

# THE EARLIEST GEOLOGICAL MAPS IN NEW ZEALAND

Bruce W. Hayward, Sascha Nolden and Mike Johnston

**The earliest geological map** of the whole of New Zealand was made by James Hector in 1865 (Nathan, 2014, fig 1), which was based on a compilation of contributions from Ferdinand von Hochstetter (Auckland and Nelson provinces – Hochstetter and Petermann, 1864a, fig 2), James Coutts Crawford (Wellington Province – Crawford, 1864; Grapes et al., 2011, fig. 3), Julius Haast (Canterbury and Nelson provinces) and his own mapping (Otago Province – Coombs, 2007; Nathan, 2011). Hector's 1865 geological map of New Zealand was not published as the government declined to authorise publication as a cost-saving measure (Nathan, 2014). Thus, the publication of this first geological map of New Zealand was delayed until 1869 when Hector (1869) produced an updated version drafted by John Buchanan.

A mineral resources map of the whole of New Zealand by August Petermann with the title *Neu-Seeland (New Zealand) Zur Übersicht der Mineral-Befunde*, at a scale of 1:5,000,000 was first published in German in 1863 and in English the following year, in the New Zealand atlas by Hochstetter and Petermann (1863; 1864a) with colour symbols on the map for gold, copper, chrome-iron, titanite, magnetic iron sand, graphite, coal, nephrite, active volcanoes and hot springs.

Nathan (2014) states that the first published geological maps of an area of New Zealand were "produced" by Hochstetter and Petermann (1864a, b) of the provinces of Auckland and Nelson. The 1864 date reflects the time when the English edition of the first New Zealand atlas was published (Nolden, 2021). German versions of four of the six maps comprising the atlas were first published separately in 1862 and 1863 as plates in Petermann's geographical journal, often referred to simply as Petermann's *Mittheilungen*. All six maps were then published in the original

German edition of the atlas in 1863 (Hochstetter and Petermann, 1863). For more details on the versions, variants, and states of the maps and when they were published, see Brian Marshall's (1998) article on the subject. The first published versions of these early New Zealand maps have sometimes been overlooked, but Marshall concludes that they are of "great significance", as "Many of the earlier maps in Petermann's *Mittheilungen*, and all of those in both the German and English-language versions of the *Geologisch-topographischer Atlas*, represent the first systematic attempt to map the topography and geology of New Zealand".

These maps were based on the field work undertaken by Hochstetter in 1859 at the behest of the Auckland and Nelson provincial governments after he had been given leave from the Austrian Novara Expedition to stay on in New Zealand (Nolden and Hayward, 2023). Also in the early 1860s, Crawford's (1864) coloured sketch map of the geology of Wellington Province was published. Hector's coloured geological map of Otago Province is dated 1864 but was not published (Coombs, 2007).

Charles Heaphy submitted a geological map of the Province of Auckland to the London International Exhibition of Industry and Art (May-November 1862). According to Heaphy (1864c) it was his compilation of his own geological observations together with those of Hochstetter and others. It was presumably a larger and much-updated version of the small map of the province he submitted to the Geological Society of London in 1859 (Heaphy, 1860). It was awarded a medal at the exhibition and was one of two geological maps (the other was of the Auckland Volcanic Field) that Hochstetter incorrectly claimed were plagiarised from his 1859 field work and maps. These two maps became the subject of an acrimonious intellectual property dispute between the two in 1864 (re-examined in

detail by Nolden and Hayward, 2024). There is no known extant copy of this exhibition map, which Heaphy (1864c) says covered the entire Auckland Province (from central North Island to North Cape at that time).

The Nelson Provincial Government also submitted a geological map, along with samples of gold and coal, to the London International Exhibition in 1862. In this instance the map was attributed to the authorship of Hochstetter (Nolden and Hayward, 2023), but was probably a redrawn version of Hochstetter's (1859a) map that he left behind after his 2-month long visit there (see below).

We now know that there were several unpublished coloured geological maps of parts of the country that were produced in the 1850s (and one possibly even earlier). These are (in reverse chronological order):

**1. Geological Map. Northern part of the Province of Nelson, New Zealand, by Ferdinand Hochstetter, 1859 (Nelson Provincial Museum) (Fig. 1)**

When Hochstetter left Nelson on 2 October 1859 he left behind for the use of the provincial government a large multicoloured geological map of most of the province (Johnston and Nolden, 2011, p. 218), primarily drafted by Hochstetter. It was based on the field work of Hochstetter (Nelson, Golden Bay and Nelson Lakes) and that of Julius Haast (northern Marlborough, which on 1 November 1859 had become a separate province). Hochstetter and Haast's observations were supplemented by information from knowledgeable locals such as colliery engineer James Burnett, mining geologist Thomas Hackett, the surveyors John and James Rochfort and miners. This map in the Nelson



Figure 1: Ferdinand Hochstetter, *Geological Map. Northern part of the Province of Nelson, New Zealand*, 1859. Manuscript map, ink, pencil and watercolour on mounted tracing paper, 950 x 880 mm (Nelson Provincial Museum, M1671; Johnston and Nolden, 2011, p. 188, 218).

Provincial Museum is presumably a copy of one that Hochstetter would have taken back to Vienna. The results of subsequent field work by Haast in southwest Nelson (now north Westland) as described in his report (Haast, 1861) was later added to this map (Johnston and Nolden, 2011, p. 264, 265) and formed the basis for later published maps (e.g. Hochstetter and Petermann, 1864a).

**2. Sketch of the Geological Formation of the Auckland District, by Ferdinand Hochstetter, 1859 (Auckland War Memorial Museum) (Fig. 2)**

When Hochstetter departed Auckland on 28 July 1859, after completing his field work around Auckland, southern Auckland Province and Coromandel gold diggings, he left this geological map for the exclusive use of the commissioning entity, Auckland Provincial Government. Alan Mason mentions seeing a map with this title in the Auckland Museum Library and photographed a small corner of it (Mason, 2002, p. 35). Until 2023 it was uncatalogued by the library and therefore





Figure 2: Ferdinand Hochstetter, *Sketch of the Geological Formation of the Auckland District*, Scale 1 inch to the Mile, 1859b. Manuscript map, pencil, ink and watercolour, 1260 x 1120 mm. Copy of Hochstetter's manuscript map drawn by William Boulton (Auckland War Memorial Museum, G9081.C5A8; Nolden and Hayward, 2024, fig. 9).

barely known. It was “rediscovered” by Nolden and was kindly digitally imaged by the Auckland Museum Library and reproduced for the first time in Nolden and Hayward (2024, their fig. 9). Many of its colours have faded, probably as a result of hanging on a wall of the library for many decades (pers. comm. 2024, Ian Thwaites, former chief librarian, Auckland Museum). A study of correspondence over the Hochstetter-Heaphy controversy of 1864 indicates that this map was one of two identical maps produced side by side in 1859 by William Boulton in the Auckland Survey Office under the direction of Hochstetter (Nolden and Hayward, 2024).

This map clearly formed the basis for Hochstetter and Petermann's (1865) map of “The Isthmus of Auckland with its extinct volcanoes”, although the map was completely redrawn by Petermann in a different style on a different base map. Comparison of the 1859 and later published map show a

number of other differences, possibly left off this original in the original in the rush to complete it before Hochstetter left Auckland. This is presumably one of the maps and plans displayed by Hochstetter during his public lecture at the Mechanics' Institute (chaired by Charles Heaphy) on 24 June 1859 on the geology of the Auckland Province.

The above map is the most complete unpublished geological map prepared in 1859 by Hochstetter or under his guidance. Hochstetter's diaries (e.g. Nolden and Hayward, 2023) show that days he spent in the field were interspersed with days he spent writing up his observations and preparing sketched geological maps of where he had been, some in colour. One of these was a five-colour map of the geology of South Manukau-Port Waikato area drawn for Hochstetter by Boulton at the Auckland Survey Office after his field trip there in January 1859 (Nolden and Hayward, 2023, fig. 23).

Other smaller coloured geological maps based on Hochstetter's field work were of more specific areas, such as around Kawhia Harbour (Nolden and Nolden, 2013, their fig. 3.3.10) and Lake Rotomahana (Nolden and Nolden, 2013, their fig. 3.5.10; Johnston and Nolden, 2011, p. 96).

### **3. Rough map showing configuration [of the geology of Wellington Province], by James Coutts Crawford, 1859 (Dr Albert Schedl Collection, Vienna) (Fig. 3)**

When Hochstetter stayed behind in Auckland after the *Novara* departed, he sent a call out for people from around the country to send him samples and information on the geology of their area, as he was not going to have time to visit everywhere. Thus, among the rocks and other specimens he received were snippets of information or small sketch maps of the geology. Of these the map covering the largest area was a three-coloured freehand sketch map of the distribution of three major rock types for



the whole Wellington Province by avocational geologist James Coutts Crawford sent to Hochstetter with a letter dated 30 June 1859 (Johnston and Nolden, 2011, p. 139). Soon afterwards Crawford was appointed Wellington Provincial Geologist 1861-1864.

Hochstetter also compiled several coloured sketch maps of the geology of places such as northern Northland based on the information provided by others (Nolden and Nolden, 2013, their fig. 3.1.1.) which could also be said to be an early unpublished geological map.



Figure 3: James Coutts Crawford, *Rough map showing configuration [of the geology of Wellington Province]*, 1859. Manuscript map, ink and watercolour on watermarked laid paper, 330 x 210 mm (Dr Albert Schedl Collection, Vienna; Johnston and Nolden, 2011, p. 139).

Figure 4: Charles Heaphy, *Sketch of the geology of Wellington*, 1859a. Manuscript map, pencil, ink and watercolour on mounted tracing paper, 590 x 540 mm (Humboldt University Berlin, Universitätsbibliothek der Humboldt-Universität zu Berlin, Historische Geographische Sammlung, AG 72-2)

#### 4. *Sketch of the geology of Wellington*, by Charles Heaphy, 1859 (Humboldt University Berlin) (Fig. 4)

A digital copy of this map was generously donated to the Alexander Turnbull Library (Fig. 4) some years ago. The original map, along with a sketch of Coromandel geology (see below) and plans of some Auckland volcanoes, were taken to Vienna by Hochstetter and later from Vienna to Humboldt University by Albrecht Penck.

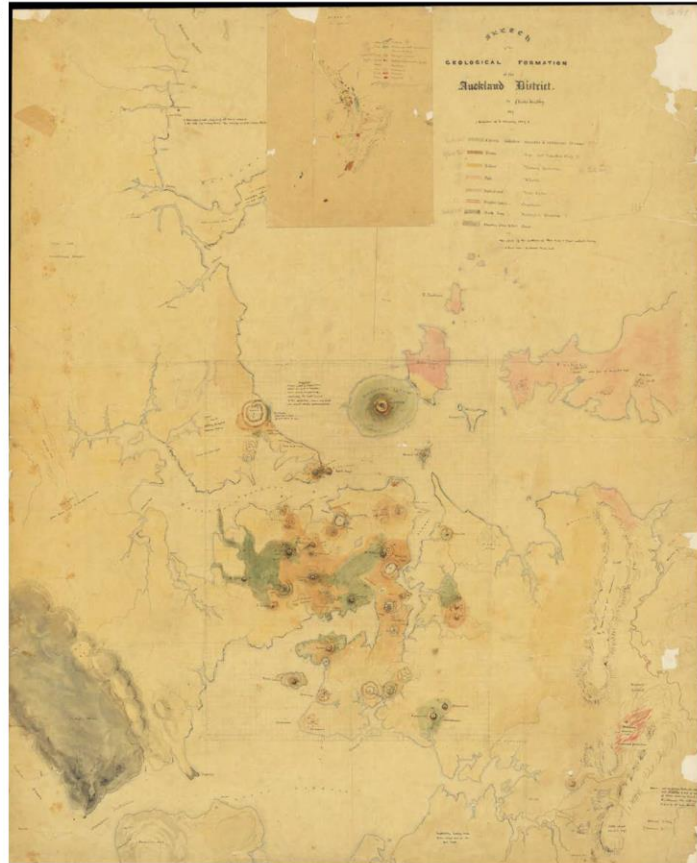
The map shows mostly greywacke on a shaded topographical base, with some "Tertiaries" and minor "Clay Slate" and is a very simple early representation of the province's geology. It is signed by "Chas Heaphy, 1859", but otherwise not much else is known about it. As it was taken to Vienna by Hochstetter we can confidently assume it was among the geological information provided to him while in New Zealand of areas he was not likely to visit. It can also be noted that Heaphy (1864b) claims "When Dr. Hochstetter went to Nelson [July 1859], I made for him at his own request, a general map of the geology of the Nelson country, in treating, as far as I was able, the various formations and intended to serve as my map had done here [in Auckland] as a guide to him in exploring. He wrote to me privately, saying that my map had been of much assistance to him, and was very correct." Unfortunately, there are no known extant geological maps of Nelson province by Heaphy.





**5. Sketch of the Geological Formation of the Auckland District, by Charles Heaphy, 1859 (Archive of the Geological Society of London) (Fig. 5)**

Note that this map has the same title and scale as the one by Hochstetter (1859). It was also drawn on the same base map and has many of the lava flow boundaries the same as Hochstetter's (1859). This is not surprising as correspondence from several survey office staff published in the newspapers in 1864 clearly state that Hochstetter borrowed Heaphy's map from off the wall in the Mechanics' Institute soon after he arrived in Auckland and made a tracing of it for his use in guiding his field work. This is substantiated by the existence of several field maps by Hochstetter of parts of Auckland that are on tracing paper presumably with Heaphy's earlier observations and base map (Nolden and Nolden, 2013, their figs. 3.2.1, 3.2.2, 3.2.7)



This large coloured map was not known to be extant until 2023 when Nolden found a reference to it in the catalogue of the Library of the Geological Society of London and commissioned the digitisation. It was first published in Nolden and Hayward (2023, fig. 13). The map was submitted to the Geological Society of London by Heaphy in 1859 along with a manuscript titled "On the volcanic country of Auckland, New Zealand" which was read at a Society meeting in November 1859 and published a year later (Heaphy, 1860). The central part of Heaphy's unpublished coloured map was copied (with a few errors) and published in black and white together with the manuscript (Heaphy, 1860).

What is the meaning of the words "updated to February 1859" in parenthesis under the map date of 1857? It is well-established that Heaphy presented a coloured sketch map of the geology of Auckland to the Mechanics' Institute in 1857

Figure 5: Charles Heaphy, *Sketch of the Geological Formation of the Auckland District*, 1859b. Manuscript map, pencil, ink and watercolour on mounted tracing paper, 1000 x 830 mm (Geological Society of London, LDGSL/209; Nolden and Hayward, 2024, fig. 3).

(Nolden and Hayward, 2024): "Minute-book of this Institute on the 9th of February, 1857, the following extract is recorded upon the minutes of a general meeting of Committee: - "A geological map was then presented to the Institute by Charles Heaphy, Esq., comprising geological sketches of the district of Auckland. It was moved, seconded, and unanimously carried that a vote of thanks be presented to C. Heaphy, Esq., for his highly esteemed present to the Institute." (Heaphy, 1864a).

It would seem that "updated to February 1859" refers to the field work by Hochstetter on Auckland's volcanoes which was completed in that month, but might be referring to one of the few trips in which Heaphy accompanied Hochstetter around Auckland, to the North Shore volcanoes on 5-7th February 1859 (Nolden and Hayward, 2023).



Hochstetter met Thomas Rupert Jones, the editor of the *Quarterly Journal of the Geological Society*, during his visit to London in June 1860 and was shown Heaphy's manuscript; subsequently the editor added the following statement:

*"The corrections here alluded to have arisen from observations made during the progress of Dr. F. Hochstetter's geological survey of the Auckland District. It is expected that a more complete description of the volcanic and geological features of this and other parts of New Zealand will be supplied in the scientific publications of the Austrian "Novara" Expedition, by Dr. F. Hochstetter, the Geologist of the expedition who remained in New Zealand, at the expense of the Provincial Government of Auckland, for the purpose of making a geological survey of the province."* (Heaphy 1860).

In 1864 Heaphy appears to have accepted this editorial note as being correct, but this was somewhat different from Hochstetter's later assertion (in Hochstetter and Petermann, 1864a) that: *"The map of the Isthmus of Auckland, given in the Quarterly Journal of the Geological Society of London, by Mr. Charles Heaphy, was published without my knowledge, and is a very incomplete copy of my observations and maps, which were in Mr. Heaphy's official charge. In this map that gentleman also introduced his own observations upon the geological formations of the neighbourhood of Auckland, made previous to my arrival in New Zealand, but without possessing even the most elementary knowledge necessary for making a Geological Survey."*

Detailed examination of Heaphy's (1860) essay and unpublished map (1859b) shows that there are only a few places where he possibly changed and updated his 1857 map based on the fieldwork and scholarly interpretation of Hochstetter (Nolden and Hayward, 2024). In our opinion this 1857 map (updated to 1859) may be regarded as essentially that of the avocational and self-taught "geologist" Charles Heaphy.

#### **6. Coromandel Gold District. Distinguishing the apparent Geological Formations, by Charles Heaphy, 1857 (Humboldt University Berlin) (Fig. 6)**

A digital copy of this map was generously donated to the Alexander Turnbull Library some years ago, but only following correspondence with Gerd Schilling, head of the cartographic collections at the Humboldt University in Berlin and additional provenance research, was the map correctly identified and the catalogue record updated by Nolden. The original map was taken to Vienna by Hochstetter when he left New Zealand and later from Vienna to Humboldt University in Berlin by Albrecht Penck. As part of his last field work for the Auckland Province, Hochstetter had visited the Coromandel gold district with Charles Heaphy in July 1859.

This map only marginally qualifies as a coloured geological map of a local New Zealand area, as it consists primarily of a detailed topographic base map with snippets of colour showing locations/ areas of different rock units. The legend recognises



Figure 5: Charles Heaphy, *Sketch of the Geological Formation of the Auckland District*, 1859. Manuscript map, pencil, ink and watercolour on mounted tracing paper, 1000 x 830 mm (Geological Society of London, LDGSL/209; Nolden and Hayward, 2024, fig. 3).

three basic rock units in different colours – slate (=basement greywacke), conglomerate and porphyry (= andesitic breccia) and granite (=crystalline lava) plus surface sand. Also shown are quartz veins, quartz boulders, dikes and gold diggings. The map has additional manuscript annotations and corrections in German by Hochstetter made during or after his visit there with Heaphy.

**7. Hand sketch of the South part of the Middle Island, by Walter Mantell, circa 1848 (Alexander Turnbull Library) (Fig. 7)**

Unlike the previous five unpublished geological maps, this one was likely produced a decade earlier by Walter Mantell in circa 1848 while he was Commissioner for the Extinguishment of Native Titles. The map is based on what he saw during a trip from Akaroa to Kaiapoi and down the coast to Dunedin. On the map there are no formation

boundaries, just coloured patches where he recorded the occurrence of "Primary, Slate & quartz conglomerate, Limestone, Diluvial, Tertiary and Green gritty marl". This could be regarded to be the earliest coloured "geological map" from New Zealand. However, as McLernon has shown with regard to other early geological maps by Mantell, in this case both the dating and attribution may also be considered to be somewhat uncertain (McLernon, 1975). Mantell's (c. 1848) map is similar in basic quality to Heaphy's Coromandel (1857) and Wellington (1859a) maps, nowhere near the quality and detail of Heaphy and Hochstetter's (1859) manuscript maps of Auckland and Hochstetter's Nelson (1859a) map. These last three maps are probably best cited as the earliest New Zealand geological maps.

Are there any earlier coloured geological maps of local New Zealand areas?

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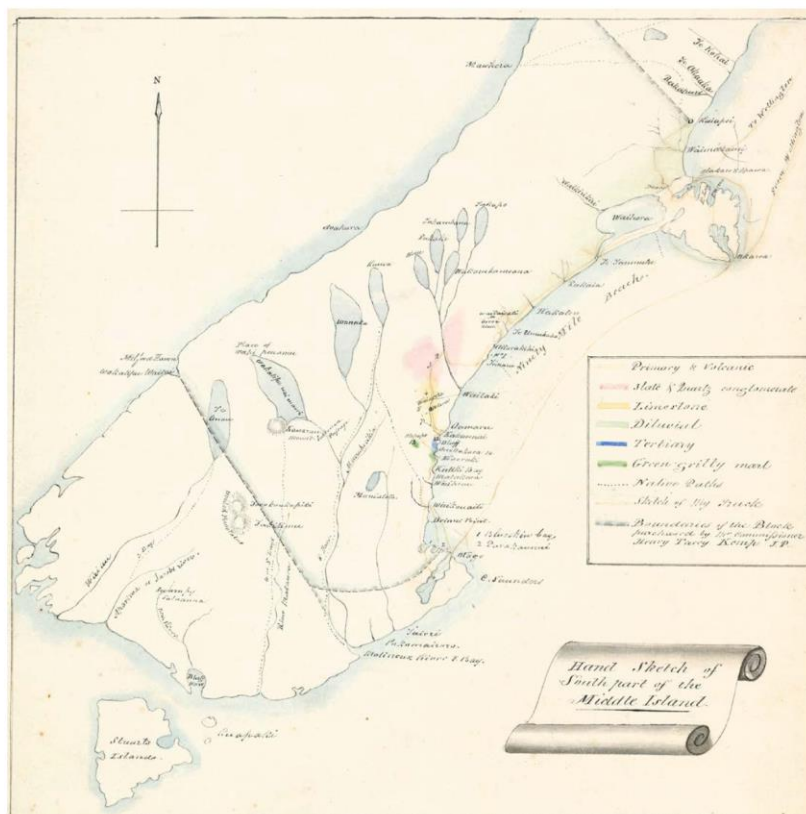


Figure 7: Walter Mantell (attrib.), *Hand sketch of the South part of the Middle Island*, circa 1848. Manuscript map, ink and watercolour on paper, 200 x 201 mm (Alexander Turnbull Library, MapColl-834caq/[ca.1848]/Acc.23675).



# Hayward BW, Nolden S, Johnston MR 2024. The earliest geological maps in New Zealand. Geoscientist Aotearoa / New Zealand 6: 12-19.

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