

The Archaeology of Neolithic Dairying

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ABSTRACT: Until little more than three decades ago, the exploitation of domestic ruminants for milk by Neolithic peoples in Europe was almost completely overlooked by prehistorians. After first being raised as a possibility by Sherratt, Legge, and others, the existence of Neolithic dairying is today supported by multiple lines of evidence. A challenge now is to determine the variability of this practice over time and across space. Of special interest is the role of dairying in the establishment and consolidation of agricultural communities during the sixth through fourth millennia B.C., the possibility that it was practiced more intensively in some areas than in others, and its role in the percolation of agricultural practices into the foraging societies of northern and western Europe. This paper attempts to identify some directions that future research might profitably pursue.

I am immensely grateful to have been invited to speak at the LeCHE conference. Everything I have heard in the last two days has reflected a remarkable convergence of prehistoric archaeology, bio- and geochemistry, and archaeogenetics around a major research question. Such truly interdisciplinary research represents the ideal of modern scientific scholarship, in which collaboration and friendly competition yields reproducible results that advance knowledge.

Slide 1:
title

Just to introduce myself, I am an archaeologist (and “recovering zooarchaeologist”) who studies early farming societies in central Europe. Thus what I say will be from an archaeological perspective. My deary employment at Princeton is to look after the 1,000 undergraduates who are studying engineering, which is unusual and which I can explain in private later if you really want to know. Being among engineering faculty and students has given me a keen appreciation for interdisciplinary laboratory science research.

The Archaeology of the Archaeology of Dairying

Slide 2:
field

Let me say a few words about how I came to be here, at the risk of seeming self-reverential. My path to dairying began in **the fields of Kuyavia** in Poland at Brześć Kujawski, where in the late 1970s we found sieve sherds in Linear Pottery features, and where sieves had been known **from previous excavations**. Among the animal bones, I noted the predominance of cattle in the Linear Pottery samples. My path then continued in the hills of Vermont. In early September 1981, my wife and I were driving back to Boston from Montreal and stopped in

Slide 3:
Grafton

Grafton, Vermont, to visit a woman named Jean Whitnack. Jean had a keen interest local history, and one of the artifacts that we saw in her house was a **redware ceramic sieve**. Remembering my Neolithic sieves, I asked what it had

been used for, and Jean said that such vessels were used for straining curds from whey in cheese manufacture (for which Vermont is known).

Slide 4:
Sherm

On the drive back to Boston later that evening, I mulled over the sieve I'd just seen and its relevance for Neolithic dairying. **Sarunas Milisauskas** had raised the possibility of ceramic sieves having been used for cheese making in his 1978 book *European Prehistory*, but only in passing. Over the next several months, I composed an essay that discussed Linear Pottery sieves and searched through the literature for such artifacts from colonial American or European prehistory. Other examples from North America were documented cheese strainers, while in the archaeological literature from other times and places in Europe they were often thought to be braziers for holding hot embers. With all those cattle bones from Linear Pottery sites, I was convinced that they were for making cheese.

Slide 5:
Andrew

Andrew Sherratt had recently advanced his Secondary Products Revolution hypothesis, but he was writing about Neolithic communities around two millennia later than the ones that I studied. So my essay appeared to undermine the “revolutionary” character of his hypothesis. Nonetheless, I plunged forward, having a lot of free time in post-Ph.D. semi-employment. My argument was not just about the sieves, although that's what everyone remembers because they're mentioned in the title. Actually, it was a complicated case that involved sieves,

cattle bones and their age structure, and most importantly, the illogic of pioneer farmers keeping cattle only for their meat.

In late 1982, I wrote to Sherm Milisauskas to ask whether he'd ever seen sieves at the Linear Pottery sites that he studied in southern Poland. **Sherm's response**, shown here with his permission, is illuminating, in that he didn't know of any sieves in his part of Poland, and, more importantly, echoed what I was already thinking, namely that the Kuyavian sieves had a **dairying function**. I don't believe I prompted him to say this.

Slide 6:
S. note

I sent a draft to Andrew Sherratt and received back a **cordial response** written on January 27, 1983. I show it here with the kind permission of Susan Sherratt, and it reflects Andrew's generosity of spirit in writing a four-page note to a callow youth and also how he respected and took under consideration points of view that might have challenged his. A few things to note: the first is that Andrew gladly reconciled the notion of Linear Pottery sieves for dairying with his Secondary Products Revolution hypothesis, and he grasped what I was trying to say about the potential value of dairy products for pioneer farmers. Another point, which I had not noticed until I took this letter out of my file a few days ago, is that he suggested that the practice and intensity of dairying may have varied from one region to the next. I will say more about this in a bit.

Slide 7:
A. note

With this encouraging response, I submitted the essay to the relatively new *Oxford Journal of Archaeology*, and I was grateful that it was accepted.

I thought I would remind you how recently the concept of Neolithic dairying, and especially during the sixth millennium B.C. or earlier, has penetrated archaeological thought. For many of you, it may seem that it was always there as a possibility, and just needed to be demonstrated biochemically or genetically. But it hasn't been. A search through books on European prehistory, particularly those that focus on the Neolithic and later, was illuminating. I looked for entries of "milk", "dairying", or "cheese" in the indexes along with page numbers that indicated that these subjects were discussed with reference to Neolithic societies.

Until about 1980, the possibility of Neolithic dairying was **not on the radar screen of most scholars** of later prehistoric Europe. Neolithic subsistence was characterized as grain agriculture, usually of the shifting variety, and animal husbandry. It's generally clear from the context that animals are viewed as beef, mutton, and pork. Several books discuss dairying in later prehistoric periods, the Bronze and Iron Ages, but it's clear that it was not thought to be an option during the Neolithic, especially not prior to 3000 B.C.

One exception, that I have already mentioned, was Milisauskas' 1978 *European Prehistory*. On page 81, in his discussion of Alpine Neolithic

Slide 8:
books

Slide 9:
books 2

settlements, Sherm notes, "It is very important for subsistence analysis to determine when the earliest milking of cows and production of cheese occurred in Europe. Cheese would be a significant addition to the food supply, since it can be preserved for many months... we find clay strainers in some Neolithic sites, and although these finds are not numerous, they may indicate milking of cows and making of cheese." Here at least was someone open to the possibility of dairy production prior to 3000 BC, although he had not raised it with specific reference to the Linear Pottery culture.

Another prescient suggestion of dairying during the earlier Neolithic was made by Tony Legge at a conference on **farming practice in British prehistory** in Edinburgh in November 1980. I wasn't aware of this when I started the sieves essay, and Tony graciously called it to my attention at the 1982 ICAZ meetings in London. Writing about domestic cattle from Grimes Graves, Tony wrote (1981: 172): "the bone dimensions also suggest that females exceed males...in ratios of 4:1 and 6:1; this further argues that the majority of those killed at early ages were males. ...the main outputs from the cattle herd were calves and aged cows... for meat production this would be unlikely, and I would argue that a third output was of interest – that of milk."

After the mid-1980s, the notion of Neolithic dairying was accepted as a reasonable, if unproven, possibility, but that was not quite three decades ago. In scientific scholarship, that is several lifetimes, but in archaeological scholarship, it is almost yesterday. I mention this simply to show how much the field has changed in a short time, and also to highlight how important the conclusive demonstration of Neolithic dairying and lactase persistence is for our understanding of the **earliest farmers of Europe**, and of southwestern Asia as well.

Slide 10:
village

Why is Neolithic Dairying So Important?

Clearly we are here because we consider the origins of dairying and lactase persistence to be important milestones in human biocultural development. Sometimes, however, it seems that it could be considered an esoteric curiosity, a diversion from curing cancer or resolving profound questions of human identity. Let me try to articulate a few reasons why I think we are not wasting our time.

The transformation of milk into derivative products represents one of the earliest anthropogenic biochemical transformations, alongside fermentation of grain into beer. Hitherto, gathered and harvested organic substances were either used raw or transformed structurally or mechanically. Even the cooking of meat did not fundamentally alter its composition. The only other significant chemical process undertaken in the Stone Age was the transformation of clay into

pottery by firing. In cheese production and beer brewing, Neolithic farmers developed two key biotechnologies that enabled them to make use of materials that could be harvested in abundance and to preserve them for use over extended periods.

It was not a particular revelation that mammals produce milk. The idea that some of the milk production of domestic bovines could be diverted to human consumption was probably in the air concurrently with their domestication. So one of the things we are interested in is not just the beginnings of milking but also of the technology that enabled milk to be transformed into reduced-lactose derivatives, and to do it in quantities that made it economically feasible. In many respects it's like the **discovery of penicillin** and then its **production** on a scale at which it could save millions of lives. It's not just prehistoric biochemistry that interests us, but also prehistoric chemical engineering.

Slide 11:
Fleming

A household using its livestock for **dairy production** to meet some portion of its nutritional minima will organize itself, its use of the landscape, and its relationships with similar units differently from just tilling fields and herding flocks to be used for meat. It has to pay special attention to the reproductive biology of its cows. You want your herds to grow and to make sure there are enough cows with calves at any given moment to make the whole enterprise worthwhile.

Slide 12:
cow pot

All those calves pose a problem, however, in that half of them will probably be males. This is a dilemma. Do you kill them as soon as possible, or do you let them grow to full meat weight as well? One possibility is that you just let the males and non-lactating females roam freely in the forests and wetlands, and essentially hunt them when you want meat for salting or drying for the winter.

Slide 13:
cartoon

It is interesting to speculate on how the practice of transforming milk into cheese might have appeared to foragers on the fringes of the farming world.

The use of livestock for meat may not have appeared particularly revolutionary other than that they were tame and controlled. Sheep and goats were exotic, but if they were only being used for meat, the motivation to adopt them instead of hunting deer and wild pig may have been minimal. Domestic cattle would have been very attractive as docile smaller versions of the fierce aurochs, but if all it involved was killing them for meat, then I would argue that they may not have provided such a compelling value proposition to the foragers.

Dairy production, however, would have been a completely novel biotechnology to indigenous foragers. It may represent what Clayton Christensen of Harvard Business School would call a “disruptive technology”. A disruptive technology isn’t simply something that permits an existing system to be improved. Instead, it is something that exploits a novel niche, often very small,

that then can expand dramatically. An example would be Alexander Graham Bell's **electric speech machine**, now known as the telephone, which did not merely improve telegraphy but rather penetrated a new niche and attracted different users, other than telegraphers.

Similarly, dairy production would not simply represent an improved method of hunting and gathering, as foragers might have viewed cultivated plants and livestock, but rather may have been taken up by a small group of early adopters who seized on its potential. In parts of northern and western Europe, as well as the Alpine foreland in central Europe, it may have represented a way to capitalize on areas of poor arable potential, where grain cultivation and meat production alone may not have represented sufficient motivation to shift from foraging to farming.

One idea that I don't find particularly compelling is the idea that Linear Pottery farmers "outsourced" the care of their livestock to indigenous foraging groups. This suggestion has gained some prominence in some quarters, as

suggested by **the caption to this image**, which depicts indigenous makers of La Hoguette pottery along the Rhine and adjacent areas coming by to pick up Linear Pottery cattle to take them up to higher pastures in a transhumant system. If this

Slide 14:
funny
phone

Slide 15:
Hoguette

ever actually happened, it would probably be the last time the farmers ever saw those cattle.

It seems more likely that feral livestock, as well as knowledge of their potential for both meat and dairy production, were taken up by foraging groups, who then integrated easily into Linear Pottery society. This may have taken a generation or less, so practically invisible in archaeological time.

Diversity in Uniformity

Although he may not have been thinking specifically about the Linear Pottery culture, Sherratt's suggestion that certain areas may have been more into dairying than others may yet ring true. In the archaeological literature, most authors choose to emphasize the homogeneity of the earliest farming communities of central Europe. From Ukraine to Normandy, Linear Pottery farmers made **fine vessels** decorated by incised lines, usually in the same limited repertoire of shapes. The tradition of **longhouse architecture** is also widespread, except that **regional variability** in the arrangement of posts is immediately apparent. Cattle are the dominant domestic animal species almost everywhere.

Slide 16:
LBK

As a result, it is very tempting to see the Linear Pottery farmers of the late sixth millennium B.C. in central Europe as a tightly bounded ethnolinguistic unit

that so closely shared its core values and practices that a farmer from Slovakia transported to Belgium would feel right at home and even find a few cousins, since it is easy to presume an equivalency between common ethnolinguistic identity and common biological ancestry. Reality was probably much more complicated.

If we start looking beyond the longhouses, pottery, cattle, and crops, then we find regional variations in other practices. **Burials**, for example, differ widely across the Linear Pottery world. In some places, they interred whole corpses, elsewhere they cremated the bodies, and in some communities they did both. In some places the dead are found in extramural cemeteries, and in others they are buried among the houses on settlements, often in small intramural burial precincts. A recent Ph.D. at the Jagiellonian University in Kraków (Kaflińska 2011) has noted regional and temporal variability in the practice of making deposits or caches of chipped and ground stone tools. In some places they are common, while elsewhere they are scarce.

It is also necessary to account for the involvement of indigenous foragers across the Linear Pottery realm. While they were much scarcer in interior central Europe than in the more luminous regions of hunter-gatherer activity such as southern Scandinavia and the Atlantic Façade, they nonetheless were present in

Slide 17:
burials

central Europe. What apparently happened, however, was that they quickly became entrained into the Linear Pottery diaspora. If, as Eszter Bánffy suggests, the origins of Linear Pottery lie in western Hungary along Lake Balaton when indigenous foraging communities merged with Late Starčevo farmers, then the assumption of a common biological ancestry for all Linear Pottery agriculturalists that can be traced deep into southeastern Europe or even Anatolia becomes

Slide 18:
Vedrovice

curious. After the initial dispersal of pioneer farming communities, we are dealing with local, **heterogeneous creole societies** throughout the Linear Pottery world (Bogaard, Krause, and Strien 2011, Bickle et al. 2011, Bogucki 2012, Zvelebil and Pettit 2012).

Where Do We Find Linear Pottery Sieves?

It is not surprising, therefore, that we find concentrations of Neolithic ceramic sieves (and thus a particularly obvious form of dairying technology) in some areas, while they are rare or absent in others. This is not to say that where we don't find sieves that they didn't practice dairying, but that there are areas in which sieves are so common that dairy production must have had a particularly special place in their routine activities, or that they found it necessary to devise relatively durable equipment.

Kuyavia

Slide 19:
Kuyavia

One such area is the **Kuyavia** region in Poland along the lower Vistula. We have already seen how Sherm Milisauskas noted the absence of ceramic sieves in southern Poland along the upper Vistula and in the Carpathian Foothills. The upper Vistula in southern Poland drains the loess-covered plateaus that are part of the great Central European loess belt, the classic landscape of the Linear Pottery farmers. Kuyavia, on the other hand, is part of the North European Plain, much **flatter** than the loess uplands and, moreover, had been covered by ice during the Weichsel glaciation. Its surface is covered by fertile ground moraine broken by tunnel valleys, outwash fans, finger lakes, and ponds that formed where blocks of stagnant ice were left behind by the retreating glacier.

Linear Pottery farmers were specifically drawn to the smaller tunnel valleys and ponds of Kuyavia during the last centuries of the sixth millennium B.C. The flatter terrain and broken landscape may have been attractive for raising cattle, and as pioneer farmers on the fringe of the Linear Pottery world, dairying would have made considerable sense as a complement to grains and meat. Thus we see the **concentration of sites that yielded the sieve fragments** that Mélanie Salque has studied along the eastern edge of the Kuyavian plateau, as well as other sites with published sieves at places like Radziejów, Bożejewice, and Grabie.

The ubiquity of sieve fragments at the earliest farming sites in Kuyavia compared with most other parts of the Linear Pottery world suggests a special economic character to this area. It would have been especially well-suited to a sort of free-range grazing due to the flat terrain and the interconnections between the shallow valleys and basins.

The Lower Oder

A potentially critical, but barely known, area for studying Linear Pottery dairy production lies about 700 kilometers east of here. It is full of early Neolithic sites, but unlike Kuyavia which has been intensively studied, very little work has been done on the Linear Pottery sites **along the lower Oder** since World War 2.

Slide 20:
Pyrzyce

This region is almost completely unknown from the standpoint of modern Linear Pottery settlement archaeology, but sieve sherds and cattle bones abound in prewar collections and from the limited postwar test excavations.

Sites are found on both the Polish side and the German side of the lower Oder. We can transform the 1980s DDR map into **Google Earth** and see that as in Kuyavia, tunnel valleys and glacial troughs were attractive for Linear Pottery farmers. On the Polish side, they run along the Płonia valley and Lake Miedwie near the town of Pyrzyce. **Sieves are ubiquitous.** On the German side, Linear

Pottery sites are concentrated along a small river known as the Ücker, especially around the town of Prenzlau. **Blindow and Zollchow are notable for sieves.**

One thing we know now that we didn't 30 years ago is that the Oder was a major corridor for Linear Pottery penetration to the North European Plain in Poland and eastern Germany, perhaps more so than the Vistula. For example, the analysis of the stylistic affinities of Linear Pottery decoration in Kuyavia reflects a mix of motifs that came from both the upper Vistula and the upper Oder, as well as from points to the west beyond the Oder. In fact, many of the Kuyavian sites from which sieves have been reported, such as Brześć Kujawski and Smólsk, are linked stylistically with the west and southwest, with the Oder drainage and beyond.

A curious thing about the lower Oder sites is that they are only a **short distance from the Baltic coast** and its thriving population of late Mesolithic foragers. We know that **stone tools** characteristic of the Linear Pottery culture and its successors are found in northern Germany and Denmark. But the earliest domestic cattle in northern Germany are only dated to about 4100 B.C. at Wangels and Rosenhof and in Denmark to 3900 B.C. at Åkongø (oh-kon'g). So there is about a 1000-year time lag between the Linear Pottery sites on the Lower Oder and the eventual breakthrough of domestic cattle to southern Scandinavia.

It is also interesting that after the first centuries of the fifth millennium B.C. there is very little evidence of post-Linear Pottery settlement on the lower Oder, suggesting that we may have one of the few instances of a Neolithic “retreat” from a region. It looks like a brief contact with dairying wasn’t sufficiently persuasive by itself to get the Baltic foragers to come over to farming a millennium before they did.

An archaeogenetic challenge lies in the origins of the first domestic cattle in southern Scandinavia. It has been demonstrated that they do not represent local domestication from aurochs and must have been obtained from Neolithic societies to the south. But from where and from what direction? A possible candidate lies in Kuyavia, where the **Brześć Kujawski Group** flourished between 4700 and 4100 B.C. Several intriguing elements of its material culture hint at possible connections with the foragers of the Baltic (Bogucki 2008). It would be interesting to compare the genomes of the Brześć Kujawski Group cattle with those of the earliest cattle in southern Scandinavia to see if they might have been closely linked.

Closing Remarks and Future Directions

I would like to close with several observations about the evidence for dairying in Neolithic Europe and about the research that has been presented at this conference.

The first is that the techniques presented here represent analytical approaches that should be standard parts of any archaeological research project seeking to understand early farming communities in western Eurasia. Much as radiocarbon dates, archaeobotanical analysis, and zooarchaeological studies are routine budget items in research proposals, so also should be residue analysis and archaeogenetic sampling. With regard to the latter, it will be important for fieldwork protocols to be widely propagated that can be invoked the moment a burial is found in order to avoid contamination. I would be happy to learn about any existing publication or handbook along these lines. Similarly, guidelines for collecting pottery samples for residue analysis should be widely disseminated.

I see residue analysis in particular as being at a stage similar to where faunal analysis and archaeobotanical studies were several decades ago. The proof of concept has been established, and particular studies have shown impressive results. The goal now is to develop carefully planned research designs that will drive archaeological fieldwork and test hypotheses, as well as to

study spatial and temporal variation in the intensity of dairying practice. With regard to the latter, it will be necessary to develop some quantitative approaches to permit the comparison of materials from one site to another, much as archaeozoologists have different measures to compare the relative numbers of species.

The question of regional variation in the practice of dairying is, as Andrew Sherratt suggested in his letter, is going to be important. One area that I haven't mentioned yet which bears close examination is the Late Linear Pottery of the Paris Basin and its westward extension into Brittany by the Villeneuve-St. Germain Group. Was this possibly a dairy-driven expansion as I have suggested may have been the case with the initial incursion of the Linear Pottery culture onto the North European Plain? To my knowledge, there are no sieves involved here, although it may well be that different straining technology was employed.

Finally, I just want to point out the role that analytical techniques from natural science have played in re-invigorating the study of the transition to agriculture and its consequences. In the 1960s and 1970s, probably no other research question attracted the same amount of attention than the domestication of plants and animals and the dispersal of farming. There was a search for broad causal models, such as demographic pressure and climate

change. When the determination of what caused the transition to agriculture proved intractable, the discussion in the 1980s and 1990s dissolved into local debates. Eventually, in my view, agricultural origins and dispersals were relegated from the list of Grand Challenges to a lesser priority. In the last decade, it's really been the emergence of archaeogenetic, isotopic, and residue analyses, along with high-resolution radiocarbon dating, that has re-energized the study of early agricultural societies. And for this I thank you all very much.

Slide 22:
Thanks

Word count: 4293