4. Fossil Mollusks and Exotic Raw Materials in Late Glacial and Early Postglacial Find Contexts: A Complement to Lithic Studies

Berit Valentin Eriksen

In this paper focus is shifted to an analysis of the use and procurement of non-local lithics and ornamental mollusks in late glacial and early postglacial southwestern Germany. The author brings together and evaluates data on ornamental objects and lithic raw material sources from 77 Late Upper Paleolithic (Magdalenian and Late Paleolithic) and Early Mesolithic (Beuronian) sites. It is argued that lithic raw materials used for tools and mollusks or other materials (such as jet and amber) used for personal adornment represent different and complementary expressions of past hunter-gatherer mobility and inter-group communication patterns. Throughout the period in question, lithic raw materials were procured actively and directly within the region. Most evidence points to a pattern of embedded procurement, probably reflecting seasonal movements throughout the region. Fossil mollusks, jet and ammonites presumably were exploited in much the same way, but the evidence is more inconclusive, and some of the deposits may have been more directly exploited. Exotic mollusks (originating from the Atlantic, the Mediterranean, or the Paris or Mainzer Basin), most likely represent different expressions of inter-group communication patterns. Some are obvious expressions of procurement through a long-distance communication, or barter, network. Others seem to represent an inter-regional communication network with direct contact through visiting between neighboring groups. The author finds a decrease in use of exotic stone raw materials in the Mesolithic assemblages, as well as changes from the late glacial to the early postglacial in the kinds of ornamental materials used, but notes that the procurement of ornamental mollusks and materials is similar to the Late Upper Paleolithic in the predominantly north-south direction of long-distance connections as well as the extremely long-distance ties to the Atlantic and the Mediterranean. *–Editors.*

Introduction

Numerous Paleolithic and Mesolithic sites from western Europe have yielded fossil or sub-recent mollusks or exotic raw materials of very 'dispersed' origins. Many of these findings obviously represent different kinds of long-distance connections. The purpose of this paper is to examine the nature, range and possible meaning of such regional and inter-regional relationships in late upper Paleolithic and Early Mesolithic central western Europe.

Keywords with respect to the interpretation of these relationships are mobility and communication. It will be argued that lithic raw materials used for tools and mollusks or other exotic materials used for personal adornment represent different expressions of mobility and inter-group communication patterns. Organic tools represent yet another expression, however, closely related to that of portable art and jewelry.

The Study Area

The case study will focus on sites associated with the Jurassic limestone formation and its immediate surroundings in northwestern Switzerland and southwestern Germany (Figure 1).

Within this area of approximately 35,000 km^2 we can differentiate several primary landscape zones (Figure 2). Most important in the present study are the mountainous region of the Jura proper (i.e. Swiss Jura, Swabian Alb and Franconian Alb) and the Black Forest foothills as opposed to the morainic lowland area of the Swiss Mittelland and Oberschwaben.

Obviously, paleoenvironmental and paleoclimatic conditions must have differed quite a bit across this area. The differences observed, however, are of minor importance with respect to the general comparative approach adopted here. The chronological table in Figure 3 does not take local deviations into consideration since—as a whole—these fertile landscapes would all have sustained a rich variety of plants and wild life throughout the period in question. From a mere subsistence-economic point of view hunter-gatherer groups of the late glacial and early postglacial could easily have subsisted all year round within even smaller parts of the study area.

On the other hand, late glacial and early post-

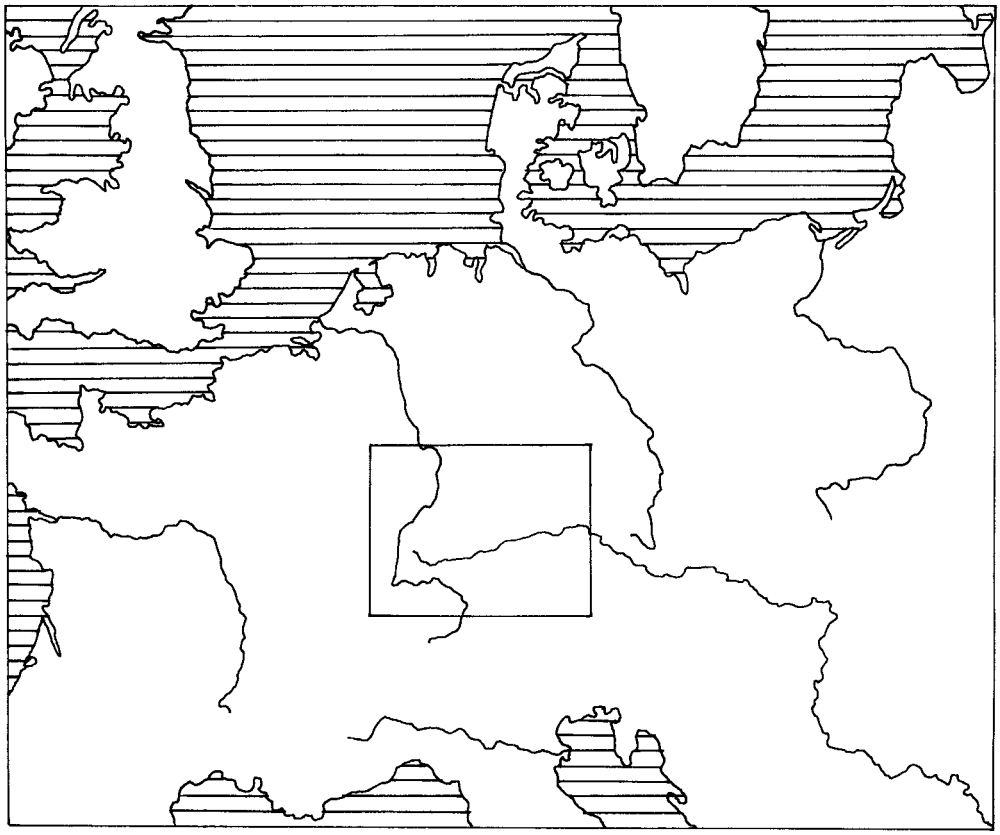

Figure 1. Location of the study area in Central Europe.

glacial settlement and mobility patterns were clearly influenced by regional differences relating to topography and hydrology (Eriksen 1996b, 1997). The Alb highland is characterized by marked karst conditions resulting in rather dry conditions on the plateau. The deep valleys cutting through the highland are generally water-bearing or would have been during the period in question. Most of the Magdalenian sites known from the study area are located in these valleys.

The Swiss Mittelland and the southern part of Oberschwaben were covered by ice during the last glaciation. During the late glacial this was a very moist region (Frenzel 1983:139) characterized by many rivers and a great number of small lakes and kettle holes (Gradmann 1956). For a long time this virgin area remained practically devoid of human occupation, but beginning in the late Allerød and throughout the early postglacial it witnessed an intensive exploitation by Late Paleolithic and Early Mesolithic hunter-gatherer groups.

The Chronological Framework

Figure 3 synthesizes our present knowledge with respect to the late glacial and early postglacial chronostratigraphy of southwestern Germany and northwestern Switzerland. Cultural development is generally conceived of as being continuous and highly endogenous in the period in question.

For methodological reasons, however, the precise dating of many sites and site levels is very difficult. This is especially problematic as regards the Late Paleolithic. Virtually all of these inventories can only be dated within a relative archaeological framework. As a result we are having severe problems in determining the absolute as well as the relative contemporaneity of especially the late glacial sites (Eriksen 1996b).

Thus, given the current state of absolute chronology, as well as the general lack of Late Paleolithic finds with fossil mollusks and exotic raw materials, it is considered justifiable to operate within a broad chronological framework. In the following analysis, the sites will therefore be divided into two groups: 1) a Magdalenian *sensu lato* comprising all sites belonging to the late glacial chronozones of Bølling, Allerød and Younger Dryas, and 2) an Early Mesolithic (Beuronian) comprising all sites belonging to the early postglacial chronozones of the Preboreal and Boreal. The Late Paleolithic findings will be specifically commented upon, whenever they differ from the 'Magdalenian norm'.

The map in Figure 4 shows the location of sites included in the study. All inventories analyzed here either contain fossil mollusks or exotic objects (e.g. jet or amber) or they have provided reliable data with respect to provenance of lithic raw materials. It must be stressed, however, that the map chiefly

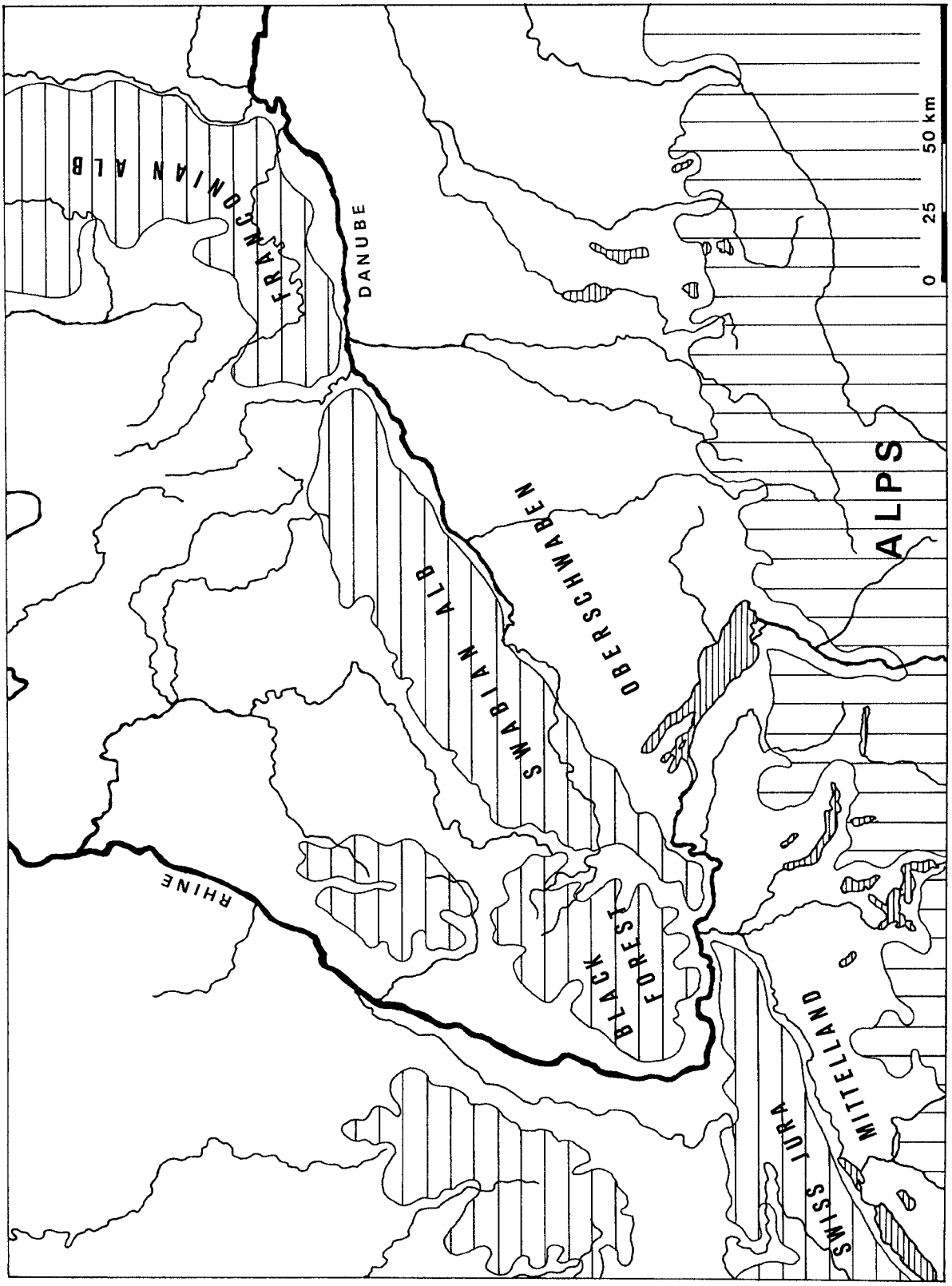

Figure 2. The study area—primary landscapes.

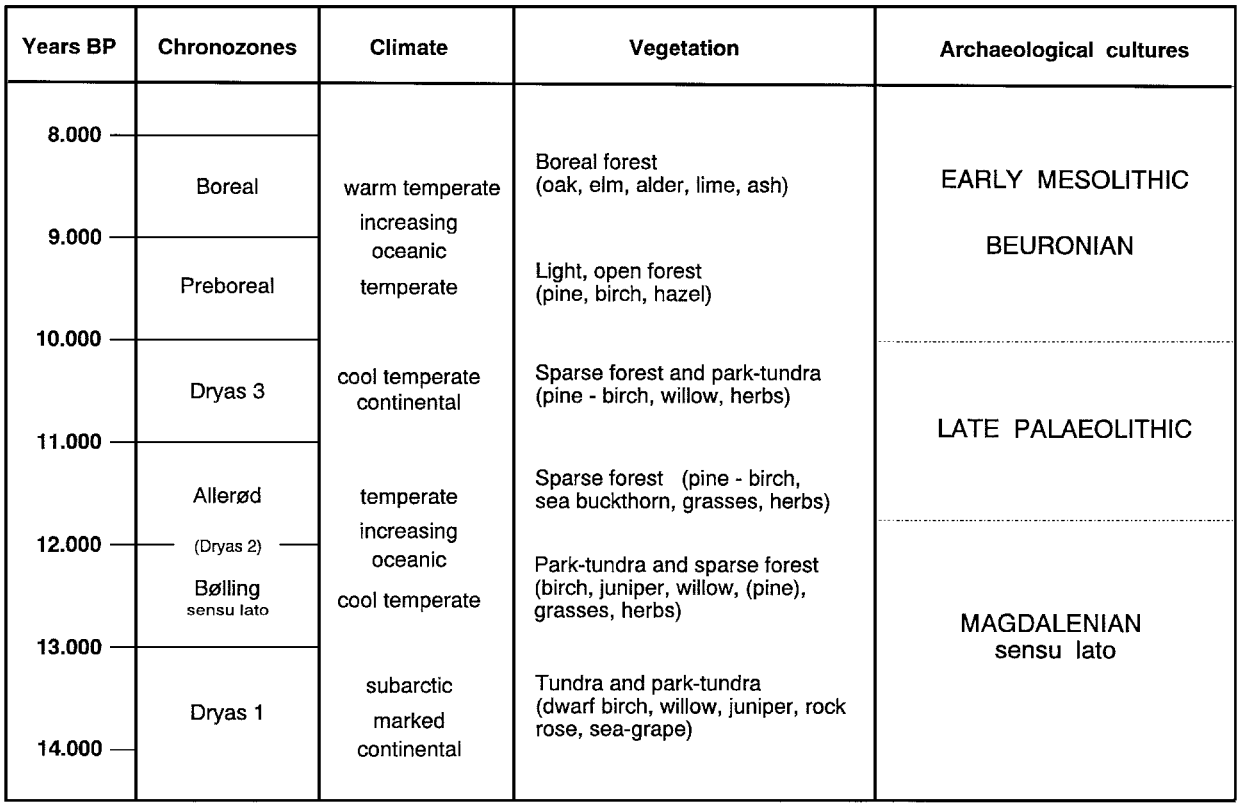

Figure 3. Chronostratigraphy of the Late Glacial and Early Postglacial in southwestern Germany and northwestern Switzerland.

reflects the current state of research within the region. Neither the Paleolithic nor the Mesolithic sites known constitute a random sample of the original occurrence of sites (Eriksen 1991:62f). The previously mentioned apparent migration from the Jura to the surrounding lake and river regions starting in the late Allerød thus might be at least partly due to methodological weaknesses in the data.

Lithic Raw Materials

The lithic inventories of the study area are characterized by a richly varied spectrum of raw materials. Two circumstances in particular must have influenced this variation: 1) the quality or workability of the individual materials, and 2) their accessibility and natural occurrence respectively. The map in Figure 5 synthesizes the known occurrences of local raw materials in a very generalized form. The map and the following presentation relies largely on Deecke 1933 and Hahn 1991.

An important distinction may be made between the Jurassic and the alpine raw materials. Jurassic hornstones (marked A in Figure 5) occur in a number of different varieties. They represent a generally good quality chert which is very suitable for artifact production. Most abundant is the 'Weißjura-δ' variety which may be collected in large quantities almost everywhere in the Swiss Jura, Swabian Alb and Franconian Alb. The 'Muschelkalk' hornstone (B) is also common although this is a relatively poorer quality chert. The 'Keuper' hornstone (C) is generally of a very poor quality. Only nodules from primary outcrops are suitable for artifact production. 'Keuper' hornstones, thus, are generally rare in the lithic inventories. A very fine quality chert, on the other hand, is represented by the Bavarian tabular hornstone (D) originating from the 'Weißjura-ζ' layers near Kelheim. Jasper (E) and Kimmeridgian chert (F) are also 'Weißjura' varieties of a generally high quality. However, due to their limited occurrence they are not very commonly used. Siliceous tuff (G) from Randecker Maar is finally a very distinctive raw material. It is of volcanic origin and thus has a very localized provenance. The quality, however, varies widely.

Most important among the alpine raw materials (H) is radiolarian chert. It is a highly characteristic material of a generally problematic quality. There are primary outcrops of radiolarian ores in Switzerland and Allgäu, but redeposited nodules are found almost everywhere in the alpine foreland in morainic or molasse deposits as well as in the major riverbeds. Other alpine raw materials include different varieties of quartz and quartzite.

Reservations must be made both for an insufficient knowledge of the outcrops or occurrences known in prehistoric times, as well as for the very rough, i.e. generally macroscopic, classification of individual raw material types (Weniger 1991:86).

An exact provenance determination of specific raw material sources is thus exceptional, but the evidence still allows a more general discussion. Unfortunately, the Mesolithic inventories in particular are very poorly represented in the analysis. Mesolithic artifacts often display a comprehensive patination due to heat treatment, and therefore very few Mesolithic assemblages have been analyzed with respect to raw material provenance. A total of 67 lithic inventories have been included here in a general analysis (Table 1). Of these only 10 are Mesolithic, 7 are mixed Late Paleolithic and Mesolithic, and the remaining 50 are Paleolithic (39 Magdalenian and 11 Late Paleolithic).

In the analysis, lithic raw materials occurring within certain distances from the sites were recorded with respect to their relative frequency in the inventories. A simple distinction was made between on-site, local, regional and exotic raw materials. Local raw materials (<10 kilometers) occur within the site catchment area and are thus within daily reach. Regional raw materials (10–50 kilometers) occur within the probable annual territory of the group. They either represent basic equipment brought from a previous settlement or they result from an extended trip. The so-called exotic raw materials (>50 kilometers) may theoretically represent either long-distance migrations or barter

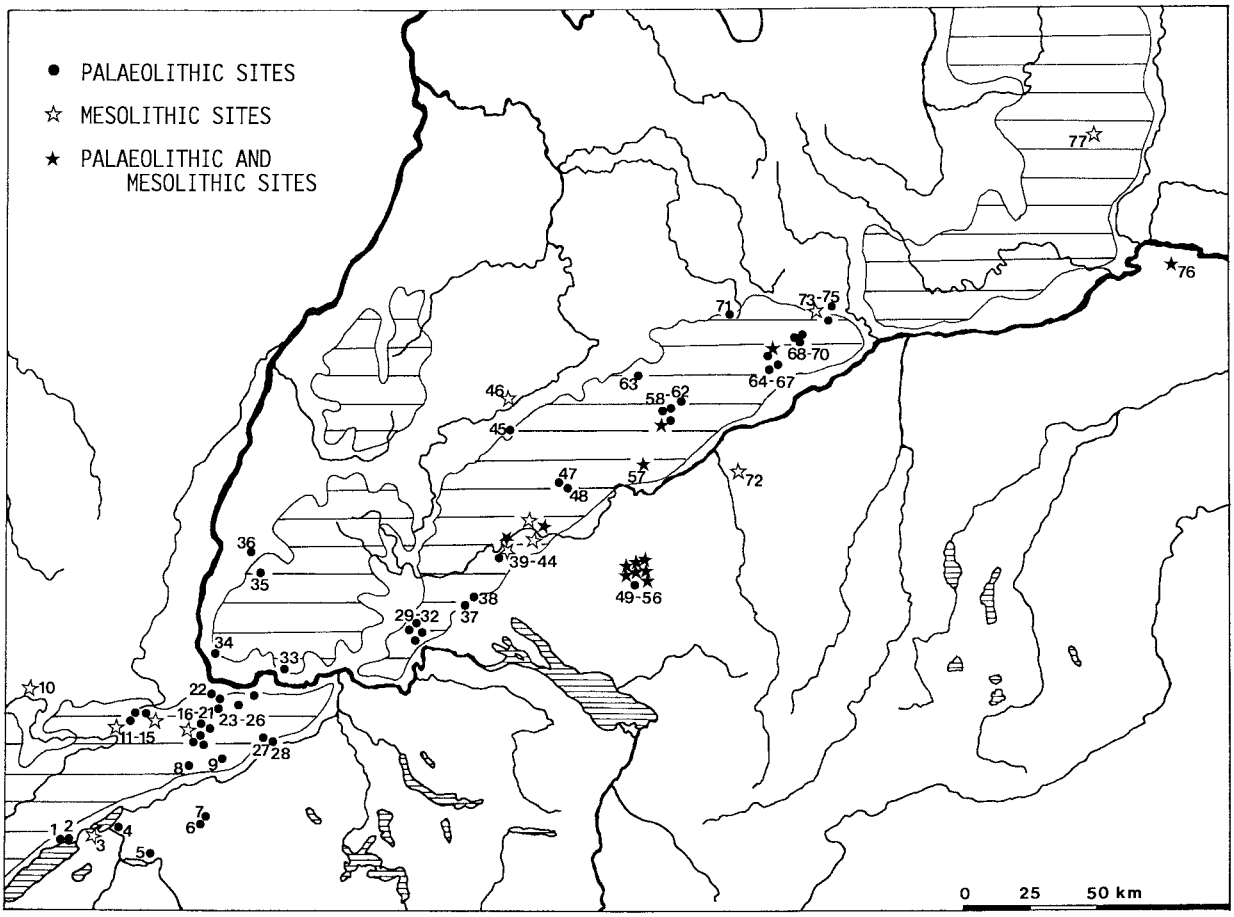

Figure 4. Location of the sites included in the study: 01 Monruz, 02 Champréveyres, 03 Gampelen-Jänet 3, 04 Lüscherz-Moos, 05 Moosbühl, 06 Hintere Burg, 07 Fürsteiner, 08 Balm bei Günsberg, 09 Rislisberghöhle, 10 Bavans, 11 Gripons, 12 Löwenburg-Ziegelacker, 13 Löwenburg-Niederfeld II, 14 Neumühle, 15 Roggenburg-Ritzigrund, 16 Chesselgraben, 17 Kohlerhöhle, 18 Kastelhöhle, 19 Birsmatten-Basisgrotte, 20 Wachtfels, 21 Büttenloch, 22 Bruederholz, 23 Birseck-Ermitage, 24 Hollenberg-Höhle 3, 25 Eremitage, 26 Bönistein, 27 Köpfli, 28 Käsloch, 29 Kesslerloch, 30 Vorder Eichen, 31 Schweizersbild, 32 Freudenthal, 33 Röthekopf, 34 Isteiner Klotz, 35 Teufelsküche, 36 Munzingen, 37 Petersfels, 38 Gnirshöhle, 39 Buttentalhöhle, 40 Jägerhaushöhle, 41 Probstfels, 42 Falkensteinhöhle, 43 Burghöhle Dietfurt, 44 Zigeunerfels, 45 Napoleonskopf, 46 Rottenburg-Siebenlinden II, 47 Annakapellenhöhle, 48 Nikolaushöhle, 49 Schussenquelle, 50 Aichbühl A, 51 Aichbühl B, 52 Aichbühl C, 53 Aichbühl D, 54 Aichbühl E, 55 Aichbühl F, 56 Henauhof NW, 57 Felsställe, 58 Hohler Fels Schelklingen, 59 Helga Abri, 60 Sirgenstein, 61 Sirgenstein Südwand, 62 Brillenhöhle, 63 Burkhardtshöhle, 64 Hohlenstein Stadel, 65 Vogelherd, 66 Spitzbubenhöhle, 67 Malerfels I, 68 Bärenfelsgrotte, 69 Spitalhöhle, 70 Klingenfelsschutzdach, 71 Kleine Scheuer Rosenstein, 72 Attenhofen, 73 Große Ofnet, 74 Hohlenstein Ederheim, 75 Kaufertsberg, 76 Sarching, 77 Bettelküche.

transactions. They generally have been transported between 50 and 200 kilometers. Obviously, this is not very exotic and it appears that all lithic raw materials may indeed have been (and very likely were) procured actively, i.e. not by trade or barter.

In the Jura inventories we observe a strong predominance of local raw materials, i.e. Jurassic hornstones. These generally account for 80 or more percent of all lithics. The inventories from the Black Forest foothills and those from the lowland area of Oberschwaben and the Swiss Mittelland complement this picture in a very interesting way. Here regional raw material predominates, while local types account for generally less than 15 percent and only appear significantly in sites situated close to the Jura. Thus, Jurassic hornstones also dominate in these regions.

Exotics are always rare, in the Jura as well as in the lowland area. Exceptions in this respect are represented by the Bruckersberg sites (Bärenfelsgrotte, Spitalhöhle and Klingenfelsschutzdach, Auffermann 1991) and the sites from Neuchâtel (Monruz and Champréveyres, Affolter *et al.* 1994 and Le Tensorer and Niffeler 1993) together with the nearby Gampelen-Jänet 3 (Nielsen 1991). Incidentally we find that the exotic raw materials primarily seem to move along a northeast-southwesterly axis following the southern limit of the Jura formation (Cattin 1990; Pousaz, ed. 1991:87, fig. 79; Hahn this volume).

The observations from this preliminary analysis emphasize the significance of material quality, i.e. workability. Jurassic hornstones are generally of a marked better quality than the alpine stones occurring in the morainic deposits of Oberschwaben and the Swiss Mittelland. Apparently the advantages of a high quality raw material seem to generally outweigh its higher costs.

It has not been possible within the present study to investigate the variation in different raw material types with respect to selective manufacture and discard patterns of specific artifact types. However, the general impression from the literature and from my own analysis of a number of inventories is that exotic raw materials (like Bavarian tabular chert) generally reflect the overall pattern of tool frequencies (see also Fisher this volume and Hahn this volume). There is no evidence of a preferential raw material selection for specific tool types. Yet, it does seem that in the Paleolithic inventories backed

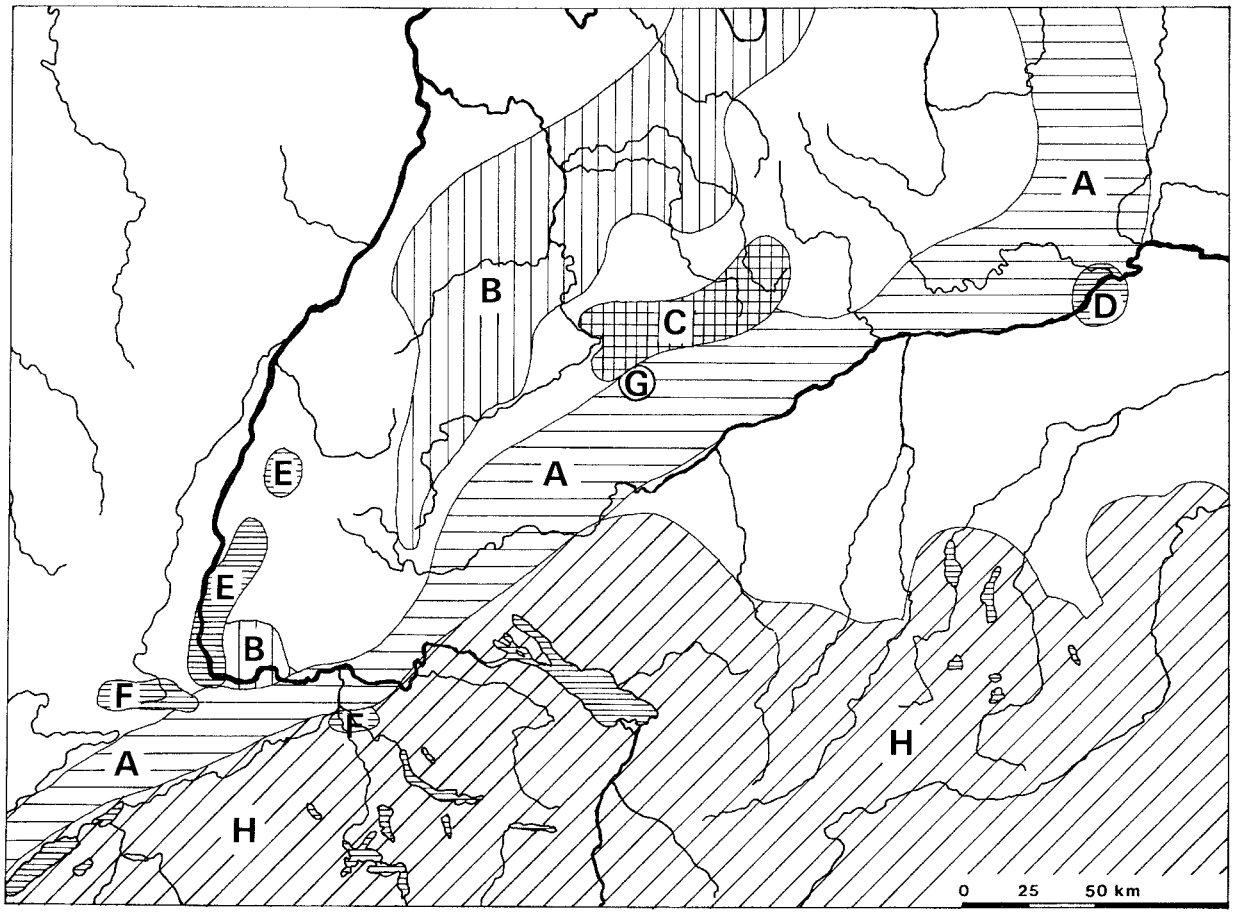

Figure 5. Important raw material provinces. A: Jurassic hornstones, B: 'Muschelkalk' hornstone, C: 'Keuper' hornstone, D: Bavarian tabular chert, E: Jasper, F: Kimmeridgian chert, G: Siliceous tuff, H: Alpine raw materials (radiolarian chert, quartz, quartzite, etc.).

Table 1. Relative Frequencies of On–Site, Local, Regional and Exotic Raw Materials in various Magdalenian (MAGD), Late Paleolithic (LP) and Early Mesolithic (EM) Inventories

Site, Level, Archaeological Dating		Provenance of lithics*				References
		on site	local	regional	exotic	
		<500 m	<10 km	10–50 km	>50 km	
01. Monruz	MAGD	–	60%	–	40%	Affolter et al. 1994
02. Champréveyres	MAGD	–	59%	–	41%	Le Tensorer and Niffeler 1993
03. Gampelen–Jänet 3	EM	–	33%	51%	16%	Nielsen 1991
04. Lüscherz–Moos	LP	–	xxx	x	–	Schwab 1972
05. Moosbühl I–II	MAGD	–	xx	xx	–	Barr 1973
06. Hintere Burg	MAGD	–	x	xxx	–	Flükiger 1964
07. Fürsteiner	LP	x	95%	4%	1%	Zimmermann 1988
08. Balm bei Günsberg, 6	LP	x	67%	33%	–	Schweizer 1941
09. Rislisberghöhle, II	MAGD	–	xxx	x	–	Barr 1977
10. Bavans, 6	EM	–	x	xx	x	Pousaz, ed. 1991
11. Gripons, 4	EM	–	xxx	x	(x)	Pousaz, ed. 1991
12. Löwenburg–Ziegelacker	LP	xxx	–	–	–	Jagher and Jagher 1987
13. Löwenburg–Niederfeld II	LP	xxx	–	–	–	Jagher and Jagher 1987
14. Neumühle	LP	–	xxx	?	?	Rozoy 1978
15. Roggenburg–Ritzigrund, lower	EM	–	xxx	x	?	Jagher 1989
17. Kohlerhöhle, upper	MAGD	?	x	x	?	Lüdin 1938
20. Wachtfels, 5	LP	–	xxx	xx	–	Sedlmeier 1989
21. Büttenloch, A–B	MAGD	–	xx	xx	–	Sedlmeier 1989
22. Bruederholz	MAGD	–	xxx	x	–	Sarasin 1918
23. Birseck–Ermitage, lower	MAGD	–	xxx	x	?	Sarasin 1918
24. Hollenberg–Höhle 3	MAGD	–	34%	64%	–	Sedlmeier 1982
25. Eremitage	MAGD	–	xxx	x	–	Sedlmeier 1989
26. Bönistein	LP	–	xxx	x	–	Bandi 1947
27. Köpfli	MAGD	–	xxx	x	–	Zürcher 1969
29. Kesslerloch	MAGD	–	100%	–	–	Schmid 1977
31. Schweizersbild	MAGD	x	xx	x	–	Nüesch 1896
33. Röthekopf	MAGD	–	x	x	–	Andrée 1939
34. Isteiner Klotz	LP	–	x	x	–	Kuhn 1969
35. Teufelsküche, B–C	MAGD	–	28%	67%	?	Pasda 1994
36. Munzingen	MAGD	–	17%	82%	?	Pasda 1994
37. Petersfels (Peters)	MAGD	–	xxx	xx	x	Wiegers 1950
Petersfels (Albrecht)	MAGD	–	99%	–	1%	Albrecht 1979
38. Gnirshöhle, I	MAGD	–	xx	–	x	Albrecht et al. 1977
39. Buttentalhöhle	MAGD	x	xxx	x	x	Hahn this volume
41. Probstfels (Schmidt)	MAGD	–	83%	6%	2%	Pasda 1989
45. Napoleonskopf	MAGD	–	xx	x	(x)	Mauser 1976, Schmidt 1912
46. Rottenburg–Siebenlinden II	EM	x	60%	40%	–	Kieselbach 1993
49. Schussenquelle	MAGD	–	7%	93%	1%	Schuler 1989
50. Aichbühl A	LP,EM	–	14%	78%	8%	Eberhardt et al. 1987
51. Aichbühl B	LP,EM	–	6%	94%	–	Eberhardt et al. 1987
52. Aichbühl C	LP,EM	–	7%	92%	1%	Eberhardt et al. 1987
53. Aichbühl D	LP,EM	–	8%	88%	4%	Eberhardt et al. 1987
54. Aichbühl E	LP,EM	–	14%	81%	5%	Eberhardt et al. 1987
55. Aichbühl F	LP,EM	–	3%	97%	–	Eberhardt et al. 1987
56. Henauhof NW, 6	LP	–	17%	81%	2%	Jochim 1993
Henauhof NW, 4–5	EM	–	17%	82%	1%	Jochim 1993
57. Felsställe, IIIa–b	MAGD	99%	–	1%	–	Kind 1987
Felsställe, IIa3	EM	37%	61%	2%	(x)	Kind 1987
58. H.F. Schelklingen, Ia–c, IIa	MAGD	–	100%	(x)	–	Hahn, ed. n.d.
59. Helga Abri, IIIa–d	MAGD	–	xx	x	x	Hahn and Scheer 1983
Helga Abri, IIF1–IIF2	EM	–	100%	(x)	–	Hahn and Scheer 1983
60. Sirgenstein, I	MAGD	–	80%	20%	x	Author's registration
61. Sirgenstein Südwand, 5	MAGD	–	98%	2%	–	Author's registration, Riek 1959

Table 1. Continued

Site, Level, Archaeological Dating		Provenance of lithics*				References
		on site <500 m	local <10 km	regional 10–50 km	exotic >50 km	
62. Brillenhöhle, IV	MAGD	(x)	68%	22%	8%	Lauxmann 1988
63. Burkhardtshöhle, V	MAGD	–	92%	2%	6%	Simon 1993
64. Hohlenstein Stadel, III	MAGD	–	95%	5%	–	Hahn n.d.
65. Vogelherd, II–III	MAGD	–	95%	5%	–	Riek 1934
66. Spitzbubenhöhle, 2	MAGD	–	100%	–	–	Hahn, ed. 1984
67. Malerfels I, 3	LP	–	100%	–	–	Hahn, ed. 1984
Malerfels I, 1b	EM	–	98%	2%	–	Albrecht 1984
68. Bärenfelsgrotte, III	MAGD	–	50%	3%	32%	Auffermann 1991
69. Spitalhöhle, VIII	MAGD	–	46%	2%	12%	Auffermann 1991
70. Klingenfelsschutzdach, III–IV	MAGD	–	73%	3%	24%	Auffermann 1991
71. Kl. Scheuer Rosenstein, I–II	MAGD	–	xx	x	(x)	Maier 1936
72. Attenhofen	EM	–	50%	50%	–	Wischenbarth 1991
75. Kaufertsberg, 1 (lower)	MAGD	–	70%	30%	–	Kaulich 1983
76. Sarching '83	LP,EM	–	xx	xxx	–	Heinen 1986

*Lithic raw materials of uncertain provenance are not included in the statistics.

bladelets and backed points, in particular, appear to be made of a non-local (regional or exotic) material (Albrecht 1979:63; Kind 1987:115). Here the presence of non-local elements undoubtedly reflects re-tooling activities, and the pieces themselves represent basic equipment brought along from a previous site.

In the Early Mesolithic local hornstones also seem to have been subjected to heat treatment before the final processing into tools, especially microliths (Eriksen 1991:175f). When thermally altered, Jurassic hornstones change color from white, grey or yellow-ochreous to pink or red. At the same time their flaking abilities seem to improve significantly (Rottländer 1983:562, 1989:47f). There still remain some problems to be solved with respect to this presumable heat treatment (Eriksen 1991:180; Price *et al.* 1982:484). However, assuming that it did take place, it represents a significant technological difference between the Paleolithic and the Mesolithic flint knapping traditions. It indicates that flint knapping in the Mesolithic did require a certain degree of specialization and a thorough knowledge of raw material properties.

Heat treatment of chert or hornstone is a fairly complicated process which needs to be carefully controlled. Obviously, it adds significantly to the costs of tool manufacture and it thus may be expected to have been applied fairly selectively in prehistory (Lurie 1989:53). A preliminary analysis of some Mesolithic inventories from southwestern Germany (Eriksen 1991:178f) indicates that heat treatment probably was related primarily to the production of microliths. There is thus good reason to interpret this phenomenon as an indication of Mesolithic flintknappers trying to economize scarce high quality raw materials (Hahn 1983:370). Increased fine sedimentation of riverbeds and flourishing vegetation together with reduced erosion of outcrops must have made good quality hornstones harder to find in the early postglacial.

To summarize, we find a marked tendency to use lithic raw materials of local, or at least regional, origin during the entire period in question (of course with reservations for the relative scarcity of Mesolithic and Late Paleolithic data). The choice of raw material depends more on quality and less on distance—good quality raw material is always preferred. Exotic raw materials are usually rare and generally confined to a few, worn out blades or tools.

Most evidence from the Jura inventories points to an embedded procurement pattern (Binford 1979) probably reflecting seasonal movements throughout the region. The only significant exceptions are represented by the Magdalenian occupation of Felsställe AH IIIb (Kind 1987) and the Late Paleolithic sites of Löwenburg-Ziegelacker and Löwenburg-Niederfeld II (Jagher and Jagher 1987). At the same time, the amount of regional raw material in the inventories from the Black Forest foothills, the Swiss Mittelland and Oberschwaben indicates the complementary existence of a more direct procurement by special-purpose trips to source areas in the Alb. Admittedly, though, all distances referred to in the analysis are very short (even regarding the so-called exotic raw materials) and it is difficult to distinguish explicitly between an 'embedded' and a 'direct special-purpose' procurement pattern. In the present case study the only reasonable distinction is one of degrees.

There are only minor differences between the Paleolithic and the Mesolithic procurement patterns. The most prominent distinction is represented by the probable heat treatment in the Early Mesolithic. With the exception of Gampelen-Jänet 3 (Nielsen 1991), there appears to be slightly less

exotic raw material in the Mesolithic inventories, but this observation is more or less outweighed by the occurrence of generally more regional raw material. The differences observed may be partly explained by an increased scarcity of high quality raw materials caused by environmental factors in the early postglacial. On the other hand, they may also be indicative of diachronic changes in settlement and mobility patterns (Jeske 1989). This intriguing aspect will be discussed in more detail below.

In my opinion, however, lithic raw materials are not ideal for a thorough analysis of hunter-gatherer social territories. They obviously represent a critical resource, which will be optimized with respect to investment of time and energy (Jochim 1989). Yet, at the same time they very often represent an instant 'here and now' use or production of artifacts. In the study area lithic raw materials suitable for artifact production were generally widely accessible and neither the late glacial nor the early postglacial flint knappers would have had explicit reason to 'plan ahead' except for maintaining so-called basic equipment.

In general the lithic artifact inventory of mobile hunter-gatherers will only reflect mobility within shorter periods of time (a year) and shorter distances (a few hundred kilometers) (Weniger 1991:87). A chronologically and geographically more comprehensive mobility and inter-group communication pattern would rather be reflected in the organic inventory and portable art objects and ornaments. These have a considerably longer 'lifetime' than lithic artifacts and they provide a much more reliable impression of cultural affinity or even ethnic (group) identity (Weniger 1991:99f).

Jet Ornaments and Ammonites

Jet and lignite are easy to work with flint tools and appear to have been commonly used raw materials for ornamental or art objects during the Magdalenian (Figure 6). The objects are variably referred to as being made of jet, lignite or even fossil wood, and a specific petrographic determination is rarely available (Preuschoft-Güttler 1995). The actual raw material thus may vary, but due to their morphological and typological homogeneity, the objects will be treated as a group.

Jet and lignite occur sporadically in the Posidonian slate deposits of the Lias-Epsilon (Black Jura) along the entire northwestern Alb ridge (Figure 7). Jet and lignite also occur in rich molasse deposits in Hegau, Schaffhausen and northwestern Switzerland.

The map in Figure 7 shows all Magdalenian finds of jet/lignite within the study area. The majority of the inventories contain only a few, often fragmentary pieces, but three finds in Hegau and Schaffhausen differ significantly. In Petersfels alone, more than 600 pieces have been found (Peters and Toepfer 1932). The large quantities of jet/lignite found here are very likely of local origin. As

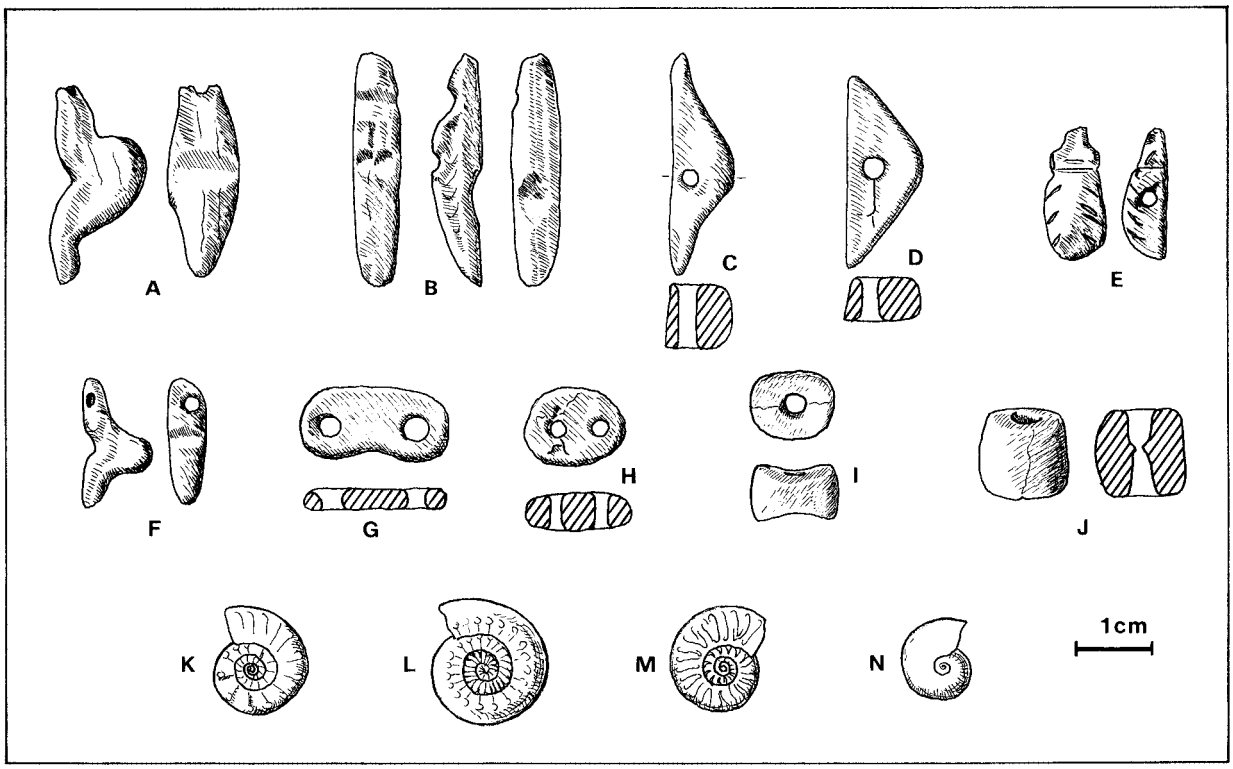

Figure 6. A-J: Magdalenian pendants in jet from Petersfels 1927-32 (after Mauser 1970). K-N: Miscellaneous ammonites from the Swabian Jura.

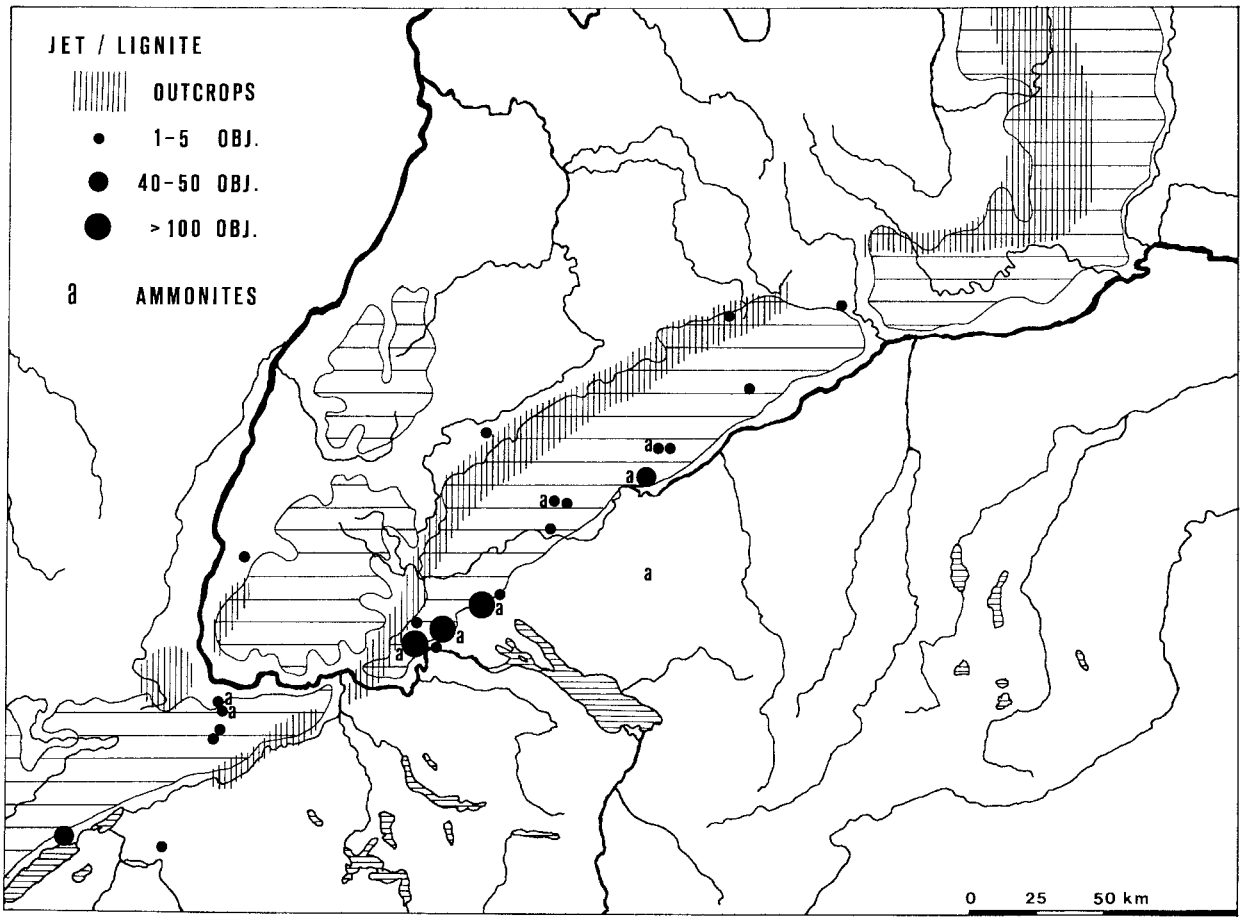

Figure 7. Outcrops of jet in the study area and Magdalenian finds with jet/ lignite objects or ammonites.

regards the remaining finds the question of provenance (and indeed sometimes the question of raw material) is more open. A precise provenance determination of individual pieces does not appear to be possible (Schmid 1977:62; Preuschoft-Güttler 1995). In any case, though, jet and lignite are local or regional raw materials that very likely were procured actively, i.e. not by trade or barter.

It is striking that they have never been found in Mesolithic or even Late Paleolithic inventories. Since we have now a fair number of recently excavated and well documented Mesolithic sites, this is very likely a valid observation, free from methodological reservations, and it represents a significant difference between the Paleolithic and Mesolithic groups.

Incidentally, the majority of pieces have been found in four sites (Kesslerloch, Schweizersbild, Petersfels and Felsställe) that all appear to have been settled in the cold season. Perhaps this is a manifestation of the existence of long-term winter base camps where people had time left for doing home crafts?

The map in Figure 7 also displays all Magdalenian finds of fossil ammonites (Figure 6). Ammonites are probably the most prominent group of Jurassic index fossils (Geyer and Gwinner 1991:132-133, fig. 69) occurring in large numbers and a variety of different species throughout the study area. The archaeological examples represent one of the more obscure find categories. They are all very small and inconspicuous and thus generally rare in the inventories. They often possess a natural central hole, but in fact it is also very easy to pierce the central part of an ammonite by pressing a small flint tip against it (Sedlmeier 1982:51). Precise species and provenance determinations of the archaeological examples are rare. Quite a few, however, are reported to be from the Lias- deposits, which makes it reasonable to treat them together with the jet ornaments (Albrecht *et al.* 1994:31f). The procurement of ammonites and jet/ lignite, in my opinion, is closely related. Incidentally, ammonites, like jet and lignite, have never been found in Mesolithic or Late Paleolithic horizons. They do, however, all occur in both Aurignacian and Gravettian inventories (Hahn 1992). The use of these raw materials, thus, appears to be strictly Paleolithic.

Ornamental Mollusks

Last but not least, ornamental mollusks occur throughout the period in question, and the Mesolithic finds, for once, appear to be fairly well represented. A total of 13 Mesolithic and 22 Magdalenian inventories contain fossil or sub-re-

cent mollusks, and 2 Late Paleolithic inventories each contain an unspecified shell fragment. Tables 2 and 3 summarize the contents of these mollusk inventories. The map in Figure 8 displays the location and archaeological dating of the sites included.

For both the Mesolithic and the Paleolithic it is found that shells of limnic or marine Tertiary fossils were preferred to sub-recent mollusks. They have often been artificially perforated for use as pendants. Sometimes natural holes have served the same purpose. Many, however, have not been pierced and may rather be considered as blanks (Rähle 1987b:383).

The species found may be grouped by classes, including bivalves (mussels) and scaphopods (tooth shells) of a usually reasonable size (Figure 9), and gastropods (snails) which are often fairly small and inconspicuous (Figures 9-10). The retrieval of these tiny mollusks is very much dependent on the use of meticulous excavation methods like wet-screening. Thus, the majority of gastropods come from recently excavated sites. Unfortunately, most of the inventories are from caves with relatively loose gravel sediments in which the stratigraphic position of very small objects may be somewhat misleading. In a few cases the tiny gastropods very likely have 'trickled down' from overlying cultural layers. Similarly, the scant number of bivalves known from old excavations very likely represents only a small proportion of what may originally have been there.

The Magdalenian inventories display the largest variety of species (Figure 9). Bivalves play a prominent part. Fossil or even sub-recent *Glycymeris* shells are the most frequent and numerous. Gastropods are most in evidence in the recently excavated finds. Here tower shaped species like *Turritella, Tympanotonos, Potamides* and *Pirenella* occur most frequently, but the round, barrel shaped *Viviparus* are also numerous. Tooth shells (*Dentalia*) and various fossils like ammonites, belemnites and Tertiary shark teeth are also common.

In the Mesolithic inventories we find neither tooth shells nor ammonites or other fossils (Figure 10), and only one Mesolithic site within the study area has produced bivalves. The species most frequently found in Mesolithic inventories are the elegantly tower shaped *Potamides* and *Pirenella*, and the more inconspicuous *Gyraulus*.

Große Ofnet stands out quite exceptionally when compared to the other Mesolithic sites. This is partly due to the quantity of mollusks (especially *Lithoglyphus naticoides*, which is unique both in

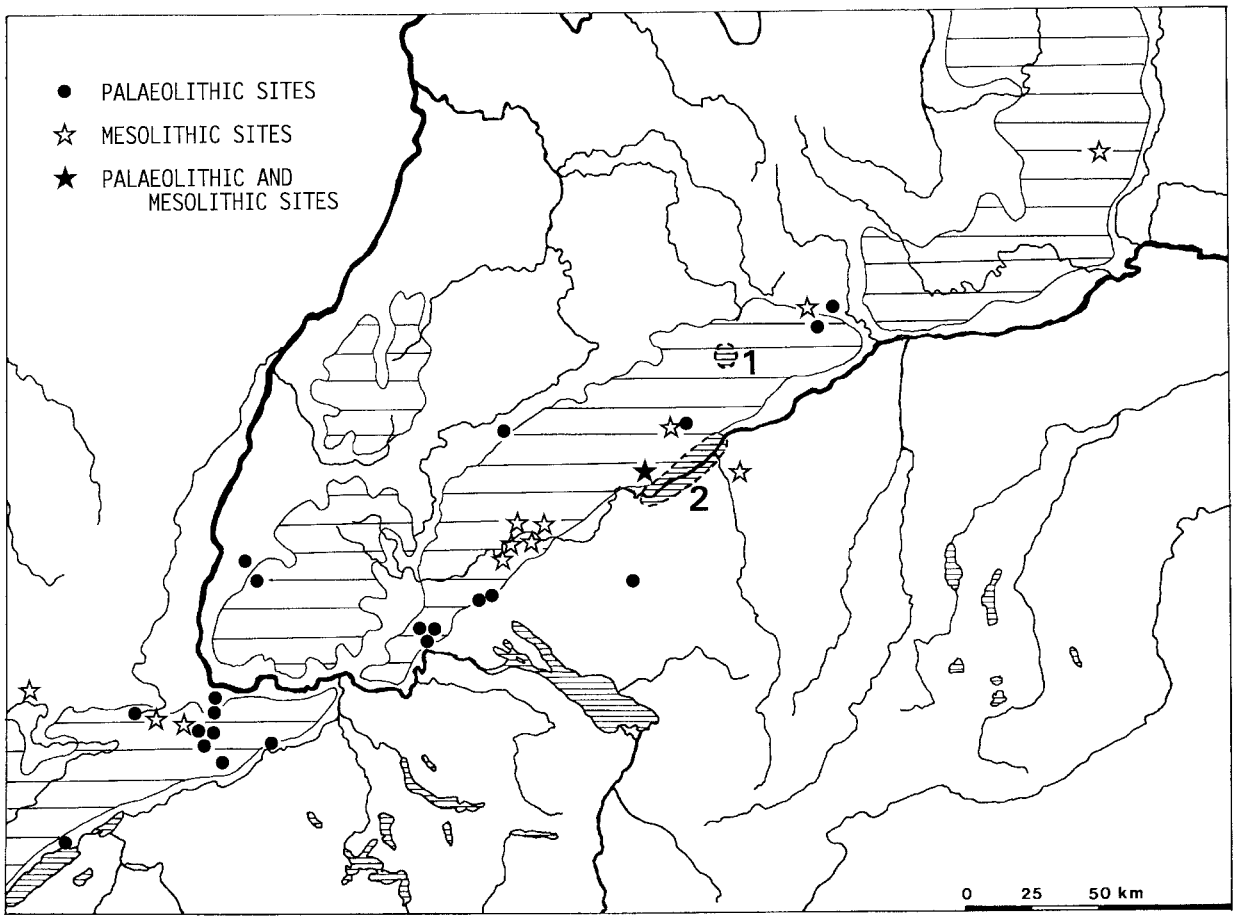

Figure 8. Location of Late Glacial and Early Postglacial sites with ornamental mollusks and domestic deposits of fossil mollusks from (1) the Steinheimer basin and (2) the Kirchberger layers on the Upper Danube.

number and provenance), and partly because of the find context. All other mollusk inventories represent stray finds associated with probable occupation floors. In Große Ofnet, however, the fossil shells were recovered from two pits containing head burials (Figure 11) where the tiny gastropods were found partly strewn in the ochreous filling, and partly attached to individual skulls, especially those of

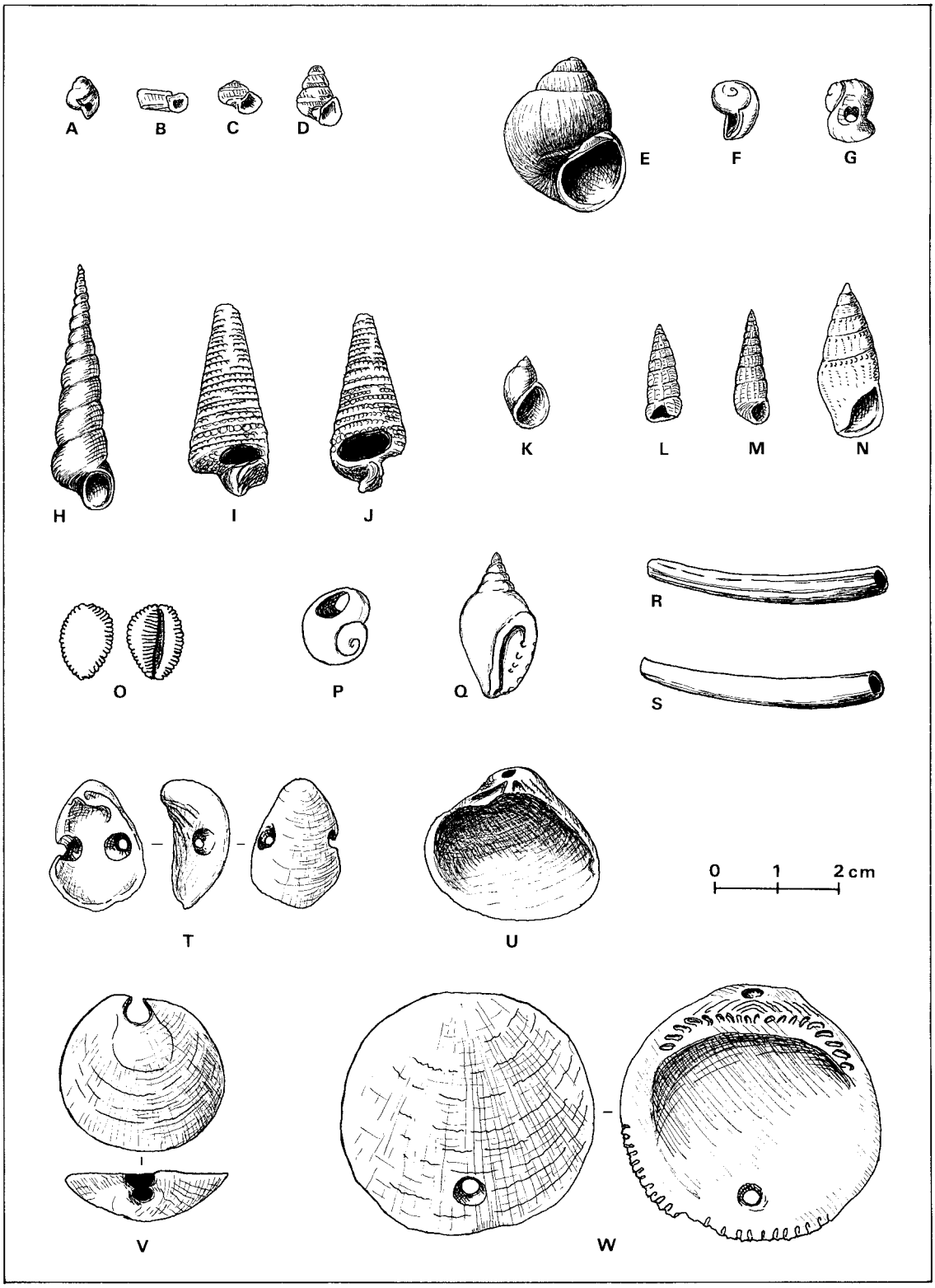

Figure 9. Ornamental mollusks from Magdalenian inventories: A-D: *Gyraulus sp.*, E-G: *Viviparus suevicus,* H: *Turritella sp.*, I-J: *Tympanotonos margaritaceus*, K: *Radix socialis*, L-N: *Pirenella sp.*, O: *Trivia sp.*, P: *Littorina obtusata*, Q: *Purpura lapillus*, R-S: *Dentalium sp.*, T: *Gryphaea arcuata*, U: *Cyrene sp.*, V-W: *Glycymeris sp.*

children and younger women (Schmidt 1912:37f). The find circumstances reveal that here the ornamental mollusks must have been part of some kind of headgear or other garment. This observation ought to be applicable to the other finds of fossil and sub- recent mollusks. In the Magdalenian as well as in the Mesolithic these objects undoubtedly were part of personal equipment.

The presumed provenance of many of the mollusks have been identified (Tables 2-3). These identifications, however, are not always quite as unambiguous as we like them to be. I have chosen to depict the most probable connections with reference to number of positive source identifications, proximity, and travel route—the latter especially with respect to pieces of Mediterranean origin.

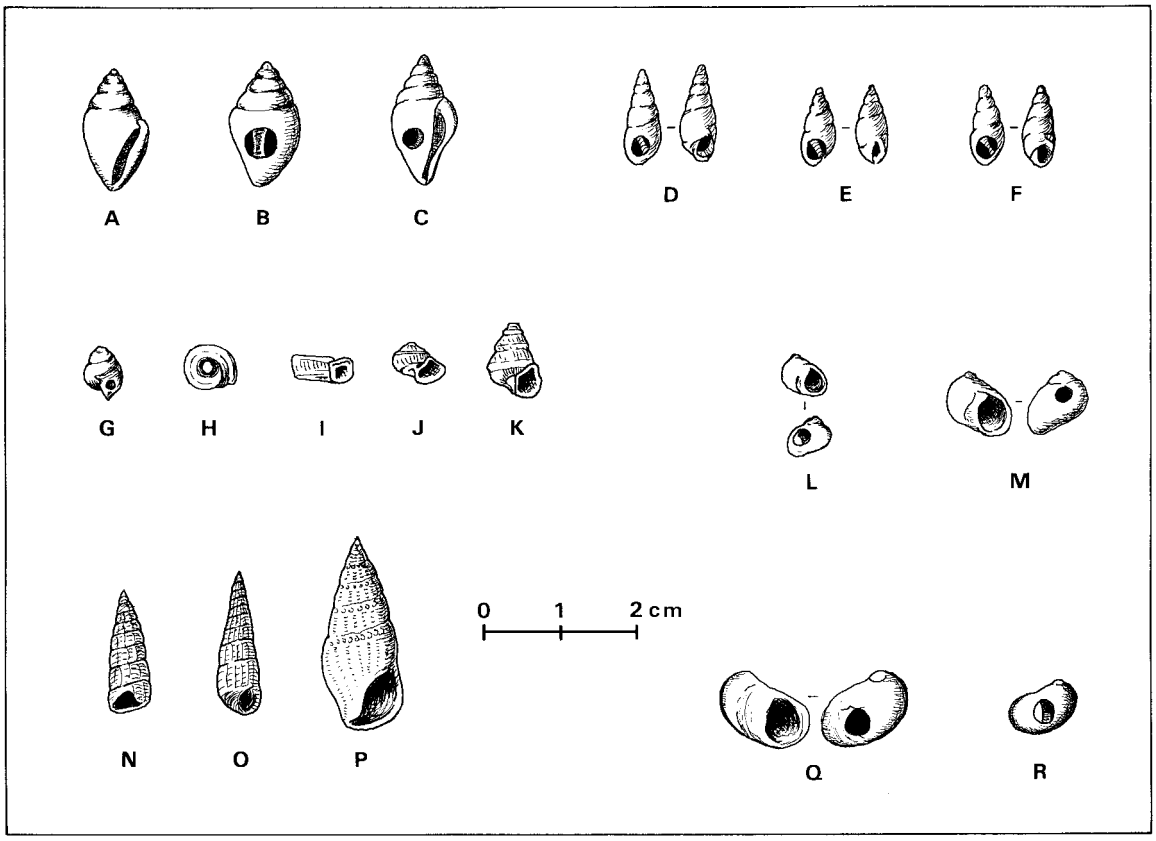

Figure 10. Ornamental mollusks from Early Mesolithic inventories: A-C: *Columbella rustica*, D-F: *Bayania sp.*, G-K: *Gyraulus sp.*, L-M: *Lithoglyphus naticoides*, N-P: *Pirenella sp.*, Q-R: *Theodoxus gregarius*.

Figure 11. Große Ofnet—the head burials (after Schmidt 1912).

Table 2. Schematic Survey of Ornamental Mollusks (Gastropodae [G], Scaphopodae [S] and Bivalvae [B]) found in Magdalenian Sites* within the Study Area*

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Mediterranean sea (sub-recent)																							
Homalopoma sanguineum	(G)	-	-	-	1	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	-	-	-
Cyclope neritea	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	2	-	-
Pirenella plicata	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Pleurotoma sp.	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Trochus obliquatus	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Cytherea sp.	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-
Glycymeris sp.	(B)	-	-	-	-	-	1	-	-	-	-	-	-	-	10	-	-	-	-	-	-	-	-
Atlantic sea (sub-recent)																							
Nucella/ Purpura lapillus	(G)	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-
Littorina obtusata	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Astarte montagui	(B)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
Paris basin (fossil)																							
Bayania sp.	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Sycum sp.	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-
Turritella sp.	(G)	-	1	-	-	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mainzer basin (fossil)																							
Proadusta meyeri	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Natica sp.	(G)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Buccinum cassidera	(G)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Tympanotonos margaritaceus	(G)	-	6	-	1	1	-	14	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Potamides lamarcki	(G)	-	-	-	-	-	-	-	-	-	1	-	2	-	-	2	-	-	-	-	-	-	-
Pirenella plicata	(G)	-	1	-	19	2	-	-	-	X	-	-	3	-	-	7	-	-	-	2	2	-	-
Polinices achatensis	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Dentalium sp.	(S)	-	1	-	-	-	-	-	-	X	4	-	-	1	-	18	-	-	-	1	3	-	-
Glycymeris sp.	(B)	7	1	1	18	10	-	20	2	-	5	1	3	-	98	28	-	1	-	-	2	-	2
Cyrene sp.	(B)	-	-	-	-	-	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	2	-
Bivalvae pernostrea	(B)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Gastropodae & Bivalvae unsp.	(B)	-	-	-	-	-	-	-	-	XX	-	-	-	-	-	-	-	-	-	-	-	-	-

Table 2. Continued

		A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Steinheimer basin (fossil)																							
Gyraulus trochiformis	(G)	18	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	4	7	-	-
Gyraulus sulcatus	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-
Radix socialis	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-
Kirchberger layers (fossil)																							
Viviparus suevicus	(G)	12	-	-	1	-	-	-	-	-	1	-	-	-	-	34	1	-	43	10	4	-	-
Brotia escheri	(G)	1	-	-	-	-	-	-	-	-	-	-	-	-	1	8	-	-	-	2	-	-	-
Melanopsis kleini	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-
Congeria sp.	(B)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	1	-	-	-
Jurassic formation (fossil)																							
Gryphaea sp.	(B)	-	-	-	-	-	-	-	-	-	-	-	-	-	4	3	-	-	-	-	-	-	-
Ostrea sp.	(B)	-	-	-	-	-	-	-	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Various fossils		-	-	-	-	-	7	-	-	X	30	-	1	-	18	1	-	-	9	-	-	-	-
Unknown provenance																							
Trivia sp.	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Terebratula insignis	(G)	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Gastropoda indet.	(G)	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-

*A: Monruz (Affolter *et al.* 1994), B: Rislisberghöhle II (Sedlmeier 1988), C: Chesselgraben, lower (Sedlmeier 1988), D: Kohlerhöhle, upper (Lüdin 1938; Sedlmeier 1988), E: Kastelhöhle Nord, upper (Sedlmeier 1988), F: Birseck-Ermitage, lower (Sarasin 1918; Sedlmeier 1988), G: Hollenberg Höhle 3 (Sedlmeier 1982, 1988), H: Käsloch (Stampfli 1981; Sedlmeier 1988), I: Kesslerloch (Heierli 1907; Schmid 1977), J: Schweizersbild (Nüesch 1896; Rähle 1987b), K: Freudenthal (Karsten 1874), L: Teufelsküche (Zotz 1928; Pasda 1994), M: Munzingen (Padtberg 1925; Albrecht 1981; Pasda 1994), N: Petersfels 1927-32 (excavation) (Peters 1930; Peters and Toepfer 1932), O: Petersfels 1927-32 (screened fill) and 1974-76 (excavation) (Rähle 1983b, 1994), P: Gnirshöhle (Albrecht, Drautz and Kind 1977; Rähle 1987a), Q: Napoleonskopf (Schmidt 1912; Padtberg 1925), R: Felsställe IIIb (Rähle 1987a), S: Hohler Fels Schelklingen Ia-Ic (Rähle 1981, 1994), T: Hohler Fels Schelklingen IIa (Rähle 1981, 1994), U: Kaufertsberg 1 (Kaulich 1983), V: Hohlenstein Ederheim (Narr 1965).

Table 3. Schematic Survey of Ornamental Mollusks (Gastropodae [G] and Bivalvae [B]) found in Early Mesolithic Sites* within the Study Area

		A	B	C	D	E	F	G	H	I	J	K	L	M
Mediterranean sea (sub-recent)														
Columbella rustica	(G)	-	-	1	-	-	1	-	-	-	-	-	5	-
Atlantic sea (sub-recent)														
Cerastoderma sp.	(B)	-	-	-	-	-	-	-	-	-	-	19	-	-
Macoma balthica	(B)	-	-	-	-	-	-	-	-	-	-	2	-	-
Paris basin (fossil)														
Bayania sp.	(G)	-	3	-	-	-	-	-	-	-	-	-	-	-
Mainzer basin (fossil)														
Potamides lamarcki	(G)	-	-	-	-	-	-	2	-	-	-	-	-	-
Potamides laevissimus	(G)	4	-	-	-	1	2	-	-	-	-	-	-	-
Pirenella plicata	(G)	1	-	-	-	-	1	1	-	-	-	-	-	-
Theodoxus gregarius	(G)	-	-	-	-	-	-	-	-	-	-	-	50	-
Steinheimer basin (fossil)														
Gyraulus trochiformis	(G)	-	-	-	1	-	-	7	-	3	-	-	160	1
Gyraulus sulcatus	(G)	-	-	-	-	-	-	12	-	10	4	-	-	-
Eastern Europe/ Central Danube														
Lithoglyphus naticoides	(G)	-	-	-	-	-	-	-	1	-	-	-	4000	-
Unknown provenance														
Bivalva indet.	(B)	-	-	-	-	-	-	-	-	-	-	4	-	-

* A: Bavans 6 (Aimé and Devits 1984), B: Roggenburg-Ritzigrund, lower (Jagher 1989), C: Birsmatten-Basisgrotte, upper (Rähle 1978), D: Jägerhaushöhle 7 (Strauch 1978), E: Probstfels (Rähle 1978), F: Falkensteinhöhle (Rähle 1978), G: Burghöhle Dietfurt 250-300 (Rähle 1978, 1987b), H: Zigeunerfels A (Rähle 1978), I: Felsställe IIa3 (Rähle 1987a), J: Helga Abri IIF1-IIF2 (Rähle 1983a), K: Attenhofen (Wischenbarth 1991), L: Große Ofnet VII (Schmidt 1912; Rähle 1978; Strauch 1978), M: Bettelküche 4 (Strauch 1978).

The map in Figure 12 illustrates the probable Magdalenian connections. We find that sites in the southwestern part of the study area have considerably more long distance connections (in number of different connections, range, and number of pieces involved) than the sites in the northeast. Long distance connections are also for the most part northerly and cover distances of at least 250 kilometers. It is very probable that these connections (as illustrated) were directed primarily at the Mainzer Tertiary basin, but the possibility that they reached even further to the Paris basin or to Belgium cannot be dismissed (Sedlmeier 1988:3).

Two domestic Swabian deposits of fossil mollusks were also exploited: the Miocene lake deposits of the Steinheim basin in the Ostalb, and the so-called Kirchberger layers (Miocene molasse deposits) on the Upper Danube (Figure 8). It is notable that only Felsställe IIIb distinguishes itself by having exclusively domestic species in the mollusk inventory. As noted above, Felsställe also distinguishes itself by the fact that 99 percent of the lithics were obtained within 500 meters of the habitation area (Table 1).

Among the Mesolithic inventories, the picture remains fairly complicated (Figure 13). The domestic exploitation of fossil mollusks from the Kirchberger layers has ceased (probably because of an increased vegetation cover in the Danube river valley), but instead we observe an intensified exploitation of the Miocene deposits in the Steinheimer basin. Northerly long distance connections are still most common, but they are completely surpassed in extent (i.e., number of objects involved) by the connection between Große Ofnet and eastern Central Europe.

In conclusion, we find that there are major differences, but also clear similarities between the Magdalenian and the Mesolithic use and procurement of ornamental mollusks. The similarities include the preferred species or types of species, the chiefly northerly direction of long distance connec-

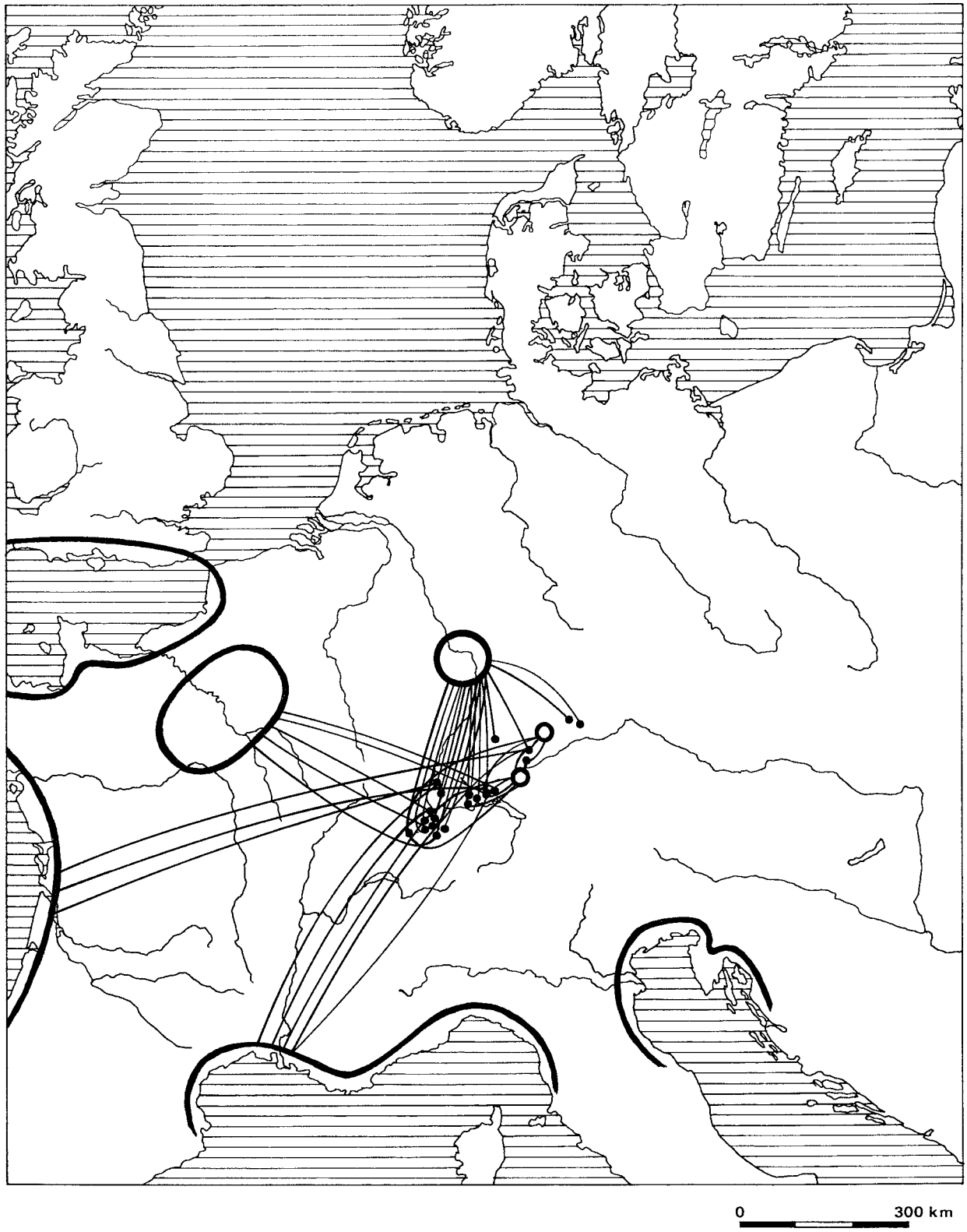

Figure 12. General map: Provenance and archaeological occurrence of ornamental mollusks in the Magdalenian. Thin lines indicate the direction of connections between archaeological sites (dots) and the most probable source areas (heavy lines) of fossil and sub-fossil shells.

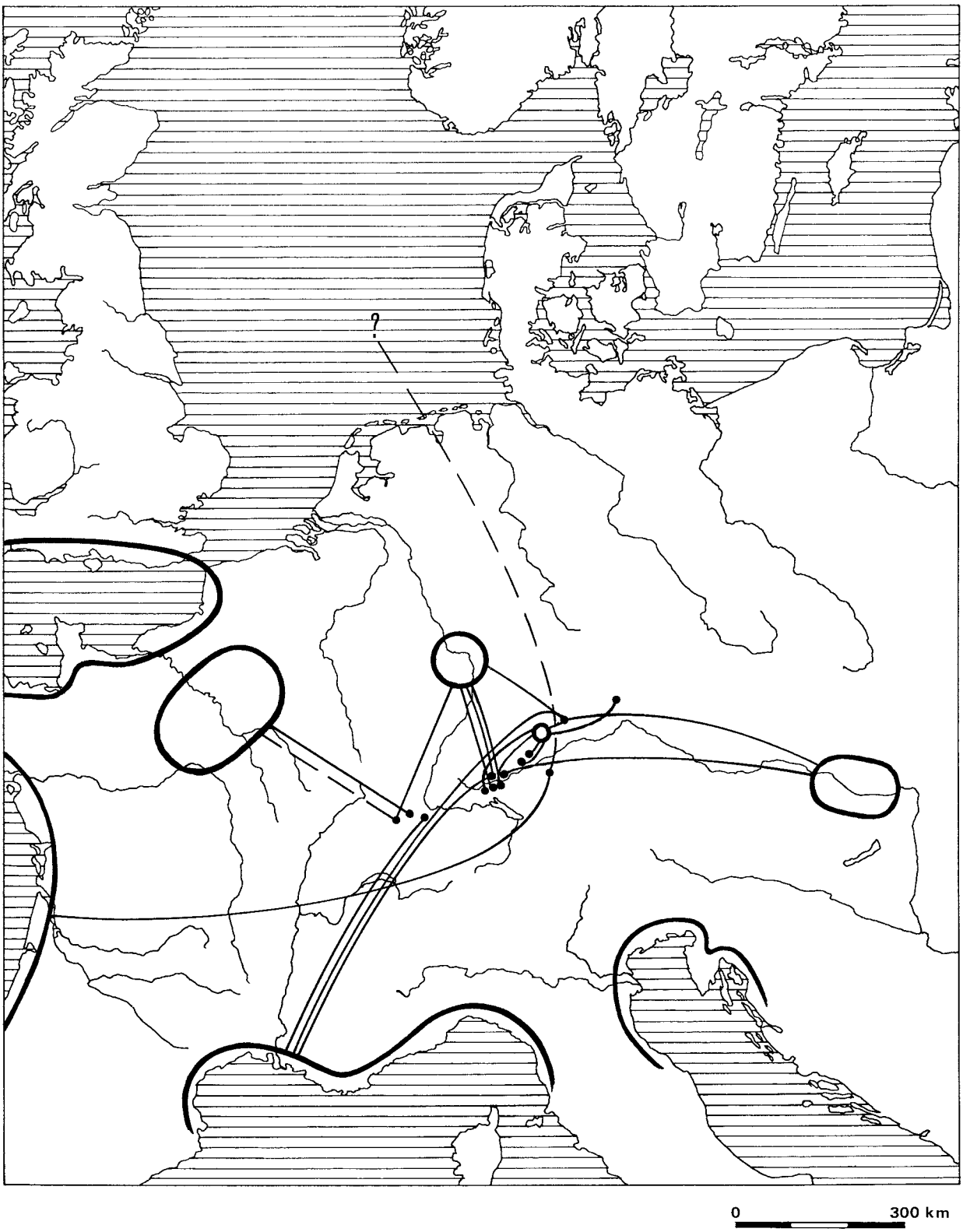

Figure 13. General map: Provenance and archaeological occurrence of ornamental mollusks in the early Mesolithic. Thin lines indicate the direction of connections between archaeological sites (dots) and the most probable source areas (heavy lines) of fossil and sub-fossil shells.

tions, the extreme long distance connections with the Atlantic and the Mediterranean, and the domestic exploitation of deposits in the Steinheimer basin.

Now the question is—do these similarities also apply to the mobility and communication patterns which are reflected in the presence of the ornamental mollusks in the inventories?

Discussion

Drawing on the work of Binford (1977, 1979), Morrow and Jefferies (1989) have presented a very useful threefold classification of general procurement patterns. They distinguish between 1) (indirect) procurement through a trade, or barter, network, 2) direct procurement by special-purpose trips to the source areas and 3) embedded procurement within seasonal movements through the region. Though initially designed for discussing lithic raw materials, this conceptual framework is also excellent for examining the procurement of 'ornamental raw materials'.

The exploitation of lithic raw materials may be attributed to the individual activities, or mobility patterns, of the past hunter-gatherer groups. This also applies to the exploitation of jet and ammonites during the Magdalenian, and to the exploitation of fossil mollusks from the Steinheimer basin and the Upper Danube. Yet, it is difficult to determine exactly how these domestic deposits of 'ornamental raw materials' were exploited.

While lithic raw material represents a critical resource, which may be optimized with respect to investment of time and energy, fossil mollusks (as well as jet and ammonites) should rather be regarded as luxury items used for personal adornment. They may be socially important, but they are in no way critical. In the mobile hunter-gatherer societies of the late glacial and early postglacial, the exploitation of local and regional deposits of such 'ornamental raw materials' most likely would have been thoroughly embedded in other (i.e. subsistence economic) activities.

It is therefore notable that within a distance of 30 kilometers from Steinheimer basin neither Paleolithic nor Mesolithic finds of ornamental mollusks have been made (Figure 8), not even in the recently excavated sites of Malerfels and Spitzbubenhöhle. If the exploitation of Miocene mollusks from Steinheimer basin was part of an embedded procurement pattern, we would expect to find those fossils in at least some of the Paleolithic and Mesolithic sites of the nearby Lone and Eselsburger valleys.

Direct procurement, on the other hand, would seem a very high investment in such tiny objects. Unfortunately, though, we lack conclusive evidence. If small special-purpose procurement camps had existed in the Steinheimer basin or along the Upper Danube, we would never be able to find them. Quarries, gravel pits and intensive cultivation would have destroyed all remains.

Jet, ammonites and the mollusks from the Upper Danube deposits are only exploited in the Magdalenian. The fossils from Steinheimer basin are exploited throughout the period in question, but the exploitation is clearly intensified in the Early Mesolithic. It is tempting to interpret these differences as another indication (cf. the discussion of lithic raw material procurement patterns through time) of diachronic changes in settlement and mobility patterns.

Previous analyses of settlement dynamics and subsistence strategies within the study area (Eriksen 1991 with references) indicate that especially the Magdalenian was characterized by a complex settlement and mobility pattern. The Magdalenians were highly adaptive and generally opportunistic hunters who had the choice of a variety of game animals. All evidence suggests that the groups stayed within the region throughout the year. In the central part of the study area (Hegaualb and Randen) they were able to practice periodic mass killings of reindeer to an extent that allowed periodic (autumn and winter) aggregation camps and probably also storage of meat.

Moreover, indications of site seasonality support a model of short seasonal movements between spring and summer residential camps in the Swabian Alb, Swiss Jura and Black Forest foothills, and autumn and winter aggregation camps in Hegaualb, Randen and the adjacent lowland (Eriksen 1996a). Once more, movements primarily seem to follow a northeast- southwesterly axis parallel to the Jura formation. On the other hand, we should also add to this model the possibility that certain groups might have been able to remain within fairly limited parts of the area, in the northeast or in the southwest, throughout the year. A fine example of such a residential winter site in the Swabian Alb is Felsställe IIIb (Kind 1987).

During the Early Mesolithic these regional differences are no longer observable. Neither is there any evidence of aggregation camps from this period. Instead we find indications of a more stable settlement structure, which apparently was accompanied by a reduction in the size of settlements (probably related both to duration of occupation and number of inhabitants). The difference in subsistence strategies between the Magdalenian and the Early Mesolithic may to some extent be reduced to a difference of degree (Eriksen 1991) caused by environmental factors. Unfortunately the evidence on seasonality offers only a rather diffuse picture, which does not support any particular model of interpretation of mobility patterns. Nevertheless, the Mesolithic groups seem to have stayed within the

bounds of the study area.

The obvious changes in settlement structure, and to a certain degree subsistence strategies, are likely to be accompanied by changes in mobility strategies through time. Given the marked increase in boreal vegetation in the early postglacial, we should expect increased residential mobility in this period compared to the late glacial (Kelly 1983). It appears very reasonable to explain the differences between Magdalenian and the Early Mesolithic use and procurement of lithic raw materials and of domestic occurrences of 'ornamental raw materials' in the light of these general socioeconomic differences. Still, a few open questions remain, concerning the use of heat treatment. If Mesolithic people are characterized by high residential mobility, how do they find time to perform this allegedly complicated and time-consuming process? Heat treatment probably required some degree of advance planning.

So far, we have only discussed the local and regional procurement patterns, but as a matter of fact there are also quite a few truly exotic elements in the mollusk inventories. In the Magdalenian as well as in the Early Mesolithic the occasional subrecent mollusks from the Mediterranean and the Atlantic are obvious expressions of procurement through a communication, or barter, network. Incidentally, these extreme long distance connections are complemented by at least two Magdalenian finds within the study area of presumably Baltic amber, at Moosbühl II (Schwab 1985) and Champréveyres (Le Tensorer and Niffeler 1993).

The exploitation of the remaining mollusk deposits represents a more complicated problem, especially with regard to the Mainzer basin which lies only some 250 kilometers from the Jura. An active exploitation of these deposits is possible, especially during the Magdalenian where connections between the two areas appear to have been quite intensive.

Two possible models of interpretation may then be considered. The first implies fixed, possibly seasonal migrations between the southwestern part of the study area and the Mainzer basin, probably following the Rhine valley. A realistic discussion of this model, though, would require evidence of clear, mutual connections, involving also lithic raw materials. But the evidence from the lithic raw material analysis rather indicates that seasonal migrations followed a southwest-northeasterly direction.

The second model (Figure 14) thus assumes that there existed Magdalenian aggregation camps in the southwestern part of the area, which more or less regularly received visitors from the Mainzer basin. As previously mentioned, possible aggregation camps are documented in this area by way of subsistence-economic and settlement dynamic analyses, and this model is thus given preference.

It is concluded that in the Magdalenian, lithic raw materials used for tools were procured actively and directly within the region. The procurement was usually embedded in the subsistence activities of the groups, thus reflecting seasonal movements throughout the region. Domestic occurrences of mollusks and other 'ornamental raw materials' generally are supposed to have been procured much the same way as the lithics, but the evidence is inconclusive, and especially the Steinheimer basin deposits may have been exploited more directly. Exotic mollusks (i.e. mollusks coming from the Atlantic, the Mediterranean, Paris or Mainzer basin), in my opinion, represent different expressions of inter-group communication patterns. Some are obvious expressions of procurement through a long-distance communication, or barter, network. Others seem to represent an inter-regional communication network with direct contact between neighboring groups.

It is very interesting to note that elements expressing an active (direct or embedded) procurement and elements expressing contact networks run transversely to one another. The seasonal migrations of the Magdalenian groups followed a southwest-northeasterly direction parallel to the Jura formation, but their contacts with other groups were primarily northerly. This observation is in no way unique among Magdalenian finds in Central and Western Europe (Floss 1994:336f).

A fine example of highly different provenance directions with respect to lithic raw material and ornamental mollusks is thus represented by Andernach find concentration II. The vast majority of lithic raw material (86.5 %) here consists of Maas flint coming from a distance of at least 100 kilometers to the northwest (Floss 1994:193f). However, the site also produced a small depot of sub-recent mollusks: 46 *Homalopoma sanguineum* and 1 *Cyclope neriteus* (Floss 1994:218) both coming from the Mediterranean, i.e. at least 800 kilometers to the south.

In the Mesolithic, lithic raw materials used for tools still were procured actively and directly within the region. As before, procurement probably was embedded in subsistence activities. The relatively few connections to the Mainzer Basin and the small number of pieces involved indicate a passive procurement (i.e., perhaps by trade or barter) of ornamental mollusks from here. The only serious exception is that of Große Ofnet.

The head burials from Große Ofnet have now been firmly dated to approximately 7,500 BP (conv. ^{14}C) (Hedges *et al.* 1989:210f). Thus, at least one of the major problems concerning this find (Naber 1974; Newell *et al.* 1990:107f) has finally been solved, but many others still remain. The find context is quite spectacular, though not entirely unique. Isolated head burials probably of Mesolithic age are known from the nearby Kaufertsberg (Kaulich 1983:93f; Schröter 1983) and Hohlenstein Stadel

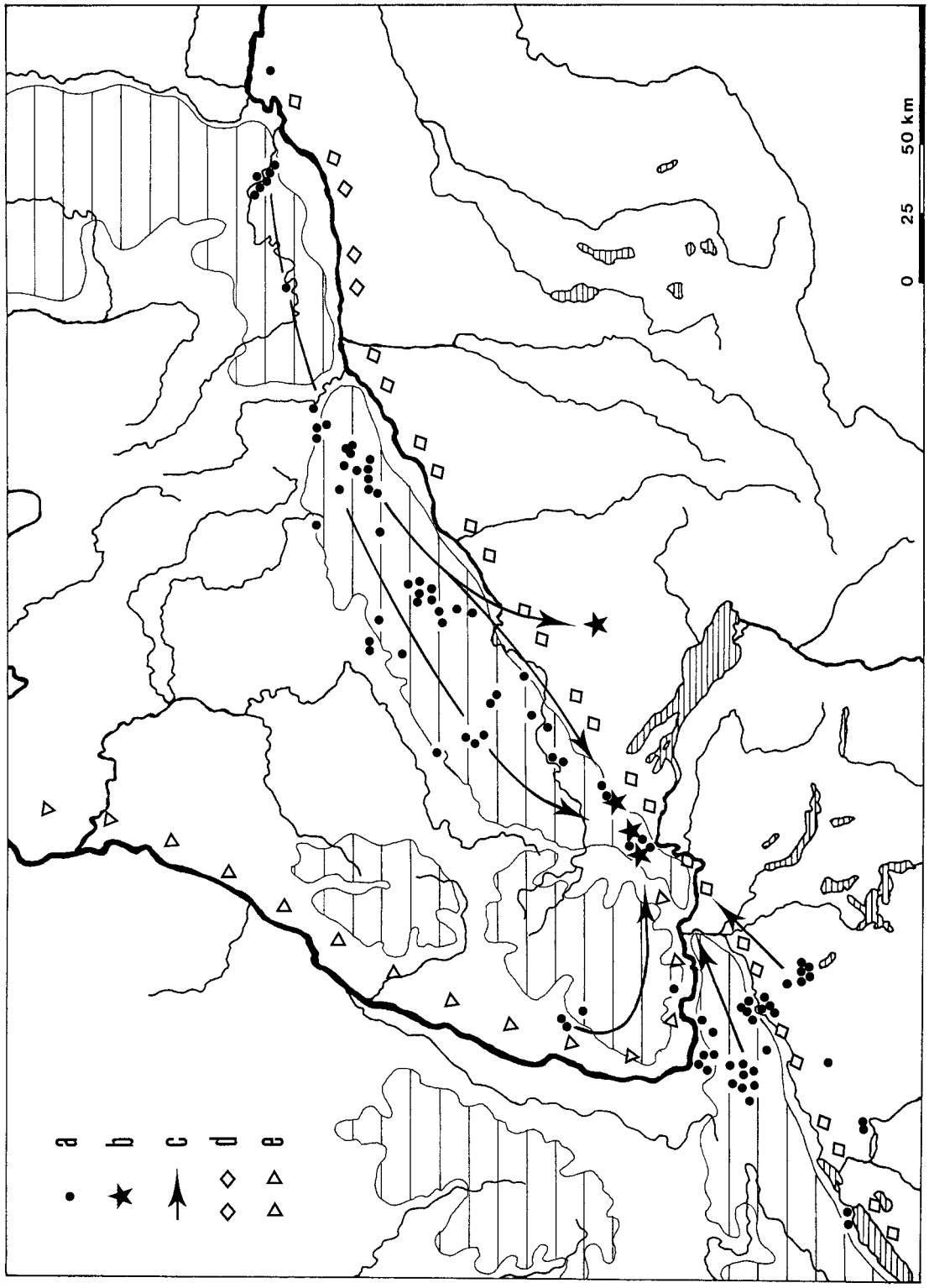

Figure 14. Model illustrating the seasonal movements of Magdalenian groups and the connection with the Mainzer Basin: A: Residential sites, B: Probable aggregation camps or other sites of major socioeconomic importance, C: Autumn-winter movements, D: Line indicating predominant direction of lithic raw material transport, E: Line indicating direction of regular inter-group communication.

(Wetzel 1938, 1961) as well as from Mannlefelsen I in Alsace (Kaulich 1983:94 with references). These sites, like Große Ofnet, are all caves or rock shelters, but this is very likely a question of conditions for preservation. Kaufertsberg and Mannlefelsen both represent solitary head burials with no grave goods. At Hohlenstein Stadel, 3 heads (adult male, adult female and little child) were found together in a pit. The woman wore a necklace of teeth from the Black Sea roach (*Rutilus frisii meidingeri*), but no ornamental mollusks. At Große Ofnet a total of 33 heads (4 adult males, 9 adult females and 20 children or juvenile females) were found in two pits (Schmidt 1912:37f). Almost all heads were lavishly adorned with ornamental mollusks or perforated red deer teeth.

The find context, the extremely large number of ornamental mollusks, and their in part truly exotic origin invites speculation. However, this is not the place for fictitious stories. In any event, the evidence from Große Ofnet is in no way inconsistent with the point made in the present discussion. The fundamental differences between the Magdalenian and the Early Mesolithic groups are socioeconomic. Ornamental mollusks and lithic raw materials each express different aspects of this basic distinction.

Acknowledgments

I dedicate this paper to my old friends and colleagues at the 'Institut für Ur- und Frühgeschichte - Abteilung ältere Urgeschichte und Quartärökologie' at the University of Tübingen. Moreover, the financial support of the Alexander von Humboldt Stiftung as well as the Danish Research Council for the Humanities is gratefully acknowledged.

References Cited

Affolter, J., M.-I. Cattin, D. Leesch, P. Morel, N. Plumettez, N. Thew and G. Wending
1994 Monruz—Une nouvelle station magdalénienne au bord du lac de Neuchâtel. *Archäologie der Schweiz* 17:94-104.

Aimé, G. and J.-A. Devits
1984 Les coquillages de parure du Mésolithique moyen des abris de Bavans (Doubs). Données récentes. *Bulletin de la Société Préhistorique Française* 81:268-269.

Albrecht, G.
1979 *Magdalénien-Inventare vom Petersfels. Siedlungsarchäologische Ergebnisse der Ausgrabungen 1974-1976*. Tübinger Monographien zur Urgeschichte 6. Archaeologica Venatoria, Tübingen.
1981 Die neuen Ausgrabungen in Munzingen 1976/1977. *Archaeologica Venatoria, Mitteilungsblatt* 2:21-23.
1984 Der spätpleistozäne und altholozäne Fundplatz Malerfels I. In *Die steinzeitliche Besiedlung des Eselburger Tales bei Heidenheim (Schwäbische Alb)*, edited by J. Hahn, pp. 90-122. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 17. Konrad Theiss Verlag, Stuttgart.

Albrecht, G., H. Berke, S. Haas-Campen and A. Hahn-Weishaupt
1994 Die Funde vom Petersfels in der Stätischen Sammlung Engen im Hegau. *Fundberichte aus Baden-Württemberg* 19:1-62.

Albrecht, G., D. Drautz and J. Kind
1977 Eine Station des Magdalénien in der Gnirshöhle bei Engen-Bittelbrunn im Hegau. *Archäologisches Korrespondenzblatt* 7:161-179.

Andrée, J.
1939 *Der eiszeitliche Mensch in Deutschland und seine Kulturen*. Ferdinand Enke Verlag, Stuttgart.

Auffermann, B.
1991 *Magdalénien und Mesolithikum der Bruckersbergstationen in Giengen*. Unpublished M.A. Thesis, University of Tübingen.

Bandi, H.-G.
1947 *Die Schweiz zur Rentierzeit*. Huber, Frauenfeld.

Barr, J. H.
1973 *The Late Upper Paleolithic Site of Moosbühl: An Attempt to Analyze some of its Problems*. Ph.D. Thesis, University of Bern.
1977 Die Rislisberghöhle, ein neuer Magdalénien Fundplatz im Schweizer Jura. *Archäologisches Korrespondenzblatt* 7:85-87.

Binford, L. R.
1977 Forty-seven trips: a case study in the character of archaeological formation processes. In *Stone Tools as Cultural Markers: Change, Evolution and Complexity*, edited by R. V. S. Wright, pp. 24-36. Australian Institute of Aboriginal Studies, Canberra.
1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35:255-273.

Cattin, M.-I.
1990 Silex-Economy on the Magdalenian Site: Hauterive-Champréveyres (Switzerland): Spatial Organization and Technology by Refitting. In *The Big Puzzle. International*

Symposium on Refitting Stone Artefacts, edited by E. Cziesla, S. Eickhoff, N. Arts and D. Winter, pp. 363-369. HOLOS-Verlag, Bonn.

Deecke, W.
1933 *Die mitteleuropäische Silices nach Vorkommen, Eigenschaften und Verwendung in der Prähistorie*. Gustav Fischer Verlag, Jena.

Eberhardt, H., E. Keefer, C.-J. Kind, H. Rensch and H. Ziegler
1987 Jungpaläolithische und mesolithische Fundstellen aus der Aichbühler Bucht. *Fundberichte aus Baden-Württemberg* 12:1-51.

Eriksen, B. V.
1991 Change and Continuity in a Prehistoric Hunter-Gatherer Society. *Archaeologica Venatoria* 12. Archaeologica Venatoria, Tübingen.
1996a Resource Exploitation, Subsistence Strategies and Adaptiveness in Late Pleistocene–Early Holocene Northwestern Europe. In *Humans at the End of the Ice Age: The Archaeology of the Pleistocene-Holocene Transition*, edited by L. G. Straus, B. V. Eriksen, J. M. Erlandson, and D. R. Yesner, pp. 101-128. Plenum Press, New York.
1996b Diskussionsbeitrag zum Spätpaläolithikum Mitteleuropas—Apologie einer urgeschichtlichen Quellenkritik. In *Spuren der Jagd–Die Jagd nach Spuren,* edited by J. Hahn, I. Campen and M. Uerpmann. Tübinger Monographien zur Urgeschichte 11. Mo Vince, Tübingen.
1997 Settlement Patterns, Cave Sites and Locational Decisions in Late Pleistocene Central Europe. In *The Human Use of Caves*, edited by C. Bonsall and C. Smith. B.A.R. International Series 667. Oxford: Archaeopress.

Floss, H.
1994 *Rohmaterialversorgung im Paläolithikum des Mittelrheingebietes. Monographien des Römisch-Germanischen Zentralmuseums* 21. Rudolf Habelt, Bonn.

Flükiger, W.
1964 Die steinzeitliche Siedlung "Hintere Burg". *Jahrbuch für solothurnische Geschichte* 37:263-304.

Frenzel, B.
1983 Die Vegetationsgeschichte Süddeutschlands im Eiszeitalter. In *Urgeschichte in Baden-Württemberg*, edited by H. Müller-Beck, pp. 91-166. Konrad Theiss Verlag, Stuttgart.

Geyer, O. F. and M. P. Gwinner
1991 *Geologie von Baden-Württemberg*. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

Gradmann, R.
1956 *Süddeutschland I–II*. Darmstadt.

Hahn, J.
1983 Die frühe Mittelsteinzeit. In *Urgeschichte in Baden-Württemberg*, edited by H. Müller-Beck, pp. 363-392. Konrad Theiss Verlag, Stuttgart.
1991 Erkennen und Bestimmen von Stein- und Knochenartefakten. Einführung in die Artefaktmorphologie. *Archaeologica Venatoria* 10. Archaeologica Venatoria, Tübingen.
1992 *Eiszeitschmuck auf der Schwäbischen Alb. Alb und Donau*, Kunst und Kultur 5. Süddeutsche Verlagsgesellschaft Stuttgart, Ulm.
n.d. Der Hohlenstein im Lonetal (Markung Asselfingen, Kreis Ulm). Mesolithikum und Jungpaläolithikum. Tübingen:manuscript.

Hahn, J., editor
1984 *Die steinzeitliche Besiedlung des Eselburger Tales bei Heidenheim (Schwäbische Alb).* Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 17. Konrad Theiss Verlag, Stuttgart.
n.d. Das Achtal in der älteren und mittleren Steinzeit. Klima, Ökologie, und Archäologie einer Landschaft der Mittleren Alb im Jungpleistozän und Frühholozän. Tübingen:manuscript.

Hahn, J. and A. Scheer
1983 Das Helga Abri am Hohlen Felsen bei Schelklingen: Eine mesolithische und jungpaläolithische Schichtenfolge. *Archäologisches Korrespondenzblatt* 13:19-28.

Hedges, R. E. M., R. A. Housley, I. A. Law and C. R. Bronk
1989 Radiocarbon Dates from the Oxford AMS System: Archaeometry Datelist 9. *Archaeometry* 31(2): 207-234.

Heierli, J.
1907 *Das Kesslerloch bei Thayngen.* Neue Denkschriften der Schweizerischen Naturforschenden Gesellschaft 43. Zürcher & Furrer, Zürich.

Heinen, M.
1986 Die Bedeutung der Rohstoffanalyse an dem spätpaläolithischen, mesolithischen Freilandfundplatz Sarching '83. *Archaeologica Venatoria, Mitteilungsblatt* 10/11:6-21.

Jagher, R.
1989 Le gisement mésolithique de Roggenburg-Ritzigrund, commune de Roggenburg, canton de Berne (Suisse). In *Epipaléolithique et Mésolithique entre Ardennes et Massif Alpin*, edited by G. Aimé and A. Thévenin, pp. 105-123. Mémoires de la Société d'Agriculture, Lettres, Sciences et Arts de la Haute-Saône, Vesoul.

Jagher, E. and R. Jagher
1987 Les gisements paléolithique de la Löwenburg, commune de Pleigne. *Archäologie der Schweiz* 10:43-52.

Jeske, R.
1989 Economies in raw material use by prehistoric hunter-gatherers. In *Time, Energy and Stone Tools*, edited by R. Torrence, pp. 34-45. Cambridge University Press, Cambridge.

Jochim, M. A.
1989 Optimization and stone tool studies: problems and potentials. In *Time, Energy and Stone Tools*, edited by R. Torrence, pp. 106-111. Cambridge University Press, Cambridge.
1993 *Henauhof-Nordwest — Ein mittelsteinzeitlicher Lagerplatz am Federsee*. Materialhefte zur Archäologie in Baden-Württemberg 19. Konrad Theiss Verlag, Stuttgart.

Karsten, H.
1874 Studie der Urgeschichte des Menschen in einer Höhle des Schaffhauser Jura. *Mitteilungen der Antiquarischen Gesellschaft Zürich* 18(6):137-162.

Kaulich, B.
1983 Das Paläolithikum des Kaufertberges bei Lierheim (Gem. Appetshofen, Ldkr. Donau-Ries). *Quartär* 33/34:29-97.

Kelly, R. L.
1983 Hunter-gatherer mobility strategies. *Journal of Anthropological Research* 39:277-306.

Kieselbach, P.
1993 Die Artefakte der mesolithischen Freilandstation Rottenburg-Siebenlinden II. Unpublished M.A. Thesis, University of Tübingen.

Kind, C.-J.
1987 *Das Felsställe. Eine jungpaläolithisch-frühmesolithische Abri-Station bei Ehingen-Mühlen, Alb-Donau- Kreis.* Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 23. Konrad Theiss Verlag, Stuttgart.

Kuhn, F.
1969 Höhlen am Isteiner Klotz I. *Archäologische Nachrichten aus Baden*, Oktober 1969:15-19.

Lauxmann, C.
1988 Die Steinartefakte des Magdalénienzeitlichen Fundhorisonts IV aus der Brillenhöhle bei Blaubeuren. Unpublished M.A. Thesis, University of Tübingen.

Le Tensorer, J.-M. and U. Niffeler
1993 Die Schweiz vom Paläolithikum bis zum frühen Mittelalter. *SPM I: Paläolithikum und Mesolithikum*. Verlag Schweizerische Gesellschaft für Ur- und Frühgeschichte, Basel.

Lurie, R.
1989 Lithic technology and mobility strategies: the Koster Site Middle Archaic. In *Time, Energy and Stone Tools*, edited by R. Torrence, pp. 46-56. Cambridge University Press, Cambridge.

Lüdin, C.
1938 Kohlerhöhle. *Jahrbuch der Schweizerischen Gesellschaft für Ur- und Frühgeschichte* 30:61-64.

Maier, H.
1936 Die altsteinzeitliche Wohnhöhle Kleine Scheuer im Rosenstein. *Mannus* 28:235-252.

Mauser, P. F.
1970 *Die jungpaläolithische Höhlenstation Petersfels im Hegau (Gemarkung Bittelbrunn, Ldkrs. Konstanz).* Badische Fundberichte Sonderheft 13. Freiburg:Staatliches Amt für Ur- und Frühgeschichte, Freiburg im Breisgau.
1976 Das eiszeitliche Jagdlager im Katzenbachtal. *Der Sülchgau* 20:35-44.

Morrow, C. A. and R. W. Jefferies
1989 Trade or embedded procurement? A test case from southern Illinois. In *Time, Energy and Stone Tools*, edited by R. Torrence, pp. 27-33. Cambridge University Press, Cambridge.

Naber, F. B.
1974 Das Ende des Ofnet-Problems? *Quartär* 25:73-84.

Narr, K. J.
1965 Die Altsteinzeitfunde aus dem Hohlenstein bei Nördlingen. *Bayerische Vorgeschichtsblätter* 30:1-9.

Newell, R. R., D. Kielman, T. S. Constandse-Westermann, A. van Gijn and W. A. B. van der Sanden
1990 *An Inquiry into the Ethnic Resolution of Mesolithic Regional Groups. The Study of Their Decorative Ornaments in Time and Space*. E.J. Brill., Leiden.

Nielsen, E. H.
1991 *Gampelen-Jänet 3. Eine mesolithische*

Siedlungsstelle im westlichen Seeland. Staatlicher Lehrmittelverlag, Bern.

Nüesch, J.
1896 *Die praehistorische Niederlassung am Schweizersbild bei Schaffhausen. Die Schichten und ihre Einschlüsse.* Zürcher & Furrer, Zürich.

Padtberg, A.
1925 *Das altsteinzeitliche Lößlager bei Munzingen*. Dr. Benno Filser Verlag, Augsburg.

Pasda, C.
1989 Das Magdalénien des Probstfels bei Beuron—Die Funde R. R. Schmidts. Unpublished M.A. Thesis, University of Tübingen.
1994 *Das Magdalénien in der Freiburger Bucht.* Materialhefte zur Archäologie in Baden-Württemberg 25. Konrad Theiss Verlag, Stuttgart.

Peters, E.
1930 *Die altsteinzeitliche Kulturstätte Petersfels*. Dr. Benno Filser Verlag, Augsburg.

Peters, E. and V. Toepfer
1932 Der Abschluss der Grabungen am Petersfels bei Engen im Badischen Hegau. *Prähistorische Zeitschrift* 23:155-198.

Pousaz, N., editor
1991 *L'abri-sous-roche Mésolithique des Gripons a Saint-Ursanne (JU/Suisse).* Cahiers d'archéologie jurassienne 2. Porrentruy:Office du patrimoine historique, Société Jurassienne d'Émulation.

Preuschoft-Güttler, A.
1995 Untersuchungen zur Präzision des Begriffs "Gagat" im Magdalénien Südwestdeutschlands und der Schweiz. Unpublished M.A. Thesis, University of Tübingen.

Price, T. D., S. Chappell and D. J. Ives
1982 Thermal Alteration in Mesolithic Assemblages. *Proceedings of the Prehistoric Society* 48:467-485.

Rähle, W.
1978 Schmuckschnecken aus mesolithischen Kulturschichten Süddeutschlands und ihre Herkunft. In *Das Mesolithikum in Süddeutschland. Teil 2: Naturwissenschaftliche Untersuchungen,* edited by W. Taute, pp. 163-168. Tübinger Monographien zur Urgeschichte 5/2. Archaeologica Venatoria, Tübingen.
1981 Schmuckschnecken aus jungpaläolithischen Fundschichten vom Hohlen Fels bei Schelklingen (Alb-Donau-Kreis). *Archäologisches Korrespondenzblatt* 11:179-180.
1983a Die Mollusken der Grabung Helga Abri bei Schelklingen mit einer Anmerkung zum Fund einiger mesolithischer Schmuckschnecken. *Archäologisches Korrespondenzblatt* 13:29-36.
1983b Schmuck aus Molluskenschalen von der Magdalénien-Station Petersfels bei Engen (Hegau). In *Naturwissenschaftlichen Untersuchungen an Magdalénien-Inventaren vom Petersfels, Grabungen 1974-1976*, edited by G. Albrecht, H. Berke and F. Poplin, pp. 154-158. Tübinger Monographien zur Urgeschichte 8. Archaeologica Venatoria, Tübingen.
1987a Die Molluskenfaunen der Grabung Felsställe bei Mühlen, Stadt Ehingen, Alb-Donau-Kreis. In *Das Felsställe. Eine jungpaläolithisch-frühmesolithische Abri-Station bei Ehingen-Mühlen, Alb-Donau-Kreis*, edited by C.-J. Kind, pp. 269-274. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 23. Konrad Theiss Verlag, Stuttgart.
1987b Schmuck aus Molluskenschalen von dem Abri Felsställe bei Mühlen, Stadt Ehingen, Alb-Donau-Kreis. In *Das Felsställe. Eine jungpaläolithisch-frühmesolithische Abri-Station bei Ehingen-Mühlen, Alb-Donau-Kreis*, edited by C.-J. Kind, pp. 383-385. Forschungen und Berichte zur Vor- und Frühgeschichte in Baden-Württemberg 23. Konrad Theiss Verlag, Stuttgart.
1994 Neue Funde jungpaläolithischen Schalenschmuckes vom Hohlen Felsen bei Schelklingen, Alb-Donau-Kreis, und vom Petersfels bei Engen, Kreis Konstanz. *Fundberichte aus Baden-Württemberg* 19:95-98.

Riek, G.
1934 *Die Eiszeitjägerstation am Vogelherd*. Franz F. Heine, Tübingen.
1959 Ein magdalénienzeitlicher Rastplatz unter der Südwand des Sirgensteinfelsens. *Fundberichte aus Schwaben* N.F. 15:30-42.

Rottländer, R. C. A.
1983 *Einführung in die naturwissenschaftlichen Methoden in der Archäologie.* Archaeologica Venatoria 6. Archaeologica Venatoria, Tübingen.
1989 *Verwitterungserscheinungen an Silices und Knochen.* Archaeologica Venatoria 8/2. Archaeologica Venatoria, Tübingen.

Rozoy, J.-G.
1978 *Les derniers chasseurs*. Bulletin de la société archéologique champenoise. Société archéologique champenoise, Reims.

Sarasin, F.
1918 *Die steinzeitlichen Stationen im Birstal zwischen Basel und Delsberg*. Neue Denkschriften des Schweizerischen Naturforschenden Gesellschaft 54/2, Zürich.

Schmid, E.
1977 Die Umwelt der Jäger vom Kesslerloch. In *Die Kultur der Eiszeitjäger aus dem Kesslerloch*, edited by H.-G. Bandi, J. Bürgi, K. Gerhardt, H. Müller-Beck and E. Schmid, pp. 56-62. Seekreis, Konstanz.

Schmidt, R. R.
1912 *Die diluviale Vorzeit Deutschlands*. Schweizerbart'sche Verlagsbuchhandlung, Stuttgart.

Schröter, P.
1983 Zum Schädel vom Kaufertsberg bei Lierheim (Gem. Appetshofen, Ldkr. Donau-Ries). *Quartär* 33/34:99-105.

Schuler, A.
1989 Das Magdalénien der Schussenquelle. Die Steinartefakte der Grabung von Oskar Fraas (1866). *Archäologisches Korrespondenzblatt* 19:11-22.

Schwab, H.
1972 Lüscherz-Moos. Eine epipaläolithische Fundstelle im Bernischen Seeland. *Jahrbuch des Bernischen Historischen Museums* 49/50:207-230.
1985 Gagat und Bernstein auf dem Rentierjägerhalt Moosbühl bei Moosseedorf (Kanton Bern). *Jahrbuch des Bernischen Historischen Museums* 63/64:259-266.

Schweizer, T.
1941 Die Azilien-Station "Unter der Fluh". *Jahrbuch für solothurnische Geschichte* 14:259-269.

Sedlmeier, J.
1982 *Die Hollenberg-Höhle 3. Eine Magdalénien-Fundstelle bei Arlesheim, Kanton Basel-Landschaft*. Basler Beiträge zur Ur- und Frühgeschichte 8. Habegger Verlag, Derendingen-Solothurn.
1988 Jungpaläolithischer Molluskenschalen-Schmuck aus nordwestschweizerischen Fundstellen als nachweis für Fernverbindungen. *Archäologisches Korrespondenzblatt* 18:1-6.
1989 Jungpaläolithikum und Spätpaläolithikum in der Nordwestschweiz. Ph.D. Thesis, University of Bern.

Simon, U.
1993 Die Burkhardtshöhle—eine Magdalénienstation am Nordrand der Schwäbischen Alb. Unpublished M.A. Thesis, University of Tübingen.

Stampfli, H. R.
1981 Die Fauna der Magdalénien-Station Winznau-Käsloch. Ergebnisse einer musealen Nachforschung. *Archäologie der Schweiz* 4(2):36-41.

Strauch, F.
1978 *Gyraulus trochiformis* als Schmuckschnecke aus mesolithischen Kulturschichten Süddeutschlands (Jägerhaus-Höhle, Große Ofnet, Bettelküche). In *Das Mesolithikum in Süddeutschland. Teil 2: Naturwissenschaftliche Untersuchungen*, edited by W. Taute, pp. 161-162. Tübinger Monographien zur Urgeschichte 5/2. Archaeologica Venatoria, Tübingen.

Weniger, G.-C.
1991 Überlegungen zur Mobilität jägerischer Gruppen im Jungpaläolithikum. *Saeculum* 42(1):82-103.

Wetzel, R.
1938 Die Kopfbestattungen und die Knochentrümmerstätte des Hohlensteins im Rahmen der Urgeschichte des Lonetals. *Verhandlungen des deutschen Gesellschafts für Rassenforschung* 9:193-212.
1961 Der Hohlestein im Lonetal. *Mitteilungen des Vereins für Naturwissenschaft und Mathemathik in Ulm (Donau)* 26:21-75.

Wiegers, F.
1950 Rohstoffversorgung im Paläolithikum. *Prähistorische Zeitschrift* 34(1):225-230.

Wischenbarth, P.
1991 Eine mesolithische Freilandfundstelle mit Konchylienfunden im Lkr. Neu-Ulm. *Archäologisches Korrespondenzblatt* 21:203-210.

Zimmermann, T.
1988 Die spätpaläolithische Fundstelle Seeberg-Fürsteiner. Die Silexaufsammlung von Walter Flükiger. Unpublished M.A. Thesis, University of Tübingen.

Zotz, L. F.
1928 Die paläolithische Besiedlung der Teufelsküchen am Ölberg beim Kuckucksbad. *Prähistorische Zeitschrift* 19:1-53.

Zürcher, A.
1969 Die spätjungpaläolithische Freilandstation Winznau-Köpfli. *Jahrbuch für solothurnische Geschichte* 42:138-201.