X. CALENDARS

Discussing beliefs, the whole of the Nordic Bronze Age seems to display more or less the same adherence to Sun-worship and cosmological explanations of the basic facts of life. Sun-images are quite early, occurring at least from Period I (cf. Meller 2004), they peter out in Period VI. In other words, the cult is linked to the Bronze Age culture proper. In other parts of Europe, evidence of Sun-worship is also common, although the iconography is poorer and somewhat different. Worship of the Moon is seemingly quite rare, in particular in the northern part of Europe.

Evolutionarily, worship of the powers of nature and of celestial bodies are seen as more "primitive" religious states than that of anthropomorphic deities and monotheism - the ultimate meeting between man and the supernatural. Thus, the decline of sun worship might herald the arrival of the pagan northern pantheon and its mythology. Nevertheless, the latter is recorded only from the first millennium AD, and the religious beliefs and cultic realities of the later first millennium BC are poorly known. Often Tacitus' tales about Germanic practices play a large role in conceptions about Iron Age religion (Tacitus 98).

However, male and female statuettes are known from the Bronze Age, which are depicting either decked out human beings participating in rituals, or, more likely, deities. These include males with tall brimmed "magician hats" on a Near Eastern divine model (Randsborg 1993a, 111f.). The brimmed hat, likely of the Sun god, is also depicted on the rock-carving panels of the Kivik grave of the transition from Period II to III and in the form of gold-foil hats found in Central Europe (Randsborg 1993a; Schauer 1986). Notably, the same brimmed hat makes up the point of the famous female spiral decorated belt-plates of Period II; on the better executed specimen the brim is clearly indicated as a step between the disc of the Sun (with spirals) and the tall point/hat. The image of the sun is here rendered both as we always see it and in the shape of an anthropomorphic element, the hat. In fact, other messages are hidden in the spirals (cf. below).

These observations are very important, in particular since they demonstrate the existence of anthropomorphic conceptions of deities living side by side with abstract and symbolic ones, like the images of the sun and its movements - the latter in terms of spirals and other ornaments.

LARGE CULT ITEMS

From Hasfalva, Hungary comes a bronze "drum" (or metal cover, perhaps for a pole), in fact likely a throne, or even an altar, which has a twin found in a bog at Balkåkra, Skåne, both evidently depicting the sun and its rays on the head (Knape & Nordström 1994) (Figs. 26-27) (Table IV). The sides of both "drums" are in 10 pieces, held together by 20 nails with large conical heads and a ribbon at the top with 10 similar nails and 30 large bosses for decoration. The pieces are equipped with large openings - 30 in all; each piece is ending in a four-spoked "chariot" wheel. The date of the "drums" is likely Period I, a later part. Probably, the two "drums" were both made in Central Europe. We can only guess as how the Balkåkra specimen arrived in Southern Scandinavia, later to be deposited in a bog: perhaps it was a diplomatic gift, and even so, a highly remarkable one, difficult to comprehend. Even if a stolen item, it is nearly beyond imagination.

On the "drum"-head of the Hasfalva "drum", the rays around the central Sun ornament are arranged in six zones, the total number of rays being 337, or virtually the same as the number of days in 11 months in a year defined on the movements of the Sun, the solar year (336). The fine correspondence is particularly remarkable for such a high number. On the head of the Balkåkra "drum" are 275 rays, also arranged in six zones (3+1+2) around a Sun ornament, or exactly the number of days of 9 months of a year as defined in the same way. One starts wondering if these "drum"s were nos. 11 and 9, respectively, in a series of 12, for the twelve months of the solar year. Finally, the repeated use of numbers 10, 20, 30 in the construction not only speaks in favour of a ten-digit system, but also of the possible use of the Ancient Near Eastern (ANE) calendar with 12 months of 30 days each as a standard reference.

In Denmark, the famous Sun-chariot of late Period II (or early Period III), deposited in a bog at Trundholm bog, Holbæk County (AK II 867), is another dramatic example of astronomic considerations: the sun riding like an aristocrat in his chariot, drawn by a horse (in reality, two)[16] (Müller 1890-1903) (Fig. 28). The four-spoked wheels are both to move the model and symbols of the twin wheels of the invisible chariot, and thus of the Sun itself.

The golden diurnal side of the disc of the Sun-chariot has at its centre a decorative zone consisting of 1 large concentric circle (in fact, 1 group of concentric circles) surrounded by 8 smaller ones. These are followed by a middle decorative zone of 16 concentric circles linked in pairs by a forward-two-backward-one encircling ribbon, no doubt symbolizing astronomical both movement and repetition. The outer decorative zone consists of 27 concentric circles to which are added beams in a narrow outermost zone.

The bronze night-side has the same central decorative zone (of 1+8 concentric circles) at its centre, but only 25 concentric circles in the outer decorative zone. The middle decorative zone has 20 spirals linked in pairs but in such a way that any tracing is taking the student in, then out - jumping over two spirals each and every time. In the process, a "mushroom-shaped figure" is produced which also appears as a symbol on other bronzes (Kaul 1998, 188f.; seemingly first described by Sprockhoff (Sprockhoff 1954, 83f.)). Therefore, to judge from the Sun-chariot, this figure may be a symbol actually indicating "night". The alternating arches, as they seem, connecting the spirals, might thus symbolize the new and the waning Moon, respectively.

To interpret the spirals as such as symbols indicating "night" is not possible, since their significance is obviously broader. Thus, the classical running spirals of the contemporary female belt-plates seems to relate to "day", or rather days - the richer the women, the larger the belt-plate, and the more decorative zones. As indicated, on the finest, best executed, and largest belt-plates, the central point is clearly a brimmed hat, likely that of the Sun-god (cf. Randsborg 1993a, 111f.). As we shall now see, certain other information also enters these equations.

Firstly, the ornamental elements on the two sides of the disc are reflecting both style and effect: Day - more lively and dense; Night - calmer, the spirals here actually looking like simple pairs of concentric circles at first glance.

Secondly, studying the numbers of ornamental units, the outline of a Bronze Age mathematical system appears, including multiplication, perhaps even involution - which perhaps is a surprise: 1 = 1x1, 8 = 2x2x2, 16 = 2x2x2x2; 27 = 3x3x3; 16 = 4x4; 25 = 5x5. Or, in other words, a system built on multiplications of same numbers: 1x1, 1x1x1, 1x1x1x1, etc.; 2x2, 2x2x2, 2x2x2, etc.; 3x3, 3x3x3, etc.; 4x4, etc.; 5x5, etc.; and so on. This much reminds of the Bronze Age love of the "twin" - two (or two times two) of the same item or symbol (Randsborg 1993a). In addition to these multiplications, we note multiples of different numbers - the examples being 2x4, 5x4, and 3x9. Certain more complex multiplications, such as 20 = 2x2x5, were probably originally based on the number of fingers on one or both hands. The existence of certain repeating or "holy" numbers is also a possibility.

At first sight, neither astronomical properties, like days of the month, months of the year, etc., nor length of human pregnancy, or other stable time-units, are involved. Years and days are, of course, defined by the Sun. Months are defined by the Moon (29½ sun-days to the moon-month). Looking at the four cardinal shapes of the moon, a moon-week is established, probably early in Prehistory. Human pregnancy is exactly 9 moon months, or 265½ sun-days (with the standard uncertainty).[17] A quartering of the year is natural = 91½ sun-days, being rather close to three moon-months of 88½ moon-days. Between the two, 90 days is the average, reminiscent of the Ancient Near Eastern (ANE) calendar of 360 days. Probably thus, emerged the idea of creating a sun-month and a sun-week, even though these numbers do not fit within the overall frame of the year. Traditional and varying calendar definitions are therefore legion.

16 As the possible "Sun-chariot" from a hoard at Helsingborg, Skåne (Montelius 1917, 980), also of Period II.

17 Cattle gestation, incidentally, is only a little more than that, but horse much more.

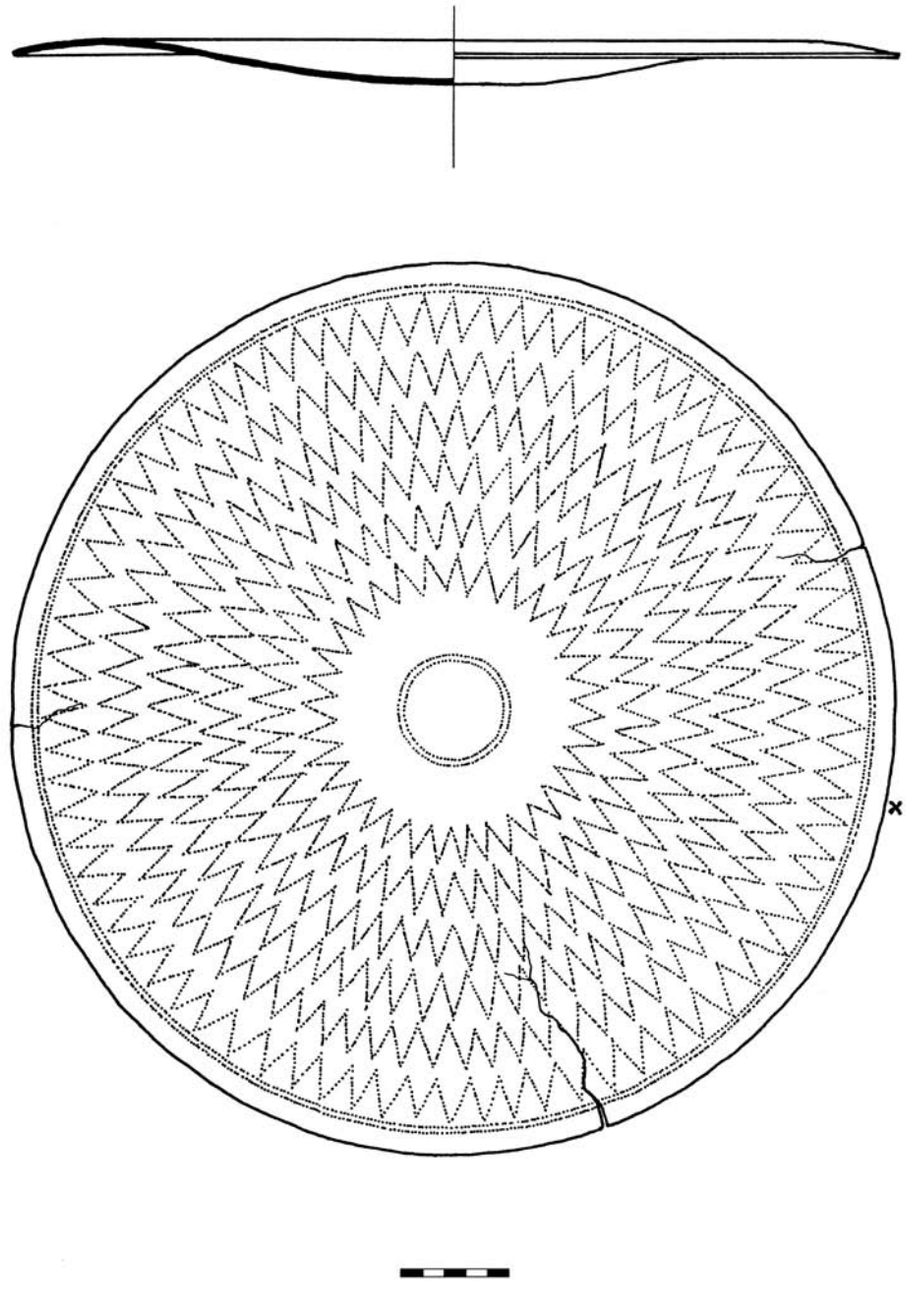


Fig. 26. The disc of the "drum" from Hasfalva, Hungary. After Knape & Nordström (1994).

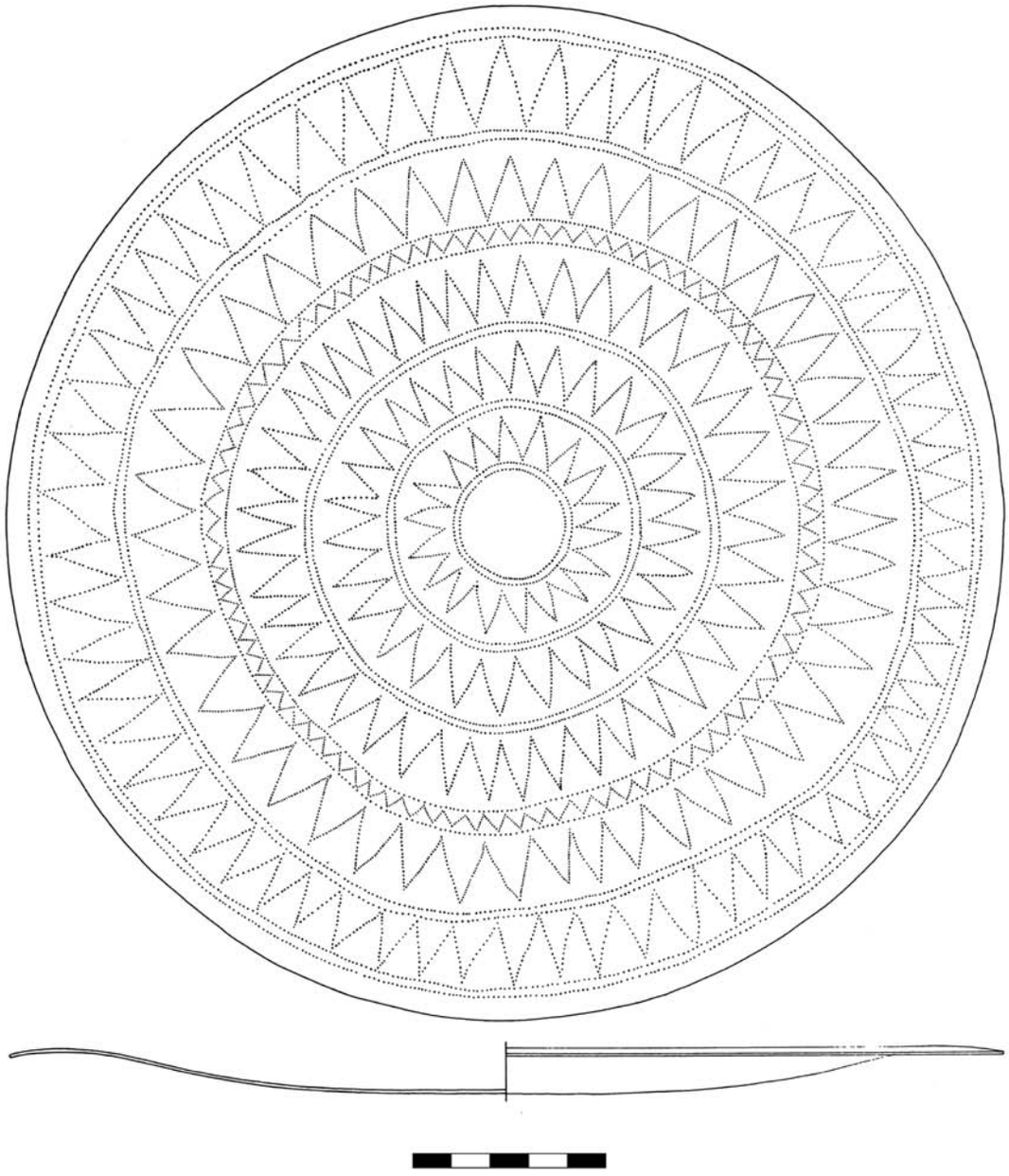


Fig. 27. The disc of the "drum" from Balkåkra, Skåne. After Knape & Nordström (1994).

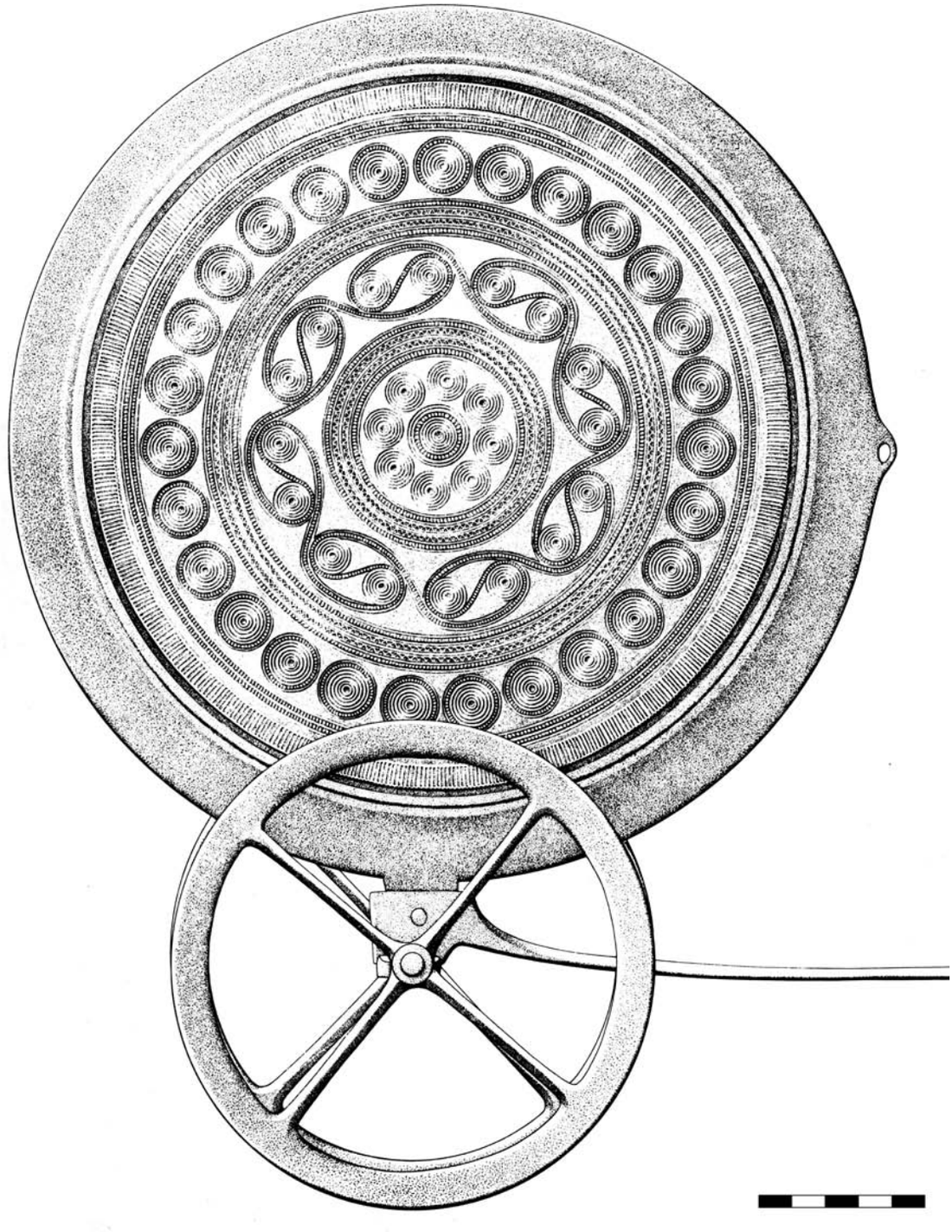
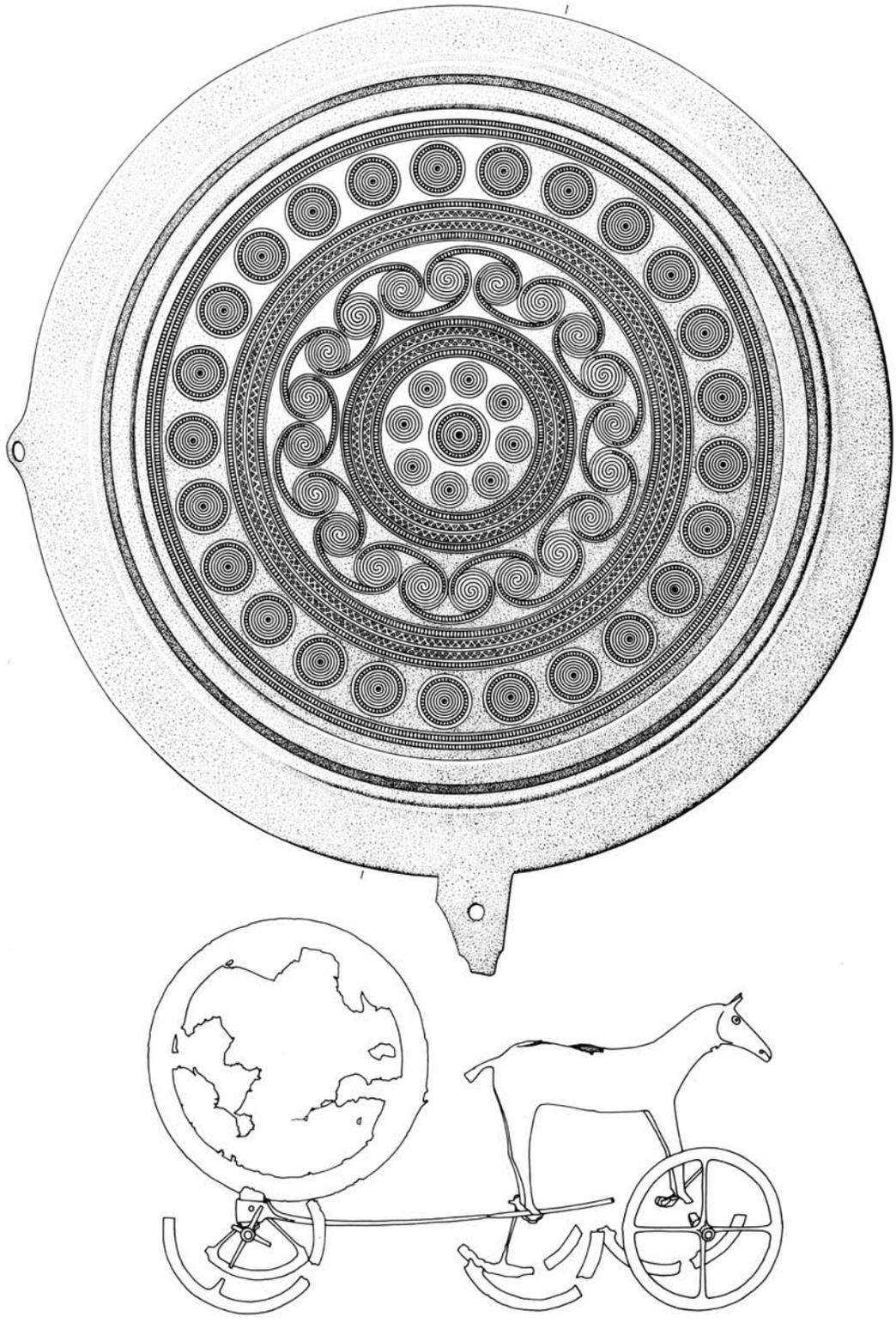


Fig. 28. The two sides - day (golden: left) & night (only bronze: right) - of the sun-disc of the Sun-Chariot from Trundholm, Højby parish, Holbæk County (AK II 867). The item was deposited in a bog, seemingly without other artefacts. After AK.



Interestingly, on the disc of the Sun-chariot, the total number of ornamental units on the diurnal side is 52 (equivalent to the number of weeks in a solar year), while it is 54 on the night side, possibly indicating the number of lunar weeks making up the equivalence of a solar year.[18] Incidentally, the central ornament of the central decorative zone on the disc of the Sun-chariot - almost a small Sun in itself - is mirrored in the two "shining" eyes of the horse. Interestingly, two contemporary bronze horses (likely for another sun-chariot) from Tågaborg in Skåne have shining eyes in amber (Randsborg 1993, 90; cf. Montelius 1917, 980). We shall pursue these observations below, but before that a short excursus into other cultic items, then the elegant belt-plates.

Firstly, the Jægersborg gold disc, København County (AK I 417), which comes from a grave and is a parallel to the diurnal side of the Sun-chariot: Even though it is only partly preserved, it does not seem to carry any calendar correspondences.

Secondly, among the most outstanding objects of the Early Bronze Age is a series of very large shaft-hole axes, often found in pairs (Jensen 1978; 2000, 288f.). A number of these carry spirals on the broad sides; the spirals are counted, but also without wholly satisfactory results, even though a series of virtual correspondences (+/-1) were observed for the Egebak and Meuse River axes (cf. Table IV). The latter is particular interesting in being a Nordic cult item found in Belgium. Only very few Nordic artefacts travel that far South: perhaps a diplomatic gift, like the Balkåkra drum (travelling in the opposite direction) (Fig. 27), or the large Northwest French ceremonial sword found in a bog at Østerhoved, Ringkøbing County (AK X 4704), which probably arrived by way of the Netherlands (cf. Briard 1965, 91f.). A decorated Fårdrup axe of Nordic Period I, also a likely ceremonial axe, has been found at Löbschütz, Kreis Meissen in southern East/Central Germany (Billig 1958, 147 Abb. 87).

Long-distance exchange of ceremonial items is a most interesting phenomenon, likely indicating high-ranking travel even to very distant lands for participating in religious rituals as well as social gatherings and trading, in much the same way as the fabled Queen of Sheba/Saba of the Bible visiting King Solomon in Jerusalem in the 10th century BC - Period IV of the Nordic Bronze Age (I Kings 10; cf. II Chronicles 9; etc.).

BELT-PLATES

The famous female so-called belt-plates - round and flat, with a point and an ear on the back - are beautifully decorated in zones of spirals and other ornaments; the level of craftmanship is often very high. Nevertheless, the belt-plates are often considered slightly boring when compared to the contemporary rock-carvings or the much later highly abstract animal-decoration of the Late Iron Age. This is hardly correct, as we shall see in a moment. In the graves, belt-plates are found on/at the abdomen of the women but may not have been carried in their thin woollen tape-like waist-belt. Rather, they were moved around in a leather strap, as, seemingly, indicated by the traces of wear on the ears of the plates. Indeed, the belt-plates from Lüneburg, Northern Germany, seem to have been carried in a string covered by bronze spirals around the neck (Piesker 1958, Taf. 65). In fact, in the Egtved grave (No. 18), the rather small belt-plate was placed on top of the belt, not in the belt itself (Thomsen 1929-35, 182).

A very large superbly made belt-plate comes from a Period II deposit at Langstrup, Frederiksborg County (AK I 201) (Fig. 29). Langstrup, one of the very few belt-plates found with four main decorative zones (even three is quite rare), carries 15+22+26+32 = 95 spirals in all (Neergaard 1890-1903). Seemingly, a pattern does not emerge. However, by once more applying multiplication and considering the four zones as factors - in the following termed "the primary factors" - the sum of the spirals emerges as 15x1+22x2+26x3+32x4 = 265, or virtually the number of days of human pregnancy, equivalent to 9 lunar months (265½).

Is this particular number arrived at only by chance? Certainly, Langstrup is the largest (28 cm in diameter), most beautiful, best calculated, and best executed among hundreds of such conspicuous female items from the same period as the Sun-chariot.

18 S. Albek, BA, Copenhagen once observed the 52 units of decoration on the diurnal side.

Indeed, Langstrup ranks with the disc of the model Sun-chariot, if it is not finer. As noted above, the belt-plates should all be seen as "suns", shining on the belly of certain women, whether pregnant or not, as images of the Sun-god (cf. the brimmed hat). Indeed, a fragment of a belt-late, originally of like size and quality, comes from a Period II hoard at Stockhult, Skåne (Randsborg 1993, Fig. 60, cf. 111f.). This hoard, among other items, contains figurines of in the Near Eastern model of men in loincloth, with moveable arms and brimmed hays with holes for feathers of the like, presumably Sun-gods, perhaps in the disguise of supreme rulers/priests.

We can only surmise on the cultic functions of these prominent women.

Tentatively, going one step further and using a new series of factors - in the following termed "the secondary factors" - in fact, seeing the riffled brimmed point of the Langstrup belt-plate as a zone in its own right, only lacking in spiral decoration - the sum of the spirals emerges as 0x1+15x2+22x3+26x4+32x5 = 360.

This is close to the number of days in a year, actually equivalent to the number of days in the year of the Ancient Near Eastern (ANE) calendar. Furthermore, 360 is a near perfect number calendar number, divisible by 12, 10, 9, 8, 6, 5, 4, 3, and 2, and giving Sun- and Moon-months almost the same length. As indicated, such calendar was in use in Ancient Egypt, Sumer, and other societies and cultures of the Near East. The Romans originally used the lunar year, changing only to the solar one with the Julian calendar of the first century BC. Lunar years were/are also used in Muslim countries, in India, and in China, and, possibly, in Ancient Europe as well.

In fact, a lunar month is suspected to be behind the deposits of 241 sickles and fragments thereof from Frankleben in Central Germany (Meller 2004, 117ff./ C. Sommerfeld). Firstly, the shape of a sickle symbolically mirrors the new or the waning Moon. The Frankleben sickles, dating from the early Late Bronze Age (Nordic Period III), seemingly carry two numbering systems, the first and simpler one (of oblique strokes) only displays numbers up to 29 - 29½ actually being the number of Sun-days in a lunar month. The second more complex, though fragmentary, numbering system holds higher numbers, 88 - virtually three moon-months (88½) - being the highest recorded. Due to the numbers, the items are supposed to be ritual, even though the deposit may not be.

A few more examples should be discussed to demonstrate the approach (cf. Appendix B for yet other examples and additional information). A fine Period II belt-plate from "Skåne" (Montelius 1917, 954) has a large 9-pointed star ("3x3") around the powerful point and otherwise carries 8+15+21 = 44 spirals in its 3 decorative zones (Fig. 31). Multiplication by the above primary zonal factors gives a sum of 8x1+15x2+21x3 = 101 units. This number is likely of no significance in the present context, even though it is virtually equivalent to 3½ lunar months (102), but only if the half day is omitted (month of 29 rather than 29½ Sun-days), and - likely a more serious reservation - half-months are employed. However, seeing the star as a zone - in fact, multiplying by the secondary factors - the sum emerges as 1x0+8x2+15x3+21x4 = 145, or exactly 5 lunar months (of 29 Sun-days, if again ignoring the half day).

By contrast, a very fine belt-plate from the extremely rich Period II grave of a young woman, possibly the richest in the country, at Hverrehus, Viborg County (Broholm 1943f. Vol. I, Grave 728) carries 3 decorative zones with 12+24+30 = 66 spirals (cf. Figs. 27 & 29). Multiplying by the primary zonal factor gives a sum of 12x1+24x2+30x3 = 150 units, or exactly 5 solar months of the 360 sun-days Ancient Near Eastern (ANE) calendar.

At this point, one should perhaps make a reference to the geographically different orientations of the graves of Period II: the western part of the Danish area mostly pointing the coffins towards sun-rise - thus the day - the eastern part mostly towards the sunset - thus the night - on the day of burial (to judge by plant-finds) (Randsborg & Nybo 1984). Such differences might have been linked to varying cosmological, even calendar systems. At present, however, there is no clear evidence as to geographical differences in the use of the said calendars.

Taking these observations back to the Sun-chariot, we arrive at the following observations (cf. Fig. 28 & Table III):

(A) The golden diurnal side displays a sum of 9x1+16x2+27x3 = 122 ornamental units, when multiplying by the primary factors. This is exactly one third of a solar year (4 months). The night-side similarly

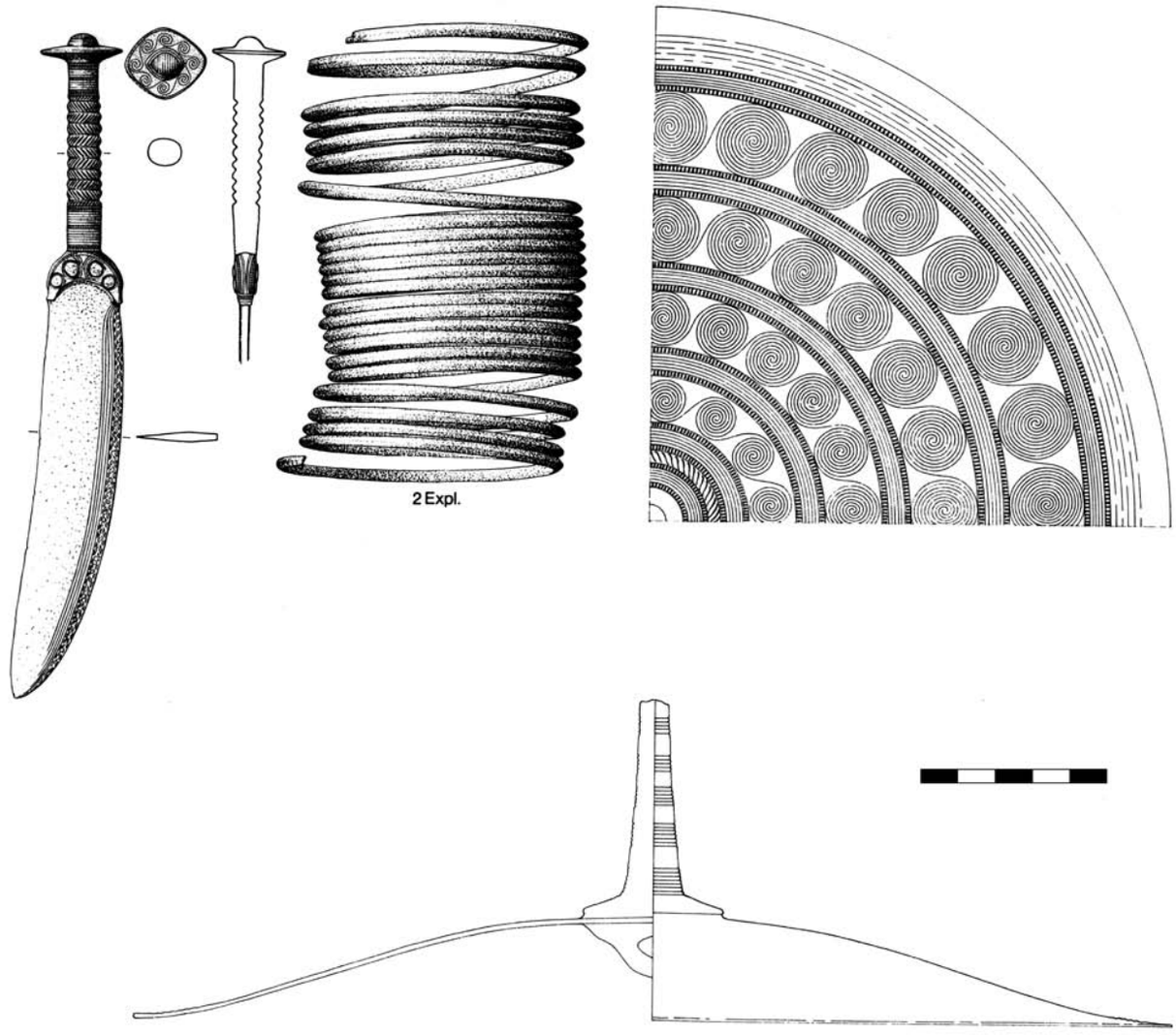
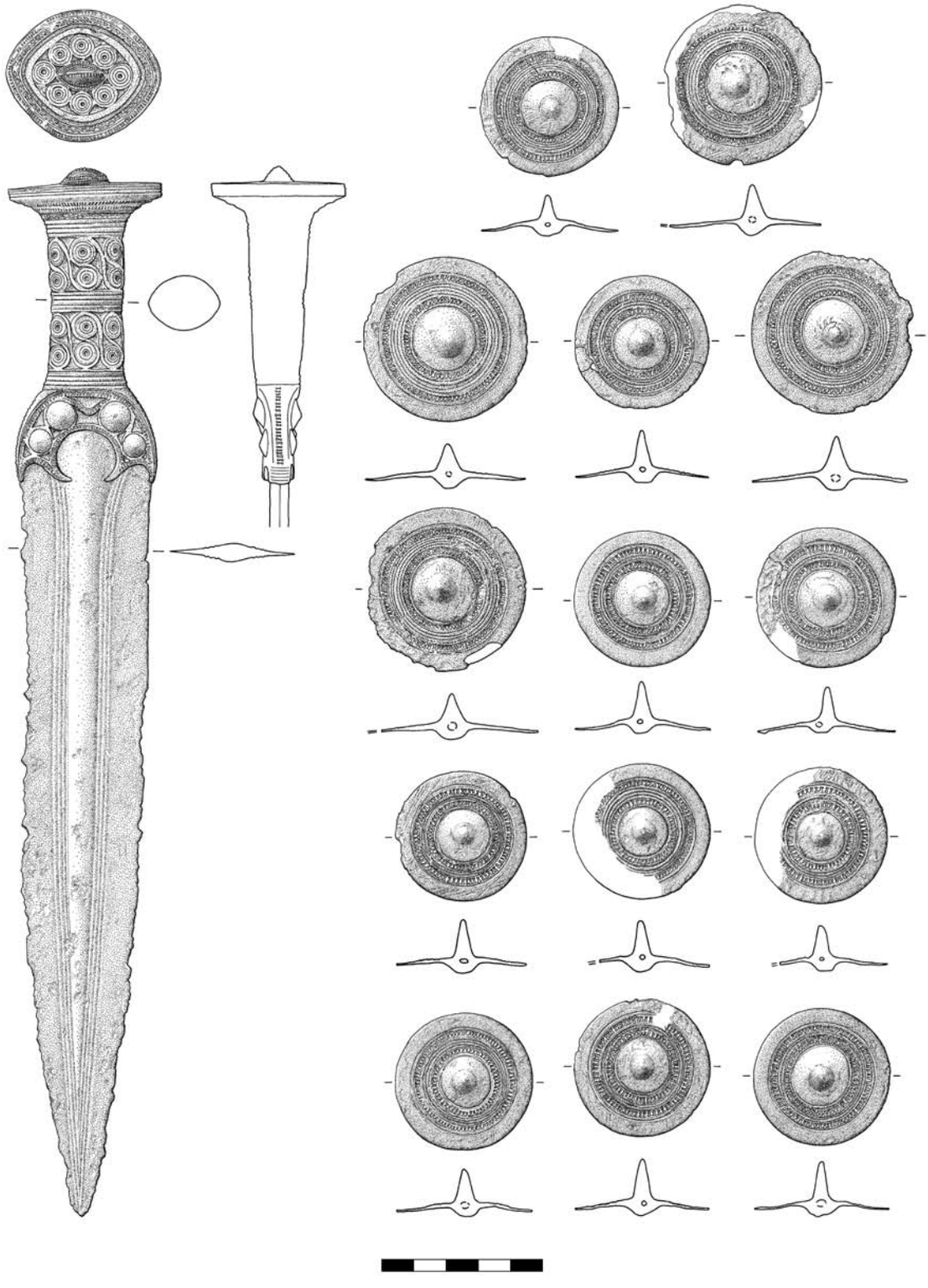
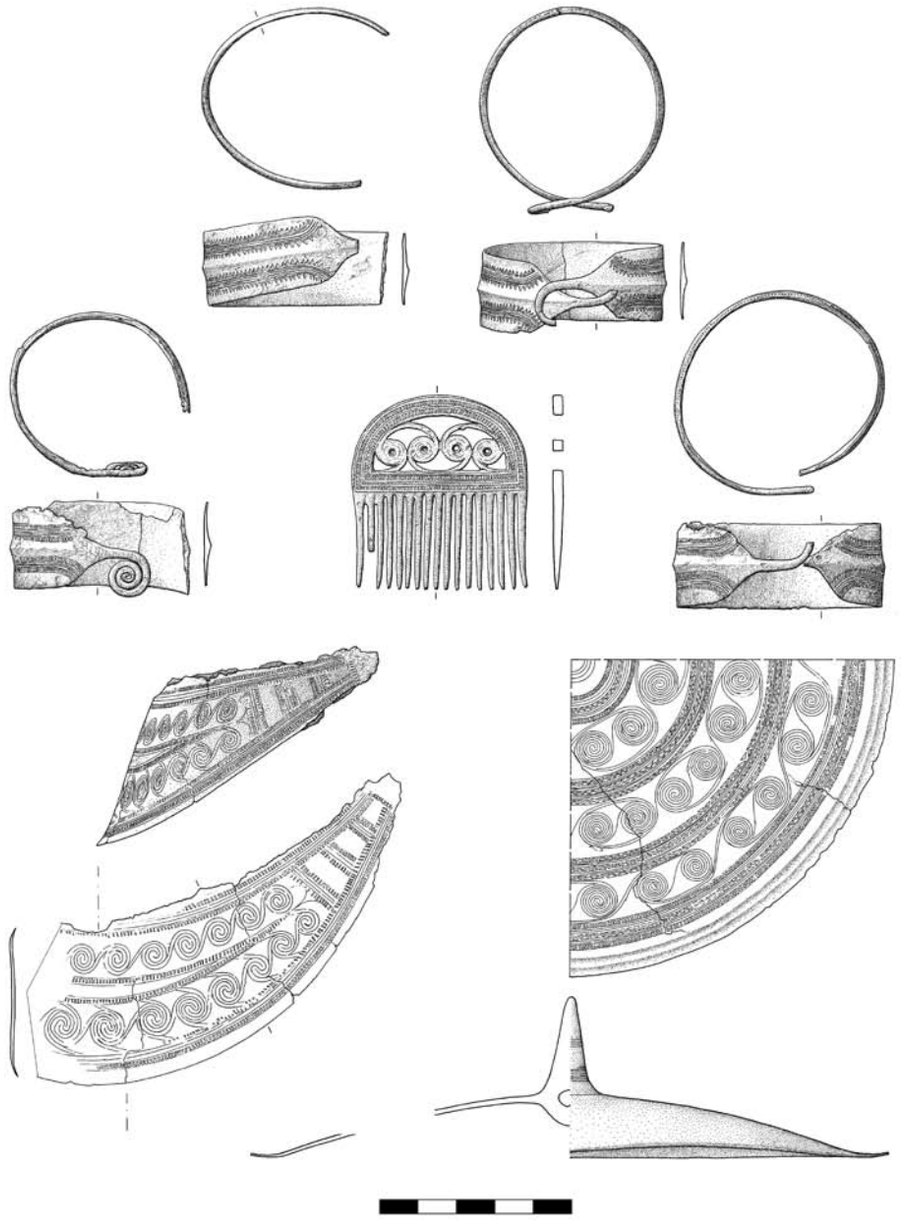
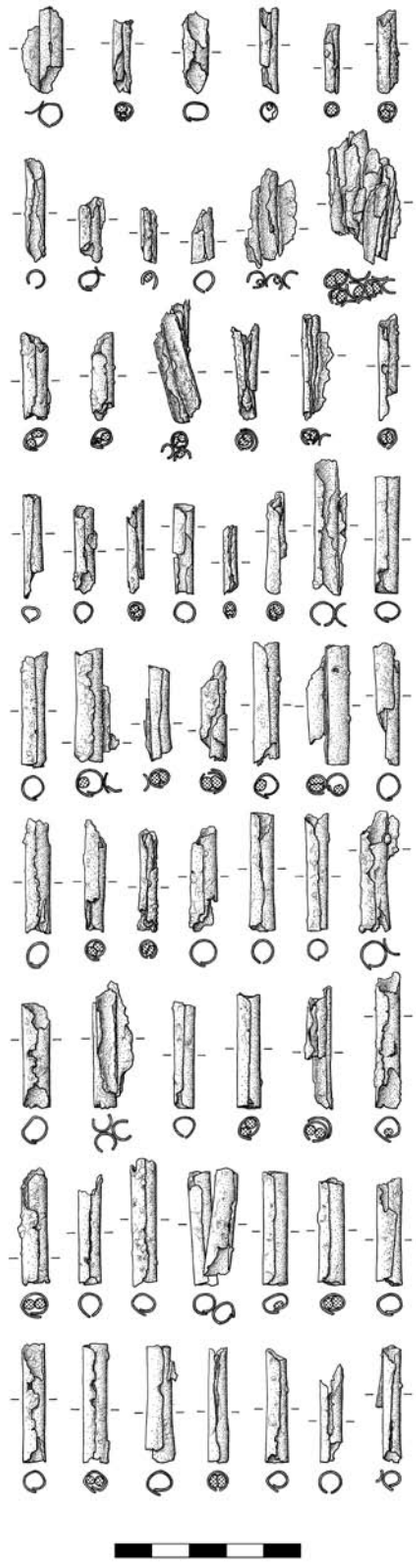


Fig. 29. The Langstrup belt-plate and associated items (AK I 201), Asminderød parish, Frederiksborg County. The items were deposited in a bog. After AK (right) & Neergaard (1890-1903) (left page).





Fig, 30. Belt-plate, neck-collar, arm-bands, tutuli, comb, dagger and tubes for string-skirt, all of bronze. From lavishly equipped female Period II grave at Hverrehus, Viborg County (Broholm 1943f. Vol. I, Grave 728; AK XII, no. not yet given). After AK.



displays 9x1+20x2+25x3 = 124 ornamental units, a number of no particular significance. (B) Seeing the central large group of concentric circles as a separate zone - equivalent to multiplying by the secondary factors - the following sums emerge. For the day-side, the mathematics are 1x1+8x2+16x3+27x4 = 173, a number of no particular significance. For the night-side, the mathematics are 1x1+8x2+20x3+25x4 = 177, the latter being exactly 6 lunar months in Sundays. Incidentally, the two sides taking together display 350 units when multiplying by the secondary factors, 10 short of a solar year even of only 360 days (the ANE calendar), and 4 short of a lunar year. This sum is obviously of no importance.

Highly interestingly, even in terms of calendars, the day-side of the famous Trundholm Sun-chariot refers to the Sun, the night one to the Moon. In fact, this famous artefact ought to have been called the "Sun & Moon-chariot", even though it is probably depicting only the Sun on its day-and-night journeys. The diurnal side of the Sun-chariot is adhering to a solar calendar of 366 days to a year, the night-side to a lunar one of 354 days.

Above, the above very elegant Langstrup belt-plate referred to the solar calendar of the Ancient Near East (ANE), with 360 days to a year, as well as to the length of human pregnancy (265 days), equivalent to 9 lunar months (Fig. 29, cf. Table V). The fine Hverrehus belt-plate also referred to the ANE 360-days solar calendar (Fig. 30, cf. Table V), while the beautiful belt-plate from "Skåne" seems to refer to a lunar one (Fig. 31, cf. Table V). These findings, as confirmed by several other fine belt-plates (cf. Appendix B), demonstrate a new and remarkable astronomical knowledge among the mostly Sjælland cousins of the elites resting in the famous Jylland Early Bronze Age oak-coffins.

A natural question is the extent that other fine and less fine belt-plate confirm the patterns of Langstrup. In fact, some do some do not, or do most likely by chance. The supreme belt-plates, like Langstrup, produce sums equal to months (in some cases, half months) of the relevant calendar; deviations of the order of +/- 1 are permitted. There is more than one such reference, often to different calendars. These belt-plates are commonly equipped with long powerful points or "hats", usually with a "brim" (Table V).

They demonstrate a new and remarkable astronomical knowledge among the elites. On the supreme level, we are very far from mere sightings of the cardinal points of the Sun (or Moon), as in Stone Age henge monuments. Notably, the Moon is very much present in the above deliberations, while it is otherwise next to invisible in European Bronze Age iconography, except for the early Central German so-called Sky-disk from Nebra (Meller 2004).

However, many ordinary belt-plates carry only banal (i.e., direct readings of) calendar correspondences or, at most, a single reference to a calendar system (Table VI, and below Appendix B). The points of these belt-plates are never equipped with "brims", are mere renderings - in terms of interlinked running spirals - of the movements of the Sun (and Moon - even the whole sky) around the tall hat of the Sun-god. Indeed, such image of the Sun is highly interesting in itself, integrating a personified deity (the hat) from the celestial bodies of his - more likely than her - sphere of power (cf. the above Stockhult male figurines).

The hidden calendar mathematics of the high quality discs and belt-plates no doubt reflect a secret knowledge (cf. Table III). This knowledge, to judge by the very high artistic quality of the items in question, was housed at the very top echelons of society. Royal craftsmen were probably akin to this knowledge, or the princes were themselves the craftsmen. Finally, the supreme items seem to have been concentrated in central Denmark, with a particular emphasis on Sjælland (cf. Appendix B) (Fig. 32). A few supreme belt-plates are from Fyn, a few from the north-western part of Jylland, rather far from Sjælland, and one from Skåne to the east. Common belt-plates, especially those with only one or two decorative zones have a wider distribution.

Even though the numbers of spirals vary in various decorative zones, all belt-plates may have served as sundials, if calibrated by the owners against mid-summer and mid-winter solstices and taking into account the period of the year. Thus, rather precise indications of time, for instance in agreements or rituals, would have been attainable.

Thus, the famous dead personages of the oak-coffin graves, discussed above - all from Central and South Jylland - may not have possessed such secret and doubtless very powerful knowledge as housed on the Danish Islands, at least not in depth. Only the trappings of the cults of the age, in particular those of the Sun, were known. In fact, many of the dendrodated graves are not particularly well furnished (cf. Pl. 1ff.).

Furthermore, the many often rather ordinary - and usually not particularly well designed and produced - Period II belt-plates generally have rather low points without the "brim" of the tall hat. Evidently, deeper mathematical, astronomical and other knowledge was hidden even from common members of the elites and only harboured among a very few princely families, in much the same way as much later the runic alphabet.

Examples of common belt-plates (cf. Appendix B & Table VI) are No. 18 Storehøj, Egtved (AK IX 4357; Thomsen 1929-35, Fig. 8), a small belt-plate of two zones with 10+17 = 27 poorly made spirals (Pl. 9). A grave at Langvad, Thisted County (AK XI 5542) held a standard belt-plate of 12+16 = 28 spirals. A second grave found at Hverrehus, Viborg County (Broholm 1943f. Vol. I Grave 730) held an ordinary belt-plate of 2 zones with 10+16 = 26 spirals. A grave found at Bustrup, Viborg County (Broholm 1943f. Vol. I Grave 741) held a belt-plate of 2 zones and 12+19 = 31 spirals (Fig. 11).

In No. 2 Borum Eshøj Grave C (not dendro-dated; Broholm 1943f. Vol. I Grave 791; cf. Boye 1896, 58f.; Pl. 20) was a rather ordinary belt-plate also of 2 zones; this has 12+18 = 30 spirals, which perhaps refers to the month of an ANE year of 360 days, but merely in the obvious visual fashion (cf. Bustrup above, with 31 spirals). Indeed, several belt-plates of two decorative zones, including the above ones, have about 30 spirals in all. The Borum Eshøj grave comes from a huge burial mound and is certainly one of the richest female grave of Period II, but even this women and her family was no part to the supreme cosmological and calendar knowledge of the Early Bronze Age.

Finally, as to composition and execution of these discs, a certain geometrical knowledge is required. This presupposes calculation of the perimeter of a circle from the radius (= $2\pi r$; r = radius), and thus of the notion of π (= 22/7), calculation of equations, and perhaps even fractions. π is easily estimated by help of a string. In the above discussions, knowledge of multiplication and division was presumed. Addition

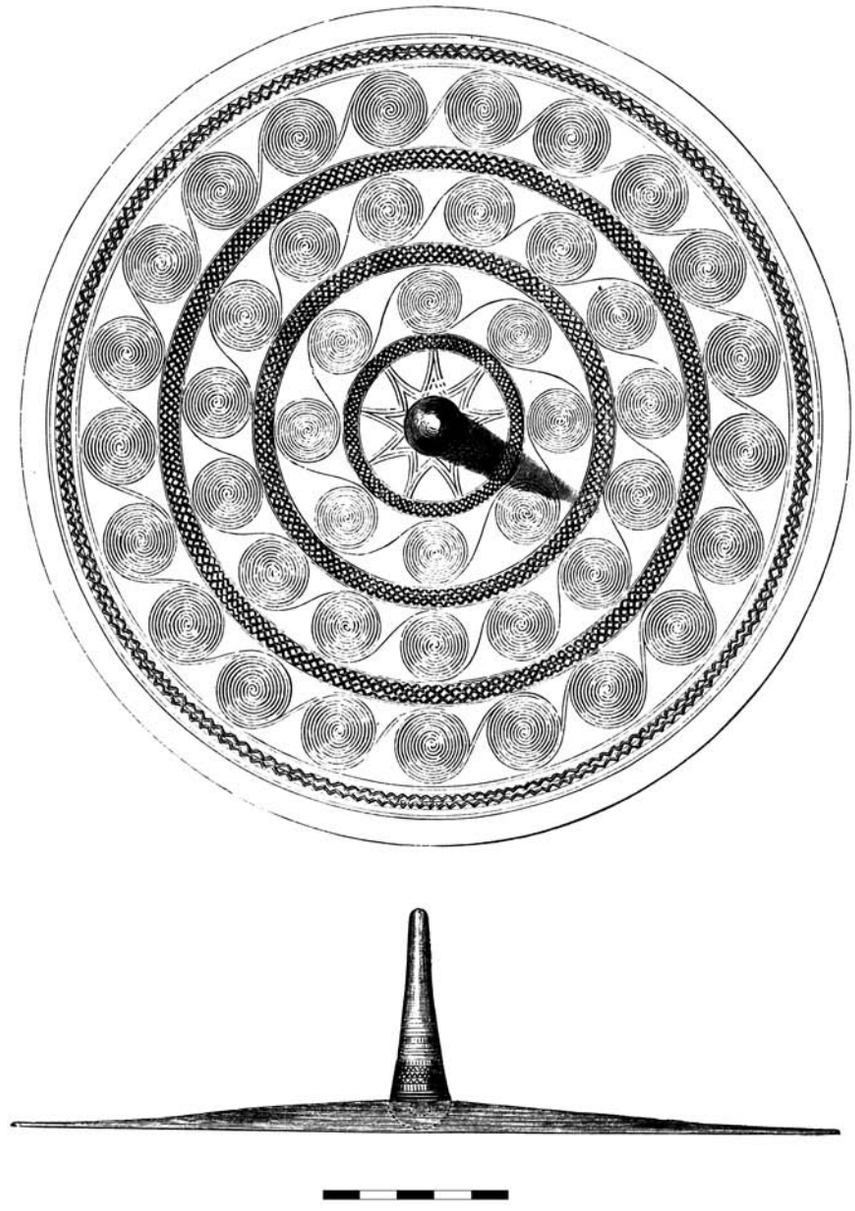


Fig. 31. Period II belt-plate from “Skåne”. After Montelius (1917).

Fig. 32. Distribution map of supreme belt-plates (rings) of Period II (cf. Table V). Filled ring = the Trundholm Sun-Chariot (cf. Fig. 28). Randsborg del.

and subtraction are of course as basic as a numbering system. Fractions work the easiest with a 10-digit system.

Above, the Bronze Age ability at weighing even smaller amounts of metal accurately was demonstrated. Measuring (of smaller distances) is demonstrated by the find of a hazel stick in Borum Eshøj (No. 2), next to the coffin of Grave A (Boye 1896, 53). The stick, 78½ cm long, was equipped with notches delineating a system of "inch and foot", in fact units of 15.7 cm and 31.4 cm (as measured with a modern yard-stick, available at the excavation). Surprisingly, this system seems to have been the same or very close to the same as the traditional Danish one, with rather large inches (2.6 cm) and feet (31.4 cm). The Bronze Age yard-stick was probably used when finishing the coffin, then discarded. Measures taken on the coffin approximately adhere to the stick.

Measuring sticks for much shorter distances, used, e.g., in connection with bronze work, presumably also existed. A closer study of the Langstrup belt-plate did not reveal any standard units, however, which would also have been a surprise when the number of spirals in the zones is the determining factor. The nearest is, perhaps, small units of about 3 and about 4 millimetres, likely too small to be identified with certainty.

Apart from the point/hat and "brim" of the belt-plate, the width in millimetres of the decorative zones (S = spirals) are, from point and brim to rim as follows: 7½ - 12S - 8 - 15S - 7½ - 18S - 8 - 20S - 6½ - 16 (blank). Also the "brim" carries a separating zone, here of 6½ millimetre. It should be mentioned that these measurements were taken from a supposedly highly accurate drawing in 2:3, not from the belt-plate itself (AK I 201) (Fig. 29).

Use of a string to map out decoration is possible but hardly sufficiently precise in extraordinary cases such as Langstrup and the Sun-chariot, where complicated pre-defined tasks were solved. Decoration of the wax model (for producing the clay mould for casting the final object) may seem simple, since it was carried out in each zone by series of often identical stamps, likely made of gold-wire coiled in spirals (Rønne 1989, studying the Langstrup belt-plate). Thus, the provision of wax (through bee-keeping), clay, copper, tin, and gold, as well as knowledge - the apex and base of organization - are all necessary elements in the production of fine decorated bronze artefacts. The underlying calculations pertaining to the decoration were quite complicated, as demonstrated by the above examples, no doubt representing a series of "secret numbers", known only to a very few.

LATER ARTEFACTS

The important question of a possible later use of ornamental units in calendar systems is still an open one. Nevertheless, in the following, a few preliminary studies are presented here, which indicate that calendar properties were in fact employed on artefacts of Periods III to V date (at least), appearing from both complex formulas and simple counts of units or decoration, the latter on imported objects.

The first study concerns a well known star-, ray- or - as seen from the edge - arch-decorated very fine later Period III so-called belt box from a lavishly equipped grave (or a deposit) in Kassemosehøj, København County yields the interesting observations below (AK I 532; Sprockhoff & Höchmann 1979, no. 171, Taf. 197) (Fig. 33). The belt-boxes are round and have a flat or pointed bottom carrying rich ornamentation; also the sides are decorated, but in a simpler fashion. The rim is equipped with lugs (for the lid). Thus, the belt-boxes bear a certain resemblance to the belt-plates.

The earliest quite small belt boxes might have been carried in the narrow woollen waist-belt of the women, even though this - as in the case of the belt-plates - is less likely, due to the weight of the boxes and other factors. Just like the somewhat later and much larger hanging vessels, the belt-boxes were closed by a lid of metal or wood secured by a peg through the lugs. The boxes were probably intended for holding "amulets" or, rather, items used for divination, as in the case of the small specimen with a wooden peg through the lugs from a grave in Maglehøj, Frederiksborg County (Boye 1889; AK I 183A). This held the following items, apart from a greasy and soft (animal?) substance:

- a worn upper incisor of a horse
- a piece of a tooth of an old horse (?)
- bones of a weasel, including lower jaw, a shoulder blade, and feet
- a claw likely of a lynx
- a bone of very young sheep or roe
- a piece of bird's air-pipe
- three parts of the spine of snake
- a couple of burned bones (human?)
- a small branch of rowan
- a piece of charcoal (likely aspen)
- a quartz beach stone
- a flat beach stone
- a clay conclomerate
- two pieces of pyrite
- a fragment of a bronze knife
- a piece of bronze wire (with hook)
- "a piece of iron (?)", not mentioned in the primary publication (cf. AK I, p. 54 that also mentions three stones, but see the "pyrite" above).

The Maglehøj grave, a cremation in a stone cist in a barrow, also held a large double button (for a leather belt), a fibula, and a knife. Obviously, the dead person, most probably a woman, performed as a diviner and physician, to judge by the contents of the fine belt-box, all of the items being of special significance even in historical times. A similar function is surmised from the similar and related vessels of Periods III-VI. Incidentally, the vessel in question is quite worn,

in particular the bottom, likely from polishing and tracing the ornamentation. The same type of wear, often heavy, is seen on most other belt-boxes and hanging vessels.

Incidentally, male divination and medical function are suggested on the base of the Hvidegårds find, København County (Herbst 1848; AK I 399). This Period III grave held a sword in a scabbard with a bronze ferrule carried in a bronze-buttoned shoulder strap, a razor, and, in a leather purse (with a bronze pin for fastener) on the starp, the following extraordinary items (apart from a bronze razor, knife, and tweezers, and a flint strike-a-light):

- a piece of amber (fragment of bead with drilled hole)
- a reddish stone of the same size
- a small sea-shell with a hole, the Mediterranean Conus Hwass
- fragment of a larger sea-shell
- a small cube (coniferous wood)
- a small spall of flint
- several dried roots
- the tail of a young grass snake
- a piece of bark (?)
- a claw of falcon
- small leather bag, containing: the lower left jaw (with two teeth) of a small rodent (likely a very young squirrel); a small bladder (?) holding small stones (gravel); some loose such stones

These amulets refer to several geographical directions and all physical elements: land, sea, and sky. It is even possible that the Hvidegård grave, a cremation in a stone cist in a mound, the bones wrapped in a mantle, also held a ceremonial dress (Lomborg 1981). This dress, seen on Late Bronze Age figurines, much looks like a belted T-shirt open to the sides with long points front and back.

Regarding the Kassemose belt-box, the arches of the first zone ("star") are 6 in number, of the second 13, and of the third 42 (zones one, two, and three, respectively). In the second zone the bases of the arches are equipped with a likely "Sun", accompanied, like the arches themselves by points ("shine"); thus, the arches likely represent the nocturnal and diurnal movement of the Sun. In between the second and third zones of arches are 29 rather "dull", or perhaps full Moon-like, concentric circles or rather groups thereof. This number corresponds exactly to the number of days in 1 lunar month. The sum of the arches in zones one to three is 6+13+42 = 61, or exactly 2 months in the Solar calendar (months of 30½ days). Adding the 29 concentric circles gives a sum of 90, or exactly 3 months in the ANE calendar.

Using the first formula from the Period II belt-plates (Table III) on the Period III Kassemose belt-box arches, the following sum appears 6x1+13x2+42x3 = 158, a number of limited significance, even though it comes rather close to 5½ month (if halves are accepted) in the Lunar calendar of 29 days (160, or rather 159½). Using the same formula but including the concentric circles as a new Zone Three gives 6x1+13x2+29x3+42x4 = 287, also a number of limited significance, even though it comes close to 9½ (if halves are accepted) months in the ANE calendar (285). Using the second formula (modified, since there is no point) from the belt-plates on the same arches gives 0x1+6x2+13x3+42x4 = 219, also a number of limited significance, even though it comes rather close to 7½ Lunar months of 29 days (218, or rather 217.5). Using the second formula but including the concentric circles as a new zone three (the old zone three thus becoming zone four) gives 0x1+6x2+13x3+29x4+42x5 = 377, or exactly 13 months in the Lunar calendar (of 29 days).

Thus, in the case of the princely Kassemosehøj belt-box we are probably dealing with calendar properties to be read both directly and though the formulas established above on the basis of the Period II belt-plates and, not least, the contemporary Sun-chariot from Trundholm (Fig. 28; cf. Table III).

Jumping, for the experiment, to Period V, a fine so-called hanging vessel - as indicated above, likely serving the same function as container for amulets as the belt-boxes - comes from a deposit at Veerst, Ribe County (Sprockhoff & Höckmann 1979, no. 267, Taf. 129f.). The decoration is in the wavy-pattern style typical of Period V (and VI) and arranged in three zones around a small mid-point "shining" Sun. The interlinked waves likely represent the diurnal-nocturnal movements of the Sun in much the same way as the spirals of the belt-plates of Period II. The central pattern opens up in ship sterns: the ship being the main carrier of the Sun on its eternal journeys in the Late Bronze Age (cf. Kaul 1998).

The zones carry 8, 20, and 34 ornamental units, respectively. The sum of the units is 62, or close to 2 Solar months of 30½ days (61). Using the two formulas of the Period II belt-plates (Table III), the following sums occur: (A) 8x1+20x2+34x3 = 150, or exactly 5 months in the ANE calendar. (B) 0x1+8x2+20x3+34x4 = 212, a number of limited significance, even though it comes rather close to 7 Solar months (214, or rather 213½). Thus, in calculation (B) one wonders if the small mid-point Sun ought to be included as a "Zone 0" with a value, raising the sum to 213, in fact, 1x1+8x2+20x3+34x4 = 213, or the 7 Solar months. Actually, this is equivalent to recalculate (A) with the Sun as Zone 1. According to this view, Calculation (B) will amount to [0x1+] 1x2+8x3+20x4+34x5 = 276, or virtually 9 solar months (275).

On the Late Bronze Age hanging vessels, there is no central point as "Zone 0" without a value among the ornamental units (as on the Period II belt-plates), usually the central motive is an integrated part of the decorative panel. Thus, only future studies will show what calendar points of view are correct, and on what hanging vessels.

A beautiful, even elegant and quite different Period V hanging-vessel with decoration in relief comes from a deposit in a bog (Find II) at Vester Doense, Ålborg County (Sprockhoff & Höckmann 1979, no. 272, Taf. 132) (Fig. 34). A string-skirt was wound around the vessel, the items perhaps being in a bag of bast. The shield-like decoration consists of a central zone with 7 large identical bosses all in a ring, a second zone with 245 small bosses, a third with 64 very small also identical bosses all in a ring, and a fourth of 535 small bosses. The zones are separated by very large rings (centre in the mid-point of the vessel bottom), also in relief.

As to calendar properties, the zones with small bosses hold practically 8 and practically 17½ Solar months of 30½ days (244 and 534). The grand sum of these bosses - 780 - has an even better fit of exactly 26 months in the ANE calendar. The other decoration, 7+64 = 71 units, at first does not seem to adhere to calendar properties. However, using the formulas of the Early Bronze Age belt-plates (modified, since there is no point unit) on the other decoration, we attain (A) a sum of 7x1+64x2 = 135, or exactly 4½ months in the ANE calendar, and (B) [0x1+]7x2+64x3 = 206, or practically 7 month in the Lunar calendar of 29½ days (207, in fact even less). Other calculations are less satisfactory, including applying all zones to the well-known formulas based on the belt-plates.

In the case of Vester Doense, the central units of the overall decoration are thus considered as belonging to the same zone, since they are identical and unseparated and in spite of the fact that they appear as six elements arranged around a single one. In a way, we have come full circle back to the Trundholm Sun-chariot (Fig. 28).

This being stated, and the road marked for future calendar studies of decorative units, it should be noted that several tested Late Bronze Age hanging vessels (just like the ordinary belt-plates of Period II of the Early Bronze Age, seemingly, do not display adherence to the calendar principles. The ordinary items only refer to the Sun and to cosmos through their decoration, not by particular numbers of their decorative units.

Finally, the large hammered items, round/oval shields (e.g., Schauer 1980) and various mainly larger vessels, richly decorated and mostly foreign, or "imported", ought to be studied for potential calendar properties. An obvious candidate is the very thin metal shields with decoration in relief, like the above hanging-vessel from Vester Doense. These shields, certainly, were not for ordinary military use, only display.

Among the completely preserved metal shields is a slightly oval specimen, likely of Period IV (or III) date, from "Denmark" (Thrane 1975, 78 Fig. 39 left). Two decorative circles around the large central shield-boss (with handle and other decoration, cf. below) hold respectively 76 and 116 smaller bosses, or 192 in all. The number of 76 is exactly 2½ Solar months of 30½ days (if halves are accepted); an even better fit is actually obtained by using the slightly more correct 30.4 days. 116 is exactly 4 Lunar months (of 29 days). 192 is exactly 6½ Lunar months of 29½ days (if halves are accepted). However, using the first formula from the belt-plates of Period II, the sum of 76x1+116x2 = 308 is obtained, a number of no particular significance, even though it is not far from 10 Solar months of 30½ days (305), considering the high number involved. Using the second formula, the sum of 76x2+116x3 =

500 is obtained, a remarkable enough number, but of no particular calendar significance. Thus, such formulas may be of no (or limited) value considering imported objects.

A round likely Period IV shield - one of two - comes from a bog at Sørup, Maribo County (Thrane 1975, 80 Fig. 40 left; Thrane wrongly quotes the locality as being in North Jylland). This shield is decorated by a cross of multiple lines of smaller bosses and circles of similar bosses at the rim and around the large central shield-boss (with handle). Four rings at the rim and in the line of the arms of the cross are for suspension, likely as a "Sun symbol", in the ornamental shape of a chariot wheel or wheel cross[19]. The number of bosses is 30+52+24x4+109 = 289, or virtually 10 Lunar months of 29 days (290). It should be noted that the ornamental units of the inner circle consists of 24 bosses to which is added 2x3 = 6 nail-heads (of the same size) of the handle. Partly, the handle is overlaying a couple of the bosses. In fact, the two flattened areas for the handle might accommodate up to 7 bosses, or an intentional total of 31 units, thus providing a perfect fit for 10 Lunar months in Solar days (290).

The second round and similarly sized shield from the bog at Sørup, Maribo County has 6 circle zones of smaller bosses (separated by fluted circles) (Thrane 1975, 81 Taf. 40 right). The total number of bosses is 42+56+70+83+97+110 = 458. The single numbers of the circle zones do not seem to hold any special significance. However, the sum does, being exactly equal to 15 Lunar months of 30½ days.

As above, multiplying by the primary factors (cf. the formulas of the Period II belt-plates) gives 42x1+56x2+70x3+83x4+97x5+110x6 = 1841, a number of no particular significance. Multiplying by the secondary factors gives 42x2+56x3+70x4+83x5+97x6+110x7 = 2299, also a number also of no particular significance. The closest significant number is 78 Lunar months of 29½ days = 2301; 78 Lunar months incidentally is the same as 6½ such years.

A highly interesting set of shields to test for calendar properties is those of the complex Herzsprung type of Period V (Thrane 1975, 72f. Taf. 35-38; the eponym shields are sometimes rendered in their reconstructed state, but larger parts are in fact missing). These particularly thin - thus, often very poorly preserved - oval shields have a basic decoration of several fluted ovals around the central shield-boss, which almost looks like an oval house from above. The fluted circles carry one simple (inner) and two complex openings with a round gateway; the openings are turned towards the same long side. Between the fluted ovals and the rim, and even coming in (or going out) through the complex openings, are circles and lines of bosses, sometimes accompanied by smaller ones. Other decoration includes birds (Thrane 1975, 76 Taf. 38, cf. below). The whole arrangement much looks like a large number of people entering en multi-fenced compound. One inevitably comes to think of a chiefly or divine homestead, like the Asgård of the Nordic Patheon housing the supreme gods of the Aser lineage (cf. below). On earlier shields, the shield boss is often equipped with a gateway, or a "notch" (e.g., Thrane 1974, 78f. Fig. 39 left & right; cf. above, from "Denmark").

Notably, the gateway openings of the Herzsprung shields mirror the two tilted Omega-figures on Panel/Slab 8 of the Kivik cist (Randsborg 1993a, 11ff. Fig. 4f., cf. 33 Fig. 13). The openings of these figures are facing due South, which therefore may be the correct orientation of the shields, if used for astronomical purposes. Each Kivik "Omega" is entered by two lines of seemingly male figures, almost like the line of bosses through the gateways of the Herzsprung shields.

The very well-preserved shield of type Herzsprung stemming from a bog at Nackhälle in Halland has an edge zone decorated with 15 swans (or ducks). These are looking left and outlined in very small bosses lined by points (extremely small bosses), which give extra contour, including beak and toes (Montelius 1917 no. 1164; Thrane 1974, 76 Taf. 38; Stenberger 1964, 221 Fig. 98 for details). Each bird is framed by 4 large bosses (32 in all). (Incidentally, 15x4 = 60, or exactly 2 months in the ANE calendar, while 15x32 = 480, or exactly 16 months in the ANE calendar.) The web-footed bird is of course a sacred animal in later Bronze Age cosmology, often appearing with Solar images. The edge zone and the "road" to the first gateway on the Nackhälle shield also carry small framing bosses, in fact to the number of 170+1+246+15+15 = 447.

19 Also very small accompanying bosses are seen, likely ornamental.

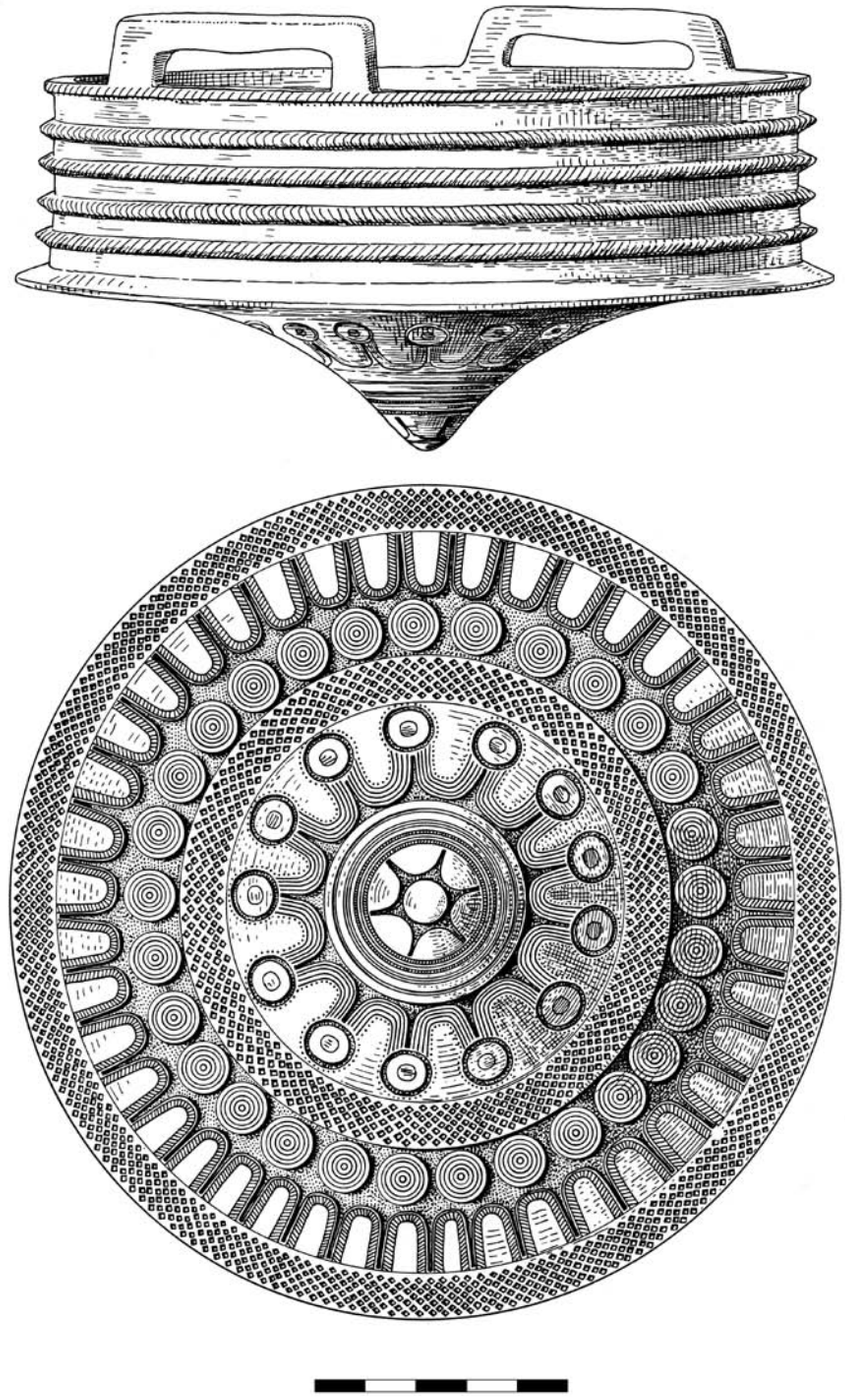


Fig. 33. Belt-box from a princely (later) Period III grave (or a deposit) in Kassemosehøj, København County. After Sprockhoff & Höckmann (1979).

Fig. 34. Hanging vessel from a Period V deposit at Vester Doense (II), Ålborg County. After Sprockhoff & Höckmann (1979); photo Danish National Museum

Fig. 35. Herzsprung type shield of Period V, found in Tårup Mose/Bog, Maribo County. After Broholm (1943f./Vol. IV); photo Danish National Museum.

Five large groups of concentric circles "march" on the road to and through the round gateway openings. The number of 447 is not significant, possible because the smaller bosses are only decorative. Neither 170/171 nor 246 carry any particular significance, only 15+15 does (1 month in the ANE calendar), but perhaps by chance. (Regarding 246, 8 Solar months of 30½ days is 244, a fit not close enough, in particular when considering 170/171, which is of no significance.)

That the larger bosses of the Herzsprung shields carry significance is emphasized by a shield from Tårup Mose/Bog, Maribo County (Broholm 1943f./ Vol. IV, 258 with Pl. 70; Thrane 1974, 75 Fig. 37) (Fig. 35). This specimen, almost fully preserved, displays bosses in three different sizes of which the smallest are used for frames, Nackhälle style. Two full ovals of large bosses hold respectively 98 and 115, at the ends are arches of respectively 24 and 25 (by an error, due to asymmetry?) large bosses. This gives a sum of 262, or virtually 9 Lunar months of 29 days (261). A final 9 large bosses are on the road to and in the outermost gateway opening. Adding these to the above, a sum of 271 occurs, or virtually 9 months in the ANE calendar (270), cf. the above remarks. Incidentally, the pertaining angles for the ends of the arches of the 24/25 large bosses suspiciously look like those of a pair of Summer and Winter solstices respectively for a southern part of Central Europe (the supposed area of origin for the item), when turning the openings towards the South (cf. the Kivik Omegas above).

The intermediate oval zones of medium sized bosses of the Herzsprung type Tårup shield carry 151+186 = 201 specimens. To this come two large arches (almost a full oval) of 96+94 = 190 medium sized bosses. Two shorter arches at the ends carry 27+30 = 57 medium sized bosses. Similar sized bosses occur in prolongation of the short series of large bosses, namely in the number of 9+11 = 20, and 9+[11] = [20]. Unfortunately, the numbers in [] are wholly uncertain due to poor preservation, and to conservation. The grand sum of the medium sized bosses is thus a high 201+190+57+20+[20] = 468+[20] = [488]. In fact, the number of 488 is exactly 16 Solar months of 30½ days.

This is an almost surprisingly significant and interesting result, in particular in the light of the above Nackhälle shield, where the small bosses seemingly had no significance and were mere frames and borders. Incidentally, the smallest bosses of the Tårup shield, also making up frames, can not be numbered with certainty, due to damage at the edges of the item.

At Fröslunda in western Sweden, a high at least 17 almost leaf-thin oval Herzsprung shields of Period V were deposited in a cove of Lake Vänern seemingly without any other types of artefact (Hagberg 1988; 1995; Jankavs 1995). The number is so high and the locality so marginal that a southern origin may even be called in doubt. Most shields were in a rather poor condition and are, basically, unpublished. However, one well-preserved curved specimen has been rendered in a published photo (Jankavs 1995, 107). This is an untypical shield, however, although with parallel to its typological elements in the same find.

The shield carries 6 groups of concentric circles (with a smaller boss in the middle) in a zone around the central shield-boss. After an empty zones (there is no inner opening towards the shield-boss, unless wrongly restored) follows a usual Herzsprung arrangement, but here with alternation concentric circles (around smaller bosses) and slightly larger bosses. The first such zone carry 10 concentric circles and 10 bosses (one such is squeezed in like an afterthought); an additional boss sits in the gateway opening (not counted). The second such zone, carry 19 concentric circles and 20 bosses, and the third one, 20 and 20. Three concentric circles sit in the road to the first gateway or in it.

This gives a total of 58 concentric circles, or exactly two Lunar months of 29 days, and 50+1 = 51 bosses, a number of no particular significance. The total, of 109 units, is not significant either, so perhaps the number of 58 is arrived at by chance. Thus, this shield might rather be compared with the ordinary belt-plates of Period II and is perhaps a Nordic copy. Other photos of the find seem to indicate ordinary Herzsprung shields. Incidentally, the frames of the said specimen are in quite small bosses not counted here for uncertainty about the degree of restoring of the shield (this comment also covers the above musings). Indeed, inspection of this item is requested before a final conclusion can be reached.

In preliminary conclusion, the imported objects also adhere to calendar principles, but in a straight-

forward manner, applying simple counts and additions only, not formulas, as in the case of the Nordic objects. In fact, the same was the case with the above identical "drums" (or thrones) of an early part of the Early Bronze Age, from Hasfalfa in Hungary and Balkåkra in Skåne: both foreign objects (Figs. 26-27). This is not to indicate that the Central European and other foreign objects were simple in conception (cf. below).

Evidently, the North and Central Europe shared calendar systems with the Mediterranean and the Near East. All regions must have pondered the same cosmological observations and problems. Again, we have noted multiple calendar references in the decoration of costly and important female items, the belt-boxes and hanging-vessels, no doubt used in performances and rituals, as well as in divination. All the items - from the early belt-plates to the late hanging vessels - in themselves bear witness to conceptions of cosmos, beautifully executed. The additional secret of some of these items lies in the gracing by supreme calendar knowledge on the precise workings of the Universe.

It is remarkable that this knowledge is often the clearest expressed on relatively common female items, in spite of the fact that the manufacturers in all likelihood were men. These men were also responsible for the particular Bronze Age styles in both male and female metalwork. The styles were - and are - defined both temporarily, and to a lesser extent, locally: thus, displaying the powers of both novelty and place, or society. The rise in the investment in female bronzes seemingly took the route through participation in high-status rituals concerning religion and cosmology. The common, almost vulgar, direct link between women and fertility is seemingly not the primary issue here. Some high-ranking Bronze Age women may even have been familiar with the calendar secrets and participated in their maintenance and transmission.

On the other hand, the major cosmological and cult items of the Early Bronze Age have a clear male connotation: the "drums"/thrones (likely for men), the Sun-chariot (modelled on male chariots), and the Skallerup-waggon from the Early Bronze Age (from a male grave), etc. The same is the case with major cult items from both the Early and the Late Bronze Age: the golden cups, the paired lur trumpets, and the shields. Foreign or imported objects almost always occur with the male sex or gender. This was obviously playing the central role in the cult, while the female one was mainly a performing one, as demonstrated by the rock carvings. The two sexes or genders were both practicing divination.

In many ways, this society differs substantially from that of late prehistory, dawning during the Iron and Viking Ages more than a thousand years later and transmitted in texts, images, and things: economically developed, technologically more advanced, expressedly martial, but less integrated in ideology. The Nordic Bronze Age, by contrast, was based on a common cosmology and ideology in a society integrated by chiefly forces linked across Europe. However, the Bronze Age fell to Iron Age economics, European divisions, and a new spirituality.

MATHEMATICS

Above, we have met Bronze Age mathematics in calculations concerning calendar issues. We have seem the use of addition (and subtraction), multiplication, and the supposed use of division. We have supposed the knowledge of π (= 22/7), and, in fact, far more intricate calculations. We have observed operations with at least three calendar systems. The first one is based on a Solar month of 30½ Solar days (or a little less), the second one with a Lunar month (or rather two) of respectively 29½ and 29 Solar days, and, finally, the Ancient Near Eastern (ANE) calendar with a month of 30 Solar days, but a year slightly too short.

In studying the belt-plates, it occurs that they not only carry references to various numbers of months in the three (four) calendars. They also display number games where either all sums, both of the ornamental units (usually spirals) in different zones and various multipla of the ornamental units, are divisible by the same whole number, for instance seven. Thus, the Langstrup belt-plate not only refers to 9 Lunar months (= human pregnancy) and to 12 month (= one year) in the ANE calendar, both all sums of direct observations of ornamental units and all multipla of the same are divisible by the number of 5.

This is a surprise, the deeper point of which seems rather obscure, except for the fact that Bronze Age

elites, as transpires from the above, were obsessed with calendars and numbers, in fact, with order and regularity, as also expressed by their sublime metal work. At any rate, the occurrence of common divisors confirms the suggested use both of the said calendars, reading of direct numbers of ornamental units and multiplication by primary and secondary factors. A number of belt-plates has the divisor of 2, which statistically is no great surprise, even 3 is to be expected, perhaps 4, but a fair group has higher numbers, at least up to 17. Thus, [1], 2, 3, 4, 5, 6, 7, and 17 are with certainty accounted for. The open question is if this system is in any way related to the calendar ones, which it certainly is with calendar numbers like 29 and 30 (including numbers that 30 is divided by - 2, 3, 5, and 6). If halves are accepted, 29½ and 30½ might also be relevant and included. The next question is how the systems are related.

One possible explanation of the common divisors is that they merely reflect a fascination with order in the same way as the calendars, since the two systems are at least partly independent of each other, as transpires from Tables V(f.), cf. Table III. There are calendar belt-plates without common divisors and vice versa, even though a correspondence is common. Another explanation is that the divisors are part of a system numerically much larger than the areas covered by the belt-plates and difficult to reconstruct or to identify from these, in fact large tables of critical numbers. The one larger system, which would have been of great interest to Nordic Bronze Age peoples - as well as other - in Antiquity is a table of correspondences between Solar and Lunar months longer periods of time, and with other calendars, including the Ancient Near Eastern (ANE) one.

In fact, the common occurrence of more than one calendar system on one and the same supreme belt-plate (or the like) is most likely proof of the knowledge of such important astronomical and, no doubt, ritually important correspondences (Tables IIIf.). Traditionally, such findings have been ascribed to the Greeks of the late fifth century BC (Meton of Athens). They can now be taken back to nameless scientists of the Early Nordic Bronze Age in the 14th century BC, and no doubt to other areas of Europe and the Near East as well - in accordance with the normal direction of the flow of knowledge and cultural traits. The Greek of Classical Antiquity in many cases only refined, systematized, and theorized about knowledge. An example in case is the famous doctrine of 6th century BC Pythagoras concerning right-angled triangles. This doctrine was already known to Babylonian and Egyptian architects of much earlier dates, and even to prehistoric Europe, at least as a convenient way of creating a right angle by using triangle measures of 2, 3 and 5, thus $3^2+4^2 = 5^2$, since $9+16 = 25$. Even square roots may somehow have been acknowledged, since a triangle with two sides (a, and b) of 1 adjacent to the right angle has a third side (c) of $\sqrt{2}$, following the general Pythagorean formula of $a^2+b^2 = c^2$.

The existence of knowledge of such calendar correspondences has even been supposed for Central Europe in the Late Bronze Age, as indirectly above on the base of imported objects. The most important item in question is the "Berlin" golden hat of the Sun-god decorated with the very many concentric circles, the combined counts of which, from the various decorative zones, gives Solar and Lunar months in days over very long periods indeed (cf. Menghin 2000). Here no formulas are applied, though, only intricate counts of direct readings. Further studies along these lines should be welcomed.

Other largely contemporary golden hats and various gold and bronze items may also come into question for such considerations, including at least one golden hat (Schifferstad, Bayern/Bavaria) contemporary with the Trundholm Sun-chariot (Randsborg 1993, 114). If this hypothesis is correct, such hats would potentially have acted in much the same way as the wooden "eternal calendars" of the Late Middle Ages and recent times to keep trace of time and main events (Moberg 1938). Or rather, such tables - which no doubt must have existed also in the Bronze Age - were the calendar and numerical models upon which certain items, including the belt-plates and possible other artefacts were designed, no doubt with a digital systems and other symbolic rendering to support the supposed Bronze Age "Masters of the Time".

Above, it was suggested that the Hasfalva and Balkåkra "drums" (or thrones), of respectively 11 and 9 solar months, might have been parts of a larger series of possibly twelve drums (one year) (Figs. 26-27). For a later part of the Bronze Age, one might wonder

if the thin "calendar" shields were also parts of sets. At any rate, as already mentioned, at Fröslunda in western Sweden, 17 (or perhaps more) fine Herzsprung shields of Period V, were deposited together without any other artefacts (Hagberg 1988; 1995; Jankavs 1995). This very high number in itself suggests some kind of "system", which may never reveal itself fully, however, due to the incomplete preservation of most of the items.

In the same way, the fine and calendar correct belt-plates - to stress the items that have most occupied us in the present context - might have been elements of series of identical items with different months of the same or even other kinds, perhaps emblems of particular cultic societies. Of course, belt-boxes and hanging vessels might also have been produced in series, but there is no evidence.

The number system *per se* is difficult to gather, but the use of various calendars with different numbers of days would speak in favour of both a 10- and a 12-digit system. Looking at signs on sickles - the latter even half-moon shaped - existence of two counting systems are supposed for Central Europe in the Late Bronze Age (Sommerfeld 1994). The first and simpler one (of oblique strokes) displays numbers up to 29 - 29½/29 actually being the number of Sun-days in a Lunar month. The second and more complex, though fragmentary one holds higher numbers, 88 - virtually three moon-months (88½/89) - being the highest recorded number. Of course, counts and counting systems are not the same as numbering systems.

Zero (0), which had a particular status in the Ancient systems - claimed to be a late invention, from India - may also have been in use in the Early Bronze Age in the North. This seems indicated by the de facto "zero" status of the point of belt-plates (vis-à-vis the surrounding decorative zones) in the above multiplications. If so, Bronze Age mathematics were surprisingly highly developed.

For the moment, this and other questions must stand unanswered, at least partly, even though it is certain to say that a new world is beginning to open up as to astronomical and mathematical knowledge - and manipulation thereof - in the Bronze Age. The existence of sophisticated calendar systems in societies and cultures without written records is a great surprise, not least since calendars presuppose advanced numerical systems, observations - and, not least, records thereof. In fact, some numerical systems have already been established, not least within enumeration, and measuring of distances and weights.

Incidentally, there is a much later parallel to the distinction between "supreme" artefacts - with correct number of days - and similar items, which only display visual similarity in terms of type and decoration. The parallel in question is the early runic literacy in Denmark (of the second/third century AD onwards), where some inscriptions are correct, or almost correct. Other inscriptions only consist of single letters in seemingly meaningless order, or, with very limited meaning in terms of conveying a precise message, other than knowledge of letters and, possibly, of the runic alphabet (cf. Fischer 2005).

At any rate, the Early Bronze Age displays a remarkably coherent cosmological system, which at first seems mythological in character but also holds distinctive scientific elements, like the calendar knowledge. The ideology of the Bronze Age is a culturally eloquent mixture of concrete observations explained by beliefs. At least in part, the latter are based on yet other observations placed on a social stage with immortal aristocratic inspirations. In such a context, a heliocentric world-view would almost seem the logical consequence. When, most likely, this was not accepted as a physical reality, the reason, ironically enough, rests with Bronze Age science - concrete observations from the platform of the Globe, a base that even a Tycho Brahe of the 16th century AD could not free himself from.

In the Nordic Late Bronze Age (1100-500 BC), the basic elements of the cosmology were probably the same as in the Early Bronze Age, even though ships now played a mayor role in transport of the Sun on its day-night-day journeys (Kaul 1998). It is something of a mystery, however, how, during the Early Iron Age, the transformation took place from Bronze Age cosmology to the Nordic mythology of the Late Iron and Viking Ages known from the Islandic Sagas and other evidence (the Sagas were not written down until after 1200 AD, though, more than 200 years after Scandinavia turned Christian). In the Nordic cosmology, the cosmological elements are wholly unscientific, the universe inhabited by very many deities of various families, as well as giants, enemies of the gods and of

the order of the world, as well as other creatures and beings, like the dangerous Midgårdsorm (giant sea-snake). The gods belong to families of respectively "Vaner" (fertility gods) and "Aser" (aristocratic gods, residing in Asgård, the Scandinavian Olympos)[20].

The Vaner are supposed to be the oldest layer, perhaps due to evolutionary thinking on behalf of historians of religion, but certain elements and attributes may well stem from the Bronze Age, or perhaps the pre-Roman Iron Age, such as the light ship of Frey and the wagon and necklace of his sister Freya. Even Bronze Age worship of the Sun - thus reproduction - can be cited in support of the supposed ancestry of the Vaner. By contrast, the Aser rather fit into an AD cultural milieu. The Icelandic Sagas even claim they arrived from the East.

Possibly, Classical and other European mythology (Celtic, Thracian, Scythian) were distant stimuli, Bronze Age and older religious elements only surviving in the cult of fertility of the Early Iron Age, in particular the pre-Roman part (500-0 BC). Probably, Nordic mythology, like so many other cultural elements of the period, developed in opposition and yet parallel to the Classical world. By 100 AD, the Roman writer Tacitus attempted to identify Germanic deities similar to the Roman ones (Randsborg 1993). Of course, several of the names of the days of the week are derived from respectively Roman and Germanic gods, for instance Wednesday - Mercurius & Odin, in Latin and Germanic languages respectively.

In the Classical world science developed independent of religion. The Bronze Age therefore is likely the last period without this modernist distinction, heavenly bodies being the gods of the age (even though other supernatural creatures, in fact animals, also existed). By contrast, both Classical and Nordic mythology, and even the late monotheistic Near Eastern religions, had and still have no scientific dimension.

Thus, it is significant that the end of the Bronze Age with its international ethos, aristocratic (or chiefly) organization of society, integrated culture, and astronomically based religion and science co-insides with the rise of the Classical World. The international spirit of the former age was no doubt voluntary, encouraged by the demand for rare metals and supported by a koinë of petty rulers in particular along the Southeast-Northwest axis of the Continent, along with more marginal corridors of communication.

The Classical civilizations, by contrast, came to represent the "modern" order of things, ultimately in all of Europe (not least after the rise of Christianity). Greek and Roman city state civilizations (and derivates) came to dominate the Continent by culturally marginalizing other societies, the latter often left with rejecting rather than imitating. The Classical civilizations were "compartmentalized" in structure - in spite of common and uniting styles of culture - possessing a cultural "division of labour", in fact several life forms in the same society. Rulers and gods would serve as symbols of this order but did not possess the evident powers of the astronomical universe of the Bronze Age. Public engagement of the citizens, including military service, created and re-created vitality.

In fact, the Bronze Age could not survive the arrival of iron technology on a large scale and the concomitant rise in general production, in the South in particular by slave labour. The latter were usually acquired by conquests, along with new land. Nor could the Bronze Age survive the new stimuli from the Near East, ultimately creating a commercial Mediterranean region dominated by mass production, the economic basis of civilizations. In terms of military provess, the novel phalanx techniques of massed fighters substituted for the lighter Bronze Age armies (cf. Randsborg 1995; 2002b). In turn, military conquests provided estates, and empires (Randsborg 1991).

The point here is that the fall of the Mediterranean and later of the European Bronze Age - and, in particular, the eventual rise of the Classical polis-based societies - left a significant impact on even distant societies and cultures, like the Bronze Age of Denmark. The traditional fields of interaction were no doubt alliances, in the form of luxury gift exchanges and elite marriages, as well as foreign participation in important events like cultic feasts, typically involving the high echelons of society. Fighting techniques and military organization were other fields of interaction, positively as negatively, in addition to commerce.

20 On thin cultic shields of the Late Bronze Age appears what looks like a hall - the shield-boss - surrounded by several fences and entrances (e.g., Jensen 2002, 429:1 & 4). Other decoration requires further scrutity too, including studies of the numbers of decorative units for possibly calendar properties.

Even religious thinking was seemingly involved, including similar cosmologies, calendar systems, etc. Obviously, the challenge or even disappearance of leading groups would have left a void locally and negative impacts on communication and other aspects of such elite society.

Whatever the particular reasons, and there were no doubt multiple, the traditional aristocratic culture of the Bronze Age was challenged by egalitarian sentiment, as revealed by the change towards modest burials, mostly cremations. Cremation may have fulfilled a common European dream about rising to the Sun, by the spirit or soul of the death, in contrast to the "oak-coffin" or similar graves for the traditional elites, striving to become immortal members of the society of the Sun-god. The idea that a class of independent yeoman farmers emerged - the "citizens" of Greece - is supported in Denmark by the very large number of smaller long-house farmsteads in the Late Bronze Age (and Pre-Roman Iron Age), in contrast to the fewer and often much larger ones of the Early Bronze Age.

However, development almost never follows a predictive path. Elites survive whenever the option, like military challenges, state building, or commerce. Over time, estate building became an important element, as in Greek colonization, in turn supporting new citizen elites. Thus, Iron Age elites arose, though on the material level often in disguise, while contemporary Late Bronze Age elites - often equally elusive in burial - in Europe survived as such. The Late Bronze Age elites in Denmark, for instance, played a central role in the cult, likely the ideological base for their survival. In addition, they provided bronze and gold not only for their own trappings and weapons, but also for the tools used by the expansive Late Bronze Age society before it technologically gave way to the Iron Age.

Thus, being carried rather far away from the point of departure, it is no doubt the moment to round off this short essay on the archaic though very sophisticated society of the Early Bronze Age of the North.