Session 7

https://doi.org/10.1017/S174392132100017X Published online by Cambridge University Press

Education and Heritage in the era of Big Data in Astronomy
Proceedings IAU Symposium No. 367, 2020
R. M. Ros, B. Garcia, S. R. Gullberg, J. Moldon & P. Rojo, eds.
doi:10.1017/S174392132100017X

Archaeoastronomy in the Big Data Age: Origin and Peculiarities of Obtaining Data on Objects and Artifacts

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Abstract. The impressive transition from an era of scientific data scarcity to an era of overproduction has become particularly noticeable in archaeoastronomy. The collection of astronomical information about prehistoric societies allows the accumulation of global data on: – the oldest traces of astronomical activity on Earth, emotional and rational display of celestial phenomena in astronomical folklore, "folk astronomy" and timekeeping, in fine arts and architecture, in everyday life; – the most ancient applied "astronomy" – counting the time by lunar phases, accumulation and storage of ancient databases in drawings and pictographic compositions in caves and artificially constructed objects; – "horizon" astronomy as an initial form of observational cult astronomy, preserved only in characteristic material monuments (the oldest cult observatories) with indisputable astronomical orientations. The report shows the importance of collecting the maximum number of artifacts and monuments from prehistory associated with the early emergence of interest in celestial phenomena. Spiritual, emotional and rational (including practical) needs that have aroused interest in Heaven are discussed. The huge variety of activities in realizing the regularity (cyclicity) of celestial phenomena as a stimulus for their use for orientation in space and time is shown.

Keywords. Sociology of Astronomy, History and philosophy of astronomy

1. Introduction

Archaeoastronomy (AA) is a scientific discipline that has a methodological connection with many sciences, but mostly with natural sciences. It unites the efforts of astronomers, archaeologists, architects, surveyors, geologists, epigraphists, ethnographers, mathematicians. AA is part of an interdisciplinary scientific approach that provides solutions to various problems related to the study of astronomical knowledge of ancient societies. An artifact in AA is a man-made object that has certain physical characteristics, astronomical orientations, and signs containing symbolic astronomical information; bearer of socio-cultural information, means of communication and is a subject of prehistoric culture in three main areas of its existence: material culture, spiritual culture, human relationships.

2. Archaeoastronomy as a science

AA is a branch of science that is formed in the contact zone between the humanitarian and natural sciences. The subject of its research are monuments from the ancient illiterate epoch of Mankind, studied by the methods of archeology, astronomy and other basic or applied sciences. The aim of the research is to clearly restore the astronomical

knowledge and culture of ancient societies, taking into account the evolutionary factors in the surrounding natural environment. Astronomical knowledge in antiquity built any concept of nature, encouraged the creation of myths, presupposed relationships between mythological characters and events. What does archaeoastronomy study ? – (1) Objects that show a simple interest in the sky, celestial objects and phenomena and their cyclical appearance: decorations of domestic ceramics, jewelry, tools; (2) Objects that testify to astronomical knowledge and skills and their practical use: megalithic and rock – cut monuments, ancient sanctuaries, masonry and rock tombs, astronomical images and calendar ornaments, ancient calendars and calendar records; (3) Ethnoastronomy: myths, legends.

3. Digitization of archaeoastronomy

A problem with the documentation of archaeoastronomical monuments requires the appropriate levels of accuracy and adequacy of the methods. This suggests that researchers scan ancient megalithic and rock-cut monuments with an astronomical orientation, obtaining accurate 3D images with high resolution. The creation of digital libraries containing hundreds of archaeoastronomical artifacts will require the creation of specialized digital laboratories. They will provide experimental astronomical azimuths of orientation, connection with sunrises, sunsets and culminations of bright celestial bodies, GIS modeling, traceological methods and mathematical statistics for studying the archaeoastronomic culture of ancient societies. The finished 3D model of the archaeoastronomical object can become part of a collection, documented in such a way that it can then be shown to all interested parties without violating the physical original. The very possibility of creating and transmitting electronic copies of archaeoastronomical objects will be a huge step towards worldwide collective research. The digital model of the stone astronomical instrument can be emailed to colleagues for joint research or consultation (Beale & Reilly 2014). One of the areas of application of 3D reconstruction will be the study of petroglyphs and monochrome paintings with astronomical and calendar content. With the help of photogrammetry and 3D scanning it will be possible to obtain a digitally scaled copy of the drawings' surface with a high resolution. Information on the technology of making and morphology of petroglyphs and monochrome paintings can be used for their relative dating. It will be possible to automatically classify traces of different types of tools on the surface of petroglyphs, as well as the evolution of the trace during the aging of the rock substrate (Hurcombe 2014). With the help of a special program it will be possible to automatically restore the 3D relief of the drawing, made with a stone or metal tool, with fingers or a brush.

4. Conclusion

The main goal of creating a national, regional and global digital database of 3D models of archaeoastronomical objects is to move to solving research problems using volumetric models with high resolution (Forte & Campana 2017). Researchers will be able to analyze the shape and orientation of stone astronomical instruments, comparing them on a number of metric parameters, basic characteristics and landscape relationships. The virtual three-dimensional model created during the excavations will allow to record and save all the information about the spatial characteristics of the studied archaeoastronomical object much more accurately than text, depictions, exact drawings and photographs. Laser scanning, structured lighting technology and photogrammetry can be used in field 3D fixation. Accurate measurements allow high-level research and, in combination with trasological research, to restore the function of the archaeoastronomical artifact. Comparing the shape and orientation of megalithic and rock-cut monuments can provide

https://doi.org/10.1017/S174392132100017X Published online by Cambridge University Press

researchers with information on the most likely migration routes and possible cultural interactions in the field of observational technologies of ancient people.

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