Welcome

Welcome to this pages of the private initiative "Horizon Astronomy in the Ruhr Area" (abbreviation Initia Horae, lat.: origin of time). Here, you can find all information related to our goals, our mission and our main project - the establishment of an Astronomical Theme Park including a Horizon Observatory on top of one of the many slagheaps in the Ruhr Area.

We provide information on the philosophy and the cornerstones of the project. Furthermore, the private initiative promotes the basic astronomical knowledge through development of educational teaching materials and resources.

Horizon astronomy as an ancient cultural technique

During the dawn of mankind, observing the shifting positions of the rising and setting points of the Sun on the apparent horizon was the only possibility to construct a solar calender that times the practical and ritual order in society.

Remains of buildings from past cultures still display today that astronomical concepts played an important part in the social and religious life of our ancestors.

The stone age complex of Stonehenge in southern England is the most famous example of aligning a monument towards the Sun. The axis of symmetry - and the procession way as its continuation - point towards the direction of the rising Sun during the longest day in summer and of the setting Sun during the shortest day in winter. Another well known example is the passage tomb of Newgrange in Ireland. Its burial chamber is illuminated daily for approx. 15 Minutes during the time of the winter solstice by the rising Sun, shining down the passage way into the interior.

An archaeoological dig in Goseck in Sachsen-Anhalt in Germany has revealed the up until now oldest comple of circular ditches with astronomical function. 7000 years ago an enclosure was created by a circular ditch and two palisades that has entrances and unobstructed views designed with astronomical constraints.

The Stardisk of Nebra is prove of the attention bronze-age society gave towards the celestial bodies. The golden limb segments span the region that can be covered by the rising and setting directions of the Sun along the horizon and documents the tradition of observing then horizon in this cultural time period as well.
To what extent stone-age man occupied himself with the stars, and to what purpose ancient astronomy was carried out, is since decades a research topic of astronomy, archaeology, and Ethnology. The resulting interdisciplinary research areas of archaeoastronomy and ethnoastronomy analyse the astronomical knowledge of ancient mankind and its integration into the context of prehistoric society.

**Horizon astronomy today – A chance for a conscious experience of nature**

The modern civilisation does not require the visible annual Solar and Lunar events to structure its calendar and chronological structure. Since basic horizon observations are not necessary any more, the key element of a conscious celestial observation and the related sensory experience have become obsolete and have been lost, together with the awareness of a millennia old cultural activity and archaic observational methods. This cultural decline goes hand in hand with the general lack of knowledge with respect to basic astronomical occurrences. The knowledge of how Sun, Moon, and stars move above the local horizon are nowadays not very well pronounced. Furthermore, basic astronomical education is not included in the national curriculum for schools.

Since 1999 the 'Initiativkreis Horizontastronomie im Ruhrgebiet e.V.' has developed proposals for the construction of observing installations accessible to the public, to revive the lost tradition of visual horizon observations and to advance elementary astronomical observing culture. Each of these buildings incorporate different ancient observing techniques. Two of the installations proposed by the private initiative have already been realised by the Regionalverband Ruhrgebiet (RVR) on top of the Halde Hoheward: the obelisk as a shadow caster in a horizontal sundial and the horizon observatory.
The Halde Hoheward

The Halde Hoheward, located south of Herten and on the city boundaries of Recklinghausen in Germany, forms together with the neighbouring Halde Hoppenbruch the largest slag heap landscape in the Ruhr area. The Halde Hoppenbruch has been re-cultivated in the 80s, compared to the Halde Hoheward where the dumping of spoil has been completed in 2013.

The Halde Hoheward is part of a planning area that envisages a regeneration creating an attractive landscape with a quality of stay and many recreational sites for the public. Thereby, this area addresses the industrial past and its influence upon the Ruhr area.

As a result of a planning workshop created through collaboration between the cities of Herten and Recklinghausen, a winning design by the planning bureau ‘Agence Ter’ (Prof. Bava) was selected. This plan proposes the Halde Hoheward as the central part of the ‘Emscher Landschaftspark’ and the regional green corridor D. Since 2008, the entire planning area therefore carries the name ‘Hoheward - Der Landschaftspark’. The Halde Hoheward comprises an area of 395 acres, the plateau at its summit is 152.5 m above sea level, and therefore rises 100 m above the surrounding as a table mountain.
The Horizon Observatory

On the plateau of the Halde Hoheward's summit, approximately 100 m higher than the surrounding, the horizon observatory was created in 2008. It consists of a circular plane with a diameter of 80 m and two large arcs of 43 m and 45 m radius that span this plane. The surface of the plane is absolutely horizontal and is the perfect mathematical horizon for an observer located at its centre. Set into the horizon plane is a stepped forum for seating. Its base is 1.5 m below the surrounding plane. The observer sitting on the central stepped pyramid can now place himself comfortably at the observing centre of the observatory and can take a bearing of a direction towards the mathematical horizon. The entire architecture is arranged towards the centre reserved for the viewpoint of the observer which is not marked by any structure. The centre is found by ones own observations. Only at the right position can one view exactly level over the artificial horizon and can see exactly through the sighting hole that connect both large arcs at their intersection. This central point used for the observations is located roughly 70 cm above the round central segment of the forum. One has to crouch down on the segment and not stand on top or next to it.

Artificial Horizon

The horizontal plane of the observatory is a tangential surface on the spherical surface of the Earth which arcs away from beneath it. Therefore, distant places appear below the horizon, more so the further the place is away from the horizon observatory. The Ruhr area disappears nearly entirely below the artificial horizon due to this curvature of the Earth’s surface and obviously because of the elevated location in the landscape. Only a few chimneys of industrial plants project above the horizon and one feels strangely removed from the metropolitan area. The senses are inevitably directed towards celestial appearances and the position of the Sun or other celestial bodies that only remain as orientation. A special acoustic effect can be observed in the centre of the forum. The sound is reflected back from the walls of the forum and enhances the feeling of the talking and listening person in the middle to be at a very special central point. Leave the middle of the forum and the acoustic effect disappears. A grove is set in the horizon plane that allows the observer at his observing location to view both the artificial horizon and its visible natural segment. The grove points
towards two gas storage tanks next to each other: On the left hand the gas storage tank of the coking plant Prosper in Bottrop is 15 km away, on the right hand the gas storage tank in Oberhausen used now for exhibitions is 22 km away. Their roof levels lie at 152 m above sea level just as for the horizon observatory. On an Earth with a flat surface, the tips of the gas storage tanks would lie on the artificial horizon. However, a slight lowering with respect to the artificial horizon can be observed resulting alone from the spherical shape of the Earth. The observation through the grove allows to experience the spherical shape of the Earth over a distance of 22 km with the naked eye.

He Two Large Arcs representing the Local Meridian and the Celestial Equator

The observing centre is spanned by two large semi arcs representing the local meridian and the celestial equator. They are visible from a distance and turn the observatory into a landmark for the region surrounding the motorway junction of the A2 and A43. The meridian arc, its plane being perpendicular to the horizon plane, separates the sky into a morning and afternoon hemisphere. The slanted equator arcs separate the sky in a northern and southern hemisphere. The arc is mounted such that it is parallel to the equator plane of the Earth.

The meridian arc or the line connecting its two base points where it meets the horizon surface marks the North-South direction at the location of the slag heap. The line connecting the two base points of the equatorial arc marks the East-West direction.

While observing the Sun’s position from the centre of the observatory with respect to the arcs, the time of day and the season can be estimated: In the mornings the Sun is to the East of the meridian arc, in the afternoon to the West.

In the summer half of the year the Sun is located above the equator, in the winter half of the year below. The Sun is always moving along a parallel circle to the equator during the day.

A more precise estimation of the Sun’s location is possible using the graduation marks on the arcs. The equator arc has been given a time graduation. Within an hour the Sun moves a distance along its path equal to the distance between two square graduation marks on the equatorial arc. The distance between two circular graduation marks is covered by the Sun in 20 minutes. The graduation measures the duration between the current Sun’s location and the time of it crossing the meridian that indicates local midday.

Local midday is the time when the Sun has reached its highest altitude. Then the Sun is exactly due south and behind the meridian arc. At this time it is moving from the
morning hemisphere (rising segment of its daily path) to the afternoon hemisphere (falling segment of its daily path).

Local midday does not occur at 12 CET or CEST, since we commonly use the zonal time which does not refer to the conditions for our meridian but for the meridian at the 15 degrees longitude. The time determination at the observatory refers to the symmetry of the path of the Sun above the Halde Hoheward. Since this time is related to the local meridian it is called the local time.

The daily path of the Sun is always parallel to the equatorial arc. Its inclination is explained by the geographic location of the slag heap on the spherical Earth. If it were at the equator, the equatorial arc would be perpendicular running from the eastern base point, through the zenith (the perpendicular direction above the observer), and to the western base point. If it were at the North Pole, one could eliminate the equatorial arc entirely since it coincides with the horizon and there is also no local meridian, since there is no highest daily altitude of the Sun. During a day at the North Poles, the Sun moves along a parallel circle parallel to the horizon. Therefore, it is impossible to define a characteristic direction using the position of the Sun. At the North Pole every direction is due south since the Sun has the same altitude towards each direction.

**Equinox**

The direction towards the East or West is characterised by another criteria. Towards these directions the Sun rises or sets at the start of spring or autumn. The equatorial arc in the horizon observatory marks therefore the path of the Sun at the beginning of spring or autumn, the so called Equinoxes. On these days during the year (20th/21st March and 22nd/23rd September) the Sun is twelve hours above and twelve hours below the horizon (this is not entirely true, since the position of the Sun is raised by the refraction in the atmosphere close to the horizon, causing the day to become a few minutes longer and the night shorter).

In the observatory the equinoxes are visible from the centre through the daily movement of the Sun exactly behind the arc. However, because the arc is a bit wider than the apparent size of the Sun and this occultation can be observed a day before and after the equinox as well. During these days the Sun radiates only through the round window in the intersection of both arcs. This special installation marks the equinoxes through an impressive illumination event during the local midday.

How does the position of the daily path of the Sun change continuously? – The Earth orbits the Sun every year on its orbit. The axis of Earth’s daily rotation (that points towards a location in the sky where incidentally a well visible star is located, called therefore Pole Star) is not perpendicular to the orbital plane, but is tilted with respect to the perpendicular direction by 23.4°. During its yearly orbit of the Earth around the Sun, the direction of the rotational axis remains (virtually) fixed in space. Therefore, sometimes the Sun shines perpendicular onto the northern hemisphere (summer in the northern hemisphere and winter in the southern hemisphere), sometimes perpendicular onto the southern hemisphere (winter in the northern hemisphere and summer in the southern hemisphere), and sometimes perpendicular onto the Equator (Equinoxes). The orbital motion of the Earth around the Sun in combination with the daily rotation of the Earth leads to a spiral movement of the Sun above the horizon. After the winter solstice the Sun moves during its daily spiralling motion into higher paths and after the summer solstice it winds itself down towards the next winter solstice. Thereafter, 365.2422 days have passed and a new cycle in the year begins.
Using Alignments on the Horizon Surface to mark Special Dates

The cardinal points along the horizon are derived from the daily movement of the Sun. A further not so common division of the horizon is possible, when transferring the various aspects of the Sun’s motion during the year – the daily paths of the Sun with different heights and their change during the year – onto the Earth. This becomes apparent in the direction of the Solstice on the horizon and contributes towards another organising principle of space and time. The important directions along the horizon, regularly assumed by the Sun and with which a solar calendar can be established, are marked in the horizon observatory. Fore- and back-sights consisting of circular windows - through which the rising or setting Sun close to the horizon shines - are located on the horizon plane. They mark the dates of the solstice (20th/21st June and 21st/22nd December) at which the Sun moves along its extreme summer and winter path. Refraction of the light rays in the atmosphere creates the illusion of a more elevated Sun close to the horizon than when observed from an Earth without an atmosphere. This elevation increases the closer the Sun is to the horizon. Since the lower limb of the Sun is – inevitably – closer to the horizon than its upper limb, it is further elevated and the disk of the Sun appears elliptical.

On either side of the horizon surface (East or West) the angle between the directions towards the two large windows of the summer and winter solstice is 80°. This angle subtends the arc covering all possible positions of the Sun close to the horizon as seen from the geographic latitude of the observatory (51.57°). The direction of alignment from the middle of the observatory to the solstice windows is clearly identified in the forum by transition lines from the white to the gray paving. With respect to these alignments, the ground plan of the observatory is similar to the sky disk of Nebra. This artefact also points towards solstice observations made at the 51st-52nd latitude, since the according arcs of 80° - highlighted by golden segments – cover its eastern and western limb.

On the one hand, the solstice alignments in the horizon observatory take on a symbolic function, because their elliptical window in the shape of the Sun point towards the position of the Sun even if it is not visible. On the other hand, they are conceived as functioning exact alignments with which an observer by himself can determine these positions of the Sun to a precision of a few days and can assess for himself the date of the solstice. To achieve this, an opening has been left below the elliptical windows for the Sun that is exactly filled by a screen further away. Only
when the eye of the observer is located within a few centimetres of the exact centre of the observatory, does the screen exactly fill in the opening. Otherwise, one can judge from the extent of the slit between screen and the foresight how far off one is from the centre. The centre of the observatory is best located using this fine adjustment of the observing position; even better than when using the round window in the intersection of the two large arcs that does not offer the high precision of the foresights on the horizon.

While carrying out systematic observations at the time of the summer solstice one can experience how the direction of the sun rise slowly shifts towards the north east. The rising Sun will fill out more and more of the circular window until it fills it entirely at the day of the solstice. After that event the direction of the sunrise shifts again systematically to the south east where the next solstice event in the region of the shortest days of the year will occur. The behaviour of the motion of the sunrise’s location reminds of the motion of a pendulum with an amplitude of $80^\circ$ along the horizon. It also shows the permanent motion back and forth including the slow drift into and out of the reversal point limiting the sector containing the pendulum motion.

After having determined the solstice dates, the year can be further structured by dividing the time between the solstice dates. The equinoxes – for which the path of the Sun is indicated by the equatorial arc and the circular window high up along the southern meridian - lie at equal times from the solstices. The time between the equinoxes and the solstices are divided into equal halves by certain days that are referred to in the following as quarter days. The four quarter days are also marked by foresights on the horizon plane. Since these dates are of lesser importance than the solstices, their foresights are smaller and only have a small window. The rays of the rising Sun shining through such a window will indicate a quarter day.

These foresights are not located in the middle between the eastern or western base point of the equatorial arc and the large solstice foresights. Their location is shifted, because the change of the rising and setting direction along the horizon is smaller during the quarter days and solstices compared to the changes during the time between equinoxes and a quarter day. Therefore, the symmetric division of the solar year into equal time intervals does not lead to a symmetric division with respect to the location of the rising or setting Sun along the horizon.
The small fore sights are also useful to determine the basic leap year cycle of a solar year in our calendar. Every fourth year a year is included which consists of 366 days. This is necessary, since the natural solar year is longer than 365 days by nearly a quarter of a day and we can only count years with whole numbers of days. Therefore, for a given quarter day there exist four possible paths for the rising Sun. After each year the rising of the quarter day Sun occurs after a whole number of 365 days and not after a fractional period of 365.2422 days defining a natural solar year. As a result, the path of the rising Sun is either higher or lower – with respect to the selected quarter day – than in the year before. After four years have passed and the February 29th has been included in the fourth year, a (nearly) identical path of the rising Sun compared to the one four years ago can be observed. During attentively observing this sequence over several years at a certain quarter day it becomes evident that it is necessary to include February 29th every four years. For the Solstice fore sights this is not observable, since the sequence of the four possible paths of the Sun virtually does not exist. The changes in the path of the Sun from year to year are so small that they are not observable with the naked eye.

The directions towards the smaller fore sights of the quarter days – compared to the solstice fore sights – are also marked in the forum by transition lines from the white to the gray paving. The sector between the quarter days and the solstices are all paved in gray and are continued into the horizon plane via gray steps leading up to the horizon plane; all other regions in the forum and on the horizon plane are paved white. From an aerial perspective the design of sectors appears as an oversized cross. This cross was also an old symbol used to mark prominent surveying points or boundary stones.
Stellar Observations during the Night

At night time the graduation marks on the large arcs glow in a discreet manner and allow the determination of the position of bright fixed stars. Using specially designed stellar foresights which are again discreetly illuminated, it is possible to determine special symmetric positions of the celestial sphere (the sidereal time 0, 6, 12, and 18 hours).

At the height one observes, when using the designed stellar foresights, the effects of the stellar precession on the paths of certain stars is detectable within a period of time of one to two decades. The stellar foresight consist of pegs pointing downwards, behind which the star Arcturus will be briefly covered along its path. The slope of the imaginary line connecting the tips of each peg is steeper than the slope of the path of a bright star Arcturus. Due to its precession, the path of a star will be lowered in the future. The movement of a star's path (approximately 3’ in 10 years) caused by precession is observable when counting the number of occultations of the star by the pegs.

A detailed interactive illustration of the various celestial movements and special events that can be observed at the horizon observatory, are available as a Java script Applet from Jürgen Giesen on the following website:

www.geoastro.de/horizon.
The obelisk as a pointer of a sundial

The motion of the Sun – the change of day to night – is one of the earliest natural phenomena observed by mankind and makes the passage of time perceivable. Examples of the first determinations of time using the position of the Sun or the movement of the shadow are already known to us from antiquity. Many examples of sundials exist of various design.

The horizontal sundial on Halde Hoheward with its obelisk as a shadow caster is modelled after the sundial of the emperor Augustus on the Marsfield in Rome. If the ancient sundial was complete, i.e. including hour and date lines on the morning and evening side, or only consisting of a meridian to measure the altitude of the Sun at midday, is unknown. The recent scientific finding point only towards a meridian. The observation of the progression of a shadow on a surface marked with a grid enables the measurement of date and local time. Therefore, not only does time become perceivable, but also laws governing celestial mechanics. The observer can now understand his relation to the cosmos.

The first step towards realising a astronomical park was made on 17th May 2005 with the inauguration of the obelisk. The obelisk is located on the south-east plateau of the slag heap at a height of 140 above sea level. The area covered by its shadow is 62 m in diameter.

The tip of the obelisk has an additional ball on a pole mounted above actual tip of the obelisk. This construction considerably increases the precision of measuring the location of the shadow of the tip.
The image of a model shows the gridlines and the cast shadow of the obelisk. The tip of the shadow moves during a day along a hyperbola. For specific days, e.g. the solstices or equinoxes, the hyperbolic shadow path is marked on the area on which the obelisk is standing. The hour lines, converging towards a point, are also visible in the model. An observer sitting at this special point is located as it were at a place of temporal rest. From his perspective the ball is located at the celestial pole around which the stars rotate. The ball covers the polestar. If located at a location from where the ball is covering the Sun, an artificial solar eclipse can be witnessed. Through appropriate movement across the shadow area the Sun can be kept covered by the ball and one can experience the speed at which the Sun and shadow location moves. The sundial gives the local time which is differs from the common standard time for central Europe (CET).

A detailed interactive depiction of the motion of the obelisk shadow on the Halde Hoheward has been provided for us by Jürgen Giesen as a Java script applet on the following page: [www.geoastro.de/obelisk](http://www.geoastro.de/obelisk)

Visitors’ Center

On the grounds of the former colliery Ewald at the western base of the slag heap you find the Visitors’ Center Hoheward. In the former Wage- and Lighthall you find the exposition “New Horizons - on the Traces of Time” and an Information Desk. Brochures, topographical and touristical maps of the Ruhr Area are offered there, as well as guided tours over the Halde Hoheward.

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**Important:** During a walk on the top of the Halde Hoheward you have to manage an altitude difference of 100 m and a distance of approximately 3 km. A wheelchair user or a person with difficulties to walk has to cope with some more than 5% slopes. The entire walk is in principle freely accessible. The visitors’ center offers shuttle busses.

**Wind and weather:** At the summit of the slag heap you will be unprotected and open to wind and weather. It can be very hot during the summer and much colder during the winter compared to the more protected city. Furthermore, a light breeze or slight drizzle at the foot of the slag heap can turn into an unpleasant storm on the summit. Please wear appropriate clothing and footwear.
The private initiative *Initiativkreis Horizontastronomie im Ruhrgebiet e.V.*

The charitable private initiative 'Initiativkreis Horizontastronomie im Ruhrgebiet e.V.' (short: Initiae Horae = source of time, lat.) was founded in March 2003 in a collaboration of members of the Institute of astronomy at the Ruhr-University Bochum and the Westphalian Public Observatory and Planetarium Recklinghausen in Germany.

Our goal is to further develop the initial idea of horizon astronomy in the Ruhr area and the focusing of astronomical skills in a scientific advisory board in the project planning and realisation.

The private initiative appears in numerous public presentations and negotiations concerning the further progression and planning of the astronomical installations with the project executing organisation – the RVR and the Cities of Herten and Recklinghausen – as official representative of the astronomical concept of the project. Additionally, they represent the authority responsible for a scientifically founded planning of the observing installations.

The charitable Initiativkreis operates across the Ruhr area and is independent. It therefore fulfils the requirement of the RVR: To realise a project - astronomical park within the landscape park Emscherbruch - with importance beyond the local region.

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