Olaus Magnus and the 'Compass' on Hvitsark

Kirsten A. Seaver

Three textual works by Olaus Magnus (1490–1557) hold the key to the 'compass' on his invented island of Hvitsark, shown on his 1539 *Carta marina*. Although Olaus had little general understanding of the magnetic compass or of navigation in the Far North, he evidently did not intend the navigational device he drew on Hvitsark to represent a magnetic compass, but a sundial. His muddled ideas about the relationship between 12 wind-directions and direction-finding at sea by means of such a dial appear related to his second-hand information about a gnomonic navigational device used by the medieval Norse.

KEY WORDS

1. History. 2. Norse. 3. Compasses. 4. Maps/Charts.

1. INTRODUCTION. There is reason to be grateful for the wide-reaching curiosity of the Swedish ecclesiastic Olaus Magnus (1490–1557), and for his urge to communicate his ideas. These qualities are evident in his detailed map of the North, the *Carta marina*, published in Venice in 1539, and in his equally compendious and idiosyncratic disquisition on the Nordic peoples, the *Historia de gentibus septentrionalibus*, first published in Rome in 1555 and soon available in various translations from the original Latin. The *Carta marina* still greets us in newly published works, as do reproductions of the woodcut chapter headings for Olaus' 1555 book, however flimsy the pretexts. Less frequently noted are the two short compendia to the map that Olaus wrote in German and Italian and published shortly after the appearance of the map in 1539.

Recognizing the continued appeal of Olaus' work, the Hakluyt Society recently completed the publication of his *Historia* in a new English translation (Foote, 1996–98), in which excellent editorial comments illuminate many aspects of this fascinating picture of the Far North. However, there is little discussion of what Olaus may have meant by his observations concerning navigational instruments and practices. It is an area worth studying given the compass-like gnomonic device Olaus showed so prominently on his 1539 map and its likely relationship to the half of a 1000-year-old wooden disk found in a Norse Greenland ruin. A simple instrument based on this Greenland discovery has been subjected to much research and practical testing by Captain Søren Thirslund and others with navigational experience in the North Atlantic, with results demonstrating the likelihood that Norse sailors used a gnomonic device in their navigation more than five centuries before Olaus made similar claims in his *Historia* about a device employed by fishermen in the far North of Norway.

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The present essay will use Olaus' textual works, as well as his map, to examine his navigational ideas by the light both of his invented island of Hvitsark and its compass-like device, and the present state of knowledge about Norse navigation. However poorly Olaus understood either the sailing practices of those who plied the distant northern seas or the workings of a magnetic compass, his cartographical and textual works taken as a whole suggest that the huge device on Hvitsark was not supposed to represent a magnetic compass, but a sun dial ('gnomon compass') which not only reflected his likely awareness of a device used by his Continental contemporaries, but which also incorporated his ideas about direction-finding at sea and its relationship to the wind-directions, 12 in number.

2. THE *CARTA MARINA* OF 1539. The island of Hvitsark, a rocky feature close to Greenland in the extreme northwestern corner of the *Carta marina* (Figure 1), is shown separated from Iceland by a considerably distorted latitudinal guide and

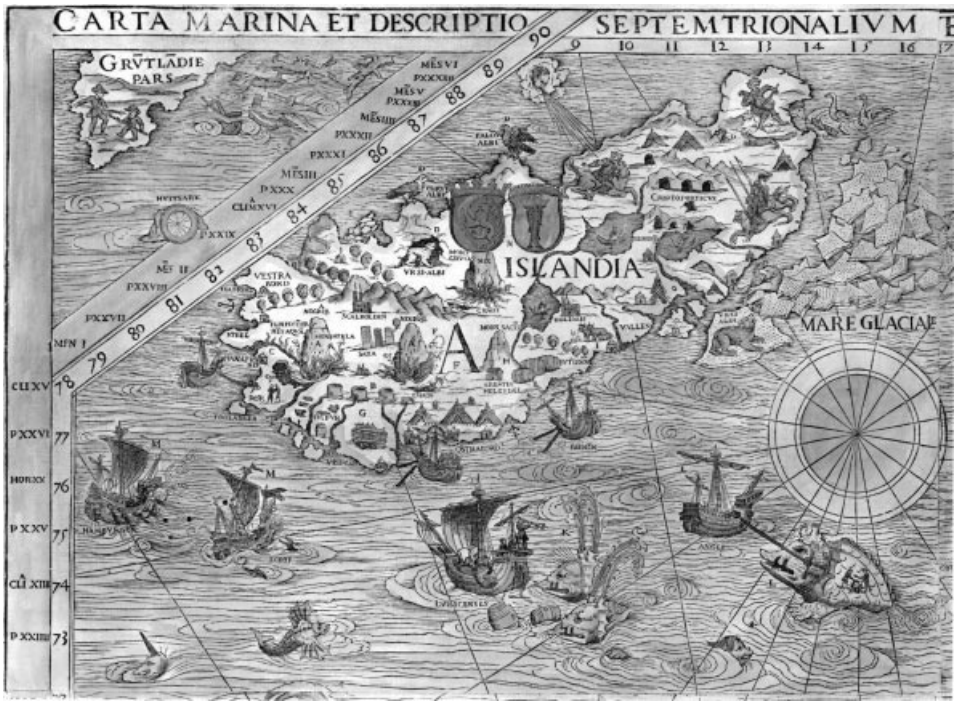


Figure 1. Section A of the Olaus Magnus *Carta marina*, published in Venice in 1539. From the James Ford Bell Library facsimile. Courtesy of the James Ford Bell Library. The only two copies known of this map are at the Bavarian State Library and the University of Uppsala in Sweden. Made up of nine sections, A-I, the entire map is 170 centimetres wide and 125 centimetres high.

echoes Adam of Bremen in the nearby depiction of an awe-inspiring whirlpool just off the East coast of Greenland (Tschan, 1959, Bk. IV, ch. 40, n. 142). Before we focus on the details, however, a general look at the map is in order.

The *Carta marina* et *descriptio septemtrionalium errarum ac mirabilium* …, on which

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Olaus worked for 12 years, consists of nine sheets of woodcut prints with Latin text. Its total width is 170 centimetres and height 125 centimetres. It depicts Denmark, Sweden, Norway, Finland and other Baltic countries, as well as the eastern parts of England and Scotland, the latter skewed eastward in accordance with traditional Ptolemaïc concepts. Beyond the areas Olaus knew from his own travels, his understanding of geography was so vague that if a zero meridian were marked on the *Carta marina*, it would scrape the West coast of Ireland (Richter, 1939, p. 103).

Looking North to the Hebrides, the Orkneys and Shetland, the modest 'Tile' lying southwest of the Faeroes is not intended as a double for Iceland. Generously sized, the latter island appears in its more or less rightful place in the northwestern Atlantic. Olaus shows it flanked to the West and the East by parts of Greenland suspended from the upper edge of the map, revealing the influence of the Claudius Clavus concept of Greenland as part of the Eurasian land mass arching over Iceland.

Because Claudius drew his representations of the Far North around 1427, he did not worry about Greenland in relation to North America (Bjørnbo, 1912, ch. 3; Ehrensvärd, 1984, pp. 552–56; Seaver, 1996a, pp. 164–67, 215, 276). Although the New World had become a familiar concept in Europe by the time Olaus began his career, he was strangely uninterested in the exploration and exploitation of North America going on at the time (Buschbell, 1932). Despite the keen interest his friend Archbishop Erik Walkendorf of Norway took in Greenland, believing it connected both to the Eurasian land mass and to the New World with its economic promise (Seaver, 2000, pp. 42–49), Olaus shows no concern with areas to the West of Greenland. The *Carta marina* nevertheless reveals his indebtedness to the Norwegian archbishop including the matter of Hvitsark and its 'compass' dial. It is also to Walkendorf that we owe the inspiration for the splendid sea monsters in Olaus' map. Walkendorf had personally visited northernmost Norway in 1512 and subsequently (ca. 1519) sent Pope Leo X a dramatic account of the frightful *morsus* – walrus – and other monsters in the far northern seas (Foote, 1996–1998, pp. 1086–7; Karlsson and Storm, 1902, pp. 1–24; Ahlenius, 1895, pp. 39–44; Hamre, 1943, p. 39; Seaver, 1996b, pp. 10–13).

In the map's lower right-hand corner, 'Olaus Magnus Gotus Lincopensis' greets his readers, and to the lower left we find a scale incorporating Gothic or Swedish miles along with German and Italian ones. To the left of this again, a box contains Pope Paul III's letter of privilege for 10 years and a short key to the map, along with a promise of more information in a projected book. In the key, nine large letters, ranging from A to I and corresponding to the nine sheets, have subdivisions arranged by smaller letters, which contain explications to various features in the map. Our present discussion will focus primarily on Section A (Figure 1), because the most easterly tongue of Greenland shown in Section B has no bearing on our topic here.

Olaus' 1539 brief compendia – the Italian *Opera breve* and the even shorter German version entitled *Ain kurze Auslegung und Verklerung der neuuen Mappen* – elaborate on the map's short Latin key. Both were printed by Giovanni Tomaso in Venice, as was the map. While the *Auslegung* should be considered an abbreviated redaction of the *Opera breve*, it has some additions missing in the former. A later Latin commentary to the *Carta marina*, included with the edition of the *Historia* printed in Basel 1567, was evidently based on a combination of the original Latin commentary printed on the map and on information from the *Auslegung*. Yet another commentary is reproduced in Johann Baptist Fickler's German translation of the

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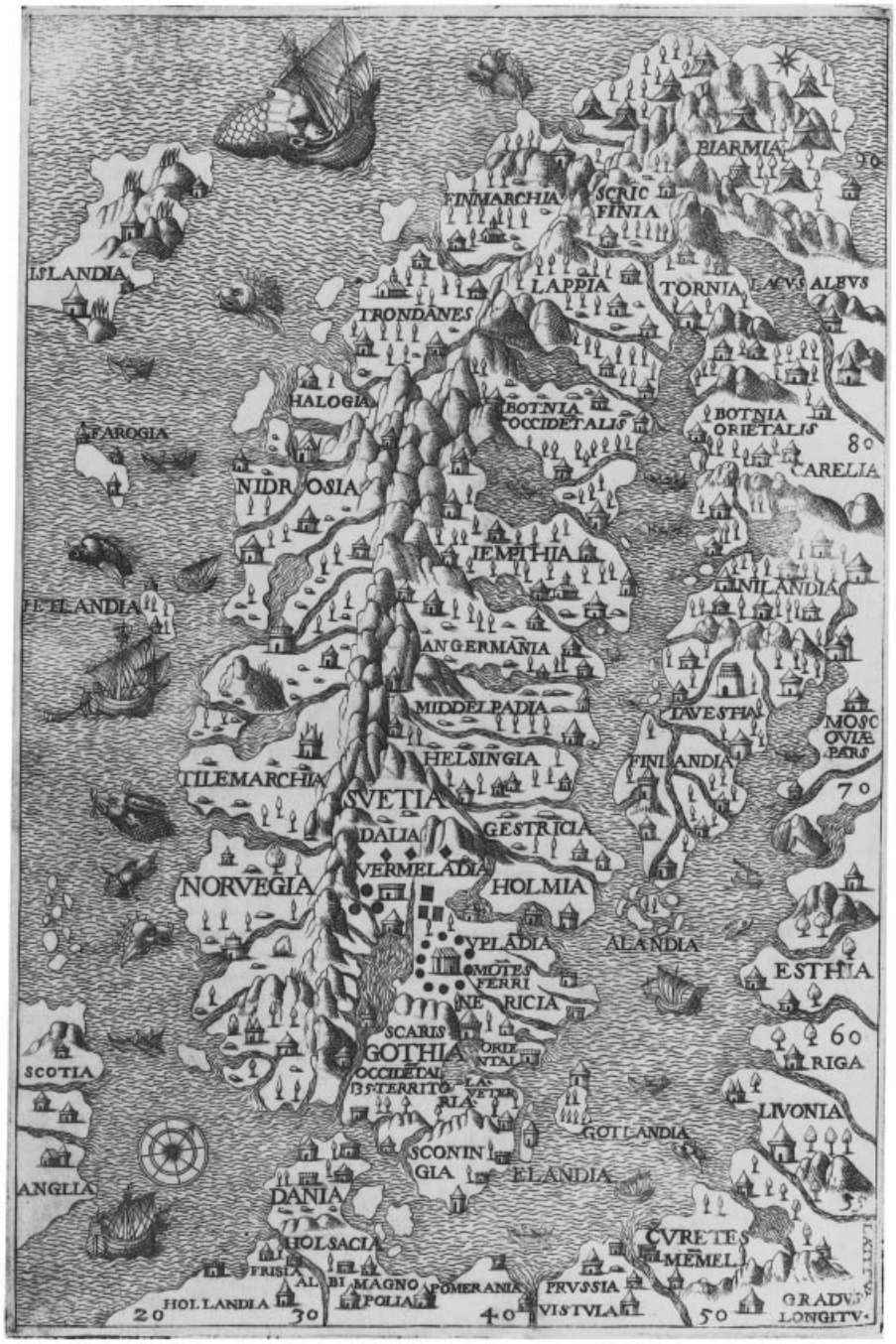


Figure 2. From *Historia delle genti et della natvra de'lle cose settentrionali, Da Olao Magno Gotho Arciescovo di Vpsala … descritta en XXII Libri. Nouamente tradotta in Lingia Toscana … Con vna Tauola composissima delle cose piu notabili, in quella contenue*. Venice, 1565. (Copy used: The British Library, pressmark 155.e.14.) The map appears after the Index, facing fol. 17. Until the 1539 *Carta marina* was recovered in 1886, this map was often assumed to reflect Olaus' original map, because it featured both in his brother Johannes Magnus' *Historia de omnibus Gothorum Sveonumque regibus* (Rome, 1554) and in Olaus' own 1555 *Historia de gentibus septentrionalibus*, where it was entitled *Regnorum Aquilonarum descriptio, huius operis subiectum*.

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Opera breve, in a shortened version and with added information from the *Auslegung* (Richter, 1967, p. 40).

Rare as these two compendia are, the map is even rarer. Relatively few copies were printed and soon vanished from public view. Finally, in 1886, Oscar Brenner discovered a copy in the Bavarian State Library, and in 1962 another copy, found in Switzerland, was bought by the University of Uppsala in Sweden (Brenner, 1886, pp. 1–23; Karrow, 1993, p. 362). The addition of a coat-of-arms for Saxo Grammaticus suggests that the Uppsala version may be slightly younger than the Munich one (Richter, 1967, p. 38). Before the 1886 rediscovery, scholars were unable to trace the connection between the original *Carta marina* and the allegedly late-fourteenth-century map of the North which Nicolò Zeno the Younger published in Venice in 1558, and which he had invented himself by using many of the same sources available to Olaus, as became apparent soon after the reappearance of the *Carta marina* (Lucas, 1898). Nor could there be a useful discussion of the island of Hvitsark as depicted on the original 1539 map.

Some cartographic derivations, such as the map *Gemeine Beschreibung aller mitternächtige Lender*…which Sebastian Münster drew for his 1544 Basel *Cosmographia*, did not include this island at all. Nor did it appear in a map (Figure 2) that many scholars subsequently assumed was a trustworthy reflection of Olaus' original map, because this version appeared in both his brother Johannes Magnus's *Historia de omnibus Gothorum Sveonumque regibus* (Rome, 1554) and in Olaus' own 1555 *Historia*.

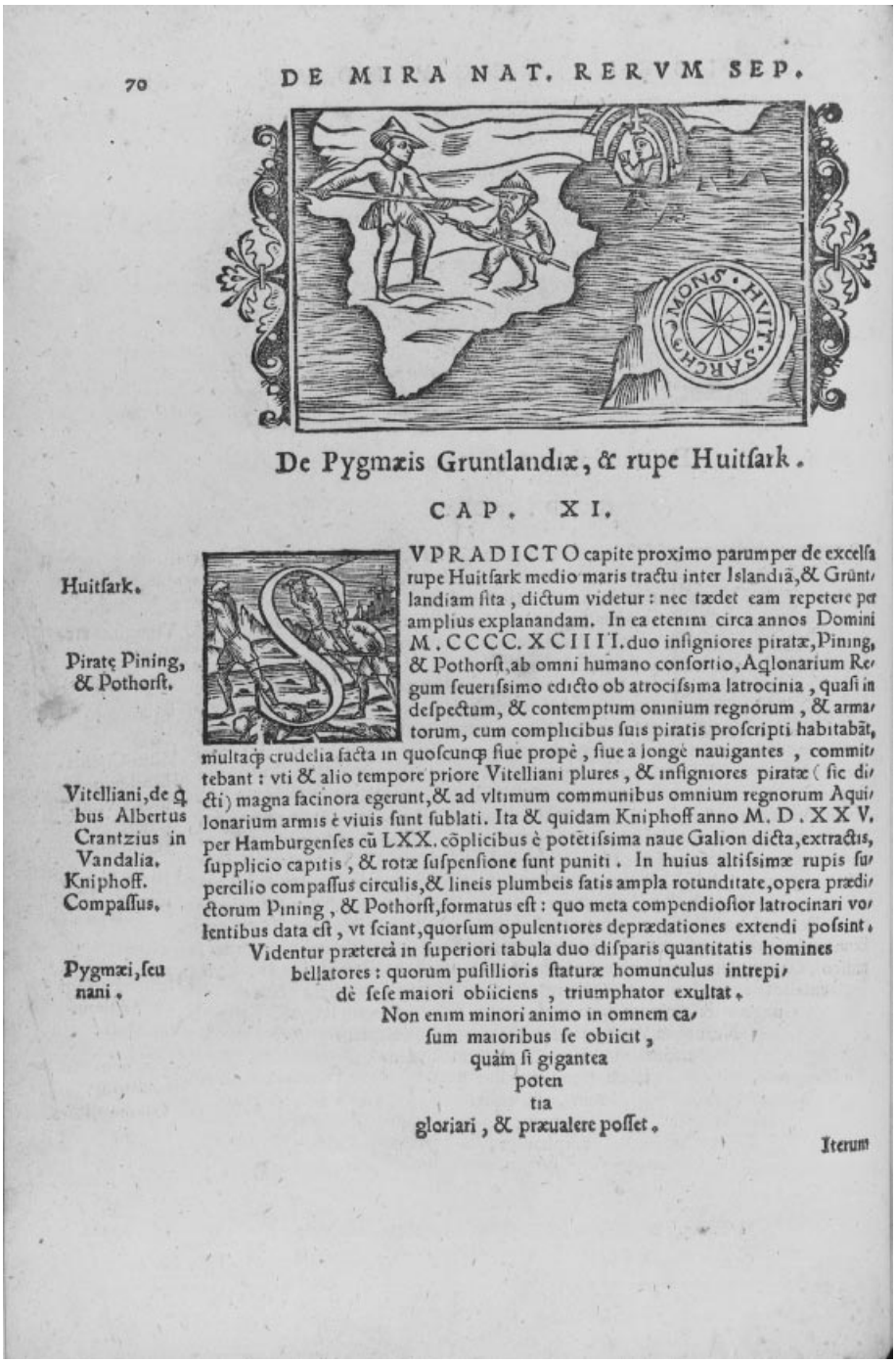
Others believed that a crudely distorted map of Scandinavia accompanying the 1567 German translation of the *Historia* (published in Basel and recognizably based on the *Carta marina*) must have represented the original 1539 map. A small map in Antonio Lafreri's 1572 *Atlas*, entitled *Olaus Magnus Gottus Upsalensis*… *septentrionalum suarum partium* (…*Europae*) *geographiam*…*in hicem*, stayed fairly close to Olaus' depictions of the northwestern Atlantic and included his Hvitsark island with a dial, but it was so different from the version in Figure 2 that until the original map reappeared no proper comparison was possible in this case either (Karrow, 1993, p. 365).

Prior to 1886, those who wrote about the 'compass' and a reputed pirates' nest on Hvitsark relied primarily on the text in Olaus' *Historia* and on the woodcut (Figure 3) above chapter 11 (i) in Book II of that work. In consequence, a number of misconceptions became so firmly rooted that they thrive to this day.

3. THE NAME 'HVITSARK'. Before taking a closer look at the island with its 'compass' and at three gentlemen-of-the-sea named Hans Pothorst, Didrik Pining and Johannes Scolvus (also known as Jón Skolp and variously assigned Danish, Norwegian or Polish nationality), it is instructive to see how Hvitsark got its name and evolved into an island.

In Old Norse, *hvítserkr* meant white shirt (or shift). The earliest known use of this term for a geographical feature is in the sailing directions found in the 'Description of Greenland' by the Norwegian priest Ívar Bárdarson (Rafn and Magnusen, 1837, pp. 293–95; Magnusen, 1845, Vol. III, pp. 211, 248–51, 482–504; Jónsson, 1899, pp. 322–29; Seaver, 1996a, chs. 4 and 5). We do not have this description as it came from Ívar himself when he returned to Bergen in 1364 and reported to the Norwegian king and court about his experiences in Greenland, where he had been since 1341 as the

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70 DE MIRA NAT. RERVM SEP.

De Pygmæis Gruntlandiæ, & rupe Huitſark.

CAP. XI.

Huitſark.

Piratę Pining, & Pothorſt.

Vitelliani, de q̃ bus Albertus Crantzius in Vandalia.

Kniphoff.

Compaſſus.

Pygmæi, ſeu nani.

VPRADICTO capite proximo parumper de excelſa rupe Huitſark medio maris tractu inter Islandiã, & Grüntlandiam ſita, dictum videtur: nec tædet eam repetere per amplius explanandam. In ea etenim circa annos Domini M. CCCC. XCIIII. duo inſigniores piratæ, Pining, & Pothorſt, ab omni humano conſortio, Aqlonarium Regum ſeueriſsimo edicto ob atrociſsima latrocinia, quaſi in deſpectum, & contemptum omnium regnorum, & armatorum, cum complicibus ſuis piratis proſcripti habitabãt, multacp crudelia facta in quoſcunqꝫ ſiue propè, ſiue a longè nauigantes, committebant: vti & alio tempore priore Vitelliani plures, & inſigniores piratæ (ſic dicti) magna facinora egerunt, & ad vltimum communibus omnium regnorum Aquilonarium armis è viuis ſunt ſublati. Ita & quidam Kniphoff anno M. D. XXV. per Hamburgenſes cũ LXX. cõplicibus è potẽtiſsima naue Galion dicta, extractis, ſupplicio capitis, & rotæ ſuſpenſione ſunt puniti. In huius altiſsimæ rupis ſupercilio compaſſus circulis, & lineis plumbeis ſatis ampla rotunditate, opera prædictorum Pining, & Pothorſt, formatus eſt: quo meta compendioſior latrocinari volentibus data eſt, vt ſciant, quorſum opulentiores deprædationes extendi poſsint.

Videntur præterea in ſuperiori tabula duo diſparis quantitatis homines bellatores: quorum puſillioris ſtaturæ homunculus intrepidè ſeſe maiori obiiciens, triumphator exultat.

Non enim minori animo in omnem caſum maioribus ſe obiicit, quàm ſi gigantea potentia gloriari, & prævalere poſſet.

Iterum

Figure 3. Woodcut heading for Book Two, Chapter 11, of Olaus Magnus, *Historia de gentibus septentrionalibus*, Rome, 1955, p. 70. (Copy used: The British Library, pressmark 432.K.18.)

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Bergen bishop's *officialis* at the Gardar See. Scholars must therefore make the same allowances for the surviving sixteenth-century Danish version as for the sixteenth-century English fragmentary recounting of the vanished book *Inventio fortunatae*, the work of an 'English Minorite from Oxford' who gave an astrolabe to Ívar in Greenland in 1360. (Taylor, 1956; Seaver, 1996a, pp. 123–24, 132–37, 150, 262).

This connection between *sira* Ívar and the English author of the *Inventio* is worth scholarly notice. Equally significant is the fact that Ívar's description of Greenland was in the archives at the disposal of Archbishop Erik Walkendorf, who collected material for a planned expedition to Greenland, for which he received a papal indulgence on June 14, 1514, but which came to nothing (*Diplomatarium Norvegicum*, XVII:1260; Hamre, 1943, p. 50; Jónsson, 1930, pp. 8–9). During Olaus' visit to Trondheim in the course of his 1518–19 travels in northern Sweden and parts of Norway, as a young priest acting for the papal tax collector Arcimboldus, it would have been natural for Walkendorf to share his Greenland information, including Ívar's description, with a young man so thirsty for knowledge. In that case, Olaus would have learned (Jónsson, 1899, p. 21):

> Item those who would sail directly to Greenland from Bergen, bypassing Iceland, should sail straight West until reaching South of Reykjaness in Iceland … and then, by staying the aforementioned westerly course, he should arrive at the elevation in Greenland which is called Huarff ('turning point') one day before seeing the said Huarff he will see another tall mountain called Huidserch …

In other words, the 'Huidserch' (Hvitsark) mountain lay on the East side of Greenland. Many have tried to guess to which snow-clad mountain on Greenland's East coast this name might have referred, but that is immaterial here. It is clear that Ívar (or the person recounting his tale later) relied on general Norse sailing lore about the familiar medieval route from Norway and Iceland to Greenland, on which a sailor halfway across the Denmark Strait might see the Greenland glaciers well before sighting the actual coast. Olaus simply added confusion by drawing a separate island somewhere between Iceland and Greenland. In Book II, chapter 9 of his *Historia*, he firmly stated that Hvitsark 'marks the mid-point in the passage to Greenland.'

4. A 'GNOMON'. In order to calibrate the sun's shadow on a disk or dial while the shadow's tip moves around the dial's circumference, a perpendicular piece must come up through the centre of the dial to cast the shadow. This perpendicular piece is called a gnomon – a term Olaus used repeatedly in connection with the 'compass' employed by sailors in the farthest North. Although his second-hand knowledge of their navigational device clearly was vague, he would have been sufficiently familiar with sundials for telling time to know that they, too, must be calibrated according to the latitude of the dial's intended use. This was already generally understood when Facundus Novius built his horologium in Rome between 13 and 9 BC (Nicolet, 1991, p. 105).

5. A COMPASS BY ANY OTHER NAME WOULD BE AS ROUND. The northwestern corner of Olaus' 1539 map depicts a tall European battling a supposed native Greenlander. Book II, chapter 11 (i) in his *Historia* has a similar woodcut heading, and the chapter title is 'On the Pygmies of Greenland, and

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Hvitsark Rock.' In the text, next to the marginal note 'Pygmies or dwarves,' the 'little dwarf' is lauded for his courage in assaulting much taller men. The term 'Pygmy' goes back at least as far as Pliny; what is interesting in the case of Olaus is that despite being a Northerner, he did not employ the term *Skrælingar* ('inferior sorts') for the indigenous peoples the Norse Greenlanders had encountered on both sides of the Davis Strait. 'Pygmies' was also the term used in the *Inventio fortunatae* to describe the natives on what was most likely the southeastern coast of Baffin Island (Seaver, 1999). It is worth remembering in this connection that the English author of the *Inventio* and Ívar Bárdarson had met in 1360 and exchanged gifts. During such meetings, they would no doubt also have exchanged information in Latin, using the word *pygmei* about the Thule-culture Eskimos, who were well entrenched in both Greenland and Arctic Canada by that time. We are left to wonder how much of Ívar's own recollections became lost to posterity, and how much was still available to Olaus through Archbishop Walkendorf.

Although the *Historia*'s chapter heading (Figure 3), done under Olaus' supervision and probably also drawn by him, is deceptively similar to the map illustration of the 'compass', it differs from the latter in a very important respect. The map shows the face of the Hvitsark dial with 16 neatly placed radials, executed by crossing the diameter in the centre eight times at evenly spaced intervals, compatible with compass divisions of the horizon. On the chapter heading, the number of radials has been reduced to 12. This number, which requires more care in spacing the lines, is compatible with the division of time; it is also compatible with Olaus' account of the 12 winds, which he named for their directions as envisioned on a circle (Foote, 1996–98, Bk. I, ch. 9). Evidently, Olaus quickly realized that his professional map designer had misunderstood the ideas he wanted to convey about the dial on Hvitsark, because he immediately addressed the topic in his two 1539 compendia to the map, in addition to correcting the visual message in the woodcut chapter heading for his *Historia*.

The Latin key on the *Carta marina* does not elaborate on either the Hvitsark rock or its compass-like device, but the *Opera breve* notes that Section A, which contains both Iceland (reported to be twice the size of Sicily) and a part of Greenland, also includes Hvitsark (*Huitsarch o uogli piu tosto dire*, *monte bianco*), which has at its summit a clock (*horologio*) inlaid with lead and made by pirates (Olaus Magnus, 1539).

As E. G. R. Taylor cautiously noted, 'compass-clocks' date back at least to the first half of the fifteenth century (Taylor, 1930, pp. 142, 145). Such an instrument was certainly known to Olaus' early sixteenth-century European colleagues. During the period 1511–1513, Erhard Etzlaub, famous for his 1492 *itinerarium Rom-Weg*, made several versions of his 'Nuremberger Horologia', which was a pocket sundial equipped with a compass, and with a cover featuring a map (oriented toward the South) reaching from the Equator to northern Europe. The Horologia allowed a traveller from Europe to the Equator to calculate latitude at various times of year, by orienting himself to the sun while facing South. Martin Waldseemüller's *Carta Itineraria*, published in 1511 in Strasbourg, is similar to the *Rom Weg* and had an accompanying pamphlet that instructed the traveller to place his *horologium* above the printed compass rose on the map, turning the map until the North-South line upon it coincided with that indicated by the gnomon of the *horologium* or compass-clock (Krüger, 1958, pp. 7, 10–11, and plate IIb; Taylor, 1930, pp. 142, 145).

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The word *horologio* was Olaus' own choice, and he surely used the term advisedly. The same word is used in the complete 1565 Italian translation of Book I, chapter 32, which deals with clocks of various kinds, including a wondrous mechanical clock recently set up at Uppsala. In the Italian translation's index, the Uppsala wonder is listed as *Horologio di Vpsala marauiglioso* and the other kinds of clocks as *Horologij di uarie forme*. The subsequent chapter discusses sundials or the *Horologio da Sole* ('On shadow clocks'). Here, Olaus refers explicitly to his intention of writing elsewhere about how the practice of telling time by the sun's shadow on a dial is applied to 'navigation used by those who dwell on the Ice Sea or the Scythian Sea'. On the *Carta marina*, the 'Ice Sea' and the 'Scythian Sea' are called *Mare Glaciale and Oceanus Scithicus*.

In both Book II, chapters 7 and 8, and Book XXI, chapter 1, Olaus described the perils experienced by seafarers in northernmost Norway and the navigational aid to which they sometimes resorted. In writing about the dangerous tides and maelstroms of northern Norway (Bk. II, ch. 7), he noted that men wanting to sail from Germany to these regions hired only 'the most skilful captains or helmsmen' with long experience in avoiding these dangers – presumably Norwegians with local knowledge. While in these perilous regions, 'they are in the habit of directing their voyage on varying routes over a long sea passage by the guidance of a gnomon, so that they will not plunge into a whirlpool' (Foote, 1996–98, pp. 100–101). (The original Latin text reads: 'Hiquæ longo maris spatio gnomonis directione, ne in charybdim incidant'.) The marginal note here in the recent English translation is 'gnomon compass', corresponding to the original Latin marginalis *gnomon*, *compassus*. An editorial footnote in the English text concerning the use of 'gnomon' speculates that Olaus 'is perhaps referring to a compass which combined a small sundial and a magnetic needle'. The same footnote also calls attention to chapter 8, in which Olaus reluctantly admits that the Spanish and the French 'are very skilful in handling the mariner's gnomon, or compass' – here referred to in the margin as 'Requisites of mariners'.

When Olaus returns to the dangers of the Norwegian Ocean in Book XXI, chapter 1, it is to describe how the local fishermen reach shore safely when finding themselves out of sight of land: '…they have but one preservation, a mariner's compass (*gnomonis nautici*), for with this they can see which way to set their course after the winds have risen. The marginal note here, which in the Latin original is *gnomonum nauticum*, is translated in the new Hakluyt edition as 'A compass, the fishermen's aid' (Foote, 1996–98, pp. 100–105, 1082–83). A somewhat abridged 1561 Italian translation of the *Historia* refers to this navigational aid as a '*gnomone*, *o stilo de nauigare*' (Olaus Magnus, 1561, p. 38), while the more complete 1565 Italian version uses the term '*gnomone nautico*'.

In Book XXI (chapter 1), just as in Book I (chapter 9), Olaus sees a connection between 'the winds' and direction-finding. Furthermore, although both chapters reveal the second-hand (not to say apocryphal) nature of the information provided, it soon becomes evident that Olaus must in fact have heard of a navigational device upon which these northern sailors depended, but about whose application he was as confused as about practical navigation generally. He did not envision a dial which in itself indicated the usual compass divisions of the horizon, but imagined these Norwegian sailors relying on a gnomonic device that recorded the height of the sun, like a sun dial for telling time. They then used the information thus gained to

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determine the direction of the wind, after which they could work out the direction in which they needed to steer to return home.

6. PIRATES RESPONSIBLE FOR THE HVITSARK DIAL. When Olaus noted in the *Opera breve* that the clock (*horologio*) on Hvitsark's summit was made by pirates, he had ample inspiration concerning pirates off the East coast of Greenland. The assumption that such a problem existed goes all the way back to Adam of Bremen, who regarded pirates as an inescapable part of life at sea and in coastal areas, and who wrote, ca. 1070, that the people of Greenland 'live in the same manner as the Icelanders except that they are fiercer and trouble seafarers by their piratical attacks' (Tschan, 1959, Bk. IV, chs. 3, 37).

Among the innumerable later scholars who availed themselves of Adam's work was the Danish clergyman Saxo Grammaticus. In his *Danorum Regum Heroumque Historiæ*, completed in 1204, he hinted heavily that the South shore of the Baltic was a good *source* of pirates as well (Saxo, 1514, Bk. XIV, fol. cxxxvii R). The text suggests that the pirates were Slavs, i.e. Wends, while the Index to this segment calls them Frisians. Through the concerted effort of several northern worthies, Archbishop Erik Walkendorf of Norway among them, Saxo's manuscript history was printed in 1514 in Paris, in the original Latin (Saxo, 1851, p. 17). We know that Olaus was inspired by Saxo's writing, and that the Parisian publisher Henri de Gourmont in his turn is unlikely to have needed a huge leap of the imagination in 1548 when he published a map of Iceland, drawing heavily upon Olaus' map, where he named (Hans) Pothorst and (Didrik) Pining as two pirates holed up on Hvitsark (Morison, 1971, p. 89; Karrow, 1993, p. 364).

In reality, Pothorst and Pining were Baltic pirates, from the Hanse city of Hildesheim, who had enjoyed a measure of fame while in the employ of the Danish king during the last third of the fifteenth century (Friedland, 1984, esp. p. 541). Their chief responsibility had been to keep the English in line, primarily in the North Sea and in the entrance to the Baltic, but also on the approaches to Iceland. In addition, Pining had served for a while as a royal administrator in Iceland. Neither man is known to have come anywhere near Greenland or to have engaged in exploration of any kind (Seaver, 1996a, pp. 199–205, 226, 256–59, 360).

However, the snowball of myth had started rolling. Three years after the publication of De Gourmont's Iceland map, Mayor Carsten Grypp of Kiel (another Hanse city) saw the map in Paris and reported to King Christian III of Denmark (Bobé, 1936, pp. 5–6; Seaver, 1996a, pp. 200, 360):

> [T]he two sea captains Pining and Pothorst who, in the days of Your Royal Majesty's grandfather Christian I, at the request of His Royal Majesty of Portugal, etc., were sent off in some ships to seek new islands and lands in the North, have erected – on the rock Hvitsark, which lies before Greenland, and directly opposite to the Snæfell Glacier in Iceland – a large structure, because of the Greenland pirates who with many small ships without bottoms launch surprise attacks on other ships…

The Danish scholar Louis Bobé discovered this letter in the Danish National Archives in 1909. Picking up the now centuries-old snowball, his fellow countryman Sofus Larsen in 1925 used the letter to produce three completely unfounded theories which, taken together, gave rise to the story that there had been a 1473 voyage of northern exploration in which João Vaz Corte Real was under the capable management of Pining, Pothorst, and Johannes Scolvus. Larsen conveniently

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overlooked the fact that in 1476, the Danes were not involved in expeditions to either Greenland or North America because the politically and financially troubled Danish crown had long since ceased to care about the ancient Norse colony in Greenland. He also seems to have been unaware that the first known time Scolvus (by any version of his name) was credited with a search for the Northwest passage, was in the ca. 1537 Gemma Frisius (Zerbst) globe, where a legend on the north-western shore of a fictitious Northwest passage notes that 'These are the people reached by John Scolvus a Dane about the year 1476' (Nørlund, 1943, pl. 8.1). There was no mention of Pining, Pothorst or Greenland pirates.

When Olaus addressed the pirate topic in Book II, chapters 9–11, he added to the confusion by describing two kinds of pirates on the island of Hvitsark, not just the kind so persistently spawned among the Wends in the Baltic. In Book II, chapter 9, he noted that 'a kind of pirate is found who sails about in a craft made of hide'. He had seen such vessels with his own eyes while visiting Oslo in 1505, he wrote, and he made it clear that those skin boats were from Greenland. His description fits reasonably well with information about Thule Eskimo kayaks, but from there on his tale slides into a fantasy which includes how those cunning Greenland pirates would bore into merchant ships from below to sink them. However, a description in chapter 10 of these natives' architecture, which used whale ribs supporting 'massive timbers' covered with moss and brush wood, carried at least the echo of realistic information. The same cannot be said of chapter 11 (ii), entitled 'More on Pygmies'. It is fair to suppose that the wily natives Olaus described here primarily reflected his scanty information about Eskimos.

No dial or compass was ascribed to native Greenland pirates, however. Instead, the Hvitsark landmark was attributed to the second brand of pirates encountered in Book II, chapter 10. Around 1494, 'two notorious pirates, Pining and Pothorst, having been totally barred from the communities of men' because of their outrageous brigandage, lived in outlawry on Hvitsark with their cohorts and inflicted many atrocities on every seafarer, whether sailing close at hand or at a distance'. Farther along, Olaus noted (Foote, 1996–98, pp. 104–05):

> On the brow of this very high rock a compass was shaped under the hands of these sea-robbers, Pining and Pothorst, with circles and straight lines of lead, which occupied a fairly large round space; by this means, a shorter distance to their goal was afforded to would-be freebooters, since they knew in what exact directions they could range to carry out more profitable plundering forays.

In the 1555 Latin original (Olaus Magnus, 1555, p. 70), the passage reads:

> In huius altissimæ rupis supercilio compassus circulis, & lineis plumbeis fatas ampla rotunditate, opera prædictorum Pining & Pothorst, formatus est: quo meta compendiosior latrocinari volentibus data est, vt sciant, quosum opulentiores deprædationes extendi possint.

Olaus evidently imagined a dial big enough to be visible from afar, making it easy for Pining, Pothorst and their fellow corsairs to return home after lightning pirate forays.

Just how Olaus thought the dial functioned is less obvious. The radial lines were supposedly made of lead, not iron, so magnetism, even as Olaus understood it, was not involved. Furthermore, for the chapter heading he deliberately drew twelve, not sixteen, radials in the illustration – a pointed reminder that the direction indicator on Hvitsark was not marked for East, West, North, South and points in between, to the

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number of 16, as on the map, but was intended to be in keeping with a sun clock or *horologio*. We have also seen that, in his chapter on 'shadow clocks', he observed that telling time by the sun's shadow on a dial was applied in 'navigation used by those who dwell on the Ice Sea or the Scythian Sea'. As Figure 1 shows, the Ice Sea (*Mare Glaciale*) has nothing to do with Norway; it is the ocean surrounding Iceland and Greenland and would have included Hvitsark had this island existed.

Considering these details and the distant northern location to which Olaus assigned those well-planned piratical operations, it is likely that he had in mind a device related not only to the gnomonic instrument accompanying the itineraries used by his Continental contemporaries, but to the 'gnomon compass' that fishermen in northern Norway were said to use when they had drifted beyond the sight of land.

It is safe to say that Olaus never saw this northern 'gnomon compass'. Nevertheless, he understood it to depend on the relationship between the sun's position and man's ability to tell both time and direction by the measured shadow cast by a gnomon. Except for his notion that this process also tied in with the twelve wind directions, Olaus was probably not far off the mark, as we will see shortly.

7. THE MAGNET'S PLACE IN OLAUS' UNDERSTANDING. Olaus' grasp of navigation generally, and of mathematics and the other sciences of his day, demonstrably left something to be desired. Undaunted, he gleaned information in all of these areas from classical, medieval and contemporary sources and incorporated it with a mixture of hearsay and personal observations. His treatment of the magnet and its properties reflects this often bewildering approach.

Right below the *Polus Arcticus* marked in the upper right-hand edge of the *Carta marina*, there is an island (in Section C) named *Insula magnetum* – the Magnetic Island. It has the letter key D. On the map's key, C(D) explains that this island, located some 30 miles from the Pole, turns ships to stone. In his *Historia*, Olaus leaves his readers in no doubt about the merciless nature of this phenomenon, when he notes in Book II, chapter 26:

> Also in the extreme North are found magnets, by which sailors steer their course at sea, as they do by taking bearings from mountains. The influence of these magnets is so powerful that, if they are laid touching certain sticks of beech wood, they communicate to them a hardness like their own, with the property of attraction.

In Book 12, chapter 1, we learn that 'magnetic mountains have been discovered in the islands beneath the Pole. If pieces of beech wood are held against fragments of these for a certain length of time, they too become rock-hard and gain the power of attraction'.

Olaus may well have heard described the fifteenth-century English method of sailing 'by the needle and stone', which called for magnetizing a needle by rubbing it with a 'lodestone' and then placing the needle in a straw or on a chip of wood ('certain sticks of beech wood?') so it could be made to float in a dish of water (Carus-Wilson, 1962, p. 6; Seaver, 1996a, p. 180). However, it is clear that his mind had also been fertilized by other notions as current in his own day as in preceding centuries.

Stories about magnetic islands, familiar to any reader of *Arabian Nights*, go back at least to Ptolemy (Lynam, 1949, p. 12). The island's northward migration is also to some extent traceable. We meet it fully fledged in a surviving account from the *Inventio fortunatae*: '… right under the Pole there lies a bare rock in the midsts of the Sea … all of magnetic stone. And is as high (words illegible) so the priest said' (Taylor,

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1956, pp. 57–60). The authorial voice here belonged to Jacobus Cnoyen, who had clearly been in Bergen when Ívar Bárdarson ('the priest') returned there in 1364 and reported on his encounters with the English friar – presumably both before and after the latter's voyage North in the Davis Strait. There, the Englishman would have seen Disko Island looming tall and dark in rolling northern waters, ready to confirm his notions about both 'indrawing seas' and a 'magnetic island'.

It is largely due to the preservation of Cnoyen's account in a letter from Gerhard Mercator to John Dee that fragments have survived of the geographical ideas and other notions in the *Inventio*. However, there is also telling evidence of the book's one-time existence in later cartographical works. Olaus is likely to have been aware of at least some of these, given his good Dutch and German connections.

There is no knowing whether Martin Behaim had read the English friar's original account, or just Jacobus Cnoyen's retelling of it, when he made his 1491–92 Nüremberg globe and wrote near the North Pole: 'In the book *De inventione fortunata* it may be read that there is a high mountain of magnetic stone … surrounded by the flowing *mare sugenum* …' Another German cartographer, Johannes Ruysch, also referred to the *Inventio fortunatae* when placing a small magnetic island in the northern centre of the world map he drew for the 1508 Rome edition of Ptolemy's *Geographia*. Mercator similarly featured a northern magnetic island in his 1569 world map, published well after Olaus had been laid to rest in Rome.

Although a true child of the Renaissance, Olaus was also in many respects a late medieval person, having spent his formative years in the Far North where the Middle Ages held sway past A.D. 1500. This combination of cultural elements would have enabled him to feel right at home with the views noted down in Hauksbók, an early-fourteenth-century compendium named after the Icelander Hauk Erlendsson, who partly wrote the manuscript himself and partly commissioned others to copy useful information, such as a treatise on precious stones, based on Marbode's *Liber de Gemmarum Lapidumque* and reflecting the classical and medieval views on the subject held by Hauk's Continental contemporaries (Kålund, 1908, esp. p. xxviii; Smith, 1992).

Hauk's description of the *magnetis* mentions only briefly its ability to attract iron, but he leaves the reader in no doubt that this blackish-blue stone, found in India, is a precious substance, able to ensure good health and desirable matrimonial conditions. Placed under the head of a sleeping woman, a magnet reveals whether or not she is virtuous. If she embraces her husband while asleep, she is pure. A whore, on the other hand, will fall out of bed. Of grateful mariners there is no mention either here or in the subsequent disquisition on the *adamantis* or diamond, which was also thought to possess extraordinary properties (Hauksbók, 1892–96, p. 227).

The medieval readiness to believe in magic is as discernible in Olaus' work as it is in Hauk's. Olaus' ideas about specifically northern navigational devices also appear similar to Hauk's notions on that subject – notions which in fact look rather different from those with which Hauk is usually credited (e.g. Marcus, 1980, pp. 108, 195 n. 65), and which will be discussed below. Unlike Olaus, however, Hauk would have had in mind a device whose use he would have had occasion to observe during his many crossings between Iceland and Norway. Olaus never went far enough North in Norway to observe first-hand the dial said to be used in far northern navigation and most likely heard it described during his visit to Archbishop Walkendorf in Trondheim.

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Olaus was aware that magnetic compasses were used on shipboard in his own time, because among the crimes which mutinous sailors might commit, he considered especially heinous any tampering 'with the ship's gnomon, or compass, and particularly the part of the magnet upon which the whole navigation depends' (Foote, 1996–98, Bk. X, ch. 16). However, while he evidently considered 'gnomon' synonymous with compass, there is no telling whether he was referring to the disk itself or to a midpoint feature consisting of a magnet fixed perpendicularly to the disk, like a sun dial's gnomon. His reference to 'the part of the magnet upon which the whole navigation depends' suggests that his concept of the magnetic compass was as vague as his understanding of the 'gnomon compass'.

8. EARLY USE OF THE MAGNET IN NAVIGATION. The magnet's fundamental properties, known in both Asia and Europe well before the English scholar Alexander Neckam (1157–1217) and others wrote about the stone's use in navigation, were fleshed out with mystical and magical qualities as well as with thoughts about how these characteristics might be put to practical use. For people who already thought in terms of the 360-degree circle, it was reasonable to focus on the stone's uncanny ability to seek out the North, even in dark and stormy weather, and to consider how this property might be used in navigation.

It would nevertheless be a mistake to assume that these early commentators on the magnetic compass were privy to accurate information. Rather, their speculations resemble Stanley Kubric's in his classic film '2001'. The concept of computers was becoming widely known at the time the film was made, and awe at the possibilities of such an invention was mixed with fear of its unknown powers. In the film, the monstrous spaceship computer *Hal* developed unpleasant human characteristics and became as uncontrollable as any magic force ever envisioned by Hauk Erlendsson and Olaus Magnus. Of the small, mass produced computers made in the actual year 2001 Kubric knew nothing; he was addressing a development he thought would profoundly influence the future.

Hauk's manuscript compendium was completed around 1306–08 and includes a version of the Landnámabók (Book of Settlement), which constitutes the next-oldest extant redaction of this work, originally believed to have been undertaken by Ari Thórgilsson the Learned (c. 1067–1148). The oldest surviving medieval redaction is in Jón Erlendsson's seventeenth-century copy of the Sturlubók compendium, which Sturla Thórdarson (1214–1284) probably completed towards the end of his life (Schei and Pálsson, 1997, pp. 27, 29). Sturla added no personal observations to his account of Flóki's navigational methods, but Hauk's version says about the Norwegian Flóki Vilgerðarson's ninth-century voyage to Iceland that Flóki sacrificed four ravens so that he might find his way, adding: 'because at that time ocean-sailing men (hafsiglingar menn) in the North did not have a guiding stone or *leiðar steinn* (Hauksbók, 1892–96, p. 5). Hauk's *leiðar steinn* has invariably been translated as 'lodestone' and considered synonymous with 'magnet' – an interpretation commonly used as evidence that the magnetic compass was known and used in the Far North in the early fourteenth century. Two assumptions need particular scrutiny here.

The first unwarranted assumption is that 'guiding stone' refers to the stone known variously as *magnes* and *adamantis* in the Middle Ages. The very fact that people in Hauk Erlendsson's day still used those two names interchangeably suggests that even men as well educated as Hauk wrote about phenomena they had heard or read about,

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but of which they had seen no practical demonstration. The *leiðar steinn*, by contrast, was Hauk's term for a familiar object he clearly considered a well tested and reliable navigational tool.

The second untenable assumption is that the earliest writing about the use of a magnet in navigation represents the earliest time of its actual practical employment in a given culture. We know that this cannot be so. Neckam is widely credited with being the first European author to mention the magnetic compass in some form (Wright, 1857, pp. 114–15 and n. 2), but it would require a leap of faith to regard his descriptions as user manuals. If the English of the early thirteenth-century already knew how to make and use a recognizable version of the modern compass – an oscillating magnetic device indicating the compass points marked on its dial – one has to ask why English fishermen and merchants were still relying on the 'needle and stone' when going to Iceland in the fifteenth century. It is also worth noting, as the Norwegian historian Gustav Storm did more than a century ago (Storm, 1889 p. 17), that the Fra Mauro 1459 map says that in the Baltic, sailors did not navigate by means of compass and charts.

9. A NORSE BEARING DIAL. During the so-called Viking Age (late eighth century until about A.D. 1100), Norse people searching for new economic opportunities left their homelands in ever widening circles. The Norwegian explorer Flóki Vilgerðarson was one such traveller. He went to Iceland in the ninth century, before the Age of Settlement (870–930) had properly begun and, says Hauk Erlendsson, before the Norse had a *leiðar steinn*. Flóki and other early Norse sailors nevertheless seem to have managed very well, using their knowledge about currents and other marine conditions as well as their ability to navigate by the North Star and to determine their approximate latitude. In the earlier Viking period, they stayed within sight or feel of land as much as possible, and they no doubt practised the same kind of 'island hopping' as that which had enabled Irish monks to precede the Norse in Iceland. But before the Norse could strike out even farther West in the Atlantic and colonize Greenland just before A.D. 1000, they would have needed reassurance that they were following a retraceable route, even when there was no land in sight and the pale summer nights at those latitudes prevented them from seeing the Pole Star.

It appears from the *Grænlendinga saga* description of Bjarni Herjolfsson's first voyage out to Greenland to join his father that he had already been given sailing directions based on the latitude involved. When Bjarni and his crew had sailed far enough West to be out of sight of land, they were beset by northerly winds and fog, and for several days they had no idea where they were until 'they saw the sun again and were able to get their bearings'. When they spotted land on the following day, Bjarni said he did not think that could be Greenland. He eventually arrived there after sailing North and north-eastwards for several days (Magnusson and Pálsson, 1965, p. 53; Seaver, 1996a, pp. 1, 17, 23).

This passage strongly suggests both that Bjarni knew how to determine his latitude by the sun and that people back home in Iceland had told him what latitude to aim for. To accomplish this in an unfamiliar setting, he would have needed a dial on which a gnomon cast a shadow, and where the principal compass directions were already marked. It would have been especially helpful for him to know the curve of the gnomon's shadow at the latitude for which he was supposed to set his course at that time of year.

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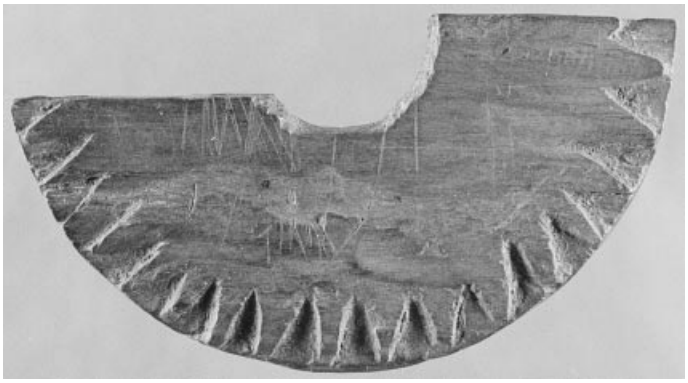


Figure 4. A half wooden bearing dial from around A.D. 1000 which C. L. Vebæk found in a Norse Greenland ruin in 1948. The gnomon lines have been incised at least twice. Reproduced with kind permission from Captain Søren Thirslund.

One half of a small wooden dial (Figures 4 and 5) with two carefully incised gnomon curves, and with compass points carved along the outer edge, was found in 1948 at a Greenland Norse farm ruin in a stratum dating back to the settlement period, around A.D. 1000 (Vebæk, 1991, pp. 65–71). The Danish archaeologist C. L. Vebæk, who excavated the half dial, could not at first interpret the object's use, but he wrote about it in *The London Illustrated News* in 1952 and accompanied his story with an illustration. The Danish navigation expert Captain Carl V. Sølver spotted the article, concluded that the mysterious little object represented an early bearing dial, and had a reconstruction made of what he thought the dial must have looked like when whole, with 32 compass points (Sølver, 1953, p. 294; Vebæk and Thirslund, 1992, pp. 9, 1–13).

The Greenland disk immediately became the focus of controversy. Some scholars argued that it represented a genuine navigational device, while others thought it was probably just a gaming piece or a butter-jar lid which someone had decorated in an idle moment. Sølver's 1953 article in this *Journal* met with strong resistance from E. G. R. Taylor, among others, and little was heard of the matter for several years until 1978, when the Swedish astronomer Curt Roslund decided that the gnomon curves, whose deliberate incision was later confirmed by police experts, were the most significant features of the dial (Vebæk and Thirslund, 1992, pp. 15–19, 21–23; Taylor *et al*., 1954, pp. 78–84; Thirslund, 1999).

For more than ten years, modern versions of the dial have been tested innumerable times, both at the Danish Maritime Museum by Captain Søren Thirslund and his associates and during ocean sailing by other practical navigators. The dial's basic concepts have functioned very satisfactorily. As the distinguished English mariner Sir Robin Knox-Johnston recently noted, it is an amazingly simple system. One need only mark off the sun's shadow cast by the gnomon throughout an entire day to produce the gnomon curve enabling a sailor to set his course. 'It can be made and used by anyone without training and…can provide a human with a very accurate means of following a desired direction in sunlight on sea and land' (Thirslund, 1997, p. 5).

It is beside the point whether the thousand-years-old wooden disk represents a finished navigational aid or just a rough example of such a device. The principle

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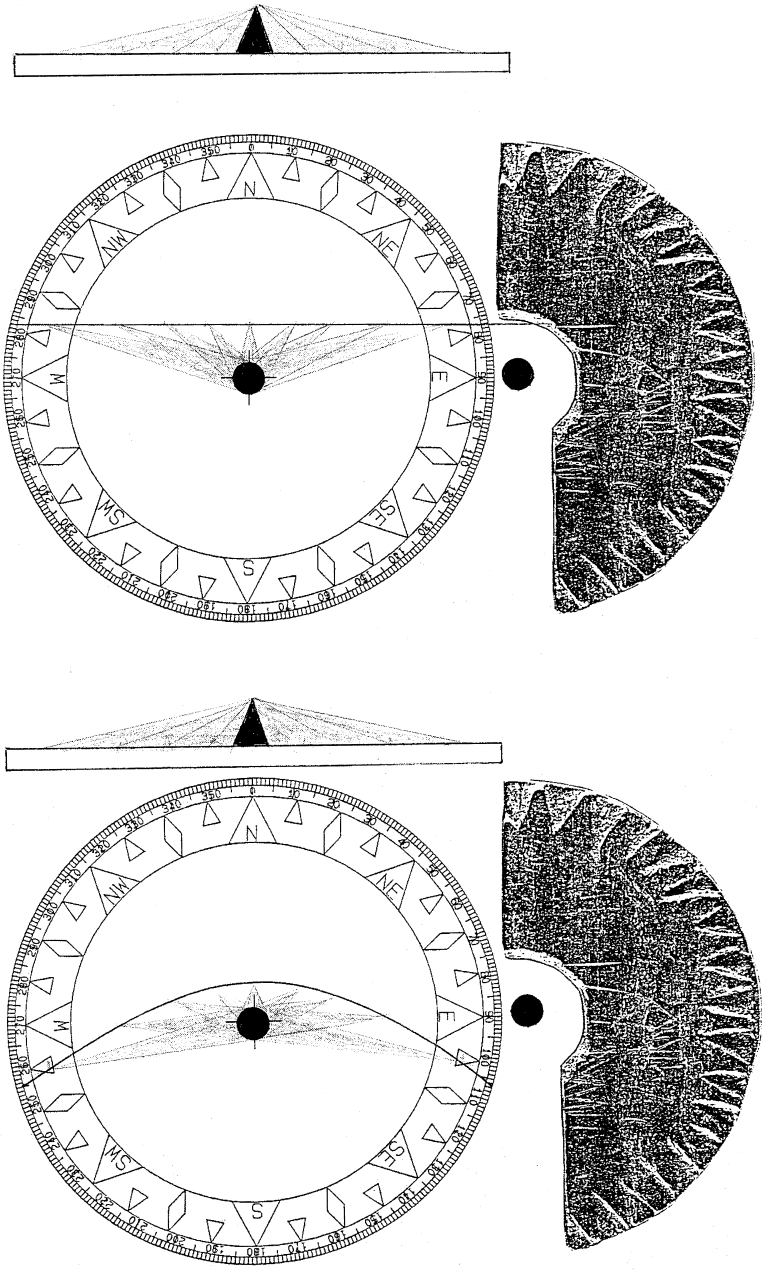


Figure 5. Top: the straight line in the wooden disk (Figure 4) shown transferred to a modern compass. Around the time of both equinoxes, the sun's shadow throughout the day follows this approximate line. Bottom: The curved line in the wooden dial shown transferred to a modern compass. The sun's shadow follows this line around the time of summer solstice. (From Søren Thirslund, *Vikingetidens navigation og Amerikas opdagelse*, Skjern, Denmark, 1999, p. 18. Reproduced with kind permission from Captain Søren Thirslund.)

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demonstrably functions in a gnomonic compass. It is hardly a matter of surprise that the Norse had figured this out, considering that the device employs the same basic idea as a sun dial for telling time. A sun dial was in use at Canterbury around the year 1000, and the Norse are known to have been frequent (though not always welcome) visitors to the British Isles both before and after that time.

10. CONCLUSION. The blurred line between the *magnes* and the *adamantis* in medieval and early renaissance descriptions signals a linguistic minefield, as does Olaus' lack of consistency when naming circular navigational aids. Confusion may arise both from misguided translations and from easy assumptions about the names given to objects. One term may in fact cover several different objects, and, conversely, several different terms may have been used for what turns out to be a single object.

Sun dials made for telling time were normally made of stone if not of metal, and the same was probably true of most sun dials used in navigation. The *leiðar steinn*, the navigational aid which Hauk Erlendsson said was not yet in use when Flóki sailed to Iceland in the ninth-century, may reasonably be associated with a stone, as is the case with the Old Norse word *sólarsteinn* or sun stone. It is clear from Icelandic documents and other written Norse sources that *sólarsteinn* was used about both navigational devices and clocks, again indicating the association in the medieval northern mind between the time of day and the points of the compass. The mid-thirteenth century Norwegian work *The King's Mirror* says it plainly (Larsen, 1917, p. 93):

> As to how long an hour should be I can give you definite information, for there should be 24 hours in … a night and a day, while the sun courses through the eight chief points of the sky: and according to right reckoning the sun will pass through each division in three hours of the day.

In the early fifteenth century, the word *sólarsteinn* disappears, probably because of the advent of mechanical clocks and early magnetic compasses (Seaver, 1996a, pp. 17–19, 333 n. 12), and, to the best of my knowledge, the word *leiðar steinn* was never again used to describe the magnetic compass in the centuries after Hauk's death.

If the words of Olaus Magnus are anything to go by, the simple gnomon compass was still used in the early sixteenth century, not only on the mythical island of Hvitsark, but in northernmost Norway and perhaps elsewhere as well. Northern fishermen and sailors had every reason to continue with a navigational aid they could construct easily and cheaply themselves, for they were very poor. Far into the twentieth century, many of them still could not afford to purchase a magnetic compass (personal comment from Olaf Engvig). Alert to every nuance of wind and weather in their familiar waters, they preferred to rely on their traditional knowledge, including the gnomon compass.

REFERENCES

Adam of Bremen, see Tschan, F. J.

Ahlenius, K. (1895). *Olaus Magnus och hans framställning af Nordens Geografi*, Uppsala.

Bjørnbo, A. A. (1912). Cartographia Groenlandica. *Meddelelser om Grønland*, **48**, Copenhagen.

Bobé, L., ed. (1936). Diplomatarium Groenlandicum 1492–1814. *Meddelelser om Grønland*, **55** (3), Copenhagen.

Brenner, O. (1886). Die ächte Karte des Olaus Magnus vom Jahre 1539 nach dem Exemplar der Münchener Staatsbibliothek. *Christianaia Videnskaabs Selskabs Forhandlinger*, Christiania (Norway), **15**, 1–23.

https://doi.org/10.1017/S037346330100128X Published online by Cambridge University Press

Buschbell, G., ed. (1932) *Briefe von Johannes und Olaus Magnus*. Samfundet för utgifvande af handskrifter rørande Skandinaviens *Historia*. Stockholm, Historiska Handlingar, Del. 28: 3. *Diplomatarium Norvegicum*. (1849–1970). Christiania/Oslo.

Carus-Wilson, E. M. (1962). *Merchant Adventurers of Bristol*. Bristol Branch of the Historical Association, Local History Pamphlet 4, Bristol.

Ehrensvård, U. (1984). Cartographical Representations of the Scandinavian Arctic Regions. *Arctic* **37**, 552–56.

Foote, P. G., ed. (1996–98). *Olaus Magnus: A Description of the Northern Peoples*, *1555*. Hakluyt Society, London, Second Series, No. 182. Three volumes.

Friedland, K. (1984). The Hanseatic League, and Hanse Towns in the Early Penetration of the North. *Arctic* 37, 539–43.

Hamre, L. (1943). *Erkebiskop Erik Valkendorf. Trekk av hans liv og virke*. Oslo.

Hauksbók. *Udgiven efter De Arnamagnæiske Haandskrifter No. 371*, *544 og 675*, *4o* (*1892–96*). Det Kongelige nordiske Oldskrift-Selskab, Copenhagen.

Jónsson, F. (1899). Grønlands gamle Topografi efter Kilderne. Østerbygden og Vesterbygden. *Meddelelser om Grønland*, **20**, 322–29.

Jónsson, F. (1930) *Ivar Bårdarson. Det gamle Grønlands Beskrivelse. Udgiven efter Håndskrifterne*. Copenhagen.

Karlsson, K. H., and Storm, G., eds. (1902). Finnmarkens Beskrivelse af Erkebiskop Erik Walkendorf. *Det Norske Geografiske Selskabs Aarbog*, Christiania (Norway), xii, 1–24.

Karrow, R. W., Jr. (1993). *Mapmakers of the Sixteenth Century and their Maps*. Chicago.

Krüger, H. (1958). Des Nürnberger Meisters Erhard Etzlaub älteste Straßenkarten von Deutschland. *Jahrbuch für frankische Landesforschung*. [Nüremberg?]

Kålund, K. (1908). *Alfræði íslenzk. Islandsk encyklopædisk Litteratur*. I. Cod. Mbr. A < .194.8v°. Copenhagen.

Lafreri, A. (1572). Lafreri's 1572 map (*Geographiae studioso/typographus*) is shown on Plate 19 in the collection *Italian Maps of the Sixteenth Century*, British Library, Maps C.7.e.2.19. The Royal Geographical Society also has a copy, Map Room: 264.G.2(80).

Laurence Marcellus Larsen, L. M., tr. (1917). *The Kings Mirror* [*Speculum regale*]. New York.

Lucas, F. W. (1898). *The Annals of the Voyages of the Brothers Nicolò and Antonio Zeno in the North Atlantic about the End of the Fourteenth Century and the Claim Founded thereon to a Venetian Discovery of America*. London, 1898.

Lynam, E. (1949). *The Carta marina of Olaus Magnus*, *Venice 1539 & Rome 1572*. Tall Tree Library, Jenkintown, Pennsylvania.

Magnusen, F., ed. (1845). *Grønlands Historiske Mindesmærker*. Det kongelige nordiske Oldskrift-Selskab, Copenhagen. Vol. III.

Magnusson, M., and Pálsson, H. trs. and eds. (1965). *The Vinland Sagas: The Norse Discovery of America*. Penguin Books.

Marcus, G. J. (1980). *The Conquest of the North Atlantic*. Suffolk.

Morison, S. E. (1971). *The European Discovery of America: The Northern Voyages*. Vol. 1. New York, Oxford University Press.

Neckam, A. See Wright.

Nicolet, C. (1991). Space, geography, and politics in the early Roman Empire. *Jerome Lectures*, **19**, Ann Arbor, Michigan.

Nørlund, N. (1943). *Danmarks Kortlægning*. Copenhagen. (The Zerbst globe no longer exists, but The British Library Map Library has a set of photographs (Maps 8.bb.10.(4)).)

Olaus Magnus (1539). *Opera breve*, *laquale demonstre dechiara*, *ouero da il modo facile de intendere la charta*, *ouer delle terre frigidissime di Settentrione: oltra il mare Germanico*, *doue si contengono le cose mirabilissime de quelli paesi*, *fin'a quest'hora non cognosciute*, *ne da Greci*, *ne da Latini*. Venice. (Copy used: British Library C.55.c.2.)

Olaus Magnus (1555). *Historia de gentibus septentrionalibus*. Rome. See Foote, Peter.

Olaus Magnus (1561). *Storia d'Olao Magno*, *Arcievescovo d'Uspali de' costvmi de' popoli steentrionali*, *tradotta per M. Remigio Fiorentino… con dvue tavole*. Venice. (Copy used: British Library 153.a.35.)

Olaus Magnus (1565). *Histori delle genti et della natvra de'lle cose settentrionali Da Olao Magno Gotho Arcivescovo di Vpsala… descritta in XXII Libri*. Nouamente tradotta in Lingua Toscana… Con vna Tauola copiosissima delle cose piu notabili, in quella contenue. Venice. (Copy used: British Library 155.e.14.)

https://doi.org/10.1017/S037346330100128X Published online by Cambridge University Press

Rafn, C., and Magnusen, F. eds. (1837). *Antiquitates Americanæ sive Scriptores septentrionales rerum ante-Columbianarum in America* (*Samling af de i Nordes Oldskrifter Efterretninger om de gamle Nordboers opdagelsesreiser til America fra det 10de til det 14de Aarhundrede*). Hafniæ [Copenhagen].

Richter, H. (1939). Olaus Magnus och hans Carta marina 1539: Ett fyrahundraårsminne. *Ymer* (Svenska Sällskapet för antropologi och geografi), **59: 2**, Stockholm.

Richter, H. (1967). Olaus Magnus *Carta marina* 1539. Lund (Sweden).

Saxo Grammaticus (1514). *Danorum Regum Heroumque Hitoriæ*. Paris. (Copy used: British Library 6247).

Saxo Grammaticus (1851) *Den danske Krønike*, translated by Anders Sørensen Vedel. In a new edition by G. F. Wegener. Copenhagen.

Schei, L. K., and Pálsson, H. (1997). *Landsnåmsboken*. Tr. by L. K. Schei with an introduction by H. Pálsson. Oslo.

a. Seaver, K. A. (1996, paper ed. 1997). *The Frozen Echo: Greenland and the Exploration of North America ca. A.D. 1000–1500*. Stanford University Press, Stanford, California.

b. Seaver, K. A. (1996). A very common and usual trade: the relationship between cartographic perceptions and fishing in the Davis Strait c. 1500–1550. *Images & Icons of the New World: Essays on American Cartography*, Karin Severud Cook, ed., London (first published in *The British Library Journal*, **XXII: 1**), 1–26.

Seaver, K. A. (1999). How Strange is a Stranger? A Survey of Opportunities for Inuit-European Contact in the Davis Strait before 1576. *Meta Incognita*: *A Discourse of Discovery*. *Martin Frobisher's Arctic Expeditions 1576–1578*. Thomas H. B. Symons, ed., *Mercury Series Directorate Paper* 10, The Canadian Museum of Civilization, Hull, Québec, Vol. **2**, 523–52.

Seaver, K. A. (2000). Renewing the quest for Vínland: The Stefánsson, Resen and Thorlákssons maps. *Mercator's World*, **5: 5**, 42–49.

Smith, J. A. (1992). Precursor to Peregrinus: The early history of magnetism and the mariner's compass in Europe. *Journal of Medieval History*, **18** (1), 21–74.

Storm, G. (1889). Den danske Geograf Claudius Clavus eller Nicolaus Niger. *Ymer* **IX**, 129–146. Stockholm.

S¿lver, C. V. (1953). The discovery of an early bearing-dial. This *Journal*, **6**, 294.

Taylor, E. G. R. (1930). *Tudor Geography 1485–1583*. London, Methuen & Co.

Taylor, E. G. R. (1956). A letter dated 1577 from Mercator to John Dee. *Imago Mundi* **13** (Stockholm), 56–67.

Taylor, E. G. R., May, W. E., Lethbridge, T. C. and Motzo, R. B. (1954). A Norse Bearing Dial? This *Journal*, **7**, 78–84.

Thirslund, S. (1997).*Viking Navigation: Sun-compass guided Norsemen first to America*. With a foreword by Sir Robin Knox-Johnston. Skjern (Denmark).

Thirslund, S. (1999). *Vikingetidens navigation og Amerikas opdagelse*. Skjern (Denmark).

Tschan, F. J., transl. and ed. (1959). *Adam of Bremen: History of the Archbishops of Hamburg-Bremen*. Columbia University Press, New York.

Vebæk, C. L. (1991). The church topography of the Eastern Settlement and the excavation of the Benedictine convent at Narsarsuaq in the Uunartoq Fjord. *Meddelelser om Grønland: Man & Society* **14,** Copenhagen.

Vebæk, C. L. and Thirslund, S. (1992). *The Viking compass guided Norsemen first to America*. Skjern (Denmark).

Wright, T., ed. (1857). *A Volume of Vocabularies … from the tenth-century to the fifteenth*. Privately printed.

https://doi.org/10.1017/S037346330100128X Published online by Cambridge University Press