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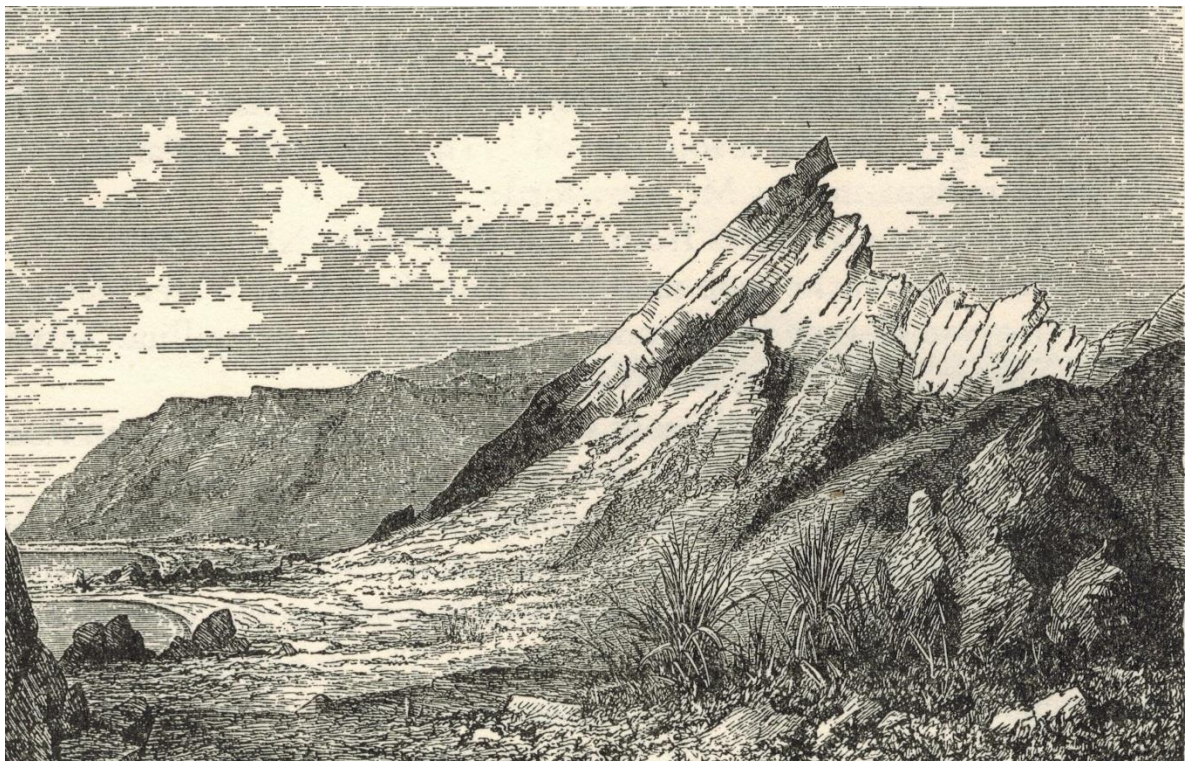

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Contents

Front Cover

Woodcut print of a painting by William Smith, "Tetera Ekupe" (*Kupe's Sail*), near Cape Palliser, published in Hochstetter's *Geology of New Zealand* (1864).

Remembering Professor R. G. Burns

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Roger George Burns, professor of mineralogy and geochemistry, Massachusetts Institute of Technology, died 1994-1-7 of cancer in Cambridge, Mass., aged 56. Little notice of this prominent New Zealand scientist has yet appeared in his native land. This note relies largely on the obituary published by the MIT News Office 1994-1-26, and the more detailed memorial (with selected bibliography) by his MIT colleagues F.A. Frey and T.L. Grove (*American Mineralogist 80:* 1082-1084, 1995).

Roger Burns was well known for his major role in developing mineral spectroscopy and as the author of an influential book, *Mineralogical Applications of Crystal Field Theory*, first published in 1970 and revised for the second edition in 1993. This classic showed clearly how laboratory study of minerals interpreted in the context of crystal field theory leads to an understanding of mineral structure that could not be obtained by other research techniques.

Born in 1937 in Wellington, Roger grew up in Khandallah. Unusually, he commuted from there to Rongotai College from Form I. From my viewpoint a couple years behind, he looked like the outstanding Victoria physical chemistry student for several years on either side. His MSc in 1961 gained first-class honours, with a thesis supervised by the late physical chemist Brian England on kinetics of bimolecular nucleophilic substitution reactions in aqueous alcoholic media.

On the prestigious 1851 Exhibition Science Research Scholarship he gained his PhD in geochemistry from the University of California, Berkeley, in 1965, applying the instrumental and theoretical capabilities of chemistry to geology - a subject which had been his minor interest at Victoria. At Berkeley he married an American, Virginia Mee.

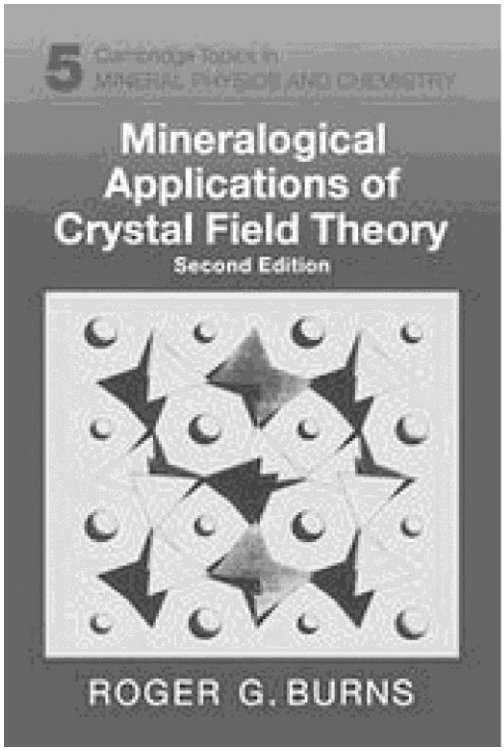
His PhD thesis, supervised by famous ex-Kiwi geology Professor W. S. Fyfe, made major progress in using chemical principles to understand the bonding of transition metals in silicate minerals. In particular, he was a pioneer in using absorption spectra to explore the location and atomic coordination of transition metals in minerals. Brief postdoctoral research at Cambridge led to appointment as senior lecturer in geochemistry back home at Victoria, but then after only a year he moved to a lectureship in geochemistry at Oxford. This busy latter-1960s period, adding newer methods including Mössbauer spectroscopy, effected his transition from chemist to mineralogist.

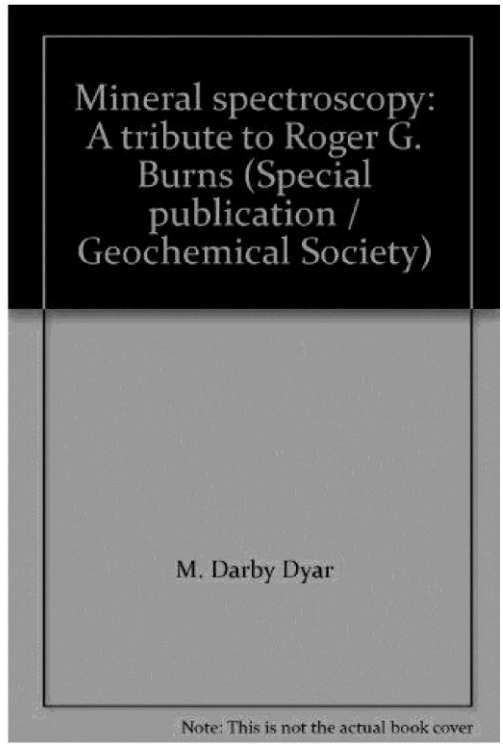
Roger was 'head-hunted' by MIT in 1970 as associate professor and within two years was promoted to professor (some Nobel prizewinners-to-be have taken longer than that to attain this rank at MIT**!**). His expertise in mineralogy and geochemistry and rapport with students led to innovative research. In addition to his energetic application of spectroscopic techniques to mineralogical problems, he broke new ground in several areas of earth and planetary science. In the 1970's, he and Virginia were instrumental in characterizing the widespread formation of manganese-rich minerals on the sea floor. In his later years Roger researched the reactivity of zeolites in proposed repositories for high-level nuclear waste. He also made major contributions to understanding the composition and mineralogy of the Martian surface, culminating with his contributions to a workshop titled "Chemical Weathering on Mars"; his last words on this subject appear in an abstract for the 1994 Lunar and Planetary Science Conference.

During his career Professor Burns supervised 23 PhD and 10 master's theses, published more than 140 research papers, served as an editor for several journals and books, and received many honours, awards and fellowships, including a DSc in mineralogy and an honorary MA in geology from Oxford and a Guggenheim Fellowship in 1991. In the other key aspect of academic life he also excelled. As a graduate-student demonstrator in undergraduate labs he had been extremely diligent and helpful; it is not surprising that he was a much-respected teacher at MIT.

Roger Burns's non-scientific interests included distance running. He often commuted this way between MIT and his Cambridge home, a distance of about 8 km, and he was a frequent finisher of the Boston marathon. Roger returned to his homeland on a few visits when I was lucky enough to see him and Virginia. The lifelong impression was of immense modesty. He is survived by his wife Virginia and their sons, Kirk and Jonathan.

Showing great promise in a New Zealand master's degree, and then much more on the 1851 Scholarship, so that the world's top science centres vie to hire a humble Kiwi, is a pattern we recognise from Rutherford. Roger Burns did not achieve world scientific dominance - indeed no-one since Rutherford has attained such status; but he did build his own smaller 'wave', and rode it with distinction. That such an accomplished scientist could pass away with little or no mention in his homeland may suggest that we still lack to some extent a due respect for our own.





Saga of the manuscript *The Geology of New Zealand* and the *Wahine* disaster

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One of our worst maritime disasters in modern times occurred on 10 April 1968. The inter-island ferry *Wahine* was blown off course by a huge storm as it was attempting to enter Wellington Harbour. The ship struck Barrett's Reef on the western side of the harbour entrance and after being badly holed sank in mountainous seas off Seatoun. The severe list to starboard that the ship very soon developed after striking the reef prevented the launching of many of the lifeboats. In accordance with nautical tradition ('women & children first'), the few useable lifeboats were filled with women and children and the men were left to fend for themselves and to jump into the sea. Of the 610 passengers and 123 crew that were on board 53 people were drowned – many of them while attempting to land on the rocky shoreline of the Pencarrow coast (Lambert and Hartley 1969). Pat Suggate was one of the passengers who had to jump into the mountainous sea. Luckily he was rescued by the Wellington Harbour Board tug *Tapuhi*.

The ferry "Wahine" listing heavily just inside the entrance of Wellington Harbour, 10 April 1968 ("Evening Post" photographer).

At the time Pat was the Chief Editor for *The Geology of New Zealand* (Suggate et al. 1978). As all the work for this massive project was done in the period before the advent of photocopying, the entire manuscript was in typescript and any alterations usually involved extensive re-typing. Using carbon paper, a maximum of three copies could usually be obtained but often the third copy was not very distinct. Therefore each copy was rather precious because it was impossible to replace in the event of loss or damage. The manuscript evolved through a number of revisions. Sections were circulated to various geologists for comment. The comments or suggestions for amendment were written in handwriting directly onto the top copy of the typescript and at various stages they were collated by the three editors and after discussion and consultation an agreed version was produced (often accompanied by a lot of angst).

Towards the end of the editorial process, Pat took the top copy of the entire MS (a huge wad of foolscap} around the various Geological Survey district offices and the universities, in an attempt to iron-out the various points of contention that had arisen. In March 1968 Pat travelled to the two district offices in the South Island, in Christchurch and Dunedin. As he boarded the inter-island ferry *Wahine* to return to Wellington he was carrying the copy of the MS. By this time written comments, annotations, corrections etc., were liberally sprinkled on the pages of the MS. The MS was in Pat's briefcase – which had to be left behind in his cabin when the order came to 'Abandon Ship'. During his trip south Pat had spent any spare time on a revision of the MS of the article he had written on the Rangitata Orogeny (Suggate et al. 1978: 318-333), following on from discussions with the South Island geologists. At the last moment whilst leaving his cabin, he tucked the pages of this MS under his shirt before leaping into the water. This was the only part of the MS that survived.

With the precious MS sitting on the bottom of Wellington Harbour, a major dilemma emerged: how to salvage the situation. Pat, Martin Te Punga and myself, as the editorial team, had to 'put our thinking caps on' and dredge into our memories to try to resurrect the various alterations that had been made to our respective sections of the MS. Colleagues throughout the country helped where they could. After a lot of effort and numerous phone calls the MS was largely reconstructed (we hoped!). *The Geology of New Zealand* was published in 1978.

Because the submerged *Wahine* was sitting in the main shipping lane providing access to Wellington Harbour, it was decided to completely

remove the wreck – to satisfy any concerns about maritime safety. The huge job of removal was carried out over almost a decade and material that had been salvaged was transported to a large wharf shed on Aotea Quay where it was laid out and sorted. Anything capable of identification (mainly passenger's luggage and freight) was returned to the owners, if they could be traced. So it was that on one day an officer from the Marine Department came to the Geological Survey and presented to Pat his briefcase that had been left in his cabin and had been found by the salvage team working on the removal of the wreck. Inside was the precious MS – absolutely saturated and very mouldy but still readable (with very much effort!). In the meantime *The Geology of New Zealand* had been published.

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Birth pains of *The Geology of New Zealand*

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The recent death of Pat Suggate (*Dominion Post*, Saturday 25 June 2016) has prompted me to write this article about the various hurdles we had to negotiate in the lead up to the publication of *The Geology of New Zealand*. As the lead editors Pat and I copped a lot of flak from colleagues about the length of time it was taking to move to publication and perhaps it is now a good opportunity to set the record straight because, as I hope the reader will appreciate, the delays were caused by circumstances totally beyond our control. [Pat had turned down an earlier suggestion of mine that a file note should be prepared recording the trials and tribulations we had encountered – for the sake of historians in the future. Pat said that it was all in the past and that we should move on.]

The Geology of New Zealand had its genesis in the 4-mile mapping programme of the NZ Geological Survey (Stevens 2011). As the programme drew to its close in 1959-1960 Dick Willett and senior NZGS officers suggested that NZGS should capitalize on the huge amount of new information obtained during the programme. It was also suggested that as many of the field staff and specialists were busily moving onto other areas of research that it would be good to make a start reasonably promptly. Thus, Dick adopted as an NZGS priority project the writing of *The Geology of New Zealand*. It is my understanding that at the time there was a lot of opposition from the Old Guard at Head Office DSIR. Things that were said included that in their opinion DSIR was not in the business of writing and publishing University textbooks. DSIR's function was to carry out high quality ORIGINAL scientific research, not to mull over and dissect old research. In my view this response was very small-minded indeed and profoundly ignorant of the way geology worked. Dick Willett's response was entirely typical of the man – that NZGS was going to do it anyway (Stevens 2015)!

An editorial team was set up consisting of Pat Suggate (Chief Editor), Martin Te Punga and myself (Associate Editors). Pat was certainly the Driving Force behind the whole project and put in a tremendous amount of effort, often in his own time at home. I can guarantee that Pat read every word in the 820 pages of the two-volume publication. The editorial work was divided up with Pat overseeing the Palaeozoic, myself

the Mesozoic and Martin Te Punga the Tertiary and Quaternary. Unfortunately, at various times Martin had bouts of a serious illness (Stevens 2013b) and although he made excellent contributions, Pat often had to take over to maintain the momentum of the writing-up process.

By early 1968 the bulk of the writing-up had been achieved. However, the first of many set-backs occurred when the top copy of the typescript, complete with numerous annotations, corrections and suggestions for improvement ended up lying in Pat's cabin in the wreck of the interisland ferry *Wahine* sitting on the seabed at the entrance to Wellington Harbour (Lewis 2013; Stevens 2016, this issue). The loss of this typescript was a terrible blow but luckily Pat, after jumping into the mountainous seas, was saved by a Harbour Board tug (minus his satchel carrying the precious MS). Perhaps it should be mentioned that as all this was occurring before the computer/photocopier era, typescript was the only record (no computer back-up!). After the loss of the typescript we were only left with the carbon copies – often of poor quality. However, we made the most of the situation and set about trying to remember the various annotations, corrections etc. Our colleagues helped enormously – with the help of numerous phone calls.

As Pat worked through the complete MS he picked up a number of anomalies, related to differing interpretations put forward by various authors. Some of these differing interpretations were due to the nature of geology itself (Stevens 2013a). Whereas sciences such as chemistry, physics etc. are built on firm bases of hard facts, many areas of geology are subject to interpretation because we are dealing with the earth itself, with huge gaps in the preserved record. Hence, we frequently apply The Principle of Multiple Working Hypotheses (Chamberlin 1897) – that drives judges and lawyers mad when they expect geologists to provide an exact answer to a question! The resolution of these differences in interpretation was the source of much discussion, often very heated. The people involved usually had strong opinions and held doggedly onto their 'pet' hypothesis. Often a lot of bad blood was generated, leading to complaints of editorial dictatorship and riding rough-shod over any interpretation that ran counter to the general tenor of the book. These differences had to be resolved come what may for the overall sake of the book.

Another problem that became apparent was that as time dragged on ideas in tectonics, structure etc., were changing very rapidly (with the advent of plate tectonics and the consequent revolution in the earth

sciences). The original plan for 'The Geology of New Zealand' envisaged the publication ending with broad-brush chapters on tectonics, structure etc. Authors had been selected and were looking forward to the opportunity to participate. However, it was very clear that anything that was written would probably be completely out-of-date by the date of publication. Therefore it was decided very reluctantly not to proceed with these chapters. This decision led to a great deal of anger and disappointment (cf. Stevens 2013). As it turned out it was the correct decision because the cumulative effect of numerous delays both at Science Information Division and The Government Printer meant that the publication did not appear until 1978!

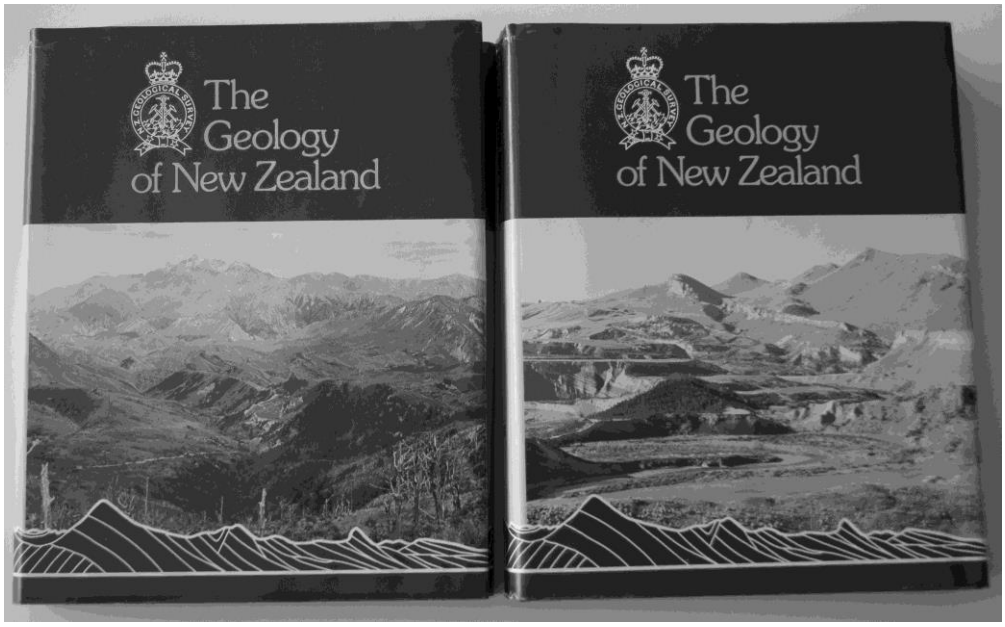
After the reconstruction job on the original MS lost in the wreck of the *Wahine* a complete re-type was undertaken by the NZGS typing staff. A huge effort carried out with a large degree of professionalism. Eventually the revised MS was submitted to Science Information Division, the publishing arm of DSIR. The function of SID was to prepare the MS for the Government Printer. Thus, it was thoroughly edited to conform with DSIR house style, figure placements were decided, references checked, etc. The progress through SID was at a snail's pace and Pat and I were powerless to do anything. We found that we were at the bottom of the heap in DSIR's publishing programme. We were obliged to work through SID and we had very little if any support from Head Office DSIR (perhaps a hangover from their earlier animosity towards the project?). As time dragged on, we saw that we had to fight our battles on our own. We found that we were up against a system of priority that consistently favoured other DSIR publication material over 'Geology of NZ'. SID staff were being constantly being pulled off 'Geology of NZ' to work on other publications. So there was very little, if any, continuity – very frustrating!! Because we were totally dependent on SID as an integral part of the publication process, I could not see any sense at all in rocking the boat too much. As so many problems were cropping up in the operational area, it was decided that Pat with his extensive knowledge of NZ geology should have a major role in editorial matters. I took over operation and implementation.

When the MS finally made it to the Government Printer another crop of seemingly endless delays were encountered. After talking to a neighbour of my parents who held the position of a Senior Foreman at Govt. Print I was able to glean some idea of what was happening (Stevens 2010, p.42). The delays were basically because work for DSIR had the

lowest priority (work for Hansard, Parliamentary Order Papers and large departments such as Justice, Education, MOW, Police, Social Welfare, etc., had priority). Furthermore, the DSIR work was done by the nightshift, often by poorly supervised and inexperienced (and probably sleepy) staff, often apprentices. Mistakes were common and sometimes an entire page would end up on the machine floor (this was the era of lead type) and would have to be re-set (introducing yet more mistakes). Also, the DSIR work would be off-and-on various machines as higher priority work had precedence – a perfect situation for mistakes to be introduced. All the text for 'Geology of NZ' was set on large linotype machines using molten lead. Printing was done by the Letterpress method. As pages of type came off the linotype machines they were placed into wooden form trays. Sometimes a tray would be knocked off the work bench and end up on the floor. Type would be scattered everywhere. I would then be called into the Government Printer to reconstruct the page because the technical nature of the material was beyond the capabilities of the printer. The galley proofs that came from the Government Printer would often be full of mistakes. Great care had to be taken with the spelling of technical terms, especially that of fossils. So frequently several versions of the galleys had to be checked to iron out the mistakes. Altogether, it took a long time to get to the page proof stage.

Once the page proofs of the MS became available an index could be prepared. It was a huge job and because Pat was feeling battered and bruised by the intensity of the criticism in the wake of some of his more controversial editorial decisions, as well as pressures from other work, I assumed overall responsibility for the index. It was decided that for ease of reference five specialized subject indices would be produced: general, author, geographic, stratigraphic and palaeontological. Initially I worked through the text with a felt pen, highlighting the words and subjects to be indexed. Then myself, assisted by Elma McGregor and Ian Keyes of the NZGS staff, together with my wife Diane, wrote the highlighted material onto index cards, together with the appropriate page number. The index cards were sorted into categories and condensed if necessary. Then a typescript was produced by the NZGS typing staff and thoroughly checked. The entire process was done entirely by hand and was extremely time consuming. Now it would largely be done by computer!! At the page layout stage the NZGS Cartographic Section worked through the various maps and figures required to illustrate the articles. The reductions and readability of each map and figure had to be very carefully checked. As the publication process dragged on and the earth science revolution changed

our thinking on so many things it became very clear that when publication was eventually achieved the work would be woefully out-of-date in so many areas. To try to make amends, it was decided to include a section of supplements (Suggate et al. 1978, pp.747-775) giving brief details of recent advances in knowledge and citing important works.



The Geology of New Zealand, vols.1 (left) and 2.

As completion time with the Government Printer approached Pat and I selected two very photogenic scenes from Lloyd Homer's collection. We decided that as the books were likely to be heavily used – sometimes in the field – that a conventional dust cover would soon get very ragged and torn, and perhaps eventually discarded. At the time The Government Printer was producing books with illustrations printed directly onto the bindery cloth of the cover (cf. Begg and Begg 1969), avoiding the need for a separate dust cover. Therefore, we went ahead with confidence and specified similar treatment for 'Geology of NZ'. After some time we were presented with a series of proofs. All of the examples had problems with colour rendition and sharpness of image. As there was no way we were going to spoil Lloyd's beautiful photos, we reluctantly agreed to dust covers, but in a conciliatory gesture on the part of the Government Printer the books would be fitted with clear plastic slip-on covers, to protect the dust covers. To cap it all off, the Government Printer slapped a price of $125 on the two volume set, without any consultation whatsoever; $125 was a great deal of money in 1978. To give some idea of how unaffordable the publication was – using the inflation index of the Reserve Bank of New Zealand – $125 in 1978 is equivalent to $796 in today's money. The aim of

making it affordable to students and the general public went by the board. Pat and I were extremely disappointed. Undoubtedly, the Government Printer could see a golden cow that they could milk for all it was worth. However, they fell in massively – probably because of the price – and sales were pathetic. Eventually the entire stock remaining was sold off with the volumes separately priced at $2 each (equivalent to $12.75 in today's money).

Footnote: With the establishment of GNS Science the services of the Government Printer were quickly dispensed with. After a competitive process Graphic Press of Levin was chosen and GNS has received excellent service and high quality products. To give a small example of their care and attention to detail: On one occasion I had to travel up to Levin as the printers were concerned because they were not able to obtain clear definition of some parts of the ammonites they were printing. I was able to tell them that the areas of concern were matrix and were not essential!

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William Mein Smith's Wairarapa coastal survey of 1855-56 and first geological descriptions

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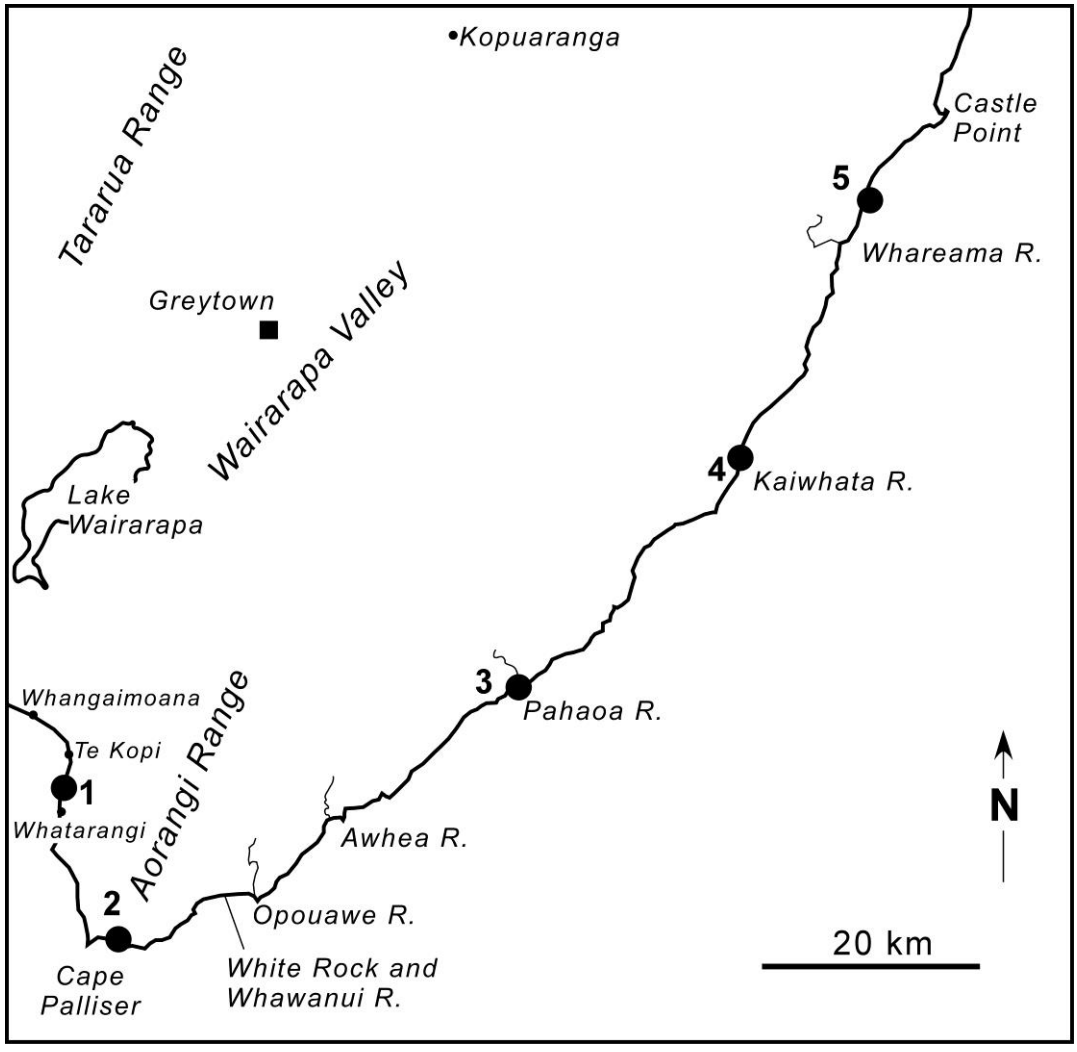
William Mein Smith (1798-1869), army officer (Captain, Royal Artillery), surveyor, magistrate, farmer, politician and artist, arrived in Wellington as the first surveyor general of the New Zealand Company between 1839 and 1843. Early in 1845 he moved to Huangarua, between Greytown and Martinborough, in the Wairarapa, where he became a runholder in partnership with Samuel Revans (the first commercial printer and newspaper proprietor in New Zealand between 1839 and 1844). Although a successful farmer, Smith was reluctant to leave his profession and returned to the New Zealand Company during 1849 and 1850 as contract surveyor when he made a sketch survey of the Wairarapa and explored the Manawatu area. As government district surveyor in the Wairarapa between 1853 and 1857, Smith surveyed the Crown purchases by Donald McLean (Chief Land Purchase Commissioner), and determined Maori reserves. He partly mapped the Wairarapa, including the Wharekaka Plains in 1854, surveyed eastward, and completed a coastal survey from Palliser Bay to Castle Point between October 1855 and March 1856.

William Mein Smith (oil-painting in possession of Miss Olive Wolters, Carterton, Wairarapa, photographed by P. Shankland).

Smith's report to Francis Dillon Bell, Commissioner of Crown Lands, Wellington, dated 1st May 1856 of the coastal survey provides the earliest description of the geology and he also made a number of sketches (later paintings) of places of interest, five of them showing Tertiary rock formations. These are reproduced here beginning on the eastern side of Palliser Bay (Locality 1) and ending near Castle Point (Locality 5) (see map), together with initial geological descriptions and sections of these localities given by James Coutts Crawford (1859, 1863, 1864), Ferdinand von Hochstetter (1864), and Alexander McKay (1877, 1878, 1879).



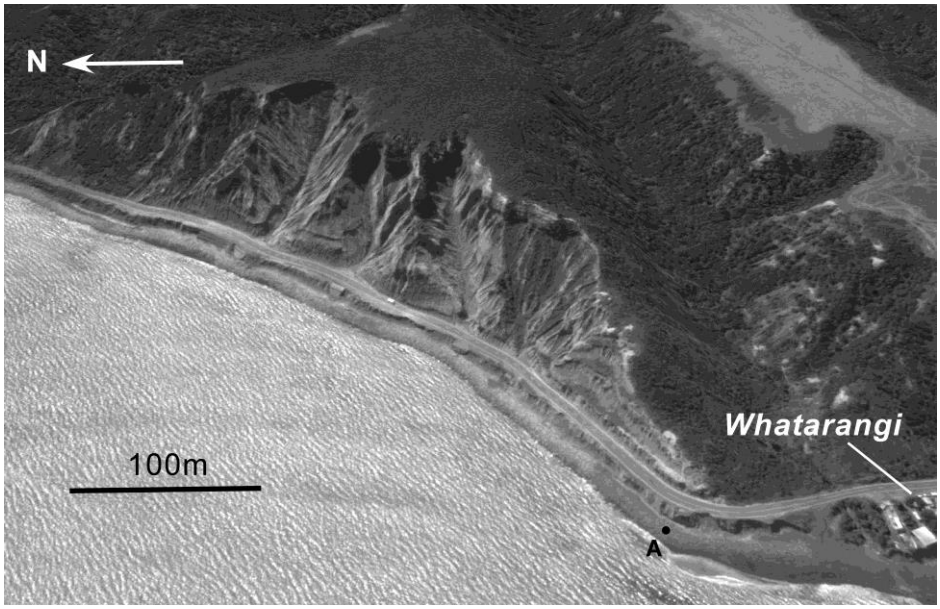
1. "***Cliffs between Te Kopi and Whatarangi, Palliser Bay*"** (C-028-038-a Alexander Turnbull Library, Wellington)[1]

This painting shows the deeply-eroded mudstone cliffs along the eastern side of Palliser Bay, which Smith describes "as bold cliffs varying from 120 to 200 feet in height, …of light blue clay containing blocks of

grey limestone in which numerous sea shells are embedded[2]. Alexander McKay had difficulty passing these cliffs on October 21, 1878:

"I continued my journey, purposing to take the coast-line track, and thus be enabled to examine the high marly cliffs forming precipices along the north-east shore of Palliser Bay. The heavy surf breaking rendered the road along the base of the cliffs impassable, and I was thus compelled to take the horse-track cut along the side of the range, where I found nothing of particular interest till the track again descended to the beach" (McKay 1879). McKay regarded the "marly cliffs" as Lower Miocene (*Pareora Beds*), describing them as "brown sands, with concretionary masses of a more calcareous nature, containing numerous fossil remains. These sands are overlaid by sandy clays, which at many places in the lower beds contains fossils plentifully, but the higher part of these beds appears to be wholly destitute of fossils".

An early observation from this locality by Charles Clifford in March 1844 noted that "A curious circumstance occurred in these cliffs. About 30 ft. below the surface is a strata of sand in which large trees are imbedded lying in a horizontal position". In Smith's painting, the horizontal "strata of sand", and referred to by McKay, can be seen overlying the mudstone. Crawford (1861) describes these horizontal sediments as "fine, light red gravel… capping the argillaceous shale between Wangamoana *(Whangaimoana)* and Tekopi" *(see map)* and assigned a Tertiary age.



Google Earth image 1/2/2003 showing eroding cliffs between Te Kopi and Whatarangi painted by William Mein Smith from the position marked "A".

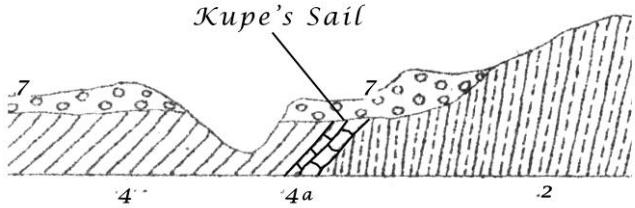
2. "*Tetera Ekupe*[3]*, spur of the Aorangi Range near Palliser Bay*" (E-011-f-004, Alexander Turnbull Library, Wellington)

Smith's painting shows the prominent 45° SW dipping Tertiary sequence of Kupe's Sail viewed towards the west. In his report he writes:

"After passing the Clay Cliffs in Palliser Bay (*from Te Kopi to Whatarangi figured above*), the hills seem to be chiefly of sandstone and Grauwacke[4], but I could not examine them as I wished to have done for the weather was very wet and boisterous and I could only judge from the fragments I met with on the low lands. About a mile beyond Cape Palliser I found a high and remarkable rock called by the natives Tetera Ekupe. This is a stratified rock composed of seasand and comminuted shells. The rocks here run out to sea forming a reef. This I believe to be the beginning of a line of rock I have traced through the hills on the eastern side of Wairarapa as far as the valley of Kopuaranga *(see map)*, a distance of from 60 to 70 miles to the N.E. of Tetera Ekupe. Beyond this the hills are rocky and composed principally of sandstones[4a]…"

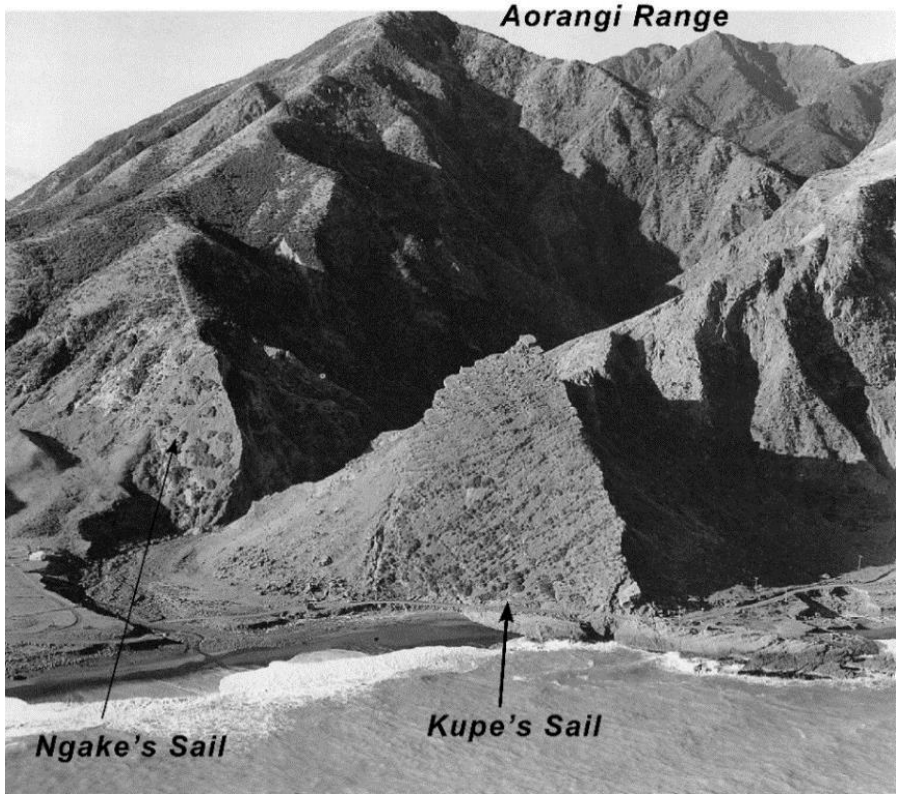
A woodblock print of Smith's painting is shown in Hochstetter (1864) (*Front cover*) to illustrate "the remarkable attitude of the beds" of Tertiary rocks which, according to Crawford (1859) consist of limestone, sandstone and clay at the Cape Palliser end of the "eastern mountain region of the Wellington Province".

The first geological report on this unique outcrop was by Alexander McKay in 1878, although his description of the locality is ambiguous; "…on the East Coast *(taken to indicate the east Wairarapa coast)*, two miles north of Cape Palliser, where, as seen from the seaward, the beds form a high, gabled cliff resting on the shoulder of the mountains, which rises immediately behind to a height of nearly 2,000 feet." McKay briefly described the lithology ("highly calcareous greensands"), thickness ("150 to 200 feet" [46–61m]), fossils ("corals, Brachiopoda, spines and fragments of Echinodermata"), and concluded an Upper Eocene age (equivalent to the *Hutchinson's Quarry beds*, Oamaru).



2. Permian (Coarse sandstone, black sandy shale and slate, conglomerate, dark limestone)
4. Lower Miocene (Pareora) (Brown sands, calcareous concretions, overlying sandy clays)
4a. Hutchinson s Quarry Beds
7. High level gravel

Part of a section "Palliser Bay to White Rock" in McKay (1879) showing position and dip of Kupe's Sail Tertiary rocks near Cape Palliser.

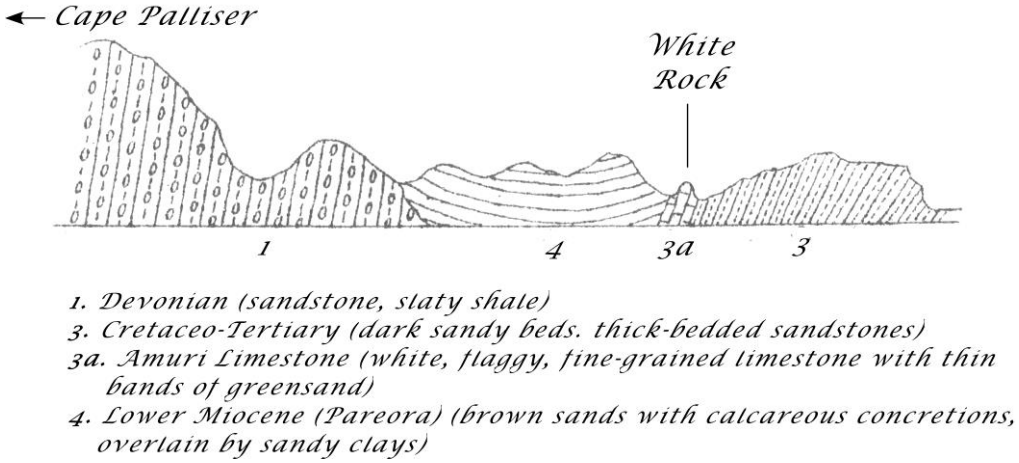


The 45^{o} SW-dippingTertiary rocks of Kupe's and Ngaki's sails [3] *viewed towards the north*

Proceeding along the coast, Smith reached the "Whawhanui" (Whawanui) River, about 13 km NE of Cape Palliser *(see map)*, where he noted:

"a large rock of stratified white limestone, the strata varying in thickness from 6 inches to 16 inches. The rock is very hard and similar to that which I have seen imported by some of the builders in Wellington from Kaikoura[5]. This rock forms a reef running out about half a mile from the shore in the direction 195^{o} or nearly S.S.W. The native name is Taungatara[6]. At a little more than a mile further to the Eastward we arrived the mouth of the river Opauawe *(see map)*, here, rises a large hill called Maungaroa; this hill is composed entirely of the while limestone which crops out in many places. It forms a point here and a reef running some distance out to sea. The strata here are not so thick as those at Taungatara nor is the dip so great, the one being nearly 70^{o} which the last is not more than from 15^{o} to 20^{o} both to the NE. Immediately beyond the limestone and lying above it, we found another stratified rock, blue, hard and of the grauwacke formation[7], beyond this again and lying over it, is a stratified sandstone[7] …A little beyond this we found some large blocks of sand or freestone, many of them would weigh I should think, from 25 to 30 tons each. As we proceeded the rocks are for the most part a stratified sandstone, but as we approached Awhea *(see*

map) they assumed a shaley (*sic*), and a slatey (*sic*) character and still further on, at the Point called Manurewa the lime again showed itself. The strata here are much disturbed…The rocks from here are chiefly sandstones, till we reached Mr. Cameron's station at Pahaoa (*see map).* Here again we met with the limestone in great abundance, it runs across the river into a large hill which like the Maungaroa is composed entirely of this rock".



Part of section "Palliser Bay to White Rock" from McKay (1879)

3. "Mouth of the Pahaoa" (….) (A-035-029; Alexander Turnbull Library, Wellington)

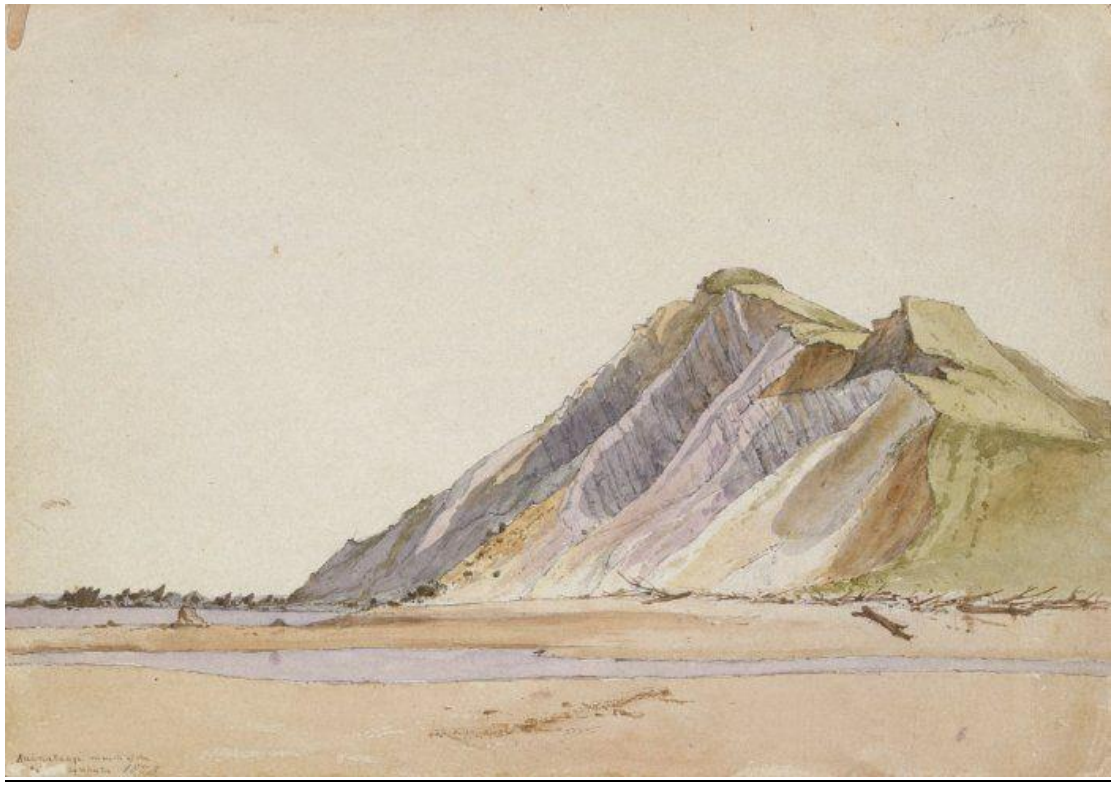
This partly finished painting, viewed towards the north, shows outcrops of thin-bedded limestone dipping ~50° NW and a pa at the mouth of the Pahaoa River. The inset shows the same rocks today.

The area was traversed by the Wellington provincial geologist, James Coutts Crawford, in 1863 who noted a lithological change from "white limestones and sandstones" on the north side of the river, as depicted in the sketch, to "Paleozoic rock" on the south side of the river. This change is shown on his geological map of the Wellington Province (Crawford 1864). McKay (1878, 1879) noted the same relationship with Cretaceo-Tertiary rocks (*Amuri Limestone*) "resting on Paleozoic rocks at the mouth of the Pahaua River", and that "grey and black flints are quite common in the limestone at the mouth of the Pahau (sic) River", commenting that such flints are "not found in New Zealand except in the near presence of the Amuri limestone" (McKay 1878). Crawford's "limestones and sandstones" are Late Cretaceous-Paleocene *Kaiwhata Limestone* and Eastern Facies *Whangai Fm.* thin-bedded calcareous mudstone-glauconitic sandstone (Lee and Begg 2002), and the "Paleozoic" rocks are Early Cretaceous (Pahaoa Group, *Mangapoika Fm.*) "greywacke" (?Urutawan-Motuan) (Moore and Speden 1984, p.46), juxtaposed along the Adams-Tinui Fault (Lee and Begg 2002). Chert nodules from the limestone mentioned by McKay were extracted by Maori living at the pa shown in Smith's sketch for tool making (Dodd 2015).

Beyond Pahaoa River to Castle Point, Smith describes the geology as: "The sandstone both stratified and unstratified was found from time *(to time?)* through the remainder of our route to Castle Point. The cliffs near the Kaiwhata *(see map)* are also of a stratified sandstone but of no value being so soft as to be easily cut with a knife."

4. "Kaimatangi mouth of the Ri[ver K]aiwhata 1855" (A-035-932; Alexander Turnbull Library, Wellington)

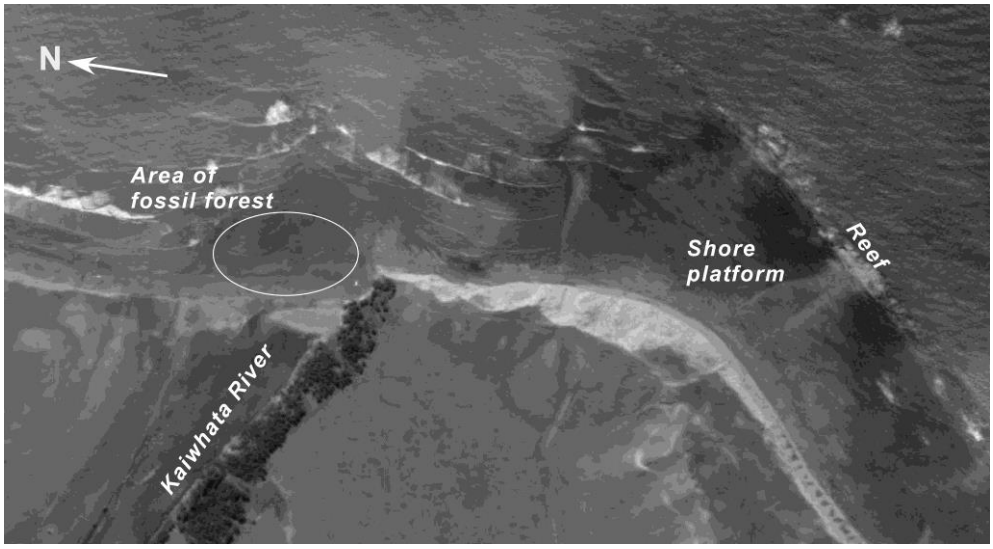
This painting, viewed towards the south-west, shows the cliffed exposure of NW-dipping Tertiary rocks on the south side of the Kaiwhata River mouth. In the distance the irregular shore platform that extends to an offshore reef, the line of drift wood, and exposed beach bar across the river mouth indicates that the painting was made at low tide, so that the three protuberances showing above the fine gravel to the left probably represent part of the fossil forest that can be seen at low tide today (e.g., see Homer and Moore 1989, p.26).



The Tertiary exposure is well-bedded sandstone-mudstone of the *Whakataki Fm.* of Early Miocene age forming the eastern (NW-dipping) limb of a syncline. In Smith's painting the strata have an apparent NW dip of ~70^{o}, whereas the true value on the 1:250000 geological map at the river mouth, presumably on the shore platform, is 45^{o} (Lee and Begg 2002). The fossil trees were first described by Lester King (1930) when he revisited the mouth of the Kaiwhata River and found that great changes had taken place:

"On the first visit it was easy to cross dry shod by means of a high storm beach of gravel thrown up by the sea which dammed the river to produce a lake 75 yards (68m) wide and 600 yards (548m) long; the outflow from which seeped through the gravel to the sea. On the second visit the river mouth was open to the sea. Owing to much rain in the back country the river had broken the dam and built a temporary bar (about awash at high water) 30 yards (27m) seaward of the previous high tide mark. Inside the area thus enclosed the river had exercised a scouring action and disclosed the trunks of 22 trees, all upright in the position of growth, previously covered by the sea and marine gravel, just seaward of the beach. That these trees were actually in the position of growth is shown by the fact that many were slender tree ferns without spreading roots, so that if overturned, they would not subsequently regain the vertical position. Another tree stump, which, though not protected by the bar, had been uncovered by the outwash, and overturned by the force of the waves, was also found to the north".

Radiocarbon dating of these tree stumps yields ages of 8.3 and 8.0 kyrs BP (9.3 and 8.9 cal. yrs BP) (Ghani 1974), suggesting, from the Holocene sea level curve, coastal uplift at this locality of c.19 m (an average rate of ~2mm/yr), as the result of possibly 7 or 8 earthquakes.



Google Earth image 1/2/2003 showing area of Kaiwhata River mouth and limestone cliff (right) depicted in Smith's painting "Kaimatangi mouth of the River Kaiwhata".

5. "Castle Point" (A-034-033; Alexander Turnbull Library, Wellington)

This painting, viewed towards the north-east, shows Castle Point (*The Castle*; 163 m)[8] from the shore platform in the foreground at low tide about 11 km to the south, probably just north of the Whareama River mouth *(see map)*. The rocks of the shore platform are well-bedded sandstone-mudstone of the Early Miocene *Whakataki Fm.* (as at the mouth of the Kaiwhata River), that here dip west at ~45° (Lee and Begg 2002). On the seaward-facing near-vertical cliff of Castle Point, Smith has drawn the unconformable contact (the rock brown colour difference near the base of the hill) between lower 25° WNW-dipping, dominantly poorly-bedded Early Pliocene mudstone-siltstone *(Rangiwhakaoma*[9] *Fm*.), and overlying Late Pliocene coquina limestone (*Castlepoint Fm*. of Johnston 1973, 1975; *Totaranui Limestone* of Lee and Begg 2002) that forms the bulk of Castle Rock. The low uncliffed area to the left (west) of Castle Point is a c.200m wide crush zone in *Whakataki Fm.* rocks faulted against the Pliocene sequence of Castle Point (Johnston 1973). Holocene limestone breccia that flanks Castle Point (Johnston 1973) is possibly depicted in the painting by steeply-sloping lines extending down the grassy western side of the hill.

A woodblock print of Smith's painting is reproduced in Hochstetter (1864) and is used to illustrate the formation of wave-cut platforms:

"…the sediments in the sketch, dipping towards the land, are presumably alternating beds of sandstone and marl. Below the steep cliffs the tops of the individual beds extend across the platform in longitudinal ribs and make the platform appear as if it had been ploughed in furrows. The platforms may have a breadth of more than 50-100 ft. Its formation is attributed to the destructive erosion of the breakers. Such coastal platforms always lie between low and high tide levels, usually at 1/2-2/3 the height of high tide above the lowest water level. At low tide the platform lies dry, washed by the surf at its outer margin. At high tide the platform is covered with water, and the breakers roll with all their destructive might over the platform right up to the foot of the shore cliffs, which are progressively washed away. The platform is thus formed by the breakers during high tide, and marks the lower boundary to which the waves at high tide operate in eroding and transporting, or the lower boundary of maximum wave effect which, as experience teaches, always takes place at high tide. The less violent waves of low tide work near the outer margin of the platform, and the breadth of the platform corresponds therefore with the difference between the eroding power of waves at high tide and the waves at low tide."

The Tertiary rocks of this area were examined by Crawford in 1863:

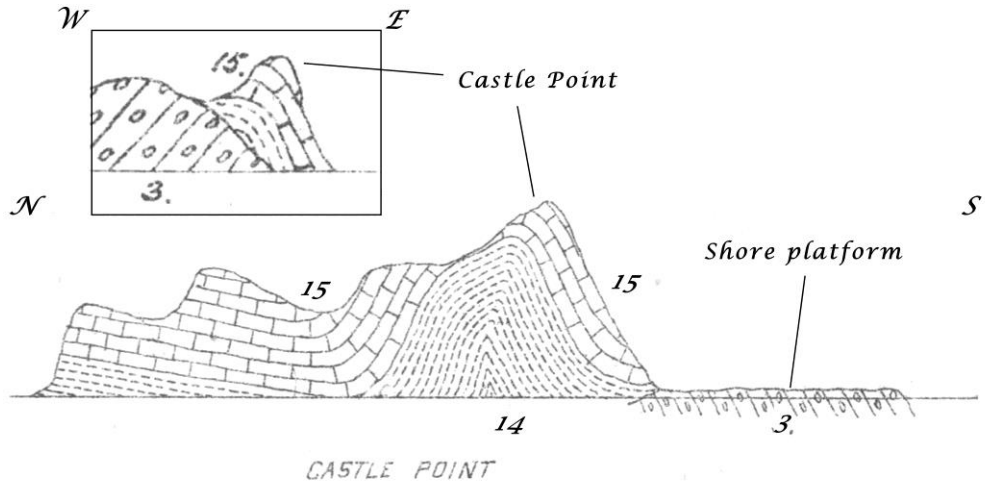
"On January 23rd I examined the reef at Castle Point. This reef is a peninsula forming the shelter to the anchorage. Both it and the rock called the Castle are composed of calcareous sandstone, resting unconformably on the sandstones and mudstones just mentioned. In it I found venus, pecten, terebratula, ostrea, turritella, struthiolaria, &c. The reef, which is a ridge perhaps fifty feet high, is penetrated by a cave, through which the tide passes and in which the roar of the wind and waves is very striking. Between the reef and the Castle Rock, the sea has another passage through the rocks into a basin. The Castle Rock is of similar formation to the reef.

In the mudstones and sandstones on the shore I found plant impressions, and in consequence proceeded in the afternoon up the bed of the stream behind Castle Point in the hopes of falling in with some seams of coal. I went on as far as I could penetrate, perhaps three miles, finding plenty of plant impressions, but no actual coal seams.

Mr. Guthrie informs me that some years ago, one of his shepherds, who has since returned to Australia, brought in a handkerchief full of coal, (stating that there was plenty more where he found it) which burnt well and seemed of good quality, and which must have been found within three miles of the Castle; but unfortunately he had neglected to ask him where he got it.

On the 24th January, Mr. Thomas Guthrie kindly accompanied me to point out some coal seams on the shore. Near the Nakaua (*Ngakauau Stream*) river we found soft sandstones containing plant impressions and some coal seams about two inches thick. They were not continuous, but thinned out in a yard or two. The rocks are the same as those at Castle Point and dip slightly to the Westward".

Alexander McKay (1877) was the first to provide sections through Castle Point (*below*). His E-W section (*upper*) is the same view as shown in Smith's painting; the other section (*lower*) appears to run northward from shore platform "contorted sandstones and conglomerate" and possibly "sandstones and dark-coloured shales" (as stated in McKay's text), through a steep anticlinal fold that forms Castle Point composed of a core of "blue sandy clay" overlain by "shell limestone" extending north to the present-day lighthouse where the rocks dip gently southward.



Sections of Castle Point after McKay (1877) (see text)

William Mein Smith ended his coastal survey at the mouth of the Whareama River, and although the stretch of the coast between Whareama and Castle Point was "beyond the limits" of the district "under his charge" (it formed part of the Ahuriri District and in 1858 became part of the Province of Hawkes Bay), not the Province of Wellington, he nevertheless surveyed it and made the sketch used by Hochstetter. Smith then returned to his "Survey Office" at Greytown in the Wairarapa Valley from Whareama *(see map)* by the "inland track" through hilly country noting the vegetation and availability of land for farming, arriving there on March 19, 1856.

1 This painting was figured in AA St CM Murray-Oliver 1966. Some notes on New Zealand geologists and artists. *New Zealand Journal of Geology and Geophysics* 9: 133-145, with the caption "Cliffs between Te Kopi and Watarangi, Palliser Bay. Watercolour by an unknown artist (c.1860) in the Turnbull Library".

2 Massive blue-grey calcareous mudstone (*Bells Creek Mudstone*) with discontinuous lenses of limestone (*Clay Creek Limestone*) of the Late Miocene *Palliser Group* (Begg and Johnston 2000).

3 The original Maori spelling is Nga-ra-o-Kupe (the sail of the early Polynesian explorer, "Kupe") and the story connected with this, according to the ethnologist, Percy Smith (1910), is that Kupe and his companion Ngake were camped here on one occasion, when an argument arose as to who could succeed in first completing a canoe sail (ra). So each started to work in the evening to make a sail; Kupe had finished his a little after midnight, whilst Ngake did not complete his until dawn. Thus Kupe won. Both sails were then hung up against the cliffs "and may be seen there to this day", Kupe's Sail at the coast, being the largest.

4,4a *Pahau terrane* greywacke (Early Cretaceous) (Begg and Johnston 2000). It is interesting that Smith uses "Gauwacke and sandstone" to describe the rocks of the western, and "sandstone" for the rocks of the eastern Aorangi Range. McKay (1879) differentiates these indurated rocks as Upper Devonian (Rimutaka Series) and Permian (Kaihiku Series), respectively.

5 *Amuri Limestone*; in the Wairarapa termed the *Mungaroa Limestone* (Teurian) (Begg and Johnston 2000).

6 Now called *White Rock*.

7 Well-bedded sandstone-siltstone of the *Mangapoika Fm.* (Early Cretaceous) (Begg and Johnston 2000).

8 James Cook described briefly the appearance of Castle Point as "a remarkable hillock", but only the journal of Sydney Parkinson, the illustrator assistant of Joseph Banks, mentions that he named it "Castle Point", which appears on Cook's map of the "Island of Aeheinomouve 1770". When Durmont D'Urville sailed by in *L'Astrolabe* on 1st February, 1827, he gave a more detailed description of Castle Point: "At half past three in the afternoon we hove to about three leagues from Cook's Castle Point, in seventy-five fathoms of water, mud and shell. Castle Point is a high bluff rising straight up from the water, a little like a fortress; nearby on the north, a long black rock with a flat top forms a little island close to the shore" (*on the northern end of which stands the lighthouse*).

9 The Maori name for Castle Point is *Rangiwhakaoma*, after which the formation is named (Johnston 1973).

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Dr Fulton's elastic stone

Glenn Vallender
ge.vallender@xtra.co.nz

Not all rocks are hard, grey and brittle; nature has a few tricks to play. When looking for suitable rock specimens to add to the collection for the highly successful Ashburton Heritage Centre exhibit and holiday programme, 'Papers, Scissors, Rock', a chance opening of a small box (Fig.1) found a very unusual pink and flexible rock nestled inside. But, along with this specimen (Fig. 2) there was a letter (Fig. 3) written by W.N. Benson of Otago University and dated 10/9/1919 as a reply to a Dr Fulton. This rock sample was accessioned to the museum in 1985. Who was Dr Fulton and what was this specimen doing in the Ashburton collection? And what about the box it was kept in?

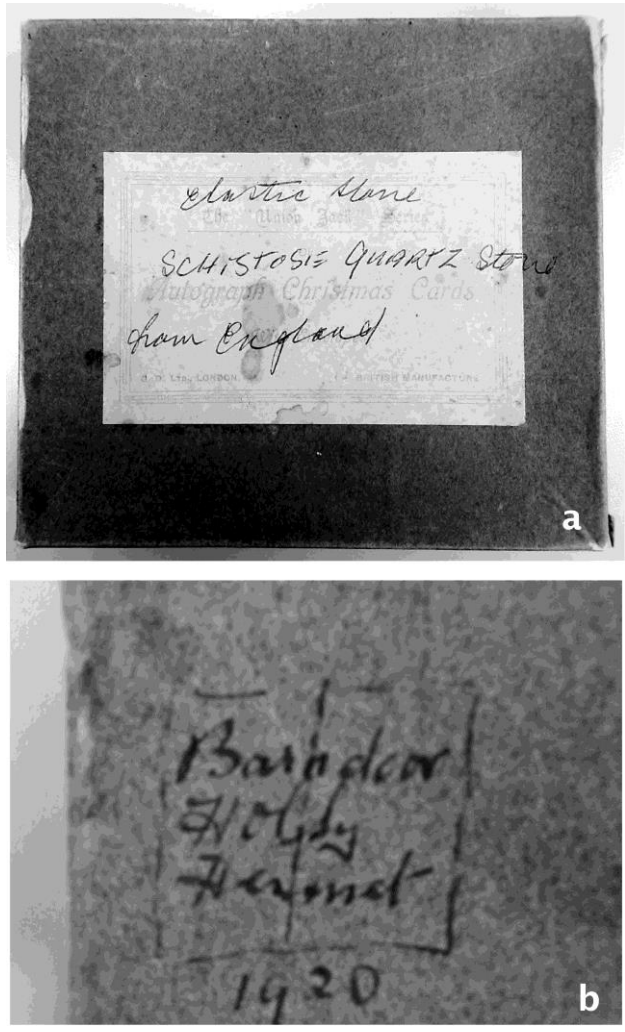


Fig.1. ***a.*** *Top of box;* ***b.*** *Underside of box.*

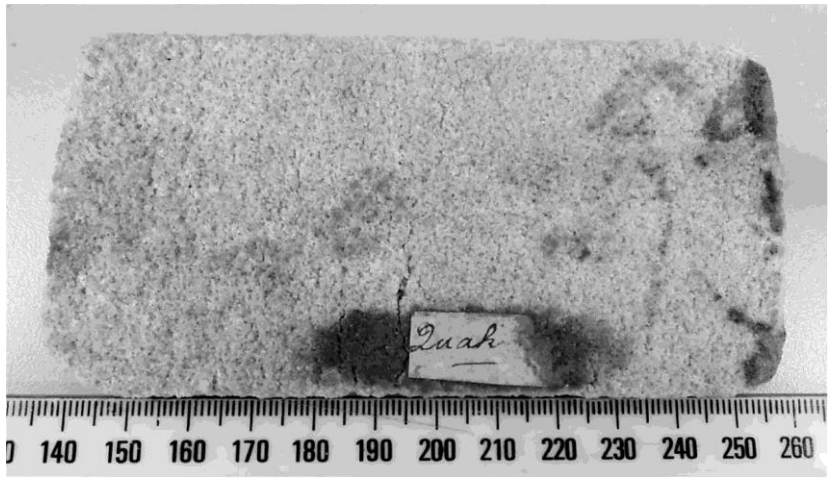
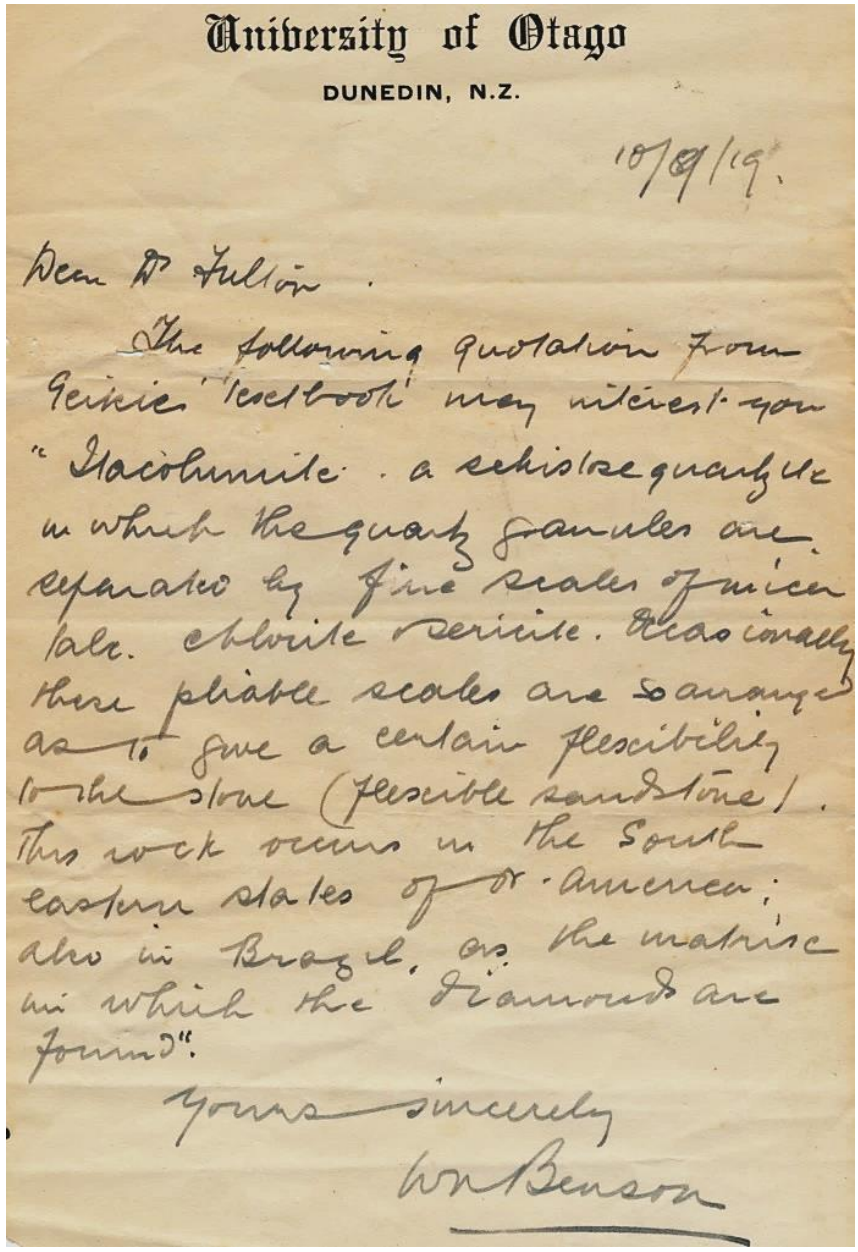


Fig.2. *The itacolumite flexible rock specimen*



University of Otago

DUNEDIN, N.Z.

10/9/19.

Dear Dr Fulton.

The following quotation from Geikie's 'Textbook' may interest you "Itacolumite. a schistose quartzite in which the quartz granules are separated by fine scales of mica talc. chlorite sericite. Occasionally these pliable scales are so arranged as to give a certain flexibility to the stone (flexible sandstone). This rock occurs in the South eastern states of N. America; also in Brazil, as the matrix in which the diamonds are found".

Yours sincerely

Wm Benson

Fig.3. *Prof. Benson's letter to Dr Fulton*

The son of well known Dunedin writer and doctor Robert Valpy Fulton (1865-1924), Dr Noel Edward Hertslet Fulton (1893-1978) was born and educated in Dunedin and one of six children two of whom were medical doctors. Hertslet is Dr Fulton's mothers last name. Dr Fulton completed his medical degree in 1924 at the age of 31 and served in both world wars achieving the rank of captain in January 1942. A gifted violinist and orchestral leader Dr Fulton was the patron of the Ashburton Musical Club. He was also a talented and dedicated chess player (Mr Roy Keeling pers.com.) and became the South Island champion in the 1950s. In 1915 Dr Fulton started work in an architects office but then enlisted in the medical corps as a private and went to Cairo. A little later he was transferred to Brokenhurst Hospital in Hampshire, England. Back from the war, Dr Fulton went to Rotorua to work in the military hospital and completed significant cancer research. He spent his whole working life in Ashburton after purchasing the medical practice of Dr Miller in 1927. Dr Fulton saw service in Fiji during WW2 (Fig.4) and was a surgeon for St John (1941-1964). He married Magdalene Buchan Lane and both are buried in the Ashburton cemetery. He is survived by a son and two daughters.

Fig.4. *Dr Fulton in his army Captains uniform c1945*.

Professor William Noel Benson (aka Noel Benson) was born on Boxing Day 1885 in England and educated in Australia. He was just eight years older than Dr Fulton and they probably knew each other in Dunedin when Fulton was a medical student just after WWI. In 1916 Benson

received a DSc from Sydney University and in that year he took up the position of Professor of Geology at Otago University where he became a major contributor to our understanding of New Zealand geology. Significantly, this year, 2016, marks the centennial of Benson's initial tenure at Otago University. Prof. Benson married Gertrude Rawson in 1923 (herself a professor of Home Science at Otago), retired in 1949 and died August 1957 with no children.

So, what about this flexible rock specimen called *itacolumite*? NE India (Kaliana Hill, 100km from New Delhi) is one of few places in the world where itacolumite or 'flexible rock' is found in situ. It is possible that Brokenhurst Hospital may have been the place where Dr Fulton acquired this rare rock as this hospital prior to 1916 specialised in helping wounded soldiers from India. On the other hand it may well have been a family heirloom as his father's in laws had strong connections with India. As Prof. Benson states in his letter, two places known to him as localities for *itacolumite* were Brazil and the south east of the United States (Carolina), but itacolumite is also found in France and Madagascar, and not England (as on the box lid. *Itacomulite* is named after Mt. Itacolumi (meaning 'giant') in Minas Gerais, Brazil. These flexible or 'elastic' rocks were first known about in 1740 and formally named in 1822. Although not completely understood, it is flexible or bendable because of the way in which the mineral grains interlock with each other and the style and degree of weathering the rock has undergone. If it is from Brazil it is about 580 milion years old and if from India is even more ancient at about 1.8 billion years old (see Suzuki and Shimizu 1993). The specimen itself has a label and name on it and I wonder who, when and where placed this and perhaps misspelt the name 'Quartzite'?

The box that holds the 'flexible rock' also has a story. On the underside (Fig.1b), dated 1920, is a name (perhaps referring to the original cards inside) "Barndoor" and a persons indecipherable name (Holly Harnet?). The date of 1920 suggests that the rock was placed in here after Prof. Benson had identfied and returned it to Dr Fulton. But wait, the box itself is also uncommon as it was made by the publishers G.D. Ltd (Delgado) of London which originally contained a set of Christmas cards as part of the "Union Jack Series". So, discovered by chance, a small package from a local Ashburton identity from 97 years ago (or more) has left us an interesting story and probably the only specimen of *itacolumite* in the country.

Thank you Dr Fulton.

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Further reading

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http://www.edinburghgeolsoc.org/eg_pdfs/issue27_full.pdf

Triphook[1] to Hochstetter 1859[2] with notes

Rodney Grapes
rodneygrapes@gmail.com

"Government Survey Office: Port Napier Hawkes Bay
February 15: 1859

Sir:

I beg leave to forward you the accompanying Rough Section, which I do with some reluctance in consequence of the paucity of my observations made & noted during my employment on the Government Topographical Survey, but without further apology I shall briefly in explanation of the section, observe that it seems this' a Tertiary district if I may judge from the fossils which are all with one exception taken from No 1 on section. As I am not a Palaeontologist I w[d] feel obliged by your mentioning if I am correct in supposing them to be Terebratula, Pecten, Planorbis, (?) Ostrea, Volutus & the Common Mussel[3]. The rock in many beds consists of these fossils only, varying from extreme friability to considerable hardness – without any cleavage & but few joints, the stratification distinct. No 2 marked sandstone hard is a deposit extending over a very considerable extent of country and accounts for the presence on the sea shore between the limestone cliffs. Can this be drift? the whole mass cemented with peroxide of Iron. I have observed fragments of No 2 included in No 1 at Pukekura of section; I can only account for it by supposing that during the deposition of No 1, that No 2 in some places occupied a higher level. No 3, a seam of lignite 8 inches thick (specimen accompanying) overlies No 4, an argillaceous shale where fossils occur in seams or a seam of 6 inches thick, in a remarkable state of preservation considering their friability when touched or removed. I have roughly estimated the thickness of the foregoing series on section, omitting for want of observation the minor detail of local stratification and disturbance but I believe the superposition of the series to be clearly proved & correctly delineated. I have not observed the occurrence of any minerals other than the components of the rocks – some jasper in No 4.[4]

I cannot conclude without expressing my regret that such apathy exists with respect to Geological or Mineralogical Research in New Zealand, and tho' yielding to no one is expressing individual gratification at reading your able report on the Auckland Coal Fields, I cannot but feel ashamed that this Colony should be so far behind the age as not to have made long since, ample provision for Mineralogical (at least) if not Geological

Surveys. Nor even while availing themselves of your valuable services have the authorities as I am informed obtained any information touching land in procession of the Crown or the Natives, which I humbly submit would have been of much greater importance than the examination of the land of private individuals.

I shall enclose herewith a table of observations of Earthquake Phenomena[5] up to present date from the period of my arrival in the Colony, and shall be happy to give you every information in my power which you may require on this, to me, most interesting subject.

I am Sir,

Your obedient servant

Thos Dawson Triphook

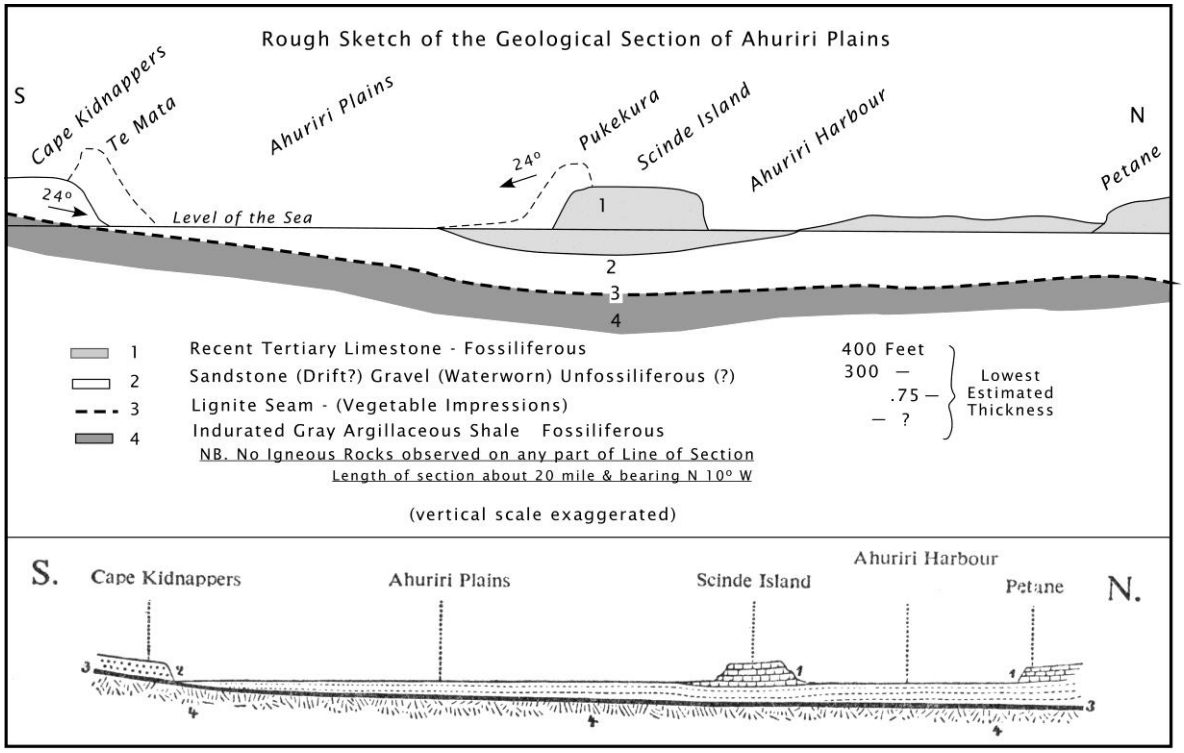
Ferdinand Hochstetter Esq. M.D.
Imperial Austrian Scientific Expedition"

From the Dr. Albert Schedl Collection, Vienna.
(www.aucklandcity.govt.nz).

Notes

[1] Thomas Dawson Triphook, a surveyor, land and commission agent, and amateur geologist in Wellington-Wairarapa, then Hawkes Bay (December 1857 to February 1863), and finally moving to Christchurch (in 1863) as a surveyor and civil engineer. Triphook was a member of the Philosophical Institute of Canterbury, where he "kindly made a drawing, in natural size, of the principal pieces" of saurian remains (Haast J 1869. Notes on a collection of saurian remains from the Waipara River, Canterbury, in the procession of J.H. Cockburn Hood, Esq. *Transactions of the New Zealand Institute* 2: 186-189). He also provided a blowpipe analysis of a carbonaceous rock sample from Wellington sent to him by James Coutts Crawford in March 1863 (Crawford JC 1863. *Geological and other Reports*. Council Paper, Province of Wellington, Session X: p.6).

[2] Triphook's letter of February 15 1859, accompanying geological section and samples, was prompted by a letter dated January 10, 1859 from Hochstetter to the Superintendent of Auckland, John Williamson, published in the *Hawkes Bay Herald* of January 29 1859:



Upper. *Copy of Triphook's sketch of the geological section of the Ahuriri Plains that accompanied his letter to Hochstetter. Ink and watercolour on watermarked blue paper 20.5 x 32.5. 1 = blue, 2 = brown. 3 = grey. The diagram is signed "Thos Dawson Triphook" and dated "Port Napier February 1850". From the Dr. Albert Schedl Collection, Vienna (www.aucklandcity.govt.nz).*

Lower. *Triphook's section as reproduced in Hochstetter (1864) (in Fleming 1959, p.14).* Hochstetter's text with the section reads: "At Petane and on Scinde Island, Tertiatry limestone (1) appears, approximately 400 ft thick and full of fossils. The following were included among the specimens sent to me be Mr Triphook:

Mytilus sp. (only in casts)
Venus sp. (only in casts)
Pectunculus sp. (only in casts)
Pecten Triphooki Zitt.
Trochita dilatata Quoy (a living species)
Waldheimia lenticularis (a living species)

The same limestone is to b found on Long Point, on Mahia, the peninsula enclosing Hawkes Bay to the north, at a height of 1,180 ft above sea level.

Under the limestone lies iron-stained sandstone and unfossiliferous conglomerate (2) about 300 ft thick, and under this at Cape Kidnappers, there comes to light at sea level a lignite seam 8 in. thick (3). The lignite overlies clay marl (4); the very abundant molluscan shells in the separate beds of this clay marl are so friable that they can scarcely be collected."

“Auckland, Jan. 10, 1859.

Sir, — I have the honor to request that notice may be given to the Inhabitants of this part of New Zealand that I shall be happy to receive specimens of any rocks, earths, or other minerals found here, with information as to the various localities and as far as may be in my power to answer questions in reference thereto. Any specimens illustrative of the Natural History of New Zealand will be gratefully received by me on behalf of the Austrian Scientific Expedition. I may mention that fossils of all kinds are especially desirable, and particularly the fossil bones of the Moa and other extinct birds. All such specimens may be forwarded to my address at the offices of the New Zealand Government, or at the office of the Superintendent, Auckland, and the receipt will be duly acknowledged by me.

I have &c,
Dr. Ferdinand Hochstetter
To his Honor the Superintendent, Auckland.

We refer thus prominently to this matter, from the fact that the other provinces may, if they so please, have the benefit of a visit from Dr. Hochstetter, –The “Southern Cross" thus says, referring to the arrangement generally; — "This arrangement does not preclude the General Government from availing themselves of his services in other provinces, should the respective Provincial Governments be willing to make good the travelling expenses on behalf of each."

Now, Hawke's Bay presents a field of peculiarly interesting research to the man of science; and the inhabitants of the province would gladly see amongst them, though but for a short period, a gentleman of Dr. Hochstetter’s attainments. The only difficulty - the want of a Provincial Government to provide the necessary funds — might easily be obviated by one or more of our principal settlers assuming for the present the requisite responsibility.”

(*Hawkes Bay Herald* January 29, 1859)

A similar letter from Hochstetter dated January 13 to the Colonial Secretary, Edward Stafford, in Auckland was published in the *Taranaki Herald*, January 29, 1859 with comment:

“It is known throughout the Colony by this time that an Austrian frigate, the Novara, is engaged in a scientific expedition round the world, and is at the present time at Auckland. About thirty gentlemen are attached to the expedition, all eminent in their own departments of science. One of these, the geologist Dr Ferdinand Hochstetter, whose name appears to the report on the Auckland coal fields in an admirable letter to the Colonial Secretary, which we give below, expresses his readiness to receive specimens illustrative of any branch of Natural history from every part of New Zealand, and adds that if the specimens be sent in duplicate, one set may be transmitted by him to Europe for future Report, leaving

the other behind as a nucleus for a New Zealand Museum. The privilege of ready and free access to the Doctor is not only accorded to every person in the Colony, but specimens forwarded to him will be investigated by the most celebrated men in the Austrian empire, and the result communicated to the New Zealand Government. It may be said we are poor in specimens and we have nothing worth sending. But the specimens of a new country are always interesting and are examined by learned men with great interest, and if we' so summarily decide upon their value or -character, we in effect place ourselves above the expedition. We have our dyeing and tanning barks, our gums, and minerals" (including the Iron ore), and if we can only send a clay suitable for brickmaking, it will receive careful and earnest attention, and contribute to the little as yet known of the land we are occupying.

Auckland, January 13th, 1859.

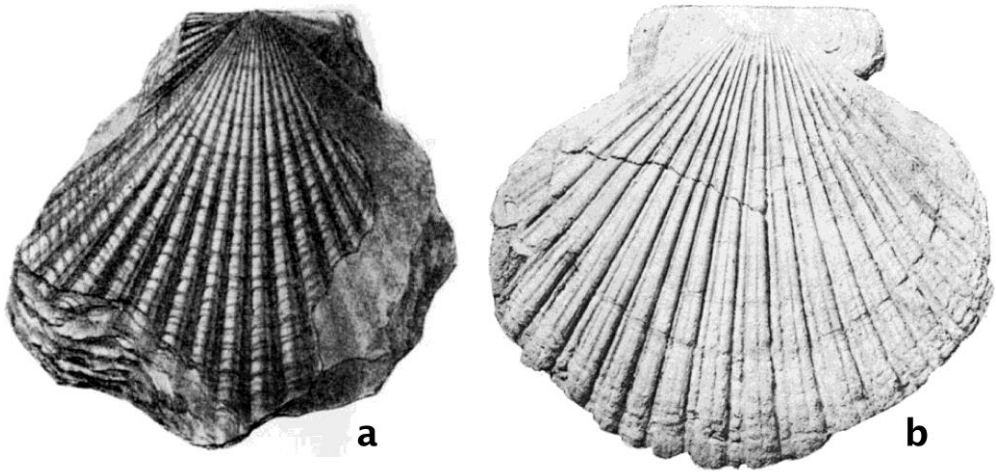
Sir, — With a view to make my stay in New Zealand as conducive as possible to a more complete acquaintance with the Natural History of the country than has hitherto been attainable, I have the honor to suggest that it would be desirable that public notice should be given to the inhabitants of the Colony, that I shall be happy to receive specimens illustrative of any branch of Natural History from any part of New Zealand, together with information relative to the locality from whence obtained, and any other remarks that may be thought likely to render the scientific examination more perfect. By sending such specimens in duplicate the donors would enable me to transmit one set to Europe for the purposes of the Expedition to which I belong, and to leave the other here as a nucleus for a New Zealand Museum, — every specimen in which being numbered to correspond with those sent home, the future Report of the Expedition would enable the colonists to identify them, and to learn all that had been ascertained in reference to them by the united labours of men eminent in their respective branches of science in Europe. With your permission I would request that such specimens may be sent to my address at the offices of the Colonial Government in Auckland.

Dr Ferdinand Hochstetter.
To the Honorable the Colonial Secretary."

(*Taranaki Herald*, January 29, 1859).

In his lecture on the "Geology of the Province of Auckland" at the Auckland Mechanics Institute on June 24, 1859, Hochstetter acknowledges the contribution of specimens sent by "Mr. Triphook of Hawkes Bay" to his "collections" that had "been growing from day to day, and include specimens of great interest in most branches of Natural History" (Reported in the *New Zealander* June 29, 1859).

3 Hochstetter (1864) lists some of the fossils sent by Triphook (see above) that includes *Pecten triphooki Zitt* (subspecies *Chlamys (Phialopecten triphooki triphooki*, Beu 1978; a common Pliocene –Lower Pleistocene fossil in New Zealand) from the Scinde Island limestone, "named after Mr. Triphook of Ahuriri" by Karl Alfred von Zittel (1864, p.52), Professor of mineralogy, geognosy and paleontology at the Karlsruhe Polytechnic (1863-1866), and shown below,



a. *Pecten triphooki* from Zittel (1864; Pl. 11, fig.4); **b.** *Chlamys (Phialopecten) triphooki triphooki*, from Lower Scinde Island Limestone at Napier (Milton Road locality) of Nukumaruan age, reduced to x 0.66, from Beu (1978; Fig.23). This is a right valve. According to Fleming and Hornibrook (Appendix in Flügel 1959, p. 843), the specimen collected by Triphook is most likely to have come from a shell-bed in the lower part of the limestone exposed on Milton Road (Napier Hill, formally Scinde Island), the "restricted type locality of *P. triphooki*".

4 In 1859 Triphook also provided James Coutts Crawford, Wellington Provincial geologist, with his "list of rocks in the Province of Hawke", somewhat different from that provided to Hochstetter, which Crawford (1861) lists in "a descending series" as:

"**Tertiary**

Fossiliferous limestones, marine fossils, 500 to 800 feet thick.
Crystalline gravel waterworn, unfossiliferous, 300 to 500 feet thick.
Seam of lignite (9 inches thick).
Argillaceous indurated shale, fossiliferous.

Metamorphic or altered rock, probably Silurian.

Hard, green, gritty, sandstone, unfossiliferous."

[5] Triphook's table of earthquakes from December 11, 1856, to July 1, 1859 is given in Hochstetter (1864), and was regarded by him as "weaker earthquakes" that were much more frequent that the great earthquakes of 1848 and 1855 which he describes (Fleming 1959; p.38).

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