DOI: 10.16359/j.cnki.cn11-1963/q.2019.0034

Goals, constraints and challenges of palaeolithic archaeology

Michael JOCHIM

Department of Anthropology, University of California, Santa Barbara, USA

Abstract: Palaeolithic research can address some of archaeology's biggest questions, including the origins and spread of modern humans. As a result, research often attracts much public attention and imagination. It is clear, however, that the reconstruction of life in the Palaeolithic faces many problems, both practical in terms of the limitations of the data and interpretive in trying to make sense of the finds. Both experimental archaeology and ethnoarchaeology have proven useful in dealing with some of these problems, but they also emphasize some of the constraints archaeologists face.

Keywords: Archaeology; Palaeolithic

Chinese Library Classification: K871.11; **Code:** A; **No.** 1000-3193(2019)03-0335-09

1. Introduction

The goals of archaeological research in general are: 1) to determine the patterns in time and space of the material record of the past; 2) to reconstruct prehistoric ways of life; and 3) to explain the variations and changes in behavior through space and time.

In exploring the patterns of the archaeological record, however, only Palaeolithic archaeology can provide information about some important global questions. These include the origins of modern humans, their first appearance and spread into all parts of the world, and in particular the development of those universal characteristics that define us as humans.

收稿日期：2019-03-08；定稿日期：2019-05-28

作者简介：Michael Jochim, E-mail: jochim@anth.ucsb.edu

Citation: Jochim M. Goals, constraints and challenges of palaeolithic archaeology[J]. Acta Anthropologica Sinica, 2019, 38(3): 335-343

Great public attention has been given to research on these topics. We have recently learned, for example, that the manufacture of stone tools may have occurred in Africa 3.3 million years ago, much earlier than previously believed[1]. Burial of the dead, as found in a number of Middle Palaeolithic sites, appears to predate the appearance of modern humans[2]. Shell beads and abstract markings on ochre at Blombos Cave have been interpreted as evidence for symbolic reasoning developing in southern Africa well before the well known "art" of Palaeolithic Europe[3]. The darker side of human nature has been suggested by early evidence of cannibalism at the French site of Moula-Guercy[4]. A recent discovery in the Spanish site of Atapuerca Pit of Bones has been interpreted as documenting the earliest known murder 430,000 years ago[5].

Most archaeologists, however, carry out research on more focused questions that emphasize the chronology and lifeways of Palaeolithic people. These, too, are exciting topics that attract much public attention and that are often the most engaging aspects of museum displays and videos. How did our remote ancestors live, and how did this vary through time and from region to region? In order to answer these questions, archaeology might be viewed as a forensic science, one devoted to the collection and examination of evidence to reach conclusions. Like other forensic sciences, we have a number of new, often high-tech, analytic tools at our disposal that have made great contributions to our understanding of the past. Advances in remote sensing technology, for example, have led to the discovery of Palaeolithic sites in the eastern Sahara along buried river channels[6]. Chemical trace element analysis has facilitated many studies of stone raw material transport and trade, as illustrated by studies including those of obsidian in Korea[7]. Many recent studies of ancient DNA, such as those of the Denisovans, have led to new understanding of prehistoric population interactions and movements[8].

Two of the most useful analytic tools, however, are microscopic use-wear analysis and ethnoarchaeological studies. Both are labor-intensive, but both have produced ideas and implications of potential relevance to a broad archaeological audience. Some of these implications help to emphasize the nature and importance of constraints facing Palaeolithic archaeology. It is clear that our interpretations of evidence from Palaeolithic sites face a number of constraints. These fall into two general categories: 1) practical limitations and biases in the archaeological record and our retrieval techniques, and 2) problems in our abilities to interpret this record.

2. Practical Constraints

All archaeologists are familiar with the limitations of the archaeological record, including problems of site visibility and discovery and artifact preservation. Heavily forested regions, especially in the tropics, present great barrier to site discovery. Cave sites are overly represented due to their high visibility. Many open-air sites are found only by accident during construction or mining projects, as exemplified by the Lower Palaeolithic discoveries at Schöningen in

northeastern Germany[9]. The result is that our knowledge of sites in a region and among regions is rarely representative of prehistoric land use. Taphonomic processes, including slope movement and water flow, can further distort this biased record and differential preservation results in assemblages that usually lack organic remains, or contain only the more durable, large bones[10]. Plant remains are much less often preserved.

2.1. Tool Typologies and Function

Stone artifacts, consequently, are the major class of evidence available, and we try to wrest as much information from them as we can. Stone artifacts, however, pose their own problems. Our tool typologies form the foundation for our interpretations of both cultural identity and activities, but microscopic use-wear suggests that many unretouched artifacts were also used as tools. This observation is supported by ethnoarchaeological studies of Australian aborigines, among whom most "tools" were not retouched[11] . Moreover, different tools were often used for similar activities. In a study of French Middle Palaeolithic tools[12], for example, it was found that the scraping of wood was carried out by eight different formal types of scraper. Similarly, ethnoarchaeological studies by Hayden in Australia led him to infer that "scrapers, notches, denticulates (and burins) are really stylistic variants of the same functional tool"[11]. Furthermore, a single type may have been used in different activities: in the Middle Palaeolithic study, simple convex side scrapers were used not only to scrape wood, but also to scrape hides and to harvest plants. Insights into the function and use of stone tools may be provided by analyses of residues on the tools, both to indicate some aspects of diet[13] and to suggest manner of hafting[14].

Experimental archaeology has alerted us to other considerations. Heavy tool use and resharpening, often common in situations of scarce stone raw material, means that a single tool type can change in form considerably through its lifespan, appearing to represent different formal tool types[15]. Patterns in lithic reduction sequences, such as *chaines operatoires*, may reflect cultural traditions, but they also may be sensitive to the quality and availability of raw material, to the degree of residential mobility, or to the predictability of resources, and therefore highly variable.

2.2. Regional Studies

Regional studies face numerous problems beyond the probability of the biased sample of sites. Excavation techniques, conditions of preservation, and sample sizes vary among sites, making comparisons difficult. Many of us have surely experienced the difficulty of comparing recently excavated sites to those excavated decades ago using different collection techniques. Excavations in the 1930s at the German Upper Palaeolithic site of Petersfels produced an assemblage of relatively large artifacts. Later excavations in the 1970s introduced screening techniques and produced a very different assemblage dominated by very small backed bladelets[16].

Surface collecting produces a very different sort of assemblage from that obtained by

excavation. In a comparison of surface-collected and excavated assemblages from the same Mesolithic sites, for example, it was found that visibility played a major role in creating differences: surface assemblages tended to have larger artifacts, relatively more retouched tools with regular shapes, a greater proportion of heated artifacts due to their brighter color, and fewer artifacts retaining cortex that resembles normal gravel[17]. As a result, differences we observe among sites may not necessarily reflect differences in behavior and lifeways.

Broad contemporaneity of different sites is usually assumed on the basis of stylistic similarities and radiocarbon dates, but this gross chronological scale may mask significant variations in land use through time. An innovative study of three Gravettian sites in one valley in southern Germany found lithic refits among these sites, suggesting their contemporaneity on a more meaningful, behavioral scale[18].

3. Interpretive Constraints

In a broad way, our interpretations of this archaeological record, our attempts to breathe life into the material objects, are based on our knowledge and assumptions about how people generally behave, and in particular, how hunting and gathering people would behave. A knowledge of the ethnographic record of living hunting peoples helps inform these interpretations. This involves the familiar dangers of imposing the present upon the past and of creating rigid stereotypes of such people. By contrast, ethnoarchaeological research over the last decades has emphasized the considerable variability of hunter-gatherer behavior and has provided at least warnings about oversimplification. Many of these warnings have archaeological implications.

3.1. Site Structure

Studies of campsites, for example, document a huge range in camp area, in part reflecting differences in hut spacing. A study of Efe Pygmy base camps in central Africa, which had populations of 4–33, found an average area of 243 square meters, with a range from 44 to 532[19,20]. Aka Pygmies, with a similar lifestyle and similar environment, have a similar average camp size (260 square meters), but a much larger range, from 28 to 1256 square meters, largely due to their larger range of camp inhabitants, from 6 to 67[21]. The determinants of camp area for these and other people such as the !Kung[22] and Kua[23], appear to include not only number of people, however, but also the length of occupation and season. In sites occupied for longer periods, materials tend to be dispersed over larger areas by purposeful dumping and foot traffic. By contrast, a study of the Alyawara Aborigines of desert Australia found campsites to vary from 10,000 to more than 100,000 square meters[24]. Although this much larger size reflects, in part, larger populations (up to 200), a more important determinant is the considerably larger spacing

among household clusters, which in turn appears to be related to the lack of danger from large predators as well as a lower incidence of food-sharing[25]. This enormous variation in camp size, together with the great amount of relatively empty space within the larger settlements, suggests dangers inherent in archaeological definitions of site boundaries. Rarely are excavations large enough to encompass complete sites at the large end of the spectrum, and relatively empty spaces are not necessarily indicative of a site's outer boundary. As a result, our usual excavations may sometimes, or even often, produce only a partial picture of the actual settlement. Excavations in the 1930s of the Upper Palaeolithic cave site of Petersfels in Germany concentrated inside the cave. Later testing in the 1970s revealed that the majority of activities occurred downslope in the front---an area now buried under several meters of deposits[16].

Studies of patterning within sites face similar uncertainties. Sites often contain a variety of artifact clusters, such as the Palaeoindian sites of Lindenmeier in Colorado[26] and the Fisher Site in Ontario[27]. These clusters invite interpretation, and are frequently thought to represent areas of different activities[28]. Ethnoarchaeological research, however, suggests that the degree of separation of activities within camps is variable and is influenced by a variety of factors. These factors may include 1) the type of activity (messy butchering is often separated from other activities), 2) the need for warmth and shelter, and 3) the length of camp occupation. Camps occupied for a longer period are more likely to be disturbed by foot traffic or sweeping; this often results in the dispersal of larger artifacts to the edges of the campsite, as illustrated by studies of the Alyawara Aborigines[24]. Among the !Kung San of the Kalahari, most activities occur around the hearths in front of huts, forming mixed clusters of many activities[22]. The resulting clusters represent household areas rather than single activity areas. Among many arctic and subarctic groups, most activities in winter occur within structures, creating similar clusters unless the huts are cleaned[29]. The question of whether different artifact clusters are contemporary may be partly addressed by refitting of lithic artifacts and the number of refits between different clusters[30].

In many regions, caves are used mainly for storage or temporary shelter from rain, while most activities occur outside. In some cases, activities are moved during the course of a day, as illustrated by observations among Australian groups who shift the location of their activities throughout the day to follow the shade[24]. Reoccupation of a campsite may obscure spatial patterning if the location or types of activities change between occupations. Two Late Palaeolithic sites in southern Germany show this contrast. Both are located on sand spits jutting out into a lake, but one, Henauhof West, appears to have been a single, brief occupation[31], while the other, Kappel, was occupied many times over a long period[32] . Spatial patterns of materials around a hearth are clear in the short-term site, but in the other the artifacts show a relatively uniform distribution across the site. These observations suggest that small, short-term, single-occupation sites may be most likely to preserve spatial patterns of artifacts because they are less likely to be disturbed by sweeping, foot traffic, or subsequent occupation. The more frequent sweeping that is characteristic of longer-term sites is likely to have created its own patterns of size sorting

of artifacts, with only the smallest remaining in the locations of their original use or production. Only careful screening is likely to retrieve these small materials. In contrast to open-air sites, on the other hand, cave sites may show more redundant patterns of space use, since the spatial distribution of activities and artifacts tends to be more constrained by the size of the usable space as well as by the tendency to carry out many activities near the cave mouth.

3.2. Site Function

The determination of site function and activities faces its own set of problems. Stone tool assemblages may be quite useful in many cases, assuming that different activities have specific associated sets of tools. A comparison of two Late Palaeolithic sites in Germany, for example, suggested that one site, dominated by projectile points and backed blades, was a short-term hunting camp, whereas a nearby site, which contained an assemblage of much greater diversity, including scrapers, burins, notches, and borers, was more likely to represent a residential base camp[33]. Unfortunately, such distinctions in lithic assemblages may not always be apparent. A study of Australian aborigines, for example, concluded that there was a "lack of evidence in the lithic material for the seasonal differences in settlement and subsistence," although activities did vary considerably among different seasons[24]. The differences among assemblages that were found appeared to relate largely to the amount and quality of lithic raw material available.

Another category of evidence that often helps in interpreting site function is the site location. Many high altitude Palaeolithic and Mesolithic sites in the European Alps have been interpreted as hunting camps, largely on the basis of their location[34]. The two German Late Palaeolithic sites mentioned above, however, were located within 200 meters of each other along the same lakeshore, even though they were functionally different. Moreover, any particular site can be reoccupied and used in different ways at different times, as suggested by research among the Nunamiut of Alaska[35].

Ethnoarchaeological research among a variety of foraging groups indicates that faunal assemblages, when preserved, have great potential for indicating site function and activities. Distinguishing active hunting from scavenging, for example, may be possible by careful study of animal body parts and butchering marks, as illustrated by studies of the Hadza of East Africa[36-38]. Contrasts between kill sites and base camps based on differential occurrence of animal body parts have been recognized in studies of the Hadza of East Africa[38, 39], the Kua of the Kalahari[40], and the Alyawara of Australia[41].

Newer research techniques hold the promise of contributing significantly to our understanding of prehistoric diets and therefore of the activities at, and functions of, archaeological sites. The illusive role of plant remains, for example, may be suggested by studies of phytoliths[42] and starch grains[43,44]. More general dietary patterns can be revealed by isotopic studies of human skeletal material[45] and dental calculus[46].

4. Challenges

If archaeology is a forensic science, it certainly is a challenging one. Palaeolithic archaeology in particular faces a number of constraints that affect how we do our research as well as the stories about the past that we are able to tell. These constraints pose challenges that should be met with a full recognition of both the problems and potential of archaeological research. In an ideal world our excavations would be much larger and would all utilize the exact same excavation and sampling methods. We would explore well beyond any apparent site boundaries to seek other areas of activity. Cave terraces and downslope regions would be regularly explored along with cave interiors. We would screen all sediments possible to seek flakes, beads and other small artifacts. Microwear would be a consistent part of our lithic examinations. Patterns in the distribution of artifacts by size alone would be a normal component of our analyses. We would give as much attention to small sites as we do to large, multicomponent sites. We would examine artifacts for clusters, but consider alternative interpretations of their meaning.

In the not-so-ideal real world, given limits of time, money, preservation and access, the best we can do is to remember the warnings that microwear analysis and ethnoarchaeology have produced. This would force us to consider as many of the determinants of artifact form and site patterns as possible, to develop multiple hypotheses interpreting their meaning, and to evaluate these hypotheses as well as we can utilizing as many different analytic approaches as possible.

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旧石器考古学的目标、制约和挑战

Michael JOCHIM

美国圣巴巴拉加州大学人类学系

摘要：旧石器研究可以设法解决包括现代人起源和扩散在内的最重大的考古学问题，因此常常会引起公众的关注和想象。要重建旧石器时代人类生活状况显然也面临着很多问题，既有数据局限性导致的实践上的限制，也有试图理解发现本身时遇到的解释性的困难。过去的研究已经证明了实验考古学和民族考古学可以解决其中一些问题，但这也突显了考古学家所面临的限制。

关键词：考古学；旧石器