

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 funktionalen 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 – Gebrauchsspurenanalyse – 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 iden-

tification 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).

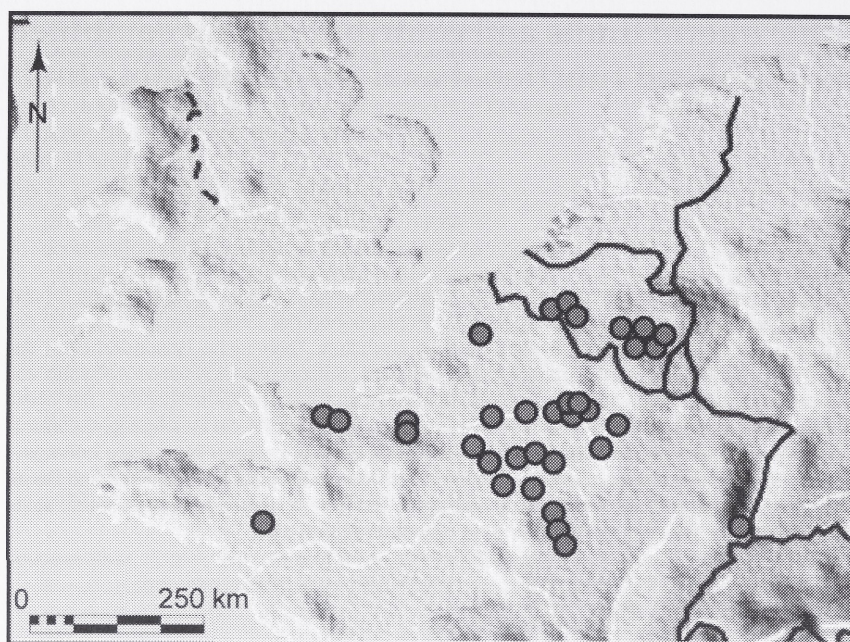


Fig. 1 Map of localisation of Linearbandkeramik and Villeneuve-Saint-Germain sites studied in the Paris Basin and Belgium.

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 equipment 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 prejudicial 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 marriage, foundation of a new home or inheritance between mother and daughter 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 vari-

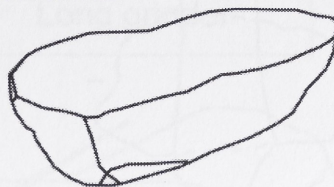
ous raw materials such as flint, bone or wood, but only two surfaces are in contact: the tool active surface and the matter to transform. This is not the case for grinding activities. Grinding actions involve at least three matters in contact: the active surfaces of the quern and grinder working in pairs 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.

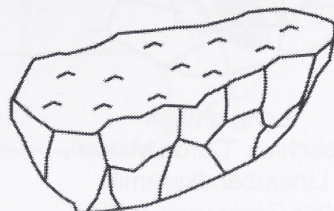
The long duration of use of querns and grinders is also an important parameter to take into account for a functional analysis. It implies several states of use and a progressive distortion of the initial morphology of the tools. Besides, and according to several ethnographic examples (DAVID 1998), querns 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.

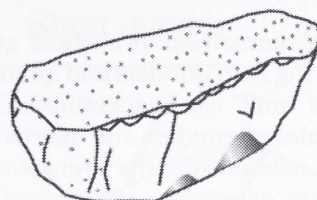
Raw material



Shaping



Use



Rejection

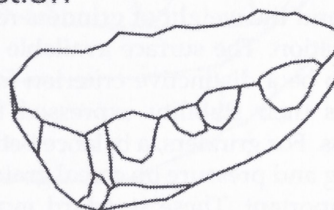
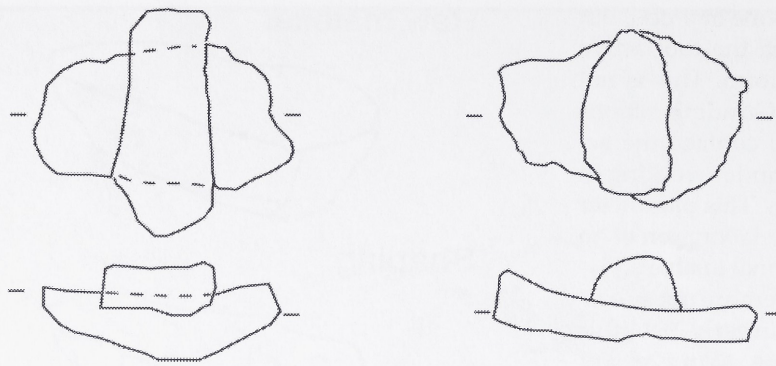


Fig. 2 Sequence of shaping of Linearbandkeramik and Villeneuve-Saint-Germain querns and grinders (after HAMON 2006).

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 cycles 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 equipment. 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 equipment generally implies the progres-

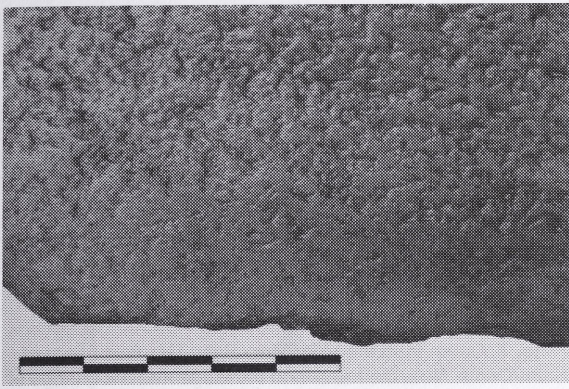


Fig. 4 Partial repecking of the active surface of a quern (photograph: C. Hamon).

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 exaggerated hollowing of the central part of a quern, its ends and sides must be reduced by flaking. A regular repecking may also have slowed 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

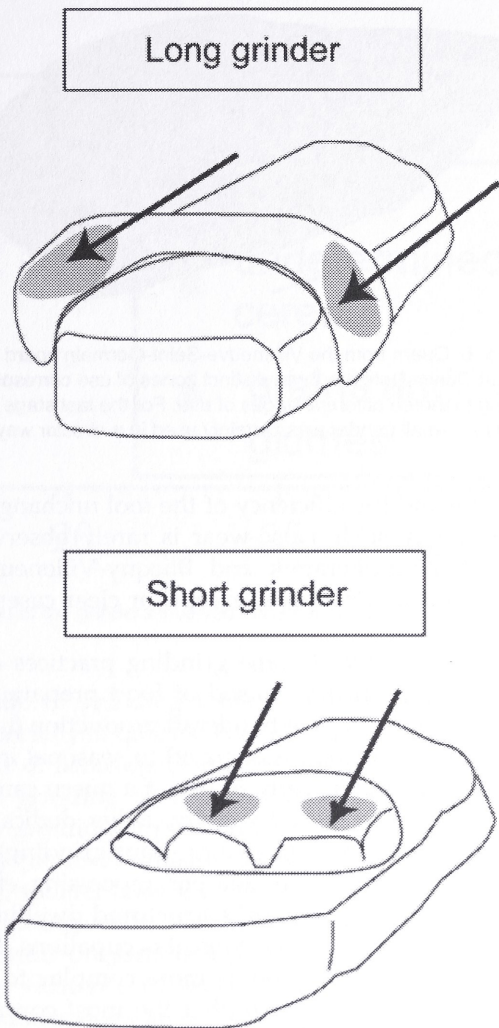


Fig. 5 Localisation of the handling zone and representation of the pressure put on both types of grinders.

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

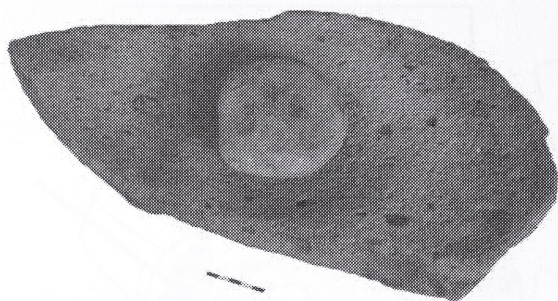


Fig. 6 Quern from the Villeneuve-Saint-Germain hoard of Saint-Denis. Note the three distinct zones of use corresponding to three different stages of use. For the last stage of use a small grinder was certainly used in a circular way.

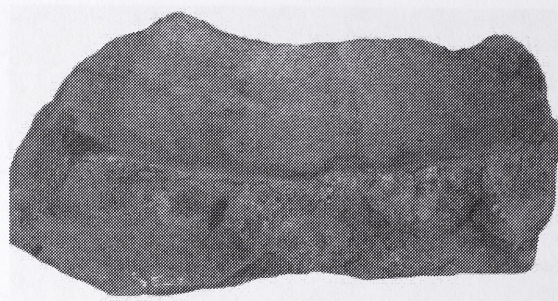


Fig. 7 Quern from the Villeneuve-Saint-Germain hoard of Saint-Denis. Note the transversal breakage and the change of orientation of the tool.

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"

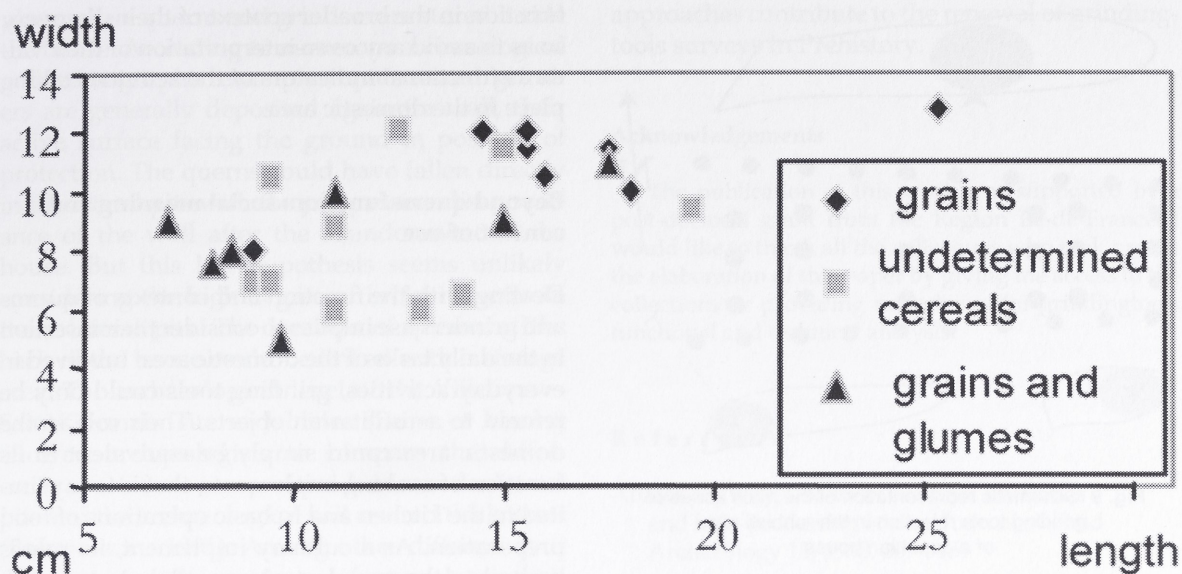


Fig. 8 Correlation between the dimensions and the function of the grinders involved in cereal processing.

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 analysis, 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 thick, 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.

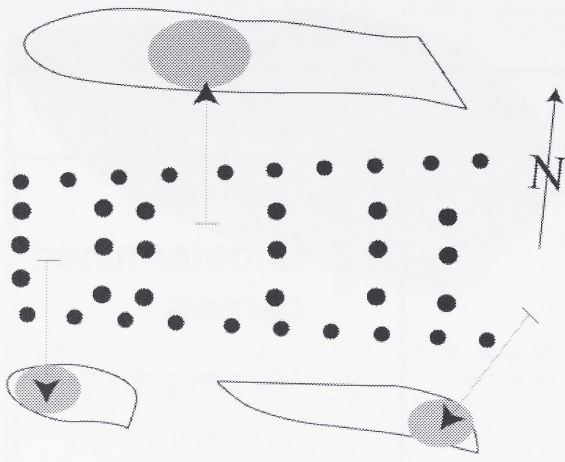


Fig. 9 Schematic representation of the main zones of grinding tools rejection in the rubbish pits of a danubian house.

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 episodes. 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 referred 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 grindingtools surveys in Prehistory.

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