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Special Assemblages

Participants in the WBRG 1999 Budapest conference (left to right): Ülle Tamla, Elisabeth Brynja, Tina Tuohy, Liina Maldre, Karlheinz Steppan, Heidi Luik, Gitte Jensen, John Chapman, Alice Choyke, Janet Griffitts, Andreas Northe, Noëlle Provenzano, Jörg Schibler, Nerissa Russell, Colleen Batey, Lyuba Smirnova, László Daróczi-Szabó, Daniella Ciugudean, Mária Bíró, Kordula Gostenčnik, Eszter Kovács, Christopher Morris, Sabine Deschler-Erb, Ans Nieuwenberg-Bron, Katalin Simán, Isabelle Sidéra, Mickle Zhilin

CRAFTING BONE - SKELETAL TECHNOLOGIES THROUGH TIME AND SPACE

Proceedings of the 2nd meeting of the (ICAZ) Worked Bone Research Group

Budapest, September 1999

Introduction

Archaeologists and Archeozoologists, both study worked osseous materials (bone, antler and tooth, including ivory, in short all referred to as "bone"). Such reports, however, are often buried at the very back of faunal analyses appended to site reports. Furthermore, the two groups of specialists have had little chance to interact, even within Europe since they tend to attend different conferences and write for different fora.

At the root of this problem lay the arbitrary, largely institutional division between pre- and proto-historians, often imposed on bone manufacturing experts by nothing but formalism in research tradition. The most exemplary series of studies n this field is entitled: "*Industrie de l'os neolithique et de l'age de metaux*" (Bone industry *from the Neolithic and Metal Ages*). Another classic, a book, is sub-titled "The Technology of Skeletal Materials *since the Roman Period*". In very early prehistoric assemblages, attention is often focused on the question of whether a particular piece of bone was worked or not. In later assemblages, it is the intensity of manufacturing that often renders objects zoologically non-identifiable, so that important aspects of raw material procurement, including long distance trade, remain intangible.

The history of raw material use, however, is continuous and many of the constraints and possibilities inherent in skeletal materials are the same whether one is dealing with Paleolithic or Medieval artifacts. Indubitably, the organization of manufacture, the function and value of bone artifacts (as well as some technological innovations such as the regular use of metal tools or lathes), differ substantially between simple and complex societies through time. On the other hand, fundamental questions of tensile characteristics, procurement strategies, style and certain technological requirements are not only similar diachronically, but also open up new vistas when apparently unrelated periods are compared. The function of these objects as social markers, for example, remains remarkably constant through time, even if details vary. The papers in this volume reflect these conceptual similarities and differences as did the papers delivered at the conference itself.

The first meeting of what was to become the Worked Bone Research Group (WBRG) was organized by Dr. Ian Riddler in the **British Museum, London, in January 1997**. The committment and enthusiasm of that first workshop has greatly inspired subsequent efforts in recruiting a wide range of bone specialists, capable of contributing to discussions concerning bone manufacturing.

In keeping with the aims of the Worked Bone Research Group, since 2000 an official working group of the International Council for Archaeozoology (ICAZ), an effort was made to present these papers on the basis of what *connects* them rather than segregating them by archaeological period or region. Contributions mostly include articles based on papers delivered in September 1999 at the second Worked Bone Research Group meeting in Budapest, organized by the editors with the unfailing support of the Aquincum Museum (Budapest) and its staff. Several people who were unable to be present at this conference were also asked to contribute papers. Finally, five of the studies in this volume, originally delivered at a symposium on bone tools organized by Dr. Kitty Emery and Dr. Tom Wake, entitled "*Technology of Skeletal Materials: Considerations of Production, Method and Scale*", at the 64th Annual Meeting of the Society for American Archaeology (Chicago 1999), were added thereby expanding the academic spectrum both in terms of research tradition and geographic scope.

There are a total of 36 papers in this volume. Research was carried out on materials from Central and North America to various regions of Europe and Southwest Asia. The authors represent scientific traditons from Estonia, Hungary, Romania, and Russia, European countries in which, until recently, ideas developed in relative isolation. Other European countries represented include Austria, Denmark, France, Germany, Great Britain, Greece, and Switzerland. Last but not least, the North American scholarly approach is also represented here.

Schools of thought may be said to be exemplified by what used to be Soviet research, well known for pioneering works on taphonomy, experimentation and traceology. Bone manufacturing was first brought to the attention of Western scholars by the publication in 1964 of the translation of S. A. Semenov's *Prehistoric Technology*, published originally in 1957. Scholars in France have also carried out decades of co-ordinated work on operational chains in the manufacturing process from the selection

of raw materials to finished products, with special emphasis on prehistoric modified bone. An entire working group, "Unspecialized Bone Industries/Bone Modification", is directed by Marylene Patou-Mathis. This working group itself is part of a larger research program on bone industry "*La Commission de Nomenclature sure l'Indistrie de l'Os Prëhistorique*" headed my Mme. H. Camps-Fabrer. Several specialists such as Jörg Schibler in Switzerland, have created laboratories where ground laying work has been carried out for years on worked osseous materials, especially from Swiss Neolithic Lake Dwellings and Roman Period sites. Language barriers have often prevented these important bodies of work from being as widely disseminated as they deserve. Arthur MacGregor in England, writing in English, has had a decisive influence on specialists working on more recent Roman and Medieval worked bone assemblages in Europe.

The work of all of these groups as well as certain individual scholars is well known within limited circles. Otherwise, however, the overwhelming experience of most researchers on worked bone have been feelings of isolation and alienation from most archaeological or archaeozoological work related, most importantly, to the absence of an international forum where their often specialized work can be presented and problems discussed.

In spite of the fact that there have been many practical obstacles to information flow between specialists in this field, there are really remarkable similarities of approach which should ultimately lead to the development of more compatible paradigms in research. Agreement on methodologies will have a positive feedback on communications, helping the field to grow and develop properly.

It seems that, at last, archaeologists and archaeozoologists and other specialists are talking to each other and sharing methodologicial points of view. One striking example of this can be seen in the the emphasis on raw materials studied in parallel to types found in the majority of papers in this volume. Previously studies often concentrated on typo-chronological questions, ignoring the questions of raw material morphology and availability. The series published by the *Centre National de la Recherche Scientifique*, edited by Mme. Henriette Camps-Fabrer in France is largely to be credited for beginning this new trend. It contains many papers concentrating on understanding manufacturing sequences and, indeed, from Europe to North America there are papers which explicitly deal with manufacturing sequences in individual assemblages.

There is also a consistent emphasis on experiment and manufacturing techniques present in much of the work in this volume. The related but fraught question of function continues to tantalize and frustrate most specialists. A number of articles attempt to apply techniques of hard science, such as scanning electron microscopy or light microscopy, together with experiment to get objective, "processual" answers to this important group of questions. Other researchers rely deductively on analogy, archaeological context, gross morphology, and textual sources as they try understanding how these objects were used.

When editing the volume, we tried to concentate on the underlying main concepts represented by each paper rather than grouping them diachronically or by geographical region. As a result, contributions follow a line from the theoretical through the problems of raw material selection, manufacturing techniques, experimental work, technical function and socio-cultural interpretations. Obviously many of these papers deal with several of these aspects simultaneously. Finally, analyses of assemblages are grouped to show the current state of general application of these principles as illustrated in papers in the rest of the volume. Reports on bone tool types will ultimately benefit from more unified typologies and also provide researchers with comparitive databases from regions beyond their own.

Finally, a word on the organization of papers in this volume. Although the editors have tried to group these papers by what they see as the main theoretical and methodological thrust of the authors it should be understood that most papers, to a greater or lesser extent, overlap between these artificial sub-titles. Happily, almost all these works include considerations of raw material exploitation, manufacturing and functional analyses and all make some attempt to consider the social context from which these artifacts emerged. It is exactly this cross-cutting of boundaries which allows us to hope that the study of worked osseous materials is well on the way to developing into a discipline in its own right.

In addition to the generous support given by our sponsors and technical editors for this volume, organizing the conference would not have been possible without the active help of numerous colleagues. Special thanks are due to Paula Zsidy, Director of the Aquincum Museum, Katalin Simán, archaeologist and two students from the Institute of Archaeological Sciences (ELTE, Budapest): László Daróczi-Szabó and András Markó. The Hotel Wien, Budapest and its efficient manager provided a comfortable setting for our discussions at a reasonable price. Last but not least, help with abstract translations by Cornelia Becker, Noelle Provenzano as well as Marjan Mashkour and Turit Wilroy should also be acknowledged here.

NEOLITHIC RELATIONS OF PRODUCTION: INSIGHTS FROM THE BONE TOOL INDUSTRY

Nerissa Russell

Abstract: Technology consists not only of tools and techniques used to accomplish tasks, but also includes the social context of these tasks. I will explore the bone industries of Neolithic southeast Europe, Anatolia, and south Asia. I argue that the differences seen among these regions are attributable to the social organization of production, and that the bone industry can provide a window to this social organization. I will focus on raw material selection and conservation, standardization of tool forms, and reuse. These represent decision points in the production process that reflect how manufacturers and users approached bone as a raw material.

Keywords: Neolithic, technology, reuse, standardization

Résumé: La technologie ne concerne pas seulement les outils et les techniques utilisées pour accomplir des tâches données, mais elle inclut également le contexte social dans lequel sont accomplies ces tâches. Nous explorerons les industries osseuses néolithiques du Sud-Est de l'Europe, d'Anatolie et de l'Asie du Sud. Nous montrerons que les différences observables entre ces régions peuvent être reliées à l'organisation sociale de la production, et que les industries osseuses permettent d'approcher cette organisation sociale. Nous nous centrerons sur la sélection et la conservation des matières premières, la standardisation de la forme des outils et leur réutilisation. Ces éléments cristallisent les choix opérés au cours des procédés de fabrication et reflètent la façon dont artisans et utilisateurs ont appréhendé l'os en tant que matière première.

Mots-clés: Néolithique, technologie, réutilisation, standardisation

Zusammenfassung: Technologie besteht nicht nur aus Werkzeugen und Techniken zur Bewaeltigung von Aufgaben, sie schliesst auch den sozialen Kontext dieser Aufgaben ein. Ich werde die Knochenindustrien des neolithischen Suedosteuropa, Anatoliens und Suedasiens untersuchen. Ich vertrete den Standpunkt, dass die in diesen Gebieten beobachteten Unterschiede der sozialen Organisation von Produktion zuzuschreiben sind, und dass die Knochenindustrie einen Einblick in diese soziale Organisation bieten kann. Im Mittelpunkt meiner Untersuchung stehen die Auswahl und Konservierung von Rohmaterial, Standardisierung von Werkzeugformen und Wiedergebrauch. Diese stellen Entscheidungspunkte im Produktionsprozess dar, die den Umgang von Herstellern und Verbrauchern mit Knochen als Rohmaterial reflektieren.

Schlüsselworte: Neolithikum, Technologie, Wiedergebrauch, Standardisierung

Technology consists not only of the tools and techniques used to accomplish tasks, but also includes the social context in which these tasks occur (Dobres 1995; Dobres and Hoffman 1994, 1999; Ingold 1990; Lemonnier 1992; Pfaffenberger 1988). In this paper, I will explore the bone industries of Neolithic southeast Europe, Anatolia, and south Asia. I will argue that the differences among these regions are attributable to the social organization of production, and that the bone industry, in conjunction with other materials, can provide a window to this social organization.

This discussion is based on my study of the bone tools from fourteen Neolithic sites in the former Yugoslavia (Russell 1990), the new excavations at Çatalhöyük in Turkey (Russell, this volume), and from Mehrgarh in Pakistan (Russell 1995; see Table 1). Four of these (Selevac, Opovo, Çatalhöyük, and Mehrgarh) are large, well-collected assemblages from recent excavations and may confidently be considered representative of at least the areas excavated. The remainder are museum collections that often derive from small excavations and that have been subjected to various kinds of selection. They must therefore be used with caution, but can still provide useful information. Given these limitations, I will confine my discussion here to the bone points from these sites. Points are the most frequent tool type in all the assemblages, of obvious importance in the Neolithic, and are generally recognized and curated by the excavators.

I will focus on raw material selection and conservation, standardization of tool forms, tip angle, and reuse. These represent a series of decision points in the production process (*chaîne opératoire*) that reflect how the manufacturers and users of these tools approached bone as a raw material. Since the productive process does not occur in a vacuum, but is embedded in social life, these decisions reflect both the nature of the raw material and the tasks undertaken, and the social relations of the producers and consumers (Dobres 1999).

Raw material selection

The choice of taxon and body part for the bone points appears to be motivated chiefly by practical considerations of size, shape, and strength in all these assemblages (see Tables 2 and 3). Heavier points are made on bones of larger taxa (red deer, cattle), while most points are made on bones of smaller taxa (roe deer, gazelle, sheep, goat). Their shape largely limits points to long bones and ribs. It is only in the Vinča culture assemblages from southeast Europe that rib points are common. Rib points may have been used as multi-purpose tools, burnishing with the flat part of the tool as well as piercing with the tip.

While bone points could have been used in a variety of tasks (e.g., sewing leather or cloth, weaving, basketry, decorating pottery), they must surely have functioned primarily as perforators. Perforation places considerable stress on the tip of the point (Bouchud 1977), no doubt accounting for the large number of fragmentary points found in most assemblages. The strength of the bone is thus an important consideration. While we lack complete information on the relevant physical properties of the bones available to prehistoric bone tool makers and users, testing of modern materials has revealed certain patterns: pig bone is less strong than that of cattle, horse, or deer; wild animals have stronger bone than their domestic counterparts; and within the body, the radius and tibia are stronger than the humerus and femur (Albrecht 1977, Evans 1973, Yamada 1970). Unfortunately, I have been unable to find test data for metapodials, a favorite material in most prehistoric bone industries, but they are dense and seem strong in comparison to the other long bones, and due to their shape are easily split.

Raw material selection in these assemblages tends to follow these patterns. Bone tool manufacture often obliterates the diagnostic characters needed for identification of taxa and body parts, so many tools can only be placed in general categories such as medium (sheep-sized) vs. large (cow-sized) mammal or indeterminate long bone. Moreover, ribs, which are commonly used in the Vinča assemblages, are easy to identify as a body part, but generally not identifiable to species even when complete. At Mehrgarh, many of the tools from the earlier seasons were available only in the form of their catalog entries, thus precluding precise identifications. Nevertheless, there is a clear preference for wild taxa in those points that can be identified to species in all the assemblages with a reasonable sample size. Wild animal bone often predominates, and, with the exception of the small sample from At, always exceeds its proportion in the general fauna from the site where this is known (see Table 4). Pig bone is rarely used, although pigs, both wild and domestic, are quite common in the southeast European assemblages. Çatalhöyük cannot be evaluated in terms of usage of wild vs. domestic bone, as we have not yet determined which, if any, of the animals present were domestic. The overwhelming predominance of sheep/goat (mostly sheep) in the bone points from Çatalhöyük (almost 95% if we include the medium mammal category, which are most likely mainly sheep/goat) is even greater than the proportion of these taxa in the general fauna (63%). This is probably related to the predominance of slender rather than heavy points at the site. Among the body parts, metapodials and to a lesser extent tibias are heavily favored, as well as ribs at the Vinča sites.

While the size, shape, and strength of the bone are clearly of great importance in raw material choice, it should be noted that there is still a good deal of variation among the assemblages, and that less optimal bones are sometimes used. Some of the variation no doubt reflects different sets of tasks carried out at the various sites, and some results from expediency. A user seeking only a quick and dirty solution for the task at hand may be less selective than someone who sets out to make a bone point as part of a curated toolkit. I also have the impression that groupings of similar forms on similar materials reflect the tastes of individual bone tool makers and users, and may have been one way of expressing identity. Additionally, we should bear in mind that the choice of wild vs. domestic bone, or a particular taxon or body part, may well have had symbolic value at which we can only guess (Hodder 1990).

Splitting

Both ribs and long bones can be split longitudinally, thus maximizing the yield from a given amount of raw material, as splitting can result in two or even four points instead of one. This is at the price of additional labor to effect the splitting, however. Thus splitting may serve as an index of the value of bone as a raw material. As can be seen in Table 5, there is a high proportion of splitting at all the sites studied here. Period II at Mehrgarh, the period with the most intensive bone tool industry, has the highest rate of splitting of the larger samples. Splitting proportions from the later, Bronze Age periods at Mehrgarh are presented by way of comparison. I have found that Bronze Age assemblages in Europe also tend to have relatively low proportions of splitting. Thus bone is treated as a valuable resource during the Neolithic in all these regions, but bone lessens in importance with the advent of metal tools.

Standardization of form

Standardization is more difficult to quantify, but there can be striking differences in the degree to which assemblages sort neatly into distinct types. Standardization may reflect a closer matching of the tool to the task and increased task specialization. These might result from a desire to increase production to meet a rising demand due to population growth, increased exchange, or the perceived need for prestige goods. To the extent that it involves modification of the base end of the point, standardization may also reflect technological factors such as hafting. Standardization is achieved through greater modification, and thus involves greater labor input.

Çatalhöyük and the southeast European sites show little standardization: the points do not divide easily into subtypes. In

Site	Period	Culture/ Period	# of Tools	# of Points	Museum
Donovac	early Neolithic	Starčevo	17	10	Suvobarajevo
Sajan	early Neolithic	Körös	30	13	Kikinda
Ludaš	early Neolithic	Körös	27	17	Subotica
Gradište	middle-late Neolithic	Tisza	12	8	Kikinda
Ašt	late Neolithic	Lčin	48	30	Vršac
Potporanj	middle Neolithic	Lčin	67	65	Vršac
Vinča	late Neolithic	Vinča	142	105	Savezno
Kalanj	middle Neolithic	Kalanj	16	13	Savezno
Donja Tuzla	middle-late Neolithic	Lčin	13	4	Tuzla
Kosnj	middle-late Neolithic	Lčin	2	1	Tuzla
Bukinje	middle-late Neolithic	Lčin	6	1	Tuzla
Donovac 'Slatina'	middle-late Neolithic	Lčin	5	3	Suvobarajevo
Selevac	middle-late Neolithic	Lčin	1032	517	Smederevska Palanka
Opovo	late Neolithic	Lčin	694	336	Pančevo
Çatalhöyük	early Ceramic Neolithic		413	192	Konya
Mehrgarh	Aceramic Neolithic	Period I	797	641	Karachi
Mehrgarh	Ceramic Neolithic	Period II	678	585	Karachi
Mehrgarh	Chalcolithic	Period III	208	84	Karachi

Tab. 1 Assemblages used in this study

Count /Percent Site	*Ovis/ Capra*	*Cervus*	*Bos*	*Sus*	*Cervus*	*Capreolus*	Equid	*Lepus*	Carnivore	Small-Medium Mammal	Medium Mammal	Large Mammal	Indeterminate Mammal	Bird
Donovac	1 /10.0										1 /10.0	8 /80.0		
Sajan					2 /15.4	4 /30.8					2 /13.4	5 /38.5		
Ludaš	4 /23.5				1 /5.9	3 /17.7					7 /41.2	2 /11.8		
Gradište	1 /12.5					4 /50.0					1 /12.5	2 /25.0		
Ašt	3 /10.0		2 /6.7								2 /6.7	23 /76.7		
Potporanj			6 /9.2								9 /13.9	50 /76.9		
Vinča	16 /15.2		2 /1.9		4 /3.8	7 /6.7		1 /1.0	2 /1.9		44 /41.9	27 /25.7		2 /1.9
Kalanj											13 /100			
Donja Tuzla											2 /50.0	2 /50.0		
Kosnj					1 /100									
Bukinje											1 /100			
Donn. 'Slatina'												3 /100		
Selevac	6 /1.2		2 /0.4	2 /0.4	6 /1.2	7 /1.4		1 /0.2	1 /0.2		75 /14.5	417/80.7		
Opovo	12/3.6		1 /0.3		10 /3.0	84 /25.4			1 /0.3		87 /23.9	136/41.1	1 /0.3	
Çatalhöyük	143/74.5		1 /0.5		2 /1.0	1 /0.5	2 /1.0			1 /0.5	39 /20.3	3 /1.5		
Mehrgarh I	22 /3.4	11 /1.7			3 /0.5						172/26.8	14 /2.2	421/65.7	
Mehrgarh II	20 /3.4	3 /0.5			3 /0.5						193 /33.0	92 /15.7	274 /46.8	
Mehrgarh III	7 /8.3	3 /3.6									65 /77.4	8 /9.5	1 /1.2	

Tab. 2 Taxa used for bone points

Count / Percent Site	Scapula	Humerus	Radius	Ulna	Femur	Tibia	Meta-podial	Long Bone	Rib	Mandible	Antler	Boar's Tusk	Indeter-minate
Donovac							1 /10.0	2 /20.0	7 /70.0				
Sajan							4 /30.8	3 /23.1	4 /30.8		2 /15.4		
Lnáře			1 /5.9	1 /5.9		1 /5.9	8 /47.1	5 /29.4	1 /5.9				
Gradište							6 /75.0		2 /25.0				
Ať				3 /10.0			6 /20.0	6 /20.0	15 /50.0				
Petronell	2 /8.1			1 /4.5			5 /7.7	32 /49.2	23 /35.4	2 /3.1			
Kiiri			2 /4.9	3 /7.9		10 /26.3	38 /36.2	46 /43.8	6 /5.7				
Kalani							10 /76.9	3 /23.1					
Donja Tuzla							3 /75.0		1 /25.0				
Fonj							1 /100						
Bóbbio							1 /100						
Donovac 'Slatina'								1 /33.3	2 /66.6				
Salvan				2 /0.4			83 /16.0	110 /21.3	320 /61.9			2 /0.4	
Opovo	2 /0.6		1 /0.3	1 /0.3			161 /47.9	38 /11.3	131 /39.0		2 /0.6		
Çatalhöyük		1 /0.5	4 /2.1	1 /0.5		15 /7.8	132 /68.8	36 /18.8	1 /0.5		2 /1.0		
Mehrgarh I			1 /0.2			6 /0.9	75 /11.7	141 /22.0	9 /1.4		3 /0.5		406 /63.3
Mehrgarh II		1 /0.2				24 /4.1	111 /19.0	202 /34.5	6 /1.0		3 /0.5		238 /40.7
Mehrgarh III			1 /1.2		1 /1.2	16 /19.1	10 /11.9	54 /64.3	2 /2.4				

Tab. 3 Elements used for bone points

Site	%n Points on Wild Fauna (N)	Approximate %n Wild in General Fauna
Sajan	100.0 (6)	45
Gradište	80.0 (5)	40
Ať	42.9 (7)	45
Salvan	10.7 (28)	25
Opovo	88.2 (110)	75
Mehrgarh Period I	75.0 (36)	50
Mehrgarh Period II	50.0 (24)	5
Mehrgarh Period III	55.6 (9)	25

Mehrgarh general faunal proportions from Meadow 1993; Gradište and Sajan from unpublished manuscript by Sándor Bökönyi on file at Ráckeve Museum; remaining assemblages analysed by the author.

Tab. 4 Proportion of wild fauna

Site	%n Split (N)
Donnovac	100.0 (10)
Sajan	76.9 (13)
Lvalo'	76.5 (17)
Gradi'te	100.0 (8)
At	87.5 (32)
Potporanj	98.5 (66)
[illegible]	90.0 (100)
Kalanj	100.0 (13)
Donja Tuzla	100.0 (4)
Koraj	100.0 (1)
[illegible]ic	100.0 (1)
Donnovac 'Slatina'	66.7 (3)
Salavac	80.7 (403)
Opovo	91.1 (314)
Çatalhöyük	89.5 (153)
Mehrgarh Period I	80.9 (209)
Mehrgarh Period II	97.2 (331)
Mehrgarh Period III	85.1 (47)
Mehrgarh Periods IV-VII	59.5 (42)

Tab. 5 Proportion of splitting

Site	%n Reused (N)
Donnovac	20.0 (5)
Sajan	80.0 (5)
Lvalo'	40.0 (10)
Gradi'te	25.0 (4)
At	10.0 (20)
Potporanj	7.0 (43)
[illegible]	12.9 (85)
Kalanj	54.5 (11)
Donja Tuzla	75.0 (4)
Koraj	100.0 (1)
[illegible]ic	0.0 (1)
Donnovac 'Slatina'	50.0 (2)
Salavac	5.2 (345)
Opovo	69.4 (184)
Çatalhöyük	87.2 (125)
Mehrgarh Period I	88.2 (388)
Mehrgarh Period II	76.5 (340)
Mehrgarh Period III	92.3 (91)
Mehrgarh Periods IV-VII	40.9 (22)

Tab. 6 Proportion of Reuse

the Körös, Tisza, and Hvar culture assemblages, there is to some degree a distinction between expedient points that have minimal modification (snap the bone, sharpen the tip) and more carefully finished points requiring more effort to manufacture. This probably reflects the length of time the maker expects to curate the point. This could be related to the kinds of tasks the points are used in, but more likely is a gauge of the intensity of these activities and the organization of labor: making expedient tools as needed makes sense for people who perform a task only occasionally. In the Vinča culture assemblages, this dichotomy is not evident, with most tools relatively carefully finished. At these sites, then, there may have been more intensive production of whatever goods were manufactured with the bone points (textiles, leather goods, basketry?), or else greater task specialization such that certain people were engaged in these tasks more regularly.

At Mehrgarh, standardization is much more developed. Period I resembles the Vinča sites, in that the points do not subdivide readily into subtypes. In Period II, several subtypes are clearly discernible, reflecting increased standardization accomplished primarily through greater modification. This increased manufacturing effort is surely related to a reorganization of labor in the direction of greater task specialization. This same trend is also reflected in increased spatial differentiation of activities in Period II at Mehrgarh. Copper tools appear during Period III, and bone tools become more scarce and less standardized. (Bone pottery polishers become common, however, reflecting the beginning of mass production of pottery at Mehrgarh [Jarrige 1984]). The Bronze Age periods at Mehrgarh show little standardization in the bone industry apart from a fairly pronounced expedient/carefully finished dichotomy among the relatively small number of bone tools present. European Bronze Age assemblages appear to follow this same general pattern.

Reuse

After the point has been manufactured and used, its use life can be extended by resharpening, repair, reworking into a different kind of tool, or simply reuse in a different task without reworking. All of these occur in prehistoric assemblages, but resharpening is by far the most common. Again, this involves investing extra labor to get more use out of a given quantity of bone. It also reflects a greater degree of attachment to (identification with?) the tool. It is in the amount of reuse that the most striking differences can be seen between Mehrgarh and Çatalhöyük as opposed to the southeast European sites, as well as among the sites within southeast Europe, and among the periods at Mehrgarh (tab. 6).

Most of the southeast European Neolithic sites have quite low rates of reuse. (Selevac, studied before I became highly sensitized to resharpening, probably has a somewhat higher rate than represented here. I doubt that I missed any substantial number of resharpened points, however, and this seems to be confirmed by the low resharpening rates at many other southeast European sites.) There seems to be little concern for extending the use life of the points.

The assemblages that deviate from this rule, most notably Opovo, appear to result from a differing balance of activities using bone points. There is a strong correlation between tip angle and resharpening rate. Tip angle is measured slightly back from the very tip of the point, so that it is a rough measure of the robustness of the tip. Every southeast European assemblage with a reasonable sample (more than 10 points with tips preserved) that has over 50% slender point tips (less than or equal to 20°) also has more than 50% of the points exhibiting reuse, chiefly resharpening. Likewise, those with less than 50% slender tips have less than 50% resharpening. In fact, the assemblages fall rather clearly into two groups: one characterized by high rates of resharpening and high proportions of slender points; the other by very little resharpening associated with very few slender tips (fig. 1). Çatalhöyük fits with the first group, with the strongest association of all between resharpening and slender tips.

This is perhaps not too surprising. Since slender tips are more delicate, they are presumably used because one needs a sharp tip for piercing. If they dull with use, they must be resharpened to maintain their viability for the task. Heavier points would be used when sharpness is less crucial to begin with. The slenderer points would also be more likely to break and need repair. It seems very likely, then, that slender tips are used for a different task or tasks than the heavier tips, something that requires a truly sharp point. Unfortunately, the present state of microwear analysis of bone tools does not permit distinction of most contact materials, so we cannot make a direct determination of what these tasks might be. The obvious candidates are sewing hides, leather or cloth; and certain types of basketry that require sharp awls. Whatever the task or tasks, it seems to have been of particular importance at Çatalhöyük. The extensive evidence for textile manufacture at the site suggests this is a likely candidate (Mellaart 1967).

In any case, the clear separation between the sets of assemblages suggests that there is some degree of specialization in certain kinds of production at the level of the settlement. Most of these sites appear to be settled, year-round villages; this is surely true of Selevac and Opovo. The functional differences, then, are unlikely to be logistical or seasonal. Rather, they imply production for exchange. Other evidence suggests that exchange was particularly important at Opovo, and may even have been its *raison d'ętre* (Russell 1993, Tringham et al. 1992, Tringham et al. 1985).

There is a different dynamic at work at Mehrgarh. As can be seen in fig. 1, the high levels of reuse are not associated with particularly high quantities of slender-tipped points; in fact, there is a negative correlation. There is also a trend to decreasing reuse through time, especially after Period II. Even the 40.9% reuse rate of the Bronze Age periods at Mehrgarh is higher than most of the southeast European Neolithic sites, however. This indicates that bone is being treated as a valuable resource to be used as fully as possible.

I would argue that bone for tools is more valuable at Mehrgarh because it is in effect scarcer. This is not because suitable animals are unavailable in the environment, but because of the social structure. It may be hard to imagine how bone could be hard to come by when so much of it is produced as a by-product of meat consumption. However, if the preferred material comprises a limited number of body parts from wild animals (primarily metapodials and tibiae), if the bone needs to be reasonably fresh and perhaps uncooked to retain its full strength, and if not everyone is a hunter and access to wild animal bone is controlled by those who are, the prime raw material for bone points begins to seem much rarer.

Much of this would also apply in Neolithic southeast Europe and at Çatalhöyük. I would argue, then, that the crucial difference is a social one. There is some evidence for a fairly developed division of labor from the very beginnings of the Mehrgarh sequence, in the form of well-differentiated activity areas. Moreover, several Period I burials, each interred with five infant goats arranged in a semi-circle around the feet, raise the possibility that these individuals were specialized herders (Meadow 1984). If there were specialized goatherds, there may also have been specialized hunters. Such hunters would have the opportunity to control access to prime tool-making bone, presumably in exchange for other goods. Greater occupational specialization at Mehrgarh may have brought about the intensified use of bone seen in the Neolithic periods, only to fade away as bone became less important following the introduction of metals.

Specialized production such as seems to have occurred at Mehrgarh implies relations of barter as opposed to the autonomous households bound in gift relationships that are believed to have characterized the Neolithic of southeast Europe (Bender 1978, Bogucki 1993, Greenfield 1991, Sherratt 1982, Tringham and Krstić 1990). That is, Mehrgarh, perhaps from the very start, tended more to organic than to mechanical solidarity. Supra-household organization, in the form of large compartmented buildings that may have been public storage facilities, appears in Period II at Mehrgarh and these buildings become increasingly large and elaborate through the sequence. By Period III, pottery is being produced on a scale that can only be termed mass production (Jarrige 1981, 1984; Lechevallier and Quivron 1981; Vandiver 1995; Wright 1991, 1995). In southeast Europe and apparently at Çatalhöyük, on the other hand, it is the individual houses that are elaborated. Households compete for status, but resist the imposition of a higher authority or the loss of household self-sufficiency (Russell 1990, 1993; Tringham and Krstić 1990).

It is hard to know how this difference in values and social organization came about, but the consequences were profound. As we can see through the bone industry, among other indications, Mehrgarh, Çatalhöyük, and the cultures of southeast Europe all experienced intensified production during the Neolithic, perhaps even centered around the same products, such as textiles and ceramics, and possibly agricultural produce, and using very similar technologies. The social context in which this production was embedded, however, led to rather different results. The more rigid roles and interdependent structure of Mehrgarh society encouraged the rapid development of craft specialization, while southeast Europe's households and those of Çatalhöyük remained more independent, with production geared to prestige competitions.

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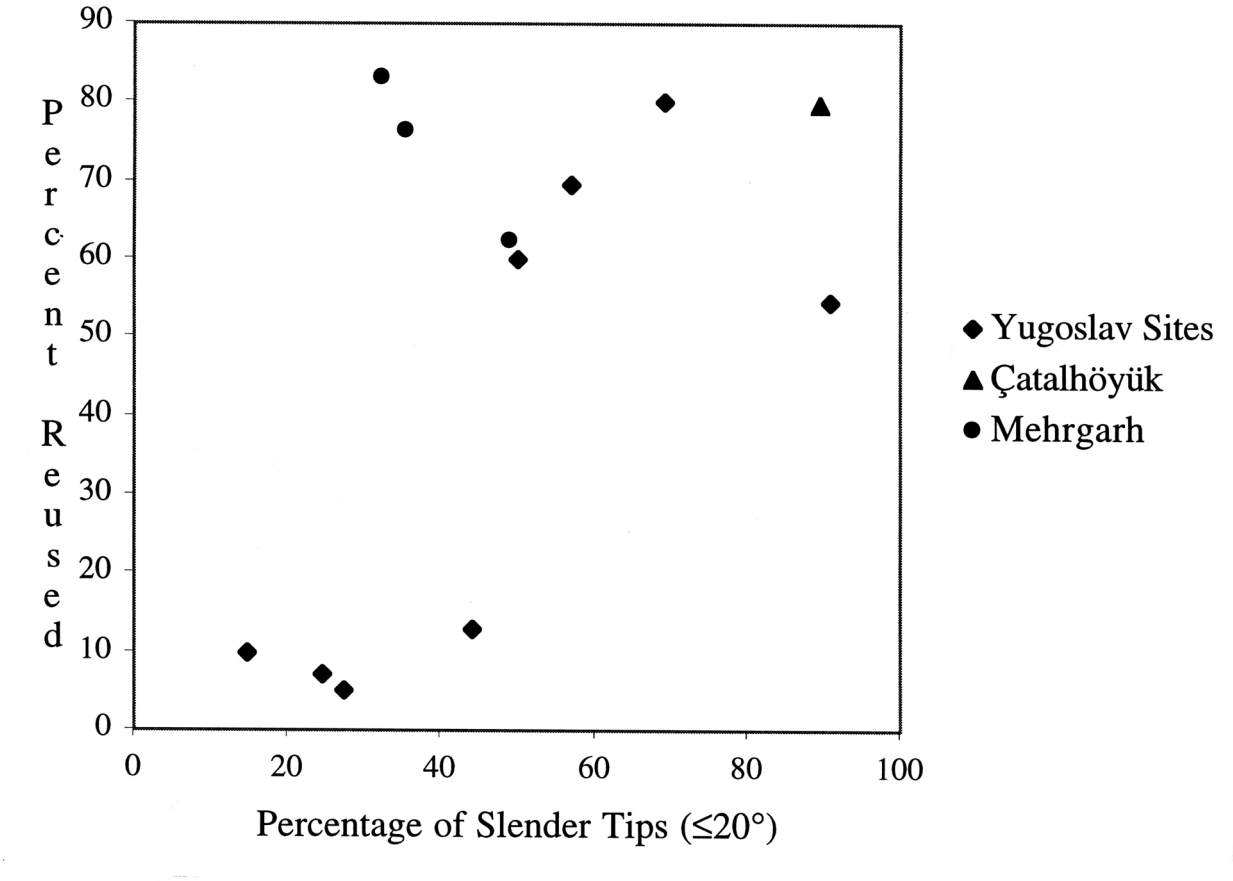

Fig. 1 Tip angle and reuse