FORUM

A Norse Bearing-Dial?

IN the July number of the *Journal* Captain C. V. Sølver described the discovery, by the Danish archaeologist Dr. C. L. Vebæk, in Greenland in the summer of 1951, of what was believed to have been part of an early bearing-dial. The object, which was dated by the archaeologists at about the year 1200, was one-half of an oak disk the outer rim of which was carved in such a way as to lead Captain Sølver to the conclusion that the complete disk was divided into thirty-two points or directions. Captain Sølver's paper was illustrated by a photograph of the fragment discovered and of his reconstruction of a similar bearing-dial.

Professor Taylor comments below on Captain Sølver's paper, and on the more general question of a Norse bearing-dial which it raised. Comment on the problem invited from a number of members and others is also given.

from E. G. R. Taylor

(*Emeritus Professor of Geography, University of London*)

CAPTAIN SØLVER's announcement of the discovery of a bearing-dial, *c.* 1200, reading to thirty-two points,[1] does not bear examination. The object discovered is a half-disk carved with a toothed margin. In one quadrant there are eight teeth, in the next nine. We do not know if both or either were intentional, nor how many teeth there were on the other half of the disk. It is very small, less than three inches overall, and may have been an ornamental boss. The stile and turning pointer with which Captain Sølver fits it are purely imaginary. The owner is said to have oriented his instrument precisely by the rising Sun. Had he then a calendar and a table of amplitudes? The divisions were supposedly made 'by successively halving squares until the thirty-two points had been marked off'. But the Norse seaman very certainly had no knowledge of geometry nor possessed drawing instruments. The bearing-dial, once oriented, is said to become a 'true compass', a point that may be left to navigators!

The number of *ættir* known to Norse literature was eight, and references to finding bearings can only be interpreted accordingly. The relation of the Norseman Othere to King Alfred contains no reference, direct or indirect, to finding bearings, for it described a coastwise voyage, and well illustrates the purely descriptive use of the cardinal points in Norway at that date, when the Anglo-Saxons already had 'northan-eastan', 'southan-westan', &c., i.e. eight plages. Othere says the land stretched 'nord-righte', and that he sailed 'nord-righte', although the actual direction of the coast is north-east. When the coast turned 'east-rihte', he had to wait until the wind blew 'westan odde hwôn nordan', for in fact the coast runs ESE. In the White Sea he went 'sud-rihte be land', although actually a winding course must be followed. But it was all clear enough.

More than a century later, we find Oddi Helgason, in his remarkable observations made in approximately latitude N. 66°, using the expression 'daghr kemr upp i midmunda stadh austars ok landnordurs', i.e. dawn comes up midway between east and landnorth. He finds it necessary to divide the eight *ættir*. But his six observations for his own horizon marking the days on which the first gleam of light coincided with what we should call ESE., ENE., NE., NNE. and N., respectively, could hardly be used to orient a bearing-dial.

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The 16-, 32- and even a tentative 64-point wind-rose came quickly in the thirteenth century, and the fact that the new names had to be learned and understood by the boy going to sea must have led to their being drawn out on paper or parchment. There is evidence that this 'compass-card' was originally thought of as 'the mariner's compass', and the fastening to it of the magnetic needle as merely making it turn to the north when it became a 'magnetic' compass. The 'dyolls' to which Captain Sølver briefly refers as mentioned in old ship inventories seem unlikely to have been such cards, and certainly not 'bearing-dials', for the *Oxford English Dictionary*, in an exhaustive list of the meanings of dial, relates it to time-keeping only down to a late date. The dictionary does not claim to be infallible, of course, but it should not be flouted without definite evidence of error. The so-called 'compass-dials', i.e. sun-dials set by a magnetic needle, were known in the first quarter of the fifteenth century, and may have been older. But further evidence is needed, and meanwhile all we can say with confidence is that multiple divisions of the horizon and precise sailing charts appear in the same period as the magnetic needle. A full discussion of the subject of Norse astronomy will be found in Dr. O. S. Reuter's *Germanische Himmelskunde* (1935) in which the original documents are cited.[2] It appears, for example, that the *sólarsteinn* or sun-stone which Captain Sølver has identified with a bearing-dial[3] was in fact a stone, that it was probably quartz crystal, while its gleam when held up was supposed to indicate the direction of the Sun when the sky was overcast.

from Commander W. E. May, R.N.

(*National Maritime Museum*)

I HAVE read with the greatest interest Captain Sølver's *Discovery of an Early Bearing-Dial* and Professor Taylor's notes thereon. I must also refer to Captain Sølver's previous paper *Leiðarsteinn: The Compass of the Vikings*[3] (where pages are mentioned below they are those of that article).

It would seem that the whole matter requires restatement. The tenets of Captain Sølver's faith are:

(*a*) Before the advent of the compass the Vikings were aided in the shaping of their courses by a dumb card, or bearing-dial.

(*b*) A twelfth-century object recently found in Greenland is probably such a dumb card, and, if it is, proves the division of the horizon into thirty-two points at a date two centuries before the well-known statement of Chaucer.[4]

Professor Taylor denies the whole theory.

Captain Sølver bases his first assumption on the mention of *sólarsteinn* (sun-stone) for finding the position of the Sun in *Flateyarbók* (2–297) and *Biskupa sögur* (1–674), on the expression *deila ættir* (to find the quarters of the horizon) in *Flateyarbók*, and on frequent references in the sagas to the state of *hafvilla* (having lost one's direction at sea). (Pp. 300–302.)

Admittedly, these are very slender grounds on which to work and an exhaustive study of the sagas is required by someone who not only knows the language well but who also knows more than a little of navigation. For such research translations, even into modern Norwegian, are useless. One must go back to the earliest texts.

Professor Taylor seems to suggest that the *sólarsteinn* was in fact a forerunner of the Sky Compass—apparently a case of an American invention being forestalled—but such an implement would have been a useful adjunct to the bearing-dial, if used, and this explanation does nothing to prove or disprove the bearing-dial theory.

The suggestion is that the bearing-dial was orientated by pointing its north to the Pole Star or the appropriate points to the Sun when rising or setting. It is further suggested that when the magnetic needle was first introduced it was used, not for steering in the modern manner, but merely to indicate the north and thus to enable the dial to be orientated in dirty weather. Once the dial had been orientated the direction of the wind could be determined by reference to it.

That the needle was merely used to indicate the north, and then only when other means was lacking, is borne out by all the early writings on the compass needle. It will suffice to give two such quotations:

> 'The sailors, moreover, as they sail across the sea, when in cloudy weather they can no longer profit by the light of the sun, or when the world is wrapped up in the darkness of the shades of the night, and they are ignorant to what point of the compass their ship's course is directed, they touch the magnet with a needle . . .'[5]
>
> 'There is a kind [of lodestone] which sailors carry, for by them they know which way the wind is.'[6]

It must not be forgotten either that before the introduction of the compass (I use the word in the most general sense to include instruments however primitive) the Vikings regularly made long voyages and these were planned repetitive voyages and not haphazard wanderings. Professor Taylor puts forward no alternative theory as to how their navigation was performed.

There are in existence a number of fourteenth- and fifteenth-century ship inventories in which a 'dyoll' appears in juxtaposition to either a 'compass' or a 'seyling nedle'.[7] This would seem to indicate an affinity between the two instruments which would support Captain Sølver in his contention. It is admitted that the proof is not conclusive and Professor Taylor maintains that these 'dyolls' were more likely to have been the compass-dials, or sun-dials orientated by the aid of a magnetic needle, which we know at a slightly later date. She quotes the *Oxford English Dictionary* as giving no earlier meaning of the word dial; but is this evidence? The *Oxford English Dictionary* is not infallible and in these early times 'dyoll' may not have been an English word, nor necessarily derived from the Latin. Sailors often took and corrupted the words of other nations. They do it still. I do not believe that today anyone seriously thinks that the 'dyoll' of the inventories was a compass card.

But we have another piece of evidence that some such an instrument as a dumb card was used and here, being in other seas, it has another name. Raymond Lull at the close of the thirteenth century refers to the use of 'Chartam, Compassum, Acum et Stellam Maris'. It has been shown that 'Compassum' refers to sailing directions and not to the compass.[8] 'Acum' is obviously the magnetic needle but what is the 'Stellam Maris'? The name has been applied to the wind rose, so why not here to the dumb card or bearing-dial. It is the only explanation which appears to fit.

Another thing; the practice of discovering the direction of the wind and then navigating by it is quite understandable to sailors. I understand that Norwegian whale catchers to this day use the direction of the wind, signalled to them by the factory ship.

To sum up, though I do not consider that the bearing-dial theory has been proved, without any doubt it has not been disproved and no satisfactory alternative explanation of any of the evidence has been produced.

Let us now turn to the object found in Greenland and consider in turn Professor Taylor's objections to its identification.

It has eight teeth in one quadrant and nine in the next. This is a very major objection to the 32-point theory. Still, as we have only a portion of the disk and the cutting of the teeth is admittedly irregular we cannot tell how many there would have been in the whole circle. It must not be forgotten that the first compass cards supplied by Lord Kelvin to the Royal Navy were divided into 359 degrees only.

The user would have needed a table of amplitudes. These had already been calculated it seems by Oddi (p. 313).

'The Norse seaman very certainly had no knowledge of geometry nor possessed drawing instruments.' If this is so it would explain the irregularity of the graduations had the dial been divided by eye.

Taking all the evidence available there does not seem to be any proof one way or another. I understand that no objects found with it gave any clue as to a maritime or other use, nor anything which might support Professor Taylor's idea that the disk is part of a decorative boss. All we can do is to note Captain Sølver's suggestions with interest and to reserve judgment for the present.

from R. B. Motzo

(*Professor of Ancient History, University of Cagliari*)

1. IN his paper Captain Sølver writes: 'For we find that the rim of the disk discovered by Vebæk was divided not into four, or into eight, or even into sixteen points, or directions, but into thirty-two.' In fact if we carefully complete the disk, of which only less than one-half has reached us, we can see that the number of points was not thirty-two but thirty-six, of which seventeen are contained in the fragment recovered and nineteen are in the missing part. A comparison of the sketch (Fig. 1) with the photograph of the fragment makes this quite evident.

This argument alone invalidates all Captain Sølver's reasoning.

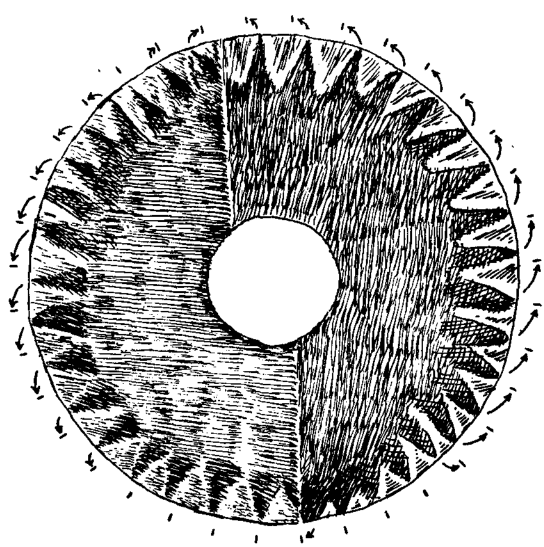

Fig. 1. Dr. Motzo's reconstruction of the complete disk.

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2. Given a clear conception of a bearing-dial, its drawing would not have been above the capacities of even a primitive people; we all know, for instance, of the marvellous geometrical engravings bequeathed to us by antiquity. A single glance at the irregular indentation of the fragment under consideration, however, shows that whoever made it was not bothered either about direction or regularity.

3. We can thus conclude that the disk was not a bearing-dial. The object illustrated in Fig. 2 of Captain Sølver's paper, showing thirty-two points and a 'shadow pin and course indicator' and lines indicating north and a cross marking east, is no reconstruction but an invention. It is what we would call a *patacca*, and in the interests of true research should not be reproduced again.

4. As the disk was not a bearing-dial, it remains to decide what it was, and this is not easily established. It could have been an ornament decorating some piece of furniture or, more probably, a *pinta-pane*, a device used to mark and decorate, before baking them, the little loaves or wafers to be consecrated during the Mass. This latter hypothesis seems the more likely since the object was found on the site of a Benedictine nunnery; the nuns would have stood more in need of such an instrument than of a bearing-dial.

5. As regards the date of the oaken fragment, the date quoted can only be accepted with some reserve. Since it was found in a heap of rubbish, it may have been moved accidentally near earlier objects, though belonging itself to the thirteenth, fourteenth or fifteenth century.

Finally, one might comment that the Vikings were audacious navigators whose achievements are too well established to require the support of fictitious arguments. At the present stage of our historical knowledge we must share Professor Taylor's view that 'even the sailors in the north-western waters had only four names [for direction] until a comparatively late date.'[9]

from T. C. Lethbridge

(*Keeper of Anglo-Saxon Antiquities, University of Cambridge*)

THE discussion on Captain Sølver's most interesting paper on 'The Discovery of an Early Bearing-Dial' must be divided into two parts:

(1) What is the probability of the Norsemen possessing some instrument of this kind?

(2) Is this object a navigating instrument?

I will be as brief as possible in dealing with the first question:

(*a*) The use of the gnomon was fully understood in all the lands of western Europe with which the Norsemen had contact. In particular, highly exact and complicated 'pocket' sun-dials were used by the Anglo-Saxons. The use of instruments for determining latitude had been known since the days of Pytheas some three hundred years before the birth of Christ.

(*b*) The craftsmen of northern Europe were fully capable of producing a dial in metal or wood exactly measured into thirty-two points. The idea that the northern peoples were lacking in geometrical knowledge is refuted by the quality of their work, whether it be the setting out of the ornamental design on a piece of metal, or the layout of a fortified training camp.

Whether or not the Norsemen used a bearing-dial of the type mentioned in Captain Sølver's article is a question of probabilities. My feeling is that some such navigating instrument had been known for a thousand years before the date

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in the thirteenth century of this problematic object from Greenland. Why otherwise did St. Brendan learn astronomy and mathematics before setting out on his voyages?

The second question must be treated as a straightforward archaeological one. Do we know exactly what this thing is? The answer is 'no'. It must be examined then as an object of unknown use and treated accordingly:

(*a*) It is very roughly cut out of a block of wood with a knife. The scratches on the surface were made during the process of making this flat. I have often produced similar marks myself. They are not runes, or deliberate cuts to indicate points, but are quite accidental.

(*b*) The points round the edge of the object strike me, as an archaeologist, as being ornament and nothing more. The disk appears to have been flattened off after they were cut, so it is not possible to see whether any attempt was made at exact measurement. There were, however, nine points in each quadrant.

(*c*) Since the probability of wooden objects being preserved is far less than those of metal, the chances are greatly in favour of this thing being something in common use about a house, a farmstead or a fishing station. The likelihood of finding part of an old sextant in the excavation of an eighteenth-century house is not great. It is even less probable that one would find a rare form of navigating instrument on a Norse medieval farm in Greenland. Still it remains a possibility,

(*d*) The Norsemen in Greenland used well-turned wooden vessels. It seems highly improbable that they would have employed such rough methods to produce a navigating instrument, or that it would have been so small.

(*e*) The disk may have no exact counterpart but there are a number of things which it might have been. The most likely was suggested by Mr. J. M. Wordie, who said at once that it was a 'butter-stamp'. Alternatively it could have formed the top of one of the small coopered kegs used in all northern lands before glass bottles came into general use. A third possibility is that it formed a mark on a line attached to some kind of fish trap. These are now of cork; but I have recovered a disk of oak, slightly larger than this Greenland object, from a medieval site in the Fens. This disk was not toothed round the edge. I considered that the Fen specimen had been used to mark the position of an eel trap.

It would be possible to continue this list for some time, but I do not feel that it is necessary to do so. It might have been a spindle whorl.

To sum up: I feel that the Greenland disk is certainly not a bearing-dial. Had such an object been recovered it would surely have been exactly made, probably of brass, and highly ornamented. The fact, however, that this object is not a bearing-dial does not refute Captain Sølver's main contention that the Norsemen used such instruments.

One other point has emerged in this discussion. That is the meaning of the term 'Stella Maris'. Whether this term was applied to a 'wind rose' or 'bearing-dial' I am not in a position to judge. It is, however, used to describe the star which replaced the oculus on the bows of many west European fishing boats. One might perhaps paraphrase it as 'The Eye of Faith'. I observed it this year on the bows of a Barra skiff 'Martha and Helen'. The compass card might well have taken its form from this star by means of which you saw your way over the waters.

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Low-Altitude Astro Sights

from P. L. Nightingale

ON 13 flights at different heights and outside air temperatures a total of 127 low-altitude sights were taken of the Sun, Moon and planets. The sights were taken with a Kollsman periscopic sextant which uses an illuminated graticule as a datum. *Hughes' Tables* were used for the calculations and the corrections for refraction taken from the table published in *Navigation*.[1]

General Observations. The sights proved to be as accurate as higher altitude sights, as the mean error of the total was 4·5 n.m. and 93·7 per cent of the total were within 10 n.m. of the actual position (ground positions or good track and groundspeed checks).

The sights are spread fairly evenly over the band of altitudes from 9° to below zero (see Fig. 1.). The 33 sights below 1° have a mean error of 5·0 n.m. but if one sight of error 20 n.m. is omitted the average error becomes 4·5 n.m., i.e. the same as the mean error for the 127 sights.

The distribution of sights between *high* and *low* is almost even with 62 *low* and 59 *high* with 6 zero error. The residual error is only 0·42 n.m. *high* (no allowance has been made for personal error as it apparently is a very variable factor[2]). It is interesting to note that while the 62 *low* sights are all within 10 n.m., 8 of the *high* sights exceed 10 n.m. in error; the errors being 11, 11, 11, 11½, 12½, 14, 17 and 20 n.m. respectively.

Accuracy and Use. The majority of the sights were taken when the body was almost dead ahead or astern of the aircraft, so that a good idea of their usefulness in checking groundspeed was obtained. It has always been the author's practice to average two, or at times three, successive sights of the Sun when checking groundspeed with Sun sights. This method was therefore adopted and the results tabulated to check the percentage gain in accuracy by combining two or more sights.

The average of two sights gives a good increase in accuracy and reduces the maximum error quite considerably. The inclusion of the third sight only increases the percentage of the position lines below 5 n.m. although the mean error for 101 averaged sights is now only 2·7 n.m.

One fact which came to light when tabulating the errors was the relationship of the distance between successive position lines and the accuracy of the mean

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