



Parchment in medieval Norway: A historical and bio-codicological approach¹

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This article deals with production, use and trade of parchment in Norway through a discussion of medieval and early modern sources. We have also used biomolecular tools to extend our knowledge of the actual biological narrative of the parchment itself. Analyses of ancient proteins (eZooMS) enables us to reveal which species of animals were used for parchment production. As source material we have used documents for which a Norwegian origin is certain or likely. This is the first study in Norway to use biomolecular methods on what we believe is Norwegian produced parchment.

1 Introduction

Parchment was predominant as writing material in Europe in the Middle Ages. According to a tradition recorded by Pliny the Elder (†79 A.D.), its use originated in the second century B.C. from Pergamum, a Greek city in Asia minor, as a substitute for papyrus (*Historia Naturalis* 13, 21),² hence the Latin term *pergamena* and modern derivations as ‘parchment’, ‘parchemin’, and ‘pergament’.³ It is extremely durable compared to papyrus and it had its breakthrough as writing material in the fourth century. At this time, it became usual to collect double leaves of parchment together into quires and then to sew the quires together in the spine to a codex, the principal form of a book in western culture ever since. This was a more practical as well as more solid format than the papyrus rolls that were worn by rolling in and out. Single parchment leaves were used for letters and documents.

¹ The authors appear in alphabetical order. Credits appear before the list of references.

² The practice of writing on skin is much older, as it is recorded already c. 2700 in ancient Egypt (Ryder 1991, 25) and in ancient India.

³ Of the adjective derived from Pergamum, *Pergamenus* (-a, -um), cf. the Greek adjective Περγαμηνός, which also refers to parchment (Liddell & Scott 1992, s.v.). Derived from the adjective is the noun *pergamenum* (Souter 1949 s.v.). The vernacular term *bokfell* for parchment occurs in a royal diploma dated 17 June 1308 (DN XI 6, p. 13).

When the Latin alphabet arrived in Norway not later than in the early eleventh century, the writing material was parchment. Not very much is known today about the local production of parchment in Norway or of parchment trade. Our aim with this article is therefore to further extend our knowledge of the narrative of the parchment and early book history in Norway. A brief introduction to the making of parchment is given in Section 2 of this article. Section 3 concerns the arrival of parchment in Norway, and section 4 presents earlier research on parchment in Norway. Section 5 gives a survey of written sources on parchment in medieval and early modern Norway. Section 6 discusses the variation between parchment and paper in late medieval and early modern Norway. Section 7 presents the analysis of parchment by modern biomolecular methods, and section 8 presents manuscript material selected for protein analysis. The article concludes with a discussion of the evidence of the written sources considering the biomolecular analysis (section 9).

2 Parchment — characteristics and manufacture

There is little written evidence on medieval parchment production (for an overview of the sources, Gullick 1991: 145–146). There are no medieval texts on parchment production that give a full description of the process. The following text gives a summary of the basic steps in parchment production, but for a more detailed description of parchment preparation, see Vnouček (2019: 188–197).

Parchment is made from skin and all skin types are chemically built up of proteins called collagen, in addition to small amounts of fat and water that keep the skin elastic. The skin consists of three rather clearly delineated layers: epidermis (upper layer), dermis (skin layer), and hypodermis (subcutaneous bond tissue) (Reed 1972: 17–20). Parchment is solely made from the dermis layer. It may be produced from either salted and dried animal skin that has been soaked, or a freshly flayed and washed animal skin. To remove the hairs without damaging, bacteria originating from the skin itself are used to decompose the skin in a controlled manner, for the epidermis to be dissolved and thus allowing the hair to be removed more easily (Ryder 1960: 394).

The drying process under tension implements a simultaneous effect of drying and shrinkage without allowing the skin to change surface area. When the moisture in the skin evaporates, this high-voltage network solidifies to a permanent and stiff structure, since the collagen fibres in parchment become fixed in the same position. Parchment is therefore essentially different from tanned leather, where the collagen fibres are disorganized in a helter-skelter manner, making the tanned leather flexible and soft. The effect of the stretching also explains why parchment can be split into thinner sheets (Ryder 1960: 394). The quality of the parchment depends on the qual-

ity of the skin used, as well as from the skills of the parchmenter. Scar tissue may appear caused by insect bites, and holes may occur by accident when the skin is scraped or is under tension. The common method to prepare a parchment for writing was to polish it with pumice or chalk. This provides a velvety surface and better bonding capacity for ink and pigments.

3 The arrival of parchment in Norway

Codices arrived in Norway at latest in the early eleventh century. The earliest known examples of parchment in Norway are from liturgical books probably copied locally in the second half of the eleventh century and in the early twelfth (Gjerløw 1957: 117–121; Karlsen 2003: 64–68). Many liturgical books were imported or produced locally in the twelfth century (Karlsen 2005; Karlsen 2006). As for the eleventh and twelfth centuries, there are no preserved charters and letters on parchment that are written in Norway. The extant material is in Latin and copied abroad. The earliest preserved complete original document in Old Norwegian is a charter by King Filippus (1207–1217),⁴ and the earliest original Norwegian diploma in Latin is from 1222, by the duke Skule (DN XIX 140; RN I 456). Achieved either by trade or by own local production, texts testify of parchment availability in Norway.

There is a lack of original documents from the eleventh and twelfth centuries from Norway. Therefore, the principal source to early parchment in Norway is fragmentary liturgical books that may be held to be Norwegian based on palaeographical and liturgical grounds. The earliest codices that still exist as complete books are the Kvikne psalter, from the late twelfth century (Gullick 2013b: no. 66), and the Old Norse Homily Book, the earliest complete vernacular book from Norway, probably written in or not far from Bergen c. 1200.⁵ After 1200 there are charters in Latin and the vernacular, codices, and fragments of codices. From then on there is a considerable amount of parchment preserved. Parchment was predominant until the early sixteenth century in the preserved material, and it occurs occasionally also later, especially for solemn occasions. Examples later than 1800 are mainly treaties with other

⁴ DN I 3. In an inventory of the archives from four monasteries in Eastern Norway drawn up on Akershus Castle in 1622, there is an entry for a charter written in two versions, Latin and Old Norse by the king Magnus Erlingsson in the 1160s (Tank 1916: nos. 1336–1337). The Old Norse version appears to be the earliest documented charter in Old Norse. The register mentions a few more documents in Old Norse that predate the letter by Filippus mentioned above and adds other lost documents by Filippus. Of the charters recorded in the register less than one percent still exists today (Pettersen 2013a: XIX).

⁵ Gullick 2013b: 57. Earlier texts composed in Norway, e.g., *Historia Norvegie* and *Passio Olavi* from the twelfth century, are preserved in later copies (Karlsen 2018: 459–461).

countries. In the early modern era, parchment was produced for the binding of books and documents, either it covered the wooden boards and the spine of books, or it was used as a cover without boards.

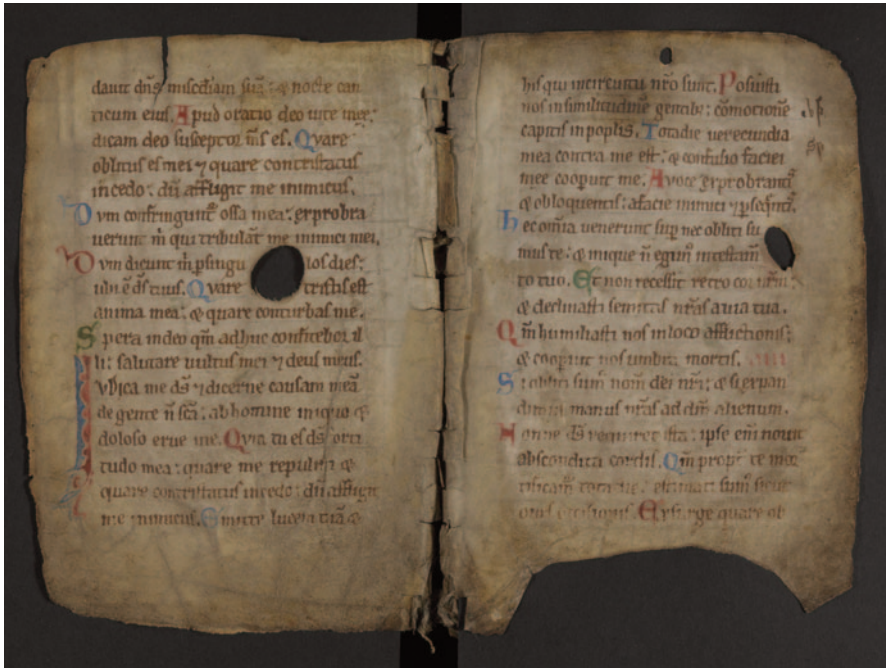


Figure 1. *Kviknepsalteret*, fol. 13v–14r. Photo: National Library, Oslo.

4 Earlier research on parchment in Norway

A brief overview of earlier research is found in the article *pergament* (1968) in KLN (XIII: 195–197) on which the present paragraph is based. Usually, parchment was made from skin from lamb and goat in Southern Europe and from calf in Northern Europe. It is mentioned that the homemade Icelandic parchment is rather coarse, and primitive compared to the finest foreign parchment. Thick parchment was usually used as book wrappings. As for Sweden, a point is made initially in the article that some Swedish letters are made from pieces cut from the wide margins of papal bulls,⁶

⁶ This must be a rather small practice, given the huge number of Swedish documents on parchment.

and that there are palimpsests. Taking into consideration the large number of documents on parchment from medieval Sweden, this must be relevant only for a small part of the material. There is evidence of production of parchment for local missals and breviaries in the diocese of Skara in the second half of the fifteenth century (KLNLM XIII: 196). A parchmenter is mentioned in Stockholm in the 1490s. As for Denmark parchment was replaced by paper by the end of the fourteenth century and the early fifteenth. There is a mention of a parchmenter in Copenhagen in 1491 (KLNLM XIII: 197).

As for parchment in Norway, Fiskaa's account in his book on paper and the paper trade in Norway adds to the picture (Fiskaa 1940: 36). Fiskaa wrote that parchment was almost universal as writing material from the twelfth century, with the most notable exception for writing materials used for runic inscriptions. Parchment-making flourished everywhere in Europe during the next centuries, also in Scandinavia. The quality of parchment among the preserved letters from medieval Norway differs a lot, Fiskaa observes, from the finest to the most crudely produced. This leads him to suggest that there was a mixture of locally produced parchment as well as fine imported parchment. According to Fiskaa it is most likely that parchment was made by *skinnari*, 'skinners', i.e., tanners. With one exception,⁷ all known tanners lived in the towns.⁸

In Old Norse scholarship it is commonly held that parchment was made from calfskin, and there are no certain examples of other skins (Jørgensen 2013: 37, 41–43; Holm-Olsen 1990: 78). Berg (2010: 57–58) comments on the parchment in the Old Norse Homily Book, the oldest book in Norwegian that is still extant. It is likely to have been made c. 1200.⁹ The parchment is mediocre, and several leaves have holes and tears, and 'it appears that it has been attempted to produce as many leaves as possible out of the little material available'.¹⁰ A bit more than one third of the 76 leaves have holes and tears, and they are unevenly trimmed. Berg argues that the book may have been made for local use, as the parchment would have been of higher quality if it was commissioned by someone else (cf. Ker 1985: 143 on the parchment in early books from the cathedral of Salisbury).

⁷ DN III 207. According to RN V 437, the document should be dated to 1341.

⁸ Fiskaa 1940: 36. The fact that the word *skinnari* appears in Norwegian place names outside of towns, such as *Skinnarbu* in Marker in southeastern Norway and in *Skinnarbu* in Telemark in the south, strongly indicates that there were tanners also in the countryside).

⁹ The earliest fragments of books in Norwegian date back to c. 1150.

¹⁰ Berg 2010: 57: '[D]et virker som man har forsøkt å få så mange blad som mulig ut av det materialet man hadde til rådighet.'

Michael Gullick has made some observations on the character of Norwegian and Swedish parchment based on material in the collections of fragments from the NRA and SRA:

However, what is important to the present enquiry is that I also noticed that a significant number of what I have identified as probably or certainly Norwegian-made books were often made on slightly thickish, opaque and even coloured parchment with both sides well scraped (often with scrape marks visible) and usually nappy. (This feature is especially noticable in moderate and poor books, and I noticed rather similar parchment in a number of the fragments of probable or certain Swedish origin . . . It does appear that the parchment used in at least some good quality Scandinavian books may have used better quality parchment comparable to good quality parchment found in English and French books. . . . However, I think that it can be very tentatively suggested that an Oslo fragment on thinnish, smoothish and even-coloured parchment may not be from a Norwegian-made book unless there is other good evidence to support such an attribution. (Gullick 2013a: 109)

Gullick argues that there are certain characteristics of Norwegian and Swedish parchment, but these characteristics do not provide decisive evidence and are only tentatively suggestive.

As mentioned, paper was introduced in Scandinavia in the fourteenth century. Jexlew (1966) has studied the variation between paper and parchment in Danish documents in the late Middle Ages.¹¹ The study is relevant to Scandinavia overall, as the material partly concern royal documents under the unions in the fifteenth century, when the kings and their chanceries were constantly on the move in the kingdoms. A good example is the Kalmar treaty of July 1397, written on paper, and confirmed on parchment by prominent men at the initiative of Eric of Pomerania in 1425. The fact that the transcript of 1425 mentions that there are only three seals out of ten appended to the original, demonstrates the problem with appending seals on paper documents (Jexlew 1966: 87). Confirmed transcripts (*vidisse*) were usually on parchment until c. 1450, when there was a turn towards paper. The preference for parchment to paper was particularly strong when it came to deeds of gift, contracts and documents

¹¹ The usual term for a confirmed transcript in Norwegian and Danish diplomatics is *vidisse* (Hamre 2004: 10–11). The witnesses to such a transcript usually attached their seals. Most preserved documents from medieval Norway belong to this category. The term *vidisse* appears not to be used in medieval Norway (but cf. DN XVIII 40), but it occurs in Danish and Swedish texts in Latin (cf. LMLD s.v. *vidisse*; GMLS s.v. *uidisse*).

confirming legal obligations. Within this field parchment prevailed in Denmark until c. 1660. The reason for the preference of parchment in such cases is that parchment was considerably stronger and was better suited for appending seals, Jexlew argues (1966: 87). Missives were closed, folded letters addressed to persons. Paper is easier to fold than parchment and was consequently preferred for missives, even royal ones of which the oldest one dates from the end of the fourteenth century. The use of paper increased simultaneously as the expansion of the central administration and was also preferred for personal letters by the end of the fifteenth century.¹² However, parchment appears not to have been more exclusive than paper. It was not uncommon to make confirmed copies of paper documents on parchment in the fifteenth century.

5 Written sources on parchment in Norway

The earliest evidence is from an incomplete runic inscription on a wooden stick from Bergen in which parchment is mentioned in a daily-life situation. Three leaves of blank parchment were deposited as a security for salt:¹³

- Line A: + guþ · signi · Yþr · sira · pro[^]fast[^]r · oddr · kom · til · min · o[^]k · mærkti
· ek · yþr · seks · la[^]upa
- Line B: salls · sua · at · firi · uinnr · um · t[^]uau · (p)u(n)d · (o)[^](k) · (a) · þorer ·
sa[^]ltet · o[^]f ha[^]rþr · engi · ua[^]r · sa[^]lt · punda[^]ren · hæima
- Line C: · o[^]k · lita · matt · þu · þessa[^]ri · lykt · at · m(i)nn(i) · (u)(i)(t)end · en
þa[^]r · liggr · at þæi(r)(r)(a) · (s)(a)l(e)(t) · (o)(k) · (·) (s)(k)(a)[^](l) · (e)(k) ·
(þ)?? —
- Line D: sem fyrst · fæ · ek · pundara · o[^]k · þat · til · ia[^]rþtegnā · at · ek · ga[^]f ·
Y · þriu · skinn · a[^]f · bo[^]kfælli · o[^]k riþ · til · min · huæso þer —

God bless Thee, sira priest. Odd came to me, and I marked for you six laup salt, so that it reaches out over two pounds, and Tore Ovhard owns the salt. There was no salt weight at home (with me). And you can trust on this payment by my knowledge. But the payment is there with them, and I will (send it?) as soon as I get a weight. And it (should be) to sign (i.e., mortgage, guarantee?) that I gave you three skins of parchment. And write to me how you . . .¹⁴

¹² For a more detailed survey of the Danish material in numbers, see Jexlew 1966, 88–99.

¹³ ^ indicates a bind-rune (ligature). Parenthesis indicates uncertain reading (due to damage). ? indicates unidentifiable remains of a rune. — indicates a lacuna.

¹⁴ Here cited after the file for the inscription B625 in the Runic Archives at the Museum

The inscription is to judge from the level it was excavated from, from the first quarter of thirteenth century and is found at the site of the Hanseatic office in Bergen.¹⁵

The three leaves were deposited for a large quantity of salt and documents a high value of parchment. One *laup* equals 15.9 kg. It is uncertain whether the value of the leaves corresponded to the actual value of the salt on the market, as six *laup* of salt was a considerable amount. Probably it was only a partial guarantee.¹⁶

The presence of parchment documented in the inscription should be linked to local book production in Bergen c. 1200. The inscription is only a few years later than Homily Book scribe who was active in or near Bergen. He wrote the Old Norse Homily Book and an Old Norse translation of Honorius of Autun (c. 1080–1154), now in fragments, as well as some fragmentary liturgical books in Latin (Gullick 2013a: 112; Gullick 2013b: nos. 57, 58, 111, 126, and 127). All in all, a local production of parchment in or near Bergen is likely c. 1200, and it probably began earlier.

Around 1308 a parchment leaf (*membranum*) accompanied a letter (DN X 10) from bishop Arne of Bergen to his brother Audfinn Sigurdsson, who was about to leave for a visit to the papal curia. Arne wanted his brother to function as his representative. The parchment leaf was possibly unwritten and Audfinn who was meant to be the bishop's representative, could compose a text he found appropriate.¹⁷ The interpretation of the parchment as unwritten is supported by a passage in the fourteenth-century Icelandic *Laurentius saga biskups*, ch. 18. The incident occurred in Nidaros c. 1300. The Icelandic cleric Laurentius (1267–1331; bishop of Hólar on Iceland 1324–1331) was on a visit to the Nidaros. Archbishop Jørund entrusted Laurentius with three unwritten parchment leaves. The leaves were sealed even though they

of Cultural History in Oslo, supplied by information from Prof. James E. Knirk. Cf. the information in *Scandinavian Runic Text Database*, Department of Scandinavian Languages, Uppsala University (<https://www.nordiska.uu.se/forskn/samnord.htm/?languageId=1>).

¹⁵ The inscription was found at Finnegården 3A (the Hanseatic Museum, i.e., the old Hansa office) in a layer from before 1225–1230) in Bergen. The excavation number is BRM (Bryggens Museum) 110/1711. The dating is based on an analysis of pieces of pottery together with which it was discovered. It is quite possible that the scribe was an Icelander on the basis of the execution of the runes and some Icelandic influence on the language, although there are Norwegian forms as well. I am indebted to prof. em. James E. Knirk (Oslo) for this information for which I am very grateful.

¹⁶ Salt had a stable high value in Norway in the fourteenth and fifteenth centuries in the material studied by Pettersen (2013: 98–101). The measure *laup*, mentioned in the inscription, could also have been referred to as *spann* ('pail') or a carrying tool of some kind.

¹⁷ RN III 546 suggests that the parchment carried a partially written, sealed letter to be completed by Audfinn Sigurdsson.

were unwritten. As it was customary, Laurentius swore in the presence of two witnesses appointed by Jørund that he would not write anything that would harm the owner of the seal or his church. Otherwise, he could write whatever he wanted. This appears to be a parallel to the giving of sealed parchment by the bishop of Bergen to his brother.

The papal nuntius Pierre Gervais throws light on the availability of parchment during his travels in Denmark, Norway and Sweden in the 1330s. He reports in his account book (PN 112–126) that he had acquired parchment on thirteen occasions. He arrived first in Denmark, and the first purchase occurred in the Danish city Helsingborg in Scania, now belonging to Sweden, in 1331:

Item .xj.ma. die Aprilis emi .xij. pelles pergameni pro negocijs seu litteris scribendis quia papirus in dicto Regno non inuenitur et solui — .xij. gross. Turonenses (PN 112).

Likewise, on 11 April I bought twelve skins of parchment for business or the writing of letters, as paper is unavailable in the mentioned kingdom, and I paid twelve Turonian grossi.

Although paper was cheaper, it is remarkable that Pierre Gervais found paper to be unavailable in Denmark on his travels. The relevant passages with indication of quantity and value are collected in Table 1. As for the remaining fourteen purchases listed in Table 1, no reason is given for the choice of parchment.

Pierre Gervais informs on prices on parchment in *grossus Turonensis* (gros Tournois), a French currency.¹⁸ On the basis of Pettersen's (2013a) study of prices and values in medieval Norway, the prices given by Pierre Gervais may be recalculated into units of value used in Norway. The calculations show that 24 skins of parchment in Western Norway (Vestlandet) correspond to the value of one cow. In Eastern Norway (Østlandet) the value was different, and eighteen skins of parchment corresponded to the value of one cow. Interestingly, this indicates that the price for cattle differed across Norway. The value of a psalter would in the thirteenth and fourteenth centuries correspond to three up to seven cows, as are the documented values (Pettersen 2013a: 292–294; Karlsen 2005: 151–152).

It appears from the acquisitions of Pierre Gervais and the other scarce sources mentioned above that unwritten parchment was available in ecclesiastical centres, such as Århus, Roskilde, Lund, Skara, Strängnäs, Uppsala, Bergen, all cities with episcopal residences. This makes it likely that parchment was produced in episcopal

¹⁸ A large thick, silver coin first issued c. 1267, the adjective *Turonensis* referring to Tours.

Table 1 Pierre Gervais' acquisitions of parchment in Scandinavia 1331–1333

Date	Place	Source	Quantity	Value
11 April 1331	Denmark (Lund?)	PN 112 Item .xj.ma. die Aprilis emi .xij. pelles pergameni pro negocijs seu litteris scribendis quia papyrus in dicto Regno non inuenitur et solui – .xij. gross. Turonenses.	Six skins of parchment	12 grossi Turonenses
8 May 1331	Scania (Lund?)	PN 113 Item solui pro .viiij. pellibus pergameni pro litteris et rationibus transcribendis – .x. gross. Turonenses.	Eight skins of parchment	10 grossi Turonenses
20 June 1331	Roskilde	PN 114 Item emi .vj. pelles pergameni pro rationibus transcribendis et solui – .vj. gross. Turonenses	Six skins of parchment	6 grossi Turonenses
6 May 1332	Århus	PN 116 Item solui pro .iiijjuor. pellibus pergameni – .v. gross. Turonenses	Four skins of parchment	5 grossi Turonenses
10 June 1332	Århus	PN 116 Item .x. die Junij. solui pro .vj. pellibus pergameni – .iiijjuor gross. Turonenses	Six skins of parchment	4 grossi Turonenses
6 August 1332	Lübeck	PN 117 Item .vjta. Die Augusti .iiijjuor. pelles pergameni pro diuersis scripturis et solui pro eis – .iiij. gross. Turonenses.	Four skins of parchment	4 grossi Turonenses
21 October 1332	Skara	PN 118 Item emi .vi. pelles pergameni pro quibus solui – .iiij. oras den. Sueuorum.	Six skins of parchment	Dimidia marca den. Sueuorum
21 October 1332	Skara	PN 118 Item emi .iiijior. pelles pergameni pro quibus solui – .iiij. oras den. Sueuorum.	Four skins of parchment	.iiij. oras den. Sueuorum
8 February 1333	Skara	PN 119 Item emi ibidem pergamaena pro processibus mittendis ad Norwegiam. solui – .x. gross. Turonenses.	Parchment	10 grossi Turonenses
27 February 1333	Strengnäs	PN 119 Item .xvijma. die Februarij solui Strengenes pro pergamento – .v. gross. Turonenses.	Parchment	5 grossi Turonenses
25 April 1333	Uppsala	PN 119 Item emi pergamaena pro – .vij. gross. Turonensibus	Parchment	7 grossi Turonenses
8 February 1333	Skara	PN 119 Item emi ibidem pergamaena pro processibus mittendis ad Norwegiam. solui – .x. gross. Turonenses.	Parchment	10 grossi Turonenses
4 August 1333	Bergen	PN 121 Item die .iiij.ta Augusti emi .vj. pelles pergameni pro – .iiij gross.	Six skins of parchment	4 grossi Turonenses

8 September 1333	Bergen	PN 122 Item solui pro pergamenō – .viij. gross. Turonenses.	Parchment	8 grossi Turonenses
26 November 1333	Norway (in the eastern part?)	PN 123 Item .xxvij. die Nouembris solui pro .iiij. uor pellibus pergameni – .iij. gross. Turonenses	Four skins of parchment	3 grossi Turonenses

centres around in Scandinavia. This is only what could be expected at that time. Prices also varied across Europe, between different types of cattle, and according to fourteenth-century accounts from Beaulieu Abbey in England, calfskin was more expensive than sheepskin (Gullick 1991, 147–148).¹⁹

We will now turn to public account books from the late Middle Ages. Little is preserved of account books, land registers and tax lists from medieval Norway. However, there are some materials from the last decades before the Reformation. Most suitable for study is the material from Bergenhushus *len*²⁰, from the administration of the archdiocese in Trondheim and from the bishop's palace ('bispegården') in Bergen.

The accounts from Bergenhushus 1516–1523 which are all on paper, do not only comment on the use of paper, but also mention calfskins that were used in the production of parchment, from two up to four skins a year (NRJ II: 32; NRJ III: 94, 570). The small quantity indicates that the parchment probably was used for bookbinding and not for writing material. On many occasions it is said that the parchment is meant to be used for registers at the royal residence.²¹ Our observation agrees with the fact that almost all preserved account books from Bergenhushus at this time are written on paper bound with boards covered with unwritten parchment. There are also mentions of payment to parchmenters. (NRJ II: 6; NRJ III: 34, 493). The account books from Bergenhushus show that calfskin was somewhat cheaper than sheepskin.²² We also see that a minimal part of all skins that arrived at Bergenhushus castle as payment of taxes and revenues that were made into parchment. In the account book for the summer half-year in 1521 there are 1269 calfskins, 1335 goatskins, and 1039 sheepskin (NRJ II: 667). A lot of it was sold. In the summer of 1521, the merchant Johan Tripmaker

¹⁹ This may be explained by England exporting large quantities of wool during this period. It has been assumed that the number of sheep slaughtered annually from 1150 to 1850 was no less than 15 million (Teasdale *et al.* 2015). The prices assumingly followed the relative availability of each species.

²⁰ *Len* was the largest administrative unit in early modern Norway.

²¹ Kongsgården, i.e., the king's estate.

²² NRJ I: 444; NRJ II: 577. In 1519, the price for ten sheepskin was ten shilling and for ten calfskins eight shilling. In 1521, the corresponding prices were twelve and nine shilling, respectively.

at Bryggen (i.e., the dock, the area of the Hanseatic offices) paid for a lot of merchandise, e.g., for 1347 goatskins, 1262 sheepskin and 1654 calfskins (NRJ II: 577).

One significant exception is found in an account from around the years of 1534–1535, where thirty calfskins were prepared to parchment for a register of the castle.²³ The large quantity suggests that the parchment mainly was meant for writing material.²⁴

The price of parchment was assumingly not only depended on the actual raw material, making parchment also required salt for preserving the skins, lime, and in some cases expensive dye were required. Variation in the quality of the craftsmanship also assumingly played in. For plain ordinary parchment, however, the price for salt might have played an important role for parchment prices. It is interesting to notice that during the thirteenth century salt prices rose extensively in the northern Europe and in England (Fiddyment *et al.* 2015).

Moreover, we can only assume that the fraction of what has survived also represents, which animal the parchment was originally produced from. The account books show that calfskin was a common raw material used for parchment in Norway, and our protein analysis of different documents, shows that calfskin was predominant in 85% of our samples. Although our number of samples is low and constitutes a preliminary data set, it corresponds with patterns indicated by written sources.

6 Parchment and the introduction of paper

Paper was first produced in Europe in the 1200s, and in Italy the earliest known production happened in 1272.²⁵

The earliest known document on paper from Norway was written in Oslo in 1370, and in the fifteenth century there are some books and charters and deeds on paper. Unlike paper, which had to be imported to Scandinavia well into the seventeenth century, one had the technical skills to produce parchment locally already in the Middle Ages.

Towards the end of the Middle Ages, the use of paper as writing material grew more common. At this time the administration of the archbishop's administration in Nidaros and that of the royal castles usually wrote on paper. According to the account

²³ 'Kalfskindt mett iij deger giortt wdj pergement tiill Slots Regiister' (NRJ IV: 449).

²⁴ Probably the register of the castle was the principal land register of Bergenhus castle, now lost. There is no such register on parchment among the preserved account books.

²⁵ Paper is first mentioned in Denmark in 1358 and in Sweden in 1345 (KLN XIII 107–108). An early example of a paper document from Norway dates from 1370 (DN VI 278; for the date, see RN VII 56).

book for the archbishop's residence in Bergen²⁶ for 1536, the administration bought paper. The account book itself was written on paper and bound with a parchment leaf from a twelfth-century English bible as cover (Pettersen 2013b: 43 with Plate 2). Archbishop Olav Engelbrektsson's land register from ca. 1533 was bound with Pope Julius II's letter of provision for his predecessor Erik Walkendorf, dated 1510.

The account books from Bergenhus 1516–1523 mentioned above show that paper was used for writing, and that the bindings of account books themselves were of parchment. There is continuous documentation of expenses for purchase of paper, and the administration of the len bought the paper from Holland. As local production of paper first began in Holland well into the seventeenth century, it means that the paper bought from the Dutch was produced elsewhere. Paper could be imported from the large production centres of Western Europe at the time, such as France, Germany, or Italy, through Western European trade lines (Tschudin 2012: 111).

Although ordinary letters were written on paper, parchment was often used for important documents. This was the case with the lost land register for Bergenhus mentioned above, for which parchment was produced. A few years after the Reformation, the protocol of the cathedral chapter in Trondheim was begun. The protocol included, among other things, important documents like the mentioned land registers of the chapter and transcripts of letters of privileges. They were all written preferentially on parchment.

7 Parchment analysed by modern biomolecular methods

Non-invasive eZooMS analysis (Fiddymen *et al.* 2015) was carried out on fourteen parchment samples from different Norwegian manuscript fragments from the National Library in Norway (NB). The sampling process involves gently wiping the surface of the parchment with a PVC eraser and collecting the resulting crumbs into a sterile tube. Samples are then extracted in the lab using a saline solution and enzyme (Trypsin) to release the protein (collagen) from the eraser crumbs and cutting them into smaller fragments (peptides). These peptides are then analysed using MALDI-TOF mass spectrometry in a process known as peptide mass fingerprinting (PMF). By comparing the resulting masses with a known database, it is possible to identify the animal used to make the parchment.

8 Presentation of material selected for protein analysis

The collection of fragments in the NB consists of material that has arrived in there as covers on archival material and printed books (see Edwards 2013 for an introduc-

²⁶ The archbishop in Nidaros had a residence in Bergen, the largest city in Norway.

tion to the collection and a discussion of fragments in the NB with musical notation that are either written or used in medieval Norway).²⁷ A few of the fragments have been found locally somewhere in Norway and sent to the NB in the nineteenth and early twentieth century. In addition, there have been a few donations to the NB of material acquired abroad, but such fragments are left out of this investigation.

Very little has been known about Norwegian parchment in the past, and in a joint interest, Sarah Fiddymnt's research group generously offered us to analyse a few samples of parchment to work as a first pilot study on protein analyse on parchment, to be performed in Norway. Although the sampled material selected for protein analysis was limited, due to financial reasons, the selection process was careful. Based on earlier palaeographical assumptions, the material that were selected for analyses, were all likely to have been written in Norway in the Middle Ages. Some of the items are dated and located.

Samples are taken from one Latin psalter, one Old Norwegian law manuscript, and fragments from nine manuscripts dating from the second half of the twelfth century until the fourteenth century. The fragments that contain musical notation have been described and reproduced in colour by Edwards (2013). The material is organised according to chronology and the results from the protein analyses of each specific document type, with individual reference number, are also further presented in table 2²⁸:

a) **NB Ms.lat.fragm. 13.** Antiphoner (Gjerløw, Ant 20²⁹). Twelfth century, second half. Almost certainly copied in Norway with awkward and unprofessional handwriting and clumsy initials (Edwards 2013: 342 w. pl. 10; Gjerløw 1979: 33–35 with plate 8). There is no indication of provenance, but the other fragments of the antiphoner in the NRA are linked to the Augustinian house at Halsnøy in western Norway (Karlsen & Weidling 2017: 169 with n. 14). The original book was almost certainly used at Halsnøy before the Reformation.

²⁷ The largest collection of fragments in Norway is in the National Archives of Norway in Oslo (Karlsen 2013b: 20–21). See further Pettersen (2013b) on the history and provenance of the material.

²⁸ These documents are digitally available at: www.nb.no/en/the-national-library-of-norway/.

²⁹ In her typewritten catalogue and files, now kept in the NRA, the liturgist Lilli Gjerløw (1910–1998), made entries for each (usually fragmentary) manuscript she knew that was used in medieval Norway, e.g., Mi, Br, Gr, Ant, Ps, Lec-Mi etc. + a number. These designations have been used in publications and is further explained in Karlsen (2013b, 17–18). Not all manuscripts mentioned here have received such designations.

b) **NB Ms.8° 102.** The Kvikne psalter (Gjerløw, Ps 9). Late twelfth (or possibly early thirteenth century). Written by several mediocre scribes (Gullick 2013b: no. 66). The oldest preserved Norwegian codex in a medieval binding (Gullick 2013b: no. 66) and probably the oldest Norwegian book still preserved as a codex. There is a runic inscription from the mid-thirteenth century on the wooden front board indicating that it belonged to the church at Kvikne in Norway. As some leaves of the original book were lost already in the Middle Ages, they were replaced with new ones with the same content in the fifteenth century. Leaves from the original book as well as late medieval replacements have large holes, but as there is no lost text, they are not caused by damage (see Plate 1).³⁰ Protein samples are collected from the original leaves and from the fifteenth-century replacements. Samples are taken from fols. 10, 15, 20, 39, and 41.

c) **NB Ms.fol. 523** *Varia ad Landstad*. A bifolium of a psalter. Twelfth century, second half. Still *in situ* as a cover on a handwritten booklet from 1786–1787 from Telemark. The double leaf appears to come from a book used in the church at Tinn in Telemark. The writing is mediocre with awkward initials and is likely to be a local product.

d) **NB Ms.lat.fragm. 5.** Breviary (Gjerløw, Br 11). Late twelfth century or early thirteenth. Thin, smooth parchment. The use of capital R points to influence from vernacular handwriting (Gjerløw 1979, 66–67), a. A date in the late twelfth century or possibly early twelfth century (Edwards 2013, 341 with plate 7). As far as the content is concerned, its exemplar was a secular breviary, Norman or Anglo-Norman, influenced by the *cursus* of William of Volpiano. Donated to the University Library (now NB) by Ola Dønhaug (†1880), a school teacher in Sør-Aurdal, Valdres. It has a clear local provenance in an area north of Oslo. There are two other fragments of this manuscript in the National Archives (NRA) (Gjerløw 1979: 66–67).

e) **NB Ms.lat.fragm. 7.** Missal. Twelfth/Thirteenth century. There is an early modern inscription in the vernacular that confirms a local Scandinavian provenance. The fragment has a French type of script, but its rudimentary execution and the quality of the musical notation may point to a local origin (Edwards 2013: 341 with plate 6).

f) **NB Ms.lat.fragm. 8.** Missal. Twelfth/Thirteenth century. Norway? ‘A very good scribe, possibly working locally. Script on a French model’ (Edwards 2013: 341 with plate 7). The leaf is removed from a bookbinding in Folkemuséet (The Norwegian Open Air Museum) in Oslo.

³⁰ In this respect, the Old Norse Homily Book and the fourteenth-century Bergens Kalvs-kinn (Johannessen 2016, XI and below) resemble the Kvikne psalter.

g) **NB Ms.lat.fragm. 10.** Antiphoner (Gjerløw, Ant 42). Twelfth/thirteenth century. Norway? Notated folio leaf with unknown provenance. Poorly written and probably local (Edwards 2013: 342 with plate 8).

h) **NB Ms.lat.fragm. 11.** Antiphoner (Gjerløw, Ant 26). Late thirteenth century. Provenance: The church at Trondenes in Northern Norway, the largest rural stone church in Scandinavia, in the late Middle Ages occupied by a canon of the cathedral chapter in Nidaros. The folio format may be typical of a large and important church. Edwards (2013: 342 with plate 9).

i) **NB Ms.40 317.** Composite law manuscript in Old Norse, fols. 89–173.³¹ Fourteenth century. From the Oslo area belonging to the Eidsivating court. The principal part (fols. 118–167) contains the Eidsivating version of the national law of King Magnus the Law-mender (1263–1280). For fuller descriptions, see NgL IV: 730–734; Rindal 2020.

Samples are taken from the following parts:

Fol. 89v A law given by king Håkon V Magnusson concerning persons summoned to court. A broad cursive hand from the fourteenth century with East Norwegian orthography.

Fol. 91v A drawing of the crucifixion.

Fol. 94v A Latin calendar for October from the first half of the fourteenth century, written by the same hand who wrote fols. 100–167r.

Fol. 144v The Eidsivating version of the national law of King Magnus the Law-mender. A Gothic hand from the first half of the fourteenth century who wrote fols. 100–167r.

Fol. 156r. The same as fol. 144v. Fol. 173v. A professional and clear cursive hand from ca. 1350, related to one of the other scribes in the manuscript.

j) **NB Ms.lat.fragm. 3.** Missal. Fourteenth century. Two complete leaves (3a + 3b) without notation. Unknown provenance. Norway.

k) **NB Ms.fol. 1804a: 2.** Parchment letter with legal content, 16 June 1395 from Skeidsbo i Frøyland in Svidulands (Sauland). Published in DN X 89.

l) **NB Ms.fol. 1804a: 3** Deed on parchment concerning land in Østre Bygland in Fones (Fon) parish in Vestfold. 11 December 1411. Published in DN X 113.

³¹ A Swedish owner of the codex divided the book into two parts in the nineteenth century, donating the Swedish laws to the Royal Library in Stockholm and the Norwegian ones to the University Library (now the National Library) in Oslo, hence the incomplete foliation (NgL IV: 730); Rindal 2020).

Table 2. Analysed material in chronological order

Dokument reference no./ type	Area sampled	Thickness max/min (mm)	Species
NB Ms.lat.fragm.13	Left margin above the blue initial C	0.31-0.23	Calf
NB Ms.8° 102	Folio 89v in the margin under lacuna	0.60-0.30	Calf
NB Ms.8° 102	Folio 91v outer margin between initials Q and C	0.40-0.60	Calf
NB Ms.8° 102	Folio 94v outer margin under the initial M	0.34-0.53	Calf
NB Ms.8° 102	Folio 144v bottom margin right	0.47-0.35	Calf
NB Ms.8° 102	Folio 156 left margin under the initial Q	0.32-0.25	Calf
NB Ms. Fol. 523	Blank area in upper part of text inside back board	0.37-0.31	Calf
NB Ms.lat.fragm. 5	Left margin under the initial E	0.30-0.20	Sheep
NB Ms.lat.fragm. 7	Blank area right side upper part in the middle	0.20-0.13	Goat
NB Ms.lat.fragm. 8	Text-page right margin upper part below signature Fr.8	0.54-0.34	Calf ?
NB Ms.lat.fragm.10	Left margin above red initial O	0.28-0.21	Calf
NB Ms.lat.fragm.11	Head margin in the middle	0.26-0.22	Calf
NB Ms.4° 317	Fol. 89v, lower corner right	0.22-0.17	Calf
NB Ms.4° 317	Fol. 91v left margin just above the middle	0.32-0.24	Calf
NB Ms.4° 317	Fol. 94v in the middle	0.32-0.24	Calf
NB Ms.4° 317	Fol. 144v in the outer margin above the middle	0.15-0.12	Calf
NB Ms.4° 317	Fol. 156r upper margin to the right	0.28-0.23	Calf
NB Ms.4° 317	Fol. 173v outer margin above the middle	0.25-0.22	Calf
NB Ms.lat.fragm. 3	Fol. 2 of bifolium, lower right corner	0.25-0.22	Calf
NB Ms.lat.fragm. 3	Page 4 in bifolium, upper margin	0.36-0.21	Calf
NB Ms.fol.1804:a:2	In the margin under written text to the right of the right seal strap	0.29-0.25	Calf
NB Ms.fol.1804:a:3	Left margin text page	0.30-0.19	Calf
NB Ms.fol.1804:a:4	Blank area above sealstrap	0.37-0.33	Calf

m) **NB Ms.fol. 1804:a: 4** Deed on parchment concerning land in Skottthveit (Skottthveit) in Morgedal in Brunkeberg parish. 1490. Published in DN X 273.

9 Discussion

During the latest years the biomolecular methods for analysing ancient proteins (eZooMS) and DNA (aDNA) have become refined. This has allowed us to take the traditionally codicology to a new level, namely to the field of bio-codicology (Fiddymment *et al.* 2019). This new field can provide us with the tools to achieve yet another level of understanding the concept of books and book history, often referred to as 'book archaeology'.

With today's technology, using biomolecular methods on parchment has revealed new knowledge on parchment worldwide (Stinson 2009 and 2010; Fiddymment *et al.* 2015 and 2019; Teasdale *et al.* 2015; Anava *et al.* 2020; Vnouček *et al.* 2020, 35–70). Analyses of European material have found that parchment usually was produced from domesticated animals, particularly cattle, sheep and goats (Campana *et al.* 2010; for review see Bower *et al.* 2010).

This study is the first to investigate Norwegian parchment by using protein analysis (eZooMs) on parchment. Here our biomolecular analyses are presented with contextual evidence, in order to extend our knowledge on the early book history in Norway in particular, but also to establish a base for future research.

Still little is known about what animals prevailed in parchment production in Norway and the rest of Scandinavia, geographically and historically. The local husbandry must have played a major role in the local parchment production, like in many other countries.

Despite the many challenges of the Norwegian mountainous landscapes, the production of animals was extensive, of calves, sheep and goats. The historian Halvard Bjørkvik estimates that shortly before the Black Death in 1349 there were c. 75 000 farms in Norway within its medieval borders (Bjørkvik 1996: 24, 36–37). An average farm in central areas of Eastern Norway (Østlandet) could have nine to ten milch cows, four to five young cattle and twelve to fourteen sheep and goats.

In Western Norway (Vestlandet), on the other hand, there was a higher number of animals, for instance in the landscape Sogn, where there were many rich pastures in the mountains. In the early 1500s, the number of farms in Norway were reduced to c. 30 000, but there were more animals on each farm. There were many animals that could be slaughtered each year. Each milch cow was expected to give birth to a calf a year. Bjørkvik estimates that one or two of the milch cows had to be replaced each year. It was also necessary to replace young cattle that died, and some calves had to grow up. Probably each farm could slaughter c. five calves a year. This gives us an estimate on 150 000 calfskins, were produced each year. The number of sheep and goats slaughtered on a yearly basis is unknown, but it gives us an indication of a rich supply.

It is frequently held that parchment usually was made from calf in Scandinavia, as mentioned above ('Earlier research'). Books and documents made of parchment were frequently referred to as made from skin. One Norwegian land registry, called *Bergens kalvskinn* (literally: 'Bergen's calfskin'), is a fragmentary codex named after the skin the parchment was supposedly made from. The text dates from 1306–1351. The name of the codex is found in the sixteenth and seventeenth centuries (Johan-

nessen 2016: XI–XII), and it is uncertain whether it is based on medieval tradition. The present authors suppose that the parchment of one codex could be made from skins of different animals, cattle, sheep etc. dependent on availability.

The evidence of the account books shows that the predominant raw material for parchment production was calfskin, and interestingly, the same pattern emerges in our biomolecular investigations, although the restricted samples investigated so far restricts us from drawing firm conclusions until more samples are analysed. To judge from the account books from the royal castle and the archbishop's administration there were plenty of skins from calf, sheep and goat available, and one could choose freely from them. The preference for calfskin for parchment production indicates that calfskin was of the highest quality and that it probably was more suitable as writing material than sheep and goat.

Of the fourteen parchment samples analysed here, twelve were identified as calf (table 2). One sample (NB Ms.lat.fragm. 5) was identified as sheep parchment and another fragment (NB Ms.lat.fragm. 7) was identified as goat. These last two results are interesting given the prevalence of calf parchment in Scandinavian manuscripts. It is possible that the parchment was produced locally as both animals were usual in Norway. However, it also offers the possibility that these parchment folios may have been imported from another country which has a stronger tradition of producing parchments from these animals (in the case of goat; Italy, for example). Palaeographically both fragments seem to have been written in Norway, therefore the only way to determine whether the fragments are domestic or imported would be to carry out genetic analysis which may help to provide evidence for their provenance. However, this is beyond the scope of the present study but may be carried out in the future.

Although the sample size for this study is small, this study provides a first attempt in Norway to be using biomolecular tools on parchments. Further down the road, samples from other institutes like for example from the National Archives (NRA) will also be included in our study enabling a further mapping of the Norwegian parchment production and livestock production, to see whether it is different compared to other parts of Scandinavia or Europe, during the same period.

The National Archives has the largest collection of book fragments in Norway and are therefore of great importance for future studies of parchment. A central issue is how to differ the Norwegian and Icelandic manuscripts in Old Norse and whether Latin manuscripts are produced in Norway or Denmark (cf. Ommundsen 2017: 213–214 for examples of fragmentary manuscripts divided between Norwegian and Danish collections), as well as to be able to disentangle Norwegian parchment from imported. Here the molecular methods would provide a key to unlock their secrets.

The investigation on documents where time and date are registered is of great importance, not only to be able to establish where and when parcels were made within Norway, and what they were made from, but also to use these documents in order to develop a reference base to which other investigations can be compared to. A genetic analysis could help us to track down these patterns by revealing the relationship between the life-stock and parchment from different areas. The NRA has many Norwegian charters, deeds and legal documents with such indication of date and place, well suited for studies of variations in time and space. In this connection it will also be of high interest to see the quality of the parchment, and which animal skin it was made from, in connection with the social position of the person issuing the charter.

While a protein analysis can give us information on species identity, it may also if requested give us information of what part of the animal that has been analysed. This is because different proteins are dominant in different organs. Ancient DNA, on the other hand, will enable us to look closer into the relationship of the cattle produced within different parts of Norway and also to Scandinavia or parts of Europe.

By analysing more samples from Norwegian and Scandinavian produced parchment in the future, it will allow us to get further glimpses into the cattle trade and production, by estimating relations between animal populations. Even animal sex can be revealed by analysing DNA. (For more information about using biomolecular methods on parchment see Fiddymment *et al.* 2019 and Teasdale *et al.* 2015.)

When analysing samples with biomolecular tools, there can be contamination in the samples making the result unclear. In some cases, the contamination can either be traced back to the production phase of the parchment, where different skin types may have contaminated each other, or it may also be later, during an eventual conservation process of parchment, where glue made from different species might have been applied to parchments (Teasdale *et al.* 2015).

Despite a risk of contamination in some cases, biomolecular analyses are the most accurate method so far in estimating the origin of parchment. However, there are alternative ways, in getting a close estimate of the species used for parchment production. By visually inspecting parchment and look at the hair follicle pattern (HFP), an experienced scholar on parchment, might be able to subjective estimate what species of animal the parchment likely could have been produced from. Lately a new method has been developed to determine animal origin species in parchments by using spectrophotometry combined with PCA data processing (Alvarez *et al.* 2019), which provides a cheaper alternative to biomolecular analyses.

Bio-molecular tools have allowed us to go beyond the contextual and palaeographical world of codices and other parchment documents, which makes libraries or

Archives that hold them, in one perspective, equal to the collections within Natural History Museums. They both contain the narrative of animals that were once alive, and give us insight in cattle economy, parchment trade as well as human cultural history. The field of bio-codicology is relevant for a wide range of scholars, like for example from the field of natural sciences, archaeology, musicology, history, art history, liturgy, philology, palaeography, diplomatics, and studies in medieval Latin and Old Norse among others.

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Dr. **Sarah Fiddymnt** (Department of Archaeology, University of Cambridge/Beasts 2 Craft) has analysed the protein samples in her laboratory, written section 7 and contributed to the discussion of the analysed samples in section 9.

Senior Book and Paper Conservator NKF-N **Nina Hesselberg-Wang** (National Library of Norway, Oslo) has taken the protein samples in the National Library, written section 2 and contributed to section 9.

Dr. **Espen Karlsen** (National Library of Norway, Oslo) has written sections 1, 3, and 4 and contributed to section 9. He has collected the medieval sources on parchment and commented upon them in section 5, and presented the material selected for analysis in section 8.

Dr. **Sara Östlund Nilsson** has written the abstract, edited table 2, and written about the use of biomolecular methods on parchment in the discussion in section 9.

Senior Book and Paper Conservator **Chiara Palandri** (National Library of Norway, Oslo/ Accademia di Belle Arti di Brera, Milano) has taken the protein samples in the National Library and contributed to sections 6 and 8.

Dr. **Tor Weidling** (National Archives of Norway, Oslo) has written the text on sixteenth-century account books and discussed the medieval currencies in section 4. He has also commented upon the protein samples in light of the medieval historical context in section 9.

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