TEMPER VARIATIONS IN ANCIENT CERAMICS. — TECHNOLOGICAL OR CULTURAL ORIGIN?

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Introduction

Temper is a matter which is added to the clay in ceramic production in order to decrease shrinking and prevent cracking during the drying and firing processes. Numerous variations of temper techniques have been recorded in the ware of ancient ceramics. Everything from sand and gravel to dung, hair and bone have been used for tempering. Mostly the observed variations could be related to the intended vessel function or environmental conditions. In some cases, however, there are doubts about the favourable effects of some additives and the technological knowhow behind them. Spontaneous experiment impulses may explain the use of some odd and rare temper materials.

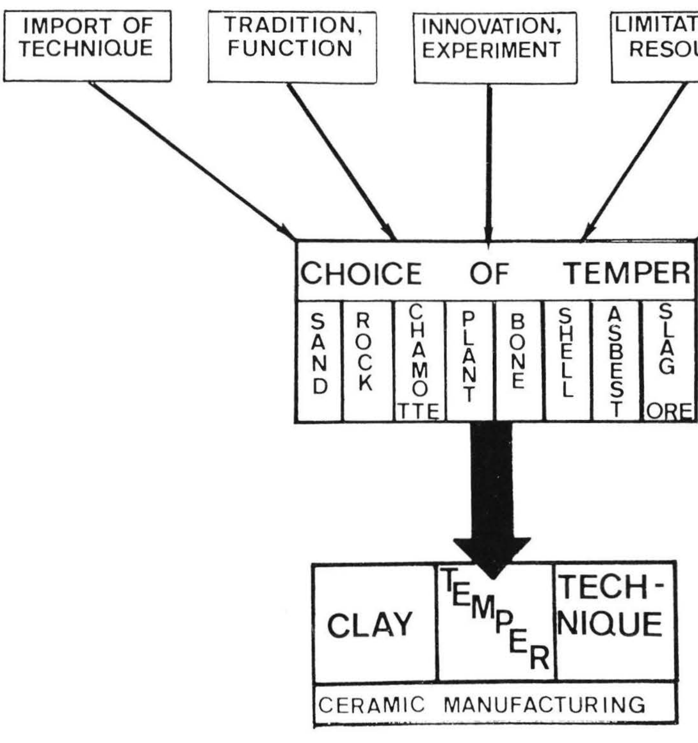


Fig. 1. Scheme illustrating various reasons for choice of temper in ancient ceramic manufacture.

Often craft methods appear to have been highly dependent on traditions within individual cultural complexes. Within the research of ancient ceramics temper can serve as a base for studies of craft development, influences from and contacts with other areas, environmental effects and not least the important vessel function (fig. 1).

Analysis methods

Different methods are applied for temper investigations. Most important in this context is petrographic microscopy. Other methods are thermal and chemical analysis and simulating manufacture. The last mentioned process is suitable for testing influences of various temper materials.

Temper in ancient ceramics

Some examples of functions of ceramic temper during different epochs in different territories are presented in the following review of Scandinavian Prehistoric pottery.

About 6000 BP the earliest ceramics were introduced to Scandinavia. What happened was not an independent spontaneous innovation but a direct import of technology to the Ertebølle culture. This is quite obvious from temper investigations of these first vessels. Mixing i.e. chamotte and plant material in calciferous clays in order to obtain a both strong and dense ceramic ware doesn't seem to be a beginners know-how (fig. 2). On the contrary this sophisticated temper procedure was typical for the long-experienced, skilled potters of the band-ceramics on the continent (Hulthén 1977, fig. 25—28, fig. 145, p. 23—51). The connection between the Danubian culture and the beginning of the Neolithic in Scandinavia has been confirmed also in other fields (Schwabedissen, 1966—67). The chamotte and plant tempered clay was the raw material for manufacturing of lard lamps. For production of cooking pots there were quite different qualitative requirements concerning clay and temper. The Ertebølle potters tempered the coarse, calciumfree clay with natural sand or gravel. In a later and more

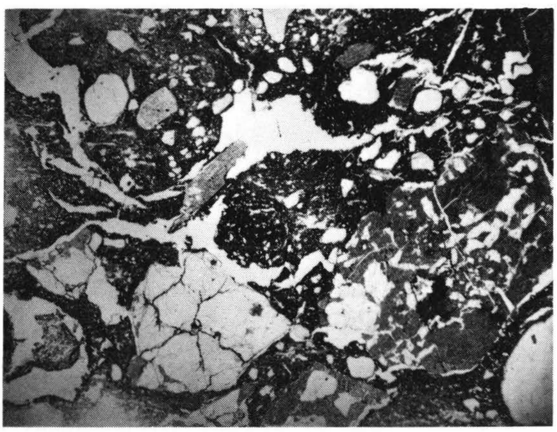


Fig. 2. Microscopephoto (20 ×) of Ertebølle lamp vessel ware from Rosenhof in Northern Germany. The calciferous clay has been tempered with crushed rock, chamotte and plant material. Photo: O. Thornblad.

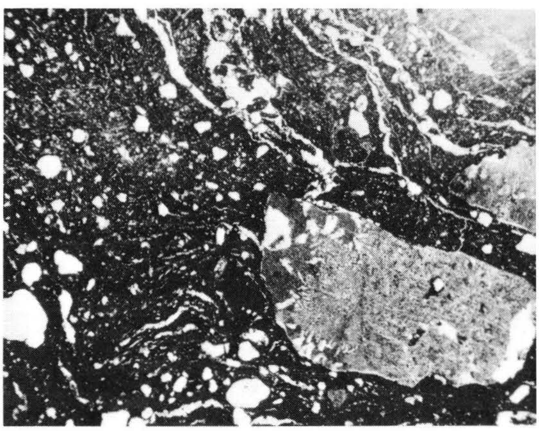
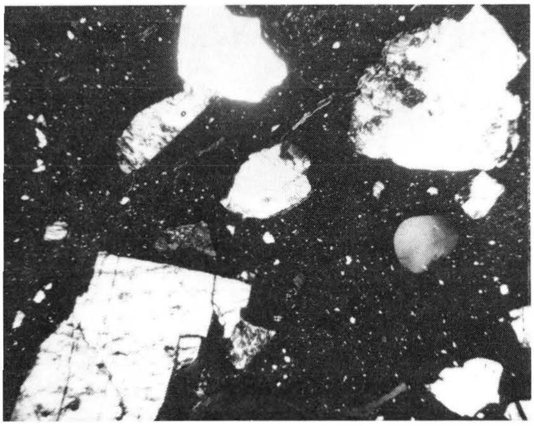


Fig. 3. Ceramic ware of an Ertebølle cooking vessel from Vik in south-eastern Scania, Sweden. A ferruginous, silty, coarse clay, free of calcium has been tempered with about 15 % of crushed, weathered granite with maximum grainsize of 4 mm. Microscopephoto (20 ×): O. Thornblad.



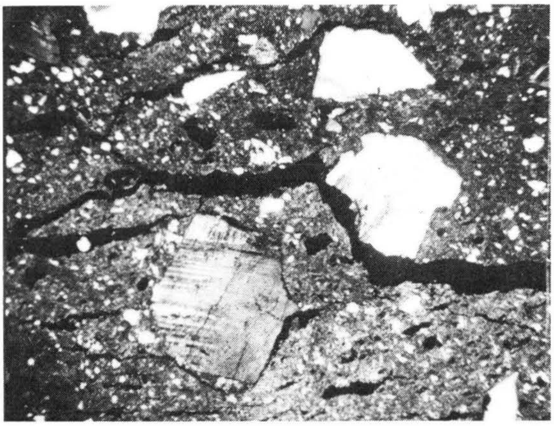


Fig. 4. Middle-neolithic pottery ware from Hagestad in south-eastern Scania, Sweden. Ferruginous, silty clay, free of calcium, has been tempered with about 15 % of crushed, weathered granite. A = TRB-vessel. B = Pitted-ware vessel. Microscopephotos (15 ×): O. Thornblad.

advanced stage, crushed rock, preferably weathered (easily crushed) granite was used (fig. 3). Technologically this was a quite appropriate choice. The bond between clay and temper is strongly enhanced if the rounded grains of sand are replaced by sharp-edged crushed rock. This tempering resulted in a permeable were necessary for cooking pots used over open fire (Hulthén 1977, p. 25—26; 1982, p. 18). The suitability of this temper technique is shown by the fact that in great parts of Scandinavia it remained unchanged for nearly 2000 years. It became a stable craft tradition with only small variations within the Funnelbeaker culture of both early and middle Neolithic as well as in the Pitted Ware production. During all this time it was based on calciumfree clays and granite (fig. 4 A—B).

In the late middle Neolithic this stability was disrupted by direct foreign import. The early G-vessels of the Battle-axe culture represented a completely new and very advanced ceramic craft. The fine calciferous clays were exclusively tempered with finely crushed chamotte (fig. 5). These vessels were certainly not suitable for cooking purposes but must have served as excellent containers for liquids owing to the density of the ware. In a later stage the Battle-axe pottery production was influenced by the local Pitted Ware manufacturing. In the late J-vessels we find granite-tempered calciumfree clays (fig. 6). This indicates an important change of the function of the Battle-axe vessels.

Porous ceramic ware

Bone is generally considered a recently introduced temper material (Bone-china). It may therefore be surprising that Bone-pottery was manufactured in many parts of Western Europe already during neolithic time (fig. 7) (Constantin, C. et Courtois L. 1980, Hulthén 1981, 1984). By means of bone temper this pottery obtained both high strength and low weight compared with rock-tempered ceramics. Was this technique a result of deliberate know-how? The porousity which today is most characteristic of these sherds was certainly never observed by its makers. Bone, consisting of hydroxi-apatite $/Ca_{10}(OH)_2(PO_4)_6/$ is very resistant to weathering, even after burning.

Hydroxiapatite will, however, be dissolved when attacked by certain organic accids such as tannin. This process is very slow, therefore the empty pores after dissolved

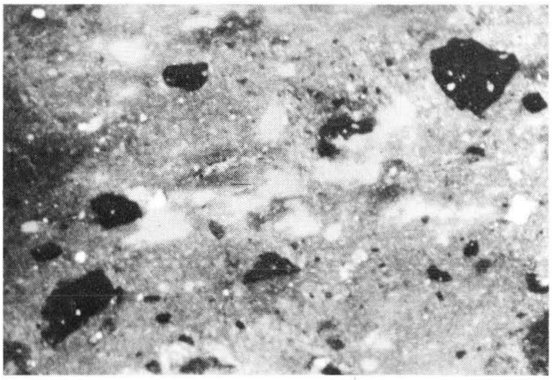


Fig. 5. Mikroscopephoto (25 ×) of early Battleaxe pottery (G-vessel) from Hagestad in south-eastern Scania, Sweden. A calciferous, fina clay, poor in iron, has been tempered with 5 % chamotte. (Photo: A. Lindahl)

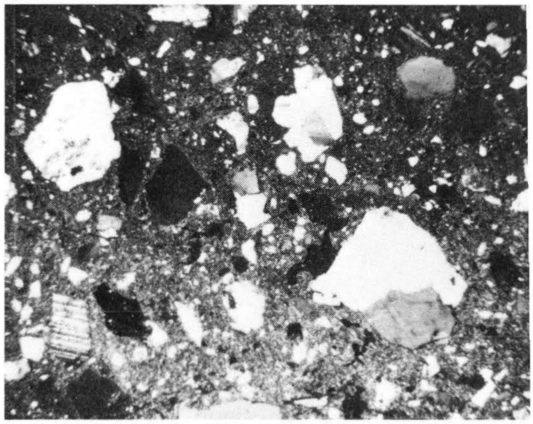


Fig. 6. Ware of late Battleaxe pottery from Hagestad in south-eastern Scania, Sweden. A ferruginous, coarse clay, free of calcium has been tempered with about 25 % of crushed weathered granite. Microscopephoto (15 ×): O. Thornblad.

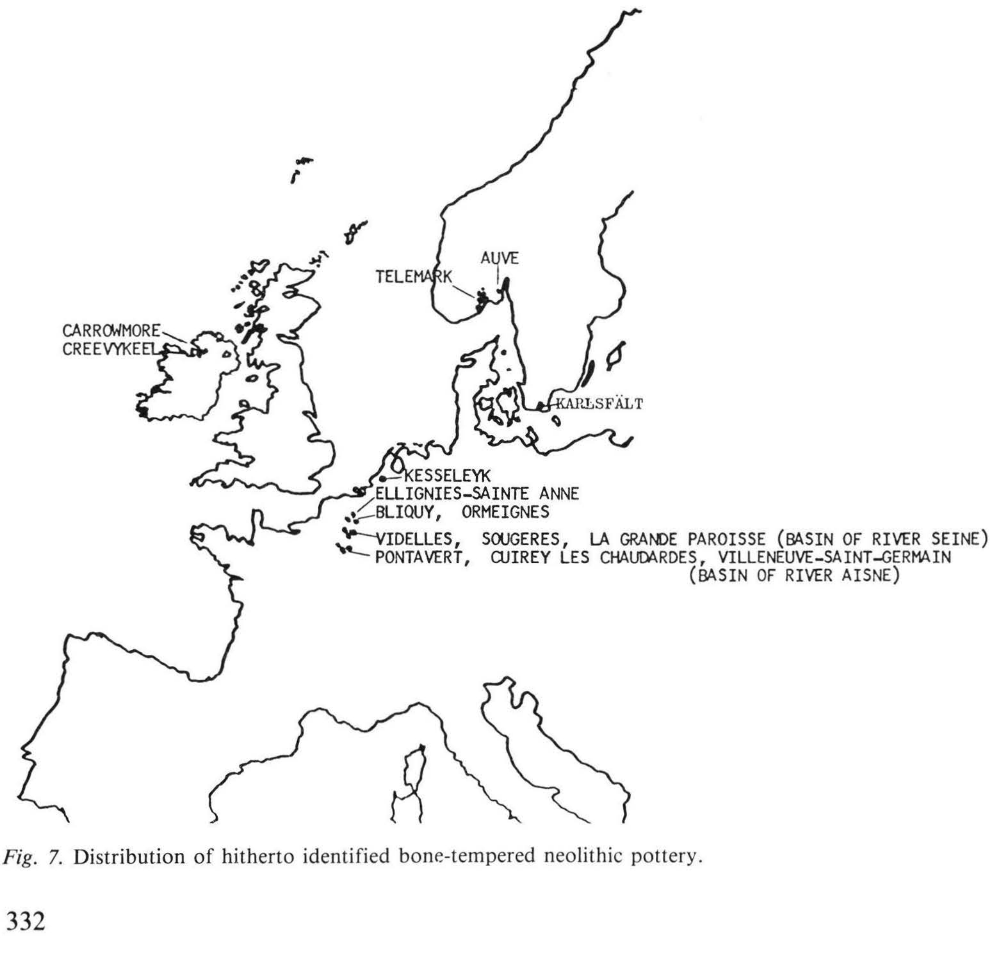


Fig. 7. Distribution of hitherto identified bone-tempered neolithic pottery.

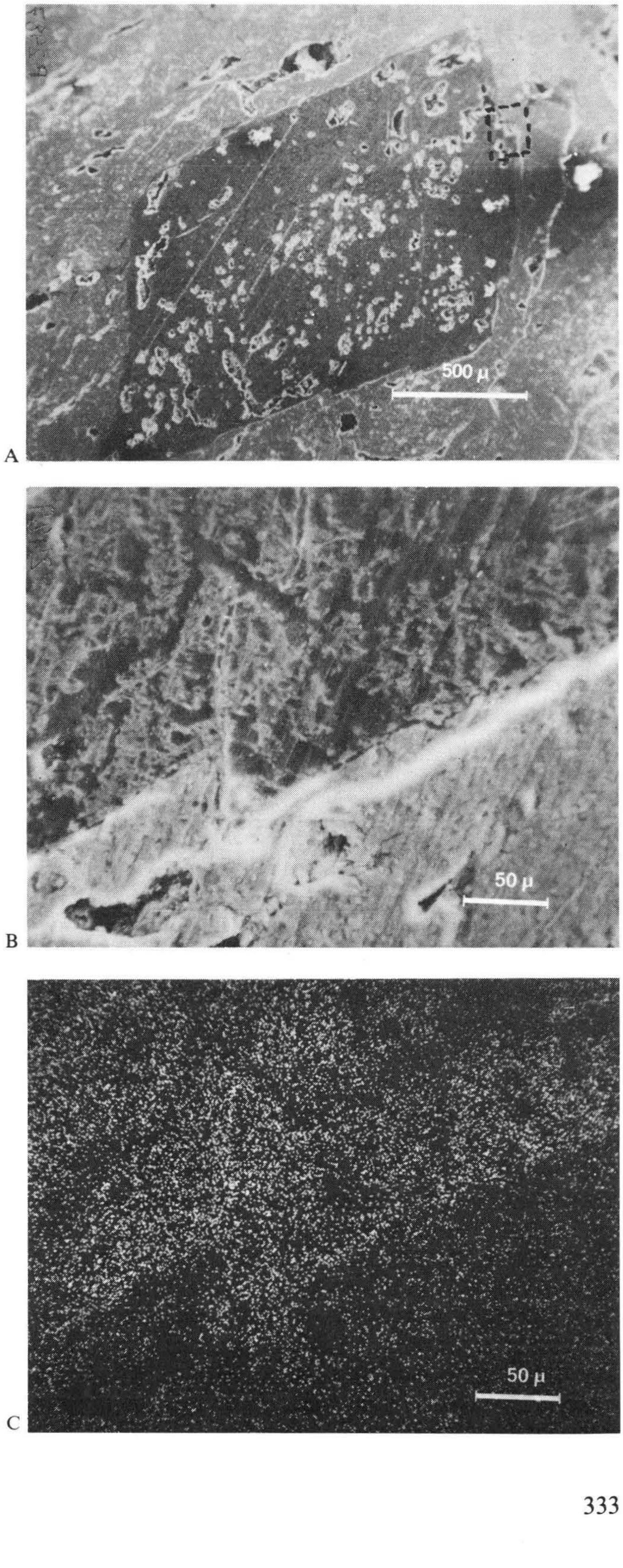


Fig. 8. SEM-photos of neolithic pottery from Telemark, Norway. A. A bone temper grain. — — — — = the area of B and C. B. The bone structure can be clearly seen at a magnification of 300 times (dark area). C. The distribution of phosphorus in the same area. Photo: O. Struglics.

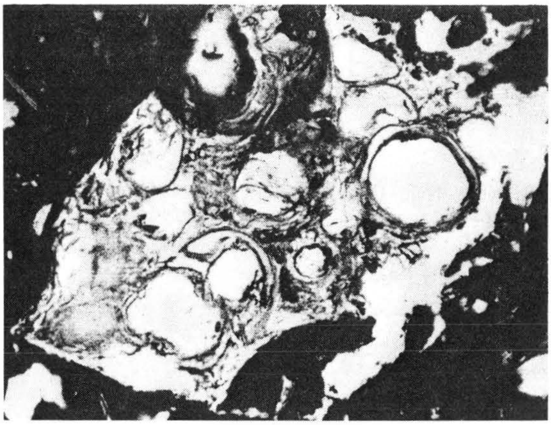


Fig. 9. Grain of bone-temper in middle-neolithic pottery (Pitted-Ware) from Karlsfält, south-eastern Scania, Sweden. Microscopephoto (300 ×): O. Thornblad.

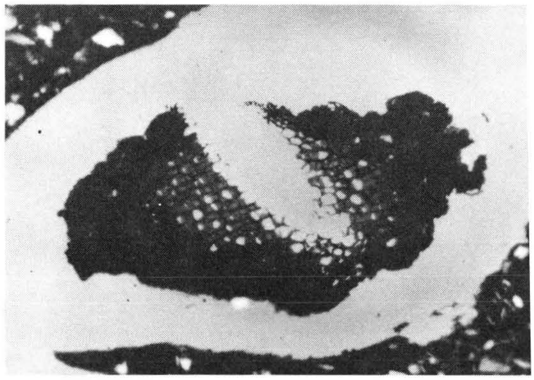


Fig. 10. Remains of plant temper in middle-neolithic pottery from Karlsfält, Scania, Sweden. Photo (100 ×): A. Lindahl.

bone fragments may have taken centuries to develop. The relation between different, Neolithic producers of bone pottery is an interesting subject for future investigations (fig. 8 A—C; 9).

In certain areas the environmental conditions forced the neolithic potters to work with less suitable raw materials. Such an area is the isle of Gotland, where only highly calciferous clays are available and limestone abundant. The shell and limestone tempered neolithic pottery on Gotland was fired in open fire. It had very low strength and contrary to the bone-tempered ware, it became relatively soon porous and brittle. The demand for new vessels must have been considerable. Efforts were sometimes made to improve the quality by mixing plant temper into the clay. The carbondioxide from the burnt plant material retards the decomposition of the calciumcarbonates which otherwise will start at 650° C and cause cracking of the pottery. It is not until the Iron age that these problems really were solved on Gotland by development and improvements of the ceramic technology.

Plant temper

Certainly also a neolithic potter once in a while got an impulse to try something different, something unusual i.e. for tempering. It is not unlikely that the admixture of 10 % of ıather coarsely cut plants in the ordinary, local, granite-tempered, non-calciferous ware was the result of such an experiment (fig. 10). It would otherwise be difficult to explain the presence of a few such odd sherds within a large, homogenious and traditionally manufactured vessel production from a pitted ware site on the Scanian southcoast (fig. 11).

Asbestos Temper

Prior to the late Bronze Age a ceramic tradition did not excist in Northermost Sweden.

During the late Bronze Age, however, very special, thinwalled vessels appeared on many sites in northern Norway, Sweden and Finland. The ware of these vessels consists

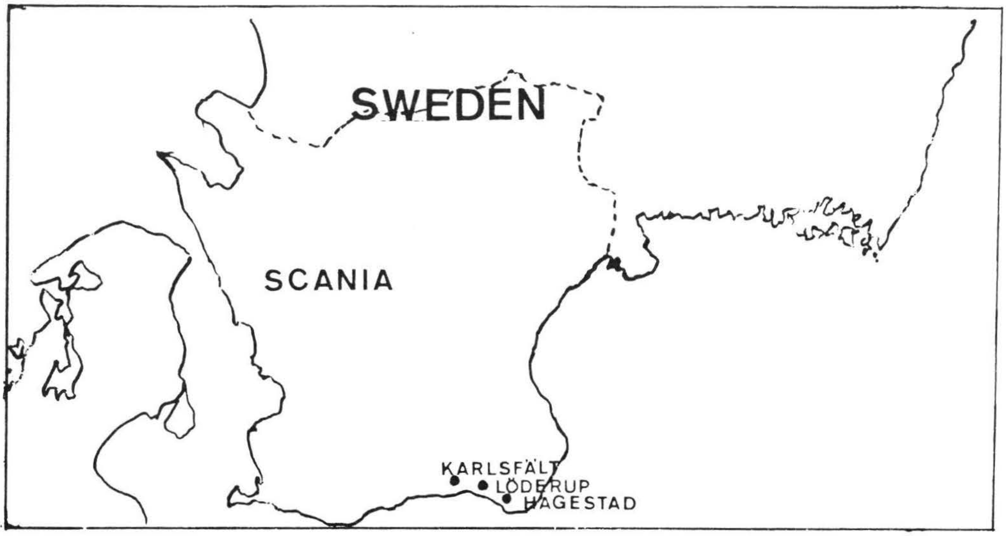


Fig. 11. Karlsfält, Löderup and Hagestad sites in south-eastern Scania in Sweden.

of asbestos fibres bond with about 5 % of clay. For this reason »Asbestos Ware» seems to be a more adequate denomination than asbestos pottery (fig. 12 A—B).

The function has probably been very specialized and unsuitable for ordinary cooking purposes. It is a very heat-resistant material and certain properties indicate a use as containers for glowing charcoal. In spite of frequent presence of different kinds of asbestos minerals in this part of Sweden these vessels are not locally made but probably distributed from one or several production centers.

There are also real asbestos ceramics in Norrland dated to the Iron age. This vessel ware contains a sorted, fine clay tempered with about 30 % of asbestos fibres (fig. 13). It is likely that this pottery was used as ordinary vessels.

Irrational reasons for choice of temper

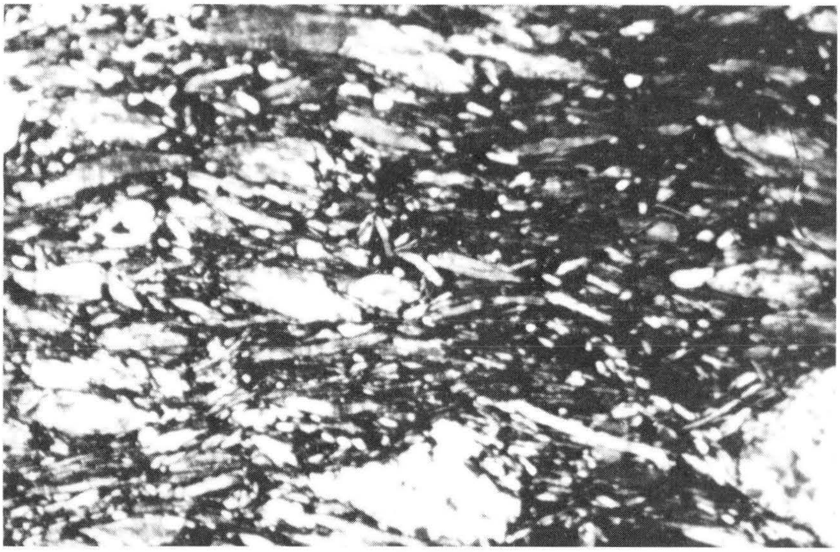
The temper materials described above have had an important influence on the properties of the ceramic products.

Sometimes, however, temper materials have been observed of which the technical sense and the positive effects are most questionable.

There are reasons to believe that the background probably was irrational thinking such as myth and belief.

The first example concerns Iron Age pottery. Among the finely crushed rock-temper one or two small fragments of chamotte have been noted. These few, solitary grains couldn't possibly have any effect on strength, function or anything else. Maybe they represent a custom which is practiced in Sudan today. When ordering a new vessel from the potter the woman brings one or two sherds from her old, broken pot in order to give it a continued »life» in the new vessel.

The next example involves the black, thinwalled, polished fine-ware of Preroman and Roman Iron Age. The shapes often remind of metal vessels. Maybe the pottery was intended to resemble such vessels as closely as possible. It seems logic if the potters then believed that some iron ore and iron slag mixed into the clay would increase »the metal properties» — strength and hardness — still more. In spite of its uselessness it



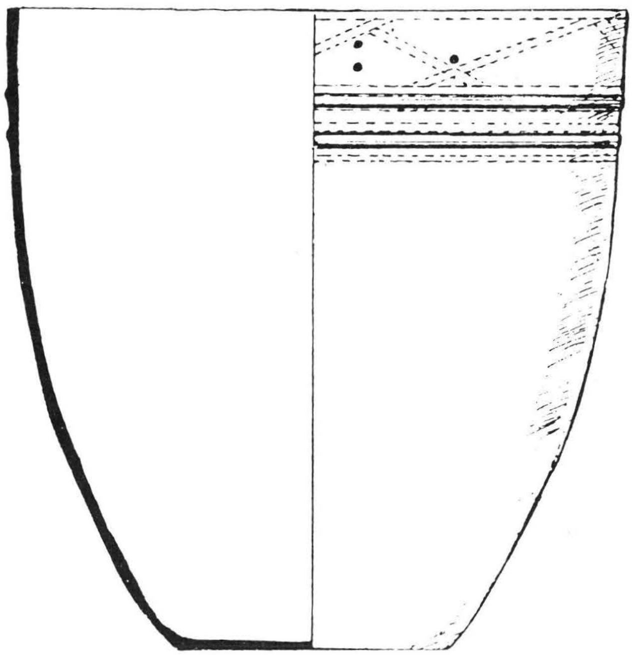


Fig. 12. Vessel of asbestos ware from Västerbotten, northern Sweden, (1 : 2) and a microscope photo of the ware containing about 5 % of clay and 95 % of asbestos fibres.

must have been a widespread conception at that time. It has been documented in contemporary pottery from the isle of Gotland, several places in Westernmost Sweden and in southern Norway (fig. 14).

Working with investigation of ancient techniques it is adviceable to remember there are not always technologically rational explanations to observed fenomena. At least not in ceramics.

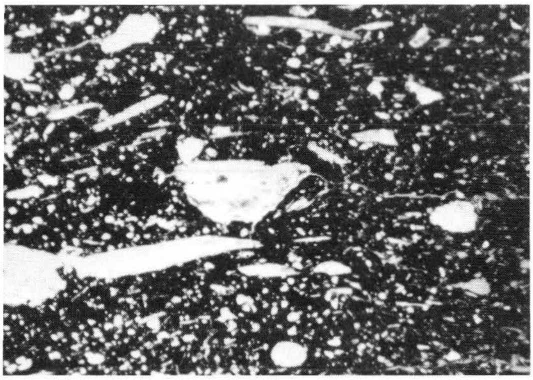


Fig. 13. Microscope photo of asbestos ceramic ware containing about 55 % of clay and 45 % of asbestos fibres.

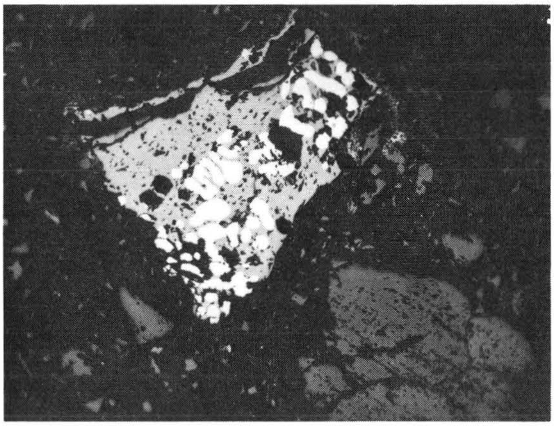


Fig. 14. Ware of Iron Age pottery from Havor, Gotland, Sweden, containing temper grains of iron slag. Microscopephoto (150 ×): O. Struglics.

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