

Victorian prescience: *The Lancet* medical journal and the loss of the Franklin expedition, 1845–1859

Research Article

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Abstract

The loss of Sir John Franklin's Arctic expedition has provoked speculation about the cause of the fatal outcome from the expedition's departure in 1845 to the present day. This study describes how *The Lancet*, first published in 1823 and now one of the world's leading medical journals, drew conclusions at the time of the expedition's loss, which closely parallel those of today's most recent research. The journal took evidence from Arctic medical and naval experts to conclude in 1859 that the Admiralty's misdirected searches committed the crews to ice-bound entrapment, which had fatal nutritional consequences. The *Lancet's* prescience has been supported by recent research showing that the unique physical circumstances faced by the expedition had nutritional effects related to vitamin deficiencies, which explain mortality over the third winter and the eventual total loss. It is significant that, although published 160 years apart and with vitamins unknown in the Victorian era, both studies took robust evidence-based approaches to draw similar conclusions.

Introduction

Background and aim

The loss in the Arctic of a British Royal Naval expedition led by Sir John Franklin has been a focus of medical interest and speculation since its departure in 1845 to the present day. This study describes how, during the fourteen years of the eponymous Franklin expedition's disappearance, *The Lancet* medical journal made a critical appraisal of the evidence to conclude that the British Admiralty's misdirected searches committed the crews to entrapment over two Arctic winters, which had nutritional consequences that reduced their health and led to the fatal outcome. *The Lancet's* conclusion was overshadowed in the late-twentieth and early twenty-first centuries by theories which proposed that “medical” factors exerted an early debilitating effect on the health of the crews, which impeded progress and caused the loss. However, those theories have not been supported by research; rather, a comprehensive, evidence-based re-appraisal by Park and Stenton (2019) has shown that the unique physical circumstances faced by the expedition were critical and eventually had nutritional implications that might explain the high mortality over the expedition's third winter. This review of *The Lancet's* intervention will show that present-day, evidence-based theorising supports the journal's early prescience and draws a conclusion with very close parallels to that reached by *The Lancet* in 1859.

The Lancet, the admiralty and the Franklin expedition

In the two centuries since its first publication on 5 October 1823, *The Lancet* has become established as one of the world's foremost medical journals. It was founded by Thomas Wakley (1795–1862; Fig. 1) who qualified as a Member of the Royal College of Surgeons in 1817. It is relevant in the present context that medicine was not Wakley's first calling, for, aged eleven, he signed on as a midshipman for what would be a traumatic seventeen-month, round-trip to Calcutta (now, Kolkata) aboard a ship of the British East India Company. He witnessed floggings, violent deaths, the desertion of the ship's surgeon and the impressment of men from his own crew when intercepted by Royal Navy ships. Perhaps understandably, the young Wakley did not elect to pursue a career at sea and rarely spoke of the experience in later life, but it may have been formative of his later campaigns to confront failings of the Admiralty and improve the lot of Naval crews (Paul, 2017).

Wakley had a strong social conscience and was an advocate for the poor and disadvantaged whose hardships he witnessed as coroner for a large area of London. Under his editorship, *The Lancet* was uncompromising in exposing incompetence, nepotism, quackery and fraud within the medical profession, which compromised the population's welfare, and in urging legislation to regulate the colleges and practitioners (Jones, 2008; McMenemey, 1973; Sharp, 2012; Tye, 2012). Significantly for the present context, this exposure of malpractice and incompetence

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Figure 1. Thomas Wakley (1795–1862); Founding Editor of *The Lancet*, 1823–1862. Reprinted from *The Lancet*, Vol. 371, R. Jones, “Thomas Wakley, plagiarism, libel, and the founding of *The Lancet*”, 1410–1411, Copyright 2008, with permission from Elsevier.

included a long-running campaign of confronting the Admiralty on matters including corruption, inadequate pay and conditions of its assistant surgeons and the state of health aboard ships (Harrison, 2009; McLean, 2010), and it was in the latter context, in 1838, that the journal targeted Sir John Barrow, the Second Secretary to the Admiralty. Seven years later, Barrow would be instrumental in sending the ill-fated Franklin expedition to the Arctic.

The Lancet accused Barrow of giving “circulation to one of the greatest illusions respecting the health of the Navy ever entertained.” The journal had long stressed the need for objective evidence and reliable medical statistics, thus anticipating the “evidence-based medicine” of today. It condemned the Admiralty’s “very imperfect and garbled documents” that grossly understated mortality across the fleet because the rate was calculated only from deaths in Naval hospitals: when deaths aboard ships were included, the true mortality rate was almost six times higher. Barrow was accused of having “very adroitly availed himself of the flattering error” in a publication describing the Navy’s health (*Lancet*, 1838b, p.124). The journal noted that the Admiralty was now preparing publication of a *Statistical Report of the Health of the Navy 1830–1836* (Parliamentary Papers, 1840), and reminded readers in characteristically insulting style that, hitherto, “no public document of any statistical value has ever emanated from the Medical Department of the Navy” (*Lancet*, 1838a, p.309).

Barrow would be long dead before *The Lancet* held the Admiralty responsible for the total loss of the Franklin expedition. The detailed history of the expedition, and in particular the role of the Admiralty, is found principally in Lambert (2009), and texts by Beattie and Geiger (2004), Cyriax (1939), Hutchinson (2017), Palin (2018), Potter (2016) and Woodman (1991). As the chronology has also been summarised in many articles in this journal and will be

familiar to readers, the present summary will focus upon events which drew *The Lancet*’s comments during the fourteen-year-long search for the expedition and will include references to the expedition’s progress recorded in the single-page “Victory Point record” written by Commander (later, Captain) James Fitzjames and discovered on King William Island.

The Lancet was not alone in its interest in the expedition’s fate. The press avidly reported events, and other journals and scientific institutions made measured commentaries. However, as will be seen, *The Lancet*’s approach was forthrightly critical and analytical rather than merely descriptive and drew upon the first-hand experience of Arctic medical and Naval experts to provide an evidence-based, non-speculative explanation for the outcome. This approach was important at the time for understanding the fate of the Franklin crews and, more generally, the implications for health on Royal Navy Polar ships, and it remains a significant historical antecedent to the similarly objective analyses and evidence-based conclusions of the most recent, present-day research concerning the expedition.

The Franklin expedition: “A sad tale was never told in fewer words” (McClintock, 1859)

On 19 May 1845, HM Discovery Ships *Erebus* and *Terror* departed for the Arctic under the command of Captain Sir John Franklin to gather scientific data and establish a Northwest Passage to the Pacific. Sir John Barrow had been “adroit” in reporting misleadingly positive statistics about the Navy’s health in 1838, and would now downplay the risks of Arctic exploration with his assurance that the Franklin expedition could depart “without any apprehension of the loss of ships or men” (Cyriax, 1939, p.20). Dr Richard King was not convinced and informed Barrow that he was sending the crews “to form the nucleus of an iceberg” (King 1855, p.195). King had served in earlier Arctic exploration commanded by George Back (King, 1836) and was an advocate of overland, rather than ship-borne missions. His retort to Barrow preceded his protracted criticism of the Admiralty’s response to the subsequent disappearance of the expedition. King’s insulting criticism would attract *The Lancet*’s support but, at this stage, the journal did not comment on the chances of success. Instead, it merely reported the appointment of senior surgeon Stephen Stanley to HMS *Erebus*, and John Peddie and Alexander McDonald as acting surgeon and assistant surgeon, respectively, to HMS *Terror* (*Lancet*, 1845). However, a meeting of the Royal Society noted well-informed – and prophetic – opinion that “barriers of ice may prove insurmountable” (*Proceedings of the Royal Society*, 1845, p.573).

By late 1847, lack of communication from the expedition led *The Lancet* (1847, p.607) to note with some understatement that there was now “the liveliest interest in the fate of Sir John Franklin.” King had advised the government that the expedition must be in difficulty but his offer to lead a rescue mission was declined. He predicted (correctly, as it would turn out) the location of survivors and persisted with his opinions, but his abrasive and arrogant style was so counter-productive as to inhibit any investigation of his claims (Swinton, 1977).

The Lancet’s “liveliest interest” in the expedition’s fate was well-founded. In May 1847, Fitzjames had recorded their status as “*All Well*” but, by April 1848, nine officers (including Franklin) and fifteen men had died since leaving England, the majority apparently over the winter of 1847/1848. The causes of death and disproportionate mortality amongst officers were not explained. The ships had been deserted and the crews would make for the

Canadian mainland. Later that year, as survivors faced their third Arctic winter of 1848/1849, Sir John Barrow died in London; his son, John Barrow Jnr., took up co-ordination of searches for the expedition.

As the searches began, a bizarre episode led to a unique moment of full accord between *The Lancet* and the Admiralty. In June 1848, Sir James Ross had been despatched to search for the expedition via passages to the southwest from Barrow Strait, but he concluded, wrongly, that the ships could not have gone that way, and his error ensured that future searches would ignore the area where the vessels lay. He returned in 1849 with scurvy-ridden crews caused by inferior provisions, and his failure left the Admiralty reluctant to order further searches. However, salvation was offered by a legion of clairvoyants, mesmerists and mediums who gained substantial publicity by claiming that their powers gave insight into the location of the expedition (Gillies Ross, 2003; Lloyd-Jones, 2001). Franklin's wife, Jane, was drawn into this folly, perhaps understandably because "when hope hangs by a slim thread reason may vanish" (Gillies Ross, 2003, p.5). The Admiralty investigated and dismissed as "Humbug!" the widely-publicised clairvoyance of a woman in Bolton who had "seen" Franklin and other survivors in various improbable locations (*ibid.*). *The Lancet* (1849, p.442) had long campaigned against the "quackeries, folly, fraud and crime" of mesmerists and clairvoyants, and derided the "recent exhibitions at Bolton" to conclude that "if Sir John Franklin finally reaches home in safety, it will be by the aid of other means than mesmeric dreams."

The Admiralty evidently agreed and despatched Captain Horatio Austin to command a further search, which discovered the expedition's winter quarters of 1845/1846 at Beechey Island but no evidence of where the expedition had gone next. By the time of Austin's return in 1851, *The Lancet* had concluded bluntly that it was unlikely that any remained alive when ridiculing the widespread attention gained by yet another mesmerist who claimed that she had found Sir John and his companions reading the gospels "in their hunger, cold and sorrow" (*Lancet*, 1851, p.705). It would hardly take mesmeric powers to divine that survivors would be cold and miserable, but that they were finding solace in the gospels was an inspired piece of theatre. *The Lancet* observed acidly that this "artful peasant" was "on safe ground in the case of men who we fear will not return from the grave to convict her." A subtler but equally accurate view was given by Henry Piers, assistant surgeon on the search ship HMS *Investigator*: the mission was no longer one of rescue but "of satisfying [...] the public mind that all that is possible has been done to rescue them; for if they are not now known to be safe, I fear it is long past with them" (Piers, 1852).

In 1852, *The Lancet* addressed speculation in the press that the expedition's provisions had been inedible and caused starvation by reducing the food available. A Royal Naval victualling yard had found that a large proportion of cans of preserved meats contained putrid and offensive parts of carcasses introduced maliciously by disaffected employees of the manufacturer, Stefan Goldner, who had provisioned the Franklin expedition (*Lancet*, 1852c). However, concern was allayed by a Parliamentary Select Committee Enquiry which found no evidence that Goldner had been supplying unfit provisions in 1845 (Parliamentary Papers, 1852). John Barrow Jnr. confirmed Goldner's previous good record and that a letter received from Fitzjames in 1845 had expressed satisfaction with the quality of the provisions. *The Lancet* (1852a) published an analysis of canned foods by the Analytical Sanitary Commission (established by Wakley in 1851) which confirmed their generally

good quality and included a letter from officers of four Royal Naval ships sent in search of the expedition, praising their preserved provisions. The journal noted that canned pemmican prepared by the Navy (and supplied to the expedition) maintained a perfect state of preservation (*Lancet*, 1852b). Nonetheless, when the fate of the expedition was eventually established in 1859, *The Lancet* (1859a) reported that speculation about "putrid provisions" had been raised again without any evidence at a meeting of the Geographical Society. One hundred years later, Lloyd and Coulter (1963) noted that some ill-informed historians continued to blame Goldner for loss of the expedition, and in the twenty-first century, he has been further traduced as a supplier of Clostridium botulinum-contaminated provisions, again without any evidence.

Despite seven years of silence from the expedition, there was still optimism about its fate. *The Lancet* published a letter, sent at the behest of Lady Franklin, seeking a medical officer for a search which the Admiralty would part-fund (*The Lancet*, 1852d). It was portrayed as a career-enhancing opportunity, which Arctic medical experience often proved to be (McLean, 2010), but applicants would be disappointed. The mission was abandoned when, to Jane Franklin's humiliation, her appointed commander was found not to have paid for the provisions (Lambert 2009). Nonetheless, the Admiralty ordered one final search commanded by the mercurial Sir Edward Belcher. It was an unedifying failure (Lambert, 2009, pp.227–246) except for the rescue of the starved, dropsical and scurvy-ridden crew of HMS *Investigator* which had been despatched to the western Arctic in 1850 as an adjunct to Austin's squadron, only to become lost and ice-bound for three winters (Stein, 2015).

Only months after Belcher's return and the Admiralty's formal conclusion that all members of the expedition had died, *The Lancet* (1854a, p.366) reported that Dr John Rae had returned from the Arctic having obtained from Inuit people some personal effects of the expedition's officers which left "no doubt, we fear, of the melancholy fate of Sir John Franklin and his crew, amongst who were Assistant Surgeons H.D.S. Goodsir, A. McDonald and J.S. Peddie" (Peddie was in fact Acting Surgeon when appointed in 1845: Lloyd-Jones, 2005). Naming the latter men reflected the journal's long preoccupation with the welfare of the Navy's assistant surgeons, but failure to mention that the senior surgeon, Stephen Stanley, was also dead would seem inept. *The Lancet* (1854b, p.368) also stated that it had received copies of Richard King's copious correspondence with the Admiralty which showed that "had the advice of this experienced and energetic member of the profession been taken, the fate of the Franklin expedition would probably have been different." *The Lancet's* comment marks its first published awareness of King's criticisms which echoed the journal's long focus on Admiralty failings. In addition to King's medical credentials, the insulting tone of his correspondence may have appealed to Wakley whose editorials were similarly abusive.

The initial attention given by *The Lancet*, the press and the public to the loss of one-hundred-and-twenty-nine men would, however, be quickly diverted to the thousands dying during the unfolding disaster of the Crimean War. As it wore on through 1854–1856, twenty thousand British troops died, the great majority from cholera, typhoid and filthy hospital conditions rather than battle injuries. *The Times* newspaper exposed the scandal of the government's "miserable, unheroic, ramshackle campaign" (Wilson, 2003, p.179) which did not escape *The Lancet's* attention: the journal's index for 1855 shows that "the War" accounted for more page references than any other topic. The Franklin expedition merited only one passing reference as the journal

advocated promotion of Dr Robert McCormick for his Naval service, which had included duty on one of the search ships (*Lancet*, 1855).

During the hiatus caused by the war, Jane Franklin continued her appeal for a final search to recover the expedition's records to establish the actual events. When informing readers of her campaign, *The Lancet* (1857) employed heavy-handed sarcasm by placing inverted commas around her suggestion that it would be a "final search": Belcher's failed search was supposed to have been the last. The journal noted that the expedition's fate had been established by Rae, and that the probable events had been presented by the *Montreal Herald* of 24 December 1855 with what would turn out to be inspired accuracy. Perhaps in deference to a widow's loss, *The Lancet* did not state explicitly that the search was pointless but the implication is clear. As for a Northwest Passage, the journal concluded that evidence that a ship might be forced through only after spending two or three winters "incurring fearful risks almost amounting to certain death" [...] "appears little enough [return] after all the exertions made to obtain it" (*Lancet*, 1857, p.532).

Jane Franklin's final search eventually gained support and, with the experienced Arctic officer Francis McClintock in command (Barr, 1987), Fitzjames's single-page record was found on King William Island in May 1859. As McClintock (1859, p.288) summed it up, "A sad tale was never told in fewer words."

Holding the Admiralty to account: "The Arctic Expedition and its Results" (The Lancet, 1859)

Only days after McClintock's return to London, and despite the significance of his discovery and great effort to achieve it, *The Lancet* (1859c, p.392) concluded dismissively that the loss of the expedition merited more than the "meagre narrative" recovered from King William Island. It stated loftily that its status as a medical journal allowed it to "recall a few of the leading facts connected with [the expedition's] history – a duty which, as members of the same profession as includes Sir John Richardson, Dr Armstrong, and Dr King, we conceive to be legitimately within our province." Wakley might have been more generous had he either been aware of or taken the trouble to read McClintock's (1859) best-selling book of his exhaustive search of King William Island, which was published shortly after his return (King's correct prediction of the location of survivors would be acknowledged in the third edition published in 1869, after Wakley's death).

The Lancet had already extolled King's efforts – "amongst the most distinguished of Arctic medical officers" – in repeatedly drawing the Admiralty's attention to the probable location of survivors (*Lancet*, 1859b, p.344). The consequence of neglecting King's advice had been "disastrous and deplorable." Warning to this theme, the journal reminded readers that King had made at least eight offers to advise and lead rescue operations when some of the crew would have remained alive but that these "courageous offers" met "official apathy" and relief attempts which were "total failures." It was "an evil inflicted by indifference to the welfare of many of the best spirits to which England had given birth." The accusation of indifference was clearly an insult too far when those involved in the searches had endured great hardship and significant risks.

The tenor of the editorial is characteristic of Wakley's prose which was often "blunt beyond the point of rudeness" (Sharp, 2012). However, much as the Admiralty and government might be criticised, it is instructive to read the balanced and objective

description of the Admiralty's role provided by Gillies Ross (2004) and Lambert (2009), and in particular Lambert's (2009) account of pressures from the press, and lobbying by Jane Franklin and her influential supporters, which had to be set against the costs, both financial and in lives, of further futile searches.

"A few of the leading facts" (The Lancet, 1859b)

When *The Lancet's* overblown polemic is set aside, the journal's measured approach to understanding the fatal outcome was to follow its principle of dealing with evidence rather than speculation. A year before the expedition's fate was known, the journal had explained the importance of diet in maintaining the health of Arctic crews by citing evidence from medical experts, including Sir John Richardson who had accompanied Franklin on an earlier overland expedition, and surgeon Alexander Armstrong of the beset HMS *Investigator* whose crew had endured three Arctic winters, the last being on very short rations. The experience of the *Investigator* was seen closely to parallel the circumstances of Franklin's ships; in fact, until the *Investigator's* crew was rescued, it had been feared that they had become "second Franklins" (*Illustrated London News*, 1852). Richardson and Armstrong explained that the physiological demands imposed by extreme cold and harsh terrain meant that Arctic crews required a greater scale of victualling to provide a diet with sufficient calorific and nutritional content to meet the body's energy requirements and avoid conditions including scurvy. In addition to the known antiscorbutics, they emphasised the importance of increasing the allowance of pemmican, bacon and preserved (canned) meats (*Lancet*, 1858). Armstrong (1857, p.545) observed that reduced rations were "inadequate to maintain health in an Arctic climate [...] much less to sustain life for any lengthened period."

The value of fresh meat derived from hunting was well recognised, and *The Lancet* quoted Isaac Hayes (surgeon to the American search for Franklin commanded by Elisha Kane) who recommended raw walrus meat, and particularly the liver, to maintain Arctic health (Fortunately, the vitamin A content of walrus liver is very low so that adherents to Hayes' advice would have avoided hypervitaminosis-A poisoning associated with eating livers of Polar bears: Rodahl, 1949). *The Lancet* included Hayes' observation that meat and liver lost their health-sustaining properties when cooked: neither the journal nor Hayes could know that cooking reduced or destroyed the crucial, heat-labile vitamins C (ascorbic acid) and B₁ (thiamine), which are discussed below. Hayes also stated that if he had a "consumptive patient," he "would send him to Greenland [...] and put him upon a train-oil diet [i.e., blubber-based], with a dog-sledge and bear hunt for exercise" (*Lancet*, 1858, p.295). *The Lancet* did not record whether any sufferer from tuberculosis had been so unfortunate as to be subjected to Hayes' novel regimen.

The Lancet cited other medical and naval officers who explained how passing a second winter in the cold and depressing Arctic darkness would insidiously reduce the health of crews even when quantities of provisions appeared adequate. The medical records of Royal Naval Arctic ships confirm this pattern (Millar, Bowman, Battersby, & Welbury, 2016) which will be shown to be central to the explanation of the fatal outcome by Park and Stenton (2019). A third winter (in the expedition's case, 1847/1848 when substantial mortality appears to have occurred) was critical for it brought a clear deterioration in health and "a depression of spirits which few [...] bear up against; more especially when [...] scurvy appears amongst them." Then, for some, "the last ray of hope departs"

(*Lancet*, 1859b, p.393). Richardson concluded that if the expedition's rations had been reduced, the "short allowance meant starvation" and the crew would have been too debilitated to trek far from the ships so that, inevitably, all would have died (*Lancet*, 1858, p.294). Regarding the fatal outcome, it is to *The Lancet's* credit that while unfounded accusations were made in the press and by the influential writer Charles Dickens that Inuit people had murdered the weakened survivors, the journal reported the first-hand testimony of the Inuit themselves that death had been caused by starvation.

The portrayal is therefore of an expedition which made good progress in satisfactory health and with unexceptional mortality until its remote entrapment denied rescue and the harsh climate and difficult terrain precluded escape. Health went into decline with the onset of the third winter of 1847/1848 when significant mortality occurred. The important point of *The Lancet's* summary is that a breakdown in health over the expedition's third winter was a *consequence* of their remote entrapment since September 1846, which had denied escape or rescue; there was no suggestion that any health factor *preceded* the entrapment to cause incapacity or mortality that led to failure of the mission. It will be recalled that even after the second winter of 1846/1847, Fitzjames recorded "*All Well*."

This broad conclusion seemed uncontentious until the late-twentieth, and early twenty-first, century when two mono-causal theories proposed that the expedition suffered progressive debility and mortality caused, respectively, by contamination of the expedition's canned provisions with lead from solder, which sealed the cans, and the neurotoxin of *Clostridium botulinum* which had been introduced by unhygienic manufacture. Both theories were cited completely uncritically in a British medical journal as evidence that the loss of the expedition represented "a medical disaster" (Bayliss, 2002). However, Park and Stenton (2019) have published a very comprehensive review in this journal to show that those theories, and others, are not supported by research evidence. There is not the scope here to summarise that extensive evidence, other than to stress Park and Stenton's (2019) crucial observation that the fundamental difficulty for such theories is that, two years into the mission, the status of the expedition was "*All Well*" and with unexceptional mortality. They explain how such status would be inconsistent with, for example, long-term ingestion of provisions that were supposedly contaminated with intoxicating levels of lead or a fatal neurotoxin, or indeed any factor supposed to have exerted an early debilitating effect. The principle of parsimony might then apply by considering the known circumstances that affected the expedition and identified by Park and Stenton (2019) as the remote besetment, the Arctic climate and dwindling provisions. A similar rational appraisal has been made by earlier authors (Fordham, 1991; Lambert, 2009; Woodman, 1991) and in recent summaries (Barnett, 2017; Byard, 2021).

"In those regions of rigorous and perpetual cold, short allowance meant starvation" (Sir John Richardson; The Lancet, 1858)

The Lancet's focus on the evidence from Arctic medical and Naval officers concerning the climate and environment, and the need for adequate nutrition, was prescient, for Park and Stenton (2019) have constructed an evidence-based explanation for how those factors were central to the unique circumstances faced by the expedition and may explain mortality over winter 1847/1848 and ensuing events.

Evidence for the debilitating effect of the climate on Arctic crews is relevant to the Inuit observation that the winters of 1846/1847 and 1847/1848 were particularly cold and that 1847 had been a "year without summer" when game was exceptionally scarce (Cyriax, 1939, p.143). The lengthy besetment from 1846 to 1848 in heavy sea ice required arduous treks from the ships to King William Island to fulfil the scientific objectives of the mission and hunt scarce game to supplement provisions. No other Arctic ships were so disadvantaged by their locations (Park & Stenton, 2019), and Woodman (1991, p.323) has noted that "a similarly equipped modern group [...] might not fare any better without outside assistance."

Park and Stenton (2019) have explained how, once beset distant from land in the pack ice, the expedition's location would have made it very difficult to obtain a significant quantity of fresh meat from hunting, which would have been a source of both ascorbic acid (vitamin C) and thiamine (vitamin B₁). Consequently, there would have been an over-reliance upon stored provisions which, through time, would have become largely, if not entirely, deficient in those vitamins (the thiamine content of flour is an example, and is considered below in the context of the disproportionate deaths of officers). *The Lancet* had observed that the health of Arctic crews would subtly decline even when the quantity of provisions remained adequate, but the journal could not have known of the critical role played by vitamins. It is important to consider the evidence for these two deficiencies amongst the Franklin crewmen (and an alternative diagnosis for the supposed evidence of scurvy) because a deficiency in thiamine in particular is central to the evidence presented by Park and Stenton (2019) and implicit in a scenario suggested by *The Lancet* (1858).

The Lancet had acknowledged the probable occurrence of scurvy on Franklin's ships through the third winter of 1847/1848 given its presence amongst other Arctic crews but, lacking objective evidence, did not speculate on its prevalence. Cyriax (1939) did not have objective evidence either but concluded that scurvy caused significant mortality over the winter of 1847/1848 because the vitamin C content of the antiscorbutic lemon juice would have declined over time. However, the expedition's skeletal remains show limited evidence of lesions solely diagnostic of scurvy as distinct from trauma or infection (Mays, Maat, & De Boer, 2012; Stenton, Keenleyside, & Park, 2015), and do not suggest a significant outbreak of disease, although there is the difficulty that when unrelieved dietary lack of vitamin C culminates in death from scurvy, it may leave no skeletal evidence (see Geber & Murphy, 2012; Mays et al., 2012). Apparent evidence was found in the Inuit report that some survivors, whom they encountered in 1850, showed signs of scorbutic oral haemorrhage, but it could say nothing of the men's condition in 1848.

It is significant in the context of *The Lancet's* focus on evidence-based medicine that these supposed signs of scorbutic oral haemorrhage have been subjected to a systematic review of oral pathology by Taichman, Gross, and MacEachern (2017) to allow an alternative diagnosis of oral hyperpigmentation associated with Addison's disease caused by miliary (disseminated) tuberculosis affecting the adrenal glands. An outbreak was proposed to have led to desertion of the ships to control the disease on shore, and with excess deaths among officers due to vulnerability associated with their greater age. As the diagnosis is historically highly plausible because tubercular disease caused significant mortality in mid-Victorian Britain, evidence from the expedition's remains is therefore important.

Autopsies of permafrost-preserved crewmen buried at Beechey Island concluded that granulomata in lung and mediastinal tissues of two men might indicate tubercular or fungal infection (Amy, Bhatnagar, Damkjar, & Beattie, 1986; Notman, Anderson, Beattie, & Amy, 1987). Disseminated tubercular disease was not found (Amy & Beattie, 1985) but Byard (2021) notes that taphonomic changes (for example, degradation of remains by the burial environment or passage of time) might have obscured the evidence in diffuse, unidentified nodules seen in one man. Pott's disease (spinal tuberculosis) was suggested in a third man but recent analysis has found no DNA evidence of *Mycobacterium tuberculosis* to support his death from the disease (Forst & Brown, 2017), and nor from remains of an officer on King William Island (Mays et al., 2011). Age-related vulnerability of the expedition's officers might be unlikely when their median age and that of other ranks were 29 and 28 years, respectively. As for the five officers older than 45 years, the population mortality rate from 1848 to 1872 for pulmonary tuberculosis in their age group was lower than in younger men (Logan, 1950).

Neither *The Lancet* nor Cyriax considered a role for tuberculosis. Cyriax was an expert in the disease, having served as tuberculosis officer for South Warwickshire Hospitals, England, until his retirement (*British Medical Journal*, 1967). Both Cyriax (1939, p.137) and Park and Stenton (2019) concluded that the expedition's long period of isolation made the supposed outbreak of an infectious disease after more than two years on mission very unlikely. McLean (2010, p.74) has also noted that infectious diseases were not normally a problem for Arctic crews.

The Lancet's neglect of the condition may have reflected evidence that the Navy's death rate of 2.6/1000 for tuberculosis from 1856 to 1858 was lower than the 4.1/1000 rate amongst English males of the same age range. Whilst Naval mortality may have been underestimated when cases were discharged from service and lost to follow-up (Thorne, 1888; Tulloch 1841), the incidence of tuberculosis was also overestimated on Navy ships at the time because brucella/undulant fever, whose initial presentation was similar, was misdiagnosed as the disease (Dudley 1931). Nine cases of "phthisis" (pulmonary tuberculosis) occurred across nine Royal Naval Arctic search ships from 1848 to 1854 (Millar et al., 2016), but two cases may have been missed by surgeons who themselves conceded that they lacked experience in pathology, and two others simply unrecorded in error (*ibid.*). It is, therefore, entirely probable that some Franklin crewmen suffered the disease, but the evidence above might suggest that the expedition would have been uniquely unfortunate to be overwhelmed by it. This conclusion does not detract in any way from the important and unique demonstration by Taichman et al. (2017) of how a robust review of signs and symptoms in expedition members may allow an alternative, evidence-based diagnosis that is as historically plausible as vitamin C deficiency and scurvy.

Turning to the role of thiamine (vitamin B₁), Savours and Deacon (1981) noted it as one of several vitamin deficiencies that affected Royal Naval health in the Arctic, and Guly (2012, 2013) has explained how, on Antarctic expeditions, the deficiency caused "dry" and "wet" beri-beri associated, respectively, with neurological impairments, and cardiomyopathy causing cardiac failure. Significantly, Park and Stenton (2019) note that signs and symptoms of the deficiency were evident in early twentieth-century Newfoundland fishing communities when they relied on diets similar to those provided by the Royal Navy's preserved foods. First-hand evidence of the deficiency on an Arctic ship is found in the crew of HMS *Investigator* who showed clear signs and

symptoms of cardiac failure as rations were reduced over a third Arctic winter (Armstrong, 1857; McDougall, 1857). *The Lancet* (1857) noted that the debility was severe as the health of the *Investigator's* surgeon, Alexander Armstrong, remained much impaired for months after his rescue. The occurrence of cardiomyopathy in the *Investigator* after a relatively brief period on short rations may support an association with acute deficiency of thiamine (long-standing deficiency has been associated with neurological signs), but Guly (2012) notes that there is considerable variation between individuals.

As noted above, meat is a source of vitamin B₁, and Park and Stenton have explained how dwindling provisions and little success when hunting might have led to a deficiency, which impaired the health of the Franklin crew over the third winter of 1847/1848. *The Lancet* (1858) had noted evidence that the Navy's scale of victualling in preserved and salted meats was inadequate to maintain health on Arctic ships (Armstrong, 1858), particularly when short rations were introduced. The thiamine content of those short rations can be cautiously estimated by applying the present-day (Public Health England, 2015) thiamine content of braised beef (0.05 mg/100 g) and ham (0.58 mg/100 g) as imperfect proxies for the Navy's weekly short allowance of preserved and salted meats, respectively, shown in Armstrong's (1858, p.14) table of victualling. The weekly allowance of 680.4 g (1.5lb) salt meat and 907.2 g (2.0lb) preserved meat would then equate to a daily thiamine intake of 0.63 mg to be set against the current UK-recommended daily intake for adult males of 1.0 mg (National Health Service, 2020). It must be emphasised that this calculation is purely illustrative and presents a "best-case" because present-day thiamine values are from fresh meat whilst, as noted by Park and Stenton (2019), the vitamin content of the expedition's three-year-old canned provisions would have been depleted by time. Hunting for fresh meat could partially restore the deficiency but, as explained by Park and Stenton (2019), would have been a challenge for the Franklin expedition. If hunting was occasionally successful then, while the thiamine concentration in meat is low, it is much higher in offal such as kidney and liver (Guly, 2012). Whether the crews rejected offal in favour of meat is unknown but, in their predicament, perhaps few would have been so particular. However, Park and Stenton (2019) note that the expedition's debility seems confirmed by the survivors' very slow progress, and significant mortality, along the route of retreat on King William Island. This scenario parallels Richardson's conclusion about the fatal consequences of short rations over the expedition's third winter, cited above by *The Lancet* (1858).

The Lancet did not comment on the excess mortality amongst Franklin's officers but it requires examination, particularly as officers' health was typically superior to that of other ranks and no health factor was selected against officers on Royal Naval Arctic search ships (Millar et al., 2016). It is notable that on early Antarctic expeditions, the cardiac signs and symptoms consistent with thiamine deficiency were more prevalent amongst officers (Guly, 2012) whose bread was made from refined flour from which the thiamine-rich husk and germ were removed. Whether this factor contributed to mortality among Franklin's officers cannot be determined because the expedition's victualling records do not mention different qualities of flour being supplied (Millar et al., 2016). However, Park and Stenton (2019) have proposed a more nuanced explanation which takes into account the scarcity of game and its consequences. They propose that the officers' concern for the welfare of their men may have led them to sacrifice their share of the meagre product of the hunt to other ranks over the winter of

1847/1848, therefore, exposing themselves to the fatal consequences of deficiencies in thiamine and other vitamins. If such self-denial occurred, it would seem misguided by those in command to have allowed fatal debility amongst officers whose skills in navigation and leadership would determine survival of the whole crew. Such altruism was not seen on HMS *Investigator* where the limited provisions continued to be shared amongst all the crew (Piers, 1852), but different attitudes may have prevailed on Franklin's ships so that this possible cause of deaths amongst officers might remain open.

Cyriax (1939, p.156) proposed a more "heroic" scenario, noting that hunting was led by officers (Armstrong, 1857, pp.549–551) and, as it risked exposure and accident, that Franklin's officers "sacrificed themselves" and paid a fatal price. However, records show that whilst hunting-related injuries and frostbite were incurred by officers of Royal Navy ships during the search for Franklin, they were not associated with mortality (Barr, 1992; McDougall, 1857; Millar et al., 2016).

As *The Lancet* observed, the expedition was beset for two years and exposed to the harsh Arctic climate and environment from which the crews could neither escape nor find rescue. Ill health and loss of hope were consequences that led to the fatal outcome. *The Lancet's* fact-based approach and avoidance of speculation would support the present-day conclusions of Park and Stenton (2019).

"To obtain the history of their fate" (*The Lancet*, 1859)

The circumstances that led to mortality over the critical winter of 1847/1848 can only be confirmed by documentary evidence from the expedition itself. *The Lancet's* conclusion that Jane Franklin's call for searches to retrieve the expedition's records was pointless might seem vindicated by the fact that later searches, which were encouraged by speculation that records had been cached on King William Island, found nothing. The ships' logs, medical records and personal diaries would provide significant insight but were assumed to have been taken by the retreating crews and irretrievably lost (Cyriax, 1969). However, it neglects the possibility, first noted by Woodman (1991, p.324), that the eventual discovery of the ships might still provide such evidence. The well-preserved wrecks of HMS *Erebus* and HMS *Terror* were discovered in 2014 and 2016, respectively, and documents stored securely on board may remain legible (Harris, 2014).

Without such evidence, "Anything else is speculation" (Lambert, 2009, p.349). *The Lancet* avoided speculation and dealt with facts drawn from McClintock's "meagre narrative" and the first-hand experience of Arctic naval and medical officers. In particular, despite its status as a medical journal, it avoided the "medicalisation" of the loss of the Franklin expedition, which has characterised some recent theorising. However, *The Lancet* (1859, p.394) conceded that much remained unknown and, in its final words on the Franklin expedition, expressed hope that efforts would be made "to obtain the history of their fate." It might seem fitting if part of that history were found in the records kept by surgeons Stephen Stanley and John Peddie, and assistants Harry Goodsir and Alexander McDonald.

Postscript

Unlikely companions: Thomas Wakley, Jane Franklin and John Barrow Jnr.

The Franklin expedition was only one of many issues that consumed Thomas Wakley's attention over his thirty-nine years as

editor of *The Lancet*. Determining the cause of the expedition's loss was emblematic of his long professional mission to expose incompetence and responsibility for failure, ensure that facts were established, and, in the case of the Franklin expedition, deplore the needless deaths of one-hundred-and-twenty-nine men. It also had the distinction of being Wakley's last significant campaign because, by late 1860, his health was in very serious decline. His symptoms of weight loss and haemoptysis (coughing of blood) were diagnosed as "senile phthisis," and he was advised to attempt recovery in the benign climate of Madeira (*Lancet*, 1894). There, he seemed to rally for, true to character, he stated his intention to expose dishonesty in the island's wine trade (McMenemey, 1973) and, in December 1861, the *British Medical Journal* (1861, p.649) stated optimistically that he was "rapidly recovering from his long indisposition" and hoped to return home to resume full editorial duties. But it was not to be. Five months later when landing from a small boat, Wakley suffered a fall which provoked a major pulmonary haemorrhage from which he died on 16 May 1862, aged 66. His body was returned to England for burial in Kensal Green Cemetery, London. There, in 1875, he was joined by Jane Franklin whose search for her husband's records Wakley had implied was pointless, and in 1898 by John Barrow Jnr., the co-ordinator of the Admiralty searches which Wakley had pilloried. Perhaps they rest in peace together, despite it all.

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