

Research Article

Archaeological Ceramics as an Object of Study and Restoration

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Abstract

The article considers the problems of preserving the information potential of archaeological ceramics during their restoration. A review of sources containing fundamental information on achievements in the field of archaeological ceramics research and the results obtained with their help, which are of interest to researchers from different fields of knowledge, is made. A retrospective of the study of ancient ceramics as a historical source clearly demonstrated the possibilities of revealing the information potential inherent in the products of ancient pottery production depending on the formulation of new tasks and the use of instrumental research methods of related disciplines. Not all archaeological ceramics extracted from an excavation are well preserved, and therefore need restoration. Over the course of its existence, restoration has developed its own methods for saving destroyed objects, giving them a "second birth". However, not all of them are safe. Some modern restoration methods lead to a change in the physicochemical properties of ancient artifacts and introduce new materials into their structure. A change in the authenticity of ancient objects leads to a distortion of the information contained in them. This is a big problem for both restoration and other sciences, because ceramics is considered one of the most durable materials and therefore much less attention is paid to new methods of its restoration than to other materials. Awareness of the specifics of archaeological objects made of ceramics and the role they played in primitive society and continue to play in the modern world should contribute to the development of a new strategy for the preservation of this type of cultural heritage using new restoration approaches and technologies.

Keywords

Archaeological Ceramics, Research, Conservation, Properties, Restoration, Information

1. Introduction

The most prevalent type of archaeological heritage is ceramics. Objects made from this first artificially created material by man have been present in all spheres of human life since ancient times. Ceramic products are a building and finishing material (brick - fired and unfired, tiles, ceramic tiles...), all types of kitchen and decorative utensils, storage containers, toys, small architectural forms (sculpture), decorations and

material for writing (cuneiform tablets of Sumer) and others. The widespread use of ceramics throughout the entire period of human existence makes products made from it a truly invaluable source of information. The specificity of archaeological objects is that, unlike written sources, they were not created specifically as a means of storing and transmitting information, but were only a result, condition or companion of some ancient

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processes and phenomena. From the standpoint of historical knowledge, archaeological sources are, as it were, encoded in the form of material objects. Therefore, archaeological ceramics is a subject of study for various specialists: ceramists, art historians, cultural scientists, designers, sociologists, ethnographers, economists, archaeologists, museum experts, builders, paleographers, nutritionists, restorers.

Ceramics, despite the durability attributed to them, are subject to destruction over time, just like other materials, and, consequently, to changes in their material structure [1]. The preservation of archaeological heritage and its restoration are regulated by many international conventions and legislative acts of different countries. However, each type of monument requires a special approach and methods. In the restoration of archaeological ceramics, there is a whole range of unresolved problems, such as, for example, the validity of removing organic residues and other traces of use on ancient dishes or traces of manufacturing defects (cracks, voids), which are not regulated by any documents. Therefore, restorers, without thinking, erase them from the artifact. Restoration can also make its own changes to the structure of the ceramic material and change its properties. For example, strengthening a fragile, weakly fired shard of a product that is poorly preserved with an impregnating polymer composition can significantly increase its physical and mechanical properties, which it did not have during manufacture. Some methods involve the use of various aggressive solvents or acids to remove salts from it, which disrupt the mineral composition of ceramics, its structure [2]. All this changes the authentic properties of the artifact and is the reason for obtaining objective information and its interpretation. Restoration does not always take into account the needs of various sciences, but is conserved at the level of museum practice. In it, ceramic objects act as a museum item and acquire new properties for them - attractiveness, representativeness, expressiveness. This leads to the fact that the task of restoring the appearance of the object comes to the fore, often to the detriment of its main quality - a source of information. Unfortunately, modern museum reconstruction used in restoration practice is often guilty of the fact that fragments of artifacts are only inclusions in the dummies created by restorers [3]. All this is a significant obstacle to further study of these monuments.

The purpose of this study is to trace the increasing complexity of ceramic research tasks in historical retrospect, so that when developing new strategies for its restoration, tasks are solved that allow for the maximum preservation of its authentic properties and, as a result, to obtain objective data during its study.

2. Retrospective Study of Archaeological Ceramics

The systematic study of archaeological ceramics in Russia began in the late 19-th century. One of the first Russian enthusiasts to put the study of ancient ceramics on a scientific basis was Prince P. A. Putyatin (1837-1919), who conducted a

series of experiments to reconstruct the technology and techniques of molding vessels. Attempts to classify them belong to A. E. Teploukhov, O. E. Kler, K. I. Fadeev. In 1901, V. A. Gorodtsov in his book "Russian Prehistoric Ceramics" [4] based on the scheme of the natural scientific method of K. Linnaeus outlined a comprehensive program for the study and interpretation of ancient ceramics as an important historical source, thereby laying down the basic methodological principles of ceramic processing, most of which retain their significance to this day. Since that time, research has been conducted regularly.

The study of the features of the technological process based on its visual assessment was carried out by A. A. Spitsyn [5], V. I. Kamensky and N. N. Bortvin [6].

The professional approach to the study of ancient technologies that emerged in the 1920s is associated with the creation of the Institute of Archaeological Technology in Petrograd and the involvement of scientists from various fields of natural sciences. At the same time, methods of chemical and microscopic analysis were first used (A.A. Popovitsky; E.I. Hoffman; I.P. Krasnikov), and the technique of molding ancient vessels was studied using experimental methods (Gorodtsov). At the same time, problems of preserving ceramic products were being solved. The main results of these scientific studies were reflected in the book by I.P. Krasnikov and M.V. Farmakovskiy "Ceramics. Its Technique and Preservation", published in 1926 [7]. The methods proposed by the authors for cleaning archaeological ceramics from salts¹ using acid are still used in restoration, despite its destructive effect on the shard.

The technological study of ceramics based on the experiment made it possible to present the production of vessels at all stages: from the preparation of the clay mass, molding, surface treatment, to decoration and firing. B.A. Bogaevsky introduced a new term - "technological style", which was based on the technique of processing the surface of vessels. He closely approached the concept of "technological tradition", the ethnocultural nature of which was revealed almost 50 years later by A.A. Bobrinsky [8]. This led to the accumulation of diverse information about ancient ceramics and led to the development of a comprehensive approach to its study, and also contributed to the growth of interest in it as a valuable source of information. As a result, new concepts, analysis systems, a method for visual-technological analysis of ceramics, and a description of a number of diagnostic features appeared. Based on the descriptive principle and chemical analysis data, in 1943 N. Toll created a chronological scale.

In the post-war period, there was an expansion and differentiation of approaches to the technological study of ceramics, the development of experimental modeling techniques for the reconstruction of technological processes of ancient pottery,

¹ When in the ground, a clay shard of a ceramic product accumulates various salts, which fill the open pores of the shard, covering the product or its fragments with a dense white crust that is insoluble in water.

visual assessment of technological features based on experiments and the use of binocular microscopy methods continued.

Awareness of the importance of research into ancient ceramics as one of the most widespread and informative archaeological sources led to the creation in 1963 of the «Cabinet of the History of Ceramics» at the Institute of Archaeology of the USSR Academy of Sciences (IA RAS USSR). Subsequently, it was transformed into the Group of the History of Ceramics. Its task is to develop new methods for studying ceramics as a source of historical information and their practical application to specific archaeological materials. During their work in the Group, such scientists as A.A. Bobrinsky, B.A. Kolchin, Yu.N. Zakharuk, M.G. Gusakov, I.A. Gey, Yu.B. Tsetlin, E.V. Volkova, O.A. Lopatina, O.L. Sharganova, V.G. Loman, A.A., N.P. Salugina, I.N. Vasilyeva, and others, a whole school of domestic researchers of archaeological ceramics appeared. Thanks to this, only by the efforts of this Group:

- 1) a methodological system of technical and technological study of ceramics was created,
- 2) methods for studying the forms of clay dishes are being developed,
- 3) various specialized devices for firing ceramics are being studied,
- 4) a theory of the origin and development of the potter's wheel and pottery was developed,
- 5) a method for determining the sex of potters by nail prints on vessels and identifying vessels of one master was developed [9],
- 6) a method for reconstructing the cultural stratigraphy of settlements with a mixed cultural layer based on the study of ceramics was developed,
- 7) pottery of different cultures is being studied, including the technology of making vessels, their shape and ornamentation, social structure and hierarchy of society.

A huge contribution was made by such scientists as A.A. Bobrinsky and I.G. Glushkov. Having processed extensive ethnographic material on pottery. A.A. Bobrinsky developed and implemented a new methodological approach to the study of ancient ceramics as a historical source, called "historical and cultural". Its essence is expressed in the fact that ceramics are considered as a product of a complex interaction of social and technical and technological experience of specific producers and from this point of view it is studied how such experience is formed, how it is realized, distributed and changed in various specific historical situations. The most important source of information, according to Bobrinsky, is the appearance of ceramics, in connection with which he identified five main objects of its study: size, shape, ornamentation, color and purpose. Ceramics are also considered as a source of information on manufacturing technology, which characterize the stages of the production process in ancient pottery. His methods of system analysis of ceramics allowed to reveal new facts from the history of pottery production.

Theories and methods of historical and cultural approach to ancient ceramics are devoted to the research of Yu.B. Tsetlin, E.V. Volkova [10]. Yu.B. Tsetlin developed a method of periodization of Neolithic cultures of the Center of the Russian Plain and stratigraphy of multilayer settlements. [11]. He brought to the forefront the solution of problems aimed at: reconstruction of cultural traditions of ancient potters and consumers of clay dishes; study of their behavior in different cultural and historical situations and identification of the possibilities of these traditions to serve as a source on the history of the ancient population and society. Moreover, this direction provides for a complete reconstruction of the technological process, starting with the preparation of raw materials, technology of vessel construction, technical devices and tools of potters, forms and ornamentation of finished products. In his works, he built a hierarchy of approaches to the study of ancient ceramics depending on the completeness of knowledge about it (from unformed knowledge to formed knowledge), where, in the first case, the emotional-descriptive approach is indicated, and in the latter - the historical-cultural one.

The tasks set required the application of instrumental analysis using the methods of natural sciences, which have become widely used by many scientists. For example, when studying the structure and morphology of the material, identifying traces of processing, the method of electron microscopy has been widely used. Identification of additives and impurities in ceramic material using chemical analysis made it possible to determine its composition and indicate specific production technologies. This became decisive for understanding historical contexts and compiling more accurate reconstructions of the past. For example, the authors of the monograph "Mineralogy of Ancient Ceramics of Baraba " [12], using these methods, developed a scheme for reconstructing ceramic products using ancient technologies. The key to it is the analysis of the raw materials used, the preparation of a ceramic mass from it suitable for molding products, the gas environment and the temperature at which firing occurs. M.P. Gryaznov [13], using mathematical methods, proposed a method for graphical reconstruction of the sizes of vessels from fragments, and V.F. Gening - statistical methods that allow reconstructing the volume of vessels [14]. S.N. Nikolaenko and I.G. Glushkov [15] used their own method for calculating the volume of vessels. Unfortunately, these reconstruction methods have not found wide application in modern museum restoration.

G.I. Medvedev considered archaeological objects in the system of archaeological resources, as a fossil reserve, as a means and source of a continuous process of cognition of the past [16]. The general scheme of the structure of pottery technology and its variants was developed on the basis of studying various types of scattered fragments of ceramic products. The purpose of all these studies was to study and identify (based on the results of the analysis of pottery technology and experiments) specific events and processes in the

history of individual groups of the ancient population, identifying data on the patterns of organization, functioning and change in labor skills in pottery production. Problems of interaction between ancient technologies and culture, as a determining factor in the direction of development of the material environment, in which every day biological and social life of man takes place, were studied by V.P. Golikov. He defined technologies as the most important link between culture and nature, arguing that they are one of the main components of the currently existing culture, and the course of history depends on their level of development. The influence of technology on spiritual culture is considered from the point of view that “technologies provide spiritual culture with models for understanding the surrounding reality. Thus, the connection between the first religious concepts of creating man from clay (for example, Gilgamesh or Adam) and ceramic production is quite obvious. Another possible way of influence is changing human thinking in the process of creating complex technologies” [17].

Use of various methods of technical and technological research: optical, IR and UV radiation, physicochemical, stereo-radiographic, neutron activation analysis, mass spectrometry (ICP-MS), electron probe (SEM) and others significantly expanded the possibilities for studying archaeological objects of ancient ceramics.

Foreign scientists in the second half of the 20-th century also did a lot of work on developing methods for analyzing ceramics as a historical source and identifying approaches and methods for studying ancient pottery. The decisive role in this belongs to F. Matson, A. Shepard [18], O. Ray [19], S. P. Rice [20] and many others. Starting with the research of the Morgan brothers and G. Child, many Western archaeologists and anthropologists began to consider ceramics as one of the main material criteria for the periodization of antiquity.

Interest in archaeological ceramics is constantly growing. It is studied not only as a historical source, but also as a cultural text [21], as cultural semantics [22], as an artistic image [23], as sacred art [24], as ethnographic material [25]. There are studies devoted to the semantic meaning of brands on ceramics found in cultural layers of various cities and regions [26]. A number of domestic and foreign studies are devoted to the study of organic remains on archaeological ceramic dishes. Their purpose is to obtain information about the lifestyle of ancient people, diet, culinary practices. Unfortunately, during restoration, these remains are often subject to removal. In recent decades, pottery has been considered as a "matrix" or carrier on which the information process of internal and external transformations is recorded [27]. For example, an attempt is made to identify in trace structures (on the surface of a ceramic product) any vibroacoustic (paleophonographic) signal - speech, physiological, technological or other productive activity, taking into account various technological, anthropogenic and other factors. As it turned out, the selection and interpretation of biomechanical components, the vibroacoustic signal showed a connection with the dynamics of

the potter's wheel and active physiological activity of a person, such as heartbeat, breathing, blood flow, even the work of the intestines and other processes accompanied by vibrations of the surface of the human body in the range of about 0.01-1000 Hz [28, 29].

3. Conclusion

Today, the data obtained as a result of comprehensive studies of archaeological ceramics allow us to restore the features of everyday life, beliefs, mentality, artistic and aesthetic tastes of ancient people, their ideas about the world around them, as well as to trace the trends in the development of society, the formation and development of its cultural and spiritual needs. In addition, data on the chemical and mineralogical composition of ceramic dough help to identify trade and economic ties, and also help to establish the place of their manufacture [30]. Therefore, archaeological ceramics serves as an invaluable material for studying and understanding the history of the development of mankind throughout its existence. It acts as an inexhaustible historical source. With the introduction of new technical capabilities into our lives, our knowledge will expand.

New approaches to restoration should consist, first of all, in an integrated approach, providing for the most complete, comprehensive study of the restoration object itself, and not just identifying the types of its destruction. Restoration should turn into a full-fledged scientific activity with its own tasks and research methods, and also use the methods of other sciences and new capabilities of artificial intelligence to model destroyed (fragmented) objects, obtain their 3-D copies from the remains and solve other problems, including for museum exhibiting. In addition, the currently available methods of archaeological reconstruction should also be introduced into museum restoration practice, as this will preserve all the inherent properties of the artifact. Based on the above, the main goal of restoration should be to maximize the preservation of the information potential embedded in the ancient artifact by its creators, and the task is to develop non-destructive methods for stabilizing its condition, eliminating the causes of the destruction of the monument. It is also necessary to make wider use of preventive conservation methods: creating conditions that maintain the stable state of the monument for the longest possible time.

Abbreviations

USSR	Union of Soviet Socialist Republics
IA RAS	Institute of Archaeology of the USSR
USSR	Academy of Sciences
Hz	Hertz Is the Unit of Frequency of Periodic Processes
IR	Infrared Radiation
UV	Ultraviolet Radiation

ICP-MS	Inductively Coupled Plasma Mass Spectrometry
SEM	Scanning Electron Microscope
СА	Soviet Archaeology Magazine
Вестник	Scientific Journal of the Saratov State
СГТУ	Technical University
ЗРАО	Notes of the Russian Archaeological Society
СПб	Saint Petersburg
СПб ГУ	St. Petersburg State University
СО РАН	Siberian Branch of the Russian Academy of Sciences
НАН	National Academy of Sciences (of Ukraine)
Труды	Proceedings of the Karelian Scientific Center
КарНЦ	of the Russian Academy of Sciences
РАН	

Author Contributions

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Conflicts of Interest

The author declares no conflicts of interest.

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Biography



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Research Field

Tatiana Nikolaevna Krasnova: Materials and technology of ceramics manufacturing, Materials, in the restoration of ceramics, Types and causes of fracture of ceramic materials, Methods of preservation of archaeological ceramics, Theory of restoration.