CRAFTING BONE – SKELETAL TECHNOLOGIES THROUGH TIME AND SPACE

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

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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

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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.

STUDY OF BONE TOOLS FROM THREE LATE/FINAL NEOLITHIC SITES FROM NORTHERN GREECE

Rosalia Christidou

Abstract: The late Neolithic deposits of Thermi B and Vasilika, and the final Neolithic ones of Megalo Nisi Galanis yielded manufacture waste in addition to finished products. This permitted a detailed description of the complex methods of tool manufacture. It further contributed to the definition of two major systems of tool production:
1. A specialized system, based on relatively complex sequences of reduction of ribs and long bones.
2. A simpler one, based on fracturing or sorting fragments of long bones out of kitchen or butchery refuse.
The two raw materials must be treated separately both because there are significant differences in their respective methods of manufacture, and also because they do not overlap in terms of tool types. Focus will concentrate on the methods of manufacture.

Keywords: Greece, late/final Neolithic, production systems, sequences of reduction, rib, long bones

Résumé: Les dépôts du Néolithique récent de Thermi B et de Vasilika et restes les dépôts du Néolithique final de Megalo Nisi Galanis - Fig. 1 - ont livré en plus des objets finis des de fabrication. Cela a permis une description détaillée des méthodes complexes de fabrication et a également contribué à définir deux systèmes de production d'outils:
1. un système spécialisé, fondé sur des séquences de débitage relativement complexes, de côtes et d'os longs.
2. un système plus simple, fondé sur la fracturation et le tri de fragments d'os longs dans les rejets de cuisine et de boucherie.
Il faut aborder séparément ces deux types. Les deux matières sont examinées séparément parce que à chacune des deux correspondent des processus techniques et des types d'outils spécifiques. L'accent est mis sur les processus.

Mots-clés: Grèce, Néolithique récent/final, systèmes de production, chaînes de débitage, côtes, os longs

Zusammenfassung: Die neolithischen Schichten aus Thermi B und Vasilika sowie die spätneolithischen Schichten in Megalo Nisi Galanis enthielten sowohl Produktionsabfall als auch Fertigprodukte. Dies gestattete eine ausführliche Beschreibung der komplexen Methode der Artefaktherstellung und trug dazu bei, zwei der wesentlichen Produktionssysteme für Artefakte zu definieren:
1. Ein spezielles System, welches auf einer Reihe reduzierender Arbeitsschritte an Rippen und Langknochen beruht (chaîne débitage).
2. Ein einfacherer Prozess, der sich auf das Zerteilen bzw. Aussortieren von Fragmenten von Langknochen aus dem Küchen- oder Schlachtabfall beschränkte.
Im vorliegenden Beitrag werde ich ausschließlich die Verwendung von Rippen und Langknochen behandeln. Diese beiden Ausgangsmaterialien müssen getrennt voneinander betrachtet werden, da sie unterschiedlichen Verarbeitungsprozessen unterliegen und sich hinsichtlich des Artefakttypus nicht überschneiden. Im wesentlichen sollen hier der Herstellungsprozesse im Mittelpunkt stehen.

Schlüsselworte: Griechenland, Spätneolithikum/Endneolithikum, Produktionssysteme, Fabrikationsabläufe, Rippen und Langknochen

Introduction

The late Neolithic deposits of Thermi B and Vasilika, and the final Neolithic ones of Megalo Nisi Galanis (abbrev. M.N. Galanis) - fig. 1 - yielded manufacture waste in addition to finished products. This permitted a detailed description of the complex methods of tool manufacture and further contributed to the definition of two major systems of tool production:

1) A specialized system, based on relatively complex sequences of reduction (chaînes de débitage) for ribs and long bones.
2) A simpler one, based on fracturing or sorting fragments of long bones out of kitchen or butchery refuse. Due to the lack of taphonomic data, it is impossible to differentiate fracturing for tool making from fracturing for other purposes.

Antler and scapulae also served as raw materials in tool manufacture. These bones occur rarely on the sites. In the description that follows, we deal with ribs and long bones. These two raw materials must be treated separately both because there are significant differences in their respective methods of manufacture, and also because they do not overlap in terms of tool types. We will focus on the methods of manufacture.

Ribs

The methods applied to work the ribs largely depended on the structure and the dimensions of the bones themselves. As a rule, ribs of large mammals were selected and split to separate the external from the internal "blade" of the bone. A few small ribs were also used. These were only shaped and used although there are also a few small ribs that were split (or prepared to be split) preliminarily to shaping.

We will discuss here the split bone. Observations are based on forty-two items, twenty-two being manufacture waste and twenty finished products.

Methods of manufacture are shown in figure 2. The rib was cut to size. The techniques were sawing and chopping: the compact bone was removed by using a tool with a sawing or chopping motion. When the inner spongy tissue was reached, the rib was snapped in two. The segment, ca.110-230 mm long, was then prepared for splitting. Preparation consisted in eliminating the compact bone along the two edges of the rib and exposing the cancellous bone. The techniques used were abrasion and chopping. Experiments have shown that elimination of one edge at least is necessary in order to split the rib (Sidéra 1993: 149, Christidou 1999: 77-78).

The "débitage" products, two slightly curved blades (sequence C, fig. 2), were identical due to the natural structure of the bone. One or both products could further be divided into narrower blades (sequence C2, fig. 2) by grooving or by fracture. The products could also be shaped directly on the core (sequences A and B, fig. 2), so that after splitting only smoothing, by abrasion, of the spongy inner face of the blade was left to do. The core was shaped as follows: one end was narrowed by fracture (sequence A) and then beveled on both faces by abrasion to form a convex edge. The other end and the lateral edges of the core were simply smoothed by abrasion. In another case (sequence B), the edge was straight.

The sequences described above were specialized in terms of tool types. The larger blades (>19 mm) were used to make edged-tools. Sequence A served one particular purpose: the manufacture of long, flat tools with a convex edge. Reconstruction of this sequence was based on nine items, cores and unfinished as well as finished products.

Sequence B is hypothetical. There is only one product with a straight edge. This is a finished product, beveled on both its inner and outer margins (fig. 3.1). Being heavily used, it is impossible to say whether the outer margin was abraded before or after splitting. The form of this object may have been the result of a change in the plans of the manufacturer. There is a narrowing of the beveled end. Also, the manufacture of the tool is expedient: one of the natural edges, the caudal one has not been eliminated; the opposite edge and the spongy face have not been smoothed. It is thus possible that the initial plan was the manufacture of a blade with a convex edge.

The narrower products (<13 mm) were used to make points. These had a straight base and a triangular shape (sequence C2, fig. 2). However, one fragment of point has been found with a chamfered base.

The débitage of the ribs is a demanding task. It is established that only fresh ribs can be successfully split (Sidéra 1993:149, Christidou 1999: 78). Elimination of the edges and selection of rather thick parts of the ribs – at least 7 mm thick – with even profiles, such as the ventral half of the ribs of large bovids can provide[1], not only facilitate splitting but provide conditions for obtaining products with regular shapes, for example, blades without a natural edge or part of it attached (Christidou 1999: 77-78, 99-100).

Nevertheless, not all ribs were carefully selected. This is observed for the final Neolithic component of the sample, where one finds thin and thick ribs, large, medium-large and small ones (fig. 3.1-2). Preparation of the core, as well as shaping of the tools before or after splitting the core may also have been expedient. As a result, one can observe accidents, like the partial splitting of the segment (fig. 3.2). Defective products with irregular shapes or with a surplus of bone matter on them are also found (fig. 3.1). As a rule, defective products and partially split segments were rejected but some of them were used in the final Neolithic at M.N. Galanis. In no case was the raw material used with economy. There are partially prepared cores that were discarded before any attempt to split them was made. Unfinished products, not defective ones, were also rejected.

Expedient work and choice of ribs unsuitable for splitting may reflect an opportunistic behavior although it might also be thought that a bad choice of raw materials reflects a lack of technical knowledge or experience. Indeed, there is evidence of unskilled individuals trying to reproduce the methods described above, in particular sequence A. One can observe on one and the same object (fig. 3.3) failure to relate a particular action to a particular result, insufficient control of the gesture or unreasonable persistence on a piece of work although this is clearly unproductive or wrong.

Could this imply specialization in the production of rib tools or could it simply be evidence of novices, learning how to work the bone? Training is difficult to prove since we lack not only contextual data but also clear evidence of gradual improvement of the skills of the individuals (Roux & Pelegrin 1989: 39-42). But one can accept that somewhere or somehow, someone was learning to work the ribs.

On the other hand, the manufacture of the rib tools should not be detached from the domestic context of production and use since we lack evidence for standardization of the production[2], redistribution, use and discard of the tools away from the usual refuse areas of the habitat.

Evidence for use of the rib tools is poor. The sample of finished products is a small one (20 items). Fragmentation as well as rejuvenation and recycling also mask wear traces. It is presently impossible to explore specialization in the use of the rib tools.

Long Bones

The long bones of small (sheep/goat size) and large (cow size) mammals were worked in different ways. The well known groove-and-split method, used to divide the bone lengthwise, was applied to produce blanks of points. Points were also shaped on splinters and rarely on the splintered ends of transversally broken bones. These fragments as well as splinters were also used to make edged-tools. A couple of splinters were used to make tools with rounded ends. Points and edged tools represent the principal tool categories.

We shall examine now the variants of the groove-and-split method. One variant consisted of cutting two parallel grooves deep enough into the bone, which was then broken along the traces of the grooves. A particular method was used to divide the large metapodials. This method is known as "débitage au quart" (Sidéra 1993:136): the metapodial was grooved not only along its posterior and anterior faces but also laterally and medially. Four blanks, quite similar in shape and size, were thus produced. As opposed to this method, small metapodials were only split in two. If the metapodials were also transversally cut in the middle of the shaft, the number of the blanks produced would be doubled. But there is no evidence of such a practice at the sites dealt with here.

The use of double grooving decreased significantly from the latest part of the late Neolithic onwards. Only two objects dated to the final Neolithic bear the marks of two grooves. Interestingly, these are defective products. During the final Neolithic, the débitage was guided by a single groove (fig. 4.1). This is a development towards the use of a more risky but a less time-consuming method of reduction. At the same time, however, a rather complex and time-consuming method appeared. This is the grooving-and-splitting of small metapodials, which had been previously abraded on both anterior and posterior faces to flatten them (fig. 4.2). In this case also, only one groove was cut.

Abraded and grooved metapodials represent only a small portion of the total of grooved bones at M.N. Galanis (12/28 items). The method was not generalized. In fact, there is evidence of individuals incapable of reproducing the sequence (4/12 items, fig. 4.3), as in the case of the ribs. Also, raw material was wasted, at least at the late Neolithic sites. Twelve out of a total of twenty-five grooved bones are manufacture waste. At M.N. Galanis, only seven out of a total of twenty-six grooved bones are manufacture waste. Five out of seven are defective products.

The products of the sequences described above were very similar in shape and size. These fragments had straight shafts with parallel or sub-parallel sides and a convex-concave cross-section no larger than 12 mm (fig. 4.1). It is difficult to define the initial length of the blanks. This is the result of the intense fragmentation of the material. Available data suggest blanks were between 80-120 mm in length.

The method applied to shape the products was a standard one. We have called it "procédé A" (Christidou 1999:124-128). The split surface was flattened by abrasion (fig. 4.2). The axis of symmetry of the plan thus created guided the narrowing of the sides from one end to the other. The tip of the point was then abraded to shape. The same method was used to shape splinters having the same general morphology and the same dimensions as the blanks described above. As a result, independently of the origin of the blank, the shape and the size of the points were similar. The majority of the points made of long bones and having preserved technical information to analyze are of this type (37/57 items). In all cases, the final product had a roughly triangular shape, but the base of a couple of points shaped on blanks extracted from abraded metapodials was narrowed, bilaterally, by abrasion. The final Neolithic sample also contains a few bipoints (4 items).

The points described above are faintly differentiated from a few ones (13 items) that do not have a flattened split surface. However, modification of the latter also extends all the way from the tip to the base. In addition, these tools are quite similar in shape and size to the points with a flattened split surface. They were shaped on splinters but the late Neolithic sample contains a couple of blanks extracted from grooved bones and not flattened on the split surface. It appears that there was a general pattern, a model of a point, usually reproduced when a point was needed. Of course, the production was not a standardized one.

The other points made of long bones, except in the case of a curved implement, show a narrowing of the active area (fig. 5.1). These tools were shaped on splintered shafts. Generally, modification was restricted to the area near the tip. Occasionally, the base was also treated.

Narrowing is also observed on recycled points of the first category (fig. 5.2). Otherwise, these tools were re-shaped by abrasion or shaving without major changes to the general form (fig. 4.2).

The technology of the points shows more variability compared to their general morphology and dimensions. Should one consider this characteristic as an indication of limited functional variability or were similar forms used in different ways? An experimental program was established. Analyses of macrowear and microwear formation were undertaken (Christidou 1999). The results, having more a methodological value than a statistical one in the case of the archaeological sample, will not be presented here. It is only a reminder that it is microwear, together with detailed analysis of the morphological characteristics of the tools that can provide a solid basis to explore modifications related to use.

The edged tools were shaped on splinters (fig. 5.3) and on the splintered ends of transversally broken bones, mostly of small mammals (fig. 5.4). Very often, modification was restricted to the active area but the base of the tools made by indirect percussion was also shaped (fig. 5.3-4).

The shape and the dimensions of the edged-tools vary. Their general form is not patterned. One can accept that to a certain degree this is due to the origin of the blanks of the tools. Still, differences in edge width and shape as well as of the angle of the edge cannot be explained on these grounds. As in the case of the points, functional analysis is based on morphological details and use wear-and-tear.

Conclusions

In contrast with the general idea that bone tool manufacture at the Neolithic sites of northern Greece was a simple task, examination of the methods of manufacture of the principal tool categories found at three sites in the region showed diversity of products, coexistence of advanced and of simple manufacturing methods, and even variations in the skills of the manufacturers. Also, chronological variations are present. These concern the complex systems of production. It seems that technological analysis provides a good basis for examining the non-standardized bone products found at these sites.

Acknowledgements

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Notes

[1] Indeed, there is archaeological evidence of preference for the ribs of large bovids. These ribs are quite flat with regular shapes.

[2] In fact, one may observe the opposite tendency for the final Neolithic.

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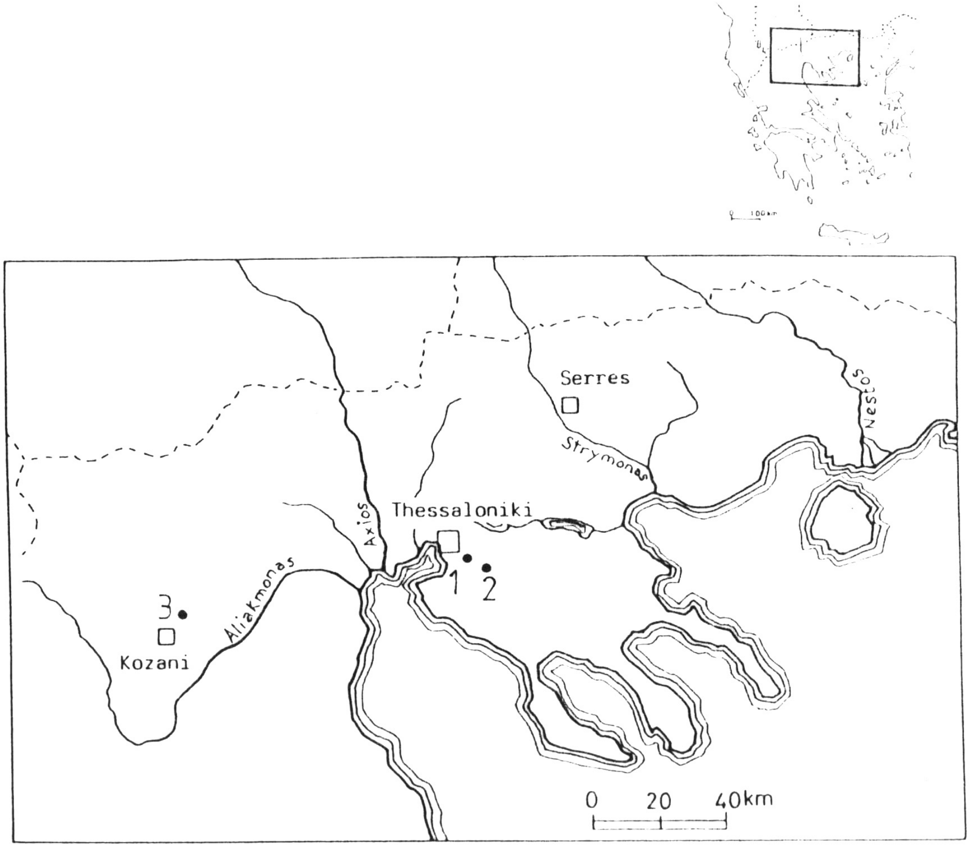

Fig. 1 The sites are located in the central and western parts of Macedonia. The late Neolithic at Thermi B (1) and Vasilika (2) are dated to ca. 5450-4900 B.C.; the final Neolithic at M.N. Galanis (3) to ca. 4800-4350 B.C.

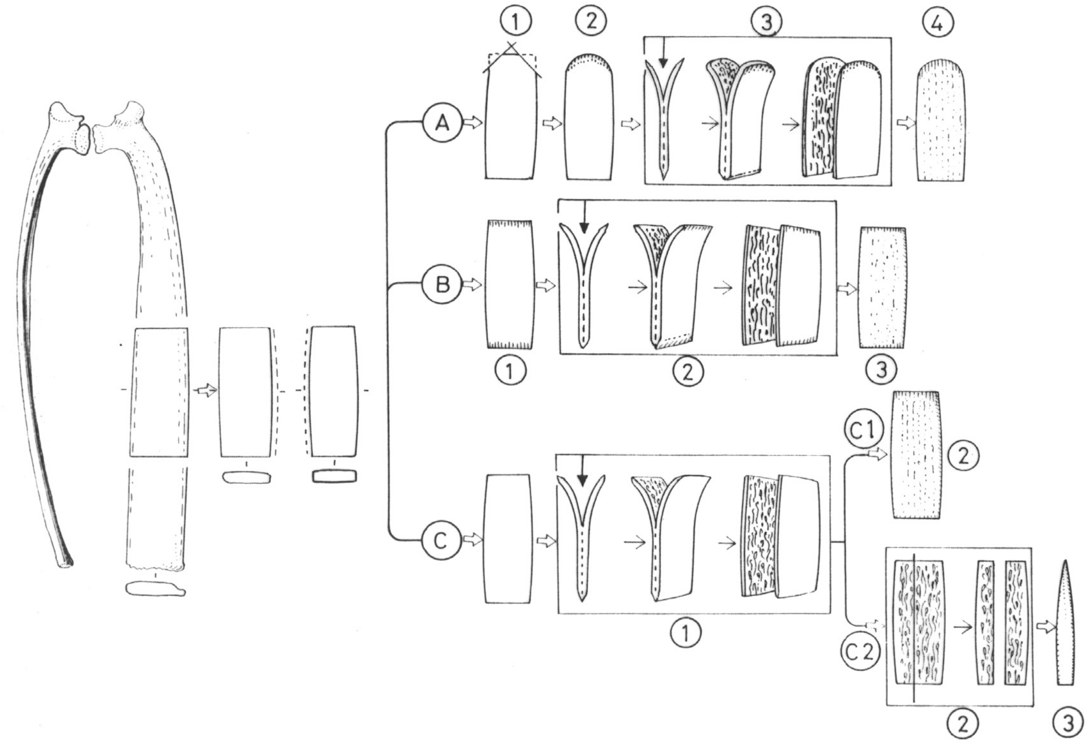

Fig. 2 Ribs: sequences of reduction

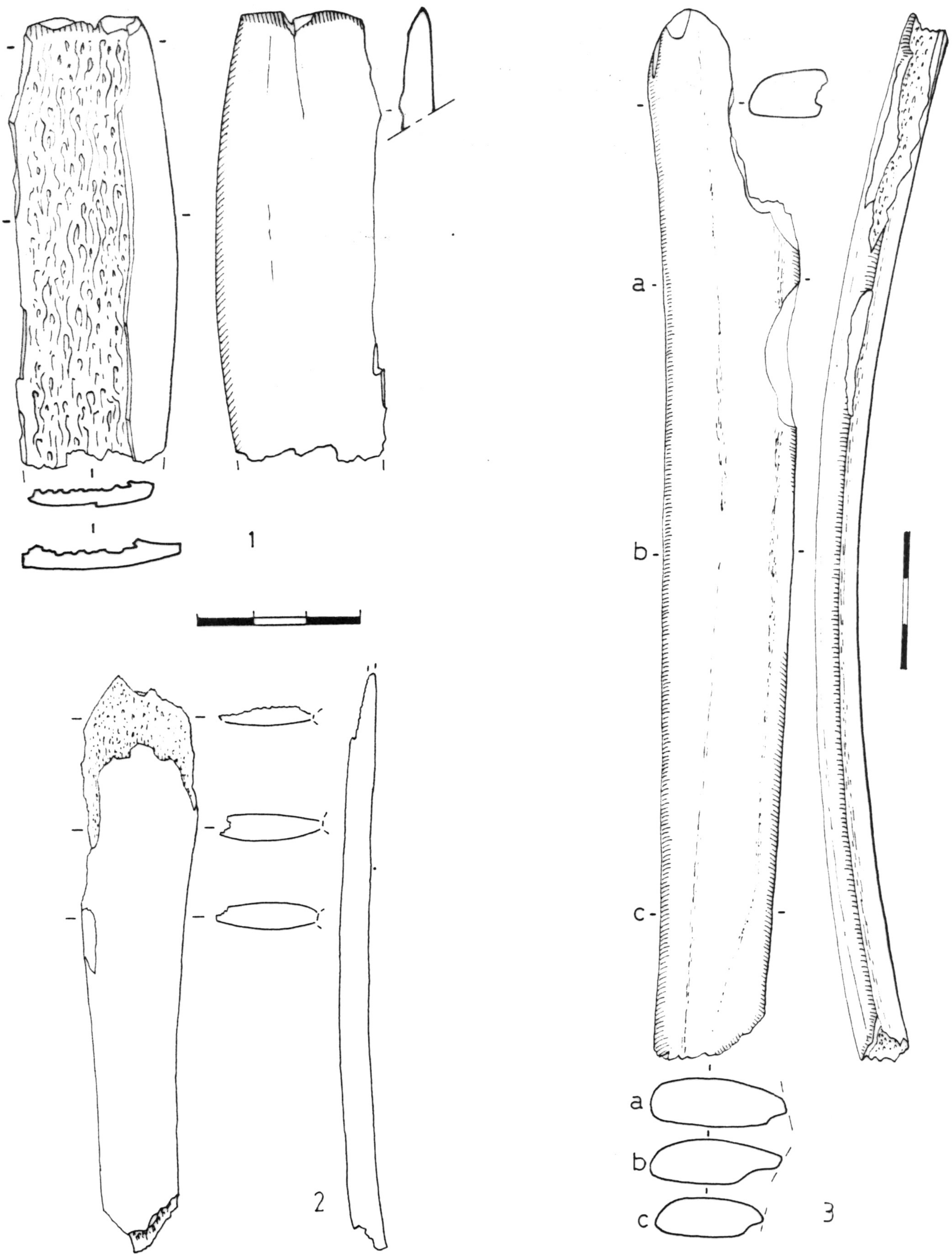

Fig. 3 Ribs (M.N. Galanis). 1. Example of expedient work; 2. The segment is partially split. Only its distal half is shaped; 3. Example of defective work. The narrowing of the end is not consistent with the pattern shown in figure 2. The contour of the entire object is only smoothed by abrasion. The cutting edge is not shaped. The lateral edges are not eliminated

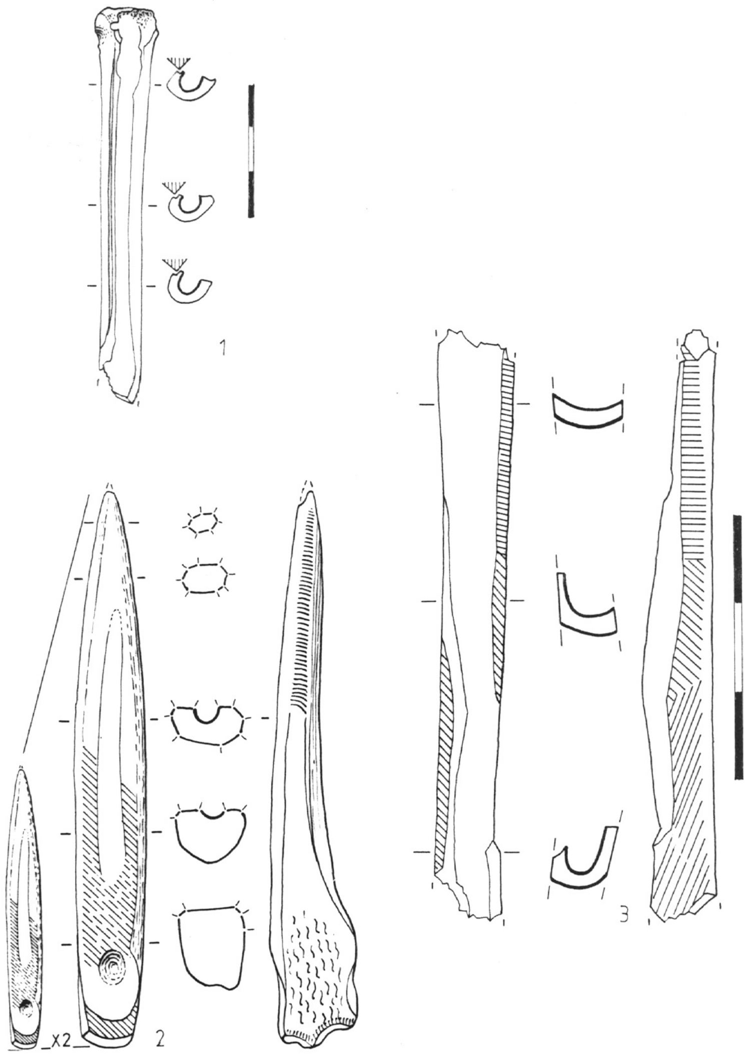

Fig. 4 Grooved metapodials. 1.The blank bears only one groove (Vasilika); 2. Point shaped on a blank extracted from an abraded and grooved metapodial (M.N. Galanis); 3. Example of defective work. The lateral flattening is irregular. Splitting does not follow the traces of the grooves (M.N. Galanis)

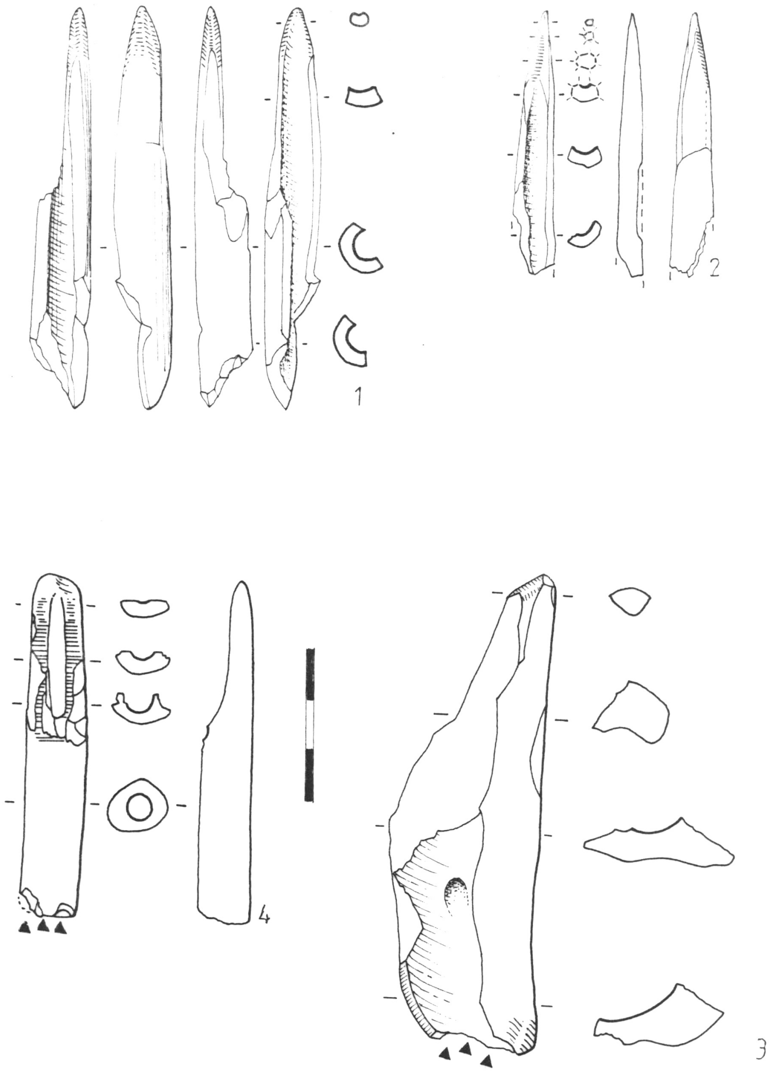

Fig. 5 Tools shaped on fragments of long bones. 1. Splintered bone pointed at one end (Vasilika); 2. Narrowed and reused point. The blank was obtained by the groove-and-split method (Vasilika); 3. Edged-tool shaped on a splinter and used by indirect percussion (M.N. Galanis); 4. Edged-tool shaped on a transversally broken bone and used by indirect percussion (M.N. Galanis)