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Geological collections associated with the Scottish Polar explorer William Speirs Bruce (1867-1921)

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Running head: Geological collections of William Speirs Bruce

Abstract

During the last decade of the 19th century and the early part of the 20th, the Scottish scientist William Speirs Bruce took part in pioneering Polar expeditions to both the Arctic and the Antarctic. He is best remembered for his leadership of the Scottish National Antarctic Expedition (1902–1904) to the Weddell Sea and the South Orkney Islands, but his Arctic endeavours in Franz Josef Land, Novaya Zemlya and Svalbard are also noteworthy. His interests ranged widely across meteorology, oceanography, and marine biology, but geological research was an important component of his expeditions' programmes. Many of the rock and fossil collections thus generated are held by National Museums Scotland, but others are more widely dispersed. This is particularly true of key specimens sent for specialist study and the collections made independently by geologists accompanying Bruce's expeditions. Here an attempt is made to bring together the details of these various collections and link them with the development of Bruce's Polar career. His achievements are not much celebrated, in marked contrast to the public acclaim afforded to contemporary 'Heroic Era' Polar explorers, but the geological collections stand as a solid memorial to his life and work.

At the beginning of the 20th century, the Scottish scientist William Speirs Bruce (1867–1921) could justly claim to be one of Britain's principal authorities on Polar exploration. He was a veteran of expeditions to both the Arctic and the Antarctic, and a determined champion of Scotland's role in Polar research (Figure 1).

Born in London to a Scottish father and a Welsh mother, Bruce arrived in Edinburgh as a student in the summer of 1887. His original intention was to complete short courses in biology before commencing medical studies in London later in the year. However, inspired by his instructors, notably the pioneer environmentalist Patrick Geddes (1854–1932), and the intellectual ambiance of the city, Bruce decided to stay, and to transfer his medical studies to Edinburgh University. Over the next few years, he also became involved as a volunteer scientific assistant examining the oceanographic and marine biological collections of the 1872–1876 *Challenger* expedition under the direction of the eminent Scottish-Canadian oceanographer John Murray (1841–1914). Other important contacts made at this stage of Bruce's life were the artist and writer William Gordon Burn Murdoch (1862–1939), who became a life-long friend and supporter, and Hugh Robert Mill (1861–1950). In 1892 Mill moved to an influential post at the Royal Geographical Society in London, and it was through his recommendations that Bruce's career in Polar science was launched.

Bruce's many achievements in Polar exploration never received the same recognition as those of his contemporaries – Amundsen, Nansen, Nordenskjold, Scott, Shackleton – despite the best efforts of his friend and Polar collaborator Robert Neal Rudmose Brown (1879–1957). Shortly after Bruce's death an account of his life and work by Brown & Burn Murdoch (1923) was more hagiography than biography and was soon forgotten, but it remains a valuable source of information. More recently, a resurgence of interest in Bruce's role in Polar exploration has been served by two major biographies (Speak 2003; Williams & Dudeney 2018) and a raft of academic papers mostly concerned with the Scottish National Antarctic Expedition (SNAE) organised and led by Bruce in 1902–1904 (*inter alia*: Bernstein 1985; Speak 1992; Keighren 2005, Swinney 2007; Stone 2017; Mair & Stone 2024).

After the SNAE Bruce established, in Edinburgh, the Scottish Oceanographical Laboratory (SOL) as a venue for the display and scientific investigation of his specimen collections. Financial support for the SOL was always tenuous and in 1919, just two years before Bruce's death, it closed. Library and archive material was shared between the University of Edinburgh, the Royal Scottish Geographical Society and the Scott Polar Research Institute, Cambridge. The collections mostly passed to the Royal Scottish Museum, now the National

Museum of Scotland and a component part of National Museums Scotland (NMS). This paper reviews the distribution and importance of the geology collections; both those from the SOL and those with close associations with Bruce but which had independent histories.

The Dundee Whaling Expedition 1892–1893

Bruce's first Polar experience was as a ship's surgeon on *Balaena*, one of four whaling ships dispatched from Dundee in 1892 hoping to exploit new whaling and sealing opportunities amongst the islands at the northern end of the Antarctic Peninsula (Figure 2a). Accompanying Bruce, nominally as assistant surgeon despite no medical training of any kind, was his good friend, the artist William Burn Murdoch, whilst another of the Dundee ships, *Active*, carried Charles Donald (dates unknown) as surgeon. Both Bruce and Donald had a keen interest in natural history and had been recruited on the recommendation of H.R. Mill, with the intention that they should make scientific observations during the voyage. Things did not work out well in that respect.

Donald was the more fortunate in that *Active*'s Captain, Thomas Robertson (1855–1918), was amenable to the opportunistic acquisition of scientific specimens. In contrast, *Balaena*'s Captain, Alexander Fairweather (1846–1896), disallowed any activity that was not directed towards immediate commercial gain. Nevertheless, Donald was only able to make one landing for geological collecting, on the western side of Joinville Island (Bruce & Donald 1893, 1896); Bruce could only complain that the few rocks he obtained came "from the ice and from the stomachs of penguins" (Bruce & Donald 1893, p. 430). Both men passed their specimens to Professor James Geikie at the University of Edinburgh, for identification. From Joinville Island, Donald reported mostly basalt and granite from erratic boulders; Bruce's meagre haul was identified by James Geikie as olivine-basalt and possibly gabbro (Bruce & Donald 1893, 1896). Separately, Captain Robertson sent a collection of specimens from Dundee Island to Sir Archibald Geikie, James' elder brother and Director of the Geological Survey, who identified granite, vein quartz, tuff and radiolarian jasper, albeit that range may have included glacial erratics (Geikie 1898). None of these rock specimen collections can now be traced.

Operating in the same area as the Scottish vessels was a Norwegian whaling ship, *Jason*, captained by Carl Anton Larsen (1860–1924). On 3 December 1892 he and his crew landed at the NE end of Seymour Island [64° 17′S 56° 45′W] searching for seals and instead found fossil shells and petrified wood. Remarkably, he had stumbled upon a richly fossiliferous site

that is now considered of global importance for geology, spanning as it does the Cretaceous-Palaeogene (K-Pg) boundary. Naturally, Larsen and his crew collected specimens and the circumstances of the discovery, and its outcome, have been reviewed by Zinsmeister (1988).

Donald, Bruce and Burn Murdoch all described seeing Larsen's fossils when their different ships met. Indeed, on 21 January 1893 Burn Murdoch and Bruce were aboard *Jason* enjoying hospitality to celebrate the King of Norway's birthday (Burn Murdoch & Bruce 1894, pp 294–5). Regarding the fossils Burn-Murdoch wrote that "Captain Larsen of the Jason has landed, and he tells us he found beds of fossils on the beach, shells, and tree trunks. Some of the fossil shells he showed us resembled very large cockles" (Burn Murdoch & Bruce 1894, p. 251). Bruce presciently observed that they were "probably of the Tertiary age, and indicate a warmer climate than now prevails in these high southern latitudes" (Bruce & Donald 1893, p. 430). Donald noted that "Captain Larsen of the Norwegian ship Jason, landed on the island to the north of Snow Hill, which may be called Seymour Island, and obtained there a number of fossils." What is not clear is how Donald acquired some of the fossils, whilst Bruce was left empty-handed. According to Aagaard (1930, p. 84, as translated in Zinsmeister 1988, p. 4) both Bruce and Donald traded tobacco for the fossils collected by other members of Larsen's crew whilst his own personal collection was taken back to Norway. That may be true for Donald's fossils, but there is no evidence from Bruce or Burn Murdoch that they were involved in such transactions.

When back in Scotland, Donald passed his fossils from Seymour Island to Professor James Geikie for further examination, and Geike, in turn, passed them on for formal identification to the Geological Survey palaeontologists George Sharman and Edwin Newton. There were nine specimens: seven contained various bivalves – two new species were defined – and a gastropod (Figure 3), two were of petrified wood (Sharman & Newton 1894). A Lower Tertiary (Palaeogene) age was assigned. Prior to its formal publication, the Sharman and Newton paper was read at a meeting of the Royal Society of Edinburgh on 4 June 1894. Bruce may have attended and gained pre-publication knowledge of the Sharman and Newton work as he included the principal identifications, verbatim and without acknowledgement, in his own account of the voyage (Burn Murdoch & Bruce, 1894, p. 356). This collection cannot be traced and is regarded as lost (Zinsmeister 1984).

One more of Larsen's Seymour Island bivalve fossils subsequently found its way to Sharman and Newton, apparently delivered by John Murray who, after his involvement with the 1872-1876 *Challenger* expedition, had become an influential advocate for Antarctic exploration

(Murray 1894). This specimen was described as another new species, *Cyprina larseni* (Sharman and Newton 1899), but subsequently redefined as *Lahillia larseni* and assigned an Upper Cretaceous age (Zinsmeister & Macellari 1988, pp 276–279). At Seymour Island *Lahillia larseni* is a common species in both Upper Cretaceous and Paleocene strata and is of particular importance as its abundance seems to have been unaffected by the end-Cretaceous extinction. Larsen's specimen, the holotype, is now held in the collection of the British Geological Survey (Figure 4) (Stone & Crame 2026). Larsen does not seem to have arranged for the identification of his own 1892 collection, leaving Donald's 'Dundee' specimens as the only published record of his discovery.

Larsen subsequently visited Seymour Island and vicinity on other occasions and more fossils collected during his various expeditions are held by the *Naturhistoriska Riksmuseet*, Stockholm. One fossil from the original 1892 collection is held by the Fram Museum, Oslo. Famously, during the 1901–1903 Swedish Antarctic Expedition, Larsen and his crew were marooned for the winter in the vicinity of Seymour Island after their ship was crushed by pack-ice and sank. Their eventual rescue was an epic of Antarctic exploration (Nordenskjöld & Andersson 1905).

The scientific importance of the Seymour Island site was recognised when, as the "most representative high latitude K-Pg boundary location and one of the most significant and best exposed globally", it was included by the International Union of Geological Sciences in the world listing of 100 geological heritage sites published in October 2022. It is now the site of the Argentinian *Marambio* scientific station. What might Bruce or Donald have achieved had they been allowed a few hours ashore?

Arctic Expeditions 1896-1899

Despite the disappointing paucity of scientific results from his voyage on *Balaena*, Bruce returned to Scotland determined to continue with Polar research. He initially took a post at the meteorological observatory that had been established in 1883 on the summit of Ben Nevis (it closed in 1904) but then, fortuitously, it was an Arctic expedition that provided his next opportunity. In 1894 the wealthy newspaper proprietor Alfred Harmsworth (later to become Lord Northcliffe) had financed a three-year exploration and scientific research programme based on one of the islands of the Franz Josef Land archipelago (Figure 2b). The leader of the expedition was George F. Jackson, an experienced Arctic traveller and big-game hunter, and it has become commonly known as the Jackson-Harmsworth Expedition (JHE). For the third

winter in Franz Josef Land a replacement zoologist was required and Bruce once again benefitted from a nomination by H.R. Mill of the Royal Geographical Society; he sailed north in June 1896.

The geological work in Franz Josef Land was already in the hands of Reginald Koettlitz (Figure 5), the expedition's doctor, who dispatched specimen collections back to Britain where fossils were described by the Geological Survey's Edwin Newton and Jethro Teall as a Jurassic to Cretaceous assemblage of ammonites, belemnites, bivalves and plants from sedimentary interbeds within a series of basalt lavas (Newton 1897; Newton & Teall 1898). A selection of the fossils is still held in the collection of the British Geological Survey, and Jackson subsequently presented rock and fossil specimens to the predecessors of The Natural History Museum, London, and NMS (Bishop *et al*. 1971; Stace *et al*. 1987; Woodward & Fletcher 1904). There would undoubtedly have been some cooperation between the scientists and when, after the expedition, Koettlitz published his own account of the general field geology he acknowledged assistance from Bruce and other team members (Koettlitz 1898). Koettlitz subsequently joined Scott's 1901–1904 *Discovery* Antarctic expedition as surgeon and botanist.

When Bruce arrived in Franz Josef Land in July 1896, he and his colleagues would have been astonished to meet not only their fellow JHE members, but also two Norwegian explorers, Fridtjof Nansen and Frederick Hjalmar Johansen. Nansen and Johansen had left their ship, *Fram*, frozen into the Arctic pack ice, in March 1895, in an attempt to reach the North Pole. Forced to turn back at about 84° 13′ N they had retreated towards Franz Josef Land. After surviving on the ice and rocky islands for well over a year they fortuitously met with members of the JHE in June 1896. Not content with recuperating in comfort at the expedition's base at Cape Flora, Nansen made a collection of the local fossils, both molluscs and plants, descriptions of which were included in the *Scientific Results of the Norwegian North Polar Expedition 1893–96* (Nakrem *et al*. 2023 and references therein). These fossils are now held in the Natural History Museum, University of Oslo. Nansen and Johansen were repatriated to Norway in August 1896 aboard the supply ship that had delivered Bruce, but the two weeks that he spent in Nansen's company allowed the development of a contact that proved of great worth during Bruce's later work in Svalbard.

The JHE ended and returned to Britain in September 1897, and once back in Scotland Bruce returned for part of the ensuing winter to the Ben Nevis Observatory. Another Arctic opportunity then arose in 1898, once again through the good offices of H.R. Mill. Mill had

himself been invited by Major Andrew Coats, wealthy from the family textile business based in Paisley, to join a hunting cruise to Novaya Zemlya. Unable to arrange leave-of-absence from his position with the Royal Geographical Society, Mill nominated Bruce to take his place.

Bruce sailed north to join the expedition in Tromsø, Norway, and thence on towards Novaya Zemlya. He was mostly concerned with oceanographical studies and marine biology as ice conditions allowed only one landing to be made at Cape Cherny, near the southern end of that island (Figure 2b). But there, Bruce discovered a fossiliferous cliff section and made a large collection: 131 specimens of a Carboniferous shelly fauna are now held by NMS (Lee, 1909; Stace *et al*. 1987, p. 46).

Major Coats' expedition to Novaya Zemlya in the summer of 1898 had been preceded the previous year by a group with mainly ornithological interests, led by Henry Pearson. One of that team, Colonel H.W. Feilden, had made a collection of fossils at a locality about 50 km further north than that worked-at by Bruce. An account of his expedition was published by Pearson (1899), and it included an account of Feilden's fossils, a Siluro-Devonian shelly fauna (Newton 1899a). But at some point there must have been communication between the expeditions, perhaps through Newton's subsequent involvement, because Pearson's book also included a short description of Bruce's fossils (Newton 1899b). Newton had been involved in the examination of the fossils from Franz Josef Land so perhaps he and Bruce were already familiar. Nevertheless, Bruce must have felt that his collection had received insufficient attention because he subsequently arranged for a more detailed review by G. W. Lee and R. G. Carruthers (Lee 1909). These two palaeontologists were both with the Geological Survey and based in Edinburgh, whereas Newton was based in London. Further, prior to joining the Survey in 1907, Lee's background at the University of Edinburgh had been in marine biology, which would almost certainly have brought him into contact with Bruce. From Bruce's collection, Lee and Carruthers described a Carboniferous shelly fauna contained in a "compact, brownish-grey, limestone, essentially foraminiferal." A large productid brachiopod was characteristic (Figure 6), accompanied by crinoids, corals, bivalves, gastropods, sponges, bryozoa and sparse trilobite fragments. The hard matrix enclosing the fossils meant that many were collected in fragments (Figure 7).

During the return voyage from Novaya Zemlya, Bruce experienced the most extraordinary stroke of good luck. Arriving in Tromsø, Norway, he discovered that also in the harbour was Prince Albert of Monaco's personal oceanographic research yacht *Princesse Alice*. Bruce

must have made a favourable impression because he was invited to join the prince's team for an exploratory cruise to Svalbard (Figure 2b). This was the start of a profitable interlude for Bruce who enjoyed the prince's continuing sponsorship for work in the Mediterranean and then a second voyage to Svalbard in 1899. This introduction to the Svalbard archipelago, and in particular to the western islands of Spitsbergen and Prince Charles Foreland, was to influence much of Bruce's later career, but first he realised his ambition to mount his own expedition southward, back to the Antarctic. And for this, the introduction to Major Coats, and the opportunity for Bruce to demonstrate his scientific abilities in a Polar environment, was to prove crucial.

The Scottish National Antarctic Expedition 1902-1904

Soon after returning from the 1892-1893 Dundee whaling expedition, on 27 November 1893 Bruce attended a meeting of the Royal Geographical Society (RGS) in London. This was the occasion of the appeal by Murray (published January 1894) for a renewal of Antarctic exploration. Bruce was introduced by the RGS President, Sir Clements Markham, as "a young volunteer who has actually been to the Antarctic regions" (Discussion after Murray 1894, p. 35). In reply, Bruce was enthusiastic that "there should be another great Antarctic expedition" and volunteered to take part. He concluded, with jingoism perhaps adopted to suit his audience, "Britain is the only nation in the World that has done good work in the Antarctic, let her keep up her reputation."

Eventually, in 1899, that there was to be a 'great Antarctic expedition' was announced by Markham, with its leader named as Royal Navy Commander Robert Falcon Scott. Bruce immediately volunteered his services. But then nothing happened and growing tired of waiting, Bruce conceived the idea of an independent Scottish expedition as a complement to Scott's. Funds were raised by a public appeal, and with large donations from the Coats family, his patrons in Novaya Zemlya, Bruce took his plan forward. When eventually an offer to join Scott was forthcoming, Bruce declined it and announced his own Scottish project. Bruce had somewhat naively assumed that his initiative would be welcomed, but Markham saw only unwelcome competition; the ensuing controversy caused life-long antipathy between the two men. In the event, Scott sailed for the Ross Sea aboard *Discovery* on 6 August 1901, Bruce sailed for the Weddell Sea aboard *Scotia* on 2 November 1902. The captain of *Scotia* was Thomas Robertson who, as master of *Active*, was known to Bruce from the Dundee whaling expedition.

The Scottish National Antarctic Expedition (SNAE) is undoubtedly the best-known of Bruce's Polar exploits yet remains overshadowed by the achievements of his contemporaries. The expedition ship. *Scotia*, penetrated far to the south in the Weddell Sea and for the 1903 austral winter a base was established on Laurie Island in the South Orkneys archipelago (Figure 2a). The story of the expedition and the voyage of *Scotia* was described in an account by "Three of the Staff" (Brown *et al*. 1906) and is fully documented by Speak (2003), and by Williams & Dudeney (2018). The geological work was the responsibility of the expedition's doctor, J.H.H. Pirie. It has been comprehensively reviewed by Stone (2017) so only a brief résumé is given below. The results fall into three categories: sea floor dredging, terrestrial survey of Laurie Island, and reconnaissance of South Atlantic Islands visited in passing. Most of the extant specimens are now held by NMS.

Though primarily intended to sample sea floor sediment and benthos, about 23 examples of which are held by NMS, several of the dredges brought up rock fragments, glacial erratics dropped from melting icebergs, and selections of these from six localities are also held by NMS (Figure 8). Those recovered from the southern reaches of the Weddell Sea – granite, schist, quartzite, sandstone etc. - were recognised by Pirie (in Brown *et al* 1906) as having been derived from a continental landmass, confirming that Antarctica was indeed such a thing. But perhaps the most important dredged erratic was not at first recognised. To the SE of the South Orkney Islands a particularly abundant collection of rocks was recovered including a block of limestone weighing about 0.5 kg. It proved to be an algal limestone rich in archaeocyaths, Lower Cambrian calcified sponges. There were no references to these fossils in the early expedition reports with the first mention in Pirie (1913), in his overview of the deep-sea deposits. In that same year the specimen had been passed for detailed examination to W.T. Gordon, then based at Edinburgh University but who shortly after took up a post at King's College, London, who recognised 14 different archaeocyath taxa (Gordon 1920). To identify the fossils it was necessary to reduce the specimen to 160 thin sections. These were retained at King's College for a number of years but in 1984 they were transferred to The Natural History Museum, London.

Laurie Island proved to consist of a thick, much deformed succession of mudstone, wacke-type sandstone and microconglomerate (Figure 9). Pirie's principal discoveries were fossils taken at the time to be graptolites, indicative of a Lower Palaeozoic age for the strata. On the expedition's return to Scotland these fossils were examined by two of Britain's foremost graptolite experts, Ben Peach of the Geological Survey and Gertrude Elles at the University

of Cambridge: both confirmed the initial identification, and the result was promptly published (Pirie 1905). Unfortunately, all were in error. The supposed graptolites turned out to be plant fragments and the subsequent discovery of microfossils established a Permian to Triassic age for the Laurie Island succession (Dalziel 1979; Dalziel *et al*. 1981; Stone 2017), now defined as the Greywacke Shale Formation. The controversial fossils and most of the SNAE rock specimens are held by NMS, but there are two other small collections held elsewhere. When Bruce took *Scotia* to Buenos Aires, Argentina, for repairs and resupply at the end of 1903, in recognition of support and hospitality received, he presented 11 rock specimens from Laurie Island to Francisco Moreno, the Director of the Museo de La Plata; at least six of those specimens remain in that museum (Carrasquero 2021). Later, R.N.R. Brown (one of the SNAE biologists) donated nine Laurie Island rock specimens (which he had presumably retained) to the University of Michigan, USA (Stewart 1937) where they remain.

One specimen held by NMS came not from Laurie Island but from the nearby Coronation Island where only one landing was made. It is of interest in that whilst the lithology is similar to that of specimens recorded from Laurie Island (Figure 9) it does not match the geology of the putative collecting locality. That locality was the intended first choice for the expedition's wintering base (Brown *et al*. 1906, pp 68–69), but the rock specimen collected there suggests that the landing had been made in the wrong place, at a point farther north on the Coronation Island coast where the geology does match the specimen, so that a navigation error led to the reorientation of the expedition to Laurie Island.

The Falkland Islands and its capital, Stanley, were visited three times by *Scotia*, although Pirie was only aboard for the first (his notebook from that visit is held by NMS). During the third visit, early in 1904, the Governor of the Falkland Islands, William Grey-Wilson presented Bruce with a number of sandstone blocks, most containing fossils, that had been scavenged from building material brought to Stanley for the construction of an extension to his residence, Government House (Stone 2017). The fossils were Devonian brachiopods of varieties originally collected in the Falkland Islands by Charles Darwin during his voyage aboard HMS *Beagle*. The sandstone came from what is now known as the Fox Bay Formation and one additional specimen containing crinoid fossils was also acquired. All the specimens, the fossils as described by Newton (1906) and a few sandstone blocks devoid of fossils, are held by NMS.

At the conclusion of the expedition, during the return voyage to Scotland, a short visit was made to Gough Island, to the SE of Tristan da Cunha where Pirie collected specimens of the

basaltic volcanic rock (Campbell 1906; Pirie 1906). Further calls were made in South Africa, Saint Helena and Ascension Island and although the expedition account by Brown *et al*. (1906) mentions rock specimens being acquired at the latter two of these places, none have been located in museum collections.

Scottish Oceanographical Observatory 1906-1919

To accommodate, study and display the collections made during the SNAE, once back in Edinburgh Bruce established the Scottish Oceanographical Observatory (SOL), located in a building adjacent to Surgeons' Hall, Edinburgh. The establishment was formally opened in 1906 by His Serene Highness Prince Albert I of Monaco, Bruce's patron for his previous oceanographical work in the Arctic, with the ceremony well attended by Edinburgh's civic and scientific elite. The finances of the Observatory were always parlous and despite Bruce's best efforts he was forced to close it in 1919, with his scientific collections passing to The Royal Scottish Museum, now The National Museum of Scotland and a component institution of National Museums Scotland.

But whilst he was able to sustain the Observatory, Bruce's own collections were supplemented by the donation of additional Antarctic rock specimens, principally by Ernest Shackleton after the 1907–1909 *Nimrod* expedition. These specimens, twelve varieties of doleritic and granitic rocks, originated from Ross Island and environs, at the head of the Ross Sea, but when later they were incorporated into the museum collection they were thought to be specimens originating with the earlier SNAE, and catalogued accordingly (Stace *et al*. 1987). The confusion can be readily explained: when making-up labels for Shackleton's Ross Sea specimens, Bruce wrote on the back of unused printed stationary from the SNAE (Stone *et al*. 2023). Less confusion surrounded two other Antarctic specimens that originated during Douglas Mawson's 1911–1913 Australian Antarctic Expedition to Adelie Land and which were donated to Bruce by John Davis, captain of that Expedition's support ship.

Contemporary photographs show well organised display cases and mounted exhibits inside the SOL, for example in Brown & Burn Murdoch (1923, facing page 248). Carefully prepared display labels in a consistent style (though by different calligraphers) are preserved at NMS accompanying both Antarctic specimens from the SNAE (Figure 9) and Arctic specimens collected subsequently on Svalbard during the next phase of Bruce's Polar explorations (Figure 10). They demonstrate a continuity of careful curation.

Svalbard and the Scottish Spitsbergen Syndicate 1906-1920

Bruce had been introduced to Svalbard in 1898–99 during his time aboard the Prince of Monaco's oceanographic yacht *Princesse Alice,* and in 1906 he was able once again to enjoy the prince's patronage for exploration there. He began what was to become a long-term involvement with the surveying of Prince Charles Foreland, the westernmost island of the Svalbard archipelago (Figure 2b). Both there, and on the neighbouring island of Spitsbergen, Bruce noted the accessible deposits of coal, gypsum and iron ore, and thought that there were good prospects for oil shale. A follow-up programme in 1907, undertaken independently of the Prince of Monaco, consolidated Bruce's ideas for the future exploitation of those geological resources. Geological specimens collected during the two expeditions are held by NMS and include fossils described by Lee (1908), notably a shelly fauna of Carboniferous to Permian age, and Paleogene plants (Figures 10 &11).

Hoping to capitalise on his knowledge of the geological resources of Spitsbergen and Prince Charles Foreland, early in 1909 Bruce established a private prospecting company, the Scottish Spitsbergen Syndicate, and later that year he led a small team north to establish the Syndicate's claims in what was at the time internationally regarded as *terra nullius* – ungoverned territory. One member of the party was an established mining geologist, Harry Campbell Hannay, who subsequently donated to the Hunterian Museum, Glasgow, four rock specimens (with thin sections) showing iron and copper mineralisation (Stace *et al*. 1987). Bruce brought back more specimens to add to the collection at NMS (Figure 10), whilst an additional collection of Carboniferous fossils was made at King's Bay, NW Spitsbergen, by Angus Peach, son of the eminent Scottish geologist Ben Peach and newly graduated from the University of Edinburgh who joined Bruce's 1909 team (Stone 2025). Angus Peach tragically died in Egypt later that year and of his small collection 13 specimens survive at NMS of an original 17 numbered fossils.

The ultimately unsuccessful history of the Scottish Spitsbergen Syndicate has been reviewed by Kruse (2013). Building on the 1909 investigations, further Syndicate expeditions followed in 1912 and 1914 and an account of the geology of Prince Charles Foreland was published by Robert Craig (1916), the geologist with the 1914 team. Craig refers to his own fieldwork and the specimens previously collected by Bruce but does not mention any additional specimens having been recovered.

The First World War prevented further activity by the Syndicate and when work was resumed in 1919, significant new investment was required. Accordingly, early in that year the private syndicate was wound-up and shares in a public company were offered on the London Stock

Exchange (Kruse 2013). The Directors of the new company were mostly Scottish businessmen and included Henry Moubray Cadell (1860–1934) who had worked for the Geological Survey between 1883 and 1888 (Mendum 2010). Thereafter, following the death of his father, he managed the family business interests in the Bridgeness Coal Company, with mines in West Lothian. He was instrumental in the expansion of the new Spitsbergen Syndicate's first field expedition, in the summer of 1919, to include mining trials for coal and the sinking of exploratory boreholes (Stone & Aspen 2024). Together with some of his fellow directors, Cadell visited Spitsbergen with the 1920 Syndicate expedition following which he published a commercially optimistic account of the geological circumstances of coal deposits (Cadell 1921); an archive of his notebooks, sketches and paintings (he was a competent artist) is held by The National Library of Scotland, Edinburgh (Figure 12).

The 1919 expedition was particularly well endowed with geological expertise. Two of Bruce's team were veterans of Ernest Shackleton's ill-fated 1914–16 Antarctic expedition: James Wordie from the Weddell Sea (*Endurance*) party and Alexander Stevens from the Ross Sea (*Aurora*) party; Wordie (later Sir James) went on to become Chairman of the Scott Polar Research Institute and Master of St John's College, Cambridge; Stevens became the first professor of geography at the University of Glasgow. Also involved were Douglas Allan, who became Director of the Royal Scottish Museum (now National Museum of Scotland) from 1945 to 1961, John Charlesworth who went on to be professor of geology at Queen's University, Belfast, and George Tyrrell who enjoyed an eminent geological career at the University of Glasgow.

Wordie, Allan and Tyrrell returned with the 1920 Syndicate expedition accompanied by another geologist, Robert Campbell from the University of Edinburgh who had previously described Bruce's SNAE specimens from Gough Island (Campbell 1906). Thereafter, it was Tyrrell who took the lead in the coordination and interpretation of the geological results, describing the older basement rocks of Spitsbergen and publishing a comprehensive account of the geology of Prince Charles Foreland (Tyrrell 1922, 1924). The Hunterian Museum, Glasgow, holds a large number of geological specimens donated by him with the majority collected on the 1919 expedition: several hundred rocks representing a wide range of lithologies and about 30 fossils derived from both the Carboniferous marine fauna and the Paleogene flora.

Bruce had taken an active part in the 1919 expedition but by 1920 his health was failing and his role on that year's expedition was largely symbolic. He was unable to join the small party

that ventured north in the summer of 1921, lapsed into serious illness and died that year on 28 October. The Syndicate probably lost momentum without Bruce as a driving force, and though small parties continued to make annual visits to Spitsbergen until 1925, there must have been a realisation that commercial success was unlikely. If any geological collections were made during this late phase of activity they have not been located. The syndicate was formally wound-up in 1952 (Kruse 2013).

Concluding assessment

Speak (2003, p. 19) wrote of Bruce that "the collections he amassed and the archive of documents left behind give a vivid impression of a man who, for a brief period early in the twentieth century, almost single-handedly put Scotland at the forefront of polar research."

The range of the geological collections certainly support that claim, and they now serve as a tangible memorial to his work in the polar regions. For Bruce, scientific research was the primary motivation, and he considered, with disdain, that "what has been aptly called the "boyish Pole hunt," can no longer be regarded as serious exploration" (Bruce 1911, p. 236). Collections were an integral part of the programmes pursued during his various expeditions and were seen to have two principal purposes. Firstly, to enable laboratory study in support of the expeditions' scientific reports, and secondly for display to interest and educate the broader public. It was to promote both these aims that in 1906 Bruce established the SOL following the success of the SNAE. His later interest in Svalbard was primarily commercial, with specimen collections illustrating and providing regional background to resource prospects.

There was also a realisation that specimens from remote regions, difficult of access, were data banked against their potential value to future research programmes or as a guide to future fieldwork. So, for example, the fossil collection from Seymour Island acquired during the 1892–1893 Dundee whaling expedition influenced the scientific plans of the subsequent Swedish Antarctic Expedition in 1901–1903 (Nordenskjöld & Andersson 1905, pp 250–252), leading eventually to the international recognition of that important site and the establishment of the Argentinian *Marambio* scientific station. Similarly, the Novaya Zemlya collections of Bruce (and Feilden) provided the groundwork for the more extensive explorations by Olaf Holtedal's Norwegian expedition of 1921 (Nakrem *et al*. 2023), thus illustrating geologically an area now rendered politically inaccessible through Russian nuclear weapons testing. Similarly, Franz Josef Land was annexed by Russia in 1926 and is now extensively militarised.

But the historical collections can also prove their worth for areas that have become better known and more readily visited. The SNAE base on Laurie Island was taken over by Argentina in 1904, renamed *Orcadas*, and has been continuously occupied as a research centre ever since (Swinney 2007). Yet only the preservation of the SNAE geological specimens allowed the definitive re-evaluation of the supposed graptolite fossils, the required Lower Palaeozoic age of which had proved anomalous as more data on the regional geology was acquired (Dalziel *et al* 1981; Stone 2017). Comparably, but in terms of the SNAE's reorientation to Laurie Island, the preservation of the Coronation Island specimen allowed the geographical discrepancy to be noted only when the geology of that island became better known (Figure 9).

One notable feature in the background to Bruce's Polar work and the acquisition of his collections, is that everything was achieved with funding raised from private sources. Unlike his contemporaries, Bruce received no financial support from a national government. His first Antarctic experience was with a commercial whaling expedition. The JHE to the Arctic Franz Josef Land archipelago was as much a Newspaper publicity stunt as a scientific enterprise: the recovery of Nansen and Johansen must have been a welcome and unexpected scoop. The Novaya Zemlya trip accompanied a party of wealthy big-game hunters, but principal amongst them was Major Andrew Coats of the family that later would largely finance Bruce's major project, the SNAE; an important contact was thus made. Very different in terms of motivation were the Svalbard voyages made with the Prince of Monaco. The prince was a respected amateur scientist and wealthy enough to finance his own oceanographic expeditions and research. For the SNAE, only substantial donations from the Coats family made it possible; their reward was the naming of Coats Land bordering the SE margin of the Wedell Sea. Bruce is often thought of as a dour and irascible character, yet to make these various expeditions succeed he must have impressed and developed good relations with a range of people from entirely different social backgrounds: these circumstances are explored in the biographies by Speak (2003) and by Williams & Dudeney (2018). Finally, the SSS was an entirely commercial enterprise with finance raised from shareholders (Kruse 2013). For the business arrangements Bruce relied heavily on others but took a leading role in lobbying, unsuccessfully, for Britain to annexe Svalbard so that the work of the SSS could be sheltered by a *pax Brittanica*. Svalbard at that time was regarded as ungoverned territory, a *terra nullius*, and Bruce was concerned about foreign competitors encroaching on the SSS claims (Speak 2003; Williams & Dudeney 2018).

During his lifetime Bruce received various awards for his scientific work, but he never sought prominence or public acclaim; nor did he achieve any financial success. Perhaps as a result his physical memorials are few: Speirs Bruce Way is a public footpath in Granton, Edinburgh; a plaque on the building that once housed his Oceanographical Laboratory also commemorates his involvement in establishing Edinburgh Zoo; a plaque on his family home in Edinburgh was put in place by the Portobello Heritage Trust. Against this low-key background, Bruce's geological specimen collections from his various Polar expeditions stand as a memorial to his life and work and should be celebrated accordingly. It is probably the kind of memorial he would have chosen for himself.

It is likely that some geological specimens associated with William Speirs Bruce have passed unnoticed and are not addressed in this paper. The author would welcome any information leading to their rediscovery.

Epilogue

From the perspective of the early 21st century, geological exploration during the height of the British Empire is increasingly interpreted as part of a broader colonial enterprise. In the context of this paper, however, it should be noted that Bruce was not an establishment figure and did not receive direct Government funding for his expeditions, relying instead on the sponsorship of wealthy benefactors. He is unlikely to have questioned the origins of that financial support, even where such wealth may have been linked, at least in part, to colonial systems. With the benefit of hindsight, we now recognise more clearly the lasting influence of colonial-era exploration on the development of geology as a discipline, a development increasingly reflected in the literature (e.g. Rogers *et al*. 2022). With the arguable exception of Novaya Zemlya, the polar regions explored by Bruce had no Indigenous population and so his specimen collections, the focus of this paper, do not raise direct concerns of colonial expropriation. Nevertheless, this does not fully remove the broader historical context in which such work took place, and it is important to recognise that our understanding of these legacies continues to evolve.

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Author contributions

PS: conceptualisation, research and writing.

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Competing interests

The author declares that he has no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

All data generated or analysed during this study are included in this published article.

References

Aagaard, B. 1930. *Fangst og forskning I Sydishavet*, Oslo.

Bernstein, R.E. 1985. The Scottish National Antarctic Expedition 1902-04. *Polar Record*, **22**, 379–392.

Bishop, A.C., Jones, V., Moore, D.T. & Woolley, A.R. 1971. *Catalogue of rock collections in the British Museum (Natural History)*. Trustees of the British Museum (Natural History) London.

Brown, R.N.R. & Burn Murdoch W.G. 1923. *A Naturalist at the Poles*. Seeley, Service & Co. London.

Brown, R.N.R., Mossman, R.C. & Pirie, J.H.H. 1906. *The Voyage of the "Scotia"*. William Blackwood & Sons, Edinburgh & London.

Bruce, W.S. 1911. *Polar Exploration*. Williams & Northgate, London.

Bruce W. S. & Donald, C. 1893. A voyage toward the Antarctic Sea, September 1892 to June 1893. Preliminary Reports. *Geographical Journal*, **2**, 429–438.

Bruce W. S. & Donald, C. 1896. Cruise of the "Balaena" and the "Active" in the Antarctic Seas, 1892-93. *Geographical Journal*, **7**, 502–521 & 625–643.

Burn Murdoch, W.G. & Bruce, W.S. 1894. *From Edinburgh to the Antarctic*. Longmans, Green & Co. London.

Cadell, H. M. 1921. Coal mining in Spitsbergen. *Transactions of the Institution of Mining Engineers*, **60**, 119–142.

Campbell, R. 1906. Notes on the petrology of Gough Island. *Proceedings of the Royal Physical Society of Edinburgh*, **16**, 263–266.

Carrasquero, S.I. 2021. The geological collection from the Scottish National Antarctic Expedition (1902-04) in the Museo de La Plata, Argentina. *Scottish Journal of Geology*, **57**, 60–66.

Craig, R. 1916. Outline of the Geology of Prince Charles Foreland, Spitsbergen. *Transactions of the Edinburgh Geological Society*, **10**, 276–288.

Dalziel, I.W.D. 1979. The mythical graptolites of the South Orkney Islands. *The Edinburgh Geologist*, **6**, 2–9.

Dalziel, I.W.D., Elliot, D.H., Jones, D.L., Thomson, J.W., Thomson, M.R.A., Wells, N.A. & Zinsmeister, W.J. 1981. The geological significance of some Triassic microfossils from the South Orkney Islands, Scotia Ridge. *Geological Magazine*, **118**, 15–25.

Geikie, Sir A. 1898. Notes on some specimens of rock from the Antarctic Regions. *Proceedings of the Royal Society of Edinburgh*, **22**, 66–70.

Gordon, W.T. 1920. Scottish National Antarctic Expedition, 1902–04: Cambrian organic remains from a dredging in the Weddell Sea. *Transactions of the Royal Society of Edinburgh*, **52**, 681–714.

Keighren, I. M. 2005. Of poles, pressmen and the newspaper public: reporting the Scottish National Antarctic Expedition, 1902–1904. *Scottish Geographical Journal*, **121**, 203–218. https://doi.org/10.1080/00369220518737231.

Koettlitz, R. 1898. Observations on the geology of Franz Josef Land. *Quarterly Journal of the Geological Society, London*, **54**, 620–645.

Kruse, F. 2013. *Frozen Assets. British mining, exploration, and geopolitics on Spitsbergen, 1904-53*. Circumpolar Studies, **9**, Arctic Centre of the University of Groningen, Netherlands.

Lee. G.W. 1908. Notes on fossils from Prince Charles Foreland, brought home by Dr William S. Bruce in 1906 and 1907. *Proceedings of the Royal Physical Society of Edinburgh*, **17**, 149–166.

Lee, G.W. 1909. A Carboniferous fauna from Nowaja Semlja collected by Dr. W.S. Bruce. With notes on the Corals by R.G. Carruthers. *Transactions of the Royal Society of Edinburgh*, **47**, 143–186.

Mair, B.F. & Stone, P. 2024. Medals awarded to the personnel of the Scottish National Antarctic Expedition, 1902-1904: an inconsistency of recognition. *Scottish Geographical Journal*, **141** (for 2025), 139–160.

Mendum, J. 2010. Henry Moubray Cadell: a geological and industrial innovator. *The Edinburgh Geologist*, **48**, 5–14.

Murray, J. 1894. The renewal of Antarctic exploration. *Geographical Journal*, **3**, 1–42.

Nakrem, H.A., Lindemann, F-J., Hurum, J.H. & Hammer, Ø. 2023. Fossils From the Arctic in the Collections of the Natural History Museum in Oslo, Norway. *Collections: A Journal for Museum and Archives Professionals*, **19** (3), 1–22.

Newton, E.T. 1897. Notes on a collection of rocks and fossils from Franz Josef Land made by the Jackson-Harmsworth Expedition during 1894-1896. *Quarterly Journal of the Geological Society*, London, **53**, 477–519.

Newton, E.T. 1899a. Notes on the fossils collected by Colonel H.W. Feilden in Novaya Zemlya, 1897. In: Pearson, H.J. 1899. *Beyond Petsora Eastward. Two summer voyages to Novaya Zemlya and the islands of the Barents Sea*. 287–294.

Newton, E.T. 1899b. Notes on fossils of Carboniferous age collected by Mr. W.S. Bruce, at Cape Cherni, Novaya Zemlya, in 1898. In: Pearson, H.J. 1899. *Beyond Petsora Eastward. Two summer voyages to Novaya Zemlya and the islands of the Barents Sea*. 294–297.

Newton, E.T. 1906. Notes on fossils from the Falkland Islands brought home by the Scottish National Antarctic Expedition in 1904. *Proceedings of the Royal Physical Society of Edinburgh*, **16**, 248–257.

Newton, E.T. & Teall, J.J.H. 1898. Additional notes on rocks and fossils from Franz Josef Land. *Quarterly Journal of the Geological Society*, London, **54**, 646–652.

Nordenskjöld, N.O.G. & Andersson, J.G. 1905. *Antarctica: or two years amongst the ice of the South Pole*. Hurst & Blackett, London.

Pearson, H.J. 1899. *Beyond Petsora Eastward. Two summer voyages to Novaya Zemlya and the islands of the Barents Sea*. R.H. Porter, London.

Pirie, J.H.H. 1905. On the Graptolite-bearing Rocks of the South Orkneys. *Proceedings of the Royal Society of Edinburgh*, **25**, 463–470.

Pirie, J.H.H. 1906. A note on the geology of Gough Island. *Proceedings of the Royal Physical Society of Edinburgh*, **16**, 258–262.

Pirie, J.H.H. 1913. Scottish National Antarctic Expedition, 1902-04: Deep-Sea Deposits. *Transactions of the Royal Society of Edinburgh*, **49**, 645-686.

Rogers, S.L., Lau, L., Dowey, N., Sheikh, H. & Williams, R. 2022. Geology uprooted! Decolonising the curriculum for geologists. *Geoscience Communication*, **5**, 189–204. https://doi.org/10.5194/gc-5-189-2022.

Sharman, G. & Newton, E.T., 1894. Notes on some fossils from Seymour Island in the Antarctic Regions, obtained by Dr Donald. *Transactions of the Royal Society of Edinburgh*, **37**, 707–709.

Sharman, G. & Newton, E.T., 1899. Notes on some additional fossils collected on Seymour Island, Graham's Land, by Dr Donald and Captain Larsen. *Proceedings of the Royal Society of Edinburgh*, **22**, 58–61.

Speak, P. 1992. William Speirs Bruce and the Scottish National Antarctic Expedition. *Scottish Geographical Magazine*, **108**, 138–148.

Speak, P. 2003. *William Speirs Bruce – Polar Explorer and Scottish Nationalist*. National Museums of Scotland, Edinburgh.

Stace, H.E., Pettitt, C.W.A. & Waterston, C.D. 1987. *Natural Science Collections in Scotland*. National Museum of Scotland, Edinburgh.

Stewart, D. 1937. Petrography of some rocks from the South Orkney Islands and the Antarctic Archipelago. *The American Mineralogist*, **22**, 178–194.

Stone, P. 2017. The geological work of the Scottish National Antarctic Expedition, 1902–04. *Scottish Journal of Geology*, **53**, 71–87.

Stone, P. 2025. The tragically short geological career of Angus McEwan Peach (1888–1909). *The Edinburgh Geologist*, **78**, 18–21.

Stone, P. & Aspen, P. 2024. From Bo'ness to Svalbard: the coal mining ambitions of the Scottish Spitsbergen Syndicate (1909–1952). *The Edinburgh Geologist*, **76**, 4–12.

Stone, P. & Crame, J.A. 2026. Concerning the historical holotype of the Cretaceous bivalve *Lahillia larseni*. *Antarctic Science*, **38**, 237–239.

Stone, P., Walcott, R. & Aspen, P. 2023. Shackleton and Bruce: disentangling Antarctic geological collections at National Museums Scotland. *Geological Curator*, **11**, 527–534.

Swinney, G.N. 2007. The Scottish National Antarctic Expedition (1902-04) and the Founding of Base Orcadas. *Scottish Geographical Journal*, **123**, 48–67.

Tyrrell, G.W. 1922. The Pre-Devonian Basement Complex of Central Spitsbergen. *Transactions of the Royal Society of Edinburgh*, **53**, 209–229.

Tyrrell, G.W. 1924. The geology of Prince Charles Foreland, Spitsbergen. *Transactions of the Royal Society of Edinburgh*, **53**, 443–478.

Williams, I.P. & Dudeney, J. 2018. *William Speirs Bruce – Forgotten Polar Hero*. Amberley, Stroud.

Woodward, A. S. & Fletcher, L. 1904. The Departments of Geology and Mineralogy. In: *The history of the collections contained in the Natural History Departments of the British Museum*, **1**, 197–442.

Zinsmeister, W.J. 1984. Late Eocene Bivalves (Mollusca) from the La Meseta Formation, collected during the 1974-1975 Joint Argentine-American Expedition to Seymour Island, Antarctic Peninsula. *Journal of Palaeontology*, **58**, 1497–1527.

Zinsmeister, W.J. 1988. Early geological exploration of Seymour Island, Antarctica. *In*: Feldman, R.M. & Woodburne, M.O. (eds) *Geology and Palaeontology of Seymour Island, Antarctic Peninsula, Geological Society of America Memoir* **169**, 1–16.

Zinsmeister, W. J. & Macellari, C. E. 1988. Bivalvia (Mollusca) from Seymour Island, Antarctic Peninsula. *In*: Feldman, R.M. & Woodburne, M.O. (eds) *Geology and Palaeontology of Seymour Island, Antarctic Peninsula, Geological Society of America Memoir* **169**, 253–284.

Figures

Fig. 1. A cartoon of William Speirs Bruce published in the Buenos Aires magazine *El Gladiator*, Number 110, January 1904, to mark the arrival of the Scottish National Antarctic Expedition's ship *Scotia*, for provisioning and repairs. Source: Image courtesy of University of Edinburgh Library Heritage Collections.

Fig. 2. Outline maps for the Antarctic and Arctic showing the localities visited by expeditions involving William Speirs Bruce. British Geological Survey © UKRI (2025). Source: Esri World Basemap v2, version 10:81 (Esri, TomTom, Garmin, FAO, NOAA, USGS, © OpenStreetMap contributors, and the GIS User Community).

Fig. 3. The first fossil fauna to be described from the Antarctic, Eocene bivalves and a gastropod: *Cucullaea donaldi* Sharman and Newton, 1894 (Figs 1 & 2), *Cytherea antarctica* Sharman and Newton, 1894 (Fig. 3), *Natica*? (Fig.4). Source: Sharman & Newton (1894, Plate 1). These specimens cannot be located and are believed lost.

Fig. 4. The holotype of the Upper Cretaceous to Palaeocene bivalve *Lahillia larseni* (Sharman & Newton 1899) (BGS specimen FOR 4053). British Geological Survey © UKRI 2025 (extract from image P1074719). All rights reserved.

Fig. 5. The label accompanying specimen NMS.G.1899.17.38, collected by Reginald Koettlitz on the summit of Cape Flora, Franz Josef Land, and now held by National Museums Scotland as part of the Jackson-Harmsworth Expedition collection. Bruce had joined the expedition by the time Koettlitz collected this specimen. Author's photograph.

Fig. 6. A specimen showing part of the Carboniferous brachiopod *Productus giganteus* collected by Bruce at Cape Cherny, Novaya Zemlya. Genus now redefined as *Gigantoproductus*. Scale in cm. Specimen NMS.G.1954.6.62 held by National Museums Scotland, author's photograph.

Fig. 7. Fossil fragments of the brachiopod *Chonetes* collected by Bruce at Cape Cherny, Novaya Zemlya. It is not clear if the fragments are as collected by Bruce or if they were produced by Lee during his development of the specimens. Scale in cm. Specimen NMS.G.1954.6.58 held by National Museums Scotland, author's photograph.

Fig. 8. Rock fragments broken from pebbles and cobbles trawled from the floor of the Weddell Sea to the SE of the South Orkney Islands during the Scottish National Antarctic

Expedition. Source: Specimen NMS.G.1954.5.25.1 held by National Museums Scotland, author's photograph.

Fig. 9. Greywacke-microconglomerates from Laurie Island and Coronation Island, South Orkney Islands, collected during the Scottish National Antarctic Expedition, with labels prepared for display in the Scottish Oceanographical Laboratory. Source: Specimens NMS.G.1954.1.18 and G.1954.2.25 held by National Museums Scotland, author's photograph.

Fig. 10. Rock specimens collected by Bruce during exploration of Prince Charles Foreland, Svalbard, with labels prepared for display in the Scottish Oceanographical Laboratory. Source: Specimens NMS.G.1954.15.1b and G.1954.15.10 held by National Museums Scotland, author's photograph.

Fig. 11. Paleogene leaf fossils collected from Prince Charles Foreland, Svalbard, during one of the expeditions mounted by the Scottish Spitsbergen Syndicate. Specimen NMS.G.1954.15.6 held by National Museums Scotland, author's photograph.

Fig. 12. A geological sketch by Henry Moubray Cadell showing operations at the Braganza Mine in Spitsbergen, drawn in 1920 during his visit as a Director of the Scottish Spitsbergen Syndicate. Source: National Library of Scotland Cadell archive, Acc.5381.70, author's photograph.

Figure 1

Figure 2

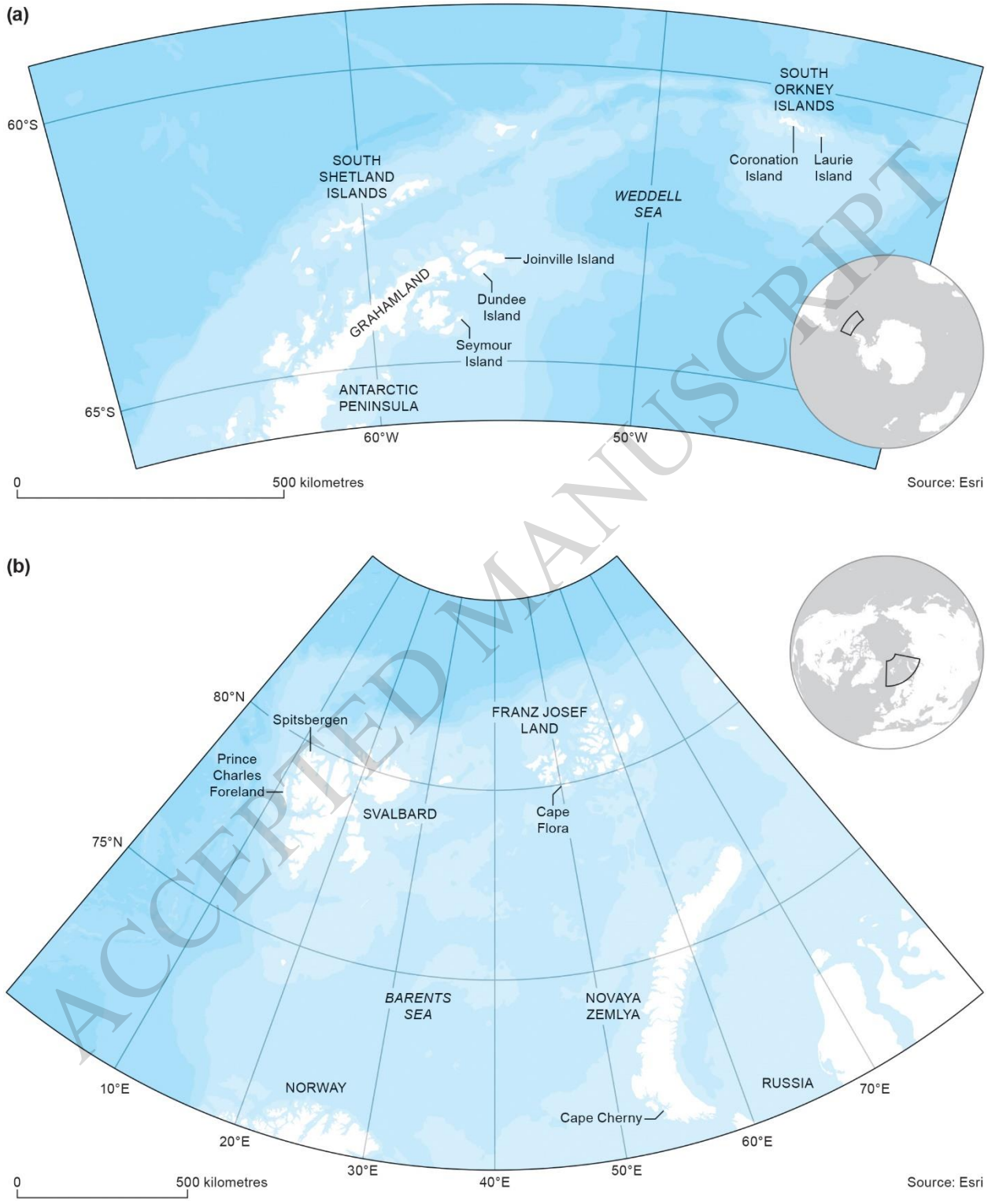

Figure 3

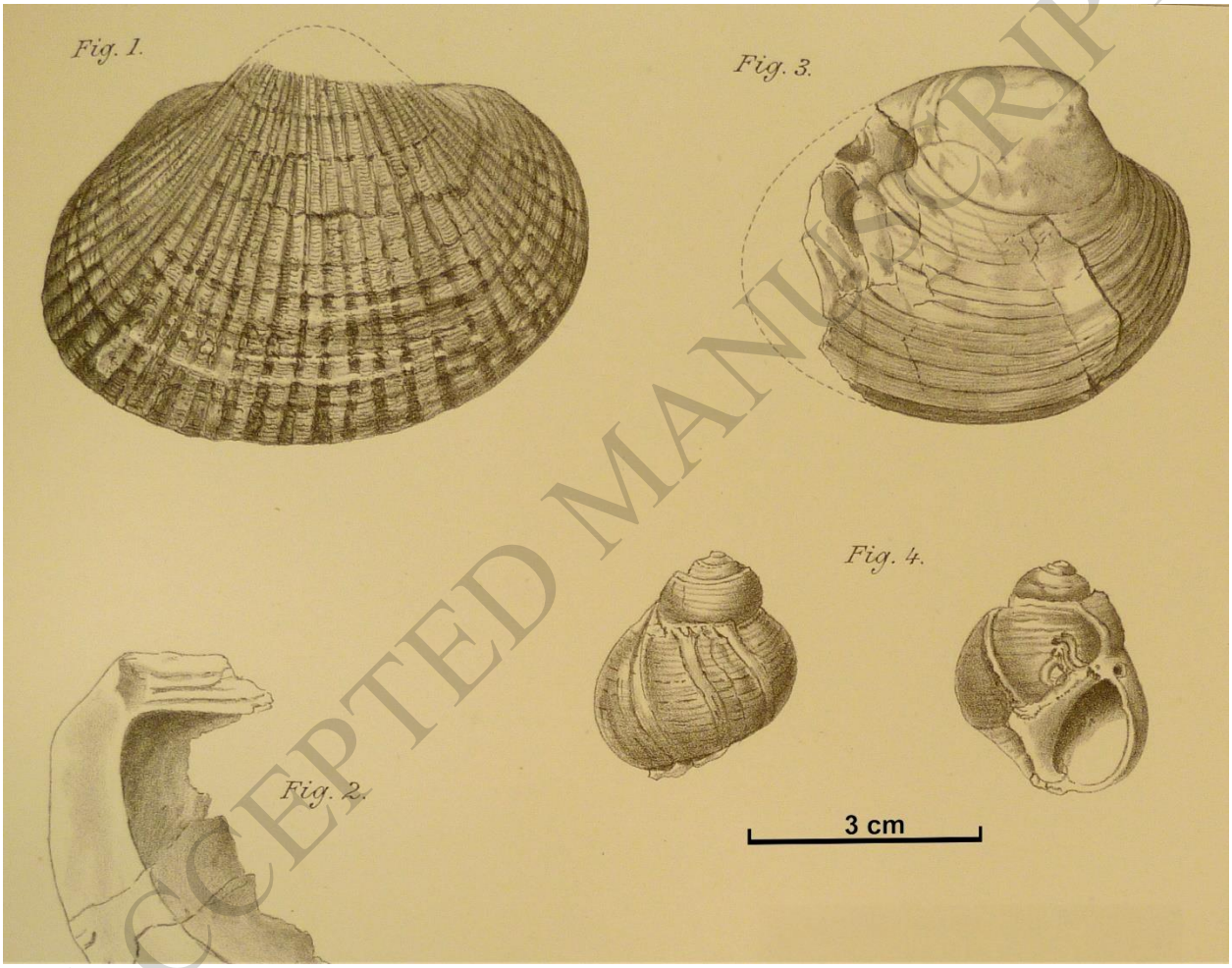

Figure 4

Figure 5

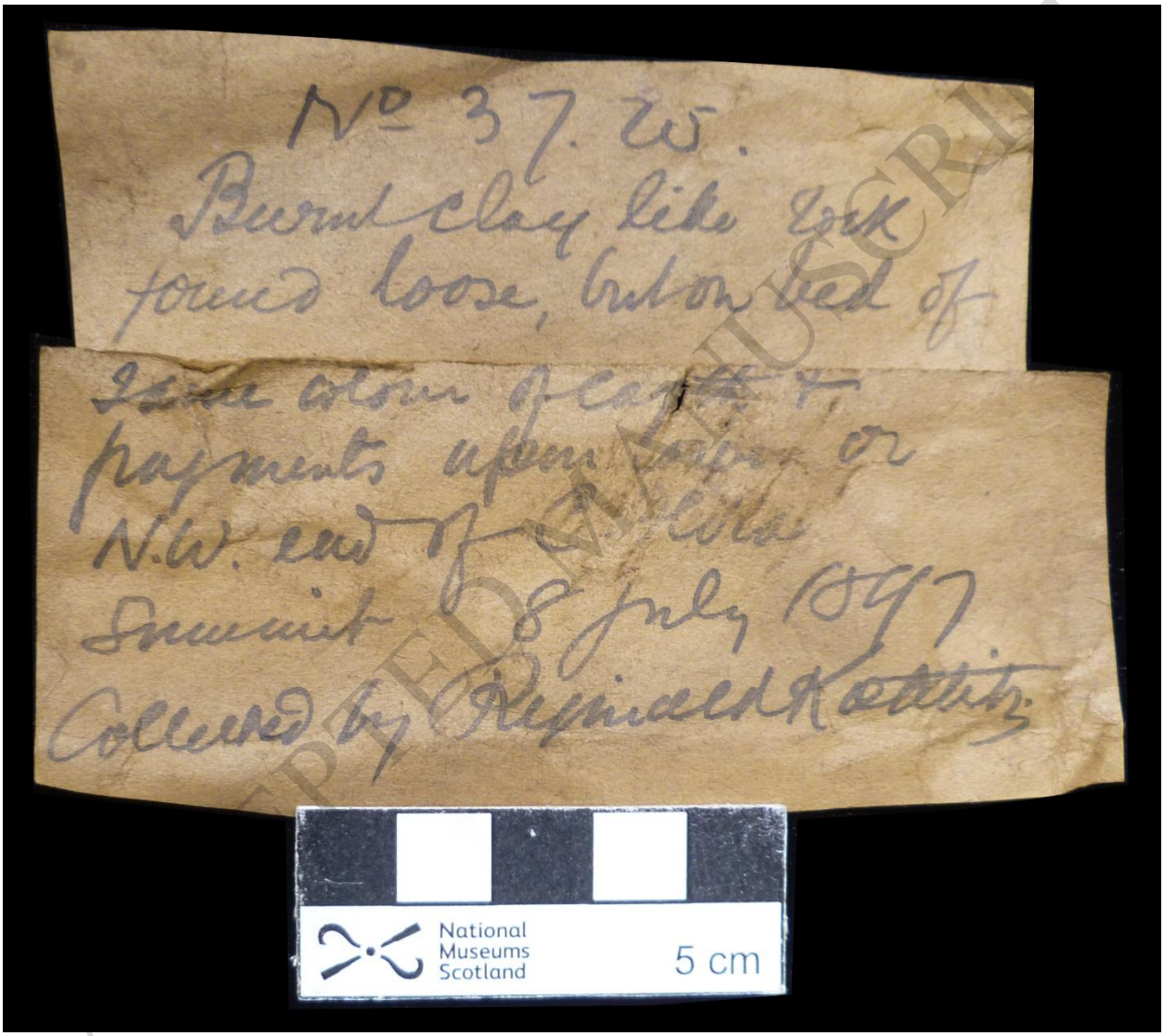

Figure 6

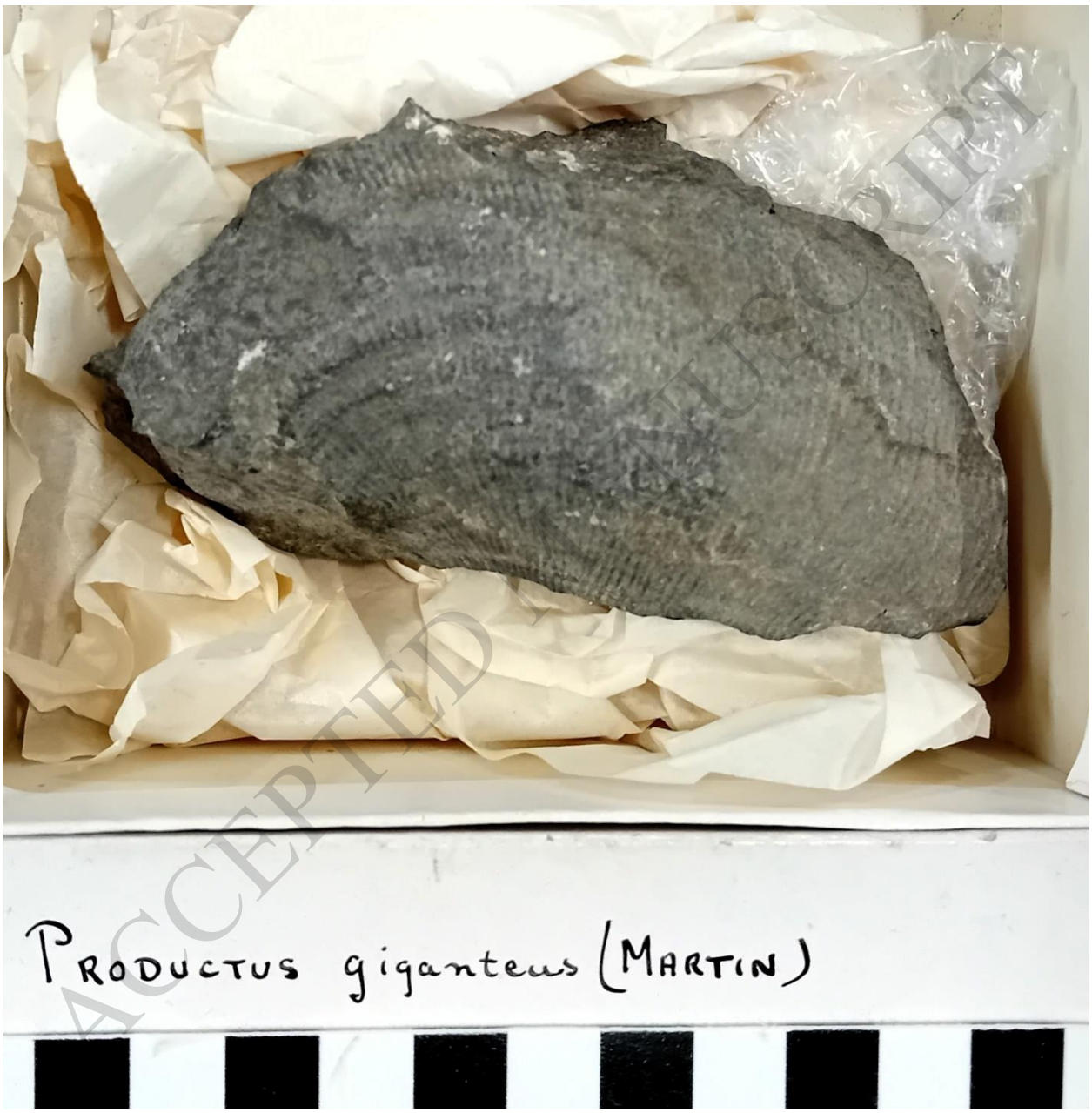

Figure 7

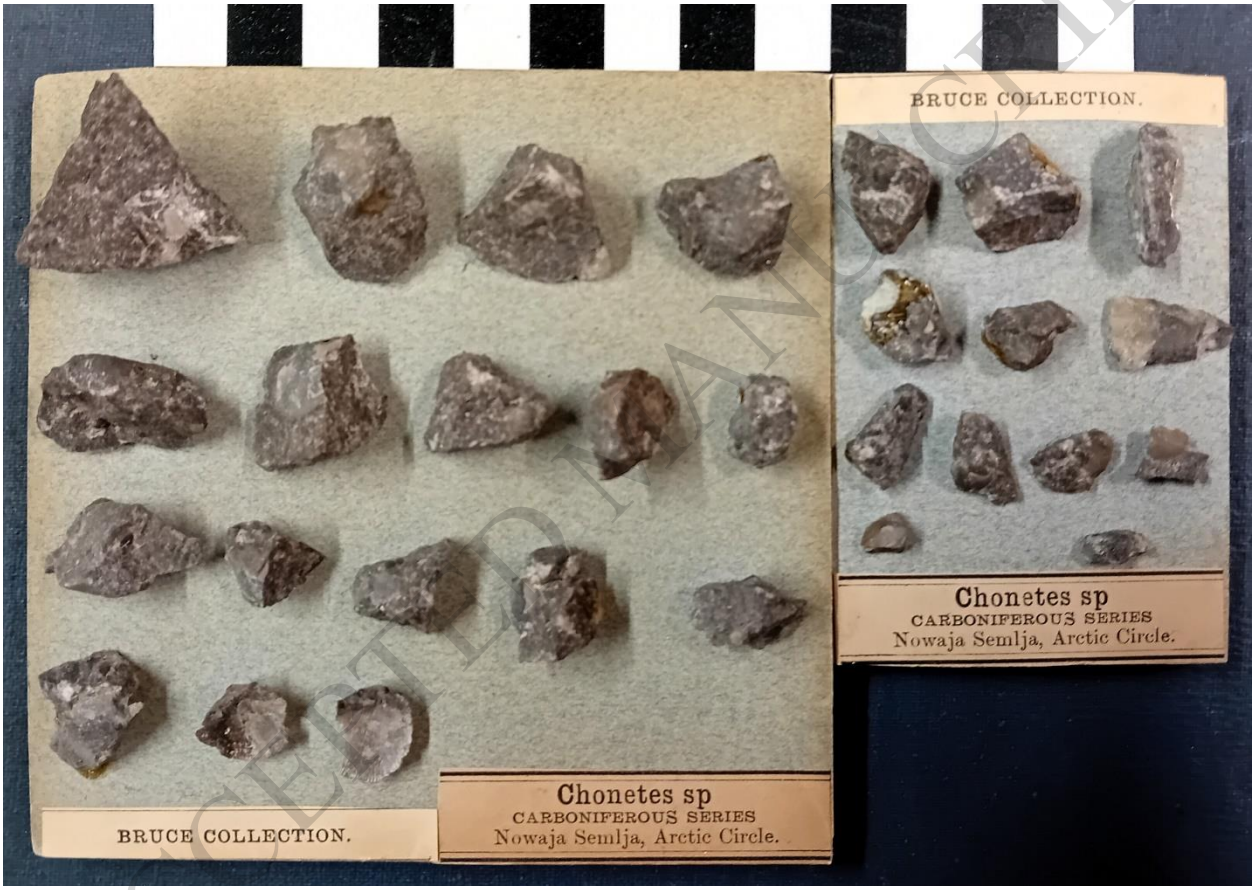

Figure 8

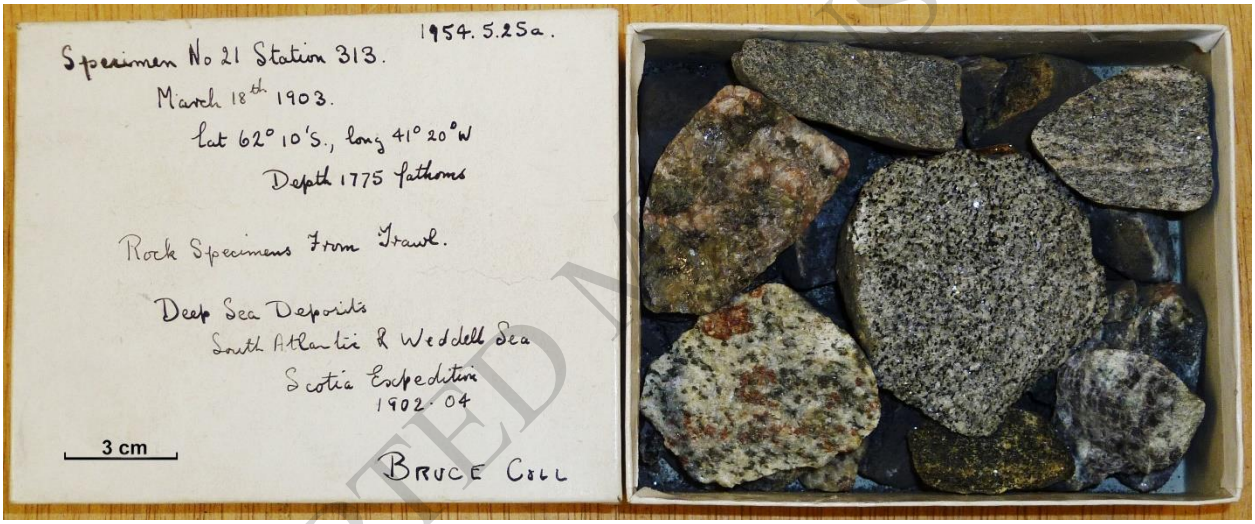

Figure 9

Figure 10

Figure 11

Figure 12