



Astroarchaeology research methods

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Abstract

Astroarchaeology is one of the most difficult scientific directions in archeoastronomy, because in addition to the time continuum of astronomical situations in the sky in certain historical times, it is necessary to take into account factors of local character – the horizon line, the estimated time of day, the allegedological and religious and religious concepts of the corresponding historical time on the archaeological site. To help the archeologists, there are astronomical programs that astroarchaeology methods, but for the competitive use of them need more astroarcheological courses, perhaps online learning.

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Astroarchaeology is one of the directions of archaeoastronomy in the field of historical and cultural research, which arose as a result of the need to explain some astronomical phenomena on archaeological monuments. Along with astroarchaeology, archaeoastronomy is possible to distinguish astronomical research in the areas of: astrophotographie (according to some astronomical elements in petroglyphs, drawings on ceramics, in the writing of ancient signs and characters); astroecology (in astronomical signs in the ornamentation of clothing, etc.); gastrototonic (in astronomical elements in the names of toponymic objects); astrobiology (in astronomical signs in the ancient myths); astrologyzone (in astronomical elements in the ancient religious systems).

Any archaeoastronomical research requires proper knowledge of the information about the change in the relative position of the astronomical coordinates over time. In our time, a great help for such research are astronomical programs and archaeoastronomical techniques. But for competent use of them requires an understanding of the application of astronomical knowledge to specific areas of archaeoastronomical research-astroarcheology, astropictography, astroethnography, astromyphology, etc.

Astroarchaeology in this sense is the most complex and multicomponent, but, as a result of competent research, some dates of events corresponding to the time continuum of the investigated archaeological monument can be specified.

The first archaeological object held astroarchaeology research was the Stonehenge in England [1].

Hockins and white in his book gave a detailed description of the astronomical calculations of sunrises-sunsets and moon in ancient times, with reference to their objects on the monument.

Around the same time V. E. Larichev, during the excavations of Achinsk Parking (1972) [2] and the settlement of Malaya Syya (1976-1979). [3] in Khakassia, he opened samples of Paleolithic art over 30 thousand years old, which determined a new area of research for Vitaly Epifanovich - cosmogony and cosmology in the worldview of ancient society as the beginning of protoscience, which was shown by the examples of following the Solar-Lunar cycles left by ancient people in small plastic, for example, on bone plates. Vitaly Epifanovs, as no one was able to recognize in the ancient samples of art captured by the ancient people, the cycles of the Sun and the moon, and the methods of calculation of the ancient calendars.

Later, in the Kurgan region (Western Siberia) M. p. Vokhmentsev and T. M. Potemkina Savin was opened – a monument with an interesting two-circle layout (1994). The astronomical research carried out by the astronomer at Sternberg astronomical Institute of V. A. Yurevich and archaeologist of the RAS T. M. Potemkina, allowed to open a way of keeping a calendar by the ancient local people in the sunrises the sunsets and the moon. The study was published in the Handbook, contains a table of latitudes and years of ad and BC, allowing archaeologists to engage astroarchaeology research related to sunrise-sunset and moon [4].

At about the same time, L. S. Marsadolov opened a sanctuary on the Charming mountain (1998) [5], where ancient people recorded sunrises and sunsets, and a whole epic of research of megalithic monuments of Altai, under the leadership of Leonid Sergeyeovich and astronomer of the Pulkovo Observatory V. L. Gorshkov, organized by the state Hermitage.

It should be noted that the participation of qualified astronomers in astroarcheological research helped to build a line of research and led to satisfactory results Dating monuments.

But not always astronomers can accompany archaeological research and archaeologists, for the most part, have to build their own theoretical assumptions, more than less successful or unsuccessful. Therefore, given the widespread interest of archaeologists in astronomical subjects in the study of archaeological objects, it is desirable to conduct astroarcheological workshops and, best of all, in the cardinal seasons: the spring and autumn equinox, summer and winter solstice. When an archaeologist himself observes the sunrise-sunset And



moon, and compares them with theoretical calculations, he begins to feel the situation and understand the real picture of the shift of modern indicators relative to the ancient.

According to this method, T. M. Potemkina and V. A. Yurevich can calculate in advance the displacement of the points of sunrise, sunset and moon for a certain monument, knowing its geographical breadth and the estimated time of construction of the archaeological monument.

But the peculiarity of astroarcheological research is not just in the identification of ancient astronomical trends in astronomical programs or tabular values in the methodology that are given for the mathematical horizon line, and the ability of the scientist to relate these theoretical values with real local characteristics. It is necessary to take into account the shift of astronomical directions depending on the local horizon line, which can be found only in field studies at the appropriate time of the year. Unfortunately, this condition is not met by all researchers. Thoughtless adherence to table values in astroarcheological methods, where, for the most part, are only extreme values of the azimuths of sunrise-sunset in the winter and summer solstice in various ancient times, sometimes lead to such statements as the shift of the points of sunrise-sunset in the equinoxes, such as the shift in the solstice. Although, if you use the formula [6] given in the methodology, substituting the value of the sun's declination in the equinox in the formula, always equal to zero, you can make sure that the azimuth of sunrise will always be exactly in the East, and, accordingly, the approach exactly in the West, with small shifts depending on the parallax and the height of the horizon line, that for a particular study area there is a constant at any time, both in ancient and in modern. Simply put, both ancient and modern points of sunrise and sunset coincide on a particular investigated monument. An exception may be only cases where the area has undergone geographical displacement as a result of earthquakes or if the geographical pole has shifted, but such a global case can be proved only on the basis of the same angular displacement for all simultaneously erected ancient monuments in different parts of the globe. Also, mistakes are made by those researchers who describe the shift of the points of sunrise and sunset of a celestial object in meters, although, unambiguously, if we are dealing with the description of astronomical directions, we must specify the angular values and only then can we make a clarification in meters for a particular monument. Some scientists make mistakes by conducting research related to the rising of stars, showing the time of the rising of the star from the astronomical program over the mathematical horizon, without considering that the sky at the described moment can be twilight, and some researchers even day when in reality the stars in the sky is not visible.

We briefly reviewed the situation with astroarchaeology studies in *Prioritetnyh astronomy examines the astronomical when the direction of the sunrise-go suns and stars.*

But go further, deeper and wider. On archaeological monuments, in addition to objects of the near-horizon recording of sunrise-sunset of stars and stars, there are other astronomical elements that can be explained by the fact that ancient people watched not only the Sun, Moon, and stars at their sunrises-sunset over the horizon, but also for the near-polar picture of the sky, and the Poles of astronomical systems. In these cases, it is necessary to use a common archaeoastronomical method that considers the displacement of all four polar systems of astronomical coordinates relative to each other over time: Horizontal, Equatorial, Ecliptic, galactic. If the study of the monument do not use knowledge of these interrelated polar astronomical systems, some of the objects or their configuration may be left without explanation, that, in General, makes astroarchaeology flawed study.

For example, in Stonehenge, based on the study only sunrises-sunsets and the moon, it is difficult to see the value of stones 92 and 94, different from other stones on the monument in that they are dug ditches. Only one more object standing out on the monument is dug in a moat-the Altar stone, which is the basis for observations of sunrise in the summer Solstice [7]. But when you consider the fact that the first phase of Stonehenge was built in a time when people observed the sky in the Ecliptic coordinate system with the Pole of the Ecliptic of that system near the "head" of the constellation the Dragon, and if you impose a map of the celestial Pole of the Ecliptic at the center of the monument, it appears that the stone 92 detects the direction of the star alpha URSA major, when the sky pole of the Ecliptic during the night is a line of Nadir in the days



from winter to summer solstice, and the stone 94 fixes the direction of the same star, when the pole of the Ecliptic during the night is a line of Zenith in the days from the summer to the winter solstice. That is, the star alpha of the great bear helped to fix the position of the pole of the Ecliptic in the constellation Dragon.

The unsuccessful experience of astroarcheological research in polar coordinates is marked by the fact that some researchers impose on the plans of archaeological monuments modern astronomical maps made in Equatorial polar coordinates, not considering the fact that the pole of the world of Equatorial coordinates shifts over time, as a result of which the near-polar picture of the ancient sky differs from the modern one and then the conclusions of the researchers are not legitimate.

Positive experience astroarchaeology research were presented by Bystrushkin based on his research of the ancient settlement of Arkaim and Sintashta complex, with the hillfort and burial mounds (2003) [8]. Astronomical research was conducted competently, with the correct understanding of the shift of astronomical coordinates over time relative to each other and the identification of the Polar star alpha Dragon, standing in the Pole of the World in the early III Millennium BC. Questions arise only about the proposal K. K. Bystrushkin names of ancient coordinates. He proposes to call the Ecliptic coordinate system the Eternal zodiac, based on the fact that the sphere of fixed stars changes little over time, and the Equatorial coordinate system shifts noticeably relative to this fixed sphere of stars [9]. But here there is a contradiction in the sense that the Equatorial coordinate system, despite the mobility relative to the Pole of the Ecliptic, shows the Eternal calendar, based on four cardinal points of transition in the seasonal calendar-the spring and autumn equinox, winter and summer solstice, and in this sense, the Equatorial coordinate system is eternal, because the passage of the Sun declination equal to zero, always give the equinox in early spring or autumn, and the passage of the Sun declination equal to angle of inclination of the Ecliptic to the Equator will always give the situation of the solstice, when the Sun "turned" on winter or in the summer. And this happens no matter in what position is the pole of the World relative to the fixed sphere of stars and the Pole of the Ecliptic. Therefore, if we do not consider the proposed C. By Bystrushkin new names are astronomical polar coordinates, we can assume that their astroarchaeology study, the author mathematically holds true, although some of his conclusions and disagree. I wonder what K. K. Bystrushkin is on the monument Sintashta and the Galactic nodes, in place of the sacrificial complexes [10], which may indicate a good knowledge of the sky by our ancestors.

In 2003, the author of this article, not knowing about the research Of T. M. Potemkina and V. A. Yurevich, and also, K. K. Bystrushkina, wrote a methodology of astronomical research for archaeological sites based on the philosophical study of ancient knowledge on the example of archaeological sites and proposed to use the generally accepted names in astronomy polar astronomical coordinates, in order to avoid confusion between researchers of ancient astronomy in different countries [11]. And, at the same time, identified the main features of the four basic systems of polar coordinates, manifested in the ancient worldviews of different peoples. For example, the ancient Ecliptic coordinate system was often symbolized by a Snake and a Dragon, obviously, by the belonging of the Ecliptic Pole to the dragon constellation, the symbol of Which is very ancient, passing through almost all the mythology of the population of the Northern hemisphere of the Earth, which indicates the religious and ideological proximity of many peoples in ancient times. Also, the symbol of the Ecliptic coordinate system of some southern Nations is the Turtle, obviously, because the pattern on the turtle shell resembles the zone of division of stars on the constellation in the near-polar sky picture. At the same time, the ancient Indians, the Serpent floats on a turtle on the eternal world waters [12], which, in principle, is observed from the earth, because the Ecliptic pole in the constellation Dragon for the earth observer always rotates around the Pole of the World, wherever among the stars was the pole of the World. There are other signs of these two poles, which are close to the near-polar picture of the sky. For example, two world Trees in the description of the picture of Paradise in the old Testament [13]: one - the Tree of knowledge of good and evil with apples, which protects the Snakes (the pole of the Ecliptic), the other - the Tree of Life, where the ideal deity (the pole of the World in the center of rotation of the sky). Or another example: two World Mountain in Hindu mythology [14], one of which is a Measure of where they live the ideal sun gods, the Asuras, headed by Indra (the celestial pole), the other mountain of Mandara, in which dwells the



Serpent and the demigods, the Devas (the pole of the Ecliptic), which has both positive and negative characteristics that, in General, characterizes the Ecliptic coordinate system with its rising and setting luminaries, the stars, the constellations on the Ecliptic.

Knowing these basic ancient signs of astronomical polar coordinate systems, it is possible to find on archaeological monuments the totality of elements related to a particular system.

For example, on the mound Revova 3, located in Odessa region and studied by archaeologists S. V. Ivanova and T. M. Potemkina, the mound is laid out in the form of a turtle that saw the first researcher of this monument, by S. V. Ivanov. But in the West side of the mound was found a hole from the post, similar to the fact that there was a pillar, perhaps a gnomon [15]. Then it becomes clear that the mound-turtle symbolized the Ecliptic coordinate system for observing the sunrises-sunsets and moon, which Was proved By T. M. Potemkina, because it is confirmed prioritetnyh fixing these astronomical directions. And the installed pole could be a gnomon, which determined the time in the day: in the afternoon-by the sun's shadow from the column, at night-by the position of the stars relative to the column when they rotate around the Pole of the World, which corresponds to the Equatorial polar coordinate system [16].

Approximately in the same sense it is necessary to consider the two-circle barrow Savin, first investigated By M. Vokhmentsev, then T. M. Potemkina and V. A. Yurevich, where on the Eastern circle researchers recorded astronomical directions on the near-horizon sighting of sunrises-sunsets and moon [17], which relates the appointment of the Eastern circle to the Ecliptic polar coordinate system, and on the Western circle – traces of a pillar similar to a gnomon, in the Northern part of the circle, which relates the appointment of the Western circle to the Equatorial polar coordinate system.

From the above I would like to make a conclusion that archaeologists must take courses Prioritetnyh and Polar astroarchaeology, reinforced with practical exercises that can be done both online courses and field seminars.

Note

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