# NORTHERN SKYLORE



OTTO REUTER

–

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# Contents

**The Sky Over Germania** – Otto Sigfrid Reuter

Preface 1
Introduction 5
I. Edge and circle of the sky 11
II. Observation and measurement 23
III. The calendar 43
IV. Constellations and cosmology 63
Summary and prospects 81
Images 85

**On the Ancient Scandinavians' Division of the Times of the Day** – Finn Magnusen

On The Times of Day 91
Plan of a Complete Dial of the Ancient Northmen 111
Table of the Divisions of Time 112
Notes 117

# The Sky Over Germania

Otto Sigfrid Reuter

*English text of "Der Himmel über den Germanen"*

# Preface

Otto Sigfrid Reuter on his 60th birthday.

*Translated from* Mannus*, 28, 279–281 (1936). This was the journal of the National Union for German Prehistory.*

Otto Sigfrid Reuter is no stranger to members of the National Union for German Prehistory. He has belonged to Kossinna's society since 1922 and has repeatedly published pioneering works in *Mannus*. Let us give some of the main facts about his life. O. S. Reuter was born on 2 September 1876 at Leer in East Frisia, the son of the captain and navigation instructor W. Reuter and his wife Emma Armknecht, daughter of Pastor F. Armknecht. By 1876 it is already insufficient, for children of officials, to know only the birthplace, which indeed is very often the result of various accidents; what is needed more, it seems, is to establish in which district the ancestors on the father's and mother's side spent their lives. If one takes into consideration Reuter's present residence, namely Huchting near Bremen, it is easy to guess that Reuter's ancestors were of Lower Saxon stock, and this assumption will not mislead us. The ancestors on his father's side came from the Hildesheim region; a branch of the family migrated a century ago to East Frisia. Reuter's great-grandfather, Wilhelm Reuter, was court painter to Queen Louise of Prussia; his grandfather was headmaster of a high school in Aurich (see also *Mannus*, **18** (1926), p. 374). The ancestors on his mother's side came from the Hanover region.

After attending classical high schools in Altona and Leipzig, Reuter matriculated in 1894 and entered on a professional career in the post and telegraph service. He ended as Director of Telegraphs in Bremen, where he retired in 1924: not however to an idle

retirement with a long pipe and games of skat. By 1902 he had already immersed himself in the study of the Eddaic poems and the so-called younger Edda; at the time this was a rather out-of-the-way field. But this branch of knowledge, and everything connected with it, Reuter never let drop in the following years. It was not a study carried out for his own amusement, but a quest for new paths of research and new perceptions, which his ceaselessly creative mind opened to him in unexpected profusion. These results were put in order when Reuter attached himself to our past master Kossinna, whose pupil he became, and to whom he was later a friend. The first fruit of this work was the two volumes of *The Mystery of the Edda and Early Aryan Religion*[1]), in which he reached down to the roots of our spiritual life. Kossinna, on the occasion of Reuter's 50th birthday, praised "the powerful influence exerted by this book". The reader who goes deeply into *The Mystery of the Edda* is constantly surprised by Reuter's breadth of thought and the deep connections that he brings out.

Among Reuter's numerous smaller publications in the following years, two in particular may be mentioned. (a) "Astronomy and Mythology. Towards a methodology." *Mannus*, 18 (1926), pp. 33 ff. This is a work which lays the foundations for a methodology of these branches of research, and which no-one occupied with them can afford to ignore. (b) "Oddi Helgason and the fixing of the solstice in ancient Iceland." With this work, which served towards a study of the peasant astronomer Oddi Helgason, Reuter made a fitting payment of his debt of gratitude to Kossinna. The work appeared in the festschrift for Kossinna's 70th birthday in 1928. From these and similar publications it became ever clearer where Reuter's path was leading, namely to the investigation of Germanic astronomy. He gave nine years of his life to this work; he sacrificed time, strength and money, to create clarity here and to

reach results that in this field were far more difficult to attain than in many others. The sources were as scanty, remote and hard to access as they could well be. Those with even a superficial knowledge of the field will admit that this statement is not exaggerated; and anyone who still does not believe it is recommended to look carefully at the sources and evidence and the bibliography of over 600 books on pages 744–766 of Reuter's *Germanische Himmelskunde*.

We Germans have every reason to be delighted with Reuter's *Germanische Himmelskunde*, which appeared in 1934; and meanwhile it has already made its way among our Nordic and Anglo-Saxon cousins. The book is pioneering in the best sense, yet works alongside other branches of German prehistory to help us to realize that our Germanic ancestors were not only intelligent and open-minded people, but also highly skilled in science. Whoever, like Reuter, devotes his life's work to revealing these facts, assuredly deserves to be honoured on his 60th birthday. That Reuter, as long as he has the strength, will pursue this life's work not for his own honour but for the glory of our people and fatherland, we already know. That it will be for many years to come, we hope and wish!

J. Hogrebe.

1) *Das Rätsel der Edda und der arische Urglaube*, Bad Berka 1922 & 1923.

## Introduction

The science of universal prehistory is concerned with the basis on which the Germanic ancestors of our modern civilization lived their lives, before time and alien cultures cast a veil over their origins. In those larger contexts that we denote by "blood and soil", the sky above us has always had a place; and to the methods of universal prehistory we may properly add astronomy, for the road through "sun, moon and stars" is by no means a detour if it leads to our own culture.

This road, in the absence of proofs, seemed to be blocked. In the train of the west European cultural revolution, when even the Germanic constellations, named after the ancient gods, were swept in their glory from the heavenly vault, to be replaced by a welter of Greek, Roman and Arabic shapes and names, the modern critic still falls into step all too readily, and, whether he knows it or not, his education and prejudices lead him to follow the easier trend. No doubt it is harder to turn against the stream, and commit oneself to proving the existence of an early Germanic astronomy, than to dismiss these early Germanic races as barbarous children of Nature, who developed nothing of their own, but borrowed everything from outside.

The silence of the sources is still held to be adequate proof of the alleged lack of a native Germanic astronomy, and even a reference to the historical fact that pre-Christian civilization was overthrown by the arms of the Carolingians is dismissed as unfounded. And yet it had already struck Jacob Grimm that no names for the conspicuously bright planets had survived from the Germanic regions. "It is hardly thinkable", he says (Mythology 3.686), "that the Pagans, if they singled out certain fixed stars by special names, did not also distinguish and name the planets,

whose appearance and movements are far more striking to the eye." If we now point out also the considerably greater number of Germanic constellations, taking their names from the great cycle of Germanic sacred myths, it becomes clear that such an explicit body of Pagan doctrine in the sky was something that the struggling medieval Church could not tolerate. The star observations of Oddi Helgason, who was honoured with the popular nickname Star Oddi, and whose number sequences (fortunately preserved) relate to the movement of the sun and the angle of twilight, have been lost; yet they were surely just as clear evidence for popular astronomical observations as the number sequences that we can verify today. The reason why the sources of Germanic astronomy are for the most part only to be found in the northern Germanic regions is that in the North the destruction began almost half a millennium later than in Germany itself. The fact of that destruction is proved.

By contrast, Alexander Tille [1] can still write (and such quotations are instructive enough): "The observation of the change of cold in winter and heat in summer is one thing, that of the movement of the rising-point of the sun on the horizon is another. … The Germanic tribes knew so little of solstices and equinoxes that they had not even names for them, and the different words which the various tribes formed to express these ideas are mere translations of the Roman denominations. There never was a Germanic solstice celebration."

In just the same aggressive style is a contribution from Gustav Bilfinger [2], who is at home in this kind of repetition: "The Anglo-Saxons (in Bede's time) were certainly not yet in a position to calculate the solstice correct to the day, and thus solve a problem requiring a high level of mathematics and observational astronomy." He is at least consistent when he writes later: "The

'bound' lunar year is one of the most complicated forms of time reckoning and presupposes a level of mathematical and astronomical knowledge that we should once again be reluctant to ascribe to a primitive people. …" But Bilfinger is scarcely reasonable when, for the sake of his argument, he reproaches the father of Icelandic history, Ari Thorgilson (1067–1148), for "carefully concealing" a fact well known to him in order to derive the old Norse calendar from Christian sources while he himself can still conclude triumphantly that "of the Germanic Yule festival nothing truly Germanic is left except the name Yule."

Bilfinger's ill-founded and erroneous judgement on the ancient Norse calendar was soon rejected by Ginzel, Finnur Jónsson, Martin P. Nilsson, J.F. Schroeter and others as "exaggerated"; today, Germanic independence has been proved in this field also. But how far such mistakes, wide open to contradiction for all their learned trappings, can spread into scientific debate, and how hard they are to root out, is shown by the fact that even Franz Boll, the author of Sphaera, was relying as late as 1913 upon Alexander Tille and "Bilfinger's as always very thorough and competent discussion" when he emphasised that among the Germanic peoples "no scientific astronomy, however primitive" had been developed. It is instructive to see how such an important judgement can rest on such selective and one-sided quotations and use of the sources, for which the blame lies less with the practical astronomer than with the critical historian.

In the following we shall distinguish as best we can between hypothesis, probability, and proof. Those who wish to enter the wider field of Germanic culture, or who wish to see from sources, reports and documents how this astronomy was not the preserve of a few but a popular heritage, are referred to my book Germanische Himmelskunde (published by J.F. Lehmann,

München). The important thing here is to recognize the independence of the Germanic race in one of the most important fields, namely the observation of astronomical cycles. Even then, what might seem from the numbered notes below to be the sum total of Germanic achievement is in reality no more than a brief survey of a few identifiable remains. At least these are such that we can recognize not only the use of astronomical phenomena, e.g. for time reckoning or ocean navigation, but also the patient struggling with the numerical concept of natural law.

In view of the unfavourable northern climate, which calls forth a man's whole strength in the battle with the elements, no reasonable person can expect the north to show such a development of mathematics and theoretical astronomy as the world owes to the racially related Greeks of more favoured regions. On the other hand, among none of the so-called "primitive peoples" do we find the independent development of a long calendar cycle, such as was definitely used among the north Germanic peoples and probably in the south, and which goes far beyond the "bound lunar year" rejected by Bilfinger. To the medieval West, as to ancient Rome, the Germanic, or at least the old Norse cultural area appeared as a separate one, with an astronomical achievement to its credit that those other regions seem to have lacked. That was the giant stride across the Atlantic, the development of ocean navigation across 40 degrees of latitude and 100 degrees of longitude, a challenge unknown to the narrower regions of the south.

The great religious concepts of the Norse Edda, which are known as far afield as Aryan Persia and apparently describe the age-old myth of the final battle between the forces of creation and destruction, appear in a new light when in the splendour of the

constellations we see the gods' great prophecy written at night in the sky itself.

We do not know how far these are common to all Germanic peoples. A wide field lies open to research. Yet from it we can see: the former age was a spiritual one, and is illuminated by every fresh proof of its lasting relationship with the stars above us.

We begin with the sun's path above the horizon and the derivation and use of the astronomical directions; then follows a survey of popular observations and measurements. The second half presents Germanic solar and lunar calendars, and the representation of the constellations.

# I. Edge and circle of the sky

For Germanic as for all early astronomical observations, the first reference plane will have been the visible horizon. The movement of the sky takes place above a fixed boundary; so it is natural for people observing it to relate the movement to some well-defined fixed plane. We shall see, however, that the Germanic peoples very soon made a distinction between the visible terrestrial horizon, irregular in shape and marked out by hills, woods, or the ocean's rim, and a quite independent, purely theoretical circle in the sky, the so-called "apparent horizon".

## 1. The sun and the concept of direction

Among the earliest evidence of Germanic observational astronomy, derived from far back in prehistoric times, is that found in the annals of language. Concepts of direction among all Germanic peoples have in common the words north, east, south and west; today these are in use the world over [3]. The original meanings of these four main direction words show that the concept of direction was based on observation of the sun's daily and nightly path (see Fig. 1).

1. North = "away, below": for the sun's nightly journey beneath the horizon: northwards and below, in old Norse speech, is the direction of the Hel road, i.e., the road of the dead.

2. East = "growing bright, burning": for the sunrise quarter. Thus Easter (Ostern) is the time when the sun crosses the midpoint of this sunrise quarter, on its way towards its summer position.

3. South = "the brilliant", or perhaps the "going" quarter, above which the sun reaches its greatest daily height and gives its fullest light.

4. West. = "the evening" quarter.

The first Germanic concept of direction did not yet imply the so-called true astronomical directions north, east south, west, but simply the four main positions of the sun.

The unity of this concept is all the more striking, when we see that such unity is lacking among e.g. the Greek and Roman concepts.

The Greeks named the north after the blustery wind Boreas; the south after the wet wind Notos; while east and west were named the bright (Euros) and dark (Zephyros) regions, from the sun's appearance.

The Roman words for the direction are related to (1) the pole of the sky (north = septem triones, the seven stars of the plough), (2) the middle of the day (south = meridies, midday), (3) the rising and setting quarters (east = oriens, west = occidens).

This kind of comparison shows that the Germanic system of directions had already arisen independently in prehistoric times; further, that the rising sun was identified with the setting sun of the day before; that the "deep north" was seen merely as the ending and restarting of the sun's circular course.

In Germanic regions during the summer months one can see on the northern horizon the bright glow of the sun beneath; in higher Germanic latitudes the sun even remains visible above the northern horizon at the end of its daily journey. In Greece, where on account of the greater steepness of the sun's path these phenomena do not occur, men of the calibre of Xenophanes and

even Herakleitos were still teaching, around 500 BC, shortly before the great upsurge in Greek science, that the sun like all heavenly bodies was extinguished in the evening, a new one being kindled at sunrise.

## 2. Observation of the circular path

Further evidence for observation of the circular path is the Germanic (probably Indo-Germanic) custom by which all movements requiring good luck were carried out sunrise, i.e. turning to the right. With the sun the boat was put about, the rope was coiled, the firewheel was turned. On a much larger scale, the same belief underlies the Germanic king's ride, a sunwise tour of the country (in Sweden called "Erik's highway") which was required for the king's election to become legally valid. Law and custom, belief and usage, were in this way placed under heavenly protection.

Here too belongs the ancient Germanic four-spoked wheel cross, seen on Swedish rock carvings and still frequently met with today. Even in prehistoric times, not only the sun symbol but the whole circle of the sky was depicted as a wheel, the "sky wheel". The magical star, the moon, appears at first sight to travel sunwise; but its true yearly motion, like that of the sun, is eastwards, i.e. against the apparent motion which simply reflects the rotation of the earth. Thus the swastika, a sacred symbol from the earliest times, can be interpreted in both its orientations as the movement of light in the quartered circle, or the divine organizing of light itself.

## 3. The fundamental direction

Of all solar directions only north and south, the sun's positions at midday and midnight, stand unshakably firm. All other solar positions, on and above the horizon, move with the seasons: northwards from the winter point to the summer point, then southwards from summer to winter. The sunrise (sunset) position swings in German latitudes between NE (NW) in summer and SE (SW) in winter. The sunrise point marks true east only on the days of the spring and autumn equinoxes (see Figs. 1 & 2).

Direction finding at night (i.e. without using the sun) begins by observation of the hub of the sky wheel (the celestial pole) which establishes true north once and for all. Every other direction depends on this. Once it is observed, the four regions of the sky can be given permanent midpoints independent of the horizon. When directions are found from the hub of the sky, east and west are not independent directions but lie at right angles to the principal direction. Circles divided into only two parts, not infrequently met with in Swedish rock carvings, thus appear to indicate the N–S direction – or in terms of the "hub" analogy, the axle of the sky.

(For North Germanic observations of the pole down into the historical period, see Sections II and IV).

## 4. Orientation in theory and practice

The Germanic concept of direction is reflected in the old Norse creation myth, and in the orientation of the house, settlement, moot hill, oath, prayer and grave.

1. The creation myth. The primeval space (old Norse Ginnungagap) is stretched out between the giant ice world in the north and the giant fire world in the south.

Between the two, motion comes into being through a divine power; from their meeting there grows in the primeval chasm the giant first being (Ymir), but at the same time his opponents, the race of Æsir. These gods killed the giant and from his skull built the roof of the sky, from his flesh and blood the earth and sea. From the hostile glowing heat of the southern fireworld the heavenly ones made the sun and other stars and gave them their places and paths.

2. Farm houses and king's halls. These are oriented so that the high seat on the northern long wall faces the sun's high point in the south; the lower seat on the southern long wall opposite faces the high point of the northern sky, the abode of the gods. On the high seat pillar of the northern wall were carved a sacred image and "the gods' nail" (the north star).

3. The village. This is built up from the south to north; the second settler takes the land to the north. The younger son has first rights on the southernmost plot of land.

4. The moot hill. The moot hill lies in the cardinal directions. King and law speaker stand in the north facing south, the assembled people in the south facing north.

The plaintiff goes from south to north towards justice; from north to south follows the defence and the oath of purification. The oath was taken towards high south (sun due south, the highest point of the wheel).

In legal proceedings that were not regarded as a contest, i.e. at the conclusion of a contract or settlement, one party came from

the east, the other from the west. In this legal procedure the reflexion of the sun's course is apparent. In north and south the most extreme opposites face each other: midday and midnight, the solstices. In east and west is the balance between the two, between light and darkness, the equinoxes.

5. Graves. Graves often show a regular orientation. Also oriented N–S is the early Bronze Age grave at Kivik in southern Sweden; the same is true of the great ship arrangements and ship burials (Blomsholm, Oseberg, Gokstad, Ynglingehög).

6. Prayer. Prayer is directed towards the immovable heavenly seat, the high north (Bilskirnir, Valhalla).

This northerly orientation of prayer came into legal conflict with the easterly orientation, the sacred direction of the Church. In the east–west churches of the Frisians, who had recently been Christianized by Charlemagne, the Danish king Gotrik (c. 800) had northern doors cut out and forced the people to crawl through them; on the Christian side, the Norwegian king Olaf Kyrre (12th century) had the northern high seat of the farmhouse and royal hall removed to the eastern side. Christian prayer implies the direction of the rising sun ("ex oriente lux", which is valid only for southern latitudes); Germanic prayer was turned towards the pole of the sky, and implied the heavens.

## 5. Basic rule of division

In dividing the horizon, the principle of continued halving is the rule. North and east meet in NE, south and west in SW. Continued halving leads to the ancient 8-fold division and to the 16-fold and 32-fold divisions.

Alongside these common Germanic terms, Norway had very early on, no doubt in prehistoric times, named the four intermediate directions according to their deviation from the N–S direction, relating them to the NNE trend of the coast in that country. NE was called landnorth, and SE was landsouth; while the westerly directions pointing out to sea were outnorth and outsouth (i.e. NW and SW). Even when far from the Norwegian coast these terms remained in use (see Fig. 2).

Charlemagne tried to replace this Germanic 8-fold division with an academic 12-fold division of Chaldean origin. The NW quarter was no longer to be halved by the intermediate direction NW, but split into three by two other directions, namely N 30° W and N 60° W, to be called north-west and west-north. Charles's plan came to nothing. The modern compass directions go back to the Germanic principle of halving.

## 6. Regions and directions of the sky

From this halving principle it follows that each true direction lies at the centre of a region of sky with the same name. In north Germanic territory the eight regions are called ætt (i.e. family, plural ættir). The true (astronomical) direction is ætting (also staðr, i.e. place).

The division is regular. The northern sector is the sector between NNW and NNE; at its centre lies true north. Later we shall see that night is defined as the time taken by the sun to cross this sector.

For the true astronomical directions the Germanic peoples still use, as in olden times, the terms due north, due west, etc.

## 7. Astronomical directions as a clock face

Among all peoples the time of day has been told by the position of sun, moon or stars above fixed landmarks such as mountains, trees and other high spots on the horizon [4]. Over and above this simple procedure, which varies with the shape of the horizon, the Germanic countries developed a method of timekeeping used nowhere else on earth, replacing random landmarks by the fixed and universally valid clockface of the directions, irrespective of the lie of the land and the observation point, measuring the course of time, through the motion of sun, moon and stars above and below this directional circle (see Fig. 2).

For time markers, the sun was used by day and the moon and stars by night. As regards the stars, see Section IV on the constellations.

The method depends on the fact that as we go further north, the celestial pole stands higher in the sky, so that the paths of the stars become more horizontal. But as a star circles round closer to the horizontal, the closer is the approximation between its direction in the sky and the time of day. The method is therefore impracticable in the Mediterranean regions, but by the same token works better in the North. The time defined by "sun due east" changes its value during the summer half year by about 2½ hours in the latitude of Tunis, but in Iceland by only ¾ of an hour. The Icelandic variation is scarcely noticeable, that in the Mediterranean is scarcely tolerable.

The attempt by the medieval Church to import the southern method (the so-called temporal hour system) into the North came to nothing. This method divided the time between sunrise and sunset into 12 daylight hours, and the time between sunset and

sunrise into 12 night hours. Since the nights in winter are longer than the days, but in summer shorter, the hours are unequal: the daylight hours are shorter in winter than in summer. In Mediterranean latitudes the difference was acceptable; in Iceland, however, where the day (from sunrise to sunset) lasted 21 of our hours in summer but only 3 hours in winter, the corresponding hours by the church's method had a length in summer of 1¾ hours and in winter of ¼ hour by our modern reckoning. The uselessness of the medieval "temporal hour" system inevitably roused resistance soon after its introduction into the North, having led to great confusion there.

Our 24 hours of equal length did not become customary until the 14th century, following the introduction of striking clocks.

## 8. The eykt division

To the eight regions of the sky (ættir) correspond eight periods of time (eyktir, singular eykt, probably related to German "joch" and English "yoke") during which the time marker passes through the region of sky in question. Among Germanic seafaring peoples the following method of dividing the day had already been developed in prehistoric times.

The sun's passage through the northern sector was regarded in Iceland as legal night; "sun due north" was thus midnight. The sun in the northeast sector was called ótta (German "uchte", Old English "uht"), that is, greying of day. With the crossover into the eastern sector the morning began; sun at ENE is daybreak and, in the summer half year, rising time (rismál). The sun due east indicates midmorning. The morning eykt was followed in the North by the daylight mealtime (dagmál); at the beginning of this

the sun stood ESE, the old Norse dagmál point. The other sectors of this sky clock can be seen in the accompanying diagram. At the end of the afternoon eykt the sun stood WSW; in the summer half year this was time to stop work, the eykt point. It lies opposite the rismál point, so that the day is divided by the ENE and WSW sun positions into two equal parts (doegr). With the crossover into the western sector the evening began; sun due west denotes midevening. (For the eykt division in Germany see Fig. 3.)

Moreover, on the day in autumn when the sun set at the eykt point, the winter half year began, in which all field work stopped. When time was told during the winter nights by the moon or stars, the eykt markers still kept their names derived from the path of the sun. "The star is at the midday point" denoted its southern and highest position. Because the rotation of the stars gains time over the sun, amounting to about 4 minutes a day, one star had to take over from another as the time marker. The request "take a look at the star" referred in winter to the Pleiades, in spring to the Daystar (Arcturus).

Telling time by the moon required a special rule, since this body, because of its marked true eastward motion among the stars, does not keep pace with the stars in their apparent westward motion.

When the sky was clouded over, people managed in various ways: vital, at least on the coast, was the observation of the regular ebb and flow of the tides. Reckoning by the roughly 12-hour tidal cycle soon led in the Germanic North to a division of the day into two half days (doegr), which started a little later day by day, and returned in the course of a month to almost the same time of day.

## 9. Eykt markers and observation stones

To make it easier to tell the time, houses, as already mentioned, were from the earliest times built facing the cardinal directions, so that whoever went out one of the doors already had the required direction in front of them, without having to work it out every time. Whoever stepped out of the south door had before them the true south; true west to the right; true east to the left. If for any reason the house did not face the cardinal points, and if moreover the horizon lacked natural high spots to act as eykt markers, then artificial markers were erected to show the directions.

But since with every step taken by the observer the eykt markers were shifted in relation to the true directions, telling the time from eykt markers of this type was valid only from a particular observation point. At the Althing in Iceland (and the same will have held good elsewhere) the sun's course was observed "from the law speaker's seat". In front of every old Icelandic house, in fact before the door, lay the "house stone", onto which the observer had to step in order to tell the correct time from the position of the sun, moon, or appropriate star.

After this it must be said that eykt markers are no more than makeshifts for the true astronomical directions. A knowledge of the true astronomical directions is gained by systematic observation.

# II. Observation and measurement

Gazing at the sky, bedecking it with constellations, worshipping it, still fall short of astronomy; this first shows itself in the observation and measurement of celestial phenomena, whether some material benefit (for example, finding times of directions) is to be achieved, or whether this observation and measurement are ultimately motivated by some inkling of natural law. With this last object in view, observation and measurement set out on the road towards science.

## 1. The midnight sun at the North Cape

In the 9th century the Norwegian Ottar sailed round the North Cape, in order to find out how far the land extended to the north. He penetrated into the White Sea as far as the mouth of the Dvina (Archangel). In the detailed account of his journey that has come down to us [5], the stretches of coast are so accurately described in terms of the astronomical directions that these, the compass being unknown, must have been found by observation. Now in those latitudes the stars are invisible throughout the summer on account of the permanent brightness of the sky; the sun itself circles constantly above the horizon. The only way of finding direction would have been by the highest or lowest elevation of the sun above the south or north point. Ottar's direction finding was based on observing the sun at the lowest point in its path. The gap between the lower edge of the sun and the visible horizon at midnight on the summer solstice at the North Cape (71° 11′ N) amounts to about 4.5° (that is half a handbreath with the arm outstretched); by means of this observation Ottar determined the middle of the northern sector, that is the true north. Since the

coastal explorer is reported to have waited some time at the head of the North Cape for a "westerly or somewhat northerly wind" (probably in the shelter of Horn Bay) he will have repeated his observation several times to check the result.

## 2. The sun's height at midday and midnight in north Greenland

On 25th July 1267 (Old Style) some fishermen of south Greenland were driven north by a storm from their home port of Gardar. At the end of their journey they established:

(Regarding 1): The practice of using the ship's side or a raised portion of the rail (sun board) to cast a shadow, or in dull light as a backsight, is often attested in the old North. With a more southerly position of the ship the shadow was cast nearer, and with a more northerly position further. Notches in the seat of the boat could mark the shadow position for the home port and for every other known position of the ship, thus allowing the distance north or south to be estimated.

(Regarding 2): The height of the midnight sun in a distant place was compared with a known elevation in the home port Gardar (61° N). In Gardar the sun on the longest day stood 3° 41′ high in the northwest; if at the more distant spot on 25th July (Old Style) the sun stood 3° 41′ high at midnight (that is when true north) then, making the necessary calculation, we find for the ship's position a latitude of 74° 34′ north, a point on the coast of Baffin Bay, north of Upernavik.

Somewhat further south (73° N), northwest of Upernavik on the island of Kingigtorssuaq, a rune stone was found in 1824, dated on linguistic grounds to about 1300. The journey into those

high latitudes was thus not unique. The astronomical method of finding position, garbled though it is in this account, rests on comparisons of the sun's height. The height of the midnight sun could not be compared with the same phenomenon at the home port Gardar, since there (61° N) the midnight sun just passes below the horizon. The citing of the "sun's height in the northwest at Gardar" is thus an expedient, and is a splendid testimony to the astronomical experience and schooling of the men concerned.

### 3. The "shaft height" of the sun

The time marker "eykt point" (WSW) was permanently fixed and recognizable for every farmstead by a landmark on the horizon. On journeys, however, the astronomical directions were not so easy to find, at least not in the summer months, when the brightness of the nights prevented the stars from being seen. From preChristian times there comes a popular method for announcing an agreed time to stop work, or any other time, by using the height of the sun instead of its direction. For instance, the law defined the "shaft height of the sun"; this occurred in the afternoon when

"the lower edge of the sun appears to rest on the point of a spear set up nine feet from the observer".

The law expressly provides that this shall be the observer's own spear, and that he shall have set up the spear so that he can still reach comfortably with a "shaft hand" (that is the thumb held out from the fist) up to the socket of the iron spear head; in other words, that in all circumstances the same sighting angle shall be ensured.

The spear's length stands in a fixed practical ratio to its owner's bodily proportions. The sighting angle "shaft height" is thus guaranteed independently of both standpoint and reach.

With a greater height of observation (for example from a hilltop) the sun's disk stands higher above the visible horizon. If the sun's height were measured from the visible horizon, then observation from a hilltop would give a different time than observation from the shore.

The legal rule, aimed at getting the same time value for observations made at any height, whether from the seashore or from a mountain, removes the horizon from the determination of height, and expressly requires the reference level to be the actual eye level, regardless of the ground height or the edge of the sky; in other words it requires the so-called apparent horizon.

Calculation gives for the "shaft height of the sun" an angle of about 10 degrees.

### 4. Finding the height of the pole by lying on one's back

In 1150 the Icelandic abbot Nikolaus completed a pilgrimage to the Jordan. At the spot where Christ is said to have been baptized, Nikolaus at once noted in true Icelandic style that the Jordan flows "from northeast to southwest", and he also noted how high the Lode Star appeared there.

"If you go down to the Jordan and lie in a flat field, raise your knee, place your fist on top of it and lift your thumb straight up from the fist, the Lode Star can be seen above it, so high and no higher."

The fist with the raised thumb is once again the old Germanic measure of the shafthand. By the Lode Star we must understand, as we shall establish in the section on the constellations, the star 32 Camelopardis in the head of the Giraffe, which we may suppose the Icelander had kept under observation on his outward journey; at that time our modern Pole Star was still far from the pole. To the Icelander it was important to compare the height of the pole at his journey's end with that at his home village in northern Iceland.

Observations while lying on one's back was another Icelandic practice, appropriate because in northern Iceland the celestial pole lies only 24 degrees from the zenith. On the other hand, lying down seems pointless on the Jordan, because the Lode Star there was only 32 degrees above the horizon. The reason for using the Icelandic practice on the Jordan was to avoid the high horizon of that mountainous district, and to set up an artificial apparent horizon (the horizontal eye level) independent of the height of the eye, such as was also required by law when fixing the "shaft height".

A repetition of this folk method gives an angle, consistent with that latitude, of about 32 degrees.

### 5. The sun's position as a year marker

In 930 the solar year was made the exclusive form of calendar in Iceland. The first day of summer was defined to be the day on which the sun in spring rose ENE, the summer "rising" eykt point (rismál). The first day of winter was to be when the sun in autumn set WSW, the eykt point for stopping work (eyktar staðr). But in addition the Icelanders wanted to count a whole number of weeks

in their year, and forgot (in the unrest of the settlement period) the 365th day, although a knowledge of this is already in evidence among the Norwegians 400 years before. They soon noticed for themselves that the legal first day of summer no longer arrived as it should, and it was Thorstein Surt who advised the Icelanders to insert a week (later named after him) every seven years or so, after which they could investigate more carefully how to bring the year into harmony with the sunrise.

It is not known in what way the "sunrise" was defined; the practice of beginning the year from a certain sun position, and the custom of observing this every year, is of old Norse origin (see Section III on the calendar).

### 6. Finding position from the sun: the site of Vinland

In 986 the Norwegian Bjarni Herjolfsson became the first European to set eyes on the American continent. The first to land in the New World was Leif Eiriksson in the year 1000. The most southerly stretch of coast that he reached, named Vinland, was identified by Leif through an astronomical report. He states:

These last two eykt markers we already know as the WSW and ESE points. Leif is comparing astronomical phenomena in the new land with those in his homeland. On Eirik's farmstead Brattahlid, the family settlement in southern Greenland (61° N), the sun set on the shortest day in the direction S 37.4° W, that is roughly 33° south of the WSW point, or eykt point.

The further south we go, the further north the sun sets on the shortest day, and the closer sunset on the day approaches the eykt point; but even on the equator it does not quite get there. On the horizon of Cuba (21° N) the difference is still 2.7 degrees; on

the horizon in Georgia (31° N), about 5 degrees. Leif's description of the country in the saga rules out the possibility that he penetrated further south than Florida; however, on this coast the sun on the shortest day still almost reaches the eykt and dagmál points. The difference amounted to 33° in southern Greenland, in Vinland 3 to 4 degrees, which were no doubt observed, although they have dropped out of the report, which was written down only after three centuries of oral tradition.

The reason why this astronomical method of fixing position must be of Germanic origin and not borrowed from the south (as Frithjof Nansen still maintained) is that it depends on the broad spread along the horizon of sunrise and sunset points: a feature which results from the flattish angle of the sun's path and is found only in northern latitudes. In the Mediterranean regions the sunrise and sunset show little variation with latitude, so that observation and measurement to determine one's position are made more difficult. In Germanic seas and lands the method provides the possibility of measurements up to five times better. The northern practice is never mentioned in southern antiquity; it developed independently from the seafaring experience of the North, and is peculiar to it.

### 7. A country rule for predicting new and full moon

Introductory note. When the moon passes between the earth and sun it usually disappears in the sun's glare and cannot be seen. Nevertheless, it is visible from time to time in this position, if its journey brings it exactly in front of the sun, so that the latter is eclipsed behind it. The time of appearance of the first delicate crescent, once the moon has passed through, is irregular. In southerly latitudes the month began with the new light, whose

first sighting was proclaimed. In Germanic latitudes the time of, appearance of the first crescent varies, even in a clear sky, between 1 and 3 days; reason enough to fix the beginning of the month by other means.

The great Germanic military king Ariovistus, Caesar's opponent, was advised by the matrons following the army not to give battle before the new moon [6]. Since this was a highly important decision, these matrons must also have been in a position to advise Ariovistus as to the day when new moon fell – assuming that he was unable to find it himself. If the sky was overcast this could only be done by calculation. When Tacitus, 150 years later, reports that the Germans assemble on certain days, namely at new or full moon, he is therefore correct when he adds that they calculate the number of the day [7]. In Section III on the Germanic Calendar, we shall show from further evidence that the Germanic lunar reckoning started neither from the first sighting nor from new moon, but generally from full moon.

A Swedish popular rule, first recorded in the 17th century, but lying as far from Christian practice as does the primestave, asserts: "All the moon's appearances are dated from full moon. Full moon occurs when the moon stands in the centre of the nightring." Nightring is their name for the cast shadow of the earth, which shows up in the east at sunset, and in the west at sunrise, as a low, broad, dark curve on the horizon opposite the sun, getting larger and larger in the evening till it covers the whole sky and passes into night, and in the morning getting smaller and smaller before the daylight and sunlight rising up opposite, until it is turned to full day. Since the full moon occurs when the moon stands exactly opposite the sun (which happens every 29 or 30 days on average), the country rule is quite correct when it states: "Full moon is when the moon stands at the centre of the nightring."

For predicting the time of new or full moon the country people used the short handspan between the tip of the thumb and the index finger, which marks off some 13 degrees in the sky. Very early on, even back in the primitive Germanic period, as can be verified among all western and northern Germanic peoples, the moon was compared with a cock, which appeared to throw its tail (German "wedel"), the new and old crescents, on the east side of the sun during one half of the month and on the west side during the other half. The metaphor was thus derived from the full moon; today people in southern Germany still say "es wädelt" when it is full moon. They speak of the bad tail, "böser wedel", meaning the waning moon.

From this metaphor of a cock the expression "cock stride", found within the above-mentioned Germanic regions, is used for the amount of sky which the moon can be seen to cover from night to night in its true path eastwards among the stars. This true eastward movement (as distinct from the apparent westward movement reflecting the earth's rotation) can easily be traced hour by hour among the stars at night. The moon returns to the same star (though not exactly the same phase) after about 27.3 (in round figures 27 or 28) nights. This marks the end of the moon's true circuit, used for reckoning the thirteen-month year as described below. The cycle of shape (that is from phase to phase) is not completed till 2½ days later, because to arrive back at the same shape (determined by the light of the sun) the moon must catch up with the sun which has also been moving eastwards in the meantime.

From night to night the moon therefore covers, in its true circuit, 360 degrees divided by 27 or about 13 full degrees. This distance corresponds to the short span and shares with it the name "cock stride", because it is the cock in the sky, the moon, that

makes a complete circuit in 27 or 28 of these strides. With practice one can obtain a quite accurate measure.

Now the Swedish country people, when the moon is waxing, use this handspan to measure the distance between the sun and the moon to the east of it, and find out how many "spans" the moon has progressed from the sun, its position at new moon; that is, how many days have elapsed since new moon. At sunset the distance between the moon and the nightring indicates how many days are left until full moon. During the waning moon, that is when the moon is west of the sun and moving towards it, the number of spans between moon and sun (measured in the morning) indicates how many days are left until new moon; the number of spans (measured before sunset) between the nightring and the moon shows how many days have elapsed since full moon.

This handspan rule can only be used by day, since at night the sun and the nightring are lacking. At night, if the stars are visible, the span allows one to read off immediately the number of days since the moon was at a certain star.

The "cock stride" measure has been known by this name among the Germanic races from the earliest times. The word "tail" indicates the full moon among both the north and the south Germanic peoples. We shall later come across the number of cock strides, 27 or 28, as a basic parameter of the moon's motion, that is as an astronomical unit.

## 8. Observations in the polar night

About 550 AD some Norwegians from the Lofoten Islands reported, on being questioned by the Greek historian Procopius

[8], that in their homeland people counted off days during the sun's upper course, that is, during the period of the midnight sun, by noting how often the sun crossed over the direction of its first rising. This sunrise takes place after the polar night every year at midday in the south point. We may thus safely assume – since the informants are described as especially trustworthy – that this observation was made by using a fixed standpoint and a landmark.

The counting of days in the 40-day polar night was so advanced, according to this report, that the length of the day could be kept track of by observing the moon and stars as they crossed the south point.

The first sunrise in this south point is by custom predicted "somehow" from a mountain summit by special observers. They announce that the sun will become visible again in five days. What kind of observations these were cannot be determined from the "somehow" of the account; we may, however, recall the twilight observations by Star Oddi (see below) in Iceland, which can be shown to rest on Norwegian practice. The account also states explicitly that the five days "that were left of the darkness (twilight)" were kept as a great feast. Some sort of twilight observation must therefore have been in use.

Incidentally, during the 40 days when the sun is invisible the moon goes through 1½ cycles; so the northerners in this report, who calculated the sun's return by the moon's cycles and by counting the days, must have got to know the number of days needed for the moon's own cycles – both the 27 to 28 days of its true course through the stars, and the 29 to 30 days of its constantly varying phase.

(On the Nordic solar year, see Section III on the calendar.)

## 9. The circumpolar moon

Introductory note. Whilst the sun, as seen north of the 66th parallel near the summer or winter solstice, remains above or below the horizon for 24 hours at a time, the moon (whose declination varies between 18.5 and 28.5 degrees every 18.6 years) shows the same behaviour over a cycle of 19 years; and also, irrespective of its phase, in each of its 27.3-day circuits among the stars. North of the Lofoten Islands, in the years of greatest declination, the moon remains above or below the horizon for an average of 7 days at a time; between these two periods there are some 14 days during which the moon rises and sets somewhere between the north and south points of the horizon. As the declination decreases, these periods of permanent visibility or invisibility also decrease, and then, for every latitude north of 61 degrees, begin to increase again in a 19-year cycle.

These phenomena are reported by the Greek historian Diodoros [9]: that in the land of the Hyperboreans the god Apollo visits the earth every 19 years, and dances a round dance without stopping from the spring equinox to the earliest rising of the Pleiades, playing on the cithara and amusing himself on his festival days. In this Greek legend the god himself is made to represent the body that was sacred to him in Greece. The Greeks knew of the 19-year calendar cycle devised by Meton of Athens; this was founded on the 19-year revolution of the moon's nodes. But what the Greeks and other Mediterranean peoples could never experience, or even deduce, was the phenomenon of the circumpolar moon, that is, the permanent circling of the moon above the horizon.

Homer's Greeks had already heard of the bright nights and the circumpolar sun [10]. News of the circumpolar moon could also

have reached them along the ancient routes, if indeed they had not brought this Doric legend with them into the south from their more northerly homeland. But only a first-rate astronomer, who also knew the so-called Great Metonic Year of 19 ordinary years, could recognize and describe the connexion between this and the appearance every 19 years of the circumpolar moon in the high north.

One such notable astronomer was the Greek Pytheas, who visited Norway around 330 BC to see the midnight sun for himself. His object was purely scientific, and the conversation he is reported to have held with the Norwegians of the Trondheim district will have touched not only upon the sun but upon the moon and its behaviour. Probably it was Pytheas himself, in his travelogue "On the Ocean" (now unfortunately lost) who brought an account of the circumpolar moon and its 19-year cycle from the North back to Greece, where it seems to have met with strong disbelief.

It is important here that this report can be derived only from an observation in the Germanic North. But since Pytheas himself spent only a few weeks in summer among the Trondheimers, he cannot have obtained the period of this phenomenon from his Northerners themselves, on whose astronomical knowledge he relied in other cases, as shown by a surviving fragment of his book [11].

Probably Diodorus, as was his custom, took this account from a reputable author, who can only have been Pytheas. We may conclude that the 19-year cycle of the circumpolar moon lay within the knowledge of the Norwegians whom Pytheas questioned.

## 10. Oddi Helgason

At the end of the tenth century AD, back in Pagan times, Oddi Helgason lived on the farmstead Muli in northern Iceland as one of farmer Thord's workmen. The Reikiadal valley, above whose northern entrance the farmstead lay on a spur of rock, was settled about 900 by a Norwegian family from Hardanger; Thord and Oddi were probably cousins. This explains why Oddi, though not a skilful worker and – coming from a large family – without means (but on the other hand described as very loyal and truthful, and skilled in time reckoning beyond anyone else at that time) was well treated by Thord. All this is reported in a short ancient saga, "Star Oddi's Dream" [12]. From it we learn his nickname, also that he looked after Thord's fishery on the island of Flatey on the north coast (66° 10′ N), and that he was in the habit of observing the stars on clear nights.

A few astronomical reports by this Thor-worshipping Icelander are preserved in a 12th-century church manuscript on time reckoning, under the name "Oddi's calculations" (Odda tala).

The first of these traditions (O I) compares the church's new calendar of 365¼ days with the Icelandic-Norwegian year, and explains how the true divisions of the year (solstices and equinoxes), current in the North and correctly observed by Oddi, move about within the new Julian leap year cycle of 4 years. The discussion is shrewd and correctly thought out. The problem to be solved is without any foreign analogue, for it could only arise and have any meaning in the clash between these two particular calendar systems.

The second tradition of Oddi (O II) concerns the increase and decrease of the sun's height at midday; the third tradition (O III),

the northward and southward movenient of the twilight zone on the horizon.

It is quite clear that the star observations from which Oddi got his nickname have not been preserved; even about the moon we hear nothing. The three traditions that have been preserved deal with the sun's motion; all three of them are attempts to find natural laws.

## The sun's height at midday

Around 1000 AD the sun at noon on the shortest day (winter solstice), as seen from Flatey, stood only 0° 35′ above the southpoint on the open horizon; at noon on the longest day (summer solstice), 47° 20′. Oddi expressed this increase in terms of an arithmetic progression; he measured not with a grid but with the natural units of the sun's diameter and radius. Since Oddi gave to each of the 26 weeks between the solstices an increase that was either 1 radius larger or 1 radius smaller than in the previous week, he established the total increase as 182 radii. The tradition states:

"The sun's path increases to the sight by ½ a sun wheel in the first week after the (winter) solstice; in the second week, 1 wheel; in the 3rd week, 1½; in the 4th, 2 wheels; in the 5th 2½; in the 6th 3; in the 7th 3½; in the 8th 4; in the 9th 4½; in the 10th 5; in the 11th 5½; in the 12th 6; in the 13th 6½; in the 14th likewise 6½. In these two weeks the sun's course increases the most, because here is the midpoint between the solstices (and the weeks join up four nights before St. Gregory's Day, that is, 16th March Old Style). In the 15th week the sun's course increases by 6 wheels, in the 16th by 5½; in the 17th 5; in the 18th 4½; in the 19th 4; in the 20th 3½; in the 21st 3; in the 22nd 2½; in the 23rd 2; in

the 24th 1½; in the 25th 1; in the 26th ½ a wheel. There the summer solstice has been reached, and by the same amounts as it has counted during its increase, the sun's course now decreases. (In autumn the midpoint between the solstices is Holy Cross Day, that is, 14th September Old Style)."

A comparison with the true situation around the year 1000 AD results in the accompanying graph (Fig. 8), which shows a good approximation. The reason why complete agreement is lacking probably lies not in mistakes of observation but in Oddi's theory, for which it was necessary to assume perfect regularity in the sun's motion (as still with Eudoxos among the Greeks).

In spite of this shortcoming, which is to be charged less to Oddi the observer than to Oddi the theorist, the resulting error in the theoretical maximum declination is only 0.7 degree. To put it another way., assuming the declination to be correct, the mean value for the apparent radius comes to 15.5′, which approximates well to the true value of 15.8′ in the summer and 16.0′ in winter. Medieval Europe at that time (Bede, Honorius) estimated the sun's apparent diameter three times too large (1° 40′).

The comments in "Oddi's calculations" referring to the saints' days do not belong to him, but to the church's transcription of an oral tradition.

## Movement of the twilight direction

Introductory note. When the sun is at a certain depth below the horizon, it sends a first, scarcely noticeable arc of light of a certain size up over the horizon: this we call, in the evening, the end of twilight, and in the morning, the beginning. The centre of this arc stands directly above the sun's position, and, for a given depth of

the sun, always has the same size. As the sun's daily path moves north towards the summer, these arcs of light also move northwards day by day; then back south towards the winter.

Oddi Helgason observed on Flatey when a twilight arc of a certain size appeared in the 16 astronomical directions, and thus how many days were needed to move from one of these directions to the next. He established the speeding up towards the summer, and the slowing down towards the winter. Oddi took this fixed size of the twilight arc as the definition of daybreak. The report (O III) states:

"Oddi (worked out that St. Andrew's day [30th November] and the fifth day of Yule were the same length. He) places daybreak on those days in the ESE, its setting in WSW. (From the fifth day of Yule) he counts off 43 nights until daybreak in the E and nightfall in the W (that is on St. Scholastica's day [10th February]). Then there are 25 nights until daybreak (nightfall) in ENE (WNW), (that is 5 nights before St. Gregory's day [12th March]); then 18 nights until daybreak in the _NE and nightfall in NW (that is on Lady Day [25th March]). Then 10 nights go by until daybreak in NNE and nightfall in NNW. The 5 nights go by until daylight no longer vanishes (that is 5 nights before Sts. Tiburtius and Valerianus [14th April]). Then 134 nights go by until daylight almost vanishes (that is 6 nights after the Assumption [15th August]), and the nights begin to lengthen in the same way as was counted for their shortening; that is 1 ætt in 5 nights, the second in 10, the third in 18, the fourth in 25, and the fifth ætt in 43 nights (thus arriving at St. Andrew's day)."

The Julian dates (here parenthesized) place the beginning of the year, that is, the winter solstice, for that period between St. Andrew's day and the fifth day of Yule, that is, between 30th

November and 29th December Old Style, and thus at midnight on 14/15th December. In the middle of the 134 bright nights lies the summer solstice on 15th June. Calculation shows that the twilight directions apply to a position of the sun about 14 degrees below the horizon in 66° 10′ north, that is, the latitude of Flatey and Oddi's observation point.

It is not a question here of measuring brightness or the visibility of stars, but fixing the centre of the very small twilight arc – a method of fixing the twilight direction which is meaningful only if applied to the same size of arc throughout the year. Oddi's results are so exact that they correspond to an error in time of only about plus or minus 5 minutes. At the same time, this proves the exactness of his astronomical directions, especially the N–S axis (the meridian).

While the results for the first sequence, used for finding the sun's height at noon throughout the year, were marred by theoretical influences, the movement of the twilight remains within the realms of observation. All three traditions in "Oddi's Calculations" serve the investigation of natural law.

All three traditions work with a year of 365 days, which is compared with the new Julian year of 365¼ days in the first sequence only. Oddi always begins his counting and observations with the winter solstice, which he consistently places in the middle of the night; thus making it take place at the north point, the sun's lowest point on the shortest day. In Oddi's time (1000 AD) this fell on 15th December Old Style and did not pass into 14th December until about 1100.

Meanwhile the western Middle Ages long continued to calculate with the Julian year points, which had become more and more inaccurate since Caesar's time. More accurate

determinations began to appear from time to time within the church in the 11th century, and then, in the two known instances (Wilhelm von Hirschau, Hermann the Lame), only under GraecoArabic influence. Iceland remained untouched by this influence until 1173.

Oddi Helgason stands at the close of a preChristian astronomy; the accuracy of his observations, even in the fragmentary traditions, appears wonderful.

## III. The calendar

Like the determination of place and direction, the calendar too is a child of the heavens. Calendar words and time words, today as at all times, go back to observations of the sky.

The short span of a month is defined by the moon in two ways: by its true circuit from star to star in 27 to 28 days, and by the cycle of its phases (from new to new or full to full) in 29 to 30 days. Our modern calendar months have nothing to do with the moon: they are divisions of the solar year.

The course of the year (representing the time taken for the earth to orbit the sun) can be fixed by the stars or the sun. The star year is reckoned from the first appearance (earliest rising) of a time constellation (such as the Pleiades) in the eastern night sky just before sunrise. This observation easily becomes inaccurate owing to haze and varying heights of horizon; also, the time when the marker constellation appears depends on the latitude of the site. A more reliable method is provided by the movement of the sunrise and sunset points along the horizon, which keep in step with the seasons. The modern astronomical year is reckoned from spring to spring, from one northward crossing of the sun over the equator to the next (equinoctial year); the Germanic year was, as we shall see, reckoned from solstice to solstice.

The old-fashioned objections to an independent development, among Germanic peoples, of the solar year, whose length (it is said) they would not have been able to calculate as a fixed number of days, fail to consider that the sky presents a different aspect to northern peoples than in the Mediterranean region, from which they are alleged to have received their calendar. The great difficulty of fixing the day of the solstice in Greece was complained of as late

as 150 BC by their most notable astronomer, Hipparchos; by Greek accounts the sun stays in its solstice position for about 40 days. But in northern latitudes, with a much flatter path, this period of time is reduced to a few days, thus making it far easier to find the middle day of the solstice period. We have seen the simple fisherman Oddi Helgason in northern Iceland observing the solstice day exactly. It may also be assumed that Oddi's method, like his reckoning of 365 days to a year, goes back to Norway, where he probably came from. Moreover, Christian traditions show that in the ancient North the solstice was universally regarded as one particular day, which governed the calendar and thus the holding of the Althing (Parliament). It is well known that the western Middle Ages, until the invasion of Graeco-Arabic astronomy, kept to the year points fixed by Julius Caesar and the Council of Nicea; Christmas for the Middle Ages fell on 25th December, and the year point on 21st December (Old Style), whereas in Iceland, long before Christianity was introduced, the shortest day was correctly placed in the middle of December.

Further, where people were anxious to hold their important festivals, which fell at full moon, at a fixed season of the year, in spring, autumn or winter, they had to reconcile their count of lunar cycles with the solar year. In this way experiments with leap years began, leading up to the bound lunar year. As mentioned in the introduction, this type of calendar is still denied to be an independent Germanic development.

The western Middle Ages, in other words the ancient Church, took over the Julian solar year from the Romans, and borrowed their bound lunar year (as used along with the solar year to decide the date of Easter) with its nineteen-year rule, from the Greeks. According to the creation poems in the Edda, the sun, moon and

stars were given regular paths by the divine ones in order to measure out time; and these poems therefore tell us that the Germanic calendar was not taken from the Greeks or Romans, but directly from the divine order of the heavens: in other words it was based upon observation.

We have to investigate the historical sources still available to us. Some of these are older than all poems of the Edda, although the substance of those poems may go as far back in time as the oldest historical sources. We shall see that whereas the Middle Ages based their calendar on borrowing, and were penalized for turning their backs on Nature by a total inability to develop, and a conformity to rules that verged on the ridiculous, Germanic reckoning then and at earlier times owed its many-sided developments to independent observation of the sky.

## The star year

As the constellation that marked the beginning of the star year, the Pleiades were most often used. It is possible that apart from the later name "Seven Stars" these were also known as the "Herd of Boars". The emergence of the sky god's sacred animal, the Yule boar and oath boar, after whom Odin's wedge-shaped battalion, and the troops at the head of the army, were named [13], could very well serve as the start of a new year. When in the Middle Ages it was said that the cuckoo was silent as long as the Pleiades were invisible, it meant that the Seven Stars were invisible until they reappeared as a time marker in the darkness just before sunrise. Again, the expression "mother hen with twelve (not seven) chicks" appears to denote the start of a new year.

Another constellation that can be identified as a year-marker is Orion, with its Germanic names "the Rake, the Three Reapers, the Plough, Frigga's Distaff". By its early rising this magnificent figure told the farmer the beginning of harvest, the time to plough, and in the North the flax harvest.

There is no surviving evidence for the use of the star year in the calendar of the Germanic peoples. It must be assumed that it had already been dropped in prehistoric times, in favour of the more advanced types of calendar, the solar and lunar years.

### 1. The old Norwegian solar year

Some 330 years before our era Pytheas (see Section II.9) asked for and received from the Norwegians in Trondheim the sun's rising and setting points on the shortest day, along with the difference in position in higher or lower latitudes; and this was in the summer, when these phenomena were not visible. The sun's position at the solstice was part of their stock of astronomical knowledge. Nine hundred years later, on the same Norwegian coast, but beyond the Artic circle, the sun's return after the 40-day polar night was observed "according to custom". This account too, written down by Prokopios about 550 AD, comes directly from the Norwegians themselves. Since the account states that the last 5 days (of the 365-day year) before the reappearance of the sun were kept as the chief festival of the year, it follows that in order not to miss this 5-day festival the days of the year would have to be counted carefully from 1 to 360. The counting of the 5 days proves the counting of the 360 days. Indeed, we have seen from the accounts already quoted how important this counting of days was to them, and that during the polar night, that is the first 35 days during which the sun stayed below the horizon, they used the transit of the moon

and stars through the south point as an aid to marking off the days correctly. Here, then, we are dealing with a calendar, namely a solar year, based upon obsevation and having a length of (365 – 5 =) 360 days. (See Fig. 9.)

We come across essentially the same solar year of 360 days a few centuries later again in Iceland, settled by the Norwegians and at that time still Pagan. There it was reckoned as twelve 30-day months plus (in Icelandic style, as a result of a mistake made in the settlement period and resulting from a desire for a whole number of weeks, not five but) four extra days. Since this kind of calendar, like the Norwegian one, is altogether non-Christian and thus not an import into the North from medieval Europe, and moreover cannot have been devised in Iceland, it follows that the Icelandic calendar is probably just a corruption of an old Norwegian one, imported from Norway; whence in turn we may infer that the Norwegian solar year of 360 days was reckoned as twelve "months" of 30 nights each. Since the new year was fixed by annual observations, no intercalary day was necessary. The five remaining days, in which the chief festival of the year was held, were "leapt over" in the calculations after every 12 months (Icelandic hlaupa, that is, a leaping over); the new year began with the first day of the first month. This leaping over, instead of an extra (intercalary) day, is apparently of high antiquity.

## 2. The thirteen-month year

In the Germanic region as a whole, as distinct from western and southern Europe, it appears that in very early times, perhaps even before the Roman weekday names were adopted in the 4th century, a year of thirteen 28-day months was in use, such as is found in neither Roman nor medieval Christian time reckoning.

The continuous seven-day week, which was probably older in Asia Minor than in Rome, is already described in the Allemanic laws around 600 AD as "an old custom". The well-known riddle of the year tree generally counts twelve boughs for the months, except that in the Germanic region, and the Finnish borders influenced by it, the year tree has thirteen boughs.

"A tree has thirteen boughs and each bough has four nests and in each nest seven young ones."

"I know a tree high on the hills with thirteen boughs four twigs on each bough", etc.

or in the Faroes:

"I know a tree on top of the hill with thirteen boughs."

How deep-rooted this calendar was can be seen from the fact that in Germany Albrecht Dürer (in a letter to Jakob Heller written in 1508) was still counting 13 months to the year, as Norway did officially even in the 17th century [14]. The name "Thirteenth Day" (instead of "Twelfth Day") for the Christian 6th January, as a prophetic day for the 13 (not 12) months, is a reminder of this.

It is certain that the Germanic regions, when they adopted the Roman god and planet names for the days of the week, did not at once adopt the Roman (that is Julian) calendar. This innovation was confined to the church's sphere of influence, and Charlemagne's twelve names for the months must be understood in this sense.

This calendar, in the form of 52 seven-day weeks, was introduced into Iceland about 870 AD along with the old Norwegian solar year (of twelve 30-night months and 5 days left over). However, people wished to begin not only every week, but

every one of the thirteen months, and every year, with the same day of the week (Thursday). But since the 52 weeks amounted to only 364 days, the 365th had to be leapt over, just as the 5 extra Norwegian days were left over. In Asia Minor this leaping over of the 365th day was general. It must also have been the custom in Scandinavia, since the Norwegians, as we have seen, were well aware of the 365 days in the solar year. But in the confusion of the settlement period the Icelanders forgot this leap day, so that their calendar very soon gained appreciably over the seasons.

This, however, the Pagan Icelanders noticed very quickly for themselves from the sun's movements, and it was Thorstein Surt in western Iceland who around 950 advised the Icelanders to insert a full week, every seven years at first, and then at shorter intervals as the length of the year became known more accurately. Thorstein's extra week was based on comparison not with the Julian year but with the actual solstice. This calendar, unique in the history of time reckoning and better managed subsequently than the Julian one, lasted in Iceland until our own time.

The dependence of the new year (the first day of summer) upon the solstice is shown once again by a decision of the Pagan Althing in 999, by which the first day of summer in every year was to fall ten weeks before the Althing. In Christian times this interval was retained, when (in Julian terms) the Althing was placed on 24th June and the first day of summer ten weeks earlier on 14th April. The pre-Christian beginning of summer appears from this to be the evening when the sun's upper edge vanishes at the WNW point, just as by other accounts the beginning of winter was defined by sunset at the WSW point, the "eykt point" (see Fig. 2 in the June issue).

The young Icelandic free state begins its time reckoning with two forms of the solar year. Of the moon, we hear no more.

### 3. The Anglo-Saxon and Old Saxon lunar year

Introductory note. The sun's yearly course of 365 or 366 days includes twelve complete lunar cycles of 29½ days, which total 354 or 355 days. The solar year always begins on the same date. If (as happens only at long intervals) the solar and lunar years happen to begin on the same day, then within the first solar year there fall not only twelve complete lunar cycles, but 11 or 12 days of the thirteenth. The remaining 19 or 20 days of this last cycle overlap into the second solar year. Thus the first lunar year has 13 cycles, and the second lunar year begins 19 or 20 days after the second solar year. Now, assuming that the lunar year is required to start as close as possible to the start of the solar year, the start of the third lunar year can fall behind again by 11 or 12 days without coming ahead of the start of the solar year. Thus the second lunar year has only 12 months; it is a "common" lunar year as opposed to a "leap" year of 13 months. Such a variable lunar year, based on the attempt to reconcile it with the solar year, is often called a "bound" lunar year (as opposed to the "free" lunar year running independently of the seasons) [15].

In 725 the Anglo-Saxon church historian Bede [16] reported on the calendar of his Pagan forebears, who had migrated from the Germanic lands into Britain. They reckoned their year by the moon, and from time to time added a thirteenth month. This 13-month year used to be called Thrilidus, because in addition to the two months called Lida in the summer half year a third month of the same name was inserted.

The solar year began with "the turning of the sun towards longer days", that is, with the longest night, which they called "mothers' night" [17]. They divided the lunar year into winter and summer halves, and began the winter half year with the full moon Winterfyllith (winter full moon), corresponding roughly to the Julian October. Besides two summer months with the same name Lida (either "mild" or "travelling" month) they had two Yule months in winter. At the full moon that ended the first Yule month and began the second, they held their Yule festival, also called "midwinter" because it was taken as the precise midpoint of the winter half year. In relation to the solar year, this feast was movable like the full moon; but it always fell on the first full moon after the shortest day ("mothers' night"), which in the 7th century fell on 18th December (not 25th December as Bede states).

Three full moon cycles after Yule, on the fourth full moon after the shortest day, there began the summer half year, in the middle of which the third Lida month was intercalated in lunar "leap years". Bede has not left us any rule for intercalation, but we have a rule from Scandinavia that probably goes back to older Germanic times (see below).

The bound lunar year described by Bede is derived by him from the immigrant Germanic peoples, and thus from the ancient Saxons. The months Eostre and Hretha named by him are also attested in Germany; Yule month is current all over the Germanic North; the Goths also had two consecutive Yule months (and probably their festival at full moon). The month Thrimilki, assigned by Bede to May, in which cows could be milked three times a day ("given the fruitfulness of Britain or Germany") can no longer be proved in Germany, but its name is still in use in Sweden and Norway.

We may conclude that this form of the bound lunar year was prevalent in the Germanic homelands before the Anglo-Saxon migrations, that is, in the first centuries of our era. In fact, it fits in with the accounts of Caesar and Tacitus at that period (see below).

## 4. The old Faroese lunar year

Introductory note. The 25 or so little "sheep islands" (Faer Oer) in the Atlantic Ocean were settled in the 9th century by Norwegians. Amid the isolation of the Faroese people, wholly dependent on fishing for their livelihood, there developed a form of the bound lunar year that is unique on earth.

The Faroese name for the moon, which at the winter full moon in these latitudes (62° N) circles above the horizon for an average of 17 or 18 hours, was "night sun". The months themselves were called "suns"; the new crescent "sun coming"; the full moon (when the disk begins to shrink) was "sun turning" or "full sun". Like all Germanic peoples they distinguished winter and summer halves of their lunar year, which, like the Angles and Saxon and (as we shall see) the Norwegians, they bound to the shortest day.

Since the islanders' livelihood depended on starting the fishing season at the right time (because the fish migrations begin regularly at the same time every year), they could not use the old form of lunar year that they had brought with them. The required insertion of a whole month every two or three years carried with it the danger of missing the shoals of fish in the main fishing month. Instead of a whole month, they therefore inserted half a month, thus beginning one year at new moon and the next at full moon.

The accounts say that "winter moon" is the one in the sky on the shortest day: the year is a common year if in addition the following summer month ("summer sun") contains the longest day. Next year, however, "summer month" will extend over the longest day only if the required period of time has been intercalated, that is, if "winter moon" has been started not from new moon but from full moon. Through this constant alternation of new moon and full moon years things were adjusted so that the start of the main fishing month (einmánasólin) varied by only a few days each year. "Yule moon" is the moon that is in the sky on the shortest day.

## 5. Date of the Yule festival. The North Germanic lunar year and the eight-year cycle

Introductory note. How could people know at the start of a lunar year that during its course a thirteenth month would have to be inserted? – On which new or full moon was the new lunar year, or the summer or winter half year, to begin? – How could the beginning be fixed if the sky was overcast? – On which day of the lunar or solar year should people attend the high sacrifice or national moot? – These questions could be answered only by a definite rule for intercalation, which for every peasant in the Swedish forest, for every sailor, for every soldier and his commander, was adequate, easy to use, and reliable.

The shortfall of a 12-month lunar year from a solar year (Introductory note to 3.) amounts not to 11 but on average 11½ days; the excess of a 13-month lunar year is not 19 but 19½ days [18]. In the church calendar, which reconciles the solar and lunar years by a 19-year cycle derived from ancient Greece, the above differences are rounded down to 11 and 19 days; in the north

Germanic calendar cycle of 8 years, the church's "eleven rule" came into conflict with the rounding up to 12 and 20 days: the "twelve rule".

The precise date of the Pagan Yule festival has not come down to us directly; we only know that in Norway in the 10th century it was shifted from its Pagan date, namely "midwinter's day", to the Julian 25th December. Things were different with the great Swedish sacrifice to Dis (the goddess of Fate), at a national festival in Uppsala; this, when sacrificial rites were abolished, was simply converted into the Disting Fair, keeping its old date on the full moon of Disting month. The Disting moon was an actual lunar cycle and took its name from the Pagan sacrifice to Dis. In Christian times the rule ran: Disting lies on the full moon following the first full moon after midnight of 6th/7th January.

Before the Disting moon the Yule moon invariably ran its course round the sky; the present Norwegian country rule still confirms this, when it says that the Yule moon is the one in the sky on 6th January, and then follows the Disting moon. But, just as the latter got its name from the Pagan sacrifice to Dis, so the Yule moon can only have got its name from the Pagan Yule festival. This fell on the full moon of every Yule moon and was therefore (like all Germanic sacrificial festivals) not fixed within the solar year, but a movable feast. The transfer of the Yule festival from its Pagan date to the Christian 25th December (proposed by Haakon the Good, but owing to Pagan opposition not carried out till later) was a transfer from the Pagan lunar year to the Julian-Christian solar year. The statement by Snorri Sturluson that Yule fell on the Pagan "midwinter's day" is confirmed. Once again, the reference is to the full moon in the middle of the six-month winter half of the lunar year, as among the Anglo-Saxon and Faroese, and probably all Germanic races.

Now the 6th January mentioned in the rule is an ecclesiastical date, quite unknown in the Pagan calendar. The point in the Pagan solar and lunar calendar that later became the Church's 6th January can be calculated by means of the Germanic "twelve rule". The Church bases its calendar on an "eleven rule", in that it calculates not 12 but 11 days difference between the 12-month lunar year and the solar year. The 6th of January is known in Germanic lands as the "Thirteenth Day"; on this day, 12 full days have elapsed since 25th December. Now there exists an east Finnish rule for intercalation borrowed from Scandinavia: there is to be a "leap" year, that is, 13 months must be counted in the coming year, if the first new moon falls before 6th January; and the significance of this date is that 12 full days have gone by since the mark day, here 25th December. The Finno-Scandinavian rule for leap years agrees with the Norwego-Swedish rule for Disting. We see, however, that 6th January can only be the dividing date because 12 (not 11) full days before that was 25th December, that is, the first day of Yule as a mark day, that is, start of the Julian solar year. Both these dates are purely Christian, but the calculation is inconsistent with the Church's use of eleven, based upon Meton's rules. However, if on the one hand this practice is not Christian, and on the other hand the Disting Fair kept to its Pagan date in Christian times, the only assumption left to us is that the Norwegian, Swedish and east Finnish twelve-rule, using 6th January, has preserved in its Christian-Julian framework the pre-Christian dividing date for the leap year rule. This conclusion can be verified quite conclusively by calculating from the date of the old Danish chief sacrifice at Lejre in Sjælland (Zealand), abolished in the year 934 AD.

As to this Danish national festival, Thietmar of Merseburg [19] reports around 1000 that it was held every 8 full years, with 99

heads of sacrificial beasts being offered each time, and this was "in January after the time when we (Christians) celebrate our Lord's epiphany (6th January)." Thietmar is trying to express the Pagan date in Christian-Julian form. We see from this that 6th January played a decisive role even in Pagan times, which had no such way of expressing it. Interpreting this expression with the help of the Scandinavian twelve-rule, we see that it coincides with the full moon following the first new moon after the shortest day at that epoch (16th December Old Style); and that not only the east Finnish rule, but also the Pagan Danish Lejre rule around 900 resembles the later Norwegian-Danish rule for the Yule moon and Disting moon. Just as the three-day Yule festival in the North fell on the full moon following the first new moon after the shortest day, and Disting fell on the full moon following the second new moon, so the Danish festival fell, every eighth year, on the same full moon as Yule.

As with the Anglo-Saxons and the Goths, all these high sacrifices were held at full moon and were thus "movable" feasts. We understand why Thietmar did not simply express the time of the Danish sacrifice as a fixed date; but we must recognize that in saying it falls between 6th and 31st January he has described it as accurately as anyone can express, in terms of the Julian solar year, a movable date of the lunar year bound to the solar year.

The old Danish national sacrifice at Lejre, abolished in the 10th century, was held at Yule "after every 8 full years". In Sweden there was a similar national sacrifice at Uppsala, which was also held "after every 8 full years", admittedly not at Yule but "around the spring equinox". The vagueness with which this time is given nevertheless allows the conclusion: the high sacrifice at Uppsala was also held on a full moon depending on the shortest day.

However, the times of these high sacrifices, both of which were 8-yearly sacrifices in the lunar calendar, must have been based upon the same rule. In the account by Adam of Bremen [20], the Swedish sacrificial heads were 72 in number, and it is clearly stated that nine of these were allotted to each of the eight days of the festival; at the Lejre sacrifice there were 99 heads. Since each 8-year interval contained 99 lunar cycles, it seems that the number of sacrificial heads, 99 every 8 years, contains a time symbol. Similarly the high sacrifice at Uppsala every eight years consists of an eight-part sacrifice with nine kinds of animal in each part. Thus the national sacrifice at Uppsala will have been fixed by the same twelve-rule as the Danish high sacrifice, the Pagan Yule festival, and the Disting at Uppsala.

This old intercalary rule, which we have already proved to be in use in the 10th century, has been handed down quite clearly, although at a late period, in Uppsala itself. At the Disting Fair in Uppsala in 1689, a well-known Swedish doctor, Olof Rudbeck, came across a grey-haired peasant with a runestave, and was told the following intercalary rule for the Disting full moon:

The moon steps 12 and 20 during Aun.

The last expression seems to be a special term for the period in which the moon's "step" takes place. But the numbers 12 and 20 (instead of 11 and 19) are precisely those on which our rules and calculations are based, and which confirm the calendrical connexion found above between the Norwegian Yule moon, the Swedish Disting moon, the east Finnish and Scandinavian leap year, and the Danish and Swedish national sacrifices at Lejre and Uppsala.

Consequently, the rule told to Rudbeck would appear to be a deliberate statement of an eight-year rule. After an arithmetical

series this rule returns to its starting point after every eight terms: if we assume that in the first year the solar and lunar years begin on the same day, then the beginning of the lunar year falls as follows:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| in year | I | | on day | 1 | | | | | |
| | | | | | +20 | | | = 13 | months |
| „ | „ | II | „ | „ | 21 | | | | |
| | | | | | −12 | | | = 12 | „ |
| „ | „ | III | „ | „ | 9 | | | | |
| | | | | | +20 | | | = 13 | „ |
| „ | „ | IV | „ | „ | 29 | | | | |
| | | | | | −12 | | | = 12 | „ |
| „ | „ | V | „ | „ | 17 | | | | |
| | | | | | −12 | | | = 12 | „ |
| „ | „ | VI | „ | „ | 5 | | | | |
| | | | | | +20 | | | = 13 | „ |
| „ | „ | VII | „ | „ | 25 | | | | |
| | | | | | −12 | | | = 12 | „ |
| „ | „ | VIII | „ | „ | 13 | | | | |
| | | | | | −12 | | | = 12 | „ |
| „ | „ | I | „ | „ | 1 as above. | | | | |

With the ninth year the series begins afresh. The use of an eight-year cycle is historically confirmed by Lejre and Uppsala, but also the eight-year rule is prevalent in Swedish provincial law, in Swedish and Danish folksong, and in the old Norwegian songs of Thor; it is also attested in Germanic myth and even early Germanic verse drama.

The equating of 8 solar years to 8 lunar years plus 3 intercalary months fails at the end of a cycle by 1½ days, and after another 8-year cycle by 3 days. People would have to make a further intercalary rule, or else begin the series afresh by observation. Probably the latter was done. A general discussion and announcement of the calendar for the forthcoming year is known to us for certain from the Pagan Althing in Iceland. Incidentally

the Church's 19-year rule had fallen behind the true moon by some 2 days around the year 1000, and by 4 days in the 17th century: reason enough for the country people to hold fast to the old practical rules from Pagan times long into the Christian centuries.

The eight-year rule is in no sense a variant of the nineteen-year rule. Using the above arithmetical method, the eleven-rule does not return to its starting point until after 30 years (11 + 19). Quite apart from the error, already mentioned, of this rule in the course of centuries, agreement between the rule and the moon's true phases every 19 years is only brought about by an artificial device (omission of a day every time, the so-called "saltus lunae"). Naturally the rule was not corrected by the Church. But just as the Norwegian and Icelandic solar year was kept in health by yearly observations, so too was the lunar year, by actual observations of the moon. The Disting Fair and the national sacrifices at Lejre and Uppsala were of necessity held at the time of true full moon, because people needed its light.

The ancient Greek eight-year cycle (oktaëteris) regulated the calendar and the sacrificial rites of ancient Greece for many centuries: the Delphic and Olympic periods were (like Lejre and Uppsala) dependent on it and its 99 lunar cycles. The twelve-rule of the Germanic North is however as little in evidence in Greece as in the Christian Middle Ages. The old Germanic eight-year cycle is of native origin.

## 6. The old Germanic lunar year

The bound lunar year in Germanic countries probably goes back to very ancient times. In the great battles between the Romans and

the Germanic Suevi in Alsatia about 58 BC, the Germanic commander Ariovistus was (according to Caesar and others) bound by religious custom not to give battle before new moon. Considering the vital importance of the coming battle, and considering that he could not transgress the law by a hairsbreadth, Ariovistus must have been in a position to fix the true occurrence of new moon (which is normally invisible) even if the sky was overcast for a week.

This was possible only through a tried and tested method of calculation. Tacitus reports explicitly on such calculations about 150 years later, when he says that the Germans "calculate" the number of days so as to take part in meetings, or begin important undertakings. From the accounts of Caesar and Tacitus, the two "tides", new moon and full moon, must have been an integral part of a fixed calendar, no doubt a bound lunar year. The oldest high sacrifices of these West Germans – for instance the autumn festival of the goddess Tamfana [21] in Westphalia – were held at fixed seasons of the year, yet also at new or full moon. Thus the oldest Germanic calendar on record was based on a compromise between the lunar year and the sun's course; but that is the hallmark of the bound lunar year, which only a few centuries later is seen fully fledged in the old Saxon and Anglo-Saxon territories.

## 7. Summary of the Germanic calendar

If researchers have until now denied the independent observation and use of the solar year and bound lunar year, we can now recognize that the Pagan Germanic peoples had in fact developed both types of calendar in various forms, namely:

The Julian calendar was first introduced into the Germanic regions by the medieval Church; even then the Germanic calendars remained in use alongside it for many centuries, in some cases down to our own times [22].

Germanic calendars took the actual appearance of the sky as their foundation. Harmony between rules and observations was achieved in various ways, by intercalation of months, half months, or weeks.

The development of all types of Germanic calendar is based on independent observation of the sky.

# IV. Constellations and cosmology.

Earth I pray, and heaven above … and heaven's might and halls on high. *Anglo-Saxon* [23]

At the end of the 10th century Oddi Helgason (see Section II.10) was named Star Oddi, because "he made a practice of observing the stars". In the Sagas he is not the only person to be so engaged: at almost the same time as Oddi, and also in northern Iceland, lived Einar Eyolfsson (brother of Gudmund the Mighty) who was renowned for his observations and wide knowledge of the constellations. In Sweden the farmer Randulf had a similar reputation, and his sons inherited his knowledge of the stars.

Of all this, nothing remains. With all the more care, then, must we follow up the smallest clue to ancient astronomy, which was doubtless not restricted to those named above. There are more of these clues than one might have dared to hope, and some of them are of such a kind as to give an idea of what has been lost.

## 1. On the nature of the stars

For as far back as historical sources reach, the Germanic concept of the stars has been different from the Babylonian one. Babylon looked upon the stars as gods, just as Augustine saw them as angels. The north Germanic creation myth, which is of high antiquity and probably springs from the earliest Germanic roots, sets the gods as creative forces above the sky and the star world. From the skull of the primeval giant, whose body became the material universe, the gods built the sky. The free-moving glowing darts hurled out from the hostile southern fire world were placed by them as stars in their present places and paths.

Caesar's brief remark [24] that the Germans worshipped the sun god and moon god (along with a god of fire) was not taken up by Tacitus, with his closer knowledge of Germany, when describing Germanic religion 150 years later. Nor is there any mention of star worship among the Germanic peoples in the reports of Christian missionaries, even in the informative letters to Boniface from the Anglo-Saxon bishop David of Winchester. Worship is reserved for "Heaven's might and majesty", that is, the work of the gods themselves.

The stars are fiery by nature: their light is their own. The Germanic opinion that the stars shine by their own light, which seems self-evident to us now, was also argued by Sisebut, king of the West Goths, in his didactic poem written at Toledo in 614 [25]; but the most important spokesmen for the western Middle Ages did not share his view. The 7th-century Spanish bishop Isidore of Seville, and Rabanus Maurus in Germany in the 9th century, two of the most respected doctors of the church in their times, taught with the elder Pliny that the stars receive their light from the sun. By the 13th century this upside-down doctrine had reached Iceland.

## 2. The lode star

Introductory note. The hub of the circling sky does not remain close to the same stars, but (as a result of the precession of the earth's axis around the pole of the ecliptic) traces out a circle in the sky, which does not bring it back to the same star until 26,000 years later. In Neolithic times the pole lay near Alpha Draconis; in the time of Arminius (0 AD/BC) it was already near the star which, around 800 AD, it approached within the moon's apparent

diameter; since 1400 AD it has been in the neighbourhood of our present pole star.

The Germanic term "lode star" denotes a conspicuous star near the hub of the sky, used as a visible direction marker instead of the invisible hub itself. The Middle Ages knew as the "mariners' star" only the bright star at the end of the Little Bear's tail, that is, our present north star or pole star, which in 800 AD stood about 7 degrees, or 14 times the moon's apparent diameter, from the turning-point.

In a medieval Icelandic manuscript, which often blends native ideas with a medieval outlook, two lode stars are given for Iceland: a bright one, most likely our own pole star, and a "not bright" one that traces out only a small circle. Around 800 AD the 26,000-year movement of the turning-point had brought it close to the star 32 Camelopardi Hevelii [26], which although only of 4th of 5th magnitude is easily picked out in the centre of a wide and apparently star-free area. In fact the Chinese at this time used the same star as their Thien Shu ("heaven point") [27]. Since no star besides 32 Camelopardi, the star in the head of the Giraffe, need be considered for early Germanic times, we may interpret the "not bright" second lode star of the Icelandic account as the Vikings' lode star, to which ocean navigation at that time owed its extraordinary achievements. (See the star-map.)

The above-mentioned (see Section II.4) observation of the lode star in a foreign land, but made by lying on the back in native Icelandic style, was intended to find the height of the pole so as to compare it with that at home. In 1500, according to an account by Olaus Magnus of Uppsala, the northern country people were observing the pole (polus arcticus), as distinct from the lode star, in "a wonderful manner". On the terms nail star and navel star,

that is, axle star, see below. The distinction between the true pole and the lode star is apparent throughout the religious myths, and also in the mythology of the sky.

### 3. The mythology of the sky

The northward gaze up to the hub of the sky, as the apparent turning-point of the universe, called forth, in Germanic sacred and astronomical myths, poetic and religious images of great power and grandeur. We cite only a few:

1. The world pillar, Irminsul. The ancient Saxons worshipped a wooden pillar of no small size set in the open air and "representing the supporting post of the universe". The word "representing" in this account by Rudolf of Fulda [28] frees the Saxons from the reproach of idolatry and establishes the macrocosmic meaning of the concept. This pillar was not itself the support of the universe, but only its symbol. The name Irminsul thus originally belonged to the basic concept, not its copy the visible world pillar. The national sanctuary destroyed by Charlemagne in 722 AD was not the only one of its kind. The original was indestructible.

2. In the northern sacred myths of the Edda the pillar is replaced by, among other things, the symbol of the world tree. It is described as a world ash, but evergreen above the heavenly sea (Urd's well), a leafy tree rising through all the worlds, even the roof of Valhalla, the starry hall of the sky. Eagle and hawk, that is sun and moon, nest in its branches. It may tremble, but will remain standing, in the coming holocaust, and being itself immortal, it protects the life of the new and perfect creation.

3. At the same time the world pillar is seen as a sword, on whose point the universe turns. The gods have placed it in the foaming jaws of the primeval wolf (Fenrir) so that it rises up from the earth to the sky. This is called "gagging the wolf" who, chained down, "evermore gazes on the throne of the gods". The world axis is a symbol of divine order.

4. In connection with the sky's rotation, which is seen as the rightward turning upper millstone of the handmill, the world pillar appears as the upright axis of the lower millstone, or of the heavenly mill; agreeing with the ancient Romans, the Hellenes and the Indians in an image of Indo-European origin.

5. In another very old image the circling universe is likened to a spindle constantly turning rightwards in the hands of the divine mother. The yearly rotation of the spindle, like the mill, is known in many Germanic customs. The distaff belonging to the vertical spindle staff is depicted in the northern sky as "Frigg's distaff" (see the next subsection).

These and many other images, like that of the world mountain, the "earth's hazel wand", etc., do not refer to a visible star, but the invisible "centre of the moon's hall", from which the Edda poem says the Norns cast their ropes of fate; not the lode star, but the true turning-point of the sky.

### Stars and constellations

The word "star", whose root is common to all Indo-European languages, appears to have meant originally "the scattered, strewn" (cf. Latin sternere = strew).

The traditional star names do not refer only to single stars; the Germanic peoples, like all others of the world, brought the

profusion of stars, scattered seemingly at random and yet moving in regular paths, into patterns of constellations.

1. The Lode Star (32 Camelopardis) common Germanic; in Anglo-Saxon Tir (= Old Norse Tyr), name of the old sky god (Old Saxon Saxnote).

2. The Lady's Wain (or Wagon) (Ursa Minor), old Icelandic; probably connected with the sky mother, as the great wagon was connected with Woden; east Swedish, North Wagon.

3. Woden's Wain (Ursa Major), Old Dutch; in Old High German, Anglo-Saxon and Old Norse, Charles's (i.e. Woden's) Wain.

4. Day Star (Arcturus), Old Norse; for telling the time.

5. Orendel's (Aurvandil's) Toe (probably Corona Borealis); Old Norse. According to the Edda, placed in the sky by Thor himself as a memorial to his divine power.

6. South Star (Vega), Old Icelandic; probably used in navigation.

7. Frigg's Distaff (Orion's belt), old in Sweden, Denmark and Norway. In Old High German: the Rake, the Three Reapers, the Plough. In Norway, mostly the Three Fishers. Seasonal and nightly time marker.

8. The [Little] Wolf's Jaws (Hyades), Old Icelandic. Directly on the sun's apparent path (ecliptic); see the star-map.

9. The [Great] Wolf's Jaws (Andromeda, Milky Way, surrounding branching point, that is, the great semicircle of stars through Pegasus to Cygnus), old Icelandic. The opening of the jaws is turned towards the pole of the sky. See item (15) below.

10. Battle of the Æsir (Auriga with Capella), old Icelandic. On the Milky Way.

11. The Torch Waver (Procyon), old Icelandic; near the Milky Way, the precursor of:

12. Loki's Brand (Sirius), Icelandic; at the foot of the Milky Way.

13. Seven Stars (Pleiades); common Germanic, Cluck Hen and Evening Hen with seven (also twelve) chicks; perhaps old European. Herd of Boars (old Saxon, Anglo-Saxon), along with Hen perhaps the oldest Pagan description of the year marker (see Section III under "star year").

14. Thiazi's Eyes (probably Castor and Pollux); according to the Edda placed in the sky by Thor as "the greatest memorial to his deeds".

15. Iring's Way (Milky Way), Old Saxon, Anglo-Saxon, Old High German. Its two streams of saliva falling from the Wolf's Jaws are Wan and Wil; the "evil Wan" as Hell's stream and road of the dead, Old High German. In the Edda, Bifrost = shaking bridge, that is, road of the dead, and Fenrir = Wan's Wolf, wolf of the river Wan. The Milky Way is at the same time the "god's bridge" leading from earth to highest Heaven, and thence to Hell.

### 5. Distribution and meaning of the constellations

Apart from a few star names like South Star (Vega), nearly all the stars named are found in the winter half of the sky, probably because of the brightness of summer nights in the North. At the winter solstice, that is, at the astronomical new year of Oddi

Helgason and the mark day of the German solilunar year (Mothers' Night), nearly all the constellations are simultaneously visible in an area of the sky occupying only 1/8 of the whole. At midnight on the shortest day (see star-map), Loki's Brand at that time stands exactly at its culmination in the southern end of the Milky Way, scarcely 10 degrees, that is, a handbreadth, above the horizon. The Great Wolf's Jaws and Orwandil's Toe stand opposite each other as spring and autumn constellations.

There can be no question of chance in the distribution of the constellations. Although handed down from widely separated sources, they are for the most part connected with religious myths. The Edda itself teaches that the two ancient names "Thiazi's Eyes" and "Orwandil's Toe" were not read off from the sky but placed within it to keep the great creative acts of the gods alive in peoples' memories.

The Little Wolf's Jaws stood at that time immediately in the track of the sun and moon, and circled round with them; the Edda tells of wolves descended from the primeval wolf Fenrir, constantly following the sun and moon. The Great Wolf's Jaws open their mighty gape immediately opposite the divine seat where the north star Tir, in Anglo-Saxon tradition, "never flinches". Concerning this shackled wolf, the magnificent song of Eirek (c. 950) makes Odin say: "Evermore the wolf, the grey one, gazes on the throne of the gods".

When autumn is over, in the middle of the winter solstice night, Loki's Brand, preceded by his torch bearer, steps onto the shining bridge of the gods, which at that time leads from the southern horizon to he north seat of the sky and then descends again towards Niflhel. But already the battle of the Æsir has begun on the bridge. It is the Edda's great prophecy of the final battle

between gods and giants, between creation and destruction, whose outcome is to free Baldur and bring creation to perfection.

This setting of religious myth among the stars, which we find consistently among the south, west and north Germanic peoples, contrasts with the purely descriptive and unmythologized picture of the sky among (say) the Arabs or Chinese. Its closest analogue is the Greek ornamentation of the sky with legendary star figures, but even in its ruined form it far superior to the latter both in spiritual greatness and in poetic and descriptive beauty and splendour.

## 6. Cosmology

We must distinguish between the sky and its movements seen as a subject for research and practical use, and the heavenly vault seen as a theme of joy and faith; between scientific and mythic cosmology. The latter, the world of thoughts and images, belongs to the contemplative and creative spirit; the former, the image and concept of the world, to the intellect.

According to the younger Edda, in which Snorri Sturluson tries to teach the bardic arts by accurate renderings of old creation poems, the earth, made from the giant's body, stands firmly in the centre of cosmic space (Ginnungagap); circular in shape, it rises like a mountain (Midgard), sloping down to the north. Around Midgard flows the deep ocean.

Over the Earth, or Irmin's ground, the sky is arched like a round skullcap, placed on the four dwarf corners – north, south, east and west. The sky and stars, like the earth, are originally made from the giant; the ordering, the work of creation, is of divine origin.

In the middle of the universe, that is the pole of the sky, is Asgard, citadel of the gods; at its centre is placed Odin's high seat, from which he oversees all worlds and fates. It is the same "centre of the moon's hall" from which the Norns spin the fate of the world, and even of the gods.

From the depths of the earth, rising above Irmin's ground, the world tree grows through all the worlds, breaking through the gods' starry hall with its golden foliage. Eagle and hawk, probably sun and moon, live in its branches.

It is Ida's whirling meadow, washed around by the stars' circling tracks, yet immortal, in whose centre Asgard is set; the centre of the moon's hall, and the reason why prayers are addressed to the north.

The fragmentary nature of the tradition does not prevent us from cautiously sketching in a few lines of the scientific cosmology.

We recognize the pre-Copernican world view: the earth is fixed; it is the sky that moves. To the wheel cross and the swastika of the rock carvings there correspond in historical times the hub and sky wheel for turning point and rotation. The axis points to the north. The "sky wheel" is the wide track travelled by the sun and moon, north and south of the celestial equator; in the Menglöð [29] myth the latter is depicted as the "wall of the sacred enclosure", which the young sun crosses in spring.

In Christian times the Arctic circle went by a name coming directly from Paganism, the "wheel-nail-circle" (hjól-gadds-hringr). The nail fastens the wheel to its axle. The old Icelandic (probably age-old) term "world nail" likewise refers to the north star (originally 32 Camelopardis), and in the form "nail star" still

extends as far as the Chukchi people of the Bering Strait. The terms "nail" and "hub" are not current in the south, while the Babylonian and Greek "navel of the earth" is lacking in the north.

The fixed stars are fastened to the "upper sky"; beneath, in the lower sky, move the "loose stars" or planets, in regular paths despite their striking looped movements. The stars' motion, the whirling meadow, is supported by the hub; "post and stars" go together in old Norse idiom. This may be compared with the ropes of the Norns, fixed to the centre of the moon's hall.

In ancient India the stars were thought to be fastened to the pole star by "wind ropes". The rotation of the heavenly vault results from the "star wind". For the rotation of the swastika see Section I.2.

The sun's motion, as far as we can tell from the surviving theory of Star Oddi, is seen as regular; the winter and summer halves of the motion are considered to be the same length. Instead of our familiar concept of equal days and nights (equinox), we find in spring and autumn the fixing of "the midpoint between the solstices". This concept is derived from the sun's motion, not, as with the equinox, the brightness of the sky. In winter the solstice invariably takes place at the north point of the lowest path (middle of the longest night), and in summer at the south point of the highest path (middle of the longest day). The universe has a concentric motion.

The "sky wheel" is divided into 8 or 16 sectors when referring to the sun, and 27 or 54 sectors when referring to the moon.

The daily path of the sun, as well as its yearly path and the monthly path of the moon, lies in a broad zone of the sky which

can be divided by the sun of moon, as one wishes. The Babylonian and Greek 12-fold division of the sun's yearly path (every night the rising or setting sun conceals from the southern observer the stars in 1/12 of the sky), along with the signs of the zodiac, cannot be observed in the Germanic region owing to the longer twilight and the bright summer nights. However, the 8-fold and 16-fold division of the sun's daily path were observed and were transferred to the sky wheel.

The moon's circuit in 27 nights divides the sky wheel into 27 star groups. In old Norse terminology the 27 nights are to be counted as 54 half days.

A division into 8, 16, and 27 can already be seen in the ritual disk of the Bronze Age sky chariot from Trundholm in Denmark, while the numerous wheel crosses on the Swedish rock carvings show similar divisions. In historic times this division appears in an astronomical fragment of the Edda, describing the celestial Valhalla with 540 and gates, each with 800 warriors, 43,200 in all, who are to be sent out against the oncoming destruction. Since multiplication by 10 and 100 is attested elsewhere as a Germanic artistic device, the basic astronomical numbers of the sky circle are 54 and 8; they divide up the tracks of the sun and moon through the common multiple 432,000, which is found with the same meaning in ancient India, and explains at last the Aryan-derived numerology in the so-called "Revelation to St. John". The symbolic hall Valhalla is built on astronomical foundations.

A similar division is lacking in Babylon, which divided the moon's path into 24 sectors. These first became known in Iceland through the works of Bede in the 13th century, when the 27-fold division of the moon's true circuit had long been superseded in

the calendar there by a count of 28 nights (four seven-day weeks).

The northward dip of the earth's vault, mentioned in the mythic cosmology (north = downwards), explains the rising of the turning-point (increase in the pole's height) as one travels north, and its lower position in the south. However, we hear nothing about a spherical shape for the earth. Nevertheless, the following observations will have brought the open-minded northern mariner at least to the threshold of understanding the true shape of the earth, with which the West Goth Sisebut was familiar in 614 AD.

The shift in sunrise and sunset directions with latitude, used to find the ship's position; likewise the height of the sun; the regular alteration in the height of the pole and of the stars as a whole (Vega); the need to measure the height of the stars, etc., not against the visible horizon but against eye level, and even to make this a legal requirement; observation of the circumpolar (midnight) sun and also, at longer intervals, the circumpolar moon; the speeding up and slowing down in the direction of sunrise and twilight relative to the horizon (certainly not by Oddi alone); the important and often recorded distinction, used by navigators for recognizing land and setting course (heiti), between full sight and half sight of a mountain, which decreased with increasing distance and grew as one went nearer.

The causes of solar and lunar eclipses were correctly stated by Sisebut, probably on a Gothic-Greek basis. In the Germanic north, information is lacking. The stars shine by their own light.

As reference planes for fixing astronomical directions and altitudes there existed:

These correspond to the Greek and modern systems of the true horizon and celestial equator.

Of the Greek angular grid system there is no trace. In its place stand natural units: the sun's diameter and radius, the moon's daily travel (span), the distance between zenith and pole, etc. However, the stability of these natural units makes them very suitable for recording natural laws, as we see from the surviving number sequences.

## 8. Ocean navigation

Thus it resounded, when smote together The long keel and Kolga's sisters (the waves), As if crag and surf were cleft asunder. Higher still hoisted Helgi the sail, The Vikings flinched not before the surge, Although angrily Aegir's daughter Tried to overturn the oarsman's steed. Edda

The practice of making ocean voyages in the North Atlantic, across 40 degrees of latitude from the North Cape and Spitzbergen down to Morocco and to Vinland on the east coast of North America, has heretofore been considered a mystery because it was thought that Germanic methods were confined to the flight of birds, magic, and a knowledge of ocean currents. In view of the supposed lack of astronomical traditions, reputable researchers have explained away the old accounts of Vinland and Greenland as fables. (See Fig. 10 in the June issue.)

But the use of astronomical phenomena is already apparent in the narrative of the Icelander Bjarni Herjolfsson, who, driven before a storm, became in 968 AD the first European to sight the coast of America. "As soon as they saw the sun again, they were able to mark out the quarters of the sky." But how did Bjarni make

his way from this unknown coast to his destination, namely Greenland? There exist sailing directions from a time before the compass was known, according to which the south Greenland mountain range Hvarf (Cape Farewell) lies "due west" of Bergen in Norway, and indeed both lie on the 60-degree parallel. How did the seamen work out this position and bearing?

Around 1150 AD the compass (lode stone) became known in the Germanic North, where, however, because of the extreme differences in magnetic variation (from 10 degrees in Norway to 45 degrees in Iceland and 80 degrees in Baffin Bay, and then back to 10 degrees in Vinland (as opposed to plus or minus 5 degrees in Iceland) it was useless for keeping track of one's direction. For this reason Columbus still sailed by the North Star.

As an aid to Germanic navigation only the sky need be considered. The art is already referred to in an Anglo-Saxon runic poem from the 7th or 8th century: by day the seamen travel by the sun, at night by the north star. And it was easy to set sail by the latter; with the sun, it was more difficult to keep the prow facing (say) due west. We get some idea of the methods from Oddi's number sequences for the annual movement of the last twilight along the horizon, at his latitude of observation in northern Iceland. A prerequisite for this kind of navigation is to count off the days of the year, which as we have seen was done in the Norwegian calendar around 550 AD. As shown by the determination of the sun's altitude in Baffin Bay, sailors knew such number sequences by heart. Counting off the days, so that the seasonal change in the sun's position could be allowed for, meant that one could find the angle between daybreak (an arc of light of defined size) and due north, and thus find due north itself; in other words, astronomical directions could in practice be worked out from the number sequence. If the sailor in a starry night could

easily keep his course by the lode star, so as the stars faded, his course could be kept by the direction of twilight; and then the sunrise position (as laid down in a similar number sequence) continued the process. At midday the sun's altitude provided, via another number sequence, a new means of orientation; towards evening the direction of sunset and finally the disappearance of twilight handed the ship back to safe steering at night by means of the lode star. The altitudes and rising positions of certain stars (such as "Frigg's Distaff", due east) could help the ship's journey in a similar way, in so far as they had been found by nightly observations on shore. Even the moon's position, whose constant changes had been observed, could help to make these techniques more reliable.

It is clear that sailors waited for favourable winds and weather, not only for the obvious reason, but so that they could also see the stars. Because the stars were invisible in the bright summer nights, spring and autumn were preferred in higher latitudes; the evidence shows that long journeys were undertaken not in summer but in spring. Naddodd, one of the first Norwegians to see Iceland, travelled back from there to the Faroes in autumn; but it must have been late autumn, for it is reported that on his voyage back he saw snow falling on the island, and we may infer that he had waited for a favourable northwest wind, which brought snow to the island but not to him. A Norwegian law, designed to keep people on the land for the summer farmwork, states explicitly that anyone can travel as they choose in spring, autumn, and winter. Nevertheless, it was the custom in winter to lay up the largest trading ships at least.

It is no accident that we possess fragments of astronomical position-finding from the extremes of this vast region, that is, from Vinland and north Greenland; these are basically the

determination of latitude, by various techniques, which however can all be proved to be of independent Germanic origin. The result of comparing these distant observations with astronomical phenomena at home was reported, and is the secret of fixing the ship's position and course. How the necessary observations were carried out in the homeland, Star Oddi has already shown us.

With the heavens as their ally – on which they could rely absolutely – exultant daring, tireless energy, scorn of hardship and death-defying willpower were able to bring about an achievement that was not only unique in its own time, but has no parallel in the cultures of the South.

## Summary and prospects

To evaluate what remains of Germanic astronomy, archaeological science will call upon, after the astronomer, the ethnologist, the Germanist, the mythologist, and the student of religious and cultural history. If the astronomical argument is convincing (as we believe it to be) then a road into the spiritual history of the Germanic races is opened, and a useful technique has been acquired for investigating religious and spiritual history.

We must discover whether any so-called "primitive peoples" have arrived at an eight-year rule, such as we find among the Germanic races, probably as early as the beginning of our era; whether the recorded number sequences (along with those hinted at by such astronomical fragments as the Baffin Bay observation) have analogs among other early cultures, for instance the ancient Romans. If the use of the solar year or bound lunar year (see introduction) is denied to the Germanic races, on the grounds that they did not have the astronomical and mathematical knowledge required, then either the proofs given here for both forms of calendar, or else the prejudice prevailing till now, must be overthrown.

Yet to this early period of the Germanic races have been denied not only mathematical concepts, but even the possibility of conceiving large numbers. Against that opinion I have already noted (in the journal Mannus, 1939) a particular feature of an old Nordic number system, which immediatley leads to the formation of large numbers, and I have also proved that such numbers were actually used. From the difficulties that Bede, the great Anglo-Saxon doctor of the church, had with simple arithmetic, it has been decided that his race as a whole were incapable of mathematical reasoning – a fallacious generalization from the

particular. To create the Uppsala rule, and to develop the various forms of calendar, needed not only simple arithmetic, but also the calculation of a mean value from various kinds of observation. The sum of a number sequence, which for every week between the solstices alters the increase or decrease of the sun's height at midday by half its apparent diameter, is converted by the observer Oddi into a number sequence that tries to represent the slowing down and speeding up of the sun's motion, and does so to a good approximation. That is a proof of mathematical insight, admittedly of the kind normally found only in a few talented people. Yet the whole Greek achievement too reached world importance only in isolated instances. The same arithmetical insight that we find in the above-mentioned number sequences, and clear geometrical thinking, are also shown in Oddi's formula for the shifting of the solstice in the Julian leap year cycle, a question that could only arise in the meeting between Pagan and Christian-Julian calendars, that is, about the year 1000 AD with the angrily disputed but voluntary subjection of Pagan Iceland to the Norwegian Church. We shall refrain from any final judgement. Perhaps there existed higher knowledge than we can establish today; but until further witnesses are called we must rest content with what has been proved so far.

In this short summary we have, of course, barely touched upon such important topics as techniques for finding position on the unknown coasts of America and northern Greenland, the old Faroese instrument for finding latitude and longitude, the sun board and the shadow plank, the water clock in the eykt division, the sunstone, the fine didactic poem of the West Gothic king Sisebut dating from 614 AD, the explanation through Nordic astronomy of the Greek Hyperborean question, and much else. The extent of the destruction amid the mass of significant details

is apparent from the sources and texts, the calculations and techniques, set down in my book Germanische Himmelskunde.

Beyond these traditions, our gaze recedes into the depths of prehistory. The Germanic orientation of the grave, the house, the moot hill, developed independently on an ancient European foundation older than Babylon, at a time when the oldest Germanic concept of the directions also developed from observations of the sun's circular path. Thanks to new professional surveys by the astronomers J. Hopmann and Rolf Müller, the more important instances of prehistoric orientation, such as the stone circles at Odry in West Prussia, discovered and explained by Paul Stephan as early as 1914, the sun window in the Externstein rock tower, with which the name of Wilhelm Teudt is associated, similarly the orientation of Stonehenge towards the solstice, can be taken as proved and their significance as probably established. The orientation theories about Hof Gierke have on the other hand been disproved by the brilliant excavations of Professor H. Reinerth.1

Comparision of these prehistoric stone monuments with written traditions shows a rich and progressive development of astronomy on Germanic soil in the face of severe climatic difficulties, and at times, despite the destruction of historical records, masterly observation and thinking for such early times. The complete independence of Germanic astronomy from southern and eastern antiquity is proved.

1 See Paul Stephan, Mannus 1914, 213 f. – W. Teudt, Germanische Heiligtümer, 1926 f. – H. Röhrig, Heilige Linien durch Ostfriesland, Aurich 1930. – J. Andree, "Die Grabungen an den Externsteinen im J. 1934", Nachr. f. Deutsche Vorzeit 1935, H. 1. – J. Hopmannn, "Die Ortung an den Externsteinen", Mannus 1935, 143 ff. "Methodisches zur vorgeschichtlichen Sternkunde I, II", Mannus 1934, 261 ff; 1935, 373 ff. – H. Reinerth, Excavation report at the Prehistoric Conference in Bremen, 1935. – Rolf Müller, Himmelskundliche Ortung auf nordisch-germanischem Boden, Curt Kabitzsch Leipzig 1936. – For mathematical understanding and for the introduction of the subject into school lessons, see Jos. Hogrebe, Himmelskunde bei den Germanen, Anwendungen und Aufgaben nebst Lösungen, Verlag Otto Salle Frankfurt a. M. 1936: Mathematisch-Naturwissenschaftlich-Technische Bücherei, Band 30.

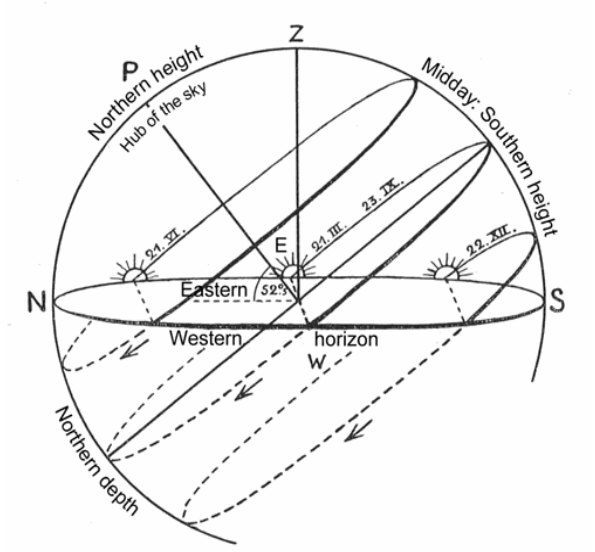



*Fig. 1. Origin of the direction concept. The movement of the sun's daily arc along the horizon between the solstices, N. lat. 52°.5 (Berlin).*

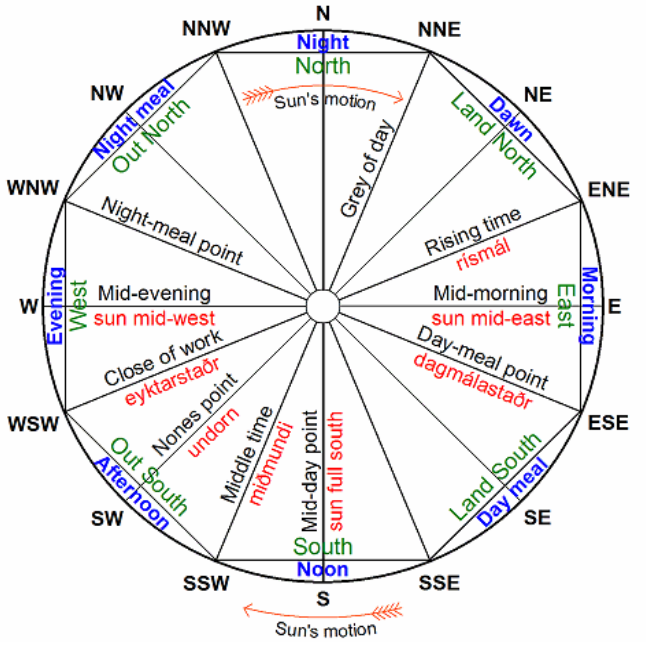



*Fig. 2. Direction concept and solar time (the sky clock).*

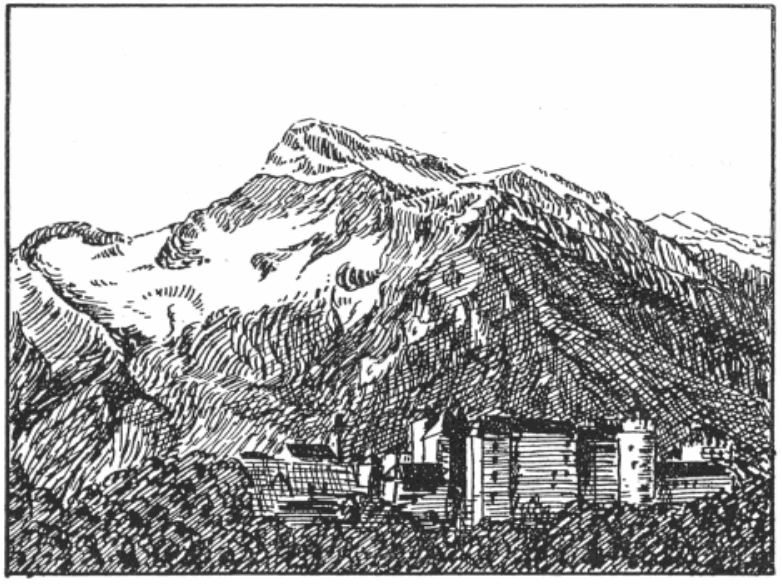


*Fig. 3. Eykt marks in Austria. The range of peaks on the Unter(n)sberg above Hohen-Salzburg.*



*Fig. 4. Determining the sky directions. The midnight sun at the North Cape.*

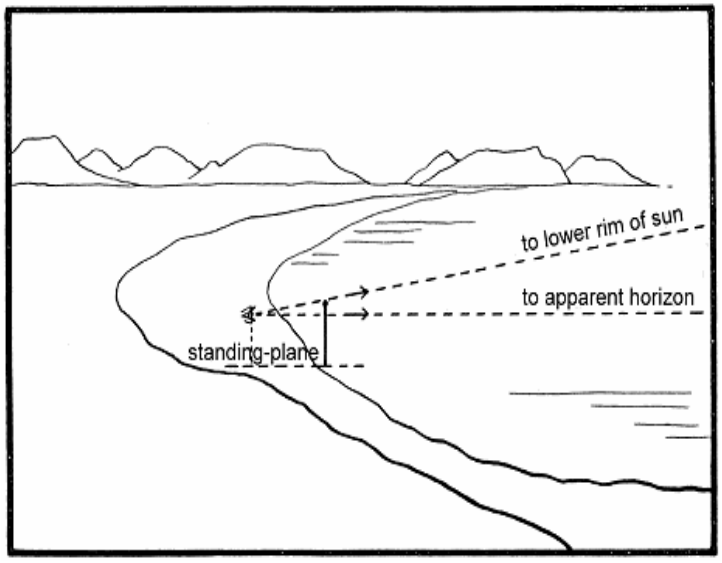



*Fig. 5. Determining the time of day. The "shaft height" of the sun.*

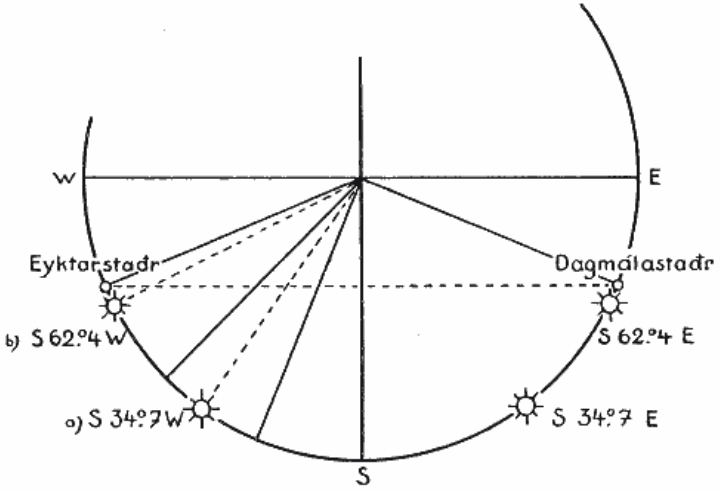



*Fig. 6. Determining latitude by astronomy. The site of Vinland. Distance of the sunset point from the eykt point on the shortest day at two different latitudes: (a) N. lat. 61° (south Greenland, Brattahlid); (b) N. lat. 31° (Georgia, north Florida).*

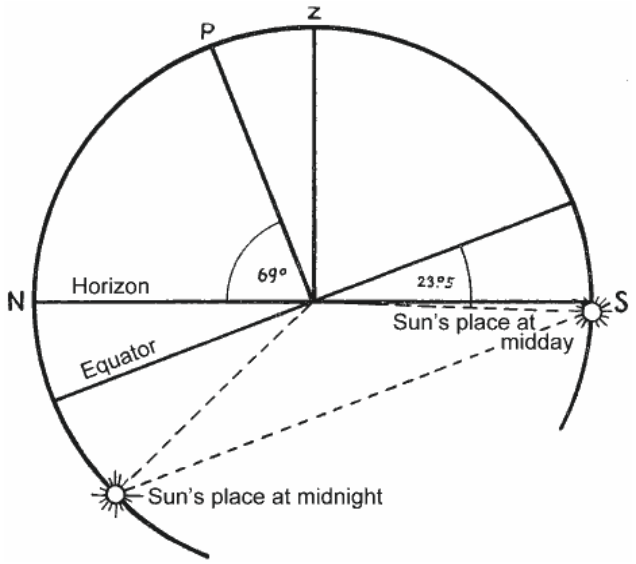



*Fig. 7. Counting days during the polar night. The sun below the horizon all day at the winter solstice in N. lat. 69° (Tromsø).*

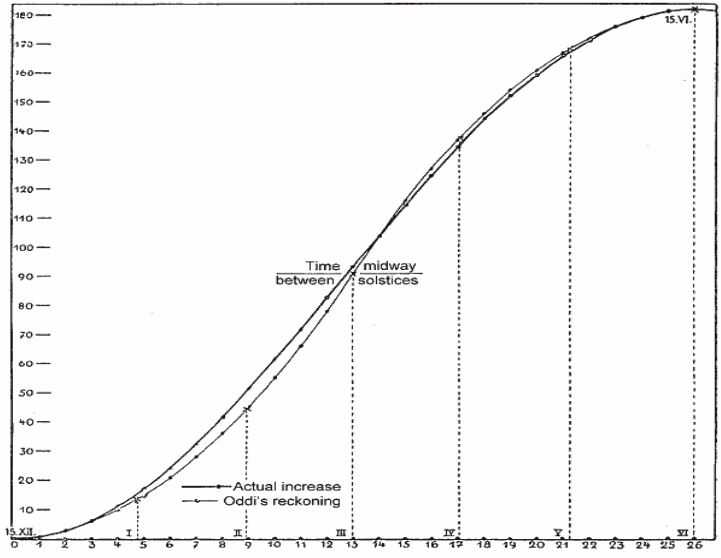



*Fig. 8. Surviving record of Odda-Tala (Oddi's reckoning). Sun's altitude at midday according to Oddi Helgason, compared with the actual value, about 1000 AD.*




*Fig. 9. The old Norwegian solar year. Every year, five days before the end of the polar night, the Norwegians sent out observers onto the mountain peaks, to announce publicly the forthcoming reappearance of the sun's disk.*

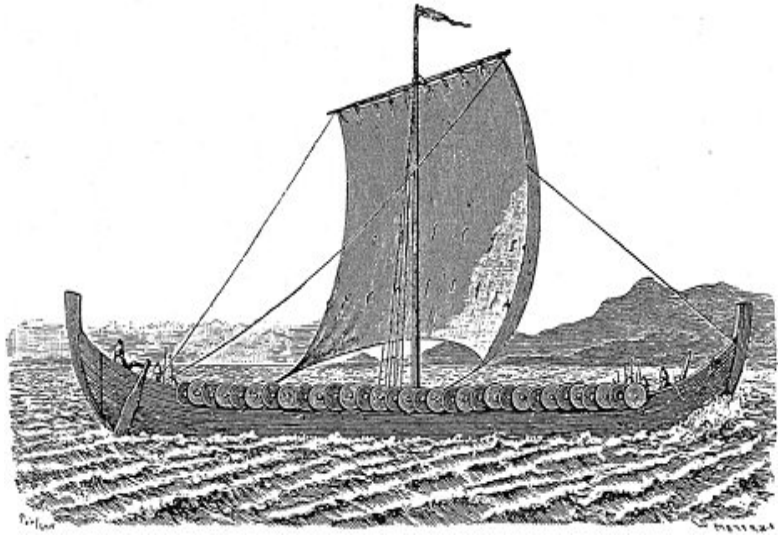
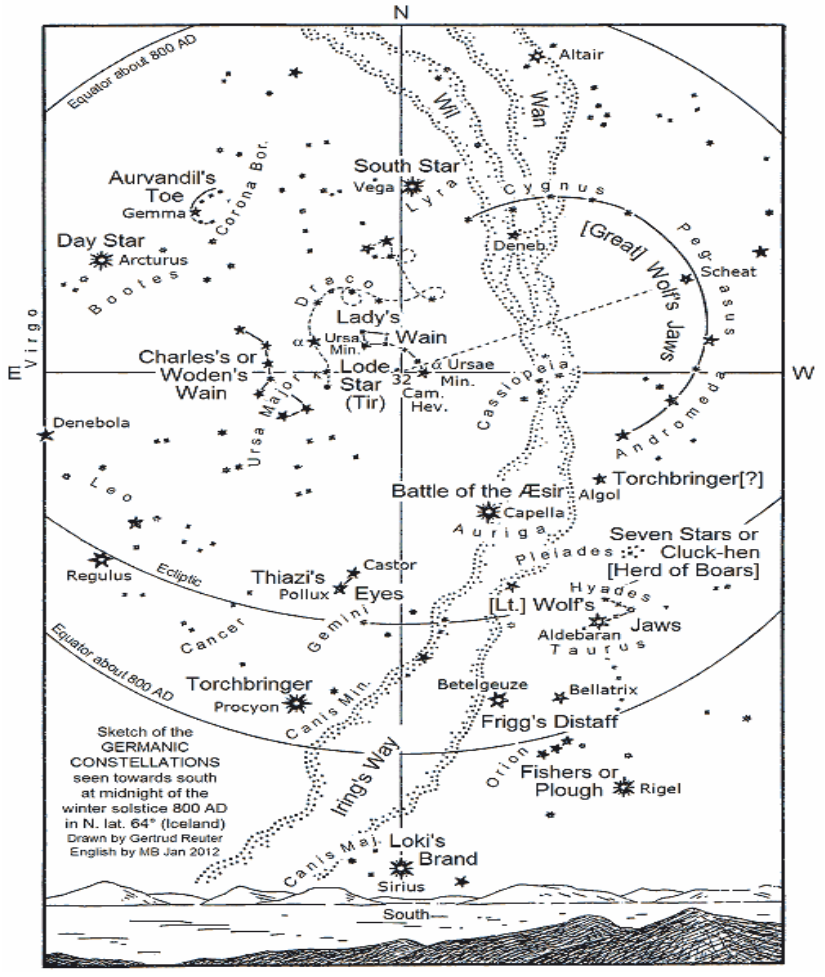


*Fig. 10. Germanic ocean navigation. The Gokstad ship, 24 metres long, 5 metres wide, from the 9th century; found in a grave mound.*




*Sketch of the Germanic constellations seen towards south at midnight of the winter solstice 800 AD in N. lat. 64° (Iceland).*

# On the Ancient Scandinavians' Division of the Times of the Day

*with special reference to Rafn's Antiquitates Americanæ*

Finn Magnusen

*Mémoires de la Société Royale des Antiquaires du Nord, 1, 165–192 (1839)*

It is well known that the ancient Scandinavians, like the modern Icelanders, divided the heavens or the horizon, first into 8 grand divisions, of which the middle points were named as follows:

| | | | |
|---|---|---|---|
| S. | suðr, South; | N. | norðr, North; |
| SW. | útsuðr, Southwest; | NE. | landnorðr, Northeast; |
| W. | vestr, West; | E. | austr, East; |
| NW. | útnorðr, Northwest; | SE. | landsuðr, Southeast; |

and, secondly, into 16 minor divisions, each of the grand divisions being bisected into equal portions by intervening lines, midt á milli. One of such grand divisions was called átt or ætt, the term being with great plausibility explained to signify an eighth part, and being supposed to have its derivation from the numeral átta, common to all the Germanico-Gothic, nay also to the Graeco-Latin and Persico-Indian languages. The word átt is still in common use in Iceland for such a division or aliquot part of the heavens, and likewise in Norway; where, however, as in days of yore, it is still written ætt.

Formerly the Scandinavians divided the times of the artificial day, dagr, (or of the natural day, dægr) according to the sun's apparent motion through the above mentioned divisions of the heavens. They supposed that the sun percurred each of the grand divisions in 3 hours: so that on this supposition they divided the times of the day into as many corresponding portions as amounted to 8 in each natural day, nycthemeron. Such a portion of time they called eykt or eikt (eicð, eykþ, öikt), which word has also been traced, through átt, to the numeral 8, and is likewise explained to signify an eighth part [166.1]. This eikt, or aliquot part of the day, was again divided, like each of the grand divisions of the heavens, into two smaller and equal portions, to which they gave the name of stund [166.2] or mál [166.3].

In order to know and settle those divisions of time, the inhabitants of each place carefully observed the diurnal course of the sun, and in as far as this could be done, they accurately noted the terrestrial objects over which it seemed to stand when in each of the above mentioned celestial points; cf. Henderson's Iceland I, 186.

In Norway, Iceland and the Ferroe-Isles, all of them mountainous countries, it was in general easy to find crags, hills, rocks, cascades, reefs, or to raise pyramids etc., whereby fixed points were obtained for each time of the day. Such natural or artificial objects were in Iceland called dagsmark, in the Plural dagsmörk, daymarks, or marks for such aliquot parts of the day. In Iceland each separate farm or estate had its own daymarks. The same was also in former times the case in Norway, where it still prevails to a certain extent among the common people, for example in Söndfiord in the West of Norway and Diocese of Bergen, from which district came the earliest inhabitants of Iceland, and where the names of the celestial points or divisions of the horizon agree with those of Iceland and the Ferroe-Isles. On this subject, Arntz [167.1], the most minute describer of this district, remarks (after having enumerated the 8 aliquot portions into which the inhabitants divided the day): "It is by marks on the hills and dales that the above mentioned times of the day are known. There is seldom much discrepancy between their noon and that shewn by the clock." This last remark will in general hold good in the case of the daymarks of Iceland and of the Ferroe-Isles.

As the word dagsmark (singularly enough) is omitted in the only serviceable Icelandic Dictionary which we as yet have [168.1], we shall here quote concerning it the following passage from Olafsen and Paulsen's Journey (1772 Part I, p. 40), "The

oldest and principal division of time has been found out by the course of the sun, and the cardinal or main points of the horizon. The primeval inhabitants of the country understood at all events to divide it into 8 equal portions and called the intersecting points dagsmaurk or daymarks." The subsequent account given by the authors is, in point of reasoning, somewhat confused, inasmuch as they had found in different places the daymarks either double or not settled uniformly, and were not then aware of the true cause of this, which we shall forthwith proceed to unfold. Their accounts of the individual position of certain daymarks, however, particularly in the interiour of the country, which has longest retained the old customs, are very remarkable, and will in their proper places be noticed by us in what follows.

There can be no doubt, and indeed it follows as a consequence of the remark of the authors above quoted, that the most ancient inhabitants were originally led to fix the daymarks by a division of the horizon according to the principal winds; "as is the general opinion in the country itself. But they were also guided", as they go on to say, "by the wants of their domestic economy, a circumstance which we have had occasion to remark during our journey almost every where throughout the interiour of the country, where the daymarks have not as yet been altered either according to the compass or sundial". Confusion was, however, gradually introduced in many places, particularly during the Catholic times, by the daymarks or their appellations being altered so as to adapt them to the Mass hours (horæ canonicæ), whereby in some instances the primeval words and significations were forgot, and in others new appellations were introduced. The Calendars published by Bishop Theodorus Thorlacius at Holum in 1671 and at Skalholt in 1692 seem also to have contributed much to this confused state of things by the incorrect names given

in them for some of the times of the day and hours of the clock. The old way of counting time was notwithstanding maintained undisturbed in many places, while in others, the ancient names of the several Eikts or Stunds were entirely forgotten, and were only partially supplied by other incorrect ones. The names of the Eikts and of the Stunds became confounded with each other, and there was in this way formed a new and incorrect system, which now-a-days in colloquial intercourse has to a considerable extent got a fixed footing in the country, particularly in some maritime districts where clocks and compasses are in use: so that for example, dagmál is there put down for 9 o'clock instead of the half past 7 of the ancient Icelanders: náttmál, on the other hand, is put down for 9 o'clock p. m. instead of the ancient half past 7. In certain places, however, the inhabitants could not agree about this, insomuch that in such places, as Olafsen remarks, they got 2 different dagmáls, or marks for the same.

This is a circumstance which has given rise to some disputes among modern scholars as to the correctness of the different ways of fixing the daymarks. The profound antiquary and lawyer Paul Johnson Vidalin, Lagman or superiour judge of the southern and eastern district of Iceland (born 1667, died 1727) who travelled on royal business throughout every parish in the whole country, and who accordingly was likely to possess the greatest imaginable local knowledge in regard to such matters, was the first who brought this literary dispute on the carpet, in one of his many commentaries which he composed chiefly in Iceland itself on certain expressions in the ancient laws of the country. The treatise in question was explanatory of the law expression "Allr dagr til stefnu", and accordingly bears that title; but hitherto no complete edition of it has been published. A very short abstract of it, which merely exhibits the general result, may be found along with many

others of a similar nature in the Transactions of the Royal Literary Society of Iceland vol 2, (17822, p. 113, 114). It is said that on this subject Vidalin wrote another separate treatise, but with which we are not acquainted; an abstract of them both, and, as it would appear, a very complete one, is to be found in the work of the celebrated scholar Bishop Finn Johnson, entitled Sciagraphia Horologii Islandici, tam veteris quam novi, p. 56, 58.

A contemporary of the lawyer Paul Vidalin, viz. John Arnason, Bishop of Skalholt (born in 1664, died in 1743) who certainly was deeply versed in theology, foreign ecclesiastical history and ecclesiastical computation, but who at the same time could not otherwise than acknowledge Vidalin's profound and certainly very superiour learning in every thing that concerned the traditions of the country, took nevertheless several opportunities to impugn sundry of his opinions, and especially his opinion on this subject; about which he composed a separate treatise called "Eyktamörk, or Horologium Islandicum," which however, first appeared in print as an appendix to his Fingrarím or Dactylismus Ecclesiasticus Copenh. 1739, 12° p. 315. It was again published at the same place with a Latin translation, as an appendix to the ancient Rímbegla and Blanda (two Icelandic works of astronomical computations from the middle ages, here united) 1780, 25 p. in 4to. The author attempts to prove that our forefathers in general reckoned the natural day from the commencement of the night at 9 o'clock p. m.; and further that all the Icelandic daymarks, as now used and received in the maritime districts, are the same as they have always been: but his erroneous views of this matter have been completely confuted by the aforesaid Finn Johnson, partly in his above mentioned work, which has likewise been published as a second appendix to Rímbegla 62 p. in 4to; and partly previously, but in a shorter and

less complete form, in his classical work Historia Ecclesiastica Islandii Tom. I, 1772 p. 153–157; wherein are, however, to he found occasional important remarks, which may help to supply the deficiencies of the separate treatise. Professor Rafn has inserted the whole of the passage hereunto relating into his Antiquitates Americanæ p. 435–438 referring at the same time to the same author's Sciagraphia, (p. 5, 23–26, 56–58). Finally Finn Johnson has quoted and explained several passages hereunto relating in the ancient MSS in his separately published work: Tractatus historico-theologico-criticus de Noctis præ Die naturali prærogativa, aut dubia aut nulla. Hafniæ 1782, 8vo.

To Finn Johnson's Sciagraphia we must also refer our readers in all the essential points, since in the main we perfectly coincide with the representation of the times of the day given there in pages 24–27 according to the system of the ancient Scandinavians. We shall by and by, in the course of the present article, exhibit a view of this in a tabular form, compared with the corresponding way of reckoning time prevalent among the peasantry of Norway, and more especially those of the Ferroe Islands, with which neither Paul Vidalin nor Finn Johnson were acquainted; although it is precisely here that we find the clearest proof of the correctness of the views given by them, and especially by the last mentioned, the more so that the inhabitants of the Ferroe-Isles have scarcely at any time had any direct communication with the Icelanders, and can by no means be supposed to have borrowed their chronometrical scale from them: but on the contrary each people must have brought it from their common aboriginal land Norway.

According to Finn Johnson's laborious and profound investigations the ancient inhabitants of the North made the working day or civil day commence at the first rising time as fixed

by the ancient codes of the country Grágás and Jónsbók, viz. the shepherd's rising time, called hirðis rismál, which was at half past 4 o'clock, and which down to this very day has continued to be the rising time of the workmen in the hay making season. The passages of the law above alluded to, however, owing to a form of construction which in our days seems somewhat peculiar or obscure, have been understood in different senses by the interpreters. We are therefore under the necessity of quoting and elucidating their expressions.

First, then, in the Grágás (promulgated in 1118) in that section of it entitled Landabrigða-bálkr, Cap. V, it is enjoined a landed proprietor or farmer in certain cases (when for example several of his neighbours complained that his sheep had passed over into their grounds and in this way had damaged their pastures): Þá skal hann láta reka fèit í miðian haga sinn of apna. Hann skal fundit hafa fè sitt, er sól er í austri miðju; þat heita hirðis rismál: that is: "He shall cause his sheep (or his cattle in general) to be driven to the centre of his own pastures every evening. He must have found (collected) his sheep (or cattle) when the sun is due East. This is called the rising-time of the shepherds." On reading these words with attention (not merely running the two last clauses together and so taking the literal sense of the words) it will be obvious to every one that the meaning of the whole passage is this, that the farmer or his shepherd (or in general all shepherds) must rise so betimes in the morning as to be able to have found and collected his flock, when the sun in the morning was due East, consequently 6 o'clock. For the performance of this task we have allowed at the most an hour and a half; that is, a stund, or the half of an eykt, which in this way must have commenced at half past 4 o'clock, (at which time of the day, particularly in summer, it is still the practise in Iceland for shepherds and others to get up) and which was

therefore called hirðis rismál. In pastures so extensive as those generally belonging to an Iceland farm, where in the course of a night's roaming the flocks naturally get widely scattered, it is not to be supposed that the shepherd should be able to find and to collect his scattered flocks in a moment (viz. at the precise time of 6 o'clock). Our learned friend, the translator of this code, has not rightly understood the real import of the expression "skal hafa fundit" (shall have found), as he translates it merely by the single Latin word recolligat (pecora) [173.1]. Subsequently in the framing of the Glossary he has had occasion to take notice of Finn Johnson's mode of translating another passage taken from this law, or of a parallel passage in Jónsbók, and he has accordingly altered his own translation to the more correct one recollecta habeat (pecora). Yet be still persists in maintaining that it is the precise moment of 6 o'clock, which is signified in the law by hirðis rismál, where as it must necessarily be an earlier period.

The parallel passage in the later Code called Jónsbók [174.1], promulgated in 1280, is as follows: Þá skal hann láta reka í miðian haga sinn fè sitt um aptna. Hann skal hafa rekið það úr haga hins, þá er sól er í austri miðju, það sem hann mátti finna; það heita hirðis rismál, Landsleigubálkr, Cap. 16. The above passage is thus rendered into Danish in the printed translation of this Code [174.2]: "Da skal han lade drive sine Kreature om Aftenen midt udi sin Græsgang. Han skal have bortdreven af den andens Græsgang alt sit Fæ, som han kunde finde, naar Solen er midt i Öster, det hedder Hyrdens Opstaaelses Tid." Or literally translated into English: "He shall let be driven his cattle in the evening into the middle of his pastures. He shall have driven out of the others pastures all his cattle, which he could find, when the sun is due East. This is called the shepherd's rising time." Finn Johnson makes the following comment in Latin on the true

meaning of this passage: "(Lex) jubet opilionem tam mane surgere, ut armenta et greges heri sui, quæ nocturno tempore limites transgressa fuerant, ex vicinorum pascuis abegerit, i. e. hora VI, ok heita þat hirðis rismál, i. e. hoc tempus (non quo opus absolverat, sed quo sur-gendum erat) vocatur opilionis surgendi tempus." In the passage above quoted this Code conveys in more express terms the import (which, however, must also be ascribed to the Grágás) that the shepherd was to search for his sheep (or his cattle in general) not only on his own pastures or fields, but also in such as were situated in the grounds of several different neighbours. That an hour and a half would often be required for the completion of this task, is, therefore, more evident from the expressions of the later Code than from those of the elder one.

That the shepherds, to whom the passage in question chiefly relates, were wont in Iceland formerly (as is frequently the case now) to be up before the other people of the farm, may also be seen from the Sagas; for example Liósvetnínga Saga, Cap. 14.

Reckoning from this earliest rising time, or the beginning of the morning half past 4 a. m., the eighth stund (or eighth half eikt) elapses precisely at half past 4 in the afternoon, and therefore this period was called, κατ'εξοχην (pre-eminently, par excellence), eykt, the eighth stund (octona) in like manner as every eikt or aliquot part of the day had the same appellation, because it consisted of an eighth part (octava) of a whole natural day. This eighth, eykt, in question commenced strictly speaking at 3 o'clock, and ended at half past 4 p. m., in what was called the eyktar staðr, or the eykt's place, limit or termination. The precise moment the sun appeared therein indicated the lapse of half the natural day, and was therefore held especially deserving of notice by our forefathers, the more so that, according to their way of reckoning, it also indicated the termination of the day proper and the

commencement of the evening. That, excepting during the seasons of harvest and haymaking, the working hours of the free people generally closed at that time, is very probable: but this is quite certain in the case of the holy eves after the introduction of Christianity. On which account in the Grágás, the oldest written civil Code, the expression eykthelgr (holy eykt) is employed in reference to saturday eve, and other eves then kept holy, most likely for this reason, that on such evenings all persons, both free men and thralls, were commanded to discontinue labor at the expiration of that eikt, or as soon as the sun appeared to be in the eiktarstaðr or eykt place as it was called. This did not correspond to the customs of other countries, in as much as the holy eve in this way commenced as early as 3 o'clock; wherefore the Bishops, as soon as a separate Churchlaw was framed for the country, got an adjusting clause introduced, namely the alteration that cessation from labour was not required to begin before half an hour later, viz. at half past 3, or the time that the daily mass of vespers called nona (from the hora nona of the Romans) was wont to he celebrated. This aliquot part of the day, therefore, or the time of 3 o'clock, got another name (of which more by and by) and was called nón; and the holy eves were now called in the churchlaws nónhelgir dagar (days kept holy after the time of nón). Yet there was partly retained in them the ancient name of the stund in question (from 3 to half past 4) viz. eikt; with this alteration that in regard to ecclesiastical matters it was shortened by half an hour: and (with reference to the people's responsibility for desecration of a holy eve) it was considered as not commencing till half past 3. On this subject the following passage occurs in the 13 Chap. of the most ancient ecclesiastical Law of the country [177.1]: Vèr skulum halda þvâttdag inn siöunda hvern nónhelgan, svâ at þá skal ekki vinna er eicð liðr, nema þat er nú mun ek telja. Þá er eicð, er utsúðrs ætt er deild í þriðiúnga, oc hefir sól gengna

tvâ luti, en einn úgenginn; that is, "We must keep each seventh day holy from nón, so that when the eikt comes on (liðr), there must not be performed any other work than what I shall now enumerate. Then is eicð (commenced), when the South West division of the heavens or the horizon being divided into 3 sections, the sun has traversed two of these sections, but one is not yet traversed." Here the Church law certainly says that Saturday is to be kept holy from the time of nón, viz. 3 o'clock p. m., but it does not adhere strictly to the precise hour, but allows the labourers half an hour to come and go upon, inasmuch as it fixes that the eikt shall not be considered as having commenced (in reference to the enjoined cessation from labour) until half past 3 o'clock, although it really commenced at 3. In consequence of this change, this stund has accordingly got the name of biskupa eikt, viz, the eikt regulated or altered according to the Bishop's way of counting.

It is, however, the regular unabridged stund called by way of excellence eykt (of an hour and a half in duration) that is mentioned as follows in Grágás (Kaupabálkr Cap. V Part I p. 395), when treating of the payments of bonds falling due on a holy day or half holy day, Ef eycþhelgan dag er eindaginn, oc á maþr cost at stefna fyrir eycþ, en viþ skal hann taka, þótt viþ aptan gialdist, ef allr dagr var til stefnu; that is, "If the term of payment falls on a holy-eikt day, the creditor has a right to cite (the debtor who does not pay) before the eykt commences; but he must receive the money even if it should be paid in the evening, in cases where the term day is no holy-day" (for in such cases the citation could be served up to sunset in summer, and to the coming on of darkness in winter). From this the obvious inference is that the Eykt, κατ᾽εξοχην, was the time or moment that most nearly preceded

evening, which commenced precisely when the sun was in the eykt's place (eyktarstaðr) [178.1] at half past 4 o'clock.

We certainly consider this explanation as of itself sufficiently clear; however, what we find said in Skálda of the daymark eyktarstaðr, or of the close of that aliquot part of the day called the eykt, according to the sun's then apparent position in the horizon, is still more clear. The passage is worded as follows in all the ancient manuscripts, whether on vellum or otherwise, (in the enumeration of the seasons and the 12 months of the year in the ancient Icelandic or Northern Calendar): Frá jafndægri er haust til þess er sól setz í eyktarstaþ. Þú er vetr til jafndægris. – Haustmánuðr heitir hinn næsti fyrir vetur; fyrstr í vetri heitir Gormánuþr; that is, "From the Equinox is Autumn until the sun sets in the Eykt-place (at the end or close of the eykt). The month immediately before winter is called Harvest month, (Autumn month); but the first in winter Gor-month (Slaughter month) [179.1]. Skálda was written in the southern part of Iceland in the 13th century, but the way of reckoning time here alluded to is much older, and derives from the heathen period. After Christianity was introduced, such computations were accommodated somewhat to the Julian Calendar, and whilst that Calendar remained in use, winter was considered as commencing about the 17th October. Bishop Theodor Thorlacius ascertained by astronomical calculations in his Icelandic Calendar (Skalholt 1692), that the sun set on that day at half past 4, consequently in perfect accordance with the statements given in Skálda and with the Eyktarstaðr as fixed by Paul Vidalin and Finn Johnson.

By way of distinguishing it from eykt in its more extended import, viz. the eykt of the natural day, the aliquot part of the day was expressly called eykt dags, that is, the eykt of a portion of the day. This expression occurs in several passages not quoted by any

of our predecessors; for example in the fragments of the very ancient Heiðarviga Saga, which were long considered as entirely lost after the destruction of a valuable Vellum MS., containing the beginning of the Saga, which was consumed in the great fire of Copenhagen in 1728, together with a copy that had been taken of it. The celebrated Professor Arne Magnusson had borrowed it from Stockholm, where also another fragment, which contained the continuation and conclusion of the Saga, was discovered by the Icelandic Bishop Dr. Hannes Finnson (Johannes Finnæus) in 1772. It was in this latter fragment that the passages above alluded to were contained. In the most remarkable of them the author gives an account of an event, that happened in the summer of 1013, and in his narrative the following circumstance is mentioned, that the harvest labourers on a farm in Iceland came home from work with their implements of labour at eykt dags, that is when the sun's position was over that mark of the day. In other passages of the same fragment, the same time of the day is mentioned as belonging to the afternoon [180.1]. Yet in Norway. even during the heathen period, it was customary to call the stund without any distinction eykt; for example in Fornmanna Sögur Vol. XI, pag. 136. We may here remark that our much esteemed colleague, residing in Iceland, Sveinbiörn Egilsson, who may deservedly be looked on as one of the most profound scholars in the ancient language of the North, has explained this word in harmony with the acceptation given to it by the editor of the Antiquitates Americanæ; see Fornm. Sögur Vol. XII, in the Glossary.

Moreover Bishop Thorlacius, the calculator of the astronomical Calendar, fixes sunrise in the South of Iceland on the 17th October at half past 7 a. m., which again completely corresponds with the dagmál of the ancients as fixed by Vidalin, Finn Johnson

and others; and thus it becomes perfectly clear that the expression applies to the very same time for sunrise in Vineland on the shortest day, and likewise that the expression eyktarstaðr applies to the time of half past 4 for sunset on the same day [180.2]. The counting of time by means of sun dials and hour glasses (or other vessels contrived for that purpose with sand or water, nay even watches and clocks) was most likely not unknown to the Northmen in the 11th century. After the introduction of Christianity such instruments naturally became indispensable for the use of the clergy, since if they were not employed, many rules in the above mentioned astronomico-computistical writings Rímbegla [181.1] and Blanda would have been entirely useless. So far back as the earlier part of the middle ages, we find that clockwork, both for indicating time by hours and also for shewing the motions of the celestial bodies, was used among the Eastern Goths, Burgundians and Germans, who in general paid some attention to Arithmetic, Grammar and Astronomy, as is attested by both Cassiodorus and Dithmar of Merseburg. Even if we should not be disposed to admit that such knowledge existed among the ancient Scandinavians (which, however, their distant maritime expeditions as well as the express evidence of history [181.2] give good ground for admitting), still we must not forget that Vineland's first discoverer, Leif Ericson, who was born heir to the sway of the Northmen's Greenland colonies, was brought up and instructed by the southern German Tyrker, and that Leif's successor, Thorfinn Karlsefne, was not only descended from princely lineage, but had moreover educated himself by long trading voyages to countries of Europe at that time by no means barbarous, such as England, Scotland and Ireland, agreeably to the practise then so prevalent among the more wealthy Icelanders [182.1]. Of the Northern merchant's and shipmaster's education in the middle ages, the reader will certainly be led to form a

favorable idea from the Speculum Regale [183.1], as it was called, written in the 12th century. In this book the merchant is exhorted to make himself well acquainted with the laws of all countries, especially as regards commercial and maritime laws, and also with the languages of all countries, particularly the Latin and Italian, which were then the most generally diffused. He should also thoroughly understand the phases and the motions of the celestial bodies, the times of the day, the division of the horizon according to the cardinal and minor points, the movement of the sea, ebb and flood, the climates and the various qualities of the several countries thence arising, the seasons of the year best adapted to navigation, the equipping and rigging of ships, arithmetical calculations, the judicious investment of capital, etc. Moreover the merchant must distinguish himself by what according to the standard of those days was considered the most polished and decorous way of living, both as regards moral conduct and behaviour, and also manners, dress, the etiquette of the table etc. Whence it is easy to infer that the better educated among our ancestors in the 11th and 12th centuries were by no means so rude and ignorant as many southrons still imagine.

Before submitting to our readers the Table promised above, exhibiting a comparative view of the methods adopted by ancient and modern Scandinavians in the division and nomenclature of the points of the horizon and times of the day, we think it fit to premise the following illustrative remarks.

The first main division of the Table exhibits in separate columns the order and number: 1, of each of the 8 larger divisions or aliquot parts of the natural day, or of the civil day, which formerly throughout the North (as is still the case in Iceland) was called eykt (eikð eikt, eycþ, öikt), and is still in the Ferroe Isles called ökt, in Norway ökt, ögt, and in some Swedish dialects ökn

[184.1]; 2, of the 16 minor divisions of this cycle, which are still known in the two first mentioned countries, but seem to be forgotten in Norway. The Iceland statement corresponds accurately with the system so ably developed by Finn Johnson, which, it will here be clearly seen, is in every respect confirmed by the system still prevailing in the Ferroe Isles.

This Eykt- or Ökt-system we have taken from Landt's attempt to describe the Ferroe Isles, Copenhagen 1800, 8vo, p. 443; wherein the following information is given of the inhabitants of the islands: "In regard to the division of the hours of the day, they know well enough, like the inhabitants of other countries, to divide the day into 24 hours, and have a tolerably accurate notion of the names belonging to each; nevertheless they have also their own customary method of dividing the day and naming its aliquot parts: and according to this method a natural day consists of 8 ökts, each ökt being equivalent to 3 hours; but for the purpose of indicating the time of the day with greater precision, they have also half ökts, which consequently consist of an hour and a half each, to which they give names corresponding to the sun's position, for example, ENE is called Halfgone East, i. e. ½ past 4 a. m.; E is called East, i. e. ½ past 6 a. m. etc." a statement of which the author gives as far as the 13th division of the horizon and of the eikt. The three remaining concluding divisions we have taken from passages thereunto relating in Svabo's Materials for a Ferroish Dictionary, which have not yet appeared in print [185.1]. From this source we have also given the names of the points of the horizon and of the stunds as used by the inhabitants of the Ferroe Isles in their vernacular or colloquial speech, which is well known to be a dialect of the Old-Northern, or, as it is now called, the Icelandic language.

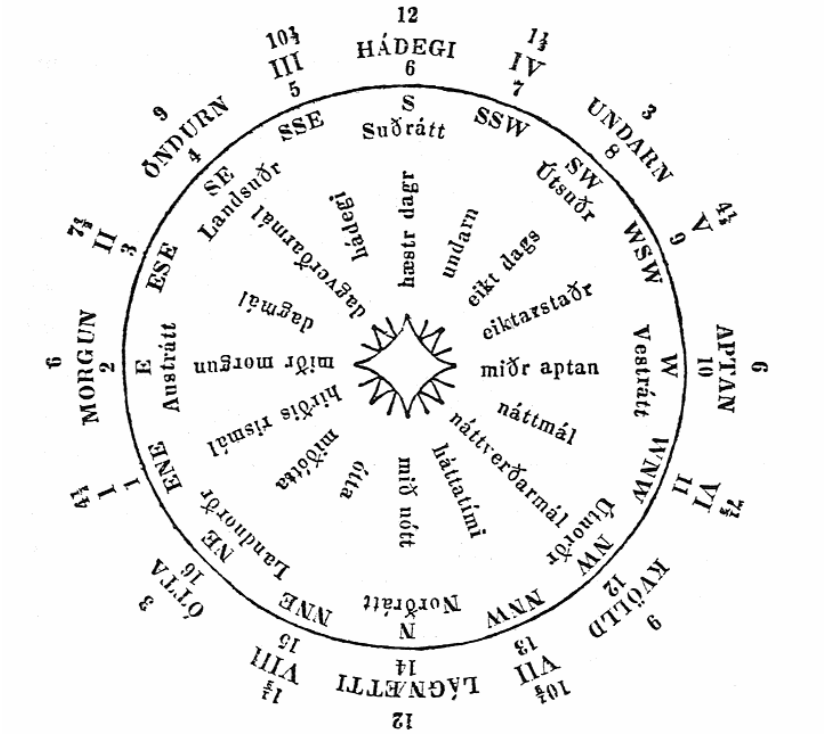
The accounts we have of the national division of the day among the common people of Norway are of a scattered nature, and by no means so complete. In the large Danish Dictionary, published by the Royal Society of Sciences, which comprehends words of the dialects of the Norwegian peasantry, we find in the 4th Vol., Let. O. p. 17. "Ögt,– in the dialect of the Ferroe Isles and of Nordlands ökt, in Icelandic eikt, – a period of 3 hours. The Norwegian peasant still divides time into ögts". It is doubtless these 8 ancient divisions of time about which Arntz (the author above quoted) in his Description of Söndfiord remarks, that they amount together to an ætmaal (or the 24 hours of the natural day. See page above, Note 1). Some of them appear in later times to have got new names, and our author himself remarks that since the inhabitants have become accustomed to use the printed Almanac, they have forgotten their ancient mode of reckoning time, and their knowledge of the stars. Nevertheless from what Arntz and others have stated, I have felt myself warranted in referring the said divisions of time to the ancient Norwegian Eikt-system, which follows precisely the same order in respect to the primary divisions of the horizon, and the enumeration of the times of the day.

The names of the points of the horizon, such as landnorðr for NE, landsuðr for SE., also útnorðr for NW. and útsuðr for SW. were evidently imported into Iceland and the Ferroe Isles at their first colonization from Western Norway; for both NE. and SE. were land winds, which blew across the land before reaching the coast; NW. and SW., on the other hand, were sea winds, which, agreeably to the ancient mode of expression, blew from without over the sea. In Iceland and the Ferroe Isles the first mentioned of these winds were considered as coming from the extensive sea coast of Norway, consequently from the great Scandinavian continent; the last mentioned, on the other hand, from the Atlantic Ocean

or Polar sea, wherefore the ancient appellations were retained unaltered in the language. The table shews that these appellations, with a few trifling alterations so as to accommodate them to the modern dialects, have been preserved in the language of the common people both in the Ferroe Isles and also in the western and northern districts of Norway. Bishop Thorlacius, however, in his Calendar of 1692, p. 95–97, has not inserted them in Icelandic, in the enumeration of the principal winds, but on the contrary has tried to frame a new nomenclature for them, so as to harmonize better with the Danish, German, English, Dutch, etc., being nearly the same as what we now see delineated on the card of the compass, among most of the European nations.

Formerly it was customary in Iceland at a very remote period – as is still the case in Norway – to designate the times of the day, or the stunds, by the sun's apparent position above the points of the horizon. In the former land this is now entirely gone out of use. The half ökts, according to the division now in use, are, however, designated in Iceland in this way, that the sun (which is only understood) is said to be half way between miðmorgun and dagmál (midt á milli), or at an equal distance from both (jafn nærri báðum). The ancient word miðmundi or miðmunda is only used for one particular such daymark, viz. half past 1 o'clock p. m., instead of undarn – an expression now completely obsolete in Iceland.

## PLAN OF A COMPLETE DIAL OF THE ANCIENT NORTHMEN.




From a drawing executed by Eggert Olafsen, Biörn Haldorson (in a work entitled Atli, 3 edition, Copenhagen 1834, p. 45–46) has exhibited and explained a plan of a sun dial constructed agreeably to the view now given of the Iceland daymarks, as the only correct one; for the use of the common people of Iceland.

| ALIQUOT PARTS OF THE NATURAL DAY. | | ASSUMED POSITION OF THE SUN. | | | | NAMES OF THE VARIOUS TIMES OR PORTIONS OF THE DAY. | | HOURS. |
|---|---|---|---|---|---|---|---|---|
| | | TERMS | TERMS USED IN | | | | | |
| *Eikt.* | *Stund.* | *now in use.* | *Iceland.* | *Ferroe.* | *Norway.* | *Iceland.* | *Norway.* | |
| I | 1 | ENE | Midm. Ln. ok A. | Hålga [1] Estur. | — | Hirðis rismál [2]. | Solrenning [18]. | 4½ a. m. |
| | 2 | E | Austr. | Estur. | Ouster. | Miðr morgun [3]. | Memorra [19]. | 6 |
| II | 3 | ESE | M. A. ok Ls. | H. Landsuur. | — | Dagmál [4]. | För-Duur [20]. | 7½ |
| | 4 | SE | Landsuðr. | Landsuur. | Landsör. | Dagverðarmál [5]. | Davremaal [21]. | 9 |
| III | 5 | SSE | M. Ls. ok S. | H. Middag. | — | Hádegi [6]. | Hög Dag [22]. | 10½ |
| | 6 | S | Suðr. | Suur (Middag). | Sör. | Hæstr dagr [7]. | Högst Dag [23]. | 12 |
| IV | 7 | SSW | M. S. ok V. | H. Utsuur (H. Noon). | — | Undarn [8]. | Undaalen [24]. | 1½ p. m. |
| | 8 | SW | Útsuðr. | Utsuur (Noon). | Utsör. | Eykt dags [9]. | (Ögt) Noon [25]. | 3 |
| V | 9 | WSW | M. Ús. ok. V. | H. Vestur. | — | Eyktstaðr [10]. | Ögterdag [26]. | 4½ |
| | 10 | W | Vestr. | Vestur. | Vester. | Miðraptan [11]. | Midefta [27]. | 6 |
| VI | 11 | WNW | M. V. ok Ún. | H. Utnoor. | — | Náttmál [12]. | Natmaal [28]. | 7½ |
| | 12 | NW | Útnorðr. | Utnoor. | Utnör. | Náttverðarmál [13]. | Naattvær [29]. | 9 |
| VII | 13 | NNW | M. Ún. ok N. | H. Noor. | — | Háttatimi [14]. | Afdag [30]. | 10½ |
| | 14 | N | Norðr. | Noor. | Nör. | Mið nótt [15]. | Högstnaatte [31]. | 12 |
| VIII | 15 | NNE | M. N. ok Ln. | H. Landnoor. | — | Óttа [16]. | Otta [32]. | 1½ a. m. |
| | 16 | NE | Landnorðr. | Landnoor. | Landnör. | Miðótta [17]. | Ottemaal [33]. | 3 |

## Table notes

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| 1. | Hålga signifies halvgaaen, halfgone, used here with reference to the sun, as otherwise generally with reference to the time and the hour. |
| 2. | See 18. Here the morning commenced. |
| 3. | Midmorning (middle of the morning). See above p. 172–175, also called rismál, rising time, from risa, to rise, now obsolete in the Icelandic. |
| 4. | That dagmál is by the peasantry of Iceland still referred to this time, may be seen in the following books of travels: Olafsen, I, 40; Troil p. 90. Henderson (about 8 o'clock, for he never mentions half hours) Iceland I, 187. |
| 5. | Forenoon meal time: for other persons than travellers who took this meal earlier. |
| 6. | In most places of Iceland the peasantry still place this daymark correctly; see Olafsen's, Troil's, and Henderson's accounts in the passage above quoted. |
| 7. | That is (like the corresponding Norwegian denomination) highest day. This very ancient term is still used by the peasantry of the West of Iceland instead of hádegi, which many now-a-days incorrectly refer to 12 o'clock. Biörn Haldorson's Atli p. 47. |
| 8. | Now called miðmunda. Undarn occurs in Old-Northern MSS, both as afternoon, and also a meal or convivial party held at that time: see, for example, Rafn's Krákumál or Loðbrokarkviða p. 2, 29, 96–97. In a similar acceptation for noon or afternoon, we found in Mœso-Gothic undaurn, in Alemannic (old High German) untorn, Anglo-Saxon undern: also in the old English of Chaucer, although the word was also occasionally used in Anglo-Saxon for a particular part of the forenoon; s. Note 9 and 24. |
| 9. | As this stund formed the latter half of the "Eikt" undarn, it is remarkable enough that the Anglo-Saxons called its close 3 o'clock p. m. heah undern; see note 8 On the other hand the Catholic clergy in England called it non from the Mass Nona (belonging to the horæ canonicæ), which took place at the same time; whence the Old-Saxon non, Old High German nuon, Scandinavian nón; see note 25. |
| 10. | The word signifies the Eikt's place (here termination or close). It was also called aptan or aptansmál, as the evening commenced here; see above p. |

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| | 175–178 and notes 26, 27. |
| 11. | The middle of the evening (now called miðaptan in Iceland); see note 27. |
| 12. | That in most parts of Iceland this daymark is still correctly placed, is testified by Olafsen, Troil and Henderson at the passages above quoted. |
| 13. | The name denotes the evening meals time. |
| 14. | i. e. Bedtime. |
| 15. | Midnight. |
| 16. | The word corresponds to the Mœso-Gothic uthvo, the Alemannic uohta, ouht, ocht, uht, uchtenstond, the Netherland and Frisian ucht, Anglo-Saxon uht, uhtentid. See Rafn's Krákumál or Loðbrokarkviða p. 12, 124, and note 32, 33. |
| 17. | The middle of the ótta; called also hana-ótta, the cock ótta; or hana-galan, cock-crowing; Anglo-Saxon hancreð; see note 33. |
| 18. | Sólrenníng, sunrise time; aabitsmaal is still known both in Iceland and in the Ferroe Isles: from ábitr, aabit, refreshment time in summer at the earliest part of the morning. |
| 19. | Also in modern Danish midmorgen, Swedish midmorgon, etc. |
| 20. | The earliest breakfast: corresponding to the Frisian vordard. This stund is also called in particular districts of Norway frokostbeel; see note 21. Corresponding expressions to the ancient dagmál are also found in the dialects of the common people in modern Denmark and Sweden. |
| 21. | Called also daguur. The ancient dagurðr, dagverðr, has in the later dialects undergone the greatest alterations, for example it has become among the Norwegians dul for dur. Otherwise in Swedish it is dagvard, in Danish davre, daver, dover, douer, in Frisian daagerd, dauerd, daaerd, dard, etc.; see note 5. |
| 22. | To this there are sundry corresponding terms, in German, Dutch, etc.; see notes 6, 7, 23. In certain districts of Norway this portion of time was also called halvgaaet til middag. |
| 23. | Otherwise also hæsdag; corresponding to the Old-Northern term. See 22. |
| 24. | Called also ondol, ondolsmaal. Traces of the ancient undarn (ondarn) especially as applied to noon or afternoon meal time, midday sleep, etc. are to be found in the peasant dialects in Sweden, Denmark, Germany, the Netherland and Great Britain: viz. in the last mentioned in aundern, |

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| | ownder, onederin, orndors, orndinner, orn-supper, orntren, etc. |
| 25. | See above note 9. To this corresponds the British shepherd's high noon as applied to 3 o'clock p. m.; the Bavarians non and the Westphalians none etc. still in use. On the other hand the English noon and the Dutch noen now signify midday, 12 o'clock. See Sir Henry Ellis's Edition of Brand's Popular Antiquities. I. 457–460. We have otherwise ground for supposing that down to the year 1700 the common people in Denmark called this stund ögt; see note 26. It would appear that several expressions among the German nations having reference to holy eves, and which are still in use among the common people, are related to the eykt, or öikt of the Scandinavians: for example aecht in Suabia, ucht in Ditmarsch, etc. |
| 26. | Also ögterdags beel, ögtebeel. These and several other words which are of great importance in fixing the time of the day now in question, are to be found collected from the Danish and Norwegian Peasant Dialects in the large Danish Dictionary, 4 Vol. 3 Section, p. 17. O. |
| 27. | The Anglo-Saxons called this time of the day ofer-non, as the Norwegians in Telemarken still call it etter-ökt (for similar etymological grounds). To the Icelandic and Norwegian term there are several corresponding ones in Denmark and Sweden. |
| 28. | Among the Scandinavians the late part of the evening commenced here, called kveld, kvöld, cvylcwyld: in use in the modern dialects. |
| 29. | See note 13. |
| 30. | The word denotes the expiration or end of the day. |
| 31. | Literally the highest night. In some British authors we meet with the expression "noon of the night". |
| 32. | This word is also used in the modern Danish and Swedish Dialects. |
| 33. | See above note 17. |

# Notes

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| 166.1 | From ætt (átt) or eykt comes undoubtedly the Danish and Norwegian word Ætmaal or Etmaal (the period of the 24 hours of the natural day) as the meted division both of the points or portions of the horizon and times of the day. It occurs likewise in the Frisian language in the form of aetmal, etmal, in Dutch etmaal. |
| 166.2 | Also in Anglo-Saxon, Danish and Swedish stund, in German stunde, in Dutch stond, in English and Scotch (though now obsolete) stound. When the times of the day began to be reckoned in the North according to the Roman or Catholic horary division, the word came at length in the Norwegian and Icelandic languages to signify one of such hours. Accordingly John Olafsen in the Glossary to his Syntagma de Baptismo, Copenhagen 1770, 4to, translates it by *hora major sive minor*. |
| 166.3 | In Danish maal; in Swedish and Ferroeish mål; in German mal, mahl; in Dutch maal; in Anglo-Saxon mæl, mel; in Mœso-Gothic mel. Hence (and not as many now-a-days imagine, the converse) the Oldnorthern mál, máltid; Danish maal, maaltid; Swedish mål, måltid; German mahl, mahlzeit; Anglo-Saxon mel, mælmete; English meal; Dutch maal, maaltyd. It was not only meals that were regulated according to such fixed times of the day, but also the time for milking of the cows, which, therefore, was also called mál in Iceland; maal in Danish; mål in the Ferroe Isles; meal in the North of England (the appointed time when a cow is milked, according to Brocketts Glossary of North Country Words 1825 p. 136; cf. the Craven Dialect, Lond. 1821 p. 92). |
| 167.1 | Arntz in his Account of Söndfiord in the Norwegian Topographical Journal 33 Nr. 1808, p. 13. See also Nr. 29, 18022, p. 37. |
| 168.1 | Björn Haldorson, Lexicon Islandico Latino-Danicum, Hafniæ, 4. In this work, which otherwise is very valuable, especially as regards the modern Icelandic, the daymarks hirðisrismál, dagmál, náttmál are incorrectly explained; while the important word eyktarstaðr is entirely omitted. |
| 173.1 | Codex juris Islandorum, qui vocatur Grágás, Pars II. Hafniæ 1829, 4to, p. 221. |

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| 174.1 | Lögbók Íslendínga, hvöria samansett hefir Magnús konúngr, Hólum 1709, 8vo, p. 230. |
| 174.2 | Den Islandske Lov Jonsbogen, udgiven af Kong Magnus Lagabæter (oversat ved Provst Egil Thorhalleson). Kjöbenhavn 1763, 8vo, p. 181. |
| 177.1 | Kristinrèttr Þorláks ok Ketils, s. Jus ecclesiasticum Islandiæ vetus. Hafniæ, 1776, 8vo, p. 92, 93. |
| 178.1 | When reference is made to the length of the day, the word staðr, at the place fixed for a daymark, if the time be morning, shows the rising of the sun in or nearest the beginning of the aliquot portion of time indicated by it; but if the time be evening, it shews its setting near another daymark, which indicates the termination of the hour, or also of the day or diurnal course of the sun; for example, dagmálstaðr, and eyktarstaðr, Ant. Am. p. 32. |
| 179.1 | See Snorra-Edda ásamt Skáldu, ed. R. Rask, Stockholm 1818, p. 188. |
| 180.1 | Heiðarvíga Sögu brot in Islendínga Sögur |
| 180.2 | See Finni Johannæi Hist. Ecclesiast. Island. T. 1 p. 150–156. |
| 181.1 | In the ancient Icelandic work, called Rímbegla, are given many rules for the measurement of time, for the study of Astronomy, Geometry etc., which, no doubt, seem to have been translated and compiled from foreign works, but which nevertheless correspond with what the clergy of the North immediately after the introduction of Christianity taught their pupils, who were partly designed for ecclesiastical and partly for temporal employments. Among these are found scientific rules and computations for finding the course of the sun, moon and stars, also the division of time thereon depending; information respecting the astronomical quadrant and its proper use; different methods of ascertaining the spherical figure of the earth; the longitude and latitude of places, and of calculating their distance from each other; the sun's declination; the earth's magnitude and circumference; the times when the ocean could best be navigated, etc. |
| 181.2 | Thus, early in the 11th century (about 1018–1028) the rich chieftain Raudulf of Österdal in Norway, taught his son Sigurd the science of computing the course of the sun and moon and other visible celestial bodies, and particularly to know the stars, which mark the lapse of time, that he might be able to know what time it was by day and by night, even if he could not see either sun or moon. See Fornmanna |

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| | Sögur V. 334–335; Scripta Historica Islandorum V. 310–59. Even belonging to the period strictly heathen we have similar accounts of Icelandic chieftains and their sons, nay even of simple peasants, who paid sedulous attention to the motions of the heavenly bodies, in order from thence to find out the true lapse of time; also of their belief in Astrology, which was intimately connected with the Old-Northern Mythology. We cannot in this place develope this subject further, but we have in some measure done this in other writings. Here we shall merely add a remark from Olaus Magnus (Lib. I. Cap. 34), that in his time (about 0) it was generally acknowledged in Sweden, that the common people in ancient times had more knowledge of the stars than they possessed in his days. |
| 182.1 | In several literary Journals the Northern discoverers of America have lately been called Pirates (Vikings). This they certainly by no means were, but on the contrary all their leaders were Merchants, and at the same time Shipowners (as, for example, Biarne HerlulfsonPresumably misprint for Heriulfson, Leif, Thorfinn, Helge, Finnboge, Biarne Grimulfson, Thorhall Gamlason). Their ships were called kaupskip, trading vessels. Neither is it a correct assertion that these men roamed about without aim or object. All of them had fixed objects in view in their voyages of discovery, although the first mentioned had not for his object to discover (to search for) America, but on the contrary Greenland, in order to spend the winter with his father, who had removed thither, with whom he actually did establish his residence. Thorfinn and his companions intended to colonize Vineland, on which account they carried with them cattle. |
| 183.1 | See Konúngs Skuggsio, Sorö 1768, 4to, p. 17-236. |
| 184.1 | Probably in Old-Saxon ekt or ett, (whence etti, intervalla, in a very ancient glossary contained in Graffs Diutiska). In Bavaria, according to Schmeller, the common people still say eicht for Weile, Stunde; and eichtlein (perhaps a half eikt) for a short Stunde. |
| 185.1 | MS. in the Library of the R. S. N. A.Royal Society of Northern Antiquaries (Kongelige Nordiske Oldskriftselskab), Copenhagen |