2 ARCHAEOMETRY – ARCHAEOLOGY – ETHNOARCHAEOLOGY: INTERRELATED DISCIPLINES

Various analytical techniques, approaches and methods of processing of ceramic finds have developed intensively since the middle of the 20th century. Nowadays we can say that archaeology is positioned between archaeometry and ethnoarchaeology, where it plays the role of a strong link in the reconstruction of past human activities and behaviour. In this process, a special place within archaeology is held by experimental archaeology, used to confirm or reject results and conclusions of research, and to try to explain technological choices and changes.

POTTERY ARCHAEOMETRY

Archaeometric analysis provides data on the source and mineral composition of the raw material, paste recipe (type and proportion of clay and tempers), firing conditions (atmosphere and temperature) and other aspects of pottery production.

The development of archaeometry as a scientific discipline began in the middle of the 19th c., with scientific analysis of the material that ceramic vessels were made of (Peacock 1970). However, the name itself appeared only in 1958, with the first publication of the English journal *Archaeometry*. In the 19th c., archaeometry developed primarily at universities which dealt with analytical issues in the field of social studies and humanities, and only at the end of the 19th c. and in the early 20th c. were the first specialized scientific laboratories founded within museums and archaeological institutions (Tite 1991). The technological aspect of pottery production, whose development began in the middle of the 20th c., marked the beginning of a slow end of consideration of pottery vessels exclusively through their chronological and typological analysis and interpretation (Matson 1942).

Investigation of the material that a ceramic vessel is made of has been conducted successfully over the past 70 years or so, in an attempt to understand the knowledge and skills necessary to produce an object, and not just to protect it from degradation and put it in a chronological frame (Vandiver 2001). In view of the limited information obtained from archaeological excavation, it is necessary to cooperate with other scientific disciplines in order to get as much information as possible about the archaeological record – that is, about the conditions and way in which people lived in the past.

Modern-day archaeology is a very diverse discipline, encompassing groups whose interests focus on various periods, regions, theoretical frameworks and methodological techniques. This diversity is positive, but it can also entail problems in communication (Jones 2004). The primary focus of archaeometry has always been the physical and mechanical properties of material culture, which involve physical scientists from the fields of chemistry, physics, biology, geology etc. However, the lack of communication between an archaeologist and a scientist can lead to a loss of basic information, and often results in archaeometry existing for its own sake. The lack of communication and scientific discourse can be observed in Croatian archaeological publications, where we often see an enormous number of graphs and tables, with no additional scientific interpretation or conclusions. Rather than on description of the mechanical and physical proper-

ties of an artefact or material, we should focus on questions of how these properties featured in the social and cultural life of the people who made the artefacts, used them, exchanged them and eventually discarded them (technological choice, production organization, social relations, environmental adaptation, technological recipes etc.). To be sure, answering those questions should involve all available analytical techniques used by archaeologists. Another important factor in this communication is the 'type of archaeologist' – whether he or she is a field archaeologist, academician, or museum archaeologist – and what his/her theoretical and acquired stances are. Depending on the type of work at hand and their theoretical stances, the requirements made and questions posed by archaeologists will also differ (Tite 1991).

Several factors are important for the relationship between an archaeologist and a physical scientist to function and endure. Firstly, every physical scientist who deals with archaeometry should begin by explaining, to the archaeologist he is working with, the basic methodology of this analytical technique, its limitations, implementation and statistical errors. In the same fashion, every archaeologist should explain to the physical scientist what the archaeological methodology looks like, what its limitations are, and the context and nature of the finds, and they should know how to ask the questions they seek answers to (Maggetti 1994; 2006). This brings us to the key issue when it comes to archaeology. Very often archaeologists cannot ask a research question that they seek an answer to, or they ask it incorrectly, and it is actually unclear what it is that the archaeologists want to learn from a given analysis. If the communication starts off on the wrong foot, the whole cooperation is condemned, and the time and financial resources wasted. For this reason, some minimal previous understanding of archaeometry and archaeology is a winning combination which can improve and facilitate communication and eventually lead to a higher quality of data interpretation. With this in mind, archaeologists should learn about the basic features and possibilities of the analytical method requested and the material they are sending for analysis, and about the method's limitations in respect of any final interpretation, in order to be able to discuss, evaluate and draw scientific conclusions on the basis of the results obtained. Perhaps M. S. Tite (1991) puts it best when he says that "the archaeologist asks the appropriate questions of the scientific technique being applied and that the scientist provides the data that the archaeologist requires and thus avoids the all-too-classic situation of a technique searching for a problem."

The following problem stems directly from what has been described above, and it regards the choice of representative samples we wish to use to obtain answers to the questions raised. The method of sampling the vast amount of pottery material will determine the results of the analysis, necessitating the sampling to be systematic and appropriate for the hypothesis put. There are several types and methods of sampling, and every archaeologist should select the method (for example, random or judgment sampling) based on the type and nature of the material processed, with a view to obtaining data which will be representative. The aim of sampling is to provide answers to the research questions/hypothesis already put, and the sampling method should be attuned to the analytical problem and the nature of the analytical information. For example, if we are trying to learn whether the paste recipe is the same or different for different functional forms – that is, whether the potter made a deliberate technological choice and used specific proportions of clay and certain tempers for different functional forms (pot, bowl, cup) – then we will sample different functional forms identified during the earlier processing. We cannot expect that random sampling of ceramic fragments from a single bag will result in relevant statistical data, and eventually rel-

evant interpretational data, if the sample is not representative. This means that the sample must have all the characteristics typical of the population of – in this case – pottery material.

The final issue is the interpretation of the data obtained, which should be systematic and comparative, which means that data resulting from any kind of analysis cannot and must not be interpreted on their own. They should be considered in a wider context, together with all other analyses performed and all other relevant data (such as the archaeological context of the deposition, material processing, archaeobotany, archaeozoology, chemical analysis etc.) In my view, somewhere along the way we have forgotten to ask *why* an object was made, rather than *how.* Our interpretation should focus on identifying social, economic and traditional elements and links, and research questions can be put from various points of view, by integrating social issues with results obtained from analyses.

Generally, investigation of any archaeological artefact, pottery vessels included, can be divided into three main fields of research. The first focuses on the origin of the raw material, and it includes identification of the location from where clay for the pottery vessels was extracted, with a view to establishing trade routes and contacts which existed between various cultural groups. Here, the analytical techniques used include mineralogical-petrological and chemical analyses such as X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF), Instrumental Neutron Activation Analysis (INNA), Scanning Electron Microscope-Energy Dispersive X-Ray Spectroscopy (SEM-EDX/EDS), Fourier-Transform Infrared Spectrometry (FT-IR).

The second field of research regards technological investigation focusing on material and production technique, where analysing raw materials and admixtures (using the same analytical techniques) can throw light on production processes, technological choices and changes. The most efficient method for determination of firing atmosphere and temperature and pottery technique is thin-section microscopy, where thin sections are prepared for examination under a petrographic microscope.

The third aspect is the functional element: that is, identification of the product's utilitarian function in everyday life (Tite 1999; 2008). When it comes to the analysis of the functional element, an important role is played by gas chromatography-mass spectrometry (GC-MS) analysis, used extensively in archaeology in the last 20 years to identify the origins of plant and animal fats absorbed in a pottery vessel's wall. More will be said about this method and the results obtained from the analysed Vučedol material in the second part of the book (Chapter 15). And finally, combining archaeological data, ethnoarchaeology and experimental archaeology, we piece together the puzzle in an attempt to get a more complete picture which will help us reconstruct patterns of past human behaviour.

ETHNOARCHAEOLOGY

As a term, *ethnoarchaeology* appeared in the 1970s. The word was first used by Jesse Walter Fewkes in 1900, and since then it has seen many variations: active archaeology, ethnography for archaeology, archaeo-ethnography, archaeological ethnography, living archaeology, ethnoanalogy. (For an overview, see Arthur & Weedman 2005). In the Croatian terminological database (STRUNA), ethnoarchaeology is defined as "a scientific discipline which studies contemporary societies with the aim of understanding human behaviour as the basis of material culture in the past."

Nowadays, ethnoarchaeological studies are explained as "archaeologically-oriented ethnographic research" (Kramer 1985: 77), or as "ethnography with an archaeological bias" (Gullick 1985). The goal of ethnoarchaeological research is to enhance our understanding and forge the links between past human behaviour and elements of material culture preserved in the archaeological record.

Ceramic vessels have been produced continuously ever since the end of the Upper Palaeolithic, and they can be found in all geographical regions, thus forming a long tradition which spans space and time. Just as it did in prehistory, today pottery also plays a key role in the social, economic and spiritual life of a community. As the technology of pottery production has not changed much since prehistory, ethnographic studies are a precious source of information, especially as concerns production organization, technological choices, craft specialization, division of labour, and supply and demand – facets that are not always clear and recognizable in an archaeological context. The contemporary communities which practise traditional lifestyles provide an insight into the whole process of pottery activity, since they use the traditional technology devoid of a contemporary way of living.

The explorations which are measurable and available within the ethnoarchaeological context are especially interesting from the point of view of refuse disposal patterns and ceramics uselife. The former aspect is of particular interest to archaeologists, because it opens up some new perspectives during the interpretation of material remains within an archaeological context (DeBoer & Lathrap 1979; Hayden & Cannon 1983; Deal 1985; Arnold 1990; 1991; Deal & Hagstrum 1995; Schiffer 1996; Stanton et al. 2008). The latter aspect poses new questions about the characteristics of the ceramic material we are processing, because the uselife of pottery is linked to its primary and secondary functions and determines the characteristics of all the material (Foster 1960; David 1972; DeBoer 1974; Longacre 1985; Deal & Hagstrum 1995; Shott 1996; Tani & Longacre 1999; Sullivan 2008).

Today – as in prehistory – the technology of pottery production can be best understood as a social tradition passed down from generation to generation over space and time. Nowadays ethnoarchaeological research helps us connect patterns of behaviour and elements of material cultural heritage, and gain a better insight into archaeological processes in the past. It enables us to appreciate the bond between the vessel and the human. Perhaps it has been best defined by David and Kramer in their 2001 work: "Ethnoarchaeology is neither a theory nor a method, but a research strategy embodying a range of approaches to understanding the relationships of material culture to culture as a whole, both in the living context and as it enters the archaeological record, and to exploiting such understandings in order to inform archaeological concepts and to improve interpretation."