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Dyes and Wools in Iron Age Textiles from Norway and Denmark

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INTRODUCTION

In 1984 a pilot study was undertaken into the dyes and wools of selected textiles from Norway, Denmark and Germany. This initial survey was necessarily small, but produced some significant results. When added to the information collected by other researchers on weave, yarn-type, etc, the dye and wool analyses proved to highlight similarities between certain native products, and to suggest importation in others.

However, it was noted at the time that this work had raised as many questions as answers. The concluding words of the report were a call for "a widening of the database for both dyes and fleece-types" (P. Walton 1985 p 13; Bender Jørgensen and Walton 1987 p 187). In 1985 it proved possible to embark on just such a larger study, due to generous grants from the Danish Research Council (who funded the earlier work) and Queen Margrethe II's Archaeological Fund. The following is an account of the results of that work.

THE SAMPLE

In Norway a selection of textile samples was gathered together by Bente Magnus (Head Curator, University of Bergen Historical Museum) from grave-finds housed in the Bergen, Oslo, Trondheim and Stavanger museums. In Denmark, Lise Bender Jørgensen (University of Copenhagen), who was the instigator of the whole survey, chose textiles from both graves and bog-finds. Only two German samples were included in this survey, both from the Thorsbjerg collection in the National museum, Copenhagen.

A summary of the textiles, their sites and dates is given in table 1. Further details of individual finds are to be found in L. Bender Jørgensen *Prehistoric Scandinavian Textiles* (1986) pp 243–272 and in M. Hald *Ancient Danish Textiles from Bogs and Burials* (1980); the Evebø/Eide burial is discussed in Magnus and Pedersen (1984). The terms used in this text, 'Haraldskjaer type', 'Virring type', 'Birka type' and 'Hessens-Elisenhof' type are defined in Bender Jørgensen 1986, pp 343–8, 358–62. 'Veka-type' is a new term, corresponding to the 'Norwegian type' described in Bender Jørgensen 1986 p. 361.

METHODS OF ANALYSIS

The techniques used to identify the dyes and fleece types were the same as those applied in the earlier study. In brief, dyes were extracted with solvents and examined with a U-V/Visible spectrophotometer; paper and thin-layer chromatography were used to confirm positive results. Fleece types were identified by measuring the diameters of 100 fibres and plotting the results as histograms; according to the shape of the histogram, the wool could be allocated to one of the seven fleece-type categories.

THE RESULTS

The results of both analyses are listed in Table 2. The statistics relating to the fleece types are given in Table 3. The most significant features of the results are discussed below.

EARLY DANISH WOOLS

When examining the wool of a textile, it is difficult to know how accurately it represents the fleece as it grew on the sheep's back. The sheepskin capes from Denmark were therefore useful in establishing the nature of Pre-Roman Iron Age wool prior to processing for textile use.

Samples from eight different capes were examined

NORWAY

(i) *ZZ twills of the Haraldskjaer type* and an *SS twill of the Huldremose type*, Scandinavian or north European in origin, from late Roman/Migration Period sites:

Stallemo (Vennesla, Vest-Agder)
Veien (Ringerike, Buskerud)
Øvre Berge (Lyngdal, Vest-Agder)
Snartemo II and V (Lyngdal, Vest-Agder)
Saetrang (Ringerike, Buskerud)
Hallem (Verdal, Nord-Trøndelag)
Døsen (Os, Hordaland)
Evebø/Eide Gloppen, Sogn & Fjordane)
Veiem (Grong, Nord-Trøndelag)

(ii) Tablet weaves and some less common textile types, of uncertain origin, from rich graves of the late Roman/Migration Period:

Snartemo V
Evebø/Eide
Veiem

(iii) *diamond twills of the Virring type*, from sites of the Roman Period, probably imports:

Hallem (Verdal, Nord-Trøndelag)
Rønsberg (Selbu, Sør-Trøndelag)

(iv) *ZS twills of the Hessens-Elisenhof type*, probably imported from northern Europe, found in Viking Age sites:

Vinjum (Aurland, Sogn & Fjordane)
Sandanger (Sande, Møre & Romsdal)
Malsnes (Balestrand, Sogn & Fjordane)

(v) *ZZ twills of the Veka type*, possibly west Norwegian in origin, also from Viking Age sites:

Sandanger
Malsnes
Dale (Fjaler, Sogn & Fjordane)
Veka (Voss, Hordaland)
Skjervum (Vik, Sogn & Fjordane)
Kongsvik (Tysnes, Hordaland)
Skjervheim (Voss, Hordaland)
Hopperstad (Vik, Sogn & Fjordane)

(vi) *raw fibre* from 4th and 5th century sites:

Saetrang (Ringerike, Buskerud)
Midt-Salte (Klepp, Rogaland)

DENMARK

(i) *raw fibre* from sheepskin capes from sites of the Pre-Roman Iron Age:

Baunsø Mose
Borremose
Fraeer Mose
Huldremose
Karlby
Rønbjerg Mose
Tvede (St. Arden)

(ii) one *SS twill of the Huldremose type* from early Roman Period Tornbuskehøj

(iii) One *Virring type diamond twill* from Rovsbjerghøj and one *two-colour ZS twill* from Vrangstrup, both of the late Roman Period.

(iv) *Haraldskjaer-type twills* from sites of the late Roman and Migration Period:

Hejrhøj
Sejlflod
Corselitze

also one *tabby* from Corselitze
and *late Haraldskjaer types* from:

Nr. Sandegaard (Gr. 426)
Lousgaard (Gr. 26)

(v) *Hessens-Elisenhof type twills* from Viking Age sites:

Skringstrup
Gerlev-Draby
Nr. Sandegaard (Gr. 426)
Riis Fattigaard

(vi) *Birka type diamond twills* from the Viking Age:

Nr. Sandegaard (Gr. 397)
Lousgaard (Gr. 7)

(vii) an assortment of less common textile types from Viking Age sites:

Nr. Sandegaard (Gr. 426)
Lousgaard (Gr. 26)
Fløjstrup
Hvilehøj
Mammen

Table 1. Summary of textile types used in the study.

and all proved to be of the same type. The wool staples were straight, sometimes with a pointed tip, and measured 25–40 mm in length. The wool consisted of a fine undercoat (with mean diameters of 16.9–21.7 microns and modes of 15–22 microns), combined with an outer coat of the coarse fibres which are called 'kemp' (58–215 microns in diameter). The histogram of one of these kempy fleeces is given in fig. 2a.

Such a fleece is very like that of the present-day Mouflon of Corsica and Sardinia, *Ovis musimon*. This animal is thought to be a once-domesticated sheep, which has returned to the wild at an early stage in its history. Its fleece is therefore probably little different from that of the earliest sheep of Europe (Clutton-Brock 1981 pp 53–4; Ryder 1983 pp 14–17). The Mouflon is brown with a white belly and some of the patches which make up the capes from Huldremose and Karlby Mose are brown, others white. However, most of the sheepskin capes are white throughout, suggesting the beginnings of development away from the wild ancestor, at any rate in terms of pigment.

How do these wools compare with the fibres of textiles of the same date? A number of Pre-Roman Iron Age textiles were examined in the earlier study and

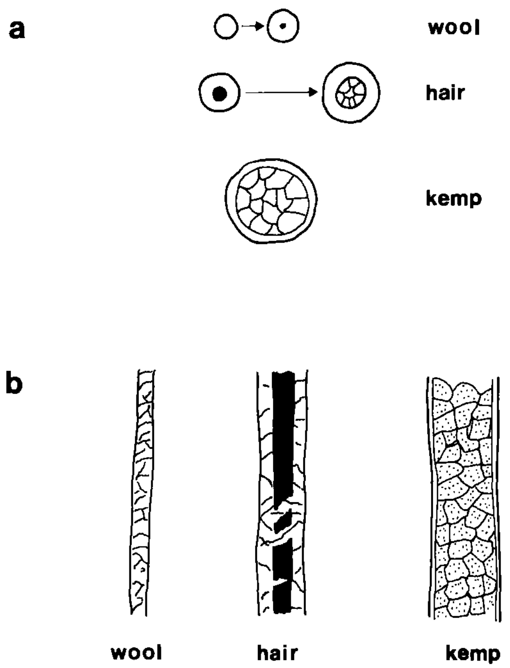

Fig. 1. The three main types of fibre in an adult fleece. a: in cross-section (from Ryder and Stephenson). b: in whole-mount.

without exception they proved to consist of the same fine undercoat but with only 1%–7% kemp – much less than in the skins (fig. 2b).

The reason for this is likely to lie in the method of gathering the wool. The coat of the wild sheep moults each year and the primitive domesticated breeds also tend to cast considerable amounts of fleece (Ryder 1983a p 45). However, the coarser fibres stay in the skin until after the undercoat is shed, and thus by plucking or combing the sheep in spring or early summer, the majority of the kemp may be left behind. In the northern isles of Britain, Shetland sheep were still being plucked, or 'rooed' as it is called, as late as 1892 (ibid. p 536).

M.L. Ryder has already pointed out that the plucking of sheep may account for the results he obtained from Danish Bronze Age textiles (1983b and forthcoming). Of the samples he examined, some did not even have 1 kemp per 100 fibres, others had 1%–5% kemp, but all had the same fine undercoat as in the Iron Age textiles at present under discussion.

The only major difference between Bronze Age and Early Iron Age wools has proved to be the predominance of natural pigment in the earlier finds. Although brown wool was still available in the Iron Age, most wools of that period prove to have been white. The change towards white wool seems to have been the first major development following domestication. The availability of both white and brown fleeces led to colour-patterning in Iron Age textiles, as for example in the checkered cloth excavated at Krogens Mølle and the striped weave from Haraldskaer Mose (Hald 1980 pp 15, 58; Walton 1985 table 1; Bender Jørgensen and Walton 1987).

NATIVE DANISH WOOLS IN THE ROMAN AND MIGRATION PERIOD

During the Roman Period, Scandinavia may have been obtaining some of its better-quality textiles from trade with the Empire. However, the 1st century textiles from Lønne Hede and the late Roman and Migration Period textiles from Sejlflod are believed to be native products (Bender Jørgensen 1986 p. 346).

There are seven different fabric-types from Lønne Hede, of which Ryder and Hedges (1973) have examined five. These wools proved to be like those of the earlier period – fine, or fine with a few coarse fibres. It is not now possible to know which of the textiles were sampled on behalf of the earlier researchers, or indeed if they were provided with more than one sample from the same fabric-type. However, by scanning samples from the same textiles under a low-powered microscope, it was possible to see that at least five contained sparsely-distributed coarse fibres, which under higher magnification proved to be kemps. These wools therefore seem to be similar to those of the earlier period. The presence of kemp in some but not in others, suggests that the practice of plucking sheep may have continued into the early Roman Period.

By the 5th century, however, a change had occurred in Danish fleeces. The Sejlflod wools have a coarser undercoat and the kemps have given way to fibres of 60–100 microns, called 'hairs' (fig. 2c). There are three main kinds of fibre recognized in the fleece of the adult sheep (fig. 1): true wool, which consists of crimpy fibre, rarely with medullas; kemp, the coarse, seasonally moulted fibres with broad latticed medullas; and hairs or heterotypes, which have a narrow or interrupted medulla, and which are continuously growing (Ryder and

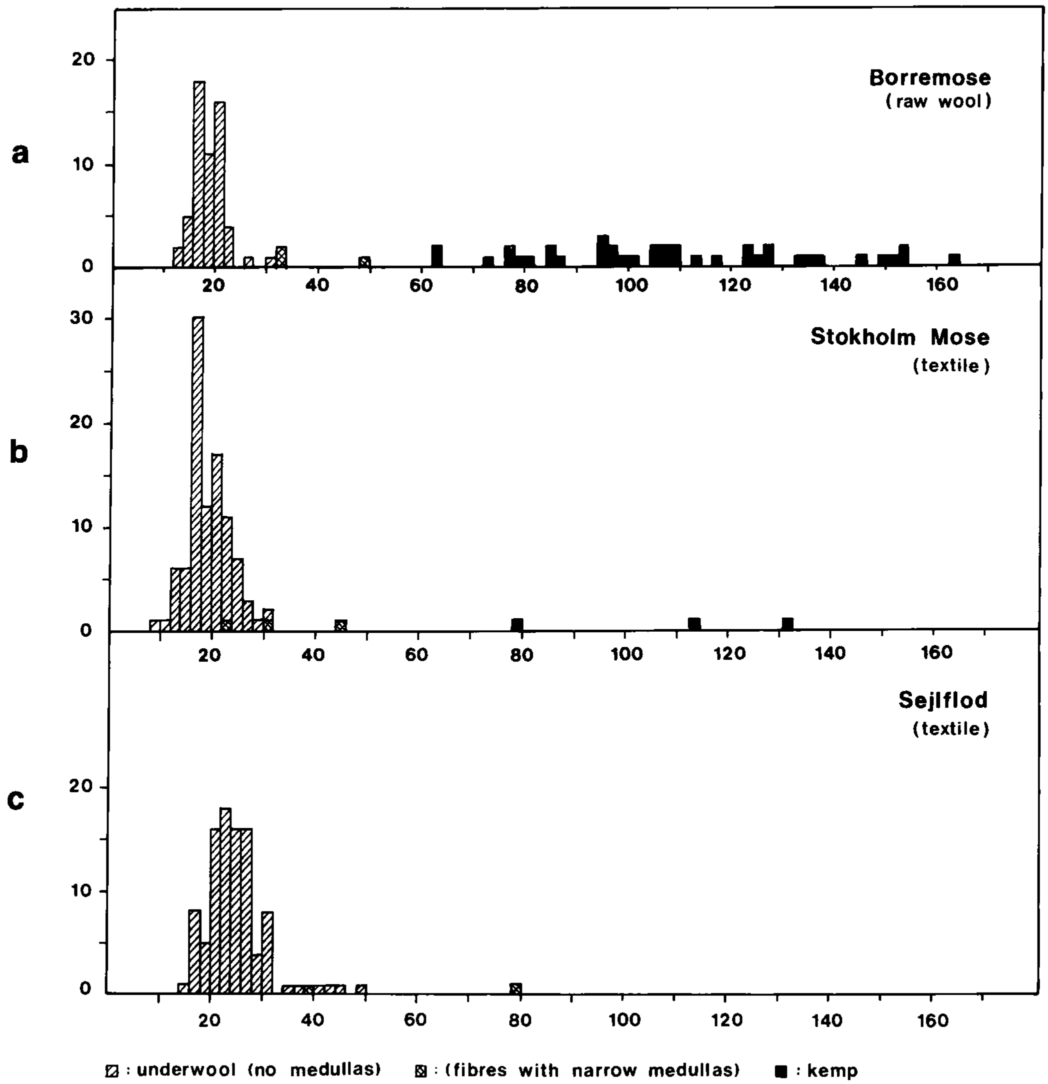

Fig. 2. Diameter of fibres measured in microns.

Stephenson 1969 pp 282–6). Despite careful scanning of all eight textiles from Sejlflod, there was no sign of any kemp and from the presence of hairs it must be assumed that the fleece was no longer moulting but was being sheared. The change towards a non-moulting fleece was of course of benefit to man, as it led to less wool-loss before shearing.

The Sejlflod wools with their hairs and coarser underwool are designated 'hairy medium'. This term is often extended to the more primitive types of the Bronze Age and Pre-Roman Iron Age, although Mouflon-type is perhaps more appropriate for the kempy wools of those periods.

EARLY WOOLS OF NORWAY

The nature of early Norwegian wools is less well-established. Two samples of raw fibre from the 4th and 5th centuries were examined, but one, from Saetrang, proved to be goat, probably kid (identified by H.M. Appleyard). The second, from Midt-Salte, is sheep's wool; it has a pointed staple, 40–50 mm in length, and the fleece type is hairy medium, similar to the contemporary wools of Denmark.

As there is little other evidence, it is interesting to note that the present-day Spaelsau, the native sheep of Norway, seems to be predominantly hairy medium in

NORWAY

SITE	TEXTILE NUMBER	TEXTILE TYPE	YARN	FLEECE-TYPE	DYE
Hallem	T 598 A	Virring type	both	–	n.d.d.
Hallem	T 598 B	Harald. type	dark	F	n.d.d.
			light	HM	n.d.d.
Hallem	T 598 C	Harald. type	grey	HM	indigotin
			light brown	HM	?yellow
			red	–	unidentified
Hallem	T 598 D	Huldremose type	both	–	n.d.d.
Rønsberg	T 2012	Virring type	dark S	GM, nat.pig	n.d.d.
			light Z	HM	
Stallemo	C 23141 f	Harald. type	green	HM	n.d.d.
			brown	HM	n.d.d.
Veien	C 348	?Harald. type	fine	M	Polish cochineal
			coarse	GM	
Øvre Berge	C 3534 A	tablet weave	green warp	M	indigotin
			beige warp	HM	n.d.d.
			weft	HM, nat.pig.	–
Øvre Berge	C 3534 K	Harald. type	dark	M, nat.pig.	indigotin
			light	GM	indigotin
Øvre Berge	C 3534 L	Harald. type	both	–	indigotin
Øvre Berge	C 3534 I-J	Harald. type	both	–	indigotin (faint)
Veiem	T 19624 F	Harald. type	a	M	indigotin
			b	GM	
Viem	T 19624 F	tablet weave	warp	M	madder (*R. tinctorum*)
			weft	M	
Veiem	T 19624 G	Harald. type	a	HM	indigotin & yellow 'X'
			b	HM	
Veiem	T 19624 G	tablet weave	warp	HM	madder (*R. tinctorum*)
			weft	HM, nat.pig.	
Saetrang	C 644	raw fibre	–	Goat	n.d.d.
Saetrang	C 644a	Harald. type	dark	HM	indigotin & yellow 'X'
			light	HM	
Saetrang	C 617–44	Harald. type	a	HM	n.d.d.
			b	HM	
Midt-Salte	S 79901	raw fibre	–	HM	n.d.d.
Døsen	B 6091 (a)	Harald. type	dark	–, nat.pig.	n.d.d.
			light	–	n.d.d.
Døsen	B 6091 (b)	Harald. type	both	–	n.d.d.
Snartemo II	C 28026 B	Harald. type	fine	Sh	n.d.d.
			coarse	HM	
Snartemo II	C 28026 C	Harald. type	a	F/GM	n.d.d.
			b	GM	
Snartemo II	C 28026 F	Harald. type	both	–	n.d.d.
Snartemo V	C 26001 (a)	Harald. type	a	HM	indigotin
			b	HM	
Snartemo V	C 26001 (b)	tablet weave	all	–	indigotin & ?mordant dye
Snartemo V	C 26001 D (c)	Harald. type	both	–	n.d.d.
Snartemo V	C 26001 R (d)	?spin-patterned	dark	M, nat.pig.	n.d.d.
			light	M	n.d.d.
Snartemo V	C 26001 R (e)	Harald. type	a	M	n.d.d.
			b	M	
Snartemo V	C 26001 R (f)	plied yarn twill	a	GM	madder (*R. tinctorum*)
			b	GM	
Snartemo V	C 26001 Ø (g)	plied yarn twill	both	–	madder
Evebø/Eide	B 4590 type 1	striped twill-?Harald. type	ground	–	madder (*R. tinctorum*) & unidentified yellow
			stripe	–	indigotin
Evebø/Eide	B 4590 type 2	Harald. type	both	–	n.d.d.
Evebø/Eide	B 4590 type 3	striped twill-?Harald. type	ground	–	madder (*R. tinctorum*)
			stripe	–	indigotin
Evebø/Eide	B 4590 type 4	napped textile	both	–	kermes or Polish coch.
Evebø/Eide	B 4590 type 5	napped textile	both	–	indigotin
Evebø/Eide	B 4590 type 6	striped textile-?Harald. type	ground	–	madder (*R. tinctorum*)
			stripe	–	indigotin

DENMARK

SITE	TEXTILE NUMBER	TEXTILE TYPE	YARN	FLEECE-TYPE	DYE
Baunsø Mose	D 11103 c	raw fibre	–	mouflon-type/HM	–
Borre Mose	C 26449	raw fibre	–	mouflon type/HM	–
Fraeer Mose	7142	raw fibre	–	mouflon type/HM	–
Huldre Mose	C 3472	raw fibre	–	mouflon type/HM	–
Karlby	D 4854 b	raw fibre, dark	–	mouflon type/HM, nat.pig.	–
		raw fibre, light	–	mouflon type/HM	
Karlby	D 4854 d	raw fibre	–	mouflon type/HM	–
Rønbjerg Mose	D 2624-26	raw fibre	–	mouflon-type/HM	–
Tvede	462/42	raw fibre	–	mouflon type/HM	–
Tornebuskehøj	C 2827	Huldremose type	dark	–	indigotin (strong)
			light	–	indigotin (weak)
Vrangstrup	C 23594 c	2-colour ZS twill	dark	HM, nat.pig.	n.d.d.
			light	HM	n.d.d.
Rovsbjerghøj	1260	Virring type	tablet warp	HM	madder
			cloth warp	F	indigotin & yellow 'X'
			cloth weft	–	
Corselitze	7325 a-e	Harald. type	a	HM	?yellow
			b	Sh	
Corselitze	7325 b	ZZ tabby	a	HM	indigotin
			b	HM	
Hejrhøj	C 27423	Harald. type	both	–	madder-type, not *R.tinc.*
Sejlflod	669 × 1108	Harald. type	both	–	n.d.d.
Sejlflod	669 × 1160	Harald. type	both	–	n.d.d.
Sejlflod	669 × 1183	Harald. type	a	Sh	n.d.d.
			b	HM	
Sejlflod	669 × 1301	Harald. type	a	HM	n.d.d.
			b	HM	n.d.d.
Sejlflod	669 × 1445	Harald. type	a	HM	n.d.d.
			b	HM	

KEY

Harald. type	= Haraldskjaer type	HM	= hairy medium	GM	= generalised medium
Hess./Elis.	= Hessens/Elisenhof	M	= medium	Sh	= shortwool
n.d.d.	= no dye detected	F	= fine	nat.pig.	= natural pigment

Table 2. Results: dyes and fleece-types.

type, as is the wool of Icelandic sheep, which are descended from the same stock (Ryder 1968 pp 154–6; 1981a pp 394–7). It is probable that the hairy medium was a fleece type available to Norwegian spinners and weavers through much of their history.

As was to be expected, the textiles believed to be of native Norwegian manufacture (the Haraldskjaer type twills and at least some of the tablet-woven braids) were in many cases made from the same hairy medium fleece type. However, there were also several other types of wool, which require some explanation.

Table 4 shows that in Norway there was a greater range of fleeces available than in contemporary Denmark. The generalised medium fleece type (GM) is believed to have evolved from the hairy medium (HM) (fig. 1) and it is therefore no surprise to see it here. The shortwool (Sh) is a more evolved type of fleece, but although rare, it has already been recorded in Migration period Denmark (Bender Jørgensen and Walton 1987). The single fine (F) and fine/generalised medium (F/GM) may be from the occasional aberrant fleece within a predominantly HM/GM flock.

However, the large number of medium (M) wools is more significant. This wool is too coarse to be confused with the underwool of a HM fleece, nor can it be produced by blending other fleece types. The medium type was particularly rare in the textiles which are likely to be imports and it must therefore be regarded as a native Norwegian fleece-type.

The medium fleece type is the kind of wool which

NORWAY

SITE, TEXTILE	YARN	RANGE	MODE	MEAN±S.D.	PEARSON COEFF. OF SKEW, DISTRIBUTION	MEDUL-LAS	PIGMENT	FLEECE-TYPE
Stallemo, C23141F	green	13-53,104	22,23	26.0±10.7	+0.60, pos.skewed	2%	0	hairy medium
	brown	17-42,77	23	26.7±7.5	+0.79, pos.skewed	1%	0	hairy medium
Veien, C348	finer	17-54	31	27.8±6.5	+0.08, symmetrical	0	0	medium
	coarser	14-38,51	22	24.9±5.4	+0.51, pos.skewed	0	0	generalised medium
Øvre Berge, C3534 A	green wa	17-58	23,28	28.9±7.7	+0.08, symmetrical	2%	0	medium
	brown wa	15-45,65	26	25.7±7.0	+0.20, symmetrical	1%	0	hairy medium
	brown we	17-58,68,81	24	32.8±10.7	+0.74, pos.skewed	≥5%	100%, heavy	hairy medium
Øvre Berge, C3534 K	dark	14-58	26	30.4±8.1	+0.25, symmetrical	2%	most, light	medium
	light	14-38	22	24.2±5.0	+0.55, pos.skewed	1%	0	generalised medium
Snartemo V, C26001 (a)	a	14-47,56,62,74	27,28	29.3±9.4	+0.56, pos. skewed	3%	0	hairy medium
	b	19-54,58,63,82	23,24	32.2±10.4	+0.83, pos. skewed	11%	0	hairy medium
Snartemo V, C26001 (d)	dark	13-50	27	28.4±6.3	+0.33, symmetrical	0	100%, heavy	medium
	light	13-53	24	28.4±8.0	+0.43, symmetrical	0	18%	medium
Snartemo V, C26001 (e)	a	15-47	22	29.1±7.4	+0.11, symmetrical	2%	0	medium
	b	15-54	29,31	31.2±8.7	+0.42, symmetrical	6%	1%	medium
Snartemo V, C26001 (f)	a	12-47	24	25.9±7.1	+0.50, pos.skewed	0	0	generalised medium
	b	14-49	26	27.4±7.1	+0.53, pos.skewed	0	0	generalised medium
Snartemo II, C28026 C	a	12-32,38	18	20.6±4.9	+0.46, pos.sk./symm.	0	0	fine/gen. medium
	b	13-41,47	22	24.5±6.0	+0.62, pos.skewed	0	0	generalised medium
Snartemo II, C28026 B	finer	14-38	26	25.0±5.5	+0.17, symmetrical	1%	0	shortwool
	coarser	14-36,88,92	24,26	24.8±10.4	+0.29, symmetrical	2%	0	hairy medium
Saetrang, C644	raw fibre	12-65	26	30.4±13.2	+1.00, pos.skewed	?	100%, heavy	*goat hair*
Saetrang, C644a	dark	13-40,71,79	23,26	24.5±8.9	+0.41, symmetrical	3%	0	hairy medium
	light	12-38,45,71	22	23.1±6.9	+0.48, pos.skewed	1%	0	hairy medium
Saetrang, C617-44	a	13-38,64	22	23.8±7.4	+0.80, pos.skewed	1%	0	hairy medium
	b	13-41,68	19	23.4±6.1	+0.67, pos.skewed	1%	0	hairy medium
Veiem, T19624 F (twill)	a	13-49	23	29.9±6.7	+0.33, symmetrical	2%	0	medium
	b	17-58	28	29.4±8.5	+0.57, pos.skewed	0	2%	generalised medium
Veiem, T19624 F (tablet weave)	wa	17-49	33,37,38	33.3±6.0	+0.02, symmetrical	2%	0	medium
	we	18-49	32	28.8±6.5	+0.25, symmetrical	1%	11%	medium
Veiem, T19624 G (twill)	a	17-54,88	22	27.1±8.4	+0.57, pos.skewed	3%	0	hairy medium
	b	18-41,82-114	23	30.2±15.7	+0.75, pos.skewed	6%	0	hairy medium
Veiem, T19624 G (tablet weave)	wa	13-59,77,79	26,28,31	31.5±11.0	+0.63, pos.skewed	5%	0	hairy medium
	we	17-64,87	24	33.1±11.4	+0.84, pos.skewed	?	100%	hairy medium
Hallem, T598 C	a	12-44,63,67	26	28.1±8.2	+0.31, symmetrical	2%	4% (coarse fibres only)	hairy medium
	b	10-37,56,60,	21	24.9±9.5	+0.61, pos.skewed	4%	0	hairy medium
Hallem, T598 B	dark	12-29	18	21.2±3.9	+0.29, symmetrical	0	0	fine
	light	12-36,56,77	21	24.4±7.8	+0.57, pos.skewed	2%	0	hairy medium
Rønsberg, T2012	dark S	13-45,53,55	24	27.4±7.5	+0.63, pos.skewed	0	100%	generalised medium
	light Z	12-47,65,72,	19	24.2±12.0	+0.85, pos.skewed	5%	0	hairy medium
Midt-Salte, S7990 h	raw fibre	14-54,81,86	23,24	25.9±11.1	+0.63, pos.skewed	3%	4% (coarse fibres only)	hairy medium
Vinjum, B7731	Z	15-54	28	30.5±7.8	+0.15, symmetrical	0	0	medium
	S	14-47	23	29.3±7.7	+0.43, symm/pos.skew	0	0	generalised medium
Sandanger, B10772 (a)	Z	12-71,100	15,19	23.6±13.7	+0.93, pos.skewed	5%	0	generalised medium
	S	18-51,56,59	26,28	29.5±8.1	+0.77, pos.skewed	1%	0	hairy medium
Malsnes, B12131 (a)	Z	18-60,65,68,69	35	36.1±11.6	+0.76, pos.skewed	4%	3%	hairy medium
	S	12-50,62	19	24.3±9.9	+0.70, pos.skewed	1%	0	hairy medium
Sandanger, B10772 (b)	fine	19-60	44	39.2±10.1	−0.34, symmetrical	21%	0	medium
	coarse	19-50,72,79	27	29.5±9.2	+0.71, pos.skewed	4%	0	hairy medium
Malsnes, B12131 (b)	fine	12-56	32.35,36	36.2±9.1	+0.18, symmetrical	1%	0	medium
	coarse	14-49	22	27.1±6.8	+0.29, symmetrical	0	5%	shortwool
Dale, B5910	fine	17-59	29	38.1±10.1	+0.07, symmetrical	3%	1%	medium
	coarse	18-50,60-72	24	30.1±10.6	+0.77, pos.skewed	3%	2%	hairy medium
Veka, B6228A	fine	18-54	26	32.5±7.6	+0.18, symmetrical	0	5%	medium
	coarse	15-46,67-74	28	29.9±10.7	+0.48, pos.skewed	4%	5%	hairy medium
Skjervum, B6500	fine	24-56	36,37	40.2±6.2	+0.14, symmetrical	8%	0	medium
	coarse	14-56,81	24	28.3±11.3	+0.73, pos.skewed	7%	0	hairy medium
Kongsvik, B7639r	fine	14-56	29	32.8±9.2	+0.47, symm/pos.sk.	1%	5%	medium
	coarse	12-46,53,68	21	26.8±9.1	+0.37, symmetrical	2%	2%	hairy medium

SITE, TEXTILE	YARN	RANGE	MODE	MEAN±S.D.	PEARSON COEFF. OF SKEW, DISTRIBUTION	MEDUL-LAS	PIGMENT	FLEECE-TYPE
Skjervheim, B7732 1B	fine	14-59	40,46	38.8±11.3	−0.31, symmetrical	15%	0	medium
	coarse	17-54,65,71,79	24	32.3±11.0	+0.72, pos.skewed	4%	0	hairy medium
Fjellsende, B7812	fine	17-55	27,28,32	34.1±8.6	+0.40, symmetrical	0	0	medium
	coarse	15-56	23	28.3±8.3	+0.72, pos.skewed	0	2%	generalised medium
Hopperstad, B9060	fine	18-62	29	38.9±10.8	+0.60, pos.skewed	19%	0	hairy medium
	coarse	12-49,56	23,31	27.3±7.2	+0.26, symmetrical	0	3%	shortwool

DENMARK

SITE, TEXTILE	YARN	RANGE	MODE	MEAN±S.D.	PEARSON COEFF. OF SKEW, DISTRIBUTION	MEDUL-LAS	PIGMENT	FLEECE-TYPE
Corselitze, 7325 a-e	a	13-46,65-104	26	28.4±12.0	+0.66, lpos.skewed	4%	100%	hairy medium
	b	14-41	28	27.0±5.0	−0.16, symmetrical	0	100%	shortwool
Corselitze, 7325 b	a	15-46,68	23	26.2±7.4	+0.60, pos.skewed	1%	0	hairy medium
	b	14-47,67,81,155	19	26.3±16.1	+0.64, pos.skewed	5%	1%	hairy medium
Mammen, C135		15-42,72	21	27.9±7.4	+0.49, pos.skewed	1%	98%	hairy medium
Vrangstrup, C23594C	a	13-44,49,65	24	26.1±7.2	+0.56, pos.skewed	1%	100%, light	hairy medium
	b	17-40,59,72	26,27,28	28.4±7.5	+0.31, symmetrical	2%	0	hairy medium
Baunsø Mose, D11103C	raw fibre	15-36,55,106-210	22	47.7±53.7	+1.44, discontin.	28%	0	mouflon-type [or
		undercoat only:		21.7±5.1	+0.44, symm./pos.sk.	8%	0	hairy medium]
Borremose, C26449	raw fibre	13-33,49,63-164	21	55.2±47.0	+2.13, discontin.	42%	14%	mouflon-type [or
		undercoat only:		20.2±5.4	+0.56, pos.skewed	3%	10%	hairy medium]
Fraeer Mose, 7142	raw fibre	9-56,72-109	17,19	26.0±22.5	+0.93, discontin.	9%	10%	mouflon-type [or
		undercoat only:		20.3±9.2	+0.56, pos.skewed	1%	2%	hairy medium]
Huldremose, C3472 (light sample)	raw fibre	13-28,50,63-162	21	38.5±37.5	+1.33, discontin.	27%	2%	mouflon-type [or
		undercoat only:		21.2±4.7	+0.27, symmetrical	7%	2%	hairy medium]
Huldremose, C3472 (dark sample)	raw fibre	12-26,35,44-118	15	29.8±30.0	+1.27, discontin.	18%	100%	mouflon-type [or
		undercoat only:		17.4±4.3	+0.06, symmetrical	2%	100%	hairy medium]
Karlby, D4854b (light sample)	raw fibre	12-24,55-127	17,18	27.5±29.1	+1.04, discontin.	13%	0	mouflon-type [or
		undercoat only:		16.9±2.4	+0.06, symmetrical	0	0	hairy medium]
Karlby, D4854b (dark sample)	raw fibre	13-33,54-124	21	34.5±30.9	+1.22, discontin.	21%	100%	mouflon-type [or
		undercoat only:		21.6±4.0	+0.57, pos.skewed	7%	100%	hairy medium]
Rønbjerg, D2624-26	raw fibre	13-32,42-132	18	40.1±35.3	+1.75, discontin.	32%	0	mouflon-type [or
		undercoat only:		18.6±3.7	+0.60, pos.skewed	2%	0	hairy medium]
Tvede, St. Arden, 462/42	raw fibre	13-26,36,79-215	18	44.5±54.2	+1.37, discontin.	19%	100%	mouflon-type [or
		undercoat only:		19.4±3.1	+0.67, pos.skewed	0	100%	hairy medium]
Sejlflod, 669×1183	a	13-46	23,26	24.1±5.9	+0.42, symmetrical	0	0	shortwool
	b	14-37,50,51	22	26.3±10.9	+0.53, pos.skewed	4%	0	hairy medium
Sejlflod, 669×1301	a	15-38,69	26	26.7±6.3	+0.39, symmetrical	1%	1%	hairy medium
	b	15-33,85	21	22.9±7.3	+0.53, pos.skewed	1%	0	hairy medium
Sejlflod, 669×1445	a	15-49,79	26	26.1±8.0	+0.36, symmetrical	3%	0	hairy medium
	b	17-50,62	23	26.9±6.5	+0.52, pos.skewed	2%	0	hairy medium
Sejlflod, 669×1463	a	14-36,42,76	21	23.9±7.1	+0.35, symmetrical	1%	0	hairy medium
	b	17-50,63,74,87	22	27.3±10.8	+0.87, pos.skewed	3%	1%	hairy medium
Sejlflod, 669×1509	a	18-41,91	22,28,31	28.6±8.3	+0.19, symmetrical	1%	0	hairy medium
	b	12-46,60,62,69	15	24.9±10.0	+0.68, pos.skewed	4%	0	hairy medium
Sejlflod, 669×1531	a	12-38,77	23	22.7±8.0	+0.18, symmetrical	1%	1%	hairy medium
	b	13-41,54,60	28	26.5±7.7	+0.57, pos.skewed	2%	1%	hairy medium
Sejlflod, 669×1533	a	13-36,63	23	23.5±5.6	+0.38, symmetrical	1%	0	hairy medium
	b	13-36,78	22	23.8±7.8	+0.49, pos.skewed	1%	0	hairy medium
Sejlflod, 669×3602	a	12-51,65	23	25.7±8.7	+0.44, sym/pos.skew.	11%	100%	hairy medium
	b	13-38,46,91	28	25.7±9.0	+0.34, symmetrical	1%	100%	hairy medium
Rovsbjerghøj	cloth wa	10-33	21	19.0±4.1	+0.14, symmetrical	2%	0	fine
	tablet wa	10-64	22	25.8±9.6	+0.72, pos.skewed	10%	8% (coarse fibres only)	hairy medium
Skringstrup	Z	19-79	23,27	38.0±14.6	+0.84, pos.skewed	6%	31%	hairy
	s	10-53	21	27.0±8.3	+0.83, pos.skewed	1%	6%	generalised medium
Lousgaard, NMC5907	?wa	18-40	32	27.7±5.4	−0.06, symmetrical	0	0	shortwool
	?we	15-45	26	26.5±5.8	+0.47, pos.skewed	0	0	generalised medium

Table 3 (continued).

SITE, TEXTILE	YARN	RANGE	MODE	MEAN±S.D.	PEARSON COEFF. OF SKEW, DISTRIBUTION	MEDUL-LAS	PIGMENT	FLEECE-TYPE
Lousgaard, NMC5667	a	13-51	23	27.6±6.7	+0.68, pos.skewed	6%	0	generalised medium
(twill)	b	10-32,38,46	21	21.9±5.3	+0.22, symmetrical	2%	0	fine/gen.medium
Lousgaard, NMC5667	a	12-45	32	27.3±7.2	+0.11, symmetrical	1%	0	shortwool
(tabby)	b	13-47	31	28.4±6.9	−0.04, symmetrical	2%	0	shortwool

GERMANY

SITE, TEXTILE	YARN	RANGE	MODE	MEAN±S.D.	PEARSON COEFF. OF SKEW, DISTRIBUTION	MEDUL-LAS	PIGMENT	FLEECE-TYPE
Thorsbjerg, 24824b	a	14-38,46	19	24.4±5.9	+0.57, pos.skewed	1%	0	generalised medium
	b	18-62	26,28	31.9±9.4	+0.51, pos.skewed	3%	0	hairy medium

Table 3. Fleece types. Measurements in microns (0.001 mm).

A. Probable native textiles (Haraldskjaer types):

Denmark:	20 HM, 0 GM, 0 M, 2 Sh, 0 F, 0 F/GM (total 22)
Norway:	14 HM, 3 GM, 5 M, 1 Sh, 1 F, 1 F/GM (total 25)

B. Possibly native (tablet weaves, etc):

Norway:	4 HM, 2 GM, 5 M, 0 Sh, 0 F, 0 F/GM (total 11)

C. Probable imports into Norway and Denmark:

Virring-type:	7 HM, 3 GM, 1 M, 2 Sh, 5 F, 0 F/GM (total 18)
Dog-tooth twill:	6 HM, 3 GM, 0 M, 4 Sh, 0 F, 3 F/GM (total 16)

Table 4. Wools of Roman and Migration Period Scandinavia (including figures from earlier study).

Birka type:	3 HM, 1 GM, 0 M, 8 Sh, 0 F, 0 F/GM, 0 H
Veka type:	7 HM, 1 GM, 8 M, 2 Sh, 0 F, 0 F/GM, 0 H
Hessens/Elisenhof type:	4 HM, 2 GM, 1 M, 0 Sh, 0 F, 0 F/GM, 1 H
Other types from Denmark:	1 HM, 1 GM, 0 M, 2 Sh, 0 F, 0 F/GM, 0 H

Table 5. 7th–10th century wools from Norway and Denmark (including figures from earlier study).

eventually evolved into the lustre longwool. In earlier times the staple would not have been as long as in present-day longwool fleeces, but it was probably still of greater length than in other wools. It is interesting to note that the Gotland, one of the native sheep of Sweden, nowadays includes many medium-fleeced sheep (Ryder 1981a pp 393–7). The Gotland belongs to the 'northern short-tail' breed-grouping, to which the Norwegian Spaelsau also belongs.

In passing, it should be noted that there were a greater number of fine (F and F/GM) types of fleece among the textiles which are thought to have been imported from the northern Roman Empire, This agrees with the evidence from Roman Mainz, where F and F/GM accounted for 60% of the wool (Ryder 1981b).

VIKING AGE WOOLS OF NORWAY AND DENMARK

In the 8th–10th centuries there seems to have been an area of quality textile production somewhere in western Norway (Bender Jørgensen 1986 pp 358–360). One of the products of this region was the fine Veka-type twill, which is limited in its distribution to Norway itself (Bender Jørgensen 1986 p. 361). More tentatively it is thought that the Birka-type diamond twill of Scandinavia and the northern isles of Britain may derive from the same source (Bender Jørgensen 1986 and 1984 p 132).

The Norwegian textiles of this period still made use of the HM and M fleece types, with a few GM (table 5). However, a fourth type, the shortwool (Sh) had now begun to appear in much greater numbers than previously. Although there are few shortwools present in the Migration Period textiles, the large number in the Viking Age is still surprising: there do not appear to be any shortwools recorded among any of the native Scandinavian breeds of sheep (Ryder 1981); and in Britain, where sheep farming and wool textile production were always important, the shortwool did not appear in any numbers until much later (Walton 1981 p 191). Again, it does not seem possible that the shortwool could be derived from any other fleece type by processing the wool in some way. If the fine quality wool textiles of Scandinavian graves are indeed West Norwegian products, then the evidence suggests that the shortwool fleece was available in Viking Age Scandinavia well before it appeared elsewhere in northern Europe.

One of the most significant features of these Viking Age wools is their arrangement within the two main textile-types. It was noted in the earlier study that the

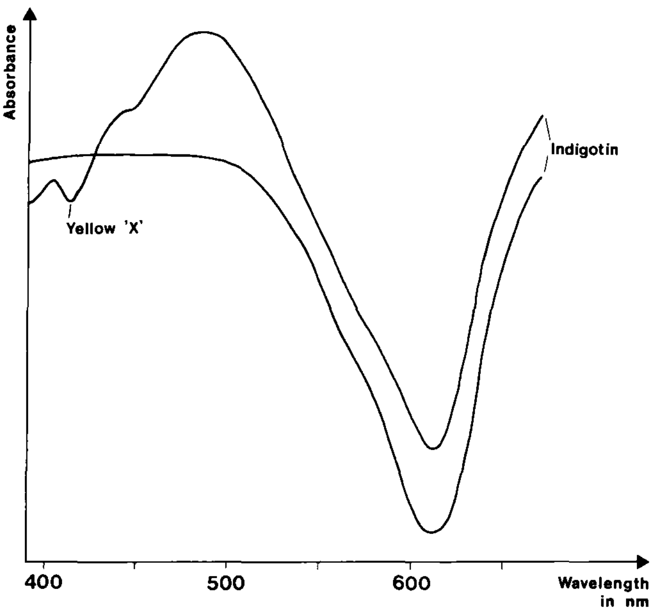

Fig. 3. Indigotin and indigotin plus yellow "x" (Sætrang C 644; in ether, ex pyridine).

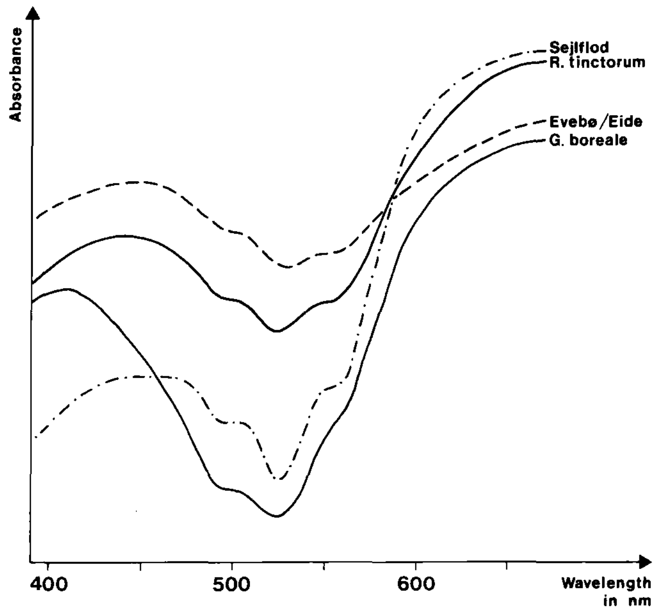

Fig. 4. *Rubia tinctorum, Galium boreale,* Evebø/Eide (3), Sejlflod (669 × 1531) in methanol plus magnesium acetate, ex IMS plus H_2SO_4.

shortwool was used almost exclusively in the Birka-type textiles. The Veka-type twills of the present survey instead proved to be medium in the warp and hairy medium in the weft: thus a smooth and firm long-fibred warp was combined with the softer, more crimpy underwool of the HM type of fleece, to give a strong, yet warm, fabric. This choosing of the right wool for a specific function, suggests a remarkably sophisticated approach to textile production.

In contrast, the coarser Hessens/Elisenhof type of textile, which probably derives from the Frisian region of North Germany and Holland (Bender Jørgensen 1984 pp 130–1) showed no pattern at all in the choice of wools. The fleece types were 4 HM, 2GM, 1M, 1H, which compares with the 11 HM, 1 GM, 4 M of the English examples of the same fabric-type (Walton forthcoming and Pritchard 1984 pp 53, 72–3). There is nothing in the wools to dispute a Frisian origin for these textiles, as the same fleece types have already been identified in textiles excavated in northern Germany (Ryder 1969 pp 514–5; Walton 1985).

The remaining wools of the Viking Age come from a variety of fabric types, whose origin is on the whole uncertain. However, it is interesting that the fine ZZ tabby from Lousgaard had the same arrangement of shortwool in warp and weft as was found in the Birka-type diamond twills. Lousgaard is a site which has produced five Birka-type textiles and it is possible that this tabby belongs with the same group.

DYES: BLUE

It has already been noted (above) that patterning with the natural colours of wool was introduced in the Pre-Roman Iron Age. However, by at least the 1st century AD, dyes were also in use. The most common dye to be identified was the blue indigotin (fig. 3) which at this time almost certainly derived from the woad plant, *Isatis tinctoria* L. (the other possible source being the sub-tropical *Indigofera tinctoria* L). Although woad is not a native of northern Europe, archaeological finds of its seeds suggest that it had reached Scandinavia by the Roman Period (Hald 1980 p 137).

Indigotin was identified in fine and coarse textiles of all periods. In several of the Norwegian finds it seems to have been used for particularly dark shades: at Evebø/Eide it formed a rich, deep stripe on a red or orange ground; in some of the Veka-type textiles only the warp had been dyed, so that the diagonal lines of twill would have stood out as dark blue on white; and in the Birka-type diamond twills, the dye was so dense that it was almost black. Since woad is an especially difficult dye with which to work and the deeper shades of blue require repeated dyeings, this is yet more evidence that the makers of the Birka-types possessed considerable skills.

In a few textiles from Norway and Denmark (Sandanger B10772, Skjervum B 6500, Sandegaard C27726 B-G) the indigotin behaved oddly when tested. The colour remained firmly on the fibre in the test for vat dyes (of which woad is one) but was easily removed in the test for mordant dyes. This behaviour has been encountered before, when indigotin has been applied on top of a mordant dye (Dalrymple 1983 p4). Although, properly speaking, no second dye was detected in these samples, the yellow dyes are notoriously difficult to pick up in our tests, and it seems likely that in these particular cases, woad had been combined with a yellow mordant dye. Indeed, in several other textiles, indigotin was found in combination with another, more clearly defined, yellow dye.

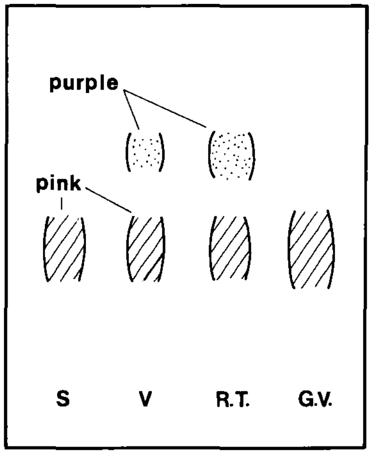

Fig. 5. Paper chromatogram of Sejlflod (669 × 1 533), Veien F, Rubia tinctorum and Galium verum (eluent IMS + H_2O; developed with KOH in methanol).

UNIDENTIFIED YELLOW DYE

Although most yellow dyes are difficult to detect, there was one which gave a very clear 'fingerprint' (fig. 3). It was found in six textiles, one. from Rovsbjerghøj, probably a Gaulish import, but the remainder native Norwegian and Danish textiles. It was always combined with indigotin and appeared to be a dye which required no mordant.

The spectrum of this dye was not like any in our collection and an extensive search of less common dye-plants had to be undertaken. As the dye was only yellow on extraction into pyridine and may have been yellow, brown, or even green on the fibre, the possibilities were numerous. However, despite analysis of all the dyes listed in Table 6, 'Yellow X' still remains unidentified.

Commercial dyes:
Reseda luteola (weld)
Genista tinctoria (dyers' greenweed)
Crocus sativus (saffron)
Rhamnus spp (Persian berries)

Lichens:
Xanthoria parietina
Hypogymnia physodes
Parmelia saxatilis
Lobaria pulmonaria
Pseudovernia furfuracea

Barks, etc:
Salix fragilis (bark)
Fagus sylvaticus (nuts)
Quercus robur (galls)
Corylus avellana
Malus sylvestris

Scandinavian wayside plants:
Potentilla anserina
Bidens tripartita
Chrysanthemum segetum
Myrica gale
Matricaria maritima
Cytisus scoparius
Equisetum arvense
Calluna vulgaris
Lythrum salicaria
Hypericum perforatum
Nymphum alba

Table 6. Dyes eliminated in the search for Yellow 'X'.

RED DYES: MADDER AND BEDSTRAW

Three of the wealthier graves of Norway, Snartemo V, Veiem and Evebø/Eide, included textiles dyed with a madder-type of dye (fig. 4). Chromatography showed that alizarin was present (fig. 5), indicating that the dye was probably derived from *Rubia tinctorum* L., Dyers' madder (Taylor 1983 p 159). This plant was widely cultivated in several parts of the Roman Empire (Pliny *Nat.Hist.* Bk.XIX, xvii), although there is no clear evidence for it in Gaul at this date. By the 9th century it was certainly being grown in the Paris region and shortly afterwards in England (Walton forthcoming). However, its cultivation is not as easy as woad and although it may survive in very sheltered areas of Scandinavia, it is unlikely to have been grown there as early as the Migration Period. Since the dye has only been found in rich graves, two of which contained imported goods, it seems likely that ready-dyed textiles or garments were being brought in from abroad, perhaps as princely gifts – or that the dye was imported for use in the best quality textiles.

In Denmark on the other hand a madder-type of dye was found in some native textiles from less wealthy sites. Chromatography proved that in at least two instances (Sejlflod and Hejrhøj) there was no alizarin present, and *R. tinctorum* could therefore be dismissed (the remaining madder results were too weak to chromatograph successfully).

Although *R. tinctorum* yields the greatest quantity of dye, there are several native Danish plants which give a similar colour. Analysis of yarns dyed with three species of *Galium* showed that these had no detectable alizarin, although they gave spectra very like madder: they were *Galium verum* L., a plant from heathland and other dry soils, *Galium boreale* L., from lusher grassland, and *Galium odoratum* (L) Scop. (formerly *Asperula odorata* L.), a woodland plant. Any of these plants may have been used to dye the Sejlflod and Hejrhøj textiles.

UNIDENTIFIED LØNNE HEDE RED

Another less commonly used orangey red dye was found at Lønne Hede. It was noted in the earlier study that this dye was difficult to extract and characterise, which hampered a search for its source. However, some of the dyes which can be eliminated are listed in table 7.

Rubia spp
Galium spp
Dyewoods, such as brazilwood or sanderswood
Insect reds, such as kermes, cochineal, etc
Fungus reds, such as *Dermocybe semisanguinea*
Rumex crispus (seeds)

Table 7. Dyes eliminated in the search for the Lønne Hede red.

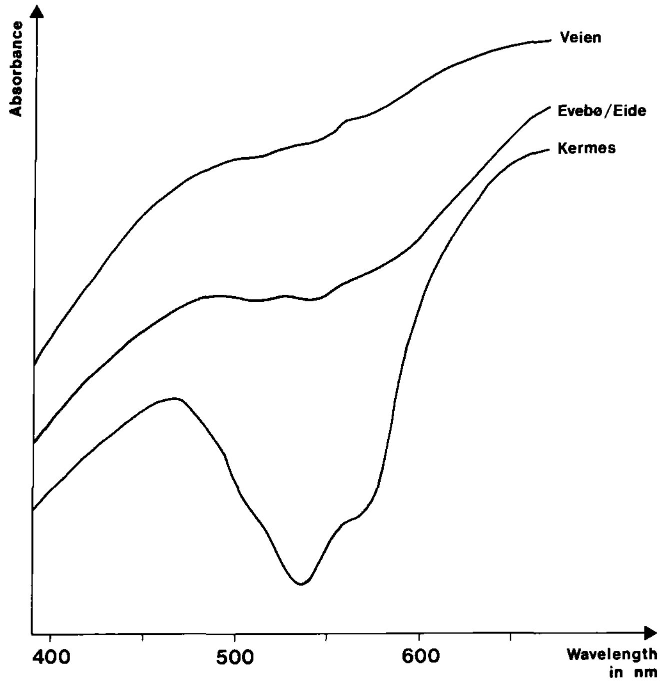

Fig. 6. Kermes, Veien C 348 and Evebø/Eide (4) in methanol plus magnesium acetate, ex IMS + H_2SO_4.

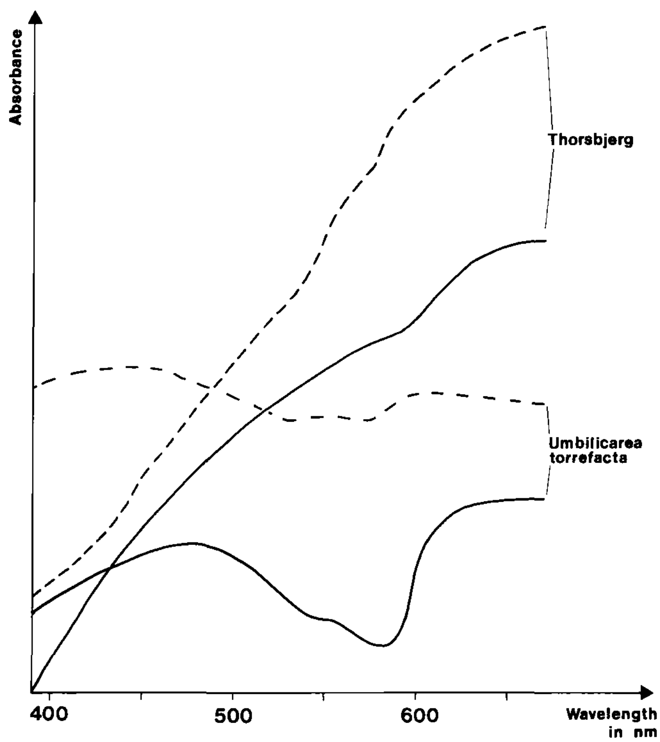

Fig. 7. Umbilicarea torrefacta and Thorsbjerg 248246b in methanol plus magnesium acetate (-) and in H_2SO_4 plus H_2O (---).

L. Dokkedal and E. Skytte Jensen (1976) have obtained satisfactory chromatograms of the Lønne Hede dye, but they too have been unable to identify its source. Since the Lønne Hede textiles seem to represent some of the earliest dyed cloth in Scandinavia, it is possible that dyeing was still at its experimental stage and once the *Galium* dyes had been discovered, this unidentified red fell out of use.

RED INSECT DYES

Although most natural dyes are obtained from plants and lichens, there is one group of reds, the cochineal/kermes/lac group, which derive from insects. All of these insect dyes give a similar graph in spectrophotometry, but may be distinguished from each other by their degrees of solubility in ether and by other characteristics.

Two Norwegian textiles, Veien C348 and Evebø/Eide B4590, again good quality products, gave the spectrum of an insect dye (fig. 6). In both cases the dye extracted, at least partially, into ether, which eliminated cochineal and lac as possible sources (and indeed geographically cochineal and lac were unlikely). However, the exact degree of solubility in ether was difficult to judge, as the aqueous residues were heavily contaminated with the organic substances which archaeological specimens collect from the soil. Nevertheless the sample from Veien certainly left an appreciable amount of dye in the aqueous residue.

This partial solubility in ether is characteristic of Polish cochineal, which contains both the soluble kermesic acid and the insoluble carminic (Taylor 1984 p 23). Although we have little experience of the chromatography of insect reds, when the Veien sample was chromatographed alongside cochineal (predominantly carminic acid) and kermes (kermesic acid) it behaved like a mixture of the two. It therefore seems safe to identify the Veien sample as Polish cochineal.

The results on the Evebø/Eide sample were unfortunately not so conclusive. Its solubility in ether and its behaviour in chromatography both indicated the presence of kermesic acid, but carminic acid could not definitely be excluded. This dye may therefore be either kermes or Polish cochineal.

Polish cochineal is obtained from the insect *Porphyrophora polonica* (L.) (formerly *Margarodes polonicus* L.), a parasite on *Scleranthus perannis* L. *S. perannis* is a plant of sandy regions, growing in central and eastern Europe, the Ukraine, Asia and the Caucasus, Turkistan and western Siberia (Donkin 1977 p 853). The eastern distribution accounts for findings of the dye in Egyptian and Syrian textiles of the Hellenistic-Roman period (Pfister 1935 pp 35, 39, 46: 1940 pp 26, 28, 67, 69). The dye is known to have been exploited in the past in Lithuania, Pomerania, Saxony, Prussia, Brunswick, Mecklenberg, Poland and the Ukraine (Donkin *op.cit.* p 854). In the 12th and 13th centuries it was subject to tithe in eastern and central Europe, and Donkin suggests that the *vermiculo* of Charlemagne's Capitularies should also be identified as Polish cochineal (*ibid*). Although rarely encountered in early European textiles, the dye may have been available to Scandinavian dyers via the Baltic trade routes. Alternatively, the textile itself may be an import.

The kermes insect, *Kermes vermilio* (Planch.) Targ. (for nomenclature see Schweppe 1986), lives on the leaves of the kermes oak, *Quercus coccifera* Planch., an evergreen shrub of the Mediterranean and S.W. Europe. It was well-known to the Romans and Pliny cites its use for the military cloaks of generals (*Nat.Hist.* XXII, ii-iii). However, it is rarely found in N. European textiles before the medieval period and if its identity in the Evebø/Eide textile is correct, it points to contact with some Mediterranean or near Eastern country (for background to the Evebø/Eide find, see Magnus 1984).

Finally, in passing, it should be noted that there are some Scandinavian mushrooms, e.g. *Dermocybe semisanguinea*, which yield a dye with a spectrum like that of the insect dyes. In chromatography the two groups of dyes may be easily distinguished, but this recent discovery is a timely reminder to researchers, not to rely on spectrophotometry alone.

LICHEN PURPLE

Another rare dye of some significance is the lichen-derived purple found in textiles from Thorsbjerg in northern Germany and Fløjstrup in Denmark. This dye may be obtained from a range of lichens (Taylor and Walton 1983) including some, such as *Ochrolechia tartarea*, which are native to Scandinavia (Høeg 1976 p 63ff). However, although the dye was available in the north, knowledge of its use seems to have been rather limited.

The earliest record of lichen purple in Scandinavia seems to belong to the 14th century, when Norway was exporting the dye under the name of 'lacmus' (Kok 1966 p 252). In Britain the dye has been found in one textile of Roman date and in several from the Anglo-Saxon period (Taylor and Walton *op.cit*), although all of the latter can be identified as imports: some were embroidery silks, probably from the Mediterranean, and the others were textiles of the Hessens/Elisenhof type (Walton forthcoming). If the Hessens/Elisenhof type of textile does originate in the Frisian area, as has been suggested, this would justify the comment of Ernoldus Nigellus, a 9th-century author, that there was a variety of colours in Frisian cloth which were not known in the upper Rhineland (van Uytven 1983 p 153).

It is tempting to suggest that the Thorsbjerg textile is evidence for a continuous tradition of lichen-purple dyeing in the Frisian region. However, it should be remembered that the Thorsbjerg relics are a collection of war booty, which archaeologists consider came from an area of Roman influence, probably somewhere between the Elbe and the Rhine (Ilkjaer and Lønstrup 1982 pp 98–9). Nevertheless, the textile itself is a typical product of northern Europe, and there is no real reason to suspect that it came from outside northern Germany.

The Fløjstrup find on the other hand is an unusual weave (Hald 1980 p 100) from the Viking Age, a period at which Scandinavia had trade contacts reaching into the Near East and beyond. Until the weave has been provenanced, no conclusion can be drawn on the origin of this particular dye.

CONCLUSION

It is hoped that these results have shown how the analysis of wools and dyes can make a useful contribution to the study of early textiles. The survey has elucidated the early evolution of the fleece of native Danish sheep and has shown how the early weavers took advantage of their raw materials; it has also indicated the import of dyes, or perhaps the import of luxury textiles, into Norway during the Migration period; and, if the fine wool textiles of Scandinavian graves are indeed of West Norwegian origin, it has highlighted a very sophisticated approach in native textile production in the 8th to 10th centuries.

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