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Contents

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1

Louis Charles Bernacchi, Pioneer Antarctic Scientist and Explorer

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ABSTRACT

Louis Charles Bernacchi was a pioneer Antarctic expeditioner who made contributions in his capacity as a professional scientist on Borchgrevink's *Southern Cross* (1898-1900) and Scott's *Discovery* (1901-1904) expeditions. He came from a European background but was raised in Tasmania, Australia. His two Antarctic expeditions followed training in astronomy and magnetic studies at Melbourne Observatory. He made a significant contribution to polar scientific fieldwork and to the production of official scientific reports of both expeditions. After Antarctica, he undertook various private expeditions to South Africa, South America and south-east Asia, after which he settled in England. Bernacchi left a literary legacy of three monographs and an edited compilation of Antarctic-science-related essays. His descendants are dispersed across the world and one branch of the family lives in the Canterbury district of New Zealand. Canterbury Museum, Christchurch has a significant collection of artefacts and manuscripts relating to Bernacchi's Antarctic expeditions. This article serves to supplement previous publications, to rectify biographical inaccuracies within them, to raise the profile of Bernacchi's significant contribution to early Antarctic expedition science and to acknowledge Bernacchi's connections with Australia and New Zealand.

KEYWORDS

Louis Charles Bernacchi; Antarctica; *Southern Cross*; *Discovery*; physicist; terrestrial magnetism

INTRODUCTION

Louis Charles Bernacchi remains a minor figure in polar history in spite of his pioneering scientific work on two expeditions that were of great significance at the time. The dramatic narratives of the geographical explorations on expeditions of the era of Antarctic exploration between 1898 and 1914 have eclipsed the contributions to polar science by Bernacchi and others. The *Southern Cross* expedition was the first to overwinter on the Antarctic continent and the first expedition to use dog sled transport, thus providing much useful information on strategies to meet the challenges of life at the frontier. Scott's *Discovery* was the first expedition to make significant geographical explorations away from the coastal hinterland and Bernacchi was charged with responsibility for the internationally collaborative programme of terrestrial magnetism, the pendulum survey for the determination of the value of gravity, auroral observations, electrostatic measurements and astronomy. At the end of 1903, Bernacchi was the most experienced polar expeditioner of the time, having spent three winters in Antarctic service. Bernacchi did

not return to Antarctica after the *Discovery* expedition although he did have an ongoing interest in Antarctic science and expeditions until his death in 1942. He had planned to lead an expedition of his own in 1925 but failed to secure funds.

Louis Charles Bernacchi in polar gear (Janet Crawford collection, with permission)

Family background and upbringing

Louis Charles Diego Bernacchi was born in Schaerbeek, Brussels, on 8 November 1876. His father, Angelo Guilio (Diego) Bernacchi, came from a wealthy Italian family involved in silk production (sericulture) and vineyards at their estates in Lombardy, northern Italy. His mother was Barbe Straetmanns, an inn-keeper's daughter of Flemish descent.

When Louis was aged seven, his father moved the family to Australia, arriving in Tasmania on 17 January 1884. By April of that year they had moved to Maria Island, just off the east coast where Diego took up a lease on the whole island for 10 years at peppercorn rent. Here he attempted to establish sericuture as the prime income producer, supplemented by vineyards and pastoral pursuits. Thousands of grape vines had been established by 1886 but the intended sericulture and pastoralism developed at a slower rate. Much later, a cement works (using local raw materials) and a coffee palace were also established in an effort to diversify and expand income streams. Of all these enterprises, wine production was the most successful (Weidenhofer 1978).

The family members were all well educated and intellectual. Diego spoke five languages, and Louis spoke Italian and French fluently. Louis described his own childhood on the island as idyllic:

..amidst those wild but enchanted surroundings, I learnt to ride, to shoot, to manage single handed a 22-ft. whale-boat, and to "rough it" in many outdoor ways. (Bernacchi 1938)

Louis was educated locally, mostly by home tutoring, until, at age 12, he was admitted to the Hutchins School in Hobart to commence formal studies. This was partly in response to the unreliability and danger of making the crossing from Maria Island to mainland Tasmania, especially during winter. He was admitted to Hutchins on 6 May 1889 and remained at the school until Easter 1891 (Hutchins School Archives, NB36, p.130).

In 1896, he commenced training at the Melbourne Observatory under the tutorship of the Acting Government Astronomer, Pietro Baracchi. Diego, who was known to Baracchi socially, brokered this arrangement. In a letter of reference dated May 1898, Baracchi described Louis' traineeship thus:

Louis Charles Bernacchi had frequented the observatory for the last 24 months, during which time he has acquired practical knowledge in, 1st Sextant work for the determination of geographical position, 2nd The making of magnetic observations with a magnetic theodolite and dip circle (Kew pattern), 3rd The general routine of Meteorological observations. He has some preliminary practice in Meridian observations with a portable Transit Instrument, and other miscellaneous astronomical work. (Crawford Collection)

Bernacchi's Antarctic preoccupation

Bernacchi's curiosity with Antarctica was stimulated by his father's intellectual interest in the sciences, particularly astronomy. Hobart was a port of call for many whaling vessels and during his time at Hutchins School, Bernacchi learned about their trips to high

southern latitudes. He also knew the polar histories of Sir John Franklin and Sir James Clark Ross who both had strong Tasmanian connections (Crawford 1998, p. 18-19). There was also an event where, in 1896, the sealing ship *Gratitude* sought shelter in Prosser Bay, adjacent to Maria Island. This small ship, then owned by Captain Hatch of Invercargill, was engaged in one of his company's many sealing expeditions to the sub-Antarctic Macquarie Island. The ship's master (Captain Barber at that time) regaled Bernacchi junior with tales of adventure on the sub-Antarctic islands (Cumpston 1968)

Bernacchi's recruitment to Antarctic expeditions was a combination of positioning, skill and knowledge: he prepared himself with practical training and then used his connections to make himself known to expedition organisers. There is no doubt he always wanted to go south as he had written various editorial articles for the local paper (*Hobart Mercury*) extolling the virtues of Antarctic expeditions and explaining how a combined science and whaling or sealing enterprise could work.

THE SOUTHERN CROSS EXPEDITION

Bernacchi's training at Melbourne Observatory was perfect for pioneer Antarctic expeditions where meteorology and magnetic studies were priorities. This training, along with his Belgian heritage, contributed to his successful application as a volunteer to join the Belgian Antarctic Expedition of Adrien de Gerlache in 1897. The expedition ship, *Belgica*, however, became trapped in ice from 2 March 1898 until 14 March 1899. The plan to visit Melbourne, where Louis was to have embarked, never eventuated. Louis therefore sailed to London in 1898 where he persuaded Carsten Borchgrevink, leader of the *Southern Cross* expedition, to take him on as physicist. Bernacchi had previously met Borchgrevink in Melbourne during a promotional tour seeking funding for the expedition. Borchgrevink secured the financial backing of the publisher Sir George Newnes and made an offer to Bernacchi for the position of physicist by post. Bernacchi initially declined as he was due to join the *Belgica* but the changed circumstances allowed him to belatedly accept the offer. Diego was furious at this as he anticipated a career for Louis as a talented mathematician (Crawford 1963).

The *Southern Cross* sailed from London's St Katharine's docks in late August 1898 bound for Hobart, the expedition's base. The ship left Hobart on 19 December 1898 and reached its southern destination, Cape Adare, on 17 February the following year. The small party established two adjacent huts in which they survived a full year. The ship did not overwinter but returned to take off the expeditioners late in January 1900, and they returned to Hobart in mid March.

In terms of exploration, the expedition was successful in showing that men could establish an Antarctic land base and survive a winter. It was not an ideal geographic location so sledging journeys away from the camp were limited by insurmountable mountains blocking any inland route, and proximity to open water reduced opportunities for sledge journeys across sea ice.

Bernacchi's narrative of the expedition, *To the South Polar Regions* (Bernacchi 1901) gives a more accurate and informative account than the official narrative, *First on the Antarctic Continent* (Borchgrevink 1901). Bernacchi's scientific work included a full year's meteorological and magnetic observations, broken only in the extremes of winter when the observing tent provided inadequate protection. The location of the South Magnetic Pole was determined and its movement since the observations of the *Erebus* and *Terror* expedition of James Clark Ross nearly sixty years earlier, was quantified. Bernacchi took part in a modest, but initial sledge trip across the Great Ice Barrier that reached 78 °50' S., the furthest south achieved to that date. Practical matters were tested, like the utility of double-glazing, primus stoves, the use of dogs in the Antarctic and the use of glycerine as a prophylactic against frostbite. Bernacchi was ginger haired and light-skinned so this may have been of particular value to him.

On his return to England from the *Southern Cross* expedition, Bernacchi busied himself looking for permanent work and writing his narrative of the expedition. He sought a position as Secretary to the Institution of Naval Architects according to letters of reference from April of 1901 (Crawford collection). At the same time, he was working in a temporary capacity for the Royal Society, reducing and working up the magnetic data in preparation for publication, under the supervision of Charles Chree, Superintendent of the National Physical Laboratory, Kew Gardens.

Bernacchi lectured to the Royal Geographical Society on the topography of South Victoria Land (Bernacchi 1901b) and was awarded the Society's Cuthbert-Peek Grant for 1901, the handsome gold fob watch engraved:

Royal Geographical Society, Cuthbert-Peek Grant for 1901, Awarded to L.C. Bernacchi for his Scientific Observations in Victoria Land and the Ross Sea Antarctic Regions.

He was also made a fellow of the society.

THE DISCOVERY EXPEDITION

Bernacchi impressed Sir Clements Markham, President of the Royal Geographical Society and prime mover behind the *Discovery* expedition. Markham wrote to Robert Falcon Scott, the Royal Navy lieutenant he groomed to command the expedition around July of 1900.

There is a very intelligent young man named Bernacchi who had charge of the magnetism, meteorology and photography under Borchgrevink. You should also make a point of seeing him. He will be here for some months. (SPRI MS 366/15; ER, item 447)

Bernacchi actually became the third physicist recruited to the *Discovery* expedition. The first was George Simpson, who later became well known for his work as meteorologist on Scott's *Terra Nova* expedition, and a scientific career leading to Directorship of the London Meteorological Office. Simpson failed the medical examination in mid 1901 (RGS Archive AA/3/1/5) and was replaced as physicist by William Shackleton. Markham's own chronological history of the expedition lists William Shackleton as "Dismissed" on 5 August 1901. This was also supposedly on medical grounds but it was clear that he fell out with Markham and some members of the wardroom (RGS Archive AA/13/2/12). Bernacchi's letter of appointment to the expedition is dated 28 September 1901 and offered a salary of £250 per annum payable until the return of the expedition to England (Crawford collection). It added that Bernacchi would perform his duties under direction of the civilian scientific director, but Professor Gregory had resigned in acrimonious circumstances in May, and Scott supervised all elements of the expedition including the scientific programme after George Murray of the British Museum (Gregory's deputy) left the ship at Cape Town.

The *Discovery* was already at sea when Bernacchi was formally appointed. He was familiar with the standard magnetic instruments; the Fox dip circle and Kew pattern unifilar magnetometer, but needed training in the operation of the Eschenhagen magnetometer. It was a new type of self recording instrument with a rotating clockwork drum loaded with photographic paper. He went to Potsdam to meet Professor Eschenhagen, to learn the operation of the instrument and to become familiar with the routine of observing required to be carried out simultaneously during the two term days each month of the expedition.

Bernacchi, having received training in Potsdam and calibrated his instrument against the standard instruments at the National Physical laboratory at Kew, then had to arrange to get himself and the instruments (including the pendulum apparatus for measuring the value of gravity) to Melbourne to meet the *Discovery*. Bernacchi caught the mail steamer *Cuzco* from Marseilles in mid September 1901 and arrived in Melbourne to find that, as *Discovery* was slower than anticipated and was running behind schedule, she would go directly from Cape Town to Lyttelton, New Zealand, omitting the stop in Melbourne. Bernacchi was the only representative of the expedition there so he had to deal with forwarding not only the instruments but also 23 dogs with their food and other stores and equipment. These included the Australian pre-fabricated expedition hut (that may still be seen at Hut Point), the German magnetic observing huts (that were later burnt down by Ernest Shackleton as a signal to his ship, *Nimrod*), 30 pairs of Canadian snowshoes, fur clothing and other hardware and provisions (Palmer collection).

Bernacchi was almost detained in Melbourne by court proceedings over an unpaid promissory note for shares he had purchased. Messrs Ellison and Everard, sharebrokers of Melbourne, sought to prevent Bernacchi's departure from Victoria on 13 November 1901 by the steamer *Waihora*, stating that he was bound for Antarctica and would be away at least three years in a situation fraught with danger, and it was unlikely that he would return to Victoria after the expedition. Correspondence between Longhurst of the Royal Geographical Society and Kempe of the Royal Society

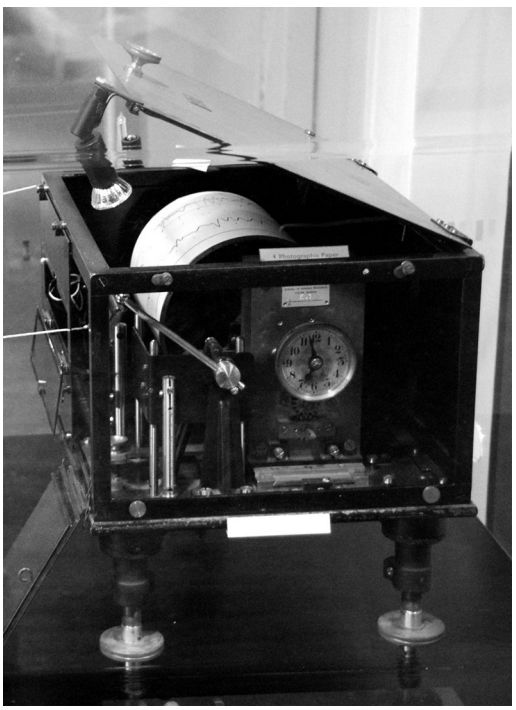
show that an arrangement was struck and quarterly payments were arranged from Louis' annual £250 salary (Royal Society Archives MS 547/7/56-85).

Bernacchi arrived in Christchurch on 13 November 1901 and immediately started magnetic work. He worked with the local specialist, Coleridge Farr, and his assistant, Henry Skey, to establish a new magnetic observatory in the grounds of the current Botanic Gardens. They had sufficient time to test and compare the expedition's instruments against those of the Christchurch observatory, a necessary part of the instrument calibration routine. The Royal Geographical Society, London, archives hold originals of many of the magnetic observation records for magnetic variation, dip and total magnetic force for this period that attest to the painstaking nature of the work (RGS/AA/10/2/1).

As the *Discovery* only arrived in Lyttelton on 30 November, Bernacchi had a head start on his shipmates meeting the society of Christchurch. He told his brother Roderick (Dick) in a personal letter (Palmer Collection 15/12/1901) that "the people here have been exceedingly kind to me" and that "Some ladies have decorated my cabin on board which is the one next to Capt. Scott and which now is a dream of luxury and comfort." In this same letter, Bernacchi expresses the hope that his sledging pennant might fly at the South Magnetic Pole, but no sledge journeys attempting to reach this point were undertaken on the *Discovery* Expedition.

Bernacchi's sledging pennant has a Maori motto, *Rapua, Rapua Ka Kitea* that Bernacchi translated as "Seek, Seek and ye shall find". Mrs Rhodes, the wife of AEG Rhodes, the Mayor of Christchurch, made the pennant for him. It was of blue silk and made along the normal pattern having the St George Cross on the hoist. The motto and the *Southern Cross* adorned the body of the pennant and it was finished with a swallowtail. Bernacchi's sledging pennant is believed to have been stolen from his son, Michael's house.

Bernacchi's magnetic work was part of a carefully orchestrated programme of international co-operation with Drygalski's German South Polar (*Gauss*) Expedition and numerous established observatories around the globe. There were specified "term days" on the 1st and 15th of each month when simultaneous observations were scheduled. Establishment of the British expedition's observatory in Antarctica was a priority once the landing site for the overwintering party on Ross Island had been resolved. Bernacchi assisted with the erection of the two magnetic huts composed of timber frames, asbestos cladding and non-ferrous fasteners. The observatory was prepared in time for the 1 March 1902 term day. Bernacchi maintained continuous observations throughout the two-year stay of *Discovery*, only being limited by the shortage of photographic recording papers for the Eschenhagen magnetometer in spring 1903. The huts were heated during the first winter using oil (paraffin) lamps but it was found to be impossible to maintain a stable internal temperature. During 1903, Bernacchi worked without heating. This was better for the instruments but more challenging for the observer. It turned out that the Eschenhagen magnetometer was reliable in spite of its recent development and the extreme conditions under which it served. Bernacchi did find, however, that the clockwork mechanism stopped in extreme cold during winter.



Clockwork mechanism and photographic drum of the Eschenhagen magnetometer, on display in the learning centre of "Geoscience Australia" in Canberra

Dr Freidrich Bidlingmaier, physicist on the German Polar Expedition ship, *Gauss*, carried out the same work. Exact coordination between the observers in the Antarctic and various established magnetic observatories was essential for success of the programme of international co-operation. Bidlingmaier's task was complicated by the fact that the *Gauss* did not make landfall. As a consequence, the magnetic observatory was an ice-house on a sea-ice floe. This presented serious difficulties. As the floe sank lower in the water with the weight of accumulating snow, it became necessary for Bidlingmaier to work almost knee deep in sub-zero slushy iced water. A new observatory was constructed a little further from the ship but it transpired that the floes were moving away from each other and eventually the distance between the ship and the observing house became not only inconvenient, but a danger to the observers. In spite of these difficulties, Bidlingmaier also acquired quality data through diligent effort.

During the expedition, Bernacchi took part in two sledge journeys. The first was in spring 1902, at a time when the expeditioners were novices at the practices of travel and fieldwork on the ice. This modest trip was a tentative exploratory survey only. The second trip

A previously unpublished image of the sports day on 8 November 1902 to celebrate the King's Birthday. The shooting match was a big event. The contestants are clearly identified in this image by number. (From the scrapbook of Janet Crawford)

was near the end of the expedition, in November and December 1903, and had a scientific purpose. It was a straight-line traverse directly away from the focus of the South Magnetic Pole, towards the south-east across the ice barrier from Winter Quarters at Hut Point. It was a significant journey over 31 days and the distance travelled was 356 statute miles.

The purpose was to obtain magnetic dip readings away from the influence of land and along a bearing that would provide data by which to better locate the magnetic pole. Bernacchi obtained a quality set of data: usually working for at least ninety minutes in the polar tent at the end of each third day's march.

Bernacchi's meticulous and diligent scientific work on the ice extended beyond just his magnetic observations. He was also charged with determining the value of gravity using a pendulum apparatus that operated under vacuum within a bell jar. Engineer, Reginald Skelton, assisted Bernacchi with repairs to the apparatus and with actual observations. Other duties of the physicist included operation of a seismograph, auroral observations and observations for atmospheric electricity. He often extended his work beyond his brief. During the second winter (1903), his observations of auroral activities are very detailed and quantitative, recording lengths of time, directions of the start and movement of auroral displays, their intensity and their alignment with respect to the magnetic meridian. Planning for the predicted solar eclipse of 21 September was carried out to ensure that all opportunities to gather useful scientific intelligence were utilized. Unfortunately, the sky clouded over making it a cause of great disappointment. Bernacchi tried using special techniques with prisms to catch spectrum lines of the low sun, and with that he was attempting colour photography, almost unknown at the time.

Bernacchi, like many of the crew of *Discovery*, enjoyed photography. It was novel to most of the crew but Louis was familiar with processing chemistry and techniques, as they were part of the routine with the magnetometer records. He had also been the most prolific photographer on the *Southern Cross* expedition and most of the Norwegian Polar Institute's photographic archive from that expedition comprises Bernacchi's photos.

Editorship of the expedition paper, the *South Polar Times*, fell to Bernacchi in the second year after Lieutenant Ernest Shackleton, the first editor, was repatriated. Three numbers were published to coincide with the disappearance of the sun in April, mid-winter's day in June and the return of the sun in August.

It is unclear whether the *Discovery* expedition took full advantage of the tacit knowledge gained by Bernacchi on the *Southern Cross* expedition. In autumn 1902, Bernacchi was stung by Scott's disregard of his urging not to place the ship's boats out on the ice over winter (Bernacchi 1938, p. 57). Bernacchi's knowledge of the local conditions allowed him to correctly predict that the boats would become covered in snow that would then become compacted into ice, causing the boats to sink into the floe. It took teams of seamen months to exhume the boats in spring and summer 1902-03 and there was considerable work for the ship's carpenter making repairs after the boats were eventually recovered. Bernacchi had also observed the success of dogs for Antarctic transport on his first expedition. After initial failures with dog hauling on the *Discovery* expedition, it was decided that the Siberian harnesses were faulty or inadequate. Complete new sets of harnesses were fabricated, then immediately abandoned after their first trials as they chafed the dogs and were ill fitting. Bernacchi illustrated the pattern for these in the fair copy of his 1902 diary held by Canterbury Museum (Bernacchi 1902).

Bernacchi recalled *Discovery* as a happy ship with no serious quarrels. He attributed this to separate and comfortable cabin accommodation, and the regime of naval discipline and formality that helped preserve a civilized tolerance among the men.

In a letter home on 8 February 1903, at which time he probably realized that the *Discovery* would be ice bound another year, Bernacchi provided a synopsis of the achievements of the expedition to date:

Now with regards to the results of our expedition I had better give you them in order.
The discovery of extensive land at the east extreme of the Great Ice Barrier.

The discovery that McMurdo "Bay" is not a "bay" but a strait and that Mts Erebus and Terror form part of a comparatively small island.

The discovery of good winter quarters in a high

latitude 77°.51' south with land close by suitable for the erection of the magnetic observatories etc.

An immense amount of scientific work over twelve months in winter quarters principally physical and biological.

Numerable (sic) and extensive sledge journeys in the spring and summer covering a good many thousand miles, of which the principal is Capt. Scott's journey upon which a latitude of 82°.17' south was attained and an immense tract of new land discovered and charted as far as 83°.30' south with peaks and ranges of mountains as high as 14,000 ft.

The great continental inland ice reached at a considerable distance from the coast and at an altitude of 9,000 ft.

A considerable amount of magnetic work at sea, also soundings, deep sea dredging etc.

These are just the large principal results, there are many other minor ones.

(Palmer Collection)

The use of the Eschenhagen magnetometer was the first occasion on which photographic registration of magnetic curves was utilized outside an established observatory.

ACTIVITIES AFTER ANTARCTICA

The *Discovery* expedition was Louis' last expedition to Antarctica. As the expedition returned to England, Louis was anticipating a significant amount of paid work assisting with the reduction and preparation for publication of the magnetic data. It transpired that he did get some work of this kind but he was hankering after greater opportunities and by 1906 had drifted away from scientific pursuits. Bernacchi's family background was one of wealth through enterprise, speculation and investment and Louis' travel after Antarctica was generally related to commercial activities. During 1905 he travelled to German Southwest Africa but there is no evidence indicating the specific project behind this.

Bernacchi married Winifred Harris, daughter of an English gentleman farmer, on 10 February 1906. Captain Scott was best man at the service, which was a reunion of Bernacchi's *Discovery* messmates. A favourite anecdote amongst descendants is that Scott, after the ceremony, stated that Louis would be welcome to join any future Antarctic expeditions that he (Scott) may get up. Winifred immediately interjected with a clear message that he would have no further part in any more Antarctic expeditions. After a brief interlude in Paris, the couple travelled to South America. A diary that has recently come to light in a private family collection explains the motivation. It commences:

March 14th 1906, Set out with my wife on a journey to Peru the object of the journey to examine the primeval rubber forests in the interior …on behalf of Sir George Newnes who contemplates purchasing a large property of some 85,000 acres.

The tour to the Excelsior plantation was to sparsely populated and extremely inaccessible regions and culminated in travel to the Inambari River in the upper Amazon Basin (Sheldon Collection). Louis brought back a mummified body from this trip, which was kept in his house along with his skis, taxidermy penguins and other Antarctic memorabilia. The mummy frightened the servants who claimed it moved at night. It was donated to the collection of the Natural History Museum in London. Bernacchi probably developed a sense for the rubber planting business during that first trip to the Amazon Basin as he maintained interests in rubber plantations throughout his life and made frequent trips to Malaya and other overseas destinations in pursuit of business opportunities. By 1925, he was director of six rubber plantations.

Bernacchi always perceived himself as an Englishman but evidence for his nationality is confused. One biographical account (Swan 1963) claims the family was naturalised in 1886 but then Louis applied in Tasmania during 1900 on behalf of his brother, Roderick, and himself, seeking naturalisation. The request was denied at that time as:

letters of naturalisation are only granted….to aliens now residing in Tasmania

(Archives of Tasmania 26/12/1900, CSD/22/38)

Louis and Roderick were both living in England at that time, thus the request was rejected. In a lecture in 1963, in South Africa, Patricia Crawford, Louis' first daughter mentions that on the *Southern Cross* expedition there were three "Britishers" of which Louis was one, as he was *…at that time an Australian.*

In any event, Louis must have eventually gained standing as an Englishman as he was able to contest

English parliamentary seats as a Liberal candidate in the divisions of Widnes and Chatham during 1910. He failed to gain a seat in either contest. In his promotional material he dropped "Louis" and made himself known as Charles Bernacchi.

In a letter to his brother Roderick (Dick) sent from the Falkland Islands in 1904 whilst returning from the ice, Louis laments that he and Dick have passed each other at sea without meeting and:

…as you say it might be years before we meet however it is inevitable & there is some consolation in the fact that the sons of nearly all English families are placed in the same way.
(Palmer Collection, 18 July 1904)

Bernacchi himself had no doubt about his English patriotism in spite of a strong Italian heritage with Spanish and Flemish influences. He later demonstrated this patriotism by serving in the Royal Naval Volunteer Reserve in both World Wars.

He was decorated with a military OBE at Buckingham Palace in March 1919 and demobilized in June of that year. In December of that year he was awarded the US Navy Cross. He also received the 1914-15 Star, the British War Medal 1914-18 and the Victory Medal 1914-19 (ADM/337/117). He served again during the Second World War but in a technical capacity from an office in London, rather than active duty prior to his death in 1942.

THE PROPOSED EXPEDITION OF 1925-26

Records in the archives of the Royal Geographical Society that detail his proposals for an Antarctic expedition of his own, show Bernacchi's deep understanding of the elements required for success in polar expeditions (RGS/CB9/14). His plan was to establish a base in King George VII Land, at Biscoe Bay and have traverse parties, using dog teams and Citröen Kegresse half-track vehicles similar to those used by Louis Audouin-Dubreuil in 1922 to make the first crossing of the Sahara. Bernacchi had negotiated for the purchase of the experienced polar ship *Terra Nova* and had the refit and delivery from Newfoundland scheduled to allow landing a party in early 1925. A feasible scheme of depot laying and support parties to allow two main treks to be undertaken to explore the unknown quadrants towards Charcot and Graham's Land, and south-east towards the Queen Maud Range and Weddell Sea region were planned. A programme of scientific work was proposed to complement the exploration and complete costings and staffing arrangements were detailed. Funding was not forthcoming and the expedition never proceeded. Bernacchi had provided the initial financial support for the planning stages but a National Archives treasury note has a handwritten comment by Winston Churchill dismissing the application for funding and the scheme (National Archives T161/252). Bernacchi later described much of his expedition plan in articles for the *News Chronicle* (4-5 May 1932)

Bernacchi maintained an avid interest in all Antarctic matters throughout his life. He was the Organizing Director of the successful Polar Exhibition of 1930 and gave the opening lecture. The exhibition was open for viewing from 2-15 July 1930 in the Central Hall, Westminster. Bernacchi called in favours from friends and colleagues and collected together an unprecedented and never repeated collection of valuable polar memorabilia, including Scott's last diary, numerous sledging pennants and equipment, charts and historical documents, portraits of explorers and paintings of polar scenes, ship models, flags and medals from private and public collections. Bernacchi complained that he had insufficient space to display all the materials gathered. He wrote to Hugh Mill in July and August 1930 (SPRI MS/100/7/6-7) noting the success of the exhibition where 6500 came to view the exhibit, 3500 to see the previews of Ponting's *90 South*, the film of Scott's *Terra Nova* expedition released in 1933, and a profit was also made from sales in the bookshop. He edited the companion volume *The Polar Book* (Bernacchi 1930) as well as contributing to its content. It gave summary and analysis of the state of polar science of the time in each of the key disciplines and had contributions from well known Antarctic scientists, including Debenham, Wordie, Mill, Simpson, Wright and Rudmose-Brown. The profit from the book was £100 from the 3000 copies printed. Total profits for the event were around £300.

In 1935, he gave the Alexander Pegler lecture, entitled "Antarctic Exploration Past and Present" to the British Science Guild in London, of which he was a member. He was also a member of the British

Association for the Advancement of Science and from 1928-32 he was a council member of the Royal Geographical Society. Bernacchi was a foundation member of the Antarctic Club, founded on 17 January 1929 in remembrance of the day that Scott and his party attained the South Pole.

Bernacchi died in 1942, at age 66, from a bleeding stomach ulcer. Swan (1963) suggested that that he died early as a result of deficiencies of diet on his Antarctic expeditions, but as he did not undertake any excessively arduous sledging journeys, this is probably inaccurate.

HOLDINGS OF BERNACCHI MATERIALS

Bernacchi's son, Michael (now deceased), made significant contributions to the Canterbury Museum collection. Artefacts on display include Bernacchi's sextant, liquid bath compass and a set of drawing instruments. A set of medals, including his Polar Medal, are also in the collection of the museum.

Bernacchi's journal from his *Southern Cross* expedition and the first instalment (from the time of his joining the ship at Lyttelton on 2 January 1902, finishing on 21 August 1902) of his *Discovery* expedition journals are part of the Canterbury Museum collection (MS232, MS138). The remainder of his original *Discovery* expedition journals are held at the Scott Polar Research Institute in Cambridge (MS 353/3/1-4; BJ) and the Royal Geographical Society in London (LCB /1). A significant amount of Antarctic memorabilia (including glass plate negatives) was lost after his death when his widow, Winifred, was relocating to Hong Kong. Sadly, these items were accidentally discarded as a burden of nominal interest or value.

CONCLUSION

Louis Bernacchi was a successful scientist whose work received great praise from his peers. His interest in Antarctic matters was a lifelong passion, and although he is one of the lesser-known figures in Antarctic exploration, his work bolstered the scientific legacy of Borchgrevink's *Southern Cross* and Scott's *Discovery* expeditions.

ACKNOWLEDGEMENTS

I wish to acknowledge the generous assistance of the descendants of Louis Bernacchi, both in New Zealand and the United Kingdom for access to a wealth of correspondence, personal records, photographs and ephemera that have been the source material for this paper and permission to use previously unpublished images from the *Discovery* expedition.

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History of Excavations at Wairau Bar

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ABSTRACT

Between 1939 and 1964 researchers from Canterbury Museum carried out a series of archaeological investigations at Wairau Bar. Early work focussed on the recovery of burials and artefacts but later excavation was carried out within formally surveyed excavation units that targeted evidence of structures. Much of the data from these excavations remains unpublished and are accessible only through examination of field books and other field documentation held in Canterbury Museum. A review of this documentation was carried out in order to document the history of investigations at the site. A Geographic Information System (GIS) was used to manage the spatial data in order to create a plan locating many of the previous excavation units to a level of precision not previously attempted. Published material was drawn on, where necessary, to supplement the unpublished data. This analysis suggests that a minimum of 1687 m^2 of the site has been investigated.

INTRODUCTION

Wairau Bar occupies a key role in New Zealand prehistory and in the historical development of archaeology as a discipline in this country. It contains the richest and most diverse range of artefacts from what is now considered to be the colonisation phase of New Zealand. Furthermore, it is unique among such sites for its size, and for the sheer quantity and diversity of information it can provide on such matters as subsistence economics, village life, material culture, moa hunting and the early adaptation of tropical migrants to the temperate conditions of New Zealand – the final stage in the world's most extensive prehistoric maritime migration. Along with such sites as Fa'ahia/Vaito'otia on Huahine (Sinoto 1979), Ha'atuatua and Hane in the Marquesas (Allen 2004; Anderson *et al.* 1994), Anakena, Rapa Nui (Hunt and Lipo 2006) and the South Point and Bellows Dune sites in Hawaii (Dye 1992; Tuggle and Spriggs 2000; Kirch and McCoy 2007), Wairau Bar is fundamental in the construction of the modern synthesis of East Polynesian prehistory.

Previously known only to the lessees and local fossickers, the site first came to the attention of the science community in 1939 following the publicity associated with the discovery of a burial by school-boy Jim Eyles. This find led to the long-term involvement of the Canterbury Museum under the direction of Roger Duff, ethnologist and subsequently Director of the Museum. Over many years Duff and Eyles uncovered a remarkably rich assemblage of artefacts, many of which were found as grave offerings in formal burials. These included personal ornaments in bone and stone

such as imitation whale tooth necklaces and reels with direct analogues in contemporaneous sites in tropical East Polynesia. Other finds included several hundred adzes, along with the remains of moa and other extinct bird species. Roger Duff's 1950 publication, *The Moa-Hunter Period of Maori Culture*, described the Wairau Bar excavations and became one of the most important contributions to the development of New Zealand archaeology and theory. Comparing artefact forms from Wairau Bar with those from sites of similar age in the Marquesas, Cook Islands and the Society Islands, Duff lent critical support to Skinner's (1921) earlier hypothesis of an East Polynesian origin for Maori culture. This position debunked previous and far more popular models (Duff 1950; Anderson 1989, p 107) that saw Maori as relatively late arrivals replacing an earlier more 'primitive' culture group (Haast 1871; Smith 1911; Best 1916). Thus Duff's publication was pivotal in the development of New Zealand archaeological theory in that it rooted our prehistory firmly in Polynesia, and unequivocally demonstrated the indigeneity of Maori society while eliminating the need to appeal to culturally unrealistic and politically questionable notions of cultural replacement of primitive people by advanced Polynesian invaders. Extending the Duff model into a more theoretical culture-historical framework, Golson (1959) used Wairau Bar as the type-site for what he termed the "Archaic Phase of New Zealand East Polynesian Culture".

An overview of the excavations and related publications

Following the earlier efforts of the fossickers, formal excavations at Wairau Bar commenced in the early 1940s with most activity occurring during the 1940s and 1950s. These were largely carried out under the auspices of Canterbury Museum and are described in a general manner in the first two editions of Duff's (1950, 1956) monograph. Later Canterbury Museum excavations at the site in 1963 and 1964 were directed by Owen Wilkes. His fieldwork was more systematic and well documented than the earlier work but his final manuscript on the site remains unpublished (Wilkes n.d.a). Field notes from the previous excavations are of varying quality and are assessed in the discussion of sources below. The 1977 edition (the third and final edition) of Duff's book contains a summary of the post-1959 work written by Michael Trotter. Trotter also published a brief summary of the post-1950 excavations and a detailed description of Burial 39 as well as radiocarbon dates from samples collected during the 1950s and the later 1963/64 excavation (Trotter 1975).

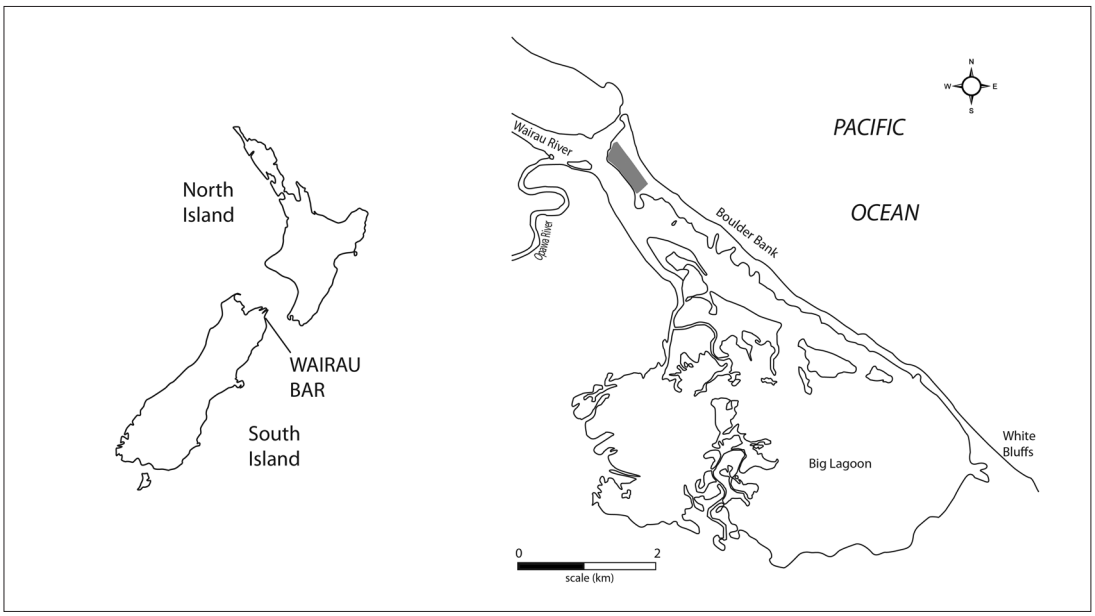

Figure 1. Location of the Wairau Bar archaeological site

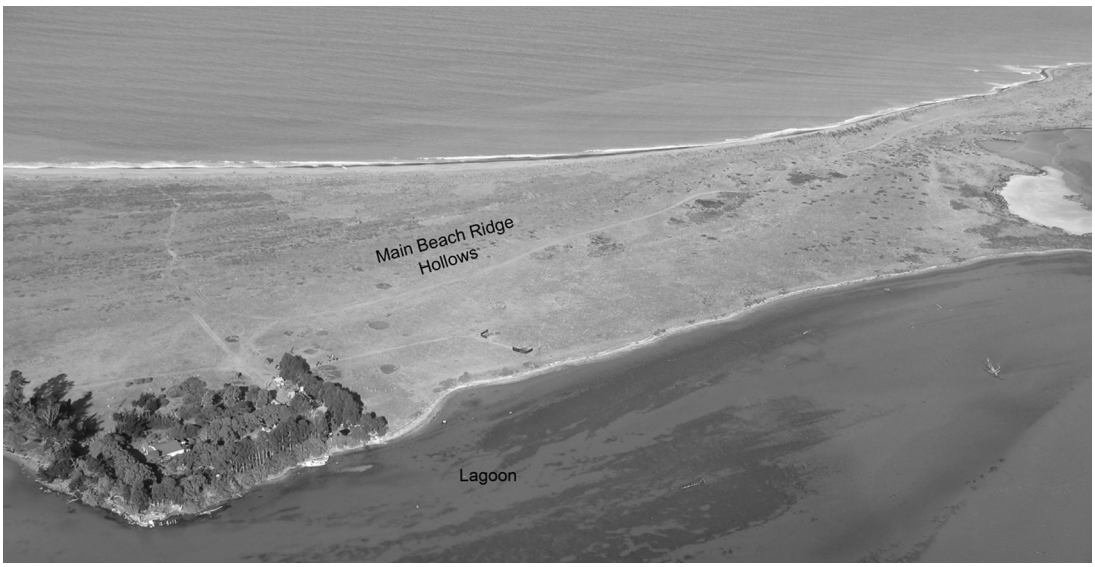

Figure 2. Aerial view of Wairau Bar looking east. The series of hollows runs along the west side of the main beach ridge.

In and around these formal Canterbury Museum excavations, Eyles was carrying out his own excavations at the site. Some of these took place either with Duff's knowledge or in partnership with Duff.

The first plan of the site (Duff 1956, fig. 2) has remained the primary reference for the location of archaeological features from that time. Other site plans have been published subsequently, but these all draw directly on the Duff plan with far less information about later excavations (eg Anderson 1989, fig. 9.2; Davidson 1984, fig. 111, Higham *et al.* 1999, fig. 2). The best of these is Anderson's (1989) which shows the locations of many of the post-1950 excavations. Anderson also published a plan of a large areal excavation carried out by Duff with Dr Robert Bell in 1955, which was later expanded in 1959 (Anderson 1989, fig. 9.4). This is the only published plan to show the spatial arrangement of excavated features and includes the outlines of at least one structure and several other post butts along with deposits of midden, ovens, scattered chert flakes and a cache of twelve adzes.

What has been published are mainly descriptive and typological studies of material culture (Duff 1942; 1950; 1956; 1977) and human remains (Houghton 1975, Leach 1977). Other specialist studies include an analysis of health and disease (Buckley *et al.* 2010), chronology (Trotter 1975; Higham *et al* 1999), and the faunal remains (Anderson 1989; Anderson *et al* 2004; Scofield *et al* 2003). Unfortunately, while the midden assemblages are rich and diverse, meaningful quantitative analyses of these are impossible because of the uncertainty of provenance, excavation, sampling and retention procedures. Other published papers have included reports of finds and excavations but none provide any systematic site description or interpretation (Bell 1957; Matthews 1981; Millar 1967; Trotter 1975; Wilkes 1959).

Today, Wairau Bar remains the best candidate for a colonisation phase village anywhere in New Zealand. This means that understanding Wairau Bar has become more critical than ever to understanding the crucial first decades of Polynesian life in New Zealand. Unfortunately, much of the fieldwork at Wairau Bar, particularly in the 1940s, was either haphazard, or simply lacked the standards of recording, analysis and reporting that is nowadays seen as standard best practice. As a result our understanding of the site is surprisingly deficient considering the efforts that have been expended on its excavation, and the international attention it has rightfully received. The aim of this paper is to remedy this situation as far as possible by sorting, systematising and correlating the information that is available on the previous excavation work at the site. Our goal is to develop a more precise and reliable spatial guide to the location of excavation units.

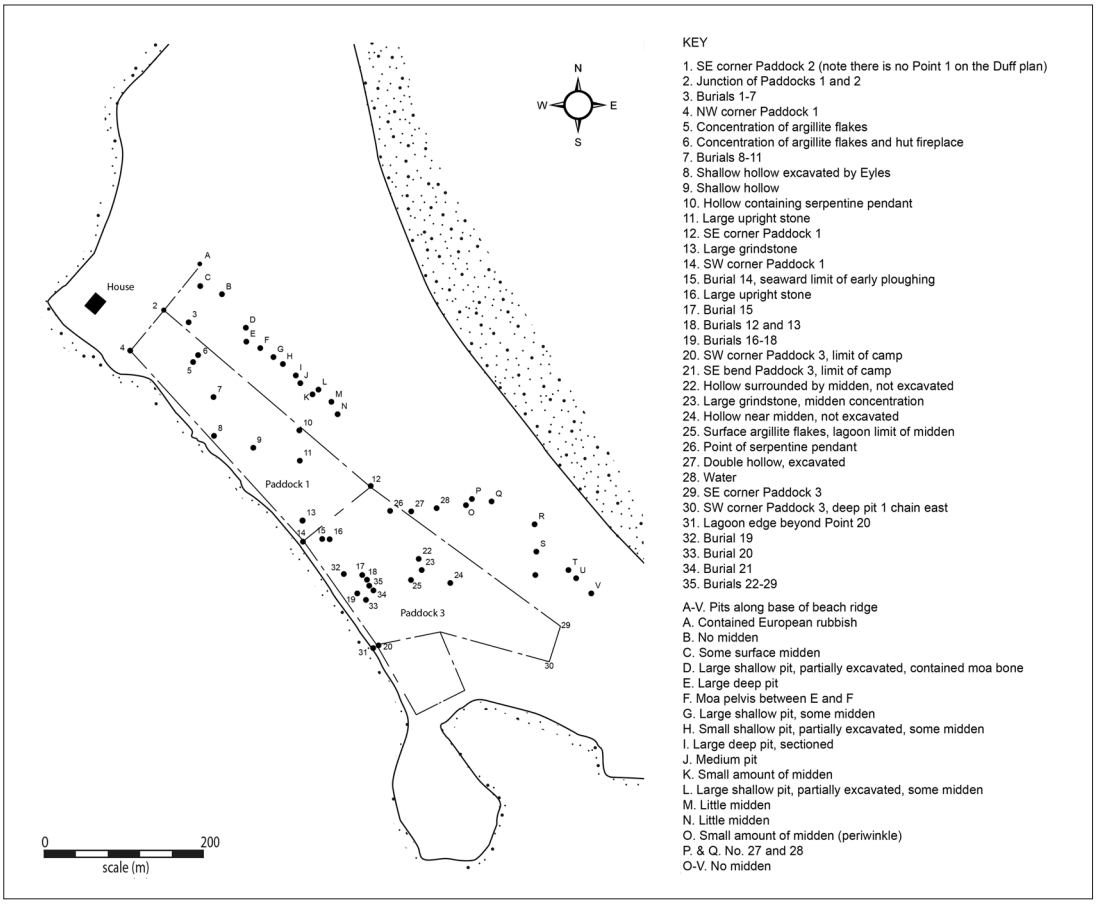

Figure 3. Duff (1950, fig. 2) plan redrawn and georeferenced in relation to current (2011) shoreline

To achieve the goal of creating an accurate site plan, we have assembled all available information about the various investigations that have taken place at the site over the last seven decades. We have focused on spatial and stratigraphic information. We do not intend to duplicate previously published material (eg the record of the material culture, burials, fauna, and chronology) except where necessary to contextualise the field notes or to clarify discrepancies between the published work and the field records. We have drawn on a range of published and unpublished material to do this (see below) but we know that there is further material in private hands in the form of field notes, letters and diaries that is not currently available to us. As this information becomes available in the future some of the interpretations offered here may require modification.

Site location and geography

Wairau Bar is recorded as P28/21 in the New Zealand Archaeological Association Site Recording Scheme. It is situated at the northern end of an eight kilometre long boulder bank that extends from White Cliffs in the south to the mouth of the Wairau River (Fig. 1). The dominant feature of the boulder bank is a ridge that runs along the seaward side with a series of large hollows along its western margin (Fig. 2). The remainder of the boulder bank is effectively flat with some small low mounds and depressions. The composition of the bank varies, with a thin topsoil overlying pea gravel deposits in places, and sand and gravel layers in others as a result of its formation through the accumulation of Miocene and Pliocene conglomerates from around White Cliffs, and gravel from the Awatere River Mouth to the south (Begg

and Johnston 2000). The boulder bank is dry, windswept and covered in low scrub and grasses. The northern end is in pasture and has been grazed by stock since at least the 1860s. Until recently the site had generally been considered by archaeologists to have been effectively destroyed by ploughing, along with the early excavations and fossicking.

SOURCES

The majority of the information for this study comes from primary sources although secondary published material was consulted where relevant, as noted above. The primary sources are the field books, notes, field plans and sketches, photographs and correspondence that are held in Canterbury Museum as well as a 1948 aerial photograph obtained from New Zealand Aerial Mapping (SN 504 1301/55 16/12/1948). Secondary sources include Duff's various publications (Duff 1942, 1948, 1950, 1956, 1977), published papers by Michael Trotter (Trotter 1975a, 1975b, 1977), and Jim Eyles's memoir published after his death (Eyles 2007). Duff's (1956, fig. 2) plan is the most important of the published plans and forms the base reference for the location of many of the historical excavations.

Duff's plan was based on a plane-table survey of the site carried out by GW Southgate, which recorded the location of most of Duff's excavations up until 1949. It shows the locations of the burials as well as midden concentrations, surface artefact finds, some of the excavation areas, and some geographical features such as the pits or hollows that occur along the western margin of the main beach ridge. While the plan is a useful guide to the locations of Duff's main excavation units, there are problems of scale, precision, and accuracy that limit its usefulness for interpreting the site. For example, the same size dot is used to mark a single artefact as for the entire cluster of Burials 1 to 7. Geographical details, particularly on the margins of the plan, appear to be purely schematic and do not resemble the actual shape of the coast and lagoon edge. Naturally, any limitations in the original plan transfer to all subsequent plans that were based upon it.

Duff kept field books during his work at Wairau Bar although the level of detail is highly variable. There are five field books that contain relevant material in Canterbury Museum Archive – Field Book 2 (hereafter FB2, Ethnology 6 10 Box 16.49), Field Book 3 (FB3, Ethnology 6 10 Box 16.50), Field Books 9 and 9A (FB9 and FB9A, Ethnology 6 10 Box 17.57), and Field Book 10 (FB10, Ethnology 6 10 Box 17.59). Unfortunately, his first field book, which predates October 1944, exists only as a photocopy so the image quality is generally poor. These field books contain excavation notes as well as sketches and drawings, although none are to scale. During the 1959 excavation Duff was absent for several days during which time other members of the field crew took notes. A catalogue of finds and features was also maintained during this excavation. Canterbury Museum does not hold copies of any field notes that were made by Robert Bell during the 1955/56 excavation so Duff's field book is the only record available of that work. The excavation of the two trenches under Wellman's supervision in 1959 is described in several locations. Duff summarised the results in his field book, as did Alan Eyles (secretary of the Canterbury Museum Archaeological Society, CMAS) who was overseeing the site while Duff was away. Attached to the field book is a letter from Harold Wellman, a geologist from Victoria University, with his interpretation of the stratigraphy. There are also loose leaves containing notes by Ian Milne who was a member of the field crew.

The remaining documentary material is held in three boxes (Wairau Bar, Box 1, Box 2 and Box 3) and this is still to be catalogued by the museum. An inventory of this material is attached as Appendix 1. Wilkes kept detailed field notes of the 1963/64 Canterbury Museum excavation which include stratigraphic profiles and feature plans. He also prepared a manuscript describing his work and the results of his analysis which has not been published (Wilkes was present during the 1959 excavations and he described the results of that work in the same manuscript). The museum also holds copies of Wilkes's lab notes including the results of faunal and lithic analyses that he carried out.

Any records that Eyles made, even while he was employed by Canterbury Museum in the capacity of a technical assistant in ethnology (Eyles 2007, p 130), have been accessioned into the museum archives and it has only been possible to infer information from correspondence between Eyles and Duff, notes in both Duff's and Wilkes's field books, and from a book written by Eyles (2007) long after the field work was carried out. The letters were useful in pinning down dates of excavation of particular areas by Eyles but they are

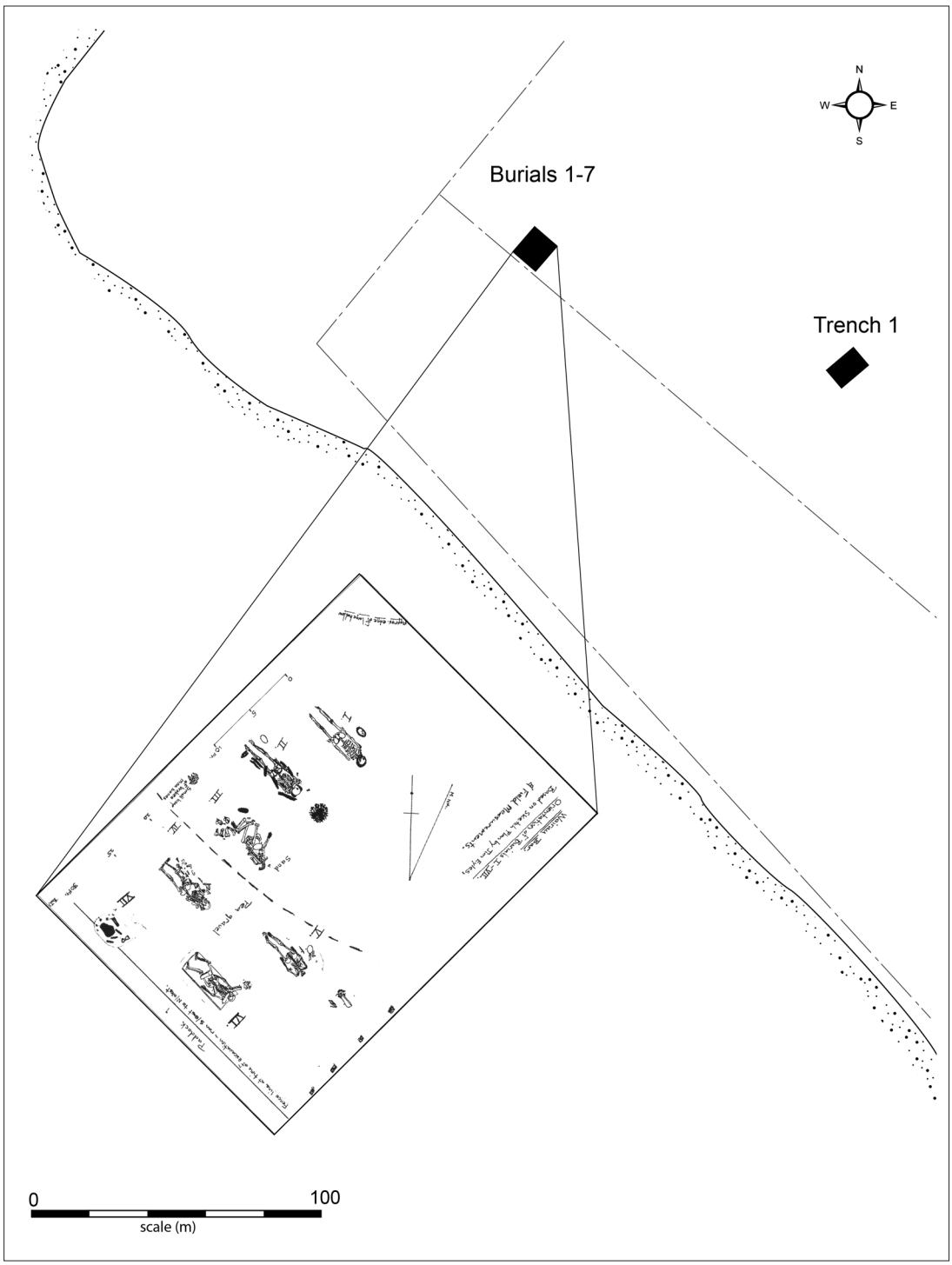

Figure 4. Locations of areas excavated during 1939-1942 (inset from Eyles 2007, p 87)

generally lacking in spatial detail and for the most part only summarise the artefacts he was finding. There are no copies of Duff's responses in the museum archives. Other correspondence includes letters from Baughan Wisely (who helped with the excavation of some of the first burials) which describe in detail the excavation of one of the hollows that he and Eyles carried out after Duff had left the site during field work in 1942.

It is unlikely, therefore, that it will ever be possible to build up a complete and accurate picture of which parts of the site have been excavated or fossicked (and what was found there) and which parts remain intact, based solely on the documentary evidence.

METHODOLOGY

The spatial data from a variety of sources were compiled into a Geographic Information System (GIS) for management and analysis. All spatial data were georeferenced to real-world coordinates (NZTM) and a base map created using shapefiles generated from the 1948 vertical aerial photograph. This showed key features referred to by Duff such as fence lines and paddocks. This in turn was used to georeference Duff's published plan (made in the following year), although it was not possible to perfectly align the Duff plan with some of the fixed geographical features such as the fences from the aerial photograph. This may be a result of inaccuracies with the plane table survey; discrepancies were also observed between the coastal margins marked on the plane table plan shoreline and that visible in the 1948 aerial photograph. Paddock names used in the GIS are the same as those given by Duff (1950) so the central paddock is Paddock 1, Paddock 2 is north of the homestead, and Paddock 3 is southeast of Paddock 1. In the GIS we have also indicated our level of confidence (low, moderate and high) in the quality of the locational information. Appendix 2 records our confidence levels for each excavation.

The lack of precise early field plans of the site means that we had to rely on the Duff (1950) plan and the descriptions from the field notes for all pre-1950 excavations. Because of the deficiencies noted above, this spatial information was ascribed with a moderate to low confidence rating. The locations of the majority of the pre-1950 excavation areas have a lower confidence level as a result. Where we know a trench was excavated this was symbolised as such in the GIS although we cannot be confident in every case about the orientation. For those areas where there was general digging we have used a circle to indicate the approximate location of the excavation. This means that we are reasonably confident about the location but are not certain about the size of the area excavated.

There are about a dozen old wooden survey pegs in the ground at Wairau Bar which are approximately 20 m apart. These can be confidently ascribed to the 1950 chain excavation grid (a chain is 20.1168 m). These pegs were surveyed in 2009 and entered into the GIS and these were used to georeference the chain grid. All of the post-1950 excavations that used this grid were coded with a high confidence level. Other post-1950 excavations that occurred without reference to this grid (eg Burials 41 to 43 in 1959) were ascribed with a low confidence level as they generally were described in relation to poorly located pre-1950 features, such as burials.

HISTORY OF EXCAVATIONS

The results of the analysis of the historical documentation are provided in chronological order below. Where there is any discrepancy between published and unpublished sources (usually to do with dates), precedence is given to the unpublished field books since these were written at, or very soon after, the time of the fieldwork.

1920s

During the 1920s, ploughing of Paddock 1 by the lessee and fossicking by local enthusiasts resulted in the discovery of many artefacts and faunal remains. The main paddock (Paddock 1) was first ploughed by the Eyles family in 1925 during which time many artefacts, as well as what were thought to be cattle bones (presumably moa bones), were exposed and two benzene tins of adzes were collected (Eyles 2007, p 19). This discovery prompted an interest from local fossickers, particularly William J Elvy, Herric Timms and Don March who used potato forks to search for artefacts (Eyles 2007, p 33). As a boy Jim Eyles spent a lot of time watching and listening to these fossickers and began his own digging for artefacts, with a long handled garden shovel. "Emulating my superiors, I dug at random spots over the site and I soon gathered a few choice pieces from my efforts with the shovel"

(Eyles 2007, p 34). These locations are not known but are probably in Paddock 1 since this is where most of the early discoveries are described as having taken place.

1939

This is the year the first burial was discovered at Wairau Bar and the potential significance of the site was brought to the attention of the scientific community. However, at this time no research institution was interested in pursuing its own research at the site.

The first burial was discovered by Jim Eyles in January 1939. Although the discovery was by chance, Eyles had spent a considerable amount of time looking for artefacts. The burial was approximately 90 m from the house on the edge of a large pit where a fossicker had recently uncovered and discarded moa bone (Eyles 2007, p 61). This burial was marked by the presence of a whole moa egg. The other particularly significant find with this burial was a necklace of seven whale ivory reels with a central pendant of a drilled sperm whale's tooth. The egg and the necklace from this burial were eventually sold by the Eyles family to the Dominion Museum for £130 (WRB Oliver to EC Perano 29/10/1940, Box Wairau Bar 3).

1942

It was not until 1942, with the discovery of further burials, that Roger Duff, ethnologist at Canterbury Museum, began formal research at the site. The excavation and analysis of these burials resulted in the first publication about Wairau Bar (Duff 1942) in which Duff described the burials and material culture in detail and proposed that the latter was of Polynesian style.

In March 1942, Eyles had resumed digging in the vicinity of the first burial and soon encountered another skeleton - Burial 2. Roger Duff did not find out about the excavation of this burial until a story about it appeared in the *Marlborough Express* after which he travelled to the Bar where he and Eyles opened a trench "for future excavation and research" (Eyles 2007, p 82). The location of this trench is unknown but it must have been in the vicinity of Burials 1 and 2 because in April Eyles carried out further digging and located Burial 3. This time he contacted Duff before he excavated it and it is described in detail in Duff's field notes (Duff n.d. [FB1]). Duff returned in May after the discovery of Burial 4, and a further three burials were excavated over a period of six days. Duff used the services of Baughan Wisely to assist with field recording at the time (Duff n.d. [FB1], p 31)

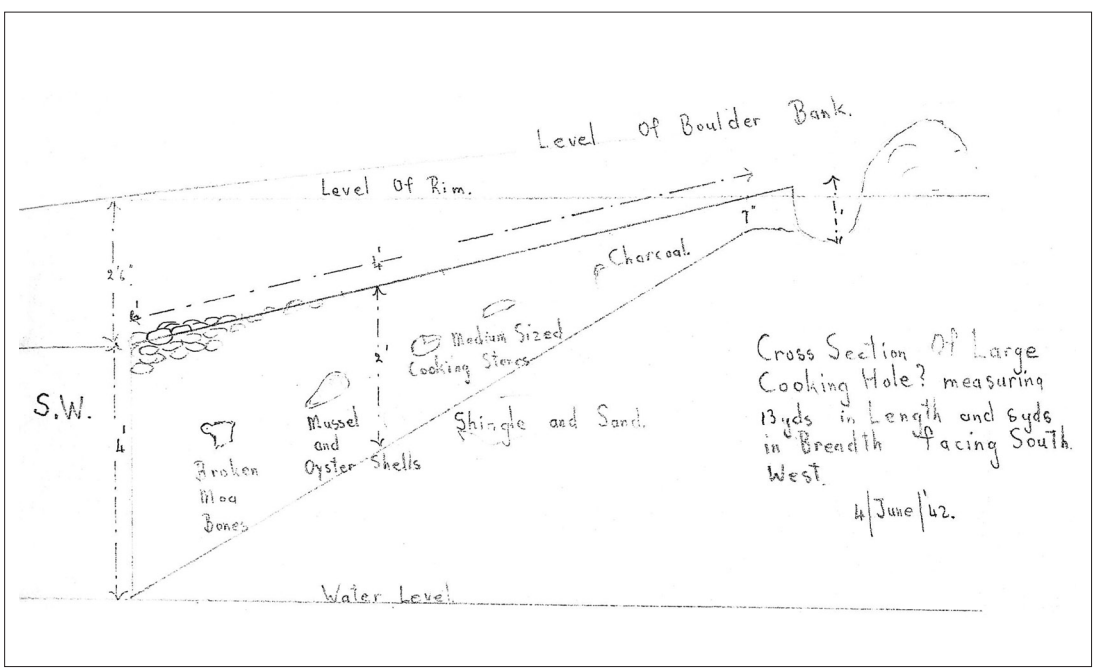

Figure 5. Cross-section of Hollow G by Baughan Wisley, June 1942, found taped inside Wilkes's field book (Wilkes n.d.b)

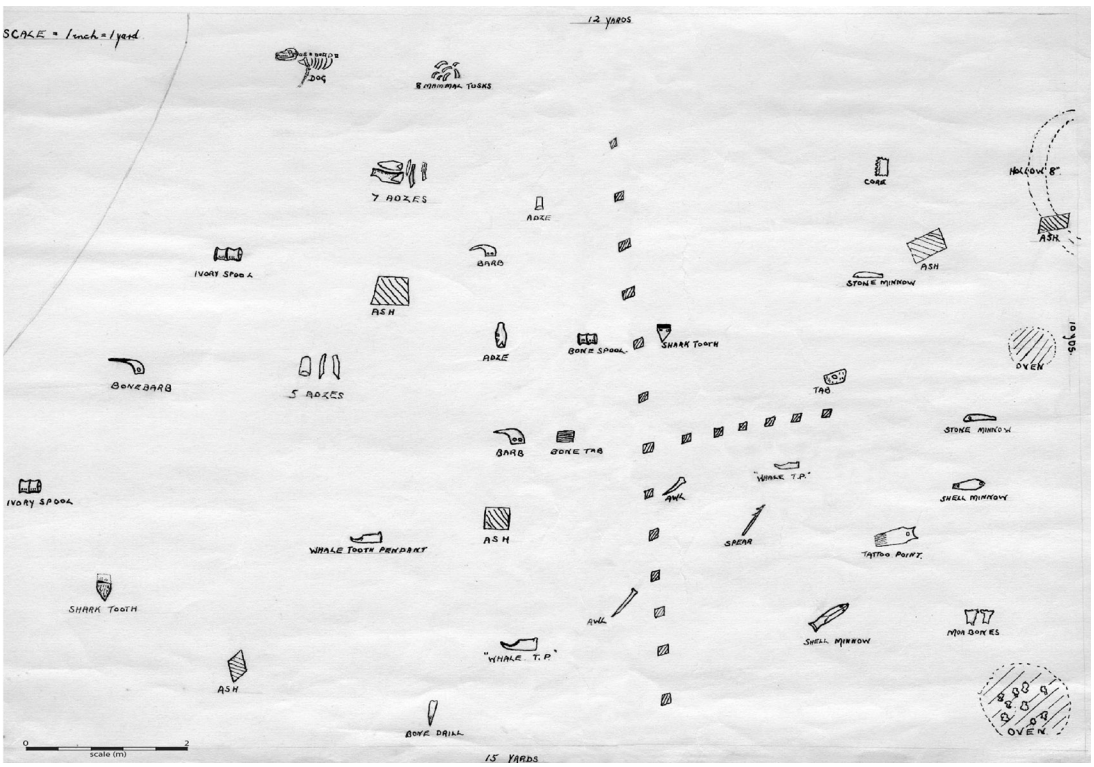

Figure 6. Undated plan showing the location of finds near Hollow 8 (scale bar added) (Box Wairau Bar 2)

After Duff left the site Eyles and Wisely continued to excavate one of the pits along the western margin of the main beach ridge (Trench 1, Fig. 4). In a letter to Duff in June 1942 (JE to RD 9/06/1942) Eyles reported that "we have dug some more of that cooking hole out but could not dig much further because we came to stagnant water about 4'6" down". Eyles later told Wilkes that this was the sixth hollow from the corner fence and Duff (1956, fig. 2) records this as such (Point G, Fig. 3) (Wilkes n.d., p 1044). A cross-section of this feature attached to Wilkes's field book (n.d.b., p: 1045) notes that it was thirteen yards long and eight yards (11.9 m by 7.3 m) wide and contained moa bone, mussel and oyster shell, oven stones and charcoal. Paddock 1 was re-ploughed in 1942 and a large number of artefacts were collected by Eyles and his family (Eyles 2007).

1943

Several investigations were carried out during 1943. Not only was Eyles carrying out his own digging, but excavated a hollow and found several interesting artefacts including five dentalium rings, fish-hook fragments and two pieces of nephrite. Eyles described two layers within this feature which he believed ran together in the centre of the hollow and noted that the nephrite came from the upper layer. Eyles later told Wilkes that this was in a pit half way along the lagoon fence (Wilkes n.d., p 1043). This is probably Point 8 on the Duff plan (Fig. 3).

In February Duff returned with GE Anstice following the second ploughing of Paddock 1. He noted that more midden had been exposed towards the lagoon and it was from this midden area that most of the artefacts were surface-collected. Duff and Anstice excavated a trench across two small ovens in which they found a midden layer of no more than nine inches (22.9 cm) depth that contained shell, occasional moa, dog and bird bones and stone flakes. The location of these ovens was not recorded, probably because they did not contain any artefacts of interest to Duff. The

description Duff also carried out a further research excavation. A second group of burials (Burials 8-11) was discovered on a low ridge to the south-east of the first, and later in the year further burials were found some 200 m SE along the bar in Paddock 3 in what became known as the southern burial area (Fig. 3).

Eyles wrote to Duff on 6 January 1943 to report that over the Christmas holiday period he had partially

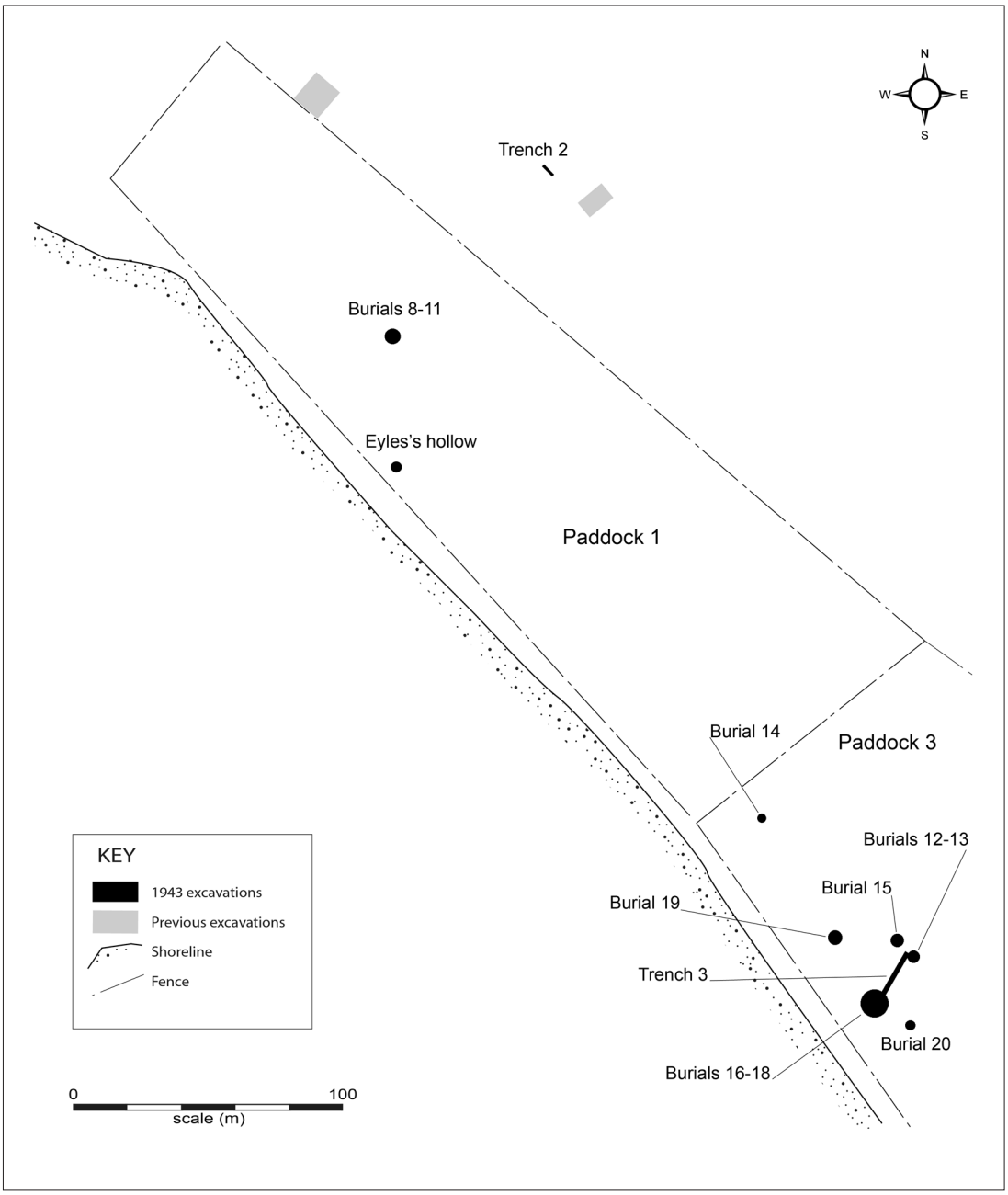

Figure 7. Locations of areas excavated in 1943. The cluster of burials in Paddock 3 is described by Duff as the "southern burial area".

of features on the 1950 plan suggests that the location could be one of the beach ridge hollows D, H or L shown on this plan (Fig. 3). Certainly, in a letter to Duff from Jim Eyles, Eyles states that he found a fish hook "on the ridge where you and G Anstice were digging" (J Eyles to R Duff 1/06/1943). Duff concluded from this work that "apparently [the] best method of dealing with midden in [a] large area in light sandy or stony soil is to plough lightly and fossick constantly" (Duff n.d.a [FB1], p 38).

Eyles, Duff and Anstice carried out further excavations to the north of the first burial area in an effort to locate further skeletons. The excavation trench encountered no midden and no further burials. The only item Duff recorded from here was a broken one-piece fish-hook made from a seal tooth. At the same time, Duff began work on an 18 foot (5.5 m) trench in a midden-rich area on the ridge at Point F (Trench 2, Fig. 3, Fig. 7). This work resulted in the identification of two layers of cultural material; a twelve inch (30 cm) upper layer that contained pipi and cockle shell midden with moa and bird bone, and an underlying charcoal layer. Moa bone was found in heaps in the clean gravel beneath this charcoal layer and included several moa vertebrae in positions of articulation (Duff 1956). In the mid-portion of this trench they located a mussel shell pendant, bird bone rings, a fragment of minnow shank, a small file and a "coffin-shaped" adze (Duff type 3C) (Duff n.d.a [FB1], p 44).

In April 1943 the paddock was again ploughed, this time with the ploughshare set at a depth of about nine inches to a foot (22.9 cm to 30.48 cm) (Duff 1956) and Burials 8 to 11 were exposed (Fig. 7). Duff describes these as being "some four chains [80.5 m] south and east of the first burial area...in the seaward slope of a slight ridge" (1956, p 47). The location information in Duff's field book matches his published description; however, the published version does not report the presence of a 3-foot (91.44 cm) deep oven just beyond the head of Burial 8, and a small oven about 6 feet (1.8 m) north of the skull, which contained an unfinished, burnt whale-tooth pendant, a drilled shark's tooth, drilled porpoise teeth, a bone point of a composite hook, bird bone tubes and moa eggshell fragments. A post butt was also identified (Duff n.d.a [FB1], p 47). The description of the location of these artefacts in his field book differs slightly from the published account, where the artefacts are simply described as part of an artefact concentration in an area of disturbance between Burials 9, 10, and 11 (Duff 1956, p 49).

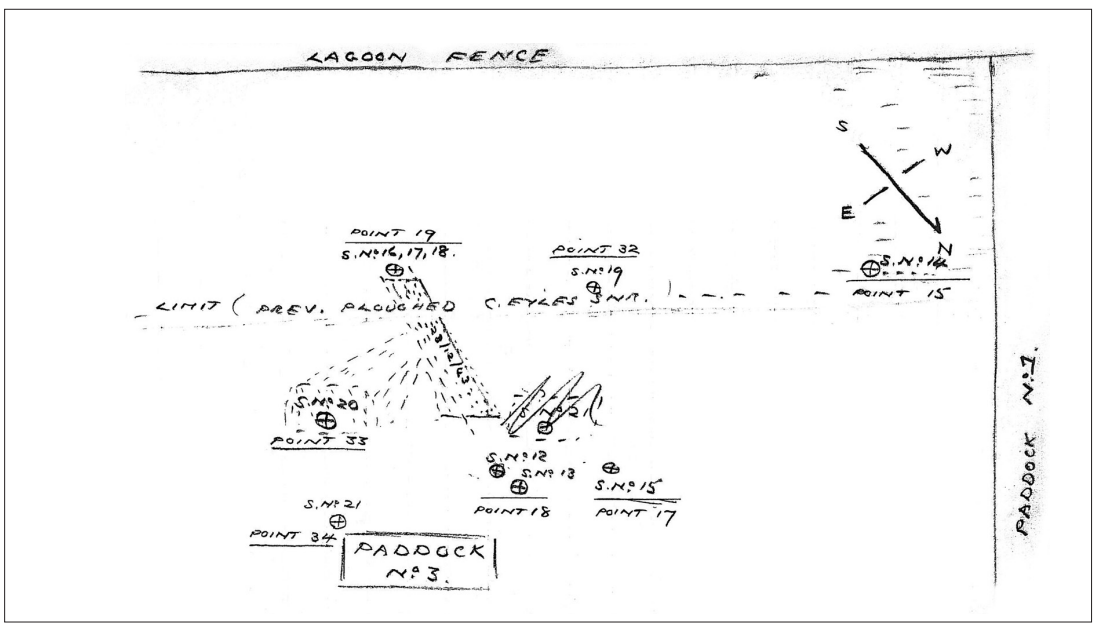

Figure 8. Sketch plan of Paddock 3 burials Duff. n.d.a [FB1], p 95)

Of note is the statement in Duff's field book (Duff n.d.a [FB1], p 48) that not all of the bones from these burials were removed, probably because of their poor condition. Of Burial 8 only the cranium was taken and only the right femur and humerus of Burial 9 were removed. The cranium in Burial 10 was also reburied (Duff n.d.a [FB1], p 50), presumably close to where it was found.

The first recorded work in Paddock 3 took place in August 1943 when ploughing in a previously unploughed area exposed Burials 12 to 16 (Duff 1956, p 49) (Fig. 7). As a result the plough was moved approximately 20 m seawards leaving a strip for further investigation (Eyles 2007). These burials were excavated by Eyles and Duff and a further two burials (Burials 17 and 18) were located at the same time. Burial 12 was found in a poorly

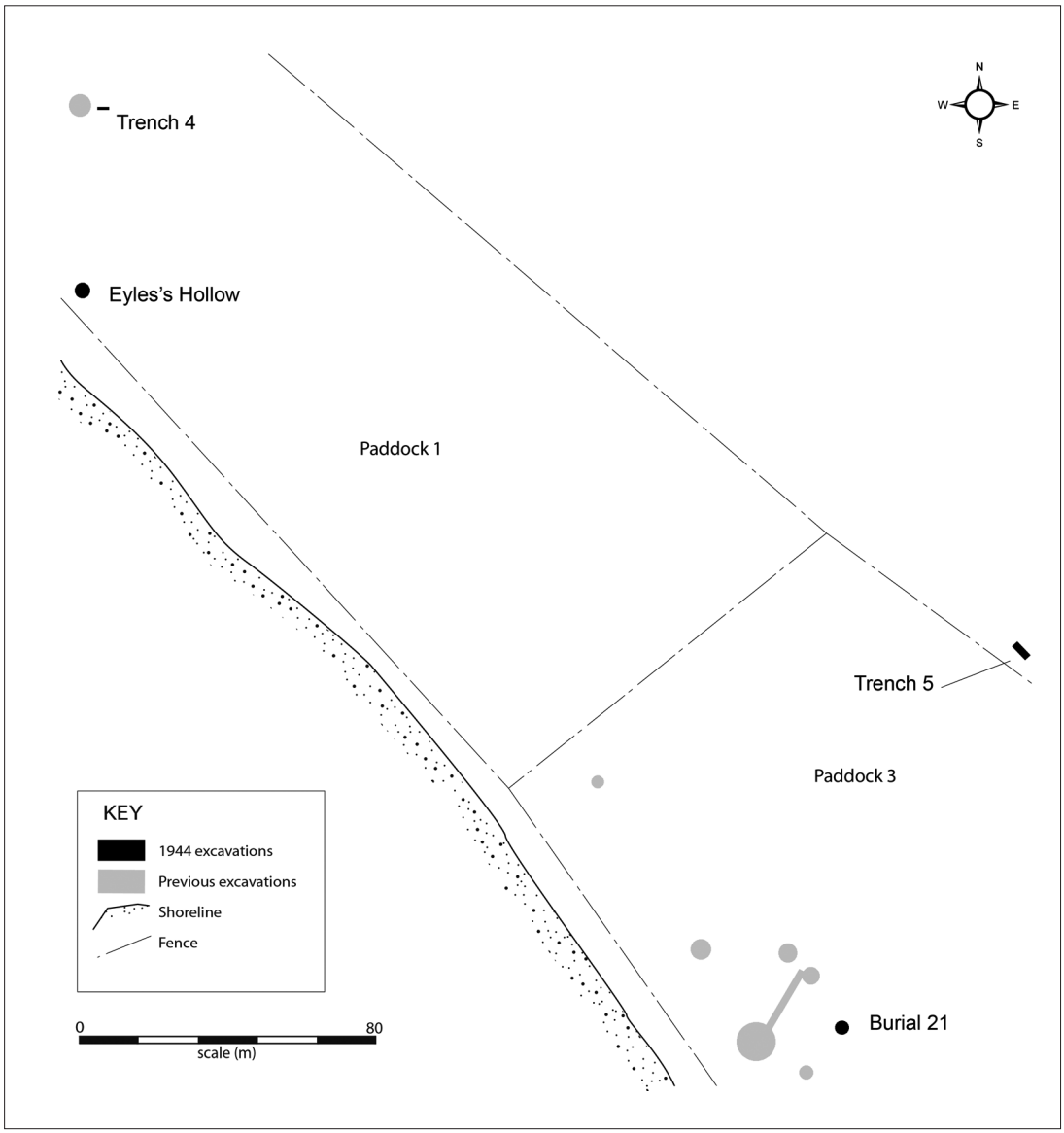

Figure 9. Locations of areas excavated in 1944

preserved condition and only the cranium was removed, the remainder of the skeleton being reburied.

In December of the same year Duff and Eyles searched for further burials within the unploughed strip by hand, excavating a trench two by twenty yards (1.8 by 18.3 m) that ran north-south from Point 19 to Point 18 (Trench 3, Fig. 7, Fig 8). The only items of interest to them were six perforated shark teeth so the plough was again used which resulted in the discovery of Burials 19 and 20 (Duff 1956).

Between 24 and 26 December Duff and Eyles investigated an area on the edge of the lagoon marked 8 on the Duff plan (Fig. 3) which they called "Eyles's Hollow" (Fig. 7). This area contained several moa-bone fish-hook tabs, complete as well as broken and unfinished fish-hooks, and about one dozen stone drill points. A fireplace was also present in this area but is not described in any further detail although nearby a cache of five adzes was found (Duff n.d.a [FB1], p 88). This may be the same hollow that Eyles had described to Duff in January. There is an undated field plan that shows several artefacts present on the edge of Hollow 8 including five adzes which may be from this excavation (Fig. 6). The small cross-hatched squares are not labelled so it is not clear what they represent. If they are test pits they are some of the earliest evidence of relatively systematic archaeological testing at the site. However, it is possible that they could equally be fence posts.

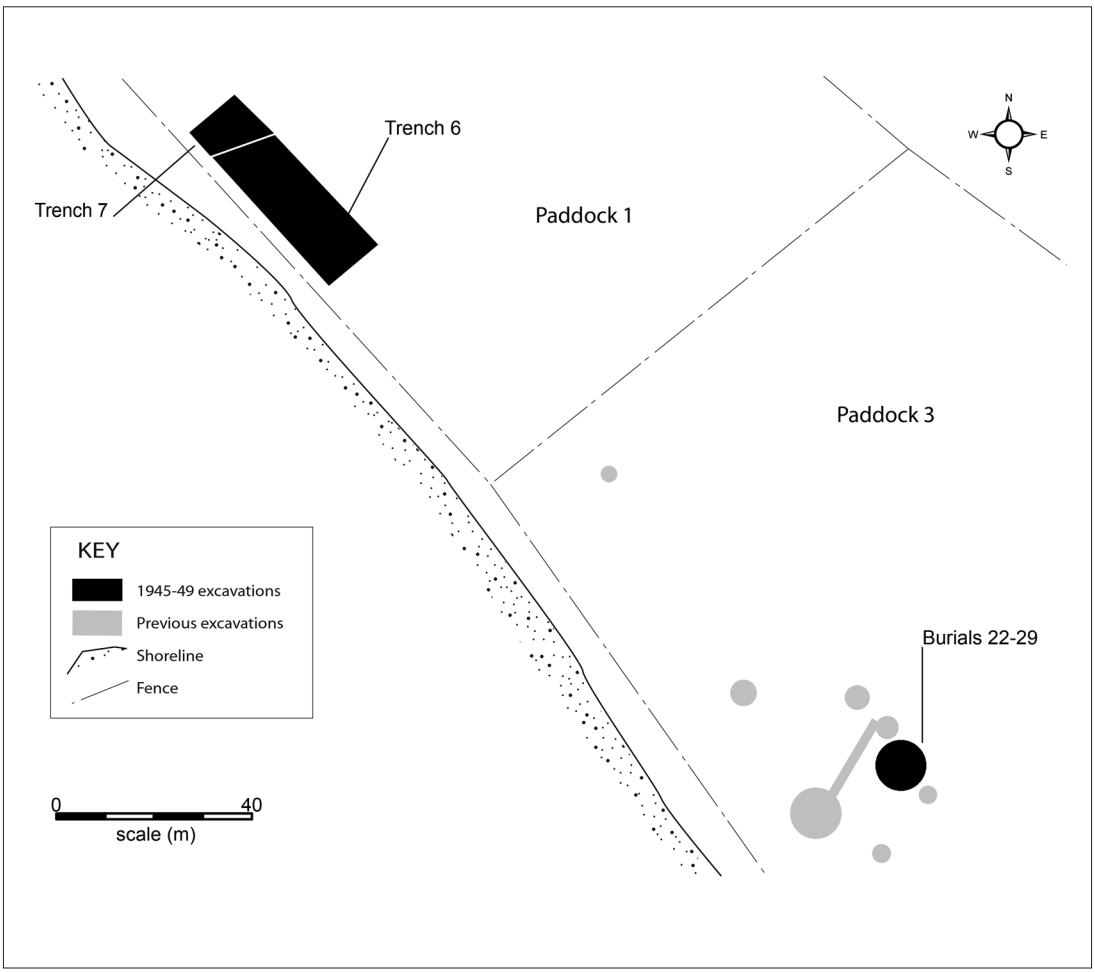

Figure 10. Locations of areas excavated during 1945-49

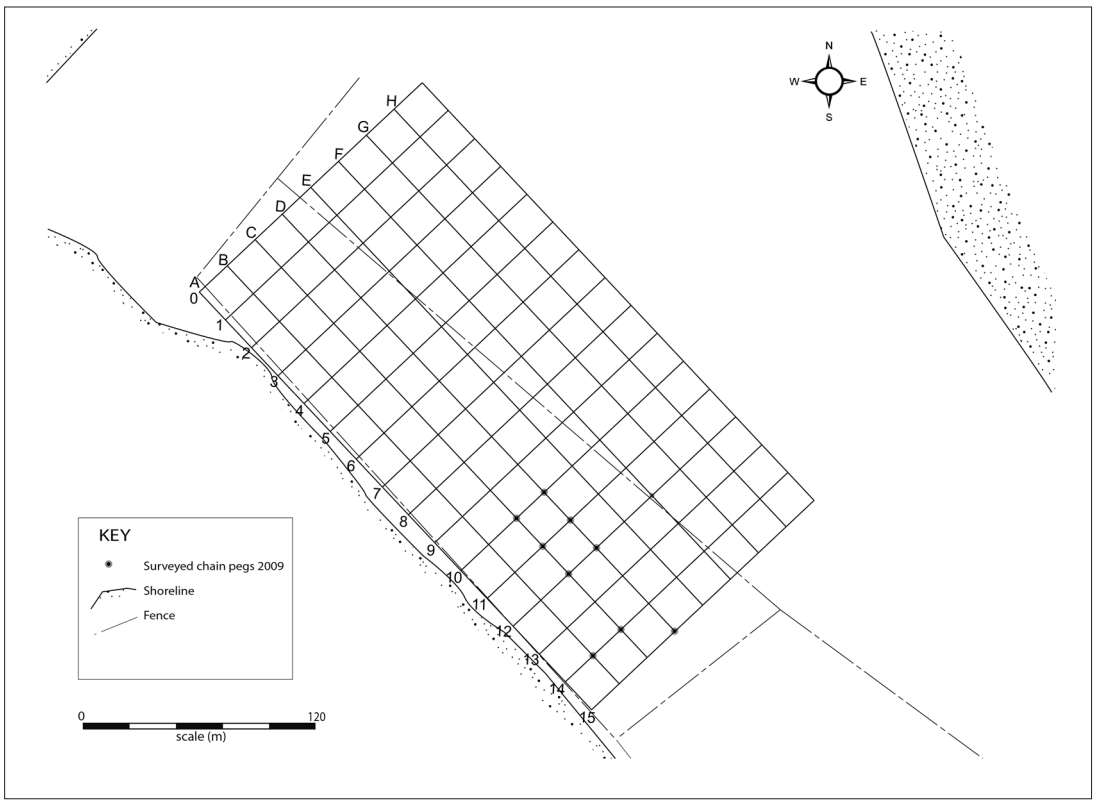

Figure 11. Chain grid as laid out in 1950

This is indicated by an entry in Duff's field book describing some of Eyles's work here, "JRE dug for an hour or so near point 8 continuing to find tabs and a fragment of polished nephrite. About 5 yards [4.6 m] past fireplace struck remains of old post, and at base of it (20" [50.8 cm]) found much decayed pelvis of moa with one femur in articulation, [and] first 5 dorsal vertebrae" (Duff n.d.a [FB1], p 104).

1944

This year saw the excavation of one further burial and artefacts by Duff and Eyles together, and one burial by Eyles working on his own. Two adjoining hollows on the beach ridge were also investigated to determine their nature and function.

In January Duff and Eyles continued to excavate Burial 20 and on 8 January they excavated a trench in an area of concentrated midden due east of Point 7 (Trench 4, Fig. 9). The midden deposit here was up to 18" (45 cm) deep with a large amount of bird bone as well as stone flakes, adze fragments and evidence for the manufacture of moa bone reels and whale tooth pendants (Duff n.d.a [FB1], p 108).

Correspondence from Eyles to Duff in July reveals that Eyles had been doing further digging near the lagoon, in an area he called the "fish hook factory" (Point 8, Fig. 3). Eyles's letter relates that he was finding fewer artefacts as he worked northwards from that point but there was more success working in other directions. The only find that he specifically mentions in his letter is a large moa-bone one-piece fish-hook (JRE to RSD 28 July 1944).

In October of that year Duff and Eyles returned once again to the site, at which time Eyles reported to Duff that he had excavated another burial (No. 21) in the vicinity of the southern burial area. It was lying extended with the head to the SE and was in a very poor state of preservation. The cranium had been badly damaged by

the plough and the only item reported in association with this burial was an argillite adze (Duff [FB2], p 31). During this same visit they excavated a trench through two adjoining hollows along the beach ridge (Trench 5, Fig. 9) which Duff believed to have been formed by the gradual accumulation of midden. The larger of the two pits was not excavated but measured 20 by 13 feet (6.1 x 4 m) and was three feet (0.9 m) deep. The second pit, separated from the first by a large midden five feet (1.5 m) wide, was fifteen by ten feet (4.6 x 3.1 m) and was eighteen inches (45 cm) deep. The trench began on the seaward edge of the hollow and ran to the north for three to four yards (~3-4 m). Three layers (Layers A-C) were identified in this feature. Layer A comprised a thin upper layer of stones and light soil with some shell and bone including moa vertebrae. Layer B contained a dense concentration of shellfish with some bone, while Layer C coincided with the base of the hollow and comprised charcoal, oven-stones and moa eggshell. At the base of the hollow, Layer C was about 12 inches (30 cm) thick but graded out to about four inches (10 cm) thick beyond the edge of the hollow.

1945

During 1945 Paddock 3 was reploughed revealing a further eight burials that were investigated by Eyles. Duff did not spend much time at the site during the year except for a brief period to investigate the relationship between midden areas and concentrations of artefacts.

Duff visited the site again between 10 and 20 May while on holiday. According to his field book he had no intention of digging but between the 14th and 19th he opened up a trench at least ten by three feet (3.1 x 0.9 m) in order to "make some notes on the problem of this digging" (Duff n.d. [FB2], p 48). The location of this trench is not recorded; Duff simply noted that it was adjacent to a mound of midden. A large amount of moa, seal and dog bone was found but few artefacts. Duff wanted to test a theory that working away from these midden-rich areas into a "blend of light midden, with much moa egg shell, numerous flint knives, flakes of argillite, and a somewhat loose packed soil" (ibid) was likely to expose many artefacts. In the remainder of the trench he found a broken tab, sawn bone, a reel of possible human bone, a "whale tooth" unit, an ivory tab and three awls (Duff n.d. [FB2], p 48).

In August the same year Eyles carried out his own investigations "past Pit 4" (JE to RD 21/08/1945). The Pit 4 referred to here may be one of the hollows along the beach ridge (possibly D on Fig. 3). He found concentrations of moa and swan bone, an ivory one-piece fish-hook and an artefact he described as "the first recognised barb from the Wairau camp".

Paddock 3 was ploughed again in September and investigations identified eight further burials (Burials 22-29) in a small area approximately eight by four yards (7.3 x 3.7 m) between points 18 and 34 (Duff 1956) (Fig. 3, Fig. 10). These were investigated by Eyles and reported by Duff in his monograph. It has not been possible to locate the relevant field notes and there are only two letters on file from Eyles to Duff that mention this work. The first contains the following:

I started digging into the plot near skeleton: the stone whale tooth owner. I had not quite opened up a trench and came across one skeleton and an adze. I proceeded to extend the trench when two other skeletons came into view. I thought seriously of informing you but before doing so I investigated to see if any pendants were to be found. I located two skulls but no ornaments: the third was the usual story skull and right arm missing. So, I proceeded on digging away all sand and gravel exposing bones for careful examination. I sketched whole three [sic] to best of my ability. Pendants were nil; and only one adze was found.

The most amazing thing was the absence of teeth in the second skull lower jaw. Not even a sign of where they had been. Of course I am keeping the bones for future reference (Eyles to Duff undated letter).

The second letter contains information about the orientation and condition of Burials 22 to 24, "No. 22 was lying on "right" side, the adze being near left elbow. No. 23 face downward minus head. No. 24 left side: facing east and down into ground. 'Twenty four' is the one without teeth" (Eyles to Duff undated letter).

1947

The only recorded work carried out during 1947 was by Jim Eyles who investigated a midden area at the request of Duff. This investigation produced over 190 artefacts including necklace units, and adze caches and other stone tools such as drill points and sandstone files (Eyles 2007, p 95). Unfortunately the location of this area is unknown and there is no information in Duff's field books or in the correspondence about this request.

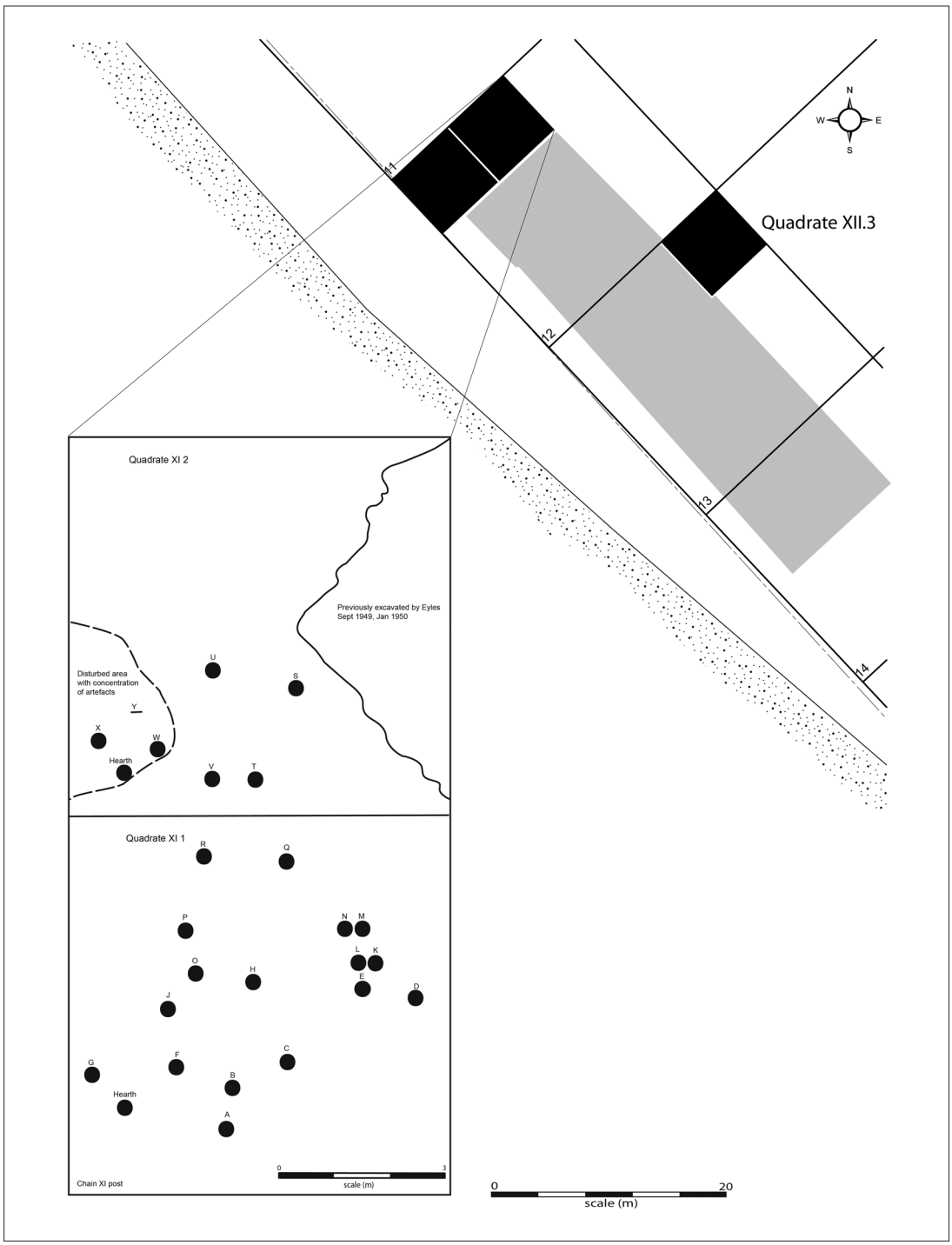

Figure 12. Locations of excavations carried out between 1949 and 1950. The inset shows the recorded features from Quadrates XI. 1 and XI. 2 – the lettered circles are post-holes and Y is a plank.

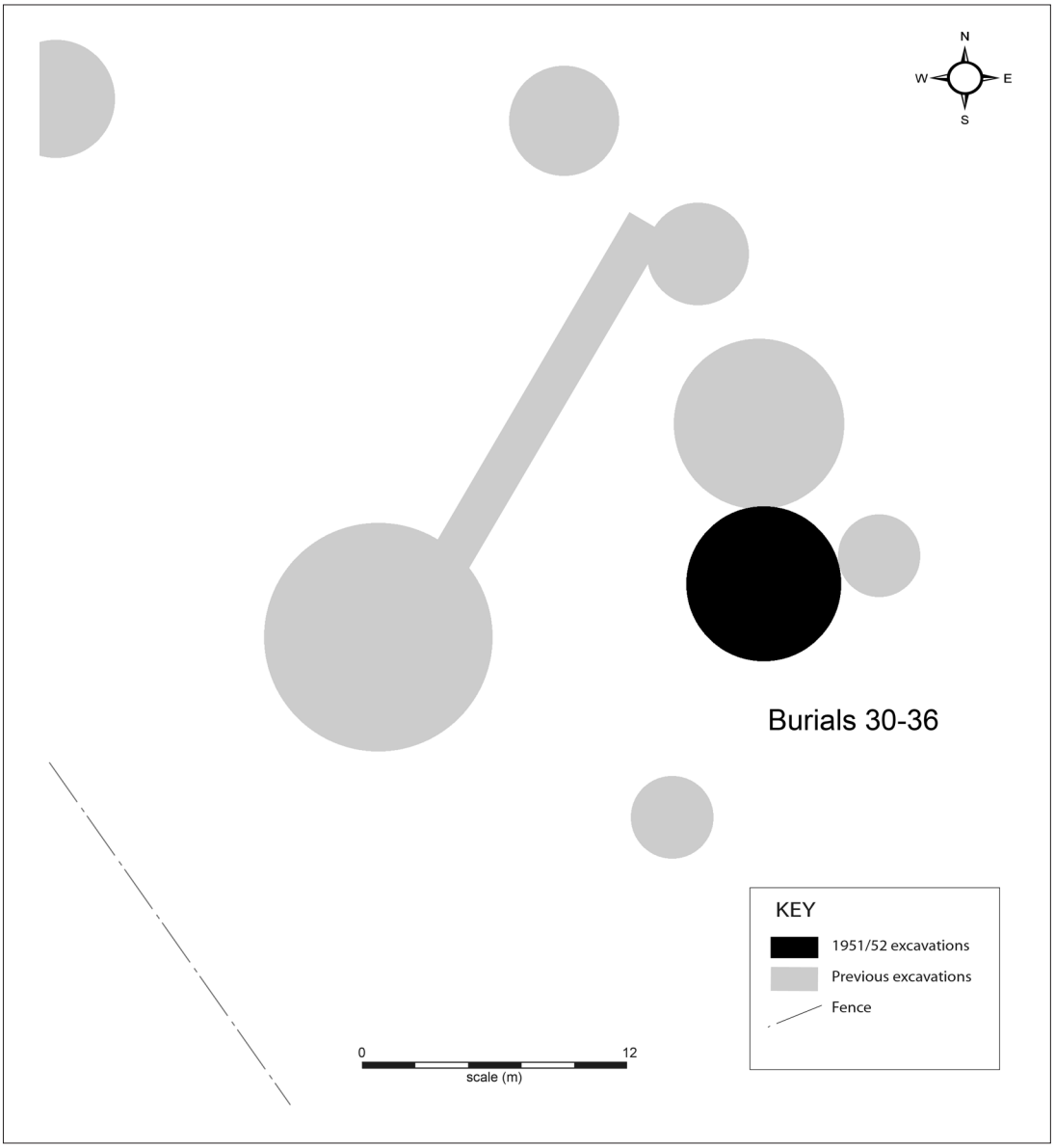

Figure 13. Locations of excavations carried out during December 1951 and January 1952

1949

This was the final year that Duff carried out any excavation without using properly surveyed excavation units. Unfortunately the results of this excavation work are not described in either his field notes or publications nor is there any information about what Eyles may have found during his own excavations.

Duff returned to Wairau Bar at the end of September with WJ Phillipps and T Barrow of the Dominion Museum who were interested in the pits along the beach ridge. His field book notes "signs of a fairly extensive area dug (unofficially) by Jim Eyles ... towards the lagoon edge of Paddock 1 near the former northern[1] [southern] boundary fence. Jim had covered a zone two chains

[40.2 m] long by 28 ft [8.5 m] wide shrewdly aligned along the rich lagoon edge deposits" (Trench 6, Fig. 10) (Duff n.d.b [FB3], p 43). He expresses some reluctance in agreeing to allow Phillipps and Barrow to square off one of the corners of Eyles's trench. After a couple of days of working in this trench he decided to create a more formal excavation area 4 chains (80.5 m) from the south west corner post of Paddock 1 creating a trench 24 feet (7.3 m) wide which he considered would "provide a deep penetration across the richest part of the habitation area" (Duff n.d.b [FB3], p 47). The results of the excavation of this trench are not recorded in his field book.

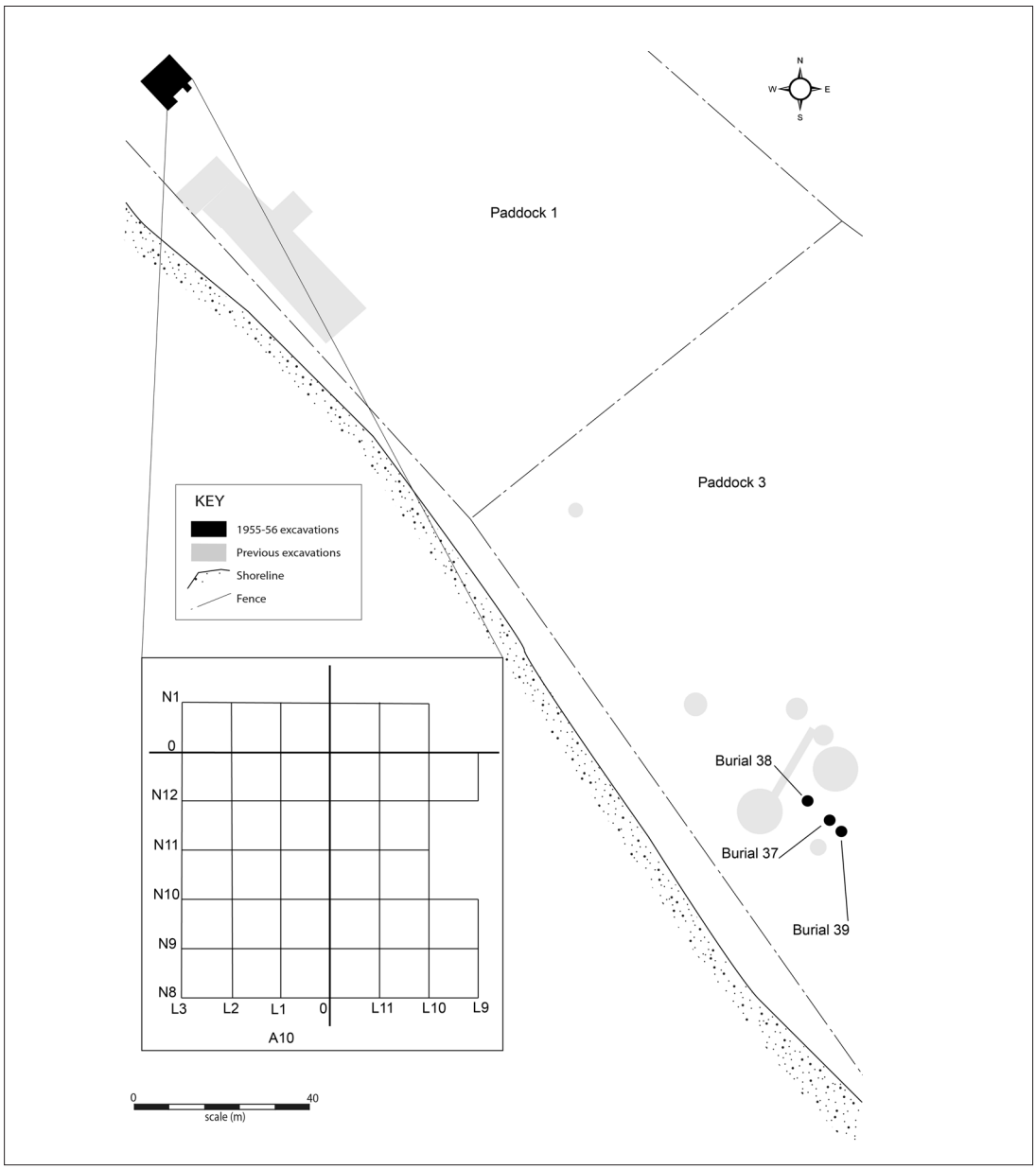

Figure 14. Locations of excavations carried out in 1955

Future work on the material culture from Wairau Bar may reveal new details about the location of excavations. Roger Duff employed a man called Heaton Rhodes whose job was to enter finds into the museum's ethnology register. Periodically, there are a large number of new arrivals with an entry at the beginning of each one that describes their origin.

On 30 November 1949, Duff wrote to J Meale at the Blenheim office of the Department of Lands and Survey seeking assistance to lay out a chain grid over Paddock 1 about 16 chains (321.9 m) long by five chains (100.6 m) wide. This survey took place on 19 January 1950. On the lagoon side the grid was located at an unspecified point south of the corner fence of the homestead block and 16 pegs at one chain (20.1 m) intervals were placed along the lagoon edge to within 40 feet (12.2 m) of the south-west corner of the paddock. Five pegs were laid out from the datum to run east of the first burial area. Due to a shortage of pegs the seaward side of the grid was not pegged out but transverse lines were established at five chains and then at one chain intervals between 10 to 15 chains (Duff n.d.b FB3, p 51) (Fig. 11).

1950

The publication of Duff's The Moa-Hunter Period of Maori Culture marked 1950 as a landmark year for New Zealand archaeology. This was the first book to be published about New Zealand archaeology and is still one of the best known. It was also during this year that archaeological excavations took place within formally surveyed excavation units and the location of features and artefacts were recorded in relation to these units. Jim Eyles was appointed to the staff of Canterbury Museum during this year.

Excavation began on 23 January with a 22 by 22 foot (6.7 x 6.7 m) square with its northwest corner on Peg 11 and called Quadrate XI.1 (Fig. 11). Eyles had started excavating on 17 January at the edge of the previous excavation (referred to above) before this grid was established and found several artefacts including a one-piece fish-hook, the point of a lure hook, a piece of a small ivory reel and a small hog-backed (Duff type 4A) adze (Duff n.d.b [FB3], p 51). In contrast to his earlier work, Duff considered the finds of this first quadrate disappointing until the discovery of an ashy hearth and several post-holes. There were also plenty of seal and

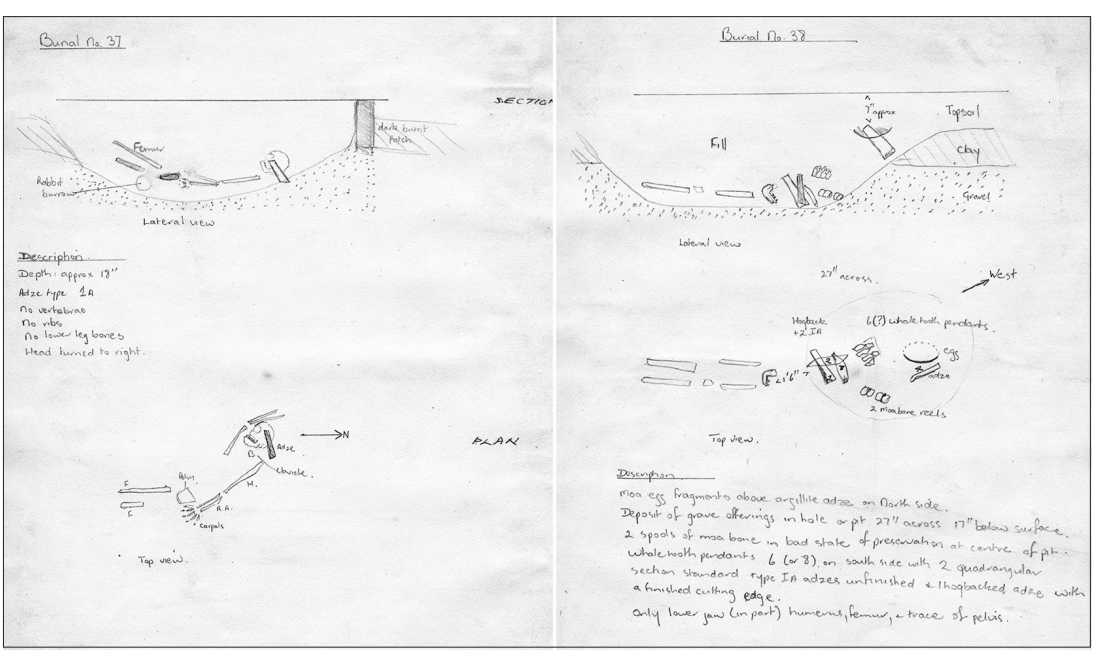

Figure 15. Eyles's sketch of Burials 37 and 38 (Duff n.d. [FB3], pp 218-219)

moa bones including fifteen moa vertebrae in position of articulation (Duff n.d.b [FB3], p 55). There was a dense concentration of shell fish in the upper right corner with fish bone (Duff n.d.b [FB3], p 59). Artefacts from this quadrate included adze fragments, tabs, awls and cut tubes, a worked seal tooth and two broken minnow lure shanks. For the first time Duff recorded scale drawings of the location of the post-holes and other features in his field book (redrawn as Fig. 12).

Quadrate XI.2 was located immediately to the seaward side of Quadrate XI.1 and had been approximately one quarter excavated previously by Duff in September 1949 and Eyles in January (Duff n.d.b [FB3], p 63). Further post-holes were located and Duff noted the presence of a "number of bones of undamaged rat skeletons found near [a] post, as Jim similarly found others by a post base (not recorded) in XI.1" (Duff n.d.b [FB3], p 63). Artefacts included a Duff Type 3 adze, an unfinished sub-triangular adze, drilled porpoise tooth, minnow shank and bone needles mostly in association with a post-hole concentration (Duff n.d.b [FB3], p 67). The stratigraphy of these two excavation units was relatively straightforward. The upper layer of humus, stones and broken shell was between five and six inches (approximately 13-15 cm) deep. This rested on a layer of discoloured mixed gravel which was about seven inches (17.5 cm) thick. This in turn was on top of beach-laid gravels between nine (22.9 cm) and 14 inches (35.6 cm) thick (Duff n.d.b [FB3]). The invention of radiocarbon dating had occurred in the previous year and the first radiocarbon samples were collected during this excavation.

While employed by the museum, Eyles continued to carry out his own work at the site. In February he wrote to Duff detailing work he had been doing in Quadrate XII.3, "it has been slow going on account of the change of soil formation chiefly the mixture of heavy clay in the upper layer...a human skull among the "hangi" stones of Quad XII.3 remains a mystery to me...It was within a few inches of the surface so much broken" (JRE to RSD 9 February 1950).

Figure 16. Jim Eyles (left) and Canterbury Museum osteologist Ron Scarlett in the vicinity of the 1955/59 excavations (photo, Canterbury Museum)

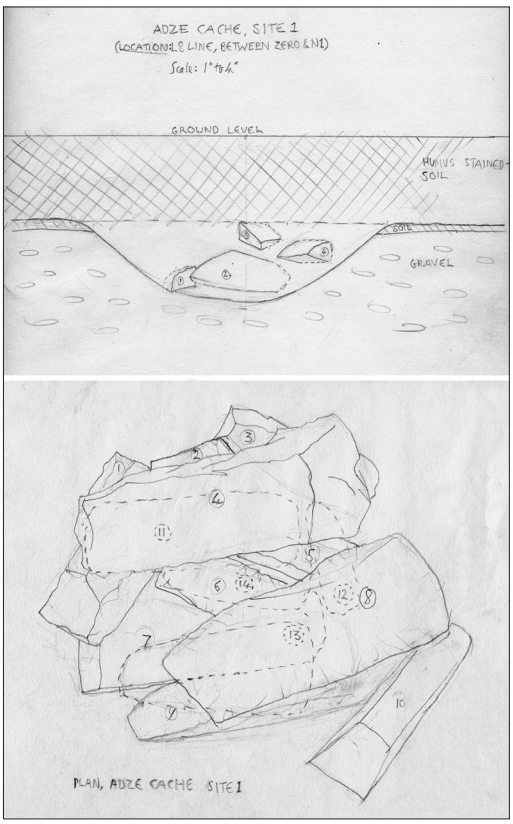

Figure 17. Section and plan drawings of the 13-adze cache from Site 1, 1959 (Duff n.d. [FB9], pp 75-76)

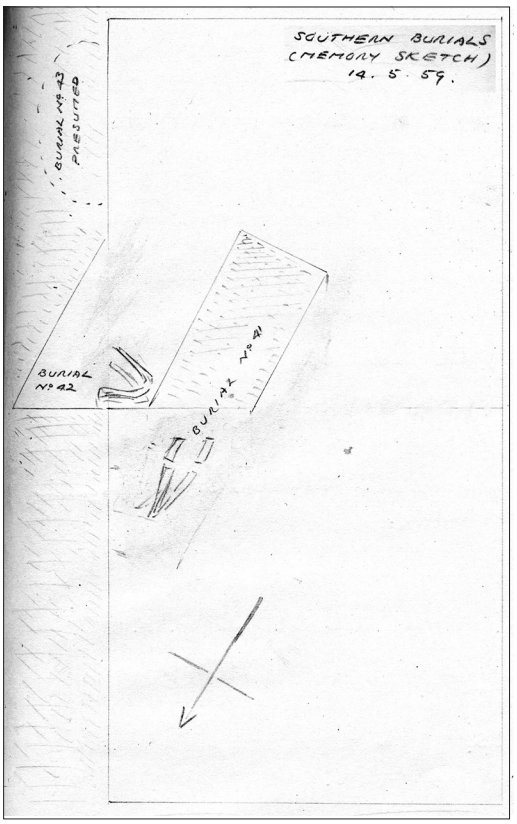

Figure 18. Sketch plan of Burials 41 and 42, May 1959 (Duff n.d. [FB9], p 71). Note the presence of a possible further burial which had yet to be excavated.

1951/52

Between 26 December 1951 and 18 January 1952 Eyles and volunteers D Millar, H Dephoff and G Palmer continued work in the vicinity of Burials 15-29. They started at the southern margin of the 1945 excavation (point 35) and recovered seven burials (Burials 30 to 36) (Duff 1956). The results of this work are summarised in Duff (1956) and type-written notes with photographs of Burials 33-36 were provided to Canterbury Museum by Michael Trotter. The location of the excavation area shown in Figure 13 is indicative only as there is no field plan that records the location of this work.

Eyles's (2007, p 165) book contains a field plan of work carried out in Quadrates 11A.7 and 11A.8 in January 1952 during which he identified a series of post-holes which he considered to be a structure, along with two small fireplaces. His book contains an excerpt from one of his field books which describes an unusual feature to the left of one of the fireplaces, "…a canoe-shaped set of planks running in line slightly east of south and west of north, about 4ft 8 ins long with upright wood at end…it looked as though it was a pit lined with wood, sides, bottom solid with end uprights. This hull-shaped body is filled with shell, broken flakes and bird bones. Two beautiful limestone 'reels' were found near the wood at bottom close together" (Eyles 2007, p 165). There are some problems with the location of this unit since Duff's field book suggests that this area had been excavated sometime before 1950 as part of the large Eyles trench referred to above (Duff n.d.b [FB3], p 63).

1955

In December 1955, Duff returned to the site with Dr Robert Bell, a Fulbright scholar from the University

of Oklahoma who was an archaeologist and dendrochronologist (Dean 2006, p 33). The primary purpose of this investigation was to look for post-holes and other evidence of structures. Bell persuaded Duff to reduce the size of his excavation units to five foot (~1.5 m) squares. These were located on the chain grid in the south-eastern corner of A10 and north-eastern corner of A11 with three units extending into B10 and two into B11. This excavation located several post-holes, some with post butts still in place, discrete concentrations of midden, and artefact caches. None of the post-hole patterns were regular enough to be interpreted as dwellings.

1956

While excavation was continuing in the above units in January, Eyles carried out some digging beyond the chain grid and located Burials 37 and 38 in the space of 35 minutes while working towards the lagoon from Burial 34 (Duff n.d. [FB3], p 217) (Fig. 14). Duff's field book contains stratigraphic sketches by Eyles of these two burials (Fig. 15). During the same month Jim Eyles and Michael Trotter excavated Burial 39 which was approximately 2 metres from Burials 37 and 38. Burial 40 was also located during this month but there is no information available about it. No field notes or drawings of this work exist although Trotter (1975, 1977) described Burial 39 in detail and there are photographs in the museum archives of this burial.

1959

Further formal excavations were carried out at the site by a Canterbury Museum team in 1959. This work extended the excavated area from 1955 and also continued the search for further burials in the southern burial area. During this excavation two trenches were excavated towards the lagoon under the supervision of geologist, Harold Wellman who was interested in the stratigraphy of the site.

Figure 19. Excavation of Burial 41, May 1959, excavators unidentified (photo, Canterbury Museum)

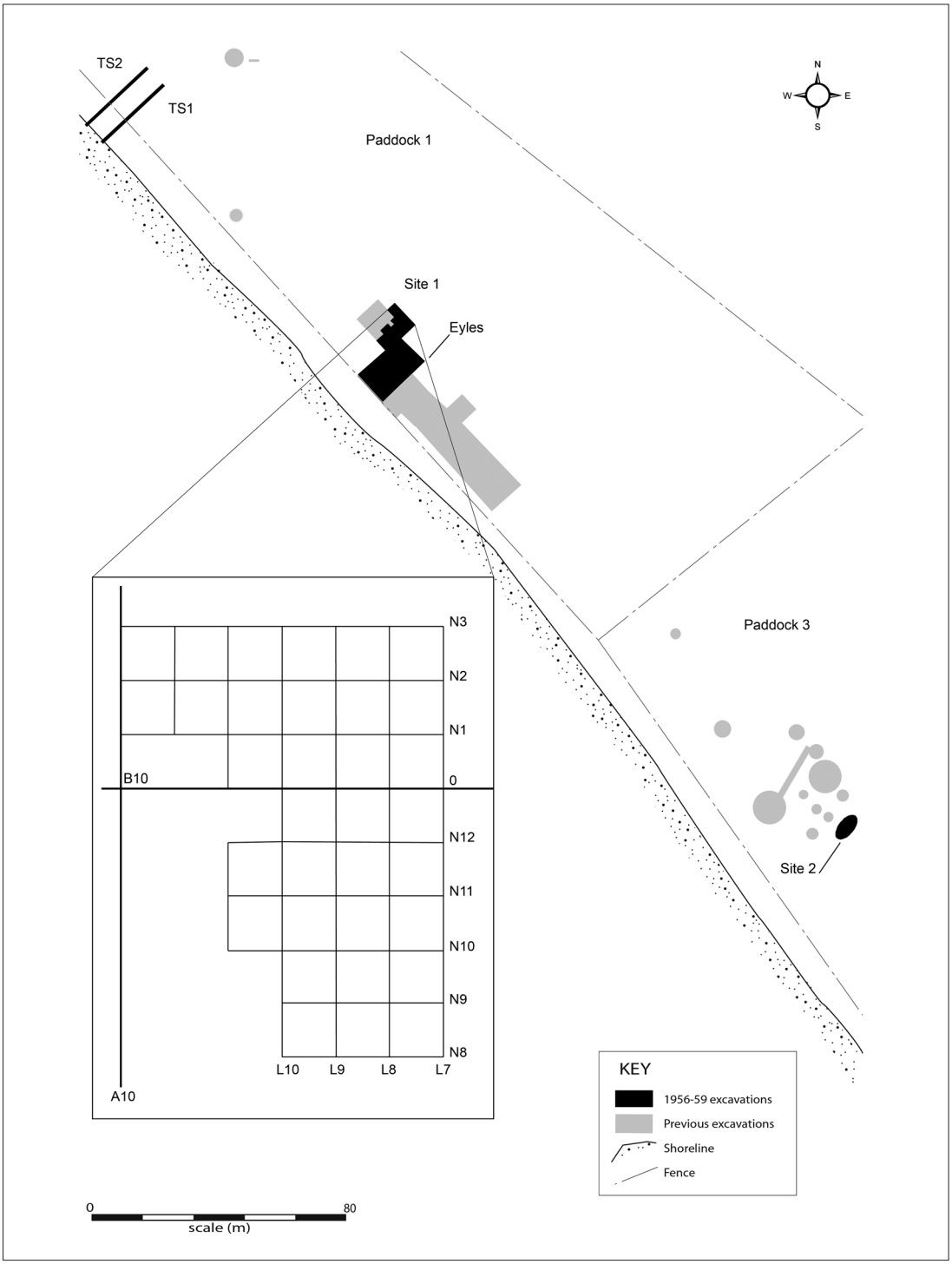

Figure 20. Locations of excavations carried out during 1959. The lighter shaded areas are those dug by Eyles between 1956 and 1959.

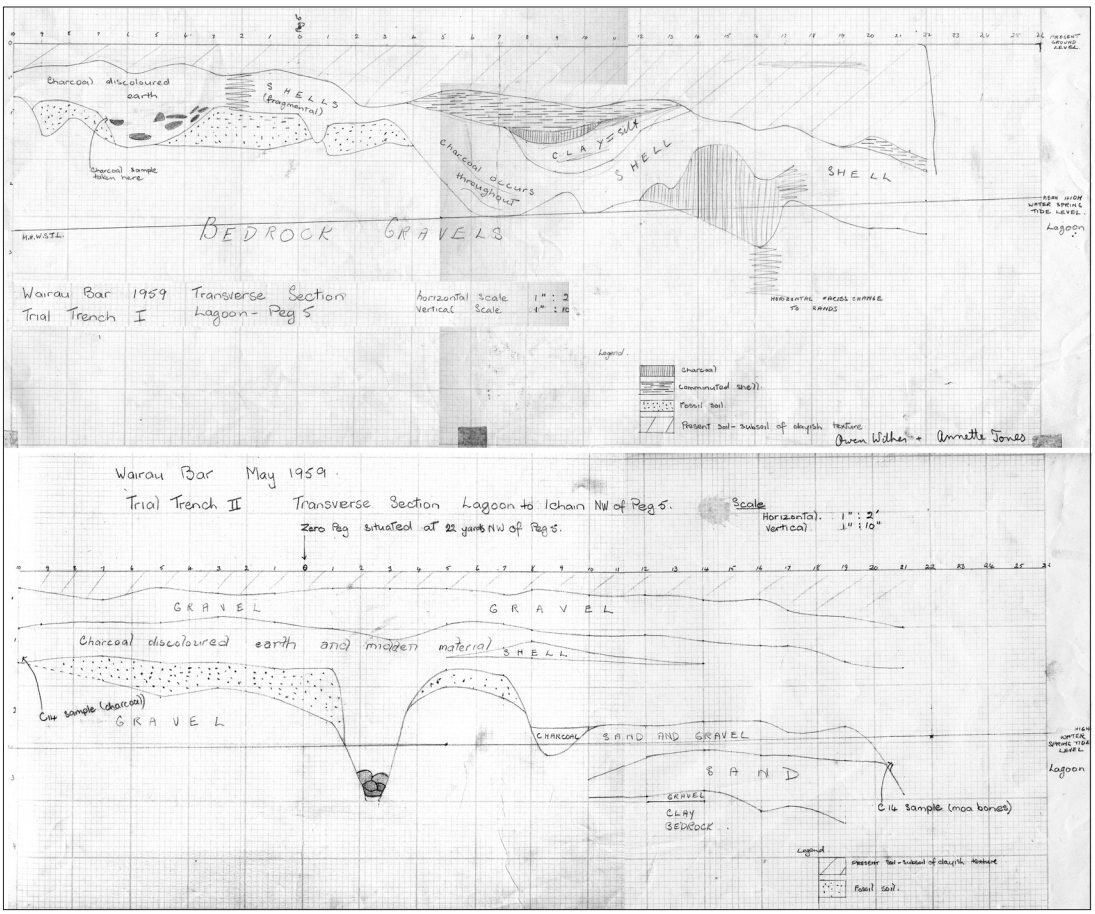

Figure 21. Stratigraphic profiles of Trial Trenches 1 and 2

In May 1959, Duff returned to the Bar with a team of twenty volunteers from the CMAS including Owen Wilkes, and made the decision to extend the area excavated during the summer of 1955/56 "and work 'south' towards fence to close short gap here" using the existing grid system (Duff n.d.c [FB9], p 62) (Fig. 20). This was designated Site 1 in his field notes. Site 2 was set up grid south of Burials 39 and 40. The main chain grid was extended by six chains (120.7 m) to incorporate this area the following day. All excavated areas were "included on [the] grid extension, including [the] dividing fence on [the] Bell grid between 11 and 12, and later Eyles [sic] digging towards this fence" (Duff n.d.c [FB9], p 66) (Fig. 16).

This discussion of the grid extension raises questions about the accuracy of the Duff (1950, fig.2) plan. When this grid is overlaid on the georeferenced plan most of the southern burial area falls outside the southern extent of the grid. This suggests an error since the purpose of the grid extension was to incorporate all of this previous excavation. The only way to rationalise this is to adjust the location of the southern burial area according to the detail provided in Duff's Field Book 9, described above. The location of the southern burial area in Figure 20 has therefore been adjusted to reflect the detail in this description.

The excavation of Site 1 revealed further post-holes, concentrations of midden, a cache of thirteen adzes

Figure 22. Excavation of one of the lagoon trenches (photo, Canterbury Museum)

(Fig. 17) and a new burial, Burial 44. The locations of features and major finds were recorded on a site plan which also contained the 1955 excavation data (published by Anderson 1989, fig. 9.4). The excavation of Site 2 resulted in the discovery of Burials 41-43 but the only record of them is a field plan showing these burials in Duff's field book (Duff n.d.c [FB9]). This plan suggests that Burial 43 was not excavated and it is not described in the field notes, unlike the other two burials (Figs 18, 19). Skeletal material, however, identified as Burial 43 is listed in the Canterbury Museum catalogue as SK392 and is reported in Buckley *et al*. (2010).

Duff was absent from the excavation between 18 and 21 May to attend the New Zealand Archaeological Association conference in Rotorua and in his absence field notes were kept by Alan Eyles. The notes over this period are essentially a record of who was digging and what they were finding.

At the commencement of this excavation Eyles reported to Duff that he had carried out his own excavations since 1956. Firstly, he had worked further along the lagoon edge northwards of the 1949-50 work to the limit of the cross fence (Fig. 20). He reportedly found two large adzes and the partially burnt bones of a skeleton "about 12 feet [3.7 m] right of No. 44" (Duff n.d.d [FB10], p 38) which was reburied. Secondly, he had worked south of the 15 chain peg between points 33 and 34 where he found a further two burials (Burials 39 and 40). At that time Duff was not able to establish what, if any, grave goods were present, although Trotter (1975) subsequently reported on Burial 39. Duff observed in his field book that "this digging is strictly unofficial" (Duff n.d.c [FB9], p 61).

During this season Dr Harold Wellman visited the site and was particularly interested in the stratigraphy. With the assistance of some of the archaeological crew (including Owen Wilkes) he excavated a trench from the lagoon edge at chain peg 5. This trench extended a chain (~20 m) seaward from the baseline and 22 feet (6.7 m) towards the lagoon. A second trench was excavated 22 feet (6.7 m) to the north by Ian Mannering and Peter Johns (members of the excavation team) in order to corroborate the stratigraphy from the first. The lagoon section between the two trenches was also recorded in order to demonstrate the relationship between the two. Wellman reported to Duff (22/05/1959) that in his opinion there were seven layers in the trench and described them from bottom to top (oldest to youngest) as follows:

Layer A *This is a loose fine gravel at the base of the main occupation layer. It is probably marine in origin.*

Layer A1 *Marine deposited clean sand overlies the fine gravel. This is up to a foot deep in places.*

Layer B *The layer comprises lenses of soil between Layer A and the main occupation layer. These lenses do not occur below the main occupation layer and may be pit fill.*

Layer C *This is the main occupation layer containing many moa bones.*

Layer D *This layer consists of a thin layer of silt which is present over only a few yards. It seals a large oven.*

Layer E *This is a thin occupation layer which is only approximately an inch thick.*

Layer F *This is a natural shell deposit comprising almost entirely cockle (Austrovenus stutchburyi) and is only visible for about 20 feet from the lagoon.*

Layer G *This layer consists of an estuarine silt up to 18 inches thick and is likely to be flood deposited. This layer contains glass.*

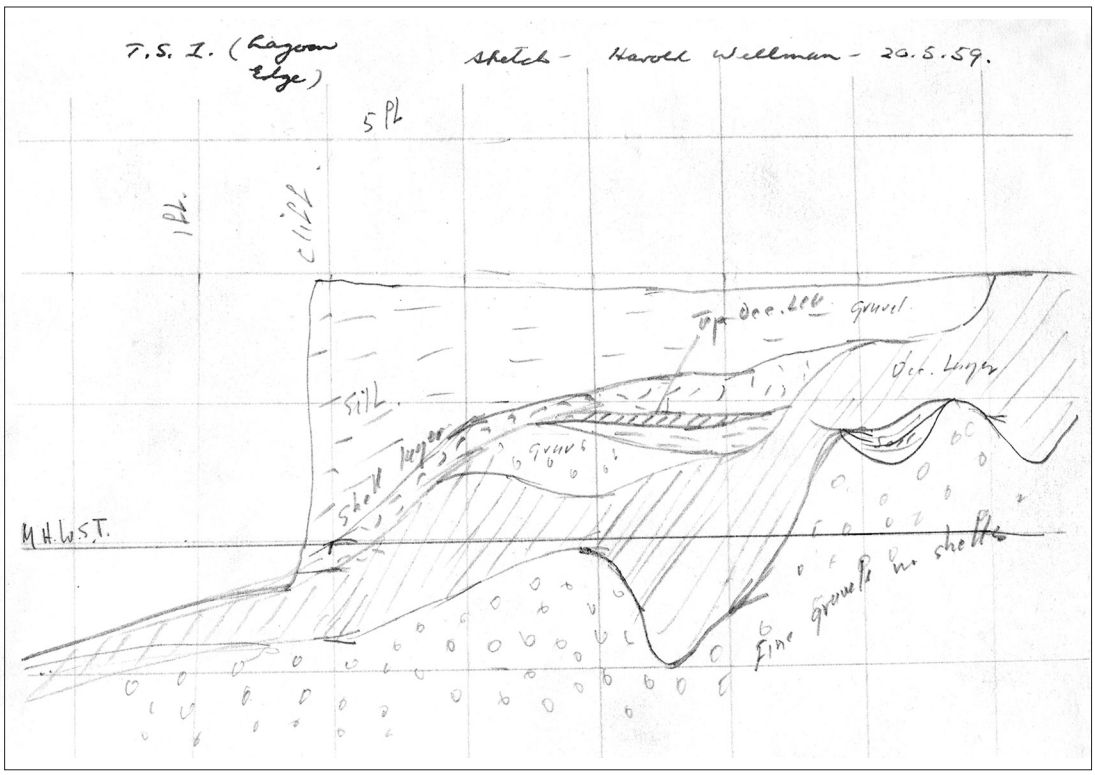

Figure 23. Sketch of the first lagoon trench by Harold Wellman (Duff n.d.c [FB9], loose leaf)

Wellman's letter to Duff did not include a stratigraphic drawing but there is a sketch on a loose leaf in FB 9 that is labelled as having been drawn by Wellman (Fig. 23). This was redrawn by Duff in FB10 (Duff n.d.d [FB 10], p 45) (Fig. 24).

His field book suggests that Duff did not consider this work to be the last project at the site as he offers several suggestions for further work. This included sectioning and sampling the seaward pits, looking for additional burials from the first burial area, further investigating the southern burial area, and excavating by the lagoon near chain pegs 4 and 5. Some of this work was to be taken up by Owen Wilkes with the CMAS in the summer of 1963/64.

1963/64

The final Canterbury Museum-led excavations took place at Wairau Bar between December 1963 and January 1964. This was to be the last excavation at the site for forty-five years.

The final Canterbury Museum field season at Wairau Bar was carried out under the direction of Owen Wilkes (the museum's field archaeologist). Wilkes was particularly interested in the issue of stratigraphy and he opened trenches in three areas of the site. The first comprised a series of six-foot (1.8 m) squares with two-foot (0.6 m) baulks between A4 and B4 on the lagoon edge (Fig. 28). The northern half of each baulk was removed at the end of the excavation in order to provide a continuous east-west section. The second consisted of an east-west trench of eight units in E2 immediately adjacent to the first burial area in an attempt to clarify the stratigraphic relationships of the burials. The third was a series of four squares across Pit E in order to investigate the hollows along the western margin of the main beach ridge.

Wilkes identified five layers in the lagoon trench with the surface being Layer 5 and the lowest Layer 1. He considered that there were two cultural layers; Layer 4 and Layer 3b. Wilkes provides the most useful

archaeological information about stratigraphy of any of the archaeological investigations to have taken place up to that time and this description is therefore reproduced here in full, as follows:

Layer 1. Beach Gravels

The underlying "natural" for most of the trench consisted on thin (2-4") seaward sloping layers of gravel, sandy gravel, and gravelly sand. Many of the layers were quite strongly stained by incipient iron pan layers, suggesting considerable age.

Water table was reached about four feet beneath the surface, and the groundwater was brackish but drinkable. A sea beach origin for the gravels is suggested on the basis of (a) with seaward inclination of 0-10° and (b) the presence of fairly numerous unburnt shells similar to those being cast up by waves at present, notably mussel and barnacle, and the lack of estuarine forms, cobbles of distinctive volcanic rocks show that the gravels are derived from the Awatere River to the south. Occasional cobbles of Taupo pumice well embedded in the gravels suggest this portion of the bar was being formed about 200 A.D.

Layer 2a. Silty Layer

Beneath squares A4/Y7 and A4/Z7 the upper part of the natural was a gravelly muddy sand, important in excavation because of its greater coherence due to a higher silt content. Intrusions in this material were better preserved and could be more accurately excavated than in other portions of the trench. In section it shows as a meniscus shaped body and probably it originated from silt impregnating the underlying gravel when a puddle stood in a hollow here.

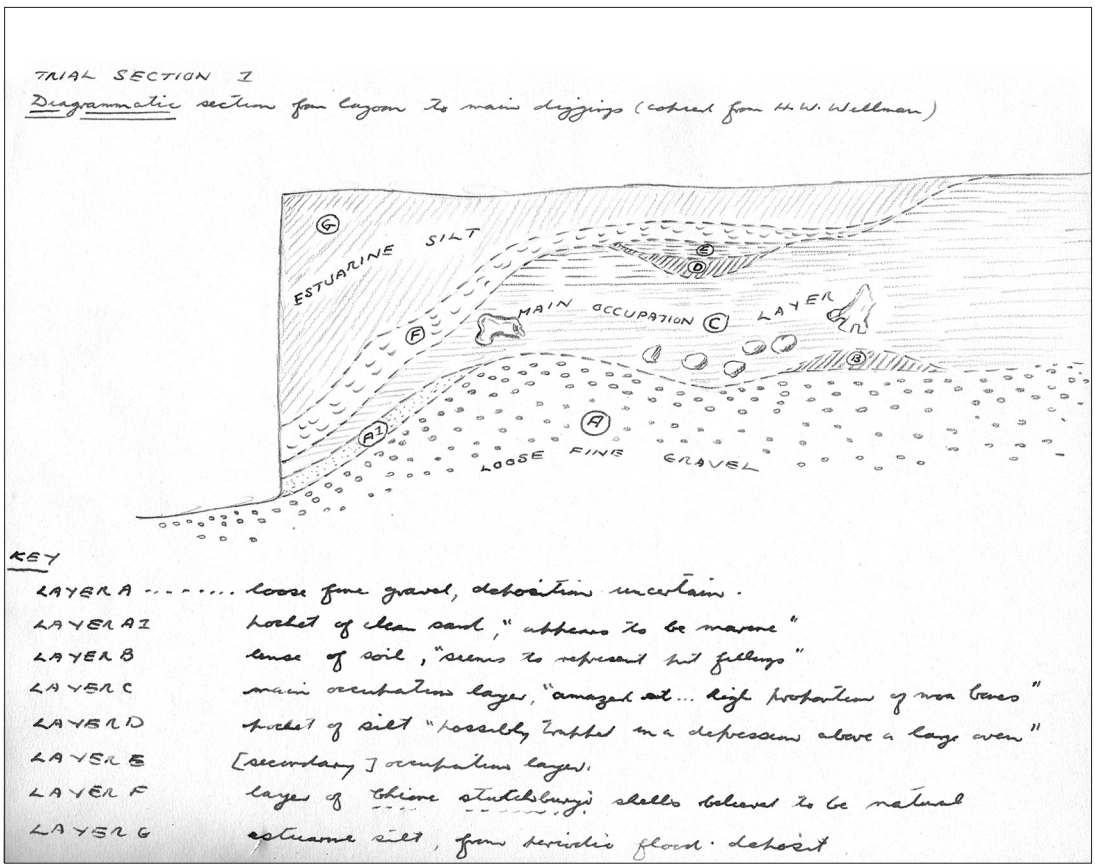

Figure 24. Duff's copy of Wellman sketch (Fig. 23) (Duff n.d.d [FB10], p 45)

Figure 25. Excavation of lagoon trench looking west 1963/4 (photo, Canterbury Museum)

Layer 2b.

Is in a stratigraphic position equivalent to IIA but there is no necessary time correlation. It consisted of slightly gravelly muddy sand of grey colour lightened by a high proportion of well comminuted unburnt shell.

There were also several entire valves of estuarine species and ribbed mussel, most of which were lying convex side up, a fairly good criterion for deposition in moving water. Top and bottom sloped eastward, and the layer is interpreted as being an estuary beach deposit. The exact relation of such a beach to sea level is hard to guess, but by analogy with the present estuary beach, it would seem that sea level was about the same as at present, with the upper edge of the beach in the vicinity of A4/Z7 peg. Thin discontinuous charcoal stains are probably due to water-borne charcoal being stranded by a receding tide.

Layer 3a

Underlying the main occupation layer east of A9/Y8, is a layer of very brown sand gravel of similar texture to Layer 1 but with more sand and some silt. On casual inspection the layer appeared a sparse scatter of shell, bone and stone flakes. It was found that many postholes and other intrusions had been dug during the formation of this layer as they were sealed in by Layer IIIA. The virtual absence of charcoal and the large number of postholes dug while this layer was forming suggest that this portion of the boulder bank then functioned as a habitation area rather than a food preparation area. This is probably the old soil layer (Layer B) of Wellman which in A5 must have extended further lagoonwards.

Layer 3b

Starting abruptly beneath peg A9/T7 and continuing westwards beneath the present lagoon beach was an intensely charcoal-stained layer of sand (gravelly) consisting largely of coalescing oven hollows. Scattered midden shellfish showed no overturning, and there was an abundance of charcoal, and altogether the layer showed no signs of lagoon washing, although it is now largely beneath high tide level. There was an abundance of ovenstones, midden moa and seal bone but very

little artifactual material and this layer presumably represents the food preparation area, corresponding to the habitation area represented by Layer IIIA. It is hard to imagine ovens being dug in a substrate which was flooded every high tide, and this requires a drop in sea level from Layer II time to at least 18 ins. below present level while these ovens were in use.

Layers IIIA and B are the surviving evidence of what is here called the First Lagoon edge occupation.

Layer 4

This is the "main layer" of previous excavations in paddock 1 which grades westward into the 'F' cockle layer of Wellman, thought by him to result from natural accumulation at the east end our track. Layer IV somewhat disturbed by ploughing, consists of an openwork pebbly gravel ("sea gravel") with fairly intense charcoal stain but few visible charcoal particles, scattered to abundant shell, and bone and stone flakes in varying abundance. The high pebble concentration of the layer suggests that extensive substrate excavation has been carried out, probably of the type represented by feature 162 beneath peg B4/T7, of unknown function which is responsible for the lens of almost clean gravel to the East, within Layer IV. The limited shell and bone content are the result of food consumption rather than preparation, as there are no ovens in the vicinity. Feature 19, a charcoally hollow, is probably a sunken hearth as it is too small to be an oven. As there are no ovenstones in this layer, probably most of the charcoal is the product of similar hearths. Towards the West, charcoal, artifacts and stone flakes decreased in abundance, and the shell and silt content increased as the character of the later changed to that of a shell dump. The silt matrix is similar to that being deposited at present by the floods of the Wairau River. There are several possible reasons for flood silts not being evident in earlier layers –

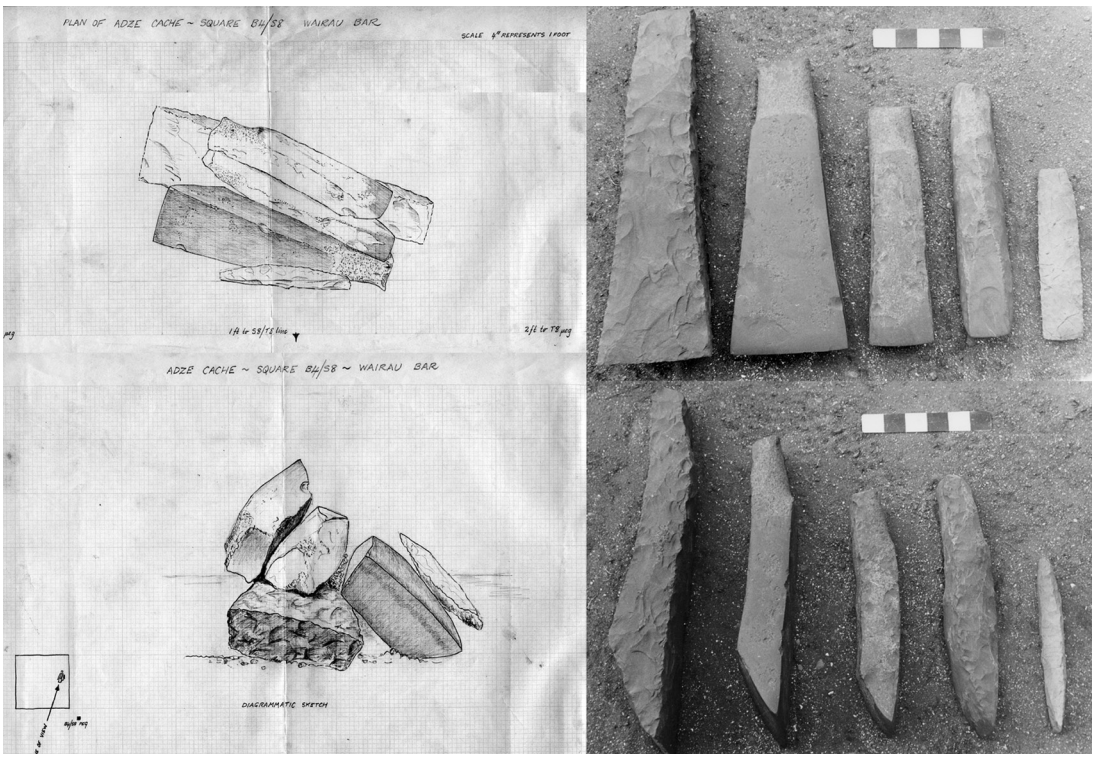

Figure 26. Cached adzes from square B4-S8, lagoon trench, 1964. The drawing of the adzes was done by Don Millar (photo, Canterbury Museum).

Figure 27. Excavation of the E2 trench adjacent to Burials 1-7 looking west (photo, Canterbury Museum)

(a) Relative sea level may have been raised at this time – thus bringing ground surface within reach of floods – this would account for the sudden incoming of silt and the abrupt change in the orientation and layout of the occupied area.

(b) Buildup of population locally and consequent deforestation of the Wairau Valley might have induced more serious flooding than in earlier times.

(c) Earlier silty layers may have been removed by lagoon erosion. Configuration of the layer seems to be against this.

The absence of charcoal except as a faint grey stain, is suggestive of lagoon washing as also are the predominantly overturned articles of the majority of fairly complete shells.

It is interesting to note that spines are the predominant type of fish bone collected in this half of the trench as contrasted with vertebra in the other half, which suggests that fish were cleaned and gutted in this shell dump area and consumed in the Eastern area.

Layer 5

Represents what is here called the 2nd lagoon edge occupation. The adjectives 1st and 2nd are not meant to imply the existence of completely separate occupations, with marked cultural differences, but merely state that there was a change in the character of occupation.

At the west end edge of the trench Layer IV grades upward indefinitely into a slightly gravelly silt devoid of occupation residue except for a very sparse scatter of fragmentary shell which may or may not be natural. The south wall sectioned and elongated lens of silty gravel within this Layer near the lagoon edge. Layer V is about 2 foot thick. It is still accumulating as shown by old-looking sometimes devitrified glass buried 5" down. The Wellington earthquake of 18? [sic] which

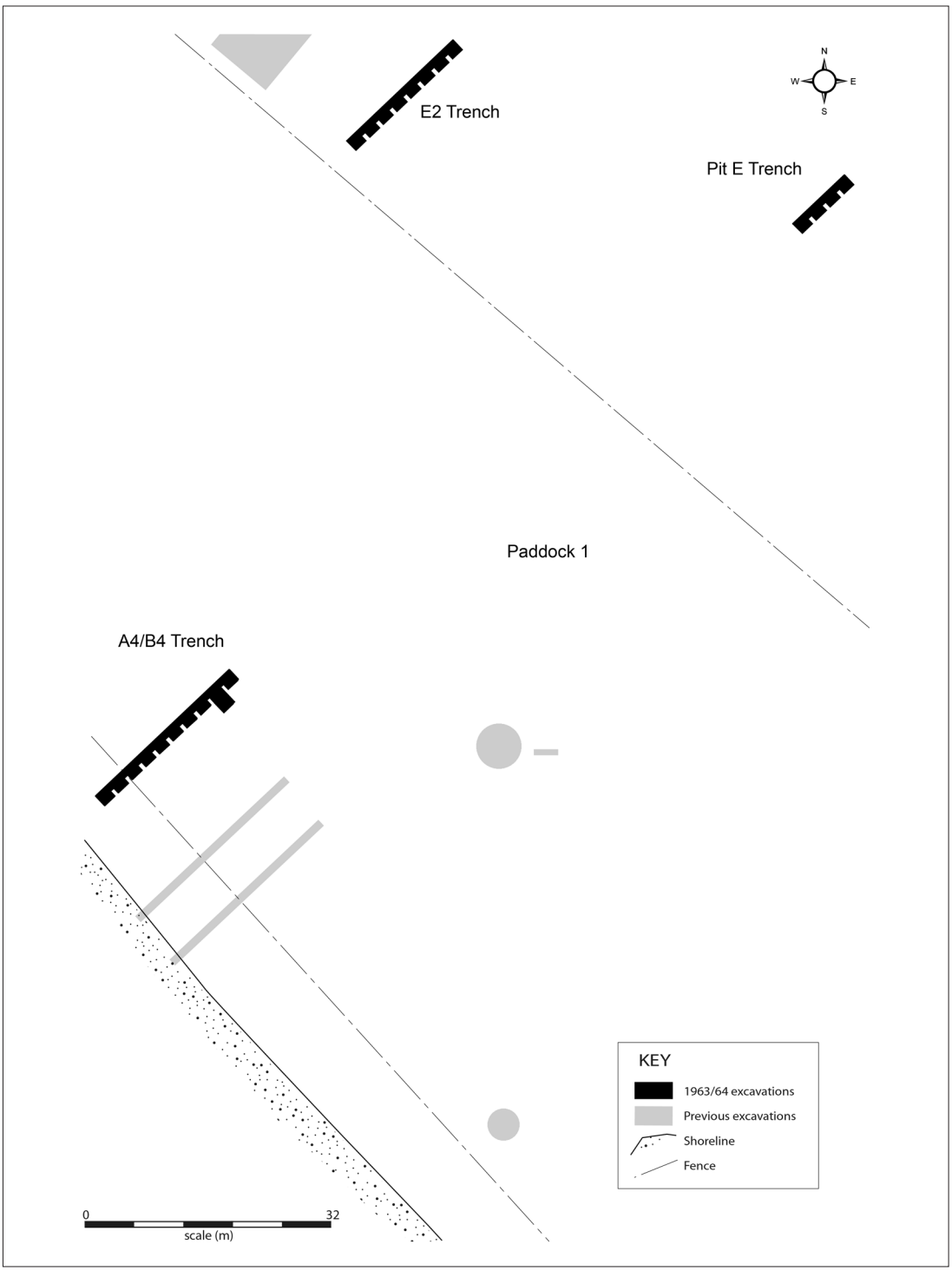

Figure 28. Locations of excavations carried out during 1963-64

lowered parts of the surrounding district by several feet appears to have left no perceptible mark in these deposits. East of A4/T8, the stratigraphy cannot be trusted as ploughing has been carried out, but it is evident that flood deposition becomes less and less important and ordinary soil-forming processes have been able to take their course to produce a yellow brown loam. The plough has mixed in occupation residue from the underlying layer. (Wilkes n.d.b., pp 3-6)

Wilkes encountered several features in the lagoon trench that included many post-holes, at least ten oven features, caches of artefacts including a cache of five adzes (Fig. 26), and a small hearth. Other artefacts were minnow lures, fish hooks, drill points, dentalium rings, cut lengths of bird bone and many flakes, particularly of obsidian and chert (Wilkes n.d.b., p 10). Faunal remains included seal and moa, some of which appeared to be cached, and a significant amount of moa egg shell.

The purpose of the trench beside Burials 1-7 was to clarify the stratigraphic relationships of the burials. This was not achieved because no further burials were encountered, but Wilkes was able to relate the stratigraphy of this part of the site to the lagoon trench, as follows:

Layer I

Consisted of sea gravels as for the A4-B4 trench.

Layer II

Consisted of very loose marine sand, which made examination of postholes difficult, but apparently was responsible for the good preservation of burials.

Layer III

Was similar in nature and origin to Layer 3A in the A4-B4 trench. In places lenses of clean Layer 1 derived sandy gravel lay on top of Layer 3 – these lenses are probably spoil from excavations elsewhere, probably for the burials.

Most of the intrusions that could be assigned to Layer 3 were again postholes – often with post mound fills of Layer 4 derivation, indicating the same sequence of events at in the A4-B4 trench. One post butt was found.

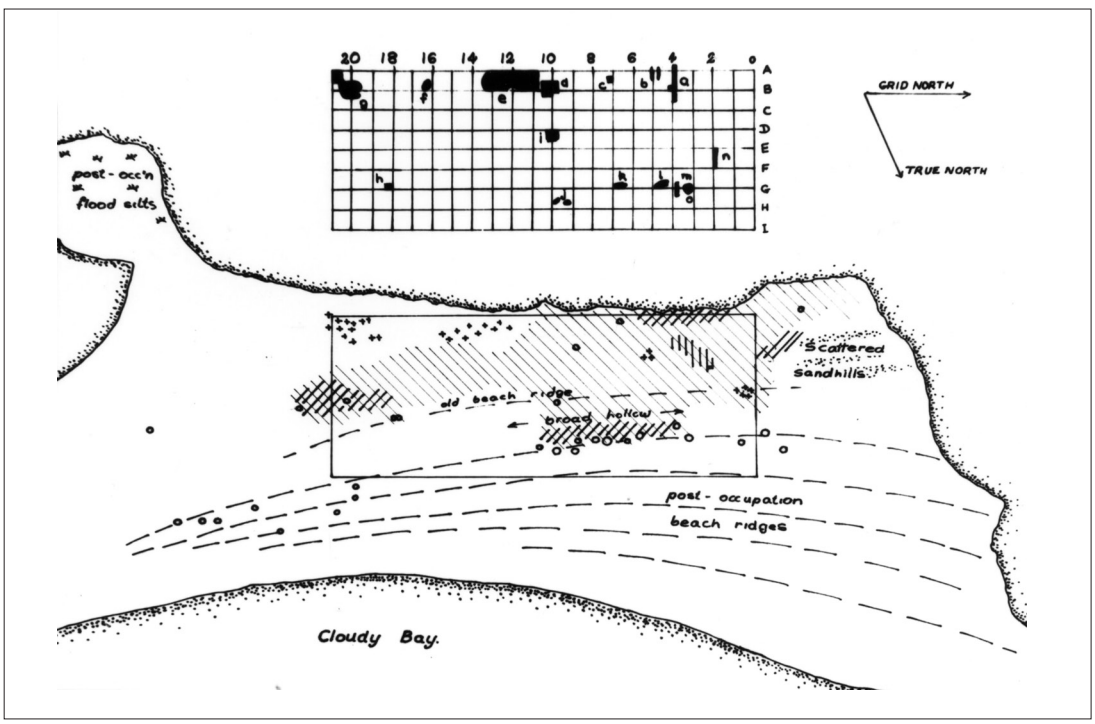

Figure 29. Plan of excavations by Wilkes (n.d.b). Note the absence of Burials 1-7 and 8-11 and that true north is closer to grid north than indicated on this plan.

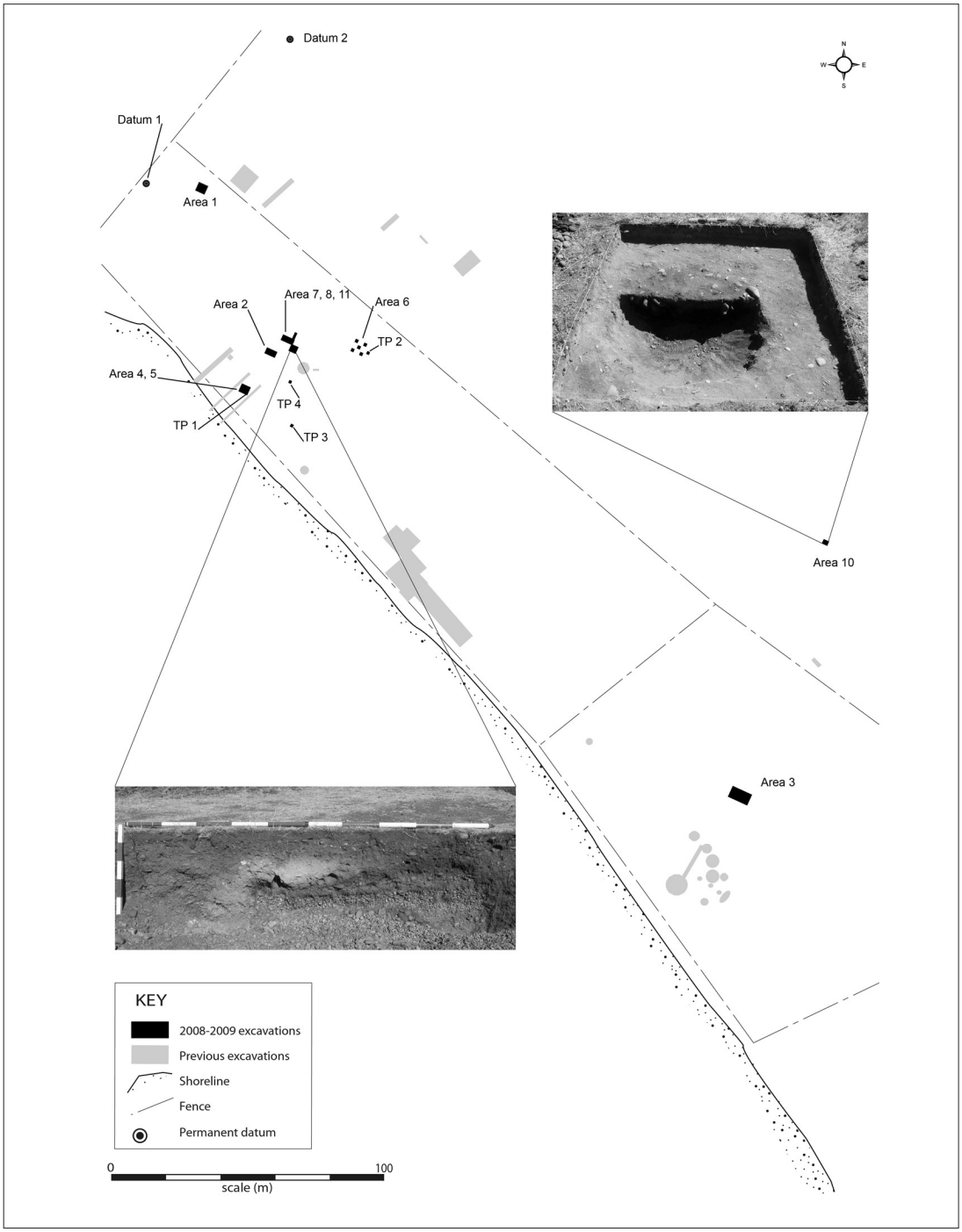

Figure 30. Locations of 2008 test pits and 2009 excavation areas. The photograph in the top right is of an oven with moa bone and the photo in the lower left is of an ashy hearth with a large post-hole visible at right. Datum 1 and Datum 2 are concrete markers placed in the ground by the University of Otago team in 2009 to facilitate orientation of future work to previous excavation grids.

Layer IV

Could be subdivided into upper and lower sub-layers. The lower sub-layer was well melanised, slightly gravelly sand containing lump charcoal, scattered shell and bone. Characteristically associated with this sub-layer were charcoal-lined oven hollows. These showed definite rims, steeps, flattish bottoms and intensely black fill with abundant lump charcoal. Ovenstones were often absent, or if present, were roughly laid on top of the charcoal. Presumably this method of use resulted in an inadequate air supply for the fire, thus giving rise to the abundant charcoal in the layer.

The upper part of Layer 4 consisted of somewhat less melanised, slightly gravelly sand, without charcoal lumps, but with an abundance of ovenstones. Generally the upper sub-layer contained less scattered midden material than the lower, but in places it gave way to lenses of fairly pure shell midden. Associated with the upper sub-layer were several stone-lined oven hollows – shallow saucer-shaped depressions with neatly laid ovenstones and most of the charcoal on top. It was notable that the shell lenses here contained a sizable proportion of mudsnail (Amphibola crenata) a species not favoured by modern Maoris, indicating possible depletion of other resources (Wilkes n.d.c., pp 3-4).

Layer 5

There was a very definite boundary between Layers IV and V, with very little midden of stone material present in Layer V. Layer V was a silty soil layer, accumulated since moa-hunter occupation and has not been disturbed by cultivation (Wilkes n.d.b., p 12).

Four squares were excavated across Pit E to determine whether the series of hollows were of natural or cultural origin. Evidence of fossicking at the eastern end of the pit disguised any stratigraphy but there was an occupation layer which Wilkes considered correlated with Layer 4 from E2 (Wilkes n.d.b., p 15). It was predominantly muddy gravel with some charcoal, oven stones and a very low concentration of stone flakes and bone.

Unlike previous archaeologists who worked at the site, Wilkes adopted a systematic sampling strategy to obtain midden for detailed analysis. The strategy involved taking column samples from every second baulk (these were 18 feet (5.5 m) apart) and samples were excavated from a rectangle that was two feet by one foot (0.6 x 0.9 m) and the samples themselves were collected every two inches vertically. A third of a cubic foot (~0.01 m2), therefore, was obtained for each of the column samples. These were sieved on site using a quarter- inch (0.64 cm) screen and the residue was retained. Bulk samples were also collected from every square at six-inch (15.2 cm) vertical intervals or where a stratigraphic change occurred. Wilkes then oversaw a detailed analysis of the midden samples and also of the large flake assemblage that was collected. The flakes were classified by stone type and whether there was any evidence of secondary working such as hammer dressing or polish. The distribution of these flakes was then investigated to determine any spatial patterning. A concentration of argillite flakes with evidence of hammer dressing or polish was identified in A4/X8 and Wilkes interpreted a concentration of flake tools of obsidian and chert as being consistent with the area's having been used for cooking rather than for habitation (Wilkes n.d.b., p 13).

Wilkes prepared a plan of excavations at the site (Fig. 29) for his paper. This plan confirms the location of some of the excavation areas described in this paper but it does not include the location of Burials 1-7 or 8-11. Conversely, it does indicate areas where excavation has occurred that we have not identified. Unfortunately there is no key on this plan. We have not included these additional areas since we have not been able to determine who excavated them, when they were excavated or what was found.

2008

The first archaeological work in some 44 years took place in October 2008 in response to an agreement between Canterbury Museum and Rangitane o Wairau to repatriate the human remains excavated from the site (Brooks *et al.* 2009). This work combined both invasive and non-invasive techniques.

The repatriation agreement between the museum and Rangitane and the approval of the New Zealand Historic Places Trust required that the proposed location of the reburial sites be investigated to ensure that any intact archaeological deposits disturbed during the process were properly documented and that no further burials were disturbed. To this end a geophysical survey was carried out that focused on the areas where burials

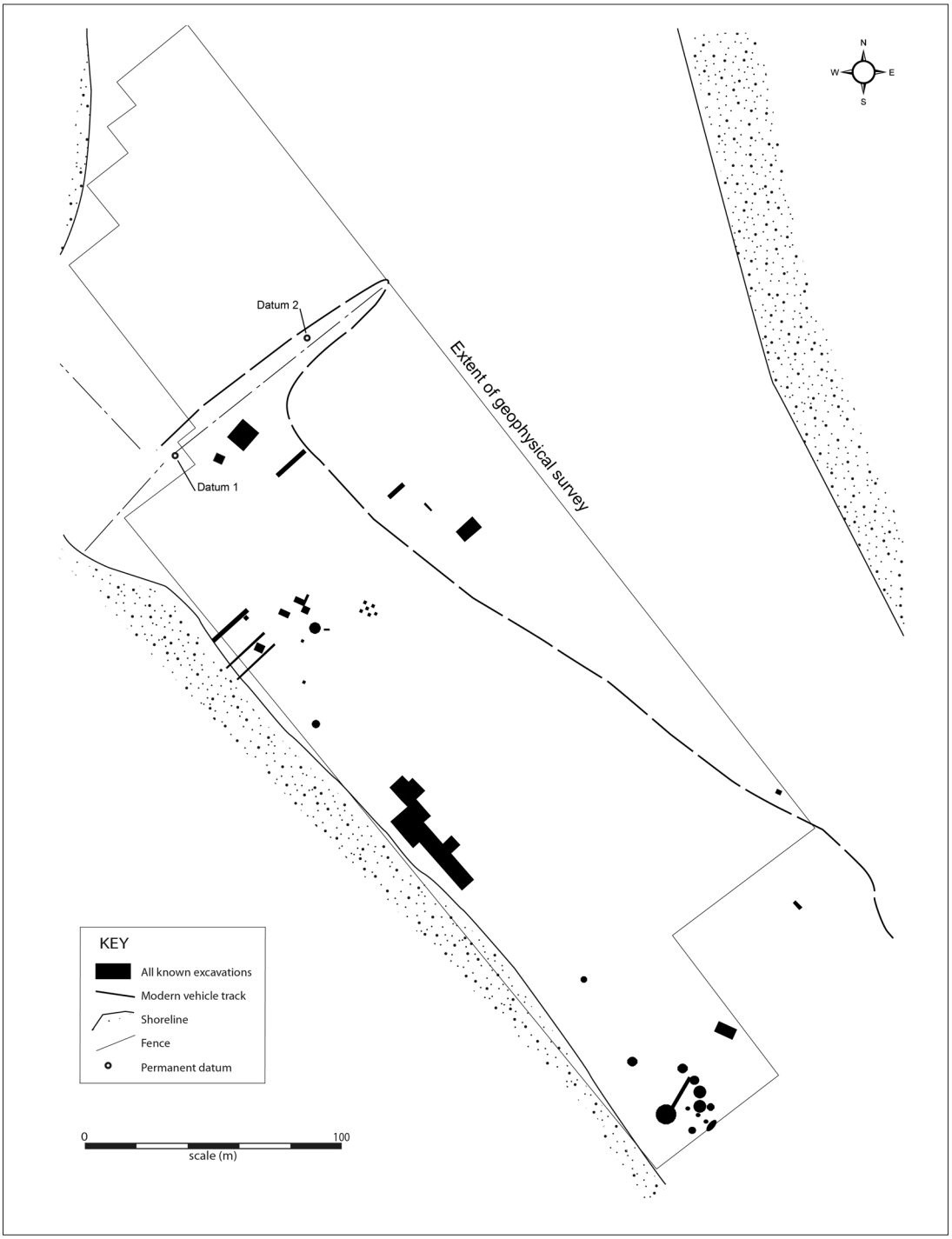

Figure 31. Locations of all of the identified excavation areas and the extent of the area of the geophysical survey. The fence line is the modern-day fence.

had been found and along the edge of the lagoon. This survey built on an earlier geophysical survey commissioned by the Department of Conservation of the area to the north of Paddock 1. This work was primarily focused on identifying the location of three nineteenth century hotel sites. The geophysical surveys employed a fluxgate gradiometer to identify areas of possible soil disturbance. Anomalies identified by the method were tested through the hand excavation of four 1 x 1 m test pits (Fig. 30). These test pits demonstrated that archaeological deposits were present beneath the plough zone and that there was considerable variability in the underlying natural stratigraphy. In some areas the archaeological remains rested on gritty sand and in others fine pea gravel. The test pits also confirmed that there is considerable variation in the stratigraphy of the site horizontally.

2009

A major archaeological excavation took place in January 2009 in preparation for the repatriation. This was carried out by Southern Pacific Archaeological Research from the University of Otago, under the direction of Walter and Jacomb in partnership with Rangitane o Wairau and Canterbury Museum. This work employed the most up-to-date excavation practices used at the site to date and resulted in the excavation of just under 80 m^2 (Brooks *et al.* 2009).

Several excavation areas were selected to provide for both repatriation and for targeted archaeological research. Areas 1, 2 and 3 were located as close as possible to the original burial areas based on the available information and where the geophysical survey did not show significant anomalies suggesting the presence of further graves. Area 1 was 5 x 5 m and contained a concentration of several thousand argillite flakes and pieces of debitage as well as adze roughouts and adze fragments, and obsidian and chert flake tools. A small intact basalt adze was also found at the base of a post-hole. Small fire features were also located here and over 200 drilled porpoise teeth and a moa bone necklace reel were located on the edge of one of these features.

Area 2 was 2 x 5 m and was located in close proximity to where Burials 8-11 are shown on the Duff plan (Fig. 3). A number of post-holes that may represent part of a small structure were investigated and a small concentration of argillite flakes and an adze roughout were found lying directly on a patch of dense cobbling. Area 3, in the southern burial area, was systematically test-pitted but the only archaeological evidence was a small fire feature containing fire cracked rock and charcoal.

Areas 4 and 5 were located where a test pit excavated in 2008 identified the presence of a deep oven and where a large circular feature was indicated in the geophysical survey results. A 3 x 3.5 m unit excavated here exposed a deep stone-lined feature that contained considerable amounts of fauna including moa and seal bone, other extinct bird remains, 1135 fragments of moa eggshell (Oskam *et al.* 2010, 2011) and several artefacts. Area 6 was test pitted in 2008 and appeared to contain a substantial amount of midden and oven remains and in 2009 was sampled in a chequer-board pattern to search for midden. Areas 7, 8 and 11 were positioned to investigate two small magnetic anomalies that may have been hearths and in a slightly flat terraced area. Two ashy hearth features were encountered here along with several large post-holes, although it was not possible to discern any meaningful pattern (Fig. 30).

Area 10 was selected to test the results of a second phase of geophysical survey. This area was 2 x 2 m and excavation revealed an oven feature (Fig. 30) with a moa skull and several vertebrae in position of articulation. This was located in an area that had never been ploughed and indicated that the site extends further towards the sea than previously thought.

Every artefact was recorded in three dimensions using a TPS1200 robotic total station which was also used to create a digital elevation model of the site. Substantial faunal samples were collected from well-provenanced contexts for detailed analysis and all features were also photographed and recorded on field plans.

DISCUSSION

Investigations at Wairau Bar have resulted in some of the most important discoveries in the history of New Zealand and Pacific archaeology. The tantalising possibility that this site may represent a first generation of Polynesian colonists (Higham *et al.* 1999) means that understanding its archaeology is crucial. Work on the site to date, for all of its shortcomings, has allowed the definition of a "Polynesian phase of Maori culture" (Duff 1950, 1956, 1977), contributed to our understanding

of human impacts on vulnerable faunal resources (Anderson 1989; Holdaway and Jacomb 2000; Scofield *et al*. 2003), provided a brief glimpse into health and disease (Houghton 1975; Buckley *et al*. 2010) and early burial practices (Duff 1950, 1956, 1977; Leach 1977) of these early New Zealanders, and refined the radiocarbon chronology of early settlement (Higham *et al*. 1999). The site has the potential to offer considerably more than this by providing us with information about life in one of New Zealand's first villages. There are several areas that require further research. Evidence for early structures remains elusive despite the discovery of post-holes and hearths by all of the researchers working at the site, the subsistence economy is poorly understood and the duration of occupation is yet to be resolved.

Perhaps it is because of the dramatic nature of the discoveries made at the site between 1939 and 1964 that the relatively mundane details of locational data, stratigraphy and faunal remains have been so overlooked. However, this information is essential if the site is ever to be interpreted properly. This paper summarises the available unpublished data, drawing on published material where necessary, in order to contextualise previous archaeological work at Wairau Bar while at the same time acknowledging the limitations of some of the data. Archaeological methods and recording techniques have changed dramatically since the first archaeological work at Wairau Bar and it has been possible to trace the increasing emphasis on detailed field recording through the history of the work of Canterbury Museum and others at the site. The changing research imperatives can also be traced through this history with the early emphasis on burials and artefacts, later shifting in the direction of structures, stratigraphy and midden analysis.

This review of the excavation data held by Canterbury Museum has allowed the development of the most detailed plan of excavations at the site currently possible. We acknowledge that the documentary archive at Canterbury Museum is not an exhaustive record of excavations at the site, but it is comprehensive enough to build a detailed excavation history of the site. The use of GIS to manage the data has allowed us to place the excavations within a real-world co-ordinate system and to extrapolate spatial information. For instance, it reveals that a minimum of 1687 m2 has been excavated since 1939. This does not include fossicked areas that were not possible to relocate because of gaps in the documentary record. It is therefore reasonable to estimate that at least 2000 m2 of this 11 ha site has been destroyed by excavation and fossicking. Ploughing has disturbed the top 200 mm or so of the site in former Paddocks 1 and 3 but all of the later excavations have confirmed the presence of significant intact archaeological deposits beneath the plough zone.

The advent of new techniques such as ancient DNA analysis, and new applications and understanding of trace elements and stable isotopes, will allow different questions to be asked of the site and material excavated in the past (eg Oskam *et al*. 2010, 2011). The full story of Polynesian settlement at Wairau Bar is far from being understood and the history of work documented in this paper will provide crucial detail to identify new research questions and design targeted excavation programmes.

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Wilkes O n.d.b Field Book

Wilkes O n.d.c Appendix. Subsequent work. Unpublished manuscript.

ENDNOTES

[1]Duff's early field notes suggest that he occasionally recorded directions without using a compass (eg Duff.n.d.a [FB1], p 56) and he acknowledges that there were errors in his early publications about the orientation of some of the burials (1956, p 58).

Appendix 1. Inventory of Wairau Bar documentation held at Canterbury Museum

Item	Description	Current Location
Lab Notes	Table showing measurements of Wairau Bar greywacke spalls	Box containing Owen Wilkes's Field notes
Lab Notes	Wairau Bar, S29/7, Flake counts, A4/B4 Trench, 1964	Box containing Owen Wilkes's Field notes
Lab Notes	Wairau Bar, S29/7, Artefact Provenience, "E2" Trench, 1964	Box containing Owen Wilkes's Field notes
Lab Notes	Wairau Bar, Concentration of Occupation Residues, 1964	Box containing Owen Wilkes's Field notes
Field book	Field notes by Owen Wilkes, Wairau Bar, pp 1035-1109	Owen Wilkes's Field notes, Waipara folder & Large Box 4 & 11
Correspondence	Letter from Janet Davidson to Charles Northcroft, dated 8 April 1965	Box labelled "Wairau Bar 1"
Handwritten Drafts	Folder labelled "Archaeology, M.S. for book". Contains handwritten drafts for newsletter and manuscripts	Box labelled "Wairau Bar 1"
Lab Notes	Graph of moa eggshell volumes from 1963/64	Box labelled "Wairau Bar 1"
Lab Notes	Various hand written notes on bone, butchering, midden, moa chicks, moa egg shell, 1964	Box labelled "Wairau Bar 1"
Field Notes	Wairau Midden Analysis, Bag Collections	Box labelled "Wairau Bar 1"
Draft Manuscript	Wairau Bar Manuscript, 30/11/66	Box labelled "Wairau Bar 1"
Lab Notes	Folder containing lab notes for midden analysis	Box labelled "Wairau Bar 1"
Field notes	Structures and Intrusions (midden), 1964	Box labelled "Wairau Bar 1"
Lab Notes	A4/S8. Distribution notes for bone, stone, shell etc., 1964	Box labelled "Wairau Bar 1"
Graph	Percentage Composition of Baulk Samples	Box labelled "Wairau Bar 1"
Field notes	"Wairau Samples"	Box labelled "Wairau Bar 1"
Stratigraphic Profile	Large sheet containing statigraphic profiles from several baulks, 1964	Box labelled "Wairau Bar 2"
Plan	Plan of early Wairau Bar excavation	Box labelled "Wairau Bar 2"
Stratigraphic Profile	Wairau - May 1959, Burial 41	Box labelled "Wairau Bar 2"
Plan, 1943	Plan of Moa-Hunter Camp - Wairau, September 1943	Box labelled "Wairau Bar 2"
Plan, 1959	Wairau Bar S29/7. Field plan of excavations carried out in 1955, 1956 and 1959	Box labelled "Wairau Bar 2"
Graph	Wairau Bar, 1963-64. Concentration of occupation residues.	Box labelled "Wairau Bar 2"
Stratigraphic Profile	Large sheet containing stratigraphic profiles from several baulks, 1964	Box labelled "Wairau Bar 2"
Aerial Photographs	Aerial photographs from the Wairau/Marlborough Area	Box labelled "Wairau Bar 2"
Burial Drawing	Illustration, Burial 41	Box labelled "Wairau Bar 2"
Burial Drawings	Illustrations, Burials 41, 42, 44	Box labelled "Wairau Bar 2"

Stratigraphic Profile	North Face of Trench Excavated East-West Taru Pit, "E". Wairau Bar, Jan '64	Box labelled "Wairau Bar 2"
Stratigraphic Profile	Stratigraphic drawings, Wairau Bar, May 1959	Box labelled "Wairau Bar 3"
Stratigraphy	Unlabeled, undated (1963), stratigraphic drawing of baulks: 04/Y8, 04/Z8, A4/58, A4/T8, A4/U8, A4/V8, A4/W8, A4/X8, A4/Y8, A4/Z8, B4/58, B4/T8, B4/U8	Box labelled "Wairau Bar 3"
Stratigraphic Profile	Stratigraphic drawing of north face of E2 trench, 1964	Box labelled "Wairau Bar 3"
Field Book	Wilkes's field book with notes of structures	Box labelled "Wairau Bar 3"
Field Book	Wilkes's field book with notes of 2nd Sections	Box labelled "Wairau Bar 3"
Field Book	Wilkes's field book with notes of squares. Wairau, 1964	Box labelled "Wairau Bar 3"
Field Notes	Folder titled "Wairau Bar Field Methods 1964", with information about the excavation procedures etc.	Box labelled "Wairau Bar 3"
Field Notes	Wairau Bar Artefact Record and Field notes. 11th-23rd May 1959	Box labelled "Wairau Bar 3"
Field Notes	Notes on Wairau Burials	Box labelled "Wairau Bar 3"
Plan	Wairau Bar, Artefact Provenance, 04-A4-B4 Trench	Box labelled "Wairau Bar 3"
Plan	Wairau Bar Tracing, A10 dig, 1955-59. Intrusions etc.	Box labelled "Wairau Bar 3"
Manuscript Notes	Moa-hunter period. Notes and correspondence relating to the 2nd edition (1956)	Box labelled "Wairau Bar 3"
Photograph	Black and White photograph of Lorraine A'Court and Rosaline Lowlent. Wairau Bar. Taken 3.1.64.	Box labelled "Wairau Bar 3"
Misc	Wairau Bar, Miscellaneous graphs, plans & stratigraphy	Box labelled "Wairau Bar 3"
Photographs	Wairau Bar, May 1964, Prints, negs, including adze cache	Box labelled "Wairau Bar 3"
Photographs	Wairau Bar, photographs and negatives. Jan 1986	Box labelled "Wairau Bar 3"
Museum Notes	List of Wairau Bar material on loan	Box labelled "Wairau Bar 3"
Field Photographs and Drawings	Field photographs and drawings, including adze cache	Box labelled "Wairau Bar 3"
Notes on Artefact Analysis	Folder containing notes on Wairau artefact analysis, 1964	Box labelled "Wairau Bar 3"
Notes	Folder containing notes on stratigraphic methods	Box labelled "Wairau Bar 3"
Photograph	Black and white photograph of Burial 39, Wairau Bar	Box labelled "Wairau Bar 3"
Correspondence	Folder containing misc correspondence relating to Moa-Hunter Period (Book), going to press 1950/1956	Box labelled "Wairau Bar 3"
Excavation Organisation	Folder containing misc notes on excavation preparation, including food, transport, packing list, participant contact details	Box labelled "Wairau Bar 3"
Correspondence	Folder containing correspondence relating to Wairau Bar	Box labelled "Wairau Bar 3"
Newspaper Clippings	Folder containing newspaper cuttings collected by R.S Duff, miscellaneous articles, newspaper photos, Control of the	Box labelled "Wairau Bar 3"

Cont.	Bolder Bank, articles by W.J. Elvy, excavation details and results.	
Manuscript	Trotter MM (1973) Further excavation at Wairau Bar, South Island, New Zealand	Box labelled "Wairau Bar 3"
Manuscript	Wilkes O n.d. Further work at Wairau Bar. Canterbury Museum	Box labelled "Wairau Bar 3"
Residue Analysis	Folder containing notes related to Wairau Bar residue analysis from 1963/64 excavation	Box labelled "Wairau Bar 3"
Photos and Negatives	Envelope containing photos and negatives from Wairau Bar excavations, 1964, 1959, 1950	Box labelled "Wairau Bar 3"
Stratigraphy	Stratigraphic drawing of E2 baulk, 1964	Box labelled "Wairau Bar 3"
Manuscript	Trotter MM (1975) Radiocarbon date for Wairau Bar and Wakanui for New Zealand Archaeological Association Newsletter 18:90-91.	Box labelled "Wairau Bar 3"
Correspondence	Folder containing correspondence relating to manuscript titled "Further excavations at Wairau Bar", MMT	Box labelled "Wairau Bar 3"
Manuscript Drafts	Folder containing notes and manuscript drafts for "Further excavations at Wairau Bar" for Asian Perspectives	Box labelled "Wairau Bar 3"
Plan	Plan of Squares excavated in Blocks O4, A4 and B4, Wairau Bar, January 1964	Box labelled "Wairau Bar 3"
Plan	Plan of Moa-Hunter Camp - Wairau, September 1943	Box labelled "Wairau Bar 3"
Manuscript Drafts	Michael Trotter's manuscript drafts	Box labelled "Wairau Bar 3"
Notes	Folder containing notes relating to Wairau Bar, 1959 Excavation	Box labelled "Wairau Bar 3"
Valuation	Folder containing Wairau Bar valuation and catalogue 1953, including letter which discusses the scientific value of Wairau Bar worth 50% of the total valuation	Box labelled "Wairau Bar 3"
Manuscript Notes	Wairau Bar manuscript, Owen Wilkes' notes	Box labelled "Wairau Bar 3"
Sketch book	Sketch book of Beatrice Walton, Feb 23rd, 1984. Contains artefact drawings	Box labelled "Wairau Bar 3"
Notes on Stratigraphy and Features	Folder containing notes on Wairau Bar stratigraphy and structures, Owen Wilkes.	Box labelled "Wairau Bar 3"
Notes on Plans and Sections	Folder containing notes on Wairau Bar plans and sections	Box labelled "Wairau Bar 3"
Correspondence	Folder containing correspondence relating to C14 dates, and cranial measurements	Box labelled "Wairau Bar 3"
Artefact Catalogue List	Wairau Bar Artefact Catalogue	Box labelled "Wairau Bar 3"
Colour Slides	Colour slides from Wairau Bar, 1963	Box labelled "Wairau Bar 3"
Negatives	Negatives from Wairau Bar, Jan 1964	Box labelled "Wairau Bar 3"
Photographs	Black and white photographs of people at Wairau Bar excavation in 1962. Taken by Tony and Lorna Howell	Box labelled "Wairau Bar 3"

Photographs and Negatives	Black and white photographs of Wairau Bar excavation. Jan 1964 taken by Ian Duff.	Box labelled "Wairau Bar 3"
Reprint	Reprint: Trotter MM (1973) Further excavation at Wairau Bar, South Island, New Zealand. Asian Perspectives 19:75-80	Box labelled "Wairau Bar 3"
Field and Artefact Drawings	Folder containing Wairau Bar, misc field drawings, Roger Duff	Box labelled "Wairau Bar 3"
Photographs	Folder containing photographs from Wairau Bar, 1964	Box labelled "Wairau Bar 3"
Correspondence	Folder containing Wairau Bar, miscellaneous correspondence, arranged by date	Box labelled "Wairau Bar 3"
Notes from Eyles Collection	Folder containing details of Eyles collection, Wairau Catalogue	Box labelled "Wairau Bar 3"
Artefact Provenance Graph	Artefact Provenance Graph of "E2" Trench. Wairau Bar, S29/7. Drawn by Owen Wilkes, April 1964	Box labelled "Wairau Bar 3"
Stratigraphic Profile	Stratigraphy of E2/UA Baulk, E face, 1964	Box labelled "Wairau Bar 3"
Bag sorting list	Basic bag sorting list	Box labelled "Wairau Bar 3"
Large Photograph	Large black and white photograph of Burial 39, adzes removed, 1956	Box labelled "Wairau Bar 3"
Large Photograph	Large black and white photograph of Burial 39, adzes attached to photograph, 1956	Box labelled "Wairau Bar 3"
Plan	Plan View of Squares A5/Z1 + A4/Z8, 1964	Box labelled "Wairau Bar 3"
Line drawings	Large blue folder containing line drawings for "Moa Hunter Period" publication	Box labelled "Wairau Bar 3"
Plan drawing	Plan drawing, Wairau Bar, Block A4, SQ 2.8, Detail SE corner to show Moa "Oven", 1964	Box labelled "Wairau Bar 3"
Stratigraphic Profile	Stratigraphic drawing of "Pit E", Wairau Bar, 1964	Box labelled "Wairau Bar 3"
Graph	Graph showing obsidian distribution of Green-Grey obsidian, Quantities at various depths. Trench E2, Trench A4, 1964	Box labelled "Wairau Bar 3"
Duff Field Book	Field Book 2	Ethnology 6 10 Box 16.49
Duff Field Book	Field Book 3	Ethnology 6 10 Box 16.50
Duff Field Book	Field Book 9 and 9A	Ethnology 6 10 Box 17.57
Duff Field Book	Field Book 10	Ethnology 6 10 Box 17.59

Appendix 2. Degree of confidence of location of each excavation unit identified

Excavation Area	Year	<5 m	5-10 m	10-20 m	Dimensions known
Burials 1-7	1939-42		X		
Trench 1	1942			X	X
Trench 2	1943			X	X
Burials 8-11	1943			X	
Burials 12-13	1943			X	
Burial 14	1943			X	
Burial 15	1943			X	
Burials 16-18	1943			X	
Burial 19	1943			X	
Burial 20	1943			X	
Eyles's Hollow	1943-44			X	
Trench 3	1943			X	X
Trench 4	1944			X	X
Trench 5	1945			X	X
Burial 21				X	
Trench 6	1945		X		X
Burials 22-29				X	X
Quadrate XI 1	1950		X		X
Quadrate XI 2	1950		X		X
A10/B10	1955		X		X
A10/B11	1959		X		X
TS1 (Wellman)	1959		X		X
TS 2	1959		X		X
A4-B4 Trench	1963-4		X		X
E2 Trench	1963-4		X		X
F5 Trench	1963-4		X		X
TPs 1-4	2008	X			X
Area 1	2009	X			X
Area 2	2009	X			X
Area 3	2009	X			X
Area 4/5	2009	X			X
Area 10	2009	X			X
Areas 7, 8, 11	2009	X			X

Appendix 3. Timeline of excavations at Wairau Bar

Date	
1920s	Paddock ploughed. Large bones found that were thought to be cattle but probably moa. Fossickers active.
Jan 1939	Jim Eyles discovered Burial 1.
March 1942	Eyles excavated Burial 2.
	Roger Duff visited site.
April 1942	Eyles located Burial 3.
May 1942	Eyles located Burials 4. Duff returned and Burials 5, 6, 7 excavated. Duff assisted by Eyles and Baughan Wisely.
June 1942	Eyles and Wisely excavated one of the hollows on the seaward ridge (G on Duff plan).
1942	Paddock reploughed and many artefacts surface collected.
Jan 1943	Eyles excavated possible house site on lagoon edge (Point 8 Duff plan).
Feb 1943	Duff returned with G.E. Anstice. Trench across two small ovens excavated (location unknown). Trench on ridge (Point F on Duff plan) excavated.
April 1943	Paddock reploughed with ploughshare set at 9 inches to a foot. Burials 8-11 located.
Aug 1943	Paddock 3 ploughed and Burials 12-16 located.
Dec 1943	Duff and Eyles located and excavated Burials 17-20. They also carried out further excavation of Eyles possible house site.
Jan 1944	Duff and Eyles excavated a trench near the lagoon edge (Point 7 on Duff plan).
July 1944	Eyles told Duff he had been doing further work near Point 8.
Oct 1944	Eyles told Duff he had excavated Burial 21. Duff and Eyles excavated trench through two adjoining hollows on seaward ridge (Point 27 on Duff plan).
May 1945	Duff excavated trench through midden, location unknown.
August 1945	Eyles dug near "Pit 4".
Sept 1945	Paddock 3 ploughed again. Burials 22-30 located and excavated by Eyles.
1947	Eyles excavated midden-rich area, location unknown.
Sept 1949	Duff visited site with W.J. Phillips and T. Barrow. Noted evidence of extensive digging by Eyles beside lagoon in Paddock 1. Duff extended this area.
Jan 1950	Chain grid established. Duff and Eyles excavated Quadrate XI, the first formal excavation unit at the site.
Jan 1950	Eyles excavated Quadrate XII.3.
Dec 1950- Jan 1951	Eyles and volunteers excavated in southern burial area. Located seven more burials.
Dec 1955-Jan 1956	Duff and Robert Bell excavated units in A10, A11, B10 and B11 on chain grid. Burial 40 found. Eyles located Burials 37 and 38. Eyles and Michael Trotter excavated Burial 39.
May 1959	Duff returned with volunteers from the Canterbury Museum Archaeological Society (CMAS) and extended 1955 excavation area as well as excavating an area south of Burials 39 and 40. Eyles reported to Duff he had carried out his own excavations since 1956 and had found Burials 41-43. Wellman excavated two trenches on lagoon edge.

Dec 1963-Jan 1964	Owen Wilkes led a CMAS team to investigate stratigraphy. Excavated a trench from the lagoon edge, another trench adjacent to Burials 1-7, and a small trench through one of the seaward ridge hollows.
Oct 2008	University of Otago carried out geophysical survey and excavated four test pits to ground truth geophysics.
Jan 2009	University of Otago team excavated five areas (80 m^2) to prepare for repatriation of koiwi and to carry out research. Further geophysical survey carried out.

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3

A twitch in time: tibial spiracles have a role in an autotomous defence mechanism in harvestmen

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ABSTRACT

The literature on harvestmen leg autotomy and the accessory tibial spiracles found on all four pairs of walking legs of phalangioids is synthesized and it is suggested that although the spiracles are likely to have evolved as an additional oxygen supply for long legs, their presence paved the way for the evolution of a post-autotomy defence mechanism. After autotomy, the leg rhythmically flexes and by being a distraction to a predator, may increase the chances of the harvestmen surviving the encounter. The tibial spiracles supply oxygen to the flexing muscles in the autotomised leg and dramatically increase the length of time that it will twitch. The structure of the accessory spiracles is examined for the first time with a scanning electron microscope using *Pantopsalis luna* (Forster 1944) (Monoscutidae), an endemic phalangioid harvestmen found on the west coast of the South Island of New Zealand.

KEYWORDS

harvestmen; tibial spiracles; autotomy; defence mechanism

INTRODUCTION

One of the most distinctive features of many species of harvestmen is their exceptionally long legs attached to a comparatively small body. Recent research on harvestmen fossils using high-resolution X-ray micro-tomography has shown that harvestmen have had long legs for over 300 million years (Garwood et al. 2011). One explanation for the evolution of long legs in this group is that they allow the harvestmen to move rapidly in complex habitats (Sensenig and Shultz 2007). Long-legged harvestmen satisfy the predictions of the SLIP (spring-loaded inverted-pendulum) model that predicts that as the centre of mass (the body), which is suspended by the legs, drops due to gravity, elastic elements in the legs are deformed and as they recoil, the centre of mass moves upwards, and forms the basis for fast and efficient running (Sensenig and Shultz 2007).

Harvestmen are tracheate arthropods. They obtain oxygen for respiration through a pair of spiracles located on the second opisthosomal sternite, posterior to the coxae of the fourth pair of legs (Hofer et al. 2000). However, within the monophyletic Suborder Eupnoi, the Superfamily Phalangioidea are united by a single synapomorphy, which is a pair of accessory non-occludable spiracles, found proximally and distally on the tibia of all four pairs of walking legs (Shultz 1998; Hofer et al. 2000; Giribet et al. 2002). Many phalangioids have

very long legs and the tibial spiracles are an additional oxygen supply for the two lateral branches of tracheae that supply the legs (Shultz and Pinto-da-Rocha 2007; Wasgestian-Schaller 1967). Long-legged phalangioids can also autotomise their legs if they are grabbed by a predator, or become trapped (Kaestner 1968; Eisner et al. 1978; Flemming et al. 2007).

In this paper, I suggest that accessory spiracles in the phalangioids were essential to the evolution of an autotomous mechanism (leg flexion) that increases the effectiveness of the autotomized leg as a distraction to a predator while the harvestmen escapes (Eisner et al. 1978). The structure of the accessory spiracles is examined for the first time with a scanning electron microscope using *Pantopsalis luna* (Forster, 1944) (Monoscutidae), an endemic phalangioid harvestmen found on the west coast of the South Island of New Zealand.

THE ROLE OF TIBIAL SPIRACLES IN POST-AUTOTOMY LEG FLEXION

The accessory tibial spiracles of phalangioids are an additional oxygen supply for distal leg segments that are prone to low oxygen supply and high carbon dioxide levels (Wasgestian-Schaller 1967; Shultz and Pinto-da-Rocha 2007). A large trachea that supplies oxygen mainly to the leg proximal to the mid-tibial region is connected to the proximal spiracle, while a smaller trachea is connected to the distal spiracle and mainly supplies oxygen to distal leg segments (Hansen 1893; Loman 1896; Wasgestian-Schaller 1967). Wasgestian-Schaller (1967) showed that sealing the spiracles of an attached leg causes the leg to develop a distorted posture, suggesting that the spiracles evolved in response to the oxygen demands of elongated legs.

Figure 1. Male *Pantopsalis luna* with left leg 3 and right leg 4 missing. The coxa (proximal) and the trochanter (distal) are the two leg segments which remain attached to the body after the proximal femur is severed and these segments can be seen at the site of the missing right leg 4.

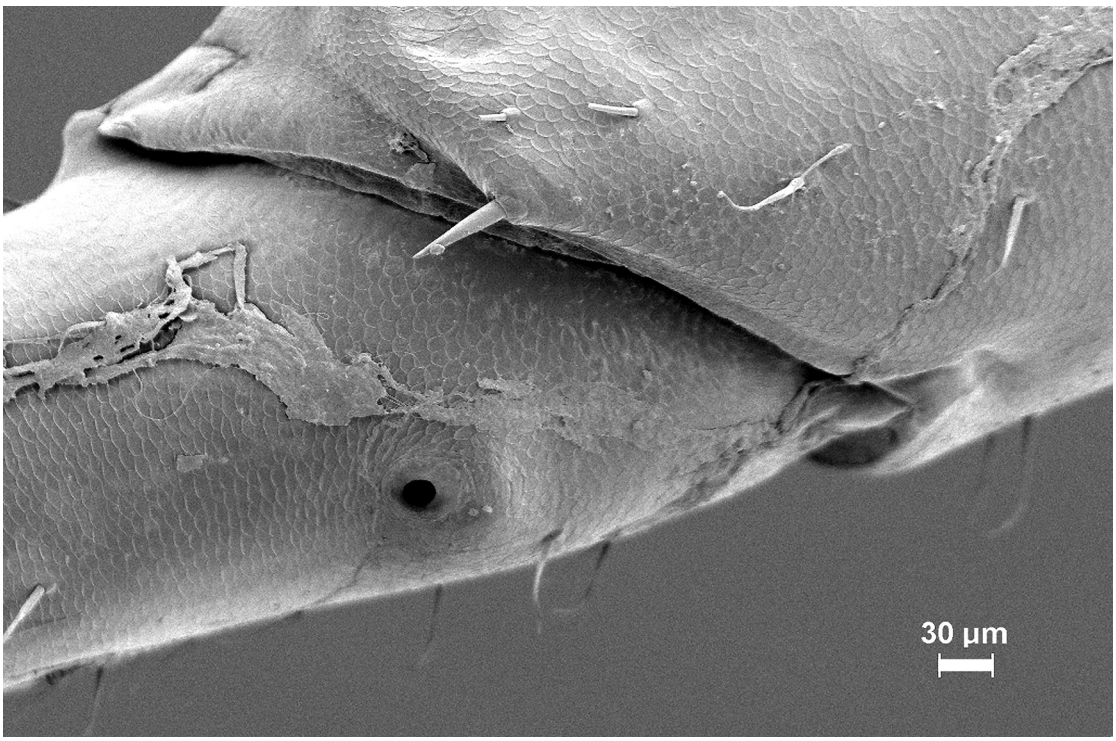

Figure 2. Proximal tibial spiracle of leg 1 of *Pantopsalis luna,* located just below the patella

Autotomy (self-amputation) is a common anti-predator defence mechanism among invertebrates (see review by Fleming et al. 2007). The costs of losing the appendage are outweighed by the benefits of escaping a potentially fatal encounter with a predator (Edmunds 1974). Comstock (1920) wrote that in the long-legged harvestmen, "the body is fenced in, as it were, by a hedge of legs", which are likely to be an easier target for a predator, than the body itself (Guffey 1999). Leg autotomy has been recorded in some long legged species in the Suborder Dyspnoi, such as the nemastomatid *Nemastoma lugubre bimaculatum* (Fabricius, 1775) (Immel 1954), although it is more common among the long-legged Eupnoi (Eisner et al. 1978; Gnaspini and Hara 2007). For example, nearly 50% of juveniles and adults of the sclerosomatid *Leiobunum verrucosum* (Wood, 1868) and *Leiobunum vittatum* (Say, 1821) were missing at least one leg (Guffey 1999). In a study on the consequences of autotomy on the development of sexually selected chelicerae in male *Pantopsalis luna*, over 60% were missing at least one leg (SD Pollard, unpublished data). The leg can be easily autotomized because there is a circumferential line of weakness near the base of the femur. If the leg is grabbed or becomes trapped, the harvestmen can break this line of weakness and the leg becomes detached from the body. Following autotomy, muscles within the trochanter contract and pull the proximal margin of the femur and the arthrodial membranes of the trochanter-femur joint into the trochanter to seal the wound (Shultz 2000). Unlike the legs of spiders (Foelix 1996), the lost legs of harvestmen are not regenerated (Kaestner 1968).

Once a leg is severed, it appears to burst into life, twitching like the rhythmic contractions of muscles in the autotomised tails of some species of lizard. While spinal networks control the movement of detached lizard tails (Arnold 1988; Cooper et al; 2004), the twitching leg of the harvestmen is not controlled by any part of the central nervous system (Miller 1977, 1980). Instead, following autotomy, two flexor motor axons that each innervate the flexor muscles of the femoro-patellar and tibia-bitarsal joints become rhythmically active, and

function as neurogenic pacemakers (Miller 1977, 1980). Flexion of the joints is produced by a short burst of spikes (action potentials) from each axon. The axons fire independently of each other and are not influenced by proprioception (Miller 1977, 1980). The antagonistic extensor muscles at the femoro-patellar joint are not involved and the tibial-bitarsus joint does not have extensor muscles. Instead, transarticular elastic sclerites cause this joint to return to its pre-flexed position (Shultz 2000). The pacemakers are located in the proximal part of the femur (Miller 1977, 1980) but it is not known whether interneurons synapsing with the motor axons at this site are responsible for the bursting activity or whether it is some intrinsic property of the two motor axons. It has been suggested that the pacemakers may be part of a central pattern generator that controls some rhythmic motor behaviour in attached legs, as is commonly seen in arthropods. (Miller 1977, 1980; Brunn et al. 1998; Tohidi and Nadim 2009). Depending on the species of harvestmen, the automised leg twitches approximately 78 times a minute for a period of between one and 60 minutes (Miller 1977, 1980; Roth and Roth 1984). The tibial spiracles are an essential supply of oxygen for the flexing joints, as the tracheae in the leg are no longer attached to the spiracles on the opisthosoma. If the spiracles of a detached leg of *Phalangium opilio* Linnaeus, 1758 are sealed, the leg only twitches for around 20 seconds, instead of approximately 20 minutes when the spiracles are unsealed (Wasgestian-Schaller 1967). This 60-fold time difference clearly shows the roll the tibial spiracles have in influencing how long an automised leg will twitch. The autotomised legs of the stick insect *Cuniculina impigra* (Brunner, 1907) also flex rhythmically at the femoro-patellar joint because of a burst of spikes from a single flexor motor axon. However, the duration of the flexing is almost always only for a few minutes and it has been suggested that this is because there is no source of oxygen to the leg muscles after autotomy (Bassler 1984). The long legged pholcid spider, *Holocnemus pluchei* (Scopdi, 1763) can autotomise its legs, but the detached legs only twitch for a few seconds (Johnson and Jakob 1999), possibly also because of a lack of oxygen.

Figure 3. Proximal tibial spiracle of leg 1 of Pantopsalis luna showing grate of spines guarding the base of spiracle chamber and the trachea

While injury current is known to produce bursting in severed nerves (Schmidt and Grund 2003), as happens during autotomy, the duration of the flexing activity is unique among harvestmen and parallels that found in the autotomised tails of lizards (Arnold 1988; Cooper et al. 2004). While autotomy allows an animal to escape the grip of a predator, the added distraction of having the detached appendage move, may increase the chances of surviving the encounter (Eisner et al. 1978; Gnaspini and Hara 2007). One scenario for the evolution of the role the two flexor motor axons have in post-autotomy flexing is that when the leg is attached they are part of a central pattern generator whose oscillatory activity comes from the co-ordinated firing of pacemaker neurons and forms the basis for rhythmic motor behaviour (Brunn 1998; Brunn and Heuer 1998; Ramirez et al. 2004; Tohidi and Nadim 2009).

Following autotomy, all communication with the central nervous system is lost and axotomy results in the rhythmic flexor activity seen in the severed leg, which is also fuelled by an oxygen supply via the accessory spiracles. Initially, in the evolution of this autotomous defence mechanism, there is likely to have been variation in how long rhythmic flexor activity continued in severed legs. If the length of time that the autotomised leg flexed was correlated with the likelihood that a harvestmen would survive the encounter with a predator, then natural selection would favour those individuals whose autotomised legs flexed long enough for them to escape. It appears that the evolution of long legs in harvestmen, coupled with leg autotomy and accessory tibial spiracles, paved the way for the evolution of an autotomous defence mechanism – post-autotomy leg flexion.

TIBIAL SPIRACLES IN *Pantopsalis luna*

The only recent published details of the structure of the tibial spiracles of harvestmen are from a redrawn figure in Schultz and Pinto-da-Rocha (2007) from Wasgestian-Schaller (1967) of a proximal tibial spiracle of the sclerosomatid *Cosmobunus granarius* (Lucas, 1846). The drawing shows how the accessory tracheae are guarded by marginal hair-like fimbrae and that the walls of the spiracle atrium have thorn-like projections.

In *Pantopsalis luna*, below the opening on the convex spiracle is a wide atrial chamber with a grate of spines guarding the connection between the base of the chamber and the trachea (Figs 1 and 2). There are no thorn-like projections on the walls of the spiral atrium. It seems likely that just as there is considerable variation in the morphology of the two spiracles found on the body of harvestmen (Hunt 1990; Taylor 2011), there will be similar variation in the morphology of the tibial spiracles in phalangioids. The tibial spiracles are non-occludable and are susceptible to respiratory water loss (Pulz 1987; Schmitz 2005), which probably explains why so many long legged harvestmen are found in humid habitats. The secondary loss of tibial spiracles in two New Zealand eupnoids (*Templar* and *Monoscutum* – see Taylor 2011) may have been in response to respiratory water loss.

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4

The invisible knight: a journey of discovery

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ABSTRACT

For nearly one hundred years, Canterbury Museum exhibited what appeared to be a facsimile suit of German plate armour of the fifteenth century. However, the true function of this artefact was never revealed. No records showed its provenance or manufacturer.

Over a period of some thirty years, with the assistance of scholars, curators, conservators and makers of reproduction armour, in countries as distant from New Zealand as Germany, Denmark and America, the purpose and origin of this 'suit of armour' has been established. The journey has been as interesting as the discoveries, and highlights the often-serendipitous aspects of research. The account also illustrates how rapidly-evolving information and communication technology over this period has enhanced the ability to access obscure resources, thus making easier the research component of the multi-faceted work traditionally undertaken by curators at Canterbury Museum.

Fascinating links have been unearthed to the American newspaper tycoon William Randolph Hearst; the ancient German noble family of Hohenzollern; Lorenz Helmschmied, one of the greatest Augsburg armourers of the fifteenth century; the international exhibitions of Art and Industry of the nineteenth century; Freemasonry in Norway and Germany; and Canterbury Museum's first director Sir Julius von Haast. Haast's interest in acquiring material such as reproductions of tenth to sixteenth century European ivories, ceramics, glass and artistic metalwork, "paintings in Fresco, Altar-pieces, and other paintings of Christian subjects, by the old Italian and German masters",[1] as well as genuine medals of the Italian Renaissance and, almost certainly, this suit of armour, is considered in the context of the nineteenth century romanticised passion for all things 'Gothic'.

KEYWORDS

Armour; hall stove; Mägdesprung; Ilsenburg; William Randolph Hearst; Sigmaringen; Hohenzollern; Lorenz Helmschmied; Julius Von Haast; Canterbury Museum

BACKGROUND

For nearly one hundred years Canterbury Museum proudly exhibited a facsimile full suit of German Gothic plate armour (Fig. 1). This popular exhibit was displayed for lengthy periods in at least two major galleries: the second floor Antiquity Room and the ground floor Period Rooms Corridor (currently the Living Canterbury Gallery and the Early Christchurch Street respectively).

The *Guide to the Collections in the Canterbury*

Museum published in 1895 and reprinted in 1900 and1906,[2] as well as a booklet produced in 1946,[3] contain few details of the suit of armour, merely listing very briefly the contents of each display case or section with a generalised commentary. Between 1895 and 1906 it was displayed in the Antiquity Room near the stairs[4] to the adjacent Sculpture Room. In the 1946 general guide to Canterbury Museum no specific location was noted,[5] but it seems the armour was still in the Antiquity Room. This gallery was devoted to "Archaeology, or Man as he was in past ages",[6] divided into prehistoric and historic periods and with the armour shown in a section dealing with mediaeval Europe.

Figure 1. Facsimile suit of German Gothic armour, 1880s. Canterbury Museum collection 19XX.3.608

In 1959, following major extensions to the nineteenth century Museum buildings, the armour was re-displayed in the newly-named Period Rooms Corridor,[7] an extension to the Canterbury Colonists Galleries. This area contained three reconstructed

typical interiors of the XVII, XVIII and XIX centuries and in the long case opposite…other examples of furniture, ornament and costume of the same periods. A small display of armour is to be seen at one end of the gallery…Although only the Victorian room portrays the Canterbury colonial period, the two earlier rooms [and other exhibits] convey a measure of the grace which was the heritage of the settlers.[8]

Placed to one side of an imitation wood-panelled wall edged by tastefully-hung green velvet curtains with green and gold tassels, the facsimile armour was associated with a genuine three-quarter suit of British armour of the Civil War period (circa 1640), a seventeenth century oak coffer, a pair of British halberds from the early sixteenth century and a "mortuary crown from a crusader's tomb" (Fig. 2). Nearby was a smaller case of assorted Italian, German and Indo-Persian swords and battle-axes, an impressive shield (also facsimile), and pieces of sixteenth and seventeenth century armour from Britain, Italy and Germany (Fig. 3).[9]

Figure 2. Facsimile armour displayed in the Period Rooms Gallery, 1959

Figure 3. 19th century facsimile and genuine arms and armour of the 16th and 17th century, Period Rooms Gallery, 1959

Figure 4. The right arm and gauntlet (front and back) from the facsimile German Gothic suit of armour. Canterbury Museum collection 19XX.3.608

Over the years, only those visitors who bought the guide books learned that the German armour was a copy. As a small child, the writer – like many other casual visitors who also knew nothing about armour – supposed it to be genuine, gazed in wonder and passed on to the next treasure. It was only when helping to dismantle this display in the mid-1970s that my visions of its presumed history of knightly splendour, daring deeds and thunderous jousts, were dashed.

A full suit of steel plate armour normally weighed about twenty-five kilograms. The Museum's armour was found to be extremely heavy, requiring four people to manoeuvre it out of the case and onto a trolley. The explanation was simple – it was made from cast-iron rather than steel. The helmet and beaver (attachment to protect the chin and mouth), shoulder, arm, elbow and hand coverings (Fig. 4), as well as the tasses or 'skirts' protecting the lower trunk and thighs, were removable. The breast and back plates of the cuirasse (trunk armour) were joined, with no openings for arms, and all the leg, knee and foot coverings were riveted to the 'legs'. These were thick, riveted pipes bolted to a mid-section and firmly attached through the sabatons (articulated armoured shoes) to the very heavy base plate. Invisible from a visitor's viewpoint at the front of the case, a large duct pipe protruded from the 'back plate' (Fig. 5). The armour does not require any additional support to prevent it from tipping over, so the opening in the back suggested another function for this curious object – that it was an ingenious (although probably not very effective) heating stove, utilising hot air piped from a wood- or coal-fired burner that would be housed elsewhere in a building.

However, many questions remained unanswered. Where and when was this elaborate stove manufactured? Was it really a facsimile of a genuine suit of armour or simply a neo-Gothic fantasy? Did any other examples of this unusual object survive elsewhere? How and when did it end up in the Museum's collections? Why might it have been acquired, and by whom?

EARLY MUSEUM RECORDS

Prior to placing the bogus armour into storage, I examined each component in the hope of finding a catalogue number. Inside the left gauntlet was a discoloured and faded paper label with an early catalogue number bearing the prefix "A.R." (for objects displayed

in the Antiquity Room). This led to the obsolete card catalogues in general use from about 1914 to the late 1930s. As discussed in detail by Sally Burrage,[10] the museum collections were not formally catalogued by Julius von Haast (the Museum's first Director, 1867–1887) although display labels gave basic information for objects, and diamond-shaped stickers with numbers were attached to some groups of collections.

Henry Forbes, Director from December 1888 to 21 May 1892, could not locate

any books or memoranda giving the information regarding the various items which it is necessary to know beyond what the labels inadequately supply.[11]

He therefore created handwritten lists of collection items, ordered by subject. However, Forbes did not describe the objects in detail, and he made no note of Haast's stickers nor any numbers recorded in the early "contribution" books pre-dating 1891.

Figure 5. Side view of the facsimile armour, with sealed cuirass and duct pipe in centre back. Canterbury Museum collection 19XX.3.608

It was not until 1914 that Robert Speight (Director, 1914–35) tackled the creation of a proper catalogue, in the form of a card system to record all objects on display as well as those in storage. This mammoth task was finally completed in 1929, incorporating (from 1925) revisions of the work done to date. However, it was only in 1924 that

a start has been made to write the catalogue numbers on some of the artifacts. This is an advisable procedure, since in case of fire it might be found impossible to identify actual specimens if they are separated from the numbered cards associated with them.[12]

This appeared to be the earliest date for the hand-written label glued to the gauntlet of the German armour-stove, and suggested that early information for the object was sketchy at best.

A typed copy label for the stove is dated 11 December 1946 in the writing of Ethnologist (later Director) Roger Duff[13] and indicates that it was still on display in the Antiquity Room. However, the label simply refers to it as "Gothic or German armour", and notes that it

illustrates the maximum development of European armour which was reached in the 15th century.

The guidebook published in 1946 describes it as a facsimile, with a date of "about 1500". Clearly some revision had taken place since Forbes included what can only be this object on his list of "European antiquities"[14], under the sub-heading "Armour", as

Facsimile of armour about AD1550

Hutton, in the first published Guide, described the same object as

a fac-simile of a complete suit of German armour, of the middle of the 16th century…[15]

By 1959, when the armour-stove was displayed in the Period Rooms Corridor, the date had again been revised backwards another fifty years, as already noted.

The fascinating thing about all these records and guide book texts is that none recorded the function of the 'facsimile suit of armour' to be anything other than instructive or decorative. Nor is there any record of maker, donor or vendor, nor when it first came into the Museum's collections. The only clue to the latter lay in the fact that it was apparently first formally recorded by Forbes, strongly indicating that it had been acquired during Haast's directorship.

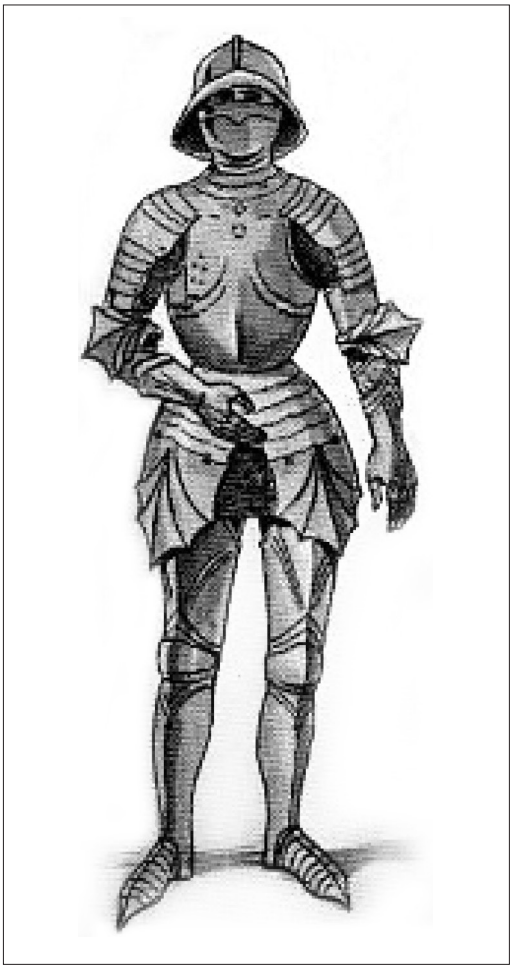


Figure 6. Illustration by Max Karl Tilke of the Hohenzollern armour as displayed at Schloss Sigmaringen ca1901–10, published in *Das Kostümwerk. Eine Geschichte des Kostüms aller Zeiten und Völker vom Altertum bis zur Neuzeit einschließlich der Volkstrachten Europas und der Trachten der außereuropäischen Länder* (1941).

There the investigation paused for some years, until – while undertaking unrelated research – I consulted *Pictorial History of Costume* by Wolfgang Bruhn.[16] This publication, under the title *Das Kostümwerk*,[17] had first appeared in Germany in 1941. The author was curator of the Berlin State Library and director of the world-famous Lipperheidesche Kostümbibliothek at Berlin's Kunstgewerbemuseum (Museum of Applied Arts). The book contained 200 plates representing 4000 specimens of costume, including a selection of colour plates. One of these illustrations rang a bell – it showed a knightly figure (Fig. 6) dressed in armour from

> *the princely armoury at Sigmaringen, [and] supposed to have belonged to Count Eitel Friedrich I of Hohenzollern (died 1439).*[18]

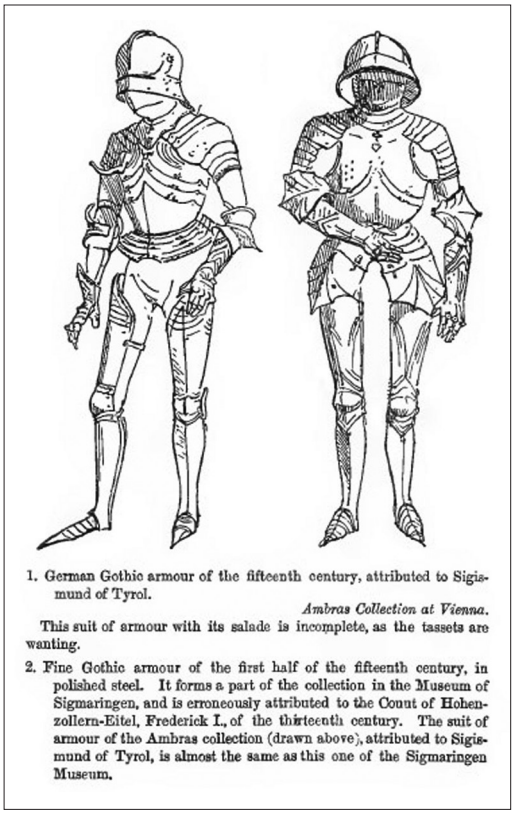
It was Canterbury Museum's suit of armour, or something very like. But who had created this picture, and when? And where was "the princely armoury of Sigmaringen" and did it – and the Hohenzollern suit of armour – still exist?

NINETEENTH CENTURY ILLUSTRATORS

Bruhn's illustrator was Max Karl Tilke (1869–1942), a well-known artist and ethnographer. In 1890, while still a student at the Berlin Academy of Arts, Tilke travelled extensively in North Africa and Italy, taking special note of ethnic and regional dress. After graduation, Tilke worked at the Prado Museum in Madrid as a copyist. Again, he took the opportunity to travel, observing interesting historic and regional Spanish dress. Returning to Berlin in 1901, he began painting full-time, concentrating on works of historical costuming that were based on observation of surviving garments or contemporary paintings. These earned him a considerable reputation and in 1911 he held an exhibition at the Lipperheide Costume Library. His work impressed the authorities so much that the complete exhibition was bought for the library's permanent collection.

Tilke's growing reputation attracted the attention of the Russian Tsar, Nicholas II, who employed him as a Professor at the Caucasus Museum in Tibilsi, Georgia. His specific commission was to paint the costumes in the museum's collection and to enlarge this collection by means of an ethnological expedition.[19]

Towards the end of his life, Tilke agreed to his paintings being used to illustrate Wolfgang Bruhn's publication. This book has subsequently been criticised for inaccuracies, which could cast suspicion on Tilke's illustrations. However, the scientific and meticulous approach which he demonstrated prior to and in the Caucasus Museum project, and outlined in the introduction to his most famous publication, *Orientalische Kostume in Schnitt und Farbe*,[20] validate the accuracy of Tilke's work.[21]



1. German Gothic armour of the fifteenth century, attributed to Sigismund of Tyrol.

Ambras Collection at Vienna.

This suit of armour with its salade is incomplete, as the tassets are wanting.

2. Fine Gothic armour of the first half of the fifteenth century, in polished steel. It forms a part of the collection in the Museum of Sigmaringen, and is erroneously attributed to the Count of Hohenzollern-Eitel, Frederick I., of the thirteenth century. The suit of armour of the Ambras collection (drawn above), attributed to Sigismund of Tyrol, is almost the same as this one of the Sigmaringen Museum.

Figure 7. Illustration by Auguste Demmin of the Hohenzollern armour as displayed at Schloss Sigmaringen ca 1867, published in Die Kriegswaffen in ihrer historischen Entwickelung von der Steinzeit bis zur Erfindung des Zündnadelgewehrs: ein Handbuch der Waffenkunde (1869).

It was thus reasonable to assume that Tilke had at some point visited the "princely armoury" at Sigmaringen and painted the suit of armour in situ, as this was his practice wherever possible. However, recent access to documents now available on the internet (unavailable as a tool when research into this object began) revealed to the writer that Tilke was not the first to do so. This particular armour had already been described and illustrated as a line drawing (Fig. 7) in Auguste Demmin's *Die Kriegswaffen in ihrer historischen Entwickelung von der Steinzeit bis zur Erfindung des Zündnadelgewehrs: ein Handbuch der Waffenkunde (The weapons of war in their historical development from the Stone Age to the invention of the needle gun: a handbook of expertise)*,[22] a volume first published in 1869 and intended as both a general guide for interested amateurs and a "scientific encyclopaedia" for serious collectors. According to Baron Charles de Cosson,[23] Demmin was also the illustrator of the nearly 2000 images in this book.

A German-born[24] decorative arts historian and collector based in Paris, Demmin commented that he had

visited for years all the museums and arsenals of Europe, and the most important collections of amateurs, [and had] thus been enabled to gather enough authentic materials to dispense with referring to any books of compilations.[25]

In the introduction to his work, Demmin made a comment that unfortunately predicted both Canterbury Museum's long-standing exhibition of its armour-stove, and Bruhn's attribution:

The desire of exhibiting "historical" curiosities has tempted many museums to accept and even to construct for their objects, genealogies and titles, which, being affirmed by tradition, have at last become gospel truths to the keepers, and to the crowd among whom these gigantic errors are circulated and preserved.[26]

According to Demmin, the Sigmaringen Armoury had

erroneously attributed [this particular armour] *to the Count of Hohenzollern-Eitel, Frederick I, of the thirteenth century.*[27]

He disagreed with the Armoury's attribution, describing it as

fine Gothic armour of the first half of the fifteenth century, in polished steel.[28]

There are subtle differences between the image of the Sigmaringen armour in Demmin's book[29] and Tilke's version reproduced in Bruhn's publication, but they are clearly the same object, drawn from direct observation.

THE AGE OF THE SIGMARINGEN ARMOUR

Bruhn (and probably Tilke) had untangled the Armoury's error in the dates for Count Eitel Friedrich I's rule – 1426 to 1439, not sometime in the thirteenth century. However, by 1941 his pre-1450 date for the production of the armour[30] was more than dubious. Its maker, Lorenz Helmschmied (fl 1467–1515) had been identified in the mid-1880s.

In his 1891 paper published by the British Archaeological Association, Baron de Cosson –

the English-born collector and scholar who was recognised by 1880 as one of the leading authorities in the serious study of European arms and armour – described a trip taken in 1886:

From Basle we went to the pretty little town of Sigmaringen. I had long known that a fine collection of arms had been formed there by one of the Princes of Hohenzollern Sigmaringen. Demmin had sketched some of the pieces, and I had seen at Nuremberg casts taken from portions of a German gothic suit there of rare beauty…Portions of the Gothic suit I have mentioned are of the very finest epoch of German fifteenth century armour, and on obtaining permission to unmount it, we were able at once to name the master by whom they had been made. Both the breast and the backplates bore the mark of Lorenz Kolman, (Helmschmied), of Augsburg, who, in the last quarter of the fifteenth century, was to Germany what the Missaglias were to Italy, the greatest artist of his time.[31]

Bruhn's error suggested to me that, at some point after 1901–11 (when Tilke is most likely to have seen it), a thorough examination of the armour to confirm de Cosson's attribution was no longer possible. Perhaps something had happened to it by the late 1930s when Bruhn was preparing his book?

THE PRINCELY ARMOURY OF SIGMARINGEN

The House of Hohenzollern originated during the eleventh century near Hechingen, in the historic region of Swabia (Schwaben) in Germany's south-west. The Zollern – or as they later became known, Hohenzollern – family were first mentioned in mediaeval chronicles in 1061 and received the title "Graf" (Count) from Henry V (King of Germany 1099–1125) in 1111, the first year of his reign as Holy Roman Emperor. The family later split into two branches, the one in Swabia remaining Catholic, while the junior branch in Franconia (incorporating parts of Bavaria, Thuringia and Baden-Württemberg) became Protestant. In 1701 this junior branch of the Hohenzollern dynasty created the Kingdom of Prussia, and in 1871 led the movement to unify the many German states, principalities and kingdoms, eventually establishing and ruling the first German Reich (Empire). The Swabian Hohenzollern branch was subdivided into three – Hechingen, Haigerloch and Sigmaringen – in 1576, and in 1623 the heirs were raised from the status of counts to princes.

As observed by Auguste Demmin, the practice of "gathering together" armour and weapons as a collection, rather than for their intended use, began about the end of the fifteenth century.[32] The museum or Armoury at Schloss (Castle) Sigmaringen was founded much later, in 1842, by Prince Karl of Hohenzollern-Sigmaringen (1785–1853).

Prince Karl's son, Karl Anton, who succeeded to the principality on the former's abdication in 1848, renovated the ancient castle, which dates at least to the eleventh century and probably to Roman times. Karl Anton's tastes in the 1860s to 1880s ran to the fashionable neo-Gothic, and during this period various additions in "the Anglo-Gothic Style" were made, including a museum (1867) and an arsenal to hold the by-then extensive collection of more than three thousand examples of armour and weapons. Described by Demmin as "graceful in form and worthy of its contents", the museum and arsenal were open to the public. After visiting and describing this facility not long after its completion, Demmin further commented that the collections of weapons and armour were "exceedingly valuable in an historic and artistic point of view." [33]

Prince Karl Anton's great-grandson, Friedrich (1891–1965), took over management of the Hohenzollern-Sigmaringen estates in 1927. Much property had been lost as a result of World War I and Prince Friedrich had to 'balance the books' during a period of extreme economic recession.[34] A similar situation occurred during and after the Second World War. Nevertheless, the Schloss Sigmaringen armoury remained largely intact, and is today

one of the largest private weapons collections in Europe…In the spacious arsenal, more than 3,000 exhibits document the development of arms technology, armaments, offensive and defensive weapons. Defense weapons as well as handguns, shields and suits of armour are on display here.[35]

FROM ARMOUR TO STOVE

In 1997, then-unaware of the history of Schloss Sigmaringen or its museum, I was using internet resources to research text for the new Mountfort Gallery of European Decorative Arts, in which the armour-stove was to be included. *The Victorian Web* website[36] included a section on "Victorian Design and the Medieval Revival" by George P Landow, Professor

of Art and English at Brown University[37] and displayed an image of a heating stove built in the form of a suit of armour (Fig. 8). This curiosity was believed by Landow to have been shown at the first great International Exhibition of Art and Industry held in London in 1851, although it has not been possible to confirm this.[38] While not identical to Canterbury Museum's example, it gave a possible date of production and clearly came from the same school of thought.

Figure 8. This mid-19th century heating stove was exhibited at one of the European international exhibitions. Illustration courtesy of George P Landow, www.victorianweb.org

Further components for the Canterbury Museum stove were now discovered among the European Arms Collection, probably having become separated when the armour-stove was taken off display in the Antiquity Room. Two long, pointed metal pieces, each with a small hole at the centre of the widest part, fitted exactly over the end of the sabatons and would have been held in place by a small screw. They created the extended tapered point for footwear fashionable in the fourteenth and fifteenth centuries and completed the armour as illustrated by Tilke and Demmin. On a real suit of armour of the period, this extremely pointed part of the sabaton was intended to be worn only when the knight was on horseback, and could thus be removed when he was on foot.

The Honorary Consultant for European Arms, Alan Quérée, also identified a small number of halberds, battle axes, a 'morning star' (a military flail with metal spikes embedded in the iron ball), a mace and several swords that were clearly cast metal reproductions, rather than genuine fifteenth and sixteenth century weapons. Following the clues in Landow's illustration, one of the swords was tried for size with the armour. The pommel and guard fitted comfortably beneath the gauntlets and the tip of the blade slotted neatly into a small indentation in the base plate, seemingly designed to stop the blade slipping. More parts of the puzzle were now in place (Fig. 9).

Figure 9. Pommel and guard of the facsimile sword associated with the stove-armour. Canterbury Museum collection, Arms1969.208

Landow was delighted to include an image of the Museum's version of the armoured heating stove on his website. The stove itself was placed on display within a case of Victorian furniture and decorative arts objects that also included an English oak neo-Gothic collector's cabinet and high-backed chair, a German stoneware facsimile *pokal* (a lidded goblet of the fifteenth or sixteenth century) and two nineteenth century German earthenware plaques depicting a man and a woman in fifteenth century clothing. For the first time, the armour-stove was exhibited in such a way that the duct pipe could be seen, revealing it to be an elaborate heating appliance.

ON THE TRAIL OF THE SIGMARINGEN ARMOUR

In 2002, I was contacted by Klaus Rousing, a Danish armour enthusiast who had spotted the Museum's stove on Landow's website. Rousing had constructed a suit of armour (Fig. 10) based on a very similar harness that had belonged to the Archduke Sigmund of Tirol and which is now held at the Kunsthistorisches Museum, Vienna. This had also been illustrated by Demmin, on the same page as the Sigmaringen harness. Rousing was intrigued by the Museum's armour-stove and was interested in its method of construction. He was familiar with illustrations of the Sigmaringen-Hohenzollern armour, but had some doubts whether the original was in fact genuine. He commented that it had not been cited or reproduced in any recent major publications, and speculated that it could have been exposed as a fake in the interim, or at least as a nineteenth century composite.

However, Rousing had also discovered, in a recently-published book about Norwegian Freemasonry *Frimureri: mysterier, fellesskab, personlighetsdannelse (Freemasonry: Mysteries, Fellowships, Formation of Personalities)*[39] by professor of theology Sverre Dag Mogstad, a photograph of a suit of armour identical to the Canterbury Museum facsimile. This stood in a room which Rousing explained was "decorated for the ritual initiation into the [Masonic] degree of Knight Templar",[40] presumably in Norway. He noted that there was no information where or when this image was taken, but that a similarly-decorated room in another image appeared to be located in Germany.

It was impossible to ascertain, from the photo in Mogstad's book, if the Masonic 'armour' had also been adapted as a stove. However, it did confirm that wherever the original harness might now be, someone had access to it during the nineteenth century, and was producing copies as a commercial enterprise. The Canterbury Museum stove was not a one-off example.

By this time (2002) it was possible, through email, to easily contact museum staff around the world. Unfortunately, Dr Peter Kempf, chief conservator at Schloss Sigmaringen, could only advise that the armour illustrated by Tilke and Demmin was no longer in the collection. It had been sold many years previously and was (he believed) in the United States, in Detroit. No further details were recorded and nothing in the Castle archives gave any indication about it having been reproduced commercially, either as a stove or any form of decorative object.[41]

Figure 10. Klaus Rousing (Denmark) in the armour he built ca 2002, based on the suit made for Archduke Sigmund of Tirol (now in the Kunsthistorisches Museum, Vienna) and illustrated by Auguste Demmin (see Fig. 7)

In the meantime, emails from Pierre Terjanian at the Philadelphia Museum of Art confirmed that the Sigmaringen suit of armour had been gifted, not to his institution (which has a significant collection of European arms and armour[42]), but to the Detroit Institute of Arts, from the gigantic collection of fine and decorative arts amassed by media tycoon William Randolph Hearst.[43] Furthermore, it was discussed in the Bulletin of the DIA published in 1954, a copy of which was later kindly sent by the DIA's Chief Librarian, Jennifer Gustafson.[44]

The frontispiece for the *Bulletin* was a photograph of the elusive Sigmaringen armour, shown in front and back views. It was unequivocally the model for Canterbury Museum's stove (Fig. 11). The article confirmed that it was

the earliest suit in the Hearst Collection… [and comprised] *a Gothic harness, complete from sallet [helmet] to sollerets, from head to foot, long famous as the pride of the Hohenzollern-Sigmaringen armory. The principal plates bear the marks of Lorenz Colman, appropriately called Helmschmeid [sic], of Augsburg, armorer to the Emperor Maximilian in the years around 1500. This suit, with its typical Gothic lines, dates about 1480.*[45]

Recent correspondence with Dr Yao-Fen You of the Detroit Institute of Arts[46] gave the latest scholarly information on the Sigmaringen armour (Inv. No. 53.193), which was included in an exhibition at the Los Angeles County Museum of Art, November 2008–February 2009. As displayed, the armour measures 180.34 x 72.39 x 66.68 cm. A short essay by Stuart W Pyrhh states:

The genuine elements comprise the breast and backplate, both shoulder defences (pauldrons), and thigh defences (cuisses), most of which bear the mark of Lorenz Helmschmid [sic[47]] *of Augsburg, the finest German armorer of his generation. They are thought to form part of a specialized armor (Rennzeug) for the joust with sharp lances that was probably made around 1485 for the future emperor Maximilian (1459-1519, r.1508-19). With their gracefully shaped plates articulated with cusps and sprays of ridges and their edges decoratively pierced, these elements are masterpieces of the armorer's art. The remaining skilfully restored parts are the work of a Munich armorer around 1870.*[48]

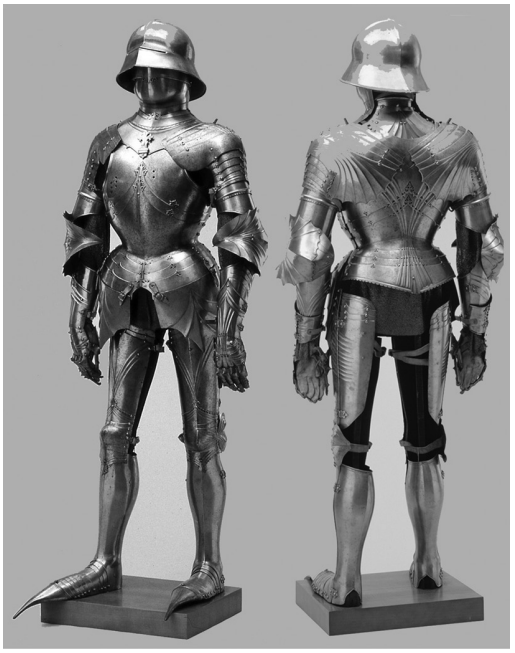


Figure 11. Front and back views of the armour by Lorenz Helmschmied of Augsburg, ca 1485. Courtesy of the Detroit Institute of Arts, Inv. No. 53.193

The essay notes that the Sigmaringen armoury is a "largely nineteenth century collection". This suggests perhaps that Pyrhh assumed the Helmschmied harness had been acquired by the Hohenzollern family during the nineteenth century. However, I propose that it had probably been in the possession of the family either from the date of its creation by Lorenz Helmschmied, or not long afterwards.

This was implicit in the nineteenth century Sigmaringen Armoury records even though it was incorrectly provenanced to Eitel Friedrich I. However, it could well have been associated with his grandson Count Eitel Friedrich II of Zollern (1452–1512). From 1487 the latter spent most of his time in the service of the imperial court. He was a very close friend and councillor of the German King and Holy Roman Emperor Maximilian I (1459–1519), serving as a trusted diplomat as well as a military commander. Maximilian had a passion for armour, not only as necessary equipment when fighting in real battles and in tournaments, but also as an art form. He commissioned many suits in the latest styles, not only for himself, but also as gifts.

An example of the latter is the previously-mentioned, very similar harness[49] of circa 1484, also by Lorenz Helmschmied, re-created by Klaus Rousing and many other modern armour enthusiasts. Part of the collection originally formed by Archduke Ferdinand II of Tirol (1529–1595) at Ambras Castle near Innsbruck, it was apparently commissioned by Maximilian (then a young prince) for himself, but gifted by him to his uncle, the Archduke Sigmund of Tirol, as a wedding present in 1484. It measures 175 x 85 x 95 cm, dimensions that differ from the Sigmaringen armour. Although it has been suggested the latter may also have been made for Maximilian, this discrepancy could indicate that it was commissioned by the future Emperor specifically for Eitel Friedrich II.

WILLIAM RANDOLPH HEARST

William Randolph Hearst (1863–1951) (Fig. 12), the entrepreneurial American newspaper and magazine magnate and art collector, purchased the Sigmaringen armour from the renowned firm of art dealers, Arnold Seligmann, Rey & Co. of New York. This was a branch of Arnold Seligmann & Cie, Paris and Munich, who had acquired it directly from the Hohenzollern-Sigmaringen family in 1929, for the then-enormous sum of $60,000.[50] This equates to USD770,000 (NZD937,000) today. The Seligmann archives[51] reveal further purchases of art works from the Hohenzollern-Sigmaringen collections, doubtless as part of Prince Friedrich's attempts to keep the estates afloat.

Hearst displayed the Sigmaringen armour in a custom-built armoury that formed part of his palatial five-floor apartment in The Clarendon, a twelve-storey building at 137 Riverside Drive, New York City. The armoury occupied a huge gallery nearly one hundred feet long with a height of thirty-five feet, created by demolishing two of the floors of the apartment and raising the ceiling through a steep mansard roof. Lit by stained glass clerestory windows, twenty-four stunning suits of armour were placed along the walls, in front of fifteenth and sixteenth century tapestries. A photograph taken in 1929–30[52] shows the Sigmaringen armour third from the far end on the right, near a massive Renaissance fireplace.

Hearst's palmy days as a collector came to an end in 1937, with the forced reorganisation of the Hearst Corporation in order to service huge amounts of debt.

Figure 12. William Randolph Hearst (1863–1951), ca 1906. Photographer; J E Purdy, Boston. Courtesy of the Library of Congress, LC-USZ62-49253

By 1941 much of his collection, housed in five palatial residences – one of them a restored thirteenth century castle, St Donat's, on the Glamorgan coast in Wales – had been liquidated, along with several of his newspapers, properties and his film company. The Clarendon apartment was dismantled and its contents either sold off or put into storage with other objects that Hearst managed to retain.

The whereabouts of the Sigmaringen armour during this period is not clear, but it was probably stored in one of several gigantic warehouses. After Hearst's death in 1951, the family-run Hearst Foundation generously gifted it, in 1953, to the City of Detroit, to be housed in the Detroit Institute of Arts. The Sigmaringen armour was part of a collection of

ten suits of fifteenth and sixteenth century armor and twenty-five other pieces of armor and arms dating between the fifteenth and the seventeenth centuries.[53]

The rationale for the gift was explained:

To the metalworking city of Detroit, armor has

a special meaning, for here in modern times vast quantities of the world's armor and armaments have been made, and here the automobile industry makes constant use of metal arts handed down from the metalworkers of the past…Knowing the need for armor in the Detroit museum and the meaning that it would have in a city of metalworkers, Mr Hearst, at the time of his death in 1951, was on the verge of giving some of his collection to the Detroit Institute of Arts. It was left for his widow, his five sons, and the Hearst Foundation, established by Mr Hearst, to carry out his wishes.[54]

"DEKORATIVE WAFFENATTRAPPEN"

The breakthrough in my search for the manufacturer of Canterbury Museum's armour-stove came with the further help of Klaus Rousing in February 2003, and revealed the marriage of industry and art in another locality long associated with the working of metal – the Harz region of northern Germany. Klaus had located a thesis for the degree of Doctor of Philosophy from the Martin Luther University, Halle-Wittenburg, written by Matthias Reichmann in 2000 and subsequently published on the internet. Reichmann's subject was

an introduction to the former Anhaltian ironworks of Mägdesprung. It covers art iron casting from the 1860's to the beginning of the 20th century. It presents exhibits from the Horn-Mägdesprung collection of Allstedt castle, including early art casts following the tradition of the Royal Prussian Foundries, copies of items from past art epochs, and pieces by well-known artists like Antonio Canova, Bertel Thorvaldsen, Ernst Ritschel, Karl Friedrich Schinkel, Christian Friedrich Tieck et al., among them the ironworks sculptors Johann Heinrich Kureck (1821-1889), Wilhelm Elster (1840-1912) and Wilhelm Elster junior (1869-1916).

The illustration section gives a survey of iron casting production, ranging from pieces of artistic work to articles for everyday use, including short descriptions and possible links to products of other iron works, especially the Ilsenburg Ironworks.[55]

The thesis had numerous illustrations from the Mägdesprung Ironworks catalogue of 1886.[56] And there, on page 167, in the section titled "Dekorative Waffenattrappen" (decorative dummy weapons), were two photographs of a facsimile of the Sigmaringen-Hohenzollern suit of armour, cast in silver-bronzed iron. According to the quoted catalogue, it was available with or without a sword and a halberd. The former version cost 240 marks and the latter 225 marks. These appear to be the only prices included in the catalogue, suggesting it was an expensive item, probably made to order. The height of the armour was stated to be 186cm – the difference from the original Hohenzollern-Sigmaringen suit was the depth of the chamfered octagonal iron plate on which the copy stood.[57] An alternative plinth featured a raised pedestal with some form of label. The armour was also manufactured as a heating stove.

The Mägdesprung catalogue described the original armour as made for a "Landsknecht"[58] – a mercenary foot soldier or pikeman in late fifteenth to seventeenth century Europe. Reichmann correctly identifies it as having been cast from "a knight's field armour". However, he does not seem to have been aware of the historical illustrations and descriptions of the original by Demmin and De Cosson or even Bruhn and Tilke, merely stating that it was "said to have once been in a collection of the Hohenzollern" family. He does not mention the Sigmaringen armoury and dates the supposed original to about 1475 based on its characteristic style.[59]

The incorrect identification in the Mägdesprung catalogue of 1886 suggests that the casts were not made by anyone from the factory, but rather that they had been obtained or copied from elsewhere and the original provenance had been lost. De Cosson's comment that he had "*seen* [in 1886] *at Nuremberg casts taken from portions of a German gothic suit* [at Sigmaringen]"[60] possibly provides the clue, but unfortunately he does not say when these casts were made or where in Nuremburg they were sighted.

Reichmann noted that this armour was also produced at the rival ironworks in Ilsenburg.

In der Eisenfaktorei Ilsenburg wurde die gleiche Rüstung mit der Musternummer 567 a und b gegossen und angeboten als Rüstung, als Kandelaberhalter und auch als Ofenaufsatz. (The same armour was cast in the Ilsenburg Ironworks with the pattern number 567a and b and offered as a suit of armour, as well as a lighting support [?candelabra] and also as a [heating] *stove.)*[61] Reichmann makes no comment about the example housed at Allstedt Castle, which is presumably part of the Carl Horn Collection relating to Mägdesprung, and

there is no information accompanying the tantalising glimpse of the armour on the short website video tour of the castle.[62] Similarly, the only located website describing the Hütten-und Technikmuseum at Ilsenburg does not mention the cast-iron armour, in any of its manifestations, so possibly this collection does not have an example.[63] Attempts to obtain more information from these museums, which hold the records of the respective works at Mägdesprung and Ilsenburg, have proved unsuccessful, and questions about the dates of design and production, quantities produced, target market and so forth cannot be answered at this time.

The Mägdesprung catalogue also shows a replica of a famous suit of ceremonial armour designed by sculptor Germain Pillon (1535–1580) for Henri II of France (1518–1559), with the decoration after engravings by Étienne Delaune (1518/19–1583). The original is in the collections of the Louvre Museum, Paris. Reichmann notes that the same facsimile armour was also manufactured by the Ilsenburg Ironworks. It is this armour that appears to be the closest model for the stove depicted on George Landow's website, although the latter lacks the upwardly-flared plate on the pauldrons (shoulder coverings), possibly an error on the part of the illustrator.

THE MÄGDESPRUNG AND ILSENBURG IRONWORKS

The technique of casting iron was not widely used in Europe before the late fourteenth century. Until the early eighteenth century its primary purpose was in producing cannon and shot. However, ironworkers also perfected the application of cast iron in cooking pots and ornamental back plates for heating stoves and fireplaces, utilising the material's excellent heat retention and diffusion properties. By the nineteenth century, cast iron had also become a major material for building construction, machinery and an increasingly wide variety of decorative and practical objects, from household furnishings and ornaments to jewellery.

The Harz region of northern Germany has a tradition of metal ore mining and smelting that dates back three thousand years, to the Bronze Age.[64] The towns of Mägdesprung and Ilsenburg, some 56 kilometres distant from each other in the state of Saxony-Anhalt in the Harz, were the sites of famous iron works. The earliest and probably more illustrious was founded in Ilsenburg, in 1530, by Count Botho of Stolberg-Wernigerode, and is now in private ownership and production under the traditional name "Fürst Stolberg Hütte" (Prince Stolberg Works). One of their earliest stove plates, cast in 1569 with a scene from the life of Jacob and Joseph, has survived and is still reproduced.

By the late seventeenth century, the Ilsenburg Ironworks had created a large market, and a widespread reputation, for the production of elaborate stove and fireplace panels as well as cast-iron stoves. Under Eduard Schott (1808–1895), who became Chief Inspector in the late 1850s, the works designed and manufactured some 3,000 cast iron 'art' pieces. The Ilsenburg Ironworks attracted international interest at the Paris Exhibition of 1855 and continued to contribute to later international exhibitions, winning awards at many. From 1930 to 1945 the works became part of the giant Krupp conglomerate, and from 1945 to 1993 were nationalised. During this period, production concentrated on locomotives and heavy machinery.

The Mägdesprung works were established in 1646 by Prince Frederick of Anhalt-Harzgerode. They were greatly expanded from 1769, producing goods such as axes, ploughs, hammers, and rifles. From 1821 decorative art casting was added to the range of agricultural, military and mechanical engineering products and these were to prove very successful until the early twentieth century.

The cast iron decorative manufactures of both these ironworks, like many others of the period, copied the works of famous artists, sculptors, designers and engravers, both past and contemporary, that were held in various museums and private collections. These included Albrecht Dürer, Benvenuto Cellini, Hans Holbein, Václav (Wenzel) Hollar, Karl-Friedrich Schinkel, Bertel Thorvaldsen and Alphons Mucha. Other artists and modellers such as Johann Kureck and Wilhelm Elster were associated directly with the ironworks and produced original pieces for casting.

All the foundries and decorative ironworks of this period copied each others' products. Mägdesprung and Ilsenburg were no exception, and there are numerous cross-overs between the two rival factories. Attempts were made to protect original and copied designs, by adding casting seals identifying the manufacturing works, but the practice continued.

IDENTIFYING CANTERBURY MUSEUM'S ARMOUR-STOVE

The various parts of the Museum's amour-stove have now been checked for casting seals, but none have been sighted. It is possible that it was made by neither of the two ironworks discussed, but to date no evidence has been located that another foundry produced this item. An examination[65] of a quantity of other decorative cast-metal objects in the Museum's collections, as well as the previously-mentioned facsimile weapons and shields, has narrowed the possibilities for the likely manufacturer.

The 'artistic metalwork' collection comprises reproductions of goblets, vases, small boxes and religious reliquaries, tazzas, plates, dishes and bowls, lamps and even a missal cover (Fig. 13). Many pieces are not marked, but several bear the seal of the Ilsenburg Ironworks. These include a bas-relief plaque of Martin Luther (AR1035), and *Cupid with a Swan and Boys picking Fruit*, *The Summer* (AR902.0) and two other rectangular plaques showing bacchanalian *putti* (AR902.1–2), all after Thorwaldsen, the originals circa 1810 (Fig. 14).

There is also a rectangular shield with C-shaped scrolls (AR893) (Fig. 15), the original attributed to Cellini[66] in the Ilsenburg (and Mägdesprung) catalogue, but now identified as by Antwerp goldsmith Eliseus Libaerts (fl.1557–72) and the engraver Étienne Delaune. Another possible Ilsenburg production is the facsimile of an elaborate parade shield (AR892.0) (Fig. 16) made for Francois I (1515–47) from the collections of the Musée de l'artillerie in Paris (now the Musée de l'Armée). Unfortunately, the casting seal has been damaged.

Another manufactory identified in the collection is the Art Foundry at Lauchhammer in Brandenburg, south of Berlin (founded in 1725 and still operating). Most of the bronzed or brass replicas (and some contemporary pieces) are associated with the Royal Berlin Factory. I suggest that the Ilsenburg Ironworks is the most likely contender for the armour-stove, no examples of works from Mägdesprung having been identified in this collection.

Figure 13. Examples from the collection of 'artistic metalwork' acquired by Haast for Canterbury Museum in the 1870s–80s. **a** - Reliquary of Charlemagne (AR912); **b** - tazza after Cellini (AR909.1); **c** - ewer after Cellini (AR904); **d** - St Michael missal cover (AR917); **e** - tankard from Saxony (AR914); **f** - nautilus *pokal* (AR915)

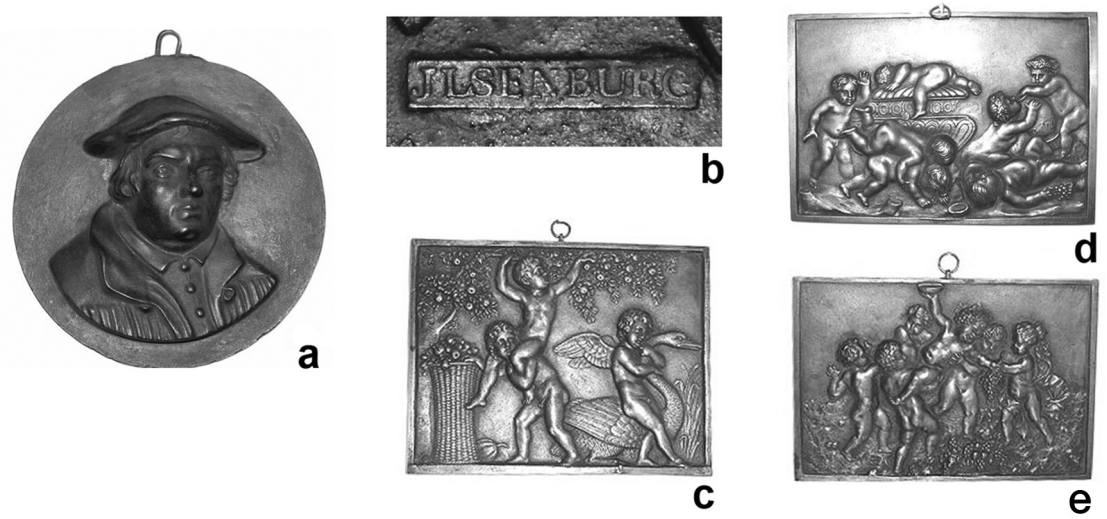


Figure 14. Cast-iron art works from the Ilsenburg foundry, probably acquired by Haast for Canterbury Museum in 1887. **a** - Martin Luther (AR1035); **b** - Ilsenburg foundry casting seal on reverse of AR1035; **c** - *Cupid with a Swan and Boys Picking Fruit, The Summer* after Thorwaldsen (AR902.0), **d-e** - bacchanalian *putti* after Thorwaldsen (AR902.1–2);

It seems reasonable to conclude that nearly all these items were collected at the same time, very probably by Sir Julius von Haast (Fig. 17). None of them are mentioned in the "contribution books" or newspaper cuttings or reports to the Board of Governors of Canterbury College (the Museum's governing body at the time) prior to 1886, but they appear in Forbes' listings for material in the Museum at the time of his taking over the directorship in 1888, suggesting they were received in the interim period.

HAAST, THE COLINDERIES AND A COLLECTING TOUR IN EUROPE

In 1884, it was decided to hold, in London, a major exhibition of the arts and industries of the British Colonies and the Indian Empire. The New Zealand Government was eager to participate, and Haast put his name forward for the position of Commissioner in Charge of Exhibits at the New Zealand Court. His application was accepted and he departed for England in January 1886 after more than six months of preparation. This included the design of the Court and the collection of an enormous range of exhibits, work that had seen him travel from one end of the country to the other. He was initially given a year's leave of absence by the Board of Governors, and his son Heinrich was left in charge of the Museum.[67]

Haast's work at the Colinderies occupied him for the next eleven months. During this period he was made Knight Commander of the Order of St Michael and St George "for the valuable services…rendered in connection with the Colonial and Indian Exhibition",[68] the honour capping and complementing the Austrian and Italian knighthoods received respectively in 1874 and 1880.[69] In his spare hours, Haast took the opportunity to visit colleagues at various museums and scientific institutions, with the aim of acquiring new material for Canterbury Museum.

In December 1886, at the conclusion of the Exhibition, Haast and his wife Mary left for an extended tour of the Continent, visiting Haast's family (for the first time since leaving Germany in 1858), friends, and the many museum and university colleagues with whom Haast had corresponded and exchanged collections for years. However, Haast's intentions for this trip extended beyond socialising. As ever, he looked to add to the collections of Canterbury Museum.

Figure 15. Facsimile parade shield after Eliseus Libaerts and Etienne Delaune, Ilsenburg foundry, 1880s. Canterbury Museum collection AR893

Early in 1886, Haast's old friend Fereday[70] *moved at a meeting of the Board of Governors a vote of £150 for the Museum to enable Haast to visit the continent and obtain works of art and specimens for the Museum; but he was defeated, Montgomery*[71] *opposing on the grounds of economy, the Museum showing a debit balance. Others followed his lead. With the aid of strong leading articles from the Lyttelton Times, and by beating up his supporters, Fereday managed to win on June 1, when the Board voted the £150 for the purposes suggested. In August they voted Haast a further grant of £150, and extended his leave of absence for a further six months. Haast also received contributions of £100 from George Gould, and £50 from John Tinline, a wealthy retired sheep-farmer.*[72]

Figure 16. Facsimile of facsimile of a parade shield made for Francois I (1515–47). Canterbury Museum collection AR892.0/Arms1999.20

Over the next six months, Haast's journeys took him to Düsseldorf (Christmas 1886), Bonn (his birthplace, where he was to stay for about six weeks, laid up sick while agents acted on his behalf, travelling to Spain, Iceland, and the Urals to collect for the Museum), Basle (2 March 1887), Milan, Turin, Genoa, Pisa, Florence (at the beginning of April 1887), Venice, Vienna (in mid-April), Dresden, Berlin and Halle before returning to Bonn on 1 May 1887 (his birthday) for his final visit with family, prior to returning to London via Cologne, Brussels and Paris. In London, Haast spent more time at the British Museum, where he managed to acquire casts of Assyrian cuneiform tablets and the Rosetta stone, and a series of electrotype copies of Greek and Roman gold and silver coins mounted in a display case.

While in Europe, Haast had similarly sought copies of what he described as "antiquities" and "ethnological objects", because it was becoming increasingly difficult to obtain originals. In Berlin, for example, he wrote to Heinrich that he had bought "a set of reproductions of those splendid Tanagra clay figures".[73] The major finds of these charmingly moulded and painted terracotta figurines (mostly of women) of the 4th century BCE had occurred in 1874, during excavations at Tanagra, a small Greek town north of Athens, near Thebes. They were hugely popular, appealing to middle-class notions

of realism in art, and fakes soon entered the antiquities market. The copies Haast bought were reproduced in Berlin from museum originals and were stamped with the manufacturer's name.[74]

Given that he visited several German cities (Berlin, Dresden and Halle) that either had decorative ironworks or were relatively close to them, it would be logical to assume that Haast extended this policy to the acquisition of high-quality artistic metalwork. The pieces collected largely represented reproductions of works from the mediaeval and Renaissance periods, and complemented material that Haast had been gathering for some years, including "rubbings from ancient brasses from England & the Continent",[75] facsimile tenth to sixteenth century European ivories, chromolithographed "paintings in Fresco, Altar-pieces, and other paintings of Christian subjects, by the old Italian and German masters" published by the Arundel Society.[76]

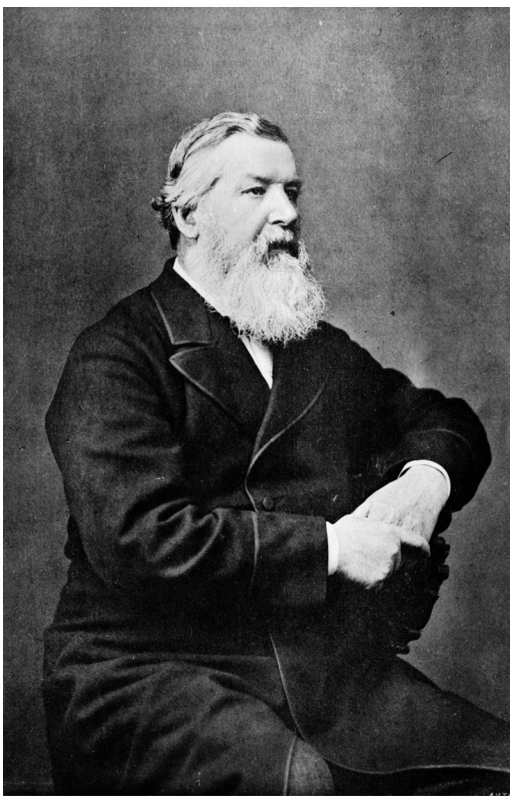


Figure 17. Sir Julius von Haast, Director of Canterbury Museum 1867–1887, ca 1880. Hay Collection, Canterbury Museum 1952.59.144

Through a long-standing correspondence with Professor Emil Cornalia at the Civic Museum of Milan, Haast had also been able to exchange moa bones for (among other objects) genuine bronze portrait and commemorative medals of the early Renaissance. These included *Sigismondo Padolfo Malatesta* (Lord of Rimini and Fano) by Matteo di Maestro Andrea de' Pasti, 1450 (Med1995.877), *Borso d'Este* (Marquess and later Duke of Ferrara) attributed to Petracini, 1460 (Med1995.870), *The Pazzi Conspiracy by Bertoldo di Giovanni*, 1478 (Med1995.880), *Lucrezia de' Medici*, *Princess of Ferrara*, (uniface) by Pastorino de' Pastorini 1558 (Med1995.876), and two examples of *Ippolita Gonzaga* by Leone Leoni, circa 1551 (Med1995.878/897).[77] These appear to have been received between 1873 and 1875.[78]

Additional exchanges with Milan resulted in the receipt of "a collection of various weapons of the 16th century" in 1878 (E78.15a), while local donors in Christchurch had gifted unspecified armour in 1868 (Isaacs, E68.1) and 1870 (Tippets, E70.8). These are probably among the items listed by Forbes as

English armour about AD1640 (2 helmets 4 breast plates)

Italian armour about AD1500 (helmet, breast plate and arm cover) – 4[79]

Haast's interest in collecting armour and genuine or facsimile examples of the portable arts of mediaeval and Renaissance Europe complemented not only the architecture of his own museum, but also that of the growing city of Christchurch and its surrounds. The nineteenth century was characterised by the eclectic exploration of many historic styles of art and architecture. The predominant neo-Gothic style was based on a romanticised vision of the Middle Ages in Europe, a period regarded in the early nineteenth century as

the epoch when the modern languages supplanted Latin, when the civilization of Western Europe equalled those of Classical Antiquity, when builders created the Gothic style, the antipode of the Greek, and when the history of the northern nations began.[80]

Canterbury was settled during the height of this Gothic Revival, and its influence in architecture found a continuing expression in a superb assemblage of religious, collegiate and civic buildings (of which the Canterbury Museum is an outstanding example[81]) throughout the city. Interior design and the various

forms of decorative arts – furniture, ceramics, glass and stained glass, and metalwork in all its variety – also reflected this style and its more eclectic variants and could be found in both public buildings and private dwellings. Some predecessors (or at least copies) of these contemporary neo-Gothic decorative arts (Fig. 18) were to be found in Haast's collections within the Museum, along with other Renaissance- and Baroque- inspired objects, serving as education and inspiration for the colonists.

Figure 18. *Historismus* glass goblet (*humpen*), Bohemia, gifted to Canterbury Museum in 1887 by Lady von Haast. Canterbury Museum collection 19XX.3.422

The revival of the arts of the Middle Ages was widely embraced in Germany as well and, naturalised British subject though he was by this time, Haast was hugely proud of his German heritage. The armour-stove would seem to be an object likely to have appealed to him on a personal level – particularly, perhaps, at a time when he was basking in the glow of his recent knighthood, in which he was invested by Queen Victoria at Osborne.[82] This facsimile armour was of German manufacture, copied from an original associated with the powerful German princely family of Hohenzollern (now rulers of a modern German Empire and related by marriage to the English monarch), and from a period when German armour was regarded as the best in Europe. It complemented, on a grand scale, the German 'artistic metalwork' facsimiles that had already been acquired, as well as the stoneware pokal from Coblenz (E2067.0), various other "copies of old German stoneware jugs and tankards"[83] and the previously-mentioned earthenware portrait plaques (C1884.1) by Herman Bichweiler of Hamburg (Fig. 19).

Figure 18. Majolica earthenware portrait plaque, probably designed by Carl Paul Börner (1828-1905), manufactured by Herman Bichweiler, Hamburg, ca 1881. Canterbury Museum collection 1884.24.1

The illustration in Mogstad's publication, of an identical facsimile of the Hohenzollern-Sigmaringen armour used as a decoration in a Norwegian Masonic temple,

could suggest another reason the armour-stove might have appealed to Haast. He was a Freemason, having been "initiated in the Lodge Philadelphia under the Grand Orient of Belgium at Verviers on October 16, 1842", receiving his Master's degree on 11 May 1843, when he was in his twenty-second year.[84] Once settled in Christchurch in 1861 he joined the St Augustine Lodge No.609 English Constitution.[85]

The Norwegian Lodge building is not unique in decorating a Chapel associated with the degree of Knight Templar with a suit of armour. One well-known example is in Washington D.C., in the George Washington National Memorial. This building

exhibits an original [sic] *suit of armor worn by a Knight Templar of the 12th century and a sword, a Bible and stained glass representations of Knights and Christian themes.*[86]

This replica suit of armour[87] and another located on the internet (location unnamed)[88] are quite different to the Norwegian/Sigmaringen example, indicating that there is no required model, but rather whatever can be obtained. Possibly Haast had in mind offering the German armour-stove to his Lodge in Christchurch.

However, it is more likely that he intended it for the Museum, to extend the "Technological and Industrial Art collections" that he had been endeavouring to make more complete since the opening of the Technological Hall, in 1882.[89] The main purpose of this very large gallery, the last extension to the Museum, was "technical instruction to artisans".[90] Among the many exhibits were examples of carpentry, joinery and masonry, specimens of metal ores from Germany, Austria, England and Tasmania in various stages of extraction and processing, ornamental gemstones from Bohemia, dressed flax from Europe and *harakeke* from New Zealand, facsimiles of old Venetian glass, new and old ceramics from all over Europe and England, textiles and jewellery from India, artistic metal work from Japan, a "case containing portions of 108 different submarine telegraph cables", and "beautifully-constructed mechanical models" made in Germany.[91] Haast would have appreciated the stove-armour as an example of the application of German *historismus* or Historicism – not just recreating a magnificent artefact in the Gothic Revival style, but producing a functional appliance that incorporated both contemporary and traditional craftsmanship.

CONCLUSION

Haast was "now beginning to wonder what he would do with all the cases of treasures that he had been dispatching to Christchurch"[92] and Heinrich's Report to the Board of Governors on 30 June 1887 reflected this concern:

During the year the Director has been straining every nerve to advance the Museum by purchases, exchanges, and presentations from Museums in England and the Continent…He has been travelling in France, Italy, Germany, and Austria, obtaining such specimens as will tend to make all branches of the Museum more complete. Already large and valuable collections for the Ethnological, Paleontological, Technological, and Mineralogical departments have arrived and have been stored, awaiting new show cases. Many cases are now upon the way, and on the return of the Director, in the middle of July, he will doubtless bring many more with him. Already some parts of the Museum are beginning to be overcrowded, and when all the new selections have arrived the want of fresh space will be still more severely felt. A number of new cases will be required.[93]

The Haasts left England for New Zealand on 4 June 1887, and Haast resumed duties at the Museum on 23 July. Less than a month later, on 16 August, he was dead.

In the inevitable confusion that followed Haast's sudden and unexpected demise lies the probable reason for the lack, or disappearance, of information about the armour-stove. It is more than likely that many of the objects acquired by Haast on his last great collecting spree remained in their packing cases for some time, adding to the muddle. Without Haast to explain its purpose and record details of the manufacturer, and, in all probability, insist on its location and correct display labelling in the Technological Hall, the armour-stove was eventually exhibited as an interesting if slightly odd reproduction, and relegated to the Antiquity Room. Over the years, its role simply as "a facsimile of a complete suit of German armour" was cemented in the minds of curators and display technicians. The function and provenance of this 'knight in [not-so-] shining armour' faded to invisibility, along with its link to Canterbury Museum's own knight.

ENDNOTES

[1]Hutton FW (1895) *Guide to the Collections in the Canterbury Museum*. Lyttelton Times, Christchurch, New Zealand. p 137.

[2]Hutton FW (1895); Hutton FW (1900) *Guide to the Collections in the Canterbury Museum*. 2nd edition. Lyttelton Times, Christchurch, New Zealand; Waite ER (1906) *Guide to the Collections in the Canterbury Museum*. 3rd edition. TE Fraser, Printer, Christchurch, New Zealand.

[3]Falla RA (1946) *Canterbury Museum–A Short Guide*, The Canterbury Museum, Christchurch, New Zealand.

[4]This staircase was removed in the early 1990s during earthquake-strengthening and renovations of the nineteenth century Museum buildings, and the floor of the adjacent gallery (currently housing Asian Arts) was raised to the same level.

[5]Falla, op. cit., p 56

[6]Hutton FW (1895), p 3

[7]This was the ground floor of the 1872 addition to the Museum, originally displaying the paleontological collection.

[8]Reynolds RJ (1960) *Canterbury Colonists Galleries - A Guide for a Self-Tour of the Galleries*. Canterbury Museum, Christchurch, New Zealand, p 71.

[9]Op. cit., p 78

[10]Burrage S (2002) A historical guide to cataloguing at Canterbury Museum. *Records of the Canterbury Museum* 16:94-109.

[11]Op. cit., p 97

[12]Op. cit., p 99

[13]Appointed as Ethnologist in 1938, Dr Roger Duff was Director of Canterbury Museum from September 1948 to October 1978. During computer databasing in 2002, the stove-armour was issued with the temporary accession number 19xx.3.608 because the original AR number was illegible. At the time of writing it has not been possible to consult the early card system to confirm and record the number noted by Duff, due to restricted access to the Documentary Research Centre store following the earthquake of 22 February 2011.

[14]Forbes HO (1888-92) *Lists*. 4/1, Box 1A, Folder 7C, Manuscripts Collection, Canterbury Museum, Christchurch, New Zealand.

[15]Hutton FW (1895), p 127. The armour was displayed in the Antiquities Room, near the stairs which led down to the adjacent Sculpture Room.

[16]Bruhn W and Tilke M (1955) *A Pictorial History of Costume. A Survey of All Periods and Peoples from Antiquity to Modern Times Including National Costume in Europe and Non-European Countries*. Zwemmer, London.

[17]Bruhn W and Tilke M (1941) *Das Kostümwerk. Eine Geschichte des Kostüms aller Zeiten und Völker vom Altertum bis zur Neuzeit einschließlich der Volkstrachten Europas und der Trachten der außereuropäischen Länder*. Verlag Ernst Wasmuth, Berlin, Germany.

[18]Bruhn W and Tilke M (1955), Plate 38, centre group, number 6; text p 23.

[19]"The results are works that combine ethnological accuracy with a talented artist's eye for character, place, detail, and emotion. It should be noted, however, that whenever possible, Tilke painted his works directly from the models." http://en.wikipedia.org/wiki/Max_Karl_Tilke

[20]Tilke M (1922) *Orientalische Kostume in Schnitt und Farbe*. Verlag Ernst Wasmuth, Berlin, Germany.

[21]"We cannot reconstruct unless we can compare. For this reason it was first necessary to gather as complete a collection as possible of new and old patterns of garments used by all nations. On journeys in North Africa, Spain, the Balkans, and the Caucasus the material found in the European museums and private collections was completed, and finally united into a collection [exhibited] in 1911 at the Lipperheide Costume Library of the Berlin "Kunstgewerbe" Museum…It was often very difficult to find out the names of the garments. I made all the enquiries I could on my journeys… Whenever I have found the names in the collections of costumes in museums I have made use of them…" http://www.indiana.edu/~librcsd/etext/tilke/ Tilke M (1922), translated by Hamilton L, electronic version prepared by Wroth, C and Liu J, Reference Department, Indiana University Libraries, June 1997.

[22]Demmin A (1869) *Die Kriegswaffen in ihrer historischen entwickelung von der steinzeit bis zur erfindung des zündnadelgewehrs: Ein handbuch der waffenkunde*. EA Seeman, Leipzig.

[23]De Cosson, Baron Charles Alexander (1891) Arsenals and Armouries in Southern Germany and Austria, Part I, *The Archaeological Journal*, Volume V. 48, pp 117-136. British Archaeological Association, London.

[24]Auguste Fréderic Demmin (1817–1898) was born in

Berlin and christened August Friedrich Demmin. He moved to Paris in 1834 to complete his university studies, and afterwards lived there, working as a clerk. Demmin wrote mainly in French, adopting the French version of his name. He returned to Germany in 1872, settling in Wiesbaden.

[25]Demmin A (1894), translated by CC Black from the revised German edition of 1893, *An Illustrated History of Arms and Armour from the earliest period to the present time*. George Bell & Sons, London and New York, p 2. Black was the Assistant Keeper at the South Kensington (Victoria and Albert) Museum.

[26]Op. cit., p 5

[27]Op. cit., p 195

[28]Loc. Cit.

[29]Demmin A, p 211 of 1869 edition and p 15 of 1894 English edition.

[30]Both Bruhn's and Demmin's dating remain unchallenged to this day in reprints of both German and English editions of *A Pictorial History of Costume* and copies of Demmin's illustrations and captions on various internet websites.

[31]De Cosson CA (1891), pp 131-2

[32]Demmin A (1894), p 8

[33]Op. cit., p 13

[34]"The Swabian and Brandenburg-Prussian Hohenzollerns – The Family Tree", http://www.hohenzollern.com/schloss-sigmaringen

[35]Op. cit.

[36]http://www.victorianweb.org

[37]http://www.victorianweb.org/art/design/armor.html

[38]The manufacture was apparently attributed to Edward Baum, a Prussian, and provenanced to the 1851 exhibition in Gibbs-Smith CH (1981) *The Great Exhibition of 1851*. 2nd edition London: HMSO. I have been unable to confirm this. Neither *The Art-Journal Illustrated Catalogue of the Industry of All Nations 1851* (1851. George Virtue, London,) nor *The Crystal Palace and Its Contents: An illustrated encyclopaedia of the Great Exhibition of the Industry of All Nations 1851* (1852. WM Clark, London.) contain this image, nor do later exhibition catalogues for Paris (1855), London (1862) or Vienna (1873) available online.

[39]Mogstad SD (1994) *Frimureri – mysterier, fellesskap, personlighetsdannelse*. Universitetsforlaget AS, Oslo.

[40]Pers. comm. by email with Klaus Rousing, Denmark, November 2002–February 2003

[41]Pers. comm. by email with Dr Peter Kempf, Sigmaringen, November-December 2002

[42]The Philadelphia Museum of Art holds the Kienbusch Collection of Arms and Armor, of which at least a quarter came from the collections of William Randolph Hearst.

[43]Pers. comm. by email with Pierre Terjanien, then Adjunct Associate Curator of Arms and Armor, January 2003

[44]Robinson, Francis W (1954), A Gift of Arms and Armor from the Collection of William Randolph Hearst, *Bulletin of the Detroit Institute of Arts*, Vol. XXXIII, Number 1, 1953-4, pp 3-5. Available online http://www.dalnet.lib.mi.us/greenstone/dia/diaBulletins/33-1.pdf

[45]Op. cit., p 4

[46]Pers. comm. by email with Dr Yao-Fen You, Assistant Curator of European Sculpture & Decorative Arts, Detroit Institute of Arts, April 2011

[47]Variously spelled Helmschmid or Helmschmied, meaning 'helmet smith'. This Augsburg family of armourers included Lorenz (fl.1467, died 1515), Kolman (1471–1532) and Desiderius (1513–1579). They worked for the Holy Roman Emperor, the archdukes of Austria and Tyrol, and various wealthy clients.

[48]Pyrhh SW (2008) "Armor in the Gothic Style", catalogue object 20, pp 159–60 in Levkoff M (ed), *Hearst the Collector*. Abrams, New York. The Munich armourer very probably worked for a studio established by Hugo Jubitz in 1868, and later purchased by Ernst Schmidt. Schmidt provided reproductions of armour and arms from established collections, as well as undertaking repairs. The studio's work was of very high quality and the business operated until 1930. (Robinson N (n.d.), *A Profile of Ernst Schmidt: German Craftsman of Reproduction Arms, circa 1870s–1930*. http://www.myarmoury.com/feature_schmidt.html)

[49]*Inv. No. HJRK_A_62*, Kunsthistorisches Museum, Vienna

[50]Pyrhh SW op. cit., p 60

[51]The Jacques Seligmann & Co. records, of which the papers of Arnold Seligman, Rey & Co., form a part, are held in the Smithsonian Institute, Archives of American Art http://www.aaa.si.edu/collections/jacques-seligmann--co-records-9936

[52]A series of photographs of the Hearst apartment at The Clarendon were taken for his *International Studio* magazine in June and October 1929. Other photographs

date from slightly later and are held by the Library of Congress.

[53]Robinson FW op. cit., p 3

[54]Loc. Cit.

[55]Reichmann M (2001) *Die Harzer Eisenhütte unterm Mägdesprung – Ein Beitrag zum Kunstguss im Nordharz*. Dissertation zur Erlangung des akademischen Doctor philosophiae (Dr. phil.) vorgelegt an der Philosophischen Fakultät der Martin-Luther-Universität Halle-Wittenberg verteidigt am 24.01.2001. Available online http://webdoc.gwdg.de/ebook/ga/2002/pub/kunst/01H313/of_index.htm

[56]Part of the Carl Horn Collection at Schloss Allstedt, in the county of Mansfeld-Südharz, south-west Saxony-Anhalt, Germany

[57]The measurements are the same for the Canterbury Museum example.

[58]"Complette Rüstung eines Landsknechts"

[59]"Diese Rüstung ist nach einem Original gegossen, das sich in einer Sammlung der Hohenzollern befunden haben soll. Die lebensgroße Mannrüstung ist sicherlich der Feldharnisch eines Ritters, aber nicht die eines Landsknechtes…Das Original ist in die Zeit um 1475 zu datieren, die Merkmale dafür sind bei der Rüstung der Helm, eine deutsche Schaller, die stark eingezogene Taille, die Anordnung der Schübe und die Linienführung der einzelnen Harnischteile sowie deren darauf befindlichen Grate, die eine schlanke vertikale Optik vermitteln. Die gegossene Rüstung aus einzelnen Teilen entsprechend dem Original, einzelne Schübe usw. sind allerdings zusammengefaßt worden."

[60]De Cosson CA (1891), p 131

[61]Reichmann M (2001), p 167

[62]http://www.allstedt-kaltenborn.de/cms/1/?i=1.136.242.21.1.de..de

[63]http://www.mv-sachsen-anhalt.de/main.pl?lang=de&page=mus_them&them=Technik%20und%20Industrie&id=66

[64]A relief map of the Harz Mountains was exhibited in the Mineral Room and the 1895 *Guide* noted that this was a "celebrated mining region in the centre of Germany" (Hutton FW (1895), p 42).

[65]At the time of writing it has not been possible to re-check many of these objects due to the temporary closure of stores following the February 2011 earthquake and aftershocks. Identification has been based on previously-taken photographs and notes, and comparison with similar artefacts in the Mägdesprung catalogues and online information.

[66]This was the attribution accepted in the mid-nineteenth century by the Louvre Museum, where the original is held. It is now known that Cellini was not responsible for design of any armour.

[67]See Haast H von (1948) *The Life and Times of Sir Julius von Haast*, Avery Press Limited, New Plymouth, pp 899–974 for a detailed account.

[68]Op. cit., p 925, quoting from a letter written by the Prince of Wales to von Haast, 26 June 1886

[69]On 22 June 1874, the Emperor Franz Joseph of Austria conferred The Order of the Iron Crown, 3rd Class on Haast. This was a hereditary knighthood and entitled him and his family to the honorific "Von". In January 1880, von Haast "received the insignia and documents of the grade of Cavalier and Order of the Crown of Italy that the King of Italy had conferred upon him" (Haast, H von (1948), p 841).

[70]Richard Fereday, a conveyancing solicitor in Christchurch

[71]William Montgomery (1821–1914), Chairman of the Board of Governors of Canterbury College

[72]Haast, H von (1948), pp 965-6

[73]Op. cit., p 946

[74]Some of these are currently exhibited in the "Victorian Museum" display in the part representing Haast's office.

[75]Old acquisitions number 3612. These were received from Samuel Hearst Seager in August 1885.

[76]Gifted through the Philosophical Institute of Canterbury (now the Canterbury Branch of the Royal Society of New Zealand) of which Julius von Haast was a founding member.

[77]All these medals are currently exhibited in the Mountfort Gallery of European Decorative Arts, the original Canterbury Museum building of 1870.

[78]Von Haast J (1875) *Report on the progress of the Canterbury Museum for the 18 months ending March 31st 1875 with 4 Appendices*. Canterbury Museum, Directors' Correspondence 4/1, B1A/F7C.

[79]Described as "a breast-plate, helmet, and shoulder-pieces, of the commencement of the 16th century" in the *Guide to the Collections in the Canterbury Museum* (1895), p 127.

[80]Germann G (n.d.) "Gothic Revival" in *Grove Art Online*, available online http://www.oxfordartonline.com

[81]The original four sections of the Canterbury Museum

built between 1869 and 1882 were designed by Benjamin Woolfield Mountfort (1825-98), who was trained by Richard Cromwell Carpenter of London, an influential Gothic Revival church architect. Thanks to a programme of seismic strengthening undertaken from 1985 to 1995, Canterbury Museum is one of the very few Christchurch Gothic Revival buildings to have survived the earthquakes of September 2010 and February 2011. Most other significant buildings and complexes of this style have been either totally destroyed or very badly damaged.

[82]2 August 1886

[83]Hutton FW (1895), p 164

[84]Haast H von (1948), p 3

[85]His fellow Masons from this Lodge, which had been consecrated on 19 October 1853, included many prominent and influential colonists – William Sefton Moorhouse, Thomas Cass, John Ollivier, William Rolleston (whose statue stands outside the Canterbury Museum, on the avenue named in his honour), and William Guise Brittan among others. Pugh-Williams R E (n.d.), *Rail and Freemasonry in New Zealand* available online http://www.mastermason.com/railcraft/RandFM.htm

[86]http://watch.pair.com/MasonicPlan.html

[87]Images available on line http://www.zentropolis.com/logs_2008_02_25/Pages/Armor.htm and http://www.zentropolis.com/logs_2008_02_25/Pages/Chapel.htm

[88]http://www.flickr.com/photos/44469679@N03/4091379461/

[89]Haast H von (1948), p 881

[90]Op.cit., p 887

[91]Op. cit., p 889

[92]Op. cit., p 947

[93]Newspaper cutting, probably from the *Lyttelton Times*, circa 30 June 1887

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5

Inspiration in the detail: documenting *upeti fala* and *upeti* at Canterbury Museum

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ABSTRACT

One wooden and four textile *siapo/tapa* design boards provenanced to Samoa, known as *upeti* and *upeti fala* respectively, from Canterbury Museum's collections are thoroughly described, documented and illustrated. Relevant literature is reviewed and evaluated against the findings of this material culture analysis. The implications of the new information about *upeti fala* and *upeti* are discussed and potential areas of new research are suggested.

KEYWORDS

upeti fala; *siapo*; *tapa*; barkcloth; Samoan textiles; gender; design tablets; Pacific design

INTRODUCTION

Amongst collections of Samoan material culture, design tablets called *upeti fala* remain largely undocumented. *Upeti fala* are made from layers of pandanus (*Pandanus sp*.) leaf strips to which raised elements of pandanus leaf, coconut (*Cocos nucifera*) fibre cordage (sennit), and coconut leaf riblets are sewn. Like their later wooden counterparts called *upeti*, they were once commonly used as templates in the decoration of barkcloth traditionally called *siapo* in Samoa. *Siapo* was made from the bark of the paper mulberry tree (*Broussoneta papyrifera*) and is more widely recognised as *tapa* by non-Polynesian speakers.

Researchers have documented the manufacture, choice of materials, use of *upeti fala* and *upeti* and traditional techniques used to apply patterned decoration to *siapo* (Buck 1930; Kooijman 1972; Neich 1985; Mallon 2003). Buck (1930, p. 308) provided both a description and an explanation of a typical example of *upeti fala* manufacture. He argued that the raised design elements were stitched to a single layer of pandanus leaf, and when the decoration was completed this layer was then joined to another layer of pandanus leaf by stitching through the sennit cord elements of the design, commenting that:

The stitches of the pandanus strip therefore keep the leaves of the upper layer together while those of the cords bind both layers together (Buck 1930, p. 308).

Four different techniques used to apply decoration to *siapo* – stamping, painting, ruling and rubbing – have been documented in Samoa (Kooijman 1972). *Upeti fala* were used in the rubbing method. In the most frequently used method, overlapping strips of plain *siapo* were placed over the *upeti fala* and *loa* (or *o`a*), a red dye (from the juice of bishop wood, *Bishoffia javanica*, bark) was rubbed into the sheets with a pad of bark cloth. The

raised designs on the *upeti fala* were embossed onto the *siapo* and the resulting patterns appeared on the upper surface against a lighter toned background which was only superficially coloured (see Buck 1930, pp 306-308, Kooijman 1972, pp 218-224, Neich 1985, pp 47-48). Simultaneously, the overlapping layers of *siapo* were glued together with arrowroot paste (*Tacco sp*.) to form a single sheet.

Observations have been made concerning changes through time in the design boards, techniques for applying decoration, and of the designs themselves. Painting and rubbing are thought to have been the most frequently employed techniques used to apply designs in Samoa (Neich and Pendergrast 1997, p.24). Buck (1930, p. 308) recorded that during the late 1920s both of these techniques were practised, and freehand painted designs were more popular (see Neich 1985, p. 50). By 1980, it was recorded that freehand *siapo* had almost disappeared but painting techniques were still used to embellish patterns made with wooden *upeti* (Neich 1985, pp 50-51). Most significantly, during this time period *upeti fala* were replaced by *upeti* made from wooden planks, a process which appears to have been relatively rapid. In the late 1920s, only a few *upeti fala* were observed still in use in Samoa, and by 1980 they had become completely obsolete and apparently long forgotten (Buck 1930, p. 308; Neich 1985, p. 51). The production of *siapo* itself and changes to the traditional naturalistic designs are argued to have also been influenced by European ideas, such as those stemming from the church and relating to the organisation of work, and introductions such as imported patterned textiles (see Mallon 2003, pp 64-73). From a gender perspective the switch from *upeti fala* to *upeti* is also significant for understanding change. While *upeti fala* are argued to have been customarily designed, made and used by women, *upeti* made from wooden planks had surface designs carved by men. However, Neich (1985, p. 51) argued that male designers replicated the earlier *siapo* motifs developed by women and created rudimentary designs, leaving large scope for infilling and over painting by women.

Despite these intriguing observations, there has not been any sufficiently detailed material culture analysis of the *upeti fala* and *upeti* themselves to allow comparative studies between collections, to determine temporal and regional provenance or to quantify technological or artistic change. Kooijman (1972, pp 218-221) did provide a brief mention of *upeti fala* and *upeti* from the Rijksmuseum voor Volkenkunde (now Museum Volkenkunde) in Leiden and hinted that pandanus strips used as foundations for the designs could in fact form a pattern or base for influencing the overall design elements, but other research has clearly focussed on *tapa* itself – the end product – either through time, looking at contemporary revival, or considering details of the production sequence from particular regions or artists (see Mallon 2003, pp 68-71). The inadequacy of the analysis of *upeti fala* design and manufacture also complicates any systematic attempt to document and examine the impact of both the technological and social processes that occurred in Samoan *siapo* production during the late 19th and early 20th centuries.

By contrast with other traditional Polynesian technologies, sewing remains under researched (for comparison see Wallace 2006, p. 79 on Maori sewing). However, sewing is a key component in the manufacture of *upeti fala* and as such offers an important subject area for enquiry. Detailed descriptions of techniques used for the manufacture of *upeti fala* can be compared with other similar textile traditions through time and space.

Many questions also remain about the apparent gender transfer of responsibility for *siapo* designs that occurred as the manufacture of *upeti fala* declined. Can design changes be explained by a simple switch of raw material brought about by the availability of wooden boards and metal tools (see Buck 1930, p. 309)? Or was this connected with the changing roles of women in the organisation of work, as discussed by Mallon (2003, p. 71) which gave them less time for traditional arts as they engaged more in employment away from village and family? Or was this a result of pre-existing perspectives of gender roles in daily life? Is it possible at all to gain information about gender roles from *upeti fala* and *upeti* themselves?

Gaps in research can be attributed in part to an absence of evidence. *Upeti fala* are relatively uncommon compared with their more durable wooden counterparts (*upeti*). Being composed of fibre it is assumed they would have quickly deteriorated, a process exacerbated by their repeated rubbing when in use. It is therefore reasonable to assume that compared with *upeti*, *upeti fala* would have been discarded and replaced more frequently. This in turn would have provided greater opportunity to innovate with new stylistic designs,

thereby acting as an inherent driving stimulus and impetus for artistic change. In contrast, did the durability of wooden *upeti* in fact contribute to their reuse for a longer duration, and therefore result in the retention and replication of women's earlier designs by males as observed by Neich (1985, p. 51)? Did the arrival of *upeti* actually remove the previous dynamic elements of innovation from *siapo* design, rather than perpetuating them?

By utilising the collections at Canterbury Museum, this study addresses gaps in *siapo* research through detailed analysis of the construction and designs of four *upeti fala* (E97.5a, E97.5b, E166.401 and E138.361) and one wooden *upeti* (E138.362) securely provenanced to a period of considerable material cultural change in Samoa during the first half of the twentieth century (Table 1). An assessment is made of the rarity of *upeti fala* in other museum collections and possibilities for future avenues of research are proposed. While conclusive answers to the myriad of social questions relating to tradition, technology, resource exploitation, gender and change are not yet possible, the detailed documentation of the *siapo* design boards in Canterbury Museum will contribute to a greater understanding of these transformations. The potential for comparative research into the naming and use of designs between *siapo* and other design forms such as tatau (Samoan tattoo) and amongst Pacific sewing technologies is assessed. Comparison between the design boards themselves and also with the end product, *siapo*, is highlighted as an essential goal of future research. The intention is to provide stimulus for a research driven re-analysis and re-evaluation of *upeti fala* and *upeti* held in museum collections internationally.

UPETI FALA AND *UPETI* AT CANTERBURY MUSEUM

Canterbury Museum's collection of *upeti fala* and *upeti* (Table 1) are presented as a case study to provide a point of reference for the ongoing analysis of *siapo*. The temporal and spatial provenance of these objects is presented followed by a detailed discussion of their construction, use and design elements.

Provenance

Various editions of *Guide to the Collections in the Canterbury Museum* (Hutton 1895, 1900; Waite 1906) along with old card indexes, original accession ledgers and catalogue books held by Canterbury Museum are used in conjunction with knowledge of collectors to define the temporal and spatial provenance of the design boards. Table 1 summarises the provenance of the Canterbury Museum's Samoan *upeti fala* and *upeti* collection by providing known time periods and locations in which these objects were originally collected. Table 1 also demonstrates when and where these design boards were likely to have been manufactured and used.

E97.5a and E97.5b are the oldest *upeti fala* in the collection. They were originally accessioned as "*tapa* printing frames from Samoa" (Canterbury Museum Ethnology Register No. 1, p. 43) by Canterbury Museum on 11 February 1897, along with a wooden box (Tokelau), stick (Savai`i) and wooden fan (Samoa), donated by TB Curack-Smith Esq, His British Majesty's Consul, Apia. Confirmation of the accession date is provided by comparing editions of the *Guide to the Collections in the Canterbury Museum*. Both *upeti fala* are mentioned in later editions (Hutton 1900; Waite 1906) but not in the first edition (Hutton 1895).

Table 1. Provenance of *upeti fala* and *upeti* at Canterbury Museum 2011

Catalogue No.	Type	Collector	Time period	Location
E97.5a	*Upeti fala*	TB Curack-Smith Esq.	pre 1897	Apia, Savai'i
E97.5b	*Upeti fala*	TB Curack-Smith Esq.	pre 1897	Apia, Savai'i
E166.401	*Upeti fala*	Rev Colin Bleazard	1892-1901	Western Samoa
E138.361	*Upeti fala*	RS Duff	1935 -1937	Upolu
E138.362	*Upeti*	RS Duff	1935 -1937	Upolu

It can therefore be safely ascertained that these two *upeti fala* were collected from Apia on the island of Savai`i prior to 1900.

E166.401 possibly overlaps in age with E97.5a and E97.5b. It was accessioned by Canterbury Museum on 27 June 1966 as a:

Rubbing sheet of pandanus leaf and coconut mid-ribs and textile. Fragmentary and in poor condition. Used for tapa cloth designing and were stretched over rounded log base Upeti Lau fala (Canterbury Museum Ethnology Register No. 7, p. 311).

Records show that this *upeti fala* was part of a large collection of ethnographic material from Western Samoa (and also Fiji and Melanesia) presented by Miss Valasi Bleazard, which was collected by her father, Rev Colin Bleazard, a Methodist Missionary in Western Samoa from 1892 until 1901. Provenance of this collection can be confirmed from the records of the Western Australian Museum, Perth, to which, on 30 March 1903, Rev Bleazard himself gave a large collection of ethnographic items that he had collected in Western Samoa between 1892 and 1901 (Bolton and Specht 1985, pp 357-358). This gift, however, contains no *upeti fala*; these were presumably retained by Rev Bleazard and later handed to his daughter. The collection provenance of E166.401 can therefore be narrowed down to Western Samoa between 1892 and 1901.

E138.361 and E138.362 are the most recent design boards in the collection. They were accessioned by Canterbury Museum on 20 April 1938 by Roger Duff as part of a collection of ethnographic material chiefly from Samoa, but also from Tokelau, Niue and Fiji, collected by Duff himself (Canterbury Museum Ethnology Register No. 2, p. 43). Duff was appointed Ethnologist at Canterbury Museum and commenced to upgrade the Ethnology catalogues in January 1938 (Burrage 2002, pp 97, 99). The catalogue entry for E138.361 in Duff's writing reads:

flexible tapa stencil (Upeti) made from pandanus leaf, with ribs of coconut, Upolu (Canterbury Museum Ethnology Register No. 2, p. 43).

Between 1935 and 1937 Duff held a cadetship in the civil administration of Western Samoa with the New Zealand Government's Department of External Affairs. Canterbury Museum Archives hold a number of folders relating to Duff's activities in Samoa, containing lecture notes on Samoan customs and observations about shortcomings of the New Zealand administration, but unfortunately no account of his field collections (Canterbury Museum Records Series 4/2). However, acknowledgement of his gift is recorded by the Director's report in the Museum's Annual Report (Falla 1938, p. 20). It can be assumed, then, that Duff collected these two design boards on the island of Upolu between 1935 and 1937.

Canterbury Museum's collection of design boards has a secure provenance spanning approximately forty-five years between 1892 and 1937. This encompasses the time period when bark cloth design boards made from pandanus leaf strips with applied designs were replaced by wooden boards with carved designs. Similarities and differences between late nineteenth century *upeti fala* (E97.5 a and b, E166.401) and the *upeti fala* and wooden *upeti* collected thirty years later will be examined in order to contribute further information to the resolution of questions about changes in the techniques used to apply decoration to *siapo*, and the design motifs themselves.

Manufacture

All of the *upeti fala* and the *upeti* discussed herein are rectangular in shape. The *upeti fala* are all manufactured in the same manner, by sewing together two layers of pandanus leaf strips to create upper and lower layers with well defined margins or borders. Attachment devices for connecting these flexible objects to papa elei (wooden platforms) to provide an anchor for the rubbing process are also present. The process of manufacture of *upeti fala* can be traced through analysis of the stitching, the construction of the body (both upper and lower layers), the back surface, and the attachment devices and borders. A detailed analysis of the only wooden *upeti* is also provided. It must be noted that *upeti fala* E166.401 is in a fragile condition, making handling, close inspection and identification very difficult, and as a result of deterioration some details are now obscure. Table 2 summarises the main characteristics of design boards while Figures 1-7 illustrate design elements through drawings, and manufacturing elements through photographs and a detailed section drawing.

***Upeti fala* sewing and stitching**

Couching stitches, defined in embroidery as fixing a thread to a fabric by stitching it down flat with another

Table 2. Manufacturing details

Catalogue No.	E97.5a	E97.5b	E166.401	E138.361	E138.362
Dimensions	589 x 284 mm	775 x 440 mm	695 x 320 mm	1000 x 450 mm	799 x 286 x 18 mm
Attachment loops remaining	4	8 (originally 9)	unknown	8 (originally 9)	N/A
Lower layer	6 longitudinal	8 vertical	7 vertical	12 vertical	N/A
Lower layer strip width	45-55 mm	85-145 mm	65 -115 mm	75-115 mm	N/A
Upper layer	14 vertical	4 longitudinal	2 longitudinal	4 longitudinal	N/A
Upper layer strip width	37-56 mm	85-110 mm	160 mm	80-140 mm	N/A
Stitching	white fibre thread (possibly fau Hibiscus sp), two-ply plaited sennit, brown bast fibre (possibly fau Hibiscus sp.), two-ply sennit	brown bast fibre thread, two-ply plaited sennit, twisted double strands of fibre thread	single and double twisted bast fibre threads, two-ply plaited sennit (fragmentary), two-ply sennit cord	machine manufactured twisted white cotton string (two thicknesses), brown bast fibre and double twisted strands of sennit, two-ply sennit cord	N/A

thread, are used to join the main components of *upeti fala*. The layers of *upeti fala* E97.5a (Fig. 1) are sewn together around the margins with parallel rows of white fibre thread (possibly fau Hibiscus sp.) drawn in a continuous couching stitch. This same stitching also holds in place a raised two-ply plaited sennit decorative border that defines the margins of the upper design surface. Similarly, a continuous couching stitch through both layers of the base holds the border in place on E97.5b (Fig. 2). However, in this *upeti fala* a single row of unidentified brown bast fibre thread is used. E166.401 (Fig. 3) is also sewn together around the margins, as well as along the centreline and through the design elements, with single and double twisted bast fibre threads, drawn in a continuous couching stitch through both layers of the base.

The youngest *upeti fala* E138.361 (Figs 4 and 5) is sewn together around the margins and along the

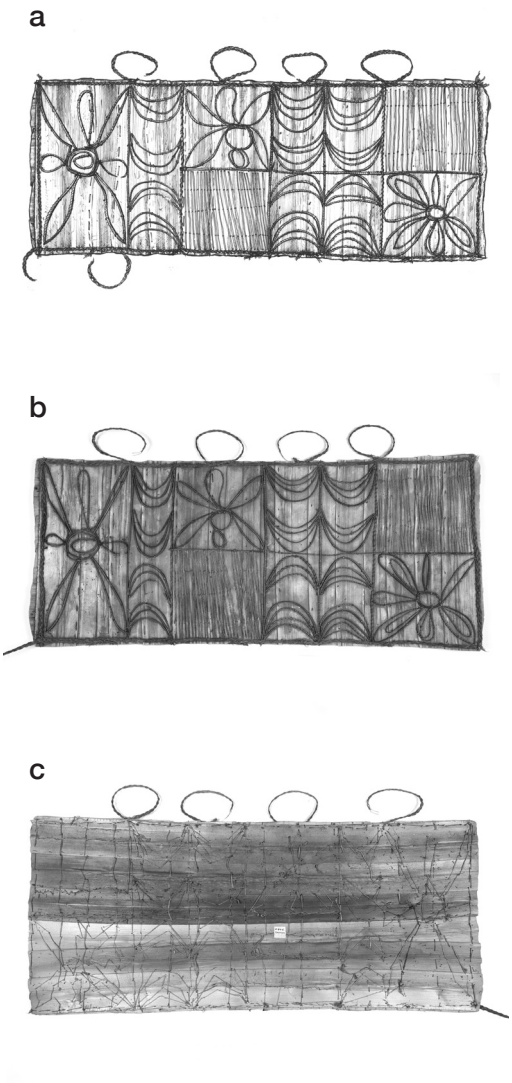


Figure 1. E97.5a, *upeti fala*, a – drawing; b – photograph of front; c – photograph of back

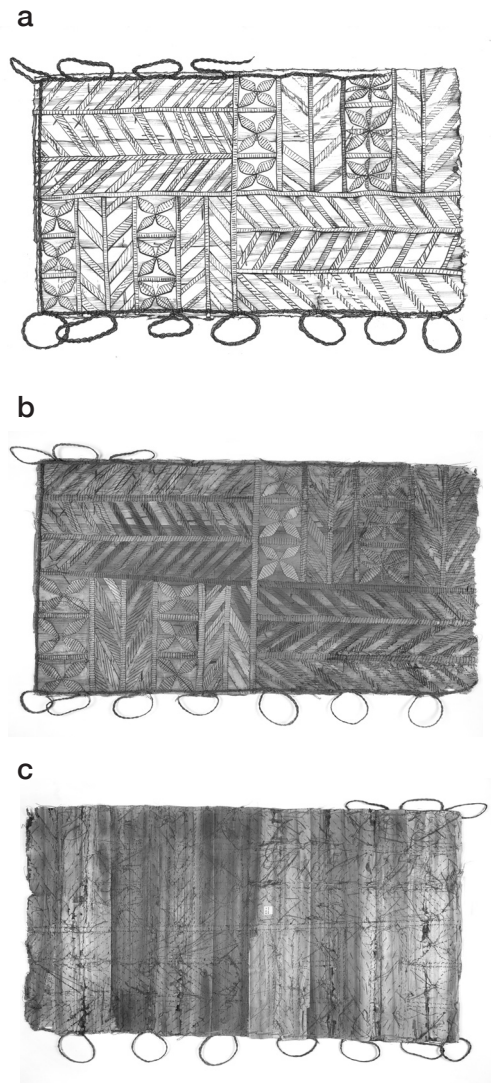


Figure 2. E97.5b, *upeti fala*, a – drawing; b – photograph of front; c – photograph of back

centre line with double, and sometimes triple, rows of European machine-manufactured twisted white cotton string, drawn in a continuous couching stitch through both layers of the base. Two different thicknesses of fine string have been used in construction, although this appears not to have any functional application. At several points around the margins an unidentified brown bast fibre and double twisted strands of sennit remain visible and appear to be the original threads holding the layers together, as the string stitching always overlies this traditional fibre. From the alignment of this stitching visible on the underside of the base, it also appears to hold in place the plaited sennit decorative border that defines the margins of the upper design surface.

Couching stitches are also used in the formation of the upper layer. In E97.5a the vertical strips are sewn together along each overlap with an unidentified brown bast fibre (possibly fau Hibiscus sp.) drawn in a continuous stitch through both the overlapping edges and the longitudinal lower strips. In E97.5b, where visible, two of the overlapped edges of strips have been sewn together with a brown bast thread, through both the overlapped edge and the lower layer. There is only one overlap in the upper layer strips on E166.401, and

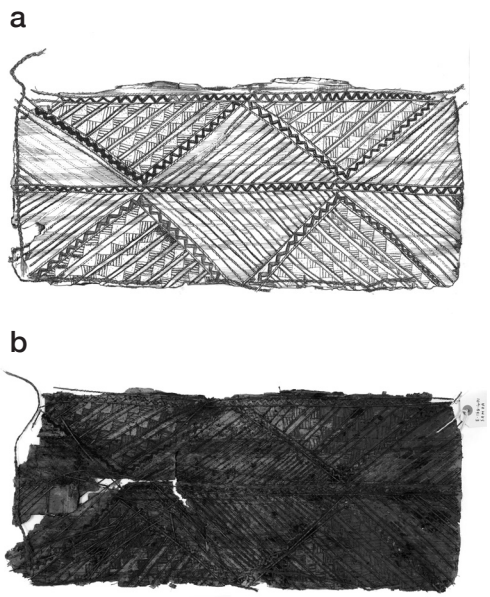


Figure 3. E166.401, *upeti fala*, a - drawing and b - photograph of front

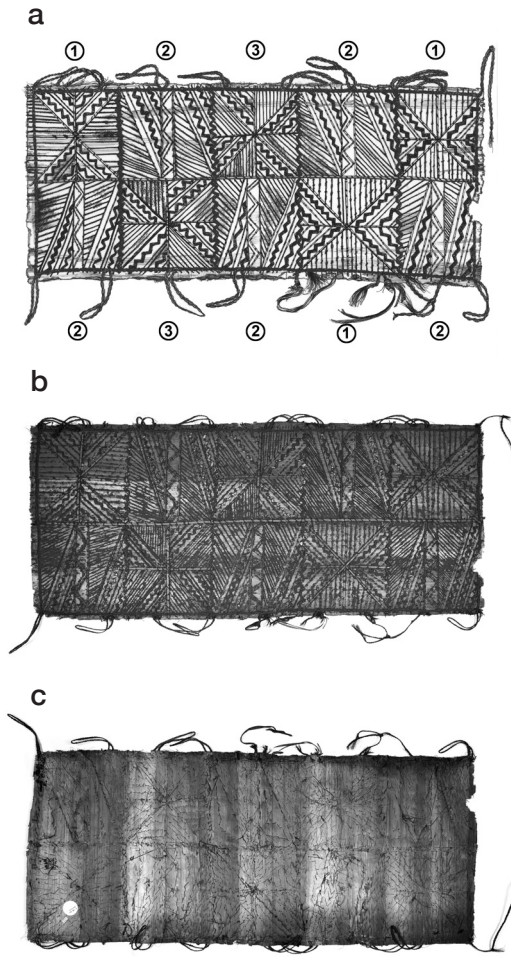


Figure 4. E138.361, *upeti fala*, a – drawing indicating Design One, Design Two, and Design Three; b – photograph of front; c – photograph of back

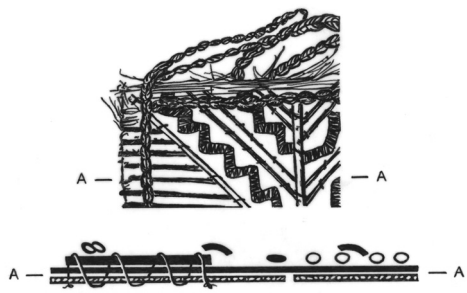


Figure 5. E138.361, *upeti fala*, enlarged schematic section through Design One showing construction

this is held in place with a row of couching stitches of bast fibre. Further details on the stitching used in the upper layer are discussed below.

Four different types of thread are used. Thin strips of unmodified bast were used on all the late nineteenth century examples (E97.5a, E9735b and E166.401) to secure overlapping edges and borders. On E97.5a an unidentified white thread of fine twisted or rolled fibres was used both to stitch the raised two-ply sennit border in place and as a design element itself. Sennit was used on all *upeti fala* both as single or double twisted threads of various thicknesses. Single threads were tightly coiled around the raised wooden design elements on two of the nineteenth century examples (E97.5a, E166.401, Fig. 6). The function was obviously to give texture to the wooden surface to facilitate the rubbing process. Double twisted threads were also deliberately used as exposed stitches on the same two *upeti fala* to enhance designs.

The back surfaces of *upeti fala* are clearly functionally different from the upper design surface but nevertheless reveal important additional details about sewing. For example, the back surfaces of both E166.401 and E138.361 show that their lower layers are sewn together along each overlap with a few widely spaced couching stitches of unidentified brown bast fibre (Figs 3 and 4). This stitching is concealed on the upper surface beneath the raised design elements. In both E97.5a and E97.5b the stitches are roughly finished on the back surface with loose and tied-off ends, but they clearly reflect the distribution of patterns on the design surface (Figs 1 and 2).

Upeti fala lower layer

The numbers of pandanus strips used to manufacture the lower (or base) layer appear to correspond with the final dimensions of the design board. The smallest *upeti fala* E97.5a had the smallest strips by width, however the second smallest *upeti fala* E97.5b had one very large strip with a width of 145 mm while the rest were between 85 and 100 mm. Individual strips were overlapped to create the lower layer. Strips were most frequently laid out vertically on the lower layer, except for E97.5a where they were laid longitudinally.

Upeti fala upper layer

As per the lower layer, the wider the strips the fewer were used. The components of these design tablets, details of sewing and design elements are all visible to certain degrees on the upper surface which forms the working surface of *upeti fala*. Stitching, while used to secure components together, is also used in the formation of design elements and at times is concealed so as not to influence the design.

In E97.5a the couching stitches which join together the upper layer strips are the only clearly visible stitches on the upper surface and appear as parallel lines of stitches at variable intervals. With all other stitching emerging onto the design surface, care has been taken to conceal them by incorporation into the raised design elements. The overlapping edges of the upper layer strips are difficult to distinguish in E97.5b and are mostly concealed beneath longitudinal design elements. Instances where the overlapped edges of strips are sewn together are randomly visible on the design surface, and some stitching appears to have been added during the application of the raised designs to tighten the construction. The proliferation of twisted double strands of fibre thread couching stitches used to attach the raised design elements to the design surface are placed in such a manner as to enhance the surface detail of the designs, and also function as the principal method of binding the two pandanus layers of the base together. The upper layer of E166.401 has two large longitudinal strips with a single overlap running approximately along the centre line of the design surface. The row of couching stitches which attach these strips together, as mentioned above, is held in place by bast fibre stitching that also secures the central raised design element formed of a folded zig-zag strip of pandanus leaf. In E138.361 the overlaps are clearly sewn in place with a couching stitch through both layers of the base. These are not visibly sewn together except where elements of the raised design correspond with the seams.

Upeti fala borders and attachment devices

Individual *upeti fala* exhibit varying surviving evidence of their original borders comprised of two-ply plaited sennit and attachment devices in the form of loops. Like stitching, the raised borders were an integral component used to define design spaces, but would have also provided strength for the attachments and contributed to the structural integrity of the entire design board.

One edge of E97.5a has four loops formed from the continuous plaited sennit border, stitched in place with

white fibre thread at equal intervals along the length of the *upeti fala*. Evidence of a corresponding set along the opposite edge still remains. A tag of two-ply sennit stitched in place with white thread extending from the decorative border at one corner is evidence of a once longer coil traditionally laced through the loops to secure the *upeti fala* to the rubbing board.

In comparison, E97.5b has seven loops of two-ply plaited sennit remaining along the length of one edge. An eighth appears to have been present on the corner which is damaged. Three intact loops and evidence of three that have broken off remain on the opposite edge. These points of attachment are formed by looping the raised sennit border during its application, and held in place by several closely spaced couching stitches in the sequence holding the border in place. The border of E97.5b only remains intact along three edges. This border has been superimposed over the main raised relief designs, which continue under and slightly beyond to the end of the *upeti fala*.

a

b

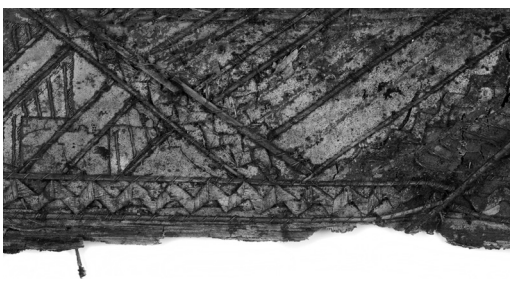
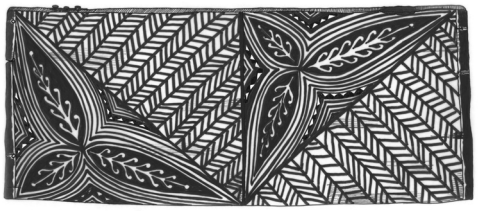


Figure 6. Close up photographs showing details of a - E97.5a and b - E166.401

a



b

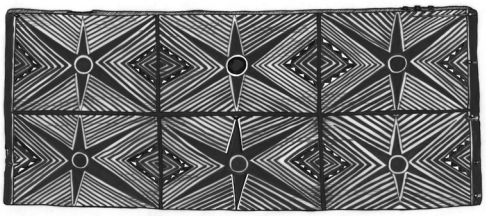


Figure 7. E138.362, *upeti*, drawings of a - surface 'a' and b - surface 'b'

The badly deteriorated E166.401 has no attachment loops now remaining, but a partially intact border of two-ply sennit fibre stitched along two margins with bast fibre probably once included folded loops as on other *upeti fala* in the collection. Similarly, the short tag of two-ply sennit cord extending from one corner was probably part of a much longer coil used to secure the *upeti fala* to a base board.

E138.361 now has eight loops of two-ply sennit cord evenly spaced along one edge. This would have had originally nine, as two adjacent loops that have broken in use have been roughly knotted together. There are eight loops along the opposing edge and a remnant tag of what would once have been a much longer cord for lashing both through the loops and the base board. These loops were also formed during the process of attaching the continuous two-ply sennit border to the design surface.

Manufacturing summary

From this close examination of *upeti fala* it is possible to begin to draw conclusions about the manufacturing process. Initially, each layer was sparingly sewn together along the edges of adjacent strips, then the two layers sewn together in the same manner around the vertical borders. On only two *upeti fala* (E97.5a and E97.5b)

is this stitching clearly visible anywhere on the upper design surface. On the remainder, care has been taken to distribute the stitches in such a manner as to be able to later conceal or incorporate them into the applied designs. This suggests that the intended design had already been conceived by the maker, and the various elements were deliberately spaced to conceal most of the regular overlaps.

The major structural integrity of the *upeti fala* comes from the numerous couching stitches used to apply the design elements. These stitches pass through or over each element and through both layers of the base. As seen on E166.401 and E138.361 the final step in the construction of all the *upeti fala* was the sewing in place of a continuous raised two-ply sennit border, superimposed over the margins of the other design elements. The borders incorporate evenly spaced loops along both longitudinal edges and a length of sennit cordage extended from one corner for attachment to a wooden base and also functioned to enclose the design surface of the *upeti fala*.

Upeti

E138.362 is a wooden *upeti*. The species has not yet been identified and therefore it is impossible to say whether it is a local indigenous timber or from an exotic imported source such as a piece of furniture. However, the presence along one edge of a row of three evenly spaced 'slot-head' iron screws eleven centimetres in from one corner and a series of three rust stained holes at the corresponding point at the other end of the same edge indicates that the *upeti* was recycled from a light wooden door, possibly from a cupboard. Both surfaces of the board are smooth, flat and level, indicating it has been machine gauged to size. A series of holes along either end of the board suggest that decorative wooden mouldings may once have been attached across the top and bottom margins. There is no evidence of a latch or other fittings along the inner edge, but the remains of two iron nails, approximately three centimetres from either end may once have served as catches. The function of a sequence of four older rust stained nail or screw holes on the same edge is difficult to explain.

Use and repair

As summarised in Table 3 the Canterbury Museum examples of *upeti fala* and *upeti* show varying degrees of usage and wear. E 97.5a and 97.5b do not show any signs of having been used. The natural fibres in E138.361 were either used to temporarily hold the base pandanus layers together during the process of design application prior to strengthening the construction with string, or were reinforced with string when they perished in use. Of these explanations the addition of string as evidence for repair is preferred. This seems consistent with the observation that this *upeti fala* shows evidence of use from the presence of dye. One other *upeti fala*, E166.401, also shows a build up of dye and when considered in conjunction with its deteriorated condition it can reasonably be suggested that this object experienced a longer use-life as a design tablet.

A series of randomly distributed patches of surface damage, caused by either boring insects or dry rot on the *upeti* E138.362, occurred apparently while the board was in use. This may also be consistent with the raw material used having been recycled from an item of furniture. At some point a decision was made that the furniture was no longer required, or perhaps useful, for its original purpose and was instead more valuable in the process of *siapo* manufacture.

Table 3. Use, repair and condition

Catalogue No.	Type	Use	Repair	Condition
E97.5a	*Upeti fala*	unused	not observed	good
E97.5b	*Upeti fala*	unused	not observed	good
E166.401	*Upeti fala*	used	not observed	poor
E138.361	*Upeti fala*	used	addition of string	good
E138.362	*Upeti*	used - both surfaces	raw material recycled	old damage

Design

The characteristics of design elements are clearly influenced by the raw materials used and their orientation. With *upeti fala*, many of the features important for the structural integrity of the object are also integral to the design layout. Design surfaces consist of patterns of reoccurring motifs arranged within sequences of smaller, usually repetitive design panels. Unlike the *upeti fala*, the wooden *upeti* has design surfaces carved on both the front and back surfaces.

The surface area within the border of E97.5a (Fig. 1) is divided into ten rectangular panels by straight lengths of as yet unidentified sections of semi-circular cross-sectioned fibrous wood (probably coconut leaf mid-rib) coiled with strands of sennit. These dividers are sewn in place with a couching stitch of white thread passed through both layers of the base. Each panel contains a design motif. Three panels contain flowers with a central eye and radiating elongated petals formed by bending semi-circular sections of fibrous wood (probably coconut leaf mid-rib) decorated with coiled strands. Each flower is held in place at multiple points with white thread sewn through both layers of the base with a couching stitch. Five panels contain twelve crescent shapes radiating in opposite directions from the centre line of the *upeti fala*. Five of the crescents are composed of a cluster of three elements; six have four elements, and the remaining crescent five. One panel with crescents extends uninterrupted from margin to margin, while the remaining four have a central fibrous wooden divider coiled with fibre. The remaining two panels are square with slightly off-vertical parallel sets of twisted white threads (numbering 30 and 31 respectively) sewn with couching stitches through both layers of the base. In one panel each individual thread is held in place with two sets of couching stitches through both layers of the base; the other has three sets in the same configuration.

E97.5b (Fig. 2) is divided into four rectangular design panels by straight strips of pandanus leaf, sewn in place with closely spaced parallel lines of twisted double threads of sennit, that enhance the otherwise low-relief raised ridges formed by a single thickness of pandanus leaf. With only minor variations, the four panels comprise two with floral and two with rectangular designs placed in diagonally opposing configuration. The virtually identical rectangular designs have two long vertical bars of a single thickness of pandanus leaf separating three rows of evenly spaced shorter bars (combinations of 12 and 13 units) alternately off-set so as to create a zig-zag pattern. The visible stitches on the surface of the bars are similarly aligned in alternating directions both between adjacent bars and adjacent rows. The intention is clearly to enhance the sense of movement across the design surface. The two floral panels have an identical basic layout, but have variations in design alignment and motifs. Each panel is divided into six vertical sub-panels, two of which have sequences of five and six off-set rectilinear bars. The remaining two sub-panels have sequences of two longitudinally aligned rectilinear bars separating a sequence of three flowers. On one panel, the paired off-set bars are all orientated in the direction of the centre line of the *upeti fala*, in the other the orientation alternates with one pair aligned towards the centre line and the other pair towards the border. The most striking variation is with the design of the flowers. Nine of the twelve are composed of sets of four lozenge shaped petals radiating from the centre of each square framed by the longitudinal bars. Each of the remaining three flowers has four extra irregular shaped secondary petals between the four main petals. Whether this is intended to be decorative or representational is not clear.

The design surface of E166.401 (Fig. 3) is divided in two along the centre line with a strip of folded zig-zag pandanus leaf flanked on either side by light wooden (possibly coconut leaf mid-rib) strips coiled with a single strand of fibre. The designs on each half are the same. A series of five design triangles on either half are separated by strips of folded pandanus flanked on either side by light wooden strips coiled with single strands of fibre. The two triangles on each side with their apexes towards the centre line are decorated with single-layered raised strips of pandanus leaf cut as repeating triangles. Each segment is held in place with closely spaced couching stitches of twisted double threads drawn through both layers of the base. The stitches enhance the contrast between the raised triangular designs and the exposed plain triangular shapes of the flat design surface. Each sequence of triangular patterns is separated from the next by a closely spaced parallel pair of raised light wooden ribs held in place with couching stitches of single sennit thread.

E138.361 (Fig. 4) is divided into ten square design panels. The design surface is divided into five

main vertical panels by four strips of pandanus leaf alternatively folded to create a zig-zag line. Each of these vertical panels is divided through the centre line with a longitudinal wooden (probably coconut leaf mid-rib) divider that extends the complete length of the *upeti fala* thereby creating ten square design sub-panels. Within the sub-panels of E138.361 there are three different designs, repeated five, three and two times respectively across the design surface. All of the design elements are sewn in place with a combination of twisted double sennit thread and cotton string running stitches drawn through both layers of the base. The three designs represented are intricate combinations of geometric, and linear patterns. In order to decipher and facilitate description of the patterns, similar discrete units were colour coded and the three different designs labelled Design One, Two and Three accordingly (Fig. 4a). This also clearly established their combinations and distribution across the design surface.

In Design One each of the three sub-panels is divided into eight triangles separated by three raised wooden (coconut rib) dividers that intersect at the mid point; two extending diagonally from the opposite corners and one vertically on the centre line of the square. Two pairs of opposed triangles have parallel lines of light wooden ribs sewn in place with twisted double sennit threads. The remaining two opposed pairs have alternating rows of light wooden ribs and folded zig-zag pandanus leaf aligned in pairs to the lines of the crossed diagonal dividers (see section drawing, Fig. 5).

In Design Two each of these five sub-panels has a layout of two larger vertical oblong units separated by a narrow oblong central unit, defined by raised wooden dividers. The design in the central unit is a parallel pair of raised wooden ribs sewn in a zig-zag formation. The larger units are separated diagonally into two pairs of triangular designs. Those triangles with their bases aligned along the centre line are decorated with parallel transverse ridges formed by a pair of twisted sennit threads. The pair of triangles with their apexes to the centre line are decorated with alternating rows of light wooden ribs and folded zig-zag pattern pandanus leaf strips laid in pairs parallel to the diagonal divider.

Design Three has the same basic layout mechanism as Design One. Each of the two sub-panels is divided into eight triangles by intersecting raised wooden dividers. The two basic designs, however are not in adjacent matched pairs but alternate around the mid point between light wooden ribs. One enclosed design has alternating pairs of light wooden ribs separating lines of folded zig-zag pandanus leaf running parallel to the crossed diagonal dividers. The other has parallel rows of twisted pairs of sennit fibre running parallel to the angle of either a diagonal or vertical raised wooden divider.

The wooden *upeti* E138.362 has designs carved onto both front and back surfaces. Surface 'a' (Fig. 7) is carved with two (almost) identical designs. Most of the carving is about three millimetres deep, but parts of a central leaf motif have been carved to an approximate depth of seven millimetres. The two design panels terminate with an open V-shaped carved margin extending across the board surface approximately 18 mm from either end. The design panels are separated from each other at the mid-point of the board with a continuous solid bar formed by carving two parallel shallow V-shaped grooves across the board. Each of the square design panels is divided, with a similarly formed diagonal bar into two triangular design motifs, one a leaf pattern, the other a contrasting linear pattern, perhaps best described in European terms as 'herring-bone-like lines'. The leaf pattern motif appears most likely to be sprigs of three smooth edged elongated oval shaped leaves, with mid-ribs clearly visible. The background spaces between the leaves are decorated with sequences of parallel carved lines and triangles.

Surface 'b' (Fig. 7) is carved with six (almost) identical design panels. The panels are separated from each other along the centre line of the board by a continuous horizontal bar, and vertically with two equally spaced bars formed by carving two parallel shallow V-shaped grooves leaving a plain bar in between. All the decorative carving is a shallow V-shape between three and five millimetres deep, terminating without a defined border approximately three millimetres from either outer edge. The design panels at either end of the board terminate at a shallow carved groove across the board, leaving a plain margin approximately 18-20 mm wide at either end. The focal motif is a star shaped pattern with a circular centre and six radiating triangular arms. The triangular spaces between the radiating arms are decorated with two different design sequences. Those orientated towards the edges and the centre line of the *upeti*, are closely-spaced lines carved parallel to the adjacent diagonal arms of the star shape. The remaining triangular designs, whose bases rest against the outer

margins and vertical divisions of the design panels, have, in addition to closely spaced lines, a single row of triangles also carved parallel to the adjacent diagonal arms.

In summary, three *upeti fala* (E97.5a, E138.361 and E166.401) have raised wooden design elements used to form both motifs and borders of design panels. These three *upeti fala* (E97.5b, E138.361 and E166.401) and surface 'b' of *upeti* E138.362 are bisected along the centre line, the fourth (E97.5a) is bisected for two thirds of its length. Two of the *upeti fala* (E97.5a and b) and surface 'a' of the *upeti* (E138.362) are bisected transversely. The designs on either half of one *upeti fala* (E97.5b) and surface 'a' of the *upeti* (E138.362) are almost identical in reverse figuration. Both halves of *upeti fala* E97.5a have an innovative design layout incorporating variations of the same basic motifs. One *upeti fala* (E166.401) and surface 'b' of *upeti* E138.362 have co-ordinated 'matched' pairs of designs on either side. The remaining *upeti fala* (E138.361) has the greatest layout variation, with three repetitive designs unevenly distributed across ten panels, and five along each side. The similarity in size, construction and provenance between E97.5a and b suggests they were possibly made about the same time by the same artist. The wide variation in layout and design elements used confirms the range of individuality and originality that existed within works by a single artist. Whereas the designs on *upeti fala* are created through the addition of raised elements to the design surface, the designs on an *upeti* are created by carving into the surface.

COMPARATIVE RESEARCH POTENTIAL

There is considerable potential for future comparative research into other similarly provenanced collections of both design boards and *siapo*. The relative rarity of *upeti fala*, like other surviving collections of material culture, offers challenges for quantitative comparison but it must be remembered that their research potential also derives from their individual stories. Knowledge of other existing collections is provided and preliminary comparative observations are offered based on the examples available. Similarly, a discussion of issues involving the identification of individual design elements present on both *upeti fala* and other comparative expressions of Samoan cultural practice such as tatau is presented. Lastly, a review of the available literature on Polynesian sewing technologies is discussed in the light of the evidence presented by the Canterbury Museum's collection of *upeti fala*.

Other museum collections and rarity

A scoping survey of international museums known to have Oceania collections was undertaken to establish the rarity of *upeti fala* and *upeti*. The collections of over sixty museums were explored online and, for clarity, direct contact was made in many cases with curatorial and collections staff. From this unsystematic survey the best estimate showed that there are approximately 17 other *upeti fala* and 35 *upeti* known in museum collections worldwide. Canterbury Museum appears to hold one of the largest and most securely provenanced collections of *upeti fala*. Another significant collection is cared for by the Museum Volkenkunde, Leiden (as reported by Kooijman 1972, pp 218-221). Other collections similar in size to Canterbury Museum's are held by the British Museum, London, the Pitt Rivers Museum, Oxford and the Bishop Museum, Hawai'i. In addition, 14 *upeti fala* and 24 *upeti* can be viewed in the "Museum" section of *Siapo*.com (accessed 13-09-2011). However, we have been unable to verify whether these are duplicates of the design boards already identified in other museum collections, or from private collections which we did not attempt to survey.

Although this survey cannot be considered as statistically accurate, and no doubt under-represents true numbers of Samoan design boards, it is indicative of rarity and highlights challenges for any future comparative research. Inconsistencies in terminology, provenance data and the identification of raw materials made positive identification problematic and at best sometimes only a probable presence or absence could be established. Unarguably, it seems that *upeti fala* are particularly rare, especially in relation to other types of Samoan material culture, due in part to their fragile nature and subsequent replacement by *upeti*. However, it also appears likely that further factors may have influenced the low ratio of *upeti fala* and *upeti* in relation to *siapo* represented in both museum collections and research outputs. Rarity may in part also be a consequence of the influence of once prevailing value judgements on museum collecting behaviours, where manufacturing tools, such as design boards, were seen as minor cultural adjuncts rather than as inseparable,

functional components integral to understanding the end products of traditional art forms such as *siapo*. The obvious bonus of such rarity is the theoretical possibility of eventually including the majority of known examples in comparative research.

As a result of our reliance upon online databases and images, any in depth comparative material culture analysis between Canterbury Museum's collections and those of other museums is difficult. At this point it is only possible to make preliminary and very general comparative observations with other collections of *upeti fala*. These indicate further variability beyond that observed in Canterbury Museum's collection, particularly relating to size, number of design panels, and types of motifs used. The variability in quality of images available made comments on stitching impossible, but the majority have visible remnants of dye indicating that some individual design boards have been used. In regards to *upeti*, the majority appear to have only single surfaces carved, although the Pitt Rivers Museum reported one "wooden block for printing designs on bark-cloth" from Samoa, collected before 1935 (Accession number 1954.9.209), which has four carved surfaces. One *upeti* was located that was reported to have had one surface carved in 1939 and the other much later in 1963, illustrating the potential for one object to have a long life of use (*Siapo*.com). More interestingly, this particular *upeti* was reported as being carved by a woman, Mary Jewett Pritchard, a celebrated Samoan artist and teacher (see Mallon 2003, p. 68).

The characteristic technical differences in composition between *upeti fala* and *upeti* design surfaces also create diagnostic impressions on the underside of those sheets of *siapo* rubbed over them. These are sufficiently distinctive from one and other to enable identification, in most cases, of which type of design board was used in the decoration of an individual piece of *siapo*. When a wooden *upeti* is rubbed, pressure is exerted against the board into which design patterns have been carved. The flat design elements register on the cloth as the coloured design figuration (shown in black in Figure 7), while the carved grooves (shown in white in Figure 7) remain as a plain uncoloured pattern. When an *upeti fala* is rubbed it is the raised, decorative surface elements that create the positive impression. The resulting imprint left by an *upeti fala* consequently tends to be more defined with crisper outlines and greater areas left undecorated. By comparison, the impressions left by most *upeti* have wider positive patterns and therefore reduced uncoloured areas. Further material culture analysis of other collections of *upeti fala* and *upeti* establishes the potential to connect individual pieces of *siapo* with any individual surviving design boards actually used to decorate them.

Even broader comparative research on *tapa* and design board collections between island groups has potential for understanding cultural choices and changes. For example, evidence from Tonga contrasts with that presented by the Samoan examples explored here. Tongan women still use textile-based design boards called kupesi tui, some of which are designed by men. Kupesi tui are argued to have been proudly protected by women due to the opportunity for them to be manufactured quickly and therefore allow innovation with new designs (Lythberg 2010, pp 153-154).

Comparing designs

To date, at least 15 graphic *siapo* symbols have been described and named, but in practice identification of these designs is not straightforward (Pritchard 1984, pp 40-46). The source of the problem is the inherent artistic freedom in the application of these designs. While the abstract designs represent recognisable forms (eg nets, bristles, trochus shells, male pandanus flower, pandanus leaf, breadfruit leaf, birds, starfish, banana pod, rolled pandanus leaf, worms, centipedes), analysis is more complicated because individual artists appear always to have been free to improvise, modify, alter proportions, and group unlimited combinations of these symbols (Prichard 1984, p. 40). However, it is this process of artistic innovation and originality which ensures an individual dynamic quality to the designs. Freehand over painting further complicates the interpretation of designs. In these circumstances, the best way to decipher the design figuration is by examining the underside of *siapo*.

This complicated process of identifying various designs can be illustrated by reference to the *upeti* in Canterbury Museum's collection. The linear pattern, described as herring-bone-like lines, observed in the *upeti* E138.362 could be interpreted following the conventions outlined by Pritchard (1984, p. 41), where patterns of small lines, *tusili'i* are described as being derived from common household items such as brooms

made from coconut leaf mid-ribs. However, in this particular case, there is no way of confirming that this is the intention of the artist. Similarly, it is not possible to confidently ascribe any particular species to the leaf patterns observed on *upeti* E138.362 on the basis of shape and structure of the leaves represented. Nor do they convincingly resemble any of the named examples illustrated in the literature (Pritchard 1984, p. 46). In like manner, representations of general conventions such as star motifs, examples of which also appear on *upeti* E138.362, according to Pritchard do not represent celestial bodies such as the sun and stars but are instead representations of starfish *fa`a `aveau* (Pritchard 1984, p. 40). Again it is difficult to determine exactly what the intention of the artist was. However, the remarkably rigid geometric conformity of the six motifs looks distinctly like the bright galactic stars of European iconography.

Pritchard (1984, pp 41-42) states that various triangular and diamond formations, common in Samoan art forms including *siapo*, tatau and wood carving, are abstract representations of trochus shells (Trocus niloticus) fa`a ali`ao. The wide variety of applications of triangular and diamond configurations, present both as elements of motifs and within design panels (see E97.5b, E138.361 and E138.362 surface 'a'), suggests that, in some instances at least, these shapes are employed simply for pragmatic design convenience and elsewhere they clearly represent other natural forms such as flower petals.

Many *siapo* designs also appear remarkably similar in composition and subject matter to those of tatau and it is reasonable to assume a similar artistic derivation. Like *siapo*, both male and female *tatau* designs include combinations of linear, geometric, and floral patterns. Like *siapo*, the surface decoration is divided into specific areas (back, front, thighs, pubic, navel), designs have an orthodox prescription, and there is considerable room for artistic expression in the decorative treatment within spaces. This involves remarkably similar processes of improvisation, innovation, and originality of symbol selection to those at work in *siapo* decoration. Many of the abstract tatau designs not only represent the same known natural objects and share the same indigenous names, but are rendered in almost identical shapes.
Some of the shared symbols include lines, pandanus leaves, male pandanus flower, trochus shell, net and starfish (for full discussion see Buck 1930, pp 641-658). While there is obviously a need for a much more comprehensive comparative study of the relationship between *siapo* and tatau designs and nomenclature, the purpose here is to establish that there are at least some basic generic links connecting essentially male *tatau* and female *siapo* art forms.

Comparing sewing technology

To date there has been no comprehensive material culture study of traditional Polynesian sewing techniques and consequently our understanding of the temporal and geographic distribution and intended functional end-use purposes of sewing is correspondingly erratic. Only on Hawaii and Rapanui (Easter Island) has sewing been recorded as a method of joining objects made of *tapa* cloth (Kooijman 1972, pp 464-465), while design tablets made of leaf material sewn together are recorded from the Southern Lau Islands, Tonga and Samoa (Kooijman 1972, pp 219, 308, 363). Maori stitched garments have been comprehensively reviewed using Maori oral tradition, ethno-historical accounts and surviving archaeological and material cultural evidence (Wallace 2002, 2006). Another alternative approach to the study of Maori sewing analysed metric and non-metric variables of bone needles in lieu of the long since decayed archaeological fabrics (Carr et al. 2005, pp 1-9). *Upeti fala* clearly demonstrate that sewing was traditionally an important technological part of the wider Polynesian cultural tool-kit. The variety, complexity and competence of sewing in the construction of the *upeti fala* as observed throughout the Canterbury Museum collections provides impetus for further comparative studies of Polynesian sewing between types of material culture, through time, and across regions.

DISCUSSION: CONTINUITY AND CHANGE

The provenance associated with Canterbury Museum's collection enhances its potential contribution to ongoing analyses of *siapo* manufacture and design, and also to investigations relating to indigenous and external human impacts on continuity and change of Samoan material culture. Interpretations made in previous research, as presented in the introduction, can be reconsidered in the context of Canterbury Museum's collection of *upeti fala* and *upeti*.

Raised wooden design elements in E97.5a, E138.361 and E166.401 all appear to be the same light fibrous wood, probably coconut leaf mid-rib, but certainly not

bamboo as recorded by Kooijman (1972, p. 219). The need for reliable methods to identify raw materials is obvious, and future studies should attempt to locate and utilise scientific techniques for wood and fibre identification.

Kooijman's (1972, pp 218-221) observation that the pandanus strip foundations of *upeti fala* may influence the overall design elements is validated and can be expanded to include other raw materials and components. The designs on several *upeti fala* have been deliberately aligned so as to either obscure or incorporate construction components. The placement of stitches and addition of borders, as well as the initial orientation of pandanus strips, clearly contribute to both the structural integrity and design elements.

The construction technique documented for all the *upeti fala* described differs from that recorded by Buck (1930, p. 308). In all examples in the Canterbury Museum, the stitches used to apply the designs clearly pass through both layers of the body and are clearly deliberately intended to contribute to the structural integrity of the construction. The only stitches applied separately to the individual layers are those initially applied along the overlapping edges of the pandanus strips as a temporary measure to facilitate holding them together during the process of construction.

In 1930, Buck described the design material of a typical *upeti fala* as consisting of single thickness pandanus strips, fau (hibiscus) threads and two-ply twisted cords of sennit fibre (Buck 1930, p. 308). The analysis of the present collection demonstrates far wider and more varied and innovative uses of both pandanus leaf strips, at least four different types of thread, and extensive use of raised wooden ribs. Two *upeti fala* (E138.316, E166.401) have pandanus leaf strips folded into two layers to produce zig-zag lines and three *upeti fala* (E97.5a, E138.316, E166.401) have raised wooden design elements; two (E97.5a, E166.401) of these have wooden ribs coiled with sennit threads. The designs include floral, geometric and linear patterns in intricate repetitive arrangements. The folded pandanus, raised ribs and exposed alignments of stitching ensure the rubbing surface has textured, raised relief patterns that would produce clearly detailed design figuration, between distinct areas of lightly coloured background. There is clear evidence for variation in the combinations of design elements, artistic freedom and innovation, and possible evidence for identifying individual artistic expressions.

In contrast to *upeti fala*, on the flat rubbing surfaces of the wooden *upeti* (E138.362, surface 'a' and 'b') the designs are executed with shallow carved pattern outlines that would produce bolder figuration and smaller areas of lightly coloured surface. Although the raw materials and techniques for applying designs to the different types of design board are vastly different, the design motifs themselves remain essentially the same. The range of floral, linear, rectangular and geometric patterns represented on *upeti fala* and *upeti* produced between the 1890s and 1930s is similar. The only likely impact of the different pattern figuration by the two types of design board represented in this collection appears to be a reduction of technical opportunities for freehand surface painting of primary detailed designs. This observation is based on the assumption that the decrease in uncoloured areas between design motifs produced by *upeti* would limit the scope for infilling. However there is still the same opportunity to over paint with darker dyes to embellish and introduce pattern.

This appears to be the point of Neich's (1980, p. 51) observation that, "the designs carved on wooden *upeti* are quite rudimentary, leaving plenty of scope for the women doing the freehand over painting to exercise their own imagination in filling in the design". This suggests that while the two types of design board co-existed, there was continuity in their designs which remained similar in detail, with the wooden *upeti* being modelled on the earlier *upeti fala*. Although there is variation, which is yet to be understood, carvers clearly attempted to retain the basic design conventions of *upeti fala*. It is hypothesised that because *upeti fala* would wear out and need to be replaced more frequently than wooden *upeti*, that this would have created greater opportunity for innovation, experimentation and individuality

Some repairs of *upeti fala* have been noted, but in each case these were undertaken in such a manner as to retain the original design. There is no evidence for the types of secondary alteration or modification to designs that have been recorded for *upeti*.

Although the process is clearly not yet fully understood, the greatest cultural impact of the decline in manufacture of *upeti fala* was undoubtedly the transfer of responsibility for the composition of the designs, the essence of the art form itself, from women to men (Neich

1985, p. 51). The possible connection between male tatau and female *siapo* symbols and conventions may also help explain both the continuity in layout and use of design elements between *upeti fala* made by women and the wooden *upeti* carved by men. Should further research demonstrate the validity of this connection it would have considerable relevance to the ongoing discussion about the impact of the gender transfer on *siapo* designs. Of course, the relationship between the social construction of gender and material culture is complex (see Conkey and Spector 1984; Nelson 1997) and already one *upeti* carved by a woman emphasises the importance of considering individual agency in understanding changing social roles and expectations.

CONCLUSION

This paper has demonstrated that the thorough descriptive analysis and documentation of *upeti fala* and *upeti* in museum collections results in significant contributions of re-discovered information. Such documentation is not intended for an academic audience alone, but also as a means of extending public access to museum collections. For the Samoan community, particularly contemporary *siapo* artists, it will offer another opportunity to review traditional practise, albeit from an alternative perspective (for example see Byrne et al. 2011, pp 4-5). The realisation that many of the more detailed elements of this study were in fact filling a void in the anthropological literature came as somewhat of a surprise. How could the detailed description of such significant elements of Samoan material culture have been largely overlooked by scholars for so long? With very limited relevant literature available for guidance, detailed material culture analysis resulted in a useful contribution towards a better understanding of provenance, process of manufacture, use, repair and creative design of *upeti fala* and *upeti*.

It is anticipated that the inclusion of the very detailed descriptive narrative and comprehensive illustrations might also offer something of a template for other scholars to follow, for without a corpus of such information the vital next step, undertaking wider comparative studies with other collections, will be virtually impossible. The most obvious first step towards this comparative research might, however, also prove to be one of the most difficult. As reported above, locating the whereabouts and obtaining the relevant documentation of the widely dispersed collections of *upeti fala* and *upeti* might pose considerable logistical challenges. As is the nature of research, this analysis has raised some questions which must remain unanswered for the present. For instance, the limitations of the present sample made it difficult to offer well informed observations about wider issues such as continuity and change in Samoan cultural practice. Further, it is hoped that future research initiatives will venture beyond documentation. A more holistic comparative approach to material culture will be required to unravel the complex social, artistic and gender perspectives that must have emerged as *upeti* carved by men replaced *upeti fala* sewn by women. Two of the many ancillary areas appear to offer exciting research potential. The first would be a material culture analysis of sewing within the Polynesian cultural tool kit, and the second would be further analysis of the organic raw materials used in the manufacture of *upeti fala* and *upeti*.

Perhaps the single most significant conclusion of the present analysis is that it reveals the exceptional technical complexity, the extraordinary forethought and planning, and the diversity of individual artistic creativity manifest in each design board studied.

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