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PREHISTORIC CONSTELLATIONS ON SWEDISH ROCK-CARVINGS

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Abstract

In 1991 the first identifications were made of total solar eclipses depicted on Swedish rock-carvings from the Bronze Age, ca 1800-500 BC. It was found that important phenomena in the sky such as solar eclipses were dated in a calendar in which six ships carried the sun along the ecliptic, each ship representing a double month. The ships have individual shapes and can be identified as prehistoric constellations. A total solar eclipse was simply dated by a precise location of the solar symbol in the relevant calendar ship. Above the ship that corresponds to the double month that began at the summer solstice there was a constellation that mainly corresponds to our Leo.

A supernova that was mentioned in Chinese oracle bone texts from the 14th century BC can also be identified on Swedish rock carvings as a solar symbol placed below the ecliptic and close to the left elbow of a male figure that lifts the highest of the six calendar ships above his head. This figure corresponds mainly to our Orion.

The Pleiades were treated as a separate constellation. The rock carvings from the Stone Age hunter culture in northern Scandinavia have also been studied. A big constellation called ”The elk” or ”The moose” has been identified as consisting of stars in Perseus and Auriga. A celestial hunter aiming at the elk corresponds to Orion. The nomadic people in the province of Lapland, the Laps or Saami, have preserved the names of these constellations as ”Sarvanasteh”, the star elk, and ”Kalla parne”, the hunter, respectively. The Pleiades were called ”Rougot”, which means the flock of calves.

Introduction

There have been several attempts to identify constellations among the patterns of cup marks that can be found in the rich material of Swedish rock-carvings. Both professional Swedish astronomers and amateurs with some knowledge of the constellations have for instance found the typical pattern of the Big Dipper and Cassiopeia but not in correct relation to each other. An isolated group of cup marks arranged like the Big Dipper cannot without any further information be identified as a depiction of this well known constellation. It is necessary to find some independent indication of an astronomical context.

In my work with the Swedish rock-carvings I have first tried to identify the way the total solar eclipses were depicted. I have found some common principles that resulted in the idea that the key to the understanding of the Swedish rock-carvings is a series of six calendar ships along the ecliptic, the path of the sun among the stars.

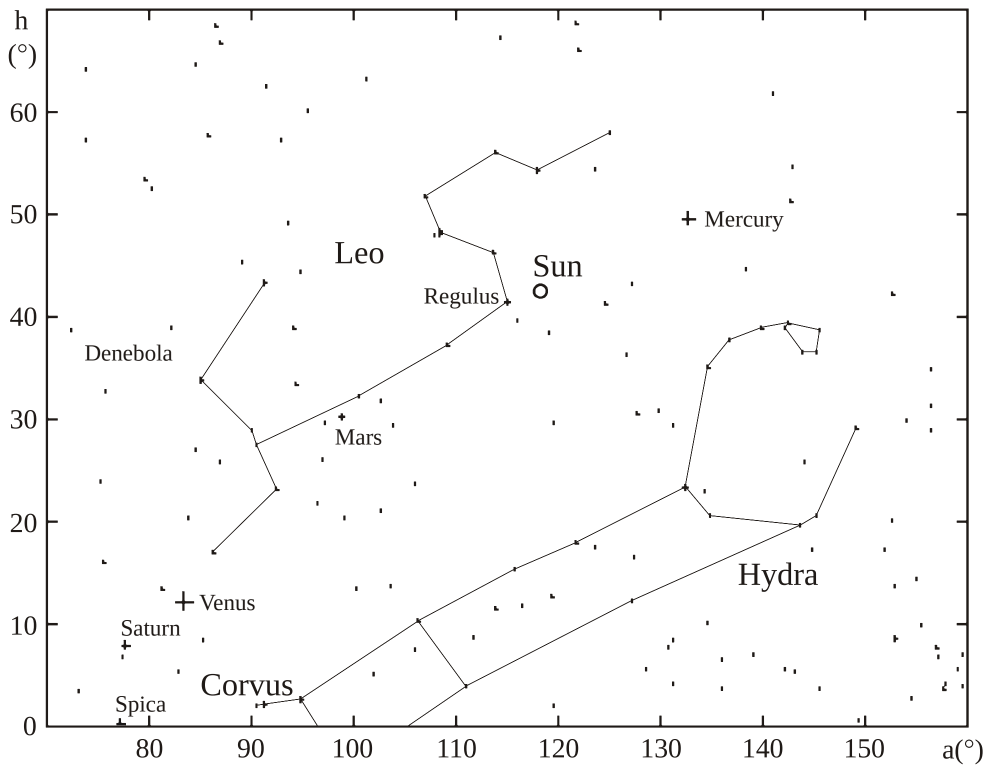
There exist some variation in the details between the different pictures of for instance a certain type of ships. But if we take into account that the pictures are made by different persons, with slightly different local traditions, at widely separated places with sporadic contact and during a time-span of may be 1000 years they are in my opinion surprisingly similar.

The six calendar ships

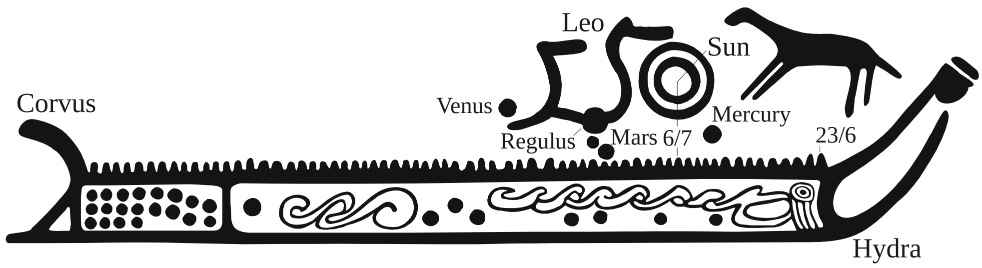
From the position of the eclipsed sun in relation to a series of six different ships at Ekenberg, in Norrköping, it was obvious to me that these ships could serve as a calendar if every ship always corresponded to a specific part of the year [*Henriksson 1991a+b; 1992a+b; 1993a+b*].

If this hypothesis was correct the purpose of the six calendar ships must have been to divide the suns paths along the ecliptic in six equal parts. It is also reasonable to believe that prehistoric peoples used a lunar calendar, and I have found evidences for such a calendar in my investigation of the many series of grooves from the Stone Ages cut in the bedrock or on boulders on the island of Gotland in the Baltic [*Henriksson 1983; 1985; 1993b*]. We also know from historical records that have been preserved in the early Medieval Nordic literature that the moon was important during the pre-Christian time and in ”Eddan” we can read that ”the moon is the time-keeper”. We have therefore good reasons to expect that the people who made the rock-carvings have invented a system, which in a simple way related the changing lunar phases to the solar year.

My hypothesis is that the **solar calendar** was a series of five ships corresponding to a double month with 60 days and one ship corresponding 65-66 days that completed the solar year of ca 365 ¼ days. The longest ship corresponded to the period beginning with the summer solstice. This idea is mainly based upon the existence of 65-66 marks along the rail of the best preserved and most beautiful of the ships at Ekenberg, which is also the most well defined in my astronomical theory. The totally eclipsed sun, 6/7, 1230 BC, is depicted in front of the breast of Leo and above the 14th rail-mark in this ship. If these marks have been used as a calendar the first mark corresponds to 23/6, which was the day of the summer solstice in 1230 BC, Fig. 1 [*Henriksson 1994*]. My program for the computations of the solar and lunar eclipses is partly based on improved formulas originally by Carl Schoch [*Schoch 1931; Henriksson 1996a+b*].



The total solar eclipse on 6/7, 1230 BC, at 08.59.00 local time at Ekenberg in Norrköping, Sweden. The sky was dark close to the sun, and it was possible to see planets and bright stars. The stars in Hydra correspond to the largest of the six calendar ships beginning with the summer solstice. The projection makes the upper part of the star map too wide. (The stars are brighter than magnitude 5.0.)



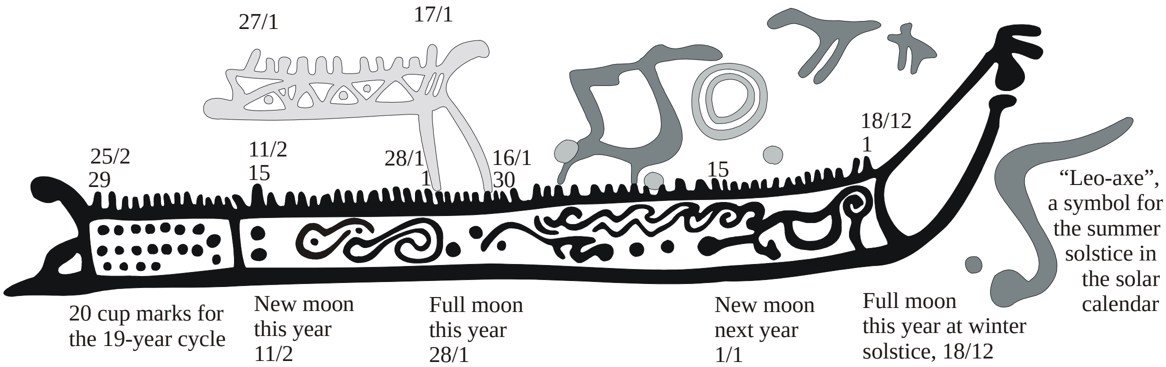
In 1869 the King's Custodian of Antiquities, Bror Emil Hildebrand, made the first investigation of this excellent example of Swedish rock-carving at Ekenberg in Norrköping. He dated it to the early Swedish Bronze Age, 1800-1000 BC. The ship is for stylistic reasons dated to ca 1500 BC. The length is 2.2 meters. The author identified, in 1991, the scene above the ship as a record of the total solar eclipse on 6/7, 1230 BC, with the sun in front of Leo and with the visible planets reproduced as cup marks. The sun was placed above the 14th rail-mark of the ship. If this mark had corresponded to 6/7, then the first mark in the ship would have corresponded to 23/6. This may be interpreted as a dating of the eclipse to the 14th day after the summer solstice which took place on 23/6 at 04.48 local time (after Hildebrand 1869).

Figure 1.

In the **lunar calendar** they may have used the same six ships, but every one corresponded in this case to 59 days, or nearly exactly two synodical months. When the moon had passed through the six lunar ships, or twelve synodical months corresponding to 354 days, there was still 11 days left of the solar year. To be able to take into account the missing eleven days compared with the solar year they may have used a seventh ship placed above the biggest and most decorated of the ships, that I call Leo-Cancer, and that corresponded to the double month after the summer solstice in the solar calendar, but the double month after the winter solstice in the lunar calendar. The seventh lunar ship is much smaller than the others used both for the solar and lunar calendars and is sometimes omitted.

In the best preserved case at Ekenberg there are only 11 marks on the rail in this seventh small ship that is situated above the back most half of the Leo-Cancer ship, with 65-66 rail-marks. One of the marks may have been used only every fourth year for intercalation taking into account that the year is not exactly 365 days but close to 365 ¼ days. In my opinion the most logical explanation is that these 11 marks should in some way be subtracted from the 65-66 marks in the Leo-Cancer ship when they counted the dates in the lunar calendar and predicted the phases of the moon one year in advance.

In the lunar calendar the first rail-mark in the Leo-Cancer ship corresponded to the day of the winter solstice, that means 18/12 during the Bronze Age (Gregorian calendar). After the last day in the first lunar month after the winter solstice, 16/1, corresponding to the rail-mark number 30, there is a line connecting the 31st rail-mark with the stern of the seventh ship and another line connecting the stern of this ship with the 36th rail-mark in the big ship. If they wanted to predict the phase of the moon one year in advance they may have continued the counting of days in the seventh ship, from 17/1 to 27/1 and then continued with 37th mark in the big ship. If this mark is considered as the 1st day, 28/1, in the second month after the winter solstice the last mark in the ship will correspond to the 29th day, 25/2, the last day of the second month or the 59th and last day in the first double month, see Fig. 2.



This is a reproduction by Burenhult of the largest and most beautifully decorated ship at Ekenberg in Norrköping. When the six calendar ships were used as a **lunar calendar**, there must have been some method to take into account the fact that the date for a particular phase of the moon will be shifted the following year so that it will appear 11 days earlier. This was probably regulated in the Leo-Cancer ship, whose first rail-mark in the lunar calendar may have corresponded to the day of the winter solstice, 18/12, during the Bronze Age. This ship has, according to the different reproductions of the rock-carving, 65-66 rail-marks, all of them used in the solar calendar. However, in the lunar calendar the 5-6 extra days have been excluded after the marker for the last day, 30th, of the first lunar month after the winter solstice, 16/1. The counting of the days continued in a small ship with only 11 rail-marks just above the back half of the Leo-Cancer Ship.

The last day counted in this small ship corresponded to the 27/1, which was one of the three most important days in the lunar calendar from Gotland (3300-2200 BC) and in the calendar used by the people who constructed the passage graves in Västergötland, ca 3300 BC. This date was also important during the Iron Age, in the ritual calendar at Old Uppsala, as it was the first day in the most important sacrificial period. Every eighth year there was a big sacrifice lasting nine days and every day one man and seven different male domestic animals were hanged in a holy tree. The last 29 rail-marks in this ship corresponded exactly to the dates, 28/1 - 25/2, during which this eight-year sacrifice took place, begining at the full moon. These dates are also known from the Medieval written sources as the period for the "Disting"-market, the most important market in Sweden. (Reproduction after Burenhult 1973.)

Figure 2.

(There are some differences in the reproductions in Fig. 1 and 2 and these may be partly explained by erosion of the rock during 100 years, but also by some different subjective opinions about which details that are relevant in the original impressions of the rock-carving.)

Every 19th year it was full moon on the 28/1 and then they could predict that it also should be full moon at the day of the next winter solstice.

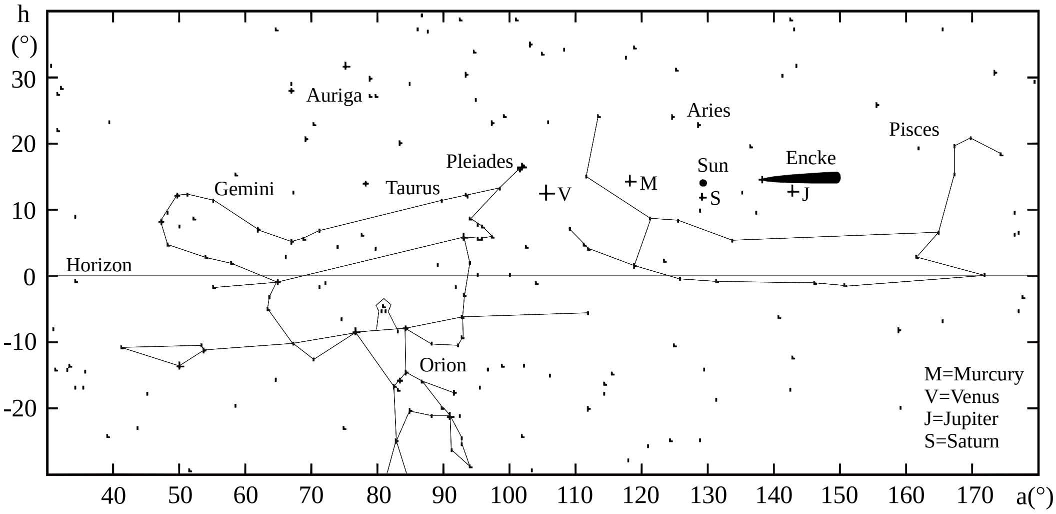
The last day in the seventh ship corresponding to 27/1 was, together with the winter solstice and the vernal equinox, one of the three important days in the lunar calendar used on Gotland (3300-2200 BC). This date was also important in the calendar used by the people who constructed the more than 200 passage graves in the province of Västergötland, ca 3300 BC [*Blomqvist 1989; Henriksson 1989; 1993b; 1994*]. The same date, 27/1, continued to be important also during the Iron Age, in the ritual calendar in Old Uppsala, as this was the first day in the most important sacrificial period. Every eighths year there was a big sacrifice during 9 days and every day 1 man + 7 male domestic animals were hanged in a holy tree [*Adam from Bremen 1075*]. The last 29 rail-marks in the Leo-Cancer ship correspond precisely to the interval 28/1 - 25/2 during which this 8-year sacrifice took place, beginning at the full moon. These dates is known from the Medieval written sources as the ”Distings”-period and after the victory of Christianity this was the time for the most important market [*Henriksson 1992c; 1993b; 1994; 1995b*].

After 3 years the phase of the moon was shifted forward in the Leo-Cancer ship by 32.6 days if the length of the year was 365 ¼, or 31.9 days if the year had just 365 days. In the first case there had been an excess of 3.1 days compared with one lunar month and in the second case the excess was 2.4 days. The small seventh ship may therefore also have served as an intercalation ship when they needed to put in an extra month. After 6 years, with 365 ¼ days, the phases of the moon were shifted forward in the Leo-Cancer ship by 65.3 days, equals to the total number of marks in that ship. This means a difference of two synodical months and 6.2 days. If they instead counted just 365 days/year the difference was 63.8 days or 4.7 days more than two synodical months. In practise they may have used the integers 6 or 5 days respectively. There exist 5-6 rail-marks between the two lines that connect the seventh ship with the 31st and 36th rail-mark in the Leo-Cancer ship and these may have been used to regulate this difference of 5-6 days, Fig. 2.

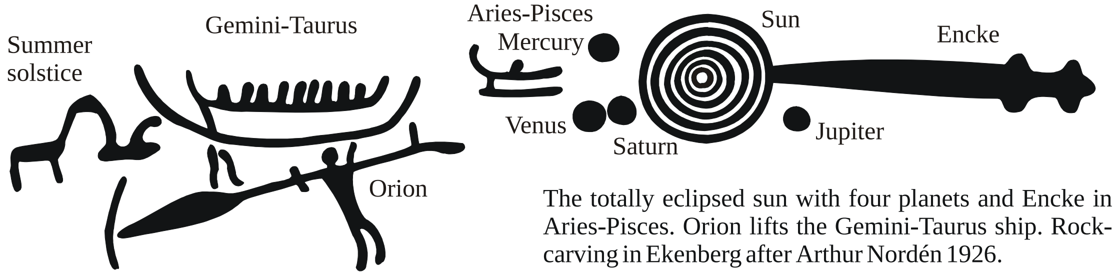
A possible explanation for this relation between the numbers is that they may have invented a rule of thumb with may be the following meaning: ”The phase of the moon on the first day in the second month after the winter solstice should be repeated six years later.”

By this rule the phase of the moon at the winter solstice was possible to calculate six years in advance if they added one day every fourth year. Alternatively they may have used the phase of the moon after six years to define the day of the winter solstice, with an implicit correction for the non-integer number of days per year. It may have been especially important to know in advance when it should be full moon at the winter solstice, which happens every 19th year.

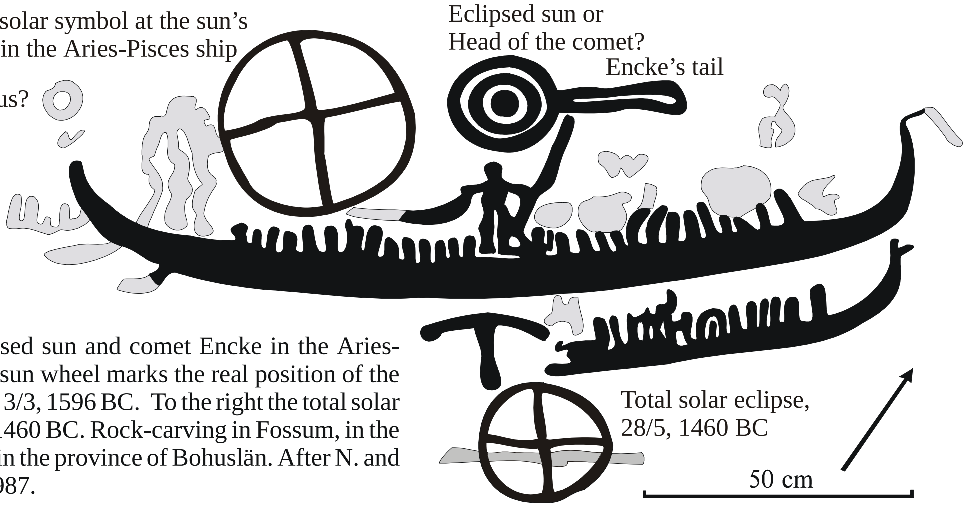
The main result from my investigation of the grooves on Gotland was a continuous use of the 19-year cycle in a lunar and solar calendar already 3300-2200 BC. After eight years (365 ¼ days) the difference is 87.0 days or 1 ¼ days shorter than 99 synodical months, but after 19 years the difference between the solar and lunar calendars is just 1 hour and 25 minutes, if the length of the year is 365 ¼ days, or 2 hours and 8 minutes, for the tropical year with 365.2422 days. That means that the two calendars can be considered to coincide exactly for about twelve 19-year cycles before the difference adds up to 24 hours or one day in relation to the tropical year. Eight years later it was necessary to change to another 19-year cycle, Fig. 1 and 2.



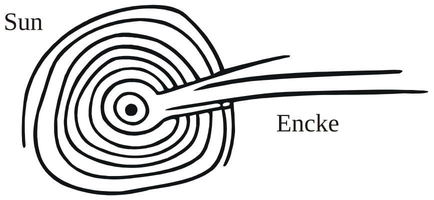
The total solar eclipse on 3/3, 1596 BC, from the horizon of Ekenberg in Norrköping. The central phase occurred at 08:57:10 local mean solar time, and the duration of the total phase was 2 min. and 46 sec. Four bright planets dominated the sky in the vicinity of the sun. But the most spectacular object was the comet Encke, visible so close to the sun because of the total solar eclipse. The length of the tail of the comet corresponds to 1.0 AE.



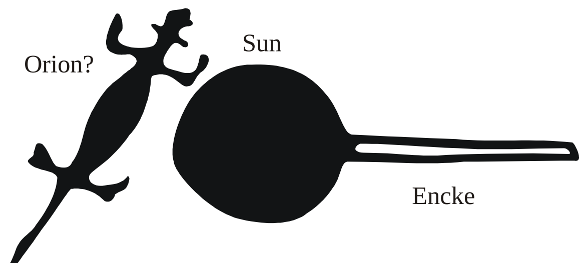
The totally eclipsed sun with four planets and Encke in Aries-Pisces. Orion lifts the Gemini-Taurus ship. Rock-carving in Ekenberg after Arthur Nordén 1926.



The totally eclipsed sun and comet Encke in the Aries-Pisces ship. The sun wheel marks the real position of the sun in the ship on 3/3, 1596 BC. To the right the total solar eclipse on 28/5, 1460 BC. Rock-carving in Fossum, in the parish of Tanum in the province of Bohuslän. After N. and E. Christensen 1987.



Fragment of a rock-carving from the prehistoric cult place at Traprain Law, Midlothian, Scotland. This place was also situated within the zone of totality of the solar eclipse on 3/3, 1596 BC. After Bailey, Clube, and Napier 1990.



Rock-carving at Lake Onega in eastern Russia, close to the southern limit of the total solar eclipse on 3/3, 1596 BC. After G. Hallström 1960.

Figure 3.

Within a division in the stern of the Leo-Cancer ship at Ekenberg there are 20 cup marks. These cup marks may in fact have been used to keep track of the year within the 19-year cycle because in older times they did not start counting from zero, but from the first. If they wanted to paint one cup mark for every year in the 19-year cycle they needed 20 cup marks to complete the cycle.

On the rock-carvings every ship has a different design that is a compromise between the possible shape of a ship during the Bronze Age and the possibility to make a picture of a ship using the available bright stars in the specified area along the ecliptic. That the ships are real constellations is evident from the fact that the most suitable bright stars have been used even if they are situated far below the ecliptic, as in the case of the Leo-Cancer ship, or with the bow below the ecliptic and the stern above the ecliptic, as in the case of the Gemini-Taurus ship, Fig. 3. I have given the ships a name that corresponds to its zodiacal position, even if the ship consists of parts of other constellation as in the case of Leo-Cancer, which is made up of the stars in Hydra and Corvus, Fig. 1.

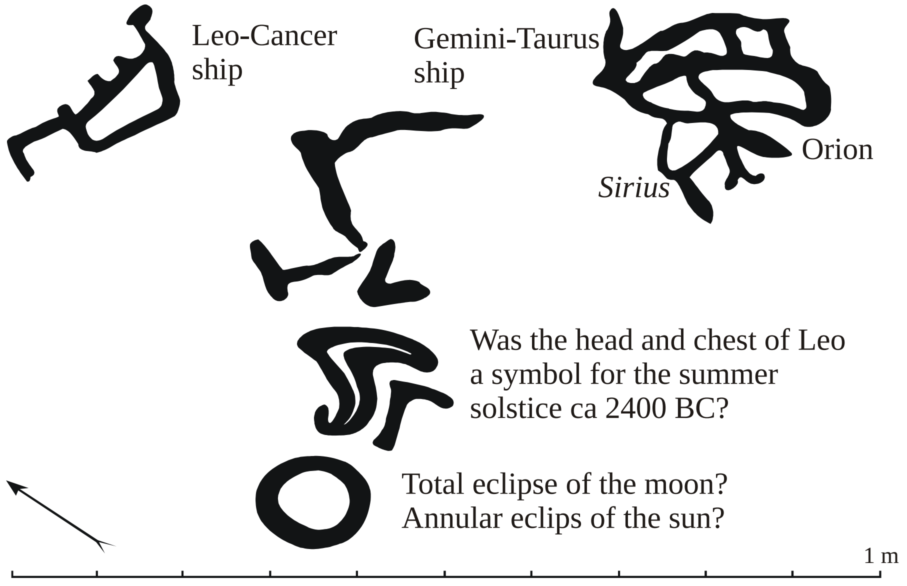
Leo

Leo was the first constellation that I recognised in my investigation of the Swedish rock-carvings. This important break through was possible thanks to the happy circumstances that the total solar eclipse, 6/7, 1230 BC, took place just in front of the breast of the constellation Leo. When I plotted the part of the sky closest to the sun, on the computer screen, I immediately recognised a particular rock-carving at Ekenberg, in Norrköping. The front half of the figure on the rock-carving is almost identical with the modern constellation Leo, but there is some minor differences in the back most part. The brightest stars in Leo have been connected by a curved line with only the brightest star, Regulus, marked as a cup mark. The totally eclipsed sun was represented as concentric circles and the planets visible during the total phase were represented as cup marks in their corresponding positions along the ecliptic.

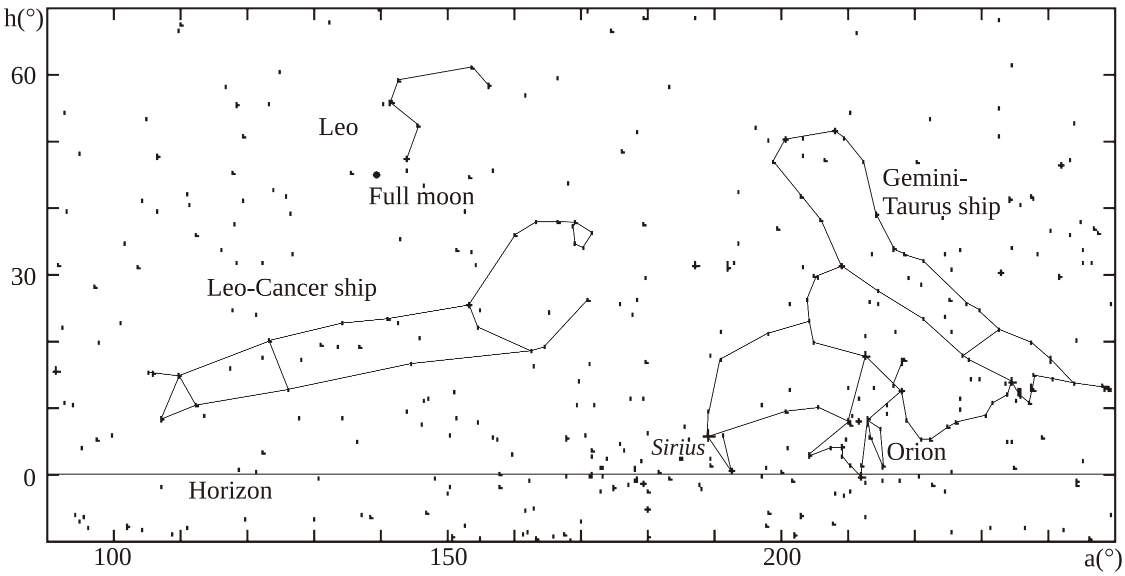
In the vicinity of this Leo-figure there are a lot of figures with only the head and breast of Leo including Regulus as a big cup mark, lower right in Fig. 2. This figure is very similar to a special kind of impractical axes found in the archaeological excavations from the Bronze Age. In my opinion this axe has served as a cult-axe used in the fertility cult. About 2400 BC the position of the sun at the summer solstice was very close to Regulus, and therefore this part of Leo naturally could have been associated with the summer solstice and even later used as a symbol for fertility.

In my preliminary study of the rock-carvings in northern Sweden, mainly dated to the Stone Age, I have identified a similar axe just above a circle, on a rock-carving at Nämforsen, that either corresponds to the sun during the annular solar eclipse at the summer solstice, 24/6, 2402 BC, or the totally eclipsed full moon at the winter solstice, 18/12, 2588 BC, Fig. 4 [*Henriksson 1996c*].

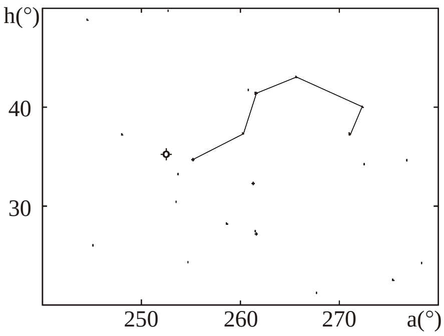
At Nämforsen there are several examples of a ”Leo-axe” in the correct position above the Leo-Cancer ship. There has been a Stone Age settlement at this place dated to ca 3500-2000 BC and the archaeologists have dated the rock-carvings to the same period. My completely independent dating to 2402 BC from the annular solar eclipse, or 2588 BC for the total lunar eclipse are in good agreement with the archaeological dating. There are also astronomical reasons to believe that the Leo-axe was used as a symbol for the summer solstice about 2400 BC because the position of the sun was close to Regulus during this period.

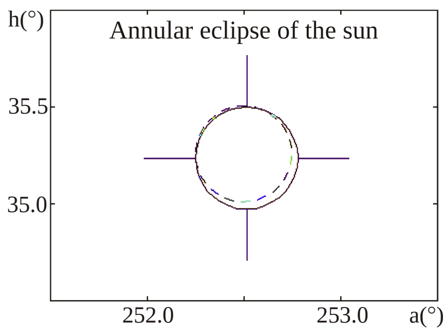


Rock-carvings at Nämforsen, main group Pl. XII, subgroup D:17, (Hallström 1960). The circles have been added and the two lowest axe-like figures have been replaced by G. Henriksson 1995.



Total eclipse of the moon at the winter solstice, 18/12, 2588 BC, maximum at 10 pm. The calculations are valid for the horizon at Nämforsen.





Marginally annular eclipse of the sun at the summer solstice, 26/6, 2402 BC. Local mean solar time 15.49.16 at Nämforsen.

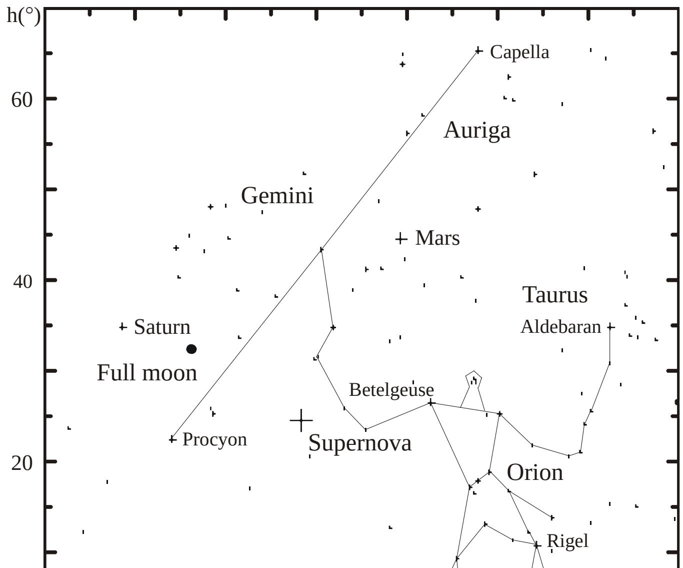
Figure 4.

Orion

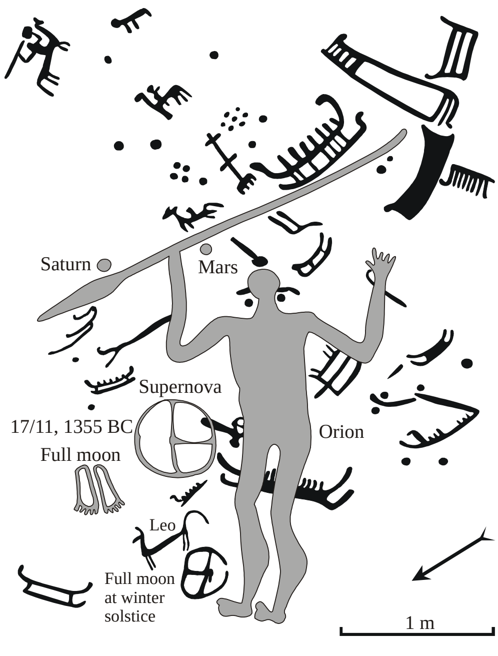
The bright stars in the modern constellation Orion have been noticed and depicted by many different peoples, often as a man but sometimes as a woman. In the Greek tradition he is a hunter fighting with Taurus.

On the Swedish rock-carvings he is often depicted as a man lifting the Gemini-Taurus ship. This ship is the highest situated of the six calendar ships on the Swedish rock-carvings. The hourglass shaped body of Orion is easily recognised on many rock-carvings both as an isolated figure, but many times as a part of a scene with other figures. Orion was first identified lifting the Gemini-Taurus ship in a complex scene with the spectacular total solar eclipse 3/3, 1596 BC, with Venus, Mercury, Saturn and Jupiter as cup marks and comet Encke as a sword, Fig. 3. The orbit of comet Encke has been integrated by doctor Mats Lindgren, Uppsala, with a subroutine by Everhart and with my empirical corrections for the non-gravitational effects, determined from observations mentioned in the Chinese chronicles, by classic authors, in the Old Testament, on a stele by Tuthmosis III and from pictures on the Swedish rock-carvings [*Everhart 1985; Henriksson 1996a+b*].

The supernova from 1355 BC on a rock carving in Litsleby, in the province of Bohuslän.



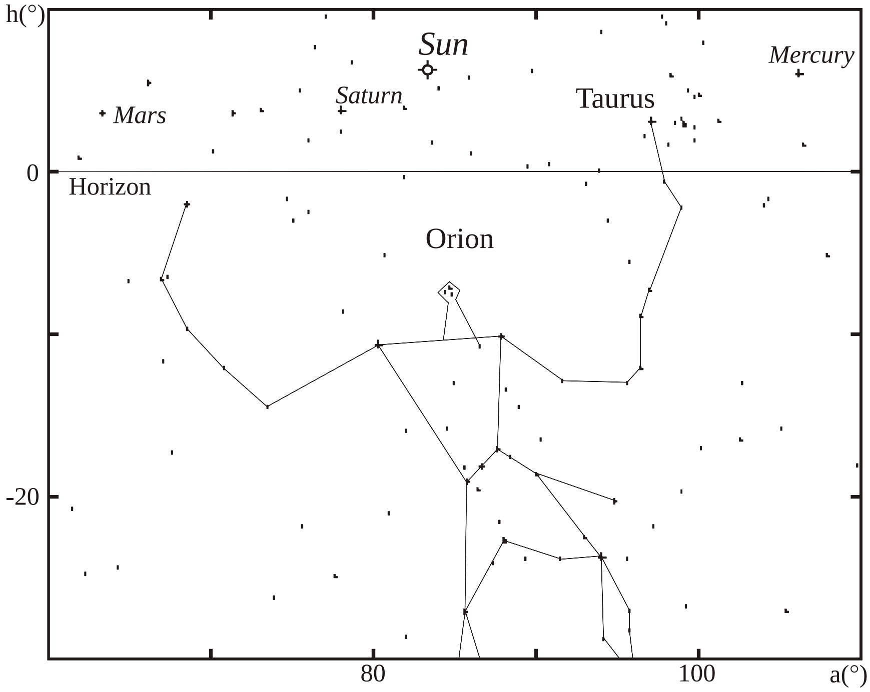
The evening sky in the south-east, at 9 pm in Tanum on 17/11, in 1355 BC, was dominated by the full moon (phase 189°) and a very bright supernova at its maximum, 8 days after the outbreak. The remnant of this explosion of a heavy star is called PKS0646+06 and can be observed by modern telescopes. On the occasion of this dramatic event the planets Mars and Saturn were visible in Gemini, above the supernova in Monoceros.



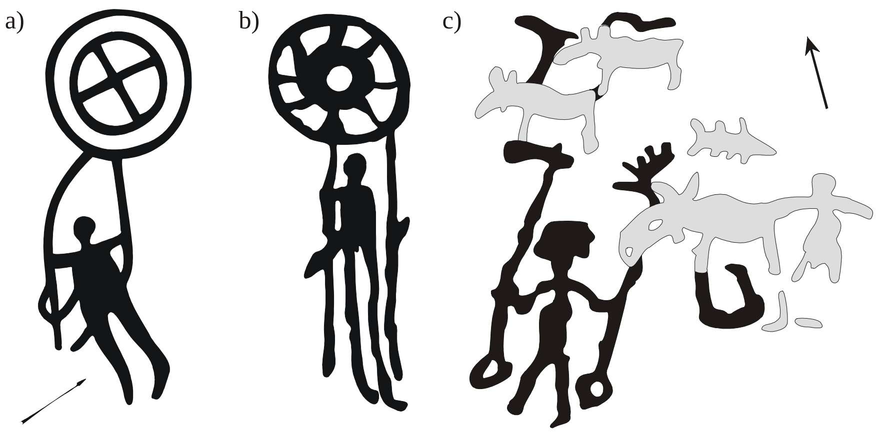
This rock-carving is situated on a rock at Litsleby, in the parish of Tanum in the province of Bohuslän. The 2.25 m high man, Orion, and the sun wheel, the supernova, have been cut on older carvings. The pair of feet represent the position of the full moon, 15° to the left of the supernova. The two cup marks at the forward end of the spear correspond to the position of Mars and Saturn, after L. Baltzer 1881.

Figure 5.

Orion has been used as a reference frame for important celestial phenomena. A very bright supernova appeared in the sky 9/11, 1355 BC below the left elbow of Orion and it was sometimes considered as sufficient to make a rock-carving with only Orion, the supernova and the phase of the moon. This supernova is also mentioned in two Chinese oracle bone texts from the 14th century BC [*Needham 1954*]. The biggest anthropomorphic rock-carving in Sweden, from Litsleby, in the parish of Tanum, in the province of Bohuslän, shows an oversized man, 2.30 m high, with a spear in his left hand and big ring-cross, normally a symbol for the sun but in this situation it is a symbol for the extra sun, the supernova. Below the mans left elbow we can see a pair of feet to the left of the ring-cross and that tells us that the picture represented the situation when it was full moon 17/11, 1355 BC. There are also two cup marks representing Mars and Saturn. This figure has been so important that it was cut across older and much smaller rock-carvings. In fact this must have been a very significant event because the supernova was so bright that it was visible in daylight during six months, Fig. 5 [*Henriksson 1994; 1995a; 1996a+b*].



The total solar eclipse 12/4, 2417 BC, 05.46.33 local mean solar time, at Bracka in the parish of Brastad in the province of Bohuslän. Orion was below the horizon, but it was still possible to know that the eclipse occurred directly above Orion's head, since the easily identifiable stars in the constellations Taurus and Gemini were visible during the eclipse.

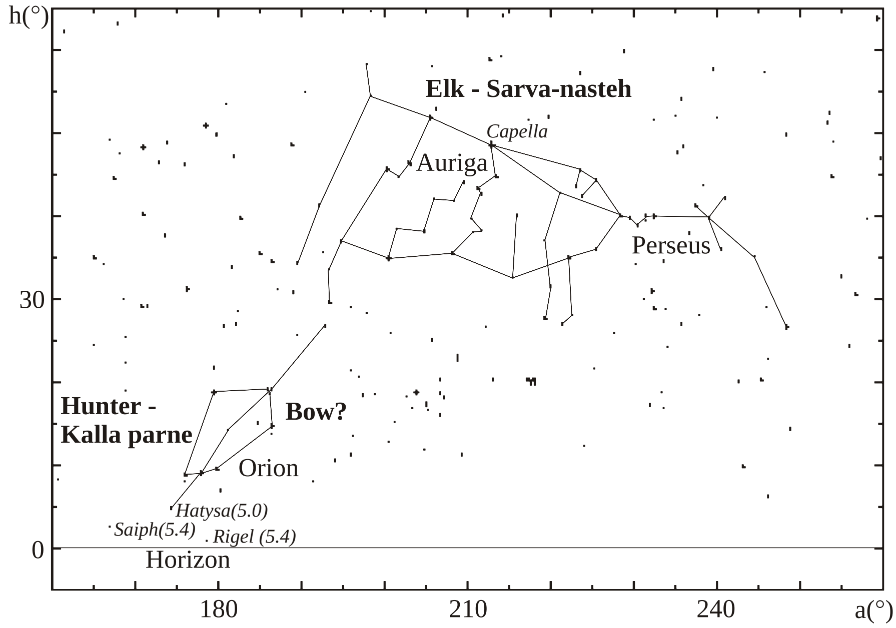


The picture on the left (a) is a detail from the large rock-carving at Backa in the parish of Brastad and the middle picture (b) is part of the rock-carving Hemsta 126, in the parish of Boglösa in the province of Uppland. The picture on the right (c) is from the rock-carvings at Nämforsen in the parish of Ådals-Liden in the province of Ångermanland. The solar eclipse of 12/4, 2417 BC, was total at all three places. (The pictures are based on those in Baltzer 1881, Schroeter-Bieler 1987 and Hallström 1960).

Figure 6.

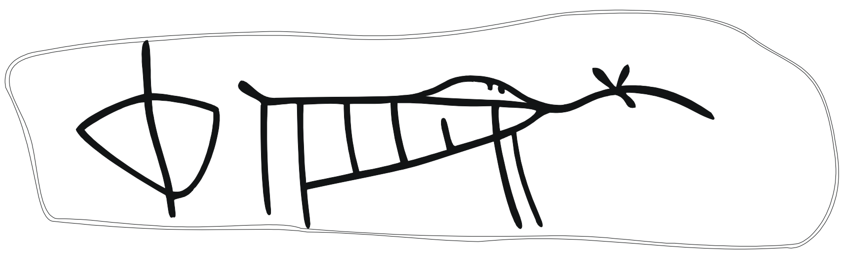
Some of the passages of comet Encke have also been related only to Orion.

The oldest pictures of Orion so far can be identified and exactly dated because the total solar eclipse, 12/4, 2417 BC, took place above the head of Orion. Along the zone of totality from Backa in the parish of Brastad, in the province of Bohuslän, close to the west coast of Sweden via Hemsta, in the parish of Boglösa, in the province of Uppland, on the eastern side and at Nämforsen in the parish of Ådals-Liden, in the province of Ångermanland, in north-eastern Sweden we can see a man holding the eclipsed sun above his head by a construction with two pools, Fig. 6 [*Henriksson 1996c*].



The southern sky at the winter solstice 18/12, 3705 BC, 19.16 local solar mean time at Sätra, in the parish of Ovansjö in the province of Gästrikland. The dating is based on the first occasion when the lowest and brightest star in Orion's sword, Hatysa or ι, appeared so high above the horizon that it was visible as a 5th magnitude star with extinction 0.18 at zenith. The two lower bright stars in Orion, Saiph and Rigel, were not visible as 5th magnitude stars before ca 3595 BC. This constellation, therefore, could not yet have been visualized as a standing man.

The constellations Arrow? and Elk (Moose) have been drawn according to the principle that stars in the area must be connected with straight lines. The Elk corresponds mainly to the important Lapp constellation Sarva, Elk, according to Bo Lundmark (1982). The weakest stars have magnitude 5.4 and the picture is a camera projection.

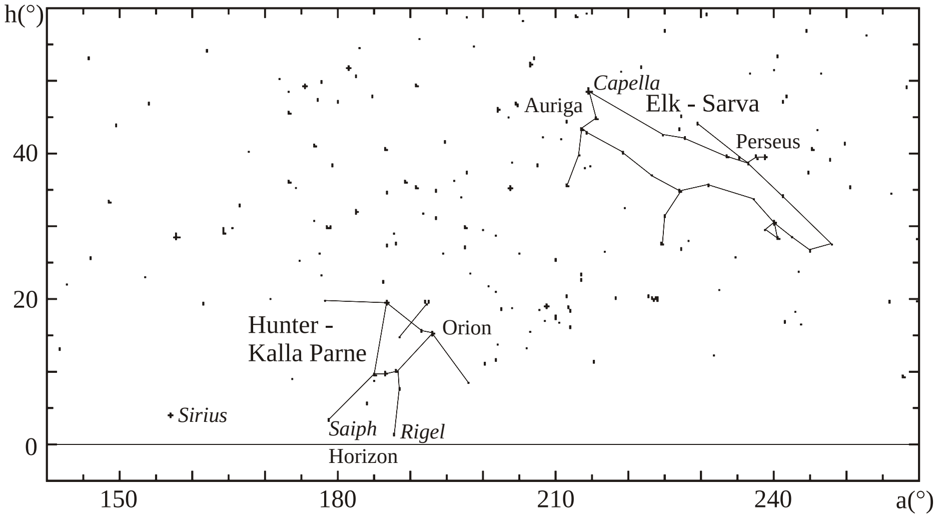


Slate stone with "engraved figure of an elk and a bow" from Sätra, in the parish of Ovansjö in Gästrikland. Figures of Elk with this inner structure can be completely explained if they represent a constellation composed of lines drawn between all stars brighter than the 5th magnitude in the constellations of Auriga and Perseus. The bow-like figure corresponds to the positions of the stars in the upper part of Orion with head, shoulders, belt and the sword down to its tip. Before the lower stars Rigel and Saiph became visible above the horizon, the bow-like figure was very logical, especially as the arrow was aimed directly at the celestial Elk.

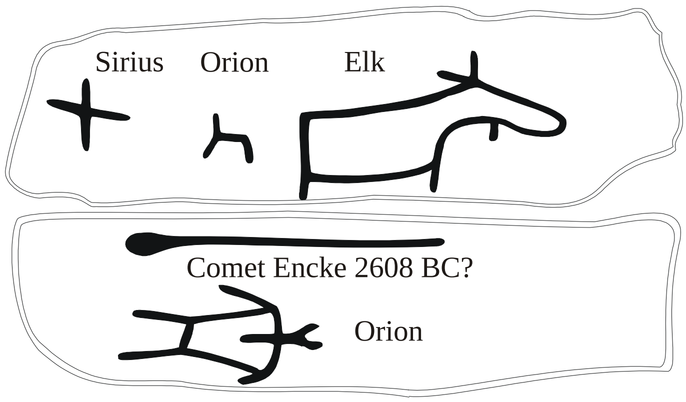
The person who engraved these figures around 3600 BC ± 105 years must have known the positions of the stars in great detail. (Based on a photo of the copy at the Historical Museum in Stockholm, Henriksson 1994.)

Figure 7.

However there also exist even older pictures of Orion that can be dated by a completely different principle using the precession of the axis of the earth with a period of 26000 years. One of the effects of the precession is that some parts of the sky are moving to the north and the stars in the opposite position are moving to the south. During the Older Stone Age, Orion was moving north and became more and more visible in the northern part of Sweden. To be able to date the first appearance of a star above the horizon it is necessary to make a correct calculation of the visibility of the star including the apparent magnitude of the star and its dependence on the atmospheric extinction at different altitudes [*Bemporad 1904*].



Orion in the south, 18/12, 3015 BC, local mean solar time 20.08, at Nämforsen, in the parish of Ådals-Liden in Ångermanland. Sirius, the brightest star in the night sky, became visible above the horizon ca 3500 BC. The leftmost of the two lowest stars in Orion, Saiph, became visible as a 5th magnitude star directly in the south about 3015 BC. When Saiph became visible, it could build together with Rigel the lower part of the hourglass-shaped figure which is formed by the main stars in Orion. The contours of the Elk have been drawn so that there are no stars brighter than magnitude 5.4 inside them. Sarva and Kalla Parne are Lapp names for the celestial Elk and Hunter, the latter of which corresponds to Orion according to Lundmark 1982. The calculations have been made with extinction 0.18 magnitudes at zenith. (Temperature 0° C and atmospheric pressure 760 mm Hg.)



The figures engraved on a piece of slate from Rå-Inget, 3-4 km north of Nämforsen, are probably Sirius, Orion with the two lowest stars Saiph and Rigel, and the Elk. This would date the engraving to ca 3015 BC at the earliest. At that time Sirius was completely visible as the only low star to the left of Orion, but its magnitude was only 1.18. In view of the presence of the large cross (Sirius?), it may be a later occasion when Sirius and Orion had risen higher in the sky. The outstretched figure to the left of Orion can represent the dramatic passage of Encke's comet in 2608 BC.

The constellations of both the Elk and Orion have been consistently constructed of stars in the area with a magnitude brighter than ca 5.4. This means that the person who engraved the figures, according to the archaeologists in the Middle Neolithic (3350-2400 BC), were well-acquainted with the night sky. (Based on a photo by G. Henriksson 1994 at the Historical Museum in Stockholm.)

Figure 8.

In the oldest picture dated so far only the lowest tip of Orion's sword was seen above the horizon and this constellation was depicted as an arrow and bow aiming at a big celestial elk This figure has been found during the excavation of the Stone Age settlement at Sätra in the parish of Ovansjö in the province of Gästrikland. It can be dated to 3600 BC ± 105 years by the linearly increasing altitude of the stars in Orion, Fig. 7.

Some hundred years later Saiph and the very bright star Rigel became visible and from that time we have the oldest pictures of Orion with a body like an hourglass, Fig. 8.

In the Lap or Saami tradition Orion was a celestial hunter that was called Kalla Parne.

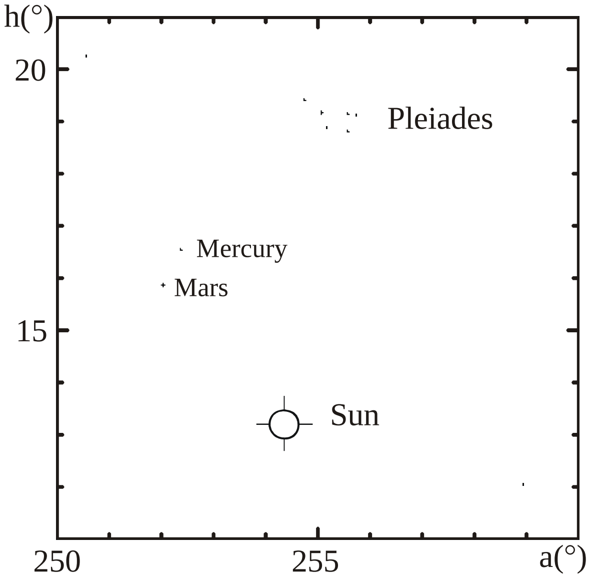
The Pleiades

Even if the Pleiades is a small group of quite faint stars they have caught the attention of people all over the world. The Pleiades have been used as an important calendar marker in in the Middle East, Europe, Africa and America. There are many myths about these group of stars and for some unknown reason they are often said to be seven, but if you can see seven you can probably also see nine or may be even eleven stars. The Greek's also called the Pleiades the ”Seven Sisters” probably for mythological reasons. However, if the myth was inspired from what they saw in the sky they would have been called the ”Six Sisters”.

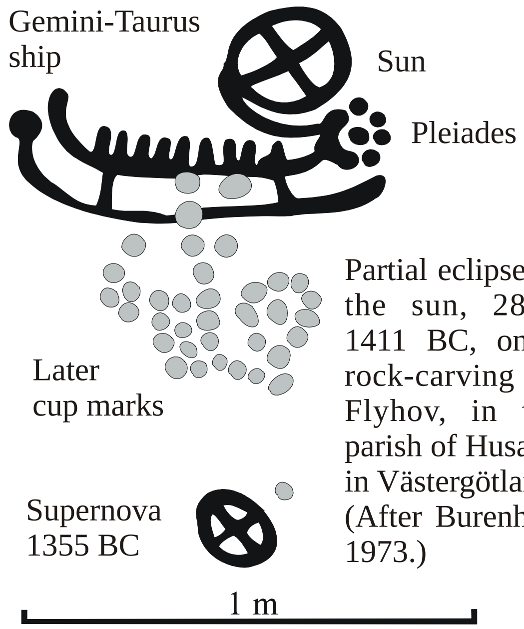
On the Swedish rock-carvings they are mostly depicted as just six stars. They may be represented in a symbolic way as six cup marks; ordered in a circle in Hjulatorp, in the parish of Berg, in the province of Småland, as a semicircle with five cup marks along the circumference and one in the centre in Flyhov, in the parish of Husaby, in the province of Västergötland, and ordered in three columns with two rows in Oppeby, Nyköping, Fig. 9. In Herrebro there are just four cup marks ordered like a trapezium, but there may have been some lost by erosion, Fig. 11. On the other hand there are eight or nine cup marks representing the Pleiades in a quite realistic picture on a standing stone at Klinta, in the parish of Smedsby on the island of Öland, Fig. 10.

My identification is not based on the similarity between the relative positions of the stars in the Pleiades and the arrangement of the cup marks in the rock-carving. The most important criterion has been a correct position of a narrow group of cup marks in front of a typical ship of the type Gemini-Taurus. Its correct relation to other calendar ships can strengthen the identification of this ship. In the cases discussed here we also have an additional very strong criterion - the correct positions of the Pleiades' cup marks in relation to the symbol for the sun during the total solar eclipses 28/3, 1411 BC, and 26/3, 1169 BC. Another strong independent criterion is the correct position of the Pleiades' cup marks in relation to the symbol for the third quarter moon and the symbol representing the comet Encke during its passage on the 9/7, 1060 BC, see Fig 9, 10, 11.

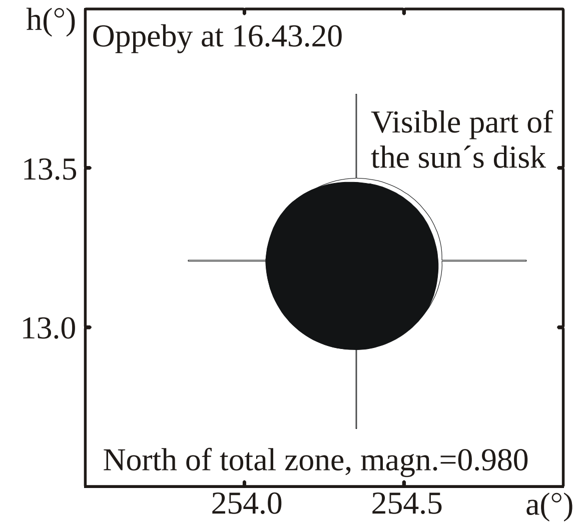
It is not surprising that the Pleiades have been depicted on the Swedish rock-carvings. Of course we do not know what they were called during the Bronze Age, but the Laps have preserved their traditional name Rougot, which means the flock of calves.



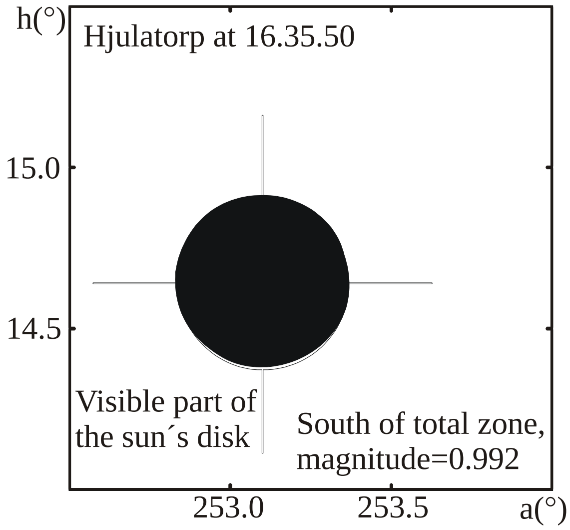
Partial solar eclipse, 28/3, 1411 BC. Local mean solar time 16.43 at Oppeby, Nyköping (m<5.0).



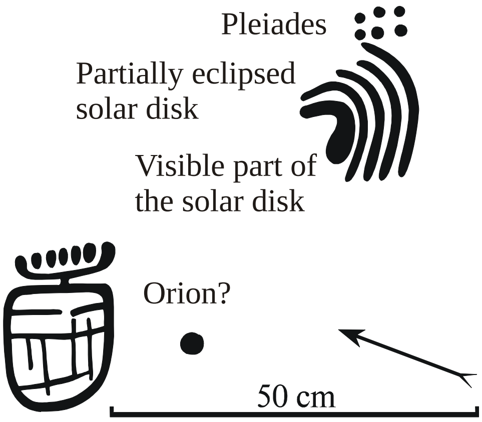
Partial eclipse of the sun, 28/3, 1411 BC, on a rock-carving at Flyhov, in the parish of Husaby in Västergötland. (After Burenhult 1973.)



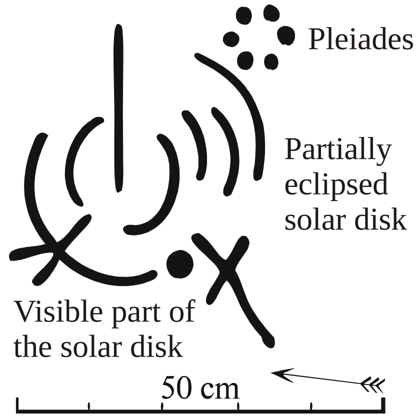
The central phase of the partial solar eclipse, 28/3, 1411 BC, at Oppeby.



The central phase of the partial solar eclipse, 28/3, 1411 BC, at Hjulatorp.

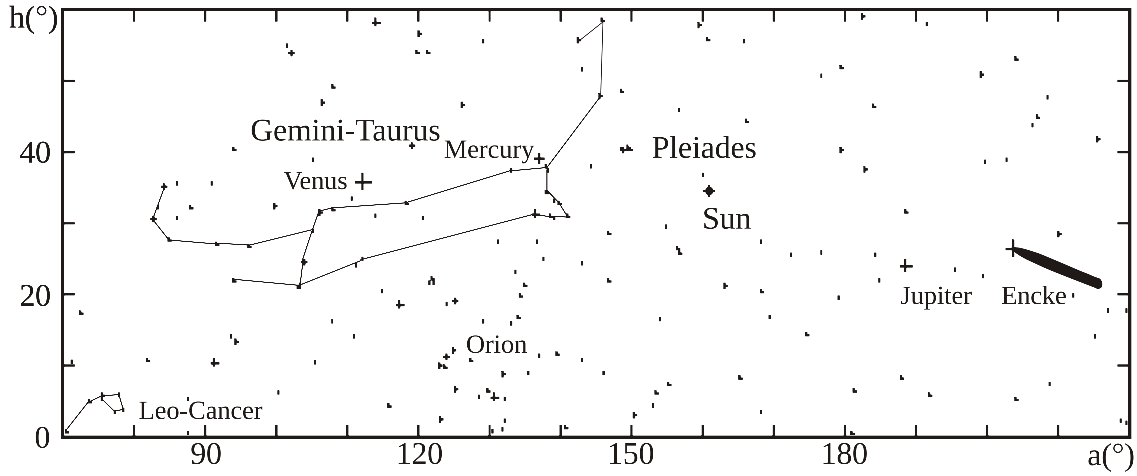


The partial solar eclipse, 28/3, 1411 BC, on a rock-carving at Oppeby, in Nyköping. (After a photo by G. Henriksson 1986.)

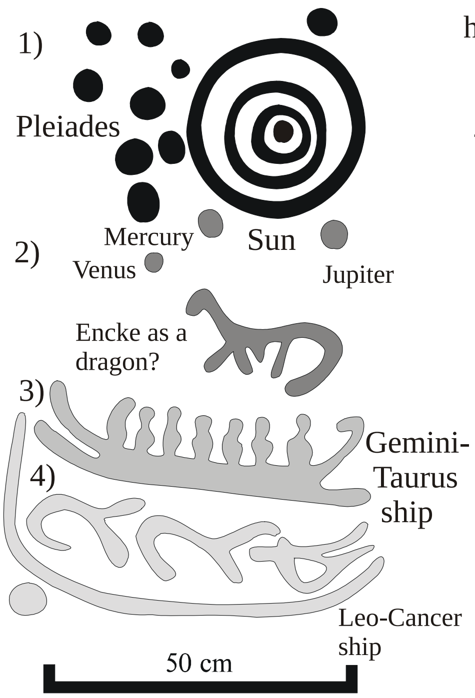


The partial solar eclipse, 28/3, 1411 BC, on a rock-carving at Hjulatorp, in the parish of Berg in Småland. (After Kjellmark and Lidsten 1909.)

Figure 9.



The total solar eclipse 26/3, 1169 BC, at 11.02.50 local mean solar time at Klinta, in the parish of Smedby on the island of Öland. It occurred to the right of the Pleiades, and Venus, Mercury and Jupiter would have been visible and probably also the comet Encke, 0.695 AU from the sun and 1.126 AU from the earth. The magnitude of the eclipse was 1.004. (m<4.5)



The rock-carving on a standing stone in the cemetery at Klinta, Smedby, Öland. Since the stone is narrow, the scenes had to be placed in four horizontal registers.

From the uppermost down:

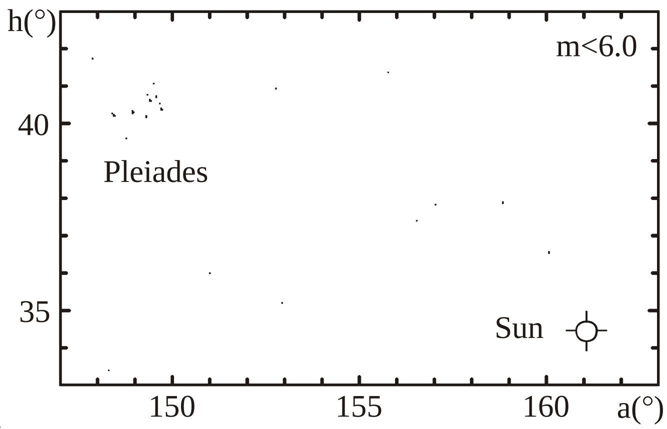
1) sun to the right of the Pleiades

2) Venus, Mercury, Jupiter and the comet Encke (?)

3) Gemini-Taurus ship

4) Leo-Cancer ship

Based on Burenhult 1973, but with the correct orientation.

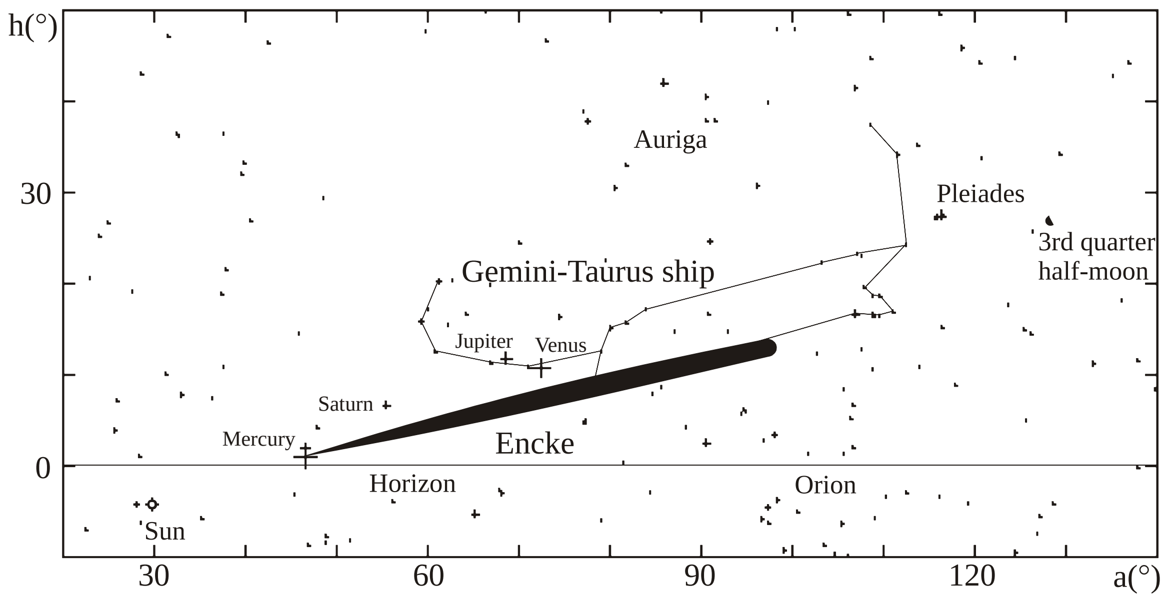


Detail of the sky during the total solar eclipse 26/3, 1169 BC. A drawing of this eclipse would naturally indicate the position of the sun relative to the well-known Pleiades star cluster. This eclipse var total in Sweden only on the islands of Öland and Gotland and within a small area of eastern Scania.

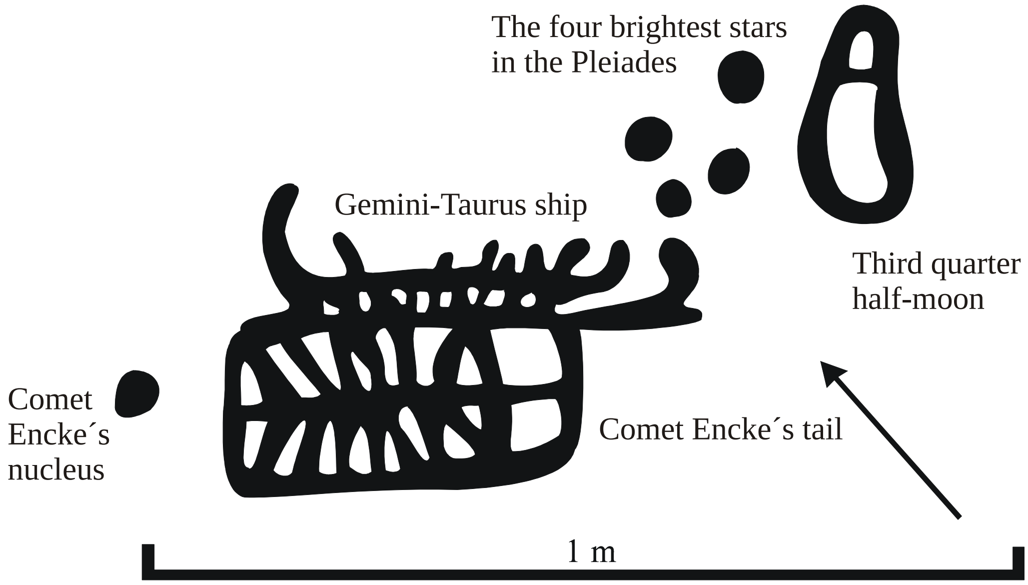
When I saw in Burenhult's dissertation that the only rock-carving on Öland, the one at Klinta, showed a cluster of cup marks beside a group of concentric circles above a typical ship of the Gemini-Taurus type, it was obvious to identify this rock-carving as a representation of the total eclipse of 1169 BC.

However, the published picture is the mirror image of the situation in the sky. This caused me to suspect that Burenhult's picture had been reversed in the process of publication. Upon checking on this at the Historical Museum in Stockholm, my suspicion was confirmed.

Figure 10.



Encke's comet, 9/7, 1060 BC, 02:10 local mean solar time in Herrebro, in the parish of Borg in Norrköping. The phase of the moon was 260.7°, the comet´s mean anomaly was 358.6°, its distance to the sun was 0.343 AU, to the earth 0.808 AU, and the length of the comet's tail can be estimated to 0.7 AU. The sky was bright, but the long tail had been visible earlier (m<4.5).



Rock-carving at Herrebro, in the parish of Borg in Norrköping, which shows comet Encke's tail (as the so-called frame figure) just below the keel of the Gemini-Taurus ship and with the bright nucleus of the comet as a cup mark to the left of the comet's tail. This situation can be dated with certainty to 9/7, 1060 BC, since a half-moon in the 3rd quarter (right foot with toes down) is represented just to the right of the Pleiades (the 4 cup marks above). This combination occurs only every 19th year and always on the 9-10 July in this period of the Bronze Age. This is a very strong set of conditions and it is also the case that Encke's comet has only once (9/7, 1060 BC) appeared in this position on either of these days between 2000-500 BC. (Figure based on G. Burenhult 1973.)

Figure 11.

The celestial Elk

An elk or moose is the most common figure on the rock-carvings in the northern parts of Sweden. At Nämforsen for instance there exist about 1800 elk figures.

From the beginning I like everybody else thought that the elk figures were just pictures of the most important booty for the Stone Age hunters. But there are also on several slate stones engraved figures with a combination of the hourglass shaped man, Orion, and an elk. In the Lap traditions about the sky there also existed an important constellation Sarva, the Elk, which was hunted by Kalla Parne, the Hunter (Orion). This has been discussed in a dissertation by Bo Lundmark [*Lundmark 1982*].

According to Lundmark the constellation Sarva was a combination of the stars in Perseus and Auriga, and he published some simple sketches of this constellation by an old Lap. After some trial and errors it was possible to get a reasonable identification of the stars in the constellation Sarva. This constellation was then compared with elk figures on the slate pieces. One of them, from Sätra, see above, was very similar to my reconstruction of the constellation Sarva and only a few changes were needed to get an acceptable similarity. The Stone Age constellation can be considered as a detailed representation of all stars within an area in Perseus and Auriga brighter than the 5^{th} magnitude. The stars within the contour lines of the body of the elk have been connected with each other and the nearest star on the contour line. This inner structure has been much discussed and has been considered as some kind of X-ray picture of interior of the elk. Another confusing detail has been an extra neck-line on some of the elk figures. This problem can also be solved by the interpretation of the elk figures as a constellation because at the position of the neck of the celestial elk there exist some stars that have to be connected by a line and the result is the double neck-line. Elk figures with double neck-lines exist also as rock-carvings at Nämforsen at altitudes higher than 75 m above sea-level.

The bow and arrow figure to the left of the elk figure on the slate piece from Ovansjö have been interpreted as the upper part of Orion and is discussed above, Fig. 7.

There also exist a smaller version of the celestial elk with no interior structures. The corresponding constellation consists mainly of stars in Perseus and the nearest parts of Auriga including the bright star Capella as the tail of the elk. Within this area in the sky it is possible to construct a figure very similar to the small elk figure on the pieces of slate and with no star brighter than magnitude 5.4 inside the contour lines. On one of these engraved pieces of slate, from Rå-Inget, 3-4 km north of the rock-carvings at Nämforsen, we can on one side see this kind of small elk, parts of a damaged Orion figure and Sirius, the brightest star on night sky. On the other side there is a complete Orion figure and a vertical line with a ”head” at the bottom, which may be the periodic comet Encke during its passage 2608 BC?, Fig. 8.

The figures from Rå-Inget can be astronomically dated by the precession of Orion to about 3015 BC as the earliest possible date. The archaeological classification dates it to the Middle Neolithic, ca 3350-2400 BC [*Papardukakis 1993*]. The rock-carvings at Nämforsen have been extensively discussed by the archaeologist Christopher Tilley [*Tilley 1992*].

The archaeologist Christian Lindqvist, who has written his thesis about the pictures of the hunting and gathering people in the northern parts of Scandinavia, has not found any conflicts between my astronomical dating and his dating from the rapid land up-lift or from the well dated Norwegian stiles among the rock-carvings. A complete discussion of the archaeological dating can be found in his thesis [*Lindqvist 1994*].

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