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Tourism as Form of Personal Liberty and General Communication: Experience of Geo-systems Analysis

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ABSTRACT

This conceptual paper presents a view of tourism as a form of personal freedom, which returns a holistic perception of the world to a person and the possibility of more complete self-realization, and the tourism sector as a form of global communications necessary to overcome the systemic crisis of civilization associated with the violation of external and internal relations in the system “society – nature of the Earth”, which for 2.5 million years has been developing as a “world without borders”. As an evidence of the continuous spatial development of the planet, prehistoric heritage objects of navigation purpose (navigation – movement and orientation in space-time) are considered, the instrumental capabilities of which are revealed on the basis of paleo-astronomical and paleo-geographical research methods, as well as geo-system approach, traditionally used in geography for the analysis of territorial systems.

In the article we proposed reconstruction of navigation technologies and the most ancient symbols of culture, conceptual models of the evolution of human biological and social nature show the astronomical nature of signs and abstract thinking, which allows us to consider modern navigation and communication technologies (including the development of tourism) as manifestations of the self-regulation of global socio-natural a system that provides sustainability based on maintaining flow and diversity. Navigation methods allow us to replenish the resources of the tourism sector, as well as to increase the level of social adaptation (tolerance) based on a rational interpretation of cultural objects, providing for the selection of a global invariant, regional variations and unique orientation conditions at each point of geographical space-time. The navigation concept of information modeling of the world provides an understanding of the harmonious development of human as part of the universe, contributes to solving theoretical problems of modern science (refining evolution models; determining the primary purpose of prehistoric cultural heritage objects; reconstructing the semantics of signs and the genesis of sign systems) and can be the methodological basis of interdisciplinary research in the geography of culture.

Nell'articolo il turismo è visto come una forma di libertà personale, che restituisce a una persona una percezione olistica del mondo e la possibilità di un'autorealizzazione più completa. Il settore turistico è una forma di comunicazione globale necessaria per superare il sistema crisi della civiltà associata alla violazione delle relazioni

esterne e interne nel sistema "società - natura della Terra", che per 2,5 milioni di anni si è sviluppato come un "mondo senza frontiere".

Come prova del continuo sviluppo spaziale del pianeta, vengono considerati gli oggetti del patrimonio preistorico a scopo di navigazione (navigazione - movimento e orientamento nello spazio-tempo), le cui capacità strumentali sono rivelate sulla base dei metodi di ricerca del paleo-astronomico e del paleo-geografico, nonché dell'approccio geosistemico, tradizionalmente utilizzato in geografia per l'analisi dei sistemi territoriali.

Nell'articolo proponiamo la ricostruzione delle tecnologie di navigazione e dei più antichi simboli della cultura. I modelli concettuali dell'evoluzione della natura umana biologica e sociale mostrano la natura astronomica dei segni e del pensiero astratto, che ci consente di considerare le moderne tecnologie di navigazione e comunicazione (tra cui lo sviluppo del turismo) come manifestazioni di autoregolazione del sistema socio-naturale globale, un sistema che fornisce sostenibilità basata sul mantenimento del flusso e della diversità. I metodi di navigazione ci consentono di reintegrare le risorse del settore turistico, nonché di aumentare il livello di adattamento sociale (tolleranza) basato su un'interpretazione razionale degli oggetti culturali, prevedendo la selezione di un invariante globale, variazioni regionali e condizioni di orientamento uniche in ogni punto dello spazio-tempo geografico. Il concetto di navigazione della modellizzazione dell'informazione del mondo fornisce una comprensione dell'armonioso sviluppo dell'essere umano come parte dell'universo, contribuisce a risolvere i problemi teorici della scienza moderna (perfezionando i modelli evolutivi; determinando lo scopo primario degli oggetti del patrimonio culturale preistorico; ricostruendo la semantica dei segni e la genesi dei sistemi di segni) e può essere la base metodologica della ricerca interdisciplinare nella geografia della cultura.

Keywords: Systems approach, Geographical system (Geo-system), Sustainability, Objects of cultural heritage, Tourism, Information, Navigation methods, labyrinths and petroglyphs, menhirs

1 – Introduction: geo-systems approach and interdisciplinary research in the geography of culture

In this article, the sphere of tourism is considered in the context of the basic laws and concepts of the geography of culture. The geographical approach allows us to review the important system-forming role of tourism and recreational environmental management in the modern world (Bugnar and Mester, 2012). Direct interaction with the diversity of the surrounding world returns the joy of life to a person, an understanding of aesthetics and the rational content of different cultures, a non-antagonistic worldview inherent in a healthy society.

The geography of culture is a relatively young area of science, the object of which is the geocultural space, and the subject matter is all forms of supra-biological adaptation. The concept of "geocultural space" reflects the connections of the "Human-Nature" system at the scale of the geographical envelope of the Earth (Streletsky, 2005; Gladkiy, 2010). The spherical space of the geographical envelope of the Earth is limitless, subject to universal laws (integrity, rhythm, zonal distribution), has regional specificity and unique characteristics at each point in space-time. Obviously, the most important supra-biological adaptation of mankind has become the physical and essential development of the surface of the planet Earth.

Unlike biological adaptation, codes of which are recorded in the genome of populations, supra-biological programs of successful behavior are stored in the collective memory of humanity. Written and pre-literate sources of information – tangible and intangible culture – have been studied in detail by humanitarian methods. However, reflection, banal logic, comparison, actualization cannot answer many questions: for example, convergent structures (created by one process, but on a different substrate), all kinds of technologies and areas of scientific knowledge, escape from understanding. Due to the shortage of materials available for the humanities, the Paleolithic culture, which accounts for 99% of anthropogenesis, remains poorly explored. Obviously, the time has come for interdisciplinary research projects.

The relevance of systemic research on the interaction of nature and culture is increasing due to the obvious manifestations of the ecological, economic and spiritual crisis of our civilization. Solving the problem of optimizing the relationship between a person and the natural and man-made environment surrounding him, one should take into account the opinion of the famous mathematician A. Kolmogorov, who stated that complex systems cannot be modeled except by repeating the entire history of their origin (Kapralov et al., 2005).

In geography, a retrospective of the development of the processes of knowledge of the world is as follows: "... The whole set of data analysis is aimed at resolving two issues: 1) how phenomena and things relate to each other; 2) what can be said about the state of some phenomena, knowing the states of others. Improving the quality of the answer to these questions determines the inevitability of the emergence of abstractions as images and concepts that are no longer related to specific phenomena of nature, but reflecting the existing properties of the relations between them ..." (Puzachenko, 2004, p. 12).

Prehistoric objects preserve information about nature and human for many thousands of years (Van der Waerden, 1991; Stafeev and Tomilin, 2006; Marsadolov, 2010; Paranina, 2011, 2017; Paranina and Paranin, 2017, 2018; Grigoriev, 2016, 2018). Stone Age objects show continuous connections of different cultures. A large amount of information about the ancient and the most ancient human communications is provided by studies of stone labyrinths and other prehistoric objects of cultural heritage.

2 – Theory and Methodology of Cultural Communication Research

Planetary space models

The "human-nature" system can be modeled as a sum of spheres or layers (Fig. 1). Human and earthly landscapes are the youngest and most dynamic layer. Outer space is the oldest and most stable part of the natural system. The main source of energy and information on the surface of the Earth is the Sun.

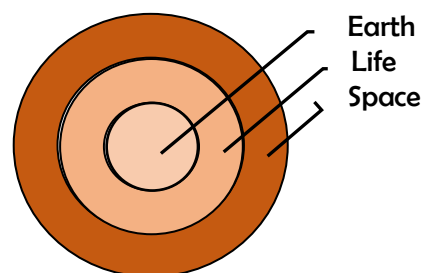


Fig. 1 – Spherical model of the "Human-Nature" system (Paranina, 2017).

The spherical model is consistent with one of the leading ideas of general physical geography: *the Earth has a shell structure*. Such a structure can be traced by geophysical methods (separation of the core, mantle, lithosphere, crust), continues above the earth's surface (hydrosphere, atmosphere) and is explained by the density differentiation of the substance. The *layer of maximum mutual penetration* increased metabolic rate, interaction of the energy of space and the Earth's interior, including the biosphere, atmosphere, hydrosphere and lithosphere, is recognized as a geographic object and is called the *geographical envelope of the Earth* (Kalesnik, 1970).

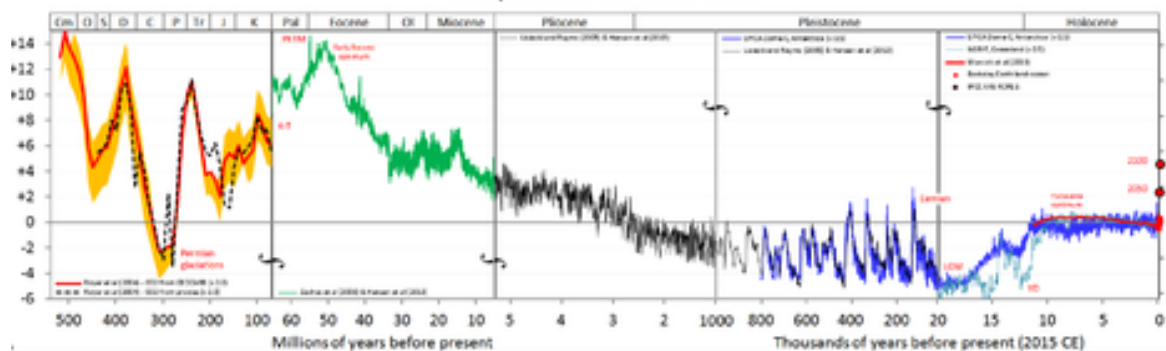
Geographic space (and *geocultural space*, its part, transformed by human activity), is considered as a hierarchically constructed *geographical system* (geo-system), which is characterized by discreteness of bodies and continuity of relations. The doctrine of geo-systems was created in

landscape science, but it has a great potential for modeling natural-anthropogenic systems (Sochava, 1976). Sphericity is the most important property of the global geo-system. Refraction of the flow of sunlight coming at different angles to the rotating earth's surface has two main consequences: the "zonality" of nature and the effects of the sunrise/sunset of the sun (and other objects, astronomical landmarks). For lateral flows (parallel to the earth's surface), the spherical space is limitless (Shubaev, 1980).

In the framework of the *theory of abiogenesis*, life time on Earth is estimated at 4 billion years, and half of this period is characterized by the fact that the main mass of organic matter is created by green plants – autotrophic organisms that receive solar energy through food chains, acting as "space mediators" between the Sun and heterotrophic organisms (Timiryazev, 1958). The dependence of living organisms on solar heat and light is also associated with weather and climate phenomena. Since energy is a leading environmental factor in the life support system, the adaptation to this factor is strictly controlled by natural selection; as a result, the daily and annual regime of solar energy is recorded in the genetic memory of all organisms (biological clock, photoperiodism, etc.).

Paleo-geographical models

The time of existence of human (genus *Homo*) is about 2.5 million years. During this period, the temperature on the Earth was repeatedly lowered (Fig. 2). The coldest anthropogenic stage was the Pleistocene, when the global temperature fell below 0°C. About 12 thousand years ago another warming began, called the Holocene. According to the calculations of Milankovitch, the rhythm of the Pleistocene cooling matches with cyclical changes in the tilt of the earth's axis in the range of about 2.5° (from 22.1° to 24.5°) over 40,700 years. At the same time, the northern polar circle is shifted in the range from 67°54' to 65°30'. With a large inclination of the earth's axis, the regions of the polar and equatorial regions expand (cold and hot lighting belts), and the Earth's climates become more contrast. When the Earth's tilt decreases, the temperate zone expands, the polar circles recede to the poles, and the climate softens. Today, the axis tilt is 23°27'. For the anthropogenic model of the rhythms of nature is developed in detail in the works



of A.V. Shnitnikov and E.V. Maximov (Maximov, 2005).

Fig. 2 – Global average temperature estimates for the last 540 My (Fergus, 2014), the average temperature in the Pleistocene below 0°C

Two competing models are associated with Pleistocene cooling, explaining the possible causes of the spread of large crystalline boulders in Europe – the glacial and marine hypotheses. Wandering, or erratic, boulders could be separated at considerable distances from the deposits, the outcrops of crystalline rocks, sea ice (as is happening now in freezing sea waters). Or maybe, on the surface of the European plains, with virtually no height difference, ice masses flew along with fragments of madder, like modern mountains, the glaciers of Greenland and Antarctica? The wide distribution of mammoths, the sites of the ancient human in Scandinavia and other

facts do not agree with the model of the ice shell up to 3 km thick, flowing down the river valleys of the Dnieper and the Don to the Black Sea. Therefore, the discussion of glaciologists with paleontologists, paleobotanists, archaeologists and physicists continues.

Obviously, not only the climate, but also the conditions of astronomical observations, as well as the magnitude of the force of gravity are associated with the tilt of the earth's axis (the greater the speed of the Earth's axial rotation, the less its inclination – the effect of a "spinner", while the centrifugal force becomes greater and gravity – less). The famous Russian landscape expert Nikolai Solntsev wrote that the effect of gravity on natural complexes is still underestimated. Indeed, the velocity of the currents and the mass of all bodies depend on gravity, which determines the appearance of the earth's surface. But the change in gravity can also explain the conditions of human activity: at high speeds of the Earth's axial rotation, gravity decreases, so the human body can be more massive, and large stone blocks can be lighter. These planetary patterns can explain many phenomena of nature and culture of the past, including: the gigantism of ancient plants (psilophytes) and animals (vertebrates – in the Mesozoic and invertebrates – in the Paleozoic); the scale of prehistoric stone structures, superior capabilities of the most modern powerful technology.

As it is known, a consequence of climatic cooling is a decrease in biomass, a change in the ranges of human populations and other species, instability, and frequent restructuring of landscapes. The harsh climatic situation explains why 99% of the time of their existence humans led a nomadic lifestyle. In conditions of instability and low biological productivity of the landscape, it is impossible to develop an intensive economy (as in the modern Arctic) and for a long time to stay within the boundaries of a well-developed and intuitively familiar regional space. The main way to master the geographical space (geographical adaptation) is navigation – movement and orientation in space and time. The most reliable landmarks of navigation are in space (the landscape is very dynamic, the space super-system is more stable). Unlike animals, human created tools and developed technologies.

Thus, the analysis of data from the modern scientific picture of the world (paleo-geographical and anthropological) shows that during the course of the anthropogen humans could accumulate considerable experience in "instrumental astronomical navigation". This allowed humans to be "at the right time in the right place" and freely develop.

3 – Research Methods for Prehistoric Navigation Tools

The objects of research are labyrinths and petroglyphs, menhirs, stone structures of the Stone and Bronze Age, created in the Holocene, as well as natural-made sculptures of an earlier age.

The most advanced ancient technology of orientation, still used in navigation and in traditional culture, is *solar navigation*.

The movement of the gnomon's shadow (the gnomon is any object that gives a shadow) allows you to trace the entire day trajectory of the sun. A record of the shadow trajectory during the year creates a solar calendar. The equation for calculating the operating principle of the solar calendar is based on the trigonometric function, which relates the height of the Sun, the length of the shadow and the height of the vertical gnomon:

$$H = \operatorname{tg} \alpha \times A, \text{ where } H - \text{gnomon height, } \alpha - \text{height of the Sun, } A - \text{shadow length.}$$

In the labyrinth, whose axis coincides with the geographical meridian, the shortest midday shadow of the year is the diameter of the first arc from the center. The longest shadow at noon is the diameter of the outer arc. If the gnomon is destroyed, then its height and exact position can be calculated using the amendment x . For the stone labyrinth No. 1 (Fig. 3), located on Bolshoi Zayatsky Island (Solovetsky Archipelago, White Sea), the equation is the following:

$$\operatorname{tg} 48,47 (1 + x) = \operatorname{tg} 4,97 (5,5 + x)$$

$$\begin{aligned}
 1,13(1+x) &= 0,09(5,5+x) \\
 1,13 + 1,13x &= 0,5 + 0,09x \\
 1,13x - 0,09x &= 0,5 - 1,13 \\
 1,04x &= -0,63 \\
 x &= -0,63 / 1,04 \\
 x &= -0,61 \\
 1+x &= 1 - 0,61 = 0,39 \\
 5,5+x &= 5,5 - 0,61 = 4,89 \\
 1,13 \cdot 0,39 &= 0,09 \cdot 4,89 \\
 0,44 &= 0,44
 \end{aligned}$$

In the example above, the calculations showed an object with height of 0.44 m, its midday shadow during the year will be the same length as the labyrinth arcs: at the summer solstice – 0.39 m, in winter 1 month before and after the winter solstice – 4.89 m (in winter solstice at 65° latitude the midday shadow is 33.3 times as long as the object, and its fixation is the northern stone formation, which forms the "screen") (Paranina and Paranin, 2016).



Fig. 3 – Labyrinth on Bolshoi Zayatsky Island (Skvortsov, 1990).

The first researcher who suggested a connection between the structure of the labyrinth and the movement of the Sun was Herman Wirth (Kern, 2007). The first researcher who applied the gnomon was Dr. Sci. in Physics and Mathematics I. Israpilov, a researcher of the labyrinths of Dagestan (Israpilov, 1993). T. Hetagurov successfully applied this experience to the labyrinth in the village Makhchek (Fig. 4) (Hetagurov, 2004).

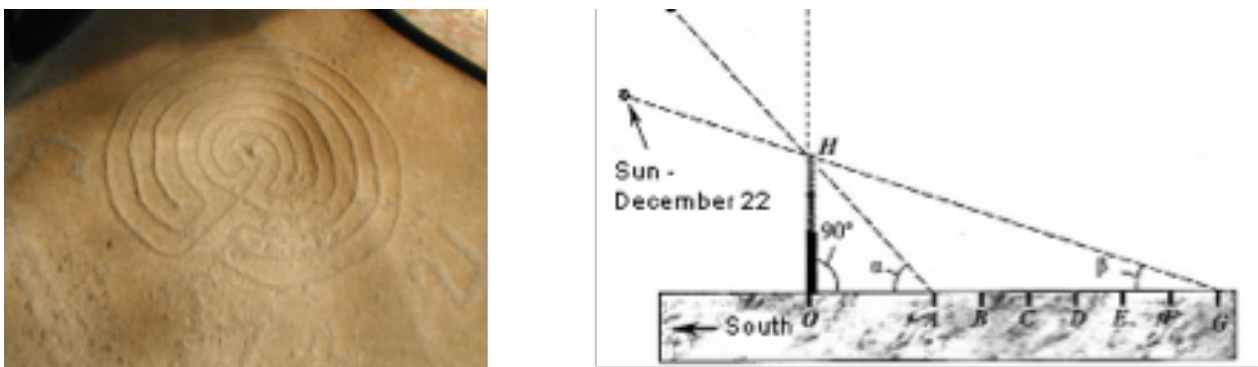


Fig. 4 – Makhchek labyrinth-gnomon (RNO-Alania) (Hetagurov, 2004)

In the 21st century, the calendar assignment of labyrinths in other regions of Europe has been defined as well, among them: the Mastishchensky labyrinth in the center of the Russian Plain, the labyrinths of Mogora in Galicia (Chekmenev, 2001; Goberna, 2012).

4 – Geography of labyrinths and global communications system

Labyrinths are found on all continents except Antarctica, most often they are found in Northern Europe, the largest density is found on Bolshoy Zayatsky Island in the White Sea – more than 30 in an area of 1.25 km². The sign of the labyrinth is revered throughout the world, and its meanings are multifaceted and universal as Time itself: birth, life, initiation, fertility, knowledge, prediction, purification, rebirth.

Decoding the labyrinth using the gnomon's shadow allows us to find the geographical latitude under which its classical seven-arc pattern could form – 55°50'N. (Fig. 5).



Fig. 5 – The latitude of the Arctic Circle is 66°33'N and Moscow 55°50'N

In the model of the Earth, created in ancient times by Eudoxus of Cnidus, the Arctic border lies at this latitude. Today Moscow is at this latitude. A specific feature of solar navigation conditions here is that sunrises and sunsets on the days of the solstices are located at horizon points 45° away from the meridian and form a regular oblique cross (Fig. 6), in the south to this latitude, changes in azimuths occur gradually, and in the north to it changes are very dynamic (Table 1) (Paranina and Paranin, 2016).

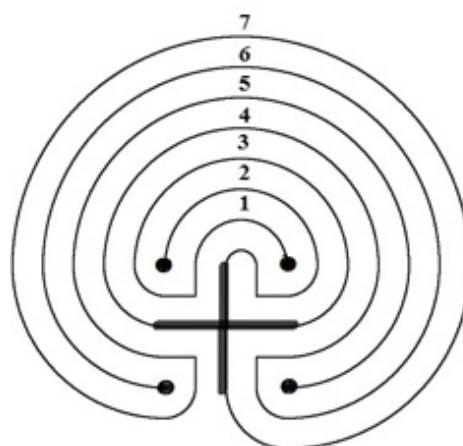


Fig. 6 – Seven-arc labyrinth

Today, many tourist routes are created on the basis of historical memory, which covers mainly the period of the Middle Ages. However, the archaeological finds of the most ancient handicrafts of flint and other minerals thousands of kilometers from natural deposits and the widespread presence of megalithic tools of astronomical navigation show that the history of many transcontinental paths goes back to the Stone Age. This will allow to saturate modern tourist projects with a large number of new aesthetically attractive, simple, but technically interesting, objects.

For example, latitude 55°50' is the geographical axis of the tourist and economic project "New Hanseatic Union". There are still preserved folk traditions of navigations by shadows (Stomma, 1981; Chenakal and Chenakal, 1985) and it is here that the main area of labyrinths on Earth is located – they are located on the places of traditional stops of the sea route. Since the most ancient of them date back to the Bronze Age and the Neolithic (on the White Sea), we can consider the deep tradition of trade and cultural relations of Northern Europe and other territories, including the Mediterranean region and the Caucasus, where the labyrinth can be found not only as a sign, but also as a folk calendar.

N (°)	22.12	22.06
66,5	180	0
65	160	20,03
60	142,86	37,40
50	128,41	51,82
40	121,29	58,74
30	117,39	62,74

Table 1– Azimuths of Sunrise

The region of distribution of labyrinths in the North of Europe can be important as an independent tourist object. Such a project may be based on reconstructions of the routes of ancient travels and presented in the context of the history of the voyage of Pytheas, for example, "Reach the last Thule". The travel plot can be presented as a search for an answer to a problematic question – is there an island called Thule/Fule? It should be noted that *thule* in different languages means "light", "fire" (Karelian), "tool" (English). It seems likely that in the description of the Pytheas route "Thule" is not the name of the island, but it denotes a network of navigation tools located on the banks along the entire northern route. These tools could be labyrinths, they are suitable for technology (using gnomon and light), age, frequency of occurrence and coverage of the region (from Scilly Isles in England to the Gulf of Finland and the Solovetsky archipelago in Russia). We would also like to add that the root *thule* is often found in the names of the objects included in the system of ancient waterways between the Baltic Sea and the Arctic Ocean (Lake Tulomyarvi, the Tulemaoki River, Tuloma, Tulgoda and other water bodies of Karelia, full-flowing during the summer season due to the humid climate, crystalline rocks and lakes of the territory).

5 – Reconstruction of the evolution of navigation technology in the geographical space-time

The reconstruction of navigation technologies is based on studies of objects of different ages and technological levels, located in close proximity or a single space. Cultural and technological multi-layers of such complexes were considered as a result of on-site development (autochthonous process). The reconstruction represents a sequence of three basic steps.

The first navigation tools could be sustainable landscape elements, for example: mountains and rivers. Observations of the rising and setting of astronomical objects make it possible to create a local navigation network, and parts of the surrounding territory receive names in the main geographic areas: East, West, North, South (Paranin, 1990).

The next step could be the creation of artificial instruments that fix astronomically significant points on the horizon (on the principle of "aiming-sight"). In imitation of nature and for reasons of sustainability, these objects were large: megaliths, bulk forms of relief, and forms of artificial clearance (the principle "to remove excess"). During this period, it was possible to make sure that space is also mobile, since points of astronomical climax are slowly shifting (Paranina, 2017).

The third step is the use of the gnomon's shadow made the astronomical tool portable, lightweight, and mobile. The simplest examples are: a spear and a rope, a staff and a belt, a human figure and the length of a foot. But the main advantage of the gnomon technology is the definition of geographic latitude, which provides for the construction of regional and global navigation networks (Paranina and Paranin, 2018).

Let's compare two models – the development of navigation technologies and the main stages of anthropogenesis. The landscape stage of development of navigation technologies can be correlated with representatives of *Homo habilis*. This will make it possible to distinguish between the levels of development of the earliest man, *the Australopithecus* (who is also characterized by erectness) and modern monkeys that create tools that are identical to *the choppers* of Olduvai archeological culture (artificial plates made of stone for digging roots, breaking nuts, etc.).

Fixation of astronomically significant directions resistant to destruction and movement of material requires considerable effort – this problem corresponds to the growth and posture of *Homo erectus*. Archaeological evidence of ubiquitous distribution, the possibility of movement on rafts along the coast, the development of anatomical features associated with the physical development of the aquatic environment (the structure of the nasopharynx) – have a direct link to navigation.

The development of reverse sighting technologies in terms of the amount of new knowledge can be compared with an "information explosion", so the processing by an *ancient human* – *Neanderthal* and late representatives of *Homo erectus* of an increased volume of navigational information well explains another leap in the development of abstract thinking that formed a man of the modern type *H. sapiens*. Existing archaeological evidence are sufficient to justify the value of navigation at this stage: finds of perfect calendars, the creation of which must be preceded by a long evolution of navigation technologies; evidence of the development of commodity exchange, which is due to the sufficient reliability of regional communication systems; signs of shamanism, as a manifestation of specialization in the performance of information function in conditions of significant accumulation of knowledge.

6 – Solar signs as the basis of modern sign systems

The sun gives life to human, and the shadow of the gnomon gives knowledge (compass, clock, calendar). Therefore, the sun signs in all cultures were the most revered. We will consider the shadow graph for one year (Fig. 7 left) It is shaped as a lotus flower. The six main directions correspond to the days of the solstices and equinoxes. The whole area covered with a shadow resembles a two-sided, two-horned ax of the gods of light – golden Labrys from the island of Crete (Fig. 7 right).

The graph of the shadow for one day looks like a fish tail, wings, horns (Fig. 7 center). A survey of ancient art shows that these are attributes of the solar gods. By many examples, you can make sure that the shadow graphics are the basis of the most revered signs and mythological images. The main directions of space-time, easily obtained anywhere in the geographic space (N, S, E, W), became the most sacred signs (swastika and straight cross), and the gnomon-

calendar became the first measurement system that served as a universal basis for creating subsequent sign systems (weights, money supply, length strings of musical instruments, etc.). Not by chance, in the ancient world it was believed that the gods gave people music, language and crafts, but they also measured life, i.e. deprived a person of the illusions of eternity ("to measure is to kill").

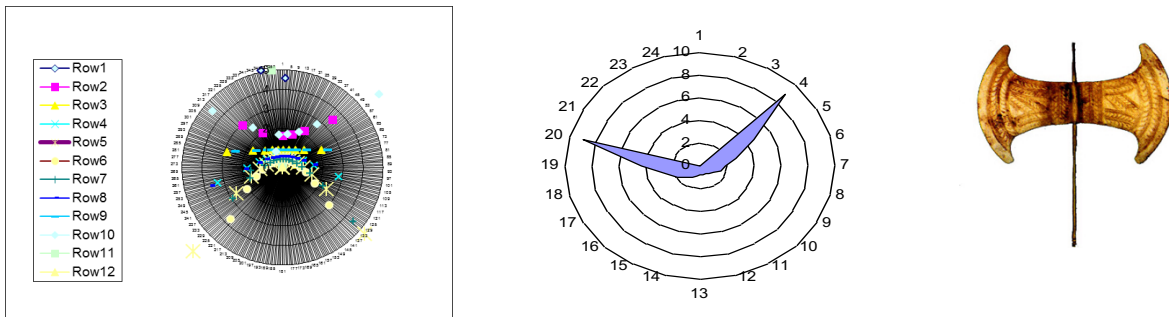


Fig. 7 – Graphs of gnomon shadows: left: for the year; Center: for the day; right: labrys.

Different forms of the gnomon (scepter, warder and staff) are endowed with deep cosmic meaning, since the navigation tools for the Sun became the basis of astronomy and geodesy, provided a rational development and structuring of geographical space.

The operation of astronomical tools reflects the global invariant of Earth-Sun relations: the axial rotation of the planet in a stream of sunlight, the annual movement around the Sun and the relative constancy of the tilt of the earth's axis to the plane of the ecliptic. Regional specificity is associated with differences in the mode of lighting in the climatic belts divided by the tropics and the polar circles. Local specificity is connected with geographical latitude, height above sea level, horizon shape, earth axis inclination, phenological and economic cycle, as well as technology level and calendar tradition at the moment of creation of a tool, the construction materials resources and personal qualities of the master have an impact.

It is obvious that the measurement of vital navigation parameters could be the basis of new signs and sign systems, which were not the case with human predecessors. The formation of a new system of concepts relating to the space-time characteristics of the surrounding reality inevitably influenced glottogenesis (the development of a simple and universal – the first language) and could be preserved at the heart of the languages of the so-called Nostratic group. At the stage of near-horizon measurements, phonetics was mainly formed; on the basis of shadow fixation, graphics, recording along the shadow from west to east (from left to right).

Genetic affinity and psycho-physiological similarity of people, regardless of race and nationality, is determined by belonging to the same biological species. The identity of modern and ancient representatives of *Homo sapiens* is confirmed by the results of anthropological and cultural studies: the rational basis of primitive art in the ancient point and spiral calendars of the Paleolithic (Frolov, 1992), solar labyrinths and neolithic petroglyphs that function as the limbus of solar gnomon calendars (Paranina and Paranin, 2017).

Understanding the genetic relationship of all cultures is important not only for scientific models and the development of all types of social communications (including during travels), but primarily for everyday life. The universal language and the life-affirming symbolism of solar signs can help to restore trust between people who are the pinnacle of evolution on the Earth and the embodiment of solar energy and information.

7 – Navigation technologies and development of abstract thinking

In this section, an attempt is made to separate the main factors of the evolution of navigation technologies (culture) and the human biological nature. But, even a brief listing of them, convincingly shows that the processes of “sapientation” (the development of abstract thinking) and the culture genesis (development of technologies) could take place only simultaneously. It is more correct to define this single process by the concept of “co-evolution”; its result has become a modern-type human (*Homo sapiens*).

Anthropogenesis and “Sapientation”

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.

1. Astronomical landmarks are more reliable than objects in a dynamic landscape (because the super-system is more inert).
2. Light is the most powerful signal in geographic space.
3. Regular repetition of the light signal, with food reinforcement, shapes a conditioned reflex.
4. The orientation reflex is paramount for adaptation.
5. Language, as a model of the surrounding world and means of communication, begins with the designation of a place and time.
6. Position in space-time is unique for each object and can be the basis of its designation.
7. In anthropogenic, the average temperatures on Earth were negative, which increased the value of astronomical navigation.
8. About 2.62 million years ago human led nomadic lifestyle and accumulated navigation skills.
9. Astronomical navigation is most in demand at sea, where there are no other landmarks.
10. Solar navigation has no competition in polar days and white nights.
11. The regions of the Arctic are the most dynamic in the lighting regime (56°N – the Arctic boundary according to Eudoxus Cnidus).

Culture genesis

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.

1. Measurement forms a system of notation.
2. On the petroglyphs of the Stone and Bronze Ages, simple geometric signs precede more complex artistic images.
3. The shadow graphics of the gnomon of sundial calendars correspond to a matrix of modern signs and sign systems.
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).
5. Archaic measures of weight, money supply and nominal retain connection with the solar calendar system.

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.
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.

It is necessary to emphasize once again that the development of programs of navigation behavior and navigation technologies takes place under the strict control of natural selection (the adapted one survives). However, recording of navigation information on genetic "medium" is possible only as long as adverse environmental factors affect the population directly. Unlike other species, for the representatives of the *Homo* genus a diverse level of technological activity has become a new level of protection. The era of "recording" the experience of adaptation in culture and the growing dependence of human on the level of technology, including navigation technology, has begun. The defenselessness of the organism of a modern person before the forces of nature is well known to any city dweller, surrounded by the walls of his home and office – many abilities are forgotten or lost (for example, the ability to endure temporary cold and hunger). Tourism, especially ecological and sports, awakens primordial immunity and biological adaptations, contributes to physical recovery and increase stress-resistance (Conz, 2019; Gazzola et al., 2019).

World without borders: era of tourism

Background: Millions of years of development without borders. According to archeology and anthropology, *Homo erectus* was the most mobile of our ancestors – he used simple means of water transportation and settled the entire planet.

The human of the modern type appeared 60 thousand years ago. We can say that "he is us in the past." But he was free and followed the laws of the cosmic order. This worldview has been preserved in archaic cultures that preserve the experience gained in the Stone Age. In many traditional cultures, the cosmic gods (the Sun, the Moon, etc.) are considered as the ancestors of human, and the main holidays are celebrated on the days of the solstices and equinoxes. Cosmism of thinking is well preserved in places where the technogenic urban culture has not penetrated.

New time: the system of boundaries and limited thinking. Ancient navigation tools were located along the roads and provided communications. In historical time they allowed not only to measure, but also to divide the world: marks of ancient ways turned into marks of modern borders. Relationships between nations, between town and country, human and nature were broken. Breaking bonds reduces the stability of the system, so this state of civilization can be described as a systemic crisis. Today it can be seen that the efforts of scientists, philosophers and teachers are directed towards the formation of systemic thinking (Hoseini et al., 2019). But, of course, life practice is of paramount importance (Dominici, 2012; Gazzola et al., 2018; Mella and Gazzola, 2018).

In the context of a retrospective analysis, tourism can be considered as a way to restore connections in the global socio-natural system. It should be noted that tourist activity covers not only the connection of modern spaces and cultures (including traditional and man-made cultures, which, as a rule, have little contact), it also establishes contact between cultures from different eras, which is also important.

Restoring connections increases the stability of the system, so recovery processes (including new navigation and communication technologies) can be viewed as manifestations of immunity or self-regulation of the "Planet Earth" system. Thus, freedom of movement and personal choice remains a condition for the sustainable development of society.

8 – Conclusions: navigation concept of the information modeling of the world as a tool for geo-systems analysis

In the authors' studies, stone labyrinths are considered as sundials and calendars – records of a shadow of a gnomon. This fully confirmed the quotation of G. Galileo (Drake, 1957, p. 237-8):

"Philosophy [i.e. natural philosophy] is written in this grand book – I mean the Universe – which stands continually open to our gaze, but it cannot be understood unless one first learns to comprehend the language and interpret the characters in which it is written. It is written in the language of mathematics, and its characters are triangles, circles, and other geometrical figures, without which it is humanly impossible to understand a single word of it; without these, one is wandering around in a dark labyrinth." (Galileo, 1623).

The results of geo-system analysis of geography, planigraphy and ornamentation of various prehistoric navigation objects, as well as associated historical and ethnographic materials, are summarized in the original navigation concept of information modeling of the world, which can serve as an effective theoretical tool for further interdisciplinary research.

The basic units of the information model of the world (IMW) reveal different aspects and levels of modeling of space-time: the first basic level – the navigation, creates a spatial and conceptual framework of IMW; second modeling level – reflects semiotic, linguistic, cartographic, toponymic, mythological units that encode, duplicate and replicate vital navigational information; and the crown of the model – a tradition that serves as the selection and storage of proven information to maintain the continuity of Life, including the Renaissance (Fig. 8). The priority of navigation in geographic space-time, as the most important adaptation, and the cumulative work of many generations explain the sacral status of navigational objects – astronomical tools and knowledge marks (Paranina and Paranin, 2016).

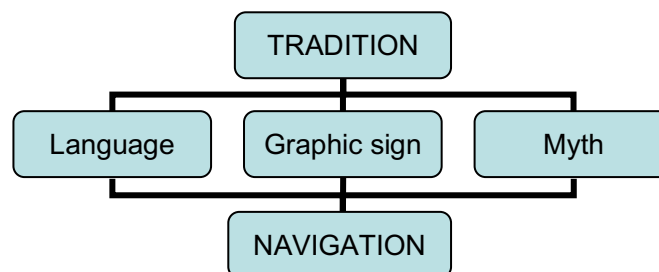


Fig. 8 – Structure of the information model of the world (IMW) (Paranina and Paranin, 2016).

In a generalized view, the navigation IMW focuses on the open nature of the self-developing intelligence-culture system: at input – solar energy (climate and landscape productivity) and information (lighting mode), at output – measurement traditions and symbols (navigation signs, knowledge and sign systems). In accordance with the development of navigation technologies, in the semiotic block of IMW, two stages can be distinguished – the formation of phonetic and graphic signs. At the first stage, the notions yes / no, sunrise / sunset, east / west could have been formed. At the second stage, shadow graphics were obtained; the middle of the day was measured – noon and other hours – parts of the day. The sides of the horizon, determined by the Sun, became the basis of the celestial sphere. Shadow graphics became the basis of a symbolic and figurative record of events. All elements of the navigation model are consistent with well-known scientific facts and cultural traditions: 1. sky maps appeared earlier than earth surface maps; 2. solar signs preceded the letters, and on the six rays of the calendar, which marks the days of the equinoxes and solstices, you can build the signs of the alphabet (Cyrillic, Latin

and Greek); 3. letters have a numeric equivalent (the tradition of alphabetic numbers and time is preserved, for example, LXXII – 72, XXI – 21), etc.

The navigation concept of IMW proves the astronomical nature of the sign and makes it possible to give functional definitions to the basic concepts of semiotics: the graph is the recording of the light trajectory along the shadow (the recording of the natural process); the symbol is the equivalent of the shadow graphics; image – artistic interpretation of the graphics of the shadow (natural process): the myth – the plot-shaped transfer of the natural process (or technological, for example: in the technology of using the Egyptian triangle, 3-4-5 aspect ratios convey the relationships of the characters of the cosmogonic myth Osiris-Isis-Horus / Time).

With all the fundamental differences, the new approach has a point of contact with the classification of signs adopted in classical semiotics: astronomical signs, reproduced by navigation tools, is an example of signs-indexes of Charles Pearce associated with the space-time characteristic of an event (Pearce, 1965-1967). This allows us to use the navigation concept of IMW today for the development of semiotic research on a systemic basis, revealing the multifaceted human connections with the surrounding landscape-geographical and outer space. In addition, a review of publications shows that the new concept may also be useful for optimizing models developed today in classical philosophy and cybernetics (Caputo et al., 2019; Vahidi et al., 2019).

Geo-systemic studies provide not only the analysis of a human's physical exploration of geographic space and time, but the creation of three-dimensional models in which the links of nature and culture are viewed not as a mirror image, but as a multi-level, vital practice-oriented process.

Thus, retrospective analysis reveals the systemically important role of navigation and all its forms. On this basis, modern tourism can be considered as a factor of sustainable development – on of the manifestations of self-regulation of the global socio-natural system, or a form of "immunity" of modern civilization, aimed at overcoming artificial borders (Angeloni, 2013.)

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