

# SPACE RHYTHMS AND TECHNOLOGIES OF ASTRONOMIC NAVIGATION AS FACTORS OF CULTURAL GENESIS AND SAPIENTATION

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**ABSTRACT:** The article proposes a new approach to these problems, developed on the basis of the navigation concept of the information modeling of the world. From the position of the navigation concept, the development of the geographical space-time played a leading role in the processes of human biological and supra-biological adaptation. Such an approach takes into account the fundamental role of the planetary-cosmic factors in shaping the structure of the geocultural space of the Earth and is consistent with the main provisions of the modern scientific picture of the world. On the basis of field and laboratory research, the instrumental possibilities of stone labyrinths and other prehistoric cultural heritage sites are determined. According to the results of the analysis of the structure of uneven-age objects, the reconstruction stages of the development of prehistoric astronomical orientation technologies are proposed. Comparison of classical signs and symbols with sun shadow charts allowed to substantiate the astronomical nature of the sign. The analysis of ethnographic materials has provided the preservation of archaic navigation technologies in everyday life practice, ornaments, mythological scenes, and sacral traditions. On the basis of generalization of materials, new models of cultural genesis and anthropogenesis, based on solar navigation, have been developed. The results of the study show that the invariant structures of genetic and social memory are associated with the order of geographical space-time, which is determined by the shape, daily and annual movements of the planet Earth.

*Keywords: Adaptation, Evolution, Intellect, Culture, Astronomical navigation technologies*

## 1. INTRODUCTION

The primary process in the system of biological and supra-biological adaptation is navigation – movement and orientation in the geographical space-time. The main source of energy and information for processes occurring on the surface of the Earth is the sun. For most living organisms, sunlight is, at the same time, a "signal" and a "food" (productivity of nursing populations).

The exploration of space and its resources, the survival and development of living organisms provide various types of astronomical navigation: phototaxis, geo- and heliotropism, photoperiodism, biological clock, near and far migrations, orientation reflex. The ancestors of modern human were nomadic and accumulated skills of instrumental astronomical navigation, representatives of *Homo erectus* settled most widely.

By examples of historical time, it is possible to trace how transport communications and product flows shaped the structure and maintained the stability of socio-natural and socio-economic systems. Today, the direction of flows of matter, energy and information determines the network of

water, land, air routes. However, even with a well-developed communications infrastructure, the need for navigation tools is preserved, and space remains the most reliable basis for navigation (while both GPS navigation and popular methods of orientation by the Sun and the stars are widely used).

The purpose of the article is to show the role of instrumental astronomical navigation in the processes of anthropogenesis and cultural genesis.

## 2. OBJECTS AND METHODS

The navigational models of cultural genesis and anthropogenesis were developed by the authors based on studies of the instrumental functions of cultural heritage sites (Stone and Bronze Ages). Reconstructions of algorithms for creating and navigating the use of northern labyrinths and petroglyphs of Karelia, objects of the Central Russian Upland, the Urals, the Caucasus and Gorny Altai and other objects were proposed.

We used standard field and cameral methods of geography and astroarcheology [1, 2, 3], models of the world and geographical space (Fig. 1).

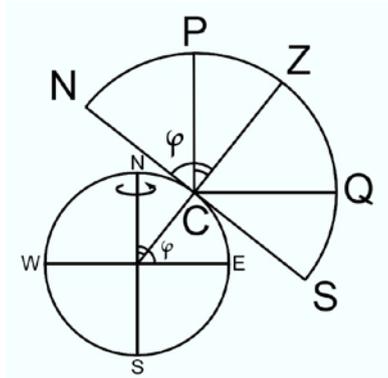


Fig. 1 The position of the Earth (circle) and the elements of the celestial sphere (semicircle) for an observer located at latitude ( $\varphi$ ) [4]. Symbols: C - position of the observer, Z - zenith, CZ - vertical line (and the position of the vertical gnomon), NS - horizontal plane (and midday line), P - pole of the world, PC - axis of the world, CQ - plane of the sky equator, NS - Earth axis, WE - equatorial plane,  $\varphi$  - latitude of point C (and the position of the inclined gnomon)

The measurements of object sizes and distances, the definition of azimuths in the structure of objects, paleoastronomic calculations and metrological analysis were carried out. Lineament analysis of surrounding landscapes was carried out on the basis of maps and satellite images: lineaments were distinguished in the landscape design – linear structures (straightened relief elements, chains of lakes, borders of wetlands, forests), rose diagrams of measured directions were constructed.

Studies have shown that at all sites, regardless of age (from 12,000 to 4,000 years old), the main tool was the shadow of the gnomon (reverse sighting). However, in the surrounding landscape stands out coarse and heavily destroyed boulder material, convenient for conducting near-horizon observations (direct sighting). In addition, linear relief elements and the shape of the horizon at the location of objects are convenient for astronomical observations, since they correspond to astronomically significant azimuths (*azimuth* is the angle between the direction to the north and the object or point of the horizon). The technological multi-layeredness of such complexes testifies to the continuous tradition and rational basis of the sacral status associated with the information function of the object and its place.

A comparative analysis of the graphs of the shadow of a sundial for the year (Fig. 2) and the structure of signs and images of different ages – from the Stone Age to our days (petroglyphs, solar signs, mythological images, modern sign systems) was carried out. Proof of the astronomical nature of the sign was received.

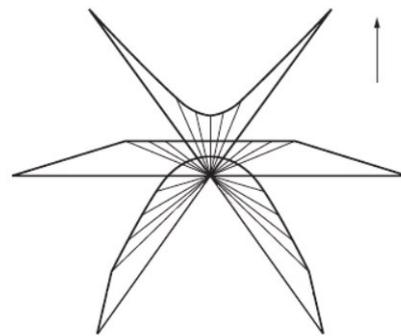


Fig. 2 The scheme of drawing the shadows of the gnomon in the days of the equinoxes and solstices is the basis of the solar signs and images: "horns", "wings", "fish tail", "lotus"

The results of the research have been summarized by the authors in the navigation concept of information modeling of the world [5, 6, 7]. The concept served as the basis for further research and theoretical constructions.

### 3. RESULTS AND DISCUSSION

#### 3.1 Solar navigation as the basis of abstract thinking

Astronomical signs are abstract in shape (directions to horizon points, shadow graphics), but are specific in terms of content aimed at life support. The lack of road infrastructure, ready-made calendars and timers forced the ancient human to constantly reproduce information about space and time. This suggests that it was not the person who created the sign, but *the sign created the person*.

Let us list some arguments confirming our thesis that navigation in space-time by the Sun could become the basis for the formation of abstract thinking.

##### 3.1.1 Astronomical landmarks are more reliable than objects in a dynamic landscape (because the super-system is more inert)

The dynamism of objects is determined by their mass (mass is a measure of the inertia of bodies). The mass of the Sun and the Universe is greater, and the rate of change is smaller compared to landscapes covering the surface of the Earth. The relative stability of astronomical landmarks was emphasized by ancient philosophers, who called the space surrounding the planet, the cosmos – "order". The dynamism of the elements of the landscape is reflected in ancient sayings "one cannot enter the same river twice", "everything

flows, everything changes", "nothing lasts forever under the Moon". The inertial properties of objects of nature were taken into account in everyday practice. Thus, for astronomical observations of fixing important dates of the calendar, the most stable elements of the landscape were selected: weathering-resistant bedrock, tectonic cracks, large erosion and tectonic forms (outcrops, mountain peaks and ravines). High resistance to movement and destruction allowed to use the tool for a long time, to transmit information from generation to generation, thanks to the monumentality, many objects have survived to this day.

### *3.1.2 Light is the most powerful signal in geographic space*

This provision probably does not require special explanation. It is obvious that all living organisms obey daily and annual rhythms of illumination, because the whole range of environmental conditions (temperature, moisture, food supply) depends on the mode of lighting. The main correlations of the mode of illumination, physiological processes and behavioral reactions are "recorded" in the genetic program of biological species. Human evolution is associated with instrumental activity in general and instrumental astronomical navigation – in particular. In general, the development of technology is a factor in increasing human emancipation from environmental conditions. Reducing the power of direct environmental influences mitigates the effect of natural selection and the "editing" of genetic programs for space-time orientation. Hence the role of instrumental navigation technologies (positive feedback) is increasing.

### *3.1.3 Regular repetition of the light signal, with food reinforcement, shapes a conditioned reflex*

This provision is formulated in the studies on the physiology of higher nervous activity. It is based on the well-known experiments of academician I.P. Pavlov, who explained the mechanisms of formation of the conditioned reflex [8]. Experiments with the dog, in the stomach of which the fistula was sewn to divert part of the gastric juice. Repeated combination of feeding with switching on the lamp leads to the formation of a stable connection between the two stimuli (1st irritant – light, 2nd – food). Subsequently, it was enough to switching on the lamp so that the dog started secreting gastric juice, which confirmed the excitation of the two nerve centers between which the connection was formed. Other conditioned reflexes are formed in the same way. Regular reinforcement of connections underlies the development of automatism (a dynamic stereotype

is formed). Navigation in space-time is carried out in order to efficiently use resources and predict adverse conditions that should be avoided. The combination of the sun's light signals and actions supported by food or other obvious success can form a stable link between the visual and other nerve centers.

### *3.1.4 The orientation reflex is paramount for adaptation*

This position is formulated in general psychology and ethology – the science of animal behavior. It has been experimentally proved that the main unconditioned reflex that solves the problem of self-preservation of the body is the orientation reflex [9]. For example, an animal placed in an unfamiliar room (or other new conditions) will not start eating until it has examined the room. All life requirements, including manifestations of the breeding instinct, are inferior in strength and meaning to the orientation reflex. When traveling in unfamiliar territory, the primacy of orientation can be felt on personal experience. According to the rules of navigation at each stop for rest, you should navigate around the map and compass, mark a point and record the track in the GPS navigator.

### *3.1.5 Language, as a model of the surrounding world and means of communication, begins with the designation of a place and time*

In the presence of road infrastructure it is much easier to navigate. However, the questions most frequently asked by strangers in a locality relate to the location of objects and directions. Since the information on space-time is of paramount importance, it can be assumed that the first words created by human meant space, time, distance and direction. The global invariant of the main geographical areas and universal solar navigation technologies easily explain the phenomenon of the Nostratic kinship of languages.

### *3.1.6 Position in space-time is unique for each object and can be the basis of its designation*

More than one object cannot be located at one point in space-time. The coordinates of an object in the geographical space-time reflect its functional connections in the structure of the system, and hence its quality. The positioning system is based on measurement and is associated with a number. Many languages have personal names and pronouns derived from numerals: Ivan is the first, Ben is the second, Thor is the third; I am the first, you are the second.

### *3.1.7 In anthropogenic, the average temperatures*

*on Earth were negative, which increased the value of astronomical navigation*

A decrease in temperature is accompanied by a decrease in biomass, a restructuring of landscapes, a change in the ranges of biological species, and massive migration of biological species outside a well-developed and intuitively recognizable territory. By the example of the polar regions of the planet it can be seen that the increase in continental climate is accompanied by an increase in its contrast in space and in time, and a decrease in biomass is accompanied by a decrease in the stability of the landscape to any effects. Therefore, in a cold climate, it is advisable to nomadic (extensive) management of natural resources, the distribution of anthropogenic loads over large areas.

### *3.1.8 About 2.62 million years ago human led nomadic lifestyle and accumulated navigation skills*

The Paleolithic occupies 99% of anthropogenesis, this is the time of the Pleistocene cold spells and the appropriating economy (hunting, gathering). In the Holocene (about 10-14 thousand years ago), in the conditions of global climate warming, the human moved to a productive type of economy and settlement. In navigation, as in other activities, the complexity of practical tasks determines the level of mass knowledge and skills. Ethnographic studies on the comparison of the culture of hunters and farmers showed a significant simplification of the calendar, inventory and vocabulary in conditions of exhausting work in a limited space. This is consistent with the general rule of evolution – slow-moving and attached forms, as a rule, are simpler in their organization than moving related biological species. Similar differences associated with the level of mobility can also be observed in individuals who are representatives of the same species.

### *3.1.9 Astronomical navigation is most in demand at sea, where there are no other landmarks*

There are no landscape landmarks in the open sea, and it is impossible to avoid access to the open sea (as a last resort, this may be the result of a storm). Sailing along the coast is dangerous: you can be aground or hit the ship on the rocks. Coastal waters are particularly variable in tidal seas with a shallow shore. The rugged coastline (with strongly inlet bays) makes one move from cape to cape. The development of the islands also makes you move away from the mainland and sail without landmarks on the way.

### *3.1.10 Solar navigation has no competition in*

*polar days and white nights*

In the polar regions and in circumpolar regions, such phenomena of illumination as polar days and white nights are observed. Under the conditions of the polar day, the Sun is the only astronomical reference point that can be observed [10]. During the white nights, the stars lightly stand out in the bright sky. The season of marine navigation in the seas of the Arctic Ocean is in the summer. In the polar regions, the summer season is a period of vigorous economic activity; the connection between solar heat and life is most noticeable here, which may not be so obvious in subtropical and tropical regions (especially in the arid part). For this reason, the ancient solar cult is most closely associated with the North. In ancient sources, the North is called the House of the Sun and by the fact that it spends the night there (goes beyond the horizon).

### *3.1.11 The regions of the Arctic are the most dynamic in the lighting regime (56° N – the Arctic boundary according to Eudoxus Cnidus)*

In ancient times, zoning of the Earth was created, with the release of the Tropic, the Arctic Circle, and other important boundaries. In the model of Eudoxus Cnidus, the boundary of the Arctic was drawn at a latitude of 56°; in the history of science, this boundary was associated with the conditions of orientation according to the constellation Ursa Major. The azimuth calculations for each degree of latitude in the northern hemisphere show an additional navigational meaning of this boundary. At latitude 55.5° (latitude of Moscow), the points of sunrise / sunset at the solstice deviate from the meridian by 45° (azimuths drawn from the center of observation form a regular oblique cross, which, together with the main geographic directions, forms a wind rose or a solar sign with radial symmetry). Moreover, the navigation conditions to the north and south of this latitude differ dramatically: from the equator to this latitude (0° - 55.5°), the azimuth of the sunrise changes gradually by 21.1° (66.6° - 45°), and when moving north to the polar circle (55.5° - 66.5°) – very dynamic: at 45° (45° - 0°). Here, other easily measured indicators are also very dynamic: the length of the midday shadow, its ratio with the height of the gnomon, etc. [11]. These indicators reflect large changes in the height of the Sun by season and in the space of the region, so they have been mastered here for a long time.

Another informational feature of the circumpolar latitudes is that every day, at 18 hours of stellar time, here one can observe all the zodiac constellations at the same time [12].

### 3.2 Solar navigation as the basis of cultural genesis

In the studies on historical geography V.I. Pararin showed that navigation by the Sun became the basis of the spatial structure and toponymic labeling of territorial systems [13]. These results are consistent with our results and conclusions obtained earlier – in studies of near-horizon observatories and the history of astronomical and mathematical knowledge [14, 15, 16]. Today it is known that the images of the maps are preceded by the written language, and the earliest known maps are the maps of the starry sky. The oldest read entries are the tables by Ancient Babylon (6000 years ago) with calculations of the angular height of the midday Sun and the shadow of the figure of average height measured by the feet. The tables are compiled for seven latitudes ( $90^\circ / 7 \cdot n$  (where  $n = 1, 2, 3, \dots, 7$ ), which are marked by the most grandiose ancient structures and graves of chiefs. For example, at a latitude of about  $51.5^\circ$  Stonehenge, Arkaim, Arjan, and many large cities in Europe are located. At latitudes  $52^\circ$  and  $38^\circ$ , the length of the shadow at the winter and summer solstice is 7:1 and can be recorded on a standard staff 7 feet long (the wish "7 feet under the keel" is associated with depth measurements of a pole of this size).

The development of navigation and the lack of state borders ensured freedom of movement and extensive intercultural communications, an intensive exchange of products and technologies. Still in the studies of V.I. Pararin it was proved that the Great Mussel of ancient authors was not a country in the modern view, but was a steppe region, symmetrical about  $45^\circ$  N. – the golden mean between the pole and the equator [17]. The characteristics of the nomadic way of life, when in the summer the herds were distilled to the north and in the winter to the south of the Caucasus, is in good agreement with the conditions of the steppes of the temperate and subtropical belt and the position of the Caucasus as a regional climate-section. This model well explains the significant concentration of hydronyms with Iranian roots in the steppes of the European territory of Russia. The meridional connections are well traced along the major rivers of Eurasia, along the distribution areas of labyrinths in northern Europe, in the Mediterranean and in the Caucasus.

As was shown in our study on the ecology of civilizations, the development of navigation technologies played the role of a locomotive of public consciousness and became the basis of the socio-cultural paradigm. Based on the technology of near-horizon observations, a model of consciousness is inevitably formed, reflecting the systemic "unity of significant parts". Examples of

such thinking can be: the pantheon of the gods – the planets, the Moon and the Sun, the personification of the 12 months of the year and the forces of nature. In the structure of society, such ideas correspond to the institutions of chiefdom, social equality and democracy.

The gnomon sundial calendars allowed us to determine the geographical latitude and increase the reliability of the navigation system, link existing observatories to a regional and global network, measure the planet – i.e. create a world of chaos. But, the altered space was broken by a system of borders, and the mono-instrument itself became a model of the organizing center. Reflection in consciousness of the processes of polarization of reality (center – periphery, one's own – alien, living – inert, good – bad) is first noted in the culture of the Iron Age, and in the artificial urban environment reaches its apogee (war, all forms of dependence and the systemic crisis of civilization a consequence of limited thinking). In the epoch of new technologies of navigation and communications, the humankind has the opportunity to return to holistic thinking, restore ties and, therefore, stability in the "human-nature" system.

We list some of the main directions of the influence of navigation technologies on culture.

#### 3.2.1 Measurement forms a system of notation

This item can also be considered primary for sapientation, since its processes are inseparable from the development of social culture and modern civilization. It is the *measurement with the help of tools* – the new field of activity on which a new system of concepts could have formed (all other spheres of life activity exist in animals, especially in social forms: construction, raising offspring, moving long distances). The very first measuring tool, a landscape transformed for orientation in space-time, is a powerful factor in the development of abstract thinking, since makes read artificially introduced markers, reflecting its vital quantitative characteristics (positive feedback).

#### 3.2.2 On the petroglyphs of the Stone and Bronze Ages, simple geometric signs precede more complex artistic images

The researcher of the Karelian petroglyphs F. Ravdonikas was the first to measure the azimuths of simple geometric signs (solar and lunar) and showed their high correlation with the astronomically significant azimuths of the Sun and the Moon (at the time of imaging, 6000 years ago). Most of the signs are directed towards the setting of the sun on the equinoxes (Fig. 3).

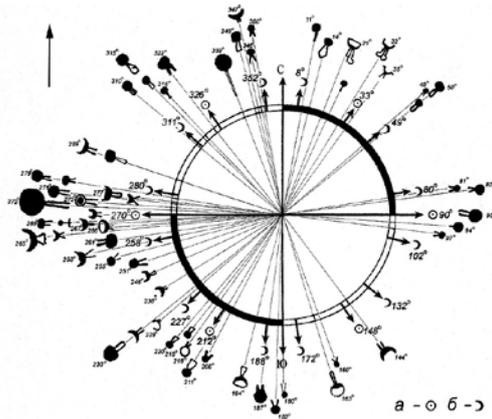


Fig. 3 The ratio of the azimuths of geometric signs and rises / sets of the Moon and the Sun on the days of the solstices and equinoxes [18]

Our studies on synchronous objects of Karelia and Gorny Altai show that rocks with petroglyphs everywhere function as a scale / dial of a sundial calendar, and their creation and use is based on shadow fixation [19]. The sequential drawing of the shadow of the vertical gnomon gives an idea of the origin of the solar signs and typical attributes of mythological images (horns, fishtail, lotus and others – see Fig. 2). The shadow of a bent or T-shaped staff continuously draws the sign of the swastika. On the Tiunovsky stone (Vologda region, Russia), you can trace the stages of creating images from the Stone Age to the Middle Ages: first, graphical signs (lines, grids, radial labyrinths oriented astronomically significant directions appeared), on them - a graphic image (man on a deer, a marquee, wood), then runic writing, and finally Christian crosses added [20].

### 3.2.3 The shadow graphics of the gnomon of sundial calendars correspond to a matrix of modern signs and sign systems

It is known that the Phoenician script consisted of solar signs, and in linguistics and philology the first successful steps were taken in solving the task of "throwing a bridge" from solar signs to modern sign systems. Hermann Wirth created the phonetic systems of vowels and consonants associated with the annual solar cycle. In the studies of Olzhas Suleimenov, continuity in the morphology of existing sign systems is analyzed. The discussed communication is so obvious that it became a subject for discussion at classes in preschool educational institutions of St. Petersburg (children perform the task: on the matrix of 6 intersecting lines to find all the letters of the alphabet). It remains to add that the graph of the shadow of the gnomon in the days of the solstices and equinoxes represents the same six directions, but fills them with a concrete meaning.

3.2.4 On the height of a person, two basic measurement systems of the ancient world are intersected - anthropometric (fathom, foot) and astronomical (the length of the shadow of the figure measured by the feet)

Anthropometric measures of length were used almost everywhere until the twentieth century. However, there is still no correlation of this measurement system with the astronomical system. Since they are related, it is obvious that all anthropometric measurements have an astronomical standard, i.e. linked to space.

### 3.2.5 Archaic measures of weight, money supply and nominal retain connection with the solar calendar system

Studies in the history of the use of the gnomon have shown that many standards of measures and weights, a measure of money supply, music theory and the practice of creating musical instruments are associated with this astronomical instrument and calendar. A six-decimal number system could be formed on the basis of daily observations of sunrise / sunset in the polar regions.

### 3.2.6 The consolidation of territorial boundaries, the development of all forms of social dependence, the struggle of urban religions with popular culture led to the loss of navigation skills and traditions

Oases of traditional culture are preserved in different regions of the world. The territories that preserve the continuity of cultures from the Stone Age include the North and East of Russia. For example, the Mari people maintain the ecological traditions of respectful care for the landscape as a living organism, non-antagonistic world perception (there is no "evil", there is only good and unmanifest good) cosmogonic thinking (Mari is the day of the heavenly girl, daughter Yume, who descended to Earth the sunbeam through the top of the birch; the holidays of the year – the creation of the universe, the solar system, the earth, life). In the culture of the Mari preserved traditions that are described by ancient authors during the practice of the Hyperborean peoples (voluntary death, burial in a basket on a tree, the possibility of jokes and laughs at the wake). Many images of the gnomon have been preserved (a stick in the courtyard, an image of a golden needle and an embroidered shawl along which one can find a way, the word "bull" means "time"). Similar features of culture are preserved among many peoples of Russia.

However, the tradition of orientation is forgotten, because the territories are well known.

### 3.2.7 Improvement of technologies and the transition to new navigation tools is accompanied by the loss of the primary rational content of ancient objects of tangible and intangible culture

Oblivion of ancient navigation technologies is associated with the development of new technologies and road infrastructure. However, as revered objects and objects of tourism, they continue to provide a link between generations and cultures. Moreover, the ancient navigation tools continue to perform information functions – these are sources of information about the nature and culture of the prehistoric past

### 3.3 Solar navigation in traditional culture

Based on an analysis of Paleolithic art, B.A. Frolov concluded that combined astronomical and mathematical knowledge manifests itself invariantly from the Atlantic to the Pacific Ocean, and the calendar can even be very different in the embodiment with peoples who live next to each other.

Traditional cultures retain the system of festivals tied to the astronomical calendar and the concept of the divine-cosmic nature of human (the goddess-mother, gods who preserve life on Earth: the Sun, planets, constellations). According to the literature and oral reports of the respondents, until the end of the twentieth century, in all regions of Russia and in adjacent regions, the gnomon was used for navigation (a human figure, a staff or a shepherd's whip, wood and stone, as well as the shadow of an object sandwiched between the fingers, move on the palm).

In ethnography, only formal similarity of objects and contexts is considered, but functional analysis is also possible. In practice, you can make sure that there is no difficulty in uncovering objectively the reflection of astronomical navigation technologies in the structure and decoration of clothing and household items, sacred objects and mythopoetic subjects. As an example, we compare the gnomon of sundials, calendars, and a number of the most typical images presented in all archaic cultures and with surprising similarities.

#### 3.3.1 World tree

In terms of shape and characteristics, the World Tree is one of the most obvious options for reflecting the real gnomon and the abstract concept of the earth axis: the Tree of Life, as it is called, connects cosmic and terrestrial space, cyclical and linear time. The crown of a tree can be represented as a set of rays passing through the top of the gnomon, into the roots – as lines of shadows

radially diverging from its base. But another option is also possible – an inverted tree (in the hands of Varuna): its roots go back to Space, and the branches are directed to Man. In all cases, it seems that the real instrument-gnomon is primary in relation to the abstract concepts "earth axis" and "axis of the world", since they could be formed only on its basis.

The Maypole is still set on the eve of May 1 in the center of many European settlements – it is a birch, spruce or a tall trunk cleared of bark, decorated with ribbons and a wreath. In calendar (astronomical) holidays, the world tree is placed in the center of the labyrinth, on the main square, in the house. Round dances lead, gifts and ribbons are hung on the top.

In the labyrinth, the place of the world tree can be occupied by a girl, with ribbons in hand, the other ends of the ribbons can be held by the participants of the round dance. Archaeologists note that even in the art of Paleolithic, the theme of the world tree is closely intertwined with the theme of the Great Goddess.

#### 3.3.2 Mother Goddess image

The image of the Mother Goddess is well-known and popular (Fig. 4). Research conducted by P.I. Kutenkov, devoted to the female calendar, allow us to distinguish the features of the Mother Goddess in dress and status of the woman, preserved in culture from the Stone Age [21].

Comparing the image of the Mother Goddess in different cultures allowed Yu. Ratnikova to show the continuity of the main functions (fertility and ancestor worship) and the relationship with the equinoxes (Belyne and Samhayn of the Celtic calendar), which for several millennia have shifted due to the precession of the equinoxes [22]. The image of the goddess with snakes (figurines from Crete) is convincing as a symbol of the equinox axis, which divides the annual circle into winter and summer, the time of withdrawal, immersion in deep sleep (anabiosis), and the time of returning to life.



Fig. 4 Mother Goddess, embroidery [23]

The researcher of the traditional cultures of the Volga region I. Kulyazheva gives evidence that the image of the Mother Goddess is the embodiment of the earth's axis. The horses held by the Mother Goddess in the canonical plot (in some cases, birds or deer) symbolize the unity of the diametrical positions of the starry sky, describing a 360° circle in 24 hours (the constellation Ursa Major and Ursa Minor, the cosmogonic legends of the Mari people can be replaced by elk or bird).

It should also be remembered that the formation of ideas about the axial rotation, shape and size of the planet is associated with the practical use of the vertical gnomon, one of the variants of which was a human figure. The traditional account of the months of the year among the peoples of Siberia is connected with parts of the human body. In parts of the palm of your hand were the solar-lunar calendar and the countdown of the hours of the day, many peoples of Europe and Asia. Calendar functions in traditional culture were performed by jewelry and clothing items (hats, embroidery and ornament).

### 3.3.3 Mount Meru

The use of the first protractor, the solar gnomon, in contrast to previous technologies at near-horizon observatories, allows us to determine the spherical shape of the Earth, the geographic latitude of the observation point, to build a regional and global geodetic network. The oblique gnomon can be viewed as a projection of the earth's axis (Fig. 1).

From the epoch of mastering gnomon technology and the information function of a spear, whip, belt and staff, *the World* exists as *measured* chaos, and the centers of territorial systems are the starting points and the place where standards are preserved. In local territorial systems, the role of the gnomon and the markup can be performed by the combination "Sacred tree-stone" (traditionally symbolically preserved in the Baltic States), "The sacred grove with elements oriented along the horizon is stone" (in Mari El), a pole in the yard of a rural house (Mari El, Poland), stone stela (in villages of Armenia, Dagestan). The centers of large territorial systems at different times were Kailas – In Tibet, omphaly – Delphic (Greece), Tours (Ireland), Jerusalem and many others. According to the authors of the article, in the considered navigation context, the center of the planetary scale could only be a pole – a point on the earth's surface, lying on the axis of rotation of the planet and the celestial sphere. Today, the poles are the fixed base of the network of coordinates, the intersection of the *meridians* "meridianus" is "midday" (from "meridians" to

"noon", the addition of the *medius* "middle" and dies "day"). In ancient culture, the pole and the earth's axis could receive the status of sacred objects, thanks to its stability and reliability (the direction to the north is easily determined and therefore serves as the main reference point and reference point). In this context, the location of the mythical Mount *Meru* in the North is the result of the fusion of mathematical, conceptual and mythological modeling of reality, characteristic of science as a form of knowledge.

### 3.3.4 Bowl

The axial rotation of the Earth and the time of day can be determined using a bowl filled with water. This tool replaces the gnomon at night and in cloudy weather. Water, like Foucault's pendulum, retains its initial position in space, and the bowl rotates along with the earth and the meridian (like a dial). The role of an arrow in such a watch can be performed by a light object placed on the surface of the water mass (Fig. 5), and the time stamps are the shape of an edge or an ornament. Observation of a circular motion of such an "arrow" (15° per hour) inevitably gives rise to the idea of the axis of rotation, and the absence of a tangible physical body leads to the search for means of expression of this important knowledge. So the bowl is combined with the image of the world tree. Another option for combining the bowl and the gnomon is scafis (Fig. 6).

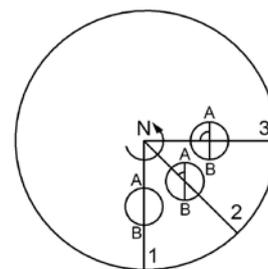


Fig. 5 Scheme of the timer "bowl with water": N - geographical pole, AB - object on the surface of the water, 1, 2, 3 ... - changes in the position of the meridian in the daily cycle

In ethnography, steady (canonical) compositions depicting a bowl and a world tree are considered as a display of three levels of the world: the lower one – the roots (the older generations, the past, the underworld, a different light), the middle world – the earth (the human world, the family, the present), the upper – the sky (world of gods, future). Two birds facing the trunk are a pair ready to make a nest (Fig. 6).

Comparison with astronomical navigation technology allows us to associate the three-part composition as a whole (the presence of the 3rd axial element) with the definition of the middle of the day, and the triplicity of symmetric elements with three nodal points in the trajectory of the midday shadow, which allow to distinguish astronomical seasons: solstice, medium – at equinox, short – in summer solstice.



Fig. 6 The World Tree in the Bowl [24] and the Tool – Bowl with a needle of Eratosthenes [25].

In ancient art this story has a wide distribution and independent significance (sometimes birds are replaced by two half-opened flowers submerged in water). It can symbolize the relationship of astronomical navigation, the cycles of the planet and biological rhythms (birds singing and blooming at the dawn – the biological clock). The consistency of astronomical and phenological cycles is also recorded in folk calendars. The comparison shows that the traditional culture of all peoples reflects rational astronomical knowledge: real tools and images of the embodiment of time.

## 4. INFORMATION POTENTIAL OF ASTRONOMIC NAVIGATION TECHNOLOGIES

### 4.1 Planetary invariant, regional specificity and unique local conditions

From the definition of culture as a form of suprabiological adaptation, it follows that its diversity is associated primarily with the dynamics of the geographic environment. Then the cultural invariant reflects the general that is necessary and accessible anywhere in the geographic space.

The universality of solar navigation technologies is based on the Earth-Sun global invariant: at every point of geographic space at noon the N-S direction can be determined, at sunrise / sunset at the equinoxes – the W-E direction.

The greatest regional differences can be observed in different zones of illumination (separated by the tropics and the polar circles).

The ratio of the general and the particular in the objects of navigation purpose transfers the rule "technologies are universal – the objects are unique". Objects are unique because they differ: in latitude, position of the earth's axis at the time of creation, height above sea level, the shape of the horizon, as well as material resources, technology and the aesthetic choice of the master.

### 4.2 Unified language of the Universe

Since there are planetary systems like ours, extrapolation of this experience beyond the limits of the geographical envelope allows us to simulate a single language of the Universe.

## 5. CONCLUSION

The navigation concept of information modeling provides a holistic view of the development of the "nature-man" system as a breed and an inseparable part of one world on a cosmic scale.

The navigation concept is a set of new scientific methods and theoretical principles, the use of which contributes to the study of information effects of the interaction of human and nature.

A systematic analysis of information processes, as factors of adaptation and human evolution, helps to solve a number of modern scientific and practical problems: it reduces the inconsistency of interpretations of ancient objects and the uncertainty in the development of the theory of cultural heritage, increases the objectivity of

assessing modern problems of public health and the search for opportunities for sound management.

In the long term, the widespread introduction of the concept will make it possible to use information about nature contained in the structure of cultural heritage objects, clarify the model of planet evolution and improve the quality of forecast.

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