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TRANSMISSION OF TECHNICAL INFORMATION IN TRADITIONAL SOCIETIES

Yulia A. Likhter

Archaeological Research in Construction Business LTD, Moscow, Russian Federation

Yulia G. Kokorina

Moscow Polytechnic University, Moscow, Russian Federation

Abstract. *Introduction*. This article is theoretical in nature. The objective of this work is to raise the problem of information transfer in the formation of ancient technical reality. The novelty of this article raises the problem of transmitting technical information in antiquity as being posed for the first time, despite the abundance of works on the history of craftsmanship in foreign and Russian archeology. *Methods and materials*. The multidisciplinary nature of modern archeology determined the choice of research material, which includes publications by foreign and Russian archaeologists, anthropologists, folklorists, ethnologists, and historians. Research methods: comparative and systematic approach. The methodological basis of the work is a systematic approach to an object as a set of subsystems: morphology (the study of form in the general scientific sense), material, technology, and function. *Analysis*. These subsystems are presented in the form of two triads: historical and cultural ("morphology, material, and function") and historical and industrial ("morphology, material, and technology"). The subject of research is the second triad. *Results*. As a result, we have identified the following ways of transmitting technical information in ancient times: replication according to a ready-made sample; imitation in another technology or material; the use of matrices or stamps; templates in the manufacture of complex artifacts; semi-finished products, the shape of which indicated the processing technology; and relocation of craftsmen. Presumably, "designers" or "interpreters" broadcast information from other-cultural "customers" about the peculiarities of decorating things with a high semiotic status; the focus on human characteristics; the preservation of technical information in folklore (epos and songs) and scientific treatises; and the proportions and sizes of the human body and its parts (transmitting metric ratios). *Authors' contribution*. Yu.A. Likhter proposed the article's concept, justified the methods and methodology used, and contributed some of the factual material. Yu.G. Kokorina collected the second part of the factual material, including foreign material, and conducted an analysis.

Key words: archaeological theory, knowledge transfer system, ancient craft, culture contact, ancient technical reality.

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ПЕРЕДАЧА ТЕХНИЧЕСКОЙ ИНФОРМАЦИИ В ТРАДИЦИОННЫХ ОБЩЕСТВАХ

Юлия Абрамовна Лихтер

ООО «Археологические изыскания в строительстве», г. Москва, Российская Федерация

Юлия Георгиевна Кокорина

Московский политехнический университет, г. Москва, Российская Федерация

Аннотация. *Введение.* Данная статья носит теоретический характер. Целью работы является постановка проблемы о путях передачи информации о формировании древней технической реальности, под которой понимается материальная составляющая искусственной среды обитания, создаваемой человеком в прошлом. В условиях современного информационного общества выявление путей передачи технической информации в древности как одного из важнейших факторов развития человечества представляется актуальным. Новизна данной статьи состоит в том, что, несмотря на обилие работ по истории ремесла в зарубежной и российской археологии, проблема реконструкции путей трансляции технической информации в древности ставится впервые. *Методы и материалы*. Мультидисциплинарный характер современной археологии определил выбор материала для исследования, которым являются публикации зарубежных и российских археологов, антропологов, фольклористов, этнологов, историков. Методы исследования: компаративный, системный подход, дескриптивный, классификационный, моделирование. Методологической основой работы является системный подход к вещи, рассматриваемой как совокупность подсистем: морфология (в общенаучном смысле как учение о форме), материал, технология и функция. *Анализ.* Эти подсистемы представлены в виде двух триад: историко-культурной («морфология, материал и функция») и историко-производственной («морфология, материал и технология»). Предметом исследования в данной работе является вторая триада. Композиция работы построена в зависимости от составляющих второй триады по хронологическому принципу. *Результаты.* В результате нами выделены следующие пути передачи информации о технической реальности в древности: повторение по готовому образцу; имитация в другой технологии или материале; использование матриц или штампов; шаблонов; схем и образцов при изготовлении сложных артефактов; полуфабрикатов, форма которых указывала на технологию обработки; переселение мастеров. Предположительно – использование «дизайнеров» или «переводчиков» для трансляции информации от инокультурных «заказчиков» об особенностях выполнения декора вещей с высоким семиотическим статусом; ориентация на особенности человека, пропорции и размеры человеческого тела и его частей (при передаче метрических соотношений). Сохранение технических сведений в фольклоре (эпос, песни) и ученых трактатах. *Вклад авторов*. Ю.А. Лихтер предложила концепцию статьи и часть фактического материала, обосновала методику и методологию. Ю.Г. Кокорина собрала вторую часть фактического материала, в том числе иностранного, провела анализ.

Ключевые слова: археологическая теория, система передачи знаний, древнее ремесло, контакт культур, древняя техническая реальность.

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Introduction. The exceptional role of information in the modern world is well known. The transmission of information ensures the existence of the technical reality of the 21st century. An ancient technical reality today is not only an object of academic interest but also a means of self-identification for various modern nations, and its study is used for educational purposes [12; 28; 30; 40; 62; 65]. We define technical reality, following Yu.L. Shchapova, as the material component of the artificial environment created by humans [54, p. 11; 57, p. 2].

Historical reconstructions of ancient technologies as a phenomenon of the cultural heritage of currently existing peoples are widespread [69]. The problem of transmitting

technical information is closely related to the problem of folk pedagogy [6]. As will be shown later, the study of the craft of traditional societies is at the center of attention of archaeology, ethnology, and historical anthropology [27, p. 24]. Therefore, it is relevant to study how people in ancient times transmitted information and created their own technical reality. Although the history of craftsmanship in traditional societies has been extensively researched, the specific issue of transmitting information in creating ancient technical reality has not been addressed or studied. This is where the novelty of this article lies. The purpose of this work is to address the issue of technical information transfer in ancient societies and identify the main pathways of this process.

Methods and materials. The work bears a theoretical nature. The research in the field of archaeology as well as ethnology and history served as the main source for it. In the foreign historiography of recent years, attention is paid to the history of the development of traditional crafts of individual peoples [1; 11; 16], types of production [46; 49; 53; 68], preservation of ancient crafts [18], and features of their social organization [66]. Domestic archaeological literature is represented by a significant number of works [63; 64; 19; 20; 21; 48; 51; 54].

Methodologically, the authors follow Yu.L. Shchapova and her scientific school, to which they have the honor of belonging. Yu.L. Shchapova recommended creating a set of features when analyzing archaeological monuments. Its initial form acts as a certain general knowledge about the subject undifferentiated in time and space [56, pp. 22-23]. Therefore, this work uses archaeological and ethnological materials from different eras and cultures. When studying ancient artifacts, their internal properties are divided into subsystems: morphology, material, technology, and function [33; 34; 38, p. 88].

These features can be summarized into two triads: "morphology, material, and function" and "morphology, material, and technology." In the first case, we consider what was used, from what, and how, while in the second case, we focus on what was made, from what, and how. We can say that the first triad is historical and cultural, while the second triad is historical and production-related. When operating the first triad, we study an object as part of the material culture of a particular society, and when using the second triad, we examine it as part of the ancient production system [38, p. 185]. It is the second triad that forms the ancient technical reality and is the subject of our research.

Analysis. In a nonliterate society, researchers identify four main methods of information transfer and learning: verbal, visual, music, and dance [50, p. 105]. In addition, the shape of the product itself serves as the repository of all vital information collected during the evolution of the craft, which is stored in the form of standards and technical skills necessary for reproducing the traditional form of the product. "These repositories contain the 'genetic code' necessary for the evolution of the craft" [29, p. 35].

As the modern research shows, the rudiments of abstract thinking can already be noticed in the tools of the Oldowan era, which required abstract thinking and the ability to perform complex sequences of actions [15, pp. 321-322; 67]. Since the moment standardized tools appeared, we can say that humans had emerged, albeit in a very primitive form. They had a concept not only of the function of a tool but also of the fact that a tool should have a specific shape that all craftsmen complied with.

The emergence of the concept of form signals the emergence of the human species, human intelligence, and the development of speech as a characteristic of the human race [25; 58]. Information was likely transmitted through imitation and learning. In the future, we can see a greater variety of methods for transmitting information.

Transfer of craft information by imitating. During the Bronze Age, for instance, stone axes remaining still in use were sometimes imitated by bronze axes, preserving all the details. Thus, jade axes were found in Troy, imitating metal ones (Troy, second half of the 3rd millennium BC) [41], and stone axes with imitations of a casting seam are known among the tribes of the Fatyanovo culture (the center of the European territory of Russia, the first half of the 2nd millennium BC) [5, p. 3; 11; 13; 67, p. 264]. A wooden replica of a broken European pouring spoon, probably made of metal, which was then repaired with a screw, is interesting. It was probably made by a craftsman from Congo [59, p. 101].

Perhaps technical information was passed on from one nation to another, initially through luxury goods utilized by the elite of the borrowing ethnic group. The upper class of the Scythian-Sarmatian world were the consumers of ancient craftsmanship, but in Ancient Rus, the products of Byzantine craftsmen were primarily sought after by the princely and boyar classes. The same tendency manifests in modern times. As noted by 19th-century ethnographers, the Orenburg region's knitting of lace shawls is "exclusively practiced by the Russian population of the province. The Bashkirs and Teptyars do not use knitting on needles, and these items are not in use at all. The poor do not know about them, but the rich and prosperous people buy them at the market" [63, p. 7].

The decor of objects developed at the intersection of two cultures has a number of features in terms of creating technical reality. Thus, among the glass vessels found on the territory of the Chernyakhov culture, there are examples of the reproduction of complex-technique decor using simpler methods. For example, a cup with convex ovals made of an overhead thread (hot lining) from the Kholmsky, Odessa region [37, fig. 1,16, fig. 3a], clearly imitates a cup with convex ovals obtained by removing the top layer of glass from a thick-walled vessel (cold grinding) – a technique close to the technology of a vas-diatretum from Malaesti [37, fig. 1,11].

The study of cultural contacts in ancient technical reality raises a number of problems. In particular, it is unclear how craft information was transmitted during such contacts. For example, the Scythian pectoral from Tolstaya Mogila and the vase from Chertomlyk were made by ancient Greek craftsmen, but their decoration reflects the complex ideas of the Scythians about the mythological universe [2, p. 212; 45, p. 473]. Other works of Greek art have been proven to bear a high level of semiotic content, reflecting the Scythian mythological beliefs. Therefore, we can assume that the ancient Greeks had "designers" or special "interpreters" who explained all the requirements of the Scythian "customer" to the craftsmen.

The shape of the semi-finished product as a means of transmitting information about the technology. Studying the metal of the Middle East in the Eneolithic, Early Bronze, and Middle Bronze Ages, L.I. Avilova suggested that information about the properties of the metal and the types of possible products made from it was contained in the form of the semi-finished product. "The shape of the thin flattened pommel may indicate the malleability of copper. The volumetric <…> pommels emphasize the casting properties of the blanks made from copper with natural impurities of arsenic and lead. Thus, the blacksmith could understand the shape of the pommel as a kind of "instruction manual" for using the ingot" [4, p. 165].

Using matrices, templates, and standards to transfer craft information. The use of templates also contributed to transmitting information, as, for example, ancient Russian craftsmen used templates to create enamel coatings, in contrast to the Byzantine method of individually drawing and stamping a pattern [55, pp. 183-184].

Technological information was transmitted using stamps and matrices, which were used to create casting molds for objects with simple shapes but complex surface decorations. [3; 9; 12, p. 28; 42, p. 66; 60; 61]. Matrices were also used for the production of tiles [23; 39]. In the "Orders of the Old Years" for 1682, "Living Records of Apprenticeship" were found, which mentioned "tile seals" that were given to apprentices after they completed their training as a tiler [39, p. 344].

Crafting items based on patterns and samples. Weaving is a unique combination of art and craft. There is evidence of using the so-called filling patterns in the Muslim East, which consist of three elements: a weave pattern, a broom pattern, and a cardboard pattern [43, p. 117] [1]. Ethnographic data on Armenian carpets show that weavers developed their own patterns. "Sometimes, the craftsman would indicate the colors of the yarn and the number of knots. Sometimes there would be a sample next to the loom" [32, p. 46]. In the medieval East, there were also ready-made patterns for constructing architectural ornaments, the so-called *girihs*. "Long, rolled-up strips of paper, made up of several sheets, passed from father to son. These strips were carefully drawn with fragments of architectural patterns, as well as inscriptions that had already been divided into individual bricks for

accuracy. The oldest of these scrolls dates back to the 16th century, but there is no doubt that they existed before that" [22, p. 116].

Folklore and early scientific works as means of transmitting craft knowledge. Texts, primarily folklore texts, served as a means of transmitting technical information. For example, the folklore of the Agaria people (Central India) tells about the origin and basic techniques of iron smelting and blacksmithing [36; 50, pp. 46-47]. The Epic of Gilgamesh also mentions metallurgy:

"Let the people of Aratta
Bring down the mountain stones,
And build the great shrine for me, the great sanctuary,
Their task of plying gold,
Like the silver in the lode,
Load the packs on the donkeys
of the mountains" [35, pp. 32-40].

There are known fragments about tempering steel, as in the Odyssey:
As a blacksmith plunges an axe or hatchet
Into cold water to temper it –
For it is this that gives strength to the iron [24, p. 219].

Also, in the Karelian-Finnish epic:
"And the blacksmith Ilmarinen,
Deeply thought and long reflected,
Steeped the ashes in the water,
Made a lye to harden iron." [64, p. 58].

The transfer of information took place in the form of craft apprenticeship. For example, the ancient Indian Dharmasastra of Narada (Naradasmrti) states that after completing the apprenticeship, the student could remain working with the craftsman, who was required to indicate the student's qualification, referred to as ante-Vasi, next to his name. The statues of Buddha from Kashmir, dating back to the 2nd century BC, bear inscriptions indicating that they were created (with the name) by the ante-Vasi of Kunika [11, p. 31]. According to Naradasmrti, a craftsman is obliged to treat his disciple as a son and to teach him honestly and with an open heart [11, p. 31]. The idea that knowledge, including about craft, is sacred and is passed down from father to son is common in ancient societies. For example, medical knowledge was passed down in the Hippocrates family for 18 generations [11, p. 121].

There are scholarly treatises that provide information about the craft. The oldest text containing glass recipes dates back to the Middle Babylonian Kingdom, around 1700 BC [10, p. 44], and similar works can be found in ancient [44] and medieval [8; 60] literature. However, it is unclear how familiar contemporary craftsmen were with these treatises. Technical information was also transmitted by travelling craftsmen [70, p. 214; 51, p. 246], as well as in the form of crafts' imitation of other cultures. Examples include gray-clay imitations of ancient kantharos found in late Scythian settlements [14; 17], encolpion crosses from Ancient Rus that imitated Byzantine crosses, imitations of Khwarezmian ceramics in the Golden Horde cities of the Volga region [52, p. 503], and so on.

Methods of transmitting information about the product metric. Some knowledge might be implicit in the products, for example, in the metrics of the products, primarily in the proportions. The concept of "ancient metrological culture" has been introduced in modern archaeology [7; 26; 31].

Turning to the analysis of metric ratios in ancient objects, Yu.L. Shchapova highlights the concept of a module as the smallest common measure that different elements should possess [56, p. 72]. Modules and proportions are an integral part of the ancient technical reality: the module in the proportions' construction of bells was the thickness of the "bell lip"; vessels – the diameter of the bottom or crown; the size of the vessel was determined by the metric of the main decorative element; the module of a sword or a dagger – the width of the blade under the cross; the module of a ship – the gap between the oarlocks, etc. [56, p. 76]. Information about what the module of the product is was passed on during training.

Archaeologists discover standards that are special artifacts containing samples of measures in a particular culture. Such artifacts depicting a human head with an outstretched arm or foot as a metric standard are known in Ancient Greece [31]. The figure of the "moduler" belongs to antiquity, where the human body is used as the basis for proportional relations. In Ancient Rus, "babylons" (a term by B.A. Rybakov) were used, which were rectangular ceramic and stone artifacts marked in a special way that allowed the calculation of the dimensions of ancient temples [47]. They were passed down through training.

Results. Thus, we can identify the following ways of transmitting craft information: replication by a ready-made model, imitation in another technology or material, use of matrices or stamps, reproduction of templates, reference to schemes and models in the manufacture of complex artifacts, the use of semi-finished products, and the shape of which indicated the processing technology. Presumably, the presence of "designers" or "interpreters" to broadcast information about the peculiarities of decorating things with a high semiotic status. These include the focus on human characteristics, the proportions and sizes of the human body and its parts (transmitting metric ratios), the migration of craftsmen, whether voluntary (wandering artisans) or forced, folklore (epics, songs), and scholarly treatises. It should be noted that the use of all these methods of transmitting information, which was an integral part of the so-called "primitive" craft production, often concealed a subtle and reliable system of information transmission that was perhaps more effective than the modern "drafting" method of design.

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Information About the Authors

Yulia A. Likhter, Candidate of Sciences (History), Scientific Director, Archaeological Research in Construction Business LTD, B. Savvinsky Lane, 2-4-6, Bld. 4, 119435 Moscow, Russian Federation, ulialikhter@gmail.com, https://orcid.org/0000-0003-4795-7398

Yulia G. Kokorina, Candidate of Sciences (History), Doctor of Sciences (Philology), Professor, Department of Humanities, Moscow Polytechnic University, Bolshaya Semenovskaya St, 38, 107023 Moscow, Russian Federation, kokorina@inbox.ru, https://orcid.org/0000-0002-2496-3958

Информация об авторах

Юлия Абрамовна Лихтер, кандидат исторических наук, научный руководитель, ООО «Археологические изыскания в строительстве», Б. Саввинский переулок, 2-4-6, стр. 4, 119435 г. Москва, Российская Федерация, ulialikhter@gmail.com, https://orcid.org/0000-0003-4795-7398

Юлия Георгиевна Кокорина, кандидат исторических наук, доктор филологических наук, профессор кафедры гуманитарных дисциплин, Московский политехнический университет, ул. Большая Семеновская, 38, 107023 г. Москва, Российская Федерация, kokorina@inbox.ru, https://orcid.org/0000-0002-2496-3958