

## Science and the Canadian Arctic, 1818-76, from Sir John Ross to Sir George Strong Nares

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**ABSTRACT.** Nineteenth-century exploration of the Canadian Arctic, primarily directed by the British Admiralty, had scientific as well as geographical goals. Many expeditions, including Franklin's, had a major scientific mandate. A northwest passage was the initial inspiration, but geomagnetism (under Edward Sabine's guidance), meteorology, zoology, geology, botany, and ethnology were the principal sciences that benefited. The Royal Society of London, with its Arctic Committee, was closely involved with the Admiralty in recommending scientific programs and in nominating observers to the expeditions. Naval officers too were much concerned with science; some, including Parry and James Ross, were elected fellows of the Royal Society of London (F.R.S.).

From John Ross through Parry to Franklin, scientific arctic voyages were strongly promoted. Geomagnetism, natural history, and meteorology were particularly prominent. During the searches for Franklin, the life sciences, geology, and meteorology continued to benefit, while geophysical researches were relatively neglected. After the Franklin disaster, geographical and other scientific exploration languished until the example of other nations and domestic lobbying persuaded the British government to send Nares north in 1875-76. This was the last of the old-style scientific expeditions to the Canadian Arctic. Afterwards, co-operation in science (as in the International Polar Year) and concern for the Arctic as national territory became dominant factors in arctic exploration.

**Key words:** science, history, Canada, geomagnetism, natural history, geology, J. Ross, W.E. Parry, J. Franklin, G.S. Nares

**RÉSUMÉ.** L'exploration dans l'Arctique canadien au XIX<sup>e</sup> siècle, qui fut surtout l'oeuvre de l'Amirauté britannique, avait des objectifs scientifiques en même temps que géographiques. De nombreuses expéditions, y compris celle de Franklin, avaient un important mandat scientifique. Si la recherche du Passage du Nord-Ouest fut à l'origine de ces expéditions, d'importants domaines scientifiques en profitèrent: géomagnétisme (sous la direction d'Edward Sabine), météorologie, zoologie, géologie, botanique et ethnologie. La Royal Society de Londres, par l'intermédiaire de son comité de l'Arctique, travaillait en étroite collaboration avec l'Amirauté à recommander les programmes scientifiques et à nommer les observateurs lors des expéditions. Les officiers de marine étaient eux aussi très intéressés par l'aspect scientifique de ces voyages, et quelques-uns (dont Parry et James Ross) furent élus membres de la Royal Society de Londres (F.R.S.).

De John Ross à Parry puis à Franklin, les voyages scientifiques dans l'Arctique connurent un grand essor, avec l'accent mis sur le géomagnétisme, l'histoire et la météorologie. Au cours des recherches en vue de retrouver Franklin, les sciences biologiques, la géologie et la météorologie continuèrent de s'enrichir, tandis que la recherche géophysique fut mise de côté. Après le désastre de l'expédition de Franklin, l'exploration de la géographie et d'autres domaines de la science fut mise en veilleuse jusqu'à ce que l'exemple d'autres pays et les pressions politiques internes poussent le gouvernement britannique à envoyer Nares dans le Grand Nord en 1875-76. Ce fut la dernière expédition de style traditionnel dans l'Arctique canadien. Par la suite, la coopération scientifique (illustrée lors de l'Année polaire internationale) et la préoccupation du maintien de l'Arctique comme territoire national devinrent des facteurs prépondérants dans l'exploration de l'Arctique.

**Mots clés:** science, histoire, Canada, géomagnétisme, histoire naturelle, géologie, J. Ross, W.E. Parry, J. Franklin, G.S. Nares

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### INTRODUCTION

In 1835, when George Back returned from his search for the Northwest Passage expedition of John Ross, the map of the north polar regions (Hydrographic Office of the Admiralty, 1835) raised more questions than it answered. It was full of uncertainties. Greenland lacked a northern coast, Ellesmere Island lacked both north and west coasts, and most of the Canadian arctic islands were missing, or else appeared only as fragments, with bits mapped and scattered around the North Magnetic Pole. The region of the geographical pole was a mystery, a giant question mark represented appropriately by a large white blank upon the map. There was plenty of room for speculation. Was there a viable Northwest Passage? Was there a northern polar sea all the way to the Pole, or was there land at the Pole? Although it seemed more than likely by the mid-1870s that there was a polar ocean covered by ice, it was not until the present century that the Pole was first reached.

Science was often a spur to arctic exploration, but not always an aid to it; and more than once, the demands of scientific research and those of geographical discovery came into conflict. Stefansson early in this century complained that the scientists on his expedition were hampered by a civil service mentality (Stefansson, 1919; Levere, 1988a).

Science was in any case almost always a secondary object of arctic expeditions, and the popular press scarcely mentioned the scientific mandate of even the most determinedly scientific voyages. Material gain, national prestige, heroism, and romance caught and held public interest, with disasters as popular as successes and more rapidly admitted to national mythologies. Gain and national glory had been the mainsprings of the early voyages of Frobisher, Davis, and Hudson. A Northwest Passage, a trade route to Cathay, would be the richest fruit of any arctic voyage.

In 1778, Captain James Cook came within sight of Bering Strait on a voyage that was much concerned with science; but by the early nineteenth century, what the public best remembered from northern voyages in those years was a youthful escapade of Horatio Nelson. Nelson, at the age of 14, had managed to be appointed coxswain on one of the ships on Constantine Phipps's scientific expedition to the Arctic in 1773 (Phipps, 1774; Savours, 1984). Playing truant one night on the ice, he challenged a bear; his musket misfired, and he was left with the butt as his only weapon until the ship's guns scared the animal off. That, rather than the extensive magnetic, meteorological, astronomical, and hydrographic work of the expedition, was celebrated when Nelson became a hero in the Napoleonic Wars. Then as now, adventure, however ill-considered, won a better

press than productive science. Science lapsed, and so, necessarily, did arctic exploration. Only Coleridge's "Ancient Mariner," whose ship had been driven by a storm towards the more remote South Pole, kept the land of ice alive in imagination.

#### THE ROYAL NAVY AFTER THE NAPOLEONIC WARS

In 1812, at the height of the Royal Navy's strength in the Napoleonic Wars, the British Parliament voted funds for 113 000 seamen; by 1816, with the war over, the parliamentary vote fell to funds for 24 000 seamen (*Encyclopaedia Britannica*, 1911). With the advent of peace, the Navy's employment was largely gone, and occupation and opportunities for promotion were much needed. The Army was little better off. One thing that the services could do in those years, the Navy and the ordnance department of the Army especially, was scientific surveying. As a contemporary remarked of such surveys, "government would catch eagerly at the idea, for all they want are situations, in which they can place the unemployed officers, without the appearance of jobbing" (Edgeworth, 1816).

Resuming arctic exploration could have just such attractions; the trouble was that sufficient was known of the Arctic to underline the difficulties of searching for a Northwest Passage. James Rennell, a geographer and naval officer, saw the objections clearly:

The *NW and Northern Passages* are much talked of. How can any one suppose, that a ship can make her way from Baffin's Bay to Behring's Strait, in the short Summer of the Arctic Region, in less than 3 Months; when the Whalers are a Month or 6 weeks, in boring thro' the *loose* Ice, 3 or 4 degrees, to get to the Whaling Station: and it is 30 such degrees, that a ship is to go. If she be caught by winter, adieu — Now is it probable that the ice is loose. [Rennell, 1818.]

#### THE EXPEDITION OF JOHN ROSS

In normal years, Rennell's objections would have been entirely valid. In 1817, however, William Scoresby, a scientifically curious whaler captain from Whitby, entered into a correspondence with Sir Joseph Banks, president of the Royal Society of London, about the unusually ice-free state of the Greenland sea (Stamp, 1975:64-70). That same autumn saw an article in the *Quarterly Review*, written by John Barrow, second secretary of the Admiralty, stating that the Russians were interested in a sea passage around America. Barrow warned that "it would be somewhat mortifying, if a naval power but of yesterday should complete a discovery in the nineteenth century, which was so happily commenced by Englishmen in the sixteenth" (Barrow, 1817:219-220).

Banks informed the first lord of the Admiralty of Scoresby's findings, which indicated the timeliness of a scientific arctic voyage; this, added to the underemployment of the Royal Navy, to fears of Russian activities in the Arctic, and to Barrow's enthusiasm, led in 1818 to an Act of Parliament offering rewards for the discovery of a Northwest Passage or for the nearest approach to the Pole (Kirwan, 1959:73-98). Men and ships were made available, and the first of the major nineteenth-century expeditions to the Canadian Arctic set off, commanded by John Ross in *HMS Isabella*. They set out in 1818, the year in which Mary Shelley's *Frankenstein* was first published, an uneasy but prophetic parallel, since the novel, like the Victorian era, began with Walton's high hopes for success and power over

nature in arctic exploration and ended with a much clearer notion of the terrifying aspects of the arctic world.

Ross, however, set out without foreknowledge, armed with encouragement and instructions from the Admiralty and the Royal Society. His departure was celebrated by Barrow as the culmination of centuries of exploration. Even if the Pole and the Northwest Passage escaped both expeditions, Barrow observed, the scientific harvest would be invaluable.

Of the enterprise itself, it may be truly characterized as one of the most liberal and disinterested that was ever undertaken, and every way worthy of a great, a prosperous and an enlightened nation; having for its primary object that of the advancement of science, for its own sake, without any selfish or interested views. [Barrow, 1818:378-379.]

Altruism made a convenient counterweight to national glory and fear of Russian expansionism, whether in trade or territory.

Ross's mission was primarily geographical discovery. He was also instructed to make comprehensive scientific observations (Royal Society of London, 1818). An attempt was to be made "to discover a Northern Passage, by sea, from the Atlantic to the Pacific Ocean." Navigation in the ice was considered to be a skill acquired by practice, and Ross's ships were accordingly accompanied by a master and mate of whale-fishing vessels, "well-experienced in those seas." Crucial evidence was the summer current flowing down Davis Strait from the north: "hence Baffin's Bay cannot be bounded by land, as our charts generally represent it, but must communicate with the Arctic Ocean" (Ross, 1819a:1-2). John Barrow, reading Ross's account of the voyage, noted in the margin: "My dear Father's theory" (Ross, 1819a:2). Here was some explanation for Barrow's enthusiasm for the enterprise.

Tracing the current from the Arctic Ocean was therefore a key to success, and Ross's first scientific instructions were for oceanographic work. Ross was told to make regular measurements of the strength and direction of the current, at the surface, and at different depths.

The main aim of the expedition was to discover, navigate, and map the Northwest Passage from Davis Strait to Bering Strait; incidentally, knowledge of the oceanography and hydrography of the Arctic would be enriched. As Barrow had pointed out, there was besides, since so little was then known, the possibility of contributing to the general "advancement of scientific and natural knowledge." To this end, the Lords of the Admiralty had caused to be placed on board "a great variety of valuable instruments." They had also, on the recommendation of the Royal Society, ordered Edward Sabine of the Royal Artillery to accompany the expedition. Sabine, who had been generously represented as "a gentleman well skilled in astronomy, natural history, and various branches of knowledge," was to be the expedition's scientific factotum (Ross, 1819a:9-10).

Ross's instructions were comprehensive and representative of similar instructions for successive expeditions for the next half century. They embraced magnetism, hydrography, meteorology, and oceanography and made reference also to natural history and geology, anthropology, and astronomy. Apart from Sabine, who would have been sorely stretched by the Admiralty's scientific demands, and the added demands of the Royal Society, there were no remotely skilled scientists to use and test the arsenal of scientific instruments and apparatus. In their over-ambition as well as their range, the instructions were also representative of what was to be the norm.

Typically, they began with magnetism, an essential concomitant to polar navigation on land, ice, or sea (Leveré, 1985). HMS *Isabella* carried a variety of azimuth and steering compasses, some of which proved hopeless, some merely sluggish, some fine as long as the ship was steady, and one in particular, made by Alexander of Leith, wholly admirable (Ross, 1819a:xix and Appendix, cxxiv). The number of instruments intended to perform the same function makes it clear that Ross's voyage was seen as an ideal laboratory in which to test instruments, many of which had previously enjoyed only theoretical advantages.

After magnetic instruments, the most important apparatus was that designed for oceanographic research, needed for elucidating the problem of the summer current flowing down Davis Strait, either from an open Polar Sea, or from the direction of Bering Strait. The Admiralty had provided Ross with a sounder-sampler for obtaining samples of the material on the ocean floor and for measuring the ocean depth at that point. The Admiralty had lauded the device as much superior to its predecessors; Ross, however, found it useless and complained of the many fruitless attempts he made to obtain bottom samples in deep water. He went on to invent his own instrument (Fig. 1), which the ship's armourer made for him. His "deep sea clamm" was a mechanical grab with jaws that sank into the ocean floor. When the clamm was hauled up, the jaws, with their load of bottom sediments, were lifted into a cast iron vessel, sealing it. The results seemed eminently satisfactory. For example, Ross claimed

that in Baffin Bay on 1 September 1818, "soundings were obtained correctly in one thousand fathoms, consisting of soft muds, in which there were worms, and entangled on the sounding line, at the depth of eight hundred fathoms, a beautiful caput medusae. . . ." Such brittle stars are indeed beautiful, but they are bottom-dwelling creatures, so at least 200 fathoms of line must have been lying on the bottom (Ross, 1819a:10, cxxxiii-cxxxvi, 178; Ross, 1819b; McConnell, 1982:42).

There was one set of apparatus partly new and partly far from new, designed to explore a problem important to natural philosophers since the seventeenth century — the shape of the earth. The principal piece of apparatus for this investigation was a clock with a special pendulum. This fine piece had been used by Captain Cook in the previous century and was still giving good service (Howse, 1969). The clock, checked against chronometers, was used to collect data for determining the length of the seconds pendulum in high latitudes. Such data, compared with similar data at the equator, enabled Sabine to arrive at a reasonably accurate value for the ellipticity of the earth (Sabine, 1825).

Ross had facilitated a good deal of pioneering work in arctic science, and although no trained scientist, he had an unskilled but eager appetite for recording what he saw — including musk oxen, arctic hares, arctic foxes, and the native peoples, who clearly delighted him and who gave besides material help with navigation (Fig. 2). His taste for natural history was, moreover, not uninformed; his manuscript journal of the voyage (Ross, 1818) contains his own list of invertebrate animals dredged up; although it needed subsequent correction, it was substantially accurate and included the identification of new species taxing to any but a trained naturalist.

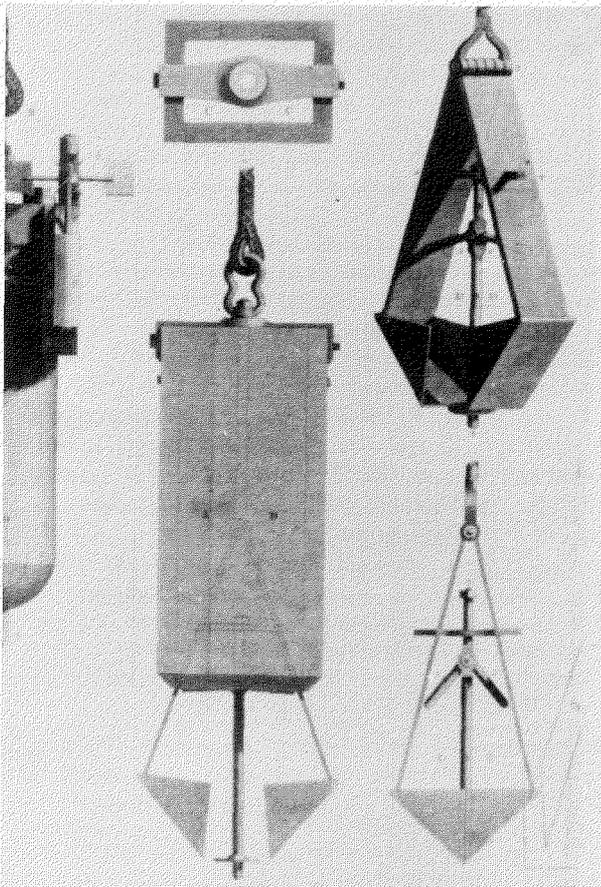


FIG. 1. John Ross's deep sea clamm. (Ross, 1819a:Fig. 1.)

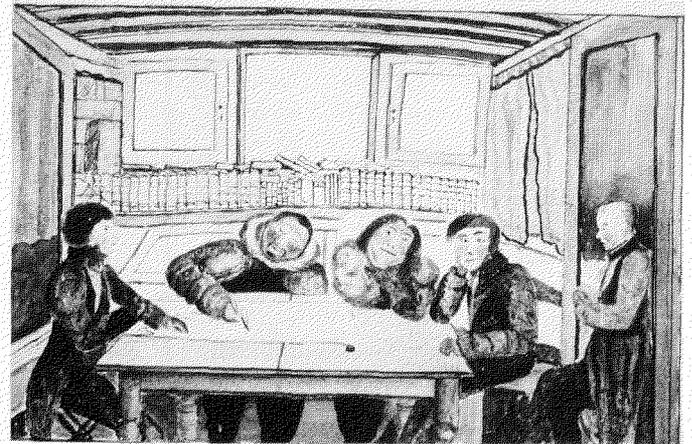


FIG. 2. Inuit helping with maps. From a sketch by John Ross (Ross, 1819a). The originals of this and other sketches reproduced in Ross, 1819a, are in the Scott Polar Research Institute, Cambridge, England.

Ross brought home his collections. Some of the natural history specimens were so contracted by the spirit in which they had been preserved as to be of little scientific use; it was unfortunate that, unlike Captain Cook, Ross had no naturalist with him capable of preparing sketches of the organisms. Such subtleties were irrelevant for the popular reception of the expedition, which, bringing with it vials of melted red snow, polar bear skins, and other treasures, invited caricature

(Cruikshank, 1819). The scientific successes of the voyage, however, were, for Ross, overwhelmed by the controversy that followed his return; he saw mountains where there were none and so failed to make progress down Lancaster Sound. Perhaps even worse, he engaged in public controversy with his subordinates. He lost the Admiralty's favour.

#### WILLIAM EDWARD PARRY

Parry was chosen for the next attempt on the passage. He had commanded HMS *Alexander* under Ross, having prepared himself for that expedition by a flurry of scientific consultations with Sir Joseph Banks, president of the Royal Society of London, William and John Herschel, Captain Kater, and Scoresby (Parry, 1817). Indeed, Barrow had recommended him for the command of *Alexander* after learning of his enthusiasm for astronomy (Markham, 1921:206; Parry, 1963:28). His private journal written during Ross's expedition explored a host of scientific issues and shows that he frequently made magnetic observations and took astronomical sightings; early in the expedition, he sent a paper on magnetism to Barrow (Parry, 1818a,b).

Now, in 1819, Parry was allowed to test his confidence in the Lancaster Sound approach to the Northwest Passage, commanding a new expedition. His instructions, as far as science went, were similar to those issued to Ross, and Sabine had his old job of scientific factotum. Scientific objects were, however, stressed more vigorously, "as being . . . likely to prove of almost equal importance to the principal one," the discovery of a northern passage from the Atlantic to the Pacific (Parry, 1821:xxv-xxvi). With relatively favourable ice conditions, and, like many of their successors, displaying superb seamanship, they sailed up Davis Strait, along Lancaster Sound, and wintered on the south shore of Melville Island. They extended the scientific work of Ross's expedition; in addition, overwintering made possible the construction of an observatory on shore, primarily for magnetic work, as well as an instrument house. It also provided the first winter observations on fauna in the arctic islands and dramatic records of paraselenae, sometimes called mock moons.

Parry on his return quickly published his narrative of the voyage, which had been a dramatic success. Natural history materials took longer to prepare, especially the botanical ones, which were in the dilatory but expert hands of Robert Brown (Brown, 1820-23). Parry had returned from his next expedition to the Arctic by the time the sheets were all in press (Parry, 1824a). There were several new plants named for members of the expedition, including *Eutrema Edwardsii*, the *Parrya*, and *Pleuropogon Sabinii*. There were also new species of insects and of marine invertebrates. The volume was of considerable scientific importance.

Parry meanwhile had been elected to the Royal Society of London for his arctic navigation and had set off again for the Arctic, without Sabine but with George Fisher as astronomer and chaplain. Fisher had received instructions from the Royal Society for physical, chemical, meteorological, and physiological observations (Royal Society of London, 1821). There was no trained naturalist on board this time, so, Parry noted, "sole responsibility in this department naturally devolved upon myself" in spite of his lack of qualifications; J.C. Ross superintended the taxidermy (Parry, 1824b:xiv).

Fisher's observations were expert (Fisher, 1821-23); the general scientific program pursued by the previous expedition was continued; dealings with the Inuit were extensive, and much information, subsequently valuable to anthropologists, was gathered. The expedition narrative ends with detailed accounts of "Esquimaux" customs, clothes, food, homes, tools, and language (Parry, 1824b:492-571).

By the time that Parry set out on his third expedition, the Admiralty was becoming more eager for geographical discovery and less concerned about the advancement of science. They sent an astronomer-surveyor, Henry Foster, lately elected F.R.S., and the usual collection of valuable scientific instruments; but they gave clear instructions that the Northwest Passage was the goal of the expedition and that scientific observations were to be carried out only when the ships were held up by ice. Parry and his men were nonetheless able to do a good deal of valuable work. They used Kater's pendulum accurately to estimate the ellipticity of the earth. They also made systematic magnetic and other geophysical observations, verified the reliability of Barlow's plate to correct local magnetic attraction aboard ship, and collected geological and zoological specimens — the latter so thoroughly that J.C. Ross felt that in matters of arctic zoology, "little is now left to be said on the subject" (Parry, 1826: Appendix, p. 91).

When Parry returned this time, having abandoned *Fury* where it had been driven ashore by ice on Somerset Island, it was to take up the post of hydrographer to the Admiralty. The appointment neither prevented him from voyaging north nor from urging others to do so; but he had made his last attempt on the Northwest Passage.

#### FROM ROSS TO FRANKLIN

Successive expeditions extended scientific and geographical knowledge, following essentially the same scientific programs as those conducted by Ross and Parry, and often enduring much worse hardships. In 1818, when Ross had set out to try for the Northwest Passage by way of Davis Strait, John Franklin had sailed north, aiming for a northern route between Greenland and Svalbard (Markham, 1876:67-69). By the time his ship had reached Lerwick in Shetland, he was writing to Sir Joseph Banks with information about some of the new apparatus with which they had been equipped (Franklin, 1818). The scientific goals were similar to those of Ross; the achievements were necessarily less, for a violent gale and heavy pack ice meant that a coastal map of northwest Svalbard was the only gain from this expedition. In the following year, Franklin returned to the Arctic, on his first land expedition. John Richardson and Robert Hood made observations in natural history (Houston, 1975, 1984). Soundings were taken on the outward voyage. On land, George Back did his best with electrical, auroral, and magnetic observations. At Cumberland House, where they were held by the winter, Back entered in his journal on 23 October 1819 (Back, 1819-20):

Though we were obliged to lose six months of otherwise valuable time, it was not our intention to remain inactive, but to obtain as many observations both astronomical and meteorological as we possibly could, as well as to make ourselves acquainted with the country through which we must pass — the language, manners etc. of the natives — in the first and last of these we find ourselves miserably disappointed — for in attempting to make observations in the winter, except such as do not occupy many

minutes — you lose every sensation in the fingers — and if suffered to remain in contact with any metallic substance, becomes almost frozen to it, the certainty is that the skin remains behind.

In spite of the hardships, the scientific harvest was considerable, with extensive observations and collections in geology and natural history, and extensive geomagnetic and meteorological data (Franklin, 1823).

Franklin's next overland expedition, from 1825 to 1827, was more successful, and less grim; the scientific haul is reflected not only in the appendices, mostly by Richardson, to Franklin's narrative of the expedition (Franklin, 1828), but also in Richardson's splendid four-volume work on the fauna of the northern regions, *Fauna boreali-americana* (Fig. 3; Richardson, 1829-37), and in William Jackson Hooker's flora of those regions (Hooker, 1840), an exemplary work based mainly upon the collections of John Richardson and of the indefatigable assistant naturalist Thomas Drummond. Geographically, the expedition was almost a triumph; the aim had been for Franklin to meet Beechey on the arctic shore, following Beechey's voyage up the Pacific and through Bering Strait in HMS *Blossom* (Beechey, 1831, 1973). They almost made their rendezvous; as they learned afterwards, Franklin's party had come within 250 km of a boat sent by Beechey to meet him. Before this was known, but after Franklin had turned back, Richardson wrote to his wife from Great Slave Lake that Franklin

got more than half way to Icy Cape and although he has not completed the Northwest passage, yet he has left so small a portion of the coast unsurveyed, that if Cap' Beechey gets round Icy Cape he can scarcely fail in completing it. The search after this passage has employed three centuries but now that it may be considered as completed, the discovery will I suppose be committed like Juliet to the tomb of the Capulets, unless something more powerful than steam can render it available for the purposes of mercantile gain. [Richardson, 1826.]



FIG. 3. Snowy owl. The sketch is by William Swainson and is reproduced in Richardson, 1829-37(II): pl. 32.

The map of the Arctic was being gradually filled in. This, more than any scientific knowledge, was a continuing preoccupation for the Admiralty (Ritchie, 1967); arctic voyages would

continue. Two years after Franklin's return in 1827, Sir Francis Beaufort succeeded Parry as hydrographer of the Navy (Friendly, 1977). He was even better scientifically informed than Parry, closely involved through his office with the work of the Royal Society, of which he was a fellow, and particularly concerned with geomagnetism and meteorology. He was also much interested in the development of scientific apparatus, whether for navigation or more abstruse research, that would be used on naval expeditions. In these various capacities, he was constantly in touch with the leading explorers of the day, John Franklin among them.

Franklin was no scientist, but he was interested in the scientific dimensions of exploration, supportive of the scientific enterprise, and, like Beaufort, keenly interested in the development of scientific instruments. A case in point was the problem of a reliable dip circle (Levere, 1985) to measure the vertical angle between a freely suspended magnetic needle and the horizontal plane at a given point. Edward Sabine had already complained about the instruments issued by the Admiralty; one problem was the lack of freedom of motion of the needle about its axis. A solution was found by Robert Were Fox, who used jewelled cups like those used in chronometers. His instrument also served to measure the intensity of the earth's magnetism. Franklin was in touch with Fox when he first developed the dip circle, advocated the use of his instrument before it came into general use, and helped to persuade the Admiralty to adopt it.

Around this time, the Royal Geographical Society was urging the government to send out another arctic expedition to complete the survey of the coast of North America. Franklin urged that George Back be appointed as commander of the expedition (Franklin, 1836).

Back had twice been to the Arctic with Franklin and in 1825-27 had been one of the two magnetic observers (Franklin, 1828: Appendix vi; Back, 1824-26). He did indeed command the expedition in HMS *Terror* in 1836-37 and took a Fox dip circle with him. In the following year, Fox came to the Hydrographic Office for discussions about his dip circle (Beaufort, 1838). Sabine was there, and so was James Clark Ross, who had located the North Magnetic Pole in 1831 and was soon to set off for the Antarctic on a voyage of magnetic and geographical exploration. He too took a Fox instrument with him; it became, and for half a century remained, a standard item of naval scientific equipment (Ross, 1847; Herschel, 1851). When Franklin in 1845 again and for the last time sailed for the Arctic, he took with him "a great variety of valuable instruments" for magnetic and other scientific observations. The Royal Society of London had informed the Admiralty that the main advantages of the expedition, beyond additions to geographical knowledge, would be in the realms of magnetism (Northampton, 1845). Sabine, who urgently advanced the claims of magnetic research, provided instruction and advice about instruments and techniques of observation (Admiralty, 1845). Franklin wrote from the Whale Fish Islands, reporting favourably on the magnetic instruments (Franklin, 1845). They vanished with him.

DR. JOHN RAE

Franklin's expedition, that had left with such high hopes in 1845, ended in disaster in 1847-48, because of a failure to adapt and an adherence to social, technical, and organizational approaches totally unsuited to the Arctic, however well suited to more normal naval service. The contrast between the Royal

Navy's generous supply of rations, and a life-style tying the explorers to their ships and to those rations, with the less generously provided but smaller and more flexible arctic journeys of the employees of the Hudson's Bay Company (the Company—HBC), is striking and has been repeatedly noticed (Wallace, 1975).

The most impressive explorer employed by the Company was John Rae, an Orkneyman who from 1835 to 1845 was resident surgeon at Moose Fort, spending much of his time in scientific studies. He was hard-headed and realistic in his approach to scientific studies, as in all things. In February 1845, he looked back to his arrival at Red River in the previous November, where he had hoped for guidance in scientific surveying from a Mr. Taylor; but Taylor was first sick, then wandering in his mind, and then dead, so that "he was incapable of affording me any assistance in my *studies*" (Rae, 1845a).

With a view to becoming an effective all-round scientific explorer, Rae set about gaining a collection of instruments as well as knowledge. He worked assiduously, consulted experts, and by the end of July was positively optimistic.

Although my stock of scientific knowledge is small I hope to find it sufficient for the purposes of the survey. The winter's study at Churchill will no doubt improve me a little if I make good use of my leisure time. [Rae, 1845b.]

By now, he had learned enough to realize the inadequacy of the Company's dip circle. Magnetic observations were then exciting great interest, Rae wanted to do a thorough job, and so he had "taken the liberty of [ordering] . . . a needle made of the sort wanted. . . . It may easily reach me at Churchill next Spring or perhaps sooner — The cost will only be a dollar or two" (Rae, 1845b).

Thus, by a combination of hard work, learning, and economy verging on parsimony, he satisfied the Company and George Simpson, governor of the HBC and his demandingly supportive superior (Newman, 1985:291-318, 1987:217-271). At York Factory that winter Rae continued to make observations, while training the men to assist him and to skin specimens for zoological collections.

The main goal of the expedition that Rae led in 1846-47 was, as Simpson instructed him, "to complete the geography of the Northern Shore of America by surveying the only section of the same that has not yet been traced." Simpson now told him that the world expected the Hudson's Bay Company to provide a final settlement of the problem — but added that, besides this principal task, Rae was to do

your utmost . . . to attend to Botany and Geology; to Zoology in all its departments; to the temperature both of the air and of the water; to the condition of the atmosphere and the state of the ice; to winds and currents; to the soundings as well with respect to bottom as with respect to depth; to the magnetic dip and the variation of the compass; to the aurora borealis and the refraction of light. You will also, to the best of your opportunities, observe the ethnographical peculiarities of the Esquimaux of the country; and, in the event of your wintering within the Arctic Circle, you will be careful to notice any characteristic features or influences of the long night of the high latitudes in question. These peculiarities, and such others as may suggest themselves to you on the spot, you will record fully and precisely in a journal to be kept, as far as practicable, from day to day, collecting, at the same time, any new, curious or interesting specimens in illustration of any of the foregoing heads. [Simpson, 1846.]

Simpson added that if Rae needed another season to complete his task, that would be in order; in that event, he was to live off

the land — an employee of the Company could live wherever the natives could. If Simpson's assumptions about Rae's subsistence were different from those of the Admiralty about Franklin, his excessive scientific demands, and the inadequate scientific training of the principal investigator, were much closer to the Naval norm. Rae was amused:

You appear to think that I have got a head stuffed with all sorts of knowledge. . . . The head is big enough certainly outside, but whether there is a large quantity of bone in it or not I have not yet tested. [Rae, 1846.]

The immediate scientific yield of the expedition was slender, but the expedition attained most of its geographic goals; Rae traced all the coast except for a short stretch near Fury and Hecla Strait; and the cost of the expedition was pleasingly low, a mere £1100-1200 sterling (Rae, 1847).

#### FRANKLIN SEARCH EXPEDITIONS

After this expedition, Rae was briefly in London, where he found that Franklin had not been heard from. Concern for Franklin's expedition had moved from discussions of relief parties to proposals for full-fledged search expeditions (Markham, 1921:248-278). Among the first of these was that of John Richardson. Rae, before returning to Canada, talked with Richardson about his impending search. Richardson wrote to Rae in November 1847, asking him whether he would be willing to join the expedition as second officer (Richardson, 1847). Rae agreed. The scientific results of the ensuing expedition (Richardson, 1851; Lefroy and Richardson, 1855) owed a good deal to Rae, who found himself taking many of the observations, Richardson being "so very anxious to get forward that he cannot fix his attention sufficiently to study the subject" (Rae, 1848). Richardson returned to England with extensive scientific data in 1849; Rae continued the search, now once more under the auspices of the Hudson's Bay Company.

Meanwhile, the Royal Navy and the government sent out a succession of expeditions, through Bering Strait and Davis Strait, gradually filling in the map. They acquired extensive experience in sledging and overwintering, and, while making the search for Franklin their principal concern and keeping scientific studies subordinate, they still added steadily to knowledge of the Arctic. Their strength was in the collection of specimens while on the move; the maintenance of observatories and of such regular programs of observations as those required for geomagnetic studies were outside their purview. Thus natural history, geology, and mineralogy benefited more than geophysics. Meteorological observations could be carried out while under steam or sail, so that this branch of knowledge also advanced.

The expeditions wove back and forth in space and overlapped recurrently in time. Most of them contributed to natural history or geology. Richardson and Rae, besides their magnetic endeavours, had made notes that touched on many realms of natural history and physical geography (Rae, 1849; Richardson, 1848, 1851). Peter Cormack Sutherland, surgeon first in HMS *Sophia* in the government-sponsored search commanded by William Penny in 1850-51 and then in *Isabel* under Edward Augustus Inglefield in 1852, made extensive geological and ethnological observations (Sutherland, 1853, 1856). M'Clure's voyage in HMS *Investigator* from 1850 to 1854 generated enough for Roderick Murchison to write an essay on arctic geology and for J.D. Hooker to write up the plants (McClure, 1857). Indeed, Hooker made a synthesis of arctic botany based on the Franklin searches

(Hooker, 1857). Such work was soon to be of prime importance for the study of the geographical distribution of plants, which in turn bore on evolutionary questions in botany (Hooker, 1861).

McClintock, who sailed on a series of searches from 1848, became the champion of European arctic sledge travellers. In 1849 he sailed under James Ross, wintered on Somerset Island, and undertook a series of sledge journeys that he described as brutally demanding. Nonetheless, he collected geological specimens and "a few waist-coat pocket specimens of fossils," at least one of which was new to science (McClintock and Haughton, 1856-57). The last of his search expeditions, the privately supported voyage of the *Fox*, was also productive of geological knowledge and led to an entire volume of arctic meteorology (McClintock, 1859, 1862).

Other Royal Naval expeditions, including those of Horatio Austin and Henry Kellett, also made some contribution to science; but the pressure was to find Franklin, not to add to scientific knowledge. Scientists were considered a luxury on such expeditions, and the keenest observers were generally untrained in all but science in relation to navigation. Sherard Osborn wrote to Barrow from HMS *Pioneer* in 1854:

I fear you will say my observation lies all in one line — Geography and Search — and that there are many other interesting points to which my attention might be profitably turned — None perhaps more generally appreciable than that of the Natural History of the North — Unfortunately my *forte* does not lie therein, and those horrid Naturalists who seem to delight in making every science a fortified space of hard names . . . , renders men less thick-skinned than a Rhinoceros somewhat diffident of approaching the subject. . . . [Osborn, 1854.]

But although not technically competent in natural history, Osborn could record his observations vividly. A polar bear on broken ice displayed "the activity of a huge *monkey* more than that of a cat," while on unbroken ice it moved with "a hard swinging pace . . . , the head . . . up, and occasionally it would stop, raise its long ungainly neck as if to inhale a fresh whiff of the distant seal, and then again, it would resume its course as straight to its point as an arrow" (Osborn, 1854).

By the time that Osborn was writing these letters, it seemed clear to all but Lady Franklin that Sir John and his companions must have perished. Osborn wrote that he looked upon them "as a sacrifice, made in the great cause of general knowledge, and many a greater has been made in a far worse cause!" (Osborn, 1854).

Confirmation of their fate was soon forthcoming. John Rae undertook his final search for the Hudson's Bay Company in 1853-54. On 1 September 1854 he wrote from York Factory to Archibald Barclay, Secretary of the Company in London:

I arrived here yesterday with my party all in good health. . . . Information has been obtained, and articles purchased from the natives, which prove beyond a doubt, that a portion, if not all, of the survivors of the long lost and unfortunate party under Sir John Franklin, had met with a fate as melancholy and dreadful as it is possible to imagine. [Rae, 1854.]

That fate was death from starvation and disease, and final desperate resort to cannibalism. On 21 October 1854, the day after the publication of Rae's findings, *The Times* of London spoke for the nation:

We have had quite enough of great Arctic expeditions; since Sir Edward PARRY's first voyage in 1819-20, with the single exception of Captain M'CLURE's, they have invariably resulted in disappointment and disaster.

Although there were subsequent British expeditions to the Arctic, the most notable ones, like McClintock's in the *Fox*, were unofficial. Franklin's fate, and perhaps also naval budgets, combined for more than two decades to discourage the Royal Navy from scientific or other exploration in the High Arctic.

#### THE BRITISH ARCTIC EXPEDITION 1875-76

In spite of the Admiralty's reluctance to resume arctic research and exploration, there was renewed enthusiasm for such ventures by the early 1860s. Its focus was in the Royal Geographical Society, which obtained letters of support and proposals for specific scientific activity from the Linnean Society, the Geological Society, the Royal Society of London, and a range of other societies, all the way to the Imperial Academy of Sciences in St. Petersburg. The Linnean Society was remarkable in stressing the safety of arctic exploration; apart from the Franklin expedition, no polar journey had cost the life of a single Fellow, whereas in African explorations, "there are very few of the numerous contributors to our publications who have not perished in the prosecution of their researches" (Linnean Society, n.d.). The First Sea Lord, the Duke of Somerset, was unimpressed: "I saw a deputation on this subject last summer and gave them no encouragement in a belief that the Admiralty would undertake such an expedition" (Somerset, 1865). The Admiralty Board was unanimous in rejecting the proposal; no doubt there were interesting scientific questions to solve, but the financial cost and the risk to life would be excessive, and the whole enterprise would be of no use to the Navy.

One problem was that there was no unanimity about the best route for such an expedition. The formidable geographer August Petermann made a strong case for the Svalbard route, while Clements Markham and others in the Royal Geographical Society favoured the Smith Sound approach (Fig. 4). If arctic authorities differed on this crucial issue, then it appeared only prudent to wait for the results of the Swedish expedition then about to leave for Svalbard (Markham, 1877).

Meanwhile, several nations other than Britain were vigorous in arctic exploration. The failure of Swedish, German, and Austrian expeditions to penetrate far into the ice to the north of Svalbard reinforced the correctness of American explorers in pushing up Smith Sound, most recently under Charles Francis Hall in 1871 (Hall, 1873; Loomis, 1971). All this foreign activity also raised the issue of British prestige and leadership; arguments of national pride were joined to those of science (Royal Geographical Society, 1873).

A deputation from the Royal Geographical Society and the Royal Society to the Prime Minister in August 1874 received encouragement. In October, the hydrographer prepared a report in which the need to reassert British supremacy in arctic exploration was neatly complemented by a list of the sciences that would gain from a new voyage (Admiralty, 1874). In November, Disraeli announced the government's support of a new expedition. The principal aim was to go beyond the Americans up the Smith Sound route towards the Pole, but scientific work was also of major importance (Markham, 1877:542).

The decision once taken, events moved swiftly. The commander chosen for the expedition was George Strong Nares (Fig. 5), a man with arctic experience from the 1850s, including a good deal of sledging, who was experienced in survey work, and who was even then engaged in a major scientific

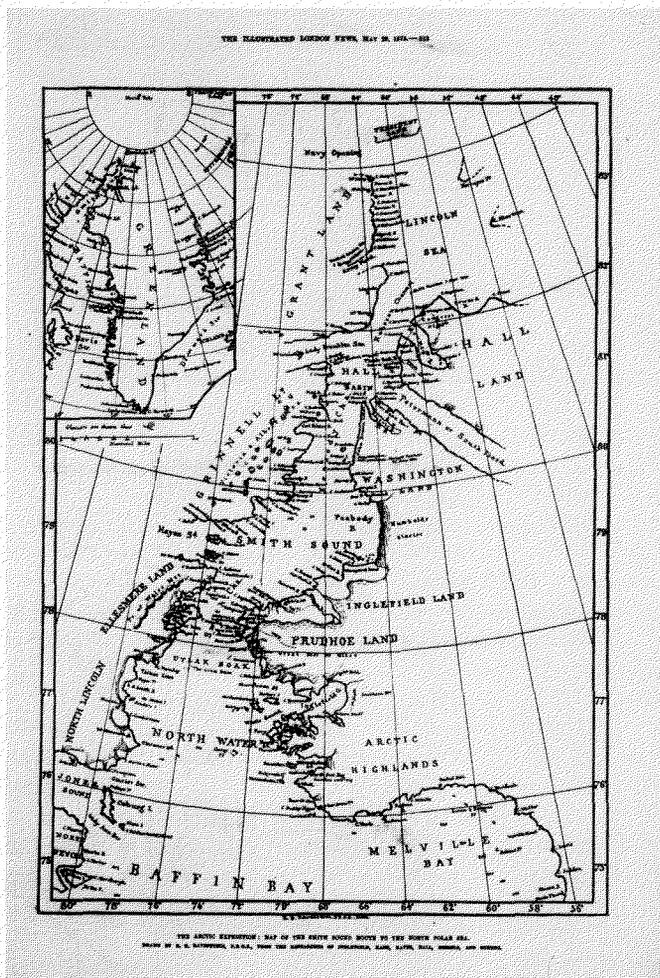


FIG. 4. Nares expedition 1875-76, Smith Sound approach (Smith Sound, Kennedy, and Robeson channels). (Nares, 1878[1]: facing p. 1; PAC/NMC C311.)

expedition, in command of HMS *Challenger*. Nares was pulled off that command when his ship arrived in Hong Kong in November 1874 and found himself instead in charge of an expedition to reach the North Pole (Deacon and Savours, 1976; Hattersley-Smith, 1976; Nares, 1878).

The new arctic expedition sailed with more scientific advice than any of its predecessors. The Royal Geographical Society sent a selection of papers on geology and ethnology; the Royal Society provided instructions; and the Admiralty authorized the publication of a substantial manual encapsulating the latest scientific knowledge — some of it sparse enough and none too recent — of Greenland, Ellesmere Island, and the vicinity. The manual was duly cobbled together in a remarkably short time and was presented to Nares (Royal Geographical Society, 1875; Royal Society of London, 1875; Jones, 1875). Then there was a relatively new edition of the *Admiralty Manual of Scientific Enquiry* (1871), not entirely revised. For that matter, not only was some of the literature conservative — the scale and organization of the expedition were similarly on the old Royal Naval pattern, which had so signally failed in Franklin's case. The plan was to sail as far north as possible, to dig in for the winter, and to carry out a scientific program from the ship.

Many of the instruments were traditional — for example, the well-tried Fox dip circle; but the scientific instructions sug-



FIG. 5. Portrait of Sir George Strong Nares (1831-1915) by Stephen Pearce. (National Portrait Gallery, London.)

gested by the Arctic Committee of the Royal Society were more comprehensive than any they had previously issued and included many suggestions deriving from recent scientific research, as well as such traditional items as the observation of the tides, or of pendulum experiments. Norman Lockyer, for example, gave instructions for the use of spectroscopes, for both solar and auroral observations. Henry Roscoe, another spectroscopist and distinguished physicist, gave instructions for the collection of meteoric dust from arctic snow. Joseph Dalton Hooker suggested observations and principles of collecting to throw light on plant geography, hybridization, and other issues going beyond the usual natural history. The instructions were written for intelligent non-specialists — even on a scientific expedition, the luxury of a team of trained scientists was out of the question. Instead, officers and members of the crew were trained in the techniques of observation — for example, magnetic work (Fig. 6) — so that they could be both observers and sailors. The only exception was that of two naturalists, one each in HMS *Discovery* and HMS *Alert*, who made themselves generally useful, but who were specifically appointed as naturalists, responsible for making collections of animals, birds, plants, and rocks and for contributing wherever they could to geological mapping, the study of the effects of cold on animal and plant organisms, the operation of the dredge, the correlation of physical oceanography with zoology, and any and everything else that they could handle. The naturalist in HMS *Alert*, Captain Henry Wemyss Feilden, of the Royal Artillery, came closest to competence in



FIG. 6. Kew Instrument (unifilar magnetometer) in use in the snow house observatory, winter 1875-76. (Moss, 1878:36.)

this wide range of tasks (Levere, 1988b); and he managed to arouse the jealous scorn of Edward Moss, surgeon to the *Alert*. A friendly reviewer of Moss's narrative of the expedition exclaimed: "How a person of high scientific attainments like Dr. Moss ever came to be associated with an expedition whose organizers seem to have regarded scientific ability as a positive disqualification for service, we know not" (Examiner, 1878).

Feilden, a fine ornithologist but otherwise an amateur, did nevertheless manage to do a very respectable job, taking geological notes, observing animal behaviour, noting remains of Inuit habitation, subjecting samples from the dredge to microscopic analysis, collecting specimens, and always applying a keen intelligence to the results.

Clements Markham, a defender of the expedition when it returned to criticism in 1876 for having failed to reach the Pole, failed to avoid scurvy, and failed to endure a second winter in the ice, publicly (Markham, 1877) and privately (Markham, n.d.:12-13) celebrated its achievements. The expedition had sledged and mapped 300 miles of new coast line and had shed light on the nature of a large section of the Polar Ocean. One party, under Markham's cousin Albert Hastings, had attained the highest latitude ever reached by man. There had been extensive magnetic, meteorological, and tidal observations. Some of the geological work of the expedition was not superseded until the 1950s. The naturalists had besides made comprehensive collections and studies of the flora and fauna — including musk oxen, of which 63 were killed during the expedition (Nares, 1878[2]:352-353).

All this was not enough. Scurvy, death, and the shadow of the Franklin tragedy were one side of the problem. On the other side, the strictly scientific, too much was being attempted by too few, with too little time and too little training in the sciences.

When the Bremen Society for Polar Investigation applied to the Imperial German Council for funds for an arctic expedition, the council referred the problem to a commission. The commission rejected the Bremen Society's proposal; the days for expeditions sponsored by a single society, or even a single nation, were past. Now what was needed was an international co-operative venture. The German government accordingly wrote to other governments, sounding them out about participation in a major co-ordinated enterprise (Admiralty, 1876).

When Nares returned from his expedition, the last of the old-style Royal Naval expeditions to the Arctic, plans were already forming for the expeditions of the First International Polar Year of 1882-83 (Barr, 1985). Geographical exploration still had room for heroes, but in polar science, they had to co-operate.

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