

## GEORGE HENRY FREDERICK ULRICH (1830–1900): PIONEER MINERALOGIST AND GEOLOGIST IN VICTORIA

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**ABSTRACT:** George Henry Frederick Ulrich (1830–1900) was educated at the Clausthal Mining School in Germany and arrived in Victoria in 1853. After a short period on the goldfields, he was employed on the Mining Commission and then on the Geological Survey of Victoria until its closure in 1868. In 1870 he was appointed Curator and Lecturer at the newly established Industrial and Technological Museum of Victoria. In 1878 he was appointed inaugural Director of the Otago School of Mines, New Zealand, a position he held until his death in 1900. His legacy includes detailed original maps of central Victorian goldfields, the foundation of the state's geological collections, and among the first accounts of Victorian geology published in German periodicals, until now little known. As the only scientist of his times in Victoria with the qualifications and expertise to accurately identify and properly describe minerals, he provided the first comprehensive accounts of Victorian mineralogy, including the identification of the first new mineral in Australia, which he named maldonite. His contribution to mineralogy is recognised by the species ulrichite. Ulrich was universally respected for his scientific achievements and highly regarded for his personal qualities.

Of all the German-born scientists who were making their mark in mid to late nineteenth century Melbourne, George Henry Frederick Ulrich is probably the least well known. Yet he made substantial and lasting contributions to our knowledge of the mineralogy and geology of the colony, from the time he arrived in 1853 to the time he left for New Zealand in 1878. While some aspects of his life, both in Victoria and New Zealand, have been covered in previous biographies (Anon. 1878; Dunn & Mahony 1910; Hoare 1976; Watters 1993; Watters & Mason 2000), a more detailed examination remained as unfinished business. The 2014 symposium organised by the Australian Association of Humboldt Fellows and the Royal Society of Victoria on the topic of early German scientific contributions to Victoria provided both the incentive and the opportunity for the authors to present information on Ulrich compiled over several decades. This paper is the result.

### 1830–1853: FAMILY AND EDUCATION IN GERMANY

George Ulrich was born on 7 July 1830 in the town of Zellerfeld, in the Harz Mountains, one of the most significant mining regions in the German-speaking realm of the time. Mining for metals such as silver, copper, lead and iron commenced in the region in the eleventh century and reached its peak, in particular for silver, between the sixteenth and mid-nineteenth century (Ließmann 2010). He was the second child of Friedrich Engelhard Ulrich and his wife, Catharine Elizabeth (nee Herrstell), after a daughter, Marie Louise Sophie, born on 5 March 1827. He was baptised Georg Heinrich Friedrich at St Salvatorius

Lutheran Church, Zellerfeld, on 15 August 1830 in the presence of his grandfather, Johann Friedrich Ulrich, Georg Friedrich Herrstell (presumably an uncle), Georg Andreas Herrstell and Johan Heinrich Tunk (Figures 1 and 2). This is the same church where his parents had married on 16 January 1826. Life for George's family had considerable setbacks, as his father was a pensioned former miner who was blind, and his mother died on 30 March 1831 when she was only thirty and George was just nine months old. His father remarried on 26 November 1833, to Christine Sophie Wiebe, and they had six children before Friedrich died on 13 March 1844 of miner's phtisis, aged fifty. On Easter day (14 April) a month later, George was confirmed at St Salvatorius Church, with the confirmation record showing that he received good marks for discipline, religion and school attendance. However, he was regarded as unsteady, and although he had much intellectual ability, there was a question over whether it would be used advantageously.<sup>1</sup>

Like most of the population of Zellerfeld, the members of the Ulrich family were involved in mining or industry associated with it. His grandfather Johann Friedrich Ulrich was a battery grate maker and his father was also well known as the author of a long poem in the Clausthal dialect, *Es Barbrig ofn Ewerharz* (Mining in the Upper Harz), published in Clausthal in 1841 (Seiffert 1993). Unsurprisingly, mining was in George's blood as well, with his interest perhaps heightened by the beautiful mineral specimens produced from the local mines.

After attending primary school, George was educated at the Royal Gymnasium (now Robert Koch Gymnasium) at Clausthal, the town adjoining Zellerfeld. Nothing is known of his schooling there, but he must have done sufficiently

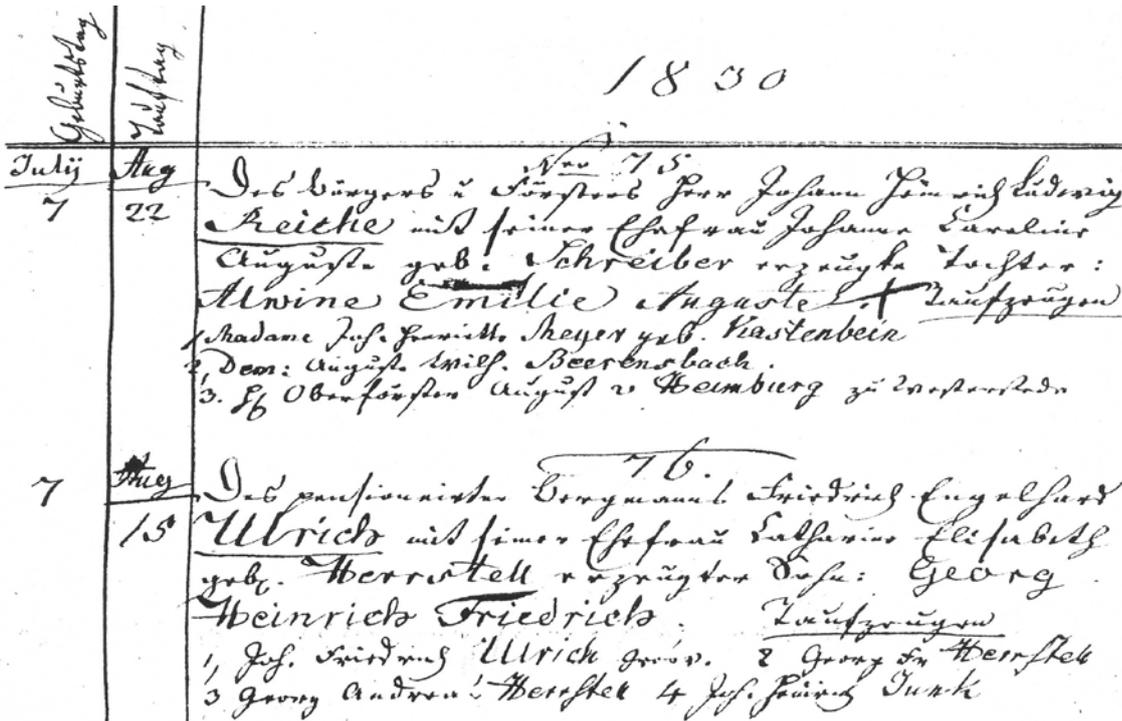


Figure 1: Birth record (lower entry) for George Ulrich in St Salvatorius Lutheran Church register, Zellerfeld.

well to be eligible to go on to the Mining School at Clausthal (Figure 3). The mining school had been founded in 1775 as a simple school to educate miners, but in 1810 the standard was raised to that of a mining college in order to train mining engineers, geologists, surveyors and other mining professionals (Müller 1988). Ulrich began his course at the school in October 1847 and not long after, in May 1848, joined the mining students of the school in establishing a society, Berg- und Hüttenmännischen Vereins Maja (Mining and Metallurgical Society Maja), with the aim of promoting scientific discussion and mutual improvement among its members.

The standard course consisted of two levels, I and II, each involving two years of study, not just in classes but also with practical experience gained by working in mines and in the ore-dressing and smelting works. Among the subjects

George studied were Spherical Trigonometry, Stereometry and Conical Sections, Technical Chemistry, Oryktognosy (mineralogy), Geognosy (geology), Mining Studies, Metallurgy, Theoretical Surveying, Blowpipe Analysis, Engineering Drawing and Perspective, Freehand Drawing, German Writing Exercises, Mathematical Examination, Elementary Mathematics, Physics and Assaying. At the completion of his course, George's academic record states that he had studied diligently and with good success in both quantitative and blowpipe analysis and had obtained the II degree of the first class with distinction.<sup>2</sup> No doubt his academic success was due substantially to the quality of his lecturers, who included Friedrich Adolph Roemer (1809–1869) (Figure 4), Bruno Kerl (1824–1905), Hermann Koch (1814–1877), Eduard August Georg Borchers (1815–1902), Friedrich Zimmermann (?–1881)



Figure 2: Thomas Darragh inspecting birth register, St Salvatorius church, Zellerfeld, September 1991.



Figure 3: The Bergakademie at Clausthal.



Figure 4: Friedrich Adolph Roemer (from Müller 1988).

and Christian Ludwig Schoof (1810–1891) (Horn 1907). Zimmermann and Schoof probably taught Ulrich at the Royal Gymnasium, while Roemer was to remain a close confidante of George for years afterwards (Müller 1997).

After graduating in October 1851, Ulrich worked for some time as a common miner. Employment by then was becoming hard to obtain, as mining in the Harz was declining, so opportunities elsewhere were attractive. According to one account (Anon. 1878), Ulrich accepted an offer from General Otto Phillip Braun (1798–1869) of a post of mining superintendent in Bolivia in 1853. Braun had extensive mining interests in Bolivia and sent German miners and metallurgists to that country to assist in working the mines. Why Ulrich didn't go to Bolivia isn't known. It may have been because political upheavals allegedly resulted in Braun losing all his mines (Anon. 1878), although there is no evidence for this happening.<sup>3</sup>

Concerned at the decline in mining in the late 1840s, the Hanoverian Finance Ministry had set up a fund to encourage miners and their families to emigrate, especially to South Australia, where the copper mines needed skilled workers. The emigrants were to be given interest-free loans to assist with passage money and setting up in their new country (Vollmer 1993, 2001). The fund was administered by the Royal Mining and Forestry Board in Clausthal. On about 18 March 1853, Ulrich and another twelve people petitioned the board to grant them funds to cover the cost of the journey from their homes to the port, because they didn't have the means to do so themselves. The response is not known, but all those who signed the document seem to have eventually emigrated, though not all on the same ship.

On 22 March 1853, Ulrich and Hermann Leuschner, a fellow student from Zellerfeld, applied to the board for a cash advance for one year to cover their costs of migrating to South Australia. They stated that following repeated public announcements by the board about settling in South Australia, they were determined to join the next party of local workers. They had reported to Oberbergamtsassessor Neuss, who was made responsible by royal authorities for the business of emigration. He advised them to prepare to leave, as the journey would take place within the next six weeks and that, as single persons, they would certainly receive preference over all others; however, he could only promise them free passage. Acting on this advice and because time was pressing, the pair made all possible preparations and their parents spared no expense in providing them suitably for such a journey. However, at the last minute they were informed that the costs of passage would not be paid, which put them in a great dilemma, especially as they couldn't procure the necessary money from their own means. As they had made up their mind to emigrate and make their way in the world, they petitioned the board to provide them with an advance or contribution to the defrayal of the cost of passage to South Australia from one of the official funds, in return for which they promised, on their word of honour, to endeavour to make restitution of the advance as soon as possible. On 26 March they received notice that their request had been unsuccessful,<sup>4</sup> yet somehow Ulrich must have raised the passage money. Before his departure, George and others inserted a farewell advertisement in the 7 May 1853 issue of the *Öffentliche Anzeigen für den Harz* (Seiffert 1993). Along with two other Harz miners, Carl Walter and Hermann Leuschner, Ulrich departed Hamburg on 17 May aboard the *Wilhelmsburg* and arrived in Melbourne on 3 August 1853. He is said to have first been given employment in a brickyard at Richmond by a fellow countryman, Böhmer,<sup>5</sup> but after three months he left for the goldfields of central Victoria, purchasing a mining licence in January 1854.<sup>6</sup> His experiences there were to transform his life.

#### 1854–1857: EXPLORING AND OBSERVING THE VICTORIAN GOLDFIELDS

Until recently, details of George Ulrich's life on the Victorian goldfields between 1854 and 1857 were sketchy, limited to references to his visits to goldfields such as Forest Creek, Maryborough and Daisy Hill (between Talbot and Maryborough). This information had probably come from Ulrich directly, in conversation with writers at the time. However, a series of extensive notes (Ulrich 1859a, 1862, 1864a), recently translated by one of us (TAD), that Ulrich had sent to colleagues in Germany, including his former lecturer Friedrich Roemer who arranged their publication,

reveal that he travelled widely through Victorian goldfields and made astute observations as he went, most likely recorded meticulously in diaries and field notes. Not only did he comment on mining practices and the hardships faced by miners, but he also described and classified the main geological formations, the quartz reefs and the minerals found at various localities. He even theorised on the origin of gold itself. At the beginning of the 1859 essay, he set the gold discoveries in their social context, being especially critical of the entrenched system of squatting and speculating in land at the expense of the diggers, as well as the administration of mining laws through the licensing system. These comments mark Ulrich out to be a social democrat, whose sympathies lay squarely with the common man.

The remainder of the 1859 essay ranged widely and it is worthwhile detailing some of his more important observations. He first subdivided the bedrock into plutonic and volcanic rocks (granite, syenite, feldspar porphyry and basalt) and sedimentary rocks. He noted the physiographic features of the granites and briefly described the textures and minerals in those found at Tarrengower (Maldon),<sup>7</sup> Dandenong Ranges and Mt Martha. 'Syenite' with attractive green, red and white colouration (sic) was found only at the Daisy Hill diggings (Figure 5). The widespread basalts received considerable attention, and Ulrich noted the distinction made by Alfred Selwyn, the Government Geologist, between the older (pre-Tertiary) and the younger (post-Tertiary) basalts. Ulrich was obviously familiar with the landscape of the volcanic plains west of Melbourne and contrasted volcanoes with 'correct volcanic shape', i.e. with a definite crater on their summit, such as Jim Crow (Mt Franklin), Mt Elephant and Mt Napier, with others from the Sunbury area, such as Mt Holden, Mt Kororoit, Mt Aitken and Red Rock, which seemed to be 'partly solidified lava blisters, partly scoria cones'. He also described the minerals found in basalt, with a significant account of the discovery of native zinc in basalt near Melbourne that reinforced the original paper by Becker (1857) and later discussed by Birch (2001). For the so-called stratified rocks, Ulrich subdivided them by comparison with the 'strata of Wales', using a scheme proposed by Selwyn and McCoy.<sup>8</sup> Hence, older greywackes and slates containing fossil *Lingula*<sup>9</sup> he referred to as 'Bala beds', nowadays the Ordovician bedrock of most of the central Victorian goldfields. The younger Silurian sedimentary rocks were referred to as the May Hill sandstone and the Wenlock shales and sandstones, best represented as the folded sequences near Melbourne and notably poorer in gold-bearing quartz reefs and alluvial deposits than the Bala beds. These stratigraphic names have long been dispensed with, but they nevertheless represent the earliest attempts

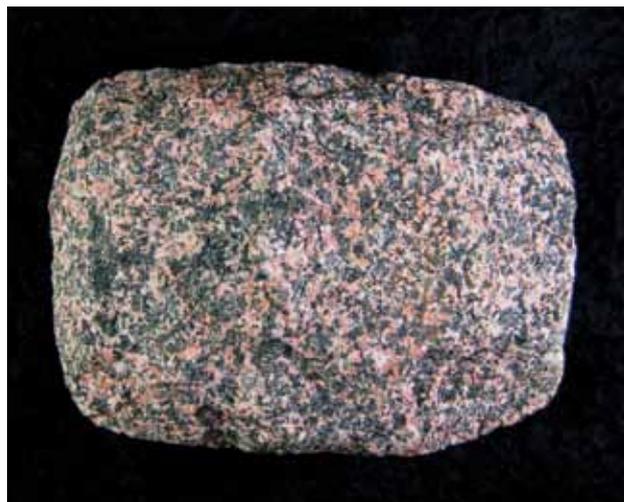


Figure 5: Specimen of 'syenite' (since identified as monzonite) from Daisy Hill, near Talbot. The specimen may have been collected by George Ulrich. Museum Victoria E6192, 10.5 x 7.5 cm. Photograph W. Birch.

at subdivision of the formations within what is now known as the Melbourne Zone (VandenBerg et al. 2003).

Ulrich was clearly fascinated by the nature and origin of the gold-bearing quartz reefs and he made numerous observations. For example, he remarked that most of the reefs lay in the strike of the sedimentary rocks, but that they were irregular along strike and at depth, making for unpredictable mining. He referred to examples at Maryborough and Bendigo, where reefs tapered and disappeared only to reappear along strike or at depth. Features of quartz reef systems at Tarrengower, Kyneton, Maryborough and Bendigo were discussed in detail, as he attempted to explain their origin and account for the unpredictability of the distribution of gold within them. He noted the great purity of Victorian gold and described its various crystal forms in some detail, along with its distribution within reefs, including the occurrence of nuggets. This led to some conjecture on Ulrich's part on how the gold and quartz were emplaced. He rejected the theories of molten and fluid emplacement and instead hypothesised on electromagnetic transfer of atomic gold from depth through the quartz mass, but left the question open until more evidence was forthcoming. The relative efficiencies of the various methods of extraction of gold from the crushed quartz also received his attention. Ulrich's interest in minerals is evident from the detailed descriptions of those found with the gold, taking up the last section of his 1859 essay (Ulrich 1859a), as well as most of the note he sent to Friedrich Roemer in 1864 (Ulrich 1864a). Apart from a brief note on pharmacosiderite and scorodite from Tarrengower (Ulrich 1857), these constitute the first published descriptions of Victorian minerals, predating his more significant 1866 and 1870 contributions.

### 1858–1869: FIELD GEOLOGIST WITH THE GEOLOGICAL SURVEY OF VICTORIA

By 1856 Ulrich had returned to Melbourne and on 27 July<sup>10</sup> he was appointed to succeed Jacob Braché (1827–1905) as secretary and draughtsman to the Mining Commission, following an introduction by Ludwig Becker (1808–1861) to Professor Frederick McCoy (1817–1899), who was one of the three commissioners. The other commissioners were Alfred Selwyn (1824–1902) and Joseph Anderson Panton (1831–1913). The Victorian Government had established the commission in May 1856 in order to enquire into, amongst other matters, the mining resources of the Colony of Victoria. Ulrich resigned from this position in August 1857, attracted by the prospect of an appointment with the Geological Survey.<sup>11</sup> The survey was under the directorship of Alfred Selwyn, who had been appointed as Mineral Surveyor in the Colony of Victoria in 1852. By the late 1850s, Selwyn was recruiting a group of talented geologists in order to expand his program of Quarter Sheet mapping, and Ulrich clearly had the required skills and experience to be appointed to the rank of Field Geologist in September 1857, on a salary of £450. He was stationed at Malmsbury in late 1857,<sup>12</sup> then at Elphinstone, the base for mapping Quarter Sheets 13 SW (Elphinstone) and 9 NW (Malmsbury and Taradale), when he was elected to membership of the Mining Institute of Victoria on 2 December 1858.<sup>13</sup> On 4 March 1857 he was elected to membership of the Philosophical Institute of Victoria, the forerunner of the Royal Society of Victoria, and he remained a member of the Royal Society until his death. He was naturalised as a British citizen on 29 July 1858.

For much of 1859, Ulrich was in camp near Castlemaine, probably at the locality known as Yapeen, where he and another Geological Survey geologist, Christopher D'Oyly Hale Aplin (1819–1875), were engaged in mapping the Castlemaine Quarter Sheet (14 SE). In October, they were visited by a talented young German-born geologist, Ferdinand Hochstetter (1829–1884), who was on his way back to Europe after spending time in New Zealand and was probably keen to see the famous Victorian goldfields and meet staff from the Geological Survey. Hochstetter kept a detailed notebook, including geological sketches, which provides some interesting details about his contact with Ulrich during his visit (Darragh 2001). After arriving in Melbourne on 18 October 1859, Hochstetter was hosted by Ferdinand Mueller (1825–1896), who introduced him to most of the influential Germans and Austrians living in the city. On 25 October, Hochstetter travelled to Castlemaine by train and coach, then on the following morning walked to Ulrich and Aplin's camp, about one and a half miles from the town. He observed a 'plain homely establishment', with four huts, a library and all necessary belongings,

and he greatly enjoyed his stay there, even though it was only for a few days. It seems that Ulrich and Aplin were generous with their time in showing Hochstetter around, probably greatly welcoming the opportunity to break the monotony of mapping. Ulrich in particular would have welcomed the chance to discuss geological matters with another young German-speaking geologist and probably provided a lot of information for Hochstetter, who also made his own observations.<sup>14</sup> On 27 October the three men visited Specimen Gully, which was an excellent example of rich alluvial gold being shed from a quartz reef crossing the gully upstream. Ulrich and Aplin had a share in the Specimen Gully Quartz Mining Association, the company working the reef. They also visited the rich alluvial deposits in 'Tertiary conglomerate' at Pennyweight Gully and Diamond Hill, where Ulrich and Aplin had a puddling machine. Gold deposits weren't their only target; volcanic hills in the region were of interest to Hochstetter, so on 28 October the trio took a trip to Mt Consultation, a lava volcano near Castlemaine, where Hochstetter described the basalt outcrop at the summit. He returned to Melbourne on 7 November before departing for Europe, via Western Australia, a few weeks later. His visit must have had a lasting impression on Ulrich, because he wrote to Hochstetter from Strathloddon on 20 November 1860, with a detailed discussion on the nature of the various gold-bearing 'Tertiary drifts'. He also described some of the latest mineral discoveries, including diamonds from the Ovens district, emerald-green zircons from the Loddon River, and a puzzling new zeolite from Melbourne (Ulrich 1862).

Throughout the 1860s, Ulrich spent most of his time encamped at localities in central Victoria, including at Malmsbury and Strathloddon during 1860 and 1861. From 1861 to at least the end of 1863 he and Aplin were camped at Yapeen, which was probably the base for their Guildford (15 NE) Quarter Sheet, as well as the Castlemaine sheet (Ulrich & Aplin 1863). Their mapping work was very highly regarded, with the Castlemaine sheet in particular (Figure 6) receiving high praise from Alfred Selwyn, Director of the Geological Survey, for 'the greatest precision and minute accuracy of detail' (Selwyn 1862: 3).<sup>15</sup> It was from the Yapeen camp that Ulrich wrote several times to Reverend William B. Clarke (1798–1878), a leading Sydney-based identity in colonial science in the nineteenth century, with a particular passion for geology. Like the Hochstetter diary notes, these letters are revealing not just for what Ulrich was doing at the time of writing, but also for the opinions he offered on individuals and events (Moyal 2003). Ulrich had the only known copy at that time of Ludwig Leichhardt's monograph *Beiträge zur Geologie von Australien*, published in Halle in 1855. He had been

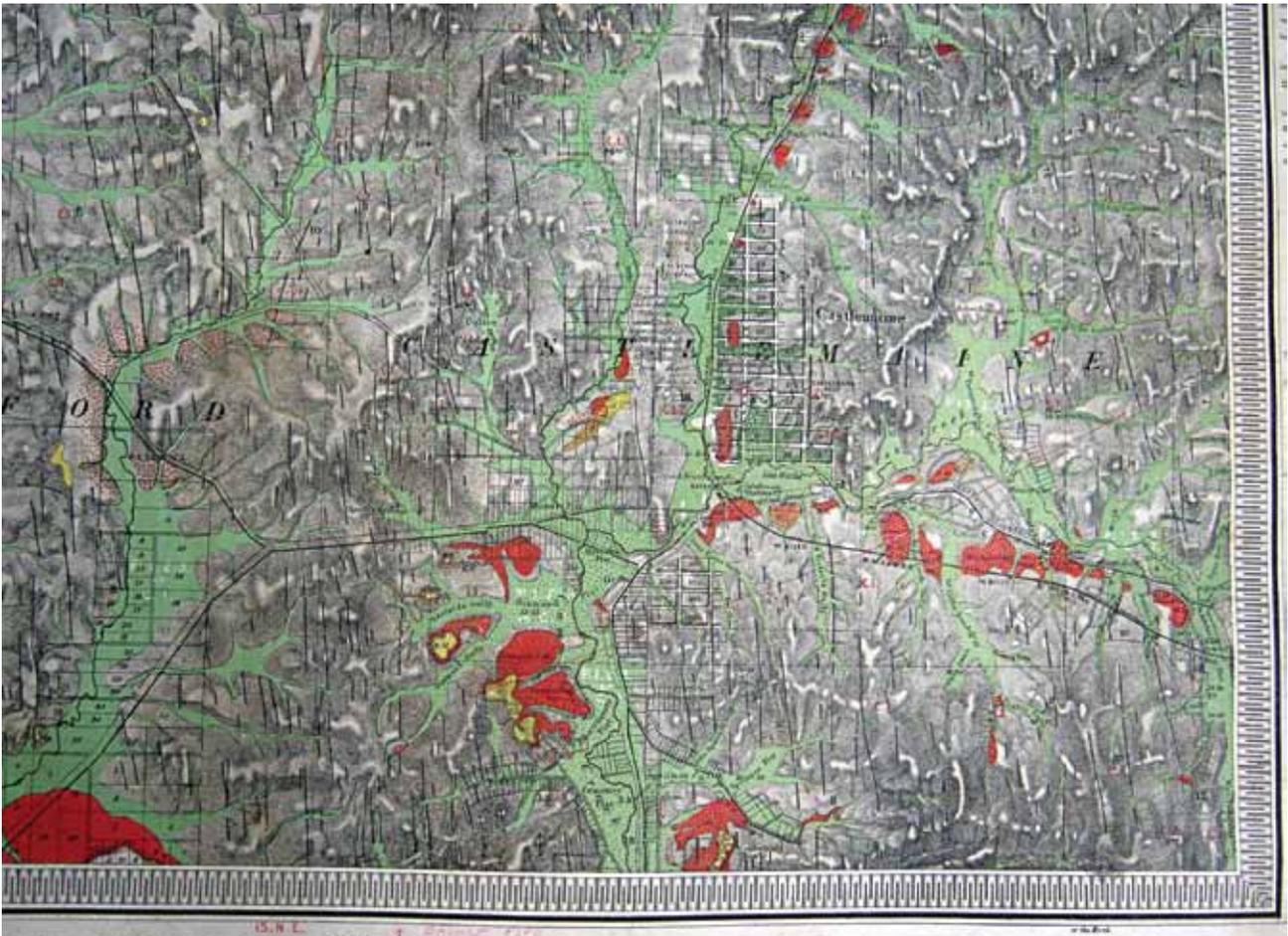


Figure 6: Part (SE quarter) of the Castlemaine Quarter Sheet (14 SE) surveyed by Ulrich and Aplin and published in 1861.

engaged by Clarke to translate the work of the intrepid but ill-fated German-born explorer, who had disappeared in central Australia in 1848. Ulrich laboured over the translation during his leisure time but found it difficult to make much progress due to his workload of mapping and consulting, which made him tired.<sup>16</sup> By November 1861 the tragic outcome of the Burke and Wills expedition, sponsored by the Royal Society of Victoria, was known to all; however, Ulrich took a more measured view than the rest of the community. In his opinion, ‘the sad occurrence has more its cause in wrong, yet at the same time quite excusable, reasoning and unlucky incidents than in real neglect on the part of anyone. People are in such instances only too apt to judge by results, forgetting the connecting chain of circumstances from which the former arose.’ Ulrich also told Clarke that Alfred Selwyn and Richard Daintree (1832–1878) had visited the Yapeen camp in the previous week on a photographic tour of the goldfields. Daintree had taken a panorama of six ‘especially good’ pictures of the great Chinese encampment.<sup>17</sup> It appears that Ulrich was quite taken with this idea of using photography for geological purposes, as he later noted (Ulrich 1864a) that he had made ‘a number of very nice photographs’ at the suggestion of Mr Selwyn, who hit on the idea of

providing each field geologist with a camera to enable them to photograph geologically remarkable features.

Another project taking up Ulrich’s leisure time was his work on improving the efficiency of extraction of gold from sulphide-bearing quartz, in preparation for lodging a patent.<sup>18</sup> He was using quartz reefs at Clunes as the source of ore material for his experiments, noting that up to 200 ounces of gold in pyrite was lost each week from crushing quartz.<sup>19</sup> He also expressed some frustration at the monotony of the local geology, consisting only of ‘Silurian, basalt and gold drifts’. An added frustration arose from the requirement that the geologists had to spend most of their time doing topographic surveying, in the absence of any topographic base maps.<sup>20</sup> By October 1863 he was still based at Yapeen and had spent most of his leisure time over the previous nine months developing his patent.<sup>21,22</sup> It had been ‘secured’ only in the previous week and already had received favourable publicity.<sup>23</sup> With that out of the way, he was able to finish translating Leichhardt’s book, although he noted that it ‘wants to be written out again in proper English’.<sup>24</sup> Ulrich also took aim at Frederick McCoy, perhaps spurred on by the release of the 1862 Mining Royal Commission’s report:<sup>25</sup> ‘What displeases me with McCoy is his obstinacy and want of fairness. He will

never give in and always puts his untried and ill-considered crochets (sic) forward. So lately again as one of the Royal Commissioners in the evidence on the auriferous character of the quartz reefs at greater depth. The press has however given it to him in full measure.<sup>26</sup> Ulrich took time off from mapping at intervals in order to visit mines at St Arnaud and Landsborough, as he prepared several reports that were published in Parliamentary Papers (Ulrich 1864b, 1866a).

By 1864 Ulrich and Aplin had completed surveying and mapping in the Daylesford district, which resulted in the publication of the Yandoit (=Franklinford) Quarter Sheet (15 SE) in 1866. By late 1864 Ulrich had shifted camp to Tarrengower in order to map the region centred on the Maldon goldfield, which was being vigorously worked. While they were camped there, in 1864, Ulrich was shown samples of an unusual black metallic mineral from the Nuggetty Reef by the mine manager, Mr Salter (Ulrich 1870). Using his skills with the blowpipe, he determined it to be an alloy of gold and bismuth, then provided the Geological Survey's assayer, James Cosmo Newbery (1849–1895), with several specks of the mineral to analyse. The results confirmed for Ulrich that 'this ore, as a natural product, is quite new to science and it is therefore proposed to name it "Maldonite" after the locality of occurrence'. His identification, while crude by today's standards, has nevertheless stood, and maldonite is recognised as the first new Australian mineral to be described (Ulrich 1869, 1870, 1875d).

Aplin moved back to Melbourne in June 1863 as Acting Director of the Geological Survey during Selwyn's leave of absence in England, then resigned from the survey in May 1865, upon which Ulrich was promoted from third class to second class on 17 May and his salary increased from £450 to £516/13/4. Aplin's replacement at Tarrengower was Henry Y.L. Brown (1843–1928), who joined Ulrich's camp in August 1865. In the meantime, Aplin had offered a budding young geologist, Edward Dunn (1844–1937), a position as foreman on seven shillings a day, and the newcomer was welcomed by Ulrich on his arrival by coach at Maldon on 1 November 1864, which happened to be his twentieth birthday. Ulrich made an immediate impression on Dunn, who would later write 'that he was a warm true friend from that day until his death and of whom I cherish the warmest and most affectionate memory'.<sup>27</sup> Dunn provided some interesting detail of life at the camp, which was at the base of Pigeon Hill, facing Mt Tarrengower. The daily routine began promptly at 9 am after breakfast and finished at 5 or 6 in the evening. The work was hard, especially as much of it involved mapping by compass and pacing, and there were no annual holidays at that time, only odd days through the year. Dunn's duties included collecting hand specimens of rocks, which had to be of a specific

size and thickness. If a sample didn't measure up to his specifications, Ulrich would merely look at Dunn and throw the rock back over his own shoulder.

One of the most significant events that affected Ulrich's life occurred only three weeks after Dunn had arrived at Tarrengower. As Dunn later described it:

Ulrich was out in the field and in the middle of the morning I was at the well or rather spring about 200 yards in front of the camp when I saw a wreath of smoke and before I could get back the flames were near the tents. I fought them and was surprised to see another man fighting them near me but it was not time to ask questions. Presently Ulrich's tent caught fire. I rushed in to save what I could and rescued a microscope and accordion but the door banged to and I had difficulty getting out. The back of my hand and my neck were scorched and now the tent was a veritable furnace for the books fell and opened and the heat was terrible. £400 worth of books and instruments were burned and the whole countryside was strewn with the leaves of the burnt books. It was the 22nd of November and early for bushfires. Ulrich came back early to find the camp burnt out and his collections and books gone. He was much distressed because his notes and manuscripts were also destroyed and he went to Melbourne for two or three weeks.<sup>28</sup>

The fire had been started by a splitter named Ebenezer May, who lit his pipe in the bush near Maldon and threw away his match when it was still alight. Despite giving himself up to police, he was charged and sentenced to one month's hard labour in Castlemaine gaol.<sup>29</sup>

The 1865 summer was particularly hot, and while Ulrich and Dunn mapped the Charlotte Plains area to the west of Maldon together, lack of water was often a problem. They had to rely on finding wells and springs, as the Loddon River was polluted with dead sheep. The Tarrengower (Maldon) Quarter Sheet (14 SW) took two years to complete and was followed by the Bradford sheet (14 NW), which was finished in 1866. The camp then moved to Birch's Creek, near Carisbrook, but before it was shifted, Dunn made a sketch of it which shows quite sturdy constructions to accommodate each of the party members (Figure 7).

It appears that by late 1866 Ulrich was endeavouring to wind down his mapping work, as the Bradford sheet was the last in which he had any direct involvement. In September 1866 he wrote to the Reverend Clarke from the Geological Survey office in Melbourne, informing him that

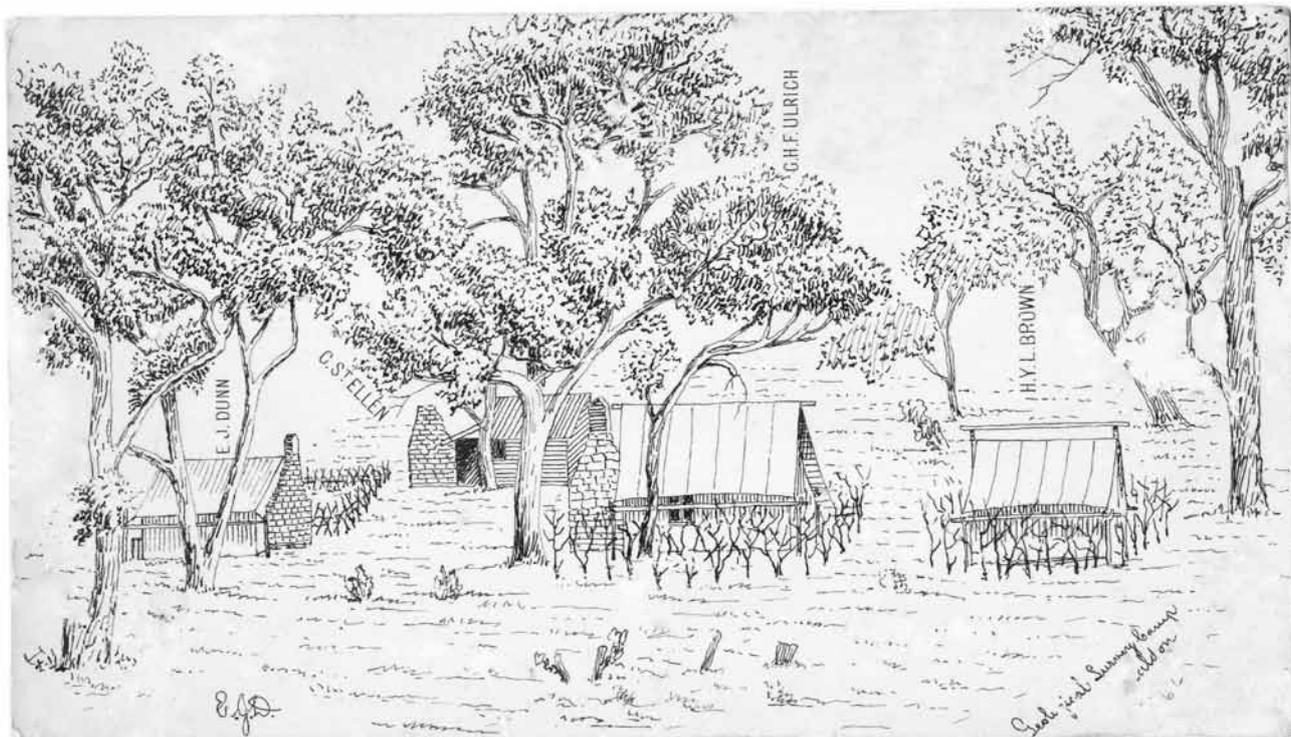


Figure 7: Sketch of the Geological Survey camp at Pigeon Hill, Maldon, made by Edward Dunn in 1866. Museum Victoria archive collection.

he'd been suffering from neuralgia, an 'old complaint', for three weeks, but that his health was improving. He also told Clarke that the bushfire that had destroyed his tent at Tarrengower in November 1864 had taken his copy of Leichhardt's book, so he was unable to supply any sections and drawings taken from the book to go with the translation.<sup>30</sup>

By this time, Selwyn and Ulrich were finalising their joint essay, *The Physical Geography, Geology and Mineralogy of Victoria*, for the 1866 Intercolonial Exhibition in Melbourne. Ulrich contributed detailed descriptions of the Mineral Species of Victoria, the first substantial compendium on Victorian minerals ever published locally (Ulrich 1866b). He must have based his descriptions on the many specimens that he'd seen during his visits to mining centres, as well as on samples presented to him by miners while he was engaged in mapping the Quarter Sheets. Ulrich had previously described many of the minerals in the notes he sent to his former lecturer Friedrich Roemer in Clausthal (Ulrich 1859a, 1864a). He also sent the occasional specimen to the Geological Survey's laboratory for analysis (Figure 8).<sup>31</sup> Gemstones such as diamonds, sapphires and zircons were of particular interest to Ulrich, who had reported as early as 1860 on the small precious stones he'd been shown by a miner washing drift near Guildford, as well as on the alleged discovery of a diamond at Yandoit.<sup>32</sup> The Geological Survey had also established a collection of rocks and minerals, most of which was housed at the National Museum and was large

enough to be considered worthy of a catalogue, which Ulrich helped to prepare (Selwyn et al. 1868).

Early in 1867, Ulrich was granted leave from the Geological Survey on half pay to return to Europe, and he duly departed for London on 18 February as a cabin passenger aboard *Superb*. He is said to have visited the Paris Exposition (later confirmed in a letter from Ulrich to the Reverend Clarke, 21 March 1870), which ran from April to October, and to have put together a large number of mineral specimens for the museum in Melbourne (Anon.



Figure 8: Specimen of albite and quartz from the Blacksmiths Gully reef, Fryerstown, forwarded by George Ulrich to the National Museum on 23 June 1863. He also sent a sample to the Geological Survey's laboratory for analysis of the albite by Charles Wood. This specimen was later displayed in the National Museum at the University of Melbourne. Museum Victoria M8769, 13 x 8 cm. Photograph by W. Birch.

1878). He returned to Clausthal to visit family members and some of his former lecturers at the Mining School, including Friedrich Roemer. When they met on 9 August, Ulrich presented Roemer with some choice mineral specimens, a selection of which Roemer subsequently forwarded to the museum in Hildesheim. These included a fine specimen of gold, which Ulrich must have sent to Roemer early in 1860.<sup>33</sup> Other major reasons for his trip were to return to various mining districts in Germany and to further his research on the extraction of gold from ores, on this occasion at the important mining centre of Schemnitz, at that time in Hungary (now Banská Štiavnica in Slovakia). Ulrich himself would later tell Reverend Clarke that he greatly enjoyed his European ‘exploit’, despite it being expensive, and that he was lucky to meet many geologists and men of science.<sup>34</sup> His Hungarian trip enabled him to inspect ‘those peculiar trachytic formations and fine mining machinery, and to meet some of Austria’s leading geologists’, although he was unable to renew his acquaintance with Hochstetter, who was away recuperating from ill health. He had also visited London, where he was well received by Sir Roderick Murchison and they had several long discussions on Victoria’s gold drifts and quartz reefs. However, he expressed annoyance that, in his ‘new edition’ of *Siluria*, Murchison quoted from Selwyn and Ulrich’s 1866 Exhibition essay, but neglected to mention Ulrich at all.

On his return to Melbourne from London aboard *Highflyer* in March 1868, Ulrich’s Schemnitz observations were published by the Victorian Government (Ulrich 1868b). Later that year, he accompanied Reverend John Bleasdale (1822–1884)<sup>35</sup> and Alfred Selwyn on an excursion to the remote locality of William Wallace Creek, near present-day Gembrook, via the newly opened Bowman’s Track (Bleasdale 1868; Birch 2007), where the party were shown gemstones found in the creek gravels. Ulrich had earlier used his geological knowledge to predict that the sapphires and zircons found in the Loddon River near Guildford had originated from the basalt lava flows capping some of the nearby hills (Ulrich 1861) and he attributed a similar origin to the William Wallace Creek gemstones (Ulrich 1870).

By 1868 the Geological Survey was under considerable political pressure, mainly because of its perceived failure to find new goldfields and economic coal deposits, instead concentrating on producing its minutely detailed Quarter Sheets under Selwyn’s direction.<sup>36</sup> The upshot was its disbanding on 31 December 1868, ostensibly as an austerity measure by the government (Darragh 1987; Darragh & Branagan 2003). Ulrich received compensation of £569/11/6 but was contemptuous of the process, telling Clarke that the Geological Survey ‘has been ruthlessly

swept away’, with Selwyn thoroughly disgusted with the treatment he had received at the hands of the government, ‘of whose members not one has the least idea of science, on the contrary who all show open contempt for it.’<sup>37</sup> The geological staff all went their separate ways, although Aplin and Daintree had already left several years earlier and by 1869 were employed by the Geological Survey of Queensland. One fortunate aspect was the survival of the Geological Survey’s assaying facilities, whose resident chemist, James Cosmo Newbery, although no longer receiving a salary, could take fees for service.<sup>38</sup>

Temporarily without employment, Ulrich indicated that he intended to try his luck in his original profession as a consulting mining engineer and geologist and, if that didn’t pay, he would consider going to the Cape (South Africa) or to South America.<sup>39</sup> Perhaps in order to enhance his credentials, he nominated as a councillor of the Royal Society of Victoria and was elected at the Annual General Meeting on 11 January 1869. He took the opportunity to travel, including a visit to Sydney in December 1869, where he met Clarke at a meeting of the Royal Society, when there was to be a talk about the separation of gold from silver using chlorine gas, a topic that Ulrich would have found relevant to his own research. Ulrich must have then continued on to Queensland, probably at the invitation of Daintree, and the pair visited various mining fields, including Rockhampton. Daintree subsequently invited him back to inspect the Gilbert goldfield, but one visit to those parts at the height of summer was clearly enough for Ulrich, who ‘felt it unlikely he would once more brave the fierce sun of Northern Queensland.’<sup>40</sup>

#### 1870–1878: CURATOR OF THE INDUSTRIAL AND TECHNOLOGICAL MUSEUM’S GEOLOGICAL COLLECTIONS

In June 1870 Ulrich was appointed to the position of curator of the geological collections at the newly established Industrial and Technological Museum, under the superintendency of James Cosmo Newbery (Perry 1972). The museum’s displays were officially opened in September 1870, so Ulrich only had a few months to catalogue and arrange the collections. In his speech at the opening of the museum, Frederick McCoy was particularly praising of Ulrich’s appointment and his qualifications for the position.<sup>41</sup> A contemporary account of the opening provides details on the outcome of his work.

From the pottery court to beyond the centre of the hall, the space is devoted to mineralogy, geology and economic geology. The first collection met with is the one containing the foreign minerals belonging to the Mining department, containing

over 750 specimens named and arranged, and next to that comes the colonial collection of the Mining department, containing 1300 specimens of Victorian rocks and minerals. On the west side, between the pillars and the wall, the quartz specimens owned by the Mining department and those belonging to the Museum have been placed together, and with them it is intended to fully illustrate quartz mining and the treatment of auriferous ores. On the east side, alluvial mining will be illustrated. The two sides are connected by tables on which are exhibited mining tools, hoisting and winding chains, and various models of machinery. Next to these is a collection of 500 specimens of New Zealand rocks, which are being named and arranged. In the centre is a fine collection of minerals, chiefly foreign, representing specimens of a great number of mineral species, some very rare. Several are from the Samson mine, St Andreasberg, Harz Mountains, Germany, nearly 3,000 ft deep. The collection contains some very fine specimens of native silver, copper and bismuth, silver glance, pyrrargyrite, stephanite, tellurium gold,

tetrahedrite, nickel ores, galena and other lead ores, manganese ores, iron ores, and amongst the earthy minerals beautiful specimens of various zeolites, heavy-spar, celestine, strontianite and calcite; the latter is shown in a great number of crystal forms.<sup>42</sup> The labelling of this collection is not yet completed; it is being classified and arranged by Mr G.H.F. Ulrich. In the next case a collection of purely Victorian rocks is being arranged by Mr Ulrich, as follows: – 1. Older crystalline rocks, granites, syenites, greenstones, porphyries, etc. 2. Metamorphic rocks. 3. Sedimentary rocks in their geological order. 4. The tertiary volcanic rocks, basalt, dolerite, etc....<sup>43</sup>

Ulrich's main tasks in his first few years as curator were to continue building the rock and mineral collections, nearly all of which were on display (Figure 9). As specimens were rapidly acquired through donations, exchanges and purchases, descriptive labels had to be prepared and display cases continuously augmented and rearranged to accommodate them all. Disruption brought about by the shifting of cases for the 1872 Melbourne International Exhibition took time to rectify. A major undertaking for

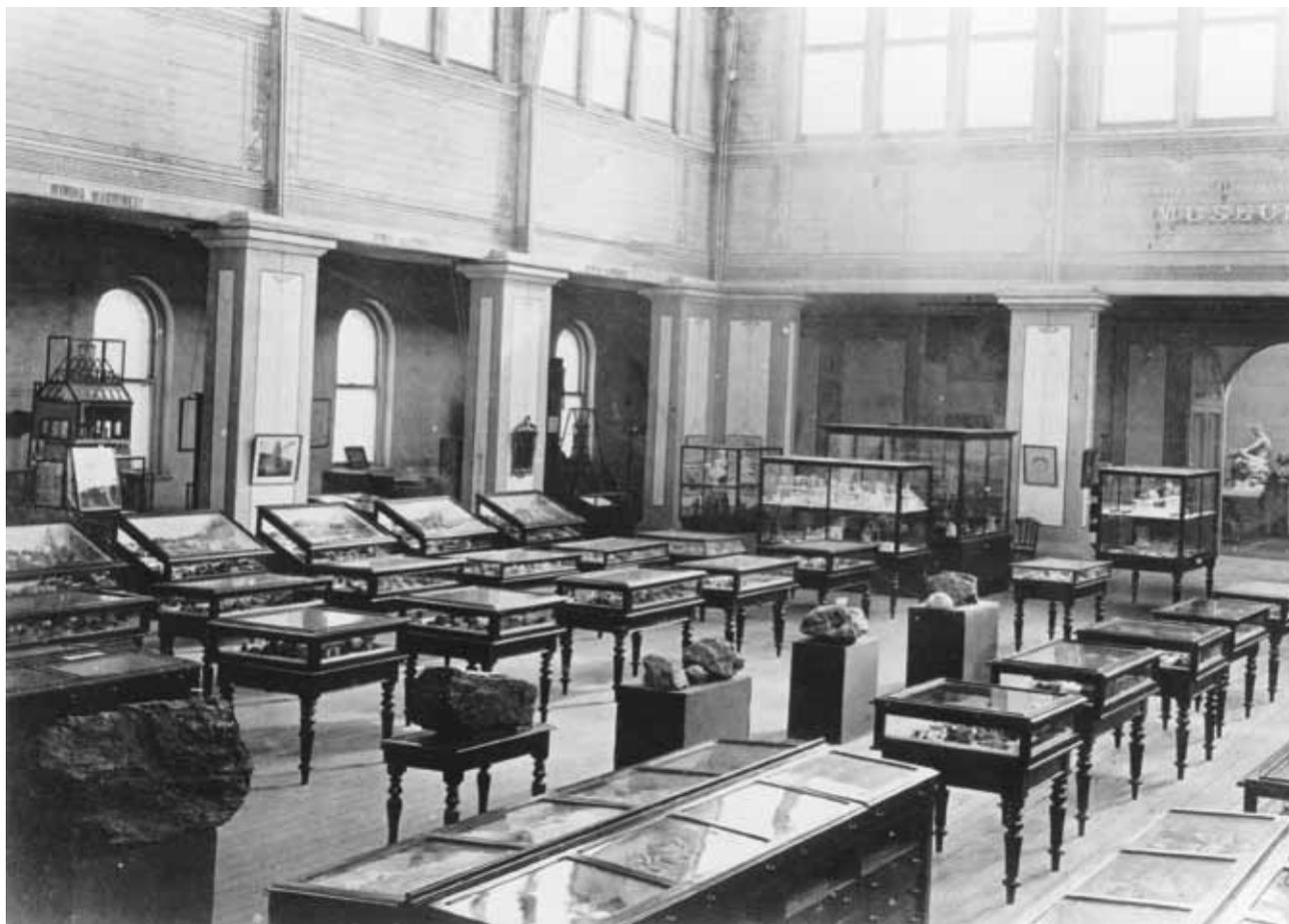


Figure 9: Mineral and rock displays in the Industrial and Technological Museum, 1870s.

Ulrich was the preparation of a descriptive catalogue of the rocks of Victoria, much of which he had to do in his spare time at home. He was able to present it to the museum trustees for printing at the end of 1873 (Ulrich 1874a). Also printed in 1873 was a catalogue of the museum's mineral collections, divided into a number of separate lists (Anon. 1873). One of these, the General Mineral Collection, consisted of over 700 specimens, most of which were from foreign countries. It's possible that many of these had been acquired by Ulrich during his visit to Paris in 1868, but there is no documentation to support this conclusion. Not content with only Victorian rocks and minerals, in 1873 Ulrich commenced a program of purchasing collections of overseas minerals and rocks to supplement all the local samples on display. The most significant supplier of specimens was the Krantz dealership, in Bonn, Germany, from whom Ulrich purchased several collections of rocks, minerals and ornamental stones.<sup>44</sup> His motivation was to make the collections as comprehensive and useful as possible to students and miners. Each year in his annual report to the superintendent, Ulrich emphasised the growth in the collections, especially through donations, which he considered to show the interest the displays had stimulated among the public.<sup>45</sup>

Exchanges were a very efficient way of building the collections, as they made use of the considerable number of duplicate rocks and minerals that Ulrich had available. One interesting transaction was arranged with the geologist in the party of German scientists who visited Melbourne in August 1874 on their expedition to observe the transit of Venus. This was taking place on 8 December 1874 and was a significant scientific event that had spawned international interest and cooperation. The German party's observation point was to be established in the Auckland Islands, south of New Zealand, and Ulrich seized an opportunity to obtain a suite of rocks for the museum's collections from such a remote locality. Unfortunately, it seems that all but one of the specimens have been lost (Figure 10).

Among Ulrich's other tasks at the museum was to conduct lectures in Practical Mineralogy and the use of the blowpipe, enabling him to apply the skills that he'd been taught in Clausthal. His classes did not attract large numbers, with students rarely numbering more than about eight or ten, but they were clearly important to Ulrich. Throughout his tenure as curator he signed himself off in annual reports as 'Lecturer in Mineralogy and Mining', as if to bestow more status to his role. This title referred substantially to his association with the University of Melbourne, where he had been appointed as Lecturer in Mining in the School of Engineering in November 1873.<sup>46</sup> His course was delivered in two lectures each week, from 2.20 pm to 3.50 pm on Mondays and Tuesdays. Certainly



Figure 10: Surviving rock specimen, probably basaltic agglomerate, from the batch of South Auckland Island samples that George Ulrich obtained by exchange in 1864. Museum Victoria E7584, 8.5 x 7 cm. Photograph by W. Birch.

his lectures, along with the tasks of continuously writing labels and rearranging cases, left him little if any time for research or writing, and only minimal field collecting. Nevertheless, he had field trips to some local sites, such as Waratah Bay (Ulrich 1875c), as well as a number of visits to important mining districts in other colonies. Several of these trips were on a contract or consulting basis, as they generated reports, including to the copper mining regions of northern South Australia in 1872 (Ulrich 1872) and the mining districts of Tasmania, in particular the Mt Bischoff mine and Mt Ramsay, in 1873 and 1876 (Ulrich 1874b, 1876, 1877). A detailed report of his observations made in Tasmania during 1876 is in the form of a letter to a mineralogical colleague in Germany, Professor Gerhard vom Rath (Ulrich 1877). He also donated to the museum suites of specimens collected on his earlier visits to Queensland and to the New England tinfields in New South Wales (Ulrich 1873).

The most important assignment during his tenure at the museum was a survey of the goldfields of the Otago district on the South Island of New Zealand, undertaken at the request of the provincial government, which set aside £500 for the purpose.<sup>47</sup> The Otago government had been negotiating with the Government of Victoria for a geologist to come to Otago to complete a survey undertaken by James Hector during 1862–1865. Ulrich was their favoured candidate because of his experience in studying the Victorian goldfields. According to an account of his visit written by a 'special correspondent' for the *Otago Witness* on 30 January 1875, 'no better or more reliable opinion on the value of the gold-bearing quartz lodes of the Province could possibly have been obtained than that of Mr Ulrich.'<sup>48</sup> Watters and Mason (2000) suggested that this

wasn't Ulrich's first visit to Otago; however, there is no evidence in the form of published work, newspaper reports or from ships' passenger lists, to support his visiting Otago earlier than 1874.

Ulrich left Melbourne on the *Claud Hamilton* in December 1874 and during the ensuing summer he and Frederick Hutton (1836–1905), then the provincial geologist of Otago, visited numerous mining operations on the Otago goldfields. Their work produced an impressive report (Hutton & Ulrich 1875) and a smaller paper on the reefs and crushing equipment published by Ulrich alone (Ulrich 1875a). Clearly his work must have impressed the mining and geological community in Otago because, in February 1878, the University of Otago, through its chancellor, H.S. Chapman, offered Ulrich the directorship of the School of Mines. Moves to establish such a school that recognised the importance of mining had only come to fruition when the provincial government agreed in 1877 to support its operations, providing an establishment grant and £500 a year towards the salary of a director (Parry 1979). The university moved quickly to draw up a syllabus and set out the staffing requirements (Thompson 1919), among which was the director, who would also be Professor of Mining. The position required a man of first-class attainments and wide practical experience.

Ulrich duly accepted the Otago appointment and his resignation from the museum was accepted by the trustees at their meeting of 28 March 1878. By now, however, he was no longer single and able to travel at will. He had married Catherine Sara Spence at Christ Church, South Yarra, on 31 July 1871.<sup>49</sup> The youngest daughter of Thomas and Eliza Spence, Catherine was born in Belfast, Ireland, in 1840, so was ten years younger than George. In a letter to Reverend Clarke just prior to the wedding, Alexander Morrison Thomson (1841–1871) wrote that 'Ulrich had "cut mineralogy *pro tem* and gone into matrimonial prospects"'. It appears that Ulrich had given Thomson an amusing account of what he had to do for the proposal to be accepted. The marriage celebration was tempered by the death of Catherine's younger brother, James Spence, just two days later.<sup>50</sup> George and Catherine quickly started a family, and two daughters and two sons were born in Melbourne before their departure for New Zealand, where they were to have three more children (Figures 11, 12).

#### 1878–1900: OTAGO SCHOOL OF MINES

The Ulrich family and a servant left Melbourne for Dunedin on the *Alhambra* in April 1878. A large group of friends was on board to farewell them and Ulrich's departure was said to be greatly regretted in Melbourne, as he had always been held in high esteem in the colony.<sup>51</sup> On arrival at the university, he immediately set out the principles upon



Figure 11: George Henry Frederick Ulrich (date unknown but probably around late 1870s). State Library of Victoria collection.

which his mining course was to be established, ranging from knowledge of useful minerals in nature, through how they are prospected for, the extraction methods and their inherent dangers, to the refining and concentration processes. To cover all these topics, the course would need to be divided into a number of sections, spread over a number of years and covering mining, metallurgy, geology, mine surveying and assaying, and with appropriately qualified staff (Thompson 1919; Parry 1979). His course structure was eventually approved by the university council in August 1878 and the school opened in 1879, occupying rooms in the old medical building. Not unexpectedly, the early years were difficult, with low student numbers and the withdrawal of the government subsidy by 1884. The school was threatened with closure in 1886, but the temporary renewal of the government subsidy enabled it to survive, albeit against some opposition and criticism. Ulrich had to defend a situation where most of his graduates went overseas to find responsible positions, in the absence of suitable jobs for them in the country, and where regional technical colleges were turning out many more mine managers, with certificates in mining engineering, than his courses were. Writing in the *University Review* in 1893, he argued that the School of Mines' courses were intended to 'afford parents opportunity to have their sons trained

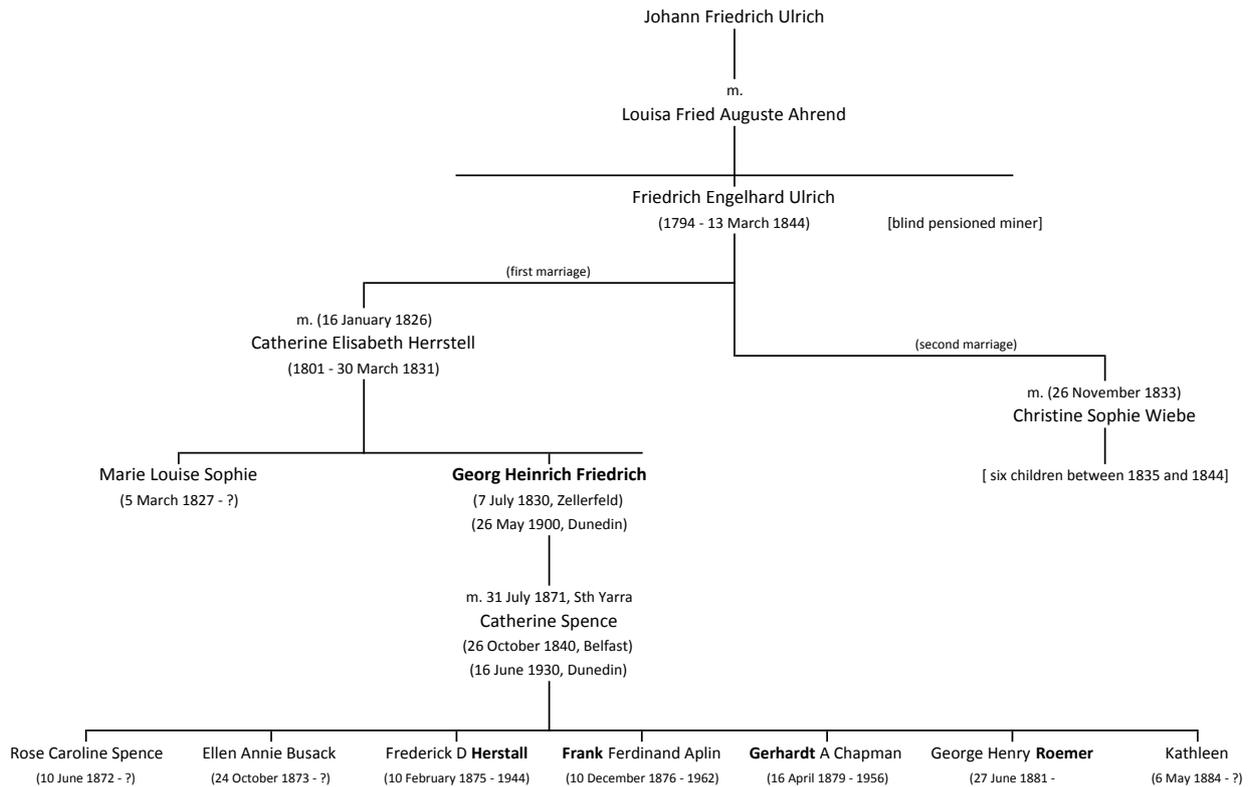


Figure 12: Pedigree for George Ulrich’s immediate family. Based on St Salvatorius Zellerfeld church records and on Ulrich family records (names of children of George and Catherine provided by W Watters, personal communication). Note the full names of the sons recognise significant figures in Ulrich’s life – Frederick **Daintree** (after Richard Daintree) **Herstatt** (his mother’s maiden name, anglicised); Frank **Ferdinand** (possibly after Ferdinand Hochstetter) **Aplin** (after Christopher D’Oyly Aplin); Gerard **Adolphus** (possibly after Friedrich Roemer’s middle name) Chapman, and George Henry **Roemer** (after Friedrich Adolph Roemer).

in professions promising a satisfactory status and income in after-life. If their own country offers openings in this respect, no doubt the young men remain; but, if it does not, they are obliged, and prepared, to try their fortunes in other countries.’ Despite these difficulties, the mid 1890s gradually saw a turnaround in the school’s fortunes, with some changes in staff, a government grant to assist with the assaying of local gold ores, and a scheme to provide students with practical work during their vacations. The addition of another building, the ‘tin shed’, in 1890 (Figure 13), had enabled students to use furnaces and do assays, while a boom in gold-dredging in Otago had also led to more interest in the school’s courses (Parry 1979). From 1896 until 1899 the school experienced its most prosperous period, with full classes and with all the furnaces and apparatus being utilised, so much so that the school was becoming overcrowded and short of equipment.

During his first few years in Otago, Ulrich included museum-oriented endeavours within his duties. Until mid-1880, he took charge of the Dunedin Museum following the departure of Professor Hutton and added a large number of new exhibits in ethnology and technology, as well as improving the mineral display. A special feature was a collection of several thousand samples arranged

according to the Dana system, and ‘probably the largest and most complete in New Zealand’.<sup>52</sup> Interestingly, one case contained samples showing the mode of occurrence and dressing of tin ore from Mt Bischoff, which obviously must have come from his Tasmanian fieldwork in 1873 and 1876. There are records of sporadic donations he made to the Industrial and Technological Museum in Melbourne, possibly as exchanges. The first was a small collection of miscellaneous minerals and rocks in June 1880, some of which have been preserved (Figures 14a, 14b). He also returned to Melbourne, alone, for a few weeks at the end of 1878 and during the summers of 1880–1881 and 1884–1885, for purposes unknown. Ulrich remained keenly interested in field investigations, although his workload probably hindered the amount he could undertake. Nevertheless, he published several significant reports on New Zealand rock and mineral occurrences (see Appendix 1), including a study of the nepheline-bearing rocks around Dunedin (Ulrich 1891), and descriptions of the rare iron–nickel alloy awaruite (Ulrich 1890) and the Makarewa (Makariwa) meteorite (Ulrich 1893).

By 1900, as well as having to deal with the problems of running the school, Ulrich had been experiencing ill health for a number of years. On 26 May, seemingly having



Figure 13: Mining School buildings at the University of Otago in 1908. The original school shared facilities in the Chemistry Department building on the right. The ‘tin shed’ housing the furnaces was completed in 1890 (from Thompson 1919).

recovered over the previous few weeks, he paid a visit to Port Chalmers, where he went climbing on the steep cliff face of Flagstaff Hill, above the harbour, examining rock specimens. Tragically he missed his footing and fell over thirty metres, sustaining fatal head injuries (Figure 15). There are differing versions of who was accompanying him at the time, with most historical accounts stating he was with a party of students, but the coroner’s report and the obituary in the *Otago Daily Times* of 28 May indicate he was accompanied by his son Frank, who was helping him collect samples. His death was met with considerable

regret, as by now the School of Mines had gained an international reputation for its graduates in mining and his leadership role in steering it through troubled waters was widely recognised. He had produced 62 associates of the school, with most of these holding responsible positions in mining companies and other schools of mines around the world, including Richard Henry Walcott (1870–1936), who was appointed mineralogist to the Industrial and Technological Museum of Victoria after Oliver Richard Rule (1835–1926), who had succeeded Ulrich at the museum (Perry 1972). At a meeting of the council of the



Figure 14: Two samples sent to the Industrial and Technological Museum by George Ulrich in 1880. (a) vesicular trachyte with tridymite crystals from Lyttleton Harbour, near Christchurch; note the handwritten label by Ulrich. Museum Victoria M2568, 11 x 8 cm. (b) cellular quartz from Matakuhia, North Island, Museum Victoria M8603, 7 x 4 cm. Photographs by W. Birch.



Figure 15: Port Chalmers, with Flagstaff Hill on left.

University of Otago held on 4 June, a glowing testimony to Ulrich's achievements was presented and the council moved to establish of a medal in his name.<sup>53</sup> The Ulrich Prize was first awarded in 1902 and is still awarded to the best geology student studying mineralogy at level 2, even though the School of Mines itself closed in the 1990s. Students erected a tablet to his memory and his mineral collection is preserved in the Geology Department.

#### ULRICH'S MINERALOGICAL LEGACY IN VICTORIA

Ulrich's mineralogical legacy in colonial Victoria can be assessed in two ways. First, as has been documented in this paper, he devoted his considerable energy towards assembling a large and diverse collection of minerals, rocks and ores during his short tenure as inaugural Curator of the Industrial and Technological Museum between 1870 and 1878. After his departure, the museum's geological collections continued to expand, until they were transferred to the care of the National Museum of Victoria at the end of the nineteenth century. While it appears that many of the uncatalogued samples did not survive the transfer, the nucleus of the collection established by Ulrich forms a significant portion of the state's geological heritage. There are now ongoing programs to track as many of these samples as possible based on available records.

In addition to collection building, Ulrich contributed significantly to the mineralogical knowledge of the colony through his descriptive notes. At the time, he was the only scientist in Victoria with the necessary training and expertise to accurately identify and describe minerals, although he was fortunate to have a skilled assayer in James Cosmo Newbery to provide him with chemical analyses. His detailed descriptive compilations, exemplified by his 1866 and 1870 essays, reveal an interest in minerals found in all geological environments throughout the colony. However, it was the diversity of species occurring in the gold-bearing quartz reefs at localities such as Tarrengower (Maldon), McIvor (Heathcote), Steiglitz and in the unusual gold–silver ores at St Arnaud, which caught his attention

from the very earliest of his publications (Ulrich 1857, 1859a, 1864a). There are far too many species to list here, but of particular note were attractive yellow to emerald-green cubic crystals of the rare arsenate, pharmacosiderite, which Ulrich found in the Beehive Reef at Tarrengower. It's likely that the 'wurfelerz' Ulrich included in the parcel of beautiful minerals that he sent to Friedrich Roemer late in 1859 was from this occurrence, as at that time no other locality for pharmacosiderite was known in Victoria. The Nuggetty Reef at Tarrengower was the subject of several papers by Ulrich (1868a, 1869), inspired by the discovery of the gold–bismuth alloy that he had determined to be a new mineral. Maldonite (Figure 16) was subsequently found in other mines at Maldon, including the Eaglehawk and Beehive reefs, and from about twenty other localities worldwide, generally associated with Au–Bi–(Te) assemblages. Its origin remains a subject for debate (Ciobanu et al. 2010).

Ulrich was also a key player in the international dispute over the identification of unusual crystals of a mineral belonging to the zeolite family, found in a basalt (or 'bluestone') quarry near the Yarra River at Burnley in about 1860 (Vince 1989). The crystal forms were unfamiliar and the chemical composition inconclusive. Ulrich sent samples to Hochstetter in Vienna, suggesting in his accompanying letter (Ulrich 1862) that the crystals might be either herschelite or possibly a new species related to chabazite, a widely distributed and common zeolite mineral. Alfred Selwyn thought the crystals were gmelinite, as did Charles Sturtevant Wood (1836–1864), then analyst at the Geological Survey of Otago.<sup>54</sup> However, Victor von Lang (1838–1921), at the British Museum, identified the Burnley crystals as herschelite by comparison with other known occurrences and concluded that all were compound twins formed from the association

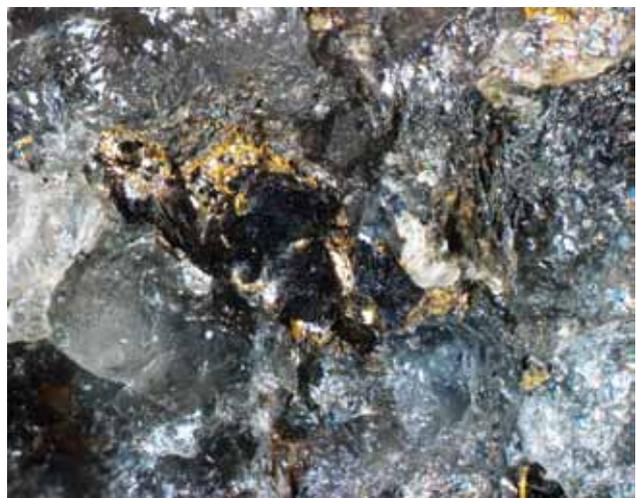


Figure 16: Specimen of quartz showing a patch of maldonite with a corona of gold from the Eaglehawk reef at Maldon. Museum Victoria M50873; maldonite patch is 1.5 mm long.

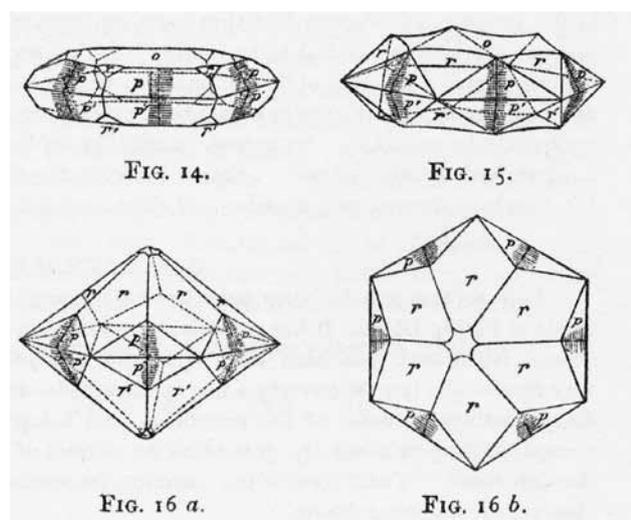


Figure 17: Ulrich's crystal diagrams for 'herschelite' from Burnley (Ulrich 1870).

of six orthorhombic individuals (Lang 1864). Ulrich seemed to accept this identification in his 1866 essay, but after he had examined more closely the original crystals and newly discovered ones, he argued against them being orthorhombic, concluding instead they were rhombohedral (Figure 17) (Ulrich 1870). With their high calcium contents, they appeared to be closer to rhombohedral crystals of a mineral named phacolite from Bohemia. Ulrich asked Gerhard vom Rath, at the University in Bonn, to resolve the problem (Ulrich 1875d), which he duly did, concluding that the Melbourne crystals were indeed phacolite, which is a twinned variety of chabazite (Rath 1875, 1876), an identification which stands today. Probably largely due to Ulrich's efforts, specimens of Melbourne chabazite are widely distributed in museum mineral collections in Europe.

As has been referred to earlier, gemstone occurrences were also of particular interest to Ulrich and he proved to be an ideal foil for his contemporary gemstone enthusiast, the Reverend John Bleasdale. During their time, sapphires, zircons, topaz and even occasional diamonds, were being found by miners washing the gold-bearing gravels in their sluices and dishes. Few stones were of gem quality, however, and the occurrences were of scientific interest rather than capable of supporting any industry (Birch & Henry 1997). Supposed rubies caused excitement, and in his 1870 essay Ulrich described and illustrated a small crystal of 'oriental ruby' from William Wallace Creek, the locality he had visited with Bleasdale and Selwyn a few years earlier. It's not known when the crystal had been found, but Bleasdale donated it to the National Museum of Victoria. Long lost, it was rediscovered in 1990 during an examination of a gem gravel sample from another locality (Birch & Henry 1997) (Figure 18).



Figure 18: The 'ruby' crystal from William Wallace Creek, described and sketched by Ulrich (1870). Museum Victoria M44231, 4 mm long. Photograph by F. Coffa.

Ulrich also played a role in identifying several rare Victorian minerals found in deposits of bat guano in the lava caves on Mt Widderin, near Skipton. Struvite and hannayite are hydrated magnesium ammonium phosphates and newberyite is a magnesium phosphate, all three minerals occurring as small, well-formed crystals in the guano (Vince et al. 1993). Struvite was found first, in 1867–1868, and Ulrich used a combination of his own crystallographic measurements<sup>55</sup> and chemical analyses obtained by the Geological Survey laboratory to confirm their identity as struvite, by comparison with crystals found at Hamburg in Germany (Ulrich 1870). Hannayite was collected in 1877 by Ralph W. Emerson MacIvor, an agricultural chemist, who showed some unusual needle-shaped crystals to Ulrich, by then in his last year as curator at the Industrial and Technological Museum. Ulrich tentatively identified them as brushite,<sup>56</sup> but because the morphology of the crystals did not match that of brushite, he sent several crystals to Gerhard vom Rath in Bonn for his opinion. Rath published the results of his study of the crystals, but he could not identify them, and noted that he hoped to receive more material from Ulrich for a chemical investigation (Rath 1878). Around the same time, another

unknown mineral in the guano was found by James Cosmo Newbery, who showed a typical tabular crystal to Ulrich at the Museum. The two unknown minerals were analysed by MacIvor, who recognised they were new to science, and gave the name hannayite, after his friend and fellow chemist James Ballantyne Hannay (1855–1931), to the crystals that he had found (MacIvor 1879). He supplied his chemical analyses to Ulrich, who by this time had taken up his appointment at the University of Otago. From there, on 28 November 1878, Ulrich sent some of Newbery's crystals, along with brief crystallographic information and with all MacIvor's analyses, to Rath. Ulrich informed his colleague that MacIvor's mineral had already been named hannayite, and suggested that newberyite be the name for the other unknown mineral. Rath subsequently published descriptions of both these new minerals (Rath 1879, 1880), as did Ulrich (1879b). Perhaps understandably for the time, some uncertainty exists over who first named the minerals, with MacIvor later writing to make it clear that it was he, not Ulrich, who had identified hannayite as a new species (MacIvor 1902). He also laid claim to naming newberyite (MacIvor 1887).

Just these few examples exemplify the dedication, persistence and expertise that underpinned all Ulrich's mineralogical observations, as well as his willingness to collaborate with scientific colleagues and share his knowledge with the public at large. However, we should not overlook his considerable abilities as a geologist, in fields as diverse as the petrology of igneous rocks and the nature of economic ore deposits and the methods used to exploit them. Although no longer accepted, the name 'ulrichite' was used by Marshall (1906) for a variety of trachyte amongst the alkaline igneous rocks of the Dunedin district, which Ulrich discovered and first described (Ulrich 1891). In Victoria, Ulrich made the most of his good fortune in having a mineralogist's 'Aladdin's cave' on his doorstep and in so doing became the colony's foremost authority on minerals during his lifetime. While his description of maldonite stands as his own personal monument, his pioneering contribution to Victorian mineralogy was recognised by the naming of a new mineral ulrichite,  $\text{CaCu}^{2+}(\text{UO}_2)(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$ , found as attractive green crystals to 1 mm in a granite quarry near Lake Boga (Birch et al. 1988) (Figure 19).

#### CONCLUSION

From all that has been written about George Ulrich, the overwhelming impression is of a man who was greatly admired and respected by all who knew him, including fellow members of various professional societies. In Victoria he was an original member of the Australian Institute of Mining Engineers (now the Australasian



Figure 19: Crystals of ulrichite [ $\text{CaCu}^{2+}(\text{UO}_2)(\text{PO}_4)_2 \cdot 4\text{H}_2\text{O}$ ] from the granite quarry at Lake Boga, Victoria. Museum Victoria M50335; crystal cluster is 1.5 mm across.

Institute of Mining and Metallurgy), both a member and briefly a councillor of the Royal Society of Victoria, and a member of the Royal Society of Tasmania. Internationally, he was a Fellow of the Geological Society of London, a member of the American Institute of Mining Engineers and an honorary member of the New Zealand Institute of Mining Engineers. Newspaper reports on his activities invariably praised his achievements. As his obituary noted, 'his scientific achievements were beyond all question, and the quiet and efficient discharge of his duties and his unostentatious worth won for him the respect and esteem of all who came in contact with him'. Above all, he remained a humble man who was able to communicate with people from all ranks of society.

Frederick McCoy clearly held Ulrich in high esteem, describing him in his lecture at the opening of the Industrial and Technological Museum in September 1870 as 'a gentleman well known for many years in the colony as one of our most valuable scientific observers', adding that 'he is, to my knowledge, a most accomplished mineralogist, having, so far as I know, no equal in this branch of the subject in the country'. Charles Wood, briefly the analyst for the Geological Survey in 1863–1864, considered Ulrich to be a 'very good mineralogist', 'a man of science' and 'a very clever fellow'.<sup>57</sup>

Perhaps George Ulrich's character is best illustrated by the words of Edward Dunn, who wrote in 1910, 'from long personal experience, and having received his (sic) geological training from him, [I] can testify to his bright and cheerful disposition, and his helpfulness to those who desired to learn. His influence will remain long after those who came into direct contact with him have departed'. Those words have certainly stood the test of time.

### Acknowledgements

The authors wish to thank the following people who have provided information on George Ulrich over many years: Dr Karl Strauss of the Mineralogical Institute in Clausthal-Zellerfeld and the office staff of San Salvatorius Lutheran church in Zellerfeld for assistance during our visit in September 1991; Prof. George Müller, Mineralogical Institute in Clausthal-Zellerthal for information on the history of the institute and its staff; Renate Vollmer, from the University of Osnabrück, for copies of archival documents in 1992 relating to Ulrich's emigration from Germany; Prof. Gabrielle McMullin for supplying relevant literature; Mrs Beverley Booth, Assistant Archivist at the Hocken Library, University of Otago, in 1992, for articles on the history of the Otago School of Mines and copies of several documents from the Ulrich family papers; Mr W.A. (Bill) Watters, of Lower Hutt, New Zealand, for correspondence and exchanges of information, including a list of Ulrich's New Zealand papers, between 1995 and 2000; and Robert Wuchatsch for information on John Boehm. We also wish to thank Rod Home and David Branagan for helpful reviews.

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Note: All Ulrich's papers referred to in the text are listed separately in his full bibliography in Appendix 1.

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#### Endnotes

- 1 Baptismal, Marriage, Death and Confirmations Registers, Saint Salvatorius Church, Zellerfeld (inspected September 1991).
- 2 Censurlisten der Bergakademie zu Clausthal, Archiv der Technischen Universität Clausthal.
- 3 Bock, Hans Joachim, "Braun, Otto Philipp" in: *Neue Deutsche Biographie* 2 (1955), p. 547.
- 4 Archiv Oberbergamt Clausthal-Zellerfeld. Record Group 158/22.
- 5 He is probably John Boehm (or Boehme), who was naturalised as a NSW citizen in March 1851. He gave his address as Richmond (NSW), origin Prussia, age 31, occupation bricklayer. Boehme arrived aboard the Pribislaw (Robert Wuchatsch, personal communication).
- 6 Ulrich family papers, Hocken Library, Dunedin. Miscellaneous manuscripts MS 43.
- 7 The original spelling was Tarrangower; it has been replaced by Tarrengower.
- 8 This subdivision of the 'Silurian' rocks was attributed to Selwyn and McCoy by Ferdinand Hochstetter in his notes (Darragh 2001) but wasn't published by them until 1861.
- 9 This identification was changed to a crustacean, *Hymenocarus*, after better specimens were found later (Ulrich 1861).
- 10 Civil Establishment 1864, p. 34.
- 11 Mining Commission and Museum Outward Letter Book, May 1856–October 1857, letter No. 57/66, p. 42. Museum Victoria Archives.

- 12 Subscribers List. *Facts and Figures*. 1(8) (1 February 1858), p. 4.
- 13 *The Argus*, 3 December 1858.
- 14 Ulrich showed Hochstetter his notes on the Victorian goldfields that he was later to send to Friedrich Roemer (Ulrich 1859a).
- 15 Ulrich did all the hill work on QS 9NW, 12SW, 14SE and 15NE.
- 16 Ulrich to Clarke, 15 November 1861.
- 17 These photographs are held in the State Library Victoria collection.
- 18 An entry in the *Victoria Government Gazette* on 31 December 1861, page 2521, shows that that Ulrich had first applied for a patent for this process on 21 December 1861 (No. 519).
- 19 Ulrich to Clarke, 20 March 1862.
- 20 Ferdinand Hochstetter had also been particularly critical of the lack of topographic mapping in Victoria, as recorded in his 1859 notes.
- 21 Ulrich to Clarke, 15 October 1863.
- 22 The patent referred to is No. 619, lodged 13 April 1863, *Victoria Government Gazette* 30 May 1863, p. 1211, Improvements in washing machines for the more effective extraction of fine gold.... See also Note 18. The time interval between patents 519 and 619 for the same process is unexplained.
- 23 *The Argus*, 30 October 1863.
- 24 This was published in the *Australian Almanac* for 1867 and for 1868, under the full title: Notes on the Geology of Parts of New South Wales and Queensland made in 1842-43 by Ludwig Leichhardt, translated from the German by George H.F. Ulrich Esq. (of the Geological Survey of Victoria) and edited by the Rev. W.B. Clarke, A.M., F.G.S.
- 25 Report of the Commissioners appointed to enquire into the conditions of the Gold Fields of Victoria. *V. & P. L. A.*, 1862-3/10.
- 26 Ulrich to Clarke, 15 October 1863. See Darragh (1987, note 40) for references to reactions of the press.
- 27 From unpublished Reminiscences and biographical notes by Edward J. Dunn, prepared in 1916. Original version in Burke Museum, Beechworth, Victoria; copy in Museum Victoria. These handwritten notes have been transcribed by WDB.
- 28 Dunn was one day out; the fire occurred on 21 November. Ulrich gave the date as 21 November 1864 in his affidavit applying for a new naturalisation certificate on 11 Feb 1867. See also Note 29.
- 29 From a report in the *The Age*, 29 November 1864, page 6 (reprinted from the *Tarrengower Times*), which also confirms the date was 21 November.
- 30 Ulrich to Clarke, 11 September 1866.
- 31 The Geological Survey's Laboratory was attached to the National Museum, housed at the University of Melbourne, from 1863 until 1868. Charles Sturtevant Wood was the first analyst, appointed in April 1863 (see Darragh 1988).
- 32 *The Herald*, 28 July 1860, taken from the *Mount Alexander Mail*.
- 33 On 15 February 1860, Roemer wrote to his brother Herman at the Hildesheim Museum informing him: 'I have recently received beautiful minerals such as gold crystals and wurfelerz (=pharmacosiderite) from a student in Melbourne'. On 9 August 1867, Roemer informed Herman: 'Today I have had much pleasure over the visit of one of my best students, the Royal Field Geologist Ulrich from Melbourne, where he has been at work for 15 years. He has brought beautiful minerals with him and I am sending herewith a selection of them to the Museum. The large specimen with gold is worth at least 10 Reichsthalers.' (Information from G. Müller (1997; page 36)).
- 34 Ulrich to Clarke, 20 January 1869; Darragh 1987.
- 35 Rev. John Ignatius Bleasdale was a prominent Catholic churchman in Melbourne and an enthusiastic and knowledgeable proponent of Victoria's gemstones and the wine industry. He was formerly President of the Royal Society of Victoria.
- 36 Aplin to Clarke, 19 February 1868.
- 37 Ulrich to Clarke, 20 January 1869.
- 38 Aplin to Clarke, 8 April 1869. The Laboratory at the University was used by Newbery until the opening of the Industrial and Technological Museum in 1870 (Darragh 1988).
- 39 Ulrich to Clarke, 20 January 1869.
- 40 Ulrich to Clarke, 21 March 1870.
- 41 *Industrial and Technological Museum Lectures delivered during the Spring Session of 1870*. Published under the direction of the Committee. Samuel Mullen, Melbourne.
- 42 It is possible that some, even most of these foreign specimens were obtained by Ulrich during his visit to Europe in 1867. It has not yet been possible to find any lists relating to his acquisitions.
- 43 *The Argus*, 9 September 1870.
- 44 At Ulrich's request, the Industrial and Technological Museum purchased three collections from Dr August Krantz, two in 1873 and one in 1874, totalling about 750 specimens.
- 45 Ulrich's reports are included in the Annual Report of the Industrial and Technological Museum Committee to the Trustees of the Public Library and Museum and National Gallery of Victoria. They are not included in his publications.
- 46 *The University of Melbourne Calendar 1873-4*, Annual Report, 1873-4 (page 245). He resigned as Lecturer in 1877.
- 47 The cost of the survey is given in a detailed report of

the visit published in the *Otago Witness* of 30 January 1875. The ‘Special Correspondent’ is not named but clearly travelled with the party.

48 See endnote 47.

49 *The Argus*, 1 August 1871, p. 4.

50 Alexander Thomson to Rev. Clarke, 24 August 1871. *Argus* 3 August 1871, p. 4.

51 *The Argus*, 10 April 1878.

52 *Otago Daily Times*, 11 June 1880.

53 *Otago Daily Times*, 5 June 1900.

54 Charles Wood was later appointed as the first assayer at the Geological Survey of Victoria’s laboratory in 1863 (Darragh 1988).

55 These measurements and others on the crystals of the Melbourne zeolites suggest Ulrich had access to a reflecting goniometer and knew how to use it.

56 Ulrich’s Annual Report to the Sectional Committee of the Industrial and Technological Museum, 1878.

57 Charles Wood’s letters to James Hector at the Geological Survey of Otago (Darragh 1988).

#### Appendix 1: Bibliography for George Ulrich

Note: Most of Ulrich’s papers and notes up to 1880 were listed in *Catalogue of Works, Papers, Reports and Maps on the Geology, Paleontology, Mineralogy, Mining and Metallurgy, etc. on the Australian Continent and Tasmania*, compiled by Robert Etheridge Junior and Robert Logan Jack and published by Edward Stanton, London, in 1881. Other contributions have been discovered since then during research for this paper. Ulrich’s New Zealand publications were provided by W.A. Watters.

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#### Maps

##### **By Ulrich, G.H.F.**

Quarter Sheet 9 NW. Taradale, 1861; second edition in 1865.

Quarter Sheet 15 SE. Franklinford; surveyed 1864, published 1866.

Quarter Sheet 9 NE. Langley (no date).

Notes referring to the geological map of Daylesford (no date).

##### **By Ulrich, G.H.F. & Aplin, C.D’O.H.**

Quarter Sheet 15 NE. Guildford, 1864.

Quarter Sheet 15 SE. Yandoit; surveyed 1864, published 1866.

Quarter Sheet 9 SW. Holcombe (no date).

Quarter Sheet 9 SE. Kyneton (no date).

Quarter Sheet 13 SW. Elphinstone (no date).

Quarter Sheet 14 SE. Castlemaine (1861).

##### **By Ulrich G.H.F. & Brown, H.Y.L.**

Quarter Sheet 14 SW. Maldon; surveyed 1865, published 1867.

Quarter Sheet 14 NW. Bradford; surveyed 1866–7, published 1868.