role in an archaeological conference, the subject matter was equally relevant to all aspects of archaeological publication. Papers by Mike Allen and Sebastian Payne emphasised the need to target reports to the intended audience. Successful integration requires continous involvement of all participants in the report from the conception of the research design through to final production of the report. Selectivity of information for publication was stressed by a number of speakers, along with the need to resist urges to impress collegues with one's grasp of up-to-the-minute jargon and terminology, and by presenting pages of raw data. Sebastian Payne argued for presentation of only as much data as was required for the validity of interpretations to be judged. Julie Gardener, for the Council for British Archaeology, aimed to curb over-enthusiastic report writers by pointing out the costs of producing data-heavy reports, and of correcting errors spotted after submission. Technical terminology and Latin names are clearly a turn-off as far as publishers and the wider British audience are concerned. However as Martin Jones pointed out, reports should also be understandable to an international audience, to whom imprecise common equivalents to scientific names may be incomprehensible. The problem of where to store the raw data and results which were not required in the text was discussed at length, but not surprisingly no firm conclusions were reached. As a first move—at least for those working for/with English Heritage-it was suggested that cheap paper copies of technical reports not submitted as Ancient Monuments Laboratory reports could be circulated to interested colleagues. Perhaps the Association for Environmental Archaeology could support this move and circulate lists of available reports?

One of the highlights of the conference was meant to be a session on 'Archaeology and Politicians'. Being politicians, the speakers did not turn up at the originally specified time, so the session was moved to a slot running parallel with that on Environmental Archaeology. Consequently most AEA members present, including myself, did not attend, so I cannot report.

The IFA, unlike the AEA, does not arrange site trips for its members. Perhaps it should be suggested?

The IFA annual conference is not just open to members and, to judge from the badges worn (red = member, blue = non-member) a fairly even mix attended. The cost ranges according to income and, of course, residential status. Assuming non-residential status, it can work out reasonably cheap. If nothing else it provides a useful way of meeting a wide range of archaeologists informally, and contacts between different sub-disciplines can only be a 'good thing'. Sessions concerning biological concerns within archaeology must help erode traditionally perceived barriers between specialists and field archaeologists, and I hope that environmental archaeology will assume an increasingly high profile.

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Short contributions

A question of scale: Material in cave ash from Arene Candide, Italy, was not textile

Introduction

Meetings of the Association for Environmental Archaeology provide a useful means of contact between specialists from diverse fields. At the Butser meeting in July 1990, Richard Macphail drew my attention to some shrunken material in Neolithic cave ash from Arene Candide, Italy, which the excavators thought was knitted wool textile. I subsequently received photographic transparencies of the material, from which I was able to report that it was almost certainly not textile. My report was too late to allow alteration of the paper by Macphail *et al.* (1990), which was already in the press. The present note is a repeat of my correction for a wider readership.

Material and methods

Two transparencies taken under plane polarised light were supplied of a 25 µm thick cross-section of the material (one is reproduced in the figure here). They had frame sizes of 0.33 mm and 0.116 mm, indicating the width of the field of view in each case and therefore calculation of the magnification. The material had a mesh-like structure and so appeared superficially like textile, but there were several observations (mostly made on the transparency with the 0.116 mm frame and the greatest magnification) that left me with the opinion that the material was not textile.

Observations and discussion

1. Although the sections were clearly thin, and the strands that appeared to be yarns had a fairly regular orientation, there was no indication of weave. Even in a thin section of cloth there are places where one system of yarns can be seen passing alternately over and under the other system. It is true that a knitted fabric has only one yarn, but knitted fabrics have a looped appearance and this material had sub-rectangular spaces between the strands. Existing evidence suggests that knitting did not begin until the second century AD (Rutt 1987).

2. The strands were single filaments whereas yarns would have contained twisted fibres, the twist of the component fibres being visible even in short lengths and sections of yarn. It is true that cultivated silk is woven as continuous filament into 'nett silk', but this represents considerable breeding and technical achievement—wild silk and early cultivated silk were spun and woven like other fibres into 'spun silk', and there is no evidence of silk in Europe before the Iron Age. The appearance of cloth, yarns and fibres under the microscope is shown by Ryder and Gabra-Sanders (1985).

3. If the strands are equated with individual fibres, no conclusive feature identifying any particular fibre type is evident. Some of the 'fibres' had a hollow in the middle analogous to the lumen in flax fibres and the central medulla in coarse wool fibres. Some 'fibres' were represented by a translucent short length, but most were seen in transverse section. The latter mostly appeared black with a yellow 'rind' that made them appear like wool fibres with dense natural pigmentation in the inner cortex and no pigmentation in the thin surface cuticle. Such a distribution of pigment is rare in sheep, but not uncommon in some animal hair. These black fibres also had a diameter distribution whose *shape* (though not the dimensions, see below) mirrored that of the primitive fleeces that first appeared in the Bronze Age (Ryder 1983; 1987). If the blackness is interpreted as carbonisation then one would expect no unaffected 'rind', which was what was found in the carbonised flax from the Neolithic site of Çatal Hüyük in Turkey (Ryder 1965). With a date of 6500 BC, this is the oldest textile in the world. This variablity and the lack of any conclusive structural feature led me to believe that these were chance artefacts that appear superficially like textile fibres.

4. The crucial evidence concerns the dimensions. A typical diameter of the black 'fibres' in the 0.116 mm frame was 1 mm, which indicates an actual fibre diameter of 0.33 µm. This is 1/30th of the thickness of an average (10 µm) flax or silk fibre (Ryder and Gabra-Sanders 1987) and 1/60th of the thickness of a fine (20 µm) wool fibre. These dimensions equate to single cells instead of entire fibres, which is in keeping with the observation that no cellular structure was observed within the 'fibres', although of course silk does not have a cellular structure. It has been suggested that heat has caused this material to shrink by 90% (R. Macphail, pers. comm.). I know of no precedent for such shrinkage—the Çatal Hüyük cloth showed no evidence of shrinkage—and I find it difficult to believe. Such shrinkage would require gross distortion of the molecular structure and would create cellular irregularities and disruption that would have been evident in the present microscopic investigation. Even moderate heat causes wool cloth to 'pucker'—an observation made experimentally by Ryder (1965) during the investigation of the Çatal Hüyük cloth. The same arguments would apply to basketry made of plant stems (which was a suggestion made by one correspondent).

Conclusions

The material thus did not appear to be basketry, fabric, or a collection of textile fibres. It did, however, appear to be organic rather than inorganic. The present investigation illustrates the limitations of a purely visual approach. On the other hand my experience of invertebrate and plant structures is limited and others used to looking at a greater range of material might recognise the structure—one thinks of insect parts such an eye, for example. At the same time, there are now sophisticated non-destructive chemical tests available that might indicate in the first instance whether it is animal or plant. Richard Macphail (pers. comm.) has suggested more recently that it might be lignin.

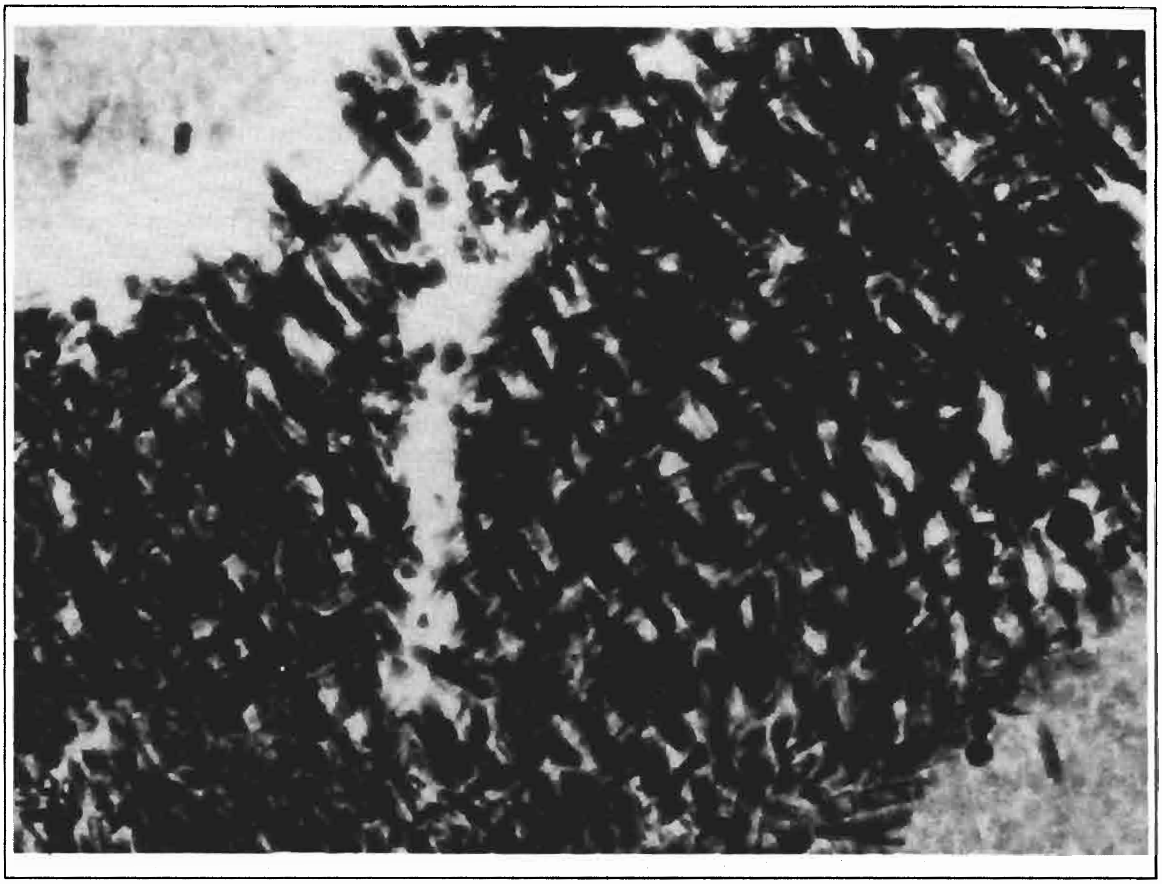

Figure 1. Photomicrograph of the material from cave ash at Arene Candide, Italy, under plane polarised light. The material came from cave ash containing sheep/goat stabling detritus that is thought to have shrunk by 90% on burning. The grey material at the edges is wood ash. Frame length 0.33 mm (from Macphail et al. *1990)*

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Wool fibres in cloth remains throw light on fleece evolution

I have long used the fibres in textile remains to study the way in which different kinds of fleece developed in domestic sheep during prehistory and history. Notably, large collections of cloth from the Danish Bronze Age, the Roman site of Vindolanda on

Hadrian's Wall and from British medieval towns have been investigated. More finds described in several papers published during 1990 have filled gaps in the record and thrown new light on the first stage of fleece development in the early Bronze Age.

Neolithic sheep had short hairs obscuring very fine underwool in a coloured coat like that of deer. A sheep surviving from this period is the 'wild' (feral) mouflon of Corsica. Haired skins preserved in the Iron Age salt mines at Hallstatt in Austria have now shown that the Neolithic type of sheep without a fleece persisted alongside fleeced sheep into the Iron Age (Ryder 1990a). During the 1960s I used wool remains from the Danish Bronze Age to show that the first fleece to develop was a primitive hairy type (the 'Hairy-medium' fleece), from which developed a primitive woolly type ('Generalised-medium' fleece). The same fleece types are seen in the hairy and woolly, brown Soay sheep that survive on St Kilda, off the north-west coast of Scotland.

What the recent studies have shown is that some of the earliest Bronze Age textiles from Denmark had wool (with no hairs) which was as fine as that of the underwool of the Neolithic sheep. It therefore appeared to have been combed from a hairy coat intermediate between a fleece and a hair coat if not from the Neolithic hair coat itself (Ryder 1990b). Before the development of shears in the Iron Age, primitive sheep (which have a natural spring moult) had their wool removed by plucking or combing.

Iron Age wool had the same two hairy and woolly fleece types as in the Bronze Age, but there was now a greater range of colour—black, white and grey in addition to the brown of wild and Bronze Age sheep. The evidence for this comes from the large collection of the *c.* 100 AD textiles from the Roman site of Vindolanda that I measured during the 1970s. Since archaeologists thought that the cloth was of local manufacture this indicated that the wools came from local sheep. A surviving sheep with this range of colours and fleece types is the native Orkney breed. The stimulus to breed sheep with white wool was associated with the development of dyes.

The large collection of cloth from Hallstatt, dated up to eight hundred years earlier than the Vindolanda remains, has the same range, not only of colours, but of fleece types, so confirming that the Vindolanda wools are typical of the Iron Age (Ryder 1990a; 1992).

All Roman sites, including Vindolanda, have also produced a few examples of modern fleece types—'Semi-fine' (shortwool),'Medium' wool (some of which later became longwools) and 'Fine' wool, and it was thought that these began to develop in the Roman period. An additional find from Hallstatt was the presence of some Semi-fine and Medium wool fleeces, which indicates that these types were already emerging in the Iron Age. The Fine fleece developed in the Near East and the Mediterranean area during the Roman period and later emerged in Spain as the modern Merino breed.

Until the Hallstatt material became available for study, very few Iron Age samples of wool had been examined. One I published in 1961 came from the Scythian, frozen burials at Pazyryk in Siberia, dated *c.* 400 BC. This was a piece of sheepskin with the wool intact, which therefore indicated the appearance of the fleece. It was a white, primitive hairy type. A larger collection of wools from Pazyryk (kept in the Hermitage Museum, Leningrad) has now been measured (Ryder 1990c). As well as the expected primitive hairy and primitive woolly types, there were also Semi-fine and Medium fleeces, which support the finding from Hallstatt that these modern fleeces were developing in the Iron Age. Of particular interest was one very fine sample, apparently combed (like the Danish Early Bronze samples) from a Neolithic type of coat (seen at Hallstatt only on skins, Ryder 1992).

I have been looking for Neolithic wool for over 30 years and now it seems to be emerging in an unexpected way. More finds are needed to elucidate further the very first stages in fleece development.

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[This contribution is reproduced, with modifications, from *Archaeological Textiles Newsletter* **12**, 13–15 (1991).]

Appendix: Wool fibre terminology and definitions

Mammals have hair, and the wool of sheep is a kind of hair. But wool biologists divide 'wool' into three types of fibre: short, thick *kemps*; long, less-coarse *hairs*; and finer, true *wool* (which itself can be coarse, medium or fine). Kemp and hair are collectively referred to as 'hairy fibres'. The coat of wild and Neolithic sheep had only very coarse kemp and very fine wool. Such 'hairy' sheep are best described as 'non-fleeced' to distinguish them from woolly, fleeced sheep. Fleeces are primarily composed of wool, but many have varying, smaller proportions of kemp and hair, depending on the fleece type.

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The last teasel factory in Britain, and some observations on teasel (*Dipsacus fullonum* L. and *D. sativus* (L.) Honckeny) remains from archaeological deposits

The last teasel factory in Britain

I came to hear of the existence of a factory processing the flower heads of fullers' teasel by a rather circuitous route and arranged to visit the factory in suburban Huddersfield, West Yorkshire, with Philippa Tomlinson late in 1989. We were shown round by the manager of Edmund Taylor (Teazle) Ltd., Mr T. J. Ledger. This firm, founded in 1849, is the only one of its kind surviving in Britain and supplies all the needs of the home industries in which teasels are used.

The teasels processed by Taylor's are both home-grown and imported. The British crop currently comes from five farms in Somerset and one in Kent, each supplier sowing about 0.5 acres (0.2 ha); Taylor's is the sole buyer. These teasels come in bunches cut in the field and have to be trimmed and graded in Huddersfield. The foreign crop is Spanish, the growers there sending the heads ready trimmed and graded.

Taylor's supply teasels to the British market and to Australia, the United States of America, Canada and India, but not to the rest of Europe, who are supplied by firms in Spain. The main market is the woollen industry where wire 'teasing' mechanisms—though now widely used—have never proved entirely satisfactory for the final raising of a nap in the finishing of woollen cloth. Teasels are also used in the paper industry and in the manufacture of felt, and a modern outlet (especially in the United States) is the decorative use of heads as ornamental 'hedghogs'.

At the factory, the teasels for the cloth industry are sorted by machine for length and diameter, though their quality is judged by hand. Quality varies depending on the source and the season of the crop, British teasels (it is said) usually being superior to imported ones.

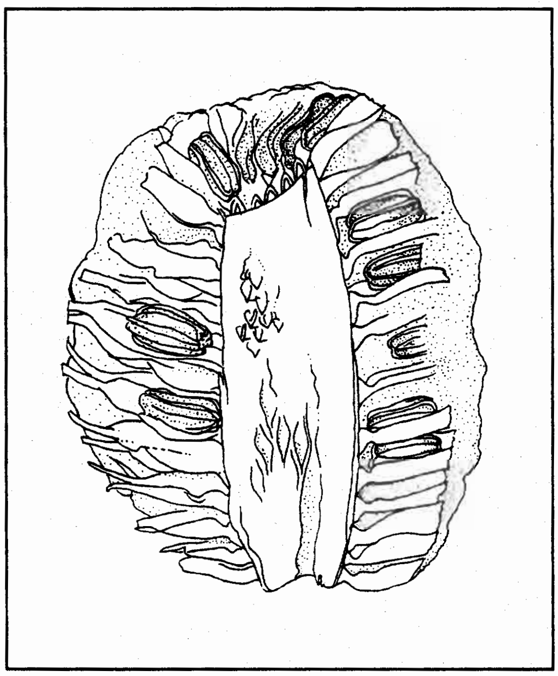

Figure 2. A half-head of Dipsacus sativus *from twelfth century deposits (layer 185) at Eastgate, Beverley, N. Humberside (site code BE84). Magnification approximately x2.*