# William Scoresby the Scientist

C. Ian Jackson

This article is based on the talk given by the author at the launch of Volume III of *The Arctic Whaling Journals of William Scoresby the Younger* (Hakluyt Society Series 3, nos 12, 20 and 21) at the Whitby Museum on 6 November 2009. It is mainly a synthesis of assessments of Scoresby's contributions to Arctic science that appeared in the three volumes.

When, ten years ago, I started editing the journals of William Scoresby the Younger, I had no notion of what they contained, or how rewarding the task would be. I must therefore begin by thanking Graham and Roger Pickles, the joint Keepers of the Whitby Literary & Philosophical Society at the time. It was they who pointed me towards the journals in the Society's collection, and it was they who made it possible for me to do most of the work on the other side of the Atlantic by providing me with photocopies of the journals. The other essential thanks are to the authors of the appendices in volumes II and III, George Huxtable and Fred Walker, and to the New Bedford Whaling Museum in Massachusetts, for allowing me to include Steward's journal in volume II. All three items made a great difference to our knowledge of Scoresby's life and work.

Many of you have seen the earlier volumes, and you know that they are an amazing blend of ice navigation, commercial whaling and science. They really are journals rather than logs: Scoresby might compress the day's events into a single paragraph or write for several pages. They are seldom boring, and there are several incidents of high drama: the *Esk* narrowly avoiding being wrecked in the tidal race of the Sumburgh Röst off Shetland; Scoresby bringing the *Esk* safely back to Whitby despite the hull being holed by ice at 79ºN; and, in the present volume, resisting an attempt by mutinous crew members to seize the *Baffin*.

Clearly, in a brief talk such as this one, a choice has to be made, and I have chosen to talk about Scoresby the scientist and, in particular, where Scoresby fits into the science of his time. I realize that, for some of you, the word 'science' may be enough to make you 'switch off', or feel that what I have to say is likely to be incomprehensible. It was ever thus: I have seen it suggested that one reason societies like ours here in Whitby chose the title 'Literary and Philosophical' rather than 'Literary and Scientific' in the early nineteenth century was because 'Scientific' would be a deterrent rather than an attraction to potential members. Fear not: there will be no equations, chemical formulae or unfamiliar units of measurement in what follows.

I begin by taking it for granted that Scoresby was a remarkably gifted individual, who would probably have made his mark in whatever activity or branch of learning he chose to take up. That said, his two brief periods at Edinburgh University seem to have been of very great importance in his scientific training. Note how brief those periods were: from late October 1806 to mid-March 1807, and from November 1809 to February 1810. A scant nine months over five calendar years. But what the experience did for Scoresby:

– he was introduced to the scientific literature of the day, to the major debates, and to major scientific figures such as Robert Jameson and John Playfair;

– he was made aware that his annual voyages to high arctic latitudes were a potential source of information about an area that was largely unknown to other scientists;

– he learned how to observe, measure and report scientific phenomena.

Most important of all, he learned how to think and study:

> I took full notes of both classes I attended in the university, and on my return to my lodgings extended them ... I found my daily notes extend, until at length the writing of them used to occupy me three or four hours. By this exercise each subject was more particularly fixed in my memory ... and I was necessarily led, at the same time, into habits of composition; for though I often took down the words of the lecturer, yet more frequently the ideas only were preserved.[1]

Scoresby took full advantage of what Edinburgh had to offer, but he was also a product of the times. As we shall see later, it was an exciting time to be at that particular university, but it was also a time when interest in science and learning was extending to a much greater segment of the population than in the previous century. Richard Hamblyn has stressed that, while we think of major scientific and technological developments of the period in terms of the steam engine or the canal system,

> ... one of the greatest – and one of the most overlooked – developments of all was the humble scientific periodical. The rise of the periodical was one of the major scientific advances of all time for without the periodical there can be little scientific or technological communication ... . Knowledge means nothing, after all, if it is not widely shared.[2]

In Britain the outstanding example was the *Philosophical Magazine*, founded in 1798, and appealing to a much wider body of people than the *Transactions of the Royal Society*. It was in the *Philosophical Magazine* that Luke Howard published in 1803 and 1804 his classification of cloud types that we still use today.[3] Scoresby read Howard, adopted his system and used it in his journals;

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[1] Quoted in vol. I, pp. xxix–xxx, of the journals, from R. E. Scoresby-Jackson, *The Life of William Scoresby …*, London, Nelson, 1861, p. 34.

[2] Richard Hamblyn, *The Invention of Clouds: How An Amateur Meteorologist Forged the Language of the Skies*, London, Picador; New York, Farrar, Strauss & Giroux, 2001, chapter 7.

[3] Luke Howard, 'On the Modifications of Clouds, and on the Principles of their Production, Suspension, and Destruction ... ', *Philosophical Magazine*, 16, 1803, pp. 97–107, 344–57; 17, 1804, pp 5–11.

Hamblyn used Scoresby as an example of the widening audience for scientific knowledge to which the *Magazine* catered.

More broadly, science, and the organization of science in Britain, changed rapidly in the first third of the nineteenth century. In 1800 the Royal Society was essentially a gentlemen's club, the Fellows being elected more on the basic of their social standing and interest in science than because they themselves had any scientific ability. Scientists were invited to lecture to the Fellows, but there was no discussion following the lecture. Scoresby benefited from the support – the patronage – of the Society's president, Sir Joseph Banks, but Scoresby was not elected a Fellow until six years after Bank's death in 1820. The Royal Society of Edinburgh had taken a more enlightened view, electing him a Fellow in 1819, even before his major work, *An Account of the Arctic Regions*, was published.

Another important feature of science at the time Scoresby was sailing the Greenland Sea was that it had not yet divided itself into rigid disciplines. There was obviously a difference between the physical sciences and the biological sciences, but it was still possible for an individual to have a good working knowledge of the state of science in several different branches, and to make contributions to them. Scoresby had that broad interest, and the index list of scientific topics he covered in the journals in volume 3 shows this:

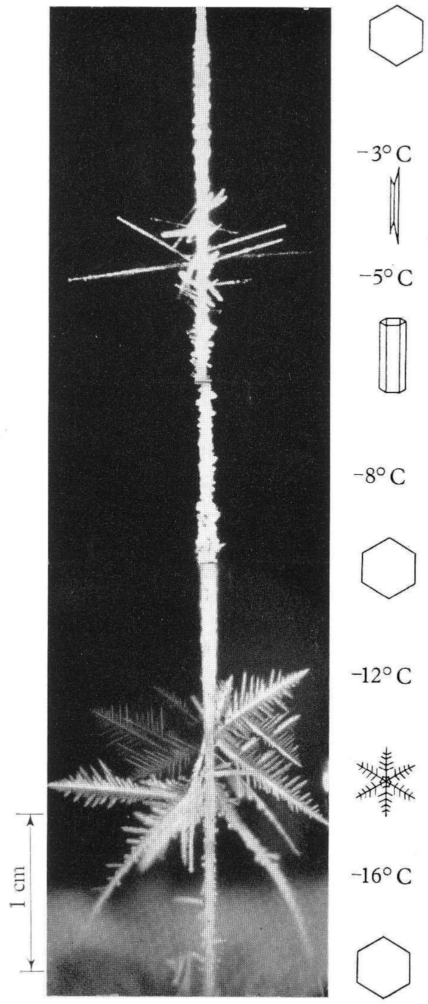
Scientific observations and measurements, Scoresby's,
arctic mean temperature, xxxviii
atmospheric electricity, 73–6
glaciers, xxxix–xl, 109–10
ice density (specific gravity), 43–4, 80–81
latitude determination in fog, 42
magnetism and navigational compass, 15, 22, 30, 123, 143, 188–9
marine biology and sea colour, 27, 56, 155–6, 179, 192–3
ocean currents in the Greenland Sea, xviii, 18, 27, 41, 47, 192
ocean depth, xviii, 30, 36–8, 104–5
optical phenomena, 176, 182–3
snow and ice crystals, hoar frost, rime, 16, 18, 21, 48, 79, 155, 156
weather systems in the Arctic, 11–12, 150–51
whale oil characteristics, 78, 83, 96

Scoresby was a careful observer and recorder of scientific phenomena and facts, even though he often could not explain the reasons for what he observed. Here are two examples. In 1814 he clearly distinguished hoar frost from what is now called rime and what he called frost-rime. I will not bother you with the physical difference between the two, but the distinction he made in the *Account* in 1820 was not clear in meteorology until a hundred years later. And notice the statement in the *Account* about the character of the crystal growth, based on his journal entry of 11 May 1814:

> In the course of the night, the rigging of the ship was most splendidly decorated with a fringe of delicate crystals. The general form of these, was that of a feather having half of the vane removed ... Many of these crystals, possessing a perfect arrangement of the different parts corresponding with the shaft, vane, and rachis of a feather, were upwards of an inch in length, and three-fourths of an inch in breadth ... There seemed to be no limit to the

magnitude of these feathers ... until their weight became so great, or the action of the wind so forcible, that they were broken off, and fell in flakes to the deck of the ship. (I, pp. 437–8.)

Scoresby also noted that these feathers only appeared when the temperature was 10ºF (-12ºC) or below. Fast forward now 150 years to the illustration I included in volume 2, from B. J. Mason's 1962 book *Clouds, Rain and Rainmaking,* where experiments in a diffusion chamber show that such feathers only develop when the air temperature is between -12 and -16ºC.[4]




Ice crystals of differing shapes growing on a filament suspended in a diffusion chamber with controlled temperature gradient. The crystals take characteristic forms at different temperatures as indicated along the right edge of the photograph. Reading from the top, the symbols represent: thin hexagonal plates, needles, hollow prismatic columns, hexagonal plates, branched fern-like crystals (or dendrites), and hexagonal plates. At temperatures below − 25 °C, prisms appear again.

[4] B. J. Mason, *Clouds, Rain and Rainmaking*, London, Cambridge University Press, 1962, Plate XIII.

If, unlike Scoresby, you had never noticed a difference between the formation of frost and rime, you may also not have wondered how the snow that falls on a glacier gets converted into glacier ice. Scoresby did, and in volume 3 I showed that his suggested explanation in the *Account* is remarkably similar to modern evidence based on detailed studies. Here is Scoresby:

> Snow subjected by a gentle heat to a thawing process, is first converted into large grains of ice, and these are united, and afterwards consolidated, under particular circumstances, by the water which filters through among them. If, when this imperfectly congealed mass has got cooled down below the freezing temperature by an interval of cold weather, the sun break out and operate on the upper surface so as to dissolve it, the water which results runs into the porous mass, progressively fills the cavities, and then being exposed to an internal temperature sufficiently low, freezes the whole into a solid body.[5]

And here is the process as described in the current *Glossary of Selected Glacier and Related Terminology*:

> Snowflakes are compressed under the weight of the overlying snowpack. ... Where the crystals touch they bond together, squeezing the air between them to the surface or into bubbles. During summer we might see the crystal metamorphosis occur more rapidly because of water percolation between the crystals. By summer's end the result is firn – a compacted snow with the appearance of wet sugar, but with a hardness that makes it resistant to all but the most dedicated snow shovelers! Several years are usually required for the snow to settle and to season into the substance we call glacier ice.[6]

Let me give you one more example, from a very different branch of science. The *Supplement* to the *Oxford English Dictionary* that was published in 1987 included, for the first time, the term 'food-chain': 'A series of organisms each dependent on another for food, especially by direct predation' and gave the earliest use of the term as Charles Elton's 1927 book *Animal Ecology*. However, in the *Account*, Scoresby emphasized how whales, dolphins, seals, and polar bears all depended, directly or indirectly, on the tiny plankton of the arctic seas that he had first described in his 1816 journal, and he went on:

> Thus the whole of the larger animals depend on these minute beings ... . And thus we find a dependent chain of existence, one of the smaller links of which being destroyed, the whole must necessarily perish.[7]

Given this insight, it is perhaps surprising that nowhere in either the journals of the *Account* does Scoresby comment on the impact of commercial whaling on the species.[8] The only place that I

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[5] William Scoresby, *An Account of the Arctic Regions*, 2 vols, Edinburgh, Constable, 1820, I, pp. 107–8.

[6] *Glossary of Selected Glacier and Related Terminology*, online at http://vulcan.wr.usgs.gov/Glossary/Glaciers/glacier_terminology.html

[7] Scoresby, *An Account*, I, p. 546.

[8] This was however recognized by others, e.g. Bernard O'Reilly, *Greenland, the Adjacent Seas, and the North-West Passage to the Pacific Ocean* … (London, Baldwin, Cradock & Joy; New York, Eastburn; 1818, chapter V.): '…when

can find where Scoresby comes close to addressing this issue is on pages 240–41 of the *Account*, vol. II. Relying on *Genesis*, I, 26 & 28, and *Psalms*, 8, he claimed that

> The Providence of God is manifested in the tameness and timidity of many of the largest inhabitants of the earth and sea, whereby they fall victim to the prowess of man, and are rendered subservient to his convenience in life. And this was the design of the lower animals in their creation.

I want now to focus on a couple of areas where Scoresby was on the wrong side of the scientific debate, and finally on one where he clearly was on the right side. In volume III, you will see that Scoresby appears not to have realized that the Spitsbergen glaciers were in motion, even though he witnessed a mass of ice break off and crash into the sea not far from his boat. In the *Account* he thought that this ice was replaced *in situ*:

> ... the annual supply of ice is not only added to the upper part, but also to the precipitous crest facing the sea; which addition being run into or suspended over the ocean, admits of new fragments being detached, and of the renewal of the vitreous surface which it presents to the eye after each separation.[9]

The surgeon on the 1818 voyage, whose paper on the subject was published in the *Edinburgh Philosophical Journal* in 1820, disagreed with this, correctly suggesting that any snow that fell on the glacier at such low altitudes would probably melt during the summer. Dr Latta was also correct in arguing against Scoresby's opinion that crevasses in the glacier surface were caused by ice melting. But Latta also failed to recognize that the crevasses were caused by cracking of the ice as it moved, even though he had the doubtful advantage of having fallen into one:

> I imprudently stept into a narrow chasm filled with snow to the general level; and immediately plunged up to my shoulders, and might, but for the sudden extension of my arms, have been buried in the gulf.[10]

The suggestion that Swiss glaciers moved had been made in the mid-eighteenth century, but neither Scoresby nor Latta seem to have known about this, and it was not until 1840 that Louis Agassiz published the first significant scientific study of glaciers.[11]

The other important place where Scoresby was on the wrong side of the argument concerned the age of the earth. As I described in the Introduction to volume I, Edinburgh University was an exciting place to be in the first decade of the nineteenth century. On the one side was John Playfair, who made James Hutton's (d. 1797) 'uniformitarian' view of geological processes widely known ('No evidence

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the yearly diminution that at present exists has continued, whales in the northern seas will become as scarce as wolves in Britain.' I am grateful to Ray Howgego for introducing me to this valuable but neglected source.

[9] Scoresby, *An Account*, I, p. 108.

[10] Thomas A. Latta, 'Observations on Ice-Bergs, made during a short Excursion in Spitzbergen', *Edinburgh Philosophical Journal*, 3, 6, October 1820, pp. 237–43.

[11] Louis Agassiz, *Études sur les glaciers*, Neuchâtel, 1840.

of a beginning, no prospect of an end'); on the other was Scoresby's mentor, Robert Jameson, follower of Abraham Gottlob Werner, whose 'catastrophist' views on geology were much more compatible with the Book of Genesis. As I noted in volume II, Scoresby was not merely inclined towards the Wernerian viewpoint; he accepted Archbishop Ussher's calculation, published in 1650, and based largely on the genealogies and length of reigns in the Hebrew Bible, that the Creation had taken place in 4004 BC.[12] In commenting on the plankton he could see through his microscope in 1815, Scoresby wrote:

> What a stupendous idea does this give of the works of creation ... which have remained unnoticed for 6000 years ...[13]

In the long view, Scoresby's careful observations were more important than his interpretation of them. It is also worth noting that Playfair and Jameson were two of his three sponsors for election to the Royal Society of Edinburgh, and that Jameson eventually abandoned his Wernerian beliefs, when faced by evidence such as that in *Principles of Geology* (1830–33), written by his former student Charles Lyell.

On one very important issue of the time, however, Scoresby's interpretation was correct. This was the notion of 'an open polar sea': the idea that if there was no land in the central arctic basin, there would be little or no sea ice there. This was a belief that was strongly held in the early nineteenth century and, despite Peary and Cook, survived in various forms into the twentieth century. To appreciate Scoresby's role in this, we need to put the dispute in the context of the organization of science at the time. In his book, *Putting Science in Its Place*,[14] David Livingstone identified a number of 'venues of science' that were becoming important and distinct in Scoresby's time:

'Houses of Experiment': laboratories that were purpose-designed
'Cabinets of Accumulation': science collections and museums
'Field Operations': travel and voyages of discovery
'Gardens of Display': botanical gardens and zoos
'Spaces of Diagnosis': hospitals

Livingstone recognizes a few other such venues, but focus on the first three of these. Nowadays, we might readily accept that the best way to determine whether or not there is an open polar sea is to go there and look, in person, or by aircraft or satellite. That was not universally accepted in Scoresby's day. For example, Georges Cuvier argued that the scientific travels of Alexander von Humboldt (or, by extension, William Scoresby) were 'broken and fleeting', whereas 'the bench-tied student of nature had time to spread out samples, to collate and analyze them, and thereby come to

[12] James Ussher, *Annales veteris testamenti, a prima mundi origine deducti*, 1650.

[13] Scoresby's journal entry for 17 May 1815.

[14] David N. Livingstone, *Putting Science in its Place: Geographies of Scientific Knowledge,* Chicago and London, University of Chicago Press, 2003, chapter 2.

reliable conclusions. ... By patient comparison and correlation, the armchair naturalist could easily triumph over the fragmentary and precarious claims of the fieldworker.'[15] Later in the century some argued that the only way to understand glacier movement was to be there: 'protracted residence among the Icy Solitudes'. Others, however, believed that 'the nature of glacial motion could be deduced from the laws of physics and their operation in laboratory-based experiments on forces, solids, and fluids.'

I have gone into the specifics of this open polar sea debate in more detail in the Introduction to volume III. Clearly, both sides had merit in their arguments. Scoresby could claim that, year after year for two decades, he could personally affirm that there was always an impenetrable barrier of ice at 80ºN in the Greenland Sea. Believers in an open polar sea could respond by saying that this was useful to know, but Scoresby's experience was geographically very limited, and that he had no way of knowing whether that barrier was narrow, wide, or, as he believed, the edge of a vast mass of ice.

At the time, however, the 'armchair theorists' overreached themselves, so convinced were they of the open polar sea's existence. John Barrow, Secretary of the Admiralty, sent the *Dorothea* and *Trent* in 1818 with instructions to attempt to sail across the pole to the Pacific from the Greenland Sea. The instructions included the optimistic view that:

> From the best information we have been able to obtain, it would appear that the sea to the northward of Spitzbergen, as far as 83½°, or 84°, has been found generally free from ice, and not shut up by land. Should these accounts, in which several masters of whaling-vessels concur, turn out to be correct, there is reason to expect that the sea may continue open still more to the northward, and in this event you will steer due north, and use your best endeavours to reach the North Pole.[16]

Who the whaling masters were that concurred is not stated; they certainly did not include Scoresby!

The *Dorothea* and the *Trent* of course got nowhere in fulfilling these instructions. Scoresby had predicted this in a letter to Sir Joseph Banks in April 1818:

> [A]s to reaching the Pole, I confess myself sceptical. From what I have observed, I imagine probabilities are against their penetrating beyond 82º or 83º, and I readily allow I shall be much surprised if they should pass the eighty-fourth degree of latitude.[17]

Nevertheless the debate continued and I think it particularly interesting that when Scoresby's *Account of the Arctic Regions* was published in 1820, an anonymous reviewer, who clearly had

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[15] Quoted in ibid., p. 40.

[16] F. W. Beechey, *A Voyage of Discovery towards the North Pole, performed in His Majesty's ships Dorothea and Trent* …, London, Bentley, 1843, pp. 8–9.

[17] Quoted in vol. III, p. xxxiii, of the journals, from Scoresby-Jackson, *The Life of William Scoresby* …, London, Nelson, 1861, p. 129.

scientific knowledge, attacked Scoresby's suggestion that the mean annual temperature at the North Pole was likely to be about 10º F (-12º C). This was in fact on the warm side, compared to modern observations, but the reviewer claimed that the idea was absurd because 'no sea could withstand the refrigerating energy' of so low a mean temperature and 'the whole ocean would become a solid rock.' Instead, the reviewer argued:

> we are entitled to conclude ... that the mean temperature of the year ... at least along the barrier of ice, will not vary much from that of the freezing point of fresh, or of sea-water; and ... it [is] probable that the same degree of mean annual heat extends with little variation to the pole itself.[18]

Not a very good argument from the armchair theorist school, since it neglects two factors that should have been appreciated even from an armchair: the insulating effect of the ice-cover itself, and the heat capacity of the underlying ocean. I think it is reasonable to suggest that what Scoresby achieved in the *Account of the Arctic Regions* to establish the importance of field-based scientific knowledge was comparable to what Humboldt's travels had done for land areas.

In closing, there is one more topic in volume III that I believe should be mentioned here, though I regret the need to do so. In their biography of Scoresby,[19] Tom and Cordelia Stamp gave considerable emphasis to their belief that John Barrow at the Admiralty actively sought to thwart Scoresby's arctic ambitions. This view has been followed by several other commentators, all of whom cite the Stamps as their authority; they include Martin,[20] Ross,[21] and Bravo.[22] I do not believe this view is justified: Barrow and Scoresby were on opposite sides in the 'open polar sea' debate, but to me the evidence indicates that Barrow had, justifiably, a high regard for Scoresby's observations, skill, knowledge and integrity. My reasons for believing this are set out in volume III of *The Whaling Journals*, pp. xxvii–xxxv.

In the Introduction to volume I of these journals, I remarked that 'much of the scientific data and evaluation in [*An Account of the Arctic Regions*] has been superseded by later research.' That is of course how science progresses. For example, the observations Scoresby made during his Arctic voyages about the earth's magnetic field became the basis for a research interest he pursued for the rest of his life. I hope that the publication of his journals will enhance the recognition that his scientific achievements deserve.

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[18] *Edinburgh Monthly Review*, III, 6, June 1820, pp. 611–46, at pp. 628–9.

[19] Tom and Cordelia Stamp, *William Scoresby, Arctic Scientist*, Whitby, Caedmon, [1975?].

[20] Constance Martin, 'William Scoresby (1789–1857) and the Open Polar Sea – Myth and Reality' *Arctic*, 41, 1, 1988, pp. 39–47.

[21] M. J. Ross, *Polar Pioneers: John Ross and James Clark Ross*, Montreal and London, McGill-Queen's University Press, 1994.

[22] Michael Bravo, 'Geographies of Exploration and Improvement: William Scoresby and Arctic Whaling, 1782-1822', *Journal of Historical Geography*, 32, 2006, pp. 512–38.