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Caroline Hamon & Jan Graefe (eds.)

New Perspectives on Querns in Neolithic Societies

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Inhaltsverzeichnis

Neue Aspekte zu Mahlsteinen in neolithischen Gesellschaften

Caroline Hamon und Jan Graefe

Seit den ersten neolithischen Gesellschaften wird das Korn der angebauten Kulturpflanzen mittels Mahlsteinen zu Mehl verarbeitet. Grundlage einer agrarischen Lebensweise stellt die Domestikation und Zucht von Tieren, sowie der Anbau und die Verarbeitung von Kulturpflanzen dar. Erst innerhalb der letzten fünfzehn Jahre konnten grundlegende Aspekte der Pflanzenverarbeitung geklärt werden. Untersuchungen zu Mahl- und Schleifsteinen tragen zum Verständnis und Wissen um neolithische Wirtschaftsformen und sozialer Organisation bei. Durch mehr oder weniger regionale Studien wurden neue Daten gewonnen, die Aussagen zu Austauschsystemen der Rohmaterialien, dem Status und die wirtschaftlichen Grundlagen von Siedlungen ermöglichen.

Die folgenden Artikel resultieren aus einer Sitzung, die im Rahmen des 13th annual meeting of the European Association of Archaeologists (EAA), im September 2007 in Zadar (Kroatien) stattgefunden hat. Thema der Sitzung war „New perspectives on querns in neolithic societies". Innerhalb dieser Sitzung wurden neue Ansätze und Perspektiven für Untersuchungen von neolithischen Mahl- und Schleifsteinen aus ganz Europa diskutiert.

Die momentan verfügbaren Studien erlauben einen generellen Überblick zu neolithischen Mahl- und Schleifsteinen und ihren Fundzusammenhängen (Siedlungen, Gruben, Gräber, Horte etc.). Die Gewinnung und die Nutzung von Rohmaterialien, die Form und Größe der Geräte, ihre funktionale und technologische Charakteristiken sind inzwischen zwar besser, aber immer noch unzureichend dokumentiert. Die folgenden Präsentationen werden zeigen, dass durch umfassende Untersuchungen zu Mahl- und Schleifsteinen wichtige Beiträge für die Interpretation des Status und der Funktion eines Fundplatzes geliefert werden können. Ebenfalls wird die Wichtigkeit der Kontextzusammenhänge der Mahlsteine sowie die Notwendigkeit eines interdisziplinären Ansatzes entsprechender Studien ersichtlich.

Die Sitzung wurde in mehrere Themenblöcke eingeteilt.

Mahlsteine können – bezogen auf eine regionale oder kulturelle Sichtweise – hinsichtlich der Bestimmung des kulturellen Hintergrundes eines Siedlungsplatzes ebenso wie Keramik, Feuersteinartefakte oder Verzierungsmotive beitragen. So stellt I. Pavlù in einem Überblick die Entwicklung der Mahlsteine hinsichtlich ihrer Morphologie, Formen und Dimensionen zwischen Westeuropa und Anatolien, sowie Schweden und Griechenland vor.

Aufgrund der benötigten Materialeigenschaften fanden nur wenige Gesteine (Basalte, Sandsteine etc.) Verwendung, so dass unter Umständen große Entfernungen zwischen Lagerstätten und Siedlungen zwecks Gewinnung geeigneter Rohmaterialien zurückgelegt wurden. Gründe für diese Rohmaterialbezüge können vielfältig sein (kulturell, ökonomisch, symbolisch...). Für Nordrhein-Westfalen (Deutschland) sind nach den Untersuchungen von J. Graefe im Laufe des Neolithikums mehrere Rohmaterialien verwendet worden, so dass detaillierte Aussagen zur Gewinnung und Verbreitung getroffen werden können.

B. Ramminger kann anhand eines kleinräumigen Untersuchungsgebietes in Hessen (Deutschland) den Verbrauch an Mahlsteinen während des Altneolithikums abschätzen.

Funktionale und technologische Studien zu Mahlsteinen haben gezeigt, dass mit einer überraschenden Komplexität bezüglich der Zyklen einer Wiederverwendung und einer echten Vielfältigkeit bei der Verarbeitung von Materialien (Farbstoffe, Getreide) zu rechnen ist. Untersucht wurden Merkmale der Gestaltung (Zurichtung) und Technologie bezüglich der Aufrechterhaltung der Funktion und der Weiterverwendung von Mahl- und Schleifsteinen. Eine funktionale Analyse von Mahlsteinen wurde – inklusive der Gebrauchsspuren und den Kontextzusammenhängen – diskutiert. Es wurden neue Werkzeuge und Methoden für die Gebrauchsspurenanalyse entwickelt, um zu weitergehenden Aussagen hinsichtlich der Mahlsteine zu gelangen. Die Techniken der Getreideverarbeitung, ausgedrückt in der Dauer und Effizienz des Mahlvorganges, werden zumeist gesicherten ethnologischen Vergleichen und experimentellen Untersuchungen entnommen. Ein Vergleich der Geräte und der Umweltbedingungen kann dazu beitragen, die Evolution der Mahlsteintechnologie sowie die Ernährungssituation der neolithischen Gemeinschaften zu klären. In ihrem Artikel präsentiert C. Hamon eine technologische und funktionale Analyse der linearbandkeramischen Mahl- und Schleifsteine aus Nordwesteuropa. Ein vergleichbarer Ansatz wurde von A. Ciriaco et al. für den süditalienischen Siedlungsplatz „Masseria Candelaro" entwickelt.

Das Vorkommen von Mahlsteinen in Gräbern oder rituellen Kontexten könnte mit einer Art „symbolischen Ernährung", der neuen agrarischen Lebensweise sowie der sozialen Bedeutung zusammenhängen. In diesem letzten thematischen Block beschäftigen sich zwei Artikel mit der Rolle und dem Status von Mahlsteinen in rituellen Kontexten aus unterschiedlichen Regionen Europas. Diskutiert wird die Verwendung von Mahlsteinen in verschiedenen rituellen Kontexten, in Verbindung mit ihren ökonomischen und sozialen Bedeutungen. Aktuelle Studien zeigen, dass Mahlsteine neben einer rein profanen Nutzung im Haushalt zur Schaffung der Lebensgrundlage auch aus Grabzusammenhängen (Bestattungszeremonien) größerer Nekropolen bzw. megalithischen Anlagen oder auch Hortfunden bekannt geworden sind. Mahlsteine nehmen also eine komplexe Stellung mit einem symbolischen Bezug in sozialen und rituellen Handlungen neolithischer Gemeinschaften ein. Aus dem Verbreitungsgebiet der Trichterbecherkultur Skandinaviens sind von C. Lidström Holmberg einige Kontexte bekannt geworden, die als Deponierungen anzusprechen sind, so dass von einer Verbindung der Mahlsteintechnologie und den sozialen Beziehungen der Gemeinschaften ausgegangen wird. S. Watts kann eine vielfältige Nutzung neolithischer Mahlsteine in Großbritannien nachweisen. Es wird eine absichtliche Niederlegung von Mahlsteinen postuliert.

In dieser Sitzung wurde nun erstmals in einem internationalen Arbeitskreis Grundlagen zur Verbesserung des derzeitig nicht zufriedenstellenden Forschungsstandes bezüglich des Themenfeldes „Mahlsteine" geschaffen. Eine der zentralen Fragestellungen betrafen terminologische Probleme, die durch den jeweiligen chronologischen, epistemologischen oder auch regionalen Kontext begründet sind. Ein neolithischer Mahlstein setzt sich aus zwei Bestandteilen zusammen. Die Benennung dieser Bestandteile unterscheiden sich im internationalen Sprachgebrauch je nach chronologischen oder regionalen Zusammenhängen. Der obere Bestandteil eines Mahlsteines wird in der englischsprachigen Literatur als "runner, hand stone or grinders", im Deutschen als „Läufer oder Kornquetscher" und im Französischen als "molette ou broyeur" bezeichnet. Der untere Bestandteil eines Mahlsteins ist im Englischen teilweise unter dem allgemeinen Begriff „quern", oder spezifiziert als "saddle querns or grinding slabs" zu finden. Vergleichbares ist auch für den deutschen Sprachgebrauch belegt. Nebeneinander werden die Termini „Mahlstein oder Unterlieger" - teilweise aber auch „Sattelmahlstein" - verwendet. Im Französischen wird der Begriff „meule" genutzt.

In den nächsten Jahren wird, Dank der kollektiven Reflexion durch Spezialisten dieser Geräteklasse, eine Vereinheitlichung und klare Abgrenzung bzw. Definition der Mahl- und Schleifsteine aus der großen Gruppe der makrolithischen Geräte erarbeitet werden können.

Durch dieses Meeting wurde - so hoffen wir - die Grundlage für einen echten Austausch von Informationen zwischen Mahlsteinspezialisten des Neolithikums geschaffen.

Anmerkung

Wir bedanken uns bei den Organisation des 13. annual EAA Meetings in Zadar (Kroatien) für die Zulassung der Sitzung mit dem Titel „New perspectives on querns in neolithic societies". Die Sitzung und die vorliegende Publikation wären ohne die enthusiastischen Beiträge aller Teilnehmer nicht möglich gewesen. Wir möchten allen Beteiligten unseren herzlichen Dank aussprechen und hoffen, dass dies nur ein erster Schritt für eine weitere Zusammenarbeit im Themenfeld „Mahlsteine" ist.

New Perspectives on Querns in Neolithic Societies

Caroline Hamon and Jan Graefe

Since the time of the first Neolithics, cereals were ground to flour by querns. Together with the domestication and breeding of animals, the cultivation and processing of plants was one of the basis of the new agrarian way of life. However, the concrete exploration of the basic aspects of cereals processing has only emerged in the last fifteen years. Today, the study of grinding tools contributes largely to our knowledge of neolithic economy and social organization. The multiplication of studies at a more or less regional scale has purchased new data concerning the circulation of raw materials, the status of the sites and the subsistence economy. The following papers aim at sharing and discussing the new perspectives of such studies on querns in neolithic societies from all over Europe. They were presented at a session of the 13th annual meeting of the European Association of Archaeologists (EAA) in September 2007 in Zadar (Croatia).

The available studies generally integrate a global survey of the grinding tool aspects and their context of discovery (settlements, pits, cemeteries, hoards, etc.). The purchasing and use of raw materials, the form and size of the tools, their technological and even functional characteristics are now better, yet unequally, documented. The following presentations demonstrate how a global survey of grinding tool aspects can bring further elements for the interpretation of the status and function of a site. They also point out the importance of the context of quern discovery and the necessity of a pluridisciplinary approach in which quern study must be involved. The session was organized in more or less four thematic blocks.

Adopting a regional or cultural point of view, grinding tools can help define the cultural background of a settlement, like pottery, lithic artefacts or ornament. The morphologies and dimensions of querns are taken into account by I. Pavlu as a basis for a large comparison of different chrono-cultural contexts from Western Europe to Anatolia, in order to underline the great tendencies of tools' morphological evolution.

Despite a large range of local resources (sandstones, basalts, granites, limestones), some rocks were chosen on purpose for grinding activities. Therefore, in some cases the material from other regions was imported. The reasons of these importations may be diverse: cultural, economic, symbolic, etc... This aspect is discussed by J. Graefe for neolithic querns in north-western Germany and by B. Ramminger for Linearbandkeramik querns in Hesse (Germany).

The technological and functional studies of querns have stressed the surprising complexity of the cycles of reuse and a real diversity in the grinding tasks (temper, colouring, cereals…). The shaping and technological features of querns are examined, focusing on the maintenance and recycling of grinding stone implements. The functional analysis of querns is also discussed, and included a reflexion on use-wear analysis and contextual elements. New tools and methods of use-wear analysis have been developed in order to make querns speak. The techniques of grinding cereals, in terms of gesture and efficiency, have benefited from solid ethnographic comparisons and experimental references. Moreover, the comparisons of the tools and environmental data can help understand the evolution of the grinding techniques together with the diet of neolithic populations. C. Hamon presents in her paper the technological and functional analysis of Linearbandkeramik grinding tools from north-western Europe. A similar approach is developed in A. Ciriaco et al. presentation about the excavations at the south Italian settlement of "Masseria Candelaro".

Discoveries of querns in funeral ceremonies or ritual contexts may be linked to diet symbolic and to the new agricultural economical and social order. This last thematic block, illustrated by two papers, explains the role and status of querns in the ritual life of different European regions. The implication of querns in varied ritual contexts together with their economic and social meanings is discussed. Recent studies reveal that the status of neolithic querns is not only profane, reduced to domestic use in the households, but also ritual. Querns are often found in funeral ceremonies such as in cemeteries or megalithic monuments and in ritual contexts such as hoards. A real symbolic seems associated to querns, probably in link with their connection with the agricultural economical and social order. C. Lidström Holmberg connects quern technology and social relations because some Funeral Beaker Culture settlements and finding places in Scandinavia demonstrate rites of separation. S. Watts explain the structured deposition of querns in neolithic Britain.

Within this international meeting a basis for future research strategies for quern study was discussed. One of the main question is still the use of different terminologies applying to querns and depending on the chronological, epistemological or regional context they come from. The upper stone and the lower stone which constitute the two parts of the neolithic mill have different names according to the language and the chronological and regional contexts of discovery. The upper part is labelled "runner, hand stone or grinders" in English, "Läufer or Kornquetscher" in German and "molette or broyeur" in French. The lower part is labelled under the generic term "quern", with different names for "saddle querns or grinding slabs". In German, you will find the term "Mahlstein or Unterlieger", with specific "Sattelmahlstein" name or the French term "meule". The homogenisation of the terminology and definition of grinding tools among the great family of macrolithic tools should be improved in the next years thanks to a collective reflexion of the specialists of these implements.

This meeting has set, we hope, the conditions for a real exchange of information between specialists of neolithic querns throughout Europe.

Acknowledgements
We thank the organizers of the 13th EAA annual meeting in Zadar (Croatia, 2007) who accepted our session on "New perspectives on quern in neolithic societies". This meeting and the following publication could not have been possible without the enthusiast contributions of all participants. We would like to express them our sincere thanks, hoping this was a first step for further collaborations on the quern topic.

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Dimensions of Grinding Stones Between Anatolia and Central Europe

Ivan Pavlů

Zusammenfassung – Schlussfolgerungen, die sich aus einer Kombination von unterschiedlichen Arten der Daten zusammensetzen, liefern ein detailliertes Bild der neolithischen Lebensweisen des 6.-5. Jahrtausends v. Chr. Das Neolithikum in Anatolien beginnt im 8. Jahrtausend mit akeramischen Siedlungen im südlichen und südöstlichen Bereich des anatolischen Plateaus. Durch die Übernahme der agrarischen Lebensweise fand eine Entwicklung zu einem keramischen Neolithikum statt. Das zentraleuropäische Neolithikum ist als zeitgleich mit frühen chalkolithischen Siedlungen dieser Regionen zu parallelisieren. Daten aus kulturell unterschiedlichen Regionen liefern die Möglichkeit eines asynchronischen Vergleichs der Größen und Formen von Mahl- und Schleifsteinen innerhalb einer Region, sowie einen synchronen Vergleich dieser Strukturen in verschiedenen Regionen. Mahl- und Schleifsteine, die aus zwei Bestandteilen bestehen, waren zur Zeit ihrer Nutzung ein universal verwendbares Werkzeug, das sich, bezogen auf die Form und Funktion, im Prinzip seit dem Jungpaläolithikum nicht verändert hat und auch noch heute von lokalen Gruppen in verschiedenen Regionen der Welt genutzt wird. Die einzelnen Gesellschaften haben die Geräte in einer spezifischen Art und Weise zugerichtet, die sich aus der Morphologie – definiert durch die Dimensionen inklusive des Gewichts – der Geräte ergibt. Die Läufer zeigen im Verhältnis zu den Unterliegern normalerweise gleichmäßige Formen, so dass Änderungen der Strukturen auf kulturelle und chronologische Charakteristiken hinweisen. Mahlsteine, die sich aus zwei Bestandteilen zusammensetzen, neigen im allgemeinen zu schmalen Dimensionen bei einer gleichzeitigen Aufrechterhaltung der effektiv nutzbaren Mahloberfläche. Dieser Trend ist in Anatolien vom akeramischen Neolithikum bis zum Chalkolithikum nachzuweisen, während in Europa eine Weiterentwicklung geographisch von Ost nach West aufzutreten scheint.

Schlüsselwörter – Anatolien – zentraleuropäisches Neolithikum – Mahl- und Schleifsteine

Abstract – Conclusions drawn from a combination of different types of data will provide a more detailed picture of Neolithic subsistence strategies in the 6th-5th millennium B.C. Anatolian Neolithic begins in the 8th millenium with Aceramic settlements in the southern and southeastern part of the Anatolian Plateau. It was developing into Ceramic Neolithic by adopting the farming activities. The Central European Neolithic is synchronous with the early Chalcolithic sites in these areas. Data from culturally diverse areas provide a possibility of asynchronous comparison of the size and shape of grinding stones in one region and also synchronous comparison of such structures in various regions. The two-piece grinding stones were in their times a universal implement as regards their shape and function, which in principle has not changed since the Late Paleolithic cultures up to the recent local groups in various parts of the world. Individual societies were shaping these implements in a specific manner, which resulted in their morphology defined by their basic dimensions that also include their weight. The upper grinding stones are usually of more regular-shape relative to lower stones so that changes in their structure are characteristic from the viewpoint of culture and chronology. Two-piece grinding stones in general tend to be smaller at simultaneous maintenance of effective milling surface. This trend in Anatolia is continues from Aceramics up to the early Chalcolith, while in Europe appears to be geographic advancing from the east to the west.

Keywords – Anatolian – Central European Neolithic – grinding stones

Introduction

Grinding stones have long been considered to be food preparation implements, specifically for cereal grain processing. However, recent research has redefined them as multi-functional tools, which were also used to grind various inorganic materials, for example, hematite in burial contexts (Farkaš 2000, 83-84). As a result, grinding stones serve as records of paleoenvironmental situation, and can be studied even from past excavations when less attention was paid to retrieving this kind of information. Conclusions drawn from a combination of different types of data will provide a more detailed picture of Neolithic subsistence strategies in the 6th-5th millennium B.C. Direct evidence gained from analysis of the grinding stone surface is considered superior to the more general data acquired from pollen analysis and anthracology.

Anatolian Neolithic begins in the 8th millenium with Aceramic settlements in the southern and southeastern part of the Anatolian Plateau. It was developing into Ceramic Neolithic by adopting the farming activities. The Central European Neolithic is synchronous with the early Chalcolithic sites in these areas. Undoubtedly, the influence of the Anatolian Neolithic can be seen even in the Central Europe (Thissen 2000). Previously and with little archeological evidence,

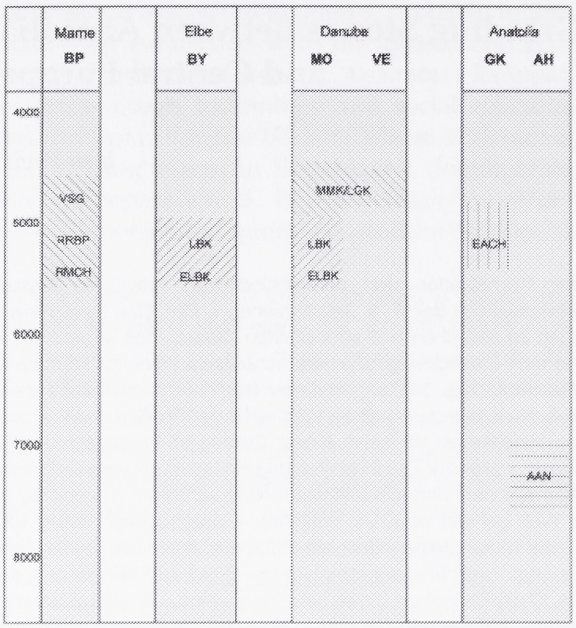


Fig. 1 Chronology of culture-geographic groups (in B.C. cal). abbreviations:
Localities: BP - Bassin Parisien, BY - Bylany, MO - Mohelnice, VE - Vedrovice , GK - Güvercinkayası, AH - Aşikli Huyuk,
Complexes: RMCH - Rubané moyen champenois, RRBP - Rubané récent de Bassin Parisien, VSG - Villneuve-Saint-Germain, ELBK - Early Linear Pottery Culture, LBK - Linear Pottery Culture, MMK/LGK- Moravian Painted Pottery / Lengyel Culture, EACH - Early Anatolian Chalcolithic, AAN - Anatolian Aceramic Neolithic).

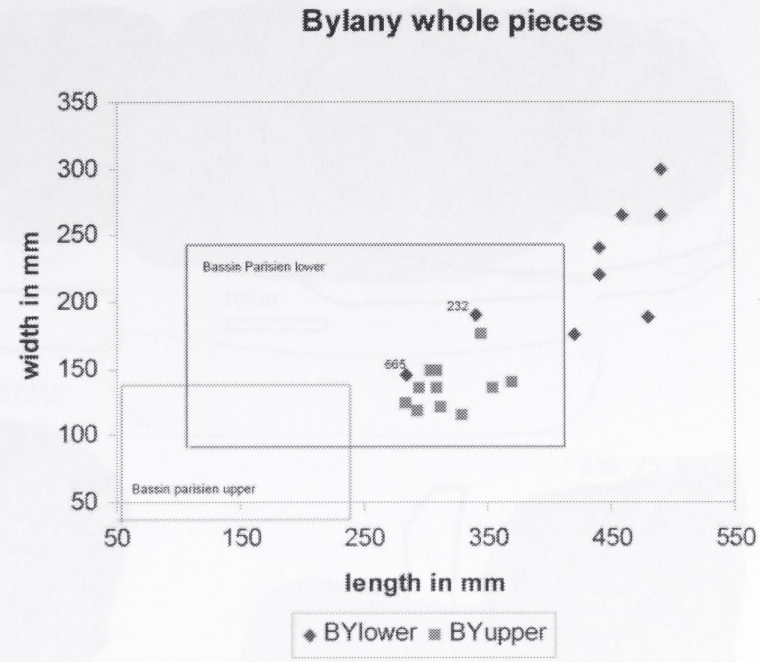
it was believed that the cradle of Neolithic civilization lay in Anatolia, from where it spread further into the central and western parts of the continent. The following two to three generations of archeologists confirmed that the role of Anatolia in the foundation of Neolithic European culture has been more complex than formerly anticipated, and still incomplete in spite of some provocative indications. Genetic evidence from central European populations has shown strong post-Paleolithic local roots on the one hand (Price 2000, 303) and a limited influence of both the Anatolian aceramic and Ceramic Neolithic populations on the other hand (for example, Summers 2001). Regardless of some supportive artifacts, the overall genetic evidence does not correspond with the original idea of Anatolia as the source of a large wave of migrant colonists thought to have settled most of the Central Europe.

Comparative databases

Data from culturally diverse areas provide a possibility of asynchronous comparison of the size and shape of grinding stones in one region and also synchronous comparison of such structures in various regions. The two-pieces grinding stones were in their times a universal implement as regards their shape and function, which in principle has not changed since the Late Paleolithic cultures up to the recent local groups in various parts of the world. Individual societies were shaping these implements in a specific manner, which resulted in their morphology defined by their basic dimensions that also include their weight (Wright 1992). Specific variability recorded in these tools was obviously influenced by locally different rocks used for their production. Regardless of numerous studies dealing with this specific issue (Hersh 1981, Hole et al. 1969, Runnels 1981; 1985) in the Near East and the Balkans, only a limited number of comparative data are available. Another problem arises from unambiguous classification of the upper and lower grinding stones that are to be treated separately as individual artifacts. As an exception may serve the latest comprehensive study by Hamon (2006) that provides a lot of fundamental information that can be used for further comparative studies.

The essence of the matter and data to be compared are studies of a Neolithic settlement at Bylany (Czech Republic), which provide information on artifactual structure of the culture characteristic of Linear Pottery Culture in Bohemia. This data set can be correlated with composition of similar sets from western areas of this culture occurrence that appear to be more or less synchronous. So far some limited data are available from the Moravian region (Czech Republic) from the localities of Mohelnice and Vedrovice (Pavlů 2006 b; 2007). The former locality includes tools that can be distinguished with difficulty so that they are to be generally considered to belong to the Linear and also Moravian painted ceramics. Small set of artifacts from Vedrovice comes from Late Neolithic furrow so that it can be classed among cultures characteristic of Moravian painted ceramics. Two collections from geographically and culturally remote region of Neolithic Anatolia give a chance to study certain asynchronous shift of the whole set of two-pieces grinding stones (Pavlů 2005; 2006a) between the Aceramic Neolithic (Aşikli Huyuk) and the Early Chalcolithic (Güvercinkayası) (Pavlů/Řídký/

Fig. 2 Lower and upper stones from Bylany and RRBP, comparison of their length and width.



Wawrushka/Gülçur 2007). The used data do not allow as yet establishing the stability of artifactual structures within smaller areas and in the frame of defined time period.

Size and shape of two-piece grinding stones

All the studies undertaken so far show that the size of grinding stones defined by their length and width are the major indicator of their morphology. Besides that the forms derived from their profiles or plans indicate rather their stylistic variability, which can be seen within individual spatio-temporal groups. To what extent is this variability also functional is a matter of more detailed analysis that has not been undertaken as yet. The only exception is a study from the western area of Rubané récent du Bassin parisien (RRBP) where correlation between the shapes of working surfaces of grinding stones and the used rock material was established (Hamon 2006).

The basic collection of the Bylany grinding stones can be characterized as being composed of rather rare finds of both the lower and upper grinding stones (Pavlů 1991; Květina/Pavlů 2007). The structure (length and width) of both grinding stones is markedly different as anticipated with the exception of small lower grinding stones from the feature 665 and similar lower grinding stone from feature 323. Both implements are made of mica schist, which is not suitable to preserve the wears. The revision of micro-wear showed not very distinct relics of fine grooves that may class them among the lower grinding stones. The comparison with the RRBP culture suggests that the lower grinding stones from this area are in general smaller as their dimensions are overlapping the upper grinding stones from Bylany. The RRBP upper grinding stones are markedly different from this early Linear Pottery Culture (LBK) (**fig. 1**).

Lower grinding stones

The lower grinding stones from Güvercinkayası (GK) were made in general of volcanic rocks brought in from nearby outcrops (Pavlů/Řídký/wawrushka/Gülçur 2007, 18). Their relatively varied mineral composition is similar to that of the upper grinding stones. Numerous fragments of basaltic lava are difficult to determine precisely but due to their massive texture they are believed to come from the lower grinding stones. It is important to point out that grinding stones are not made of local bedrock (in situ) consisting of rhyodacite on which the settlement is located. It has not been established either if the bedrock was used as natural ground for grinding. The stones are relatively large, of various shapes and morphology, forming occasionally irregular quadrangles. As for the lower grinding stones, the shapes of initial fragments of rocks were used and only roughly shaped. The majority of them are ground to form thin bowl-shaped tools, particularly as

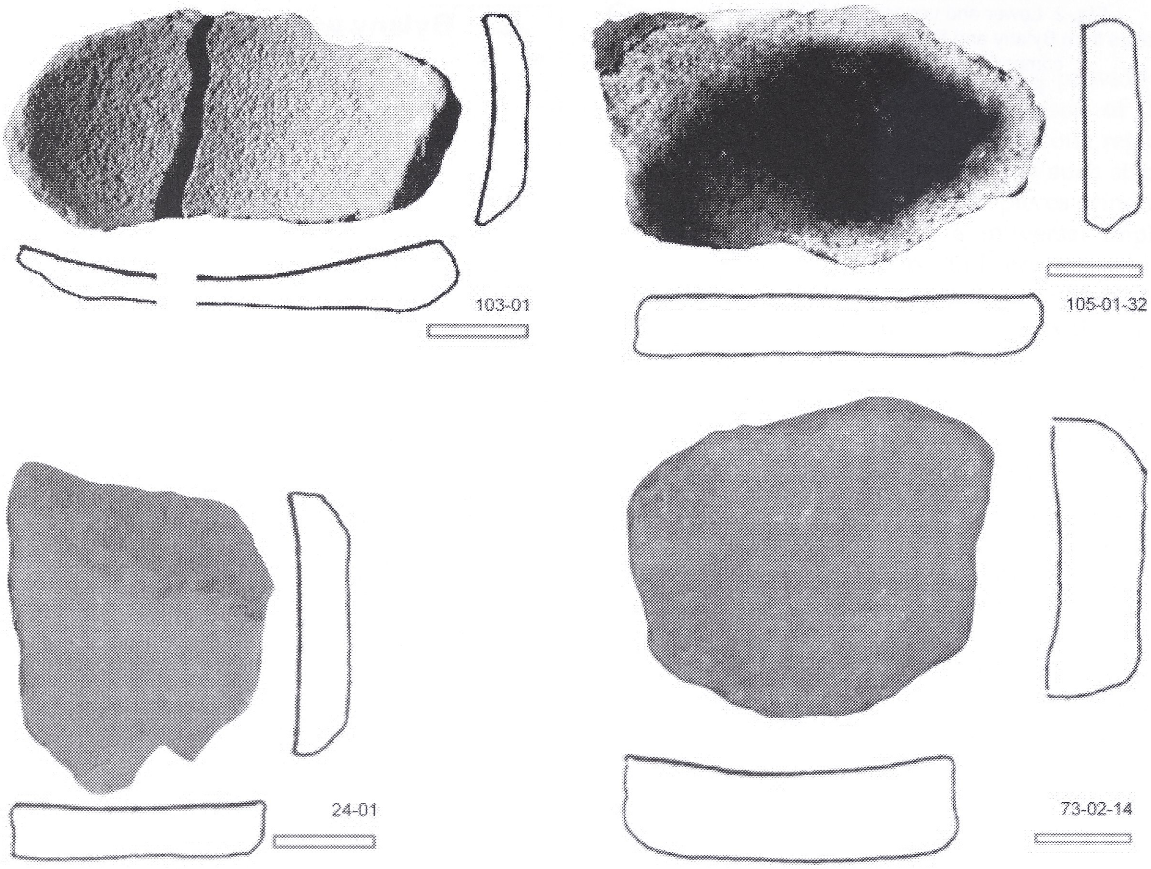


Fig. 3 Lower stones from Güvercinkayası (scale equal 10 cm).

concerns the grinding stones from grinding slabs. Their bottom parts were always roughly shaped to produce flat forms (**fig. 2**).

The lower grinding stones from the Bylany locality exhibit mostly regular quadrangular forms that were made by rough chipping to obtain the desired shape. The majority of grinding stones are made of migmatized mica schists that are easier to shape than those made of basaltic lava from Anatolia. They are not very ground and their working surface is rather bulgy due to the use of longer lower grinding stones. They differ from one another by varying form of side walls, which at some artifacts are deliberately beveled in order the upper stone surface to overlap the lower one, which facilitated the ground materials to concentrate on a certain support plate (**fig. 3**).

The length-width pattern of lower grinding stones derived from the four studied groups of data is partly overlapping but with distinct shifts. The oldest and culturally aceramic tools from Aşikli Huyuk exhibit long and broad forms. The younger and more advanced structure from Güvercinkayası is linearly shifted into smaller values of the length as well as width. More remote group of lower grinding stones from Bylany is shifted in similar way but more to the lower values of the width. The implements from the western RRBP are in general linearly shifted towards the lowest values of both dimensions. The whole of the structure shows a gentle trend in diminution of forms both chronologically and geographically (**fig. 4**).

The length-width pattern of lower grinding stones of the above-mentioned groups exhibits very similar shifts. The shifts at less variable width are more pronounced in values of the height. The general trend is heading to lower forms in younger groups that are more remote from Anatolia. The western RRBP region shows, besides the above-mentioned pattern, a trend of shortening width of the artifacts. Due to linear shift of the length and width and diminution of the width a general reduction of grinding surface of lower stones including their lesser massiveness can be seen. Consequently, their efficiency in grinding of various materials was reduced but on the other hand their better carrying within changes in settlements increased (**fig. 5**).

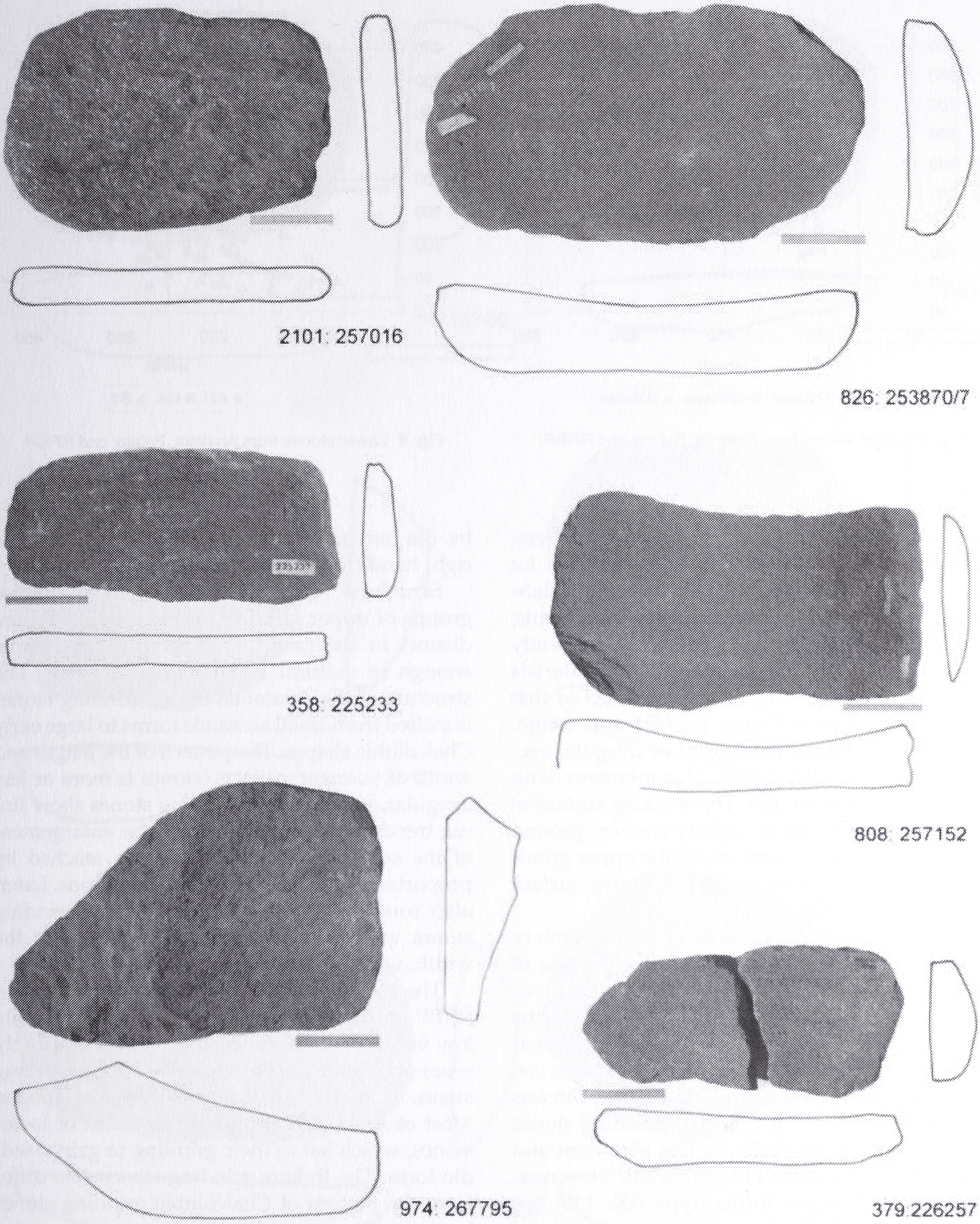


Fig. 4 Lower stones from Bylany (scale equal 10 cm).

Upper grinding stones

The upper grinding stones from the early Chalcolithic settlement of Güvercinkayası, which is in absolute ages synchronous with linear ceramics, but economically and socially different, are made of local volcanic rocks of which the basaltic lava is mostly used (132-year 2002). It is a rock of black-gray color shades with largely vesicular structure. To lesser extent are the grinding stones made of other volcanites (rhyolite, ignimbrite, gabbro, andesite) or fine- to medium-grained

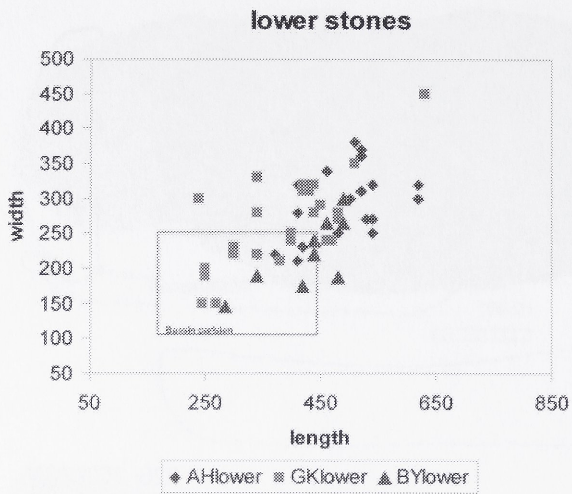


Fig. 5 Lower stones from Anatolia, Bylany and RRBP: length and width.

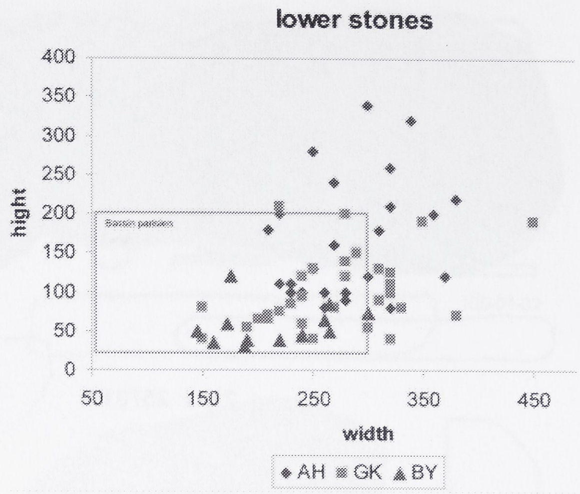


Fig. 6 Lower stones from Anatolia, Bylany and RRBP: width and high.

sandstone (14-01). Volcanic rocks are in general very hard so that their shaping deserved a lot of effort. Therefore, natural forms of large slabs or pebbles found in the environs of settlements, possibly in alluvial deposits, were frequently used and favored. The majority of raw materials contain sharp fragments of various rocks so that their surface was still very angular and rough. The grinding stones are mostly of irregular rectangular to rounded forms, planar-convex with well- shaped bottom part. The working surface at a cross-section is flat to slightly convex, ground down to the edges. Therefore, all the upper grinding stones were shorter than the grinding surface of lower stones (**fig. 6**).

The upper grinding stones of Linear Pottery Culture (LBK) from Bylany are mostly made of local chiefly mica schists (407, 974) and migmatized gneisses (feature number 462, 1213) the surface of which is easily weathered so the wear traces are difficult to be preserved. Such wear can be preserved when the working surface consists of quartz bands in mica schists. Grinding stones made of sandstones (135) are less abundant and those made of amphibolite (129) are very rare. They are of loaf-like forms (type 600; 135) but mostly exhibit flat rectangular or rarely shaped forms (129). The upper stones exceed often the width of lower stones so that their central part is more ground than the edges (500). Short edges are characteristic, they are either rounded (407, 135) or canted at one and/or both sides (974). The beveling is distinct at the left hand side forming a certain handle which argues for ergonomic holding of the stone which seems to have been hold by the left hand and moved by force with the right hand (**fig. 7**).

Structural differences between individual groups of upper grinding stones are much more distinct in the case of groups that are remote enough in cultural and geographic sense. The structure of the Anatolian upper grinding stones is shifted from small aceramic forms to large early Chalcolithic shapes. The pattern of the length and width of younger artifacts/stones is more or less irregular, while earlier grinding stones show linear trend, which indicates that the enlargement of the surface in earlier times was reached by proportional extension of both dimensions. Later, after roughly two millennia, the upper grinding stones were shaped with great variation in the width, whereas the length varied only slightly.

The structure of upper grinding stones of the RRBP group varies only within considerably low values of both dimensions being completely separated from the structure of upper grinding stones from Bylany that are markedly longer. Most of them also exceeded the width of lower stones, which led to their grinding to gain a saddle form. The Bylany grinding stones also differ from the pattern of Chalcolithic grinding stones by their narrower width (**fig. 8**).

The weight is another specific feature of upper grinding stones, which have to be sufficiently heavy in order to ensure their efficiency but at the same time the weight must not exceed certain limit which when exceeded would make the work with them difficult. The structure of Aceramic and early Chalcolithic forms is obviously different as concerns the combination of

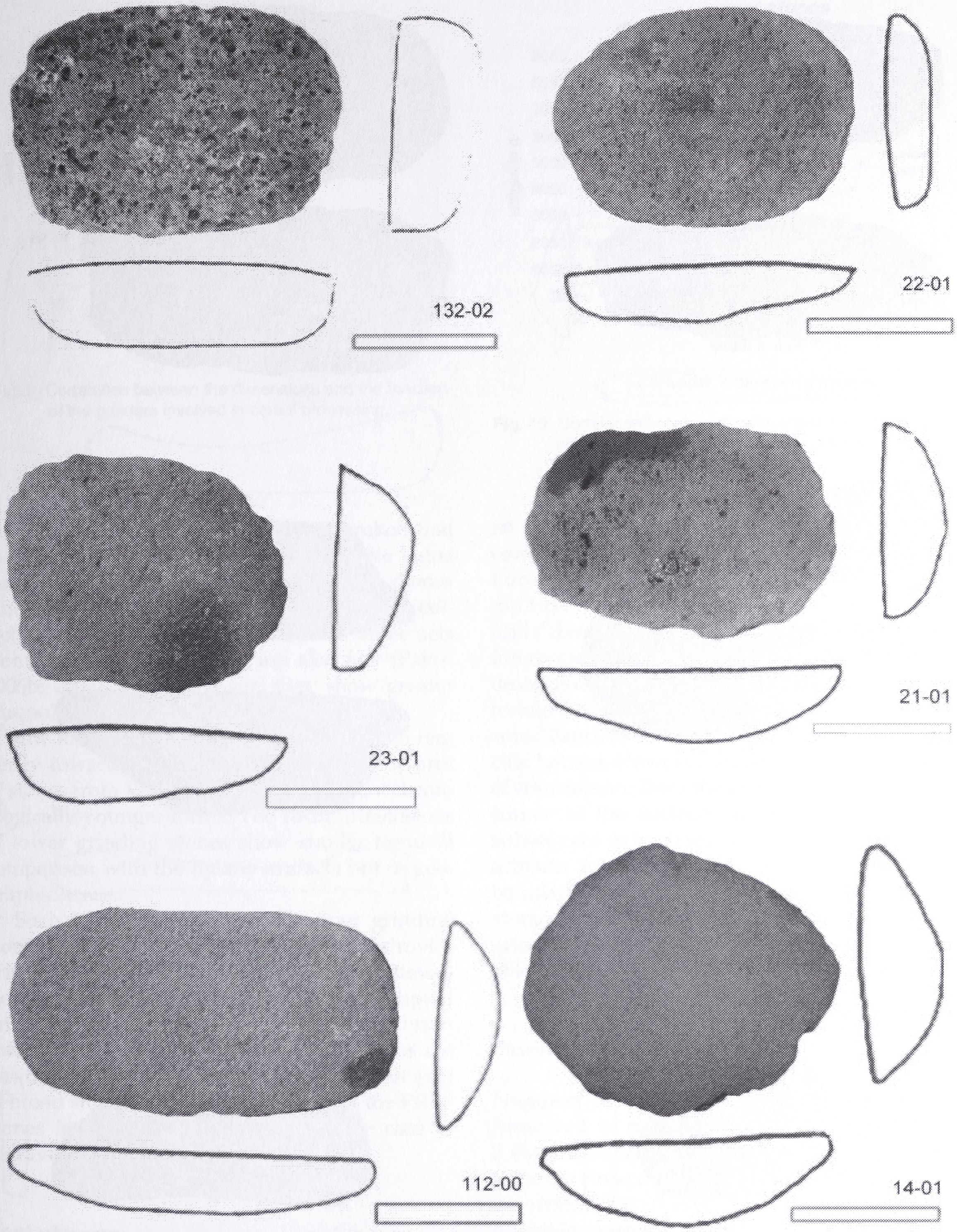


Fig. 7 Upper stones Güvercinkayası (scale equal 10 cm).

weight and width. Artifacts of the RRBP group are lighter and overlap with both groups from Anatolia (**fig. 9 & 10**).

Comparison with other background

Comparison of the whole of structures has been undertaken on rather small collections of grind-

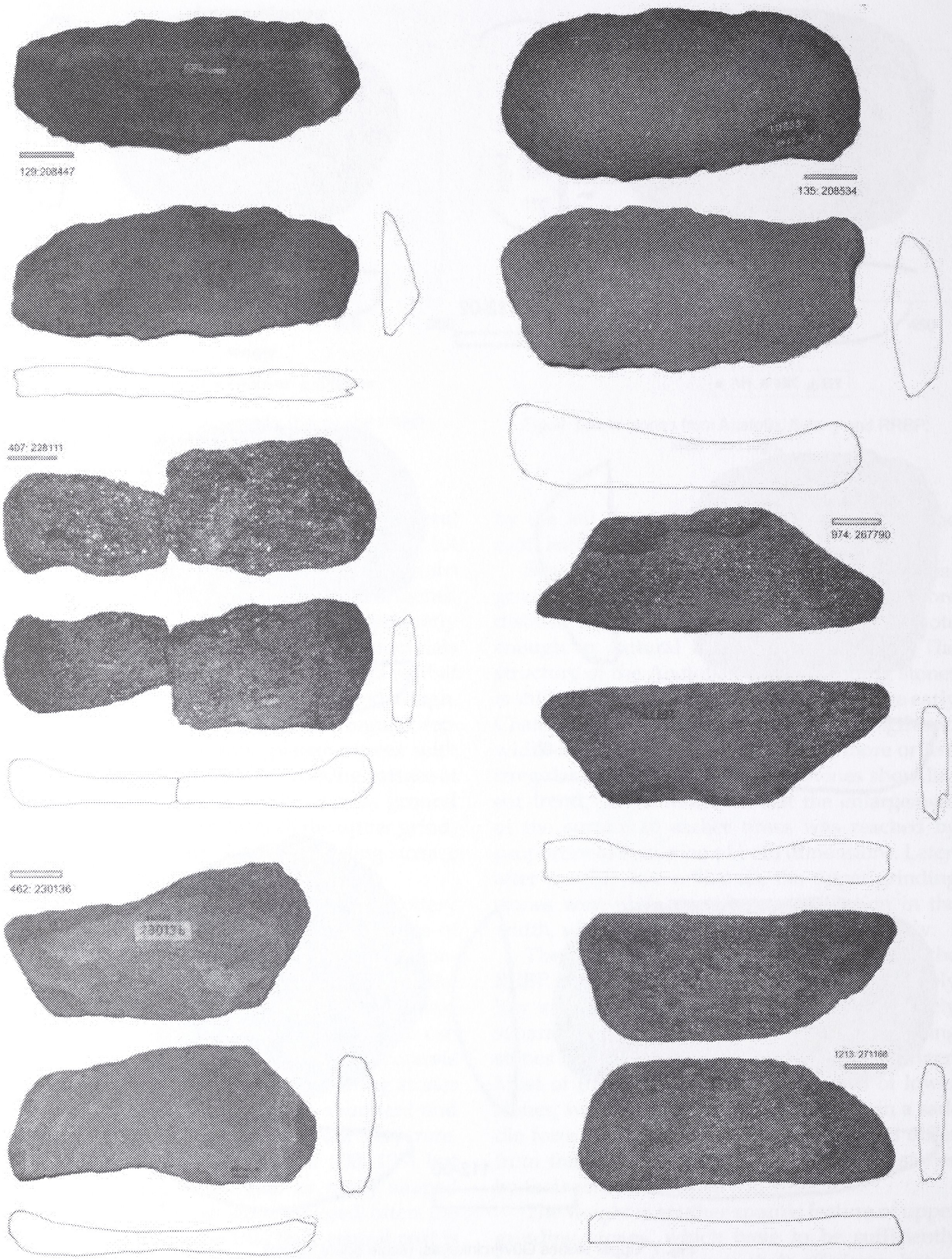


Fig. 8 Upper stones from Bylany (scale equal 10 cm).

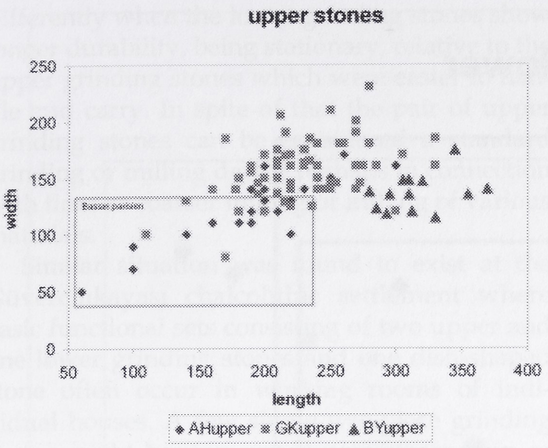


Fig. 9 Correlation between the dimensions and the function of the grinders involved in cereal processing.

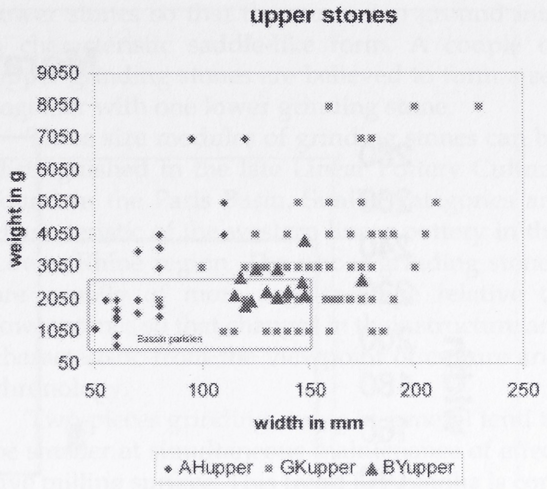


Fig. 10 Correlation between the dimensions and the function of the grinders involved in cereal processing.

ing stones which were preserved unbroken that may negatively influence the informative value derived from statistical treatment of the stones studied. Therefore, we tried to compare the collections from Bylany and RRBP with stone sets from Moravian region that are also few (Pavlů 2006b; 2007), and moreover, they show greater chronological span.

The lower grinding stones exhibit certain tendency towards shorter and narrower structures of stones from Vedrovice, which represent chronologically younger forms. The RRBP dimensions of lower grinding stones show similar trend in comparison with the Bylany artifacts but in geographic sense.

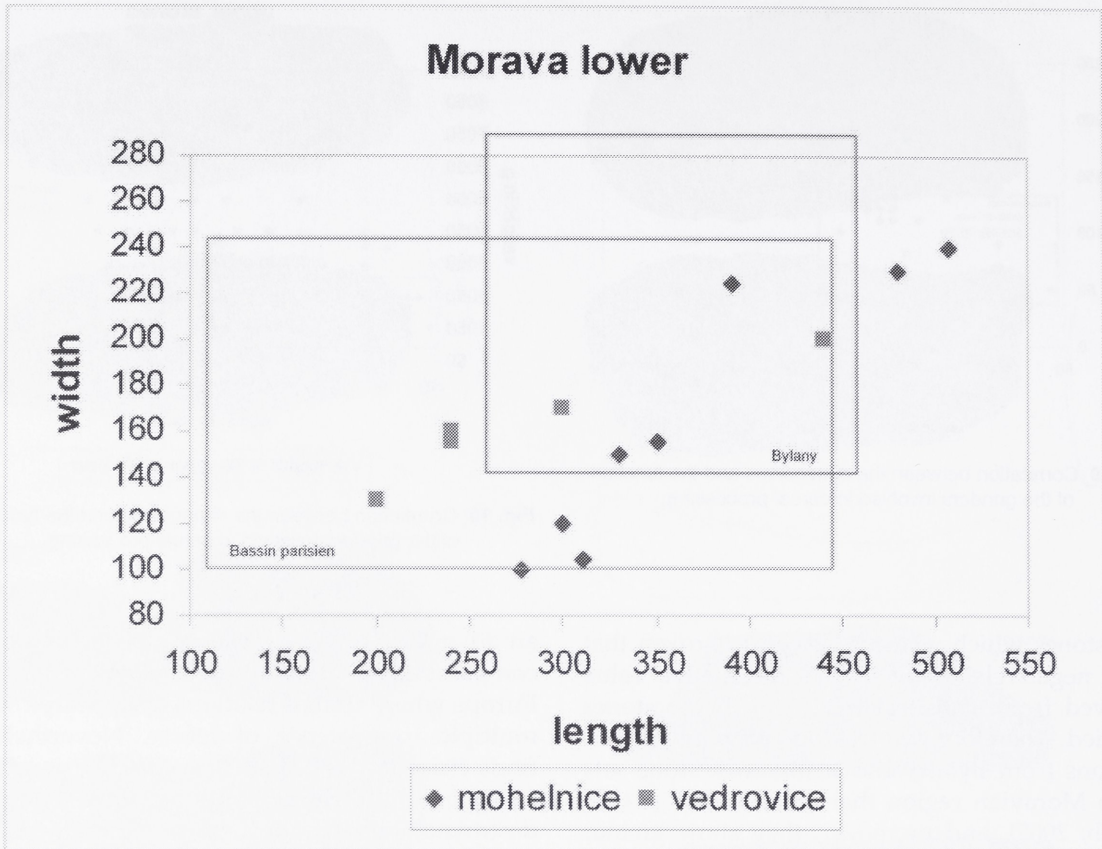
Such a trend in the case of upper grinding stones is less pronounced since the Vedrovice grinding stones are in the middle of the dimensions of the Mohelnice artifacts. The RRPB upper grinding stones lie clearly in the lower and narrower part of the Moravian stones, whereas the position of the Bylany stones is in narrower part of broad stones. Analogous tripartite of the RRBP stones is difficult to be proved in the case of Moravian finds (**fig. 10 & 11**).

Contexts

Finds of grinding stones at prehistoric Anatolian sites are characterized by contexts related to the excavated architecture. Both collections and individual artifacts are often found in situations, which can be functionally interpreted as independent of their typology. This presents an advantage of Near Eastern archaeology over comparable situations in the Balkans or Central Europe where similar relations disappeared with multiple transference of refuse. Nevertheless, finds classified as "in situ" need to be carefully interpreted elsewhere. Finds on house floors of destroyed houses can be more confidently related to individual rooms than surface finds, and with some caution, may also be connected with specific houses. However, since there is a possibility of transference from the original context over the course of the destruction process, or even the subsequent extraction, we have separated these artifacts from other floor finds. The latter can be related to different room facilities e.g., ovens, storage vessels, work platforms etc. Above all, grinding stones comprise functionally interpretable sets of artifacts.

Functional sets of grinding stones

Numbers of upper and lower grinding stones preserved in refuse at houses of the Miskovice 2 short time settlement indicate that each lower grinding stone corresponded to two upper grinding stones (Pavlů 1998) that is difficult to prove unambiguously at the Bylany settlement, which appears to be more complex. Here, fragments of two upper grinding stones made of sandstone of varying quality occur together, one of them always consisting of coarser and the other one of finer rock. This number on average corresponds to one lower stone. Each part of two-piece grinding stones was found to have been preserved



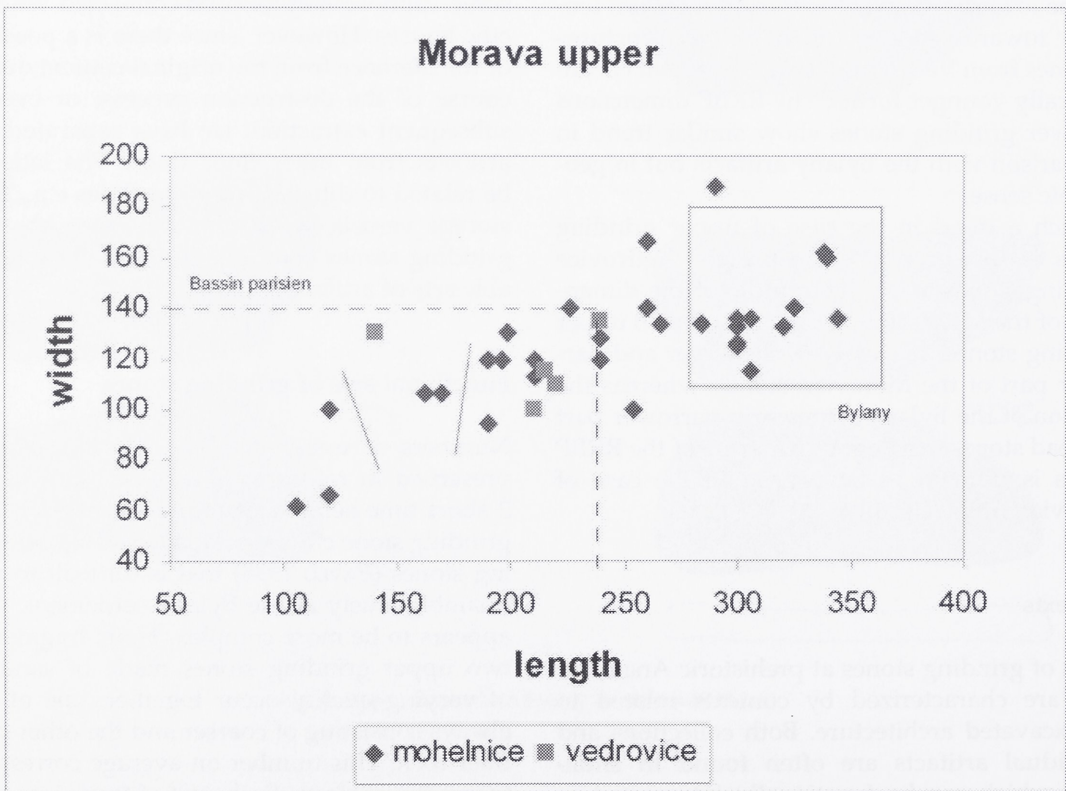


Fig. 11 Length and width of stones from Moravia and Bylany and Bassin Parisien: a - lower stones, b - upper stones.

differently when the lower grinding stones show longer durability, being stationary, relative to the upper grinding stones which were easier to handle and carry. In spite of that the pair of upper grinding stones can be considered a standard grinding or milling device perhaps in connection with finer or coarser milling or milling of various materials.

Similar situation was found to exist at the Güvercinkayası chalcolithic settlement where basic functional sets consisting of two upper and one lower grinding stones and one dish-shaped stone often occur in working rooms of individual houses. A few single two-piece grinding stones might have occurred near storage bin or an oven. Rooms with such facilities are common in the settlement and can be considered usual living rooms where food for one or more families was prepared. Nevertheless, rooms with a couple of grinding stones situated on a kind of elevated muddy grinding plate with unspecified number of upper grinding stones were also found. Moreover, rooms with greater number of large grinding stones or other tools made of stones also exist but are extremely rare. These rooms might have served for processing of materials for many people or large families.

Conclusions

Two-pieces grinding stones of aceramic Anatolian Neolithic are linked with pre-Neolithic collections from the Upper Mesopotamia as far as their structure, morphology and composition are concerned. Large lower grinding stones and mortars with dimples prevail in these collections. The upper grinding stones are in general much shorter than the width of lower grinding stones. Working sets of grinding stones and small mortars for domestic use, grinding tables and even rare places with large number of grinding stones can be identified at an Early Chalcolithic settlement. The length of upper grinding stones does not exceed the width of lower stones.

Mortars with dimples gradually disappear and were found only exceptionally in Neolithic collections, which appear to be the major evolutionary trend in the Near East that corresponds with changes in processed materials including those in preparation of new kinds of food in which milling of grain begins to prevail (Wright 1993). However, grinding of meat cannot be excluded either. Grinding stones in Linear Pottery Culture ceramics are usually longer than the width of lower stones so that they are often ground into a characteristic saddle-like form. A couple of upper grinding stones are believed to form a set together with one lower grinding stone.

Three size modules of grinding stones can be distinguished in the late Linear Pottery Culture found in the Paris Basin. Similar categories are characteristic of the western linear pottery in the Lower Rhine region. The upper grinding stones are usually of more regular-shape relative to lower stones so that changes in their structure are characteristic from the viewpoint of culture and chronology.

Two-pieces grinding stones in general tend to be smaller at simultaneous maintenance of effective milling surface. This trend in Anatolia is continues from Aceramic up to the early Chalcolithic (Baysal/Wright 2005), while in Europe appears to be geographic advancing from the east to the west.

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Trade and use of raw material for neolithic querns in north-western Germany

Jan Graefe

Zusammenfassung – In Nordwestdeutschland wurden im Neolithikum zwölf Gesteinsarten zur Mahlsteinherstellung verwendet. Die Lagerstätten sind in der Regel identifizierbar. So wurden Sandsteine und Granite aus Entfernungen von 5 und 60 km von den Lagerstätten zu den Siedlungen transportiert. In jeder der untersuchten Regionen wurde zumeist eine Gesteinsart – je nach den geologischen Verhältnissen – während des gesamten Neolithikums verwendet. Einzelne Gesteinsarten sind nur in wenigen Fällen als Mahlsteine ausgewählt worden. Der Rohmaterialbezug wurde von jeder Siedlung in Eigenregie durchgeführt. So zeigen Mahlsteine aus lagerstättennahen und -fernen Siedlungen keine signifikanten Unterschiede hinsichtlich der Form oder Größe. Abschläge von verwendeten Rohmaterialien aus ausgegrabenen Siedlungsinventaren zeugen von einer Produktion der Mahlsteine in bzw. bei den Häusern. Es wird allerdings deutlich, dass erste Zurichtungen bereits in den Lagerstätten erfolgten. Festzuhalten gilt, dass die geeigneten Materialien durch einen bergmännischen Abbau gewonnen wurden. Nur in Ausnahmefällen wurden Gesteine aus den Schottern der Flüsse aufgesammelt.

Schlüsselwörter – Nordwestdeutschland – Neolithikum – Mahlsteine – Distribution

Abstract – Abstract – The data of north-western Germany demonstrate that during the neolithic twelve different types of rock were used as raw materials for querns. In many cases it was possible to identify the raw material sources, so it is certain that sandstones and granites came to their final finding spots from deposits from about 5 to 60 km of distance. Each territory has its typical raw material which is related to the geological occurrence and which is mostly used during the neolithic. Some other types of rock are only once attested as querns.
The procurement of raw material was assured by each settlement itself. There are no differences in form or size of querns between settlements near sources and settlements apart. Small flakes of typical raw material from excavated settlements show that the production of querns took place at the houses. It has to be mentioned that the rocks were first examined at the collection spot. The extraction of material for querns must have been done by mining. In some cases only rocks from riverbeds were collected.

Keywords – north-western Germany – neolithic – querns – distribution

Raw material

Basis for a successful grinding of cereals on querns is the raw material. Only a very limited range of rock types were used as querns. The quality of the rock is related to workability, durability and efficiency. The material has to be tightly cemented and the texture roughed with a fine or middle grain size (**fig. 1**).

In neolithic times sandstones, basalts, granites and limestones were used. The hardness of rocks like sandstone depends on the strength of the matrix (carbonate or silica) which sticks the grains like quartz together. Based on a strong wear during the use, it was sometimes necessary to roughen the surface of the querns using pebbles or hammer stones.

Since the geological occurrence of usable material is quite different, in some cases rocks were imported from other (= more distant) regions (Graefe 2004, 64-80).

By means of correct geological examination of thin sections it is often possible to identify the provenance of neolithic querns.

Investigation area

The investigation area consists of – as part of north-western Germany – the region between the river Weser and the river Rhein (**fig. 2**). Besides the courses of the rivers Ems, Elbe and Main are indicated, too. As topographical fix points the cities of Cologne, Hannoversch Münden, Münster and Frankfurt/Main are included. Within the investigation area there are morphological and geological differences, for example the low mountain range and the lowlands. Framed in thin lines the region of the master´s- thesis and in thick lines the one of the dissertation- thesis are indicated. The frontiers of the dissertation corresponds to the political border of Nordrhein-Westfalen. It is important to note that both regions are situated side by side.

All in all 1135 querns were examined. **Fig. 3** shows that 21 % of the querns belongs to quern slabs, 13 % to quern slabs, secondary quern handstones, 37 % to quern handstones and 29 % to querns without certain surfaces as quern slabs or handstones. It is clear that 50 % of the querns

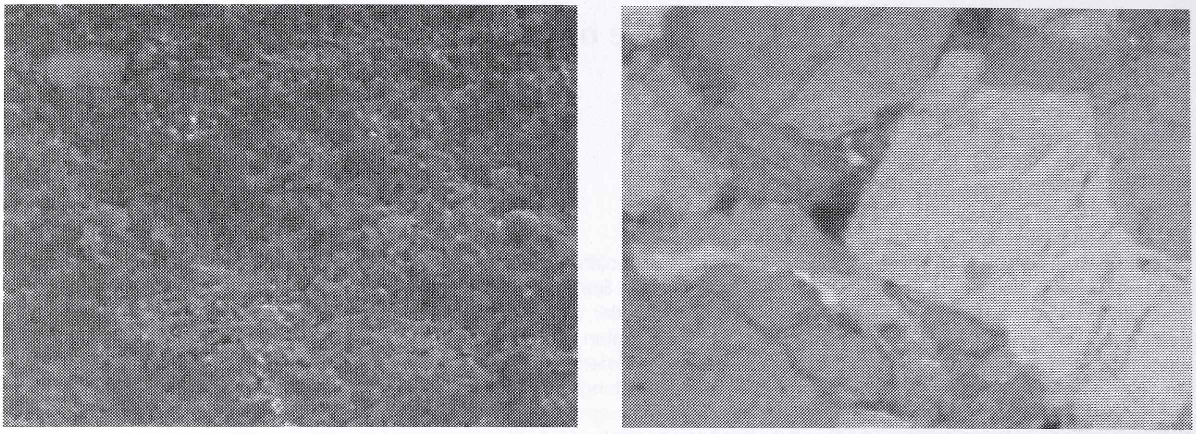


Fig. 1 Photo (left) and thin sections (right) of sandstones.

are primary or secondary quern handstones. This percentage shows that more handstones than slabs are needed. This is because of the wear and tear during the use as querns.

Master's - Thesis

Fig. 4 shows the investigation area. The main rivers are Fulda and Werra, who confluence to the Weser river at the municipal area of the town Hannoversch Münden, and the Leine river. Nearby the river Leine the town of Göttingen is situated.

A number of 405 querns from eight early neolithic (Linear Pottery culture) settlements were examinated (Graefe 2004, 44-55). Additionally 165 querns from the well known settlement Rosdorf "Mühlengrund", Landkreis Göttingen, - excavated between 1963 and 1970 - were investigated. The raw material has been mostly identified as triassic sandstones from different sources. Some of these sandstones has been also proved in early neolithic settlements of the Warburger Börde (Graefe 2008).

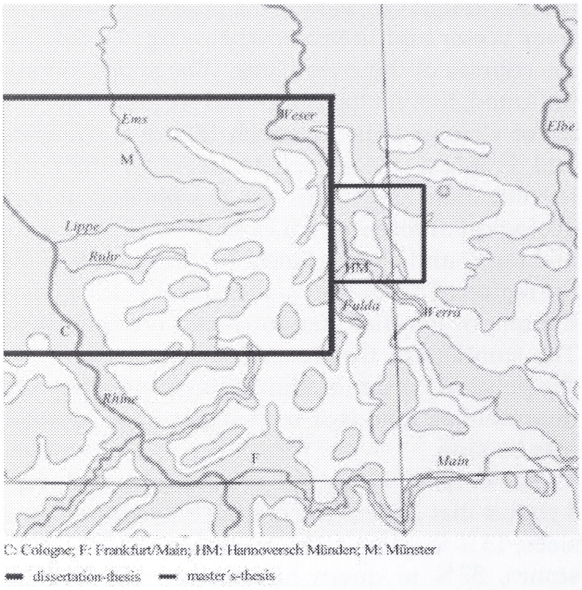


Fig. 2 Region of research of the MA- and doctoral dissertation's -Thesis.

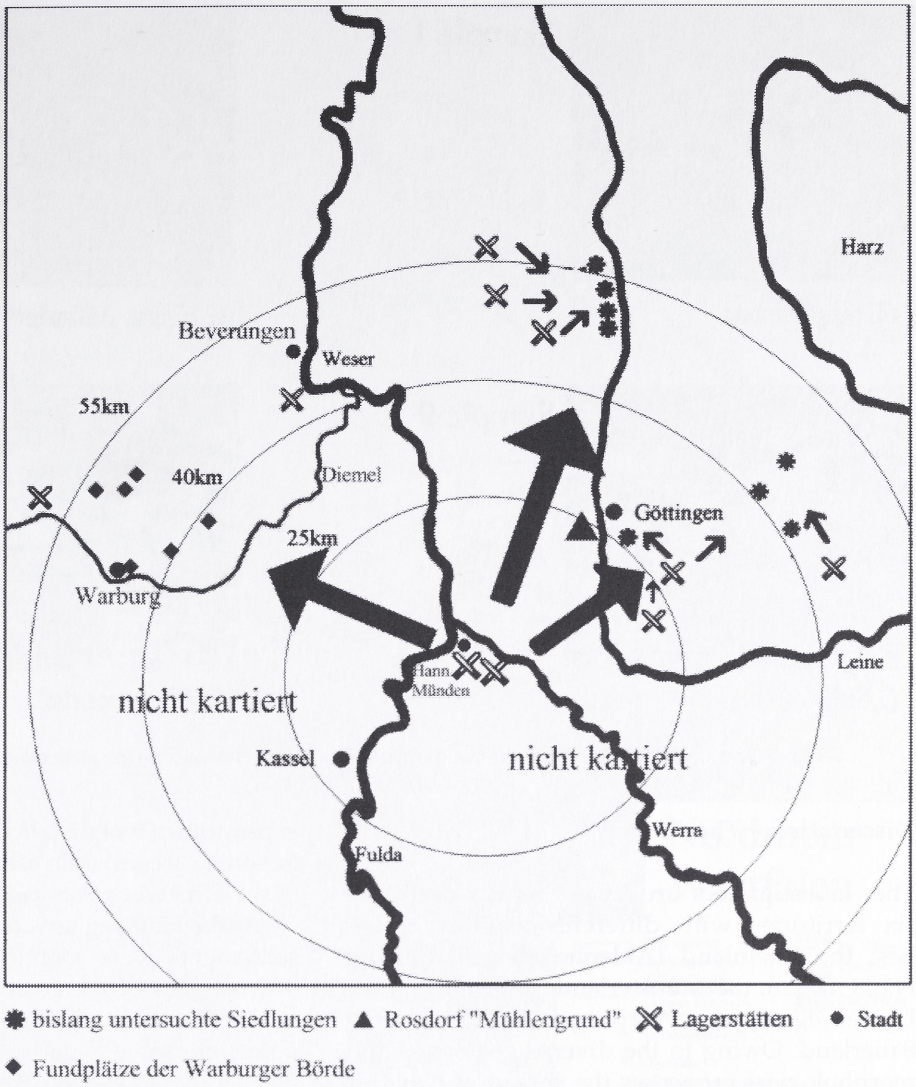
243 – 21%	quern slabs
144 – 13%	quern slabs, sec. Handstones
422 – 37%	quern handstones
326 – 29%	querns without certain surface

Fig. 3 Number and percentage of quern slabs, quern slabs, secondary handstones, quern handstones and querns without certain surfaces (n=1135).

It was possible to identify a range of rock types which were used as querns. 28 % were identified as triassic sandstones variation "Hann. Münden", 60 % as triassic sandstones variation „Solling" and 8 % as triassic sandstones variation "Anstehender". The rest are querns of an unknown material, "Breccien", "Grauwacken" or triassic sandstone variation "Volpriehausen".

Based on the geological occurrence it was possible to identify the deposits of the sandstones of the variation "Hann. Münden" between the confluence of the Werra and Fulda rivers near the town of Hannoversch Münden. In medieval and modern times the raw material for millstones was collected by mining in some quarries in Hannoversch Münden (Graefe 2004, 65-70).

Fig. 4 Region of research of the MA-Thesis. Included are settlements of the Warburger Börde as part of the dissertation's -Thesis (modified after GRAEFE 2004, 77).



The composition of the material is visible in thin sections. Due to individual geological compositions of stones it is mostly possible to identify the area of origin.

From some querns of the region of research and some sandstones at the town of Hannoversch Münden samples were taken and thin sections made. Some of these samples are given at **fig. 5**.[1]

It is clear that the thin sections are quite different. The greatest similarities with regard to grain size, structure and mineral mixture exist between Sample 1 and 2. There are no similarities between Sample 1 and Sample 13. Based on differences between Sample 9 and 1 it is certain that sandstones of the variation "Solling" does not belong to the quarries at Hannoversch Münden.

The distribution of sandstones of the variation "Hann. Münden" as querns is traceable until 55 km to the north and east of the quarries (see **Fig. 4**). At this point it is important that the investigation area of the master´s- and dissertation- Thesis are situated side by side. The distribution of sandstones of the variation "Hann. Münden" as querns into the so called Warburger Börde is only proven for the Linear Pottery culture (early neolithic). The decorations of pots between settlements of the Warburger Börde, the south of Niedersachsen and Hessen show great similarities and connections. The region is part of the so called "Westfälisch-Niederhessischer-Schraffurstil" (KNEIPP 1998, 158-160 Fig. 53).

Due to medieval and modern mining at the quarries of Hannoversch Münden no traces of neolithic mining are left. The medieval and modern quarries are located at the so called mines of "Kattenbühl", "Blümer Berg" and "Letzter Heller" (GRAEFE 2004, 68-69).

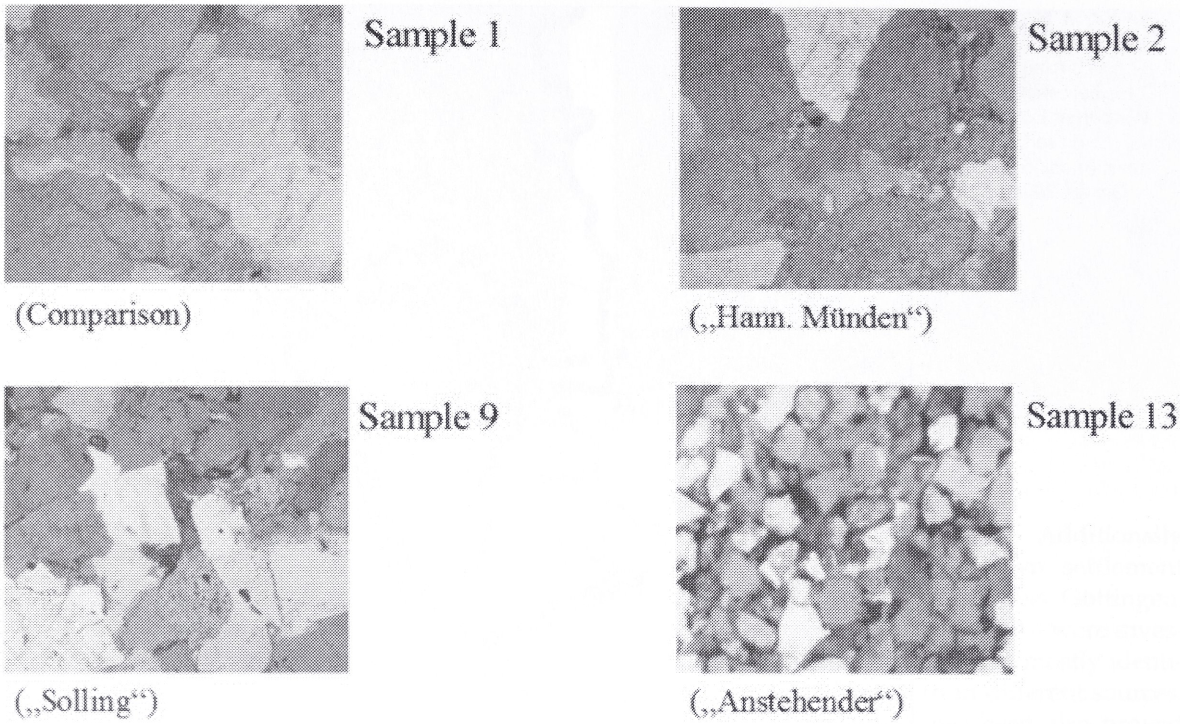


Fig. 5 Thin sections taken from querns in comparison to sandstones from the Hannoversch Münden region.

Dissertation – Thesis[2]

The investigation area can be divided into six territories with different neolithic activities: the Rheinland (Aldenhovener Platte and Niederrhein), the Münsterland, the Hellweg, the Lippe region, the Warburger Börde and the Sauerland. Owing to the diverse geological and morphological properties the spread of neolithic sites in these territories is quite different. In some of these areas a range of rocks, in other areas only one or two different rocks were used as raw material for querns (Graefe 2008).

Settlements of the first farmers of the Linear Pottery culture could only be identified in the Rheinland, the Hellweg and the Warburger Börde (**fig. 6**).

Well known settlements at the Aldenhovener Platte are Langweiler 8, Kreis Düren, and Köln-Lindenthal nearby the city of cologne, excavated in the 1930`s by Werner Buttler and Waldemar Haberey. Querns are attested as refuse at the houses and as burial objects at the cemeteries of Niedermerz 3, Inden-Altdorf and Bergheim-Zieverich.

The ordinary for querns used materials are sandstones from the Aachener Stolberg area, the so called "Eschenweiler-Kohlen-Sandstein". From here the transport of these sandstones as querns is proven up to a distance of 60 km. Additionally in some cases triassic sandstones from the north of the Eifel were also used.

At the Hellweg area only some early neolithic settlements were identified as yet. Due to the downstream of the river Ruhr from the east to west there are a lot of possibilities for collecting points of usable material. The rock can be identified as the so called "Ruhrsandstein". It has to be mentioned that the extraction must have been done by mining. In some cases only rocks from the river beds were collected.

The material used at the Warburger Börde has already been mentioned. Some of the querns can be identified as sandstones from deposits of the Hannoversch Münden region at the south of Niedersachsen. The distance amounts to 55 km. Additionally sandstones from local deposits were also used.

Middle neolithic (Großgartach and Rössen culture) sites with querns are known in the Rheinland, the Hellweg and in the Münsterland (**fig. 7**).

In principle the same types of rocks as during the early neolithic were applied: Eschenweiler-Kohlen-Sandstein in the Rheinland and Ruhrsandstein in the Hellweg region.

Ruhrsandstein as raw material for querns

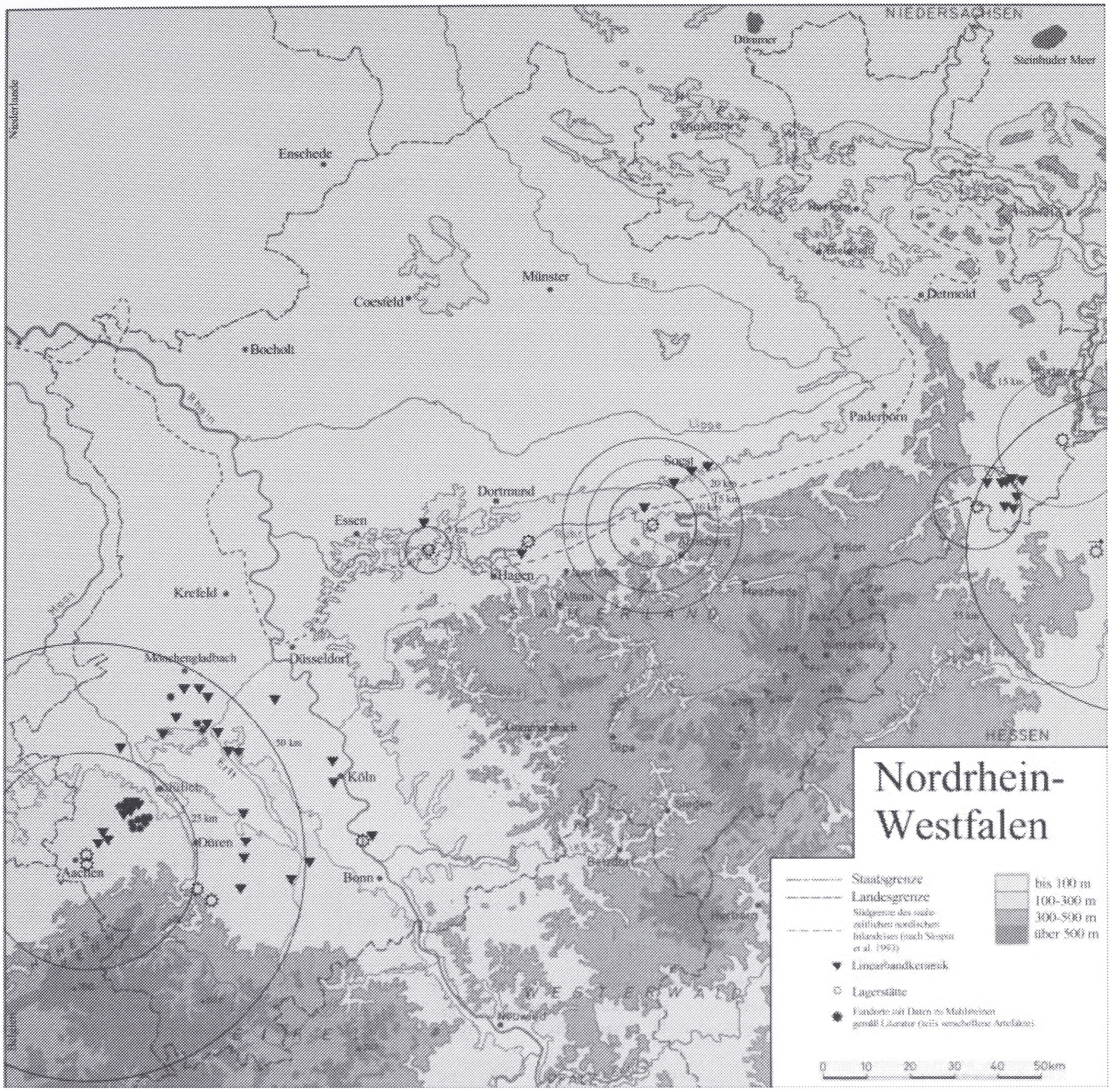


Fig. 6 Region of research during the early neolithic (Linear Pottery culture) (after Graefe 2008, Karte 2).

has been identified at the site of Nottuln, Kreis Coesfeld, in the Münsterland. Excavations of the University of Münster in summer 2007 (A. Jockenhövel/Chr. Grünewald/Chr. Groer) showed that the first colonization already occurred by settlers of the late Rössen culture. The distance between the settlement and the collecting spot of the Ruhrsandstein amounts to about 55 km.

The Warburger Börde has been part of the middle neolithic area of settlements, but it was not yet possible to identify querns.

A similar use and distribution of raw materials during the younger neolithic (Michelsberg culture) is shown at **fig. 8**.

Besides of the Rheinland, the Hellweg and the Warburger Börde, querns were examinated from settlements in the Münsterland and for the first time in the Sauerland.

Again the Eschenweiler-Kohlen-Sandstein, the Ruhrsandstein and local sandstones in the Warburger Börde were used.

The raw materials of querns from the Münsterland were now taken from granites. The geological occurrence of these granites are connected with the traces of the last ice age. It is not possible to identify the quarries. Rocks could be collected from many different places.

From the already mentioned site of Nottuln an

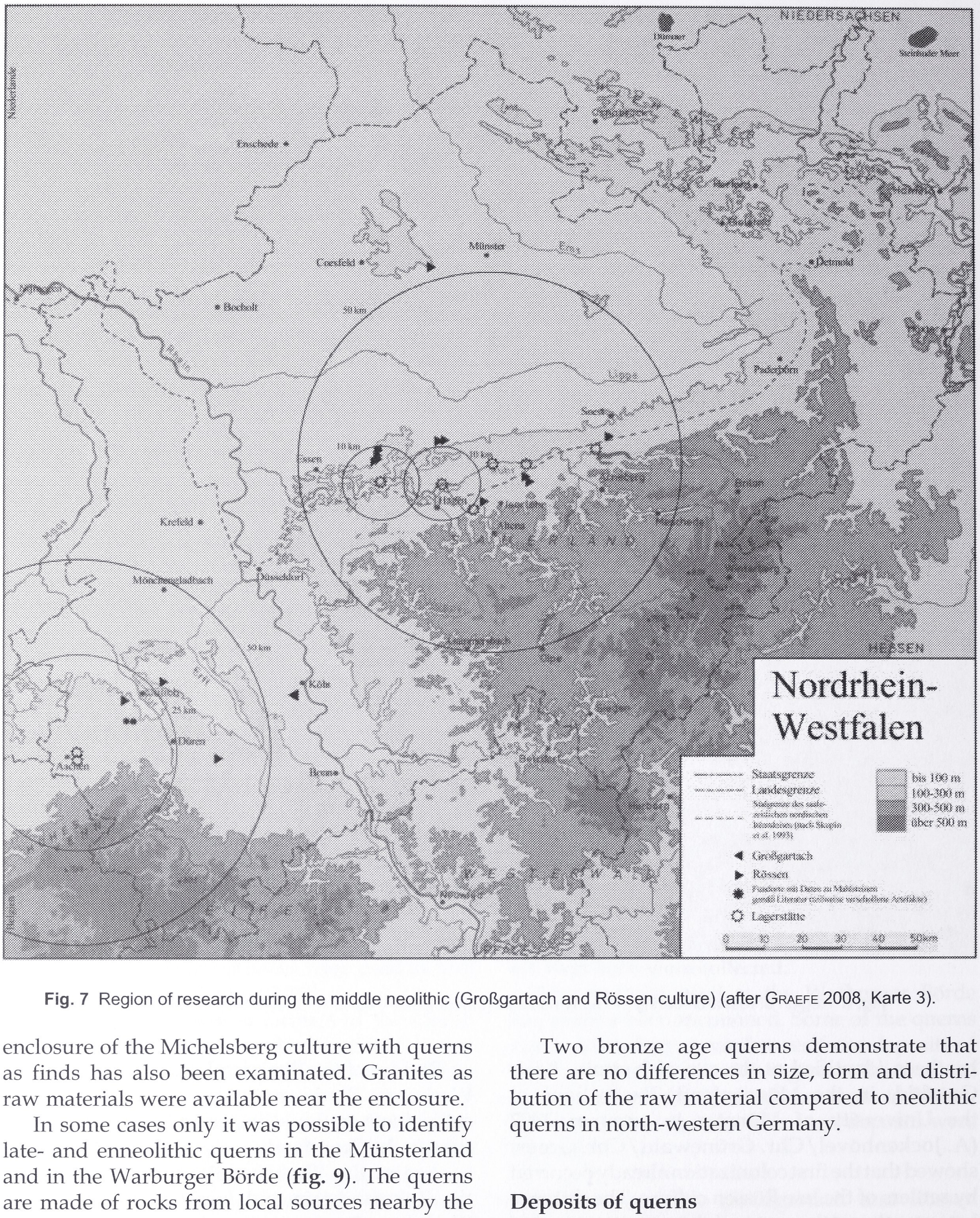


Fig. 7 Region of research during the middle neolithic (Großgartach and Rössen culture) (after Graefe 2008, Karte 3).

enclosure of the Michelsberg culture with querns as finds has also been examinated. Granites as raw materials were available near the enclosure.

In some cases only it was possible to identify late- and enneolithic querns in the Münsterland and in the Warburger Börde (**fig. 9**). The querns are made of rocks from local sources nearby the sites.

Within the investigation area the settlements expanded into new territories during the enneolithic period.

Additionally querns from sites which could not assigned to a neolithic culture were investigated. In theses cases the used rocks were taken from local quarries.

Two bronze age querns demonstrate that there are no differences in size, form and distribution of the raw material compared to neolithic querns in north-western Germany.

Deposits of querns

As already mentioned, in the Rheinland the typical raw material used for querns during the neolithic is the "Eschenweiler-Kohlen-Sandstein" or the "Gedauer Konglomerat". The quarries were located in the 1960´s nearby Aachen in the Solberg region by K. Rode (**fig. 10**). By reason of the geological occurrence there are different

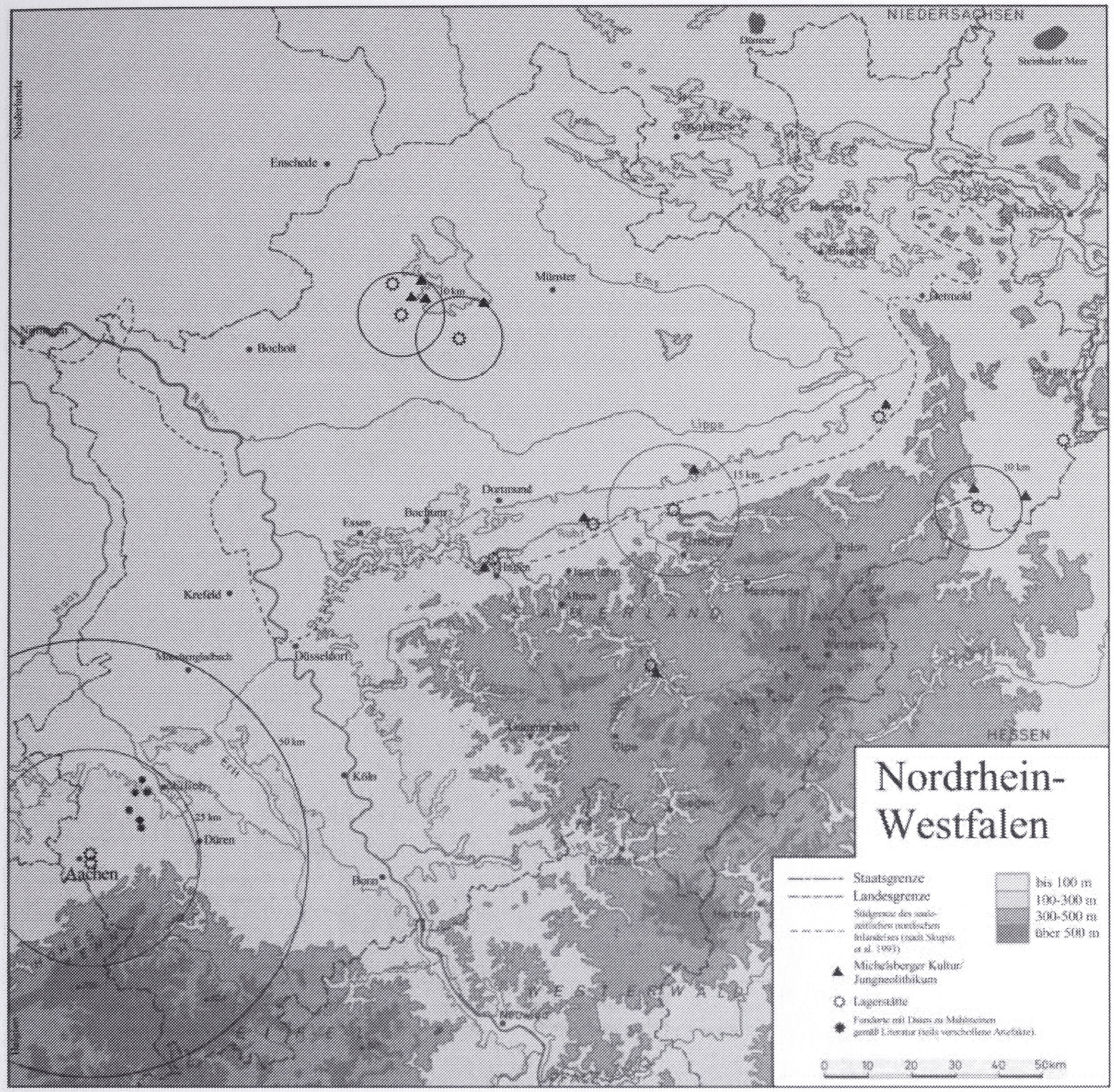


Fig. 8 Region of research during the younger neolithic (Michelsberg culture) (after GRAEFE 2008, Karte 4).

layers of sandstones with their own mineralogical composition, grain size and colour. On this account K. Rode, J. Weiner and J. Schalich identified fife different quarries for querns within a radius of 10 km (RODE 1961; WEINER/SCHALICH 2006, 205).

The extraction of material for querns must have been done by mining. In some cases only rocks from riverbeds were collected. The making of querns can be divided in several stages (**fig. 11**):

First of all, usable rocks were extracted or even collected. The basic form of querns is made by pecking and flaking. In order to finish the quern it is necessary to peck and polish the half-finished product. Some of theses half-finished products are found in settlements. Owing to the wear during the use it is necessary to re-peck or roughen the surface of querns from time to time. Finally the quern breaks and the fragments will be refused (LIDSTRÖM HOLMBERG 2004, 213; RAMMINGER 2007, 105).

One of the rare half-finished products has been found in Eschweiler-Weisweiler, Kreis Aachen. In a pit of this settlement, which is dated to the younger phase of the Linear Pottery culture, the half-finished product of a quern slab and a polishing stone were found (TUTLIES/WEINER 1999, 50-53).

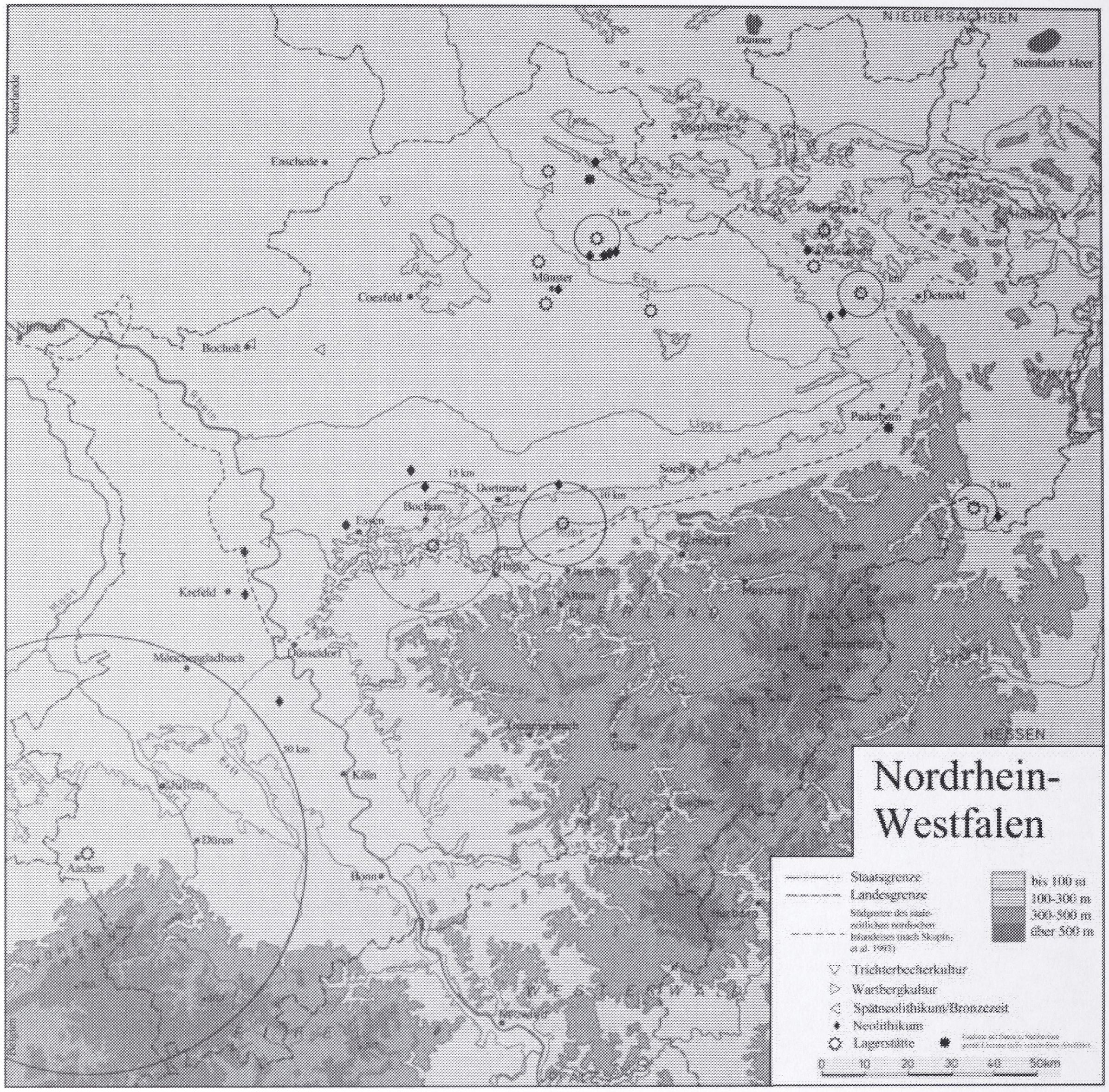


Fig. 9 Region of research during the younger neolithic (Funeral Beaker- and Wartberg Culture, the Enneolithic, Neolithic and bronze age) (after GRAEFE 2008, Karte 5).

It is visible that the quern slab got broken during the pecking in the settlement. The quern slab is refused, although it would have been possible to use the slab as a quern handstone. The raw material is identified as Eschenweiler-Kohlen-Sandstein. The quarries are situated near the settlement. Due to the proximity it was not necessary for the settlers to reuse the quern slab as a handstone. The polishing stone has a convex surface. Therefore it could not have been used as quern handstone. Traces of polishing prove that the stone was only used for polishing the quern slab.

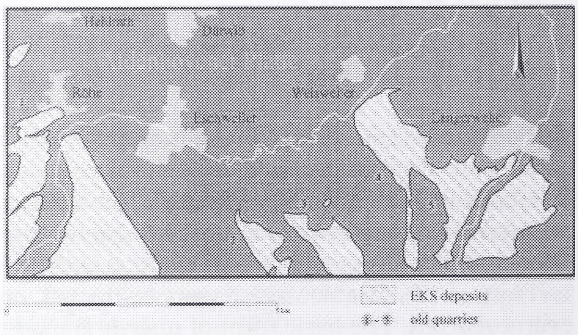


Fig. 10 Deposits of Eschenweiler-Kohlen-Sandsteins at the Aachener Stolberg region (after WEINER/Schalich 2006, 205).

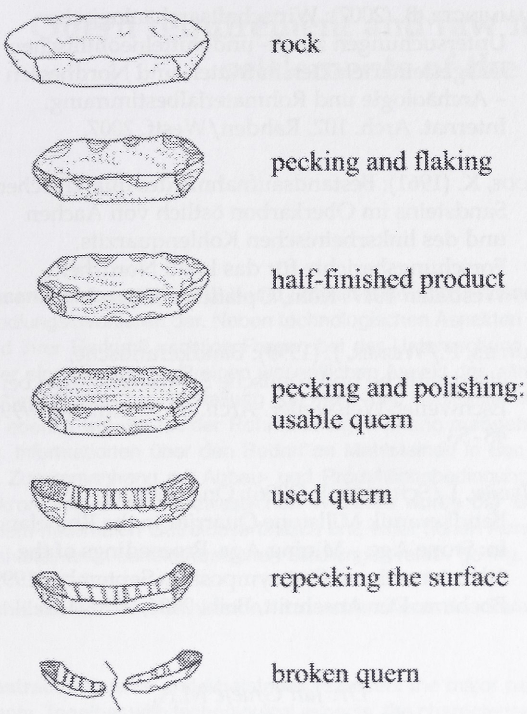


Fig. 11 Life stages of querns (modified after LIDSTRÖM HOLMBERG 2004, 213; RAMMINGER 2007, 105).

Trade? Transmission of raw materials

Models of the transmission of raw materials for querns have been proposed by N. Kegler-Graiewski and A. Zimmermann. The transmission of raw materials for querns are different to those of the transmission for flint (**fig. 12**).

There are no differences in form or size of querns between settlements near quarries and settlements apart. Small flakes of typical raw material from excavated settlements show that the production of querns took place at the houses. For settlements distant to the quarries the production of blanks might have been done at the quarries. The rocks were first examinated at the collection spot. The procurement of raw material was assured by each settlement itself.

Therefore the transmission of raw materials for querns was not done by trade.

(Footnotes)

[1] Sample 1 was taken out of a non-artificial sandstone nearby the quarries of Hannoversch Münden. Sample 2 was taken out of an artificial sandstone of the variation "Hann. Münden" from an early neolithic settlement. Sample 9 was taken out of an artificial sandstone of the variation "Solling" from an early neolithic settlement. Sample 13 was taken out of an artificial sandstone of the variation "Anstehender" from an early neolithic settlement.

[2] I would like to thank the Römisch-Germanisches Zentralmuseum Mainz for a grant of two years.

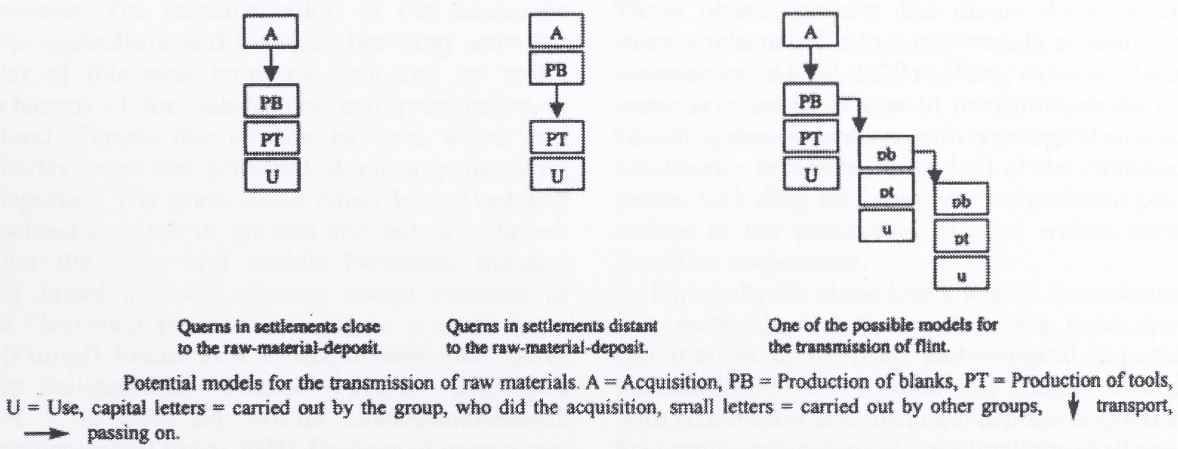


Fig. 12 Models for the transmission of raw materials (after KEGLER-GRAIEWSKI/ZIMMERMANN 2003, 34).

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Quern requirement and raw material supply in Linearbandkeramik settlements of the Mörlener Bucht, NW Wetterau, Hesse

Britta Ramminger

Zusammenfassung – Mahl- und Schleifsteine stellen zusammen den Hauptbestandteil aller Steinartefakte in bandkeramischen Siedlungsinventaren dar. Neben technologischen Aspekten sind insbesondere die Bestimmung der verwendeten Rohmaterialien und ihrer Herkunft wichtige Fragen bei der Untersuchung von Steingeräten, denn die Rohmaterialversorgung einer Siedlung oder einer Region stellt einen wesentlichen Aspekt des altneolithischen Wirtschaftslebens dar. In Hessen wurden verschiedene Rohmaterialien zur Herstellung von Mahl- und Schleifsteinen verwendet. Die Entfernung zwischen Vorkommen und Siedlungen ist ebenso wie die Art der Rohmaterialgewinnung maßgeblich bei der Untersuchung von Abbau- und Distributionsmechanism en. Informationen über den Bedarf an Mahlsteinen in den einzelnen Siedlungen sind notwendig, um die Rohmaterialmengen im Zusammenhang mit Abbau- und Produktionsbedingungen auszuwerten. Für die Mörlener Bucht, einer 6 x 12 km großen Mikroregion in der nordwestlichen Wetterau wurde der Bedarf an Mahlsteinrohmaterialien modellhaft berechnet. Selbst bei einem maximalen Getreideverbrauch und einer hohen Abnutzung durch Abrieb und Oberflächenaufrauhung war der Bedarf an Mahlsteinen in bandkeramischen Siedlungen relativ gering.

Schlüsselwörter – Mahlsteine – Linearbandkeramik – Bedarf an Mahlsteinen – Mörlener Bucht (Hessen)

Abstract – Querns and whetstones represent the major part of all recovered stone artefacts in most Linearbandkeramik settlements. Together with technological aspects, the characterisation and provenance of the raw materials are important questions for the analysis of stone tools. The supply of raw materials of a site or a region is a substantial aspect of the economic life in the early Neolithic. In Hesse various rock outcrops were used by early Neolithic populations. The distances between deposits and settlements as well as the kind of extraction are decisive to study exploitation and distribution mechanisms.

Information about the demand of querns in the settlements is necessary to evaluate raw material quantities in conjunction with exploitation and production conditions. For the Mörlener Bucht, a 6 x 12 km micro-region in the northwest Wetterau, central Hesse, the demand of quern raw materials was model-like calculated. Even with maximum grain consumption and high wear by rock abrasion and napping of the work surfaces, the need of querns was relatively small.

Keywords – querns – Linearbandkeramik – demand of querns – Mörlener Bucht (Hesse)

Introduction

The beginning of the European Neolithic brought not only changes in settling and ceramic production but also a complete renewal of the economic system. The transformation of the landscape for agriculture and livestock breeding were pillar of this new economy, followed by major changes of the subsistance and preparation of food. Cereals like emmer, einkorn, wheat and barley were the principal staple together with legumes. The grain could either be cooked and served as mash or ground and baked to bread. For the early and middle Neolithic, remains of bread are still missing except residues of a "leavened piece of dough" in a small basin (Kumpf) found in a Linearbandkeramik grave in Stuttgart-Zuffenhausen (Fundber. Schwaben N. F. 8, 1935, 50). Within Linearbandkeramik settlements (Lüning 2004), findings of oven structures and remains of querns suggest that wheat was not only cultivated and eaten as mash or groats but also ground and consumed as bread. Grinding tools, consisting of a mobile handstone, the rubber stone, and a stationed grindingstone, the quern, were used to produce flour (**fig. 1**). These objects present the major share of all stone artefacts in Linearbandkeramik settlements inventories. In total, 1839 neolithic stone artefacts were recorded in 39 sites in the Mörlener Bucht. Grinding stones together with typological similar whetstones represent about half of the collected stones. Grinding therefore was a significant procedure in the processing of corn within early Neolithic settlements.

Especially for stone tool analysis, the selected raw materials and their origin are from special interest apart from technological aspects. Classifications of raw materials enable dealing with economical and historical aspects of querns. Economic archaeological investigations shall consider the needs of the Neolithic inhabitants and

Fig. 1 Grinding on a reconstructed quern (after Lüning 2005).

note the social and cultural involvement of these objects. Material goods can, hence, be regarded as equivalent of direct needs of prehistoric people, and by consequence as a mean of expressing their social status, identity or sacred acting (Zimmermann 2001). According to this, logistic mechanisms, rights of use, technological means and division of labour play an important role, as well as social contexts, systems of values and communication networks.

Since the early Neolithic it is assumed that for each settlement an economic area was existing, wherein fields were cultivated, plants and wood collected and cattle grazed at least temporarily (e.g. Bakels 1978). This natural and cultural spaces are named *„community area"* by E. Neustupný, incorporating forest, waters, cultivation areas, burial sites, meeting places and activity areas like hunting- and fishing stations or mining places for lithic material, stone and clay (Neustupný 1987; 1991). This concept follows a social division of space, which regulates the access to natural resources. The presupposition is the assumption of humans collectively living and cultivating an area and claiming their territory at least since the Neolithic. The raw material supply of a particular site or region is therefore an important aspect of Neolithic economic life. The distance between deposits and settlements as well as the mining methods are essential for the redistribution procedure. In case of rigorous social rules for the using-rights of resources, simultaneous settlements used different deposits or the demand of products was covered by central sites. Such distributor sites should have a surplus of products in their inventories.

Raw material supply

Data about quern demands in each settlement are necessary to appreciate potential surplus production. The Mörlener Bucht - situated in the NW Wetterau between Butzbach in the north and Bad Nauheim in the south-east – is adapted for such a study: within the project *"Besiedlungsgeschichte der Bandkeramik in der Mörlener Bucht"* (BBM) intensive field-surveys and geomagnetic prospections were carried out on several sites. Due to this, the amount of houses is better known than in other Hessian areas. The demand of quern raw materials therefore was calculated model-like for this micro-region. Chr. Schade gives in his publication on Linearbandkeramik settlement history a detailed introduction to the Mörlener Bucht. (Schade 2004). Most of this 6 x 12 km micro-region fulfills the conditions for a Neolithic agriculture in relation to water supply and soil quality. In its geological structure the Mörlener Bucht is a continuation of the Usinger Becken, Taunus. Next to isolated deposits of tertiary sediments, containing limonite, hematite and manganese, outcrops of limestone, sandstone and argillaceous shale are covered with rubble alongside the slopes of the Hintertaunus. Tertiary basalt, greywacke and quartzite are found at Butzbacher Becken. The subsoil of Bodenroder Kuppe is constituted by moulded greywacke sandstones and argillaceous shale. Argillaceous shale and limestone are also found in-situ at Münster-Maibach-Schwelle. At the latter area single basalts and greywacke mould the subsoil. In the south a clod shale and sandstone is outcropping and is still exploited today.

Parameter for calculating the querns requirement

Grinding stones represent a major part of stone artefacts on Linearbandkeramik settlements in the Mörlener Bucht like in many other Hessian inventories. They are represented in various quantities in each settlement like other artefacts (Ramminger 2003). The quantity is dependent primarily on the number of houses, the duration of the settlement and the degree of artefact fragmentation. According to traditional contortions the quantities of findings due to gathering is subject to fluctuations. While prospecting, grinding stones will be left behind because of their weight, or they will be disposed of by modern farmers. Existing objects in collections represent

Parameter	Minimum	Maximum	Middle Range
Requirement of corn per person and year (in kg)	165	250	200
Percentage of ground corn	50%	90%	75%
Amount of ground corn per person and year (in kg)	82,5	225	150
Effectivity of grinding operation (minutes per kg flour)	150	30	60
Duration of grinding per person and year (in h)	41,3	563	197
Inhabitants per house	6	6	6
Duration of grinding per household and year (in h)	247,8	3378	1182
Weight of quern at the beginning of its use (kg)	8	20	14
Size of working surface of querns (cm²)	500	1500	1000
Weight of rubber stone at the beginning of use (kg)	3	6	4,5
Size of the working surface of rubber stones (cm²)	100	600	300
Minimal weight of functional querns (kg)	1	2	1,5
Minimal weight of functional rubber stones (kg)	0,5	1	0,75
Duration of house generation (years)	25	25	25
Duration of LBK (years)	500	500	500
Number of house generations during the LBK	20	20	20
Number of individuals per generation in Mörlener Bucht	345	545	435
Number of indentations per cm²	5	5	5
Volume per indentation (mm³)	24,1	24,1	24,1
Loss of stone material per indentation (g)	0,01	0,01	0,01
Amount of abraded stone material per hour (in g)	0,10	1,00	0,50
Frequency of surface roughening per year	4	12	8

Fig. 2 Parameter for calculating the querns requirement (after Ramminger 2007, 102, fig. 76).

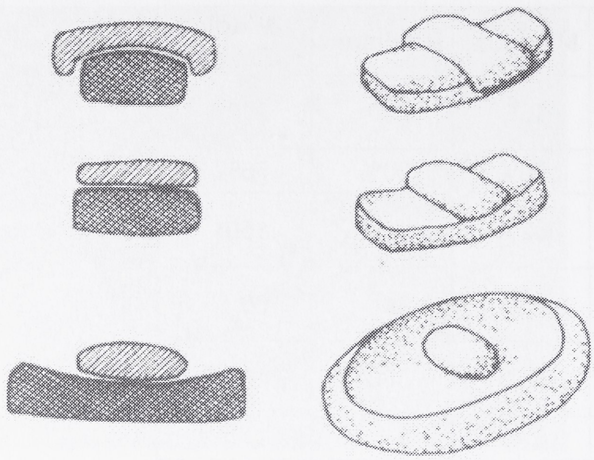

Fig. 3 Forms of grinding stones (after Zimmermann 1988, 725, fig. 640).

therefore only a fractional amount of the potential material and are insufficient to reconstruct former the initial inventory. Even inventories of excavated settlements are in cause of different state of preservation. Ethnographic data providing the amount of grinding stones per household are as rare as data from archaeological findings, leaving not much place for exact calculation of requirements. U. Sommer expected 6,2 querns per house for the later Linearbandkeramik settlement Hanau – Klein-Auheim (Sommer 1998, 207). Life and durability of Neolithic grinding stones is not easy to define, because it depends on various unknown availabilities' (**fig. 2**).

Size of grinding stones

The efficiency of grinding stones depends on the size of the active surface of the quern and the rubber stone. The subassembly of quern from Eschweiler-Weisweiler, Kr. Aachen, can be used as a benchmark for grindingstones size at the beginning of their use, with a weight of 18,3 kg by a length of 38 cm, a wide of 20 cm and a height of 18 cm (Tutlies/Weiner 1999, 52). In Hesse another complete quern has a working surface of 1404 cm². Next to smaller objects, the length and width are comprised between 33 x 16 cm and 11 x 8 cm. Model data were calculated after a measure of the size of the working surface, which correspond to a maximum and minimum for calculation. The weight of complete querns varies in Hesse between 3000 and 9100 g, the weight of rubber stones between 387 and 3420 g. All examples show wear-traces and are not at the beginning of their life. The starting weight of a quern will be set by the author - considering the subassembly of a quern from Eschweiler-Weisweiler - minimum 8 kg and maximum 20 kg. The weight of rubber stones averages between 3 and 6 kg at the beginning of its use. For northern and central Hesse, the ratio between quern and rubber stone are of 1:2 in general. This observation fits with descriptions of querns from Sudan, where one quern and two rubber stones from different fabric are used together. The corn is first "pre-ground" by coarse grinding stones, before being ground into "fine-mill" using a fine grained rubber stone (Schön/Holter 1988, 159). The examinated Neolithic grinding stones do not allow a classification in coarse and fine grain. The ratio of available quern elements would rather be explained by the smaller size of the rubber stones, which have to be replaced more often.

Amount of flour

With the size of saddle querns and rubber stones the amount of ground flour is a major criterion for the calculation of their durability. Considering the amount of corn ground and necessary for the diet one can calculate the frequency e.g. duration of grinding stones life. For example, J. Lüning estimates corn consumption around 685 g per person per day, corresponding to an annual consumption of 250 kg per person (Lüning 1979/80; 2004, 23). This can be seen as maximum requirement. C. C. Bakels calculated the calorie needs for the Linearbandkeramik-inhabitants of Hienheim (Bakels/Modderman 1986, 118). For the annual fulfilment of the demand, between 61 and 176 kg of corn per person were necessary. The author

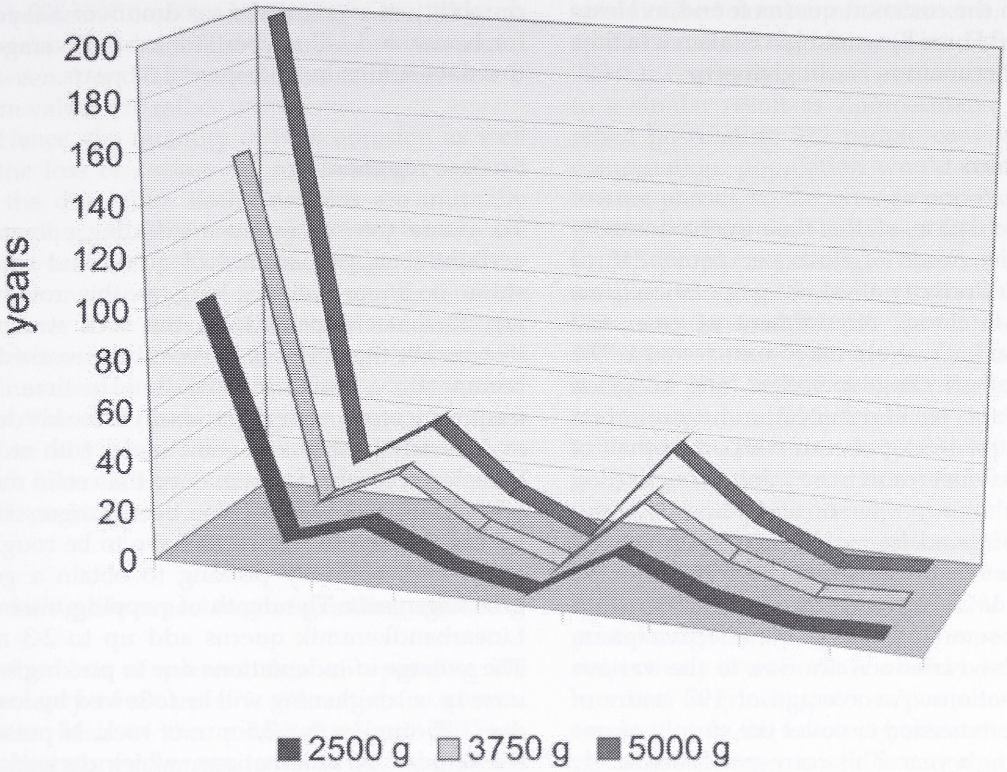

Fig. 4 Life range of rubber stones (after Ramminger 2007, 106 fig. 79.3).

counts with a minimum annual fulfilment of demand of 165 kg corn per person. The quantity of corn consumed as mash or groats or as flour for baking bread is still unknown. Therefore evaluations are used for calculation. 50% of ground corn minimum and 90% of processed corn shall be a basis.

Duration of grinding

For the duration of grinding only few solid results are available. Yet, well documented archeo-experimental tests concerning size, form and different materials are rare. Forms of grinding stones can be differenciated by the width of the rubber stone and the length of the quern (**fig. 3**). In Form A, the rubber stone is longer than the quern width, so that the supernatant ends are not involved directly in the grinding. According to this the medial diameter is reduced in use and the supernatant ends remain in their initial height forming shaped rubber stone with thickened ends. The longer the objects were in use the more the ends became marked. Form B is characterized by a correlation between the length of the rubber stones and the width of the querns. Wear traces on the rubber stones are oriented longitudinally while the wear traces on the querns are parallel to its width. The surfaces stay plan even in lengthy use. The rubber stone is shorter than the quern wide by Form C, therefore the rubber stone shows wear traces over the complete surface while the margins of length show none. By a longer use a hollow depression occurs on the quern (Zimmermann 1988). During an experiment at the Freilichtmuseum Oerlinghausen, 20 g cleaned and dehusked corn was actually ground per grinding operation. 100 g flour with a ratio of 70% bakeable fine flour needed roughly 15 grinding operations of respectively 60 minutes in a "Trogmühle" (Form C) with a small rubber stone. The grinding of one kilogram of flour would require therefore around 10 hours. E. Hennig came to other results: using grinding stones of Form A one kilogram of flour would need a grinding operation of 30-40 minutes. With grinding stones of Form C, the same amount of flour would be ground in 140-180 minutes (Hennig 1966). R. Risch produced during an experiment one kilogram of wheaten flour in two-and-a-half hours using a reconstructed Copper Age grinding stone from Fuente Álamo, Spain. The same procedure took three hours and 40 minutes to grind barley (Risch 2002, 120). The grinding on the common querns found in Hesse (Form A and Form B) would have taken less time then the experiment in Oerlinghausen.

Working hours

For the calculation of the time spent annually to satisfy the needs of flour per person, three parameters effectivity of grinding operation (time per kilogram flour), requirement of corn and amount corn to flour are taken into account. The effectivity of grinding operation (one kilogram of corn ground in 30 minutes) and a minimum requirement of 165 kg of corn per person (half of it ground to flour) result in an minimum grinding time of 41.3 hours per person and per year. About 563 hours of grinding would have been needed to obtain the maximum annual corn requirement per person of 250 kg corn (producing 90% flour for bread or semolina) using an ineffective quern. The strongest variations are due to the various time designations. An average of 197 hours of grinding were needed to cover the supply of one person during a year. This corresponds to a daily work of an hour and a half.

Stone abrasion

The life expectancy or range of grinding stones depends also on the amount of stone abrasion during grinding operations. Hard rock like quartzite or Lung basalt loses only little substance by abrasion, while soft sandstones produce more rock flour. Experimental comparisons of different rocks are still missing yet. Measurements of abrasion range were carried out only in one experiment in Oerlinghausen (Teegen et al. 1990). Here 0,012 to 0,014 g stone abrasion accrued from 40 minutes grinding. The grinding stone used was granite, an uncommon raw material for the Neolithic. U. Sommer calculated on the basis of experimental data, that by 500 g ground edible corn per person and day the quantity of a grinding stone used by a 5-persons-houshold would shrink about 547 g (Sommer 1998, 205). The recent calculation gives significantly lower loss of material due to shorter estimated working hours. The amount of abraded rubber stone and quern in sandstone would be expected between minimum 0.1 to maximum 1.0 g per hour. In fig. 4 is presented the life range of rubber stones on the basis of their issue weight, duration of grinding and amount of abrasion. That implies a minimum durability of a year and a maximum of 200 years for heavy and tall rubber stones. An average of this data results in a lifespan of 37 years.

Surface roughening

To assure the success of a grinding operation, a slightly napped surface of quern and rubber stone is important. As long as this roughening does not depend from the rock structure, like basalt, the surfaces have to be reworked by hammerstone pecking some time to time. The frequency of napping depends on stone hardness and abrading attributes. Soft rocks with strong abrasion are much faster evened than solid rocks, whose surfaces will become even progressively by use. Therefore soft rocks have to be roughed again and again by pecking to obtain a good grinding result. The depth of napping traces on Linearbandkeramik querns add up to 2-3 mm. The average of indentations due to pecking is 3-4 mm; i.e. a roughening will be followed by loss of n x (1.75 mm)^2 x ð x 2,5 mm of rock. N presents the number of indentations, which depends on the surface size and density of indentations. The individual indentations are within 1-2 mm in average, therefore each indentation is (0.25 cm)^2 x ð = 0,2 cm^2 tall regarding its surrounding distance space. The loss of rock per each indentation is 9.62 mm^2 x 2.5 mm = 24.1 mm^3. A specific gravity of 2.3-2.7 g/cm of sandstone will hence result in a material loss of 0.01 g for each indentation per roughening phase. The size and density of indentation lead to a material loss a maximum of 75 g for saddle querns and 30 g for rubber stones per pecking phase.

Frequency of surface roughening

The number of grinding phases, which can be performed before the surface of a quern has to be roughened again, is dependant upon the quantity of abraded material. In Hesse different rocks with miscellaneous strong abrasion were used. The work surfaces were polished in different timesteps. A standard size for the frequency of pecking can therefore not be determined. Basalt, rhyolithe or arkosic rocks are more durable than sandstones and do not need roughening prior to pecking, whereas sandstone surfaces had to be pecked time by time. The quantity of rock abrasion by time is also proportional to the size of the rock surface. The lifespan of querns therefore lies between 5 to 6 years minimum and 80 years maxima. The durability of rubber stones varies between 4 and 150 years. The estimated maximum values are rather unrealistic.

Hence, the quantity of rock abrasion as well as the loss of surface by roughening is crucial for the durability. Both variables are mutually depending, as the frequency of roughening are subject to length by what time the surface of the querns are completely polished and not usable anymore. The area between each indentation, which must be abraded, has to be placed around 2.5 mm deep to reach the level of the indentation' level. This area presents the discrepancy between surface and area of all indentations. Therefore, as much material has to be abraded as has accrued while pecking.

Operating life expectancy of grinding stones

On the basis of present data an operating life expectancy of six years is estimated for querns. On the basis of the quantitative ratio of both grinding stones elements within Hessian material on minor size and more frequent need of pecking, the rubber stones might have been in use only half as long as the querns. An average durability of 3 years is therefore estimated. Rocks, which did not need prior roughening due to their texture, would have had a longer lifespan. As a result the estimated values represent rather a minimum operating life expectancy. The resulting quantity of raw material measures up to maximal requirement.

Grinding stones requirement during Linearbandkeramik at Mörlener Bucht

For further calculation of requirements, the number of people which had to be provided with flour during the Linearbandkeramik, is a determining factor. A. Zimmermann and K.P. Wendt calculated the population density of the Mörlener Bucht on the basis of ascertained distances determined by Thiessenpolygones with the number of houses and estimated one household (0.8) per square kilometre (Zimmermann/Wendt 2003, 494). With an average number of six persons per household 345 people would have lived in this 72 m² wide Mörlener Bucht. Chr. Schade reconstructed the population density by geomagnetic research and find-distribution plus projection of non-prospected areas, on which he calculated an estimated number of settlements, houses and spatial extent of agricultural land (Schade 2004, 223 ff.). For early Linearbandkeramik he comes to a similar result as Zimmermann and Wendt when postulating 322 people coexisting. By his computation, population would increase in following phases, so the average population density would be 7.6 inhabitants per square kilometre or 545 people coexisting. These are at least 200 people more than according to the calculation by Zimmermann and Wendt. Therefore, during the Linearbandkeramik at Mörlener Bucht a minimum of 57.5 households (0.8 household/km²) and maximum of 91 households (1.3 household/km²) would have existed contemporaneously. Subject to the condition that in each case only one quern ensemble would have been in use and each household provided themselves with flour, a six person family of one house generation would have needed 8.3 rubber stones and 4.2 querns, postulating an operating life expectancy of 3 respectively 6 years. This would be the expected numbers of grinding stones per house during an excavation. In the following calculation the quantity of saddle querns will be rounded up to 4, the numbers of rubber stones to 8 per house.

According to 500 years settlement-duration of the Linearbandkeramik at Mörlener Bucht and generations lasting 25 years altogether 7280 querns and 14560 rubber stones would have been required by the population. Hence, the yearly requirement sums maximal 14.6 querns respectively 29.1 rubber stones for the complete Mörlener Bucht. With a maximum starting weight by 20 kg per quern and 6 kg per rubber stone 292 kg raw material for querns and 175.2 kg for rubber stones would on average have been needed annually to cover the demand of every household at the Mörlener Bucht.

Layout of grinding stones and whetstone

A regional comparison between the raw materials used for grinding- and whetstone production shows a preference of fine and middle grained quartzose sandstones. The material used as grinding- and whetstones are quite heterogeneous, and within the individual groups varieties can be discerned. Regional differences of the found raw materials are recordable on small scale basis (Kegler-Graiewski/Ramminger 2003, 33ff.). To determine the distances to sources and pattern of supply, it is necessary to analyse the used rocks found within the settlements. In a relative short period of three years research within the BBM-project, a comparatively high number of artefacts were collected. On 21 sites 881 grinding - and whetstone fragments were found amounting to a total weight of 321.5 kg along with fragments without wear-traces of 66.8 kg total weight. The latter can be seen as production waste or as non-artificial broken bits. The intensity of the field-survey is reflected by a high amount of small fragments with a low weight and rock fragments without wear-traces. Grinding- and whetstones are found in the same amount as to 370 not certain identified objects. Furthermore four sites will be entered into the following analysis. All four settlements are dated by the ceramic into middle and later Linearbandkeramik. From Fauerbach-4 and Ober Mörlen-2 middle Neolithic artefacts could also be found (Schade 2004).

Fauerbach v. d. H. „Dicknett" (FaB-1)

Fauerbach-1 is one of the richest sites at Mörlener Bucht in terms of grinding- and whetstones. More than 500 fragments were collected from the field-surface on an area of 58 hectare and secured during excavation (Schade 2004, 137f.). The average fragment-weight of 343 g is much higher than from grinding- and whetstones of the other sites. The high quantity of artefacts therefore can not be explained by their degree of fragmentation. Based on the above average high quantity of grinding/whetstones (20.3%), Chr. Schade suspects an overproduction, which was passed on to the smaller settlements in the surrounding (Schade 2004, 140f.). According to him, this site was occupied over 250 years. For the estimated number of 42 houses (Schade 2004, site 8) 336 rubber stones and 168 querns, totalling an average weight of 5376 kg, would have been needed to cover the demand of the inhabitants. Until now only 129 grinding stones and 158 grinding/whetstone identified fragments were found. The average weight of all grinding- and whetstone fragments adds up to 187.9 kg. When assuming each of these fragments to be an individual tool, about half of the former quern requirement is missing. These objects are either still concealed in the ground or were already disposed by modern farmers. By a settlement duration of 10 generations and 5 house places, the postulated scenario by Schade for this site would result in 11 fragments per household as an average. Considering exclusively the 129 certain classified fragments, each generation and house would have possessed in average 2.6 grinding stones. An excess of grinding stones is therefore to exclude. In the process probably several fragments of an implement was recorded as one individual and the quantity therefore has to be once more reduced.

Hard quartzose sandstones respectively quartzite from Taunus dominate the raw material spectrum of grinding stones. Tertiary sandstones are the second most common material used for these implements. Approximately 19% of the grinding stones are made from early Triassic sandstones. Basalts are, like other singular rocks from this site, insignificant. Overall 96 exemplars are whetstones. Raw material of whetstones is mostly Tertiary sandstone with 30%. Taunus quartzite take a part of 27%, 13% are in fine sandstones. Besides 166 rock fragments without wear traces were documented. These might represent production waste or be natural debris. These fragments are mostly composed of hard quartzose sandstone or sandstones with no further classification possible.

The site is located on loess, which today is transformed to brown (forest) soils. On the settlement area itself lots of schist and breccia can be found on the surface. These rock-types are, however, uncommon within the inventories, or show no man-made impact. Close to the site, in the west and southwest are lower Devonian deposits of quartzite and sandstones embedded in Devonian clay and greywacke schist (Geologische Karte 1:25.000 Blatt 5617 Usingen). Basalt deposits are within reach 5-6 km south of the site at Ockstädter and Ober-Rosbacher Wald. Tertiary sandstone can be found 7-9 km away to the northwest and southwest. Sandstones of early Triassic age have to come from farther away. Nearest deposits of early Triassic sandstone are situated about 35-40 km away in Bündiger Wald or 50 km to the next rubble terrace of the river Main, where greater sandstones rubble can be gathered.

Fauerbach v. d. H. „Gerhardsköppel" (FaB-4)

In 1999, middle and early Linearbandkeramik settlement was discovered 1 km away from Fauerbach-1. The site is according to Chr. Schade a "Twin settlement" and was built about 50 years later than Fauerbach-1. Due to distribution density an area of 6.5 hectares is defined as settlement area. Eight generations in 36 houses shall have inhabited the site for around 200 years (Schade 2004, 127ff.). To cover the demand of ground flour for 216 inhabitants, around 288 rubber stones and 144 querns would have been required. Until now only 44 certain defined querns were found. The average weight of the grinding and whetstones, as well as the rock fragments without wear traces, sums up to 218 g, and thereby lies beneath the average weight of Feuerbach-1. Lots of smaller fragments were classified as grinding/ whetstones but could not be assigned to definitely one artefact group. For this settlement no overproduction can, hence, be assumed, even if including uncertain fragments of grinding/whetstones to the classified findings.

The spectrum of rocks used for querns are similar to the spectrum found in the neighbouring settlement of Fauerbach-1. Here hard quartzose sandstones dominate with a quantity of 54%. Furthermore, basalts, early Triassic sandstones and breccias constitute 34%. Whetstones are represented by 39 finds. They were mostly made from quartzose sandstone (41%). 21% of the whetstones are made from fine sandstones. Further, unclassified sandstones were used by 13% and basalts along with sandstones of an early Triassic age both sums up to 8%. Singular raw material is schist of the Taunus area. From Fauerbach-4 the quantity of recorded rock fragments without wear traces is mostly made from quartzose sandstone and unclassified sandstones. The geological bedrock of this site is composed of heavenly eroded brown (forest) soil with Taunus schist in layers, which is exposed on the surface in numerous fragments. The schist is only sporadically used as raw material for grindstones. Quartzose sandstones and lower Devonian quartzite are both found close to the site. For this settlement one can therefore assume a supply with local or regional raw materials. The inhabitants themselves will have satisfied their requirement from the surrounding deposits of appropriate raw material. Only the less used early Triassic sandstone had to be obtained from a distance of 35 km.

Hochweisel „Im Loch" (HoW-1)

This middle and later Linearbandkeramik settlement was detected in 1998. On an area of 20 hectares altogether 1578 findings were collected from the surface. Chr. Schade assumes for this site 19 houses (Schade 2004, 97ff.), thereby limiting their requirement to that of 152 rubber stones and 76 querns. Only 16 certain classified grinding stones and 31 small fragments of grinding/whetstones have been found till now. In comparison to both already mentioned settlements, which have quantities of 17 and 20%, the grinding/whetstones found in Hochweisel-1 only constitute 11% of the total number of findings, that means the quantity of grinding/whetstone in Hochweisel is below the amount from the Fauerbacher' sites. The average weight of grinding/whetstones is 179 g. The degree of fragmentation is considerably higher than in the other site inventories. Selective collecting can therefore be excluded as to explain the minor grinding stone amount. Foreseeing the dispose of grinding stones by today's farmers, a smaller corn production can be considered for this site, which was possibly accompanied by animal husbandry as main economy. An inferior supply leading to greater abrasion of grinding and whetstones and for later disposal is rather implausible due to numerous surrounding deposits of raw material. With reference to the raw material spectrum used for grinding stones, Hochweisel-1 differs only slightly from the two Fauerbach settlement sites. Here also, quartzose sandstones dominate with 56% of the spectrum, next to tertiary sandstones. Whetstones were mostly made from quartzose sandstone (38%) or early Triassic sandstone (33%). Besides they used lower Devonian sandstone (13%) and fine sandstone (11%). Basalt is like in other inventories of the Mörlener Bucht unimportant. In Hochweisel-1, as well as on the other sites, rock fragments without wear-traces were found. They consist also mainly of quartzose sandstone and unclassified sandstones. A direct self-supply with sandstones from deposits in the surrounding of the settlement and an intra-site production of grinding- and whetstones is most likely for this site.

Again the seldom used early Triassic sandstone is an exception, because it had to be obtained from a distance of at least 35 km.

Ober-Mörlen „Am Jakobswäldchen" (OBM-2)

In 1999, the Ober-Mörlen-2 site was discovered yielded 355 findings of different categories on an area of 9.7 hectares. The site can be dated to the middle and later Linearbandkeramik. The remarkable high quantity of rock artefacts (43%) in the inventory is according to Chr. Schade due to the local field-conditions, because the already high natural cover prevented the discovery of smaller artefacts of other categories during the survey (Schade 2004, 161). When assuming 16 houses, 128 rubber stones and 64 querns would be expected. However, only 73 grinding and whetstone fragments and 61 rock fragments without wear traces, with an average weight of 175 g, were recorded. The degree of fragmentation is therefore higher than compared to the other three sites of the Mörlener Bucht.

The raw materials for grinding stones differ from those of the other mentioned sites. This is first obvious in the rock colour spectrum, which shows a dominance of 60% light-coloured sandstones to red sandstones. Light-coloured sandstones are present on the other sites with a quantity of at most 40%. Looking at the raw materials used for grinding stones, tertiary sandstone dominates with 41%, followed by 33% quartzose sandstone and 17% early Triassic sandstone. Similar is to be recorded for the whetstones. They were made in 52% of tertiary sandstone, in 30% of quartzose sandstone and in 7% of fine sandstone. Basalt, early Triassic sandstone and unclassified sandstones are represented each with a percentage of only 4%. Fragments without wear traces consist of unclassified sandstones as well as of hard quartzose sandstone.

The bedrock exposed on the Galgenberg dome is made up of Oppershofener schist (Geologische Karte 1:25000 Blatt 5618 Friedberg), which is intensely eroded (Schade 2004, 161). Benches of quartzite and greywacke schist can locally be found in-situ. In addition breccia of the Nauheimer gravel can be found at the alteration horizon of the surrounding area of the settlement. Larger deposits of Taunus quartzite and hard quartzose sandstone are found in situ in 3-5 km distance to the south and southeast. Tertiary sandstones can be found 5-6 km away towards the west and southwest. Basalt could be obtained in 5-6 km distance from the east. For Ober-Mörlen 2, like already mentioned for the other three Linearbandkeramik sites in the Mörlener Bucht, in general a direct self-supply with raw-materials from deposits in the surrounding of the settlement is to assume. Only few of the querns are made of early Triassic sandstones coming from 35-40 km far away.

Social economic conclusion

Querns were basic commodities in Neolithic households. They can be found in almost all excavated house-features. The used raw materials could be generally found in the surroundings of the settlements within an area of around 5-6 km, and the effort for the quern-production was relatively low. In terms of value or status these objects did not play a major part within the Neolithic life. But recording querns relating to their function for the every day production of the staple food corn, a kind of symbolic value is to be assumed for these objects (Fendin 2000). Corn as the "new" food of the Neolithic was linked with field-cultivation and therefore with the human dominance over nature. Grinding stones were used within the house and probably by women, because they are mainly buried in female graves (Zápotocká 1972, 295; Peschel 1992). In settlement-inventories we find most of the grinding stones in inoperative state. Besides intense used up and broken fragments, some examples were indeed finished but little used. U. Sommer therefore suggests a deliberately destruction of these objects (Sommer 1998, 205), probably embedded in funeral-rituals after the death of the owner, unless the quern was given as a burial object. Taking such an appreciation into account, an exchange of querns seems possible. In many societies next to production and distribution for personal benefit, there are social exchange patterns, which serve primarily the protection and stabilisation of social relations. Moreover also in non benefit exchange systems, like the tributes of material goods at certain occasions (wedding, funeral etc.) which can be found for example in the Melanesian Big-Man-system, some mechanisms aim to increase the owner's prestige and beyond to influence a group (Sahlins 1963; 1974). Because of the rather low demand, in comparison with the rich resources and the heteronomy of the used raw materials, quern exchange for benefit has to be excluded. A distribution of grinding stones for social events (like f. e. weddings) is however most likely.

In central Hesse larger sandstone deposits belonging to different geological formations are known, from where the Neolithic population could gain raw materials for their grinding and whetstones. A particular importance for these implements in cause of scarce resources or from greater distances imported querns is therefore not to record. Most of the raw materials were possible to get in the closer surrounding of the settlements within a radius of 5 to 6 km. C.C. Bakels describes areas of this range as "site territory", wherein the settlements "own" loess fields were situated, and which was exclusively husbanded by one community (Bakels 1978). To reach the inside resources, a march of less than an hour was necessary and the raw materials were mainly exploited by the settlers holding access due to spatial nearness to the deposit.

The population density during middle and later Linearbandkeramik, given by the data of the Mörlener Bucht, suggests however smaller settlement territories. In addition it is possible that the availability of larger rock deposits put no limit on territorial usage. For coexistent twin-settlements as Fauerbach-1 and Fauerbach-4, room models of clear limited and exclusive used territories seem to be more than doubtful. These settlements show very similar raw material spectres, which contradicts a partitioning of resources and associated entrance restrictions or rights of use.

For Hesse a more tightly focused mining of rock is not to expect due to the low annual requirement and heterogeneity of the raw materials. No examined site showed a clear overproduction and a self-supply of each Linearbandkeramik settlement with raw materials is in principle reasonable. Hereon indicates also the production waste and rock fragments without wear trades, which were found on each of the intensive surveyed site. A redistribution of querns during social events is in contrast conceivable. The different fine and hard early Triassic sandstones were favoured raw materials for grinding stones as well as for whetstones. These were imported from a distance as far as 40 km into the Mörlener Bucht. A self-supply with these raw materials from farther away is rather unlikely. Different to settlements in other micro-regions, which are situated closer to the deposits, in the Mörlener Bucht inventories no production waste or rock fragments without wear traces consisting of early Triassic sandstones were recorded. An overproduction by the settlements near the greater deposit of early Triassic sandstone of the Büdinger forest, for example in the valley of river Kinzig, is, however, not documented. One can therefore not assume an extensive production of querns for supply of other settler communities, but rather of occasional social contacts between the inhabitants of different micro-regions with occasional exchange of goods. For the context of grinding stone production no specialisation of individual settlements is found, but already with these artefacts we could observe occasional exchange between settler communities living in different micro-regions in central Hesse. With the comparison of other artefacts in further investigations, the network of social interactions between different settler groups could be densified.

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Lifecycle of a neolithic quern: limits and contribution of a combined technical and functional analysis on grinding tools

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Zusammenfassung – Dieser Artikel zeigt und diskutiert die Wichtigkeit von technologischen und funktionalen Analysen für das Verständnis der Bedeutung von Mahlsteinen während der täglichen Aufgaben für Populationen der Linearbandkeramik und der Blicquy-Villeneuve-Saint-Germain Kultur, die um 5100 cal. BC im Pariser Becken siedelten. Technische Besonderheiten der Mahlgeräte müssen beachtet werden, wenn mit einer funktionale Analyse begonnen wird. Sukzessive technische Abfolgen von primären und sekundären Zurichtungen der Unterlieger und Läufer zeugen von einer Komplexität der „Lebenszyklen" der Mahl- und Schleifsteine. Die Lage der Gebrauchsspuren auf den Mahlflächen ist ein brauchbarer Indikator für die Bewegung, Gebrauch und Effizienz der paarig genutzten Unterlieger und Läufer. Eine Charakterisierung der Gebrauchsspuren kann dazu beitragen, eine Spezialisierung oder auch plurifunktionale Aspekte der Mahlsteine zu bestimmen. In Verbindung mit der Intensität und Dauer der Nutzung kann dies zur Klärung der Art und Funktion eines Fundplatzes beitragen. Werden all diese Elemente vereint, sollte eine räumliche Rekonstruktion der Mahlaktivitäten in bzw. bei den danubischen Häusern möglich sein.

Schlüsselwörter – Mahlstein – Läufer- Linearbandkeramik – Blicquy-Villeneuve-Saint-Germain – Nordwesteuropa – Technology – Gebrauchsspurenanalsyse – räumliche Verbreitung

Abstract – This paper illustrates and discusses the relevance of a technical and functional analysis for the understanding of the role played by querns among daily tasks of Linearbandkeramik and Blicquy-Villeneuve-Saint-Germain populations in the Paris Basin around 5100 B.C. cal. Technical specificities of milling equipments must be taken into account when starting a functional analysis. Successive technical sequences of shaping and reshaping of querns and grinders inform us on the complexity of grinding tools lifecycle. The distribution of use-wear on the working surfaces is a good indicator of the motion, gesture and efficiency of paired querns and grinders. The characterization of the use-wear can also help define the specialization or the plurifunction of a quern. Together with their intensity and duration of use, this contributes to the determination of the nature and function of a site. All these elements brought together, it should be possible to propose a spatial reconstruction of the grinding activities which took place in and around the danubian houses.

Keywords – Quern – grinders – Linearbandkeramik – Blicquy-Villeneuve-Saint-Germain – north-western Europe – technology – use-wear analysis – spatial distribution

Introduction

Dealing with grinding tools analysis has for long been limited to the identification of the raw material they were made of or to the description of their morphological and dimensional characteristics. In the last fifteen years, new approaches to grinding implements have stressed the informative potential of querns and grinders in different contexts of discovery.

The combination of querns technological and use-wear analysis brings crucial informations on their lifecycles, their exact function and their insertion in food preparation or craft activities. An original method of functional identification has been elaborated, in the spirit of functional studies undertaken over the last twenty years (Adams 1988; Dubreuil 2004; Hamon 2003a; Procopiou et al. 2002; Risch 2002). It relies on macroscopic observation of use-wear traces on sandstones with a stereoscopic microscope (under 120 x). The identification of diagnostic traces of use is based on an experimental referential including cereal, plant, temper and colouring grinding (Hamon 2008). The determination of the nature of the transformed material (animal, mineral or plant), of its texture, of the duration of use (intensity of use) and of the state of the material (wet or dry, with adding of water) can be proposed with this method.

Relying on a functional analysis and on a technological reading of querns manufacture and reshaping, it is now possible to propose different levels of contextual and factual interpretations. Our study of grinding tools from Linearbandkeramik and Blicquy-Villeneuve-Saint-Germain contexts contributes to a better understanding of the economy and social organisation of the populations that settled around 5100 B.C. cal. in the Paris Basin (Hamon 2006).

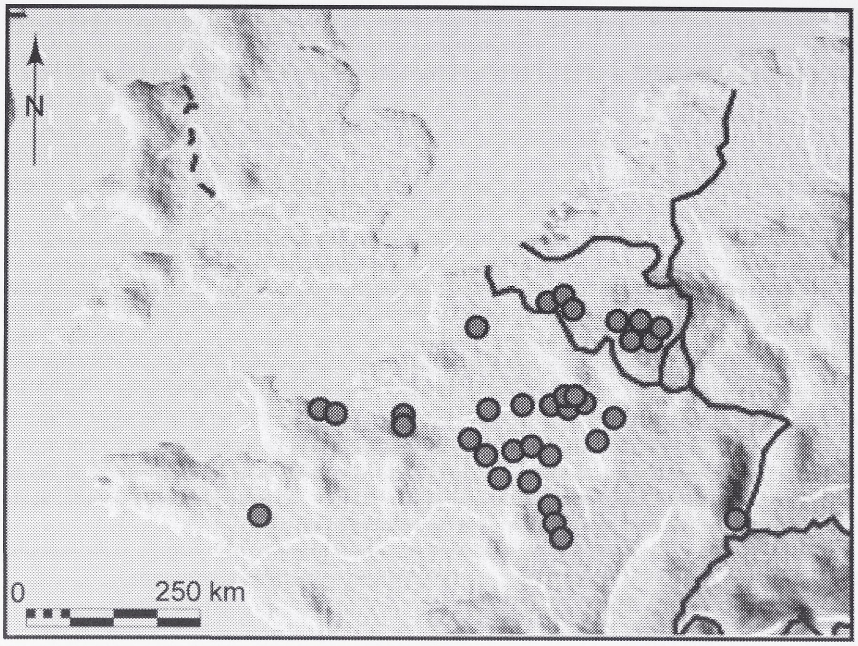


Fig. 1 Map of localisation of Linearbandkeramik and Villeneuve-Saint-Germain sites studied in the Paris Basin and Belgium.

Querns in Early neolithic contexts

The main difficulty is to deal with a tool's function with very few possibilities to study the quern and the grinder together. The lack of one half of the grinding equipement makes the kinetic, the handling and the gesture of these tools difficult to identify precisely. In most neolithic contexts of Europe, complete tools are not the majority, and paired tools are even more difficult to find.

For the Early neolithic of north-western Europe, the contexts of discovery are mostly detritic pits. There, querns and grinders are generally no more associated with each other. As a matter of fact, the presence of querns in isolated pits, storage pits or fire place also corresponds to positions of secondary use or reuse. Hoards are among the rare cases where quern-grinder associations are met (Hamon 2005, 2008b & c). But the observations made on tools from ritual contexts are difficult to extend and generalize to the one found in detritic positions. Moreover, most of the tools found in detritic contexts or secondary positions are generally broken, at half or two thirds of their length, so that their shape and size have to be reconstructed mentally. Querns secondary position in the domestic area makes the contexts of use difficult to identify and reconstruct. The presence of a clay base or a wood receptacle around the quern is by consequence difficult to discuss.

This secondary position is also prejudiciable to the knowledge of their primarily location in the domestic area and to their association rather with the cooking area or with the outside of the house. Querns long duration of life and their insertion in complex social practices can also have a role in the spatial distribution of querns in the living areas. The lack of tools in some houses or on the contrary their surrepresentation can be explained by social behaviours. Familial events such as mariage, foundation of a new home or inheritage between mother and daugther or stepdaughter are at the origin of the circulation and spatial dispersion of grindingtools (Katz 2003). The sharing of daily tasks between men and women but also between women of the same family, house or village also affects querns distribution. Several ethnographic examples relate the grouping of women for food preparation, according to complex social links (Roux 1985).

By consequence, any functional analysis on Early Neolithic querns of north-western Europe will only bring incomplete informations on their context of use.

Technical specificities of milling equipments

Throughout the neolithic of Europe, grinding tools consist in the association of a grinder and a quern representing respectively the upper and the lower parts of a unique tool. In itself, this two-part tool is original in the field of prehistoric technics. Prehistoric activities generally involve one tool and the matter or object to transform. The tool can be composite, made of several elements in various raw materials such as flint, bone or wood, but only two surfaces are in contact: the tool active surface and the matter to transform. This is not the case for grinding activities. Grinding actions involve at least three matters in contact: the active surfaces of the quern and grinder working in pairs and the matter to transform. This parameter has several consequences on the elaboration of an efficient methodology for functional analysis.

Contrary to a false idea, grinders are not so easily interchangeable, particularly in early Neolithic contexts of north-western Europe. Two types of grinders are coexisting as already mentioned by Zimmermann in his study of Langweiler grinding tools (Form 1 and 2 after ZIMMERMANN 1988). As a matter of fact, Linearbandkeramik and Blicquy-Villeneuve-Saint-Germain grinders show a high rate of shaping, far from the idea of the opportunist choice of any local stone (HAMON/MILLEVILLE 2006). A certain degree of normalisation of their shape and dimensions contradicts also any perspective of interchangeability of the grinders. The care put in the shaping of the grinders back and sides also affects their active surface. One of the most technical operations is to obtain a perfect fitting of the profiles and topography of quern and grinder's active surfaces. A grinder shape evolves in parallel with its quern shape. For this reason, the morphology of a grinder at the beginning of a quern life won't necessarily be the same as the grinder used at the end of the life of this quern. It is then theoretically possible to find the grinder corresponding to the last stage of use of a quern, although it appears much more difficult to identify the first grinders used.

The long duration of use of querns and grinders is also an important parameter to take into account for a functional analysis. It implies several states of use and a progressive distortion of the initial morphology of the tools. Besides, and according to several ethnographic examples (DAVID 1998), querns and grinders durations of use are different. Due to their thickness and their raw material, grinders get more rapidly used than querns. If a quern can be used during several decades, a grinder's life does not overlap several years. As a direct consequence, several grinders can be used during the life of a quern.

These technical specificities must be taken into account when starting a functional analysis on grinding tools.

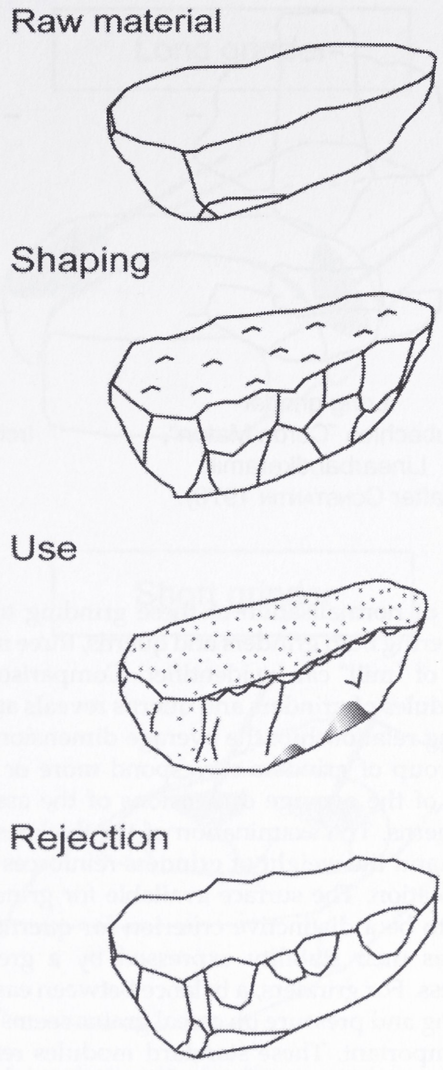
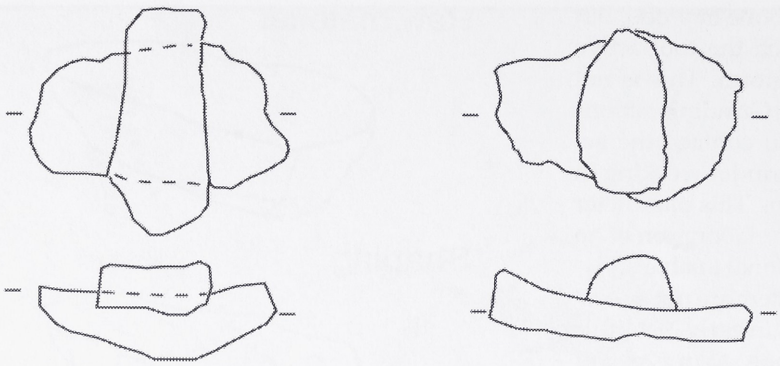


Fig. 2 Sequence of shaping of Linearbandkeramik and Villeneuve-Saint-Germain querns and grinders (after HAMON 2006).

The notion of efficiency of a quern

It is always difficult to discuss the efficiency of a tool. This notion depends often more on the social context and cultural background than on strict technical and functional parameters. Three kinds of informations are brought by quern study, respectively related to the abrasiveness of the active surfaces and to the kinetic of the grinding implements.

Despite a certain variability, dimensional analysis of upper and lower grinding stones shows a link between a tool's length and width, so as to maintain an acceptable level of efficiency during the grinding. This can be assimilated to a certain



Long grinder
Aubechies "Coron Maton",
Linearbandkeramik
(after CONSTANTIN 1978).

Short grinder
Irchonwelz "La Bonne Fortune",
Blicquy
(after CONSTANTIN 1978).

Fig. 3 The two types of paired grindingtools found in Linearbandkeramik settlements of Belgium (after CONSTANTIN ET AL. 1978).

degree of normalisation of these grinding tools. Considering both grinders and querns, three main groups of "mill" can be identified. Comparison of the modules of grinders and querns reveals an interesting relationship: the average dimensions of each group of grinders correspond more or less to half of the average dimensions of the associated querns. The examination of the thickness of querns and the weight of grinders reinforces this identification. The surface available for grinding seems to be a distinctive criterion for querns, as much as their stability expressed by a greater thickness. For grinders, a balance between ease of handling and pressure on cereal grains seems the most important. These standard modules reflect a search for maximum efficiency of the neolithic milling equipment. The efficiency of the association of the grinder and the quern relies on a good fitting of their active surfaces, on the weight of the upper grinding tools, on the ease of handling and on the rugosity of the active surfaces in contact.

Due to their long use-life (HAYDEN 1987; ROUX 1985), grinding tools require regular maintenance. The maintenance of grinding tools depends far more on the type of rock and its abrasiveness. The speed of polish formation, the frequency of resharpening and the reduction of the dimensions of a tool depend also on the intensity and duration of use. Active surfaces can be either completely or partially repecked depending on the raw material, the duration of the repecking operation and the nature of the grinding activity. The uncomplete repecking of a surface brings interesting informations concerning the cyles of use/maintenance and the reasons of the repecking itself. At first, the location of the repecked zones generally corresponds to ancient polished areas, consecutive of an intense contact between the grinder and the quern. For both querns and grinders of Zimmermann's Form 1, this strong polishing generally affects the periphery of the active surface, on one or two centimeters wide, and a circular zone in its center. It can be explained either by the handling and a strong pressure of the grinder on the quern or by some irregularities of the active surface morphology. In both cases, the repecking action aims at regularising the surface so as to fluidify the gesture of grinding. But this action aims also at refreshing the surface. This operation is generally realised when the grinder and the quern slide rather than adhere on each other. This smoothing of the surface can have important consequences on the time needed to transform cereal grains into flour, or on the quality of the flour itself. And this can objectively be considered as a relative measure of the efficiency of a grinding-tool.

The concavity of a quern and the kinetic of a grinder also bring informations on the efficiency of the milling equipement. There is an obvious link between the shape of the grinder, the transformation of the quern morphology and the modification of the grinding gesture. In Linearbandkeramik contexts, excepting the Paris Basin, two types of grinding equipment coexist (Zimmermann's Form 1 and 2). They consist in two different shapes of grinders and two different handling positions. The first equipment associates a "short" grinder with a large quern. In this case, the grinder is manipulated with the two hands pushing the back of the tool. The use of this equipement generally implies the progres-

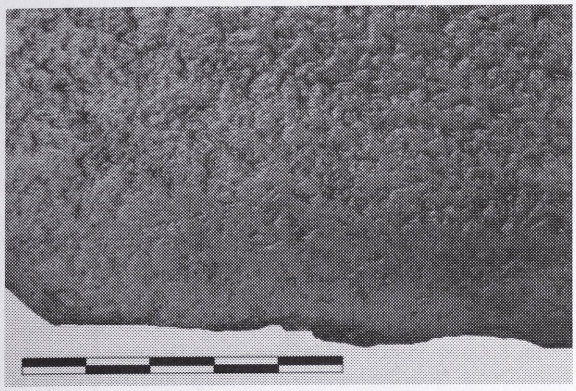


Fig. 4 Partial repecking of the active surface of a quern (photograph: C. Hamon).

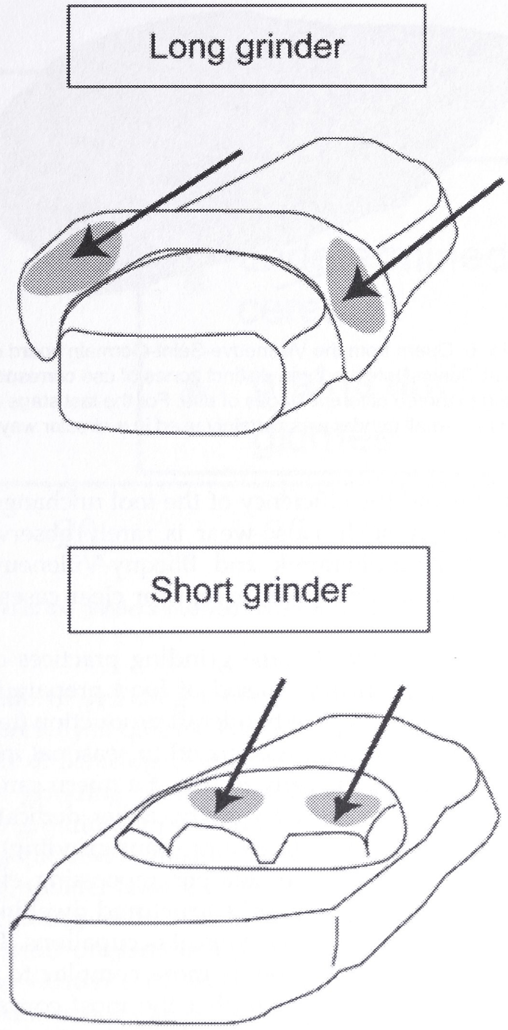


Fig. 5 Localisation of the handling zone and representation of the pressure put on both types of grinders.

sive hollowing of a central zone which affects significantly the regularity of the back-and-forth gesture. Numerous flakes and fragments from detritic pits attest of maintenance operations in the vicinity of the houses. To avoid an exagerated hollowing of the central part of a quern, its ends and sides must be reduced by flaking. A regular repecking may also have slown down the intempestive distortion of the surface. In order to maintain a regular motion of the grinder and a regular concavity of the quern, its active surface must also be regularly pecked. The second equipment associates an overlapping and long grinder with a narrow quern. They present inverse concav and convex active surfaces. In this case, the grinder is manipulated with the hands pushing the very ends of the tool. In this particular system, the convexity of the quern and the concavity of the grinder are mutually renewed by the movement. In both cases, these technical steps express a desire to keep a certain degree of efficiency, if not to say a certain comfort for the person in charge of the grinding.

Duration and intensity of use of a quern

The determination of the duration of use of a tool and of the intensity of use of an active surface can bring elements for the interpretation of the nature of a site and of the context of occupation.

Querns intensity and duration of use can be evaluated by several means. The intensity of use can be evaluated by comparing the development of use-wear and the deformation of the initial curvature of the active surface. The presence of a well-developed polish on a convex surface corresponds more likely to a high intensity of use whereas the slight smoothing of a concav surface evokes a long duration of use, independantly from the transformed matter. The profile of a tool is a reliable indicator of its relative duration of use, at least for the primary use of a quern. The more concav a tool is, the longer it has been used. In theory, the perforation of an active surface corresponds to the last stage of both the last active surface and the tool itself. It is created by the repetition of an ovoid to circular gesture but not a linear back-and-forth one. With such a motion, the concavity becomes rapidly an obstacle to the efficiency of the gesture and of the grinding action. Two different choices are then possible. Either the person modifies progressively its gesture, from linear to circular, or she gets rid of the ends and sides of the quern in order to keep the amplitude of the

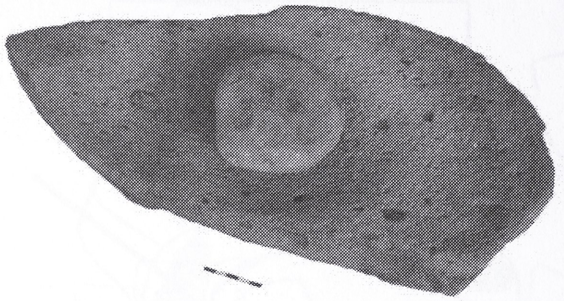


Fig. 6 Quern from the Villeneuve-Saint-Germain hoard of Saint-Denis. Note the three distinct zones of use corresponding to threee different stages of use. For the last stage of use a small grinder was certainly used in a circular way.

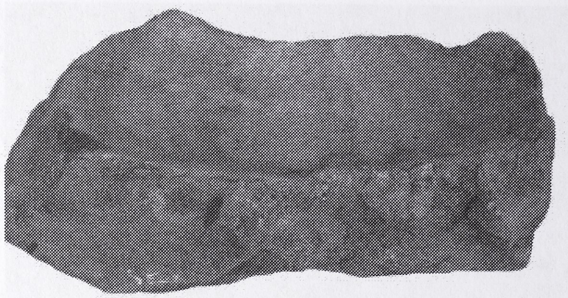


Fig. 7 Quern from the Villeneuve-Saint-Germain hoard of Saint-Denis. Note the transveral breakage and the change of orientation of the tool.

gesture and the efficiency of the tool unchanged. That's why such a use-wear is rarely observed in Linearbandkeramik and Blicquy-Villeneuve-Saint-Germain contexts, except for clear cases of reuse.

The intensity of some grinding practices can indicate a particular episod of food preparation (cereal or grinding) or handcraft production (temper processing etc.). Associated to seasonal indicators, the low intensity of use of a quern can be linked to a specialised activity, either dedicated to food preparation (cereal or plant grinding) or handicraft production (temper processing etc.). When associated to poorly structured dwellings, it refers to very short episods of occupations. The duration of use of a tool is more complex to interpret. One could argue that the most concave querns should be found on long duration settlements. Archeological and ethnographical examples demonstrate largely the relationship between the perenity of a site and the use-wear of its grinding implements. But they also mention that the duration of occupation of a site does not only depend from its inhabitant's way of life. In the Saharian zone for example (Gast 1968), nomadic groups abandonned temporarily their querns along the roads in order to recover them at their next settling. The morphology of these querns is generally very deep and testifies of a long duration of life, far above tens of years. In these contexts also, cases of reuse are frequent and archaeological querns are often reused hundreds years later even by today's groups.

Grindingtools duration and intensity of use constitutes interesting elements of characterization of the nature and duration of occupation of a site, although both are often difficult to evaluate at the light of complex cycles of reuse and recycling.

Complex lifecycle of a tool: quern reuse and recycling

The analysis of the reshaping and reuse cycles of a quern can be evaluated only after a clear and solid knowledge of the shaping sequences. The basic technics of fitting out and finishing of the querns must already be defined. At this condition, it is possible to define opportunist choices from recurrent episods of reshaping or maintenance. If querns are mainly involved in cereal grinding, numerous examples demonstrate that other matters were processed with the same gestures and tools. Cases of reuse or recycling are sometimes completely opportunist but in some other cases, real cycles of reuse can be observed.

The simple reuse of a quern can be defined as the succession of two episods of grinding of the same matter with a certain amount of time between them. Reuses can be difficult to identify when no traces of reshaping or repecking are visible. They are sometimes suggested by an uncomplete repecking of the active surfaces which evokes a pretty short time between two sequences of use. The reduction of a quern dimensions by flaking of its ends or sides is also a reliable clue of a reuse phase, when associated to a change of its function. The regular hammering of an active surface is also an indication of a new stage of use.

In the Villeneuve-Saint-Germain hoard of Saint-Denis (Ile-de-France), the combination of a technological and use-wear analysis was essential for the understanding of the complex lifecycle of a quern (Hamon/Samzun 2004). Of semi-circular shape and thin triangular section, one of the querns shows no less than three successive stages of use. The active surface is divided in three concentric zones, separated from each other by a significative difference of height and a "stair"

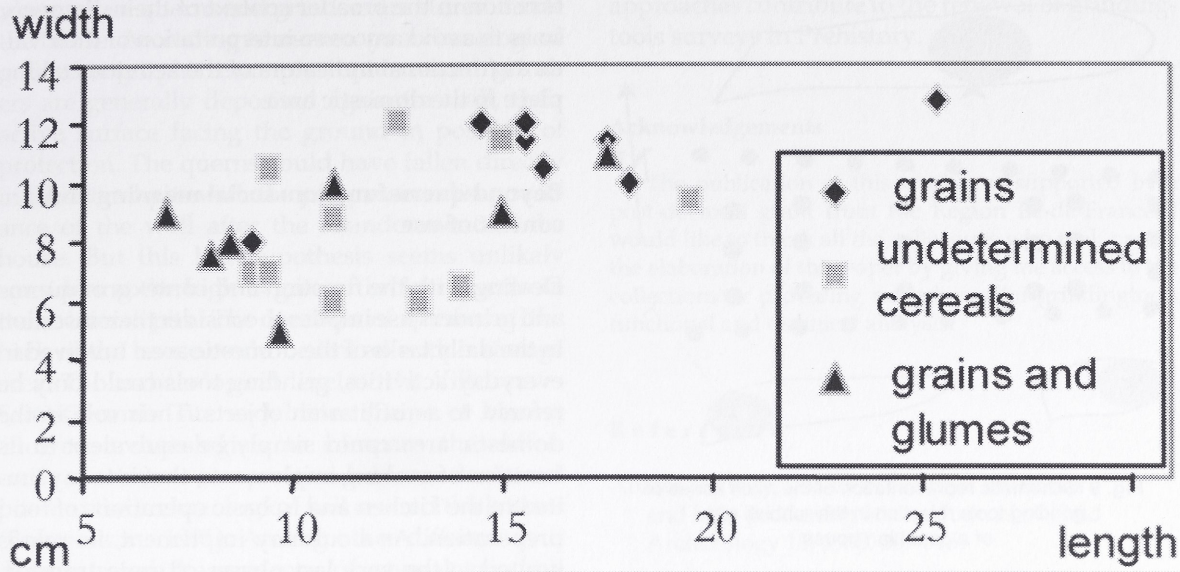


Fig. 8 Correlation between the dimensions and the function of the grinders involved in cereal processing.

effect. Their state is also characterized by different dimensions and qualities of pecking and by a different intensity of use-wear. But what differentiates the most these three active surfaces is their function. According to use-wear analyis, the most ancient surface was used for cereal processing in a back-and-forth movement while the last one was used for the grinding of a hard animal matter in a more circular gesture. The initial quern was probably quadrangular and ten centimeters thicker, the initial grinder rather ovoid and moved by two hands. On the contrary, the dimensions of the last active surface is significantly reduced and the associated grinder probably circular and moved by one hand. This example illustrates perfectly the complexity of a quern cycles of use.

When only the last active surface is visible, some technical features can indicate a reuse. A deliberate breaking can indicate a complete reorientation of the tool. In St. Denis hoard, the breaking of a quern was followed by a change of the orientation of the object: the width of the initial quern became the length of the reshaped one (Hamon 2004). Reused half grinders sometimes present a rectification of the break by flaking, so as to be suitable for their new function (Hamon 2003b).

Plurifunctional or specialised querns?

How can we determine the plurifunctionality or the specialisation of a grinding tool? Several ethnographic examples underline the functional value of grinding tools dimensions, and more especially of querns. The coexistence of two types and dimensions of querns often corresponds to the grinding of different food products, or to the grinding of food and craft substances. When big querns are mostly dedicated to cereal grinding, smaller ones show a wider range of matters, including seeds, fruits and other plants, involved in meal preparations (Roux 1985; Gelbert 2003). The existence of several categories and groups of dimensions amongst Linearbandkeramik and Blicquy-Villeneuve-Saint-Germain grinding tools correspond to specific functions (Hamon 2008). As could be expected, a large majority of querns and grinders were used for cereal processing (72,3%). A correlation between the dimensions of the grinders and their function appears clearly: smaller stones were used for the processing of grains and glumes whereas the bigger ones were only used for grain grinding. This dichotomy partially explains the coexistence of two main groups of mills on most of the sites. It also recalls the possible use of stone tools for dehusking operations, as also suggested by carpological analyses in the Linearbandkeramik zone (Meurers-Balke et al. 1992; Bakels et al. 1985). The correlation of morphological and functional parameters induces not only relative homogeneity in shaping of the tools, but also the normalisation (but not standardisation) of the grinding tools. Such dimensional and technical normalisation must in some way reflect "cultural choices". As a consequence this constitutes a case of grindingtool specialisation.

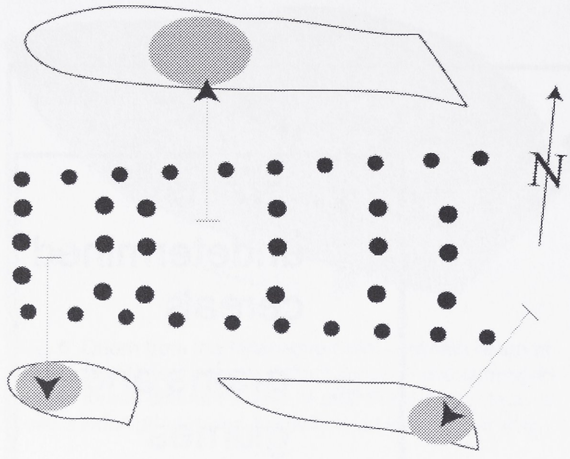


Fig. 9 Schematic representation of the main zones of grinding tools rejection in the rubbish pits of a danubian house.

In parallel, ethnographic literature insists on the frequent plurifunctionality of querns and grinders. In such cases, the use of a quern is guided by opportunist needs and by the processing of food and other matters alternatively. In archaeological contexts, the definition and characterization of such a plurifunctionality is problematic. It is generally admitted that use-wear analysis allows the determination of the last use of a surface. But considering the specificities of grinding tools in terms of dimensions and duration of use, the destruction of previous use-wear traces by the last grinding action is not so obvious. Querns long duration of use induces a long duration of use-wear formation. The visibility of the main action of grinding and the development of its characteristic traces are favoured by comparison to the processing of more occasional matters. It is also the case for the most abrasive (hard mineral) or the greasiest matters (hide) that imprint more rapidly the surfaces. Any traceologist working on grindingtools knows the difficulty to differentiate successive uses. Far from destroying the previous traces, the last ones are generally coexisting with the previous ones, with very few chronological indications between the two episods. For these reasons, the plurifunctionality of a grindingtool appears difficult to detect and even more difficult to characterize. For all these reasons too, the plurifunctionality of grinding tools is certainly underestimated in archaeological contexts, as nearly impossible to identify through a functional analysis. On the contrary, the specialization of some tools or the main function of others will be over represented.

One should always replace querns and grinders function in the broader context of their discovery so as to avoid any over-interpretation of their value as functional indicators of the activities taking place in the domestic area.

Beyond quern function: social meaning and context of use

Dealing with the function and contexts of querns and grinders use implies to consider their insertion in the daily tasks of the domestic area. Involved in everyday activities, grinding tools could only be refered to as utilitarian objects. Their role in the domestic area could simply be equivalent to its function of cooking implements, that is to say limited to the kitchen and to basic operations of food preparation. As a culinary implement, its role is limited to the very last phases of grain transformation. But in many cases, querns plurifunctionality furthers them from their initial role of cereal transformation. A purely utilitarian role could characterize querns if it did not support a profound social meaning at the same time. We must not forget that querns and grinders are also object of personal property. This personal relationship may have influenced significantly the conditions of a quern use. Whether a quern is always used by the same person, especially its owner, or put to the disposal of the community have not the same consequences in terms of use and context of use.

It has certainly an impact on the way and places where querns are stored and put in order. A strong feeling of property of this tool would encourage storage apart from the collective areas of food preparation whereas a more collective management would favour storage near food preparation and collective areas. This has important consequences for the interpretation of the spatial distribution of grinding tools in danubian villages and houses. In lateral detritic pits, querns and grinders are concentrated in three zones: near the main entrance of the house, in the middle facing the corridor and at the back of the house. Those three locations find an explanation in the conditions of use and storage of querns. For their location at the front of the house, one could evoke an area of cereal transformation, including dehusking and winnowing phases that require light and breeze. Their location at the middle of the length of a house could be explained by two different factors. The existence of a corridor could correspond to windows or lateral doors that would favour rejections on the sides of the house. Such concentrations could also correspond to the

place where querns and grinders are stored inside the house. According to numerous archaeological and ethnographic examples, querns and grinders are generally deposited against a wall, their active surface facing the ground in position of protection. The querns could have fallen directly in the lateral pits with the progressive disappearance of the wall after the abandonment of the house. But this last hypothesis seems unlikely considering the high degree of broken querns in these lateral pits. The location of querns at the back of the house could be linked with a storage area. The archaeological level of the Villeneuve-Saint-Germain site of Jablines (Seine et Marne) allowed archaeologists to compare the differences of artefacts composition between the lateral pits and the archaeological soil around the houses (Bostyn et al. 1991). Among other differences, it demonstrated the presence of several grinding tools behind the houses. If grinding tasks took place behind the house, whatever the function of the querns, it could explain the importance of tools rejections at the back of the lateral pits. Another key information concerns the organization of the rejections in the lateral pits. Does the composition of the artefacts reflect regular or opportunists rejections? Is there a specialization of the rejection areas, structured by activities or by the proximity of one particular task? Can we isolate collective or individual rejection areas?
All these questions affect our perception and interpretation of querns distribution and of the spatial organisation of all domestic activities. They must be kept in mind when studying and discussing the function of grindingtools and their role in Linearbandkeramik and Blicquy-Villeneuve-Saint-Germain societies.

Conclusion

This paper aimed at discussing the limits and contributions of grindingtools technical and functional study to the knowledge of Early Neolithic populations of north-western Europe. Through this study, I tried to demonstrate how querns were included in the technical system for more than pure domestic and dietary functions. The correlation of the exact function of a tool, of its stage of maintenance or reuse and of its spatial localization in the danubian house brings new data concerning the life cycle of grindingstone equipments at the beginning of the Neolithic in north-western Europe. Together with detailed raw material and socio-symbolic studies, such approaches contribute to the renewal of grinding-tools surveys in Prehistory.

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The role of grinding tools at Masseria Candelaro (southern Italy): an integrated approach of raw material, technological, use-wear and residues analysis

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Zusammenfassung – Der Fundplatz "Masseria Candelaro" ist in der sogenannten "Tavoliere" (Süditalien) gelegen, einer weiten durch das Adriatische Meer begrenzten Ebene. Die Siedlung ist eines der für die Region im Neolithikum typischen „befestigten Dörfer". Einzelne oder wehrhaftere Gräben schließen bewohnte Gebiete ein, die durch größere unbewohnte Regionen abgetrennt sind. Im Zentrum des umschlossenen Gebietes von Masseria Candalero wurde eine Konstruktion (Gebäude Q) aufgedeckt. Die beachtliche Größe dieser Konstruktion und das Fehlen von Pfostenlöchern oder Pflastern suggerieren, dass diese Anlage nicht bewohnt wurde. Das Gebäude ist zusätzlich durch rituelle Aktivitäten gekennzeichnet. Nachgewiesen sind Geräte aus Feuerstein und Obsidian, Keramik, Knochen und Geweihobjekte, schwere Steine, roter Ocker und Überreste einer häuslichen Fauna. Am Ende der Mittleren Neolithischen Phase III wurden alle drei Gräben im Rahmen von Bestattungszeremonien genutzt. Gebäude Q ist weiterhin wohl für verschiedene Zwecke in Benutzung, so werden die „Becken" und die Gruben verfüllt. Etwa 70 schwere Steine wurden in Schichten der Phasen II und III geborgen. Diese Funde konzentrieren sich innerhalb von Gebäude Q und repräsentieren im Besonderen kleine Mahl- und Schleifsteine sowie Stößel. Ein interdisziplinärer Ansatz mit Untersuchungen bezüglich der Rohmateriallagerstätten, typologischen und technologischen Analysen, sowie Gebrauchsspuren- und Rückstandsanalysen wurde durchgeführt, um zu einer Interpretation der sozio-ökonomischen Bedeutung dieser Objekte zu gelangen.

Schlüsselwörter – Masseria Candelaro – Süditalien – Neolithikum – Mahl- und Schleifsteine –sozio-ökonomische Bedeutung

Abstract – Masseria Candelaro is located in the so-called "*Tavoliere*" (Southern Italy), a wide plain bounded by the Adriatic Sea. This settlement is one of the Neolithic "entrenched villages" that distinguish this region. Single or more defensive ditches enclosed inhabited areas which were partitioned by wide empty spaces. In the central part of the enclosed area of Masseria Candelaro a structure (Building Q) has been found. The remarkable dimensions of this structure and the lack of post-holes and plaster suggest that this unit has not residential function. Evidence for ritual activities characterises also the building. Flint and obsidian industry, pottery, bone or antler objects, ground stone tools, red ochre and remains of domestic fauna are attested.

During Final Middle Neolithic phase III, all the three ditches were used for burial purposes. At this time building Q is still in use but, probably, for different purposes, as the "basins" and the pits are filled up. About 70 ground stone tools have been found in phases II and III. These remains are concentred in building Q and are represented especially by small grinding tools and pestles.

With the aim of interpreting the socio-economic role of these objects an interdisciplinary approach has been carried out which includes the study of raw material sources, typological, technological, use-wear and residues analyses.

Keywords – Masseria Candelaro – Southern Italy – Neolithic – grinding tools – socio-economic role

The archaeological context

The settlement of Masseria Candelaro is one of the "entrenched villages" that characterise Neolithic of the Apulian "*Tavoliere*" (Southern Italy), a wide plain bounded by the Apennine Mountains to the West and by Adriatic Sea and the Gargano Promontory to the East (**fig. 1**).

These villages are organised in one or more defensive ditches enclosing inhabited areas which are partitioned by wide empty spaces (**fig. 2a**). Because of the remarkable dimension of the settlement sample areas were chosen to be systematically investigated. Three main phases of habitation were identified (**fig. 2b**):

1 – At the beginning of VIth millennium BC, during Early Neolithic (Candelaro I), a small ditch 1.50 m-2.20 m wide, encloses an area of about 0.5 ha, where no structures are visible. A small amount of pottery and lithics have been found in the deposit. The presence of few remains suggests that the ditch has been regularly cleaned and maintained in use.

The Early Neolithic phase of Masseria Candelaro is characterised by exploitation of local raw materials such as flint and clay. Technological sequences applied to local flint pebbles have been directed to very expedient products, namely flakes, rarely retouched, and choppers. Early Neolithic pottery shows very simple shapes as to ovoid pots, with smoothed or impressed surfaces ("*impressa*" ware) and smaller open vessels, with burnished surface (plain ware).

No evidence of ground stones is attested in this phase.

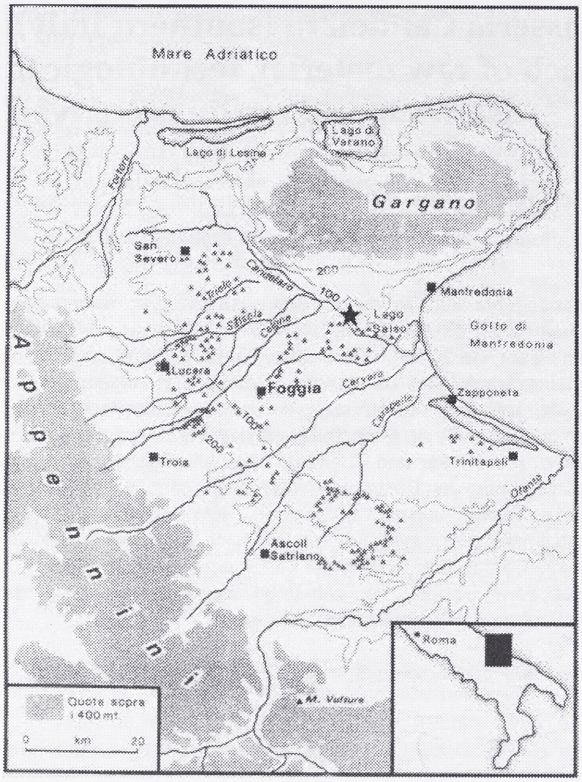


Fig. 1 Distribution of Neolithic entrenched villages of Tavoliere: Masseria Candelaro is marked by a star.

2 – The village was abandoned until the half of VI millennium BC, when three big concentric ditches have been dug. The diameter of the biggest one measures approximately 300 m. At the end of this Middle Neolithic phase (Candelaro II) the ditches were progressively filled up, probably having lost of their original use.

In the central part of the enclosed area, a structure (Building Q) has been found. Building Q is characterised by large "basins" and "pits" with no clear function, apart from two of them which have been used as storage pits for cereals and chaff. The remarkable size of Building Q and the lack of post-holes and plaster suggest that this unit has not a residential function. The results of lithic analysis and pottery agree with this hypothesis.

On the other hand strong evidences for ritual activities characterise the building. Three pebbles painted with red ochre and three legs of *Ovis aries* in a pit, a big oval stone, which probably had been standing during the use of the site, and few bones of an infant have been found in the centre of the structure.

A great amount of flint and obsidian industry, pottery, bone and antler objects, ground stones, and domestic fauna are present both in the ditches and in Building Q.

3 – At the end of VI millennium BC, during Final Middle Neolithic (Candelaro III), all the three ditches were partly re-excavated and used for burial purposes. At this time Building Q was not more in use, as the "basins" and the pits are almost filled up. They were re-used for burials and ritual purposes.

During the Middle Neolithic important changes occur to Masseria Candelaro community. Both lithic and pottery are no more only a local production and the village seems to be part of a wide exchange network. Circulation of Lipari and Palmarola obsidian, in terms of raw material and knapped products, is well attested.

Flint raw material comes mainly from the quarries of Gargano district about 50 kilometres far from Masseria Candelaro. The fine textured Gargano flint has been exclusively used for blades production.

Middle Neolithic pottery shows some substantial shift in the whole production sequence as suggested by the use of non local clay sources (cropping out about 30 km apart) and the appearance of three main classes of pottery, among which is a fine red-painted ware (*figulina*) strictly related to ritual and/or funerary uses.

The geological context

The Tavoliere is the most extensive plain in Southern Italy. It is a Mesozoic-Palaeogene limestone depression filled with marine deposits of Plio-Pleistocene silty clay (Bradanic cycle), often overlaid by post-Calabrian marine sands (Terraced marine deposits), Upper Pleistocene (Terraced alluvial deposits) and Holocene alluvial and lacustrine deposits of continental origin. The outcrops characterizing the Gargano Promontory consist of calcareous and dolomitic formations, the age of which varies between Upper Jurassic and Plio-Pleistocene (Caldara/Pennetta 1993) (**fig. 3**).

Sites settled in the Manfredonia Gulf's area show a river alignment on small Pleistocene-Holocene outcrops covered by a thick limestone layer ("*crusta*"). Geological deposits, outcropping in the Manfredonia Gulf hinterland, are composed of Pleistocene-Holocene clastic sediments, the basement of which is formed by Pleistocene clays and Mesozoic carbonatic rock, the latter pertaining to the Apulian foreland. The sedimentary

Fig. 2 a, Aerial view of Masseria Candelaro (after JONES 1987); b, Plan of the excavated area. Light grey: Candelaro I; medium grey: Candelaro II; dark grey: Candelaro III.

deposits, lying all around Masseria Candelaro, are extremely diversified. Sand layers with pebble lenses and clay horizons, and with ballstone intercalations are one of the main lithic characteristics of the sedimentary sequences. Clays and marly and fossiliferous clays are present locally, together with polygenic conglomerates highly cemented in a sandy matrix. All over the area

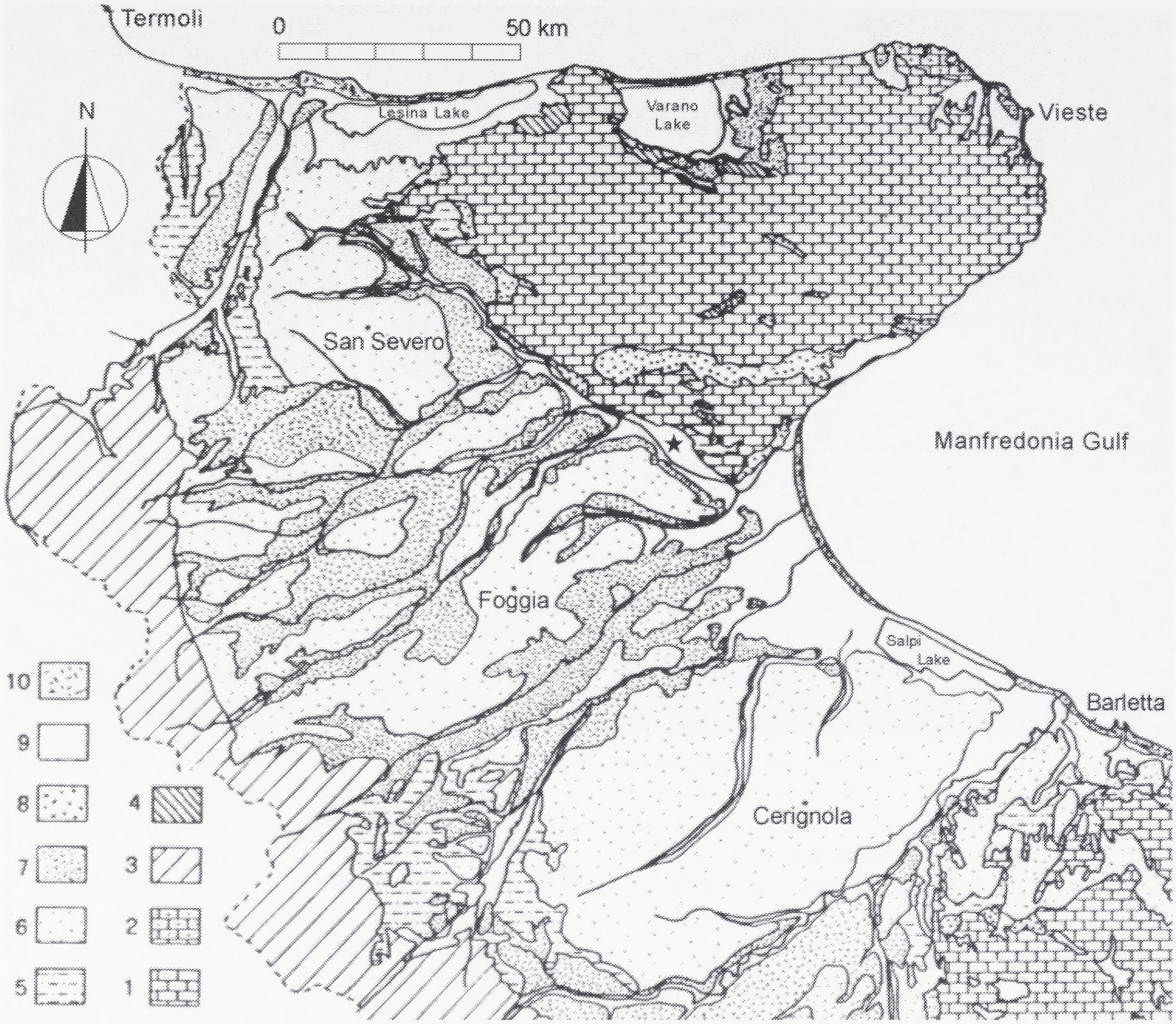


Fig. 3 Geological sketch map of Tavoliere area (modified after CALDARA/PENNETTA 1993, fig. 3): Masseria Candelaro is marked by a star. 1: Limestone (Mesozoic); 2: Calcarenites (Eocene); 3: Apenninic Chain Units (from Cretaceous to Pliocene); 4: Calcarenites (Miocene); 5: Bradano Units (Pliocene-Lower Pleistocene); 6: Terraced marine deposits (Upper-Middle Pleistocene), 7: Terraced alluvial deposits (Upper Pleistocene), 8: Detritic deposits; 9: Alluvial and lacustrine deposits; 10: coastal dunes and beaches.

there are ballstones and calcareous layer outcrops. Alluvial terraces are mainly constituted by sandy and clayey sediments; late alluvial deposits are formed by pebbles and other heteromorphic elements derived by flysch (Caldara et al. 2004).

Ground stones

Ground stones come from Building Q and from the external ditch and are related to Phases II and III (**fig. 4**).

Raw material
Mineralogical studies were carried out by powder X-ray diffraction analysis (PXRD) using a Philips diffractometer (PW 1710) with Ni-filtered CuKα radiation and employing NaF as an internal standard. They have been completed by petrological observation on thin sections, with a polarized light microscope (OM). Major element determination was performed by X-ray fluorescence (XRF), using a Philips PW 1480/10 spectrometer (Cr anticathode for major and minor elements), following analytical techniques outlined by Franzini et al. 1975 (Acquafredda et al. 2004).

The ground stones were formed of various types of stone: sandstone, limestone, calcarenite, dolomite and calcareous dolomite, which occurred in different quantities and with a notable variability of lithotypes. The limestones, although there were only two examples of them,

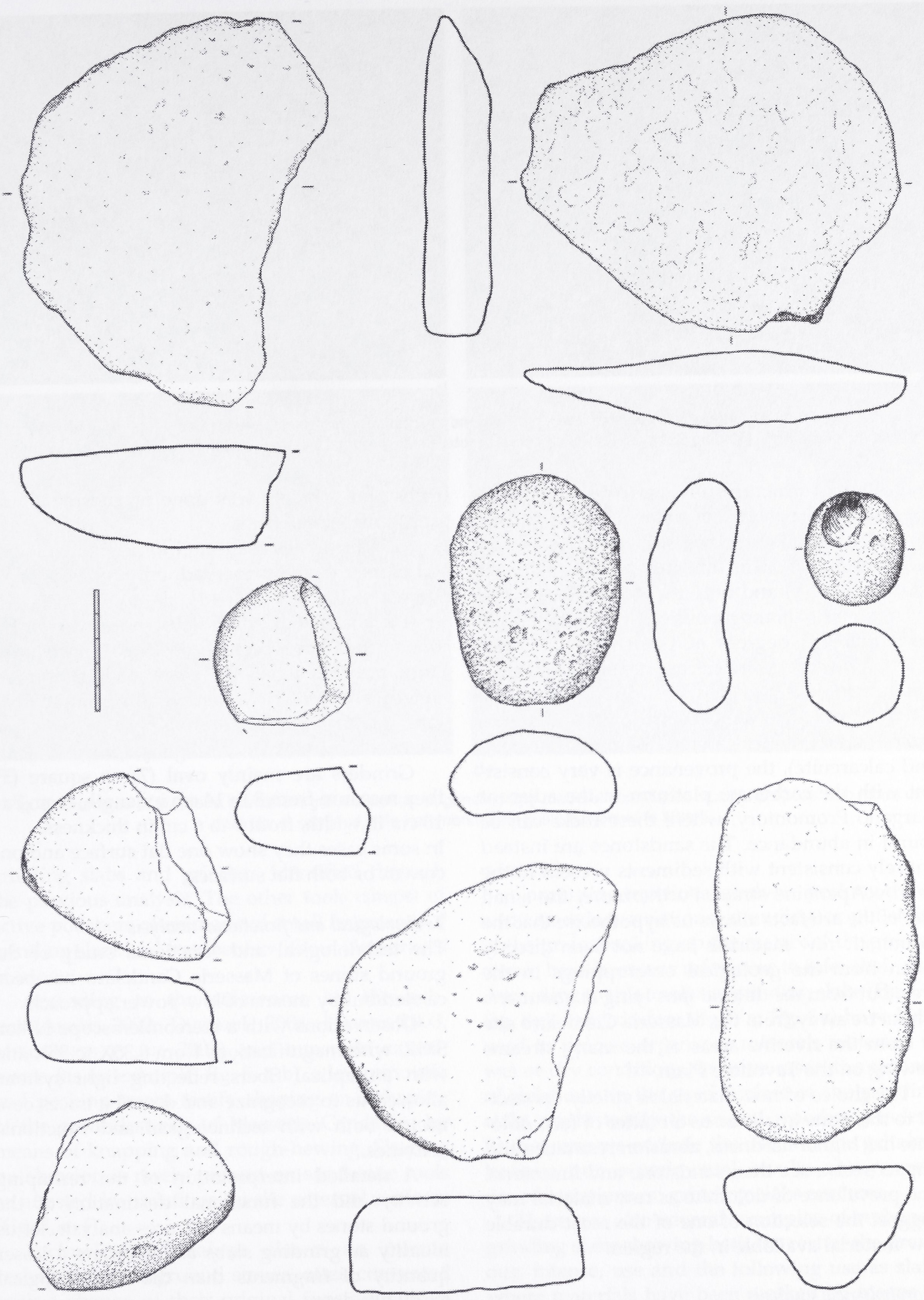
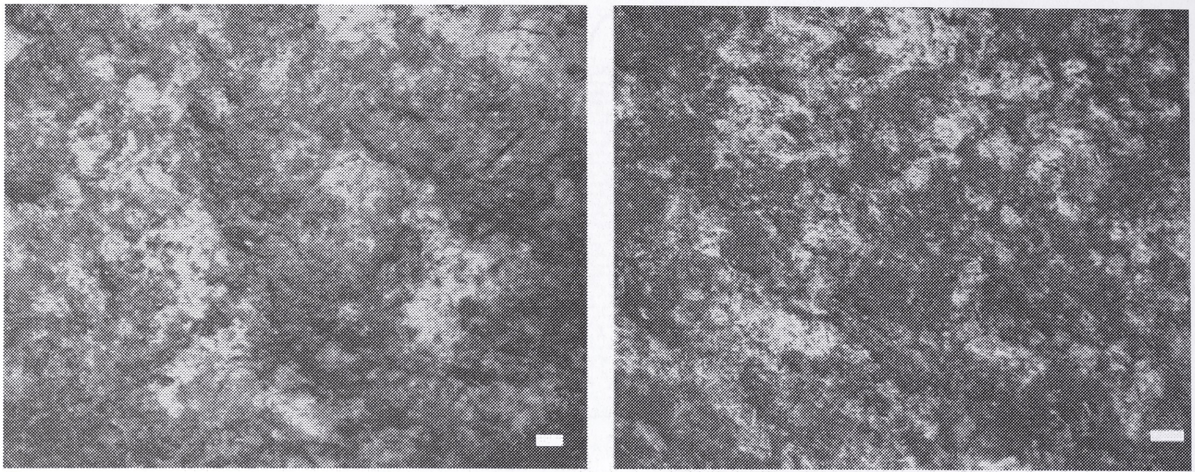


Fig. 4 Ground stone tools from Masseria Candelaro.



a b

Fig. 5 Experimental ground stones: a, slab used to pestle and to grind nuts, hazelnuts, seeds (note the pecking traces that affect the surface); b, grinding slabs used to grind cereals (note the flat topography of the surface); scale bar equal to 1mm.

had different structures, one was a *wackestone* and the other was a *packstone*. Among the two largest groups, the sandstones had slightly different proportions of the main minerals (quartz, feldspar and carbonates) and only the dolomites seemed to have a more homogenous composition, though with different degrees of porosity. Finally the last two samples were calcarenite and calcareous dolomite.

With regard to the carbonatic ground stones (made of dolomite, calcareous dolomite, limestone and calcarenite), the provenance is very consistent with the carbonate platform in the adjacent Gargano Promontory, where these rocks can be found in abundance. The sandstones are instead entirely consistent with sediments present in the nearby Apennine strata. Furthermore, the small size of the artefacts allows us hypothesise that the carbonatic raw materials have not been directly taken from the geological outcroppings in the area, but from the detrital fans lying at about one kilometre away from the Masseria Candelaro site or from the riverine areas of the many streams flowing on the Tavoliere Plain.

The choice of raw material is strictly connected to the stone qualities: as a matter of fact, dolomite has higher hardness, abrasion resistance and impact resistance than sandstone and limestone. The prevalence of dolomite as raw material may suggest the selection of one of the most durable raw material available in the region.

Morphological analysis

The site provided a total amount of 46 pieces: 34 were identifies as grinding slabs, 12 as grinders. The preliminary distinction between grinding slabs and grinders was done on morphological and dimensional basis.

Grinding slabs are found in fragments, while grinders are well preserved, only 5 pieces being fragmented.

The shape of grinding slabs is mostly oval. The dimensions have been reconstructed measuring the fragments which have one edge preserved: length is from 20 to 40 cm, width from 10 to 16 cm. Working surfaces are mainly flat, only four are concave, and two are slightly convex.

Grinders are mainly oval (7) or square (5); they measure from 8 to 14 cm in length, from 7 to 10 cm in width, from 3 to 6 cm in thickness.
In some cases they show one flat surface and one convex or both flat surfaces.

Technological and functional analysis

The technological and functional study of the ground stones of Masseria Candelaro has been carried out by means of low-power approach.

Observations with a stereomicroscope Nikon SMZ, with magnifications from 0,35X to 35X and with an optical fibers reflecting light system, allowed us to recognize and describe traces connected both with technological and functional activities.

A detailed interpretation of the reshaping activity and the functional destination of the ground stones by means of traces analysis, let us identify as grinding slabs and grinders a lesser quantity of fragments than the morphological study has done.

As a matter of fact, traces analysis showed that 26 ground stones were used as grinders, grinding slabs and multipurpose slabs versus the 46

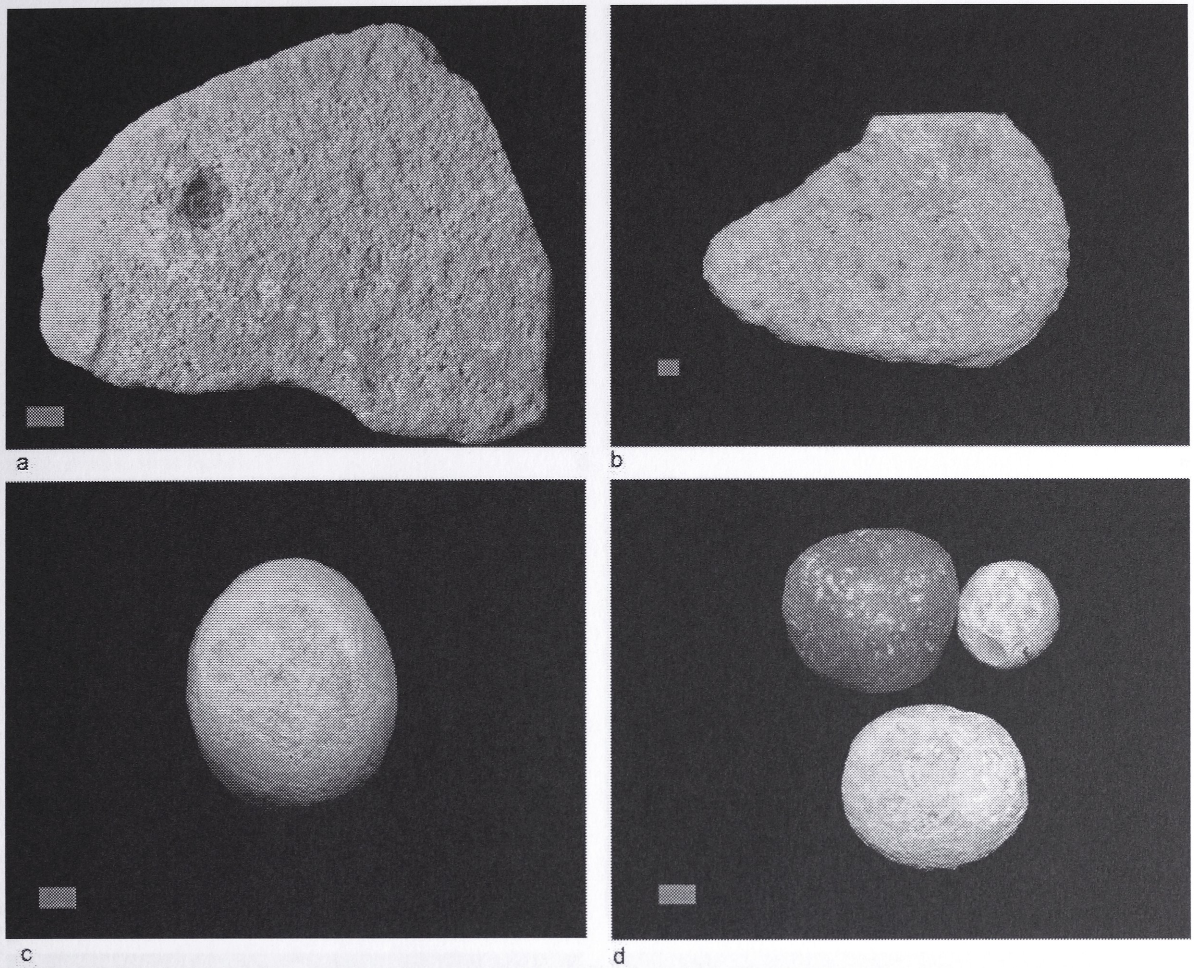


Fig. 6 Examples of Masseria Candelaro ground stones: a, grinding slab made of dolomia; b, multiple-purpose slab made of dolomia; c, pestle; d, little hammerstones; scale bar equal to 50mm.

grinding slabs and grinders identified through the previous analysis. The other tools consist of active polishers often made of small fragments of grinding slabs and fragments without clear traces of use.

According to the references on the subject (Adams 2002; DubreuiL 2004; Hamon 2003; Menasanch et al. 2002) and our own experiments (as an example, fig. 5, a-b), edge-removals and pecking traces testify shaping or reshaping of the ground stones of Masseria Candelaro by means of knapping and rough-hewing. Shaping by abrasion is rarely present on sandstone tools as attested by striations on the external surfaces (**fig. 8, e-f**).

Technological analysis shows an intense reshaping of the ground stones, often connected with a change of their original function. As an example, small fragments of grinding slabs or grinders became active polishers or many big fragments of grinding slabs became multipurpose slabs.

Concerning functional analysis, pecking traces and removing, striations, rounding or polishing of the grains making up the matrix of the ground stones have been our references to infer their use. According to this analysis, grinding slabs (**fig. 6 a; fig. 8 e**) and grinders (**fig. 7 a; fig. 8 c**) have been used to process organic or minerals materials in wet or dry conditions. In some cases, the absence of striations on the used surface of the grinding slabs might testify the use of wooden grinders. In that case we exclude the use of stone grinders because our experimental results always produced striations on grinding slabs surfaces.

There are also several examples of reshaped grinding slabs showing both the rest of the previous, intense, use and the following use as slabs where materials have been worked by means of thrusting and resting percussion (**fig. 6 b; fig. 8 a; fig. 9**).

On the worked surface of the grinding slabs

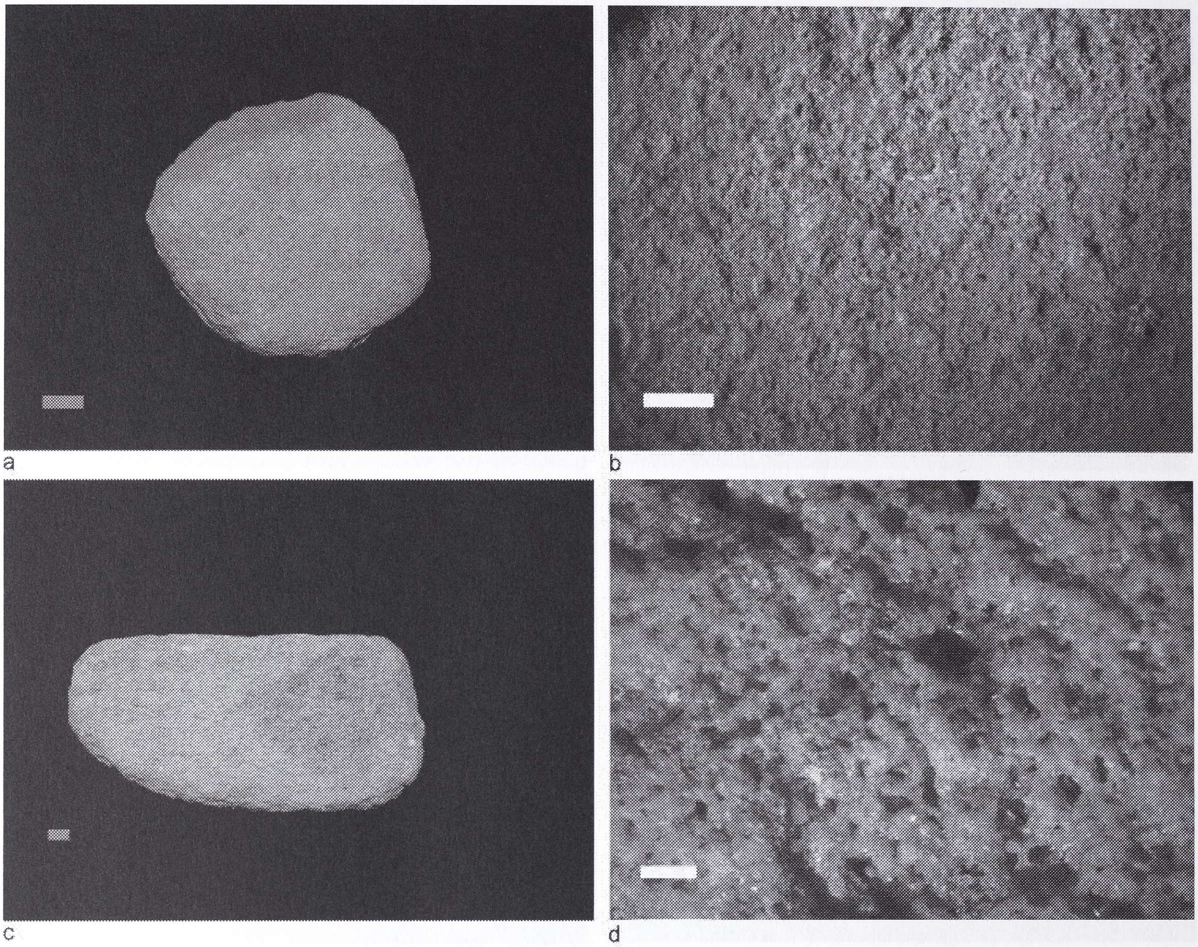


Fig. 7 Masseria Candelaro Phase II: a, grinder made of dolomia used to grind ochre; b, detail of the rounded and very flat surface, characterized by striations and spots of ochre (dark grey spots); c, active polisher made of dolomia; d, detail of the rounded, bright polished surface, characterized by spots of ochre (dark grey spots); scale bar equal to 50mm (pictures a, c) and equal to 1mm (pictures b, d).

we rarely observed the removals of matrix particles. Only one fragment of limestone slab shows this type of stress fatigue. Both dolomite and sandstone have a cemented matrix which prevents from loosing stone particles during use. Maybe, this was a pursued characteristic, especially for food processing.

In addition, four hammerstones (**fig. 6 d**) attest the reshaping activity and six pestles (**fig. 6 c**) confirm thrusting percussion.

In the following parts of our presentation we will discuss our techno-functional results in a chronological perspective, according to the two phases of the Middle Neolithic of Masseria Candelaro, and in a spatial perspective comparing the ground stones of Building Q with those collected from the ditch.

Middle Neolithic – Candelaro Phase II

The 11 tools come exclusively from the Building Q. The ground stones are all made of dolomite (**fig. 6 a-b**).

Three grinders have been recognized, one of them has been shortly used as well as little slab. One grinder has been used to work medium hard material, while the other two grinders have intensively ground red ochre on a stone surface (**fig. 7 a**).

As a matter of fact, the two small grinders show rounded griping surfaces that testify a very long manipulation. Moreover, the grains of the active surface are very rounded, with a developed polish and dense striations which suggest red ochre processing on a stone surface (**fig. 7 b**). It is interesting to point out that in the same area an active polisher has been found (**fig. 7 c**), showing red ochre residues, with light but diffuse edge-rounding, bright polish and few shallow striations (**fig. 7 d**) that suggests the contact with a soft and abrasive material like skin.

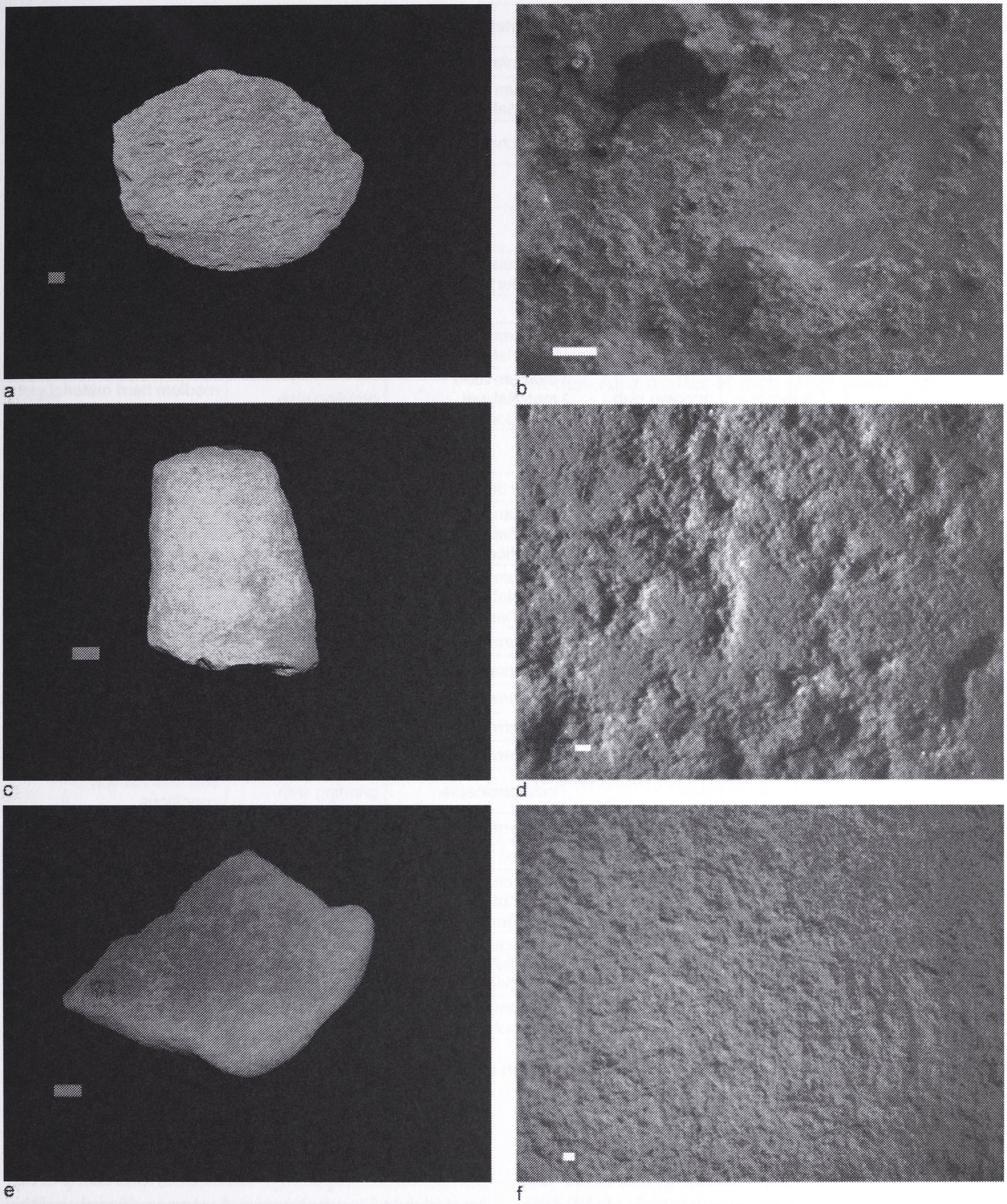


Fig. 8 Masseria Candelaro Phase II: a, fragment of multiple-purpose slab; b, detail of the surface carachterized by pecking traces that affect a flat topography related to a previous use as grinding slab; Masseria Candekaro III: c, grinder made of sandstone used to grinding medium hard material; d, detail of the flat surface; e, fragment of a grinding slab made of sandstone; f, detail of the external surface of the grinding slab showing striations related to technological shaping by abrading; scale bar equal to 50mm (pictures a, c, e) and equal to 1mm (pictures b, d, f).

These data suggest that the treatment of this mineral should have been connected with the colouring of tanned skin. This hypothesis is supported by the functional data coming from traces analysis of the chipped stones. In this phase, many large blades have been intensively used both to remove the subcutis from the fresh skin and to cut tanned, red colored skin or, more

Phase	Area	N°	Raw material	Interpretation	Material worked	Previous use	Previous material worked
II	Q	2	dolomite	grinders	red ochre		
II	Q	1	dolomite	grinder	medium hard material		
II	Q	1	dolomite	slab	red ochre	grinding slab	medium hard material wet conditions
II	Q	1	dolomite	slab		grinding slab	medium hard material wet conditions
II	Q	1	dolomite	slab		grinding slab	abrasive material wet conditions
II	Q	1	dolomite	grinder+slab (occasional)	soft material (grinder)		
II	Q	1	dolomite	grinder+slab		grinding slab	soft material
II	Q	1	dolomite	grinding slab or grinder	medium hard material	grinding slab	medium hard material
II	Q	1	dolomite	grinding slab	medium hard material wet conditions	grinding slab	medium hard material wet conditions
II	Q	1	dolomite	grinding slab or grinder			
III	Q	1	sandstone	grinder	fleshy tissues		
III	Q	1	sandstone	grinder	medium hard material dry conditions		
III	Q	1	dolomite	grinding slab	medium hard material wet conditions		
III	Q	1	dolomite	grinding slab	indeterminable		
III	Q	1	dolomite	grinder-pounder	abrasive material		
III	Q	1	dolomite	grinding slab	indeterminable		
III	Q	1	sandstone	grinding slab	indeterminable		
III	Q	1	sandstone	grinding slab	indeterminable		
III	Ditch	1	dolomite	slab	indeterminable	grinding slab	soft material wet conditions
III	Ditch	1	dolomite	slab	indeterminable	grinding slab	
III	Ditch	1	dolomite	grinding slab	unused		
III	Ditch	1	dolomite	grinding slab	medium hard material dry conditions		
III	Ditch	1	sandstone	grinding slab	medium hard material dry conditions		
III	Ditch	1	limestone	grinding slab	medium hard material		

Fig. 9 Techno–functional interpretation of Masseria Candelaro ground stones.

rarely, to scrape red ochre on the skin.

Moreover, red ochre was frequently used for *figulina* pottery decoration, painted in red exquisite geometric patterns, typical of Middle Neolithic of Southern Italy. Middle Neolithic potters of Masseria Candelaro village probably exploit, as colouring materials, a continental sedimentary deposit (*terra rossa*), very rich of iron oxides, which could be gathered from the calcareous slopes of the Gargano Promontory. Inorganic red deposits, observed on the interior surfaces of some open black burnished pots, were previously analysed and interpreted as dyes used in vessel and/or skin decoration (Muntoni 1999).

The residues of reddish-colour inorganic materials, macroscopically identified on the porous surfaces of some ground stones, were microanalysed with a Cambridge Instruments S360 Scanning Electronic Microscope (SEM), equipped with an Oxford-Link ED spectrometer. The aim was to verify the hypothesis that these incrustations were residues of the materials that have been ground in the past and that have been conserved on the surface of the ground stones, due to the porosity of the stones (Acquafredda et al. 2004) (**fig. 10**).

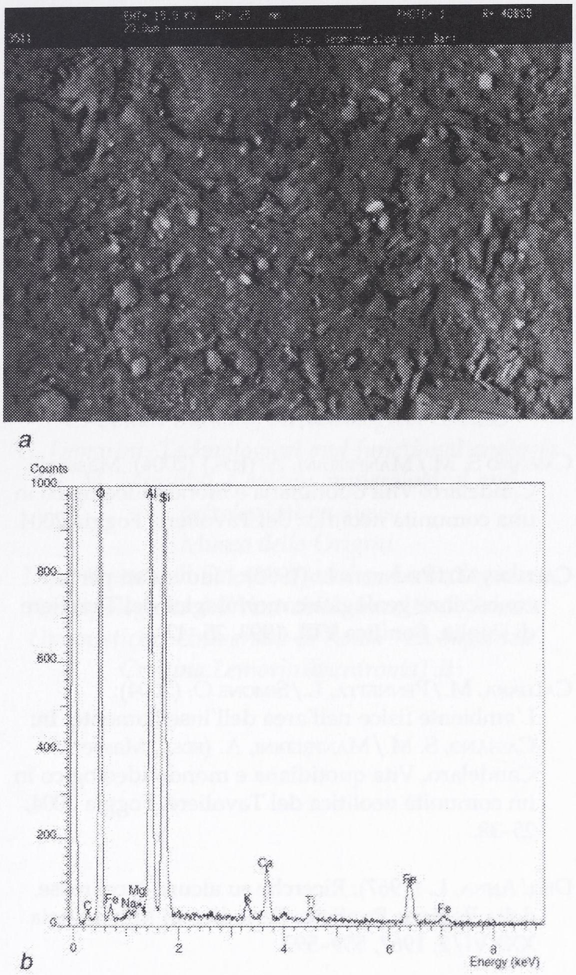


Fig. 10 BSD image (a) and EDS microanalysis (b) of reddish-colour inorganic residues (terra rossa).

The EDS microanalyses on some reddish lumps showed a chemical composition largely made up of SiO_2 (x=46%) and Al_2O_3 (x=35%), and a smaller amount of FeO (x=11%). These results are not dissimilar from those for *terra rossa*. "*Terra rossa*" are silty-clayey continental sedimentary deposits, which are very poor in carbonate (Dell'Anna 1967; Dell'Anna/Garavelli 1968), and are composed of dominant clay minerals (illite and kaolinite) and Fe-oxides/hydroxides, with subordinate quantities of quartz, feldspars, micas and pyroxenes. SiO_2, Al_2O_3 and Fe_2O_3 were the main oxides, both in the clay fraction, and in the specimen as a whole. Considering the absence of this type of sediment at the findingspots of the artefacts, these materials, seen on the surface of the ground stones, could be the residues of dyes used in one or more activities.

As far as the other ground stones from Candelaro Phase II are concerned, grinding slabs consist of only one fragment. This tool has been used to work medium hard material.

Four other tools, defined as slabs, show traces of diffuse thrusting and resting percussion. On one tool, residues of red ochre have been found on both its working surfaces (**fig. 6 b**). All the four tools show on their surface traces of a previous, sometimes intense, use as grinding slabs processing soft, medium hard and abrasive materials.

These small recycled slabs have probably had various expedient functions as breaking seeds, breaking and smoothing vegetal fibers and tendons or minerals. Evidence of these activities also comes out from the use-wear data of the chipped stones. As a matter of fact, large blades have been used, other than to work tanned skin, also to cut fleshy tissues and a big variety of herbaceous plants and wood. In addition, the light abrasion of the cutting edge observed on some tools and the presence of calcite residues, detected by Infrared Fourier Spectroscopy, suggests that the activities were carried out on stone slabs.

Final Middle Neolithic - Candelaro Phase III

15 ground stones constitute the assemblage of this phase (**fig. 8 c-f**). Eight tools are made of dolomite, six are made of sandstone (**fig. 8 c, e** and one of limestone (*packstone*). The unique functional difference between the two groups concerns the recycling that was carried out only on the dolomite tools changing their use from grinding slab to multipurpose slabs.

Eight ground stones come from Building Q. Five fragments of grinding slabs (three made out of dolomite and two made out of sandstone) have been recognized. Only one dolomite tool shows unambiguous traces of both a resting circular percussion and a contact with a medium hard material in a wet condition.

Two grinders made of sandstone have been used respectively to work medium hard material in a dry condition (**fig. 8 c-d**), as the lacking of polish suggests, and, probably, fleshy tissues in the other one, as indicated by light and diffused edge-rounding and polish. There is one more fragment of dolomite grinder/pounder, which has been related to the intense work of abrasive materials.

The ditch provided seven ground stones, four fragments of grinding slab, made of different kinds of raw materials (dolomite, sandstone and limestone), two dolomite slabs recycled from grinding slabs and one intensively used fragment of grinders or grinding slab made of sandstone.

Except for one unused grinding slab, the remaining tools have been used to work medium hard materials both in dry and wet conditions.

The ditch and the Building Q don't show any significant difference concerning their ground stones assemblage except for the presence of the recycled slabs in the ditch deposit.

The functional picture seems quite homogeneous and oriented to the process of organic materials (animals and plants) by grinding. These data agree with the results of use-wear analysis of chipped industry, which testify an important presence of meat cutting and cereals harvesting during this phase. As observed for Phase II, the abrasion of the edge testifies the use of stone slabs.

Conclusions

Phase II and Phase III of Masseria Candelaro are both characterized by ground stones related to a great variety of organic and mineral materials. This apparently uniform picture shows, nevertheless, some significant distinctions, which can be summarized as follows.

During Candelaro Phase II ground stones are exclusively present in Building Q, while in Candelaro Phase III both Building Q and the ditch provided grinding stone tools.

Phase II is characterized by a greater recycling of dolomite tools in order to obtain multipurpose slabs for grinding, pounding, cracking related to both food preparation and craft activities. On the contrary, in Phase III recycling is rare and the choice of the raw materials is less selective, suggesting a minor care in the maintenance of the ground stones.

Nevertheless it is important to point out that recycling reduces the visibility of previous activities, so that the complex history of each grinding stone tool cannot be completely detected.

As far as the use of ground stones is concerned, during Phase III grinding of organic materials is the most testified function, suggesting a shift towards a major presence of food preparation versus craft activities. It is notworthy that this major change in Phase III is related to a discontinuous use of the site, which at this time was especially devoted to funerary and ritual practices.

An intriguing picture is therefore emerging: typical daily-life activities are attested in a non-domestic context, giving us some clues about the ideological world of these agricultural Neolithic communities.

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Grinding technologies, social relations and the becoming of the northernmost TRB

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Zusammenfassung – Dieser Artikel gibt einen Überblick über die Mahlsteintechnologien des späten Mesolithikums und des frühen Neolithikums, spezifiziert für das östliche, zentrale Schweden (fig. 1). In diesem Gebiet wurden im Übergangsbereich vom Mesolithikum zum Neolithikum (ca. 4000/3900 cal. BC) kunstvoll produzierte „Sattelmahlsteine" hergestellt und genutzt. Die Einführung von Sattelmahlsteinen ist eng mit dem Auftreten der Trichterbecherkultur (Funnel Beaker Pottery, TBK) (4000/3900-3300 cal. BC) verbunden. Die Trichterbecherkultur erscheint gleichzeitig im südlichen Skandinavien um 4000 cal. BC. Ackerbau wird zur selben Zeit eingeführt. Aus der sozialen, historischen und kulturellen Sichtweise hinsichtlich der Technologie ergeben sich folgende Fragestellungen: wie fand die Art und Weise der Innovation der „Sattelmahlsteine" statt? Wer war in diesem Prozess beteiligt? Studien bezüglich der Kontextzusammenhänge und der Arbeitsschritte während der Mahlsteinherstellung bringen Licht ins Dunkel. Direkt von Beginn der Trichterbecher-Sequenz erscheinen Leitformen der lokalen Trichterbechergruppen. Die Herstellung der Sattelmahlsteine zeigt eindeutig Wurzeln des späten Mesolithikums (5400-3900 cal. BC). Design und Kontexte hingegen sind neue Eigenschaften des frühen Neolithikums. Sattelmahlsteine der Trichterbecherkultur zeigen enge Parallelen zu den Technologien der Linearbandkeramik (Linear Pottery Culture, LBK) (5500-4900 cal. BC). Es wird postuliert, dass Jäger und Sammler des südlichen Skandinavien ihre Lebensweise aktiv durch eine Übernahme von Externalitäten der LBK und deren Anpassung an lokale Gegebenheiten, veränderten.

Schlüsselwörter – Mesolithikum-Neolithikum – historische Perspektive – Mahl- und Schleifsteine – Sattelmahlsteine – Techniksoziologie – kultureller Wandel – soziale Beziehungen – Gender

Abstract – This paper presents an overview of grinding tool technologies of the late Mesolithic and early Neolithic, with specific reference to eastern central Sweden (fig. 1). At the mesolithic-neolithic transition (c. 4000/3900 cal. BC), elaborately produced saddle querns were made and used in this area. The introduction of saddle querns is closely connected with the appearance of Funnel Beaker Pottery Culture (Trichterbecherkultur, TRB) (4000/3900-3300 cal. BC). TRB culture appears simultaneously within southern Scandinavia at c. 4000 cal. BC. Agriculture is introduced about the same time. From a social, cultural and historical perspective on technology follows: what shaped the innovation of saddle querns and who were engaged in the process? Studies of contexts and operational chains involved in grinding tool production shed light on these questions. Local TRB lead-artefacts appear right from the start of the funnel-beaker sequence. The making of saddle querns shows roots back into the late Mesolithic (5400-3900 cal. BC). However, design and contexts are new traits for the early Neolithic. TRB saddle querns have close parallels with the technology of Linear Pottery Culture (Linearbandkeramik, LBK) (5500-4900 cal. BC). This suggests that southern Scandinavian hunters and gatherers actively refigured their way of life by incorporating LBK externalities into local configurations.

Keywords – Mesolithic-Neolithic – historical perspective – grinding and pounding tools – saddle querns – social technology – cultural change – social relations – gender

Introduction

The presence and recognition of grinding and pounding tools of stone, or 'ground stone' artefacts, as new tools for the Neolithic have a long tradition in Scandinavian archaeology (Montelius 1885, 1906, 1919; Müller 1907; Glob 1952; Florin 1958). In contemporary archaeology, Neolithic grinding tools are similarly frequently labelled 'news', 'innovations' or even 'clues' to the introduction of agriculture and cultural change. Mesolithic grinding tools are similarly discussed as 'innovations'. Despite the long attention, grinding and pounding tools constitute a surprisingly anonymous and neglected category of archaeological artefacts within Scandinavian and North-European Stone Age archaeology (Lidström Holmberg 1998, 2004; Persson 1999, 78).

Concerning the early Neolithic LBK, grinding tools or querns are overall seen as a new tools connected with the adoption of agriculture and the Neolithic (Barker 1985; Zimmermann 1988; Hodder 1990; Gronenborn 1997, 1999; Bogucki 2000).

Detlef Gronenborn (1999, 141) particularly specifies that tools for processing domesticated plants, sickle blades and 'saddle querns' appear with the LBK, and are not found in late Mesolithic contexts in central Europe. Peter Bogucki (2000, 202) similarly states that 'ground stone' implements, such as polished axes and querns, appear in central Europe in connection with the earliest LBK farmers.

For the early Neolithic TRB of southern Scandinavia, David Liversage (1981, 142; 1982, 15) concludes that 'querns' and axe polishers represent new artefact categories introduced with the

TRB in Denmark. Saddle querns appear at the beginning of the TRB sequence and the objects have no antecedents in late Mesolithic Ertebølle culture, at least not in northwest Zealand. In view of that, it is concluded that querns give "clues as to the source of the Neolithisation of the region". Douglas T. Price and Anne Birgitte Gebauer (1992, 102, 105, 107) similarly announce that 'grinding stones' are introduced into southern Scandinavia as Neolithic 'innovations' alongside TRB pottery, polished flint axes, domesticated cereals and animals. However, they propose that cereals were of relative unimportance for several hundred years after the introduction of TRB culture, and that changes in food production occurred only gradually.

In an MA thesis on saddle querns in Ireland, Anne Connolly (1994, 30f) concludes that 'saddle querns' of various shapes appear in Ireland with the Neolithic. The early Neolithic of Ireland is, as in Great Britain, not connected with TRB culture. Similarly, Peter Woodman (2000, 246) finds a correlation between quern tools and the formation of Neolithic Ireland. No 'saddle querns' are recovered from Mesolithic sites. As a side remark, Clive Bonsall with colleagues (2002, 19, note 2) also mentions 'grinding implements' as new tools introduced into the British Isles in the early Neolithic and with TRB culture in southern Scandinavia. In contrast to Price and Gebauer, the presence of grinding tools are said to reflect an increased importance of cultivated seed crops.

A common view held by archaeologists studying LBK Europe and the TRB of Southern Scandinavia is consequently that grinding tools are innovations and used for cultivated crops. That grinding tools cannot be taken as direct evidence of agriculture is rarely discussed (but see Barker 1985). Nor is it discussed what the term 'innovation' actually means. In the area south of the Baltic Sea, grinding tools belong to a technology descending at least from Palaeolithic times onwards (De Beaune 2000, 2004). Different grinding and pounding tools are also part of the Mesolithic tool inventory as we shall see below (cf. Zvelebil 1994). In what way are Neolithic grinding tools 'innovations?

No doubt the stereotypic image of the Mesolithic has been one of nomadic hunters and gatherers, while the Neolithic traditionally has come to stand for village-based agro-pastoral farmers (Zvelebil 1998, 25). The notion of the Mesolithic and Neolithic as separate entities has created an epistemological border between the two that clearly has had consequences for archaeological interpretations (cf. Barret 1994). From a historical perspective, such a split is highly problematic. There cannot be a divide of past and present as the past always informs the here and now. Discussions of the Neolithic thus have to include the Mesolithic, rather than set it aside.

Brian Hayden (1993, 196) consequently argues that grinding tools are Mesolithic 'innovations'. He sees grinding tools as objects signalling a technological advance towards agriculture. The Norwegian archaeologist Egil Mikkelsen (1984) on similar grounds proposes that flat netherstones of sandstone and pebble tools from late Mesolithic sites in southern Norway were used to grind both axes and plants for food. The existence of grinding tools is proposed to have paved way for the Neolithisation. Marec Zvelebil (1994, 56) strongly argues for a use of plant foods in the Mesolithic (cf. Clark 1976). He states that the lack of grinding tool equipment at Mesolithic sites is due to an archaeological neglect, reinforced by the Mesolithic/Neolithic epistemological divide.

Grinding tools from both periods are apparently taken as 'innovations' and considered indicative of some sort of economic, historical, social and cultural transformation. The label 'innovation' has however had curiously little impact on the study of Mesolithic and Neolithic grinding tools. Very little systematic archaeological research has, up until recently, been conducted on these artefacts and their object situations. This neglect has its base in a range of background assumptions, rather in the archaeological material. For some reason, archaeologists fail to bear in mind that an innovation is no utilitarian thing alone, but the result of a historical and social process where social interaction and cultural decision-making lead to the shaping of a new technique (Lemmonier 1993, 4). Without the social in the 'innovation', grinding tools are set aside from social and cultural practice. Grinding tool 'innovations', like other technologies, need to be analysed with questions of cultural decision-making strategies and social interactions asked (cf. Dobres 2000; Dobres/robb 2000). From a historical perspective on the social practice of technology, one needs to examine not only what is new in an innovation, but also what past is made part of that new and how (Sahlins 1999, 2000; Lidström Holmberg 2004).

Research histories and archaeological assumptions

Certainly, the neglect of grinding tools has a lot to do with perceived low-form variability, undeveloped schemes of artefact classification, and inconsequent terminology (Kraybill 1977; Zimmermann 1988; Lidström Holmberg 1998; Hamon 2007). Characteristically, grinding tools are often classified as archaeological 'other' or 'varia'; a 'left-over category' enclosing informal artefacts with low amount of diagnostic criteria for classification. The placement of grinding tools into the 'other' category has not assisted in improving the value of grinding tool artefacts to archaeological interpretations of the past.

Classifying grinding tools as non-diagnostic 'other' and at the same time as a technological 'innovation' further encloses a true contradiction in terms. Normally, archaeologists take technological 'innovations' seriously, as it is assumed they have important things to inform us about people's social life, actions and interactions. Why have Stone Age grinding tools for so long been set aside from studies of social life and practices of culture?

The strange combination of awareness and neglect of grinding tools is in fact early established in the history of Stone Age archaeology. In Scandinavian archaeology, the study of grinding tools early emerged as two different approaches to these artefacts. In Stone Age archaeology, grinding tools become utilitarian objects connected with crop processing, while Bronze Age grinding tools are involved in symbolic models of interpretation.

In 1885, Oscar Montelius (1885, 26f) argued that quern slabs, 'steinerne handmühle', from a Neolithic megalith-burial are direct evidence of agriculture. This is supported by archaeological finds of husbandry and crop growing in Neolithic Switzerland and an ethnographic image of a woman grinding cereals. Some years later, Montelius (1906, 14f) concluded that evidence of agriculture in the Stone Age is: bones from domesticated animals, imprints of cereals in pottery, flint sickles, and different quern slabs 'handmühle' of 'oldest form'. Crop growing and animal husbandry are also suggested as evidence of social interaction with agricultural people to the south. It is not surprising that people in Stone Age Sweden kept domesticated animals and grew crops as people in Europe did this. Cereals and animals are further suggested to represent priceless gifts (cf. Jennbert 1985).

From new finds of quern slabs and large grinders in Denmark, Sophus Müller (1907, 137, 155, 148ff) also concluded that 'kvaernstene' and 'løber' belong to Early Neolithic Scandinavia. Neolithic querns are found deposited in pits at settlement sites and in burial contexts. Müller comments that it is impossible to understand why Neolithic querns have not been found earlier. It is argued that the conspicuous lack of Neolithic querns is something related with neglect and not with past reality. Querns are simply not taken into the museums, Müller says. As querns are not brought into view, archaeologists use finds of round pebble tools 'knusesten' to explain how grain was ground. The interpretation of pebble tools as querns is strongly refuted by Müller, who concludes that pebble tools have rough crush marks that do not correlate with grain grinding.

Later, Montelius (1919, 19f) stirred up the link between grinding tools and agriculture. He states that a quern slab 'handkvarn' may be no direct evidence of agriculture as 'curious finds have shown that people in different parts of Europe still today uses roasted acorns as food'. As evidence of Stone Age agriculture he now lists: cereal imprints in pottery, apples and barley grains recovered from the Neolithic site Alvastra (cf. Browall 1986; Malmer 2002), flint sickles, and 'one or another quern slab' found in such circumstance that it can be attributed to the Stone Age. Domesticated animals and cereals are still considered priceless gifts, given Europe by the Orient.

Up until Sten Florin's (1938, 1958) exposition of saddle querns from the early Neolithic sites Östra Vrå, Mogetorp and Brokvarn in eastern central Sweden, there is sparse attention to grinding tools in Swedish Stone Age archaeology.

To sum up, earlier archaeologists draw attention to grinding tools, both as settlement-finds, as pit deposits and in burial contexts. It is however apparent that grinding tools are only referred to in terms of diet. Even though querns are found in burial contexts and despite cereals being considered priceless gifts, grinding tools simply equal the ordinary.

Long before the breake-through of postprocessual archaeology, Bronze Age archaeology in contrast opened up for grinding tools as symbolical objects (Lidström Holmberg in prep.). Through the study of burial- and sacrificial rituals, Bronze Age grinding tools soon came to be discussed in terms of agricultural offerings and as symbols of life-power (Rydbeck 1912; Sverdrup 1927). Through time, such alternative models of interpretation is reinforced within Bronze Age research, shaping a tradition of symbolic interpretations of grinding tools for this period (Fendin 2000; Kaliff 2007).

The different approaches to grinding tools have seemingly little to do with a marked difference in archaeological contexts. Grinding tools from both periods are recognised as part of special contexts, like burials and structured deposits. The difference hence outlines two separate epistemologies rather than past realities (cf. Barrett 1994; Zvelebil 1998). In the history of archaeology, utilitarian/dietary approaches to grinding tools has come to characterize Stone Age research, while symbolical approaches to grinding tools has come to characterise Bronze Age research. Stone Age grinding tools are seen as keys to subsistence, while Bronze Age grinding tools are given a wider social and symbolical object's value (cf. Renfrew 2004).

The impact of these two epistemologies is noticeable in Scandinavian and North-European Stone Age archaeology. Grinding tools in Bronze Age contexts open up questions of rituals and symbolism, while grinding tool 'innovations' in Stone Age contexts open up questions of subsistence. Socio-symbolic interpretations of grinding tools are overall refuted within Stone Age archaeology up until the breake-through of post processualism (e.g. Hodder 1990; Lidström Holmberg 1998; Pryor 1998; Wright 2000; Hamon 2004; Boyd 2005; Hernek 2005).

Underlying the neglect of Stone Age grinding tools is also the assumption that grinding tools represent the ordinary, domestic and functional work of women (Conkey/Spector 1984; Bruhn Olsen 1991; Hurcombe 1997; Lidström Holmberg 1998; 2004). Certainly, this female gendering of querns has one of its legs in the long ethnographic interest in Stone Age archaeology (cf. Montelius 1885). That grinding tools are seen as female gendered is also particularly lucid in Stone Age archaeology. Neolithic querns are overall taken to correspond to women's labour and the space and place of female gender (Van De Velde 1979, 1992; Hodder 1990; Lüning 2000b, 124f; Wright 2000). This gendering of querns reproduce even though archaeological data suggest that Neolithic querns are 'ambivalent' in terms of gender and even cross-cut gender and age categories (Lüning 2000a, 202; Kahlke 2004; Lidström Holmberg in prep.).

With grinding tools assumed domestic and ordinary, the context of recovery further tends to be downplayed in favour of the interpretation of grinding tools (Lidström Holmberg in prep.). Grinding tools carefully deposited in a pit make the pit into a settlement context as the grinding tool is taken as domestic refuse. In sharp contrast, a pit with an axe will provide the pit a ritual interpretation as the Neolithic axe is associated with the special (Andersen 1997; cf. Bradley 2005). The label ordinary domestic contribute with similar interpretations of grinding tools in burials, which either are seen as deposited as settlement refuse or at the best as markers of women's labour (Van De Velde 1979; 1992; Kossian 2005, 106).

Through the archaeological use of social theory, domestic life has further come to be reinforced as a stabile home for cultural continuity and time-reversal' practices, rather than an arena for tension and negotiation of past cultural orders (Bourdieu 1977; cf. Sahlins 2000). Archaeological uses of theories of cultural reproduction reinforce the conventional assumption of domestic (female) grinding tools as submissive to processes of cultural change (Lidström Holmberg in prep.).

It is vital to bear in mind that notions of querns as female gendered objects is based on ethnographical works without sufficient grounds to assume this for prehistorical contexts in general. Certainly, women all over the world have spent hours and hours of time grinding cereals and other substances in finer fractions. Ethnographical works show that large querns were moreover manufactured, used and maintained by women, who also quarried the raw material (Haaland 1995, 1997; Schneider 1996). A social technology of grinding tools may however enclose a multiple authorship that cross-cut gender and age categories (cf. Strathern 1988; Finley 2003). Ethnoarchaeological accounts also support other social relations of technology. Men may for example quarry the raw material and shape the quern preform, while skilled, elderly women conduct the final manufacture of a quern primarily used by young women and children (Gronenborn 1995; Baak 2003). Grinding tool-use further enclose a wide range of secondary practices, such as skin preparation, grinding of resin, plaster, ochre temper for pottery, and the polishing of axes (Lidström Holmberg 1998; Boyd 2005; Hamon 2007). With such a complex life-biography, grinding tools cannot be assumed to have a strict attribution to one gender category alone (cf. Gosden/Marshall 1999). The focus on technology should thus be on social and embodied relations of practice rather than attribution of objects to gender (Lidström Holmberg in prep.).

There is little doubt that the technological anonymity of grinding tools combined with a 'women-at-home ideology', set aside from social and ritual life, has reinforced the utilitarian tradition of Stone Age research (GERO 1985; BRADLEY 2005). Taken together, this has had profound implications for how archaeologists perceive, excavate and interpret grinding tools. Held to be ordinary refuse from women's daily life it is perhaps no surprise to find that Stone Age grinding tool are overlooked during excavations and arbitrarily mentioned in archaeological publications. The above chain of assumptions further explains why the label 'innovation' has had so little impact on the archaeological study of grinding tools, especially to the cultural process of Neolithisation.

During the past two decades, technological and typological studies of grinding tool artefacts have however increased within archaeology (HERSCH 1981; ZIMMERMANN 1988; SPEARS 1990; WRIGHT 1992, 1994; LIDSTRÖM HOLMBERG 1998; 2004, ADAMS 1999; 2002; PAVLŮ 2000; WRIGHT/BAYSAL 2005). Initially, experimental studies of tool-function and use were intimately connected with this renewed interest in grinding tools, especially apparent in German archaeology (HENNIG 1966; BAUCHE 1988; LÜNING/MEURERS-BALKE 1986; MEURERS-BALKE/LÜNING 1990; TEEGEN/HELLMICH/SCHULZ 1990). My own first work on grinding tools was inspired by this 'school' of archaeological experimentalists (LIDSTRÖM HOLMBERG 1993). Functional analyses of grinding tools through microscopic use-wear studies and residue/phytolith analysis have also formed a closely interrelated and increasing subfield of research (DE BEAUNE 2000; RISBERG ET AL. 2002; GIJN/HOUKES 2006; HAMON 2007; LIDSTRÖM HOLMBERG in prep.). Analyses of raw materials and quarrying have further come to form an increasing matter of concern (PAVLŮ 2000; GRAEFE 2004; LIDSTRÖM HOLMBERG in prep.). Grinding tools in Neolithic burial-contexts have also received new attention (FARRUGGIA 1992; LIDSTRÖM HOLMBERG 1998; in prep.), as has the structured deposition of grinding tools in various other contexts (LIDSTRÖM HOLMBERG 1998; 2004; PRYOR 1998; HAMON 2004).

The renewed focus on grinding tool technology has close connections to ethno-archaeological studies of grinding tool manufacture and use initiated in the 1970´s and 1980´s. Ethno-archaeology points out that grinding tool enclose a multipart operational technology with organised sequences of manufacture (HAYDEN/NELSON 1981; HAYDEN 1987; HAALAND 1995; MC BRYDE 1997; MULVANEY 1998; SCHÖN/HOLTER 1998). Ethno-archaeological studies from the 1990´s onwards also call attention to the role of long-distance transportation, social relations and gender to raw material quarrying, manufacture and social/symbolical use (HAALAND 1997; 1999; GRONENBORN 1995; SCHNEIDER 1996; MCBRYDE 1997; BAAK 2003). Seen from ethnography, grinding tools are objects with profound significance in the social and cultural life of people, and employed in a range of life-generating and transforming rituals (LIDSTRÖM HOLMBERG 1998; in prep.). If grinding tools are to be valued as social and cultural objects rather than utilitarian things devoid of social life, archaeological assumptions of Stone Age grinding tools as 'ordinary' has to be stirred up.

Studies of grinding tools from different geographical areas show that Neolithic querns are elaborately manufactured objects, designed by means of flaking, pecking and smoothening techniques (HERSCH 1981; LIVERSAGE 1981; ZIMMERMANN 1988; WRIGHT 1994; SCHNEIDER 1996; LIDSTRÖM HOLMBERG 1998; 2004; GRAEFE 2004; TAKAOĜLU 2005; GIJN/HOUKES 2006; HAMON 2007). The social process of innovation resulting in such elaborate technology urges to be more deeply examined. Needed are not only systematic and methodological studies of Mesolithic and Neolithic grinding and pounding tools, but the insight that grinding tools inform on matters of social relations and cultural formation (LEMMONIER 1993). A social archaeology of Mesolithic and Neolithic grinding tool technologies is therefore requested.

A social archaeology of processes of innovation and transformation further requires a dynamic, historical and hybrid perspective on culture (SAHLINS 1999, 2000). People both can and do change their culture, simply speaking because that is all they ever do (SAHLINS 2000, 12, 287). Culture is a hybrid course of action, it trespasses borders and is in the continuous process of becoming. Therefore cultures, like the TRB or the LBK, cannot be seen as bounded entities. Sometimes cultural change is rapid, sometimes very slow yet always in motion. The question is thus not what culture is, but how culture is made and what culture does. There is however the possibility that a culture of things will never again be the same (ibid, 290). In this respect, the introduction of saddle querns in the Early Neolithic TRB can be taken as solid sign.

Terminology

Noticeably, the term 'ground stone' commonly used in archaeology is not a satisfactory term to categorize elaborately flaked and pecked grinding tools. The term is however still commonly used, especially in American and East Mediterranean archaeology (WRIGHT 1992; 2000;

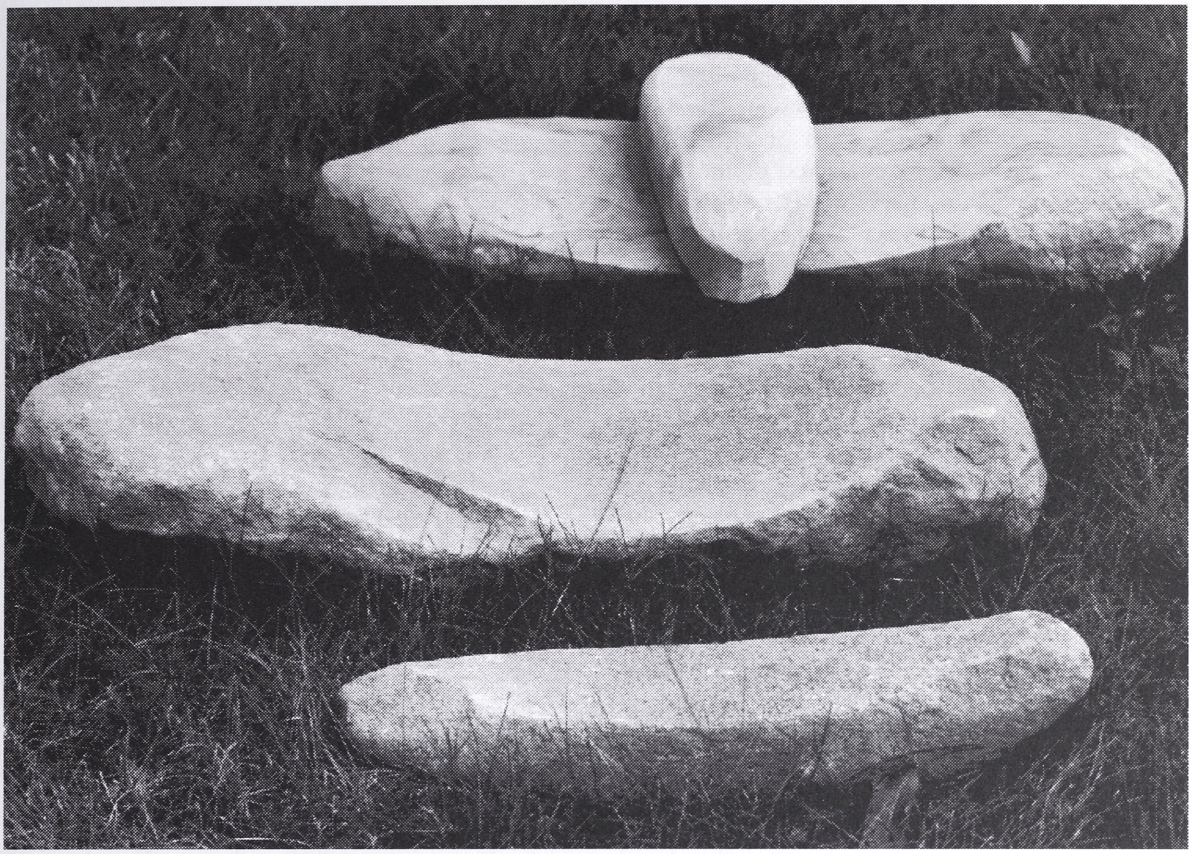

Fig. 1 An elaborately produced, large-sized Neolithic saddle quern slab detached from its loaf-shaped grinder. Both tool parts are made of coarse, arcosic sandstone. Note the beak-shaped ends of the grinder. A replicated copy used for grinding experiments shows how the quern was found during excavation.

Adams 2002; Boyd 2005). In the cultural context of North-Europe and Scandinavia, the term 'ground stone' is extra problematic as it has come to refer to polished axes and other 'ground' stone tools rather than tools for grinding. I will not use the term ground stone in the following text. Instead, I will talk about grinding and pounding tools as a general category of tools used for the processing of different substances into finer fractions, and querns as a particular grinding tool-set originally designed for the processing of cereals and other plants. The recently launched umbrella-term of macro-lithic artefacts is well-suited to enclose both grinding tools and querns (Hamon 2007, 1; cf. Spears 1990, 495; macrocrystalline artefacts). From Adams (2002), I have borrowed the term netherstone to specifically discuss flat stone slabs of various shapes displaying a multiple use-wear with marks from polishing, grinding, pitting, pounding and/or crushing. A grinding tool not possible to classify as a quern but with grinding/polishing wear is a netherstone. Unmodified pebble grinders can be used with netherstones but not with saddle quern slabs.

A quern-set consist of two tool-parts manufactured to fit together. The upper part of a quern set will here be called grinder (in Swedish: löpare, cf. läufer, molette, handstone, mano), while the lower part of the quern is called quern slab (in Swedish: underliggare, cf. unterlieger, meule, grinding slab, metate). The word quern or quern-set is used when discussing the two parts joined as a complete tool (in Swedish: malsten, cf. mahl/mühlstein, moulin, grinding stone, milling stone).

From 'loafs of bread' to manufactured TRB saddle querns

In the 1930´s, Swedish archaeologists harshly argued over the Mesolithic-neolithic transition and the introduction of agriculture in eastern, central Sweden, a debate of which some text lines were luckily never taken into the printers. At the centre of debate were a number of Neolithic sites newly excavated by Axel Bagge and Sten Florin (Florin

1938; 1958). The sites yielded finds of funnel beaker pottery, thin-butted axes of flint and greenstone and artefacts looking like 'poorly fermented loafs of bread'. The debate continued – were the 'brotförmige' objects polishing tools or agricultural tools for the grinding of cereals and plants. Based on ethnographic parallels, Florin (1958) proposed that the artefacts were quern slabs used for cereal processing. Left in the archaeological oblivion for over half a decade, recent technological analyses of grinding and pounding tool assemblages from Mesolithic and Neolithic sites in the area positively confirm that the 'loafs of bread' are elaborately produced grinders of saddle querns (**fig. 1**) (Lidström Holmberg 1993, 1998).

The introduction of saddle querns of this specific design is closely connected with the appearance of a material culture complex since the 1930/40's labelled Funnel Beaker Pottery (Trichterbecher, TRB) Culture (Becker 1947). The northernmost TRB area however was for long unknown. With the excavations of Bagge and Florin it became apparent that the Neolithic of eastern, central Sweden had to be set in connection with agriculture and the TRB complex further south (Florin 1958; Becker 1947, 185). Florin claimed that agriculture was introduced into the area by local hunter/gatherers. Bagge on the other hand argued that agriculture was introduced with immigrants moving in from the south. The mesolithic-neolithic debate has been a major matter of concern in Stone Age archaeology for about 150 years (Fischer/Kristiansen 2002; Knutsson 2004).

Probably initiated in Poland at c. 4200 cal. BC, TRB culture appears simultaneously within southern Scandinavia up until eastern central Sweden at c. 4000 cal. BC (**fig. 2**) (Midgley 1992; Persson 1999; Hallgren/Possnert 1997). Datings of domesticated animals, charred cereal grains and saddle querns from TRB sites shows that agriculture is introduced about the same time (Becker 1947; Hallgren et al. 1997; Persson 1999; Price 2000; Rowley-Conwy 2004).

As lead-artefacts of TRB culture archaeologists commonly include funnel beaker pottery, collared flasks, clay-discs, point/thin-butted axes, and polygonal battle axes (Midgley 1992). Large querns of stone connected with the processing of agricultural products were early also recognised as part of the tool inventory, but not as lead-artefact. All TRB lead-artefacts including large saddle querns are recovered from the early Neolithic of the northernmost TRB (Hallgren et al. 1997; Lidström Holmberg 1998; Persson 1999; Segerberg 1999; Malmer 2002).

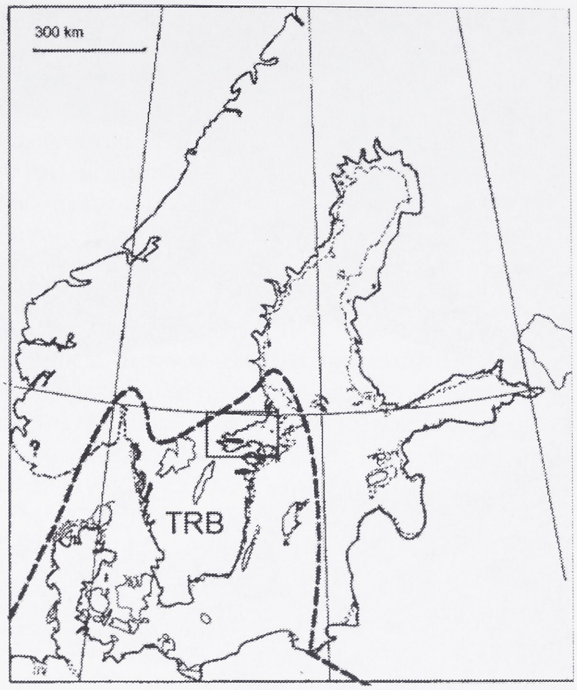

Fig. 2 The northern area and border of TRB culture with eastern, central Sweden marked and the early Neolithic shore-line outlined (modified after Hallgren 2003).

In discussions of TRB and agriculture, querns have not been taken seriously into debate. While referred to as innovations, there is seemingly a widespread supposition that as grinding tools can be used for many things, they cannot be support for agriculture. A wish to emphasise the northern TRB as hunter/gatherers rather than agriculturalists often reinforces this premise. While it is accurate to argue that grinding tools can be used for a wide range of practices, design, size, use-wear traces and residues on saddle querns, all speak in favour of a strong link between large querns and cultivated crops (Hamon 2007; Lidström Holmberg in prep.). Flat to saddle-shaped saddle querns are currently known from many, but not all, early Neolithic TRB sites in eastern central Sweden (Lidström Holmberg 1993; 1998; 2004; in prep). Some sites include only single finds of saddle quern, while other sites contain over fifty querns and more. The presence of large, manufactured saddle querns inform on the introduction of cultivated crops, new practices and worlds of thought.

TRB culture within this area encompasses two types of sites. Inland sites located at some distance away from the sea include, apart from wild game, remains of cattle, sheep/goat and cultigens such as barley, wheat, beans and vine-grapes. Coastal

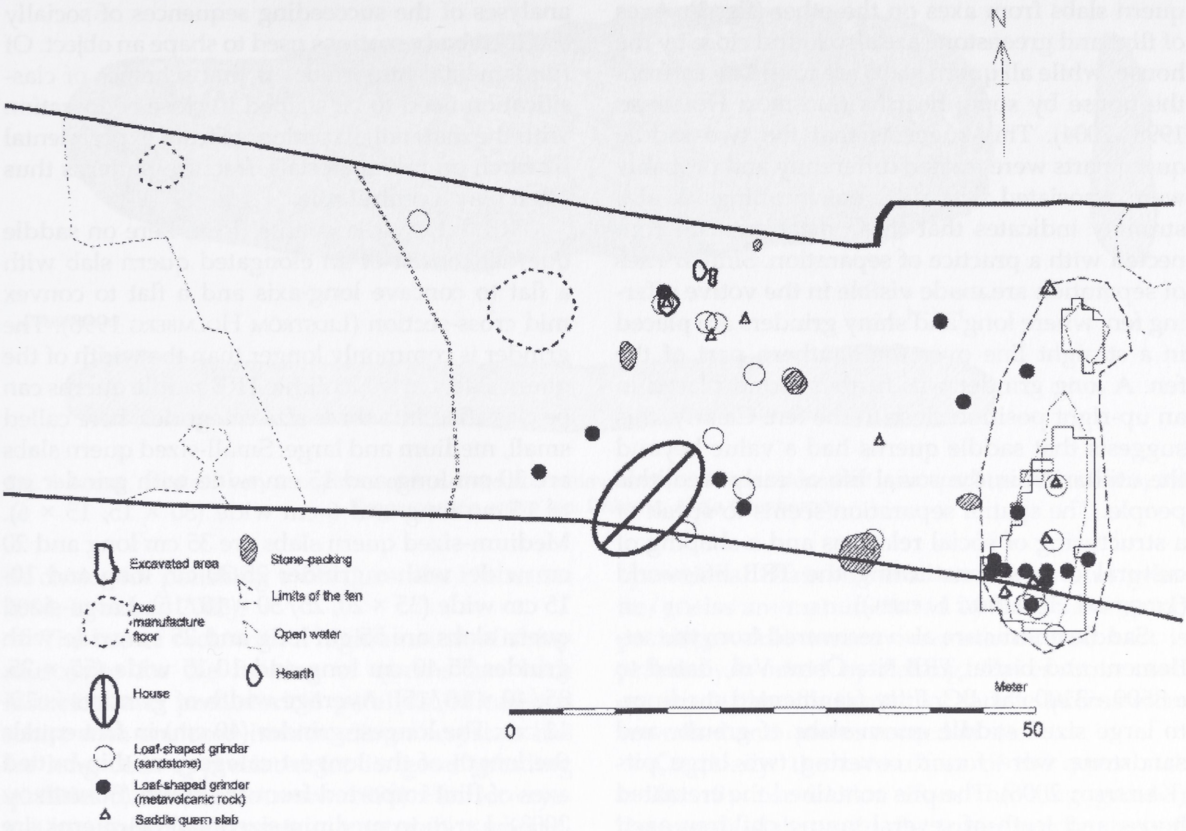

Fig. 3 Spatial separation of saddle quern slabs from grinders at the TRB site Skogsmossen. Note the structured deposition of grinders in a straight line across the southern part of the fen.

sites located close by the sea, or immediately on the sea-shore, are dominated by wild game, fish and seal (Welinder 1998).

At inland TRB sites with more than one saddle quern, agriculture is often indicated by the presence of charred cereal grains, imprints of cereals in pottery and bones of domesticated animals (Florin 1958; Hallgren et al. 1997; Welinder 1998; Persson 1999, 94f; Rowley-Conwy 2004). The location away from the sea-shore can be taken as further indication for crop growing (Persson 1999, 108). Bones from wild game, seal, fish, and hazelnuts on these sites show that fishing, hunting and gathering was a component alongside agriculture (Welinder 1982; Segerberg 1999). Coastal TRB sites commonly include only single finds of saddle querns. Saddle querns found on early TRB coastal sites are further small-sized saddle querns, which are possible to move around. Finds of saddle querns and other TRB artefacts on both inland and coastal sites show that both site-types are connected with TRB culture, and that people may have travelled between these sites on a seasonal basis.

Saddle querns encompass a complex life-biography and are recovered from a wide range of contexts in the early Neolithic TRB. The two parts of the saddle querns are deliberately separated, found deposited in pits, placed in upright or inverted positions, deposited in burials and water (Lidström Holmberg in prep.) The earliest find of a single saddle quern slab in a pit-hearth comes from a coastal site dated to the Mesolithic-Neolithic transition c. 4000 cal. BC (Hallgren 1996). Over fifty saddle quern slabs and loaf-shaped grinders of sandstone and shiny muscovite-rich metavolcanic rock are recovered from inland settlement site Skogsmossen, dated to c. 3900-3300 cal. BC. It is considered the best dated TRB site in eastern, central Sweden with a find material that encloses both domestic animal bone and charred grains of barley and wheat (Hallgren/Possnert 1997; Persson 1999, 107). The site contained the remains of a house and a votive offering fen located some twenty-five meters away (Hallgren et al. 1997, 2000). Within the dwelling space it is possible to visualise a rather distinct spatial separation of quern slabs from grinders on one hand, and quern slabs from axes on the other (**fig. 3**). Axes of flint and greenstone are also found close by the house, while all quern slabs are found away from the house by some hearths (Lidström Holmberg 1998, 2004). This suggests that the two saddle quern parts were treated differently and probably were associated with different meanings. It also strongly indicates that these meanings are connected with a practice of separation. Similar rites of separation are made visible in the votive offering fen, where long and shiny grinders are placed in a straight line over the southern part of the fen. A long grinder was further found placed in an up-right position close to the fen. Clearly, this suggests that saddle querns had a value beyond the utilitarian in the social life of early Neolithic people. The spatial separation seems to speak of a structuring of social relations and a shaping of cultural orders constituting the TRB life-world (Lidström Holmberg in prep.).

Saddle querns are also recovered from the settlement and burial TRB site Östra Vrå, dated to c 3500 - 3100 cal. BC. Fifty fragmented medium- to large sized saddle quern slabs of granite and sandstone were found covering two large pits (Kihlstedt 2006). The pits contained the cremated bones and teeth of several young children aged between 1-7 years old, deposited in concentrations at the bottom of the two pits. One pit contained carbonised wheat grain. The saddle querns, some newly manufactured, must have been brought to this place of burial. The amount of quern slabs deposited shows that the burial ceremony must have included the participation of a large collective. It further shows that also large querns were transported if thought necessary. The quern slabs show traces of deliberate fragmentation, a meaning-laden practice associated with saddle querns also at other TRB sites (Lidström Holmberg 1998, in prep.). Certainly, TRB saddle querns were used in a social and culturally informative way. They were also elaborately produced.

The operational chain of TRB saddle querns

A mix of modified design theory and chaîne opératoire is useful in seeking out sequences of saddle quern manufacture. The idea that tools are produced to solve a practical problem is central to design theory (Horsfall 1987; Adams 2002). Systematic studies of raw materials, fracture-patterns and debris from manufacture play a central role in studies of the operational chain (Dobres 2000; Apel 2001). The emphasis is on in-depth-analyses of the succeeding sequences of socially ascribed body motions used to shape an object. Of fundamental importance is that schemes of classification need to be shaped in close cooperation with the material. Experiences from experimental research on raw materials, fracture-patterns thus often play a central role.

TRB flat/saddle querns (from here on saddle querns) consist of an elongated quern slab with a flat to concave long-axis and a flat to convex mid cross-section (Lidström Holmberg 1998). The grinder is commonly longer than the width of the quern slab. Early Neolithic TRB saddle querns can be classified into three size categories, here called small, medium and large. Small-sized quern slabs are 30 cm long and 15 cm wide with grinder up to 15 cm long and 6 cm wide (30 × 15, 15 × 6). Medium-sized quern slabs are 35 cm long and 20 cm wide, with a grinder 25-30 cm long and 10-15 cm wide (35 × 20, 25/30 × 10/15). Large-sized quern slabs are 55 cm long and 25 cm wide with grinder 35-40 cm long and 10-15 wide (55 × 25, 35/40 × 10/15). Average width of grinders is 10-12 cm. The longest grinder (40 cm) in fact equals the length of the longest category of thin-butted axes of flint imported from the south (Sundström 2003). Large to medium-sized saddle querns are often but not exclusively found at inland TRB sites, which also include cultivated cereals. Small-sized querns are more often, but not exclusively found at coastal sites.

The beginning of a saddle quern life starts when a person or several persons decide to make a tool to be used for a specific purpose (Hayden 1987, 188, 228). From a social and cultural idea of a desired form, function, aesthetics, the technician starts off by selecting an acceptable or ideal raw material. Raw materials chosen for TRB saddle quern manufacture can be grouped into four major categories; heterogeneous arcosic sandstones, muscovite-rich metavolcanic rock with enclosed crystals of quartz (cf. micaceous schist), gneiss/granites and greenstones. Raw materials were generally quarried locally or at a walking distance away. Saddle querns of coarse, arcosic sandstone dominate TRB sites in the northern and eastern part of the study area, whereas mica-rich metavolcanic rock dominates in the western area. Saddle querns of gneiss/granite are more common in areas to the south. Neolithic quern makers/users further chose coarse-grained raw materials for saddle querns, but fine- to medium grained, hard and homogenous sandstone for polishing tools and whetstones. In the Mesolithic of this area, fine-grained hard sandstone is a characteris-

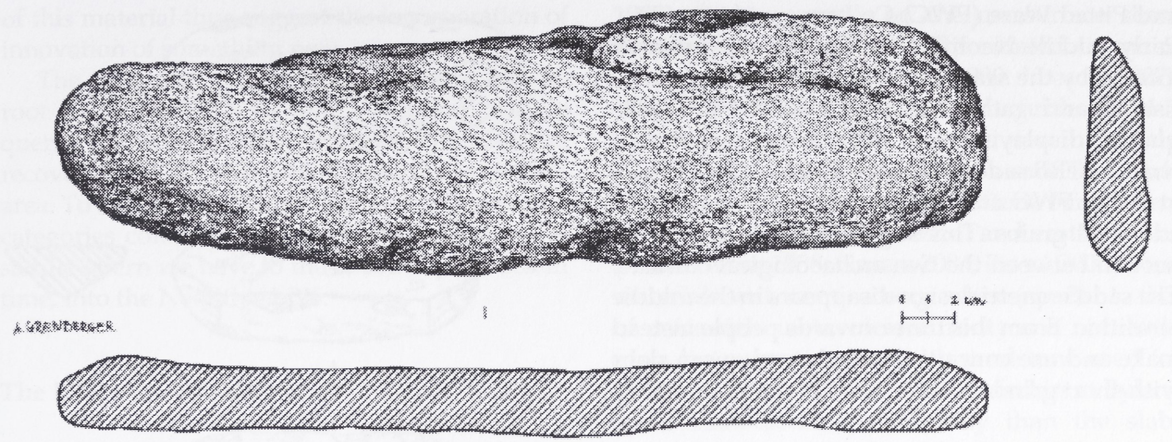

Fig. 4 A long, used and very thin grinder of muscovite-rich metavolcanic rock found deposited in an upright position close by the Skogsmossen votive fen. Drawing: Alicja Grenberger.

tic choice for polishing tools (Lidström Holmberg 2004; Lindgren 2003).

The use of rock with a high amount of shiny muscovite for the making of querns has both historical and prehistorical parallels. Micaceous schist with enclosed harder mineral crystals has for long been appreciated for its good grinding qualities (Lidström Holmberg 1998). Harder crystals in a softer matrix retain a natural rough surface during the grinding. This means that the surface does not have to be pecked as do quern slabs of sandstone. However, the efficiency of the material is one thing, the aesthetics and shiny lustre another variable for choice. As water depositions, long and shiny grinders may well have given the rituals carried out at Skogsmossen an added effect (**fig. 4**).

Flaking, pecking and smoothening techniques are succeeding stages in the operational chain (cf. Lidström Holmberg 2004). Both quern slab and grinder are elaborately produced objects, manufactured to fit together as one tool-set. The initial preform is formed by knapping techniques. Flakes and preforms recovered from some TRB sites show that saddle querns and polishing tools were manufactured on-site (**fig. 5**). The grinder is thereafter carefully pecked into a comfortable loaf-shape, as are the sides of the quern slab. Similar pecking techniques were enclosed in the operational chain of late Mesolithic and early Neolithic greenstone axes. The whole surface of the quern slab is also pecked to a rough texture. As demonstrated by experiments, a rough surface is compulsory for a quern to be an efficient working tool (Lidström Holmberg 1993, 1998). The use-surface of saddle querns made of metavolcanic rock shows much less traces of pecking. Other differences in the operational chain are that sandstone and granite/gneiss are manufactured by both flaking and pecking, while muscovite metavolcanic rock is primarily worked by flaking. Flakes from used querns further illustrate that saddle querns were reworked and querns reused at sites.

Originally, the use-surface of the quern slab is flat. By use-friction from the long grinder, the quern slab gradually turns saddle-shaped. Similar transformation is visible on the grinders, which get characteristic and easily identified beak-shaped ends by hard stone-to-stone contact with the slab's margins. The friction further leaves clearly visible smoothly polished margins on the long sides of the slab, which facilitate the classification of saddle quern slabs. The elaborate design, large size, use-wear traits and micro silica residues recovered on the tool surface show that TRB saddle querns were originally manufactured and used for the processing of cereals (Lidström Holmberg in prep; cf. Hamon 2007). Saddle querns were secondarily also used for a range of other functions. Quern parts reused for the polishing of stone tools get a concave cross-section with smooth polish and uni-directional striations.

Saddle querns of the type described above were seemingly not in use in the early Neolithic of Scania, nor are such tool-design represented at the Swedish west-coast (Lidström Holmberg in prep.). Instead, concave or bowl-shaped quern slabs with short pebble grinders are recovered in these regions (Larsson 1984). This suggests a regional variation in grinding tool technology within the wider TRB area, which most probably has a history in the geographical variationsof the Mesolithic (Lidström Holmberg in prep.) After c. 3300 cal. BC, TRB material culture go out of sight and Pitted Ware (PWC) Culture come into view. Early middle Neolithic PWC sites are generally located by the sea and dominated by wild game, fishing and gathering (WELINDER 1998). Saddle querns displaying the very same operational chain as TRB saddle querns occur in low numbers at earlier PWC sites, as do sparse finds of cultivated cereal grains. This suggests a very close connection between the two archaeological cultures. The saddle quern design disappears in the middle Neolithic. From this time onwards people instead make and use concave, bowl-shaped quern slabs with short grinders.

The social and historical process of innovation

From a historical and agency perspective on technology and culture follows the question what shaped the introduction of large and elaborate saddle querns. Who may have been engaged in the social process, and what transformations emerged with this new technique (LEMMONIER 1993; ZVELEBIL 1998; DOBRES/ROBB 2000; HALLGREN 2003; LIDSTRÖM HOLMBERG 2004; KNUTSSON 2004)?

With Linear Pottery Culture and late Mesolithic society as historical substrates to the becoming of the TRB, the role of social technology and history to cultural change can be discussed.

To be noted from the above is a regional variation in raw material choice and differences in schemes of production existed from the onset of the early Neolithic TRB. This suggests that the making of TRB saddle querns was guided by past Mesolithic traditions of social technology. The use of sandstone shows one connection to the late Mesolithic, another is the technique of pecking (see below). Most lead-artefacts of the northernmost TRB in fact occur as local designs of manufacture from the onset of the TRB sequence. The operational chain of thin-butted axes of greenstone and tools of quartz shows continuity into the late Mesolithic (CALLAHAN 1987; APEL/SUNDSTRÖM 1998). Local TRB pottery designs also appear right from the start of the local funnel-beaker sequence (HALLGREN 2000a, 2003, 30). The rapid appearance of TRB material culture, with locally produced saddle querns and novel TRB objects in local designs, suggests that TRB culture was initiated by local hunter/gatherers. The northernmost TRB thus seem to enclose local hunters and gatherers incorporating a new object world while at the same time innovating and transforming this new into something of their own (cf. SAHLINS 1999, 411).

What then can be considered entirely new?

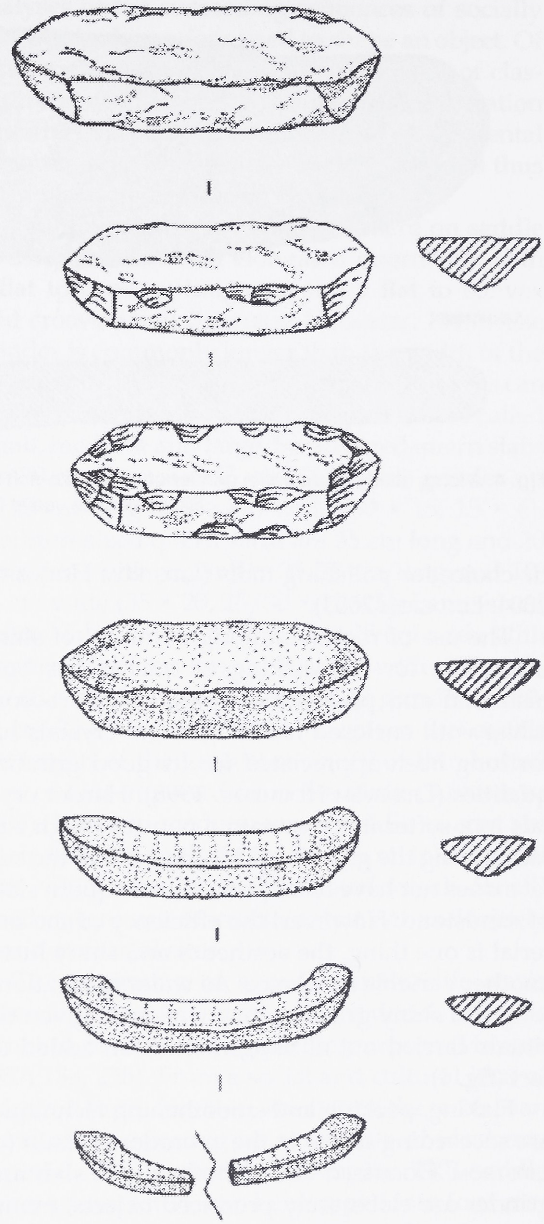

Fig. 5 The operational chain connected with a loaf-shaped grinder of sandstone. Grinders transform through use-life and often break when c. 4 cm thick. Large grinders have a weight of c. 4 kg, while large quern slabs weigh 20 kg or more. Drawing: Alicja Grenberger.

Sheep and goats, barley and wheat are not native in the flora and fauna of southern Scandinavia and must have been brought into these areas (PERSSON 1999, 116). Thin-butted axes of flint were also incorporated as ready-made objects imported from the south (SUNDSTRÖM 2003). What is new in the saddle quern? From a raw material point of view it can be noted that there is little evidence of a use of muscovite-rich materials in the stone tool technology of the late Mesolithic. TRB saddle querns of this material thus suggest the incorporation of innovation of something new.

The design of saddle querns further has no root in the local Mesolithic tradition. Saddle querns of the largest size category are also not recovered within the wider Scandinavian TRB area. To find saddle querns with a design and size categories comparable to the northernmost TRB saddle quern we have to move south and back in time, into the Neolithic LBK.

The LBK past substrate (5500-4900 cal. BC)

Roughly about the same time as late Mesolithic hunter/gatherers in eastern central Sweden and late Mesolithic Ertebølle culture emerged along the Baltic coast in southern Scandinavia, Linear Pottery Culture (LBK) was established in central Europe. The LBK appears at c. 5500 cal. BC, a thousand years before the TRB emerges in southern Scandinavia (Bogucki/Grygiel 1993; Gronenborn 1999). Social interactions between Ertebølle groups and the LBK are documented archaeologically, but present an image of material complexity and regional variation (Fischer 1982; Jennbert 1985; Klassen 2002). While late Mesolithic hunter-gatherers did not produce large quern tools, the LBK most certainly did.

Long, loaf-shaped grinders and flat/saddle-shaped quern slabs are part of the LBK grinding and pounding tool inventory from the oldest LBK (Farruggia 1992, 104; Gronenborn 1997). Whereas the earliest LBK lithic technology (blades and microliths) and net-works for raw material distribution derive from late Mesolithic hunter-gatherer traditions, the saddle quern is suggested to come with in moving agriculturalists from the south-east (Gronenborn 1999, 168f). No studies on this topic has however been conducted.

Within the Neolithic LBK, querns are found as structured deposits and discard at settlements, burials, and enclosures. LBK querns are however most strongly connected with the long house, its hearths, lateral ditches and pits (Boelicke 1988; Hodder 1990; Gronenborn 1997; Lüning 2000 B; Pavlů 2000; Hamon 2004). Use-wear analysis of grinding tools from late LBK sites in the western part of the LBK area shows a strong correlation of large querns to the grinding of cereals (Hamon 2007, this volume).

Like TRB querns, LBK querns are elaborately produced objects. Flaking and pecking are common techniques of manufacture of both quern slab and grinder (Farruggia 1973, Zimmermann 1988). Pecking marks on the use-surface show that the quern was carefully curated to maintain a rough surface (Pavlů 2000; Hamon 2007). Like TRB querns, LBK querns are further manufactured from carefully selected raw materials. Coarse and often heterogeneous sandstone and granites are common, with sandstone being a central raw material in the central and eastern areas (Zimmermann 1988; Graefe 2004; Pavlů 2000). Raw materials such as micaceous schist (similar to that of mica-rich metavulcanic rock) are not common, but were together with sandstone used for querns at Bylany (Pavlů 2000). Grinders at Bylany were manufactured differently than the slabs and further seem to have been moved around the site separated from the quern slabs (ibid, 85, 280; cf. Skogsmossen). Raw materials for quern production were quarried locally or at distance (2-5 km) away from the living site (Kulczycka-Leciejewiczowa 1997, 222; Pavlů 2000; Graefe 2004). Grinders seem to have been of special concern. Flakes from quern tool production show that querns were manufactured on-site. Fragments with used surfaces also show that querns were reworked on-site (Farruggia 1973, 130).

From the LBK site Langweiler 8 in Germany, Andreas Zimmermann (1988, 723-787) has produced a classification of Neolithic LBK grinding tools. Three morphological designs of querns are pointed out, labelled form 1, 2 and 3 (**fig. 6**). The classification is based on the curb of the mid cross-section and long-axis of quern slabs and the existence of beak-shaped ends on long grinders. Form 1 represents what I refer to as a saddle quern (Lidström Holmberg 1998). Like TRB saddle querns, LBK querns of form 1 consist of a quern slab with a concave long-axis and a flat to convex mid cross-section. The convex curb of the mid cross-section is caused by friction from a grinder longer than the width of the quern slab. The upper back of the grinder is often pecked into a loaf-shape, which gives it a comfortable grip (Pavlů 2000, 76). A manufactured quern slab of form 1 has originally a flat upper surface, which gradually turns saddle-shaped during use-life. Similar transformation by friction is visible on the long grinder, which get a curbed long-axis and characteristic beak-shaped ends. As discussed, loaf-shaped grinders with more or less beak-shaped ends are characteristic for the northernmost TRB area (cf. Lidström Holmberg 1993, 1998).

Form 2 consists of a flat quern slab maintained flat as the grinder is as long as the quern slab is wide. A quern slab of form 2 has the same shape as a slightly used quern slab of form 1. The same goes for modestly used grinders, which initially are flat and get beak-shaped ends only through use. This makes form 1 and 2 difficult to separate, which is why I do not refer to form 2 as a separate category of classification. Following Adams (1999), I refer to flat/saddle querns as one category labelled saddle quern. Form 3 in the schema of Zimmermann represents what I call a bowl-shaped quern slab (**fig. 6**). Due to friction from a grinder shorter than the width of the quern slab both cross-section and long-axis are concave in outline.

A regional variation in quern tool technology has also been proposed for the LBK complex (ZIMMERMANN 1988, 726; PAVLŮ this volume). The form 1 saddle quern is the dominant tool design within the central and eastern LBK area, with regional and chronological variation in tool size (HENNIG 1966; ZIMMERMANN 1988; FARRUGGIA 1992; GRAEFE 2004, PAVLŮ 2000). Form 1 saddle querns are also recovered from Early Neolithic TRB sites in Poland, which further is the area where TRB culture is thought to have initiated (ZIMMERMANN 1988, 726; GRYGIEL/BOGUCKI 1997; MIDGLEY 1992).

Form 2 and 3 is proposed a more northern orientation within the LBK area, including the areas north of the LBK and southern Scandinavia (ZIMMERMANN 1988, 726). Flat to bowl-shaped querns with smaller grinders are common within the north-west LBK area (HAMON 2007; PAVLŮ this volume). Bowl-shaped quern slabs are likewise found in north-west Europe later in the Neolithic, c 3500 cal. BC (GIJN/HOUKES 2006, 179). With the introduction of TRB culture, hunter/gatherers along the Baltic coast of northern Germany also made use of bowl-shaped querns (HERTZ ET AL. 2002, 328, see below). Bowl-shaped querns are also part of the early Neolithic TRB in Scania (LARSSON 1984). The suggestion of a northern orientation of bowl-shaped querns at large seems applicable. It does however not come true for the northernmost early Neolithic TRB area. Here, the large flat/saddle quern analogous to form 1/2 is the leading quern tool design from the earliest TRB (LIDSTRÖM HOLMBERG 1998; in prep.).

Studies of LBK querns according to size thus point towards a cultural and geographical as well as temporal variation in technology (HENNIG 1966; FARRUGGIA 1992; PAVLŮ 2000; HAMON 2007). This speaks in favour of a social transmission of quern tool technology over generations, creating geographical traditions of social technology.

Three size categories of querns are noted for the north-western LBK area (HAMON 2007, 3, this volume). Longer grinders and quern slabs seem to have been preferred in the central LBK area (HENNIG 1966, 73, FARRUGGIA 1992; GRAEFE 2004, 49f). A decrease in grinder size from older LBK to the post-LBK (Hinkelstein) phase has however also been noted (FARRUGGIA 1992, 103ff, 107). This includes a shift from long and narrow saddle querns with long and loaf-shaped hand stones in the earlier parts of the LBK, to shorter and wider quern slabs with lighter and shorter grinders to the end of the LBK. In the eastern LBK we seem to find the longest saddle quern slabs and grinders of the LBK (PAVLŮ 2000, this volume).

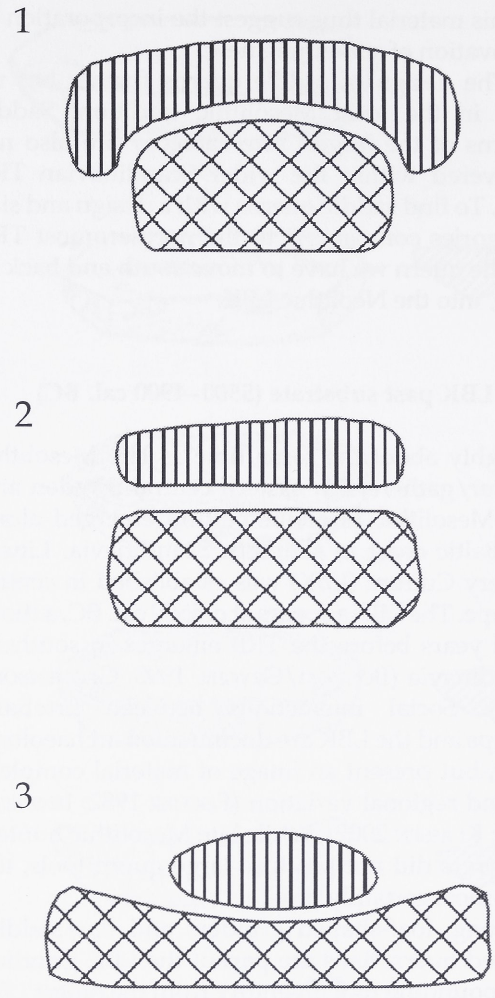

Fig. 6 Andreas Zimmermann's classification of LBK querns forms 1, 2 and 3. Note the convex mid-section of quern slab and beak-shaped grinder ends of form 1 (modified after ZIMMERMANN 1988, 725).

To compare LBK size-dimensions with TRB saddle querns, it can be noted that the size of TRB quern categories to some extent are similar to those of the western LBK area. The largest saddle quern category of the TRB is however far larger than the largest quern size of the western LBK. TRB grind-

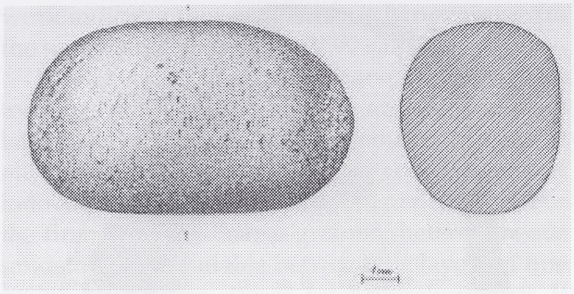

Fig. 7 A pebble grinder with mixed use-wear marks of pecking, crushing and grinding. Pebble grinders come in different size categories but rarely exceed a weight of 500 gram. Drawing: Alicja Grenberger.

ers are also overall much longer. Grinders and quern slabs of the central LBK area show greater similarity in size with the TRB. The largest saddle quern size, as represented at Skogsmossen but also other TRB sites, is however most comparable with the even larger saddle querns in the eastern LBK area.

The similarity in quern tool technology indicates that TRB saddle querns are agricultural objects. A historical connection between the northern TRB area and the LBK area is further made visible. This connection cannot however be understood without an insight into the roughly contemporary late Mesolithic substrate, and the interactions between late Mesolithic Ertebølle groups in southern Scandinvia and farming cultures to the south.

The Mesolithic substrate (5400 - 4000 cal. BC)

Mesolithic Ertebølle groups located along the southern shores of the Baltic Sea in southern Scandinavia were most likely well aware of the agricultural life-style of the LBK. They lived only a short boating-distance (100 km) over the Baltic Sea from by the northern fringe of the LBK (Grygiel/bogucki 1997; Klassen 2002). The water routes most certainly facilitated social interaction between hunter/gatherers and the LBK (Fischer 1982; Jennbert 1984; Gronenborn 1999; Malmer 2002). Domesticated animal bones from late Mesolithic Ertebølle/Ellerbek sites located along the Baltic coast of southern Scandinavia, and the occasional imprints of cereal grains in pottery interpreted as Ertebølle pottery, suggests that agriculture in some shape was incorporated prior to the TRB (Jennbert 1984; Persson 1999). Yet, Ertebølle hunter/gatherers did on the whole not make and use saddle querns. To my knowledge there are no documented finds of saddle querns from the late Mesolithic Ertebølle (Lidström Holmberg in prep.).

A netherstone from the late Mesolithic site Tågerup in Scania has recently been suggested as a saddle quern (Karsten/Knarrström 2003, 178). The eco-material from the site indicates a rich menu of fish, meat and vegetables. The netherstone is thus taken as evidence of a late Mesolithic advance in food production (Mikkelsen 1984; Hayden 1993; Zvelebil 1994). Despite its 'saddle-shaped appearance' this object shows little technological similarity with saddle querns. It is most probably a polishing tool, perhaps also used for wild seeds (Lidström Holmberg in prep.)

The lack of saddle querns however does not mean that Mesolithic grinding and pounding tools does not exist. Certainly, Mesolithic grinding tools are underrepresented in the archaeological record (Zvelebil 1994; Lidström Holmberg 2004). Palaeobotanical studies support plant food consumption in the late Mesolithic (Kubiak-Martens 1999). Grinding and pounding tools have further been used by Mesolithic hunter/gatherers to process ochre and other substances (Sulgostowska 1998).

Four general categories of grinding and pounding tools can be identified from the late Mesolithic of Scandinavia; 1) small, non-modified cobble netherstones, 2) flat and thin irregular netherstones, 3) shallow concave or bowl-shaped netherstones/quern slabs, and 4) hand-sized pebble tools/grinders (Lidström Holmberg 2004).

Cobble netherstones are natural, water rolled stones about 10 cm wide and 15 cm long. Use-wear traits suggest a multiple grinding/crushing use. Microsilica analyses of residues recovered from cobble netherstones suggest a possible function of this grinding tool for the grinding of minerals or shells from shellfish (Risberg et al. 2002, 20) or perhaps edible algae (Persson 1999, 63).

Pebble tools/grinders are found throughout the Mesolithic and Neolithic (Mikkelsen 1984; Lidström Holmberg 2004; Hernek 2005) (**fig. 7**). As indicated by contexts and a mixed use-wear marks of pecking, crushing and grinding found on these artefacts, they were used for a wide variety of practices, including stone tool production. In Danish and Norwegian Stone Age archaeology, pebble tools have however since long been discussed as cereal grinders. Connected with flat netherstones they have further been used as evidence for a late Mesolithic advance in plant processing technique, paving way for the Neolithisation (Müller 1907; Mikkelsen 1984; cf.

HAYDEN 1993). Pebble tools however occur at sites dated well before late Mesolithic, which suggests that pebble tools cannot be approached in terms of a pre-adaptation of agriculture (HERNEK 2005; CF. DE BEAUNE 2000). With its mixed use-wear, there is so far no unswerving support for pebble tools as cereal grinders.

Flat and thin netherstones of various shapes are found at late Mesolithic sites in southern Scandinavia, as well as in Mesolithic Finland (ANDERSEN 1975; MIKKELSEN 1984; ERIKSSON 2007; LINDGREN 2004). The preferred raw material is fine-grained, homogenous sandstone or quartzite. In eastern central Sweden sandstone is available as boulders and in bedrock. Sandstone must have been quarried and brought to the sites. Netherstones sometimes show traces of manufacture by flaking. Flakes from production have however not been identified at Mesolithic sites and the quarries are unknown. Size and shape of flat netherstones are variable, from irregular and rounded to rectangular and with weights from under 1000 gram for fragments up to 15800 gram for intact artefacts. Netherstones display a smooth use-wear caused by circular motions over the slab. A wavy appearance of the use-surface is often caused by this motion (**fig. 8**). Short linear striations with no clear-cut directionality and randomly placed pits sometimes accompany these tools. The latter shows that flat netherstones were used as anvils, for example of bipolar reduction of quartz. The use-surface is not roughened by means of pecking. All netherstones have a flat to concave cross-section, and repeatedly demonstrate a similar use-wear on the two, opposite flat sides. Use-wear traits overall indicate that the netherstones were used for the polishing/grinding of stone or bone tools (cf. GIJN/HOUKES 2006, 178f). The lack of surface-treatment supports this view.

Critical remarks as to the function of flat netherstones have been raised in archaeology. Due to a contextual correlation between netherstones, pebble tools and stone axes at late Mesolithic sites in southern Norway, Egil Mikkelsen (1984, 93) argues that netherstones had a multiple function for the grinding of axes, wild seeds and/or ochre for paint respectively. The hypothesis has hitherto not been backed up by use-wear analysis or other archaeological data. Ethno-archaeological accounts from Australia may be valuable in this respect as flat netherstones with wavy appearance are used for the wet-grinding of wild hard seeds (MULVANEY/KAMMINGA 1999, plate V).

Microsilica analysis of residues recovered from wavy Mesolithic netherstones show traces of grass (ERIKSSON 2007; LIDSTRÖM HOLMBERG in prep.). The use-wear however indicates stone tool polishing. As suggested by ethnological accounts, polishing grass increase the abrasive effects of sandstone polishing tools. Flat netherstones are further often found in contexts close the shore-line or actually placed in the water. Both grass and water would facilitate the polishing of axes. Pecked and polished green stone axes with a rounded body are characteristic for the late Mesolithic of this area (LINDGREN/NORDQVIST 1997, 59f). A rounded axe-body correlates well with use-wear visible on the flat netherstones. Taken together, flat netherstones were most likely used as polishing tools.

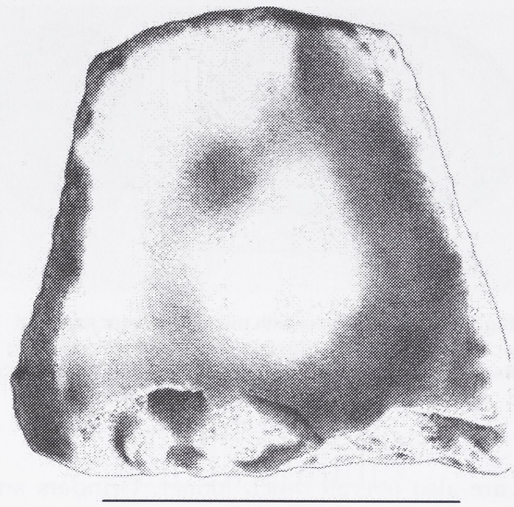

Fig. 8 A late Mesolithic double-sided netherstone of fine-grained sandstone. The shape is produced by flaking. Note the smooth and circular use-wear with raised centre. Scale bar is 20 cm. Drawing: Mattias Petterson / Societas Archaeologica Upsaliensis.

Mesolithic sites dated to before 4500 cal. BC show a contextual relationship between flat netherstones of sandstone, bipolar quartz reduction, pecked and ground green stone axes and sometimes also preforms and flakes from greenstone axe production. Pebble tools are however not contextually correlated with flat netherstones in this area (LINDGREN/NORDQVIST 1997, 61; LINDGREN 2004; CF. MIKKELSEN 1984). Interestingly, a contextual correlation of greenstone axes to flat netherstones is much less apparent at sites dated after 4500 cal. BC, as shown in a thesis by Christina Lindgren (2004, 248ff). After 4500 cal. BC, netherstones are spatially separated from the manufacture of green stone axes, in turn spatially separated from quartz tool production. The separation of technological practices into different areas of work indicates that something is happening with the social technology after 4500 cal. BC.

No investment in netherstone technology or tools resembling saddle querns are noticed in the late Mesolithic. The change in netherstone context may nevertheless be linked to the social process of innovation by which saddle querns emerge. For the first, layers of coarse-grained, heterogeneous sandstone are available between the layers of fine grained sandstone chosen for flat netherstones. It was this material that was chosen by TRB saddle quern makers. It is highly probable that people continued to use these sources in the Neolithic, but for the innovation of a new product - the saddle quern. Secondly, the pecking of axes and the pecking of saddle querns of sandstone into shape constitute the very same manoeuvre of the body. This strengthens the notion of local hunter/gatherers using their knowledge of sandstone, polishing tools and axes to experiment with quern tool manufacture.

Flat netherstones with a wavy use-surface seemingly disappear with the early Neolithic. So does overall the pecked and polished green stone axe with a rounded body. At the latest phase of the late Mesolithic or at the mesolithic-neolithic transition c. 4000 cal. BC, a few shallow bowl-shaped netherstones/quern slabs however come in view. At the same time, the first saddle quern of sandstone appears in the archaeological record, as do TRB pottery and thin-butted axes of flint and greenstone (Hallgren 2000b; Sundström 2003).

Shallow bowl-formed netherstones/quern slabs are only recovered from a few sites in eastern, central Sweden, all which belong to the latest phase of the late Mesolithic or the Mesolithic/Neolithic transition c. 4000 cal. BC (Lidström Holmberg in prep). Of the Mesolithic grinding tool categories discussed, this is the only type of netherstone that can be called a quern slab. A few examples of shallow, bowl-shaped netherstones are also found from the early Neolithic TRB. The raw material is commonly granite/gneiss. Traits of manufacture show that bowl-shaped netherstones are formed with flakes taken along the sides. A bowl-shaped quern slab is round or oval in plan, and can be about 38 × 28 cm in size (**fig. 9**). The used surface is often rather smooth with use-wear striations in different circular directions. This shows that the body motions used with bowl-shaped quern slabs is comparable with flat netherstones used for axe polishing. Use-wear is not possible to differentiate due to the coarse-grained texture of the raw material (cf. Gijn/Houkes 2006, 179f). A multi-purpose function can however be suspected. No

Fig. 9 A bowl-shaped netherstone/quern slab. The used surface is rather smooth with use-wear striations in different circular directions. Photo: Jenny Holm.

direct evidence of pecking or re-roughening of the use-surface is noted. Taking body motions as part of the operational chain, the circular motion suggests continuity into the Mesolithic past of axe manufacture. The circular grinding of both pecked axes and plants further indicates a cross-cutting of technologies and practices. Such cross-cutting coupled with a negotiation of social relations may well be the very vehicle for technical innovation and cultural change.

Bowl-shaped netherstones/quern slabs are occasionally documented at late Mesolithic Ertebølle/early Neolithic TRB sites of the Baltic coast. A few bowl-shaped quern slabs of coarse granite are recovered from the site Wangels in Schleswig-Holstein (Hartz et al. 2002, 328). Cereal grains, one identified as emmer wheat, were further found from a funnel beaker pottery sherd. The site has produced absolute datings assigning it to the final part of Ertebølle and the beginning of Funnel beaker culture c. 4100-3900 cal. BC. The authors see the querns as evidence of agriculture and TRB within this hunter/gatherer area.

Two grinding tools that are possibly part of bowl-shaped querns are further recovered from the late Mesolithic Ertebølle site Löddesborg in Scania (Jennbert 1984, 96). Both are unfortunately collected as stray-finds and lack context. Due to finds of cereal imprints in pottery defined as Ertebølle, the author however suggests that these objects may have been used for the grinding of cereals into porridge, bread or beer. Mesolithic people of southern Scandinvia are further suggest to have adopted cereals as 'fertile' gifts from the LBK area, exchanging these gifts within the social networks of Scandinavian hunter/gatherers. Bowl-shaped quern slabs are also recovered from early Neolithic TRB sites in Scania (Larsson 1984).

It is worth noting to note that the few bowl-shaped netherstones/quern slabs so far recovered from the area of eastern central Sweden, show a contextual connection with hearths and/or house. This is hardly a coincidence. Past changes in spatial context, from netherstones with axe production before 4500 cal. BC, netherstones separated from axe production after 4500 cal. BC, and at c. 4000 cal. BC netherstones next to hearths, are most surely indicative of a transformation of both practice and social relations. A structuring of everyday social relations can be a vital source for wider cultural change (Sahlins 2000). It can thus be suggested that the above contexts can inform on the social process of innovation leading to the introduction of saddle querns, and the active formation of TRB culture (Lidström Holmberg in prep.).

Saddle querns and cultural transformation

Like wavy netherstones, the bowl-shaped quern with its circular body motion soon comes out of sight in this area. Instead, people begin to make and use large saddle querns. The saddle quern becomes the leading tool for the processing of plant foods. A large saddle quern slab with a long grinder is an efficient grinder of cereals, with 1 kg dried cereal grains ground into flour in between 30-45 minutes (Lidström Holmberg 1993; Welinder 1998, 196). As demonstrated by other experimental studies, grinding techniques (rather than pounding) is most beneficial in the processing of cereals (Wright 1994, 242).

Functional analyses of LBK querns add force to the use of large querns for cereal grinding (Hamon 2007). Phytoliths classified as barley-type are also recovered from some TRB saddle querns (Lidström Holmberg in prep.). No doubt large TRB saddle querns were originally manufactured to process the newly incorporated item from the south, cultivated grains.

The innovation of saddle querns further bring about a new body technique. Saddle querns are used with a back-and-forward or reciprocal body movement, in contrast to the circular motions used with flat and bowl-shaped netherstones. Reciprocal body motions were also needed to polish the locally produced thin-butted TRB axe of greenstone. Thin-butted TRB axes show no traces of circular grinding, as do the pecked and ground greenstone axes of the late Mesolithic. With the early Neolithic, the last part of the operational chain of grinding tools as well as axes thus changed.

The earliest TRB saddle quern found was deposited in an up-right position within a hearth located a hut area (Hallgren 1996; Lidström Holmberg 1998). Similar to bowl-shaped quern slabs, the first saddle quern also connects with hearth and house. This combine of new tool design, new body motion, and new contextual relationships indicates the incorporation of much news, but transformed from within the old. One side of the quern slab quern slab was further used for the processing of plant foods, while the opposite side was used for the polishing of axes. This well exemplifies the cross-cutting of new body motions linking thin-butted axes with saddle querns. The small sized quern slab is made of coarse arcosic sandstone. Slightly later TRB saddle querns from this area are also made of this raw material. This suggests the formation of a new tradition of social technology, but with roots in the Mesolithic.

In the somewhat later TRB contexts with finds of saddle querns, the above relationship of querns to hearth and house is much less clear. In fact, the saddle quern now seems to have become part of an active and dynamic negotiation of social relations, with reinforced rites of separation. The Skogsmossen site, with its separation of quern slabs from grinders, axes from quern slabs and spatially ordered offerings of long grinders is a compelling case in point. The dynamic use of saddle querns probably inform on gendered social relations and the cultural orders of the TRB. By this I mean the meaningful ways by which people structured their relations and construed the existence within which individuals and groups could act (Sahlins 2000, 12; Connell 2002, 9). Spatial patterns of separation, made visible also at other TRB sites, can be interpreted as the materialization of inner tensions and perhaps even conflicts within TRB social life. With reference to grinders and quern slabs it seems that at least one cause of tension has to do with the house (Lidström Holmberg in prep.). What may be the cause of such spatial and structural tensions?

Refiguring Life

From studies of the late Mesolithic substrate it can be concluded that Ertebølle hunter/gatherers did not make and use saddle querns, but used other grinding and pounding tools. The same goes for late Mesolithic people in eastern central Sweden. With the co-existing and interaction of Ertebølle culture with different early farming cultures for a time-span of around 1500 years, one has to ask why they did not manufacture and use large querns, especially if some had also started to use cereals for food, porridge or drink.

From an efficiency point of view, it can be argued that hunter/gatherers may be in no need of time-consuming large querns (Wright 1994). Intensified plant food processing does not necessarily need a change in stone technology (Adams 1999, 476). Large grinding tools are not always more efficient than small pounding and grinding tools. Ethnographical accounts indicate that processing and consumption of large quantities of plant foods require tools, but not for any practical necessity large grinding tools. Digging sticks, birch-bowls, pebble stones, bone and stone axes are well suited to process wild plant foods (Lidström Holmberg in prep.).

A practical explanation is however not the only model of understanding the lack of Mesolithic querns. An operational gesture of daily life practice is only reworked if it is considered somehow beneficial to do so. To adopt or invent a new tool, the new technique and its associated practices consequently have to be supported by belief. The survival of a gesture is likewise dependent on the belief invested in it, practically, symbolically and/or ideologically (De Certeau 1988, 202f).

From studies of the LBK substrate we have learnt that saddle querns were manufactured to be used for cereals. The strong contextual connection of LBK querns with the long house, its hearths, lateral ditches and pits has also been mentioned (e.g. Boelicke 1988; Pavlů 2000; Hamon 2004). Associated with the house it is close at hand to suggest that the LBK quern can be taken as practical icon or symbol for house and crops. Southern Scandinavian hunter/gatherers were most likely aware of these connections, through direct contact interaction or story-telling. Most likely, hunter/gatherers saw the LBK as a life-world different from their own, and perhaps as one not supported by hunter/gatherer belief. It is possible but difficult to move around with large querns. The incorporation of this technique would lead to a more settled life. Perhaps the norms and values of the agricultural quern of the house were therefore not at all in accordance with the cultural belief and cuisine of hunter/gatherers doing-cooking and thinking life (De Certeau 1988, 209). Unsupported by belief, practically, socially and ideologically, hunter/gatherers had no need to change their gestures. It is even highly plausible that hunters and gatherers actively came to resist its incorporation (cf. Klassen 2002, 305). As the incorporation of something new always contributes to a transformation of cultural gestures (De Certeau 1988), the choice of not innovating large querns was a wise choice. By an agency of resistance, hunter/gatherers successfully were enabled to modify their life-style slowly and by choice rather than necessity. There came however a point in time when hunter/gatherers came to rapidly refigure both the resistance towards large querns and their way of life.

At 4000 cal. BC, locally manufactured saddle querns were introduced in the northernmost TRB area. By engaging LBK externalities in local configurations, making elements of this external world their own, hunters and gatherers actively sought change (Sahlins 1999, 411). The adoption of very large saddle quern with long, sometimes over-dimensioned grinders used by the house can be seen as a solid sign of this new scheme for change. The shift from resistance of querns, grain, and increased settled life, to the adoption of a large saddle quern symbolising these very values was no easy transformation. Rapid transformation can cause a lot of problems, perhaps especially between people of different generations. Tensions may cause conflicts between past and present, young and old, between those that look back and those that look ahead, between men and women. As hunter/gatherers become the TRB, it is no wonder that spatial rites of separation materialize within early Neolithic social life.

Final comments

Taken together, it has been argued that deeper studies of Mesolithic and Neolithic grinding tools from a social and historical perspective on technology provide insights into cultural formation and change. The social process of innovation leading to the introduction of saddle querns trespass the dichotomy of a Mesolithic and a Neolithic, and connects hunters and gatherers to the becoming of the northernmost TRB. Regional variations in the grinding tool technology of the Scandinavian TRB area suggest that TRB culture was shaped from variations already existing in the Mesolithic. The becoming of the northern TRB was thus not a whole-sale adoption of a Neolithic 'package', but a historical process. Seen from the perspective of saddle querns, the change towards agriculture is rapid rather than gradual. Subtle changes in late Mesolithic contexts of daily social relations however suggest that transformations in social life precede the rapid materialization of the TRB. Having close social interaction with the LBK, southern Scandinavian Ertebølle people form an active link between northern hunter/gatherers and the agricultural world to the south. As hunter/gatherers actively incorporated the saddle quern they used history in the present for a future.

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Object biography and its importance in furthering our understanding of the structured deposition of querns in Neolithic Britain

Sue Watts

Zusammenfassung – Die Kontexte vieler Funde von prähistorischen Fundstellen suggerieren, dass diese nicht einfach entsorgt wurden, sondern absichtlich in bzw. an exakt die Positionen niedergelegt wurden, in denen sie vorzufinden waren. Die absichtliche Platzierung oder Niederlegung von Objekten scheint auch Mahlsteine einzuschließen. In diesem Artikel wird postuliert, dass die „Lebensläufe" bzw. die Biographien der Mahlsteine untersucht werden müssen, um zu einem besseren Verständnis hinsichtlich der Gründe für solche absichtlichen Niederlegungen dieser Gebrauchswerkzeuge zu gelangen. Auch wenn mit Mahlsteinen ein Vielzahl an Produkten generiert werden können, darf die Wichtigkeit für die Verarbeitung der Hauptnahrungsmittel nicht vernachlässigt werden. Die Aufgabe des Mahlens dieser Produkte ist eine wichtige, sozial bedeutungsvolle Handlung, die einen pragmatischen, emotionalen und symbolischen Wert enthält. Diese Handlungen scheinen sich in den absichtlichen Niederlegungen von Mahlsteinen widerzuspiegeln. Die ökonomische Bedeutung von Getreide ist für das britische Neolithikum jedoch schwer einzuschätzen, so dass nach dem derzeitigen Forschungsstand Getreide weniger für eine reguläre Nahrungsmittelgewinnung als eher für besondere Verwendungen angebaut wurde. Es wird daher postuliert, dass sich diese besondere Nutzung – bezogen auf vorgefertigte Muster neolithischer kultureller Praktiken und Glauben – in den absichtlichen Niederlegungen von Mahlsteinen in neolithischen Siedlungen manifestiert.

Schlüsselwörter – Mahlsteine – Biographie von Objekten – absichtliche Niederlegungen – Neolithikum in Britannien

Abstract – The contexts in which many artefacts are found on prehistoric sites suggest that they were not simply discarded but were deliberately placed in the positions in which they were found. This deliberate placement, or structured deposition, of objects also appears to include querns. To gain a better understanding of why such utilitarian tools should have been considered suitable for structured deposition this paper suggests that their life history or biography should be analysed. Although querns can be used to process a variety of products, their importance for grinding staple food stuffs should not be underestimated. The task of grinding these products is a vital, socially meaningful act embodying pragmatic, emotional and symbolic values and it is these values that are thought to be reflected in the structured deposition of querns. However, the economic importance of cereals in Neolithic Britain is difficult to assess and it is now thought that grain was grown for particular uses rather than as a regular food supply. It is suggested, therefore, that it is these especial uses, drawing on pre-established patterns of Neolithic cultural practice and belief, that are made manifest in the structured deposition of querns on Neolithic sites.

Keywords – querns – object biography – structured deposition – Neolithic Britain

Introduction

The condition, context and association of many of the artefacts found on prehistoric sites has prompted the theory that these objects were not simply discarded or abandoned but were deliberately placed in the positions in which they were found for reasons that had meaning to the persons who deposited them. This deliberate placement of objects is often referred to as 'structured deposition', which may be defined as 'patterning in the way that artefacts are found which allows the suggestion that behavioural regularities underlie the way in which they were put in the ground in the first place' (Darvill 2002). The term was first used in Britain by Colin Richards and Julian Thomas in 1984 to explain the nature of the depositions of ceramic, faunal and lithic assemblages within the late Neolithic henge monument at Durrington Walls in Wiltshire (**fig. 1**). They suggested that highly formalised, repetitive modes of behaviour were reflected in the association and context of various artefacts. Such artefacts were imbued with symbolic meaning and their patterns of deposition were governed by underlying rules and structures (Richards/Thomas 1984, 189, 191-192). Although it can be argued that there is a reason for the deposition of all artefacts in the archaeological record, including chance loss, structured deposits are generally deemed to refer to those made with some formality, with particular reference to a place, event or person, rather than casual discards. However, such formal deposition is not easy to prove. Even rubbish, if indeed prehistoric peoples had such a concept, may have been categorised and ordered, which could cause patterning in the archaeological record. It has been suggested, therefore, that rather than create a typology of structured deposits, the phenomenon is perhaps better viewed in more general terms, as being a specific form of social practice, the motive, scale and context of

Fig. 1 Map showing location of sites mentioned in the text. 1 Durrington Walls, 2 Balbridie, 3 Lismore Fields, 4 Skara Brae, 5 Knap of Howar, 6 Wayland's Smithy, 7 Burn Ground, 8 Gwernvale, 9 Hazleton North, 10 Windmill Hill, 11 Briar Hill, 12 Etton, 13 Husbands Bosworth, 14 Milsoms Corner, 15 Deal, 16 Wingham, 17 Maiden Castle, 18 Ness of Gruting.

which was determined by cosmological rules and structures (Bradley 1984, 58; Whittle et al. 1999, 355-358).

It is possible that this form of social practice predates the Neolithic period. It has been suggested, for example, that Mesolithic shell middens may have been erected with some purpose. But the Neolithic period was a time when people first began to build monuments and to dig pits and ditches in the earth and fill them not only with what might today be considered exotic, unusual items but also everyday objects including saddle querns and rubbing stones (Pryor 2003, 100-101, 157). But why should such utilitarian tools have been considered suitable objects for structured deposition? Taking examples mainly from the central and southern half of Britain, this paper, which is based on that given at the European Archaeological Association Conference in Zadar, Croatia in September 2007, looks at the evidence for the structured deposition of querns in the Neolithic period and uses the concept of object biography to further our understanding of how these tools may have functioned within society at that time and why they should have been considered worthy of such special treatment.

The concept of object biography was first put forward by Igor Kopytoff who, through his work on slavery, realised that as saleable commodities, slaves became objects and that all objects, therefore, could have biographies, a life history, just as those slaves did (Kopytoff 1986). Kopytoff's concept of object biography related principally to the trade and exchange of artefacts but the term has now been expanded to incorporate the technical aspects of André Leroi-Gourhan's chaîne opèratoire and the utilitarian processes of Michael Schiffer's behavioral chain and encompasses both the social and ideological aspects of an artefact's 'life' (Hurcombe 2007, 38-43).

Querns are long-lived artefacts and consequently have the potential to be immensely rewarding subjects in the study of object biography (Watts in prep.). There can be few regularly used artefacts whose primary use can span several generations and they can also see several phases of secondary use, as building material, for example, and so there may be many years between the date of a quern's manufacture and the date of its final deposition in the archaeological record. And throughout its life history that quern is enmeshed in a network of associations and relationships with people and other artefacts, any of which may have had a bearing on the location of a quern's ultimate deposition in the archaeological record. Of course, a quern's biography does not end there. Following its excavation, for example, new relationships are created as archaeologists, museum curators and members of the public engage with it. But in the study of structured deposition it is those aspects of a quern's biography prior to its deposition in the archaeological record that are important. For example, how did it come into the community - was it made by someone within that community, was it part of an exchange or dowry? The answers to these questions will probably never be known, although a greater significance could perhaps be inferred on querns of non-local stone. And, within that community, the quern does not operate in isolation but functions as part of a particular social setting, the task of milling being very much associated with women. It is also a key element within the process that transforms a raw material into a usable product (**fig. 2**). Although mainly associated with grinding cereals, there is

Fig. 2 Illustration of a Basuto woman and child showing the quern functioning as part of a particular social setting (after Casalis 1861, 141).

in fact plentiful evidence, ethnological, historical and archaeological, to show that querns can function as tools for grinding a wide variety of products. However, although the physical action of using a quern may be the same for each product, the reason for that action and the meaning behind it, and thus the cultural significance of the function attached to it, is dependent upon what it being ground and why it is being ground. The task of grinding temper for pottery, for example, would carry with it a totally different set of meanings and values compared to that of grinding pigments, as would milling corn for an everyday meal compared to preparing malted grain for brewing beer for a festival.

The importance of querns for grinding staple foods, however, should not be underestimated. The task of grinding such products may be a utilitarian, practical function but in this lies the heart of the quern's raison d'être. The provision of 'daily bread' is synonymous with the continuance of life. The sound of it being used would have been familiar, even comforting. There would have been an almost subliminal relationship between the noise of the stones and the provision of food (Thomson 1877, 526). In this scenario it is easy to understand why, in the Bible, the laws of Moses state that one should not take an upper millstone as a pledge for that is taking a man's life away, and why the absence of the sound of millstones is used as a sign of desolation, symbolic of a place that is uninhabited and forsaken. The task of grinding staple products is, or was, therefore a vital, socially meaningful act, embodying pragmatic, emotional and symbolic values related to gender, fertility, life, death and regeneration and it is these values that are generally thought to be reflected in the structured deposition of querns in the prehistoric period, although such depositions may have had more personal meanings, functioning as expressions of grief, remembrance or an offering.

However, the importance of cereal cultivation in Britain during the Neolithic is difficult to assess for, contrary to popular belief, there is little evidence for domestic settlement and farming for the period. Although certain aspects of Neolithic culture, such as pottery, and large, impressive monuments, such as causewayed enclosures and long barrows, were rapidly adopted by the indigenous Mesolithic population in the period after c 4000 BC, it seems that there was a much slower and more gradual change from hunting and gathering to subsistence farming. Settled agricultural

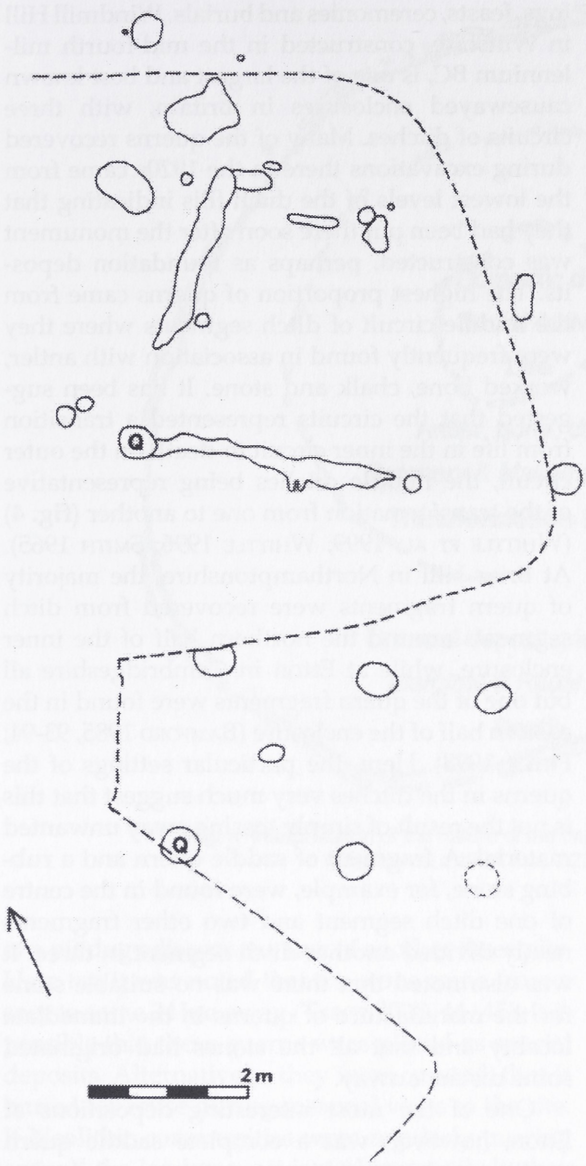

Fig. 3 Plan of the timber structures under the entrance to the long cairn at Gwernvale, Powys. Quern fragments (Q) were found in the south western post holes (after BRITNELL/SAVORY 1984, fig. 14).

communities with permanent field systems do not appear to have become the norm until the Middle Bronze Age, c1700 BC (THOMAS 1999, 16; POLLARD 2002, 10). The remains of large rectangular timber houses have come to light, such as Balbridie in the Grampian Region of Scotland and Lismore Fields in Derbyshire, but the nature of these buildings and their associated material culture has led to the suggestion that these were not simple domestic dwellings but had a more specialist function, perhaps more in the nature of tithe barns (FAIRWEATHER/RALSTON 1993, 317; RICHMOND 1999, 12-13; THORPE 1999, 151-154). Of course there are exceptions and these can be found, for example, on Orkney off the north coast of Scotland, such as the settlements at Skara Brae and Knap of Howar. Here it is suggested that the year round availability of marine resources led to the development of permanent coastal settlements (RICHMOND 1999, 56; POLLARD 2002, 10). But generally, it seems, Neolithic communities continued to live a fairly mobile life style, perhaps following cattle as well as hunting and gathering, with much of their plant diet, as evidenced by carbonised plant remains, continuing to come from gathered sources. That is not to say that cereals were not grown and indeed recent research has shown just how widespread the adoption and cultivation of cereals was across the British Isles in the earlier Neolithic period (BROWN 2007). But, although the same patterns of cultivation should not be envisaged across the country, it is now thought that grain was generally grown on a small scale, in garden sized patches of land. It is possible that, as in some mobile communities today, such cultivation formed part of the annual cycle of hunting and gathering. The Hamer of Ethiopia, for example, are primarily cattle herders but plant crops at the start of the rainy season before moving on their seasonal nomadic journeys (THOMAS 1999, 25; PESSOLANA 2007).

Such small scale cultivation may have been intended as a means of extending the range of naturally available resources, rather than as a regular food supply. Alternatively, domestic crops may have been considered a symbolic or social resource, grown as a status symbol, for exchange or obvious consumption, or for more esoteric reasons, for use in particular ceremonies and events (POLLARD 2002, 10; FAIRBAIRN 1999, 151-156; THOMAS 1999, 25). It has been suggested that the importance of alcoholic drink to prehistoric communities and its potential role in ceremonial and ritual events should not be underestimated. It would have been a valuable resource, playing a key role in hospitality, providing a context for sharing, creating social links and obligations (DINELEY 1996, 6; SØRENSEN 2000, 118). But special foods made from ground meal could also have been used to similar, if less intoxicating, effect. And in either case querns would have been important tools for grinding the raw products. Evidence for cereal cultivation, in the form of carbonised grain or impressions on pottery, comes primarily from monumental or special sites (THOMAS 1999, 24-25; RICHMOND 1999, 41-42). And it is on these sites that evidence for the structured deposition of querns is also found, although interestingly it seems that they are not generally found in association with the henge monuments of the later Neolithic period, a point that will be returned to below.

Excavations at a number of long barrows, dating to the fourth millennium BC, have produced fragments of querns. Wayland's Smithy in Oxfordshire actually comprises two barrows - a small barrow incorporated within a later, larger monument. Quern fragments were found in association with both barrows, including fragments amongst packing stones in the northern-most post hole and in the pavement of the earlier tomb. Another fragment had been used as a packing stone for the west jamb of the chamber entrance of the later monument (WHITTLE 1991, 87). The most significant find within the long barrow at Burn Ground, Hampnett, Gloucestershire was a large fragment of saddle quern embedded in the floor of the cairn on the north side of the main chamber (GRIMES 1960, 75). At Gwernvale, Powys in South Wales two fragments of quern were incorporated into the mass of stones that made up the cairn. Of more significance perhaps, however, are the two fragments found in postholes of the timber structure(s) that probably predated the barrow. It is surely more than coincidence that both fragments were placed in the south-west corners of the structures (**fig. 3**) (BRITNELL/SAVORY 1984, 134). It is possible that the quern fragments derive from deposits associated with activity on the sites before the barrows was constructed. Evidence for pre-barrow activity has been found on a number of sites including Wayland's Smithy and Gwernvale. And at Hazleton North in Gloucestershire, although no fragments of quern were found in the barrow itself, the fragmentary remains of at least two saddle querns were found in the midden beneath. It was suggested that the pieces were deliberately chosen for incorporation within the midden (SAVILLE 1990, 178). If the quern fragments found in long barrows did derive from prior activity then although they may have been simply picked up and reused, it must also be considered that they were deliberately collected, perhaps for use as symbols or links with the ancestors or with the continuity of the sites themselves.

Saddle querns and rubbing stones are also found in the ditch segments of causewayed enclosures. Causewayed enclosures, so called for the gaps or causeways across their circuits of ditches, appear to have been important foci in the landscape, places of temporary settlement, for meetings, feasts, ceremonies and burials. Windmill Hill in Wiltshire, constructed in the mid-fourth millennium BC, is one of the largest and best known causewayed enclosures in Britain, with three circuits of ditches. Many of the querns recovered during excavations there in the 1920s came from the lowest levels of the ditch fills indicating that they had been put there soon after the monument was constructed, perhaps as foundation deposits. The highest proportion of querns came from the middle circuit of ditch segments where they were frequently found in association with antler, worked bone, chalk and stone. It has been suggested that the circuits represented a transition from life in the inner circuit to death on the outer circuit, the middle ditches being representative of the transformation from one to another (**fig. 4**) (WHITTLE ET AL. 1999; WHITTLE 1996; SMITH 1965). At Briar Hill in Northamptonshire, the majority of quern fragments were recovered from ditch segments around the northern half of the inner enclosure, while at Etton in Cambridgeshire all but one of the quern fragments were found in the eastern half of the enclosure (BAMFORD 1985, 93-94; PRYOR 1998). Here, the particular settings of the querns in the ditches very much suggest that this is not the result of simply tossing away unwanted material. A fragment of saddle quern and a rubbing stone, for example, were found in the centre of one ditch segment and two other fragments neatly divided another ditch segment in three. It was also noted that there was no suitable stone for the manufacture of querns in the immediate locality and that all the stones had originated some distance away.

One of the most interesting depositions at Etton, however, was a complete saddle quern and its matching rubbing stone in a specially dug pit, within the interior of the enclosure (**fig. 5**). The rubbing stone had been placed working side down at the bottom of the pit with the saddle quern above it, on its side. Another complete saddle quern was found inverted in a small waterlogged pit on the western side of the enclosure. In each case the stones had been placed in positions in which they would not have been used (PRYOR 1998, 103; 107).

Pits containing complete saddle querns have also been found on other sites. Two pits to the north of the causewayed enclosure at Husbands Bosworth in Leicestershire, for example, each contained a saddle quern, one of which had been placed on its side (ULAS 2007; M. BEAMISH PERS. COMM.). And at Milsoms Corner in Somerset a saddle quern was placed face down at the bottom

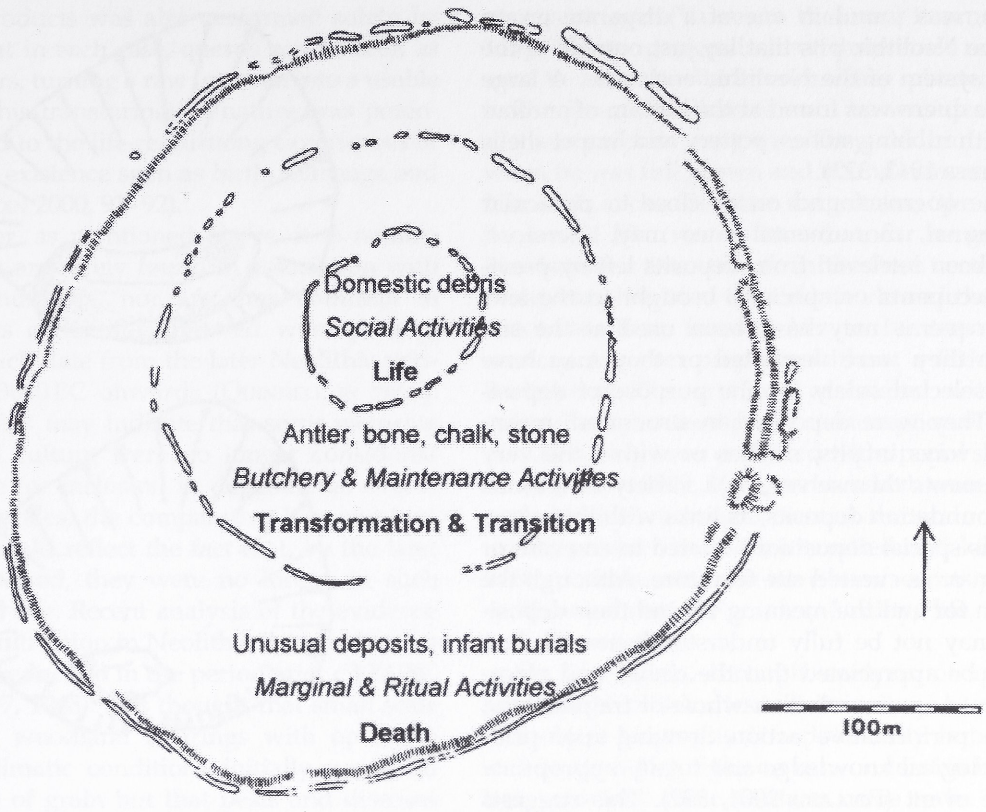

Fig. 4 Interpretation of the nature of the deposits in the ditches at Windmill Hill, Wiltshire (after Whittle 1996, Fig. 7.25; Whittle et al. 1999, fig. 14).

of a pit dug adjacent to a line of another three pits. Here too it was noted that the stone came from a source some 24 km away (Tabor 2008, 44-45). It is possible that these querns were placed as special deposits. Alternatively, they were curated, that is buried for reuse during seasonal visits to the site. If Neolithic communities were regularly moving around the landscape, it is perhaps unlikely they would have taken such heavy tools with them but would have left them at convenient locations. Some Australian aboriginal women, for example, often leave their grinding tools at campsites they expect to visit again (Gould/Koster/Sontz 1971, 164).

The majority of Neolithic pits are thought to have fulfilled special, non-utilitarian functions, being dug just for the purpose of placing various artefacts in them and they changed in character and meaning over time. Pits of the earlier Neolithic are considered to basically commemorate events – some pit fills, for example, are thought to represent formalised acts undertaken on leaving a site and as such pre-empt the abandonment processes seen in the deliberate demolition and infilling of round houses in the Bronze Age. By the later Neolithic pit digging is thought to have been an event in itself (Thomas 1999, 64; Richmond 1999, 45-46; Pollard 2001, 323-325). Some pits, like those at Etton and Milsoms Corner mentioned above, appear to have been specially dug for the querns placed within them and as such contrast with those that contain fragments of quern in association with other, sometimes unusual, artefacts. Two of the other three pits at Milsoms Corner contained fragments of saddle quern and rubbing stone together with flints, burnt bone, charcoal, hazelnut shells, pottery and lumps of half-baked clay (Tabor 2008, 44-45). At Deal in Kent, five pots were found neatly arranged at the bottom of a 1.2m deep conical pit with a rubbing stone placed in the central one. Rough flints were packed around the pots and half way up the pit fill was a layer of flint flakes (Dunning 1966, 1-4). The combination of artefacts found in a pit at Wingham, also in Kent, included a fragment of saddle quern, a rubbing stone, pottery, flint, animal bone, an antler bone and a bone awl (Greenfield 1960, 66). And at Maiden Castle, Dorset, a chalk figurine, together with pottery, scallop shells and a fragment of saddle quern, was found in one of a disparate group of nine Neolithic pits that lay just outside of the ditch system of the Neolithic enclosure. A large saddle quern was found at the bottom of another pit with rubbing stones, pottery and limpet shells (Wheeler 1943, 322).

The querns found on or close to particular communal, monumental sites may, therefore, have been retrieved from deposits left by previous occupants or specially brought to the site. Some querns may have been used at the site before they were deposited or they may have been selected solely for the purpose of deposition. They were deposited in structured, meaningful ways in pits, ditches or within the very monuments themselves for a variety of reasons – as foundation deposits, as links with the ancestors, as special depositions related to an event or person or as curated site furniture. Although the reason for and the meaning behind their deposition may not be fully understood, nevertheless it can be appreciated that the choice and placement of a quern, whether whole or fragmentary, was a 'performative' action, drawing upon prior cosmological knowledge and totally appropriate to the event (Pollard 2001, 322). This suggests that querns had a particular cultural significance within Neolithic society and it is tempting to link this significance with the new crops.

However, these querns could have been for processing products other than grain, such as wild plant resources. But such resources would also have been utilised during the Mesolithic period and as yet there is little evidence for Mesolithic querns. It is possible that they have not been found yet, or it may well be that some Neolithic querns are in fact Mesolithic in origin. But the overall impression is that, although they may well have been used for processing a variety of food stuffs, querns did not become common tools until the Neolithic period. Querns may also have been used for grinding temper for pottery, an important aspect of Neolithic material culture. The association of half-baked clay and quern fragments in pits was noted above. A large saddle quern found in the settlement at Knap of Howar on Papa Westray, Orkney with two rubbing stones and a pile of broken shells beside it is thought to have been used for grinding the shells for use as temper (Ritchie 1983, 43). However, evidence was also found for the cultivation of cereals together with other saddle querns. If, as this suggests, querns were utilised for grinding a variety of different products then their significance to Neolithic communities may have lain

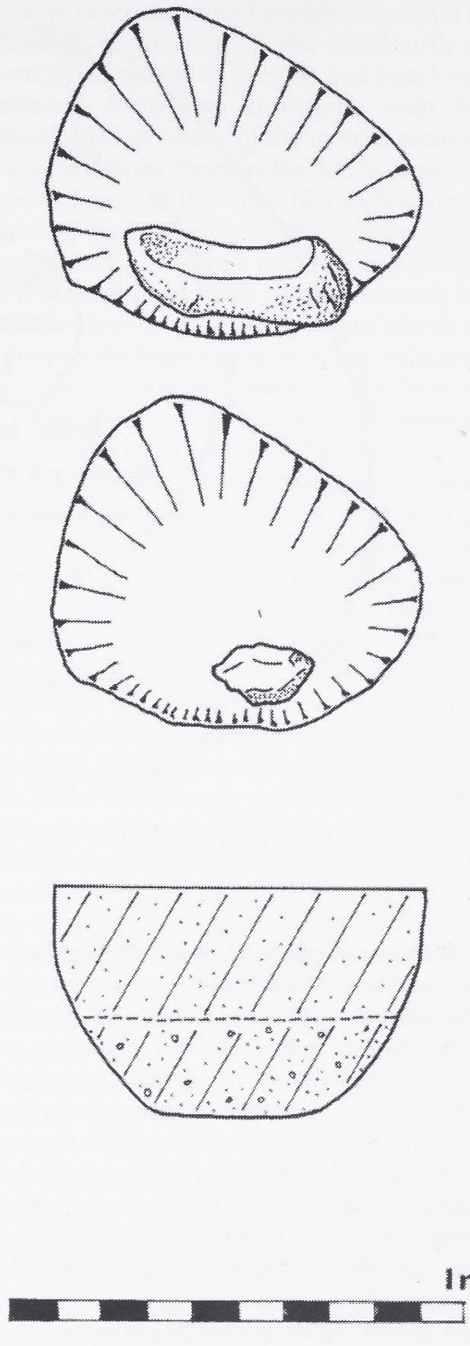

Fig. 5 Pit F711 in the causewayed enclosure at Etton, Cambridgeshire showing the rubbing stone at the bottom of the pit with the saddle quern turned on its side above it (after Pryor 1988, fig. 111).

in some generic quality rather than their being associated with one particular function. Although ethnographic, historical and archaeological evidence all point towards the processing of food stuffs being a female preserve, it cannot be stated with any degree of certainty that the grinding of other products was also performed solely by women. But in each case, querns can be seen as transformers, turning a raw material into a usable product. This transformative nature was potentially linked to the life-reaffirming experiences of the human existence such as birth, marriage and death (Fendin 2000, 91-92).

However, as mentioned above, it is notable that querns are rarely found in association with henge monuments, nor are they common in pit deposits containing grooved ware pottery, both of which date from the later Neolithic period, about 3000 BC onwards (Quinnell in prep.). Although this may indicate that some elements of material culture were no longer considered appropriate for inclusion in depositional events at certain locales, the comparative low numbers of querns could reflect the fact that, by the later Neolithic period, they were no longer in such widespread use. Recent analysis of the evidence for cereal cultivation in Neolithic Britain shows a significant reduction in the period after c 3000 BC (Brown 2007, 1048). It is thought that small scale farming in woodland clearings with optimum soil and climatic conditions initially produced high yields of grain but that pests and diseases subsequently evolved which, together with other environmental and cultural factors, significantly impacted on yields (Dark/Gent 2001; Brown 2007, 1050). The general lack of querns on later Neolithic sites suggests, therefore, that, although querns may have been used for grinding pottery temper and other products, their particular cultural significance lay in their association with grain. This association is well illustrated at Ness of Gruting, on Shetland, where some 14 kg of carbonised barley were found beside the inverted half of a saddle quern in the wall core of a house (Calder 1955-56, 353).

It has been suggested above that the importance of cereals to Neolithic society in Britain was as a special element within a broader economy that was still largely based on hunter-gathering (Richmond 1999, 42). Crops may have been grown as a status symbol or for symbolic use, for consumption, perhaps in the form of an alcoholic beverage, at particular ceremonies and events. The traditional symbolical link between grain and fertility, life and death may derive from this time, indeed it was possibly a pre-existing belief, introduced as part of the overall Neolithic cultural package. This belief is echoed in an old English folksong, 'John Barleycorn', the origins of which are obscure but which may be a survival of a myth surrounding the slaying and resurrection of a corn god (Vaughan Williams/Lloyd 1959, 116). The song records how three men made a vow to kill John Barleycorn. They planted him in the ground and were sure he was dead but to their surprise he grew. They cut him down when he was full grown and bound him and beat him with sticks. But, the song states, 'the miller he served him worse than that, for he ground him between two stones'. In the final verse John Barleycorn has been turned into ale and the song concludes that, from tinker to huntsman, no one can function properly without a little John Barleycorn. The artefacts associated with the cultivation, processing and consumption of grain may also have been endowed with special significance (Watts 2002, 26). Querns, which were used, probably by women, to convert the grain into a usable product but which crushed and killed it in the process, may also have been seen as potent symbols relating to gender, fertility, life, death and regeneration.

In conclusion, through analysis of querns found on Neolithic sites in Britain, it can be shown that object biography is a potentially important tool in shedding light on our understanding of how and why these artefacts came to be in the positions in which they are found in the archaeological record. It can be shown that querns were brought to certain sites, often from some considerable distance away, or retrieved from previous occupations, and deposited in pits and ditches in structured, meaningful ways. This suggests that they held a significant place in Neolithic society. The apparent link between the lack of querns on later Neolithic sites and a reduction in cereal cultivation in c 3000 BC implies that this significance lay in their function as tools for grinding grain and it is this particular role that is reflected in their structured deposition. It has been suggested that cereals were originally grown in Britain for special uses rather than as a regular food supply. It is these uses, drawing on pre-established patterns of practice and belief associated with fertility, life and death that are made manifest in the structured deposition of querns, artefacts which are intimately connected with the transformation of grain from raw material to life-giving sustenance.

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Caroline Hamon & Jan Graefe (eds.)
New Perspectives on Querns in Neolithic Societies

Since the time of the first neolithics, cereals were ground to flour by querns. Together with the domestication and breeding of animals, the cultivation and processing of plants was one of the basis of the new agrarian way of life. However, the concrete exploration of the basic aspects of cereals processing has only emerged in the last fifteen years. Today, the study of grindingtools contributes largely to our knowledge of neolithic economy and social organization. The multiplication of studies at a more or less regional scale has purchased new data concerning the circulation of raw materials, the economy of subsistance or the social and symbolic value of querns. The papers aim at sharing and discussing the new perspectives of such studies on querns in neolithic societies from all over Europe. They were presented at a session of the 13th annual meeting of the European Association of Archaeologists (EAA) in September 2007 in Zadar (Croatia). The presentations demonstrate how a global survey of grindingtool aspects can bring further elements for the interpretation of the status and function of a site. They also point out the importance of the context of quern discovery and the necessity of a pluridisciplinary approach in which quern study must be involved.

Seit der Zeit der ersten neolithischen Gesellschaften wird das Korn der angebauten Kulturpflanzen mittels Mahlsteinen zu Mehl verarbeitet. Grundlage einer agrarischen Lebensweise stellt die Domestikation und Zucht von Tieren, sowie der Anbau und die Verarbeitung von Kulturpflanzen dar. Erst innerhalb der letzen fünfzehn Jahre konnten grundlegende Aspekte der Pflanzenverarbeitung geklärt werden. Untersuchungen zu Mahl- und Schleifsteinen tragen zum Verständnis und Wissen neolithischer Wirtschaftsformen und sozialer Organisation bei. Durch neue mehr oder weniger regionale Studien wurden neue Daten gewonnen, die Aussagen zu Austauschsystemen der Rohmaterialien, die wirtschaftlichen Grundlagen oder auch die soziale und symbolische Bedeutung der Mahlsteine ermöglichen. Die Artikel resultieren aus einer Sitzung, die im Rahmen des 13th annual meeting of the European Association of Archaeologists (EAA), im September 2007 in Zadar (Kroatien) stattgefunden hat. Thema der Sitzung war „New perspectives on querns in neolithic societies". Innerhalb dieser Sitzung wurden neue Ansätze und Perspektiven für Untersuchungen von neolithischen Mahl- und Schleifsteinen aus ganz Europa diskutiert. Die Ausätze zeigen, dass durch einen globalen Überblick zu Mahl- und Schleifsteinen wichtige Beiträge für die Interpretation des Status und der Funktion eines Fundplatzes geliefert werden können. Ebenfalls wird die Wichtigkeit der Kontextzusammenhänge der Mahlsteine während ihrer Auffindung und die Notwendigkeit eines interdisziplinären Ansatzes von entsprechenden Studien, ersichtlich.

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Die DGUF gibt regelmäßig die Zeitschrift Archäologische Informationen heraus, die jedes Mitglied kostenlos erhält. In loser Folge erscheinen zumeist monographische Bearbeitungen archäologisch-historischer Themen als Archäologische Berichte. Anlässlich des 25. Jahrestages ihrer Gründung hat die DGUF 1994 beschlossen, zukünftig regelmäßig den Deutschen Archäologiepreis zu vergeben. Durch ihn sollen herausragende Leistungen auf dem Gebiet der Vermittlung archäologischer Sachverhalte, der archäologischen Forschung sowie der Entwicklung und des Ausbaus der für die Archäologie wichtigen Methoden gewürdigt werden. Dieser Preis wurde 1999 das erste Mal verliehen. Preisträger waren Herr Prof. Dr. Irwin Scollar und Frau Dipl. Math. Irmela Herzog. Im Jahr 2002 wurde der Preis an die 'Jungen Archäologen der Altmark', im Jahr 2004 an die Archäobotanische Arbeitsgruppe NRW vergeben.
Die DGUF wendet sich an Facharchäologen, lädt aber auch die Freunde und Förderer der Archäologie zur Mitarbeit ein. Sie bietet ein Forum für Gedankenaustausch und Zusammenarbeit.

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