that it is contained in the ores of metals, as wheat is in the grain; and the folly of alchemists has hindered them from adverting to this, so that they have always sought it in the vulgar metals, which are factitious and not a natural production, therein acting as foolishly as if a man should sow bread and expect corn from it, or from an egg which is boiled hope to produce a chicken. Nay, though the philosophers have said many times the vulgar metals are dead, not excepting gold, which passes the fire, they could never imagine a thing so simple as that the seed of metals was contained in their ores, where alone it ought to be expected; so bewildered is human ingenuity, when it leaves the beaten track of truth and Nature, to entangle itself in a multiplicity of fine-spun inventions.”

Collectanea Chemica

# 7. THE OTHER LEAD MINERALS OF TASMANIA

## AIKINITE

**$PbCuBiS_3$**

Aikinite was first described from the Beresov district, in the Urals, Russia, the same region that first supplied us with crocoite. It is a rare sulphosalt and recorded from Tasmania only in microscopic form from the Hecla mine, Dundas, and in concentrates prepared from ores of the Kara mine, Hampshire.

## ANGLESITE

**$PbSO_4$**

This usually white or grey sulphate is a secondary mineral occurring in the oxidised zone of lead deposits. It is often found in association with cerussite, although it is much less common. At times, anglesite is found in cavities in decomposing galena, from which it has evolved.

The most significant occurrences in Tasmania are from the Dundas region, the Susannite mine (Zeehan), and the Magnet mine near Waratah. Characteristic dagger-shaped crystals of exceptional size and perfection were recorded from the Maestrie's Broken Hill Silver-Lead mine at Dundas by Petterd (1893). In later catalogues, the same occurrence was reported as the Comet mine, Dundas (the Maestries leases having been sold to the Comet Silver Mining Company in 1900). A Comet mine specimen in the Petterd Collection (number 3984) contains a number of white to grey anglesite crystals to 2cm across, occurring in the form of rhombic prisms. W.F. Ward in 1892, reported clear, colourless, tabular crystals up to 5cm by 0.5cm from the Susannite mine, between Zeehan and the Comstock, in the oxidised portion of a lode carrying a large proportion of pyrite. At the Magnet mine, Waratah, anglesite is a common mineral and occurs in several habits including as white blocky prismatic crystals up to 6cm long. Petterd (1910) reported attractive specimens of anglesite occurring with crocoite, pyromorphite, and silver halides. Diligent searching can still produce specimens at this location.

In more recent times, crystals of green anglesite have been reported from the Dundas Extended mine (F. Doedens, pers. comm.) associated with yellow cerussite and crocoite. Anglesite also occurs sparingly at other mines in the Zeehan and Dundas districts, and at mines in the Whyte River silver-lead field.

## BEAVERITE

**$Pb(Cu,Fe,Al)_3(SO_4)_2(OH)_6$**

Beaverite is one of the alunite-jarosite group of minerals, and forms from the oxidation of lead-copper deposits. In Tasmania, it has only been recorded from the Orieco mine, Scamander, where it occurs as a yellow-brown crust, associated with a number of other sulphates, including chalcoalumite (as the second recorded occurrence in Australia), brochantite, and chalcanthite.

## *BELLITE*

Bellite, a variety of mimetite found in the upper workings of the Magnet mine, was named by Petterd in compliment to his old respected friend, W.R. Bell. The following description is taken from the original description by Petterd (1905):

> "This extremely interesting and, it may be said, attractive new substance usually occurs in delicate tufts aggregated together, and velvet-like coated

surfaces thickly lining and clustering in drusy cavities in somewhat soft iron-manganese gossan. The coated surfaces are often met with of reasonable size, and have been obtained covering several square inches of the gossan, more especially where vughs and fractures occur. More rarely bunches of galena are wholly or partially covered by the substance. It is often in crypto-crystalline incrustations, occasionally pulverulent, and more rarely in bunches of hexagonal crystals of almost microscopic dimensions. The largest crystals so far observed were but three millimetres in length, but the outline was sharp and very distinct. The crystals are of adamantine lustre, and a remarkably bright red to crimson colour. Minute acicular patches of crystals are common, and under the lens are perfectly distinct, and thus afford very fine microscopic objects of considerable attractiveness. The bright crimson colour of the general mass is very characteristic, and by this feature it is noticeable by the most casual observer, even when not directly interested in mineralogy. It sometimes occurs in aggregates of extremely minute needles, much like velvet, of a distinct and bright yellow to orange colour, and in this form it also occasionally coats somewhat large surfaces. Chromiferous cerussite and more rarely crocoisite and mimetite are intimately associated with it. Although so noticeable, the coating of the substance is usually of such extreme thinness that it was only with the greatest difficulty and by using the utmost care that enough was secured to make a complete analysis."

It's status as a distinct species has been revoked as analysis in 1970 by the Tasmania Department of Mines, showed it to be a mixture of mimetite and crocoite.

Bellite was "revisited" by Nickel and Hitchen (1992) to try and remove confusion, as a lead chromate silicate compound synthesised by F. Cesbron and S. Williams in 1980 was given the name, bellite. Nickel and Hitchen determined that the original bellite is not a valid species, but can be regarded as a variety of mimetite containing amounts of phosphate (PO), silicate (SiO), and chromate (CrO).

## ***BERESOWITE***

**$Pb_6O_2CO_3(CrO_4)_3$**

Both the name beresowite (as spelt in Petterd's 1910 catalogue) and beresovite (in the revised catalogue) have been used for two different substances, neither of which are now recognised mineral species. The names have been used to describe a magnesian chromite and, in the Tasmanian context, an altered phoenicochroite, a lead chromate. The latter was thought to be a mixture of either phoenicochroite or crocoite with cerussite and massicot.

"Beresowite" occurred at the Magnet mine as minute plates and pseudocrystals in cracks and vughs in the gossan.

## **BERTHIERITE**

**$FeSbS_4$**

Although berthierite is not a lead mineral, Petterd considered it to be so in his 1893 catalogue where he described it as a sulphide of lead and iron. He changed the classification in his 1910 catalogue, correctly including it as a sulphide of antimony and iron. His mistake was not in the initial investigations, which must have indicated lead and iron, but simply in his choice of mineral species, as later XRD tests showed the material to be the lead iron sulphosalt, jamesonite.

## BETEKHTINITE
**$Cu_{10}(Fe,Pb)S_6$**

Betekhtinite is a rare mineral, found at only a few localities worldwide, including Germany, Kazakhstan, and Namibia. It was recorded as a microscopic constituent of the Mt. Lyell copper ores occurring with mawsonite and bornite in 1965.

## BEUDANTITE
**$PbFe_3(AsO_4)(SO_4)(OH)_6$**

The beudantite group of minerals, which also includes hinsdalite, hidalgoite and corkite, vary considerably in chemical composition, and are related to the alunite-jarosite group and the crandallite group. They are often difficult to identify, generally occurring as green to brown fine grained material.

Beudantite mixed with bindheimite has been recorded from Dundas, associated with scorodite, szomolnokite, quartz and pyrite from East Mt. Pelion, and with anglesite at the Queen of the Earth mine near Scamander. Each has been identified using XRD.

## BINDHEIMITE
**$Pb_2Sb_2O_6(O,OH)$**

Any earthy yellow substance that occurs in deposits containing lead and antimony minerals such as jamesonite, is usually identified as bindheimite. It has been recorded at a number of West Coast mines, including the Comet and Adelaide mines, Dundas, the Silver Queen mine, Zeehan, and the Godkin and Whyte River mines in the Heazlewood district.

## BOULANGERITE
**$Pb_5Sb_4S_{11}$**

In addition to those localities recorded in the Catalogue (Waratah, at the Silver Cliff and Old Waratah mines, at the Melba mine and Block 291 mine at North Dundas, and at other Dundas mines), the Petterd Collection contains specimens labelled boulangerite from Zeehan (in particular, the Argent mine and the Spray mine), the Magnet mine and from Heazlewood. In all cases, boulangerite occurs as granular metallic masses, or as compact fibres, and has been confused from time to time with another physically similar mineral, jamesonite.

Metallic silver hairs, often curved, even to the extent of forming classic boulangerite rings, occur with pink rhodochrosite and quartz, on specimens from the Hercules mine. Such specimens were available to collectors in the late 1980’s.

## BOURNONITE
**$PbCuSbS_3$**

Bournonite, also known as cog-wheel ore, was named by Jameson in 1805 for J.L. de Bournon. He was describing specimens from one of the classic Cornish localities that occur in characteristic “cog-wheel” shaped crystals. All of the bournonite so far reported in Tasmanian occurs as massive patches or veins.

Petterd's first reference of bournonite is in 1893 quoting Gould's report to the Royal Society of Tasmania (1871) where bournonite occurs in patches near the junction of the slates and granite on the south-east shores of King Island. A specimen in the Petterd Collection (number 511) is labelled as being from King Island.

Bournonite has been recorded from several localities in the Zeehan region, most notably from a tribute of the Argent Company, an occurrence recorded last century, from Brown and Turner's Prospect near the No. 6 Montana lode as lumps up to 5cm in length, and from the Swansea and Western mines. Recent mining activity at the Globe mine near Zeehan, has produced specimens of bournonite and pyrargyrite(?) in granite.

Bournonite has also been recorded from Tullah, Mt Farrell, the Adelaide mine, Dundas, Lefroy, and recently, reported from Colebrook Hill and from the Hellyer mine. Specimens in the Petterd Collection from Tullah and Zeehan are of bournonite with galena.

## PLUMBIAN CALCITE
**$CaCO_3$**

"Plumbocalcite", a varietal name for a lead-bearing calcite, was reported by Petterd as having the ordinary characteristics of a dark-coloured calcite. Several specimens were obtained at the Bell's Reward mine, Heazlewood.

## CARMINITE
**$PbFe(AsO_4)_2(OH)_2$**

Originally found in Germany in 1850, carminite was so called because of it's often characteristic colour of bright carmine-red. It was First described by Petterd in 1902 as occurring:

> "In minute orthorhombic groups of crystals coating fractures and vughs in gossan. It is of a reddish colour, and adamantine lustre. The Magnet Silver Mine."

The description in the subsequent Catalogues changed little. It wasn't until 1993 that any of the specimens were analysed. Of the five specimens of carminite listed by Petterd, two were tested and found to consist of small red-brown hexagonal prisms of mimetite (Bottrill and Woolley, 1993).

## CERUSSITE
**$PbCO_3$**

A common alteration product of galena, this lead carbonate often occurs as blocky to prismatic colourless, white or grey crystals. It has been known as cerussite since 1845, but has been known for much longer, with the ancient name, cerussa, appearing in *De Omni Rerum Fossilium Genere* in 1565.

Cerussite is abundant in the lead producing mines in Tasmania. Many of the West Coast mines had produced specimens in many varied habits, some spectacular, by the turn of the century. From Petterd:

> "The native lead carbonate is almost an invariable accompaniment, in more or less quantity and perfection, of the sulphide in lead mines. It is subject to ready formation by the action of carbonic acid derived from a gangue or adjacent rock containing soluble calcium-carbonate such as ordinary calcite, dolomite or ankerite, and is thus a secondary mineral, where its formation is due to epigenic action mainly in the upper or more superficial portions of the load. It crystallises in the orthorhombic system, and but few mineral species afford such extreme variation of crystal habit or diversity of arrangement of the individual groups or bunches. It is at times in the form of a white amorphous mass, or thin coating on its parent galena, or a thin layer of sulphate may rest between the original sulphide and the external carbonate. Within the zone of oxidation it is frequently in enormous quantity, and cavities in the surface outcrop or galena may contain fairly developed crystals; these are often met with in exquisite perfection. When attached to a gossany base it attests the superficial origin of the group. It is frequently in the form of long slender crystals, often acicular and of extreme delicacy. They may be almost water-clear or snow-white, in which latter case when implanted, as is not rarely the case, on almost black ferro-manganese gossan, they afford specimens of remarkable refinement. Again, the arrangement of the long

acicular crystals may be in a crudely stellate pattern of equal attractiveness. Such masses occur in both these states at the Comet Mine, Dundas. The large vughs which have occasionally been met with at the Hercules Mine, Mt. Read, have been found on many occasions completely lined with a comparatively thick coating of exquisitely beautiful crystals of this mineral, oftentimes much stained externally with cupric carbonate and iron oxide, the pure white of the cerussite strongly contrasting with the green and blue of the copper and the yellow of the iron. At the Magnet Mine many perfectly-formed groups of crystals have been frequently obtained. They are often seated on the parent mineral galena or nestling in the cavities. In the gossan zone they are very frequent and of perfect form, showing single crystals as well as mackles[14] and trillings[15]. In certain positions they are of a bright yellow colour, owing to chromic acid influence, but the clear to glassy condition prevails. Fairly large quantities have been mined at the Silver Queen, Sylvester, Austral, and other mines at Zeehan, and the Heazlewood mines have one and all produced excellent examples, amorphous, sub-crystalline, and of perfect crystallisation. It is always an attractive mineral, and one such as soon arrests the attention of visitors to the silver-lead localities, and thus the most elementary collections are almost certain to contain specimens."

Other specific occurrences cited by Petterd include the Maestries Broken Hill and Adelaide Proprietary mines, Dundas, The Godkin and Whyte River mines in the Heazlewood district. A specimen from the Whyte River mine (Petterd specimen number 1096), consists of lustrous crystals of green cerussite, a most attractive specimen.

### CHROMIFEROUS CERUSSITE

Yellow, or so-called "chrome" cerussite, of which the Whyte River specimen (above) undoubtedly belongs, is locally abundant at a number of the mines on the West Coast. In fact, a recent excursion by the Mineralogical Society of Tasmania (January, 1999) turned up a few small specimens from the Heazlewood mine. The "type locality" (a term used to signify where a mineral was first found) for "chrome" cerussite is the Magnet mine at Waratah. The Comet and Adelaide mines at Dundas have both produced spectacular specimens of this variety, often liberally sprinkled with tiny bright orange or red crocoite crystals. The Dundas Extended and Red Lead mines have also produced specimens, but in lesser amounts.

There has been much debate as to the chromium content of "chromiferous cerussite", and the jury is still out. However, this does not detract from the fact that "chrome" cerussite is one of the most beautiful and aesthetic minerals that Tasmania has produced. The first record of this attractive variety of cerussite is provided by Petterd (1903):

"This attractive variety of a common species is, so far as known, confined to the Magnet Mine, in the upper workings of which it is, although local, fairly abundant. It occurs in fractures and vughs in the gossan zone, but in bunches and sparsely attached as beautiful little crystals, generally in close association with crocoisite, but never, so far as observation has gone, intermixed with the normal form; although this is somewhat abundant in its usual adamantine characteristic habit, often shewing remarkably perfect development in stellar and cruciform triplet crystals.

[14] A particular type of contact twin, usually two crystals rotated at 180°(from the French)
[15] A form of cyclic twinning often giving a pseudo-hexagonal symmetry

It is noticeable that, while the variety under review is invariably associated with the chromate of lead, the common type is rarely, if ever, obtained in the vicinity. It is always opaque, with a shining lustre, but not adamantine. The colour is canary yellow, with an occasional tinge of red where the crystal has impinged upon the chromate. The tint does not vary to any serious extent, although paler examples are occasionally met with. It is a most attractive mineral, and soon arrests attention. Its most constant feature is its crystallisation in flatish frondose and spear headed groups, twinned by repeated angles across different faces of the prism (110). The striated faces of the twinned groups are the brachyprisms 011 and 013; these are commonly deeply grooved, affording a most interesting leaf-like and unfamiliar appearance.

This variety is perfectly distinct, both as regards colour and habit of crystallisation. Moreover, intermediate variations between it and normal type have not been met with. It is undoubtedly one of our most attractive and typical minerals. Under the blowpipe gives reactions for chromic acid."

These days, any yellow or green cerussite from the West Coast is usually termed "chrome" cerussite, based purely on colour and habit. In fact, Petterd considered that it was (so far as was known), confined to the Magnet mine. This wasn't because yellow cerussite with a similar habit had not been found elsewhere, but because of the care that Petterd took when examining specimens. For example, a specimen of yellow-green cerussite from the Adelaide Proprietary mine, Dundas, was analysed, and found to contain only a minute trace of chromium. Perhaps this is why there are differing schools of thought as to the validity of "chrome" cerussite today.

## CLAUSTHALITE
**PbSe**

Clausthalite, a rare lead selenide, occurs as fine veinlets in hematitic copper ore in the North Lyell mine, near Queenstown. It was identified by I. Hart using Electron Microprobe Analysis.

## CORKITE
**$PbFe_3PO_4SO_4(OH)_6$**

Samples occurring as grey-yellow-green powder with crocoite in isolated pockets and seams from the Red Lead mine, Dundas, were identified as corkite by XRD.

## CORONADITE
**$Pb(Mn^{4+},Mn^{2+})_8O_{16}$**

Manganese oxides are widespread in the gossans of lead deposits, and are often difficult to identify and referred to as wad. Coronadite is one manganese oxide that has been confirmed from the Red Lead mine, Dundas, as black coatings and stalactites. It is probably fairly common, but overlooked. Hollandite, a related barium manganese oxide, has also been reported from the Dundas area, but its identification is unconfirmed.

## COSALITE
**$Pb_2Bi_2S_5$**

The Catalogue considers the identification of cosalite by Stillwell (1935), where it was observed microscopically in association with gersdorffite and other minerals from the Hecla mine, Dundas, as a doubtful identification. No other details are given.

## Dufrénoysite
**$Pb_2As_2S_5$**

Petterd relates a second-hand occurrence in 1893 of "dufrenosite":

> "... said to occur intermixed with tetrahedrite and cupiferous pyrites at the Fahl Ore Mine, Dundas."

In his catalogue however, a much more positive report reads:

> "This mineral was obtained as thick orthorhombic crystals, which are deeply grooved longitudinally, colour lead-grey, highly polished, and occur implanted on and in the cavities of crystalline siderite. Several of the beautifully developed crystals exceeded 1 inch in length and 3/8-inch in width.
>
> Locality: Block 291, North-East Dundas."

Unfortunately, the only dufrénoysite in the Petterd Collection is a specimen from Binnental, Switzerland (number 488), even though two Tasmanian specimens were originally listed (numbers 487 and 489). The whereabouts of these specimens are currently unknown, and the Register at the Museum shows them as "missing".

## DUFTITE

**$PbCuAsO_4OH$**

Groves (1972) reported chenevixite (a copper iron arsenate) intergrown with possible duftite from the Orieco mine, Scamander, as a pale green encrustation on the surface of small arsenopyrite veinlets. Both minerals were listed as being tentatively identified from the presence of their most intense X-ray diffraction peaks.

## **DUNDASITE**

**$PbAl_2(CO_3)_2(OH)_4.H_2O$**

Dundasite is a rare mineral found only at a few localities around the world, including Derbyshire in England, Wales, and as a spectacular blue form at Te Aroha on the north island of New Zealand. It is nowhere found in quantity. The original description of dundasite from, and named after, the Adelaide Proprietary mine, Dundas, was provided by Petterd in 1893:

> "This apparently new mineral compound forms an incrustation on ferro-manganese gossan. It is composed of small spherical aggregates, usually closely matted together. Under the lens these bunches show an extremely fine radiating structure. The colour internally is silky milk-white with a velvety outer crust of a dusty yellow brown.
>
> The surface often has numerous adherant crystals of Crocoisite which not rarely penetrate the mass. These crystals are always minute, but remarkable for their extremely fine development and acute angles."

In 1902, Petterd reported that dundasite had been found at the Hercules mine:

> "At the Hercules Mine, Mt. Read, a mass of snow-white cellular quartz has been obtained, throughout which are scattered crystals of cerussite, gibbsite, and numerous patches of dundasite, the whole forming one of the most attractive associations of minerals as yet obtained in this State."

A few years later in 1905, Mr. Alex Morton read a paper to the Royal Society of Tasmania prepared by Petterd entitled "A note on the occurrence in Wales of the mineral dundasite which was supposed heretofore to be peculiar to Tasmania". In this paper, Petterd took the opportunity to expand on the knowledge of the distribution of dundasite in this State:

> "In a catalogue of the minerals known to occur in this island, which was published in the proceedings of this society for the year 1896, I brought under the notice of mineralogists for the first time the occurrence of a mineral of remarkable chemical composition, to which was applied the scientific term of dundasite, and I have now the satisfaction of bringing under notice the recognition of the original diagnosis by the announcement of the detection of this interesting substance at the Welsh Foxdale mine, Trefrico, Carmarthenshire, by Mr. H.F. Collins (the author of "The Metallurgy of Lead and Silver"), and of which discovery a paper has been read before the Mineralogical Society on March 15 by Mr. G.T. Prior ("Nature," April 13, 1905). Dundasite is a mineral substance of extremely unique and peculiar composition, and up to the time of its determination as occurring at the silver-lead mines of Dundas, was previously unknown to mineralogical science, although such a vast amount of research work had been accomplished among the numerous secondary lead salts. Its detection was, therefore, of special interest, and it followed that its characteristic habit, coupled with its composition, necessitated that a specific name should be applied to it. As it was considered to be restricted to the Adelaide Proprietary mine at the locality indicated on account of the local peculiarities necessary for its molecular growth, the term Dundasite was applied to it. Under what conditions and with what associations it has been found at its newly recorded locality is not as yet fully apparent, but the interesting fact remains that a new

> mineral originally discovered in this island has been obtained at a special locality in the old world. This in itself is worthy of record.
>
> I now have some additional information to offer as to its distribution at the mines at Dundas, and its detection at other localities on the West Coast. Its general habit of occurrence is in somewhat small rounded aggregates closely packed together, which show white radiating tufts on separation. It is easily disintegrated into fine silky fibres after the manner of chrysotile. In many instances the individual tuft has as a nucleus a minute crystal of the bright hyacinth-red coloured crocoisite, which is again sometimes implanted on its surface. It often occurs coating the interior of vughs in the harder ferro-manganese gossan which is immediately beneath the softer superficial lode capping, and in the zone above the unaltered primary sulphide minerals. At its original locality it is occasionally coated with an outer film of extreme tenuity, and of a bright green colour. This is probably a substance allied to pyromorphite, but as only an extremely minute quantity can be secured, this has not been satisfactorily determined. It is again sometimes stained on the exterior with a salt of copper to a pale bluish green, and more rarely discoloured by brown hydrated iron oxide. At the Hercules mine at Mount Read it has been found on rare occasions in a very pure condition, when it is immaculately white, implanted in isolated internally radiating tufts and small aggregates on cellular quartz; and yet more rarely on crystals of cerussite, closely associated with another rare lead mineral which has been named hydrocerrusite. These groupings, although very attractive, are extremely fragile, and thus most difficult to preserve for the cabinet, but through the kindness of the late general manager, Mr. Sydney Thow, I was enabled to secure a specimen, both unusually large and very beautiful. This is doubtless the finest example which has so far been obtained, but needless to say it is simply of scientific interest. At the Florence mine at Zeehan the mineral under review occurs sparingly in gossany cavities, but much iron-stained, and at a few other mines it has occasionally been met with, but never in any appreciable quantity."

More recently, dundasite has been found at the Kapi mine, associated with crocoite and cerussite, and can still be found in limited quantities with gibbsite at the Hercules mine, presumably from the remnants of the same gossan that provided those specimens almost 100 years ago.

At the Red Lead mine, a lilac coloured mineral occurs, associated with cerussite and galena. XRD indicated a dundasite-like mineral, but with chromium. It is possibly a new mineral.

## Franckëite

**$Pb_5Sn_3Sb_2S_{14}$**

The Catalogue (citing Stillwell and Edwards (1942)) records that this sulphosalt has been observed microscopically in ore from Renison Bell tin mine. It was reported as replacing stannite and occurring in thin plates, prisms or fibres which gave it a feathery appearance.

## FREIESLEBENITE

**$AgPbSbS_3$**

The Catalogue (citing Ramdohr (1960)), records freieslebenite, another sulphosalt, as occurring amongst minerals observed in ore from the Electrolytic Zinc Company mine at Rosebery, but no details of the occurrence were given.

## GALENA

**PbS**

In his Catalogue, Petterd tells us that the earliest recorded discovery of the lead sulphide, galena in Tasmania was one of "an unimportant nature" at Norfolk Plains[16] in 1851, citing the Proceedings of the Royal Society of Tasmania, 1851. In fact, this discovery took place some time earlier with the following description appearing in the Society's Proceedings of 12th September, 1849:

> "Specimens of Galena from the Estate of Abraham Walker, Esq., of Norfolk Plains, placed on the table by the Secretary. The ore is found in nodules in a highly siliceous limestone, underlying a slatey clay-rock and clayey breccia, beneath a hill of greenstone on the margin of the "Western Lagoons"."

A second report appears in the Proceedings of 9th January, 1850:

> "Mr. Milligan read a paper illustrated with an ample series of specimens, upon the occurrence of Galena, with traces of copper in the old siliceous limestone, for some years quarried and burned for lime on the property of Mr. Abraham Walker, at the western side of Norfolk Plains, and immediately under Dry's Bluff, a portion of the western range of mountains."

Some attempt at mining, as well as quarrying operations, was carried out as demonstrated in a third report which appeared in the Proceedings of 9th October, 1850:

> "Samples of plumbago (Graphite), obtained in the shaft lately opened on the estate of Creekton, Norfolk Plains, the property of Abraham Walker, Esq., in pursuit of the veins of Galena with copper, occurring in the limestone and slate there, were presented from Mr. Walker."

Dr. J. Milligan, a prominent member of the Royal Society, also reported an occurrence of "Galena" in mountain limestone at Franklin River in 1851, with an entry in the authorised Catalogue of the International Exhibition, Tasmanian Section.

Galena is an important ore of lead and often carries high silver values. Petterd provides us with it's physical description and geographical and geological occurrence in the state:

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[16] Norfolk Plains was an early name for the northern Tasmanian township now known as Longford.

"This mineral - the most abundant ore of lead - is widely distributed over the northern and western portions of the island, occurring in all its many variations of structure, from the steel-grained to the coarse cubical ore, often exhibiting extreme variation in this respect in the same district, or even in the same mine. In geological occurrence it also varies to a greater extent than almost any other mineral. Here it is common to the tin-bearing granites of Ben Lomond; to the fossiliferous Silurian slates and sandstones of the Zeehan field; as well as occurring in the dolomitised rocks of the Heazlewood and Magnet; and is even found to a limited extent in the auriferous quartz reefs of the Mathinna, Lefroy, and other districts. From nearly all localities the lead sulphide, as occurring in this State, is characterised by the unusually high assay returns of silver that it yields. As is usually the case in lead-producing countries, the common ore of lead is the sulphide. It crystallises in the cubic system, but the occurrence of crystals in this island is quite exceptional. It admits of remarkably perfect cleavage, readily breaking into cubes.

Among the minerals bearing paragenetic relationship occurring here are ferrous-carbonate, blende, and pyrites. Except in rare instances, what are known as the "sparry" accompaniments of the Old World lead-mining localities, such as fluorite and calcite, are usually absent. Galena readily suffers decomposition or alteration near the exposed surface, due to the action of oxygen and carbonic acid, owing to which anglesite, cerussite, and other secondary lead salts are produced by chemical reactions. In rare instances the gradual change from the crystalline sulphide into lead-carbonate and sulphate-carbonate, or, when antimony is present, into bindheimite, is readily detected, the Comet mine at Dundas affording excellent illustrations of the latter alteration, where the graduation can be distinctly traced. At times, when such an alteration does take place, a nucleus of unaltered galena may be found, which is perfectly surrounded by either one or other of the secondary derivatives. Galena easily tarnishes, in which case it sometimes shows a brilliantly iridescent surface, exhibiting beautifully striking shades of blue-green and red. This phenomenon is specially noticeable in much of the ore obtained at the Junction and Queen Mines at Zeehan. Cavities occurring within the zone of oxidation often exhibit a marginal coating of unaltered galena, with beautifully developed complex crystals of cerussite in the interior.

The coarsely crystalline ore is generally considered to be poor in silver contents, but this is not always the case, as such an ore may at times contain higher values in silver than the steel-grained material which, among miners, is so universally considered such an acquisition. As a rule lead sulphide is richer in silver from lodes occurring in slate, less so when from granite, and is commonly poor in the desired companion when from limestone."

Crystals are rare but have been found at the Magnet mine, at the Hellyer mine, and a number of the Zeehan mines, generally only a few millimetres across. However, sometimes, the crystals are quite spectacular. Again, we turn to Petterd's description:

"At the Farrell Mine, at Tullah, a remarkable pipe of galena has been worked, which in portion showed a quantity of greenish lithomarge[17] surrounding and throughout which occurred a considerable number of finely-developed galena crystals, varying in size from very diminutive to about 1

[17] Early name for soft clay-like minerals.

> inch in length. They represent mainly cubo-octahedra and perfect octahedra; many single with excellent terminations, while others are irregularly bunched together. They may be said to represent the finest discovery of its nature that has occurred in this island."

A specimen labelled "Galena, Mt. Farrell" in the Petterd Collection (number 245) consists of four single crystals, the largest being a sharp octahedral crystal about 1.5cm across.

Other occurrences have, from time to time, been reported in various publications, particularly in the Proceedings of the Royal Society of Tasmania (usually as a result of one of the members donating a specimen to the Museum). These occurrences would mostly be of non-crystalline galena. Locations mentioned include Bubs Hill (near Queenstown), Cygnet, from a drill core at Franklin, New Norfolk, Mount Claude, and elsewhere.

## GEOCRONITE

**$Pb_{14}(Sb,As)_6S_{23}$**

Under the heading of jamesonite, Petterd (1910) records:

> "At Zeehan a considerable quantity of this mineral closely resembles schultzite."

Schulzite is now considered to be an arsenic-free end member of the geocronite-jordanite series.

## *GUITERMANITE*

**$Pb_{10}As_6S_{19}$**

Petterd (1910) described a massive mineral occurring in the south workings of the Magnet mine, as having the same physical appearance, colour, and hardness as guitermanite, but he was unable to isolate the pure material. He therefore provisionally named the Magnet material guitermanite. His description of this sulphosalt was as follows:

> "It is bluish gray in colour, with an obscure metallic lustre, always intimately mixed with galena, sphalerite, and sometimes zinkenite. Upon being struck it emits a strong odour of garlic."

The validity of guitermanite is in question with the type specimens from the Zuñi mine, Silverton, San Juan County, Colorado, appearing to be jordanite, and specimens from other localities found to be identical with baumhauerite. With the original material from Magnet being unavailable for study, the "Doubtful Validity" classification given in the 1970 Catalogue must remain.

## HIDALGOITE

**$PbAl_3AsO_4SO_4(OH)_6$**

A specimen from the Adelaide mine, Dundas, described as an earthy, lemon-coloured material with a waxy lustre on tabular crocoite, was found to be hidalgoite (Lawrence, 1977).

## HINSDALITE

**$PbAl_3PO_4SO_4(OH)_6$**

Hinsdalite has been recorded from the West Comet mine, Dundas, as white pseudomorphs after hexagonal prisms of pyromorphite, and from the Sylvester mine, Zeehan, as cream coloured pseudomorphs after pyromorphite, to 6mm long, in cavities in a sub-lode cutting the main silver-lead lode.

It is likely that the exact location of the latter occurrence is not the Sylvester mine itself, but the "Pyromorphite Lode", part of the nearby Silver Queen orebody. Early maps show the Pyromorphite Lode to be within a large Sylvester Mine lease, which is why there is some confusion.

### *HUASCOLITE*

**(Zn,Pb)S**

Not now considered to be a valid mineral species, but simply a mixture of galena and sphalerite, huascolite was first described by Petterd (1893) from the Godkin Extended mine, Whyte River. He considered that the mineral may have been of a secondary deposition of marine origin, as it contained indistinct fossil shell casts.

He later described the occurrence of huascolite from the Hercules-Read mines, and the Comstock mine, Zeehan. His description graphically illustrates the dilemma facing early miners, that of extracting zinc:

> "If the metals are chemically combined, it will to a great extent account for the utter impossibility of mechanically separating the lead and zinc contents of these ore-bodies."

The 1970 Catalogue invalidates huascolite.

### HYDROCERUSSITE

**$Pb_3(CO_3)_2(OH)_2$**

Initially described by Petterd as a white fluidal substance from an adit in the Hercules mine, Mt. Read, the specimen was later analysed and found to be cerussite, and subsequently invalidated in the 1970 Catalogue. Bottrill and Woolley (1993) however, when analysing a specimen of native lead from Mt. Dundas, in the Petterd Collection, found that most of the sample comprised litharge and hydrocerussite.

From the Magnet mine, hydrocerussite(?) occurs as pearly white overgrowths on cerussite, in association with anglesite, in a decomposed galena vein. This material was collected in 1994 from the gossan in the open cut on the access track into the mine.

### JAMESONITE

**$Pb_4FeSb_6S_{14}$**

Jamesonite occurred in somewhat large quantity at the Silver Cliff and the old Waratah mines at Mount Bischoff, as filiform and amorphous masses. Massive specimens, but with a crystalline structure, exist in the Petterd Collection labelled "Berthierite, Mt. Bischoff" (eg: specimen number 448). At the Madam Melba mine, Dundas, it was discovered forming a dense compact lode, occasionally forming bunches of fine acicular crystals on siderite, and sometimes intermixed with boulangerite (with which it is often confused) and galena. It has also been recorded from a number of mines at Zeehan.

### JORDANITE

**$Pb_{14}(As,Sb)_6S_{23}$**

Jordanite has been recorded as a soft grey mineral occurring in association with tetrahedrite and sphalerite from the Electrolytic Zinc Co. mine at Rosebery.

## KEGELITE

**near $Pb_{12}(Zn,Fe)_2Al_4(SO_4)_4Si_{11}O_{38}$**

Kegelite has been recorded as occurring in lead-zinc rich limestones, Oceana mine area, near Zeehan.

## KOBELLITE

**$Pb_{22}Cu_4(Bi,Sb)_{30}S_{69}$**

Kobellite has been identified as a microscopic constituent of the Rosebery orebody.

## LEAD

**Pb**

Lead found in its native state is very rare. It is usually found as flat plates in alluvial deposits, and is also known to occur in limestone.

Petterd reported two separate occurrences of native lead. The first of two minute specimens from the South Nevada mine, Dundas, although, he does not report on how it occurred. The second was from the gossan at the Comet mine, Dundas. A specimen labelled "Native Lead, Mt. Dundas" in the Petterd collection was tested by Bottrill and Woolley (1993) was found to comprise mostly litharge and hydrocerussite.

More recently, native lead has been found as irregular grains to 1.5mm occurring in alluvial deposits at the New Henbury mine, Avoca. Alluvial grains have also been found in the Great Northern Plains, near Gladstone, and John Lynch Creek near Rosebery.

## LEADHILLITE

**$Pb_4SO_4(CO_3)_2(OH)_2$**

Petterd identified leadhillite from the Godkin and Victoria Magnet mines[18], Whyte River, several of the Dundas silver-lead mines, and at the Magnet mine. His identification was based on the pearly lustre on cleavage faces, colour, and chemical reactions.

A sample of leadhillite labelled "Heazlewood River" (the district that the Godkin is in) in the Petterd Collection, was analysed by XRD (Bottrill and Woolley, 1993) and found to contain galena, limonite, anglesite and cerussite, but no leadhillite. The Petterd sample, presumably representing the sample used for the original chemical analysis, is actually a mixture of cerussite and anglesite, and the occurrence of leadhillite in Tasmania is considered doubtful.

## LILLIANITE

**$Pb_3Bi_2S_6$**

Lillianite is a lead bismuth sulphosalt. It was first described by H.F. Keller in 1889 from material near $(Pb,Ag_2)_3Bi_2S_6$ in composition, from the Lillian mine in Colorado. Petterd records lillianite associated with bismuthinite in quartz at the Osborn Blocks, Mt Farrell, adding that it is:

---

[18] It is likely that the reference to the specimen from the Godkin Mine (1893) and the Victoria Magnet Mine (1910) is one and the same.

> "....highly argentiferous, often assaying several hundreds of ounces of silver to the ton of ore."

A specimen labelled lillianite from Mt Farrell exists in the Australian Museum, Sydney, and is currently undergoing tests. No specimen exists in the Tasmanian Museum.

Lillianite is a mineral that has been the subject of some conjecture. The original material from the Lillian mine, and similar material from Sweden, both of which were mentioned by Petterd, were found to be mixtures. The 1970 Catalogue considered the Tasmanian record of lillianite to be of 'doubtful validity', based primarily on the uncertainty of the validity of lillianite as a recognised species.

Work on synthetic lillianite by Klyakhin and Dmitrieva (1968), and Otto and Strunz (1968) confirmed the validity of the natural material from Bukuinsk, described by D.O. Ontoev (1959).

Analysis of the specimen from the Australian Museum, although not yet finalised, suggest that the mineral is not lillianite, but is a very closely related mineral.

## LINARITE

**$PbCuSO_4(OH)_2$**

Occurring as small (less than 1mm) typically blue prismatic crystals, linarite was identified, for the first time in Tasmania, on cerussite from the open cut on level 4 of the Hercules mine, Mt. Read. This material was collected early in 1997, and its identification confirmed by XRD. The uncommon copper sulphate, posnjakite, which occurs in association with the linarite, was also recorded for the first time in Tasmania.

## LITHARGE

**PbO**

Bottrill and Woolley (1993) analysed a specimen of native lead from Mt. Dundas, in the Petterd Collection, and litharge and hydrocerussite were found to comprise most of the sample.

## MASSICOT

**PbO**

Petterd recorded massicot from a number of mines including Maestrie's Broken Hill, Comet, and Adelaide Proprietary mines, Dundas; Madame Melba, North Dundas; and in limited quantity at several of the Heazlewood and Zeehan silver-lead mines.

Three specimens of massicot from the Petterd Collection have been analysed and no massicot was found to be present (Bottrill and Woolley, 1993). Sample A consisted of powdery yellow bindheimite and minor brown goethite. Sample B, yellow to orange, red and green powdery to resinous sulphur, varying from botryoidal to dendritic to finely crystallised with some small clear crystals of arsenolite. Sample C, coarse grained galena coated by rims of white cerussite, red-orange crocoite and yellow-brown mimetite in turn. Based on these analyses, the existence of massicot in Tasmania is considered doubtful.

## MATLOCKITE
**PbFCl**

Matlockite has been recorded from the Sylvester mine, Zeehan, as tabular crystals of a greenish-grey colour, and in small plates of a honey-yellow colour attached to galena from the Montana mine, also at Zeehan.

A sample labelled matlockite from the Magnet mine in the Petterd Collection (number 622) greatly resembles matlockite from the type locality (Matlock, England), with the matrix unusual for the stated locality. It was not tested by XRD due to the small number of crystals present (Bottrill and Woolley, 1993). No other matlockite specimens exist in the collection.

## MENEGHINITE
**$Pb_{13}CuSb_7S_{24}$**

This rare sulphosalt occurs as massive lead grey aggregates of prismatic habit intergrown with chalcopyrite and pyrite in quartz, and as slender striated needles of felted appearance in vughs in chalcopyrite, from the No. 8 level of the Electrolytic Zinc Co. mine at Rosebery.

## MIMETITE
**$Pb_5(AsO_4)_3Cl$**

Mimetite is not uncommon and is found at a number of mines in Tasmania where the ore bodies contained galena and arsenopyrite. Colours range from colourless to white, yellow, green, orange, red and brown, often colour zoned, and may be flat tabular or prismatic hexagonal crystals, even fibrous.

A number of different "varieties" have been described including bellite, campylite, chromiferous mimetite, and petterdite. Bellite and petterdite have been given their own entries for historical reasons.

W.R. Bell, a close friend of Petterd, provided details of an occurrence of mimetite at the Hampshire Silver mine. This, the earliest description of mimetite in Tasmania, was included by Petterd in 1893:

> "Occurs in minute bunches of crystals on the wall of a lode at the Hampshire Silver Mine. The groups of crystals are composed of aggregations of six-sided prisms, abruptly terminated at their apices, of a highly polished dark brown colour. They are of extreme rarity, and were only obtained in one portion of the lode."

Bosworth and Shelton (1978) reported that mimetite was found in one small pocket in the Adelaide mine, Dundas, as canary yellow, short prismatic to capillary crystals to 25mm "grading into vanadinite". A large piece of gossan was extracted from the lower adit in 1998 that has green, yellow and dark brown mimetite crystals to 5mm long.

Mimetite is commonly found in the gossan at the Magnet mine. It occurs as tabular to elongated hexagonal crystals and less commonly as fibrous crystal groups. The most common form is perfectly formed tabular hexagonal crystals, either brownish red or yellow, up to 2mm across.

Mimetite often occurs as brown to red flat tabular hexagonal crystals which do resemble vanadinite, and it is likely that some, if not most or all of the reported occurrences of vanadinite, are also in fact, mimetite. In addition to the Magnet mine, this form has recently been found at the Heazlewood mine, and a similar specimen in the Tasmanian Museum (Petterd specimen No. 2014) is labelled "Vanadinite - Whyte River".

Campylite is a term used for a variety of mimetite which often occurs as barrel-shaped crystals and where the chemical composition is somewhere near mid-way between mimetite and pyromorphite. Small crystals of this mineral have been recorded from the Brittania mine, Zeehan, and from near Williamsford. The Hercules mine at Williamsford has also recently yielded specimens of colourless to white mimetite to 2mm long.

### MINIUM

**$Pb_2PbO_4$**

A sample labelled minium, Whyte River, Tasmania, in the Petterd Collection, is a white shaley-looking rock with a bright red ocherous coating. It was tested by XRD (Bottrill and Woolley, 1993) and the red coating contains, in approximate order of abundance, quartz, hematite, chlorite, goethite and illite. The red colour is presumably due to hematite, there is no indication of any lead minerals present.

Petterd's description of the Whyte River material reports minium as a pulverulent coating on other lead minerals and lode-matter. He also records a dull black lead oxide from the Adelaide Proprietary mine, which he considered to either be minium discoloured with powdery manganese, or else plattnerite, a rarer lead oxide. Unfortunately, there was insufficient material for him to confirm his suspicion.

### *PETTERDITE* – NOT TO BE CONFUSED WITH THE MINERAL NOW NAMED PETTERDITE

Although a variety of mimetite, and not a separate valid species, from an historical perspective, petterdite deserves its own entry in this list.

It was first described as a new species of mineral by William Harper Twelvetrees and read to the Royal Society of Tasmania in April, 1901, and was dedicated to his friend, W.F. Petterd.

> "This apparently absolutely new chemical combination occurs in attached crystal groups in a quartz gangue containing disseminated pyrites, in the form of somewhat thin hexagonal plates, which are usually minute in size (about 5 millimetres in diameter), but occasionally reach 9mm. dia., and, still more rarely, a larger size.
>
> Macles are not rare, irregularly attached and implanted on each other, and on the matrix.
>
> Locality. – In the superficial workings of the Brittania Mine, Zeehan.
>
> It is evidently rare, and, so far as is known, confined to the locality mentioned. One remarkably fine specimen contains about 200 perfectly formed implanted crystals. The accompanying illustration fairly represents this specimen. It is an attractive mineral when in large groups, as shown, and is easily distinguishable from the more abundant sulphate and carbonate of lead. It is occasionally associated with fine groups of campylite."

The "accompanying illustration" turned out to be very important as we shall see later.

Anderson (1906) suggested that petterdite was probably a form of mimetite, based on crystallographic measurement, but no further analysis was carried out until many years later. Petterd included petterdite as a variety of mimetite in his 1910 Catalogue, based on Anderson's work, and with a similar description to that of Twelvetrees:

> "Occurs in the form of somewhat thin hexagonal plates or crystals, which are usually about 5mm. in diameter, but occasionally up to 9mm., and still more rarely of a large size. The colour is white, passing to a pale-grey on the surface. Locality: The Brittania Mine, Zeehan."

In the revised Catalogue (1970), a specimen of this mineral in the Petterd Collection, was found by X-ray study to be adamite. This specimen was described as:

> "...occurs in small groups of transparent faintly green elongate crystals which encrust gossan."

This description is markedly different from the earlier ones. The reason for this difference was discovered by Ford and Kemp (1980) while re-analysing petterdite:

> "Petterd bequeathed his collection of some 2500 specimens to the Royal Society of Tasmania who loaned it to the Trustees of the (then) Tasmanian Museum and Botanical Gardens for a period of 999 years. In the accompanying hand-written catalogue the Trustees received, are included details of four specimens of petterdite:
>
> No. 633 from Zeehan, No. 634 from Mt Read, No. 635 from Mt Read, No. 636 from Zeehan. Only Nos. 633 and 634 are now extant.
>
> X-ray diffraction studies made on specimen No. 633 showed it to be adamite. Presumably on the basis of this result, specimen No. 634 was relabelled "adamite" also. However, No. 634 has now been analysed by x-ray diffraction and is similar to specimen 622.
>
> The "type specimen" of petterdite, recognizable from the excellent photograph (Twelvetrees 1902) was found in the collection of the Museum and Art Gallery labelled as matlockite from Cromford, Derbyshire, England with the number 622. The hand-written 1910 catalogue lists specimen no. 622 as matlockite from that same locality. The source of this confusion can now only be conjecture as the mistake was made more than 70 years ago."

If it hadn't been for Twelvetrees photograph, exhibited at that Royal Society meeting almost 100 years ago, petterdite would still be considered as adamite, and not mimetite, and the "type specimen" may have been lost forever. Clark in Hey's Mineral Index (1993) incorrectly lists petterdite as a synonym of adamite, based on the description given in the revised Catalogue of 1970.

## PHILIPSBORNITE

**$PbAl_3(AsO_4)_2(OH)_5.H_2O$**

This mineral was first described from the Dundas area in 1982. There is some discussion about the origin of the type specimen. Some consider the Red Lead mine to be the source, however, according to Dr. Laurie Lawrence (pers. comm.), who has the co-type specimen in his collection, it was from the Adelaide mine. Dr. Lawrence described the unusual way that it was discovered, and how it came to be named:

> "I had obtained a suite of Dundas minerals from a person who had been collecting at Dundas some years ago. I noted that there was a greenish-grey earthy mineral on one specimen and sent a small piece to a leading German collector, Walter Khan. I indicated that this grey mineral was not identified but may be weilerite. Walter Khan sent it to Professor Walenta who found it to be a new species. It was named after a German mineralogist, Professor

> Philipsborn. I expressed my disappointment that it was not named after an Australian or after the mine, but the name had been published and that was that!"

Philipsbornite has since been found at the Red Lead mine, and also at the Linton Gold mine, Forester, in the State's north-east, as small brown grains in a weathered quartz vein, with arsenopyrite and dussertite.

## PHOENICOCHROITE

**$Pb_2CrO_5$**

Melanochroite, an early name for phoenicocroite, was a name used by Petterd (mis-spelt in the 1910 catalogue) to describe a form of lead chromate darker in colour than crocoite that was found at the Adelaide mine, Dundas. The original identification was probably a visual one based on the darker colour and may have been in error. A recent specimen from the Dundas region labelled as phoenicocroite, although "mission brown" in colour is in fact, crocoite.

## PHOSGENITE

**$Pb_2CO_3Cl_2$**

The first description of phosgenite is provided by Petterd in 1893, under the heading of "cromfordite", an alternative name given by Greg and Lettsom (1854), named after the original locality, that of Cromford, Derbyshire. This "chlorocarbonate of lead" was described by Petterd as:

> "A single example obtained ; the crystals are rectangular four-sided prisms, with the terminal edges replaced. It is very frangible, colourless, and white, with an adamantine lustre. It occurred as a small group attached to Galena with some associated Cerussite. Adelaide Proprietary Mine, Dundas."

In later references, Petterd uses phosgenite instead of cromfordite, citing fine examples from the Comet mine, Dundas, and from the Magnet mine.

A sample of phosgenite from the Dundas area in the Petterd Collection, was analysed by XRD and found to be cerussite (Bottrill and Woolley, 1993).

Another sample in the Petterd Collection, labelled as phosgenite from Magnet, actually consists of two quite different specimens. One contains a large grey, glassy, blocky, partly broken crystal in a cavity in fine-grained massive galena, with some massive to crystalline cerussite. XRD indicates the large crystal to be phosgenite, but possibly with an expanded lattice. The second specimen contains bands of limonitic gossan, granular carbonate (dolomite?), galena, and white to brown crystals to a few millimetres. XRD indicates the presence of sphalerite, mimetite, and siderite in the crystal crusts, but no phosgenite.

A specimen of phosgenite from Dundas exists in the Albert Chapman Collection in the Australian Museum, Sydney, New South Wales. This specimen, measuring 2.5 x 5 x 3cm, consists of a group of grey crystals making up about a third of the specimen.

## PLAGIONITE

**$Pb_5Sb_8S_{17}$**

The 1970 Catalogue considers the occurrence of plagionite to be invalid as studies showed that the material from the Heazlewood mine was a fine-grained mixture of galena, sphalerite and quartz. Petterd (1893) had also considered the identification uncertain.

## PLUMBOGUMMITE

**$PbAl_3(PO_4)_2(OH)_5.H_2O$**

Petterd originally reported plumbogummite as occurring as stalactitic and irregular globular forms of a pale brown colour and resinous lustre from the British mine, Zeehan.

A sample in the Petterd Collection from the Montana mine, Zeehan, was found by XRD to be a thin coating of brown smithsonite on white cerussite and galena (Bottrill and Woolley, 1993).

It has since been verified on a specimen found at the Tasmanian Smelters, Zeehan, as white pseudomorphs after pyromorphite, probably a post-mining occurrence, and has been reported from the Mount Mary mine, Cygnet, where it is earthy brown, in zincian nontronite.

## PLUMBOJAROSITE

**$PbFe_6(SO_4)_4(OH)_{12}$**

Analysis of a greenish brown to reddish brown mineral, coating or replacing mimetite on specimens collected in 1993 from the Magnet mine gossan, showed it to be plumbojarosite.

## PYROMORPHITE

**$Pb_5(PO_4)_3Cl$**

Hexagonal prisms of pyromorphite were recorded by Petterd (1910) from the Sylvester mine, Zeehan as:

> "…the largest and most perfect crystallised masses of this mineral so far obtained in this State. The crystals are intricately interwoven, the normal colour being an intensely dark-green."

Specimens labelled Sylvester mine were available on the collector market in the 1980's, however, the exact location is unclear. It is probable that the site where the pyromorphite was mined is the "Pyromorphite Lode", which, although within the boundary of the greater Sylvester mine lease, is really part of the adjoining Silver Queen orebody. Some specimens from this latter period of mining contained hinsdalite as pseudomorphs after pyromorphite.

At the Platt mine, Dundas, pyromorphite occurs as small translucent to opaque, light to dark green, hexagonal prisms, where it is often associated with bright orange crystals of crocoite, forming a very attractive combination.

It has also been recorded sparingly at a number of other mines, including other mines in the Zeehan and Dundas areas, the Hercules mine, Williamsford, the Godkin mine, Whyte River, and at the Magnet mine where the crystals are well developed, but usually small. Petterd (1910) reports that the colour range at the Magnet mine varies from milk-white to pale and dark green, yellow, and shades of a dark port-wine tint. It is possible that some pyromorphite from here is actually mis-identified mimetite.

Petterd (1893) also lists polysphaerite, which is a term for a calcium-rich pyromorphite, as occurring as minute rounded pellets, which had an internal radiating structure, of a brown colour, with a somewhat greasy appearance. This occurrence was from the Sylvester mine.

McIntosh Reid (1919) recorded "a three inch" vein of pyromorphite at Sloane's Prospect, near the Devon mine.

## SHANDITE

**$Ni_3Pb_2S_2$**

Shandite, a rare nickel lead sulphide, was first described by P. Ramdohr in 1960 from Trial Harbour, on Tasmania's West Coast. Specimens were recently collected by members of the Mineralogical Society of Tasmania, from dumps at the Nickel Reward, a few kilometres south of Remine, Trial Harbour. Shandite occurs as rims around the edges of blebs of heazlewoodite, a nickel sulphide first described from Tasmania. The dumps also yielded aesthetic specimens of crystalline hydromagnesite.

## *STEINMANNITE*

Formerly believed to be a lead antimony sulphide, steinmannite is now considered as probably a mixture of galena with small amounts of antimony and arsenic.

Petterd's report of steinmannite from the Heazlewood mine follows. He describes what should be considered as one of the more attractive occurrences of galena in the State.

> "What is apparently this mineral occurs in small but perfectly developed octahedral crystals of a tin-white colour and bright lustre. They range from 1 to 5 millimetres in diameter. In habit they are found singly or in bunches of three or four crystals implanted in cavities of the green-stained dolomitic gangue, and more rarely as small reniform masses, the surfaces of which are often studded with well-formed crystals. In the druses they are usually accompanied by bright little yellow crystals of sphalerite, and equally well-developed crystals of quartz."

## STOLZITE

**$PbWO_4$**

A number of skarn type assemblages exist at the Kara mine, near Hampshire, north-west Tasmania. The skarns occupy a trough-like pendant within late Devonian red granite known as the Housetop Granite. At the Kara No.1, ore-grade scheelite mineralisation forms an irregularly-shaped blanket draped 15-25m above the granite. Between the skarn and the granite is a tungsten-poor, quartz-epidote reaction zone. Open pit mining of scheelite has been in progress since 1977. Magnetite is also of economic importance.

Yellow-orange tetragonal platy to blocky crystals to about 8mm were found in November, 1997, by S. Dohnt on epidote and andradite from this mine. Initial XRD tests suggested that these crystals were stolzite with subsequent tests confirming only about 2% wulfenite. In mid-1998, S. Dohnt and A. Fraser excavated some more specimens, many transparent orange and exhibiting a thin square tabular habit. Unfortunately, the matrix is very friable. Most crystals and crystal groups are small, only a few mm, but one large rough single crystal is about 2cm across. This is the first, and so far, the only instance of stolzite in Tasmania. This is perhaps a little surprising, given the number of localities in the state, where both tungsten and lead occur together.

## TEALLITE

$PbSnS_2$

Teallite, a rare lead tin sulphide, was reported from the Mt. Bischoff ores by Ramdohr. Identification is uncertain.

## UNKNOWN DUNDASITE-LIKE MINERAL – SINCE DESCRIBED AS A NEW MINERAL – PETTERDITE

At the Red Lead mine, a lilac coloured mineral occurs, associated with cerussite and galena. XRD indicated a dundasite-like mineral, but with chromium. It is possibly a new mineral.

## UNKNOWN LEAD ANTIMONY SULPHATE

Petterd (1910) described an alteration product of "zinkenite" from the Magnet mine, as a possible new mineral, allied to lamprophanite, a lead sulphate of uncertain composition. His description of this possible new compound follows:

> "In its *(zinkenite)* fractures and joints there occurs a peculiar secondary mineral, which is exclusively derived from its decomposition. This secondary mineral assumes the form of very small discs composed of divergent milk-white spicules, which are commonly clustered together in radial form. They have a bright shining lustre, and hardness of about 1.5. They are closely attached to their base, and of such extreme tenuity that it is practically impossible to secure enough material for a satisfactory analysis, A minute quantity before the blowpipe gave the qualitative reactions for sulphur, antimony, and lead, with $H_2O$. It appears to be a basic sulphate of the metals mentioned, and is in all probability, a new compound closely allied to lamprophanite."

## UNKNOWN LEAD CHROMIAN MANGANESE OXIDE

An unknown lead chromian manganese oxide (or possibly a lead manganese chromate), possibly a new mineral, occurs as masses of small black needle-like crystals on coronadite from the Red Lead mine.

## VANADINITE

$Pb_5(VO_4)_3Cl$

This mineral usually occurs as red to brown tabular hexagonal prisms and has been recorded from the Magnet mine, Bells Reward, Whyte River and Heazlewood mines, and from the Hampshire Silver mine. Vanadinite was also described from one small pocket in the Adelaide mine, Dundas (Bosworth and Shelton, 1977), as yellowish-brown to red crystals to 3mm, grading into yellow mimetite.

The occurrence of vanadinite, including the arsenatian vanadinite known as endlichite, at the Magnet mine is considered doubtful as a number of tests have shown the mineral to be mimetite. No recent analysis has been undertaken on specimens (that are visually similar to those from Magnet) from the other mines, to determine if they are, in fact, vanadinite.

## VAUQUELINITE
**$Pb_2Cu(CrO_4)(PO_4)OH$**

A sample labelled "Vauquelinite, Queen of the Earth, Scamander River" in the Petterd Collection, was analysed by XRD (Bottrill and Woolley, 1993) and it was found to contain quartz-sulphide ore with a poorly crystalline yellow-green coating. XRD indicates the coating to consist of anglesite and a jarosite or beudantite type mineral.

Petterd's description of vauquelinite is of siskin-green colour, amorphous, and dull in appearance, from George's Bay and from the Adelaide Proprietary mine, Dundas. An earthy lemon-coloured mineral on a tabular crocoite specimen from the Dundas area, had all the appearance of vauquelinite from the crocoite locality of the Ural Mountains in Russia, but was found to be hidalgoite (Lawrence, 1977).

## WULFENITE
**$PbMoO_4$**

There has been, for many years, doubt about the existence of the Hampshire Silver mine and of the range of rare and unusual minerals recorded from there. The list of minerals includes erythrite (a cobalt arsenate), eulytite (a bismuth silicate), strontianite (a strontium carbonate), and wulfenite. Noldart (1969) did find the mine, but found little evidence of mineralisation. Members of the Mineralogical Society of Tasmania rediscovered the mine in January, 1999, and access to it proved extremely difficult, not only due to thick natural vegetation regrowth, but also because of dense thickets of gorse. Mineralisation appeared to be limited to massive magnetite, minor fluorite and sulphides, and the zeolite, stellerite.

Exploration at the Hampshire Silver mine, the only recorded location for wulfenite in Tasmania, had begun in 1877, but little was recorded about the mineralogy for the first few years. W.R. Bell, who incidentally, is attributed with discovering this mine along with many others in north-west Tasmania, provided a number of references in general correspondence to the Van Dieman's Land Mineral Company Ltd. (VDLM Co. Ltd.), including in June of 1887 (from Noldart):

> "...partial yellow coating which is either Molybdine or Molybdate of Lead."

According to Petterd, wulfenite was first described from the Hampshire Silver mine by the eminent Victorian mineralogist, George Ulrich[19]. Ulrich had been invited to visit the recently discovered Mt Bischoff mine in March, 1874, and would no doubt have made contacts while in Tasmania. The description of this wulfenite is provided by Petterd for the first time in his 1910 Catalogue, quoting Ulrich:

> "Occurs, though rarely, in the lode of the Hampshire Hills Silver Mine, associated with very fine-grained galena and sphalerite. The crystals are of a brownish-yellow colour, and square, thin, tabular, with rounded basal plane, and hemihedral planes of the octagonal prism are distinctly recognisable round the edges."

This presents us with some problems. The first is that locating the paper mentioned by Petterd in relation to Ulrich, "Minerals of Tasmania", proved to be very difficult. Eventually, a paper so-called

[19] George Ulrich was invited to visit Mt Bischoff in 1874 in the role of a consultant mining geologist and engineer (Groves, et al, 1972), At the time of his visit however, he was engaged as the Curator of Mineral Collections in the Industrial and Technological Museum and had been in this role since 1870, according to the biographical notes provided in the facsimile edition of Ulrich's Contributions to the Mineralogy of Victoria. Ulrich also collected specimens from the Hampshire area and from the Australasian Slate Quarry at Back Creek in the northeast of the State.

was located in a German publication in 1877, Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefaktenkunde. However, this paper does not mention wulfenite at all. A mystery indeed.

It is obvious from this description (if it was Ulrich that provided it) that Ulrich had access to the wulfenite specimen, which must have been found very early in the life of the mine (Ulrich had accepted the position of Professor of Mining and Mineralogy at the University of Otago in New Zealand in 1878, the year following the commencement of mining). It is unlikely that the same specimen was acquired by Petterd from Ulrich, however, he may have acquired one from his friend, W.R. Bell. This brings us to the next problem. Why did Petterd not describe in his catalogue, a specimen from his own collection, labelled "Wulfenite, Emu River, Tasmania"? The Hampshire mine is on the Emu River.

This specimen, in the Petterd Collection, was examined by Bottrill and Woolley (1993), and contains fine blocky orange crystals on a white schistose matrix. Doubt was cast on its provenance however, as the matrix indicated that it had most likely originated from Broken Hill, New South Wales, an origin supported by the presence of blue quartz and pink garnets.

Very little information on the type, size, mineralogy, grade or production of the Hampshire Silver mine, is available with the only description of the lode channel given by Noldart (1969) quoting Rowe (1886):

> "... The adit has been extended on the course of the lode for a distance of 27 fathoms. The first 23 fathoms the lode is in granite, and for the last 4 fathoms it is hard hornstone and felsite rock. The driveage on the load which is about 18 inches wide, when in the granite showed very favourable indications. Yielding in a gangue of quartz and hornblende, native silver, galena, blende and arsenical pyrites."

This description tends to support the view of Bottrill and Woolley. The deposit is later described by Whitehead (1990) as a small fissure load containing native silver with bismuth and molybdenum minerals in the north-western part of the (Housetop) granite. The same granite is associated with a number of skarns, including the Kara mine where stolzite has recently been recorded.

A hand-written catalogue of the Petterd Collection contains three Australian wulfenite specimens, number 2265 and 2267 from New South Wales, and number 2266 from Tasmania. Specimen number 2265 is most likely from the Junction mine, Broken Hill, and does, in fact, closely resemble a specimen of wulfenite in the collection of Milton Lavers of Broken Hill, a photograph of which appears in the Broken Hill issue of the Australian Journal of Mineralogy. Specimen number 2266 is the one examined by Bottrill and Woolley. Specimen 2267 consists of brownish square thin tabular plates, but the matrix of this specimen also suggests an origin in Broken Hill.

On the basis of this evidence, doubt must be cast on the occurrence of wulfenite in Tasmania.

## ZINKENITE

**$Pb_9Sb_{22}S_{42}$**

Zinkenite was originally described as a massive, semi-fibrous, metallic, steel-grey mineral, occurring plentifully at the Magnet mine. It was later found to be boulangerite and therefore invalidated in the 1970 Catalogue. It has since been reported as occurring in magnetite in the St. Dizier tin skarn, near Granville Harbour on the West Coast.

“The gossan outcrop of silver-lead or copper lodes is of great interest to the mineralogist, as it is from this that he secures many of the most beautiful minerals occurring in nature, both as regards attractive colouration and crystallisation. It is in this laboratory that the oxysalts have their origin, and form numerous homogenous chemical combinations known as mineral species. The beautiful chromates, phosphates, arsenates, carbonates, and other secondary minerals are almost confined to the zone of oxidation, and would be practically unknown but for the influence of this, **Nature’s alchemist**.”

W.F. Petterd

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