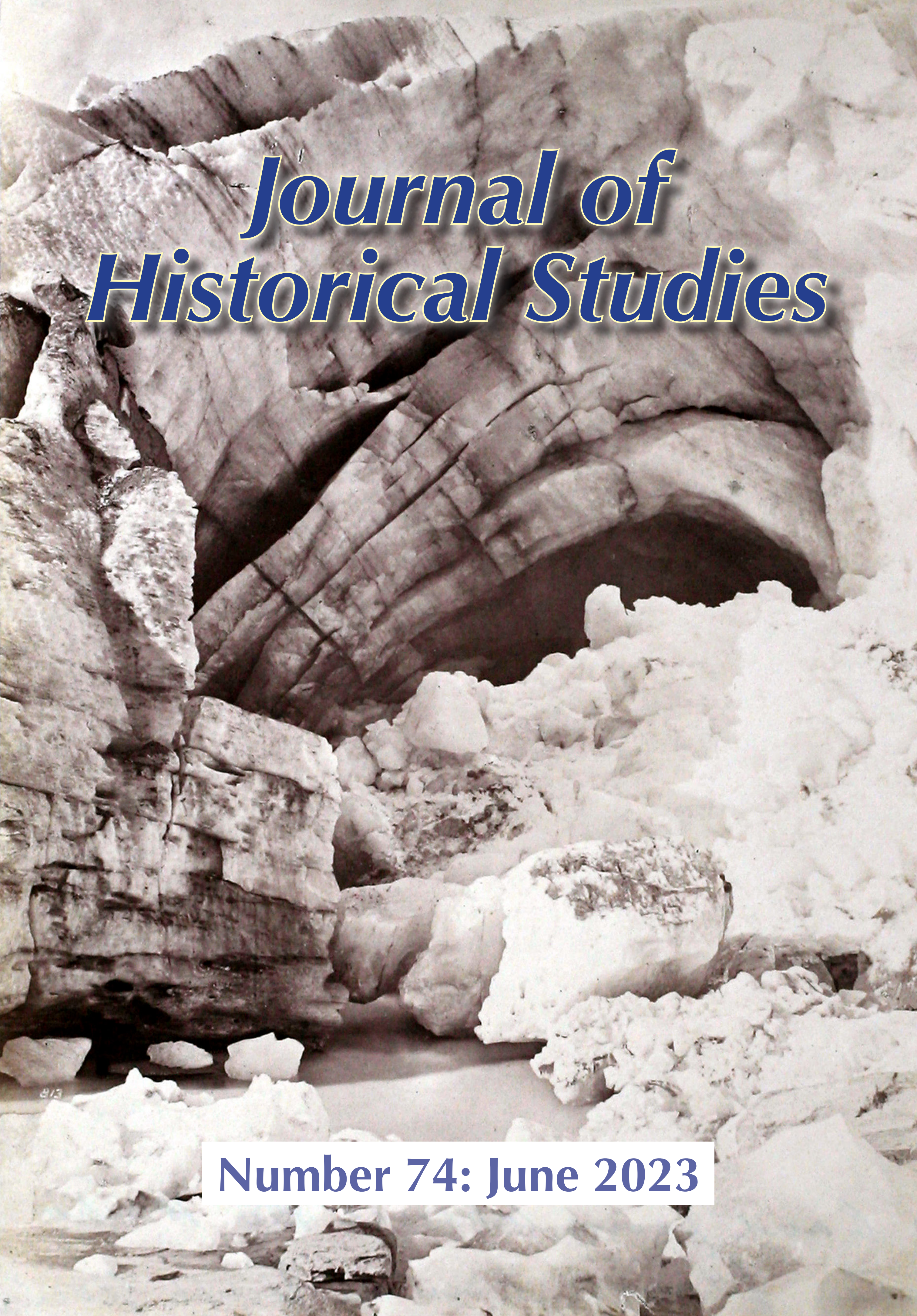
Geoscience Society of New Zealand

Journal of Historical Studies



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Contents

Front cover: Charles Spencer, *Der Franz-Josef-Gletscher südl. Alpen von Neu-Seeland, Gletscherthor mit dem Ausfluss des Waiho*, 1878 (detail). Mounted photographic print with caption by Hochstetter, 205 x 152 mm. Hochstetter Collection Basel (HCB 2.17.3).

Back cover: Julius Haast, *Reconnaissance Map of the interior of the Province of Canterbury, New Zealand* (detail). [Scale 1:253,440] Drawn by Alfred Jarman, Christchurch. Signed: "Christchurch, July 30th 1868. Julius Haast". Archives New Zealand, R22668481.

Julius Haast's first scientific paper: the long-lost Royal Society of Victoria manuscript of 1861 rediscovered

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Introduction

Julius Haast (1822-1887) (Fig. 1, left) was a German-born New Zealand geologist, explorer, and the founding director of the Canterbury Museum. After first arriving in Auckland on 21 December 1858 he travelled with Ferdinand Hochstetter (1829-1884) (Fig. 1, centre) in the provinces of Auckland and Nelson assisting with topographical, geological and mineral resource surveys. In October 1859 Hochstetter left New Zealand and returned to Vienna (Johnston & Nolden 2011).

Haast continued the survey and exploration in the western parts of Nelson Province, producing a manuscript map and published report (Haast 1861b). On completion of his task in Nelson, Haast then went to Christchurch where he undertook a reassessment of the geological properties affecting the planned Lyttelton Tunnel construction. He was subsequently appointed Provincial Geologist on 15 February 1861 (Nolden 2017: 126).

Fig. 1 (from left to right): Julius von Haast (PA2-2514), Ferdinand von Hochstetter (PA2-1004), Ferdinand von Mueller (PA2-0249), Alexander Turnbull Library.

In this new role Haast undertook major annual exploratory surveys in the Southern Alps, following major river systems to their sources and making some of the earliest scientific observations of the glacial regions, while also paying close attention to the flora and fauna in the areas he explored. Although the journals he wrote during his exploratory journeys have not yet been located, many of his printed reports, sketches, maps, and botanical specimens collected survive.

In the year he was first appointed Provincial Geologist, Haast wrote his first major scientific paper and submitted it to the nearest scientific society, namely the Royal Society of Victoria. In Melbourne the manuscript was deemed to be of sufficient interest to be read in full over two meetings and accepted for publication in the *Transactions of the Royal Society of Victoria*, although maps and sketches were requested. However, the journal was in hiatus due to financial constraints, and by the time publication resumed in 1864 the manuscript of Haast's paper had been lost.

Heinrich von Haast, the son and biographer of Julius, noted this most regrettable loss in an entry of the bibliographical section in his monumental work, *The Life & Times of Sir Julius von Haast*, writing:

> On the Physical Geography and Geology of New Zealand, Principally in reference to the Southern Alps. [At page xv of the *Proceedings of the Royal Society of Victoria*, 1861, it is recorded that a paper with this title, contributed by Haast, was read by the Secretary, but the Editor's Preface states that publication of the Transactions having been delayed for four years, Haast's paper had disappeared. It has not been preserved.] (Mentioned in Proc. Roy. Soc. of Victoria. 1861. p. 423.). (Haast 1948: 1089)

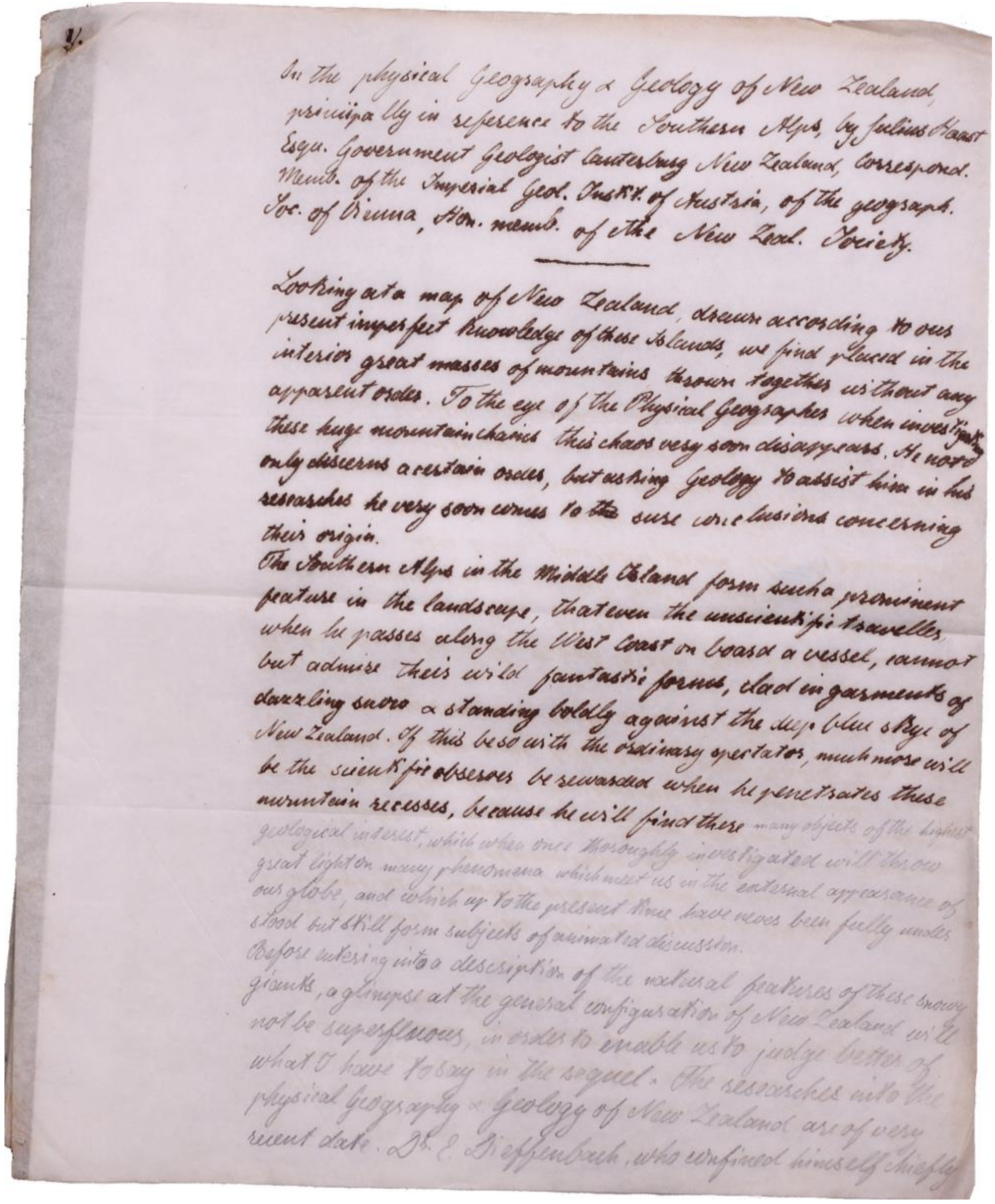
This loss of Haast's manuscript left a considerable gap in the understanding of Haast's earliest scientific writing, as previously he had only written an unpublished treatise on immigration (Haast 1859), a number of newspaper accounts from his explorations and travels with Hochstetter, the important published report (Haast 1861b) on the explorations of the western parts of Nelson province, (which was to earn him his PhD), and the first report for Canterbury – on the survey of Mount Pleasant (Haast 1860). The Royal Society of Victoria paper was the first of Haast's to be read at an overseas learned society and the first to be accepted for publication.

It was a most memorable and satisfying moment when Sascha Nolden found a copy (Fig. 2) of the lost Haast manuscript among Hochstetter's papers he was appraising, documenting and digitising in Basel, Switzerland on 26 July 2011. It was immediately clear what the manuscript was, although written in a completely unfamiliar hand, and therefore obviously a copy.

Research into the mystery of the missing manuscript and the survival of the previously unrecorded copy in the Hochstetter Collection Basel now held in the collections of the Natural History Museum Vienna, revealed some fascinating details, which will be written up in detail and published with full references as a separate paper in due course (Hook & Nolden in preparation).

The copy was made at the instigation of Ferdinand von Mueller (1825-1896) (Fig. 1**,** right) in Melbourne, in contravention of usual rules of the Royal Society of Victoria, and then sent directly to Hochstetter for his reference, given an anticipated delay in the planned publication in the *Transactions of the Royal Society of Victoria*. Late in 1863 the original manuscript was sent on loan to William Branwhite Clarke (1798-1878) in Sydney, but eventually disappeared. Hochstetter published extensively on New Zealand and his descriptions of the Southern Alps were based on information received from Haast, as he acknowledges (Hochstetter 183: 336, footnote 1).

Following the digital repatriation to New Zealand, the manuscript was transcribed by Sascha Nolden in 2023. The transcription was then jointly edited and annotated with George Hook and is published here for the first time, thereby resurrecting Haast's important early paper.



1.

On the physical Geography & Geology of New Zealand,
principally in reference to the Southern Alps, by Julius Haast
Esqu. Government Geologist Canterbury New Zealand, Correspond.
Memb. of the Imperial Geol. Inst. of Austria, of the geograph.
Soc. of Vienna, Hon. memb. of the New Zeal. Society.

Looking at a map of New Zealand, drawn according to our
present imperfect knowledge of these Islands, we find placed in the
interior great masses of mountains thrown together without any
apparent order. To the eye of the Physical Geographer when investigating
these huge mountainchains this chaos very soon disappears. He not
only discerns a certain order, but asking Geology to assist him in his
researches he very soon comes to the sure conclusions concerning
their origin.
The Southern Alps in the Middle Island form such a prominent
feature in the landscape, that even the unscientific traveller,
when he passes along the West Coast on board a vessel, cannot
but admire their wild fantastic forms, clad in garments of
dazzling snow & standing boldly against the deep blue skye of
New Zealand. If this be so with the ordinary spectator, much more will
be the scientific observer be rewarded when he penetrates these
mountain recesses, because he will find there many objects of the highest
geological interest, which when once thoroughly investigated will throw
great light on many phenomena which meet us in the external appearance of
our globe, and which up to the present time have never been fully under
stood but still form subjects of animated discussion.
Before entering into a description of the natural features of these snowy
giants, a glimpse at the general configuration of New Zealand will
not be superfluous, in order to enable us to judge better of
what I have to say in the sequel. The researches into the
physical Geography & Geology of New Zealand are of very
recent date. Dr. E. Dieffenbach, who confined himself chiefly

Fig. 2: First page of the copy of Julius Haast's 1861 manuscript *On The Physical Geography and Geology of New Zealand principally in reference to the Southern Alps*. Hochstetter Collection Basel.

Editorial conventions applied in preparing the manuscript aim to retain, render and represent the original text as it has been preserved in the 1862 manuscript copy of Haast's manuscript written in 1861. The unidentified scribe who was commissioned by Mueller to prepare the copy may have introduced some additional idiosyncrasies and transcription errors, but the language reflects Haast's own unedited text. As the manuscript would have undergone some copy-editing as part of the production process if it had been published as planned by the Royal Society of Victoria, so too has the text presented here been edited to a limited extent, but the original form is referenced in the footnote annotations. The original includes only one small sketch and no subheadings. Sketches, paintings, prints, maps and photographs have been added to illustrate scenes and features described in the manuscript. Where possible sketches and maps that Haast could have supplied in the 1860s have been used. Current topographic maps are viewable by clicking on underlined words. High resolution images of sketches and watercolours can be seen by clicking on underlined reference numbers, titles or holding institutions.

JULIUS HAAST: ON THE PHYSICAL GEOGRAPHY & GEOLOGY OF NEW ZEALAND, PRINCIPALLY IN REFERENCE TO THE SOUTHERN ALPS

[*Start of manuscript*] On the physical Geography & Geology of New Zealand, principally in reference to the Southern Alps[1], by Julius Haast Esqu[ire][2] Government Geologist[3] Canterbury New Zealand, Corresp[onding] Memb[er] of the Imperial Geol[ogical] Instit[ute] of Austria[4], of the [G]eograph[ical] Soc[iety] of Vienna[5], Hon[orary] memb[er] of the New Zeal[and] Society[6].

Looking at a map of New Zealand [Fig. 3], drawn according to our present imperfect knowledge of these Islands, we find placed in the interior great masses of mountains thrown together without any apparent order. To the eye of the Physical Geographer when investigating these huge mountain chains this chaos very soon disappears. He not only observes a certain order, but asking Geology to assist him in his researches he very soon comes to sure conclusions concerning their origin.

The Southern Alps in the Middle Island[7] form such a prominent feature in the landscape, that even the unscientific traveller, when he passes along the West Coast on board a vessel [Fig. 24], cannot but admire their wild fantastic forms, clad in garments of dazzling snow & standing boldly against the deep blue sky of New Zealand. If this be so with the ordinary spectators, much more

1 Original manuscript forms part of the Hochstetter Collection Basel. Digitised by Sascha Nolden & Sandy B Nolden in Basel, Switzerland, on 26 July 2011. On 30 April 2016 Inge von Hochstetter gifted the collection to the Natural History Museum Vienna (Nolden 2016: 15).

2 Editorial corrections, additions, insertions, and other amendments are in square brackets; in the case of abbreviated words, the expansions in square brackets usually replace the original full stop. Editorial adjustments in cases of orthographic variation or idiosyncrasy are noted in the annotations.

3 Haast became the Provincial Geologist in Canterbury on 15 February 1861 (Nolden 2017: 126).

4 Haast was elected as corresponding member of the Austrian Imperial Geological Survey in 1861, with the certificate signed by Wilhelm Haidinger, dated 20 March 1862 (see Alexander Turnbull Library MS-Papers-0037-20-3; Nolden et al. 2016: 43 Fig. 2).

5 In a letter to Haast dated 1 March 1861, Ferdinand von Hochstetter mentions that he has discussed Haast's election as a corresponding member with the committee, of which Hochstetter was a member (Nolden 2013: 41). In a letter dated 4 May 1861, Hochstetter writes that he nominated Haast as a corresponding member at the general meeting [23 April 1861] and the nomination was apparently unanimously accepted, however Hochstetter notes that foreign members must be approved by the Ministry of Foreign Affairs (Nolden 2013: 42). This explains why the formal election and issuance of a certificate of membership was delayed to the meeting on 14 January 1862. The certificate as a corresponding member of the Imperial-Royal Geographical Society in Vienna is dated 14 January 1862 (see Alexander Turnbull Library MSO-Papers-0171-03; Mattes 2022: 141 Fig. 1).

6 Haast was an honorary member of the New Zealand Society; the certificate confirming his election is dated 2 August 1862 (see Alexander Turnbull Library MS-Papers-0037-21-1; Nolden 2017: 128 Fig. 2). The Society was founded in July 1851 with Sir George Grey as founding president but became defunct after Grey left New Zealand. It was then revived in August 1859, and became the forerunner of the Wellington Philosophical Institute, which in turn became the Wellington branch of the Royal Society of New Zealand.

7 Middle Island (Te Wai Pounamu) was the term for the South Island (Stokes & Drury, 1861).

will[8] the scientific observer be rewarded when he penetrates these mountain recesses, because he will find there[9] many objects of the highest geological interest, which when once thoroughly investigated will throw great light on many phenomena which meet us in the external appearance of our globe, and which up to the present time have never been fully understood but still form subjects of animated discussion.

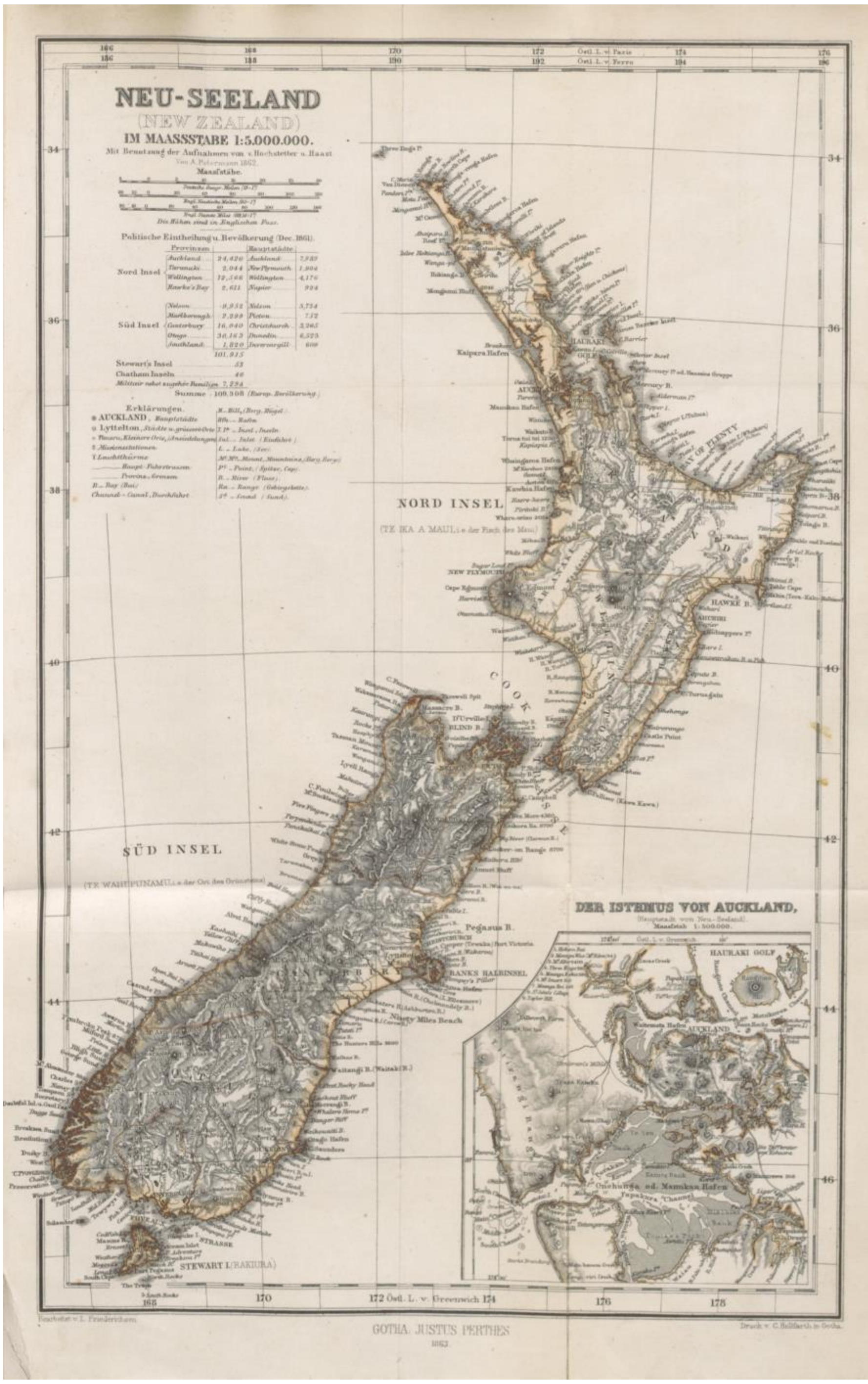


Fig. 3: *Neu-Seeland (New Zealand) Im Maassstabe 1:5.000.000. Mit Benutzung der Aufnahmen von v. Hochstetter u. Haast. Von A. Petermann 1862*. Hochstetter 1864.

8 "be" in manuscript.

9 At this point the writing medium in the source manuscript changes from brown ink to pencil.

[Outline of the Physical Geography and Geology of New Zealand][10]

Before entering into a description of the natural features of these snowy giants [Fig. 4], a glimpse at the general configuration of New Zealand will not be superfluous, in order to enable us to judge better of what I have to say in the sequel. The researches into the physical Geography & Geology of New Zealand are of very recent date. Dr. E. Dieffenbach[11], who confined himself chiefly [2][12] to Zoology, travelled exclusively on the Northern Island, whilst the United States Expedition with the eminent Geologist Mr. Dana[13] on board, visited only one spot, in the far North of the Northern Island. It was not till within the last few years therefore, that anything like a general outline of the Physical Geography & Geology of the Islands could be obtained. In this work my distinguished friend Dr. F. Hochstetter the Geologist of the I. R. Austrian scientific Expedition took the lead, and although he confined himself to the Interior of the Northern Island and the North Western part of the Middle Island, he was notwithstanding able to lay down the broad outlines of the natural features of the whole of New Zealand. Although I enjoyed the privilege of travelling with my eminent friend I shall only touch slightly upon these broad natural features, leaving it to him to give in his work on New Zealand, which we may expect next year, more ample details.[14]

Fig. 4: *The Southern Alps. View from the Mouth of the River Grey*. *From sketches by Dr. J. Haast*, woodcut proof. Hochstetter 1867: 480. Based on the sketch *Ansicht der südlichen Alpen von dem nördlichen Ufer des Mawhera*, *1 Juni 1860*, C-097-051-1, Alexander Turnbull Library.

[10] There are no subheadings in the source manuscript. Subheadings are an editorial addition.

[11] Ernst Dieffenbach (1811-1855), also published in English under Ernest Dieffenbach, the anglicised form of his name. He was one of the first geologists to visit New Zealand, arriving on the New Zealand Co. vessel *Tory* in 1839 along with Charles Heaphy. Dieffenbach went on to complete extensive explorations of the interior of the North Island (Dieffenbach 1843) and Chatham Islands (Dieffenbach 1841).

[12] The numbers in square brackets indicate the pagination of the source manuscript, where the page numbers are written in the top left corner of each page. The manuscript is written single-sided on loose sheets of light-weight semi-translucent letter-size paper (ca 27 x 21 cm), similar to that found in letterbooks of the period.

[13] James Dwight Dana (1813-1895), American geoscientist, geologist and mineralogist on the United States Exploring Expedition, 1838-1842. Some members of the expedition were present at the signing of the Treaty of Waitangi in February 1840. Dana went on the explore the Bay of Islands (Mason 2006: 16-19).

[14] Hochstetter's major illustrated descriptive and narrative account of New Zealand was first published in German under the title *Neu-Seeland* (1863), and in the form of an expanded and revised English translation under the title *New Zealand* (1867). Hochstetter's scientific work on the geology of New Zealand was published as part of the results of the *Novara* expedition, under the title *Geologie von Neu-Seeland* (1864), and translated into English by Charles Fleming (1959).

The main feature of New Zealand is the existence of a high longitudinal mountain system, which begins at the South Western end of the middle Island [Fig. 5], and continues to the East Cape in the Northern Island, broken through by Cook Strait[15], and by a few rivers flowing through lateral or oblique fissures. The South West Coast of the Middle Island presents us with picturesque fiords. Enormous mountain masses rise abruptly from the sea and deep indentations run for many miles inland. The parallel between this coast and the South Western coast of America, or those of Scotland & Norway is very striking; and just as South America has an insulated[16] continuation in the Terra del Fuego, so we find Stewart Island[17] separated from the Middle Island by Foveaux Straits. May we not therefore attribute to one common cause the fact, that nearly every continent & Island has been devastated by some destruction coming from the West, until it has been arrested by some huge mountain chains forming a saving barrier to the low lands lying at their Eastern base?

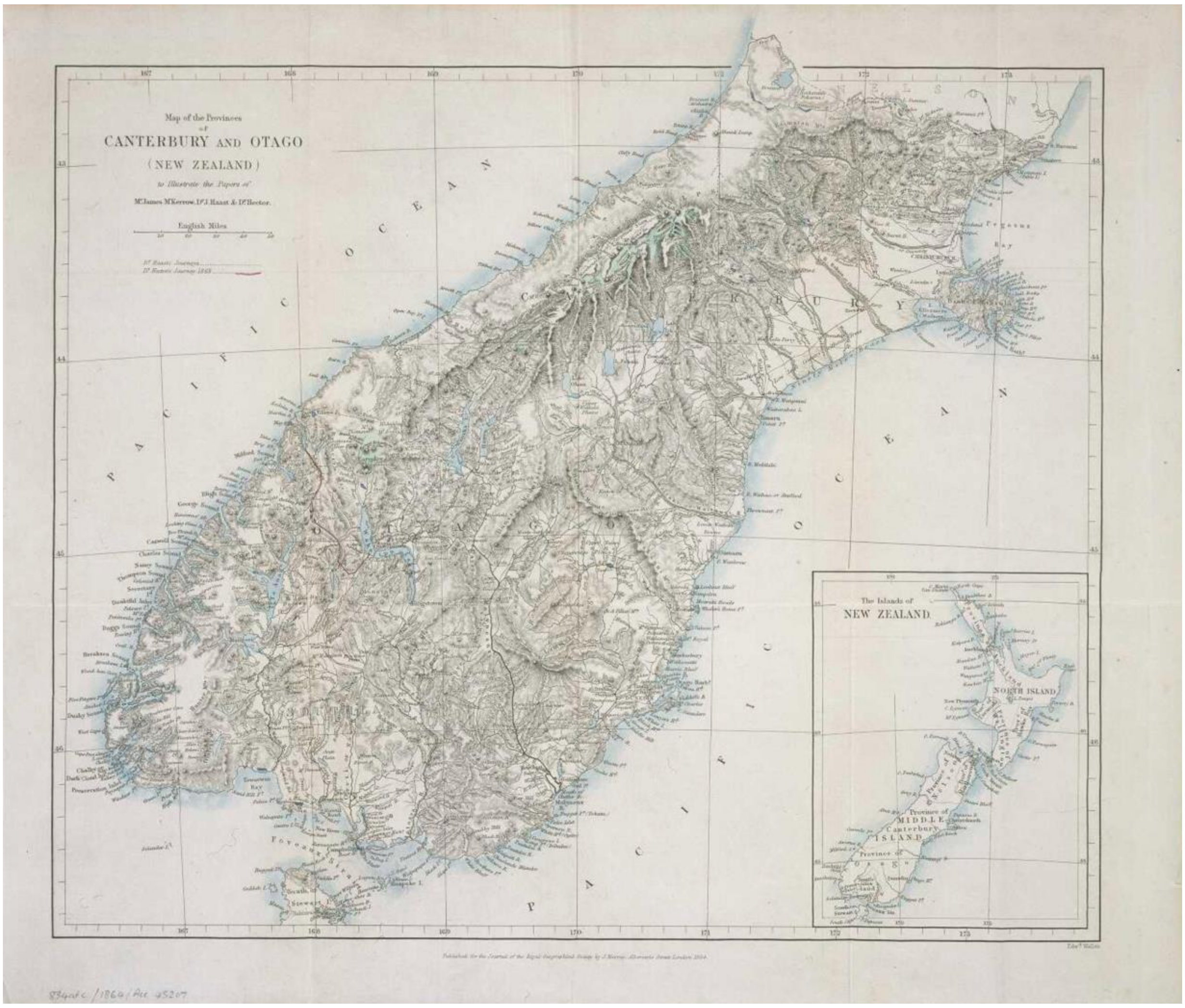


Fig. 5: <u>Map</u> *of the Provinces of Canterbury and Otago (New Zealand) to Illustrate the Papers of Mr. James McKerrow, Dr. J. Haast & Dr. Hector.* Published for the Journal of the Royal Geographical Society by J. Murray, Albemarle Street London 1864. Hand-coloured, 300 x 350 mm, Alexander Turnbull Library.

[15] "Cooks Strait" in manuscript. By 1861 this toponym had been standardised to Cook Strait (see Stokes & Drury 1861).

[16] Authorial intention may have been to use the word 'isolated' here.

[17] "Stewards Island" in manuscript. The name at the time was South or Stewart Island (Rakiura).

In the Middle Island this central chain consisting of one, or sometimes several longitudinal ridges, sends out on its Eastern side many lateral branches, instead of falling abruptly as it does on the West Coast. [3] Eastward of this chain and parallel to it, we find a large Volcanic Zone, consisting of Trachytes and Phonolites, the former rocks forming domes of considerable altitude as f[or] i[nstance] Mt Somers, Mt Hutt, Mt Grey &c. Besides these 2 volcanic rocks we meet a great assembly of pearlites, pitchstones & amygdaloids, filled either with zeolites or siliceous minerals. The existence of water highly charged with silica is rendered still more evident by the occurrence of large veins filled with chalcedony, of large groves of Achate[18], rock crystals[,] Amethysts, cairngorms, citrines, opals and many other forms. The Quartz is often found in pseudomorphous crystals after calcareous spar. Continuing towards the North East this Volcanic zone attains its greatest altitude in the inland Kaikora [Range][19], reaching the sea at Cape Campbell. I am not prepared to say positively whether we meet with volcanic rocks of the same character at the Eastern side of the Ruahine Range in the Northern Island, not having been able to visit this part of New Zealand, but from the few specimens forwarded from that part of the country, I feel certain that there also a large Volcanic zone occurs.

In the Canterbury Province [Fig. 6] these volcanic systems are probably of a Miocene[20] tertiary age, as is shown by the fossils in the strata at their base which are connected with the extensive lignite beds. These Miocene strata again have been broken through & dislocated by later volcanic eruptions of a doleritic & basaltic character. At their base begins a large plain, sloping insensibly downwards to the sea from an altitude of 1500 ft.[21] and reaching in some places a breadth of 40 miles, of which I shall have to treat more fully, when speaking of the Southern Alps. The Eastern coast of these plains would be without harbours but for the existence of another volcanic line running nearly parallel to the first named, say from South South West to North North East, forming around its orifices systems of very interesting character. Whilst in the higher trachytic mountains we miss Lava streams almost entirely, finding instead large deposits of tufa, we find in this Eastern zone true Craters with calderas, in the centre of which small Islands rise, without doubt the lateral centres of volcanic action, (Leopold von Buch's Craters of Eruption[22]). The barrancos[23] of these harbo[u]rs form their entrances. I may here mention that if the theory of Craters of Elevation & Craters of Eruption had not already been proved to be fallacious[24] [4] by a more minute

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[18] German synonym for agate.

[19] "Kaikoras" in manuscript. Toponym was Kaikora Range at the time (Stokes & Drury, 1861). In modern orthography Kaikōura Ranges. These ranges are not of volcanic origin.

[20] "myocene" in manuscript. The term has been editorially adjusted for consistency in this edition; noting that by page 7 of the source manuscript Haast uses the correct orthography of Miocene, albeit still in lower case.

[21] Feet. 1000 feet = 304.8 metres.

[22] Leopold von Buch (1774-1853), German geologist and palaeontologist. In 1821 Buch revived and expanded the controversial elevation crater theory about the origin of volcanoes, first proposed by Peter Simon Pallas in 1777.

[23] Barranco is a Spanish term for a narrow valley with steep sides.

[24] In a letter dated 1 March 1861 Hochstetter had informed Haast that he, "Like Lyell and most other geologists, had given up on the idea of elevation craters" (Nolden 2013: 41).

examination of the observations upon which that theory was constructed, these systems of New Zealand would give ample opportunities for its refutation. This 2nd Volcanic system ceases in Cook Strait[25] and it is obvious that the volcanic action travelled from South towards North, because whilst the other vents have been long since extinct we meet here with an active submarine Volcano lying a little to the North of the centre of the straits. The eruption of this volcano causes the visitation of the neighbo[u]ring country with numerous earthquake shocks, generally without doing mischief, although during the last 22 years, of which only we have any record, there has occurred every seventh year an earthquake of more than usual violence. The last of these took place in 1855.[26]

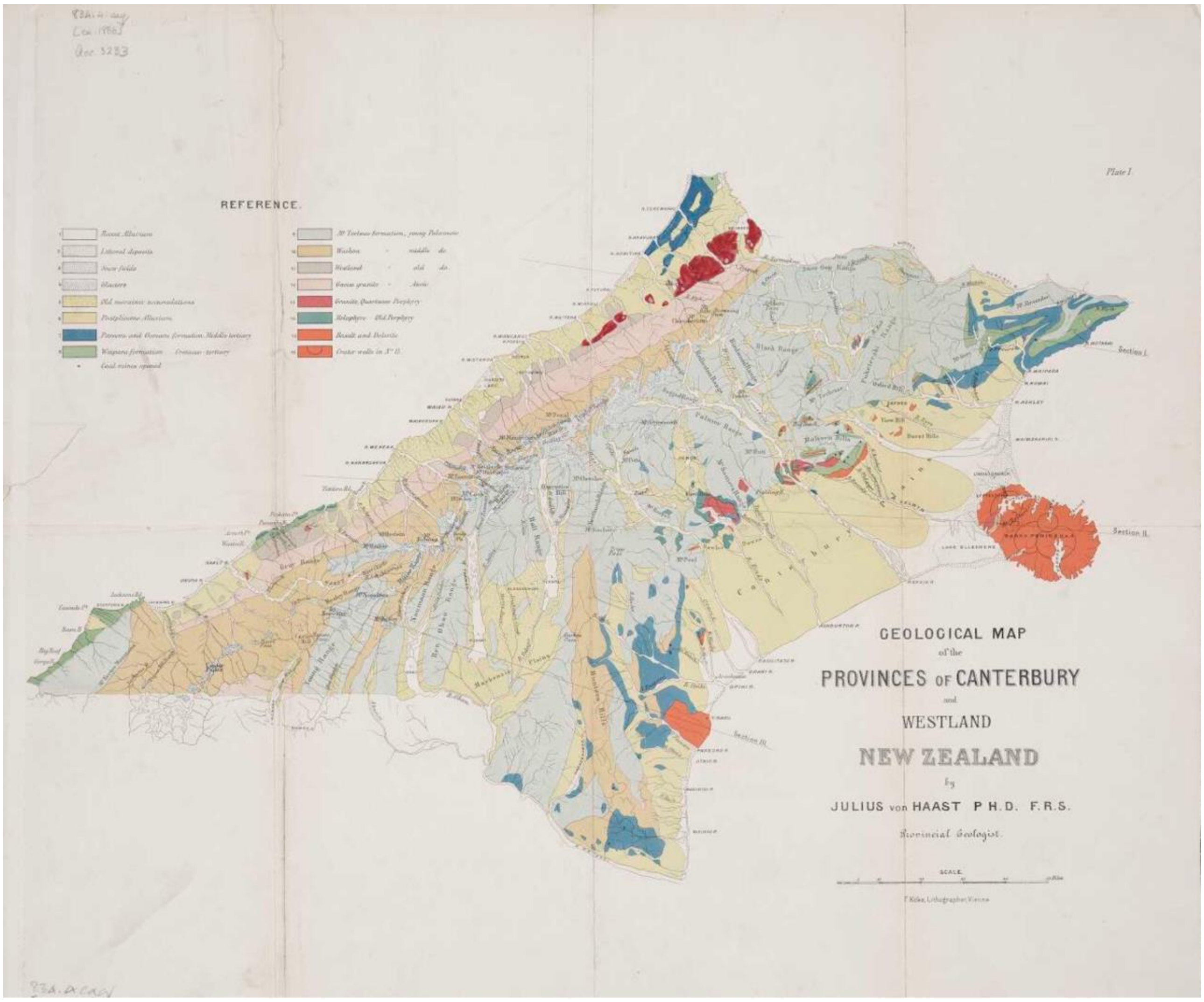

Fig. 6: Julius von Haast, *Geological map of the Provinces of Canterbury and Westland, New Zealand*, colour lithograph by F. Köke, Vienna. Haast 1879: plate 1, 390 x 470 mm, Alexander Turnbull Library.

Had we not sufficient data to prove the existence of this volcanic system in the Straits from the soundings, which give us accurately the position of its orifice & the configuration of the crater walls, the observations made during the great earthquake of 1855 would furnish all with ample

[25] "Cooks Straits" in manuscript. The correct toponym at the time was Cook Strait (Stokes & Drury 1861).

[26] The 1855 Wairarapa Earthquake took place on 23 January.

proofs. During this earthquake a wave several feet high came on shore and Muka Muka[27] point near Wellington was suddenly raised 9 ft, the elevation gradually diminishing towards East & West to 2 ft in Wellington itself. Two days after the earthquake vessels sailing over this submarine volcano met with tons of dead fish, covering the surface of the sea.[28] It is evident that the coast is rising considerably near Wellington, the raised beaches being most conspicuous even to a spectator on board a steamer entering the harbo[u]r. I had another opportunity of studying some earthquake phenomena connected with this submarine volcano when occupied with a Geological Exploration of the Wairau & Awatere valleys. In the former I met with many smaller fissures, in the latter I found one 3 ft broad in some places & many feet deep now nearly filled up. All these were formed during the great earthquake of 1855. This remarkable Awatere fissure runs in a straight line some 40 miles inland in a South Westerly direction.[29] Where it runs along the hillsides enormous slips have taken place. All these fissure lines point to the submarine volcano in Cook Straits, from which they radiate as their common centre.[30] The phenomenon forces upon me the conviction that the numerous dykes which we find in volcanic zones also radiating from the centre of the crater orifice, have been formed by the same agency & filled up by molten matter from below. If they had been formed by gradual upheaval according to the theory of Craters [5] of Elevation, they would thin out, being thickest near their centre. But during a survey of the crater walls of Port Victoria[31] in Bank's Peninsula (a true caldera), I had ample opportunity of studying the nature of the numerous dykes and of measuring them from their common centre to the slopes of the caldera at the beginning of the plains; and I found invariably that they were not only equally broad in their whole length, but that some of them became broader the more they were distant from the latest centre of eruption.

[32]Unfortunately we have not any observations on the waves of commotion (no sei[sm]ometers being placed anywhere). The only shock which I felt in New Zealand occurred in Nelson on September 21 1860 at 12h. 32m. p.m. A rumbling subterranean noise was first heard which continued for 1 minute, after which a slight & single horizontal shock took place. The direction was from East to West pointing to Cook Strait[33]. A light South Westerly wind seemed to cease but began to blow again after a few minutes. The sky was lightly covered with cirrocumuli, but it was a fine sunny day. Aneroid 29,875". Thermometer in shade 53.43. (I examined carefully the mountain chains on both sides of Cook Strait & I found that they corresponded closely with each other in strike, dip & lithological character, so that the Tararua mount[ains] on the Wellington side & the Ruahine Range, as the same chain is called more towards the North, form[34] the continuation of the

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[27] Muka Muka Point is a location on the western side of Palliser Bay, now known as Windy Point.

[28] This account of the cause of the 1855 Wairarapa earthquake is very similar to that given in *Neu-Seeland* (Hochstetter 1863: 42–43). It was one explanation in vogue at the time (Grapes & Downes 1997: 338).

[29] Hochstetter describes Haast's observations of that fault in the English translation of *Neu-Seeland* (Hochstetter 1863: 43) and the English translation (Hochstetter 1867: 72).

[30] On the basis of historical evidence, the 'preferred location' of the epicentre of the 1855 earthquake is currently considered to have been in Cook Strait at 41.4°S, 175.5° (±0.5°) (Grapes & Downes 1997: 279).

[31] Port Victoria was an earlier name for Lyttelton Harbour.

[32] Editorial insertion of paragraph break.

[33] "Cooks Straits" in manuscript. This has been editorially adjusted in this edition for consistency.

[34] "from" in manuscript.

Eastern chains in the Middle Island, & particularly of that between the Wairau & Awatere, and we may therefore safely assume that this break has principally been occasioned by the submarine Volcano in the Straits[)]. At the Western side of this central chain in the Middle Island no volcanic rocks are to be found, the rugged coast consisting almost exclusively of granitic or metamorphic rocks. But it is at the Western side of the central chain of the North Island [Fig. 7] that we meet again with a large volcanic zone[35], which not only exhibits extinct craters of huge dimensions as f[or] i[nstance] Ruapehu[36] & Taranaki, but also presents us with many natural phenomena proving that there volcanic action goes on with unabated activity. This volcanic line begins at the Western coast with the magnificent volcanic cone Taranaki (Mt Egmont 8676 ft), now extinct and ends at White Island in the Bay of Plenty, still active. It is in this line that we find Tongariro a volcano of an altitude of at least [6] 7000 ft, which from its 3 orifices exhales continually dense clouds of white vapo[u]r.

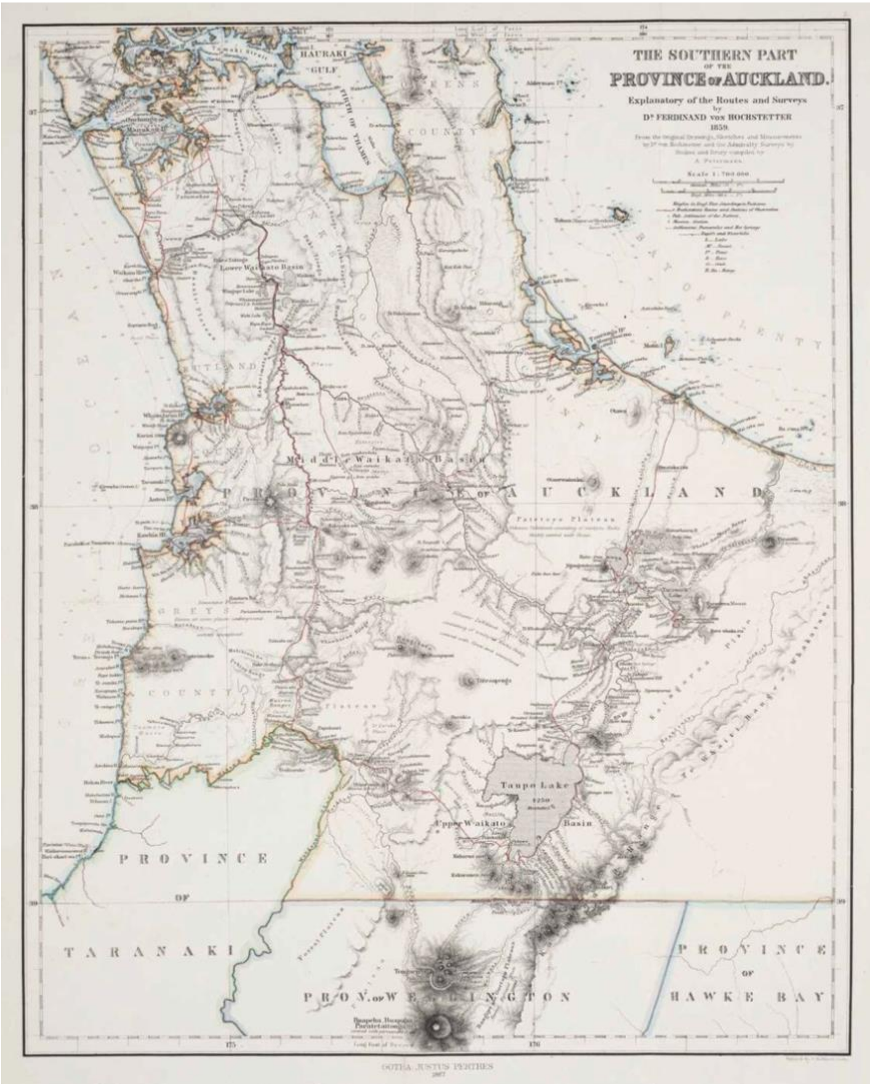
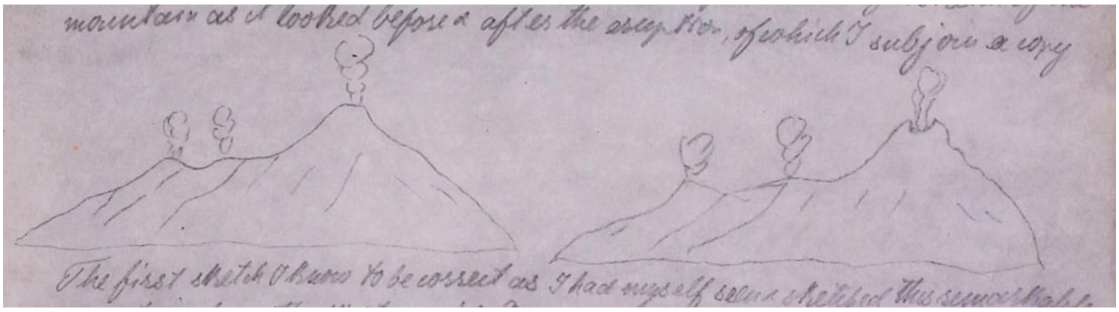


Fig. 7: *The Southern Part of the Province of Auckland: Explanatory of the Routes and Surveys by Dr. Ferdinand von Hochstetter, 1859*. From the Original Drawings, Sketches and Measurements by Dr. von Hochstetter and the Admiralty Surveys by Stokes and Drury. Compiled by A. Petermann. Hochstetter 1867. Alexander Turnbull Library.

35 Now known as the Taupō Volcanic Zone, but it does not include Taranaki.

36 "Ruapeha" in manuscript is likely a transcription error, with correct spelling found elsewhere.

The last eruption, accompanied with subterranean thunder which lasted many hours, took place in the beginning of December 1859. During this eruption the form of the highest cone Ngauruhoe[37] was changed, a part of it being thrown down. In order to preserve the account[38] of this event I shall give the narrative of the 2 gentlemen who related to me the circumstances of this eruption. Mr Charl[es] Smith[39] & Mr Götty[40] both settlers in Wanganui, at the end of November 1859 passed over the vast pumice stone plateau lying at the Western base of Tongariro & Ruapehu, on their way to Lake Taupo, and observed that from the highest cone of Tongariro great masses of steam ascended. The[y] arrived at Tukanu[41] at the Southern side of Lake Taupo without anything unusual having occurred, but on one of the first days in December a loud subterranean noise, like thunder, began and lasted with unabated force for 1½ hours, they did not feel any motion of the ground, the sky at the time was cloudless & the weather very hot & oppressive. They observed that during this time unusually large quantities of boiling water issued from the Tukanu Springs, which were in great activity falling & rising sometimes to a height of 30 ft. the usual rise being from 2 to 3 feet. On my asking w[h]ether the water of the lake had not been disturbed or become turbid[42] or muddy, or w[h]ether they had not observed ashes, lapilli[43] or pumice stones falling down from the air or floating on the lake, brought down by the neighbo[u]ring Waikato or Tongariro river, they assured me, that there had not been the least change in lake or atmosphere, both remaining in their usual state. As Pihanga, a volcanic cone[,] lies between Tukanu & the system of Tongariro, they could not observe the latter, so as to judge w[h]ether larger clouds of vapo[u]r than usual were rising. 8 days after this disturbance they returned by the same road to Wanganui and in passing again over the pumice stone plains they were not a little astonished upon finding instead of the rounded unbroken highest cone Ngauruhoe, two horns & it was quite evident to them that the Western side of the cone had fallen in or had been blown out, the clouds [7] of steam issuing from this crater being now unusually small. Although they searched carefully on the ground they could not observe the least sign of fresh lapilli on the plains. Mr Smith at my request made from memory a sketch of the mountain as it looked before & after the eruption, of which I subjoin a copy[:][44]



[37] "Ngaurohoe" in manuscript is likely a transcription error, with correct spelling found elsewhere.

[38] Haast reported the account to Hochstetter, who included details in a publication (Hochstetter 1864: 99-100).

[39] Charles Smith (1833-1908) of Whanganui, born in Wiltshire and arrived in New Zealand circa 1859.

[40] John Gotty (1809-1893) of Whanganui, formally named Johann Maximilian Wolfgang von Goethe.

[41] Modern orthography for this toponym is Tokaanu.

[42] "turpid" in manuscript.

[43] Lapilli are rounded droplets of ejected molten lava that partly solidify in flight.

[44] The drawing on page 7 of the manuscript, which shows Mount Ngauruhoe pre- and post-eruption, would have been copied or traced from the original document.

The first sketch I know to be correct as I had myself seen & sketched this remarkable mountain from the Western side 8 months previously.

Lakes, Geysers, boiling springs, solfataras, salses[45] [Fig. 8] without number lie all along this line or fissure, which runs nearly South West & North East, and make this part of the Northern Island without doubt one of the most interesting countries in the whole earth. North of this line we also find here & there older stratified rocks, but the greater part of the country to Cape Maria van Diemen is covered with volcanic systems of several periods from the Miocene tertiary age to more recent times. But here also the existence of extensive lignite beds with their characteristic exuviae in the Waikato & Waipa basins, as well as near Auckland prove that the volcanic action took place principally during the Miocene period, although at many points those beds are broken through or disturbed by later eruptions of basaltic rocks. Earthquakes on the Volcanic line between Mt Egmont & White Island are very frequent, principally round Tarawera[46], at this lake a month seldom elapses without a slight shock being felt, but it seems that it is only where greater oscillations occur from the centre near Wellington, that the waves of commotion are very heavy and at those times they are felt considerably even in Auckland.

Fig. 8: *Die Solfatatare Ruahine am See Rotoiti (The solfatara Ruahine on lake Rotoiti).* Hochstetter 1864: 148. Woodcut by Eduard Ade, commissioned by Hochstetter in 1861. Based on a sketch by Hochstetter dated 6 May 1859.

[The Southern Alps]

The Southern Alps begin properly speaking on the Southern side of the saddle[47] between the Taramakau and Hurunui [rivers], the boundary of the Nelson & Canterbury Provinces. The Spenser Mountains, although covered with perpetual snow, from which on both sides glaciers descend,

45 "salsas" in manuscript. They are mud volcanoes.

46 "Taravera" in manuscript, likely a transcription error.

47 Harper Pass.

giving rise to the Wairau-ua[48] and the Mataki-taki [rivers], are isolated and belong to the system of Kaikoras. Here on the Southern side of the Taramakau Kaimatau[49] raises his snow pyramid, and from here, as far as [8] observations have been made and passes have been sought for, no breaks occur till we arrive at Foveaux Straits. Like a wall this stupendous chain rises covered with perpetual snow from which huge glaciers descend, from whose ice vaults in this province the turbid[50] waters of the Waimakariri, Rakaia, Ashburton, Rangitata & Waitaki rush towards the [east coast of the province. The rivers of the][51] west coast, also glacial streams do not attain the same magnitude, being much more numerous owing to the chain lying here much nearer to the coast. Before I began my researches in this alpine country several adventurous persons desiring to reach the West coast by land had tried to cross these chains. The[y] returned without success & related that they had seen glaciers, but they were hardly believed till I confirmed their statements.

The alpine chain continues from Kaimatau to Mt Tyndall[52], apparently in one unbroken mass, having on its Eastern flanks the sources of the above named rivers, with the exception of the Waitaki[53]. From Mt Tyndall which lies in lat 43°20' long 170°46' its course, which till then was from North East to South West, changes, the main chain running in a West South West direction towards Mt Cook, the highest point in the whole Alps. Another, the middle chain, continues in a South Western line from the same nucleus; and in the valley between it & the main chain the sources of the Pukaki are found, forming at the base of Mt Cook a lake of considerable size. Another high range also branching off from Mt Tyndall has a South South West direction. I named it the Forbes range[54], in hono[u]r of Profess[or] James D. Forbes[55] the eminent natural philosopher.

Between the middle & Forbes range flows another branch of the Waitaki, forming in the same latitude with Lake Pukaki another lake of considerable extent, called Tekapo[56]. The outlets of these 2 lakes uniting, form the Waitaki, the most important river of the East coast, because it not only brings the waters from the same névés[57] which feed the glaciers of the Rangitata but it also drains the chains as far down as Mt Cook, and even this giant with its Southern continuation contributes largely to its volume. The Southern continuation of the Forbes range is called by the settlers the [9]

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48 Most likely Haast was referring to the Waiau Toa / Clarence River.

49 Kaimatau is also known as Mount Rolleston (2275 m) in Arthur's Pass National Park.

50 "turbid" in manuscript.

51 Missing text replaced with text from an identical passage in a newspaper report of a lecture by Haast (1861a).

52 This was one of three peaks named Mount Tyndall by Haast. This particular mountain is now known as Outram Peak (Burrows 2005: 48).

53 The Waitaki River catchment is south of Mount Tyndall (Outram Peak).

54 Now part of the Sibbald Range.

55 James David Forbes (1809-1868), Scottish physicist and glaciologist.

56 "Tecapo" in manuscript, most likely a transcription error.

57 A névé is the upper area of a glacier in which accumulates snow. In the manuscript the acute accent tends to be used only on the final letter. This term has been rendered consistently using the modern standard orthography of "névé" in this edition.

Two Thumb range & still lower down Mt Peel, the foot of it being washed for a considerable extent by the Rangitata.

The Rangitata [Fig. 9] has 2 main branches both arising from Mt Tyndall[58] and lying close together the glaciers from which they issue, descending probably from the same névé. Between them run[s] for 16 miles in a South South East direction a high lateral ridge[59] also covered with glaciers, and still reaching in Cloudy Peak near the junction of these 2 main branches an altitude of at least 9000 ft. I named the South branch the Havelock & the Northern the Clyde.

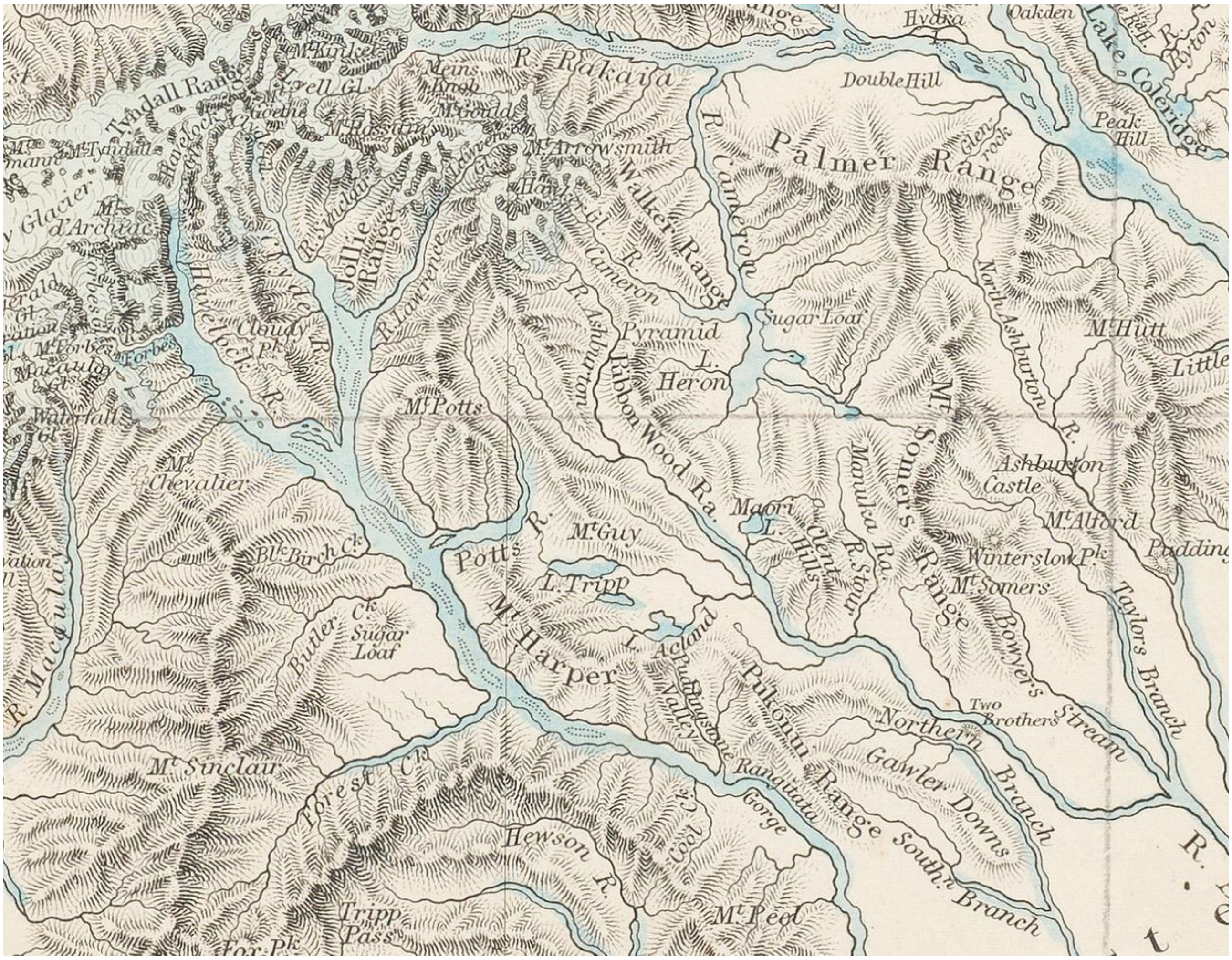

Fig. 9: *Map of the Southern Alps in the Province of Canterbury (New Zealand). Reduced from the large map by Julius Haast, Ph.D. F.R.S.* (detail), 693 x 411 mm. Published for the Journal of the Royal Geographical Society by John Murray, Albermarle Street, London 1870.

Between the Clyde & the Rakaia we meet another lateral chain[60] running in a South East direction to Mt Arrowsmith lat 43° 44' long 179° 97'.[61] This chain, being in fact little inferior in

[58] Outram Peak.

[59] Now known as the Cloudy Peak Range.

[60] Now known as the Jolie Range.

[61] The coordinates given here are obviously incorrect due to transcription errors. The correct location of Mount Arrowsmith is latitude 43°21'25''S and longitude 170°58'42''E.

altitude to the central range, is also covered with perpetual snow, from which numerous glaciers are fed. From this lateral chain 3 main streams descend to the Clyde, the most westerly of which I called the McCoy, in hono[u]r of Profess[or] F. McCoy[62] the distinguished palaeontologist, the middle one the Sinclair in commemoration of my lamented friend Dr. A. Sinclair[63], who was drowned in the Clyde during this exploration, and the Easterly one the Lawrence after an Indian Hero[64]. The last mentioned stream issues from a stream the névé of which covers the South Western sides of Mt Arrowsmith opposite to the sources of the Ashburton. I was not able to reach the line of perpetual snow in this wilderness, though I tried several times, owing to the frightfully steep character of the mountainsides, & to its luxuriant alpine vegetation the density of which defies description, besides which my companions, though very willing to assist me, were unexperienced mountaineers & I did not like to risk another life in my attempts. From the observations, which I was able to make I conclude that the line of perpetual snow must be at an altitude of about 8000 ft. But as I shall have the opportunity of trying further ascents for which I shall make the necessary preparations, I hope to verify this important point.

[65]One highly striking observation, which thrusts itself on the explorer is the enormous waste which goes on amongst the rocks. I have seen mountains rising from 5000-6000 ft from the valleys, which were covered everywhere with rubbish, [t]hey were in fact [10] one continuous talus[66] of detritus from the summit to the foot [e.g. Fig. 10], with hardly any rocks visible in situ, but the reason is obvious when we consider the frequent thunderstorms with lightning, by which the rocks must be riven, the heavy falls of rain by which the loose pieces are washed down & the great difference between the diurnal & nocturnal temperature. After the observations which I made, I can state that in this region at an altitude of more than 3000 ft. the temperature at least for 6 months of the year falls generally during the night below freezing point, whilst by day the sun is so powerful, that in middle of winter in the shade the temperature is much above freezing point and in the sun it is really warm, the days being generally very fine & the sky cloudless during that season. If we further consider the continual changes between the hot North West & the cold South East winds by which the mountains are alternately swept it is evident that [by] the condensation of the clouds forming ice in the fissures, another & powerful agency for the destruction of the rocks must be furnished. All these causes however would not give such a result if the rocks themselves in their lithological character, as far as I examined the Alps, did not offer the greatest facilities for their disintegration. These rocks consist of very much inclined generally almost vertical strata of greyish & greenish sandstone often passing into very hard pebble beds, and of blueish, purple & black clay slates alternating with each other, so that the steep rocky walls have quite a ribbon like appearance. On the edges of these strata lie unconformably more recent beds, consisting for the most part of dark & blueish slaty shales, arenaceous & argillaceous dark colo[u]red limestones & conglomerates, the

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62 Frederick McCoy (1817-1899), Irish palaeontologist, academic and museum administrator in Melbourne.

63 Andrew Sinclair (1794-1861), British botanist, administrator and surgeon. Drowned on 26 March 1861 while on an expedition of exploration with Haast to collect botanical specimens for Joseph Hooker.

64 Most likely John Lawrence (1811-1879), English statesman who served as Viceroy of India. But could also refer to one of John's older brothers, Sir George and Sir Henry.

65 Editorial insertion of paragraph break.

66 Talus is another name for a scree.

former at some places replete with fossil shells at others with impressions of ferns & other plants, which show that they belong to the carboniferous period. The older beds seem generally to be devoid of fossils, for though I searched perseveringly in many places I was only able to secure 1 fossil of doubtful character, but the rocks have all the appearance of Silurian beds; Both formations are not only slaty but also very much [11] jointed, and this will also account for their being much more disintegrated than would have been the case if the huge mountain masses had consisted of Plutonic or eruptive rocks. It is astonishing indeed, that whilst this central chain North of the Hurunui[67] consists almost entirely of Plutonic or metamorphic rocks, its continuation presents quite another appearance[.] I examined carefully into the lithological character of the mountains along the banks of the River Ashburton & Rangitata to their icy sources and was not able to find the le[a]st sign of the existence of hypogene rocks[68], not even the existence of a dike. In the Rangitata in its upper plains I found only one large half decomposed boulder of dioritic rock (trap) but it is very possible that it was derived from the drift formation[69] which is here so largely developed, and I met with another similar block in the terminal moraine of the Ashburton glacier [Fig. 10]. In the conglomerate of the carboniferous beds, which consist principally of boulders & pebbles derived from the same rocks of which the Alps are composed; I met besides great quantities of cherts, hornstones Quartz & other silicious rocks, many boulders of granite, gneiss & porphyry, some of the latter of great beauty & never seen by me anywhere in situ. From the specimens collected for me down the West coast, South of the Taramakau I conclude that granitic & metamorphic rocks will again make their appearance there.

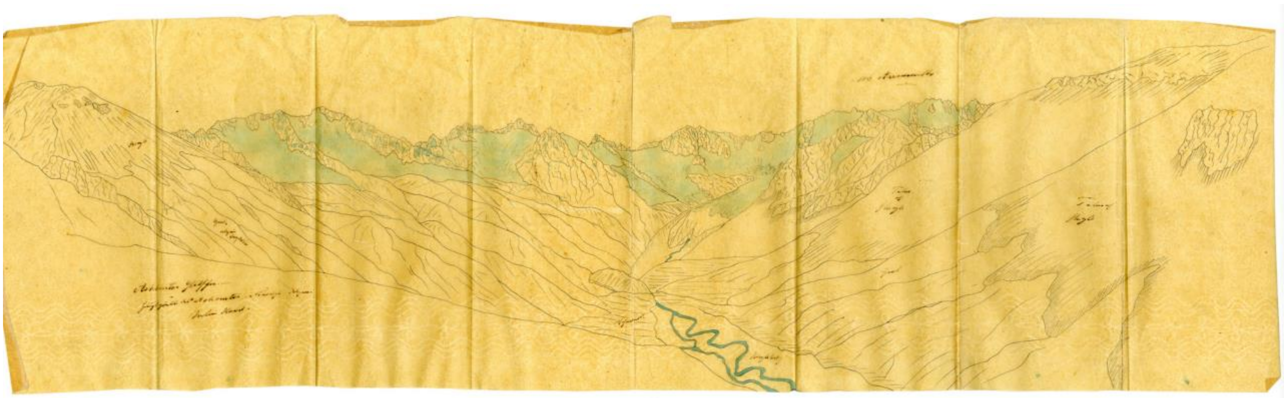

Fig. 10: Julius Haast, *Ashburton Gletscher Hauptquelle des Ashburton - Südliche Alpen* [1861], ink and watercolour on tracing paper, 250 x 850 mm, Dr Albert Schedl Collection, Vienna. The labels on the mid-ground slopes framing the view read "Talus of shingle".

Having given in the preceding remarks a short outline of the features of the country I shall now proceed to enter into the main object of this paper, treating more particularly of the Alps & the physical & geological phenomena connected with them & I shall give such extracts from my journals as bear directly on the subject.

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67 "Huranui" in manuscript, likely a transcription error.

68 Hypogene rock is formed at great depth in Earth's crust, such as plutonic and metamorphic rock are.

69 Drift formation refers to deposits of till and erratic boulders that, according to Charles Lyell, had been deposited by melting icebergs on the seafloor before the land rose above sea-level (Lyell 1837: 173-174). Till is unsorted material ranging from boulders to clay particles.

[The Physical and Geological Features of the Rangitata River]

Standing at the mouth of the Rangitata near the seashore the eye of the spectator sweeps Westwards over large plains seeming to be level; but ascending one of the small sand hillocks which have been formed here & there near the coast, he will be able to see their whole extent to the foot of the hills nearly 40 miles distant. This alone without further observation would show that they are greatly though gradually rising. I may here mention that these plains, covered with grass over which occasionally [12] an elegant Cordylina Australis[70] raises its palm like crown of leaves are, with the exception of the large rivers rushing through them, without water, so that distances of more than 20 miles have often to be travelled over, before it can be obtained, which fact in New Zealand may be considered a curiosity. These plains present us often with the beautiful[71] phenomenon of Fata Morgana (Mirage) of which I had one interesting instance. Following up the Rangitata, the water of which after rainy weather, hot North West winds & the melting of the snow has quite a muddy dirty colo[u]r, whilst in winter & after a long continuance of fine weather in summer it is of that deep semi opaque blue peculiar to glacier streams; we observe that the river for several miles from the sea flows above the level of the plains. It resembles therefore the Po & the Adige[72]. Its shingle bed is often 2 miles broad, over which the river rushes in 1 or several streams, changing its channels continually with every heavy fresh[et].

Fig. 11: Julius Haast, *Geological Sketch Map of the Canterbury Plains*, 1864. ENZB Collection, University of Auckland. Hand-coloured map in Haast's report of the formation of the Canterbury Plains (Haast 1864).

70 *Cordyline australis*, the cabbage tree or tī kōuka, first scientifically described by Georg Forster.

71 "beautyfull" in manuscript.

72 The Po is the longest river in Italy. The Adige is the second longest river in Italy.

My first impression was, that the whole plains were formed by these mountain torrents, that they were in fact of a purely alluvial formation [Fig. 11], but 8 miles from the seashore an important change takes place, and instead of filling up the river begins to excavate & terraces on both sides of its banks begin to show themselves, but being still a mile from each other they leave plenty of room to the river to[73] shift its course. The first terraces become higher as you ascend the river, and they begin to increase in number till we arrive at the base of the mountains, where we find 4 rising altogether 300 ft above the level of the river. There were some beautiful[74] sections of sudden turns of the river nearly 200 ft high, where the nature of these deposits was clearly shown. It became evident to me as soon as the terraces began to be developed on such a large scale, that the alluvial formation had ceased and that the drift formation[75], already so extensively deposited in the Northern part of this Island, again made its appearance.[76] The cliffs consisted of boulders, in some cases approaching a regular arrangement according to their size, and showing rude lines of stratification, but sometimes of all sizes & shapes indiscriminately mixed together, rounded or angular, with layers of sand or loam, or here & there small beds of blueish clays lying between. At some places these layers were perfectly level or very slightly inclined towards the East, at other places they were very [13] much disturbed & in great confusion. On the highest part of the plains I met with large blocks, often angular & half buried, but all having the appearance of true erratic[77] blocks. Where the river enters the plains from the mountains, in descending from the higher terraces I looked at least 200 ft down from vertical & in some places from overhanging walls upon the river, which was confined in a narrow channel. At this point a spur stretches[78] across towards the North, which had formerly united the mountain on both sides, proving clearly that the river had cut a deep channel through it, receding every century till it had arrived at the foot of its Western base, which previously had formed a barrier to its course. This gorge is 4 miles long and it is impossible to follow the course of the river, but there is a saddle[79] over[80] 2208 ft high, leading again to the banks of the river, which from here to the junction of the Havelock & Clyde has a large bed often 2 miles broad, flowing in numerous branches over broad & shingly reaches. The view from this last mentioned saddle towards the sources is most magnificent [Fig. 12]; Peak over peak was rising at the end of the valley, whilst the drift formation began to be developed to an extent which I had never before seen, giving me a deep insight into the great physical changes affected[81] here.

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73 This is rendered as "&" in the manuscript, which is likely a transcription error.

74 "beautifull" in manuscript.

75 Drift is sediment on land, consisting of silt, clay, sand, gravel and boulders, which was erroneously believed to have been originally deposited on the seafloor by icebergs that had run aground after being calved from glaciers. Drift was also known as 'boulder clay'.

76 Haast had described the extent of the distribution of drift in his report on the geography and geology of the Province of Nelson (Haast 1861b).

77 Erratic rocks are those which have been transported, often for long distances, away from their sources by glaciers.

78 "streachs" in manuscript.

79 The Rangitata Gorge Road goes over this saddle.

80 Editorial deletion of "the" in manuscript.

81 "effected" in manuscript.

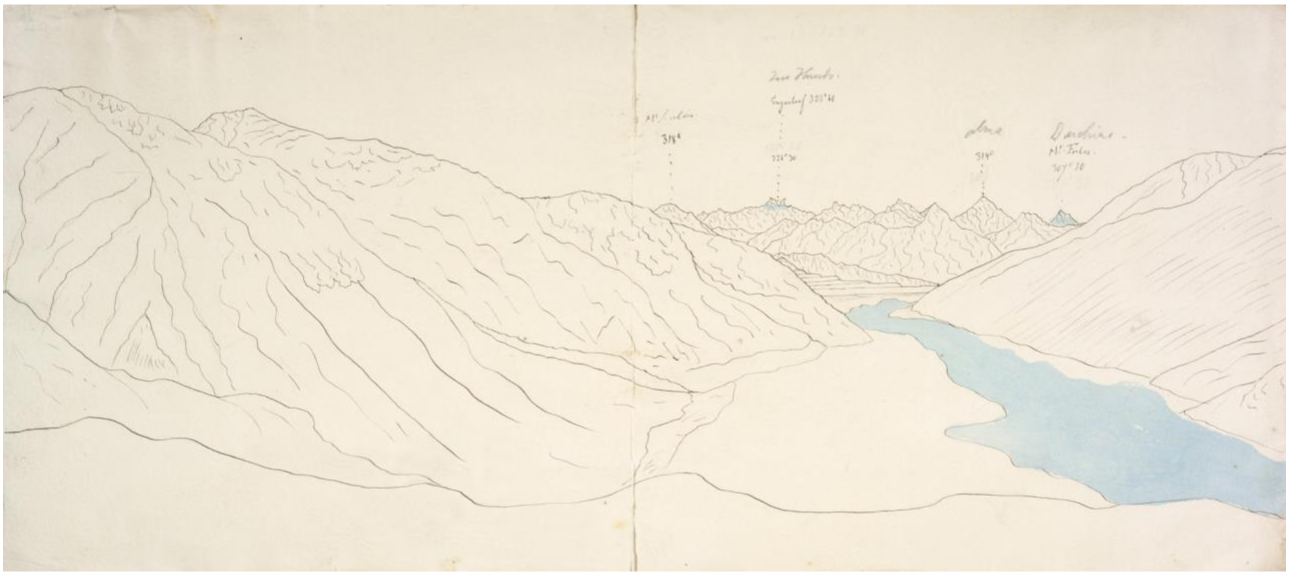

Fig. 12: Julius Haast, *Mt Sinclair, Two Thumb, Sugarloaf, Alma, Mt Forbes, D'Archiac* [26 April 1861], pencil and watercolour on paper, 250 x 450 mm, C-097-005, Alexander Turnbull Library. The terraces of Butler Downs can be seen near the far end of the Rangitata River, which is flowing towards the viewer.

Eleven miles from the point where the river enters the gorge, & 12 from the junction of the 2 main branches, the valley opens considerably [Fig. 13] and on its right banks terraces[82] appear, the regularity of which is really surprising. They rise from the river to an altitude of 1700 ft. & I counted 28 of them, of which the lowest the 25th & 26th were the largest. Where the river swept along the mountains the lower terraces were destroyed, but the uppermost were visible on both sides[83], rising as you ascend the river at a greater inclination. The upper line was so sharply defined that at many places I could take its angle which varied from 1 to 2½ degrees, becoming towards the central chain higher and steeper.

Fig. 13: Julius Haast, [Rangitata River, from Mesopotamia. Third part of four. 1861], ink and watercolour on paper, 131 x 456 mm, C-097-026-3, Alexander Turnbull Library. Very regular sloping terraces are visible.

All the hills lying in their line were smooth, as if they had been worn down by the polishing action of moving ice, whilst above them the mountains exhibited their usual sharp & craggy

[82] These terraces are Late-glacial outwash terraces and moraine surfaces of the Butler Downs (Barrell et al. 2011, 1:100,000 Geomorphological Map, Sheet 4 Central).

[83] The terraces can also be seen on the slopes of the Potts and Harper ranges above the left river banks.

outlines. On the right bank of the river rose an isolated[84] hill amongst the terraces [Fig. 14], some 300 ft above them, having been sheltered by a high mountain, which projected towards the river. The name given to it by the sheep farmers in the neighbourhood the Sugarloaf shows that its smooth regular form had already attracted their attention. [14]

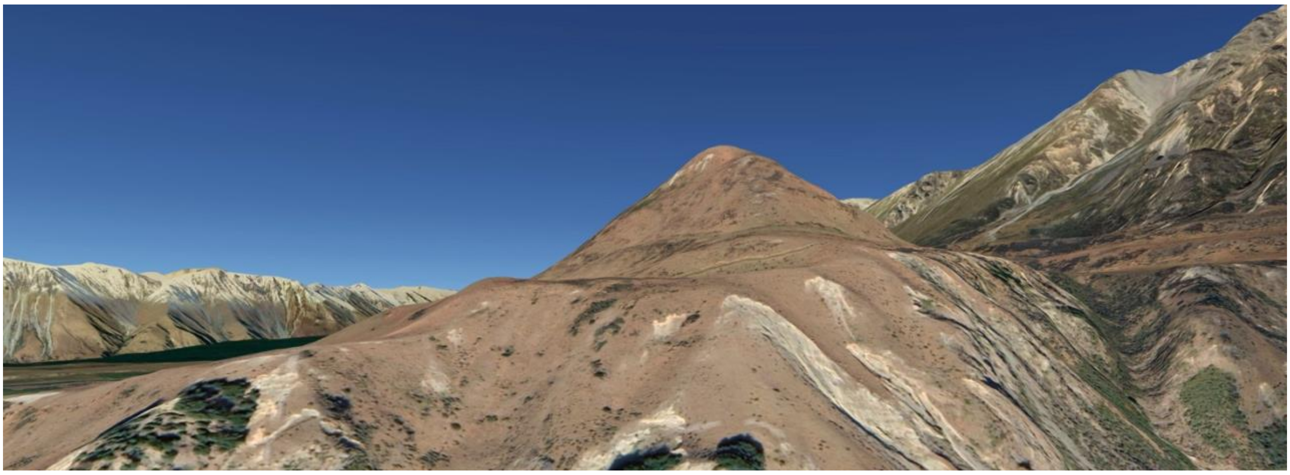

Fig. 14: Google Earth Pro digital elevation model of Sugarloaf as viewed from the north.

Higher up these terraces ceased & where they disappeared I could trace their uppermost line only all along the mountains, as far as those lying between the Havelock & the Clyde [Fig. 15], & reaching at least 5000 ft above the sea or 3000 ft above the level of the valley. No signs of them were visible at the precipitous sides of the craggy mountain giants, their existence having perhaps been destroyed by avalanches, mountain torrents & the disintegration of the rocks above. I closely examined these terraces & the rocks jutting from them, but it was only at one place that flutings & groovings could be distinctly seen, and the same reason which I assigned for the destruction of the rocks without doubt will also account for the obliteration of all signs of former glacier action[85]. But there were also indications of glacier action in the presence of huge erratic blocks perched on the sides of hills & lying on the terraces.

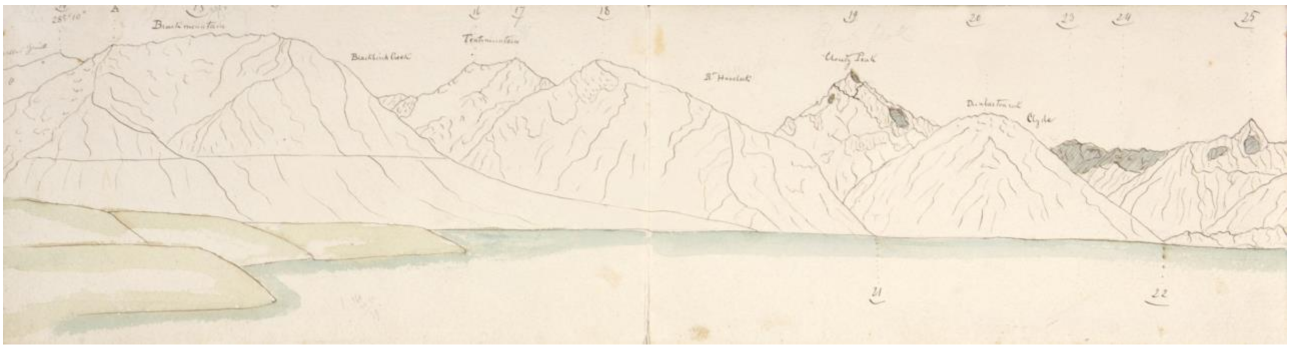

Fig. 15: Julius Haast, [Rangitata River, from Mesopotamia. Left side of four. 1861]. Left sheet only, ink and watercolour on paper, 130 x 698 mm, C-097-026-1, Alexander Turnbull Library. The uppermost line of the terraces can be seen crossing Black Mountain on the left.

[84] "insulated" in manuscript.

[85] "Glacier action", more commonly known as 'glacial action', is a nineteenth-century term introduced by Louis Agassiz, which referred to the erosive or transportive power of glaciers.

Another perplexing & still more interesting fact was, that for at least 1000 ft above the level of the river, in the middle of this large valley, I observed that these terraces consisted of 2 different formations [Fig. 16]. At some places I met with the true drift formation, whilst at others I found deposits of quite a different appearance and what seemed to me a lacustrine origin. This was principally observable where deep gullies crossed the terraces, a stream descending from the adjoining mountains. Here the strata had all the appearance of a section of the deposits brought down by a mountain torrent into a lake, fan shaped & shewing distinctly in different layers the different effects of a flooded or quiet stream. Being anxious to solve this problem I was several days occupied with its investigation, and I think that the following explanation will perhaps be sufficient to account for it.

Fig. 16: Butler Downs as viewed from the opposite bank of the Rangitata near Mount Potts Station. Some of the sloping terraces that Haast observed can be seen behind Sugarloaf hill on the right, while the apparently level terraces are found above the right end of the large forested area on the left. Photograph: George Hook.

Long before the occurrence of the drift formation & before the existence of the Gorge of the Rangitata a large lake extended to the Eastern hills, over the lowest point of which the waters of the lake forming a cascade found their way to the sea. Whilst this outlet was cutting its way backward, as the Niagara f[al]l[86] now does, the lake itself was partly filled up by the detritus brought down by the main stream, as well as by the deltas of the lateral tributaries. When the issuing stream had done its work, & the water had found a much lower outlet, terraces were formed, cut out of these accumulations, probably assisted by the upheaval of the whole country. This part of the country had before the glacial period nearly assumed its present configuration. [15]

During the latter period the country sank slowly, great masses of detritus were thrown down & the whole valley was again filled up as high as it is shown by the rising lines on the sides of the mountain. When the country rose again similar terraces were formed anew, but not exactly in the same places. In this way only the occurrence of both deposits near each other is to be explained & I

[86] Niagara Falls on the border between Canada and the United States of America.

think that this explanation based upon numerous & minute observations can alone account for such heterogeneous conditions.

[Exploration of the Havelock River Glaciers]

Having finished our preparations we[87] started towards the middle of March [1861], up the river to visit its sources [Fig. 9]. Although the river bed in these upper Rangitata plains is nearly 2 miles broad in most places & is divided in numerous branches, it is only when the water is very low that it can be crossed on foot, and even when the water is not high, horses find it difficult to bear up against the current. After some miles travelling over level ground amongst dense scrub, intersected by open ground covered with speargrass,[88] the junction of both branches is reached. I first selected the Southern branch for examination, naming it the Havelock[89]. From this point for a few miles the riverbed continues to be a mile & a half broad, consisting entirely of shingle [Fig. 17]. In some places a little grass is occasionally found growing, but as the numerous water courses are continually shifting this grass is liable to be destroyed. The Havelock for 5 miles has nearly a straight East South East course, after which it takes a more South Easterly direction and turns at the base of the central chain towards South South East.

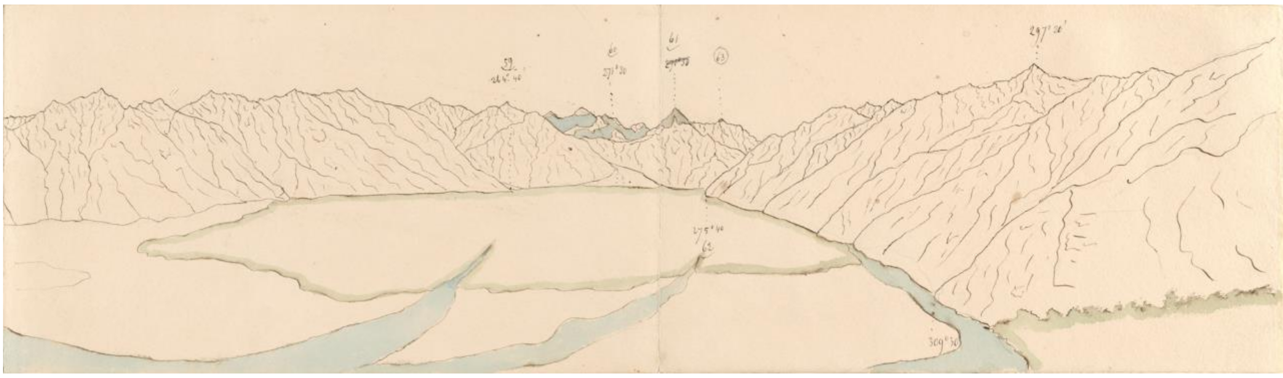

Fig. 17: Julius Haast, *Havelock Southern Branch of Rangitata from Junction with Northern Branch Clyde. 13 March 1861*, right two-thirds, watercolour and ink, 130 x 660 mm, C-097-022, Alexander Turnbull Library.

The scenery rapidly increases in grandeur, peak over peak, pinnacle over pinnacle appear covered with snow above which again brown rugged rocks rise in the most grotesque forms. The mountains on the Southern bank of the river, though very broken, being only outrunning spurs from the Forbes range[90], are not so picturesque, being intersected by deep valleys through [which] smaller tributaries flow[91]; whilst on the Northern side rise the precipitous flanks of Cloudy Peak [Range], washed by the main stream. Towering to the blue heaven 2 magnificent pyramids[92] here stand the one in front of the other, the wild majesty of which defies description. Between them

[87] Haast was accompanied by Andrew Sinclair and Richard Stringer. Little is known of the latter.

[88] Most likely the species *Aciphylla colensoi*, the giant speargrass.

[89] Haast named this after Sir Henry Havelock (1795-1857), the British general involved in the Indian Rebellion of 1857.

[90] Now known as the Sibbald Range.

[91] "flows" in manuscript.

[92] As Haast did not specify the direction in which those peaks lay, it has not been possible to identify them.

glaciers of the 2nd order[93] descend, their white masses shining like molten silver, but only visible where deep rents seem to have cloven the mountain asunder. Everywhere beautiful[94] waterfalls are seen, often more than 1500 ft in height, although not in continuous falls; the rocks between them as they fall from ledge to ledge adding not a little to the splendo[u]r of the scenery. In other places the waters wind amongst the rocks like streaks of silver, little promontories or forest vegetation alternately concealing them for a time, until they appear again clinging to the mountain side. At another point, high above us a streamlet falls over an overhanging rock, but instead of reaching the bottom the wind took [16] possession of it, blowing it in an almost imperceptible mist, over which the sun threw a splendid rainbow.

[Five][95] miles from the junction of the Havelock with the Clyde the Fagus forest[96], which still now & then grew upon the mountain side, disappeared & a new & strange vegetation replaces it. Crossing & recrossing the river where it seemed best fordable, we halted 10 miles above the junction, where another important stream joined the Havelock from the West South West. A magnificent peak[97] [adorned with glaciers][98] rose to a great altitude at the end of the valley & we could even observe their terminal faces [Fig. 18]. Another reason why I selected this spot was that here behind an outjutting spur a little flat[99] occurred covered with coarse grass, so that we had some feed for the horses, the river bed still a mile broad, consisted in its whole extent of boulders, amongst which the numerous river branches meandered, shifting however with every heavy fresh[et].

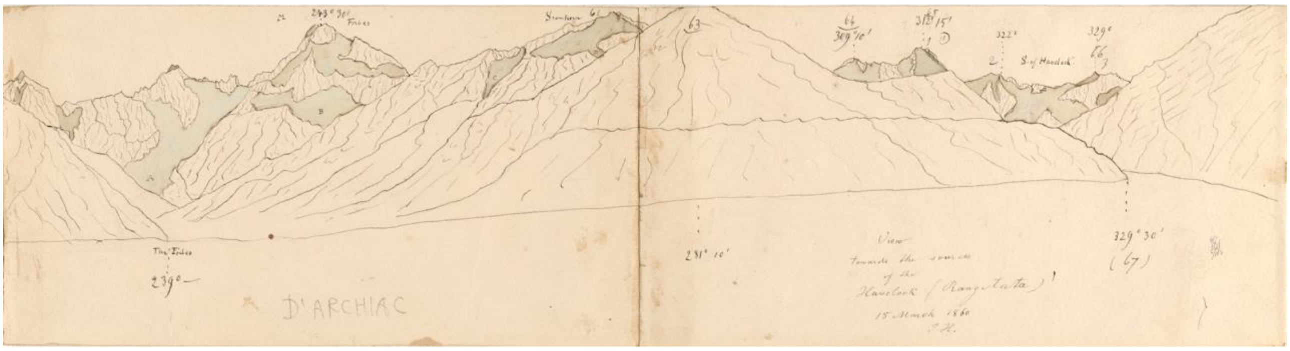

Fig. 18: Julius Haast, *View towards sources of the Havelock (Rangitata) 15 March 1861*, right two-thirds only, ink and watercolour on paper, 125 x 710 mm, C-097-021, Alexander Turnbull Library. The valley of the Forbes River on the left leads to the "magnificent peak" D'Archiac, while up the main valley of the Havelock River on the right Sword Peak and Sceptre Peak can be seen.

93 Glaciers of the second order are those in hanging valleys, where the meltwater often tumbles over falls.

94 "beautyfull" in manuscript.

95 "5" in manuscript.

96 Now more commonly known as Beech Forest, an indigenous forest type in New Zealand.

97 Haast named this peak Mount D'Archiac, after French geologist and palaeontologist Adolphe D'Archiac (1802–1868).

98 Authorial omission has been editorially rectified for clarity of meaning.

99 The flat is located behind a spur now known as Darkey Jims Bush on the left bank of the Havelock (Burrows 2005: 47).

On Thursday the 14th of March we started towards the first source[100] branch & after crossing the different streams into which the Havelock is here divided and of which the last one gave us some trouble owing to the enormous boulders in its bed, we at last arrived at the left bank of a tributary which I named the Forbes. The ground here became so rough that we were obliged to leave our horses behind & climbing over the large masses of detritus brought down without doubt by the avalanches, through & over which the foaming water was roaring, we soon reached the first tributary of this stream, which descends at an angle of 25° from a glacier of the 2nd order. This glacier hangs at an altitude of about 2500 ft above the valley on the side of the huge mountain[101] down which its icy outlet rushed with such fury, that we had some difficulty in crossing it. Signs of avalanches became now very numerous (couloir[102] succeeding couloir) and the mountain sides were every where covered with shingle & blocks. But although this image of destruction was great, the power of nature was still greater, for everywhere amongst these blocks where the least stability could be obtained, plants, often in great luxuriance had driven their roots. The clear atmosphere[103] of New Zealand, which is so deceiving in judging distances, was still more deceptive here. The snowy giants seemed quite before us, & it was only by walking constantly towards them that their distance became palpable.

After 3 miles walking we found that the valley became narrower, the river more furious enormous blocks of rocks impeding its progress, so that it wandered from one side to the other, compelling us constantly to climb over huge fragments or along the ruggy walls of [17] the jutting spurs. A large green parrot[104] quite unknown to me flew screaming over the valley wondering at the intruders in his domain, whilst a few paradise ducks (Casarka variegata)[105] & blue ducks (Anas malacorynchus)[106] on the edges of the river uttered their well known notes. After 2 hours climbing, having passed in the meantime over several other outlets from glaciers of the 2[nd] order, we reached a larger stream, pouring down the steep mountain sides with a thundering roar. It[s] feeder hung like an enormous frozen water drop at the slope of the mountain. We had great difficulty in crossing it, the water rushing against our legs like a millstream again[st] the paddles of a waterwheel. After climbing another smaller ridge, before us, squeezed between 2 precipitous promontories, the first true glacier[107] came in sight. It was 600 ft broad & 80 ft high, consisting of well stratified ice, the layers of a thickness of from 3 to 5 ft, concave & apparently adopting the form of the valley. The ice itself was very dirty at the terminal face, and instead of moraines the

[100] "sources" in manuscript.

[101] Possibly the peak Oklahoma.

[102] A couloir is a narrow, steep valley.

[103] "athmosphere" in manuscript.

[104] Kea (*Nestor notabilis*), the endemic New Zealand alpine parrot.

[105] Now Paradise Shelduck (*Tadorna variegata*). The synonym *Casarca variegata*, New Zealand Sheldrake, was still in use in 1888 when Walter Lawry Buller published *A History of the Birds of New Zealand* (London, 1888).

[106] Blue duck or whio (*Hymenolaimus malacorhynchos*). Likely a transcription error for the synonym *Anas malacorhynchos*.

[107] This was known as the North Forbes Glacier (Burrows 2005: 48) but it is not named as such on current topographic maps.

whole surface was deeply covered with fragments of rocks, some of enormous size, which concealed it entirely. From a vault of at least 20 ft in height & breadth the stream rushed turbid with suspended matter leaping over & sometimes confined between large blocks often of the size of small houses, which the glaciers throw down continually in their beds. I climbed down to the cave & found a little shelter from the rocks which constantly rattled down. A fine azur[e] twilight shone through the cave, the ice walls of which at the end of the glacier were so much decomposed, that by a single blow from the hammer, huge blocks were shivered into a thousand pieces. But I was not allowed to stand there very long, seeing that a part of the vault was giving way I retreated, and warned by the call of my companions, I had to stop behind a large rock, whilst a fragment several tons in weight, fell down, leaping over my place of shelter and falling into the river with a tremendous crash. Near the vault I measured the temperature of the issuing water and found it to be 32°20'. In order to see the difference I had taken the temperature of the river near our Camp at 7 o'clock, where I found it to be 44°,40'. [Three][108] miles from the glacier at 9 ½ a.m. it was 38,90°. This shows how soon the water in contact with the rocks & shingle obtains a higher temperature. By joint [18] observations with 2 aneroid Barometers & the boiling water apparatus, I found the altitude of the glacier[109] to be 3837 ft above the sea level.

As it was impossible, owing to the falling blocks, to ascend the glacier itself, I followed the lateral moraine, but soon came to the straits[110] through which it squeezes itself. The walls on both sides for about 500 ft were nearly vertical & were scratched & polished, showing that in winter the glacier had a much larger body[111]. As it was not possible to pass these straits, I ascended the hills a few hundred feet, but found that the upper surface of the glacier continued charged with detritus as far as I could see. Behind the straits the valley enlarged to a kind of cauldron or basin, bounded in a straight direction by nearly perpendicular walls at which the almost vertical stratification was visible. This magnificent wall many 1000 ft high, was perfectly bare of vegetation & only in a few deep holes patches of snow appeared, which otherwise would not have found any resting place. It was really a scene of wild grandeur. Main tributaries seemed to descend from both sides of the chain, skirting this huge wall & forming in the cauldron the true glacier. Returning to the outlet of the glacier I tried to find some indications of older terminal moraines, but here as well as all along the valley not the least appearance of them[112] could be detected. This glacier having an East South Easterly direction is the most important feeder of the Forbes river. Another stream but of smaller dimensions, joins it in a straight line with its general course East North East, a few hundred yards beyond where the principal stream leaves its icy vault. Not being able to find a ford, I could not make observations from the point of junction. This 2nd glacier[113] inferior in size consisted of white ice, perfectly clean, no moraine of any kind reposing on it. Only a few solitary blocks appeared to be scattered on its surface. Vast snow slopes closed the side of the range, stretching to the base of the pyramidal peaks which rose above them in savage beauty, with only occasional deep snow holes

108 "3" in manuscript.

109 The altitude of a glacier refers to the altitude at the base of the terminus of the glacier.

110 "straights" in manuscript.

111 Haast was mistaken in this assumption. The striations were caused by a much larger ancient glacier.

112 "it" in manuscript.

113 The South Forbes Glacier (Burrows 2005: 48).

on their steep sides. The soft outlines of these névés, by which this 2nd glacier was fed, were notwithstanding clearly defined. They formed concave saddles[114] between the towering giants at their sides, only pierced through by sharp needles & showing that the smaller joints of these combs were only concealed by the soft snow garment thrown over them.

All the usual phenomena could be observed, which give to the formation of glaciers such a lively interest. The unbroken surface of the névés was, lower down, rent & crevassed, a greater inclination had to be passed over & an ice cascade was formed, the towers & minarets of which [19] stood in utter confusion during their descent, & contrasted greatly with the quiet snow slopes above. But soon the scattered snowslopes were again brought near each other. They were welded together afresh into a continuous sheet & only now & then brown pinnacles of rocks pushed their bold heads between the slowly descending ice streams, which uniting formed the true glacier. Where the Cascades occurred, the colo[u]rs of the ice were most lovely, azure blue being predominant but also mixed tints between blue & green & even changes in deep green were met with. But I found also that some of these seracs[115] had a deep rose hue, which was so striking, that it was palpable to me whilst standing on the summit of a mountain at a distance of thirty miles. This occurrence of ice of different colours between the great white masses was exceedingly beautiful[116]. The red ice I had never before observed (quite distinct from the red snow so common in the European Alps) & it will be my endeavo[u]r to ascend next year to one of these seracs & ascertain if possible the cause of the unusual colo[u]r. I may here add that it was never mixed together, the greatest number of these ice cascades being blue with greenish hues, & only a few separate one[s] showing this strange property.

This 2nd glacier had its terminal about 200 ft higher than the one first described, but it seemed that in the winter it descended a considerable distance lower. A sharply defined line on the side of the mountain, running parallel with the glacier, and some 20 or 30 ft above it proved its greater dimension & descent in winter. The mountain sides above this were covered with grass & flowers, below it only shingles occurred. The line did not cease above the terminal face of the glacier, but continued for a few 100 ft lower, where it curved towards the river. It was evident to me that it owed its existence to the glacier, which in winter was not only higher in point of altitude, but also advanced further in the valley. The limit of descent of the glacier was, as I gathered from further observation, very much determined by the circumstance w[h]ether they were covered with detritus or not. In the former case, being more sheltered, from the sun's rays, they were always larger when reaching their termini, and invariably travelled further down the valley than those of which the ice was unprotected.

It was not without a certain feeling of awe, that I stood thus in the lovely wilderness gazing in admiration on one of the most beautiful phenomena of nature, and this feeling was heightened by the remembrance, that never before a human foot stood on this place. The weather was most lovely, no clouds on the deep blue heaven, but in the afternoon the wind coming from the South West brought well shaped cumulus clouds, which after appearing on the summit of the mountain wall, up which they seemed to have crept, instead of continuing their [20] course rapidly, fell down the

[114] Separation Col and Revelation Col. A 'col' is the lowest point of a ridge running between two peaks.

[115] A serac is a tower or pinnacle of ice found in an ice fall.

[116] "beautyfull" in manuscript.

nearly vertical & ribboned walls, disappearing entirely from our sight, being without doubt condensed when they reached the névé below. In order to fix the position[117] of both glaciers, so as to see in later years whether[118] they steadily advanced or retreated, I took the necessary measurements & spent part of the remaining time in examining the vegetation along & upon the lateral moraine. There was a very large Ranunculus[119] with orbicular leaves, Lomaria alpina[120], Polystichum vestitum[121], Senecio scorzoneroides[122] (?), 2 species of Anisotoma[123], Angelica rosaefolia[124], 2 snow grasses[125], a Polystichum[126] besides many mosses, on the rocky sides of the mountain 2 Dracophyllums[127], a Gaultheria rupestris[128](?) another Ranunculus, Senecio Traversi[129], 2 Celmisias, Gingidium Haastii[130], Hoheria Lyalli[131], Lycopodium clavatum[132], Raoulia grandiflora[133], Dicranum[134] &c.[135]

We returned to camp & had a heavy thunderstorm during the night, the loud peals of thunder awakening a thousand echoes[136] in the mountains. The wind was so high that we thought every moment the tent would break down. The river near out camp roared louder & louder, and we could distinctly hear the boulders roll along its bed, borne along by the furious waters. Towards morning the storm abated, blue sky was visible between the rapidly flying clouds, which followed each other in apparently endless succession. It being impossible to continue my researches up the swollen dirty river, I spent the day in examining the mountainside above our camp & the descending streamlets. Their waters were already clear again, whilst the Havelock for many days continued not only very high but also very thick & yellow from suspended matter. We may therefore assume that the dirty

[117] The positional data have not been located.

[118] “weather” in manuscript.

[119] This is likely a reference to the Mount Cook buttercup (*Ranunculus lyallii*), a New Zealand alpine plant, and the world's largest buttercup.

[120] Alpine hard fern (*Lomaria alpina*), is a synonym for *Blechnum penna-marina*, subspecies *alpina*.

[121] Shield fern (*Polystichum vestitum*), was originally described by Georg Forster.

[122] *Senecio scorzoneroides* first described by Hooker, is a synonym for *Dolichoglottis scorzoneroides*.

[123] *Anisotome*, possibly *Anisotome haastii* and *Anisotome lyallii*.

[124] Now *Scandia rosifolia*. Synonym of *Angelica rosifolia*, formerly *rosaefolia*, was originally classified by Hooker as *Anisotome rosaefolia*.

[125] Alpine tussock grasses.

[126] Shield ferns.

[127] Might include *Dracophyllum traversii*, etc.

[128] *Gaultheria rupestris*

[129] *Senecio traversii*, described by Ferdinand von Mueller, is a synonym for *Brachyglottis lagopus*.

[130] *Gingidium haastii*, a synonym for *Anisotome haastii*, described by Ferdinand von Mueller.

[131] *Hoheria lyallii*, mountain lacebark.

[132] *Lycopodium clavatum* is a club moss or ground pine species.

[133] The New Zealand alpine mat daisy *Raoulia grandiflora*.

[134] *Dicranum* mosses

[135] Editorial insertion of paragraph break.

[136] “echos” in manuscript.

colo[u]r continuing for several days after heavy rain is due to the true glacial streams forming the Rangitata. Heavy rains wash down the finely divided matter, ground to powder[137] by the action of the glaciers, but which its own actual waste cannot reach to remove. Upon rising before daylight next morning, having a long days walk before me, the stars of smaller magnitude having already disappeared & the first light very soon began to illuminate the sky. The huge mountains around us stood in all their stern majesty, having a cold steely & frozen appearance. But soon the sun smote its summits with his golden beams throwing a deep rosy hue over this vast snowfield, a wonderful change took place in their appearance, filling the soul with admiration & awe.

We started early & following up the main streams we had a troublesome walk over the boulders of large size, by which the [Havelock] valley, here a mile from side to side was almost filled up. The rise in the ground become more visible & the river which kept continually dividing & uniting in its course & was still high, roared loudly. With every foot step new views were obtained. High upon the mountains immense snowfields were visible with glaciers of the 2nd order descending to the steep sides, from which fine waterfalls hung like silver threads upon the mountain walls. These falls varying in shape & size were all of surpassing beauty. The ranges grew every moment more gigantic, & the river, which still had a general South East by South course, here turned South South East, flowing along the main chain. At this turn it is joined by 2 other tributaries[138] also coming from the huge glaciers. The first of these glaciers[139] descends a steep gorge with nearly vertical walls, from the North Western slopes of Mt Forbes[140]. It is entirely covered with detritus, and the ice at the [21] terminal face is extremely dirty. I could not manage to get near it, as it was impossible to cross the river[141] anywhere, the water being still very high & rushing amongst huge boulders with such force, that no human being could have stood against it. Although I could not take any measurements at its terminal face I am convinced that this glacier is the lowest of all observed during this journey. I made the junction of the 3 streams close to it 3212 ft & the extremity of the glacier did not lie 200 ft. above it.

A mile higher up the other glacier[142], which consisted of perfectly pure ice descended from a perfectly unbroken névé but its terminal face was at least 800 ft higher than that of the former. The [Havelock] valley from the tarn[143] became much narrower & we had to climb every moment over rocks & ridges jutting into the foaming water. For 3 miles on both sides the mountains were so very steep that no true glacier could be formed & the same magnificent cascades continued therefore to delight our eyes. We had to wade one of these streams, which though it reached only to our hips, required all our strength to bear up against its enormous pressure. But soon a new & more serious impediment presented itself in the shape of a large over hanging rock, along which the river rushed with great vehemence. We tried to round it but the water was to[o] deep so that we were compelled

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137 The powder is known as rock flour or glacial flour.

138 Eric Stream and St Winifred Stream.

139 Most likely the St Winfred Glacier.

140 Geographical error by Haast. More likely to have been Pyramus Peak.

141 St Winifred Stream.

142 Most likely the Scabbard Glacier descending from Sword peak.

143 The location of the tarn could not be identified.

to climb it. Looking down into the river below us we observed at another place a natural bridge over it, formed by the remains of a very large [snow] avalanche through which the water had excavated a passage & was then flowing. Although the summer was already declining, it had hitherto resisted the suns rays, which it is true could reach it only a few hours during the day. It being impossible to descend[144] we had to climb up the face of the rock higher & higher till we were at least some 1000 ft above the river. But then such a magnificent scene was unfolded, that it will be for ever engraved on my memory. Before us lay a broad valley, running nearly North, closed on its Western side by the ice walls of the Central chain, on the Eastern side by another high range running parallel to the former, and both uniting about 3 miles from our place of observation. At the head a stern pyramid[145] arose towering with its pointed peaks above all its neighbo[u]rs, from both sides of which glaciers descended pouring their ice streams in the valley. Those on the Western side[146] came from a very large névé lying at the base of this rocky giant. Here also an ice cascade was visible, the ice rent both transversally & horizontally, so as to form large towers & prisms shining with a deep rosy hue. This glacier sloped without any moraine into the valley, whilst the glacier on the Eastern side, partly concealed by a promontory, was densely laden with debris.

The whole valley nearly a quarter of a mile broad was filled with this second glacier[147], but no sooner had the cleaner ice of the Westerly one united itself with its large neighbo[u]r than it was very soon similarly covered with detritus. The whole valley formed in fact [22] one great mass of moving debris. On both sides glaciers of the 2nd order poured down their streams in fine waterfalls of which 1 at least 2000 ft high, quite dissolved in mist before it reached the valley. No signs of vegetation were visible on the sides of the mountain, all was ruin, desolation, and destruction.

Another glacier[148] descended from the central chain, upon whose terminal face a waterfall poured from a great height above, assisting in its destruction. This waterfall as well as the[149] stream issuing from the glacier itself soon united with the waters of the main glacier. Descending I found that the main glacier[150], which had only a very slight inclination was nearly 1500 ft broad & from 80 to 120 ft high, but without any older terminal moraine, and it seemed that in summer as well as in winter it was steadily advancing towards the gorge. I ascertained its altitude to be 3909 ft above the level of the sea. The high pyramidal central giant[151] at the head of the valley I named Mt. Tyndall, in hono[u]r of the distinguished natural philosopher Profess[or] Tyndall.[152] Upon it the lateral chain between the Havelock & the Clyde abuts, & an outrunning spur, upon which I was then standing, forms the gorge.

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144 "descent" in manuscript.

145 This would have been Outram Peak, although Haast originally called it Mt Tyndall.

146 Possibly the névés near Sceptre Peak.

147 The Havelock Glacier.

148 Possibly the glacier on the eastern slopes of Mount Edison.

149 Repetition of "the" in manuscript.

150 The Havelock Glacier.

151 The mountain now known as Outram Peak.

152 John Tyndall (1820–1893), Irish physicist. Corresponded with Haast.

The central chain between Mt Tyndall & the gorge, where the glaciers descended [and] from which a waterfall was forming, looks as if it had been rent asunder. The ribbon like appearance of the strata already observed in the cauldron of Mt Forbes, showed itself here also very conspicuously, being a constant alternation of grey sandstone & dark blue slate. It[153] rose like a stupendous wall, on which the numerous waterfalls from glaciers of the 2nd order formed silvery bands. It was nearly evening before my necessary bearings & other observations were completed, & climbing back from the summit of the ridge was obtained a last view. Turning away from this scene of indescribable magnificence on which before no human eye had rested, & over which in all probability for many years no human foot will pass, we descended to our camp.[154] For several days I was occupied with surveying & geological observations, & remained camped in the same spot. Every change in the weather, sunshine & clouds, morning & evening, gave us new opportunities for admiring the astonishing scene around us. We then returned to Mr. Butlers Station[155] to give our horses rest & food, as they disliked the snow grass & had fed principally on the leaves of Celmisia coriacea[156], the cotton plant of the settlers.

[Exploration of the Lawrence River Glaciers]

After a few days[157] we started again up the river, selecting this time the first tributary of the Clyde, to which I had given the name of the Lawrence. Near the junction of the Clyde & the Havelock & on the left bank of the former I first met with true roches moutonnées,[158] rising above the shingle to an altitude of 150 ft (Fig. 19). They exhibit by their smooth & rounded outlines all the characteristics of true glacier [23] action, not withstanding that the rocks, sandstone & calcareous slates, of which they are composed, have very much suffered by decay. They lie about 2200 ft above the level of the sea, and they have without doubt been polished & furrowed during the glacial period. The valley of the Lawrence which runs throughout in a South South Westerly direction, is much narrower than the main valley, & whilst its eastern side consists for the first 6 miles of mountains from 7000 to 8000 ft high, almost covered to their feet with shingle through which only occasionally[159] huge rock pinnacles project their bold forms, the Western side which is not less rugged rises to the same height but is covered to an altitude of 4500 ft with Fagus forest. Although this forest grows on the mountain side, from the river bed to that height it ceases invariably where the valley attains an altitude of 2500 ft although the aspect & every condition are still the same. Its place it taken by subalpine vegetation. Though I was anxious to discover the cause of this occurrence, it was nevertheless long before I could find any satisfactory explanation for it, and in presenting it to the critical examination of more competent judges upon a phenomenon much connected with the geography of plants. I may perhaps assist in solving many other questions connected with our Flora.

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[153] In reference to the central chain.

[154] Near Darkey Jims Bush.

[155] The English author Samuel Butler (1835-1902) was the runholder of Mesopotamia Station.

[156] *Celmisia coriacea*, a large mountain daisy, also known as Silvery cotton daisy.

[157] On 22 March 1861.

[158] These roches moutonnées form part of the Jumped Up Downs on Erewhon Station.

[159] "occassionally" in manuscript.

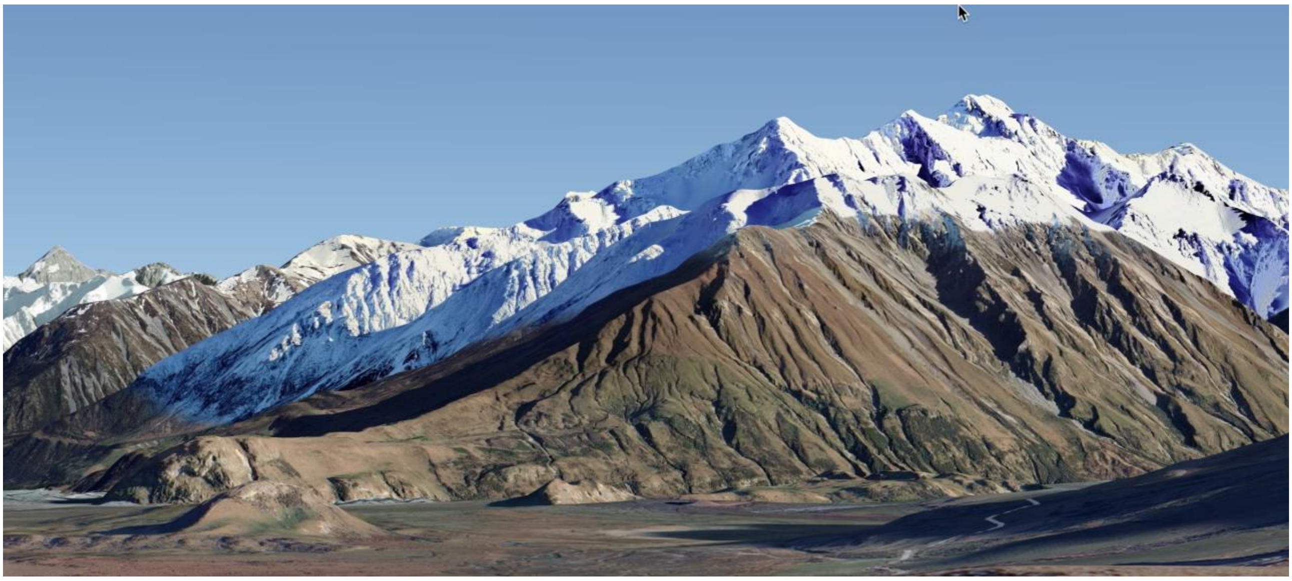

Fig. 19: Google Earth Pro DEM of roches moutonnées on the Clyde river bed near Jumped Up Downs, taken from near the Potts River Bridge. The one in the left foreground is Mount Sunday.

During my stay in the upper Rangitata plains during the month of April at Mr Butlers Station [Fig. 20] 1813 ft above the sea several heavy rain falls took place from the North West & South West. When the weather cleared again I observed, that whilst it had rained at my quarters none had fallen in the mountains. The line on the mountain side defining the limits of the snow was very sharp & clear & was here (about 20 miles from the source of the Rangitata) about 3000 ft above the sea level. Knowing the altitude of many points up the valley, I could observe by the aid of a field glass, that it gradually descended, so that 10 or 12 miles up the river it would only reach 2500 ft. Now this would exactly coincide with my observations. The snow line would there reach the river & the subalpine vegetation begin. This snowline presents the limit at which during the greater part of the winter the snow is constant. It there coincides with the level of the riverbed & we may assume this to be the reason of the absence of the Fagus forest. Larger trees are perfectly able to withstand the result of snow covering & younger plants find shelter from them, so that a Fagus forest may grow upwards from the river bed along the sides of a mountain. But the Fagus cannot spring up where the valleys are so high above the level of the sea, that the snowline lies on the very water courses. The Fagus forest, if I may so express myself, finds no starting point. I found too that in the latitude of Christchurch[160] snow is found at a much lower altitude, it does not lie long on the ground, especially when the powerful[161] rays of the sun shine from a cloudless sky as is generally the case in winter, extremely fine & bad weather alternating with singular rapidity. An observation in point may not be uninteresting. From the morning of the 29th to that of the 30th of July [1861] at which time I was near the sources of the Kowai at Mr Mac Farlanes station[162] 2048 ft above the[163] [24] level of the sea but near the plains a heavy snowstorm from the South East took place. On the

[160] "Christ Church" in manuscript.

[161] "powerfull" in manuscript.

[162] Possibly Dugald Macfarlane (1790-1882) who farmed at Kowai Forks, after his time at Ledard Station on the Waimakariri River ended in 1860.

[163] Editorial deletion of the word "the", which is repeated on the next page of the manuscript.

morning of the 30th I found at this station 2 ft 4 inch of snow, 3 miles lower down at an altitude of 1637 ft at Mr. Thomas's station only 20 inch, 8 miles lower down at Mr. Deans station 1254 ft 12 inch, and the depth of the snow diminished gradually in the plains, till it ceased at an altitude of 300 ft. In Christchurch, which lies from 12 to 20 ft above high water mark, there had only been rain mixed with sleet. During the snowfall the Thermometer stood from 31,80° to 36,62[°] but on the 31st of July with very light North West winds & cloudless sky I experienced the lowest temperature which I ever noticed in New Zealand. At Mr Thomas's station at 7.30[164] a.m. the Thermometer stood at 13,80[°] Fahrenh[eit], at 1 p.m. in the shade it was 43,20[°] & again at 7 p.m. 23,30[°]. During the day it was so warm in the sun that we were obliged to take off our thick coats. The snow disappeared[165] the first day at an altitude of 500 ft. & continued to melt till it was gone on the 2nd of August at an altitude of 1200 ft & in a few days more on the sunny sides of the hills it had disappeared at an altitude of 2500 ft. but still continued to lie in the shade.

Fig. 20: William Packe, [Huts on Mesopotamia at Samuel Butler's homestead. ca 1868], watercolour on paper, 126 x 173 mm, A-196-015, Alexander Turnbull Library. The painting was originally attributed to either Samuel Butler or Julius Haast.

To return from the digression to my researches on the Lawrence. We found after having travelled 7 miles up the valley, that it was impossible to continue further with the packhorses. Some large slips had taken place, choking up the valley in such a manner that the river was as it were squeezed between numerous blocks. He who has never seen the subalpine vegetation of New Zealand has no idea of the amount of labo[u]r required to get through it. Not being able to go along the river bed we had often for a mile to work our way through. We were sometimes able

[164] Editorial deletion of "m." in manuscript.

[165] "dissappeared" in manuscript.

to walk literally on the summits of the shrubs, which formed a kind of a table, owing to the action of the wind, which had given them the appearance of clipped shrub walls of ancient gardens. But occasionally breaking thought the interwoven branches it required all our skill & energy to extricate ourselves. Huge specimens of Aciphylla latifolia[166], the speargrass of the settlers were growing everywhere between the shrubs, which cut & pierced our legs severely from our inability to avoid their fearful[167] blades. The landscape every moment became wilder in its features, enormous walls of rock rising many 1000 ft above the valley & the waters from glaciers of the 2nd order often pouring down in magnificent cascades. Two miles from the end of the valley the first true glacier[168] was met, lying on the right bank of the river & some 800 or 1000 ft. above the valley. The river for the last 2 miles turns from its South South Westerly trend a little towards South West.

Having passed a promontory we came in sight of the main glacier[169]. The mountain chain rose here to a great altitude & the highest peak standing above the névés was so steep & precipitous that the snow could scarcely cling to it. The main névé was lying round the huge pyramid[170] North East from the glacier outlet. I named [the highest][171] mountain Mt Arrowsmith[172] in hono[u]r of the great [E]nglish Geographer John Arrowsmith.[173] From its South Eastern side [25] descends the glacier[174] from which the As[h]burton takes its rise. Another glacier[175] descends from its Eastern side from which the Southern branch[176] of the Rakaia[177] issues. This huge mountain system gives off 5 lateral chains, so that, notwithstanding it is itself only a lateral chain of the main range, it may be regarded as a culminating point, as from here all the glaciers radiate. Here also an ice cascade was visible, the seracs, towers, prisms & other strange forms having a beautiful[178] greenish blue hue. From a smaller névé descended another glacier in a South and another in a South South East direction.[179] The 2 first had no signs of moraines, whilst the South South Easterly branch was quite covered with detritus. The moraine of this 3rd glacier remained sharply defined on the western side of the twin glacier after their union. There is a large terminal moraine lying close to the extremity & apparently pushed down the

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166 *Anisotome latifolia*.

167 "fearfull" in manuscript.

168 Possibly the glacier above Hells Gates.

169 The Lawrence Glacier.

170 Most likely North Peak.

171 "this" in manuscript. Editorial correction to resolve Haast's geographical error.

172 Mt Arrowsmith is now the name of a peak south-south-west of North Peak.

173 John Arrowsmith (1790-1873), English cartographer. Given the direction, Haast appears to have confused two peaks.

174 The Ashburton Glacier.

175 The Cameron Glacier.

176 Lake Stream which flows northward to the Rakaia River.

177 "Rakaya" in manuscript. Haast confused peaks here.

178 "beautifull" in manuscript.

179 Possibly the glaciers on Red Peak and North Peak.

valley, but not the least sign of any other older moraine lower down the valley was visible, nor did I meet with any striated or furrowed rocks. This glacier seemed also to be advancing slowly & steadily into the valley, its terminal face at present lying 4061 ft above the level of the sea. Not a vestige of vegetation was visible round the mountain, all was destruction, detritus from summit to foot & only in a few spots some stunted lichens & mosses found a bare sustenance in the clefts of the rocks. Everywhere at the bottom of the numerous couloirs clear proofs of enormous & frequent avalanches were met with. One of the smaller glaciers in the chain was pierced through by enormous rocks & instead of the ice descending in a body it was broken upon reaching this place, and the fragments continually falling through a small couloir formed at the foot of this rocky barrier a new glacier.[180]

The rocks of which these rugged mountains were composed consisted for the most part of coarse greenish or blueish quar[t]zose sandstone, tabular & sometimes slaty, alternating with greyish, blueish & greenish clayslates. The general strike was from South East to North West with a dip from 75 to 88 degrees to the North East. The rocks were very much jointed, the joints traversing with great regularity their beds & the numerous quar[t]z veins with which they were intersected in all directions. The general direction of all these joints was from East North East to West South West with a dip of 43 deg. towards the West North West. The alternation of these beds was visible from a great distance, having again the same ribbon like appearance. There were no signs of fossils, but I observed that at least 4000 ft above the valley other beds were lying unconformably upon them. I had no time to climb up & investigate their character, but amongst the boulders brought down by a watercourse I observed shales containing faint impressions of ferns, of which one resembled very much Glossopteris Browniana[181], if not identical with it. The quar[t]z veins were at some places much more numerous than at others, but it was obvious that the last revolutions amongst these sedimentary strata took place after the formation of these veins, as I observed many faults & dislocation amongst them.[182]

[Expedition to the Clyde River Glaciers]

My next excursion was intended to be directed towards the sources of the Clyde the main source branch [of the Rangitata], and as I proposed to spend a few days in collecting fossils of palaeozoic age [26] in a gully[183] above the junction of the Clyde & Havelock, which I discovered in going to the Lawrence, I remained behind to set to work, but the terrible death (Fig. 21) of my lamented Friend and companion Dr. A. Sinclair on his return to a station 8 miles below my camp, compelled me to return to Mr. Butlers station, where I was kept till the 10th of April, before I was again able to start. Dr. Sinclair was drowned in an attempt to cross the Clyde.

[180] Editorial insertion of paragraph break.

[181] *Glossopteris browniana*, a Permian plant fossil.

[182] The survey of the Lawrence River was completed on 25 March.

[183] Lizard Gully in the Mount Potts Range.

Fig. 21: Doctor Sinclair's Grave in the Upper Rangitata Cemetery on the Mesopotamia Station. The inscription reads "He was drowned crossing the Rangitata on the 1 April 1861." Photograph: George Hook.

The valley of the Clyde (Fig. 22) for 5 miles up the stream is 1½ mile[s] broad. At this point 2 bold promontories[184] approach each other, the valley contracts to ½ mile in width and another branch, the Sinclair reaches the main stream, [which is] coming from the North & bringing the waters from 3 glaciers[185], which also lie at the Southern side of the lateral chain running in a South East direction towards Mt Arrowsmith[186]. The [Clyde] valley afterwards contracts still more, although large shingle reaches continue. The mountains on both sides become higher & more precipitous, their sides exhibiting glaciers of the 2nd order, the waters of which descend in fine falls, rivalling those of the Havelock. The river flowing sometimes close to perpendicular rocks compelled us several time to cross it, and though the water was low it gave us considerable trouble, owing not only to its rapid flow but also to the large boulders in the bed of the river, which afforded only very treacherous footing to the horses. Near the junction of the McCoy, another important source branch from the North, we found a small grassy spot[187] where we camped. The view up the

[184] The Armada and Black bluffs.

[185] The Clyde, McCoy and Hector glaciers.

[186] This appears to be a geographical error of Haast's.

[187] Where the McCoy Hut is now located.

McCoy was magnificent. It seemed as if the mountains on both sides, consisting of the same sandstones & slates as described before, had been rent asunder, so that the river flowed through an immense fissure.

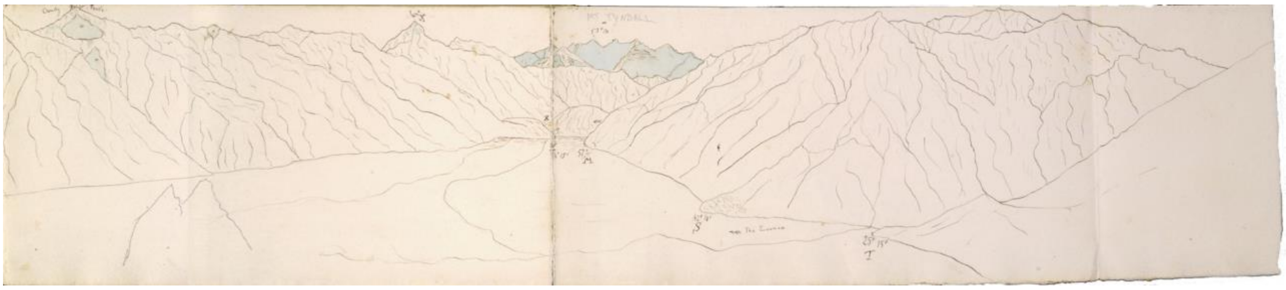

Fig. 22: Julius Haast, *View from Fossil Creek/Mt Potts, of the Clyde. Main branch of Rangitata* [1862], right half, ink and watercolour, 133 x 1159 mm, C-097-024, Alexander Turnbull Library. Cloudy Peak and Mt Tyndall are named.

The McCoy is 5 miles long & besides several streams coming from glaciers of the 2nd order, it is formed by the junction of 3 glacial streams of which the central & largest issues from a huge glacier[188] covered entirely with detritus, passing between 2 high promontories. The 2 others descending from North East & North West[189] are without any moraines. They both descend from extensive névés lying at the Eastern & Western bases of the central pyramidical peak[190], from the Southern recesses of which the main glacier descends. Here again I found that their extremities lay from 400 to 500 ft higher than that of the central glacier, owing to the circumstance, that they were not like it sheltered by a thick deposit of detritus. Also here, where the névé ends the ice is very much broken and crevassed and has most splendid blueish tints. It would be easy to ascend the South East névé, which seems to have an easy gradient & would lead over a col[191] towards the South Western branch of the Rakaia. At one place the snow exhibited a deep red colo[u]r.[192]

Another day was devoted to following the main stream[193] to its sources and it would be [27] possible to ride to this glacier on horseback, of course only after a period of dry weather. It is true the boulders are often of an enormous size, but by crossing & recrossing it could be accomplished by a strong headed horseman. I preferred leaving the poor horses behind to save them another hard day's journey as they could find so little suitable food. Climbing along the precipitous sides of the rocks & wading through smaller branches we arrived after 3 miles of laborious walking at the main glacier[194], which filled up the whole valley and presented a most magnificent sight (Fig. 23).

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[188] The McCoy Glacier.

[189] The one descending from the northeast is the Shanks Glacier. The other glacier is not named on modern topographic maps.

[190] Mt Nicholson.

[191] Now known as the McCoy Col.

[192] The red snow is a phenomenon attributed to the presence of tiny algae (Burrows 2005: 49).

[193] Now known as the Frances River.

[194] The Clyde Glacier, which has since retreated and separated into the Colin Campbell Glacier and Frances Glacier (Burrows 2005: 49).

Fig. 23: John Gully, *The Clyde Glacier. Main source of the River Clyde (Rangitata) 3762 ft.* [1862], watercolour, 290 x 545 mm, C-096-003, Alexander Turnbull Library. Based on Julius Haast, [Clyde Glacier, 1861], C-097-029, Alexander Turnbull Library, which is the upper part of the panorama, and *Great Clyde Glacier real source of the Rangitata* [1861], C-097-025, Alexander Turnbull Library, which is the lower part.

The extremity of this glacier, the largest which I visited, presents a straight wall, of an altitude of 120 ft. showing the usual bedding. The ice is very dirty, & many large boulders are imbedded in the body of the glacier itself, looking sometimes like cannon balls in the terminal face. In its centre is a wide ice vault from which the stream rushes over huge boulders which fall continually from above. The whole glacier is covered deeply with shingle & fragments of rock of gigantic size which fall with a tremendous crash. During my stay, a block of at least 10 tons just above the ice cavern, fell down into the water, dashing it high in all directions. In the perpendicular face of the glacier was a round hole, about 30 feet below its detritus roof, through which a little stream fell like water from the gutter of a house. On both sides of the cave lying close to the ice, moraines were formed, but not so extensively as I should have expected. The direction of the glacier for the first mile of its extremity is nearly due north. Its terminal face stretches obliquely across the valley. This is without doubt occasioned by the junction of another large glacial stream[195] coming from the West & washing here its base. The glacier[196] from which this stream is derived, lies in a deep gorge with nearly vertical walls, terminating about 150 ft above the great glacier of the Clyde. Its extensive

[195] Now known as the Agnes Stream.

[196] The Agnes Glacier.

névé lies at the North Eastern base of Mt Tyndall[197] opposite to another névé from which one of the branches of the great Havelock descends. There would be an easy passage for an experienced Alpine traveller over the col[198] from one of these névé[s] to the other.

The breadth of the great Clyde Glacier [terminus] is 1300 ft, but a line at right angles with the direction of the valley would reduce to 1000 ft. I climbed the mountain side near the junction of the 2 glacial streams[199] to have a better view[200] of it & could not cease to admire the wild beauty of the splendid scenery around me. For about 3 miles the glacier filled the whole valley, receiving from the central chain (the direction of which was from North North East to South South West) several affluents. The first[201] & as it appeared to me a very important one, entered the main valley from the North West[202], [the second entered from the North,][203] also coming from Mt Tyndall[204] & being like the first entirely covered with detritus. From it[s] Northern continuation 2 other large affluents descended[205], besides several glaciers of the 2[nd] order, the silvery streaks of which I could trace down the mountain side. Their waters must flow [28] below the main glacier as there was only a little sill alongside the lateral moraine. The valley at the upper part of the glacier enlarged very much, & the névés, which reached the combs between the highest abrupt peaks, often formed large basins, smooth above but much fissured & broken below. It would be very difficult to give any idea of the various shapes of the mountains around. Needles are seldom seen, but huge pyramidical peaks, frequently rise above the general line of the chain. Some of them are so precipitous, that for several 1000 ft no snow can cling to their walls, which stand above the dazzling garment at their feet in stern grandeur. Thick separated cumuli at a great altitude came from the North East, and the change from sunshine to shade gave an additional charm to the mountain forms. Here also I looked carefully, but unable to find any striated or furrowed rocks below the glacier, or signs of old moraines, and although many faces of rock were so placed, that they would easily have been affected by the action of the glacier, it was in vain that I searched for any traces of it. The view of this immense chain is quite concealed from the Eastern part of the island, because several of the intervening chains of considerable altitude run nearly parallel with it, so that even the existence of these mountains was till lately very little known.

[197] Now known as Outram Peak (Burrows 2005: 48).

[198] Disappointment Saddle.

[199] The Agnes Stream and the Frances River.

[200] From here Haast made the sketch *Great Clyde Glacier real source of Rangitata.*

[201] Now known as the Colin Campbell Glacier.

[202] Transcription repetition error, the phrase "entered the main valley from the North West" is repeated in the manuscript.

[203] Replacement text based on later description.

[204] This is one of three peaks that Haast named Tyndall, which has retained its name. Its location is 43°19'6"S, 170°43'26"E.

[205] These are not named on the current 1:50,000 topographical map.

From the West coast, where the Southern Alps slope rapidly the whole chain lies in all its wild beauty before the explorer; and I shall never forget the first view I obtained of it on a clear sunny day[206] when standing at the mouth of the Grey (Fig. 24).

Fig. 24: John Gully, *The West Coast of the Province of Canterbury from the northern bank of the River Grey* [1862], watercolour on paper, 275 x 630 mm, C-096-001, Alexander Turnbull Library. Based on Julius Haast, *Ansicht der südlichen Alpen von dem nördlichen Ufer des Mawhera, 1 Juni 1860*, C-097-051-1, Alexander Turnbull Library.

I made the terminal face of the Great Clyde glacier 3762 ft above the sea, not only by barometrical observation, but also by the boiling water apparatus, bot[h] agreeing within 23 ft., the above sum is the mean of both observations. The water issuing from the cave was of a deep semi opaque blue colo[u]r & had not the milky hue which such waters generally exhibit, the long continuance of fine weather having brought about this change. It was near sunset, when I had finished my observations, & we therefore hurried back to our camp, but found that since morning the river had risen a little, the difference in the temperature between the cold night and the sunny warm day causing without doubt a greater waste to the ice.

[Exploration of the Upper Ashburton Plains]

Having finished my survey of the Rangitata[207] I next proceeded towards[208] the Ashburton[209]. From the Rangitata I crossed to the valley of the Ashburton by a large depression in the chain which begins 6 miles below the junction of the Clyde & Havelock & runs across to the Ashburton in an East South East direction for a distance of 14 miles. This depression[210] is from 2-4 miles broad, & in it we meet several fine lakes lying on both sides of the mountain chain. [29]

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[206] Haast's sketch [*Southern Alps from the mouth of the Grey*] is dated 1 June 1860.

[207] Haast and Stringer returned to Mesopotamia to pack up the collections, and on 26 April left for the Mt Peel Station, where they were based for nearly a fortnight (Burrows 2005, p. 50).

[208] Through the mouth of the Potts River valley.

[209] South Branch of the Ashburton River / Hakatere.

[210] This depression contains lakes Clearwater, Camp and Emma.

Ascending a steep terrace[211] on the left branch[212] of the Rangitata, we find ourselves very soon at the edge of a swampy creek, which, on following it towards its source, brought us after a 3 mile[213] ride to a large tract of swampy ground, lying at the highest level of this depression, having outlets on both sides. Whilst as stated before one flows towards the Rangitata, another falls into Lake Tripp[214] 2318 ft, a very fine sheet of water 2½ miles long & ¾ miles broad. This lake receives the greater part of its waters from the chain[215] North East of it, which are outrunning spurs from Mt Arrowsmith. Its only outlet[216] flows sluggishly over swampy ground or amongst low downs[217], towards the Ashburton. Three miles before it reaches this river another outlet joins it, coming from Lake Acland[218] 2303 ft, which lies at the base of Mt Harper, an isolated mountain bounding the depression towards South South West. I call this mountain isolated, because the Rangitata flows along its Western base & along its Eastern base was another depression crossing the former at nearly right angles. I called this 2nd depression the upper Ashburton plains & I shall have to speak of them when treating of Lake Heron. Lake Acland is 1 mile long & ¾ miles broad, its outlet is 2 miles long & has nearly the same amount of water as that of Lake Tripp or Clearwater as it is sometimes called by the settlers. Besides these 2 lakes there are many smaller ones in this depression, which are merely lagoons, they have not any outlets & are filled by the waters from the mountains & plains after rain & the melting of the snow. The most considerable is Lake Howard,[219] lying ½ mile in a South Easterly direction from Lake Tripp. When I passed near it at the end of February [1861] it was unusually low, the surface of the water being then at least 25 ft below the mark of its high level. These lakes & lagoons swarm with aquatic birds & abound in eels of great size. In severe winters they are completely frozen, so as to bear horses & men.

The terraces or rather the line of drift, which continue down the Rangitata, follow the curve of the depression [containing the lakes], and continuing nearly at the same altitude are traceable to its termination. Huge angular & rounded erratic blocks are found everywhere over the plains & at the sides of the hills, which forces upon one the conclusion, that the agency which afterwards excavated this depression was not strong enough to move them. But if this lateral valley is interesting, another depression[220] of equal dimensions is still more striking. It has its highest elevation on the Southern side of Lake Heron, lying about 100 ft above the level of the lake; the altitude of which I calculated to be 2297 ft. From this point the depression runs nearly North & falls towards the Rakaia [River], bringing down the waters from the outlet[221] of

[211] Most likely the terrace around the northern side of Harpers Knob.

[212] Potts River.

[213] "miles" in manuscript.

[214] Now known as Lake Clearwater.

[215] The Big Hill Range.

[216] Now known as Lambies Stream.

[217] Now known as Fagans Downs.

[218] Now known as Lake Emma.

[219] Now known as Lake Camp.

[220] The Lake Heron basin.

[221] Lake Stream.

the lake as[222] well as those of the Moorhouse[223], a large glacial stream, the sources of which [30] are in the Eastern névé of Mt Arrowsmith, close to those of the Ashburton. Between the banks of Lake Heron & the Ashburton we meet again with two smaller lakes, the Maori lake & another without a name[224], lying on both sides of the valley, the waters from both flow into the Ashburton. This 2nd depression running North, crosses the first described[225] at its extremity, continuing as stated before to the Rangitata, which it reaches before that river enters the Gorge. Although we meet here also several lagoons, it is interesting to observe, that the centre of the valley[226] is the highest part, and that the riverlets[227] descending from both sides of the valley, which are here from 4000-5000 ft high, have excavated deep valleys which meet near the Rangitata, with terraces of at least 300 ft between them. In fact the central part of the valley is part of the drift which has not been excavated', & which continues through the Gorge of the Rangitata towards the plains. I am certain that if the angle of the drift [on the plains] were taken by the spirit level as far as the Rangitata Gorge, & afterwards above it, calculating the distance between both places, the[y] would be found to correspond exactly so that it would present one gradual uniform rise, had it not been excavated in the gorge.

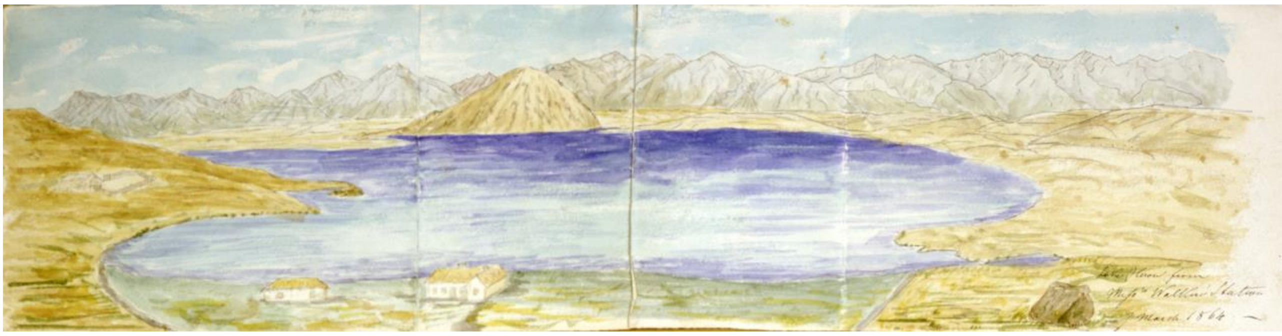

Fig. 25: Julius Haast, *Lake Heron from Messrs Walker's station, 7 March 1864*, watercolour and pencil on paper, 140 x 250 mm, C-097-036, Alexander Turnbull Library. The sketch was made three years later during Haast's return visit.

The mountains on the Western side of the depression near Lake Heron (Fig. 25) also present us with numerous terraces (Fig. 26). I had no opportunity of examining, w[h]ether in their lower parts, they were also of mixed formation, lacustrine & drift, but it is obvious, that both depressions together with the upper Rangitata plains, once formed a large inland lake in which Mt Harper stood as an Island, having its outlet towards Rakaia before the gorges of the Ashburton & Rangitata were excavated. The formation of Lake [Heron] 4 miles long & 1½ miles broad, a splendid sheet of water, is due to the junction near its outlet of 2 mountain torrents from both sides,[228] each bringing down during heavy freshe[t]s large masses of shingle, whereas the Maori lake & its smaller

[222] Editorial deletion of "as" repeated in manuscript.

[223] Now known as the Cameron River.

[224] Possibly Lake Emily.

[225] The depression containing Lake Clearwater and Lake Emma.

[226] Pudding Valley.

[227] Pudding Valley Creek and Moorhouse Stream.

[228] Now known as Smite River and Cameron River.

neighbo[u]r were formed by the shingle beds of the Ashburton, which here obliquely cross the junction of both depressions. At the Eastern bank of Lake Heron stands an isolated hill of an altitude of at least 800 ft consisting of slaty sandstone, also called the Sugarloaf[229]. The action of abrading [glacial] forces, although no signs in detail were visible during a very cursory examination, is not withstanding rendered more than probable by its regular rounded shape.

Fig. 26: View of the hills behind Mt Arrowsmith Station taken from the south-eastern bank of Lake Heron. The sloping terraces that Haast observed can be seen on the lower slopes, while the terraces he believed to be level are located higher up on the left. Photograph: George Hook.

[Exploration of the Ashburton River Glaciers]

The weather which for some time had been very foul, cleared up at last, so I started on the 13th of May for the sources of the Ashburton. Leaving my quarters[230] near Lake Heron, I did not continue to follow the depression towards that river, but ascended the chain which runs parallel to it and which is a lateral spur of Mt. Arrowsmith, [31] separating the waters of the Ashburton from those of the Moorhouse[231]; the latter forming with [the outlet of] Lake Heron the Southern branch of the Rakaia. At an altitude of 3607 ft. I met with the 1st terrace, & after ascending 9 more in succession, the last terrace was reached at an altitude of 5160 ft & 702 ft below the summit of the range (Fig. 26). These terraces were level but rather swampy & of much larger extent than could be seen from the depression, from which we had to travel 3 miles before we came to the rocky mountain summit. The view from this point was very splendid; in the foreground were seen the blue waters of the beautifully[232] shaped Lake Heron bathing the foot of the chain[233] which forms the Eastern boundary of the longitudinal depression, whilst towards the South East the eye followed the Southern

[229] Mount Sugarloaf is an example of a distinctively shaped roche moutonnée. There are four other, more typically shaped, roche moutonnées south of Sugarloaf .

[230] The quarters may have been at Lake Heron homestead of W.C. and A.J. Walker.

[231] Now known as the Cameron River.

[232] "beautyfully" in manuscript.

[233] The Taylor Range.

continuation of this remarkable valley to the Rangitata before this river enters the gorge. Several high & serrated chains rose here one behind the other closing in the view. Towards the South West the Rangitata was itself visible between Forest Creek & the Butler[234], another tributary, with numerous terraces on its right bank, over which again the jagged & magnificent Two Thumb range rose in all its picturesque beauty. The vista towards the West was narrower, the view towards the central alps being confined by a higher range lying on the left bank of the Ashburton, which was visible[235] down below, meandering through its valley. But before us towards the North West Mt Arrowsmith appeared in all his majesty, his serrated peaks & combs standing boldly against the blue heavens. Vast snowfields were visible, from which we observed that the Ashburton glacier descended, but we could not see its terminal face, which was concealed by a bold promontory. The summit of this mountain [that we were on], the Ribbonwood range[236], I calculated to be 5862 ft high. The sun was nearly down, throwing deep pink tints over the snowfields before my topographical observations were finished, and we had therefore to make haste to descend. As the mountainsides towards the river were everywhere rocky & precipitous, rendering it almost impossible to descend with the packhorse, we selected a talus of shingle, stretching from the summit into the valley, down which we made a most hazardous descent[237]. The horse, though accustomed to mountain work, slipped very often for several yards with the moving shingle, so that we feared every moment that he would roll over, but we managed at last to bring him safely down. The poor animal was so much exhausted when we reached the valley, that it lay down with its load & all our efforts were unavailing to make him rise. We camped here being 8 miles distant from the glacier, but had to shift our camp next morning, not finding any vestige of [32] firewood. The view towards the huge serrated chain was grand in the extreme, and can fairly be compared with the Alps of Europe. Our camp was 3717 ft above the sea level, and although favo[u]red with magnificent weather & a cloudless sky during day & night, the nights were very cold, so that, rising before daylight with only a few sticks for firewood to boil water was rather trying work. It was now the middle of May & I had reason to expect that the fine autumn weather would be succeeded by approaching winter. The wonderful sight of huge snowy mountains before sunrise in their cold sternness, and the lovely change they underwent when the first rays of the sun streak their pinnacles, throwing over them burning golden hues, was here enjoyed by us in all it[s] alpine sublimity.

The Ashburton[238] the smallest of all the glacial streams which I visited, flows over a broad shingly bed & was quite clear & so low that we managed to cross it several times by jumping from rock to rock. After 2 miles walking its bed became encumbered with huge boulders, 2 nearly opposite spurs recurring close to the river, and narrowing its course by enormous blocks fallen from their sides, and which I mistook at first for an old moraine. A most laborious climb partly over these rocks, partly through very dense alpine vegetation again brought us after another mile to a shingle bed. The mountains receded & formed a valley a mile wide, which continued upwards, narrowing

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234 Now known as Bush Stream.

235 “from” in manuscript ignored.

236 Now part of the Wild Mans Brother Range.

237 “descend” in manuscript.

238 Haast was on the South Branch Ashburton River / Hakatere.

till it reached the terminal moraine of the glacier[239]. Although this glacier was only from 30-40 ft high & about 300 ft broad it formed a beautiful[240] specimen of this remarkable physical phenomenon (Fig. 27). The névé beginning on the comb & lying at the base of the highest pyramidal pinnacle[241] forming the summit of this picturesque chain, is narrowed lower down on both sides by ledges of rocks running towards the valley & forming a gentle sloping basin. About 2000 ft above the terminal face the inclination suddenly becomes greater, & the glacier slopes down in the form of a most magnificent ice cascade, forming as the ice is not only laterally but also longitudinally fissured, superb towers & minarets & exhibiting vivid blueish & greenish tints. On the Western side of the seracs & at the same altitude the glacier takes a more terrace like form, like gigantic steps. But soon the ice united again & forms a smooth unbroken mass nearly to its termination where it is longitudinally crevassed. Also for the last ½ mile the glacier has the usual marginal crevasses extending from 20 to 30 ft into its body & pointing obliquely upward, the edges being rounded. I observed also a laminated structure running longitudinally, but the blue stripes were very pale & not so distinct as I have seen them in some European glaciers. Unfortunately my time in these short days was very limited, so that I could not continue my examination further.

Fig. 27: John Gully, *The Ashburton Glacier, main source of the river Ashburton (4823 feet*) [1862], watercolour on paper, 290 x 545 mm, C-096-002, Alexander Turnbull Library. Based on Julius Haast, *Ashburton Glacier. 14 Mai 1861*, watercolour and ink, 270 x 870 mm, C-097-027, Alexander Turnbull Library.

I may state however, that all the glacier appearances so familiar to the observer in Switzerland are also met with here. The glacier from the ice cascade to its [33] extremity has a nearly uniform slope of from 7-8 degrees. Its surface is quite free from any detritus, so that there is not the least

239 The Ashburton Glacier.

240 "beautyful" in manuscript.

241 Mt Arrowsmith.

sign of any moraine upon it, this is owing to the peculiar form of the mountain from which it descends, and in consequence of it the white ice shows itself in all its beauty. I took some pieces of this ice from a lateral crevasse, which were full of innumerable watercells of a lenticular form and split easily into plates. The glacier has not lateral moraine, so that I could see the lower surface of it. It stood on boulders as on rollers, so that in some places a child would have been able to squeeze itself under it. The valley between the glacier & the rocky walls was covered with boulders, like the bed of an old mountain torrent, and there was every appearance indicating that this glacier like those previously visited, was steadily advancing [towards wher]e[242] terminal moraine existed which looked as if it were pushed forward. I calculated the altitude of the terminal face to be 4823 ft. On both sides of this principal glacier were several smaller ones, the greater part of them of the 2nd order and discharging their waters by very fine falls, although in mass they were in considerable. Finding an apparently unbroken spur, I climbed towards one of these small glaciers of the 2nd order, which hurry boldly over a nearly vertical cliff. From which a little rill flowed falling to a great depth without almost any check. The ascent was not without danger owing to the shingle & disintegrated rock, which often gave way when trodden upon, being in fact only a mass of smal[l] polyhedric pieces perfectly separated from each other & waiting only for a moving agent. With every step new beauties were revealed to me, the peaks seeming to become higher as I ascended. After climbing to within about 100 ft of the terminal face of this little glacier, I was stopped by a vertical wall, which proved to be an insurmountable obstacle, so that I had to return without being able to reach the body of the ice. The calculated altitude of my highest point was about 6805 ft, which would give this glacier of the second order a total altitude of about 6900 ft. Its termination was perfectly visible from the valley & I estimated that it was lying a little less than halfway between the extremity of the main glacier & the general line of the chain, over which the various peaks rose conspic[u]ously. This would give us an altitude of from 9500 to 10000 ft, but as this manner of estimating heights is very deceptive I give it only as an approximation. What I have said of the geological formation of the Lawrence applies to this district also, the same lithological character similarly jointed, showing itself on both sides, the whole range forming in fact a huge folding. In the terminal moraine I found amongst the boulders a block of dioritic greenstone, which therefore must occur in the pyramidal masses of Mt Arrowsmith, but as far as I went I did not observe anything like it in situ. [34]

My geological description of this part of the country would have been more interesting could I have devoted more time to the study of the older rocks. The absence of true limestone is very striking, the same sandstones & slates continually alternating. But as I shall have an opportunity of devoting more time to it on a future day, I hope to be able to clear up many doubts which are still in my mind concerning the Geology of the Alps. Returning to our camp I searched carefully for signs of old moraines or striated or furrowed rocks, but did not trace the least appearance of them. Only one rock of hard coarse blueish sandstone of a diameter of three feet was finely striated, but it was evident from its position, that it has been brought down by one of the tremendous freshe[t]s, which sometimes must rush through these valleys with terrific fury.

[242] Omitted words in manuscript.

Instead of returning [by] the same [route][243] I followed the river in order to connect my survey with that of Mr Eduard Jollie[244], who had left off at the beginning of the gorge 12 miles from the glacier and of which I had been told it would be nearly impossible to pass through it with a horse. The river which up to this point runs through a valley of an average breadth of ½ mile with a South Easterly course, after 12 miles turns suddenly towards the East South East & enters roaring & foaming between perpendicular walls of rock. The bed of the river is confined to a width of from 7-8 ft, but what made the sudden change still more remarkable was an enormous fragment of rock fallen from above and forming a sort of wedge, lying with its lower extremity some 5 ft above the level of the water. The consequence is, that during heavy freshe[t]s the water which is dammed by this natural obstacle forms a little lake above it, as I could observe by the state of the surface of the valley.

In looking over the soft muddy sands I observed the tracks of a quadruped never before seen by me. In a previous publication[245] I have stated, that there is a report, that in the Alpine lakes & in the upper part of the rivers an animal exists which has been thought to be a beaver, but the observations which I made induced me to believe, that it could not belong to that family, although probably belong to the family of Rodentia. The tracks most resembled those of a small otter (Caruaria[246]), the stride & especially the footprints have all its peculiarities. On arriving a few days afterwards at Lake Heron, I met a gentleman then engaged in farming a station near this Alpine lake, who told me how sorry he had been, that a few days before he had not had a gun with him, because he then could have procured me a rare specimen, and he related to me, that walking one morning early by the shores of the lake, an animal as big as a rabbit with a smooth shining brown skin had suddenly risen before him. Having nothing but a stockwhip with him, he had tried to knock it down, but not being sufficiently hard hit, the animal had given a squeaking sound and had very soon disappeared [35] amongst the tufts of snowgrass. The existence of this animal is so far established, & I am in hopes that I shall succeed in obtaining a specimen of it. I am satisfied that its existence is not merely fabulous, as I had heard often stated for several years.[247]

To return from this digression to the gorge of the Ashburton. It was not without difficulty that I found out how to proceed, and we had to ascend the hills before we could discover a passage for our packhorse. The rocks striking across have been cut through by the river, and on them terraces have been formed very much broken by deep gullies. 2 miles below the beginning of the gorge, another stream[248] of almost the same magnitude from the West joins it. Continuing a few miles further we were stopped by perpendicular rocky walls and it was not without great trouble, that we descended to the rapid river & managed to cross it. After doing so however we had good travelling on the left bank, the terraces becoming wider & bringing us towards evening to the [upper] Ashburton plains (Fig. 28). The weather, notwithstanding that the nights had been extremely cold, had all the time been most lovely. It now, towards the end of May, broke up, and the winter with

[243] "road" in manuscript.

[244] Edward Jollie (1825-1894), New Zealand land surveyor and politician.

[245] Haast 1861: 134–135.

[246] Uncertain reading, this term has not been identified and is likely a transcription error.

[247] Haast was prominent in the research of this apparently otter or beaver-like creature, sometimes referred to as the Waitoreke or South Island Otter (see Pollock 1970).

[248] Now known as Boundary Creek.

mist, rain & snow fairly set in, so that I had to retreat before it to lower altitudes, leaving with regret the magnificent scenery of the Southern Alps.

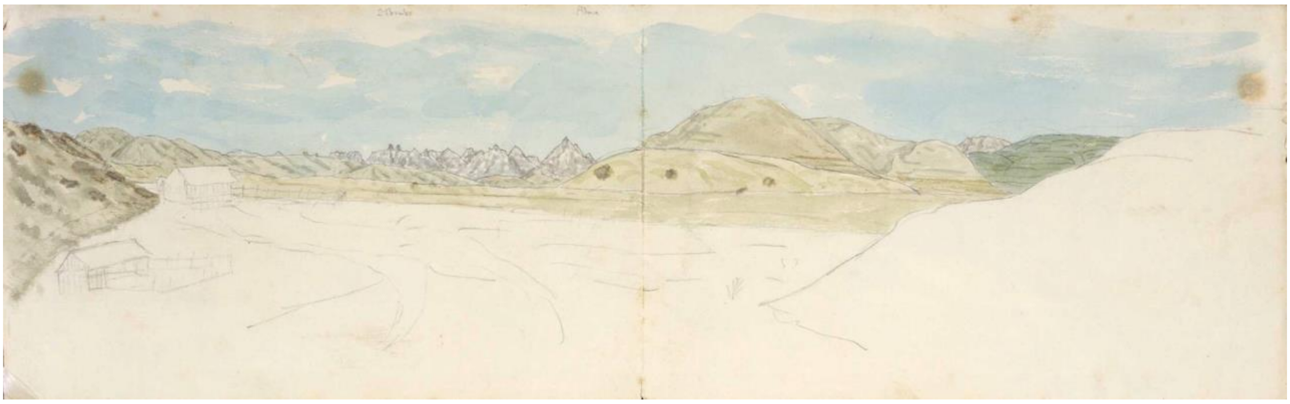

Fig. 28: Julius Haast, *Mr Pott's Station, Two Thumb Range, 1861*, watercolour and pencil on paper, 170 x 545 mm, C-097-004, Alexander Turnbull Library. The station is known as Hakatere and some of the original buildings are still in existence. Ancient moraines can be seen in the centre of the midground.

[Conclusion]

The results of this interesting journey may be said to be not without importance, & summing them up the following will be palpable. The most peculiar character of these large glacial streams is, that from their sources to their mouths they are almost continually shingle rivers. I mean to say, that after issuing from their azure ice vaults they meander through broad & comparatively level valleys. After running ½ their course, they break through the lower Eastern chains before they reach the plains. Though very rapid, the[y] do not form any waterfalls, which give such a charm to the Alpine streams of the Continent of Europe. This want however is supplied in a most remarkable manner by the streams issuing from the glaciers of the 2nd order. A second & doubtless important conclusion may be drawn from my observations, namely that all the glaciers without exception, at least so far as I examined them, are steadily advancing. This is proved from the fact, that no striated or furrowed rocks, nor old moraines below them are anywhere to be found. And not only the glaciers which I have visited show this increase, although perhaps only by negative evidence, but also my friend Mr. S. Butler, under whose hospitable roof I found a hearty welcome, and who has visited many glaciers in Switzerland, made me a[c]quainted with a fact the evidence furnished by which is of a more [36] positive nature. During his manyfold explorations in this Island he visited the upper Rakaia, and he observed there a glacier[249], which had advanced for several 100 years across the broad shingle bed of that river. J. Ademar's hypothesis[250], that the real cause of the glacial period & the present distribution of land & sea is the change of the great axis of the earth from East to West, by which the seasons are unequally distributed in both Hemispheres (spring & summer being at present 7 days longer in the temperate zone of the Northern hemisphere than in the Southern) would receive a valuable additional confirmation by the fact, that all the glaciers, as far as observed in New Zealand are advancing, whilst in Europe they are generally retreating, had not its correctness

[249] The Ramsay Glacier.

[250] Joseph Alphonse Adhémar (1797–1862), French mathematician, proposed a theory of astronomical influence on ice ages.

been refuted[251], not only by geological but also by physical & astronomical facts. The development of the drift formation on such a gigantic scale is also worthy of consideration. The enormous disintegration of the rocks has obliterated in most instances every appearance of striae & furrows, though I observed traces of them nearly 1200 ft above the valley of the Rangitata, and 3000 ft above the sea. Also true roches moutonnées lying now about 1800 ft below the terminal face of the glaciers may be a further proof of [the glacial period's][252] existence, even if we had not more ample proof in the character of the large deposits, as well as in the erratic blocks lying on the sides of the hills and in the upper part of the Canterbury plains. We should most probably find furrowed & polished rocks in the river beds themselves, were they not filled up with large deposits of boulders & shingle. Whether the [current] advance of the glaciers is caused by the lowering of the annual mean temperature, or by a lower summer temperature alone, or by the gradual upheaval of the country, or by 2 of these causes combined, is worthy of further consideration, in which a more minute examination of this beautiful Island & careful meteorological observations during a number of years will greatly assist us. [*end of manuscript*]

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[251] Adhémar's theory was developed further by James Croll (1821-1890), and subsequently by Milutin Milanković (1879-1958) into an account which successfully explains the periodicity of Ice Ages by astronomical causes (Macdougall 2006).

[252] "its" in manuscript.

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