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CERAMIC SIEVES OF THE LINEAR POTTERY CULTURE AND THEIR ECONOMIC IMPLICATIONS

Summary: *Fragments of ceramic sieves constitute a widespread, but little-known element in the ceramic inventories of Linear Pottery sites in temperate Europe. These sieves appear to have functioned as strainers for separating curds from whey in cheese production, on the basis of parallels with later archaeological cultures and ethnographic examples. Archaeozoological data support the hypothesis that dairy production has a greater antiquity than has been hitherto accepted. The sieves played an important role in early dairy production, for the manufacture of cheese was an essential step in the exploitation of milk by populations who possibly had a high level of lactose intolerance.*

The antiquity of dairying is a problem which has received scant archaeological attention, yet which is crucial to the understanding of prehistoric animal exploitation in the Old World. The keeping of animals for their milk leads to an entirely different set of economic relationships from those conditioned by the carnivorous exploitation of domestic stock, with corresponding implications for human social organisation (Ingold 1980, 176). Until recently, most of the available evidence for the earliest dairying in the Near East and Europe has been iconographic (eg from fourth millennium BC contexts at Uruk) and from the interpretation of certain container forms as having been associated with milk handling (Sherratt 1981, 275–82). As a result, it has been hitherto difficult to establish that the milk from domestic animals was exploited earlier than the fourth millennium BC in the Near East and the third millennium BC in Europe. Recently, however, attention has been called to the fact that data on faunal remains from earlier European Neolithic sites provide indications of an even greater antiquity for dairy production (Sakellaridis 1979; Bogucki 1982; Sherratt 1983). Especially crucial are the age and mortality profiles of the animal populations. It is the aim of this paper to corroborate these faunal data by focusing on a particular class of artifact associated with them, the ceramic sieves found at sites of the Linear Pottery culture in central Europe.

Sites of the Linear Pottery culture (*Linearbandkeramik*) are distributed across a wide area of temperate Europe from the Ukraine to France and from Hungary almost to the Baltic Sea. This culture appears to represent one of the few documentable demographic expansions of a unified cultural entity in prehistoric Europe, for its house forms, stone tools, pottery, and

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settlement locations differ completely from those of the indigenous hunter–gatherer populations in this area (Tringham 1968; Hamond 1981). The earliest radiocarbon dates for Linear Pottery from Hungary fall around 4600 bc (ca 5400 BC), and those from Poland and Germany begin only a century or two later (Quitta 1967; Bogucki in press a). Since Linear Pottery settlements are generally found in proximity to the loess soils of central Europe (although not in the case of northern Poland and the Paris Basin), it has been generally assumed that the cultivation of grain crops constituted the primary subsistence base of this culture and that domestic animals played a decidedly subsidiary role (eg Kruk 1980, 359; but see Jarman, Bailey, and Jarman 1982, 255 for a different point-of-view). Moreover, it has also been believed that the cattle, sheep, and goats kept by Linear Pottery communities were used solely for their meat (and other slaughter products such as hide and bone) and that the possible intolerance of lactose by the Neolithic peoples of Europe precluded the use of their milk (eg Milisauskas 1978, 71; Sherratt 1981, 276–7).

It is in this context that it would be worthwhile to examine a neglected Linear Pottery artifact type, the ceramic sieve. Archaeologists working at Linear Pottery settlements in central Europe have often come across sherds which are perforated by many small holes. Usually, one or two such sherds are encountered at any single site, if they are found at all. Since they lack decoration, they are usually relegated to catch-all *Sonderformen* categories and buried at the end of site reports. The sieve (*Siebgefässe*) sherds are by no means ubiquitous. Many large sites which have yielded the most extensive (and hence the best-studied) collections of Linear Pottery ceramics have produced no such sherds. On the other hand, smaller sites mentioned only in short notices in regional journals often include sieve sherds in their small assemblages. These factors have combined to make Linear Pottery ceramic sieves a poorly-known artifact category, but when viewed in light of an increasing body of empirical data on Linear Pottery subsistence, such sherds take on new implications for the understanding of the Early Neolithic economy in central Europe.

LINEAR POTTERY SIEVES AND THEIR GEOGRAPHICAL DISTRIBUTION

Linear Pottery sieves are represented almost exclusively by small body-sherds which occur as isolated examples in rubbish pits or the humus overlying them. Rim and base fragments are rare, and as such, it has been generally impossible to reconstruct the original vessel forms (although some partial bell-like shapes have been suggested (Fig. 1 and Gabałówna 1963; Hoffmann 1963)). Linear Pottery ceramics are often divided into two major categories: a fine ware which is decorated with the incised lines which give the culture its name and a coarser utility ware. Sieves were manufactured from both pastes, although they lack the incised decoration when executed in the fine variety. The holes which provide the sieve effect are generally 2–3 mm in diameter and are distributed in a dense, but random, pattern over the area of the sherd. Some perforated bases are known (Fig. 1–d). Although the perforations are not found in structurally-important areas of the vessel, such as close to the rim or at the wall-base angle, they do not appear to have formed any decorative patterns themselves, either on the walls or the bases.

The actual method of producing the holes requires further investigation. One possi-

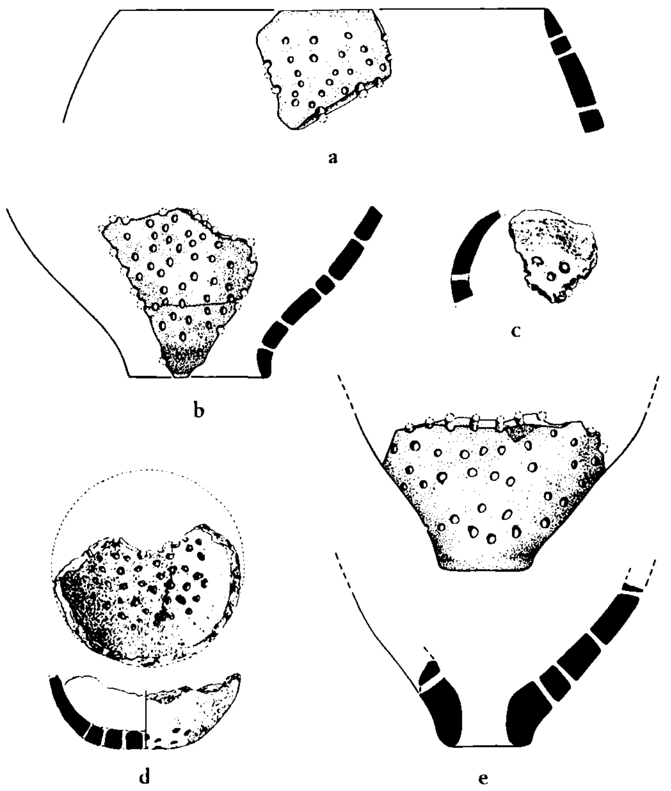
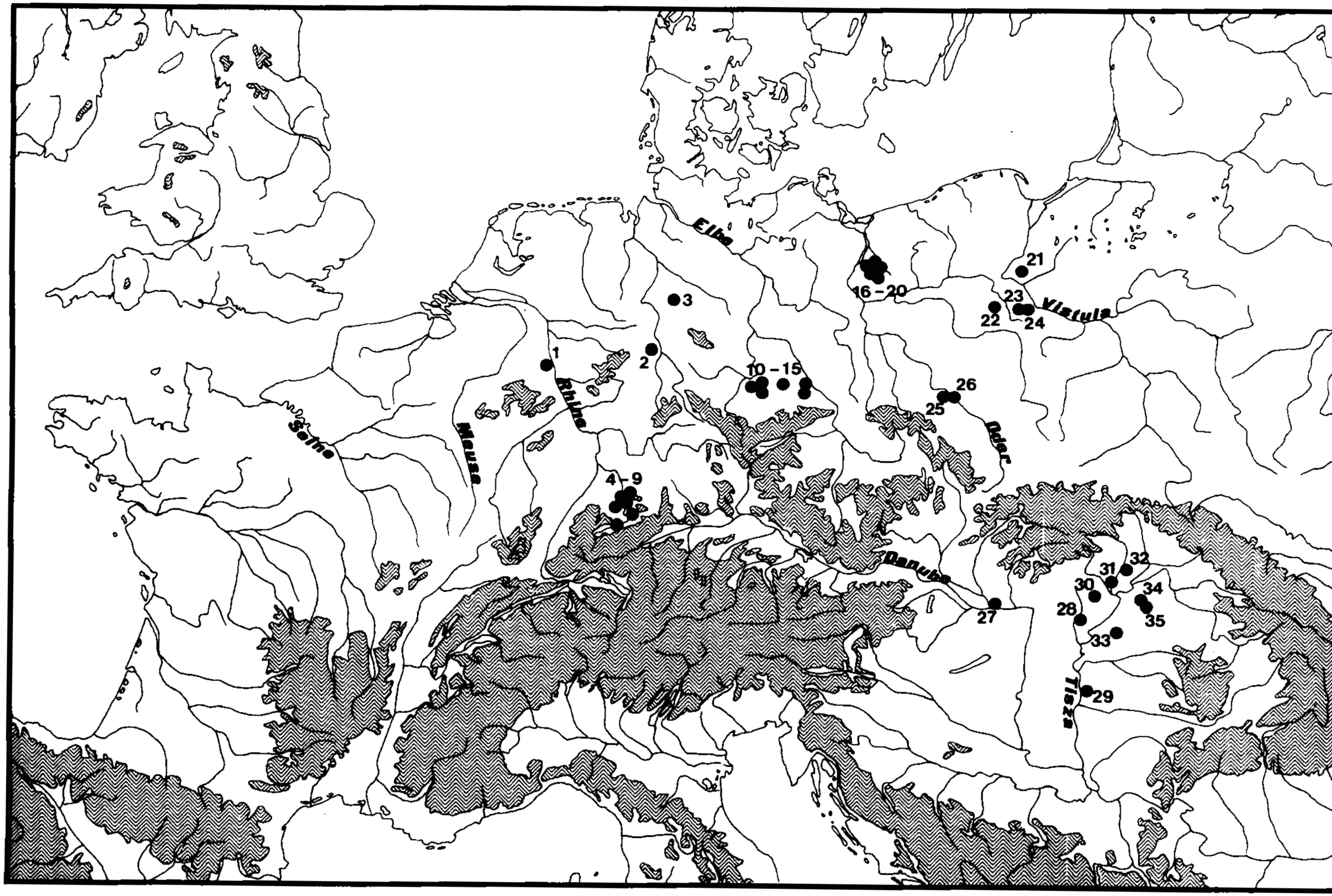


Figure 1
Linear Pottery ceramic sieves. Legend: a, b, e—Brześć Kujawski, PL (1:2); c—Murr, D (1:4); d—Ditzingen-Schöckingen, D (1:4). Note: b and e are NOT mistakenly inverted, but rather are portrayed so as to depict the funnel-like shape reconstructed by Gabalówna (1963) for similar Linear Pottery sieves from Radziejów, PL.

bility is that the holes were made while the pot was in the process of drying prior to firing, simply by poking holes through the stiff clay using a twig or bone. It would seem, however, that this technique would have led to an increased possibility that the pot would fracture or deform during firing. Another possible technique would have been to insert pieces of twigs, or even straw, through the walls of the pot shortly after it had been formed, allowing it to dry with these in place, and then firing the pot. The twigs or straw would be carbonised during firing, or at least easily pulled out of the hardened pot after the clay had shrunk away from around the holes. In no cases do the holes appear to have been made by drilling after the pot was fired. The technology of the Linear Pottery sieves is one area where fruitful experimental research might be carried out.

Since the Linear Pottery sieve sherds lack the characteristic incised decoration of the Linear Pottery fine ware, and since rims and bases with perforations are rare, sieve sherds are often briefly mentioned (with



Distribution of Linear Pottery sieves in temperate Europe (1:20,000,000). Hatched areas indicate elevations greater than 500 metres above sea level. Legend: 1—Köln-Lindenthal; 2—Metze; 3—Hanover-Duderstadt; 4—Hemmingen; 5—Ditzingen-Schöckingen; 6—Murr; 7—Neuhausen auf den Fildern; 8—Schöckingen; 9—Unterjesingen; 10—Rositz; 11—Molbitz; 12—Nobitz; 13—Döhlen; 14—Birmenitz; 15—Pitschütz; 16—Kluczewo; 17—Skrzany; 18—Zalecino; 19—Skalin; 20—Ukiernica; 21—Chelmza; 22—Strzelce; 23—Radziejów; 24—Brześć Kujawski; 25—Wroclaw, locality unknown; 26—Skoroszowice; 27—Patince; 28—Tarnazsadány-Sandorrésze; 29—Hódmezövásárhely-Szakálhát; 30—Eger-Kiseged; 31—Halmaj-Vasonca-patak; 32—Boldogköváralja-Tekeres-patak; 33—Tiszaigar-Czikostanya; 34—Tiszavasvári-Keresztfal; 35—Tiszavásvári-Paptelekhát.

possibly an illustration among hundreds of decorated sherds) in Linear Pottery site reports. Moreover, sieve sherds are often not found on the larger sites whose ceramics inventories have been comprehensively analysed. For instance, they do not appear to have been found at the major Linear Pottery sites in Dutch Limburg (Modderman and Waterbolk 1958/9; Modderman 1970), nor are they known from the larger sites in Little Poland (Milisauskas, pers. comm. 1982). Instead, sieve sherds are often among the ceramics from smaller Linear Pottery sites scattered across central Europe, many of which are known only from surface collections or from test excavations which revealed a few pits and nothing more. In some cases, these sites are probably parts of larger settlements with longhouses which await excavation; but in most instances, they are small, briefly inhabited sites with a very small accumulation of Linear Pottery debris. As such, they have not rated the monographic treatment accorded the larger village/farmstead sites but rather are mentioned in the *Fundchronik* sections of regional journals. Often, there is a sieve sherd among the handful of Linear Pottery ceramics found at such a site.

This is not to say that sieves do not occur at all at the larger Linear Pottery sites. They are known from the large settlements at Köln-Lindenthal (Buttler and Haberey 1936, pl. 65) and Hanover-Duderstadt (Ankel and Tackenberg 1961). In addition, several have been found recently at the late Linear Pottery site of Skoroszowice in Silesia (Wojciechowski 1981, 46). It is quite possible that they have been found at other large sites as well but not included in the published ceramic corpus, or that they did not occur in the areas selected for excavation. In light of their generally low frequency, there is a good chance that they have been missed even on the more-completely excavated Linear Pottery sites.

Although the occurrence of ceramic sieves on Linear Pottery sites in central Europe is relatively sporadic, they are ubiquitous at sites of this culture found on the lowlands of the North European Plain in East Germany and Poland. These lowland Linear Pottery sites appeared in the middle (*Notenkopf*) phase of this culture along the lower courses of both the Vistula and Oder rivers (Kostrzewski 1929; Dorka 1939; Wiślański 1959; 1974; Kunkel 1934; Gabałówna 1963; Grygiel 1976; Bogucki 1982). The lowland sites are generally small and do not have the longhouses that are found at the larger Linear Pottery sites elsewhere. Nonetheless, they have yielded relatively dense concentrations of Linear Pottery ceramics, among which are one or two sieve sherds per site, almost without fail. The economic implications of this distribution will be discussed further below when the subsistence data from Linear Pottery sites are considered.

Although this discussion is confined to the sieves of the Linear Pottery culture, these vessels did not subsequently go out of use. Sieve sherds are also known from the other Early Neolithic cultures of central Europe such as the Stroke-Ornamented Pottery, Lengyel, and Rössen cultures (Kaufmann 1976, 25; Jürgens 1978/9, 17–20; Jazdzewski 1981, 330), although their frequency appears to be considerably lower. They occur as well in middle Neolithic cultures, such as Funnel Beaker, Michelsberg, and Cortaillod. During the late Neolithic, interestingly, sieves appear to have been very rare, and it is not until the Early Bronze Age that they again became common, first in southeast Europe, later in central and northern Europe (Jazdzewski 1981). They are especially frequent in Bronze Age contexts in Italy and have figured in analyses of the subsistence economy there (eg Barker 1981). Iron Age sieves from central Europe are also known (Götze 1928), and they can be documented from both medieval and post-medieval European contexts as well. Finally, sieves are a part of European-derived, but locally-produced, ceramic inventories in the New World from the seventeenth century AD onward.

THE FUNCTION OF LINEAR POTTERY SIEVES

The scant attention that Linear Pottery sieves have received is reflected in the fact that little consideration has been given to their function by the archaeologists who encounter them. However, an accurate assessment of their function is important, for they clearly serve a purpose quite different from that of containers. Often, brief suggestions have been made that they might have been involved in the processing of dairy products without explaining their exact role (eg Wiślański 1974). An alternative explanation was put forth by Butschkow (1935), who called them '*Flammenstürze*' (literally, 'flame covers'), presumably some sort of brazier. This notion has recently been expanded by Jazdzewski (1981), who considers them to have served as a sort of chafing dish, holding hot coals to keep food warm. Finally, sieves from Bronze and Iron Age contexts have been hypothesised to have been 'honey strainers', a function which could conceivably be postulated for Neolithic sieves as well (Bulleid and Gray 1911, 517; Clark 1952, 126).

The suggestion that the perforated vessels might have served as honey strainers is difficult to evaluate, for the actual extent of honey utilisation during the Neolithic is almost impossible to document. Why raw honey should require straining in the first place is difficult to answer, for it would seem that it is perfectly usable straight from the comb. The case for the Neolithic perforated vessels as braziers or ember-holders is equally difficult to support but maddeningly tough to demolish, although it seems rooted in a somewhat romantic view of prehistoric rural life. However, there is no evidence either from modern European peasant ethnography or from later European pre- and protohistory to support this notion.

In contrast, the hypothesis that the Linear Pottery ceramic sieves played a role in the production of dairy products finds considerable support in both the European archaeological and ethnographic records. The best-known examples of ceramic sieves from later European prehistory are found at the Apennine Bronze Age sites of central Italy. On the basis of their similarity to the metal vessels used by modern Italian shepherds for the separation of curds from whey in the production of sheep cheese, these vessels have been interpreted as cheese strainers (Puglisi 1959; Barker 1981). Barker has supported this conclusion by noting that the economic context of the sieves reflects a subsistence pattern in which herding played an important role. Bronze Age sieves from sites in central Europe (eg Havelberg DDR (Götze 1928) and Zlota, Poland (Gardawski 1959)) also come from areas where there was an important stockherding aspect to the prehistoric economy.

Modern counterparts to the prehistoric sieves are not only found in central Italy, but in many other parts of Europe as well, particularly the pastoral societies of the Balkans (Novak 1969; Dunăre 1969). When ceramic sieves are used, they are quite similar to the Neolithic and Bronze Age perforated vessels in their generally random patterns of perforation. In all cases, these sieves are associated with dairy production, serving to strain curds from whey in the manufacture of cheese. They are often used alongside non-ceramic artifacts with similar functions, such as cloth strainers (eg Vakarelski 1969). In central Europe, ceramic sieves were also used for cheese manufacture into the first part of this century and formed an important product of the small-scale ceramic industries in many areas. In describing one such industry in the south-western Eifel mountains of West Germany, Kerkhoff-Hader writes:

> Sieves have a constant use in the dairy economy for the production of cottage cheese (*Quark*). One leaves creamy milk made thick on the hearth to drain in them. The sieves which served this purpose are closely related in their basic form to small, high pots and generally have two rolled-up handles . . . In addition to the pot-sieves, dish-sieves with and without handles also occur (Kerkhoff-Hader 1980, 205, translation of the author).

Such perforated vessels for cottage cheese production are not confined to European peasant culture. The author has seen 19th-century American examples which served the same purpose from Vermont, an area with a significant dairy component to its economy then as now.

In general, there are numerous formal similarities between the Linear Pottery sieves and vessels known to have been cheese strainers in both past and present cultures. However, the demonstration of a formal analogy between archaeologically-observed and ethnographically-observed phenomena is but the first step in drawing convincing social and economic interpretations from the study of such parallels (Binford 1967, 9). The notion that the Linear Pottery sieves were employed in the same 'behavioral context' as the ethnographically-recorded ones (that is, the preparation of dairy products from the milk of domestic animals) requires further testing against the body of empirical data on subsistence from Linear Pottery sites.

LINEAR POTTERY ANIMAL EXPLOITATION

The fact that many Linear Pottery sites are found on acidic loess soils which destroy most animal bones has led to a general belief that animal husbandry played a marginal role in the Linear Pottery economy. Moreover, when the bones of domestic cattle, sheep, and goat are found, they are usually thought to have been kept primarily or solely for meat-production to supplement the agricultural resources (see the discussion in Milisauskas 1978, 71). However, a reconsideration of the known Linear Pottery faunal assemblages from central Europe, when viewed in light of the ceramic sieves, may force a change in these points of view.

When faunal remains are found on Linear Pottery sites, the assemblages are almost always composed primarily of the bones of domestic cattle, with sheep/goat and pig represented in decidedly smaller proportions (Fig. 3). Only on some of the East German sites do the frequencies of sheep/goat bones exceed those of cattle (Müller 1964). The bones of wild animals are generally rare on Linear Pottery sites, suggesting a relatively low degree of hunting. Milisauskas (1978, 71) suggests that the low proportion of wild animals is peculiar to Müller's East German sites, but a comprehensive examination of Linear Pottery faunal reports indicates that this is a general phenomenon.

Given the relatively small size of most Linear Pottery faunal samples, it is difficult to assess whether the cattle were used primarily for either meat or dairy production on the basis of their age profiles. In

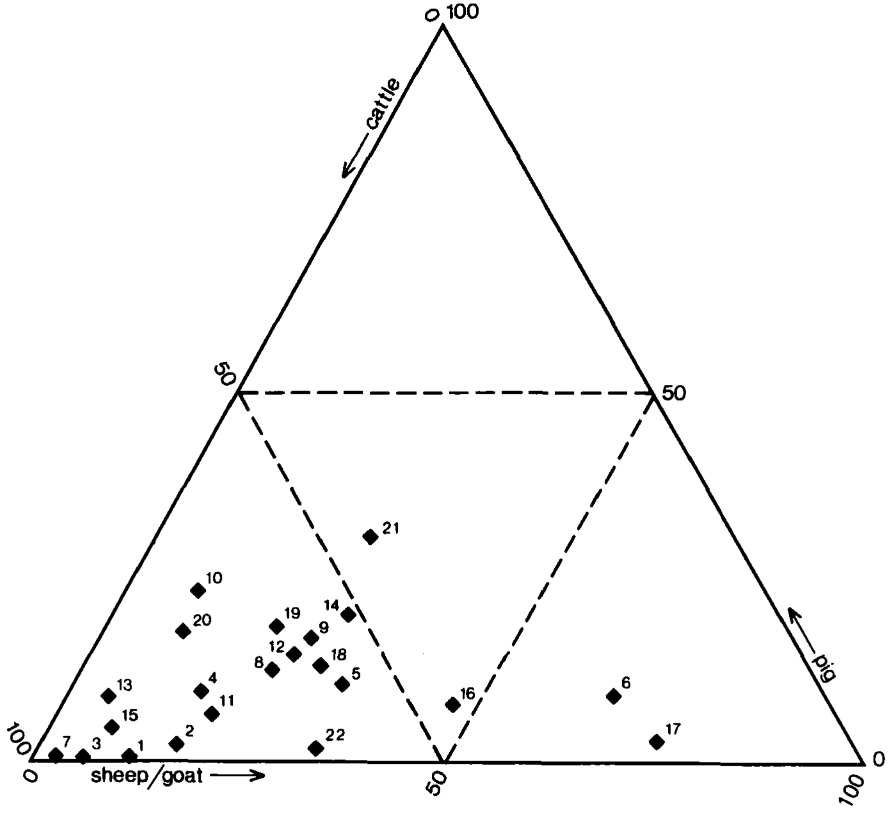


Figure 3
Relative percentages of cattle, sheep/goat, and pig bones from 22 Linear Pottery sites, based on numbers of identified specimens attributed to *Bos taurus*, *Ovis aries/Capra hircus*, and *Sus scrofa domesticus*. 1—Brześć Kujawski 3, PL (n=82); 2—Brześć Kujawski 4, PL (n=514); 3—Strzelce, PL (n=77); 4—Lojewo, PL (n=594); 5—Barleben-Schweinemästerei, DDR (n=223); 6—Barleben-Hühnenfarm, DDR (n=168); 7—Eitzum, D (n=46); 8—Armeau, F (n=928); 9—Cuiry-les-Chaudardes, F (n=501, data to 1976); 10—Samborzec, PL (n=384); 11—Gniechowice, PL (n=158); 12—Jelení louka, CS (n=532); Bylany, CS (n=540, all Linear Pottery periods); 14—Gatersleben, DDR (n=252); 15—Halle-Trotha, DDR (n=357); 16—Trobsdorf, DDR (n=345); 17—Dammersdorf, DDR (n=199); 18—Hohlstedt, DDR (n=351); 19—Hienheim, D (n=72); 20—Müddersheim, D (n=184, according to Clason 1972); 21—Reichstett, F (n=125); 22—Miechowice, PL (n=1449).

order to make a reliable judgement, the samples would have to be large enough to permit an evaluation not only of their aggregate age profiles but also of the relative proportions of males, castrates, females, and juveniles. A relatively subjective assessment of the corpus of metrical data from Linear Pottery sites (Müller 1964; Krysiak 1959; Clason 1967; 1977; Stampfli 1965; Bökönyi 1959; Bogucki unpublished data) suggests that in most instances, the assemblages are dominated by mature females. Legge (1981a) has argued that a female bias in the adult cull and a high neonatal cull, presumably of males, can be taken as an indication of a dairy economy. In some areas, there does appear to have been a relatively high degree of calf killing at Linear Pottery settlements. Müller, in his study of Linear Pottery faunal remains from 71 East German sites, found an age distribution among the cattle bones of 60.5% adult, 11.5% subadult, and 28% juvenile individuals (on the basis of an estimated minimum of 143 individuals from these sites). Although it is unclear what Müller's upper limit for his juvenile category is, it would appear that many individuals in this group were under six months of age, with most probably under a year old. Müller takes this to represent 'autumn slaughter' due to shortages in winter fodder (Müller 1964, 64). Legge has pointed out that the killing of calves to free milk for human consumption is functionally similar to such 'autumn slaughter' in that it involves a reduction in the fodder requirements of the herds while increasing the food output for humans (Legge 1981b, 180). In his words, 'cattle could hardly be kept for the annual production of one little carcass,' and instead, the killing of infantile and juvenile animals is the result of their keepers' desire to have undivided access to the mother's milk production.

The suggestion that the killing of calves necessarily indicates a dairy economy has not gone unchallenged (see comments by Clutton-Brock in Legge 1981b). Amoroso and Jewell (1963) have pointed out that it is generally difficult to persuade lactating cattle to let down their milk without their young around (save for modern breeds of 'improved' livestock). Instead, in the African cultures which they studied, the practice was to keep the calf near the mother, allow it to suckle, and then remove it from the udder before exhausting the mother's milk supply. Among cattle-herding cultures such as the Karimojong of Uganda, the calves are generally not killed, since their economic usefulness as adults outweighs the amount of milk they might consume as infants (Dyson-Hudson and Dyson-Hudson 1970, 122). Legge (1981b, 221) is of the opinion that although cattle in Africa seldom surrender their young, European cattle commonly do so, and that African husbandry practices cannot be generalised to include those of prehistoric Europe.

In other parts of temperate Europe, there does not appear to have been much calf slaughter by Linear Pottery communities. On the plains of north-central Poland, a number of Linear Pottery sites have yielded faunal assemblages which are composed of domestic cattle to the virtual exclusion of all other domestic and wild species, save for some sheep/goat (Bogucki, in press). Of the faunal collections from these sites, the one from Brześć Kujawski has been studied most extensively from an economic standpoint (Bogucki 1982). There, over 90% of the Linear Pottery cattle were slaughtered beyond their 18th month, with over 70% having survived their 36th month. A preliminary metrical analysis of the adult cattle bones (Bogucki, in preparation) has indicated that a substantial proportion of them were females. However, there are very few calf bones among the Linear Pottery cattle remains, which presents a different situation from that noted by Müller at his East German sites. The Linear Pottery sites of the Polish lowlands have a definite 'pioneer' character, and on the basis of their settlement pattern, lack of internal site organisation and permanent architecture, and the lack of evidence for winter habitation at Brześć Kujawski, I have argued that the

Linear Pottery sites in the Polish lowlands were temporary camps established by herding parties whose main residential bases were villages in the uplands to the south (Bogucki 1982, 120–1). If this is in fact the case, then it is possible that the culling of juveniles took place elsewhere (if they were, in fact, culled), and that the animal bones at the lowland sites are the remains of only surplus or ill adult cattle and do not reflect the entire range of husbandry practices.

From the foregoing discussion, it is apparent that the age and sex data from Linear Pottery faunal assemblages are still ambiguous about the extent of dairying during this period, although they do provide some hints of culling patterns consistent with dairy production. Nonetheless, there are sound economic arguments as to why the livestock kept by Linear Pottery communities should *not* have been used for meat production, which would then lend credence to the case for their having been used for dairy production. It must be remembered that Linear Pottery communities were dealing with an environment which was largely unfamiliar to them, especially to the new communities which budded off to form daughter settlements as this culture expanded across temperate Europe. Each new tract of loess or lowland glacial soils presented a new set of environmental advantages and disadvantages which took time to sort out (Bogucki 1979). In such a situation, fraught with risk and uncertainty, a concentration on cattle primarily as a meat source would seem to be poor economic strategy. Since cattle require 42 to 48 months to reach their optimal meat weight, a great deal of labour and energy must be invested in each head in return for its meat yield. Not only would the stock have to be assured adequate supplies of forage and water, but they would also have to be maintained through the central European winter on cut fodder. If no dairy products were to be obtained from the females of the herd, all this investment of labour, time, and energy would far outweigh the 300–400 kilograms of usable meat available from each head. Moreover, if meat were the only return expected from the cattle economy, it would have been impossible for a self-sufficient Linear Pottery community to increase the output from its herd quickly in response to temporary shortfalls in other subsistence resources without either maintaining an enormous reserve of surplus animals or seriously affecting the viability of their herd as a reproductive population. Given the uniparous nature of cattle, and the potential for the loss of animals to predators and disease, the Linear Pottery communities would have had to be very selective in their slaughter of cattle in order to assure that sufficient breeding stock remained. If they had only regarded cattle as a 'meat bank' which would offset crop failures and shortfalls, they would have had to have been able to predict crop yields 3 or 4 years in advance in order to receive the maximum return on their investment. The alternative would have been to maintain such large herds that more time would be spent tending stock than working fields!

Another way to approach the question is in ecological terms. As Ingold (1980, 176) has pointed out, the process by which plants are converted to milk and meat involves a net loss of energy at each step. When humans milk their lactating stock, they place themselves at an earlier point in the conversion chain than when they slaughter the animals for their meat. As a result, a much higher proportion of the original energy input can be taken back in the form of milk, thus permitting the maintenance of a larger human population, than can be returned in the form of meat. Ingold argues that 'milch pastoralism' is the most efficient use of uncultivatible land, while 'carnivorous pastoralism', in which meat is the only desired product, is no more efficient than hunting and probably less so in the long run. Yet, the Linear Pottery communities of central Europe did not engage in the hunting of wild herbivores to any great degree, even though the forests would have supported large populations of red deer, roe deer, and aurochs.

It would have made much more sense for Linear Pottery communities to concentrate on pig husbandry, assuming that meat was the only return desired from their domestic stock. These animals, which were clearly known to the Linear Pottery culture, are multiparous and reach a high meat weight and sexual maturity within a year of birth (Grigson 1982, 298). The forested environments in which most Linear Pottery sites are found, both the floodplain forests of the loess belt and the woods of the North European Plain, would have been excellent sources of pannage. Yet pigs are consistently the rarest domesticated taxon in Linear Pottery faunal assemblages. In fact, even the few pig bones that are found on Linear Pottery sites represent this species disproportionately, for the harder and denser pig bones are often more immune than those of cattle and sheep/goat to the predations of dogs, which are also documented from Linear Pottery contexts. At Brześć Kujawski and other Linear Pottery sites in the Polish lowlands, pigs are virtually absent, and it is not until several centuries after the Linear Pottery occupation that they appear prominently in faunal assemblages (Bogucki 1982, in press).

Given the relative proportions of cattle and pigs on Linear Pottery sites, along with the generally low degree of exploitation of wild herbivores such as red deer and roe deer, it would seem reasonable to conclude that meat was not the sole reason why Linear Pottery communities kept domestic cattle (and sheep and goats as well). Rather, it would appear that cattle served a variety of purposes in the Linear Pottery economy, with their slaughter occurring only when they were no longer economically useful. For most males, this would be either as calves or when they had reached their maximum meat weight, and for females, when they had ceased to produce with milk or calves. In any case, Linear Pottery communities clearly had access to milk; to ignore such a resource would negate any economic advantages gained from keeping domestic cattle in the central European forests.

CERAMIC SIEVES AND THE LINEAR POTTERY ECONOMY

The question of when humans began milking their livestock is one which is only recently beginning to be discussed (eg Sherratt 1981; 1983; Bogucki 1982). A crucial aspect of this discussion is the extent to which the prehistoric inhabitants of the Near East and Europe were able to ingest lactose, or milk sugar. The modern populations of temperate Europe are unusual among the world's peoples in that the majority of the adults can ingest raw milk without adverse side-effects. Most of the world's adult population does not produce a sufficient amount of the enzyme lactase which is required to metabolise lactose. As a result, they suffer from cramps, diarrhoea, and vomiting when they drink milk, in addition to not benefiting from the carbohydrates it contains. The development of a tolerance for lactose through the continuation of lactase production into adulthood is thought to have been a relatively late evolutionary process, occurring sometime in the last few millennia among the peoples of northwest Europe (who subsequently spread throughout the world in the past 500 years) and Asian and African pastoralists (Simoons 1979).

The ultimate derivation of the Linear Pottery populations was from the Mediterranean area, via intermediaries such as the Starcevo-Körös culture of the Balkans. In addition, there was probably some degree of recruitment of local Mesolithic populations, especially on the northern and western fringes of the Linear Pottery area. Mediterranean peoples today are characterised by high rates of lactose intolerance, and the degree of lactose intolerance among the indigenous post-glacial populations of Europe is, of course, unknown. Sherratt (1983) has advanced the proposition that as agricultural populations moved northward into temperate Europe, there would have been a selective advantage for the continuation of lactase production into adulthood, since the absorption of calcium from milk would be beneficial in preventing rickets in areas of reduced sunlight. However, the existence of such a selective pressure does not mean that the proper adaptation to it was made immediately during the Linear Pottery colonization of temperate Europe.

The existence of clay sieves, presumably for cheese production, on Linear Pottery sites indicates that the people of this culture had at their disposal a means for obviating whatever degree of lactose intolerance they had. In milk products such as cheese and yoghurt, most of the lactose is removed with the whey in their production, and what little remains in cheese becomes hydrolysed into lactic acid. Aged, mature cheese contains no lactose. Without such technology, the herding of cattle in the Neolithic forests of temperate Europe would have been of questionable value, and the presence of the sieves militates against any argument that the Neolithic inhabitants of temperate Europe did not milk their cattle because of a possible intolerance of lactose.

The evidence of the clay sieves and the faunal remains associated with them indicates that there is a very high probability that milking and the use of dairy products such as cheese (and probably yoghurt) were known by the earliest Neolithic inhabitants of temperate Europe. Cheese, which could be transported and stored for future consumption, probably played a significant role in the Linear Pottery subsistence system. As I noted above, the establishment of a successful agricultural economy in the uncharted forests of temperate Europe was a risky undertaking for the relatively small Linear Pottery communities. Lean years were probably as frequent as bountiful ones, if not more so. Growing grain would have been subject to the predations of wild herbivores and plant diseases, as well as having to become accustomed to a shorter growing season than in southeast Europe. In addition, there is some evidence to indicate that the sizes of Linear Pottery fields were generally quite small and that the crops were often contaminated with a variety of weeds (Knörzer 1971). In light of these constraints, it was necessary to have reliable secondary resources to tide the Linear Pottery communities through lean times of the year as well as through the years when the crops failed completely. One such secondary resource was probably wild plants, for which there is little archaeological evidence, but whose use is probable given the great natural productivity of the primeval temperate European forest (Clarke 1976) as well as the fact that they would have started to be available in late spring and summer before the grain could be harvested. Dairy products were probably another such supplementary resource in the Linear Pottery economy. Not only would these have been available early in the growing season when the grain supplies from the previous harvest would have run low, but they could also be stored into the winter, and thus used to supplement the grain when wild plant foods were scarce. These supplementary resources should not be considered to have been 'minor' or 'marginal'. Rather, they would have played an important role in the Linear Pottery economy in that they would have permitted the degree of subsistence certainty and reliability which would have been necessary for the maintenance of the Linear Pottery farmsteads and villages.

The fact that sieve sherds are more common on the smaller Linear Pottery sites and relatively rare on the larger settlement complexes suggests that the main location of their use (and hence of their breakage) was in the smaller settlements or camps which arguably could have been associated with stock herding. This observation, in turn, would indicate that the production of cheese and other fermented dairy products was done shortly after the cattle had been milked. The dairy products then could have been transported back to the main residential bases for consumption and storage much more easily than if they were in liquid form with the attendant risks of spillage and spoilage. If the cattle were stalled at the residential bases during the winter, it would be expected that their milk output would drop considerably. There would thus be less need for cheese production because of the reduced milk supply, hence the overall paucity of sieve sherds at the major Linear Pottery farmstead and village sites.

CONCLUSIONS

The presence of ceramic sieves on a number of Linear Pottery sites leads to the conclusion that the milking of domestic animals was practiced by the Early Neolithic peoples of temperate Europe around 4500 bc (5400 BC). When these data are combined with the zooarchaeological evidence from Linear Pottery sites, it appears that a well-developed system of dairy husbandry was practiced in Neolithic temperate Europe to supplement the cereal cultivation which formed the mainstay of the subsistence system. In some areas, such as the lowlands of the North European Plain, dairy husbandry appears to have been the predominant subsistence practice during this period.

The recognition of such an antiquity for dairy production in temperate Europe does not contradict the notion that towards the end of the Neolithic there was a shift towards the maximum utilisation of animal resources, what Sherratt (1981) has termed the 'Secondary Products Revolution'. At this time, subsistence systems appear to have emerged which had a primary emphasis on animal husbandry, particularly in Eastern Europe. Legge (1981a, 89) notes that although any economy which includes cattle will have access to both meat and milk, the exploitation of one or the other will be most efficient if it is developed in a specialised way, as appears to have been the case in this area during the Late Neolithic and Early Bronze Age. The roots of these systems, however, lie several millennia earlier, during the colonisation of Europe by the Linear Pottery culture.

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