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DYES OF THE VIKING AGE: A SUMMARY OF RECENT WORK

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Introduction

Between the late 8th and mid 11th centuries there was a great outward movement of raiders, settlers and traders from Norway, Sweden and Denmark. Some pushed eastwards through the Baltic Sea and down the Russian rivers to Byzantium and the eastern Islamic world; others went westwards to Iceland, Greenland and probably even to North America. The British Isles did not escape these Scandinavian incursions: Vikings first settled in northern and western Scotland, the Isle of Man, and Ireland, where they founded a colony at Dublin in AD 841. During the 9th and 10th centuries they also moved into northern England, where for a time they had their capital at York.

In England the Vikings did not entirely displace the native Anglo-Saxon population and for this reason we refer to York as Anglo-Scandinavian. In the same way, archaeological finds from Dublin are often called Hiberno-Norse, to indicate the mixed Irish and Scandinavian influences. London, on the other hand, although raided by Vikings, was never under their political overlordship: finds from the 9th–11th-century town are therefore referred to as late Saxon.

Published and unpublished work

In 1981 George Taylor began work on dyes in textiles from Anglo-Scandinavian York. He looked at about 60 different samples, out of which 29 (17 wool, 12 silk) gave positive results.[1] So far as we are aware, this was the first group of Viking-Age textiles to be analysed for dye. After this, the present author worked on a group of 27 wool samples from late Saxon London, while John Harvey examined four London silks of the same date.[2] A colleague at the University of Copenhagen also provided a large group of samples from various sites in Norway and Denmark, of which 28 belonged to the Viking Age: this work was reported at the 1986 *Dyes in History and Archaeology* meeting.[3]

These findings have appeared in several separate publications. In the last few years, however, a further 56 samples (49 wool, 7 silk) from Viking Dublin have been supplied by Frances Pritchard. More recently, the National Museum of Denmark has also provided Viking-Age samples, first from four textiles (3 wool and 1 silk) from burial mounds at Jelling, and then from a particularly rich group of textiles from a 10th-century royal burial at Bjerringhøj in Mammen: the Bjerringhøj samples were from 12 different textiles, but two had been embroidered with coloured yarns, so that there were 18 samples (14 wool, 4 silk) for dye-testing in all.

This makes a total of approximately 220 Viking-Age samples which have been tested for dye. The results proved quite intriguing, especially in the way that certain colours predominated at certain sites, or groups of sites. Before we examine the results of the work, however, the techniques of dye-identification in use in the York laboratory will be described.

Dye-testing procedure

The outline illustrated in figure 5 is based on the procedure developed by Professor Mark Whiting at Bristol, with some additional tests from Dr George Taylor and thin-layer chromatography (TLC) taken from Dr Helmut Schweppe's publications.[4] First, each sample is warmed in the pyridine-and-water mix, cooled, further diluted and the extract run on the UV/Visible spectrophotometer (the York machine is a Perkin-Elmer 402). The extract is then shaken up with diethyl ether and the ether extract run on the machine.

Next, the sample is rinsed and put together with an equal amount of fresh sample. This is heated in an alcohol-plus-acid mix (IMS:10% aqueous sulphuric, 2:1) until the alcohol has boiled away; the extract is then cooled and shaken with ether. The ether extract is run on the spectrometer, then, in a separate tube, boiled away and replaced with methanol, to which magnesium acetate is added. This is Dr Taylor's

development and we find that it causes dyes such as madder and kermes to absorb at 520–530 nm and thus effectively moves them away from the area where the staining often present in archaeological samples absorbs. Finally, the aqueous residue from the alcohol-acid test, usually diluted with methanol, is run on the machine.

Professor Whiting's system was originally developed for the testing of coloured samples and he would therefore only measure the absorption of an extract if it was visibly coloured. With archaeological samples from NW Europe, however, we are working with stained brown samples, often with only a trace of the original dye still present. Experience has shown that with these samples it is necessary to examine every possible extract on the spectrometer and not to rely on the naked eye to judge whether dye is present or not. This means that for every single sample, five spectrometry graphs are produced.

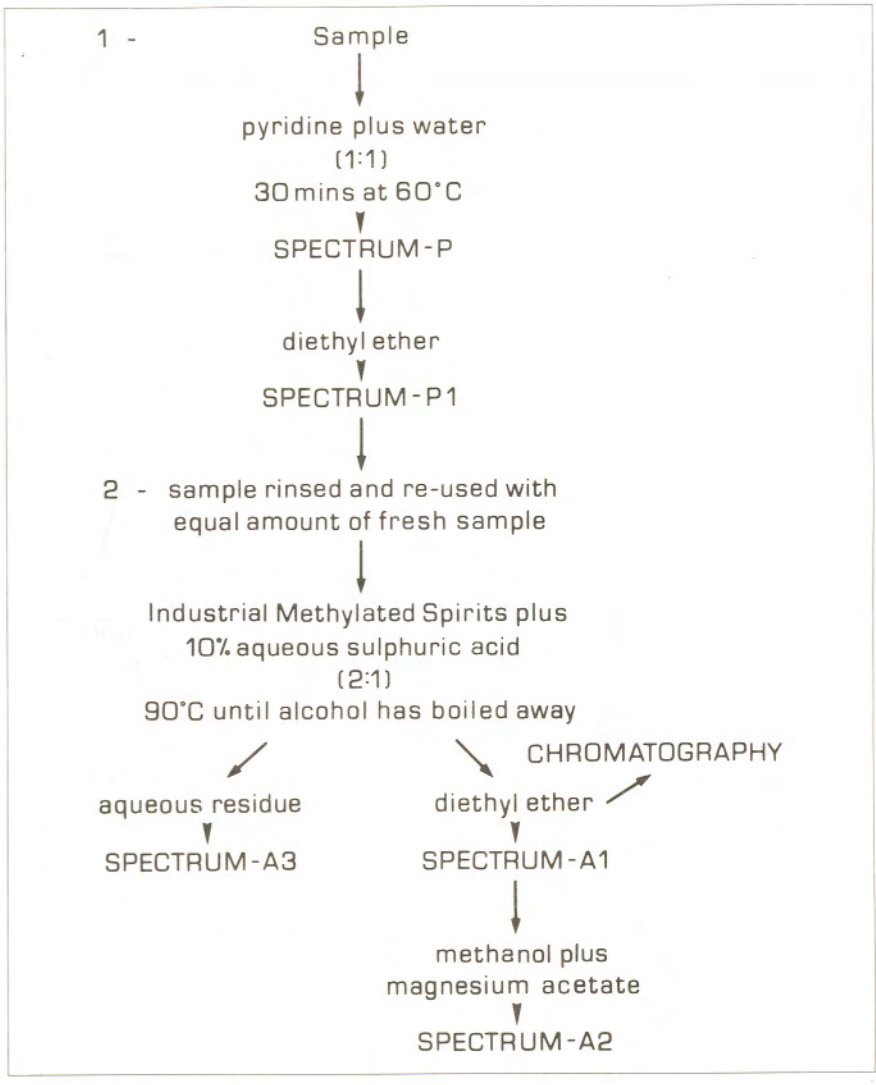

Fig.5: An outline of the dye-testing procedure used for archaeological textiles in the York laboratory

Dye identification

Any dye which extracts into pyridine, then into ether, and shows maximum absorption at 604–610 nm (fig.6), is identified as indigotin. The exact plant-source is of course not known, but woad, *Isatis tinctoria* L., is the most likely in the Viking Age.

If the dye extracts into the alcohol/acid mix, then into ether, and in the presence of magnesium salts gives the sort of shape illustrated in figure 7, with maximum absorption at 520–525 nm, the dye is identified as one of the madder or bedstraw dyes. In order to refine the identification, Dr Schweppe's TLC tests are used: the ether extract is spotted onto polyamide plates (Schleicher & Schüll, F 1700), and eluted with toluene and acetic acid (9:1); the plate is then visualised with uranyl acetate. Purpurin usually shows up straight away, but alizarin may take several hours to develop. If no alizarin is found alongside a strong purpurin spot, the dye is tentatively identified as from a bedstraw (such as *Galium verum* L.). If both components are well represented, the source is identified as dyers' madder, *Rubia tinctorum* L.

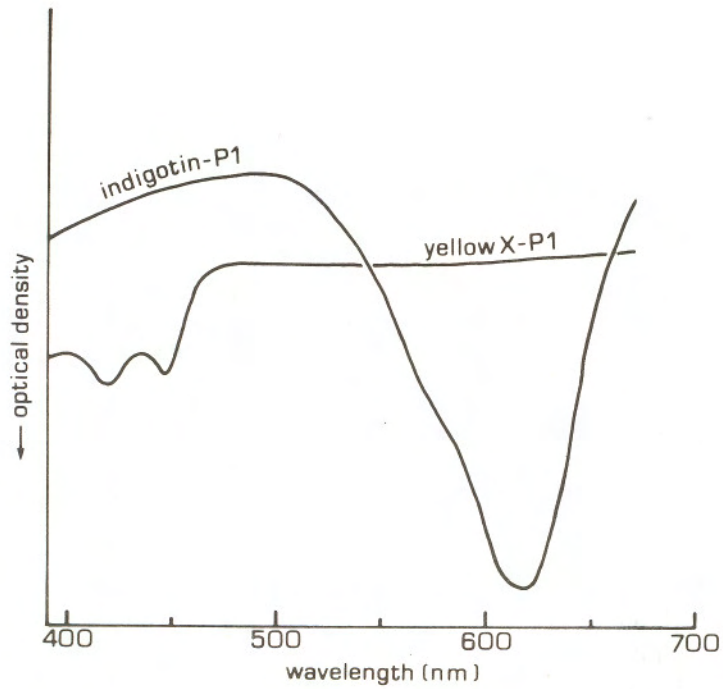

Fig.6: Absorption spectra of indigotin and 'yellow X'. P1 = ether extract out of pyridine/water.

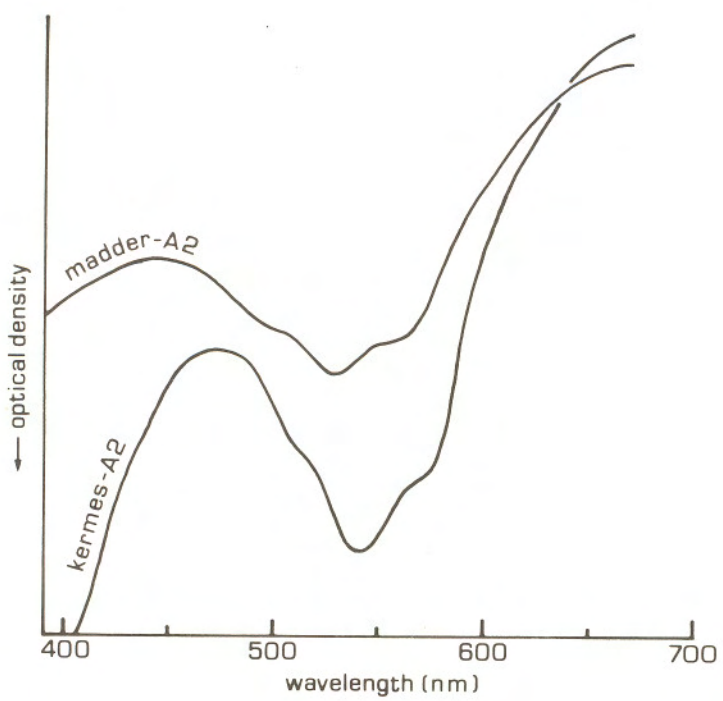

Fig.7: Absorption spectra of madder/bedstraw and kermes. A2 = dyestuff in methanolic solution of magnesium acetate

If the dye shows a similar graph to madder, but with maximum absorption at 530–535 nm (fig.7), an insect dye is indicated. TLC is carried out with the same polyamide plates, eluted this time with pentanone and formic acid (7:3) and visualised with uranyl acetate. This separates kermesic and carminic acids, and thus distinguishes between kermes (kermesic acid) and Polish cochineal (which contains both components). I have never encountered carminic acid on its own in a pre-16th century textile from NW Europe.

Returning to the absorption spectra, if a dye extracts into pyridine-plus-water, but not into ether, and gives a maximum absorption of 585 nm, the dye is identified as lichen purple (fig.8). These samples, when placed in the alcohol/acid mix, often turn quite a strong red, even though there has previously been no visible colour on the fibre. The aqueous residue of the acid test also gives a broad warp in the region of 500–530 nm. This conforms with our experience of lichen purples.[5] As the dyes are for the most part not ether-soluble, I have had little success with chromatography.

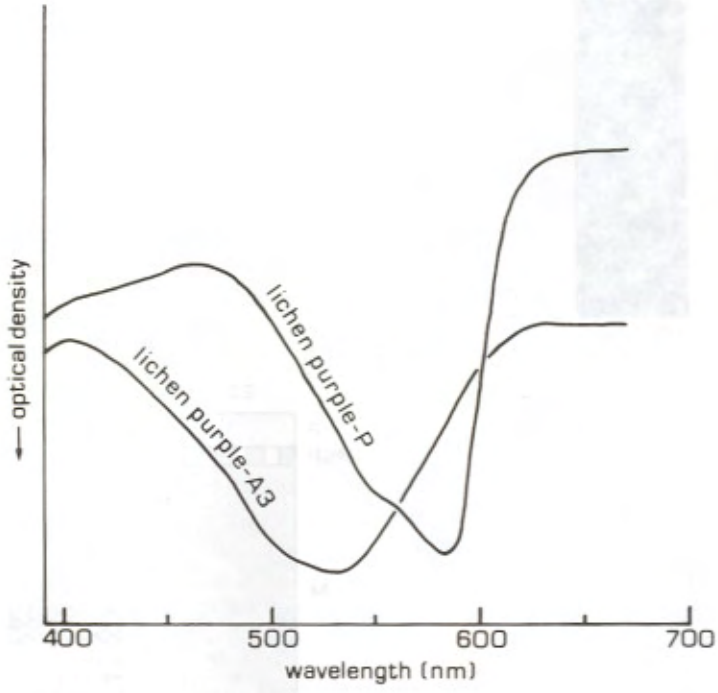

Fig.8: Absorption spectra of lichen purple. P = pyridine/water extract, A3 = aqueous residue from alcohol/acid test.

One further dye has been detected in Viking-Age samples, that to which I drew attention in 1986 and dubbed 'yellow X'.[6] This dye extracts into pyridine and then into ether, where it gives distinctive absorption at 420 and 445 nm (fig.6). It does not appear in the alcohol/acid test. When spotted onto silica gel plates, the dye gives a strong yellow in the presence of Naturstoff (2-aminoethyl diphenyl-borate). As yet, however, we have not developed a suitable eluent. The dye was at first only identified in samples from Scandinavia, all of which were combined with indigotin. Now, however, there is one example from Dublin which only has the yellow component present.

Results and conclusions

The results obtained from all this work show that four main dyes were in use in the period in question: red from madder or bedstraw; a purple derived from lichens; our mysterious yellow X; and a colorant identified as indigotin, almost certainly derived from woad. The insect dye kermes has also been found, and luteolin, presumably from weld, but only in imported silks.

The most surprising discovery was the way in which the dyes divide up into the different areas. Figure 9 shows, in bar-graph form, the Scandinavian, English and Irish dye-results (for these graphs, silks, which would have arrived by long-distance trade, are separated from wool textiles, most of which would have originated in NW Europe). A glance at this evidence might lead one to imagine that the well-dressed Norwegian or Dane wore nothing but blue, Dubliners wore purple, while in England madder-red was the fashionable colour.

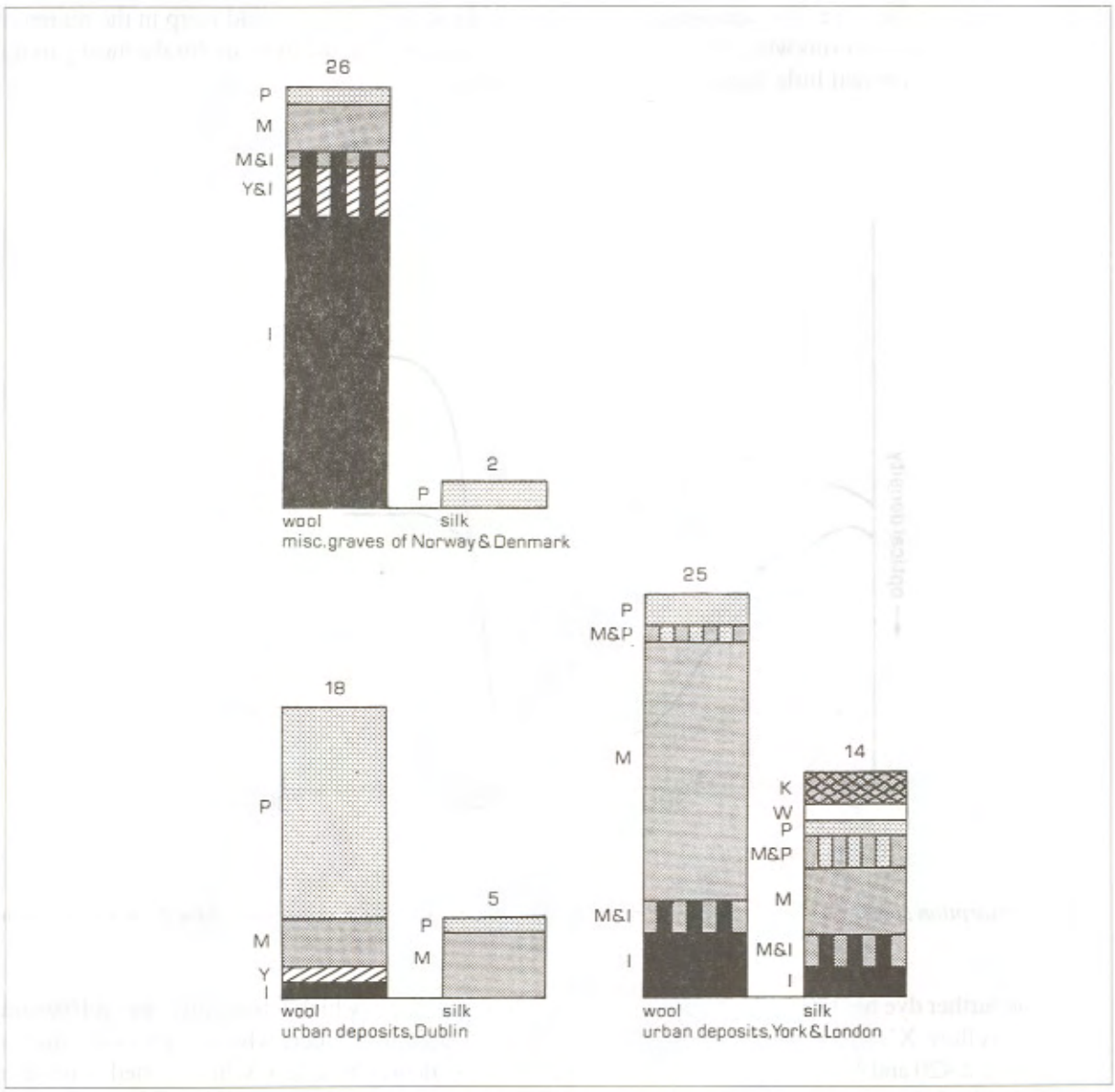

Fig.9: Bar-graphs to show the dyes identified in textile samples from the Viking Age. I = indigo/woad (indigotin); M = madder/bedstraw; P = lichen purple; Y = 'yellow X'; W = weld; K = kermes

How realistic a view is this? First of all, although a total of 220 samples have been tested, only 90 gave definite, positive results: the picture we have is therefore incomplete. Further, we cannot know whether the non-identified samples were undyed or had dyes which for some reason have decomposed beyond the limits of detection. It may be possible, for example, that different soils favour different types of dye (although against this suggestion we have the fact that the Scandinavian samples came from 19 different sites, which cannot all have had the same preservation conditions).

Is there some bias in the sampling procedure? At York and London almost all the available textiles were tested. The Dublin and Scandinavian textiles are too numerous for this approach, but in both cases a representative sample of the different fabric-types was attempted. The same fabric-types may not, of course, have been preserved at all sites: indeed, the Norwegian and Danish samples all came from graves and tend to represent the better-quality textiles of the period, whereas the samples from England and Ireland are from settlements and include a greater range of material. Strictly speaking, the Scandinavian collection is not, therefore, directly comparable with the British or Irish.

Were some dyes more readily available in certain areas? The cultivation of woad for blue seems to have been widespread and the dye, under the name of 'glaisin', appears so frequently in the early 8th-century Irish 'Cain' laws,[7] that there seems no reason why it should not have been used in Hiberno-Norse Dublin. Similarly, the lichens which give the purple dye of many of the Dublin textiles, and which are easily collected in Ireland, are also widespread in Scandinavia, where we have little evidence for their use. Only madder, which was cultivated in England and France, may not have been so easily obtained in other countries[8]—although it is difficult to imagine that Viking merchants could not have provided the commodity if it had been in demand.

Or is it possible that our results really do represent varying tastes in colour in the different areas? This is a difficult question to answer. Although the Anglo-Saxons are known to have enjoyed bright colours,[9] no documentary evidence has yet been found that they preferred madder-red to purple or blue. Our knowledge of the clothing of Hiberno-Norse Dublin is unfortunately largely based on the archaeological evidence, with little external support. In Scandinavia, however, there is rather more evidence. The deep blue identified as indigotin (indigo/woad) in the present study was also noted in many of the dress fabrics from the Viking-Age cemetery at Birka in Sweden.[10] It may therefore be significant that according to the Icelandic sagas (written down rather later than the Viking Age which they record), blue was the colour associated with the goddess of death:[11] perhaps the dark blue of the Scandinavian textiles was a colour chosen for burial? On the other hand, there are other references scattered through the sagas to blue and leaf-green clothing[12] (the leaf-green could be indigotin plus 'yellow X'): analysis of finds from settlements may show how common blue was among the living.

At this stage it is only possible to present the evidence with a few theories and comments. No doubt future research, either archaeological or documentary, will provide some clearer explanation of the present puzzle.

Notes

1. Taylor, G.W., 1989, "Detection and identification of dyes" in P.Walton 'Textiles, cordage and raw fibre from 16–22 Coppergate' *The Archaeology of York* (series ed.P.V.Addyman) 17/5, pp398–400
Taylor, G.W., 1983, 'Detection and identification of dyes on Anglo-Scandinavian textiles' *Studies in Conservation* 28, pp153–160

2. Pritchard, F.A., 1984, 'Late Saxon textiles from the City of London' *Medieval Archaeology* 28, pp46–76
Pritchard, F.A., 1983, 'Evidence of dyeing practices from a group of late Saxon textiles from London', *Dyes on Historical and Archaeological Textiles* 2, pp22–24

3. Walton, P., 1986, 'Dyes in early Scandinavian textiles' *Dyes on Historical and Archaeological Textiles* 5, pp38–43
Bender Jørgensen, L., Walton, P., 1986, 'Dyes and fleece-types in prehistoric textiles from Scandinavia and Germany' *Journal of Danish Archaeology* 5, pp177–188
Walton, P., forthcoming, 'Dyes and wools in Iron-Age textiles from Norway and Denmark' *Journal of Danish Archaeology*

4. Schweppe, H., 1986, 'Identification of dyes in historic textile materials' H.L.Needles and S.H.Zeronian(eds) *Historic Textile and Paper Materials (Advances in Chemistry Series, 212)*, Washington, pp153–174

5. Taylor, G.W., Walton, P., 1983, 'Lichen purples' *Dyes on Historical and Archaeological Textiles* 14–19

6. Walton, 1986, see note 3

7. 1869, *Ancient Laws and Institutes of Ireland, II: Senchus Mor*, pp370–375, 418–421

8. Walton, 1989, see note 1, pp400–401

9. Owen-Crocker, G., 1986, *Dress in Anglo-Saxon England*, Manchester, pp190–192

10. Geijer, G., 1938, *Birka III: Die Textifunde aus den Gräbern*, Uppsala, pp23, 35, 38, 180ff
Hägg, I., 1974, *Kvinnodrakten i Birka (Aun 2)*, Uppsala, p52

11. Palsson, H., 1970, Introduction to *Hrafnkel's Saga*, London, p25

12. e.g. *Hrafnkel's Saga*, see note 11, pp42, 48