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Dyes and Fleece Types in Prehistoric Textiles from Scandinavia and Germany

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During the past few years a large quantity of prehistoric textiles has been recorded from all over North Europe. The many textiles (from approximately 2,500 finds) have been sorted into about a score of cloth types, defined by a combination of weave, spin and quality. Distribution maps of each type have shown that most can be linked with geographical and cultural entities, and a distinction between locally produced cloth and imported fabrics has been ventured (Bender Jørgensen 1984).

It was, however, felt that additional documentation for the origin of the various cloth types would be desirable, especially as the conditions for the preservation of textiles vary greatly, and it would be impossible to gather a homogeneous material from all of the Old World. One such source of information is the examination of the fleece types found in wool fabrics, another is the dyestuffs used for colouring.

Methods for the analysing of both fleece types and dyestuffs have been developed greatly in recent years in England, based mainly on British material, but on other European material (even some Danish) as well. A grant from the Danish Research Council for the Humanities made it possible to take advantage of the English specialist knowledge by letting Penelope Walton, a textile consultant based in York, analyse a group of selected samples of Scandinavian and North German Iron Age textiles.

THE SAMPLE

The main purpose of the investigation was to see if the types defined on a technological background also had been made from homogeneous fleece types; and if any difference could be told between the wool of cloth supposed to be of local origin, and the wool of allegedly imported cloth. To this was to be added the evidence of the dyestuffs.

It was decided to take samples of 4 different cloth types of the Pre-Roman and Roman Iron Age, and two of the Late Germanic/Viking Age. A wide geographical background was obtained through the friendly cooperation of Klaus Tidow of the Textilmuseum Neumünster, and Bente Magnus of Historisk Museum in Bergen, who provided samples from the settlements of the North German marshlands and from Norway.

The four Early Iron Age cloth types selected for analysis were the Huldremose- and Haraldskjær types of the Pre-Roman and Early Roman Iron Age, and the Virring type and dog's tooth spin-patterned twills of the Roman Iron Age. The Late Iron Age types were the Birka type and the Hessens/Elisenhof type. All these types are described in Bender Jørgensen 1984 and 1986.

The Huldremose- and Haraldskjær types are both considered to be local products, the Virring type is supposed to be of central- and West European origin and thus imported to Scandinavia. The dog's tooth twills are a feature of Scandinavian Late Roman Iron Age without any known parallels. The origin of the Birka type has been greatly discussed, and Bender Jørgensen has suggested that it is of West Norwegian origin (1984, p. 131f); the Hessens/Elisenhof type was probably made along the North Sea Coast.

The following textiles were included in the investigation:

Huldremose type: Krogens Mølle Mose, Stokholm Mose, Borre Mose, and Fræer Mose, all from Denmark, and all dated to the Pre-Roman Iron Age.

Haraldskjær type: Haraldskjær Mose (Pre-Roman Iron Age), and Lønne Hede (1st century AD), both from Denmark. From Germany some samples from Feddersen Wierde were selected, however only tabbies, as no twills were available from the stores of the Textilmuseum Neumünster; to these were added two samples of raw wool.

Virring type: Vester Lem, Hjørring Præstegårds Mark, Vrangstrup grave 1, and Verdens Ende from Denmark, Tofte and Blindheim from Norway. All samples are dated to the Late Roman Iron Age.

Dog's tooth twills: Hjørring Præstegårds Mark and Donbæk from Denmark, Blindheim from Norway, all from the Late Roman Period.

Birka type: Lousgard (Denmark), from the Late Germanic Iron Age, and Dale, Veka, Vinjum and Sandanger (all Norway) from the Viking Age.

Hessens/Elisenhof type: Hessens and Niens (North Germany), both 8th century AD. To the Hessens/Elisenhof diamond twills were added samples of raw wool, a chevron twill and a tabby from the same sites. L.B.J.

Unfortunately, it was not possible to fleece-type and dye-test every specimen. Samples of 20mg are necessary for a thorough dye analysis and this is not always available where the surviving textile fragment is small. Fleece-typing requires less sample but unless the wool fibres are in an excellent state of preservation, it is not possible to measure their diameters accurately. Thus, dye tests were sometimes carried out on poorly preserved textiles which could not be fleece-typed, while particularly small fragments were fleece-typed but not dye-tested. However, in many cases it was possible to carry out both analyses.

THE METHODS OF ANALYSIS

Dye tests

A procedure for analysing dyes on textiles was introduced into archaeology by Professor M.C. Whiting of Bristol University. These techniques, which have been further developed by Dr G.W. Taylor of the York Archaeological Trust, are now regularly in use in dye identification (Taylor 1983).

Briefly, the procedure consists of putting the sample through a sequence of solvents, each of which will extract a different group of dyes. Any dye present is isolated and its detectability enhanced with further solvents, etc. The light absorption of the extracts is then measured with a U.V./Visible spectrophotometer and the spectra compared with those of known dyestuffs (for more precise details see Taylor 1983). Any uncertain results are checked with chromatography, in this instance thin layer chromatography.

Work carried out on British textiles has shown that although any number of local dye-plants must have been available, in fact only a very small number of well-known dyes, such as madder and woad, were used throughout the Roman, Saxon, Viking and medieval periods. However, it has to be said that our techniques are less effective at detecting and identifying the yellow dyes, which are often masked by yellow/brown staining from the soil.

Fleece typing

As with dye-testing, this is a technique used in the modern textile industry, but which has been transferred to good effect into archaeology – in this case by Dr M.L. Ryder of the Hill Farm Research Organisation (see for example Ryder 1964, 1969, 1982, 1983a).

Samples of fibre were viewed at 400x magnification and features of the structure such as scale pattern and medulla were examined to establish that it was indeed sheep's wool and not any other animal coat fibre. The diameters of 100 fibres were then measured and recorded in histogram form. According to the range, mean and distribution of this histogram, the sample was placed in one of the seven fleece type categories, which range from fine to hairy (see table 4). Since a sample is taken for each type of yarn visible in the textile, there are usually two fleece types per fragment, one for the warp and one for the weft.

Dr Ryder's work was originally aimed at developing a theory concerning the evolution of the fleece of sheep. However, to the archaeologist interested in textiles, his work has been significant in showing that the raw material of wool textiles has varied considerably in the past and that different fleece types have predominated at different periods of time and in different areas.

Of course, in the past, flocks were much less uniform than they are nowadays and no fleece type is therefore exclusive to any particular period or country. For this reason no conclusions can be drawn concerning individual textiles. However, when comparing the character of one *group* of fabric types with another it is a useful piece of information.

While examining the wool, a record was also made of the percentage of fibres which showed the dark granules of natural pigment and how densely the granules were distributed. Thus a white fleece could be differentiated from a grey/fawn or a brown/black.

RESULTS

The results of both types of analysis are recorded in Tables 1–3. A summary of fleece types is given in table 4. The main points of interest are discussed below.

Pre-Roman Iron Age, Denmark

The wools from the Pre-Roman Iron Age, 18 in number, are all of the same type. They consist of fine fibres, mostly less than 35 microns in diameter, with coarse 'kemps' of 90–176 microns and very few intermediate fibres. Most have no pigment (white) although four specimens have pigment on a high proportion of fibres (brown or dark grey) and three have pigment in a few fibres (still probably white to the naked eye). This is a primitive type of fleece (classified as hairy medium), only a few stages removed from the double-coated fleece of the wild ancestor of domesticated sheep.

The present day wild mouflon has a fleece with numerous short bristly kemp fibres and an extremely fine woolly undercoat, is brown with a white belly, and is subject to an annual moult (Ryder 1982 pp 224–5, 237). The 17 Danish wools from the Bronze Age which have been studied by Ryder (1969, 1983b) resemble the fleece of the mouflon in their remarkably fine undercoat and predominance of natural pigment. However, a few examples were white and the proportion of kemps was small, indicating that the fleece had begun to evolve from the wild type. Seven of these wools were clearly of the same type as the others, but lacked the kemp altogether, which Ryder suggests may indicate that they were plucked during the moult, before the kemps had been released from the skin (1983b p 330).

The Iron Age fleece types at present under discussion continue this line of development, with more white fleeces and a slight coarsening of the undercoat. Their most common measurements (modes) are 16–26 microns (average 20.4) as compared with 14–22 microns (average 17.0) in the Bronze Age and 14 microns in the mouflon. This coarser undercoat brings them closer to the Soay of St Kilda (off the north-west coast of Britain) which is believed to be a survivor from the British Bronze Age (although this sheep has a mainly brown fleece, while most of the Danish pre-Roman examples were white).

These Danish wools are a useful group, since few other fleece types have been identified from the Pre-Roman Iron Age, either from Denmark or elsewhere. Other hairy medium types are known from Iron Age Britain (Bender Jørgensen and Walton forthcoming) and France (Ryder 1982 p 226), but true hairy types are also recorded, at Hallstatt in Austria and Potrems in East Germany (Ryder 1969 p 502, 1977 pp 177–8). The Danish Rønbjerg textiles showed quite a range of types, hairy medium (1) generalised medium (5) and shortwool (1) (Ryder 1982 p 226) but unfortunately this bogfind is not firmly dated, although tentatively placed in the Celtic Iron Age (Munksgaard 1982 p 42).

All in all, since there is nothing to suggest that the present sample is not from local products and since they come from several different sites, ranging from the 6th to 1st centuries BC, it seems reasonable to suppose that their wool reflects the predominant fleece of the native Danish sheep in the Pre-Roman Iron Age. However, the Rønbjerg examples may suggest that the fleece was beginning to evolve away from the hairy median type at this time.

Although the majority of the samples were from white fleeces, some pigmented yarns had been used to introduce colour patterning. Ryder suggests this pigment was dark brown rather than grey/black, from analogy with the Soay (Ryder 1983b p 327). Only two of the pre-Roman textiles, both from Krogens Mølle, were tested for dye and both gave negative results. The group selected for dye-testing was kept small because natural pigment had clearly been used and dyeing therefore seemed unlikely.

Roman Iron Age, Denmark, Norway, Germany

Fleece types

The textiles from the Roman Iron Age show a much wider range of fleeces than the pre-Roman group. There are 5 fine (3 Denmark, 2 Norway), 2 fine/generalised medium (1 Den, 1 Nor), 3 generalised medium (2 Den, 1 Nor), 1 medium (Den), 4 shortwool (1 Den, 3 Nor), 15 hairy medium (10 Den, 1 Nor, 4 Germany), 2 hairy (Germany). The Lønne Hede textiles had already been studied by Ryder and Hedges (1973) and had proved to be 5 fine, 3 fine/gen. medium, 2 hairy medium.

The hairy medium type predominates in the Danish and German samples, but although these wools belong to the same category as the pre-Roman Danish fleeces,

FLEECE TYPES: DENMARK

	Range	Mode	Mean±S.D.	P.coeff. Distribution	Medullas	Pigment	Fleece type
Krogens Mølle							
D1310 (a–b)	13–28, 37	23	23.7±15.7	Symmetrical	3%	50–70% fibres	Hairy
dark	55, 59, 167		(22.2±6.4)	undercoat with kemp	(1 kemp)		medium
light	10–33, 41,	22	21.9±10.6	ditto	1%	approx. 6%	Hairy
	47, 114		(21.0±5.2)		(1 kemp)		medium
D1310 (c)	12–31, 46,	19, 23	23.9±17.0	ditto	41%	none	Hairy
a	126, 151		(21.5±4.2)		(2 kemps)		medium
b	12–31, 45,	21, 24	23.3±16.4	ditto	6%	none	Hairy
	87, 167		(21.2±4.5)		(2 kemps)		medium
Stokholm Mose							
C7649 (a–b)	9–35, 49,	21	23.6±16.9	+1.16, pos.skew	10%	10% pigmented	Hairy
a	92, 122, 128		(20.8±5.2)		(3 kemps)		medium
b	13–40, 138	17, 19,	22.8±12.6	Symmetrical	9%	none	Hairy
		21, 22	(21.6±5.0)	undercoat with kemp	(1 kemp)		medium
C7649 (c)	10–31, 46,	16	22.6±16.1	+0.61, pos.skew	6%	none	Hairy
a	79, 113, 131		(20.0±4.9)		(3 kemps)		medium
b	10–29, 144,	17, 18	23.5(±26.4)	+0.64, pos.skew	6%	none	Hairy
	149, 154, 159		(18.2±3.7)		(3 kemps)		medium
Borre Mose							
8/43 a	15–32, 56,	21	24.6±11.1	symmetrical	1%	approx 75% of	Hairy
	126		(23.6±4.5)	undercoat with kemp	(kemp)	fibres	medium
b	12–37, 128,	26	26.2±15.4	ditto	2%	none	Hairy
	131		(24.1±4.5)		(kemps)		medium
Fræer Mose							
7141–42 a	12–28, 72×2,	21	23.4±17.7	ditto	5%	none	Hairy
	81, 123, 128		(19.6±3.5)		(kemps)		medium
b	13–28, 108,	21	29.3(±29.5)	ditto	7%	none	Hairy
	117, 123, 126		29.3±3.8		(kemps)		medium
	146, 154, 167						
Haraldskær Mose							
3706(c) a	14–38, 65,	19	23.7±14.8	+0.66, pos.skew	18%	approx. 6% of	Hairy
	155		(21.9±5.4)		(1 kemp)	fibres	medium
b	12–37, 155	23	28.1±20.2	+0.51, pos.skew	8%	none	Hairy
	176		(25.3±5.1)		(2 kemps)		medium
3707c2 a	12–32, 138,	21	23.3±18.4	symmetrical	7%	none	Hairy
	159		(20.7±4.7)	undercoat with kemp	(2 kemps)		medium
b	12–27, 63,	19	20.8±13.8	ditto	5%	pigment on most	Hairy
	68, 99, 105		(18.2±3.5)		(4 kemps)	fibres	medium
3707c? a	10–29, 42,	18	23.0±17.5	ditto	6%	none	Hairy
	90, 106, 108, 118		(19.6±4.6)		(4 kemps)		medium
b	12–27, 35	18	20.5±13.9	ditto	5%	pigment on most	Hairy
	42, 108, 119		(18.6±4.1)		(2 kemps)	fibres	medium
Vester Lem							
C13920 Z	12–31	18	19.9±4.1	+0.18, symmetrical	0	none	Fine
(Virring)							
C13920 S	9–41, 50,	14	19.4±10.6	+0.59, pos.skew	4%	2% of fibres	Hairy
	72, 83						medium

(Mean and S.D. for undercoat only, given in brackets)

Table 1. Denmark: Fleece types and dye tests. Measurements in microns (1 micron = 0.001 mm).

		Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Hjørring Præstegårdsmark								
C2181 (g–h) (Virring)	Z	10–36	21	21.3±5.1	+0.28, symmetrical	0	none	Fine
	S	13–33	21	20.5±4.3	+0.26, symmetrical	0	none	Fine
C2181 (a–c) (dogtooth)	Za	14–40	21	23.4±5.7	+0.87, pos.skew	0	none	Fine/gen. medium
	Sa	17–45, 53	24	25.9±6.3	+0.86, pos.skew	0	none	Gen. medium
	Zb	12–32, 65, 76, 79	22	23.7±9.6	+0.47, pos.skew	3%	none	Hairy medium
	Sb	13–37, 63, 73	27	24.5±7.9	+0.20, symmetrical	2%	none	Hairy medium
Donbæk								
C5998(c) (dogtooth)	Za	14–38, 51, 85	23	24.9±8.2	+0.64, pos.skew	2%	none	Hairy medium
	Sa	15–42, 59, 60, 62, 90	26	27.1±10.3	+0.65, pos.skew	4%	none	Hairy medium
	Zb	15–41, 49, 72	27	26.1±7.9	+0.13, symmetrical	3%	none	Hairy medium
	Sb	12–50, 85	22	26.5±9.0	+0.40, symmetrical	1%	none	Hairy medium
Vrangstrup, grave 1								
C23585(d) (striped Virring)	Z	14–47	24	25.0±5.4	+0.38, symmetrical	0	stripes produced by varying proportion of pigmented fibres	Short-wool
	S	17–62	27	28.7±7.3	+0.56, pos.skew	3%	14%	Hairy medium
C23585(d) (Virring w. border)	Z	13–37, 57, 62, 90	19, 28	24.6±9.6	+0.49, pos.skew	2%	none	Hairy medium
	S	10–38, 72, 91	23	24.1±9.1	+0.52, pos.skew	2%	none	Hairy medium
Verdens Ende								
C29460(a) (Virring)	Z	18–51	33	31.5±7.4	+0.05, symmetrical	0	?	Medium
	S	12–50	23	25.2±7.1	+0.50, pos.skew	0	?	Gen. medium
Lousgård								
C5602 (Birka-type)	warp	15–38	24	27.1±4.0	−0.10, symmetrical	0	none	Short-wool
	weft	14–36	24	23.1±4.2	+0.12, symmetrical	0	none	Short-wool

DYE TESTS: DENMARK

Lønne Hede	type land 2	indigotin
	type 4 blue	indigotin
	type 4 red	unidentified orange dye
	type 5	same unidentified orange dye
	type 7 blue	indigotin
	type 7 red	same unidentified orange dye
Krogens Mølle D1310	coarse a–b	no dye detected
	fine c	no dye detected

Hjørring Præstegårdsmark	
C2181 g–h (Virring type)	indigotin
C2181 a–c (dog-tooth)	indigotin
Donbæk C5998 c (dog-tooth)	indigotin
Vrangstrup C23585 d (striped)	no dye detected
Verdens Ende C29460 a (Virring)	?no dye detected

Table 1 (continued). Denmark: Fleece types and dye tests. Measurements in microns.

FLEECE TYPES: NORWAY

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Tofte, Halsnøy, Hordaland							
B5406: Z (Virring)	15–45, 67	26	29.1±7.7	+0.67, pos. skew	1%	none	Hairy-medium
B5406: S	19–41, 51	22	29.0±5.6	+0.44, pos. skew	1%	none	Gen. medium
Blindheim, Giske, Møre og Romsdal							
B8628: Z (Virring)	15–42	22, 26	26.4±5.9	+0.26, symmetrical	0	none	Short-wool
B8628: S	12–34	19	21.6±4.2	+0.26, symmetrical	0	dense on 6%	Fine
B8628: ZSa (dog-tooth)	10–40	19	22.0±5.4	+0.62, pos. skew	0	none	Fine/gen. medium
B8628: Sa	12–50	19, 23	22.5±6.7	+0.49, pos. skew	1%	none	Gen. medium
B8628: Zb	13–44	27	27.0±5.3	+0.09, symmetrical	0	none	Short-wool
B8628: Sb	15–41	27	26.5±5.2	−0.04, symmetrical	0	none	Short-wool
Dale, Fjaler, Sogn og Fjordane							
B5910: warp (Birka)	21–67, 83	35	43.0±11.1	+0.45, pos. skew	4%	none	?*
B5910: weft	22–64	36	38.2±8.6	+0.65, pos. skew	0	dense on 1%	?*

* Not easily categorised – possibly a primitive longwool.

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Veka, Voss, Hordaland							
B6228: warp (Birke type)	17–44	33	29.9±6.0	−0.20, symmetrical	1%	slight on most fibres	Short-wool
B6228: weft	15–45	24	27.8±6.9	+0.45, symmetrical	1%	slight on most fibres	Short-wool
Vinjum, Aurland, Sogn og Fjordane							
B7731: warp (Birka type)	18–42	31	30.3±5.2	−0.02, symmetrical	0	slight on most fibres	Short-wool
B7731: weft	17–44	31	30.0±5.5	+0.09, symmetrical	0	slight on most fibres	Short-wool
Sandager, Sande, Møre og Romsdal							
B10772: warp (Birka type)	17–53, 63	22	27.0±7.6	+0.57, pos. skew	2%	slight on most fibres	Hairy medium
B10772: weft	13–40, 47	22	24.7±4.9	+0.27, symmetrical	2%	slight on approximately 50% of fibres	Short-wool

DYE TESTS: NORWAY

Tofte B5406 (Virring type)	madder (*Rubia tinctorum*)
Blindheim B8628 (Virring type)	indigotin plus an unidentified yellow/orange dye
Dale B5910 (Birka type)	indigotin
Veka B8228 (Birka type)	indigotin
Sandanger B10772 (Birka type)	indigotin

Indigotin is the dyestuff extracted from both the woad and indigo plants. At this date, woad is more likely.

Table 2. Norway: Fleece types and dye tests. Measurements in microns.

FLEECE TYPES: GERMANY

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Feddersen Wierde							
FW 593 raw wool	10–83	17	24.8±15.3	+1.11, pos.skew	>6%	dense on all fibres over 29 microns (20%)	Hairy medium
FW 708 raw wool	10–53, 74, 77	15	23.2±14.2	+1.51, pos.skew	>2%	dense on all fibres over 28 microns (24%)	Hairy medium
FW 204 tabby: warp	13–33 51–118	26	27.9±17.7	+0.70, pos. skew	9%	none	Hairy medium
FW 204 tabby: weft	9–35, 65, 83, 118	18	21.4±13.1	+0.60, pos. skew	3%	none	Hairy medium
FW 451 tabby: warp	14–83	37	42.4±13.0	+0.31, continuous	30%	slight on most fibres	Hairy
FW 451 tabby: weft	17–81, 91	26, 31,	44.4±16.0	−0.20, continuous	44%	slight on most fibres	Hairy

FW 593 consists of wool staples approximately 3.0 cms long, square-ended or slightly pointed in shape. A number of dark hairs are clearly visible projecting beyond the paler undercoat. The shortness of the staple and the presence of fibre tips in the underwool indicates that this is lambswool.
FW 708 consists of several staples approximately 4.5 cms long, similar in appearance to FW 593. Some fibre roots are present, indicating that this is 'fell wool' plucked from the skin of a dead animal.

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Hessens							
HE 70 raw wool	17–104	21, 23 26	34.2±18.7	+1.03, pos. skew	9%	dense on all fibres over 31 microns (22%)	Hairy
HE 43 raw wool	18–96	32	33.4±14.3	+0.63, pos. skew	8%	dense and light; only in fibres over 45 microns (10%)	Hairy
HE 36c diamond twill: warp	14–65	21, 22, 23	32.7±13.2	+0.88, pos. skew	>10%	dense on most fibres	Hairy medium
HE 36c weft	12–62, 69	27, 28	31.9±12.4	+0.91, pos. skew	>15%	dense on most fibres	Hairy medium

HE 70 is a staple approximately 16.0 cms long, pointed or "tippy" in shape. The pale undercoat is only 6.5 cms long, the remainder of the staple length being dark hairs.
HE 43 is a matted pad of fibres with no intact staples.

	Range	Mode	Mean±S.D.	P.coeff. distribution	Medullas	Pigment	Fleece type
Niens							
Nie 5: warp (Chevron)	10–67, 82, 82	29	30.1±12.4	+0.58, pos. skew	7%	none	Hairy medium
Nie 5: weft	15–56, 64, 74, 78	24	28.9±11.7	+0.85, pos. skew	6%	none	Hairy medium
Nie 6: warp (tabby)	23–79	27	37.5±13.0	+1.05, pos. skew	>3%	dense on some coarse fibres (7%)	Hairy
Nie 6: weft	14–56, 69	19, 24	28.0±10.3	+0.95, pos. skew	>2%	dense on some coarse fibres (8%)	Hairy medium
Nie 10: warp (diamond)	22–72	37	42.0±14.1	+0.96, pos. skew	>10%	very dense on most fibres	Hairy
Nie 10: weft	15–85	24	37.6±17.4	+1.28, pos. skew	>10%	very dense on most fibres	Hairy

DYE TESTS: GERMANY

Tests for dye were carried out on the three samples from Niens, Nie 5 (Chevron/herringbone), Nie 6 (tabby), Nie 10 (diamond) but no dye was detected on any of them. This does not indicate that they were never dyed, only that any dye which may have been present is no longer detectable. Nie 10 however probably would have appeared dark brown or black to the naked eye, due to the natural pigment in the fibre. Nie 6 may also have had a greyish appearance due to the presence of a few dark fibres.

Table 3. Germany: Fleece types and dye tests. Measurements in microns.

	Fine	Fine/gen. medium	Gen. medium	Medium	Short wool	Hairy medium	Hairy	Total
Pre-Roman Iron Age, Denmark	–	–	–	–	–	18	–	18
Virring-type, Norway, Denmark	4	–	2	1	2	5	–	14
Dogtooth, Norway, Denmark	–	2	2	–	2	6	–	12
Lønne Hede (Ryder and Hedges 1973)	5	3	–	–	–	2	–	10
Germany, Roman, raw wool and textiles	–	–	–	–	–	4	2	6
Germany, 8th century	–	–	–	–	–	5	3	8
Diamond twills, Norway, Denmark	–	–	–	–	7	?3	–	10

Table 4. Summary of fleece types.

they are much further evolved. The kemps have disappeared and are replaced by true hairs, that is continuously growing fibres with narrow medullas. This fleece would probably no longer moult in spring and would have to be shorn. Only the two hairy mediums from Lønne Hede still show a fine undercoat (modes 13 and 14 microns) with one coarse hair (not kemp) each.

One of the primary reasons for the present investigation was to discover whether fibre or dye gave any indication for the place of origin of the different fabric types. The sample size was too small to draw definite conclusions, but a few tentative remarks may be made. The Virring-type and the dogtooth fabrics both showed a range of fleece types (see table 4: Virring-type fine, generalised medium, medium, shortwool, hairy medium; dogtooth fine/generalised medium, gen. medium, shortwool, hairy medium), while the Lønne Hede group were fine, fine/generalised medium, hairy medium.

The generalised medium and the hairy type are both believed to have developed from the hairy medium type and then fine, medium and shortwool to have derived from the generalised medium (Ryder 1969; see figure 1). The predominant hairy medium and generalised medium of the Roman Iron Age textiles could, then, be a straightforward development from the sheep of the pre-Roman period; the more 'advanced' fine, medium and shortwool types could perhaps be variants from within the same flocks.

However, it should be remembered that the Lønne Hede hairy mediums were more primitive in type than those of the other textiles and that this group lacked the more highly evolved shortwool and medium types. Further, several of the fine and fine/gen. medium types from this site included medullas in fibres of less than 30 microns diameter: again this is a primitive feature, not to be seen in the same fleece types of the Virring-type and dogtooth textiles. At this stage it would appear that there may be a difference between the Lønne Hede group and the other two fabric-types. Whether it is significant or not and whether it has to do with date or place of origin can only be a matter for conjecture at the moment.

Turning to Germany, the picture is much clearer, since two samples of raw wool were available there. One of them showed fibre roots, indicating that the wool had been plucked from the skin of a dead animal. Such 'fell wool' is of low value and is unlikely to have been traded far, so that this specimen is almost certainly from a local sheep. Both samples of raw fibre were hairy medium in type and both already showed the pigment distribution which is to be seen in the later samples and in the modern native sheep of Germany (see below).

It is interesting to compare the Scandinavian and German fleece types with those from other contemporary sites. From Vindolanda in northern England (a 1st century AD site within the Roman Empire) there is a

	Fine	Fine/gen. medium	Gen. medium	Medium	Short wool	Hairy medium	Hairy	Total
Vindolanda	9%	18%	34%	2%	4%	34%	2%	
	(5)	(10)	(19)	(1)	(2)	(19)	(1)	57
Mainz	17%	43%	19%	2%	13%	6%	–	
	(8)	(20)	(9)	(1)	(6)	(3)	–	47
All other sites	29%	31%	11%	6%	3%	20%	–	
(including some more from Mainz)	(10)	(11)	(4)	(2)	(1)	(7)	–	35

Table 5. Fleece types from Roman period sites. From Ryder 1981.

large group of wool textiles considered to be native British products (Wild 1977 p 30). All seven fleece types were represented there, but hairy medium and generalised medium predominate (Ryder 1981). This is different from the totals for other sites including Europe, studied by Ryder (*ibid*; see table 5), where fine and fine/gen. medium predominate with gen. medium and hairy medium a little behind. At this stage it is not known which are likely to be native products or traded goods. However, it is worth noting that Ryder noticed an overall trend towards finer wools in the earlier sites on the periphery of the Empire, such as Denmark and Palestine (Ryder 1983a p 178).

Finally, two other points of interest emerged during the study of these finds. Firstly that natural pigment was still being used for patterning, in the example from Vrangstrup. Secondly that although alternating Z- and S-spun yarns were used in both warp and weft of the dogtooth textiles, in general the same, or similar, wool was used throughout the warp and another type throughout the weft (although only three textiles were analysed). In other textiles of this date, warp and weft are frequently of different types, perhaps because the different yarns, serving different functions, require different fibre-types.

Dyes

Dye tests were carried out on all five textiles from Lønne Hede, five Virring-type fabrics and two dogtooths. Four of the Lønne Hede, two of the Virring-types and the two dogtooths showed that they had been dyed with indigotin (in one Norwegian Virring-type, this was combined with an unidentified yellow dye). Indigotin is a blue substance which can be derived from both the woad and the indigo plant. However, indigo, a native of India, seems to have been only of slight importance to the Romans (Forbes 1964 pp 111–112) and it therefore seems safe to assume that the indigotin in these textiles comes from woad, *Isatis tinctoria* L. Woad seeds of the Early Roman Iron Age have been found at Ginderup in North Jutland (Hald 1980 p 137) while Pliny mentions the use of the plant in Gaul (*Nat.Hist.* XXII 2–3); seeds have also been recorded at the Viking Age ship-burial at Oseberg in Norway (Hald *ibid*). It seems likely that this dye-plant was readily available throughout north-west Europe, including Scandinavia.

The red dye in one of the Virring-type textiles from Norway, however, tells a different story. This was madder, obtained from the roots of *Rubia tinctorum* L. The tests proved that the dye was not from wild madder, *Rubia peregrina* L. or from bedstraw, *Galium verum* L., which yields a madder-like dye. *R. tinctorum* is indigenous to Asia Minor, the Caucasus, Greece and other parts of southern Europe, but has been widely cultivated in the past, especially in Holland, Provence, Alsace, Silesia and Hungary (Schaefer 1941, p 1398). In the Roman period it was cultivated in Italy and the dye was found in textiles, mainly of fine quality, from Roman Vindolanda (Taylor 1983b p 118). By the 9th century it was being grown in France and by the 10th–11th centuries in England (Walton forthcoming). In the 'madder boom' of the 18th century, the plant was grown on the island of Zeeland and even in Sweden, near Lund (Schaefer 1941 p 1403), but this appears to have been a new introduction at this time and one which must have been beset by problems of climate and soil. It seems highly unlikely that madder was grown within Scandinavia in the Roman Iron Age and unless the dye itself was traded, the textile is in all probability an import.

Another dye was discovered, on three of the Lønne Hede textiles. This was a red dye, probably a little more orange than madder. Unfortunately this dye could not be identified with any of our large collection of dyestuffs and has not been encountered before on any other textiles. This in itself may be significant, since it is clearly not one of the well-known dyes which were important to the Roman world. Perhaps a study of native Danish dye-plants would provide an answer.

The only other dye not to be identified was the yellow combined with indigotin in a Virring-type textile from Norway. Yellow dyes are unfortunately particularly difficult to identify, especially when combined with another dyestuff. However, its presence indicates that the textile was not originally pure blue. Judging from its spectrum, the unknown dye is an orange shade of yellow, but if combined with an iron mordant it would probably have given brown. Thus with the blue indigotin it would have made either olive-green or black.

8th century Germany

From Hessens in Germany there was one sample of unprocessed wool, hairy in type. The staple was long and pointed, the wool coarse with several hairs and kemps, and pigment was present only on the longer, coarser fibres which protruded beyond the finer white undercoat. This same arrangement of pigment can be seen in a piece of felt from Hessens (hairy fleece type) and also in a coarse textile from Niens (warp hairy, weft hairy medium). Coarse textiles are less likely to have been traded, so this too is probably from a local sheep.

The heath sheep of present day Germany, the Heidschnucke, have wool which is remarkably similar to the Hessens example. A sample of Heidschnucke fleece supplied by Dr J.P. Wild, proved to have staples of the same length and shape and to have a similar diameter and pigment distribution. The development of this fleece can therefore be seen, beginning with the Roman lambswool from Feddersen Wierde, hairy medium in type, through the predominantly hairy (sometimes hairy medium) wool of the 8th century, to the present day hairy Heidschnucke.

Ryder mentions that among the Heidschnucke there are also some brown animals and some finer-fleeced white types probably hairy medium (Ryder 1981 p 405; 1983a p 393), so it is not impossible that the wools from the other German textiles came from the same stock. Both of the diamond twills had densely pigmented wools, either dark brown or black, a fact discussed further below. The three samples of textile from Niens were tested for dye, but none was detected.

Viking Age diamond twills

The analysis of fleece and dye in this group of textiles confirmed that it is a discrete group. Five examples, one from Denmark and four from various sites in Norway were tested for dye and all proved to be indigotin, again almost certainly woad. Ten fleece types were identified and seven of these proved to be shortwools.

The shortwool is a highly evolved type of fleece. It first begins to appear in the Roman period (for example there were four shortwools among the Roman Iron Age textiles from Scandinavia). However, it has previously appeared that shortwools are not found in any numbers until the later medieval period (Walton 1981 p 191). These then are an unusual group. It is also odd that several of the shortwools include a certain amount of pigment, which is a primitive feature.

The combination of natural pigment with what appears to be a very heavy dyeing with the blue woad, would give a dark fabric, probably close to black. It is therefore interesting to note that the coarser diamond twills of 8th century Germany were also dark, probably a brownish black. Perhaps the weavers of the two types of fabric were aiming at a similar appearance, although the Scandinavian textiles were achieved with a greater degree of sophistication.

SUMMARY

The textiles of the Pre-Roman Iron Age would originally have been white with colour-patterning in naturally pigmented wools, probably brown. The handle of the fabric would have been soft, due to the fineness of the majority of the fibres.

In the Roman Iron Age textiles, natural pigment was still being used for patterning. However, by the 1st century AD, dyes were in use, one of them woad and the other unidentified, perhaps a local dye which has not since reached commercial significance. In the late Roman Iron Age, strong colours, red, blue and green or black were used for fine quality textiles and in one of these the dye was madder, almost certainly foreign to Scandinavia at this time.

The German samples show that wools of similar type

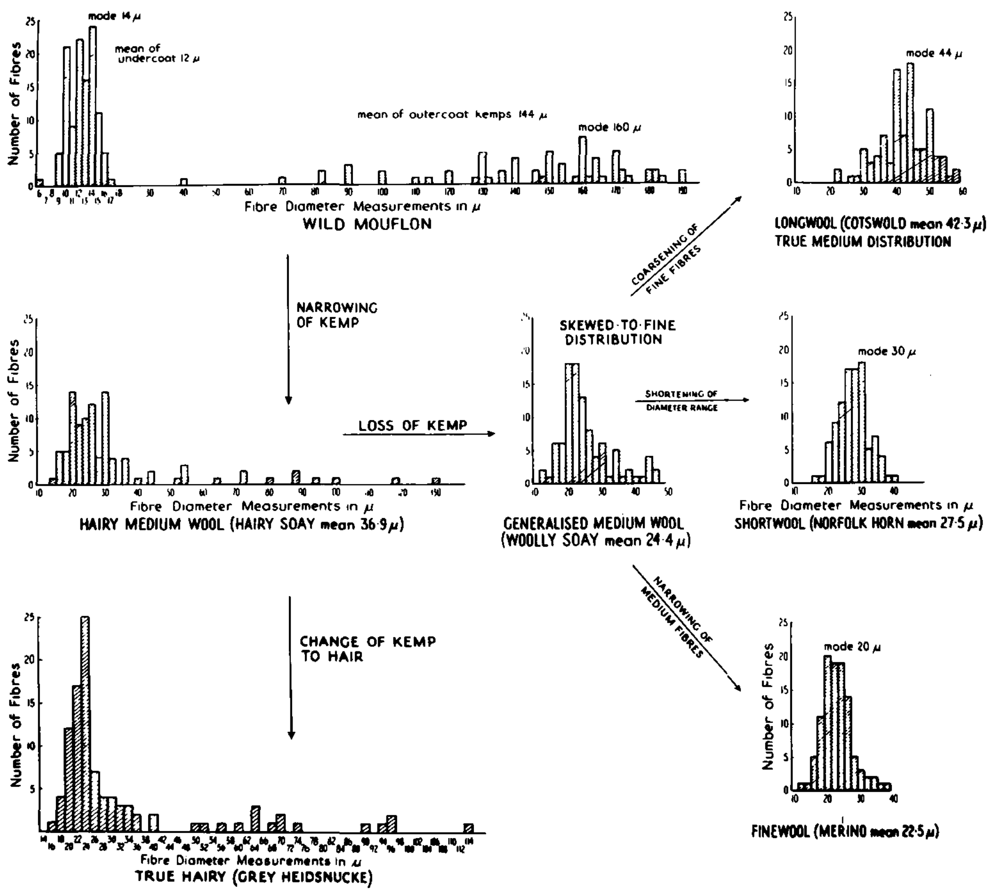

Fig. 1. (From Ryder 1983a).

to the fleece of modern Heidschnucke were already present in the Roman Iron Age and the 8th century. The textiles include two almost black diamond twills, which form an interesting comparison with the finer dark blue or black diamond twills of Viking Age Scandinavia.

COMMENTS

The sample size was necessarily small as the work is time-consuming: adequate dye-testing of one fragment, together with a fleece type identification for warp and weft, requires at the very least five hours of concentrated work.

However, the tests have produced some significant results even on such a small sample. They have also raised many more questions. For example, it would be useful to study more Scandinavian textiles of the Roman Iron Age which may be considered to be definite local products, in order to establish the nature of the native fleeces at that time. The same is true of the Viking Age when the anachronistic shortwool types appear in the fine quality textiles whose origin is open to question. More samples of raw wool would also be extremely useful.

We hope that this report has shown that a widening of the database for both dyes and fleece types would considerably improve our understanding of textile manufacture, and, more significantly for the archaeologist, of trade in textile products. P.W.

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