

**On the provenance of a historic sledge shoe fragment, said to have been collected
by Edward Wilson at the South Pole in 1912.**

Sophie Rowe

Scott Polar Research Institute, Lensfield Road, Cambridge CB2 1ER, UK

Abstract:

This paper discusses the authentication of a metal sledge shoe fragment, believed by the owner to have been collected by Edward Wilson close to the South Pole on 18 January 1912. Microscopic and elemental analysis show that the object is made from "German silver", a copper alloy used only on Norwegian Nansen-style sledges in the late nineteenth and early twentieth century, and that it was used to clad a tapering sledge runner end about 10mm thick. By comparing related objects, including sledges used by Amundsen and Scott in their South Pole journeys and a sledge from the Discovery expedition, we show that the object cannot have come from an English sledge, but would have fitted one of Amundsen's modified sledges. Written sources have been extensively searched, but no direct written provenance for the object exists. However, contemporary Norwegian and British accounts explain specific features of the object and exclude other possible provenances. We conclude that it is most likely that the proposed provenance and history attached to this artefact are correct.

1. Introduction

In 2012 a fragment of a metal sledge shoe was brought by Nick Forbes to the Polar Museum at the Scott Polar Research Institute in Cambridge, for authentication. The object was a family heirloom and was believed to have been collected by Edward Wilson from the underside of a sledge runner left by Roald Amundsen's team near the South Pole in December 1911. This paper presents the results of the investigation of the object and its proposed provenance.

Forbes inherited the metal fragment from his mother, Evelyn Forbes (née Ferrar), who was given it as a legacy by her close friend Oriana Wilson. She was the widow of Edward Wilson who died with Robert Falcon Scott in Antarctica in 1912, during the British Antarctic Expedition (also known as the Terra Nova expedition). The Forbes /Ferrar family is intimately connected to the Polar world, as Evelyn Ferrar was the daughter of Hartley Travers Ferrar, geologist on Scott's Discovery expedition of 1901-4, whilst Max Forbes (father of Nick) was formerly curator at the Scott Polar Research Institute (SPRI) and editor of the Polar Record (Robin, 1972). There was no direct written provenance for the sledge shoe, but the oral history connected with it was strongly preserved within the Forbes/Ferrar family. The proposed provenance is inherently plausible because of the well established relationships between the individuals concerned.

2. The Proposed Provenance for the Sledge Shoe Fragment:

In the nineteenth and early twentieth century, sledges for polar exploration were built mainly from wood, sometimes with bamboo elements, lashed with leather or rawhide. Metal was used for additional fittings such as stiffeners. In some circumstances, the wooden sledge runners were clad with metal to protect the wood from the abrasion of hard ice. The metal cladding, or "sledge shoe" was either applied directly to the sledge runner, or was used to clad a thin wooden "under-runner" which could be strapped temporarily under the normal sledge runner. The fragment in question in this study is believed to be part of this type of metal cladding.

The proposed provenance for the fragment is that it was collected by Edward Wilson close to the South Pole, as related in his diary entry for 18 January 1912:

“At our lunch South Pole Camp we saw a sledge runner with a black flag about ½ a mile away blowing from it. Scott sent me on ski to fetch it and I found a note tied to it showing that this was the Norskies actual final Pole position. I was given the flag and the note with Amundsen’s signature, and I got a piece of the sledge runner as well.” (E. Wilson, 1972, p. 233)

Scott said of the same incident:

“Less than ½ a mile south we saw stuck up an old underrunner of a sledge. This we commandeered as a yard for a floorcloth sail. I imagine it was intended to mark the exact spot of the Pole as near as the Norwegians could fix it A note attached talked of the tent as being 2 miles from the Pole. Wilson keeps the note.” (Scott, 2009, p.395–6)

Wilson also sketched the site (see Fig.1).



Fig.1. Sketch by Edward Wilson showing the Norwegian flag pole made from a sledge runner, said to be the source of the sledge shoe fragment. Scott Polar Research Institute, University of Cambridge, with permission.

Although both Wilson and Scott seem to have thought initially that the flag was intended to mark the Pole as reckoned by the Norwegian team, the note itself makes it clear that this was not so. Mindful of the controversy over the location of the North Pole, Amundsen sent members of his party east, west and south of his course to encircle the Pole, each group taking a flagpole, a flag and a reckoning of the position of the Pole (Amundsen, 1912; Hinks, 1944). The flag found by Scott's party was planted around 8 miles from Amundsen's trial camp, known as "Sledge Camp". The note said "The Norwegian home Polheim is situated

in 89 degrees 58 minutes S.Lat/SE by E (comp) 8 miles/ 15 Decbr 1911/ Roald Amundsen” (Reckoning, n.d).

By the time these diary entries were written Scott's party had in fact already found the point finally identified by Amundsen as closest to the South Pole, which was marked with a small tent and flags.

According to Wilson, the Scott party took the sledge runner, the flag and the reckoning. The main part of the runner itself was used as a yard for making a sail out of a ground sheet to help propel a sledge. On 19 January Bowers recorded in his diary “We then with much relief left all traces of the Norwegians behind” (Bowers, Lane, Boneham & Smith, 2012, p.45) and this may explain why on 20 January the sledge runner was discarded by the Scott party in favour of one of their own bamboo poles when they reached Last Depot (E. Wilson, 1972, p.236–7). The flag and reckoning were kept by Wilson, and later found at the site where he died (see below, section 4a). Oriana Wilson gave both these items to the Scott Polar Research Institute in 1930 (see below, section 4b).

3. Description of the Sledge Shoe Fragment

This section gives a detailed description of the physical features of the fragment, many of which contribute important evidence to the proposed provenance.

The object is a tapering piece of metal, 127mm wide at the wide end and 95mm wide at the narrow end (see Fig.2). The overall length of the fragment is 217mm at its longest. Examination by reflected light microscopy shows that the metal at the narrow end of the fragment is neatly cut and finished, which indicates that this was the original end of the metal shoe. By contrast, at the wide end the metal edge is ragged and rough, and has clearly been torn off the rest of the shoe.



Fig.2. The Forbes sledge shoe fragment. Scott Polar Research Institute, University of Cambridge, with permission.

The object is now roughly flat, but there are traces of a pair of folds running up both sides which show that it was originally wrapped around the tapered wooden end of a sledge runner. The space between the pair of folds on both sides is the same all the way along, and is 10mm. This indicates that the thickness of the wooden runner to which it would have been attached was approximately 10mm. The space between the innermost folds is 85mm at the wide end and 56mm at the narrow end, which would mirror the width of the underside of the wooden runner in these areas. It is not clear whether 85mm was the widest measurement of the runner, as the metal tapers fairly evenly along its whole length. The original runner may therefore have been wider than 85mm where it was in contact with the snow.

The edges of the fragment are not straight and they are punctuated by slits and nail holes. Along one side the space between the outer folds in the metal and the edge of the sledge shoe varies between 3-8mm, and along the other it ranges from 10-15mm. This portion of the sledge shoe was on the top side of the wooden runner and was nailed in place. The nail holes are square, with sides between 1.8-2mm long, indicating that the nails had squared shafts (see Fig.3). The impressions from the nail heads are round.



Fig.3. Detail showing the square nail holes in the Forbes fragment. Scott Polar Research Institute, University of Cambridge, with permission.

The nail holes are not evenly spaced along the length of the fragment, nor do their positions match the holes on the opposite side of the shoe. At the narrowest end of the fragment there is a pair of nail holes close together on one side. The outermost nail would have fixed the metal to the top of the runner, like all the

others, while the inner nail would have fixed the metal to the side of the runner. This is the only nail into the side of the runner, and it is apparently intended to give extra security to the end of the shoe.

About every 8cm along the length of the fragment there are slits cut in the edge of the metal where it was folded over the top of the runner. When examined by reflected light microscopy it is clear that these are deliberate cuts rather than the result of accidental damage. The cuts are appropriate for allowing the metal to conform to the curved shape of the runner, by overlapping slightly.

All the features of the shoe fragment – its tapering shape, the finished and unfinished edges, the pattern of nail holes and the cuts along the edge - clearly show that it is from the end of the metal shoe, where the wooden runner curved upwards at the tip. This is consistent with contemporary evidence, since Wilson's sketch clearly shows the curve in the runner used to erect the flag (see Fig.1). Scott used the straight part of the runner as a yard, but the curved tip would not have been very useful for this and so might well have been discarded.

The curved tip may or may not have been the front of the runner, since sledges of this period had runners which were curved at both ends. Numerous photographs from the Fram expedition show that many of the sledges had runners curved at both ends (Kløver, 2010), as did the sledges used by the Terra Nova team now in the Polar Museum collection, Cambridge. The sledge type used in both these expeditions was developed by Fridtjof Nansen, who found it useful to have sledge runners with two "front ends" in case one end should be damaged (Nansen, 1890, Vol.1 p.34–35). To plant the runner in the snow as a flagpole one of the curved ends would have had to be removed, leaving just the one shown in Wilson's sketch. It is impossible to tell from physical evidence alone what proportion of the original sledge runner was used to make the flagpole, as sledges were made in different lengths.

The metal of the fragment is heavily scratched on the outer surface, as one would expect from use in icy terrain. The surface is also coated with a yellowish material, which may be an original lacquer, or may have been applied at a later date. At the narrow end there are thicker traces of a tarry-looking substance on both

sides of the metal, which may be remains of an adhesive used to help fix the end of the shoe to the wooden runner.

Green corrosion products on parts of the surface clearly show that the metal is a copper alloy (see Fig.3).

The only copper alloy ever used for sledge shoes was one known as “German silver”, an inexpensive mixture of copper, zinc and nickel made in large quantities in Germany and Sweden as a base metal for silver plating (Nord, Tronner & Christensson, 2012). This material was favoured over iron or steel for a time because it did not corrode easily (Scott, 1969, Vol.1 p.425). Scratches on the surface of the shoe fragment reveal that the underlying metal is a very pale blonde colour, as one might expect from the name of the alloy.

The identity of the alloy was confirmed by qualitative X-ray Fluorescence (XRF) carried out by Dr Lucy Wrapson at the Hamilton Kerr Institute, Whittlesford. A handheld Bruker Tracer III-SD pXRF was used to analyse the surface of the metal and very strong peaks for copper were detected (see Fig.4). Broad nickel and zinc peaks were also present. Iron was detected but not in significant amounts. The metal is therefore an alloy, principally of copper with nickel and zinc.

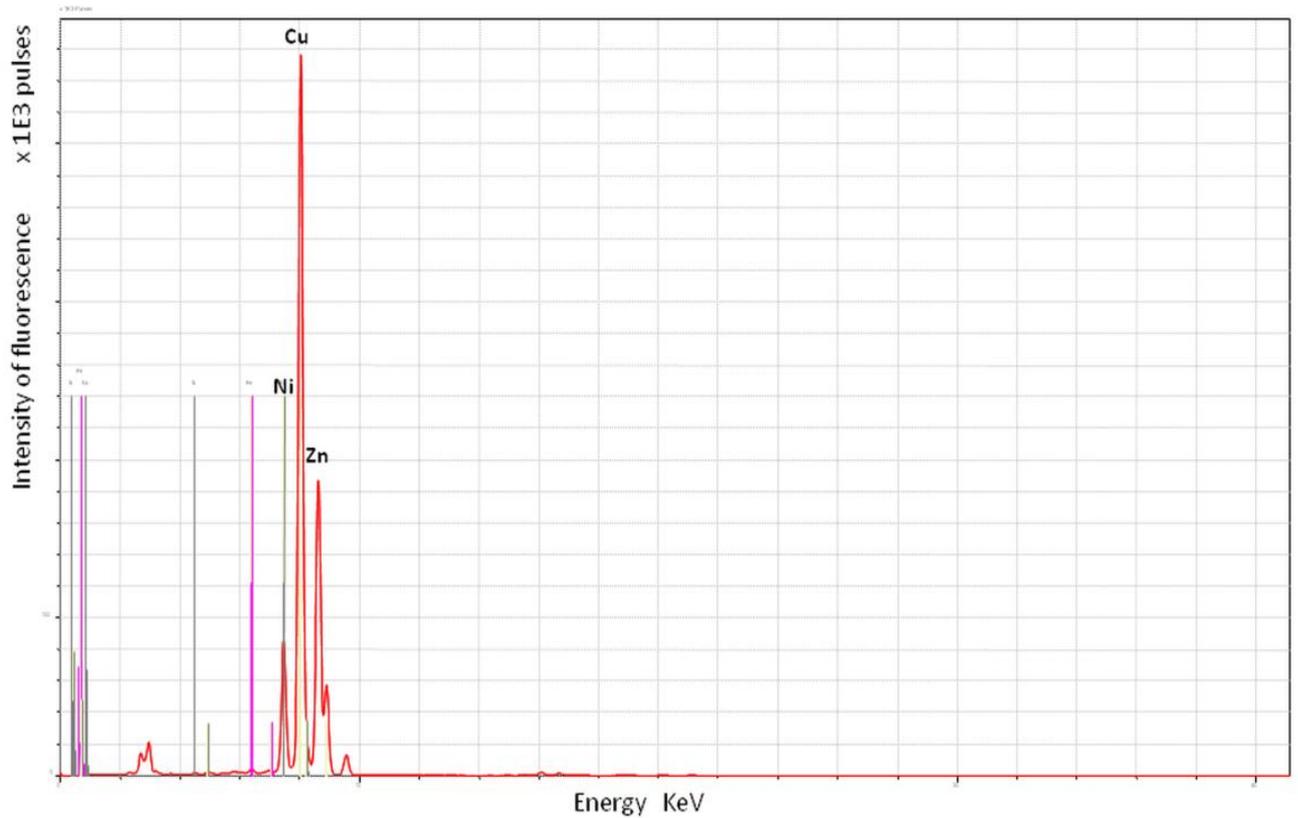


Fig.4. Graph showing results of qualitative analysis of the Forbes fragment by pXRF.

There are slight distortions on the outer edge by some of the nail holes, which may have been caused by the metal being levered off the underlying wood. Old dents close to some nail holes may also be marks from a knife or similar blade being used to separate the metal and wood parts. In theory the metal might also have been removed by burning the wood off, but there is no sign of that in this case.

As well as the folds due to the metal being wrapped around the runner, there is also a single transverse fold across the fragment. This does not relate to the technology or function of a typical sledge runner, but rather suggests the object was folded at some point to make it take up less space during transport. The profile of the fragment is now flat, and it is no longer possible to determine the original profile of the curve on the wooden runner.

4. Textual Evidence for the Provenance of the Sledge Runner:

The South Pole diaries from the Terra Nova expedition make it clear that a sledge runner fragment was taken by Wilson. This section examines whether any written evidence exists to explain what happened to that fragment subsequently and how it may have come to the Forbes/Ferrar family. Written sources include those written during the Terra Nova expedition and those written later, and are dealt with in chronological order.

4a. Accounts Written During the Expedition:

A handwritten label on the fragment records the Forbes/Ferrar family understanding that it was “found with Dr Wilson’s body by Sir Charles Wright 1912”. Charles Wright’s diary for 12 November 1912, the day on which the bodies of Scott, Wilson and Bowers were found, does not mention any detail about the items with the Polar party, other than “about 40lb” of geological specimens (Wright, 1913).

On 17 November 1912 Wright wrote:

“brought along all Sn party gear save tent, floor cloth and sledge... letter from Amundsen at Pole to King Haakon found among bumph, must remember to give to Atch [Edward Atkinson, acting leader of the expedition at this date]” (Wright, 1913)

This letter was actually found by Tryggve Gran and Thomas Williamson, according to Gran’s diary from 17 November:

“We overhauled the sledges tonight before striking camp, and as a result Williamson and I discovered by pure chance, among the things we were going to dump a bag containing a letter from Amundsen to King Haakon” (Hattersley-Smith, 1984, p.219)

Williamson also very briefly noted that this letter had been found, although he said it was on 15 November (Williamson, 1913). He had run out of space in his diary and his account of 13–18 November is very short and seems to have been written retrospectively on the 18th. This probably accounts for the discrepancy in date between his and Gran’s versions.

No other items collected at the South Pole were mentioned individually in any contemporary diaries by search party members, or in Atkinson’s official report after the expedition (E. Atkinson, 1913), and there is no exhaustive list of the items found with the Polar party. This is perhaps not surprising. In a transcript of Apsley Cherry-Garrard’s diary, annotated by him at a later (unknown) date he states:

“Of course anything written at this time was written at a time of great mental distress” (Cherry-Garrard, n.d, back of page 691).

Thomas Williamson wrote that when the tent was first sighted on 12 November 1912:

“ ...I must own I shed a few tears and I know the others did the same, it came as a great shock to us all although we knew full sure for months past that we should meet with this sort of thing everyone seemed dumfounded (sic)..." (Williamson, 1913)

Nevertheless, several eyewitnesses commented on how much material the Polar party had with them at the end, including items which some considered could have been discarded. On 12 November Cherry-Garrard wrote:

“We have everything – records, diaries etc. They have among other things several rolls of photographs, a meteorological log kept up to March 13, and, considering all things, a great many

geological specimens. And they have stuck to everything. It is magnificent that men in such a case should go on pulling everything that they have died to gain.” (quoted in Cherry-Garrard, 1965, p.481)

On 13 November Tryggve Gran wrote:

“Before we left I took stock of the Polar Party’s impedimenta. It was incredible how much they had crowded on the sledge. Apart from the geological specimens which weighed about 20kg, there were masses of empty sacks and tattered clothing. I think they could have saved themselves the weight.” (Hattersley-Smith, 1984, p.217)

Edward Atkinson noted that it was Wilson who had insisted that they keep everything they had gathered:

“All their diaries and effects were gathered on the sledge besides their gear which, from Captain Scott’s diary, together with 35 pounds of geological specimens of great importance they had kept with them at Dr Wilson’s expressed wish” (E. Atkinson, n.d., p. 3, referring to Scott, 2009, p.429)

Although a sledge runner fragment is not specifically mentioned in the contemporary accounts, neither are the black depot flag, Polheim reckoning and silk slips taken from Amundsen’s South Pole tent, all of which had also been brought back from the Pole, and were subsequently donated directly to the Scott Polar Research Institute by Edward Wilson’s widow Oriana in 1930. It is quite possible that these items were among the “bumph” with the letter to King Haakon, mentioned by Wright.

After the discovery of the Polar party, Atkinson put Cherry-Garrard in charge of the dead men's belongings, and Cherry kept a record of what happened to them in a "Gear book" which he had previously started on 7 June 1912 when all hope of the party’s return was already lost (Cherry-Garrard, 1913). None of the items collected at the South Pole (the flag, Polheim reckoning, silk slips and sledge runner fragment) are mentioned individually in this notebook, though it records that the "Polar party gear" was all stored in a "tin case" at the order of Atkinson until the expedition was packed up to go home. On 15 February 1913, Cherry met Oriana Wilson in New Zealand and gave her some of her husband's papers and sketches, while the rest of Wilson's possessions were sent home by ship (Cherry-Garrard, 1913).

4b. Written Sources from After the Expedition:

Oriana Wilson was on very good terms with Frank Debenham, formerly geologist on the Terra Nova expedition and the prime mover in establishing the Scott Polar Research Institute in Cambridge in 1920. They wrote to each other regularly and by the late 1920's Oriana Wilson was considering making a substantial donation of Wilson artefacts to the Institute. A series of letters regarding these is preserved in the Thomas H. Manning Archives at SPRI. In 1928 Mrs Wilson told Debenham that "anything to do with the Antarctic always strings me up to the last degree" (O. Wilson, 1928), but early in 1929 she wrote to Debenham's assistant, Miss Francis Drake:

"I shall probably be sending the original journal of the Winter Journey and a good many other precious things... It's a bit difficult to give up everything - but still I know it is right for them to be at the Polar Institute." (O. Wilson, 1929a)

She went on to hope that she might be allowed to borrow things back occasionally. This letter is tantalising as it suggests that Oriana Wilson was tempted to keep a few items which were sentimental souvenirs for her but would not have been considered particularly significant to Polar exploration history.

In October 1929 Mrs Wilson formally offered the Amundsen flag and the Polheim reckoning to SPRI (O. Wilson, 1929b), and they, along with the silk slips, were all sent to the Institute in May 1930 (O. Wilson, 1930). The sledge runner fragment was not mentioned in this correspondence. Perhaps Oriana Wilson did not consider it as significant as the other South Pole items and felt justified in quietly keeping it.

In July 1930 a major exhibition entitled "The British Polar Exhibition" was held at Central Hall in Westminster (Bernacchi, 1931) and both SPRI and Cheltenham Museum lent many of their recently acquired Wilson "relics" to this show, although Oriana Wilson herself did not lend anything personally, and the sledge runner was apparently not displayed (Central Hall, 1930, catalogue no. 161).

The oral history preserved in the Forbes/Ferrar family relates that Oriana Wilson eventually left the sledge runner to Evelyn Forbes (née Ferrar), who had been a close friend and had helped with setting Mrs Wilson's

affairs in order in the latter part of her life. Mrs Forbes also inherited some kitchen copperware, books and some watercolours from her friend. Oriana Wilson's will and the associated letters preserved with it do not mention these small gifts individually (O. Wilson, n.d). A letter from Rosalind Atkinson to SPRI after Oriana Wilson's death in 1945 mentions that Mrs Wilson kept a wish book for her bequests (R. Atkinson, 1945). Unfortunately this apparently does not survive, but Forbes reports that the items were passed to his mother by the executors of Oriana Wilson's estate who must have had access to this document.

In short, there is no specific mention of a sledge runner fragment in the written sources from the discovery of the Polar Party in November 1912 or subsequently. However, apart from the letter to King Haakon, none of the other items collected at the South Pole was mentioned either. Like the sledge runner, Amundsen's black depot flag, the silk slips and the Polheim reckoning are not mentioned in any textual sources apart from the initial diary entries by Wilson and Scott, although their provenance is not in doubt. This means that although there is no written evidence to prove the provenance of the sledge runner fragment, the lack of evidence is not enough to disprove it either.

The flag, silk slips and reckoning were recovered from the Polar party effects and all have a secure provenance because they were donated to SPRI directly by Oriana Wilson just 18 years after they were found. It is highly plausible that the sledge runner could have come to Mrs Wilson with these other objects, but this is not proven by the written sources currently available. It is plausible that Oriana Wilson may have kept the sledge runner fragment for sentimental reasons, since it was brought back from the Pole by her husband and found with him at his death, but was fundamentally of lesser value than the other items as a relic of the British quest for the South Pole.

5. The Sledge Shoe Fragment in Context

Despite the lack of written provenance information, the physical characteristics of the sledge runner fragment contain crucial clues about its origins. The features of the object are all entirely consistent with it being from a Norwegian Nansen-type sledge with ski-like runners, dating from the late nineteenth or early

twentieth century. However, contemporary evidence shows that these sledges were not only used by Amundsen, but also by Scott on both the Terra Nova and Discovery expeditions.

The greatest challenge to the provenance of this object is therefore the possibility that it was not collected from Amundsen's flag marker, but was part of a Terra Nova sledge, or came from a sledge used on the Discovery expedition of 1901-4, where Nick Forbes' grandfather H.T. Ferrar was the geologist. In other words, some other German silver sledge shoe fragment owned by the Forbes/Ferrar family could potentially have been misidentified as the fragment brought back from the South Pole by Wilson.

Written accounts of the sledges used on the Discovery, Terra Nova and Fram expeditions shed some light on this issue and can be compared to the physical evidence from the runner fragment itself and other related artefacts. These are discussed in detail in the following sub-sections.

5a. Sledge Runners Used on the Discovery Expedition 1901-4

In his account of the Discovery expedition, Scott explained that sledges had not been made in the UK for some decades, so when equipping his expedition in 1900 he consulted the renowned Arctic explorer Fridtjof Nansen in Norway (Scott, 1969, Vol.1 p.411). He met with both Nansen and the craftsmen making the sledges in Kristiania (later Oslo), and eventually bought all his sledges, skis and furs in Norway. The sledges were bought from C.S. Christiansen (Shackleton, 1969, Vol.1 p.12), were of different lengths and had runners 3.75 inches (95mm) wide, with slightly convex undersides and a rib to strengthen them along the top (Scott, 1969, Vol.1 p.423). On Nansen's recommendation they also took German silver for shoeing the runners. This feature had been developed by Nansen in collaboration with the carpenter H.W. Christiansen in 1895, and was intended to improve the speed and ease of movement of the sledge in some conditions (Huntford, 1997; Johansen, 1899; Nansen, 2011).

Despite the endorsement from Nansen, by the end of the expedition Scott very much disliked the German silver shoes, and found they gave "an infinity of trouble" (Scott, 1969, Vol.1 p.426). Initially, the metal runners seemed promising. Scott ordered loaded sledges with metal and wooden runners to be tested for

performance, and on that basis decided that all the sledges should be shod with metal (Yelverton, 2000, p.159). However, serious problems with the German silver occurred in the second winter, when the metal shoes frequently split and had to be removed. Without the metal to protect the sledge runners, the wood was very quickly damaged when crossing rough surfaces and sledging parties were forced to curtail their journeys. Parts of broken sledges were re-used to make repairs, German silver was stripped off, discarded and later retrieved for re-use (Ferrar, 1903, 11 November; Scott, 1969, Vol.2 pp.229,230,233,241), and old sledges were modified and rebuilt to try and salvage the situation (Skelton, 2004, p.190).

Because of these constant repairs, much spare metal was available and Reginald Skelton's diary records that many expedition members took fragments of German silver to make mementoes from. On 8 January 1903 he wrote:

“Cut up the 9ft sledge and I took a Fore and after, a bit of the runner with German silver on and a bit of the wooden runner to make to make a pipe rack or something out of. Several of the men also took bits.” (Skelton, 2004, p.153)

After the expedition, the Bruton Galleries exhibited models and matchboxes made from German silver by Lashly, Cross and Dellbridge (Bruton Galleries, 1904, catalogue items 417, 418, 419, 422). Koettlitz had a teaspoon made from German silver which is now in the collection at Discovery Point in Dundee (Teaspoon fashioned from sledge runner, n.d). Scraps were also used for more practical purposes, as when Duncan reinforced a worn block and tackle with German silver during Armitage's ascent into Victoria Land in December 1902 (Yelverton, 2000, p.204).

H.T. Ferrar could easily have acquired a bit of German silver as a memento, especially during his Western journey round the Upper Taylor Glacier where he found some very significant fossils. Ferrar's sledging diary regularly mentions the German silver problem during this trip and the efforts of Skelton and Kennar to do running repairs (Ferrar, 1903). However, Ferrar himself seems not to have been very active either in carrying out repairs or in other routine duties and this was indeed a source of friction between him, Kennar and

Weller during the Upper Taylor Glacier journey. His diaries do not mention that he collected any German silver, but the possibility cannot be ruled out on the basis of written evidence alone.

The Polar Museum collection includes a 9 foot sledge with the accession number N: 1147, used on the Western journey of 1903 (Sledge, n.d). The sledge has plain wooden runners with traces of numerous pins used to secure metal cladding around the wood, but the metal itself is not present. Along the top edges of the runners are rows of copper alloy pins or pin holes, interrupted in places by rough bevelled areas with no pin holes. The bevelled areas seem to be losses where the metal was levered off, splitting part of the wood away at the same time. Only one pin head survives and this is round with a domed top. The undersides of the runners are deeply gouged, presumably damaged by ice, as recorded by Scott and others. The remains of the pins used to fasten the metal shoes have angular shafts but are much smaller than the nail holes in the Forbes fragment. The fragment has distinctive square nail holes 1.8–2.0mm square. By contrast the pins in the Discovery sledge N: 1147 are angular but not necessarily square and the shafts are only 1.2–1.5mm at their widest. This means that pins used to attach metal cladding to the Discovery sledge are a different type from those used to attach the Forbes fragment to its substrate.

Further evidence comes from dimensions of the Discovery sledge and the metal fragment. The runners on the sledge are 96mm wide and have tapered ends narrowing to 52mm, which at first glance suggests that the Forbes fragment could have fitted on a sledge of this type. However, the runners are 14–16mm thick. As mentioned above (section 3), the space between the folds in the metal fragment is only 10mm wide, so the cladding could not have fitted around such thick runners. The textual evidence makes very clear that on the Discovery expedition German silver was only applied to the main sledge runners (Scott, 1969, Vol.1 p.425). This point is significant because it means that the Forbes fragment could not come from a detachable under-runner which might be thinner than the main runner.

The physical evidence from the nails and metal folds shows convincingly that the Forbes fragment could not have belonged to a Discovery sledge.

5b. Sledge Runners on the Terra Nova Expedition 1910-13

After his experience on the Discovery expedition, it is not surprising that Scott would not use German silver again. He declared that he would always favour well seasoned wood over German silver for Antarctic conditions, with a detachable steel under-runner for very rough surfaces (Scott, 1969, Vol.1 p.426–7). Of the five Terra Nova sledges in the SPRI collection, none have any trace of a metal shoe or holes where one might have been attached. Detachable iron under-runners were built during the expedition by the mechanic Day (Scott, 2009, p.73), and examples are still outside the expedition hut at Cape Evans (Pearson, 1995, p.15; L. Meek, personal communication, December 14, 2016). The runners built by Day were very heavy (52lb) and were criticised by Griffith Taylor for damaging the sledges on the very rare occasions when they were used (Griffith Taylor, 1997, p.118–9).

In view of Scott's previous experience it is highly unlikely that any German silver sledge runners were present on the Terra Nova expedition. Furthermore, the fragment would not have fitted on any of five Terra Nova sledges in the Polar Museum collection, all of which have runners 15–18mm thick. The possibility that the sledge runner fragment collected by Wilson near the South Pole was somehow confused with some other sledge runner fragment from a Terra Nova sledge during the expedition can therefore be discounted.

5c. Sledges Used on the Fram Expedition to the South Pole 1910-12

The Forbes fragment is believed to have come from one of Amundsen's sledges, so understanding the equipment used on the Fram expedition is crucial to authenticating its provenance. The following three sections discuss the evidence for the equipment available on the Norwegian expedition, and examine how the Forbes sledge runner may have arrived at a location where it could have been collected by Wilson.

There are several contemporary diaries by key members of the Norwegian expedition, including Roald Amundsen himself and Olav Bjaaland, the sledge and ski maker, who also reached the Pole (Kløver, 2010; Kløver, 2011b). There is also a more discursive public account by Amundsen entitled *Sydpolen*, published in 1912. This book was produced very hastily after the successful conquest of the Pole and is sometimes

inconsistent with the diaries on which it is based, but it also contains more detailed explanation on some points (Amundsen, 1912). Other diaries and accounts exist from other expedition members and the written evidence can also be compared with sledges from the expedition which are preserved in the Fram Museum and Amundsen's house in Oslo.

According to *Sydpolen*, the expedition had some old sledges from Amundsen's previous Fram expedition to the Northwest Passage, and also ten new sledges made by L. Hagen in Christiania (Amundsen, 1912, Vol.1 p.172). The latter were a gift in kind to the expedition from the manufacturer (Amundsen, 1912, Vol.2 p.423).

Some of the expedition sledges are now in the Fram museum in Oslo, and are of two quite distinct types. The older "Fram" sledges are somewhat heavier and have runners which are the same width along their whole length. The "Hagen" sledges are more lightweight, with some bamboo elements in places where the "Fram" sledges have wood. They have runners that taper at either end and also have the "Hagen" logo branded into some of the cross pieces. Metal cladding survives on the runners of both types of sledge, but the Forbes fragment could only have fitted one of the "Hagen" sledges with tapering runners.

Once in the Antarctic all Amundsen's sledges were heavily modified to prepare for the assault on the Pole. After the first depot laying sledge journey in February 1911, Amundsen realised that his sledges, which had been constructed in Norway to withstand any conditions, did not need to be anywhere near as heavy and robust for the conditions he found in the South (Amundsen, 1912, Vol.1 p.347; Kløver, 2010). He became obsessed with reducing the weight of the expedition equipment and supplies to an absolute minimum, and much of this was achieved by paring down and remodelling the sledges and shaving the walls of the wooden sledge boxes.

On 7 July Amundsen said that the "Hagen" sledges which weighed 75kg originally were now reduced to 27kg (Kløver, 2010, p.210). The sledges were broken down and rebuilt and some completely new runners were made, as Bjaaland recorded in his diary on 16 June 1911 (Kløver, 2011b, p.86). Bjaaland carried out the

carpentry, but Wisting and Hanssen bound the sledge elements together in another workshop, and Hanssen recorded that after reworking, the lightweight sledges were between 25 and 28kg (Kløver, 2011a, p.176).

The fact that the Norwegian sledge runners were so heavily pared down from their original thickness is highly significant. As we have seen, the Discovery and Terra Nova sledges had runners as supplied by the manufacturer which were between 14–18mm thick. The lighter reworked "Hagen" sledges in the Fram collection have runners about 10mm thick which is consistent with approximately 30-40% reduced runner thickness. The folds in the Forbes fragment are 10mm apart and so could certainly have fitted one of Amundsen's modified runners, whereas the British expedition sledge runners would have been too thick.

5d. Metal Cladding on Amundsen's Sledges

After feedback from the Gauss (Drygalski, 1989, p.242) and Discovery expeditions German silver had fallen out of favour for Antarctic use and subsequent expeditions including Nimrod (Shackleton, 1969, Vol.1 p.151) and Terra Nova used steel cladding for sledge runners instead. In *Sydpolen* Amundsen reported that his new sledges had under-runners shod with steel (Amundsen, 1912, Vol.1 pp.172, 239), and presumably Hagen would have donated the latest approved sledges with steel clad runners to the Fram expedition in 1910. However, on 23 May 1911 Amundsen also noted in his diary that Bjaaland had refurbished the old "Fram" sledges and removed the "zinc" which Amundsen considered unnecessary (Kløver, 2010, p.193). The "zinc" may refer to German silver cladding, or may mean the large sheet of metal suspended between the runners which survives on one old "Fram" sledge now at the Fram Museum. Its purpose was to prevent snow from accumulating under the sledge and impeding it. The "zinc plate" was also mentioned by Hassel in his diary (Kløver, 2011c, p.85).

Even if the "zinc" mentioned does not refer to a sledge runner shoe, at least two modified "Fram" type sledges in the Fram Museum have metal cladding on the runners which appears to be made from German silver, to judge from the colour and type of tarnish. This is important because it indicates that both types of metal shoeing material were available on the expedition.

Jørgen Stubberud, who worked with Bjaaland in the carpentry shop at Framheim, mentions in his account that the sledges were rebound and "sinkbekledning" [zinc cladding] was applied by Hanssen and Wisting in workshop number 3 (Kløver, 2011a, p.201). This is an interesting observation from someone who was not a veteran Polar explorer with received ideas about the equipment, and again supports the suggestion that zinc and steel cladding were both available. Amundsen often referred to the "steel" on the "Fram" sledges but evidence from the "Fram" sledges themselves suggests that this may not be accurate (Amundsen, 1912, Vol.1 pp.487, 490; Kløver, 2010, p.210)

The metal cladding which survives on the sledges in the Fram museum collection was attached with round headed nails with squared shafts. In places where the cladding is detached, the holes in the metal are identical in size and shape with those on the Forbes fragment, and show that it could have come from an Amundsen sledge. The round nail heads on the Norwegian sledges are also consistent with the nail head impressions on the Forbes fragment.

The evidence from the sledges in the Fram museum collection is only partially useful in authenticating the sledge runner fragment because it is not known which, if any, of these sledges went on the South Pole journey. Furthermore, the metal cladding on the sledges has not been confirmed as steel or German silver.

Another "Hagen" type sledge is preserved under the stairs at Amundsen's house "Uranienborg", which definitely did go to the South Pole. This sledge has no metal cladding at all and was probably one of the lightest 24kg sledges which did not have fixed metal shoes (Kløver, 2010, p.210). However, Amundsen found the metal cladding on the Fram sledge runners very useful in hard ice conditions (Kløver, 2010, p.210), so he had detachable under-runners with metal cladding available when needed. Amundsen called these "løsmeyer" [loose runners] (Amundsen, 1912, Vol.1 pp.172, 239) while Hassel called them "varemeier" [protective runners] (Kløver, 2011c, p.85). Published photographs from the South Pole journey show the under-runners in use on lightweight sledges with tapered sledge runners (Kløver, 2011c, pp.80–1, 164–5). Although apparently no under-runners survive, the photographs show that they were a similar thickness to

the main sledge runners, which as we have seen were around 10mm thick. This means that the Forbes fragment could also have fitted an under-runner of this kind.

5e. Evidence from Amundsen's South Pole Journey

Amundsen's preparations were based on taking 7 sledges and 8 men to the South Pole, and on 8 September 1911 the party set off. However, they quickly ran into difficulties with the weather and several men got frostbitten heels. Amundsen called off the journey abruptly and returned to Framheim to recover.

Immediately after this, Johansen publicly criticised Amundsen's leadership and Amundsen radically changed the plan to exclude Johansen from the South Pole journey (Kløver, 2010). The new plan was to travel with just 4 sledges and 5 men, and the smaller party would be able to travel much faster and use fewer provisions than the original group.

Accordingly, Amundsen set off again on 19 October 1911 with four sledges which "all look much the same" (Amundsen, 1912, Vol.2 p.18). However, there was one crucial difference for the forerunner, Hanssen:

" Hanssen's sledge differed from the others in that it had aluminium fittings instead of steel and no sledge meter, as his sledge had to be free of iron because he had the sledging compass" (Amundsen, 1912, Vol.2 p.18).

Any ferrous metal near the sledging compass would throw off the readings, which would be a major problem on the quest for the Pole. This means that any under-runners used with this sledge would also have to have non-ferrous cladding, in other words German silver. As we have seen, the description of the runners as "steel" shod may not be metallurgically accurate, and it is highly likely that at least one pair of under-runners taken to the Pole was clad with German silver to prevent disruption to the steering compass readings. On 22 November 1911 the Norwegians abandoned one sledge at a depot and proceeded with just three, one of which was Hanssen's "non-ferrous" sledge (Kløver, 2010, p.305).

On reaching the area near the South Pole on 15 December 1911, the Norwegians planted three flags to stake out the area around the South Pole, each with a reckoning of their position (Amundsen 1912, Vol.2 p.126–7;

Kløver, 2010, p.315; Kløver, 2011c, p.142). Amundsen's diary shows that at this point he believed his team was very close to the Pole, and he intended to raise a South Pole marker tent at their camp site (Kløver, 2010, p.315). Amundsen wrote the reckoning notes and signed and dated them 15 December, and after a celebratory meal Wisting, Hassel and Bjaaland set off to place the flags very early the next day. Amundsen stated in *Sydpolen* that:

"for flag poles we chose to use our sledge runners ("sledemeier") which were both long - 12 feet - and sturdy, and which in any case we must take off the sledges here to lighten them as much as possible for the journey home." (Amundsen, 1912, Vol.2 p.127)

Hassel recorded in his diary that his flagpole was a "varemeie", in other words a protective under-runner (Kløver, 2011c, p.145). An under-runner is clearly shown attached to a sledge in a photograph of Wisting next to the Norwegian flag close to the South Pole (Fig. 5). (This picture was published in *Sydpolen* with the caption "Oscar Wisting with his dog team at the Pole" (Amundsen, 1912, p.128)).



Fig.5. Oscar Wisting photographed close to the South Pole under the Norwegian flag. Fastened to the sledge is an under runner similar to the two which were later broken in half to use as flag poles for the reckonings placed to encircle the South Pole. Nasjonalbiblioteket Oslo: NPRA 525.

One pair of under-runners was broken in half to give four poles, each approximately 6 foot long, which could be planted easily. This supposition is consistent with the proportions of the sledge runner and flag shown in

Wilson's drawing (Fig.1). It is interesting to note here that in his diary entry for 18 January 1912 Wilson described the flag pole as "a sledge runner" whereas Scott called it "an old under-runner", which supports Hassel's version of events (see section 2). Wilson's sketch (Fig.1) shows traces of some bindings on the flagpole but these are hard to interpret.

Three of the four poles made from one pair of under-runners were presumably used to plant the reckonings on 16 December 1911. According to Sverre Hassel (Kløver, 2011c, p.144) one other pair of under-runners was left intact, attached to an upright sledge which the Norwegians abandoned when they left their first camp on 17 December.

From 16 to 18 December the Norwegian party took numerous observations to calculate their position, with confusing results (Kløver, 2010, p.315–6; Kløver, 2011c, p.144–5). Realising that their camp was actually some distance from the Pole, on 17 December they relocated their "Polheim" camp to a location closer to the South Pole and raised a small tent and the Norwegian flag there. A letter to King Haakon was left inside the tent, along with a note to Scott asking him to forward the letter and inviting him to use any equipment he found nearby (quoted in Evans, 1921, p.231–2). The note had been written at the previous camp and was dated 15th December and offered Scott "the sledge outside", which Wilson was unable to find when he looked for it on 18th January (E. Wilson, 1972, p.232). This is because it had actually been left at the Norwegians' first South Pole camp about 5.5 miles away (later designated Sledge Camp (Hinks, 1944)), but the note had not been corrected when it was placed in the new "Polheim" location on 18th December.

Hanssen and Bjaaland then staked two flags about 2.5km to either side of the new pole location. On 16 December after taking fresh observations, Hassel noted that his "under-runner" flag was the one that was closest to the actual pole (Kløver, 2011c, p.143), which, if correct, would mean that when Scott's party found the flag near to their own South Pole camp on 18th January 1912, it was Hassel's that they found. Hinks has made a thorough reconstruction from the readings recorded by Scott and Amundsen's parties to show clearly how the courses of the two expeditions intersected at the Pole (Hinks, 1944) and the locations of the different camps and flags.

To summarise the evidence from the Amundsen expedition, the folds and nail holes in the Forbes fragment are consistent with the metal being applied to a pared down, tapering sledge under-runner with nails similar to those used on the other expedition sledges now in the Fram museum. Although many accounts refer to the use of steel cladding on the sledge runners, German silver was available on the expedition as well and there were compelling reasons for having at least one pair of non-ferrous under-runners on the journey to the Pole. The accounts also clearly indicate the route by which the Forbes fragment could have been placed by the Norwegians and later collected by Wilson.

6. Physical evidence from the depot flag

The sketch made by Wilson shows the depot flag tied to the sledge runner, which is now object number N: 1038 in the Polar Museum collection at SPRI. The sketch is a little difficult to interpret but seems to show both string tying the flag to the runner and also traces of old bindings used in fastening the under-runner to a sledge.

The depot flag is now on display in the Polar Museum and still has traces of string attached to it which may provide supporting evidence for the provenance of the Forbes fragment. The flag was apparently homemade, with hand sewn hems along the top and bottom edges, while the side edges are both selvages. Coarse beige string is crudely looped through a few holes down most of the length of one side (see Fig.6) to attach the flag to a pole.

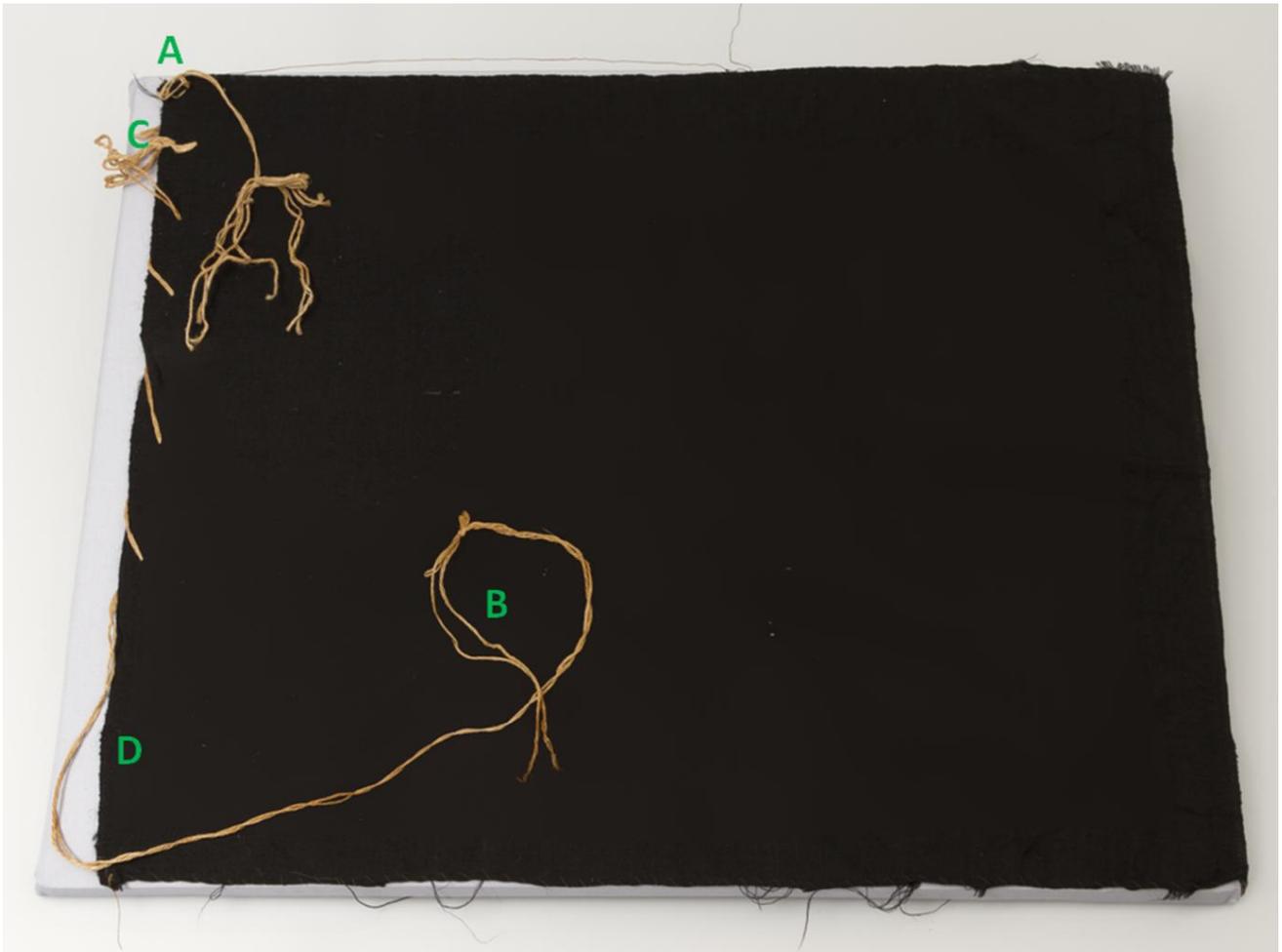


Fig.6. The depot flag (Polar Museum number N: 1038) collected by Wilson on 18 January 1912, showing the strings which bound it to the flag pole. For an explanation of points A, B, C and D please see section 6 in the text. Scott Polar Research Institute, University of Cambridge, with permission.

The top of the flag has a double strand of string threaded through it with a large knot at one end to secure it in the weave (Point A). It seems to have been looped 3-4 times round the flag pole and tied with a knot similar to a Prusik knot. The loop has then apparently been cut off with a knife, leaving six short and six long ends with clearly cut edges (see Fig. 7).



Fig. 7. Detail of the looped, knotted and cut string from the upper edge of the depot flag N: 1038 (Point A). Scott Polar Research Institute, University of Cambridge, with permission.

By measuring the full length of these the circumference of the flagpole can be deduced. This measurement is 160mm. The sledge fragment is 56mm wide at the narrowest, and the sledge runner was 1cm thick, as evidenced by the folds in the metal. This means that at the narrowest point on the metal shoe the circumference of the sledge runner was around 132mm. The string could therefore easily have been looped around the tapering top end of the wooden sledge runner slightly further down from the narrowest point of the metal.

Below this knot, a separate double strand of the same type of string is tied into the fabric of the flag and looped down the edge several times, before ending in a long tail with a knot. This knot indicates that there was another tied loop in the place where the flag was attached to the pole at the lower end of the flag. Unfortunately the ends of the string in this area are rather frayed and may be shorter than they were originally, so it is not possible to determine accurately the circumference of the flagpole at this end. The length of the loop at the lower end was at least 200mm. The widest part of the metal shoe is 85mm so the circumference of the runner at this point would have been about 190mm. The shoe may have tapered outwards even further to the widest point on the runner, and the loop could still have been long enough to reach round it. Alternatively if the string was wrapped around the sledge runner diagonally as suggested in Wilson's drawing, the length of the loop would also have been longer than 190mm.

There is some evidence that may suggest the flag was reused and had previously been attached to a thinner pole, presumably at a depot. At Point B there is a small length of string looped through the main strand, with cut edges. It looks like a remnant of string used to tie the flag to a bamboo pole, which was cut to take the flag off the pole again. There is also a hole in the fabric of the flag at Point C which may have had string threaded through it to tie the flag to a different pole before it was attached to the sledge runner.

Just below point B there is a large loop in the string. This may be where the string was looped around the sledge runner at an angle to secure the middle part of the flag, as suggested in Wilson's sketch.

The knots and loops on the flag string tally consistently with the dimensions of the sledge runner flag pole as deduced from the measurements and folds in the Forbes fragment. They demonstrate that the flag could certainly have been attached to a sledge runner flag pole of the same dimensions as the fragment, and that the string was cut with a knife to take the flag down.

7. Conclusion

Detailed physical examination of the fragment and other related artefacts alongside careful comparison with textual evidence suggest that the Forbes sledge shoe fragment is most likely to be from one of Amundsen's sledge runners left at the South Pole in December 1911.

The object is part of a German silver sledge shoe and this alloy was only used with sledges made in Norway in the late nineteenth and early twentieth century. Evidence from the nail holes and longitudinal folds shows that it definitely could not have fitted a sledge from the Discovery or Terra Nova expeditions, but could have fitted one of Amundsen's modified sledges, and been applied with the type of nails used on the Norwegian Polar expedition. Supplementary physical evidence from the associated Norwegian black depot flag found at the same time supports the attribution as well.

The close relationship between the Wilson and Forbes/Ferrar family and the clear line of inheritance make the story about the sledge runner fragment inherently plausible. However, there is a lack of written evidence for provenance after the fragment was mentioned by Scott and Wilson on 18th January 1912. We suggest this is because the fragment was only seen as significant as a small reminder of the Norwegian achievement and not as an item in its own right. During the dramatic events in Antarctica in 1911-12 only the letter to King Haakon was mentioned by writers other than Scott and Wilson. By 1930 it emerged that the black depot flag, silk slippers and Polheim reckoning collected at the same time as the sledge runner fragment had also been brought back from the Pole, although none of these had been recorded in any contemporary accounts either. These other items were only mentioned in archived correspondence because they were formally donated to the collection at SPRI, whereas the sledge shoe fragment was not. The lack of written sources in this instance is therefore not enough to undermine the proposed provenance.

The written evidence from the Norwegian team members is ambivalent because it seems partly to contradict the evidence from surviving sledges, some of which are apparently shod with German silver and not steel as recorded in the official accounts. However, the physical evidence must outweigh the written

records, some of which were produced in a hurry and were not completely accurate in other respects. There was a compelling need for at least one non-ferrous metal set of sledge shoes for Amundsen's South Pole journey, because steel shod sledge runners would disrupt the readings from the steering compass. The *Sydpolen* account makes absolutely clear that a pair of sledge runners was deliberately sacrificed to make flag poles for the Polheim reckoning and two other similar records, and Hassel's account describes these sledge runners as under-runners. There is therefore a very clear and plausible route by which German silver-shod under-runners came to be available to Amundsen at the South Pole. The under-runner pictured on Wisting's sledge could well be one of those in question, and it has the right taper-ended shape to match the fragment.

Despite the lack of definitive written evidence of the provenance of the fragment from either the English or the Norwegian side, clues from written sources are crucial for interpreting the information contained in the sledge shoe itself. Taken together, many details found in the texts, the sledge fragment and other related objects add up to support the view that this was indeed the piece of sledge runner taken by Wilson on 18 January 1912. Nick Forbes and his siblings Mike and Ginny have now very kindly lent the fragment to the Polar Museum, Cambridge, where it is displayed with the depot flag and Polheim reckoning which were collected at the same time.

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Acknowledgments

I am very grateful to the following for so willingly providing information and practical support for this study: Nick Forbes, Mike Forbes and Ginny Forbes; Naomi Boneham and Laura Ibbett of the Thomas H. Manning Polar Archives, SPRI; Dr Lucy Wrapson of the Hamilton Kerr Insitute, Cambridge; Geir Kløver of the Fram Museum, Oslo; Anne Melgård of Nasjonalbiblioteket Oslo; K. Jonas Nordby of Museene i Akershus, Oslo; Annie McCulloch, formerly of The Wilson, Cheltenham Art Gallery and Museum; Dr David Wilson; Lizzie Meek of New Zealand Antarctic Heritage Trust; Martin French and Peter Lund of the SPRI Library; Charlotte Connelly, Heather Lane, Bryan Lintott, and Willow Silvani of the Polar Museum, SPRI. Particular thanks are also due to Hugh Turner, nephew of Apsley Cherry-Garrard, for permission to quote from the annotated copy of his uncle's diary.

Financial Support

The author is supported by the United Kingdom Antarctic Heritage Trust. The research received no specific grant from any funding agency, commercial or not-for-profit sectors.

Conflict of interest: None