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On animal hides and (pre-)tanning in the Persepolis Fortification archive

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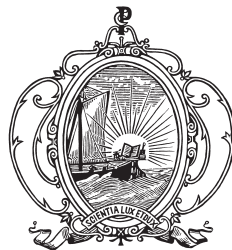


Achemenet. Vingt ans après.

**Études offertes à Pierre Briant
à l'occasion des vingt ans du
Programme Achemenet**

sous la direction de

**Damien Agut-Labordère, Rémy Boucharlat,
Francis Joannès, Amélie Kuhrt et
Matthew W. Stolper**



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On animal hides and (pre-)tanning in the Persepolis Fortification archive¹

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Introduction

Considering the vast number of uses to which leather has been put throughout human history – from clothing, belts, gloves, footwear, and headgear to armor, shields, horse and mule tack, bags, trunks, tents, straps of all sorts and so much more – it is perhaps surprising that, in describing the small corpus of twenty Persepolis Fortification texts (PF 0058-0077) that he published which ‘record the delivery of the hides of sheep, goats, cattle, and camels, usually to treasuries at various sites,’ Richard T. Hallock declared, ‘It seems likely that the hides were to serve as writing material since in other texts we find reference to a “tablet on hide” (PF 1986:31) and “Babylonian scribes (writing) on hides” (e.g. PF 1810:6 f.), where “hide” presumably means parchment’ (Hallock 1969, p. 14). Inferred from the frequent references to ‘Babylonian’ (Aramaic) scribes ‘(writing) on hide’ in the archive, yet essentially uncorroborated, this confident assertion has been followed by a number of scholars (see, e.g., Henkelman 2005, p. 139; Garrison 2017, p. 338). Others referred more broadly to manufacture of leather products (so, e.g., Hinz 1971, p. 268), but did not elaborate on this important idea.

At the start, it should be pointed out that the Fortification texts referring to animal hides, which are spread across years 17-24 of Darius I’s reign (503-498 BC), scarcely reflect active traffic in hides. Of the small corpus of texts (Table 1) referring – in some cases implicitly – to hide deliveries, 51 are dated while four are undated or have an illegible date. Only one hide delivery was registered in year 17; eight or nine in year 18; thirteen in year 19; fifteen in year 20; eight or nine in year 21; one in year 22; one in year 23; and two in year 24. Similarly the absolute number of hides involved – 1,346 sheep, goat, cattle and camel hides (294+ in year 18; 412 in year 19; 568 in year 20; 115 in year 21; 3 in year 22; 3 in year 23; and 24 in year 24) – is modest, to say the least. Only a handful of references in PF 0323, PF 0404, PF 0408, PF 0412, NN 0738, and NN 1680 (see below), provide possible evidence of the delivery of a tanning agent – flour for the making of ‘lime’ – whereas gall nuts, alum, pomegranate rind, etc. are not mentioned, nor are installations and personnel or the ship-

¹ The authors would like to thank Christopher Tuplin (Liverpool) for reading and commenting upon an earlier draft of this study. Henkelman provided editions of and commentaries on PF 0412 and NN 1680, Potts the historical parallels; this paper and the main viewpoints therein should nevertheless be seen as their joint work.

ment of tanned leather or items made thereof. All in all, neither the number of animal hide deliveries nor the number of hides mentioned reflects a supply chain for hides, prior to their tanning, on a scale sufficient to supply the immense demand for leather in the Achaemenid heartland, or even the amount required for scribal purposes alone.

Compare the situation at Persepolis with what Patricia Crone wrote about the Roman army's consumption of leather: 'the Roman army swallowed up colossal amounts of leather. The army needed leather for tents, scabbards, shields, shield covers, baggage covers, kit bags, purses, horse armour, saddles, reins and other horse-gear, sandals, boots, belts, wine skins, water skins, as well as diverse slings, strings, laces and straps for use in arms and clothing. On top of that, hides were used in military fortifications. It has been estimated that a single legion of the classical type (about 5,000 men) required the hides of 65,700 goats, or a similar number of calves, simply for the tents it used on campaigns. The number of cattle required to supply all the troops with all the equipment of leather they needed must have been staggering' (Crone 2007, p. 65-66).

Given the above, the Elamite texts on deliveries of animal hides are likely to reflect particular circumstances that made a smaller segment of the leather production visible within the branch of administration reflected in the Fortification archive.² More generally speaking, the limited evidence of a tanning industry in the Persepolis texts should not come as a great surprise. Even the Ur III texts from Umma, which contain considerable evidence of tanning, have produced no hint of a tanning archive or a central tannery (Sigrist 1981, p. 146).

Despite its laconic nature the modest corpus of Persepolis sources mentioning hides raises, however, a number of points that are worthy of further consideration.

Some features of the corpus on animal hides

The contents of the documents concerned with hides are summarized in Appendix 2. Most texts essentially follow a simple format: a specified number of animals supplied by PN₁ were slaughtered and their hides were received by PN₂ or, more commonly, PN₂ and PN₃, who delivered the hides to the treasury at GN. Although the small size of the corpus means that no statistical significance can be ascribed to the patterns observable in these texts, several observations can be made.

With respect to frequency, sheep and goat predominate in the deliveries, the largest single number being 426 hides (NN 0880). Most texts do not distinguish between sheep and goats. The total numbers of goats (173) and sheep (203) that are explicitly listed show a higher percentage of sheep, but not as high as one would expect on the basis of livestock texts in the archive at large. For cattle, the largest number of hides attested is 102; for camels 21; and for donkeys 3.

Over forty different suppliers are named in texts on hide deliveries. The majority are not attested elsewhere or cannot be confidently connected with homonymic individuals appearing in other contexts. One complication is the circumstance that the seals impressed on the relevant tablets do not – or not always – appear to be those of the suppliers. Thus, as Garrison pointed out, PFS 0127, PFS 0128, and PFS 0129 repeatedly occur with deliveries of hides but none of the seals in this trio appears to refer to a supplier (Garrison 2017, p. 65). A certain Te(a)tukka may serve as an example to illustrate the problem: this person occurs three times as supplier of hides from cattle or large

² These circumstances may have include taxation, as the occasional reference to *baziš* in texts on animal hide deliveries could be taken to suggest (NN 0167, NN 0880, NN 1628, NN 2159). The meaning of *baziš* (**bāji-*) in the Fortification archive may, however, been wider than 'tax' in strict sense. For comments, see Tuplin 2008, esp. p. 326-327.

livestock; the relevant tablets are sealed with the three seals just mentioned. An individual with the same name acts as supplier in two inventories of donkeys, but these have impressions from different seals, including PFS 0094. This seal, in turn, is found in association with animal hides (PF 0072). In short, it is plausible that the same individual is at stake, but the evidence is indirect; it is more difficult to confirm in other cases. Nevertheless, there is a handful of individuals acting as animal hide supplier whose names occur elsewhere in relation to livestock management. The case of Te(a) tukka allows for the cautious inference that here, too, the same individuals may be at stake.³

The impression gained from the profiles of the animal hide suppliers agrees with that from glyptic evidence. Among the seals repeatedly associated with animal hides are a number that occur exclusively in this context (PFS 0031, PFS 0092, PFS 0127, PFS 0128, PFS 0364, PFS 2266), while a few others occur with animal hides as well as with animal inventories (PFS 0050*, PFS 0094, PFS 0129). As with the suppliers, these observations suggest 1) a relatively closed environment and 2) a certain connection with livestock management. This suggestion finds some support in the repeated mention of *nutannuyaš*, denoting both a locale and an institution that served as link between the institution and the semi-external sphere of contract herdsmen.⁴ Since livestock management as such is only partially visible in the Fortification archive it should not surprise that animal hide deliveries and other references to leather producing are limited and elusive.

The above should in any case not be taken to imply that leather manufacture was unimportant at Persepolis. That conclusion would be at odds with the circumstance that the Fortification archives indicate the presence of hundreds of thousands of sheep and goats, not to mention large herds of cattle and other animals whose hides surely were not wasted. Moreover, even the limited corpus relating to animal hides affords glimpses of a branch of the institutional economy over which certain high-ranking officials exercised oversight or in which they were involved. The occurrence of Irtuppiya in NN 1680 (Appendix 1) is one example. Another is PF 0077, a text in which a certain

³ Te(a)tukka occurs in PF 0075, NN 1638, NN 2241 (animal hides) and PF 0289, PF 0290 (donkey inventories; his name is written Attukka in PF 0290). Another likely identification is that of Makama, supplier of hides in NN 0167 and NN 0872, with the livestock supplier mentioned in livestock account PF 2012. That last tablet bears an impression of seal PFS 0129, which also occurs on NN 0872 (some other livestock texts also name Makama, but identity cannot be established in these cases). A person called Turpiš provides a third case: he is supplier of hides in PF 0072 and of live sheep in NN 2140; both have impressions of seals PFS 0050* and PFS 0094 (PF 0072 additionally has PFS 0380). Possibly the same Turpiš occurs in a livestock account (PF 2012; the name also occurs in cattle account NN 2340). In other cases identity between an animal hide supplier and people involved in livestock management is not supported by glyptic evidence but nonetheless possible. These cases include Bagizza (hides: NN 0887; logistics official in livestock account: NN 1483; see also NN 1727); Bakuratsa (hides: PF 0064; livestock supplier: PF 1934; occurrence in livestock account: PF 2011); Battišdana (hides: Fort. 1810-101; feeding livestock and cattle: PF 1946:57-58, 59-60, 61-62), Maumesa (hides: PF 0065; occurrence in a livestock account: NN 2292), Mišumanya (hides: NN 2159; occurrence in livestock inventory: PF 2025); Takmasbada (camel hides: PF 0077; supplier in camel inventory: NN 0757; logistics official in camel inventory: PF 0331; feeding horses and camels: PF 1960:12-14, PF 1957:07-08, 09, NN 0728:04-07, NN 2184:20-23); Umaka (hides: NN 0880, NN 1628; supplier of sheep/goats: PF 0662, NN 0102); Ziššukka (hides: PF 0067; occurrence in livestock inventory: NN 1865). For the cases of Marduka in PF 0412 and Irtuppiya in NN 1680 see Appendix 1 below.

⁴ On *nutannuyaš* see Kawase 1980 and Henkelman, Jones and Stolper 2006, esp. p. 11 (with further references). The word occurs in the following texts on deliveries of animal hides: PF 0058, PF 0073, PF 0074, NN 0886, NN 1050, NN 2241, NN 2514.

Šandupirzana received 21 camel hides. This Šandupirzana (also Tandupirzana) sealed the tablet with his own seal (PFS 0165*) according to the single-seal protocol, generally indicative of overarching authority. The same person, sometimes sealing with the same seal, appears as a logistics official responsible for workers and a range of specialist craftsmen in an administrative district. Most significantly, he is involved in a delivery of 426 hides, and he co-organizes the allocation of 1800 l. flour for treating yet other hides. Šandupirzana may therefore have been a district supervisor of craft production, whose responsibilities included tanning and manufacture of leather products.⁵

Apart from Šandupirzana, at least 25 individuals are mentioned as recipients and deliverers of animal hides, mostly in pairs (PN₁, PN₂; 35x), groups of three (PN₁, PN₂, PN₃; 10x), or in the formula “PN₁ with his companion(s)”. Single named recipients (without reference to anonymous colleagues) are rare (3 or 4x). Several teams occur repeatedly, notably Irtima and Šakada, who appear, sometimes with a named or unnamed third colleague, in no fewer than eighteen texts. Another frequent combination is that of Bakadušda and Ziššama, again sometimes with a third named or unnamed colleague (10x). This last setting is also conspicuous for the consistent use of three seals, PFS 0127, PFS 0128, and PFS 0129. These may be recipient seals, as Garrison surmised (2017, p. 65), or perhaps more precisely offices involved in the receipt (and further processing, one assumes) of the hides.

Details of the locations where hides were delivered vary, though this may at least in part be due to varying scribal habit. One wonders, for example, if the delivery of one donkey hide to Hanamasan (NN 0737, received by Irtima “and his colleague(s)”) really went through a different procedure than the 22 hides from sheep/goats also delivered at Hanamasan, but this time “at the treasury” (NN 0653; received by Šakada and Irtima). Since the scribes regularly confined themselves to stating that hides were delivered “at the treasury” (without toponym; 19x) and sometimes even without any indication of location (5x), it appears that this information was not essential or, put more precisely, could be gleaned from the names of the recipients and the seals impressed on the tablet.

More relevant is the spatial distribution of the deliveries. Hides were delivered at Batrakataš/Pasargadae (2x), Dašer (1x), Halpin (reading uncertain; 1x), Hanamasan (2x), Harrinziš (1x), Hiran (2x), Matezziš (5x), Rak(k)an (9x), Šašukana (reading uncertain; 1x), Tirazziš/Šīrāz (5x), and Uškannaš (2x). This distribution spans the entire territory under the purview of the Persepolis administration.

That a ‘treasury’ would engage in tanning is in itself unsurprising: it has long been recognized that, whereas Elamite *kapnuški* can mean “treasury” (storage of valuable goods), it frequently denotes workshops – sometimes extensive – where textiles were produced, where fine stone-work, carved wood and metal objects were crafted, and where scribal and other (local) administrative activities took place. Similar craft centers existed in Achaemenid Arachosia and in other parts of the empire (see, e.g., Hinz 1971, p. 265-269; Henkelman 2017b, 97-109). Not every one of the many *kapnuškis* in the institutional landscape of Achaemenid Pārsa would have engaged in leather production or processing, but the activity as such would be entirely in line with their general profile. Although the archive, as preserved, yields only a glimpse of what must have been a far larger industry, it is probably fair to say that the places mentioned above were, as Pierre Briant recognized forty years ago, centers of leather production (Briant 1979, p. 145).

⁵ Flour for hides: PF 0323 (cf. below); delivery of 426 hides: NN 0880; district logistics official: see, e.g., PF 1111, PF 1169, PF 1409, PF 1957:02-04, 05-06, PF 2044. On Šandupirzana see also Henkelman 2017a, p. 295.

The nature of the hides and their uses

Goat, sheep, cattle, donkey and camel hides are registered in Fortification texts, from both male and female, adult and sub-adult animals. As the ultimate use of these hides is never mentioned, and as so many uses can be imagined, it is useless to speculate too much on the differential functions of the hides of different animal species. Nevertheless a few points may be worth considering since, historically, the hides of different animals had different functions, for, to put it another way, “not all hides were created equally”.

As the American chemist John Arthur Wilson (1890-1942) noted, “In the manufacture of leather for definite purposes, the choice of the kind of skin is of the greatest importance. By varying the nature of the tanning process, the properties of the leather can be varied, but not sufficiently to make one kind of skin suit all purposes” (Wilson 1923, p. 242). Just as calf skin was traditionally used in Europe for vellum; kidskin for virgin parchment (“parchemin vierge”); pigskin for bookbinding; or ass-hides for tympani (Lalande 1762, p. 5), it is highly likely, with respect to the speculation of Hallock and others that the hides in the Persepolis texts were destined to serve as writing material, that hide species must have been an important consideration. Herodotus famously observed that the Ionians “for lack of papyrus used the skins of sheep and goats; and even to this day there are many foreigners who write on such skins” (*Hist.* 5.58.3; cf. Jördens, Kiyanrad and Quack 2015, p. 327). Unfortunately, neither the Aršama letters at Oxford nor the Bactrian letters in the Khalili Collections have been analyzed (pers. comm. D. Howell, Oxford; M. Folmer, Leiden) and hence it is not known what type of leather was used for these texts. Similarly, the Avroman texts have never been analyzed, although Ellis Minns noted that they were written on leather that was “not very well prepared; the writing has had to avoid certain rough places in the skin and the hair has not been perfectly removed” (Minns 1915, p. 24).

Recent studies of vellum have revealed some patterns that may help us to put Herodotus’ statement in context. For example, it transpires that, for making the sort of ultrafine parchment used in 13th century pocket Bibles, “Sheepskin is most abundant in England, calfskin in France, and goatskin in Italy” (Fiddymont et al. 2015, p. 15068). In some cases, however, calf folios were combined with those of sheep or goat (one or the other, never with both). In England, moreover, sheepskin was preferred over that of any other species for legal texts. This was not just because mediaeval English farmers raised prodigious numbers of sheep (Hoskins 1963). In Richard FitzNigel’s *Dialogus de Scaccario* or *The Course of the Exchequer*, completed in 1179 (Johnson 1983, p. xx), the Master tells the Scholar, “The duty of the Scribe who sits next the Treasurer is to prepare the Rolls (which for a certain reason are of sheepskin) for writing. The length of the Rolls [i.e. *the ‘pipes’ or sheets of which the Roll is made up*] is that of two membranes, larger than the average and carefully chosen for the purpose....But if from carelessness, or from some other accident, he makes a clerical error, in a name, a number or an account, in which details the main value of the Roll consists, he must not venture to make an erasure, but must cancel by drawing a fine line underneath and write the correct version on the line after the cancellation. For the writing of the Roll has this in common with charters and other engrossed documents, that it ought not to contain any erasure. And that is why it has been provided that the ‘pipes’ should be made of sheepskin, on which it is difficult to make an erasure without its showing plainly” (Johnson 1983, 29, 31).

On the other hand, “the great contrast which it [sheepskin] presents to the leather made from steer hide or calf skin” was noted by Wilson. This contrast was explained by the fact that, “The holes and empty spaces left by the wool and glands give the leather a sponginess that makes it unsuitable

for many purposes,” although, “The upper layer is often split from the rest of the skin and used in bookbinding, for hat bands and for the linings of expensive shoes instead of cloth. Sheep skin leather is sometimes used as a substitute for kid leather in the manufacture of gloves, where its softness is an asset” (Wilson 1923, 242).

Regarding the leather of a male cow it has been said that, “The natural solidity of this hide is so great that a heavy degree of tannage would not have been necessary in order to produce a leather suitable for shoe soles” (Wilson 1923, 242). With respect to true vellum, i.e. calfskin, Lalande noted, “On emploie pour le vélin des veaux de tout âge, depuis huit jours jusqu’à six semaines; ceux qui vont au-delà, sont trop forts pour le vélin; on préfère de les employer aux usages de la tannerie” (Lalande 1762, 14; cf. Fiddymment 2015, p. 15069).

The unique reference to camel hides (PF 0077), already highlighted above, deserves further comment with regard to the quality and utility of this material.⁶ In 1889 Watt noted that camel hide was ‘employed for many minor purposes, such as the fastenings used by camel drivers. With the hair on, it is also manufactured both in Europe and in India into trunks. The chief use to which it is put in India, however, is the manufacture of kuppas, or the huge skin jars employed...for carrying oil or *ghī*’ (Watt 1889, 63). Later, it was noted that, “Tanners are scouring the markets of the world for raw material. Some camel hides were tried a while ago, to see if they could be used when supplies of other pelts fell too short. The camel leather was miserable stuff” (Anonymous 1915, p. 60). Several years later camel hides imported from Siberia were tanned in the United States. Of these it was said that, “They made good leather but were rather ‘baggy’” (Anonymous 1920, p. 42). Arnold Spencer Leese (1878-1956), a noted veterinarian and camel specialist, had this to say on the subject: “*Camel Leather* – The hide does not make good leather; it is used for saddlery, and, in India, for making “Kupas” or large receptacles for holding ‘Ghee’” (Leese 1927, p. 141). Wilson, however, noted that, camel hide “is remarkable for its compact structure, which would make it suitable for belting leather or for light soles” (Wilson 1923, 243). More recently it has been observed that, ‘Camel hides, if properly tanned and converted into leather or furs, have advantage on account of having good “substance”. The translucent structure of camel hides makes them useful for making items of tourist interest such as lamp shades, toys, drums, leather containers and items of art objects’ (Khanna and Rai 1991, 6).

Indeed, camel hide has been used with considerable efficacy throughout history. Pliny noted that *lycion*, a medicine produced by boiling the root of a particular thorn-bush (buckthorn; *Rhamnus* sp., *Lycium* sp.; see De Vos 2010, 37), was “imported from India in leather bottles made of camel skin or rhinoceros hide” (*Nat. Hist.* 12.15). In the mid-17th century the Ottoman traveller Evliya Çelebi observed “shields composed of ten camel-hides” (Hammer-Purgstall 1834/1, p. 140). But more commonly, as Wilson intuited, camel hide was favored for the manufacture of shoes. Thus, according to Jean Chardin, “Les pauvres gens font les *semelles* de leurs *souliers* de *cuir de chameau*, parce qu’il dure beaucoup plus qu’aucun autre; mais c’est un cuir mol, qui ramasse l’humidité comme une éponge” (Chardin 1711/4, 151). Similarly, in the late 18th century Guillaume-Antoine Olivier noted, “Les *souliers* des gens de la campagne ont un talon plat et ferré...la *semelle* est d’un cuir de chameau; le dessus est un tricot de coton très-gros et très-serré, qui joint la souplesse à la solidité”

⁶ PF 0077 concerns a delivery of hides from twelve adult camels, seven yearling camels and two camel calves. Lines 8-9 specify that KUŠ.GUD^{MES} *hu-be lip-ma 2 āš-šá-na*, “included among those hides from large livestock are two from horses.” If *āšša-na* is correctly interpreted as “of horses” (OP *asa-*; see Hinz and Koch 1987 s.v. *āš-šá-na*), it probably means that among the hides from the twelve adult camels two were actually from horses.

(Olivier 1807/3, 148). Finally, in the mid-19th century, George Fleming (1833-1901) observed that, in the Sudan, “On the death of a camel – an event of frequent occurrence – a piece of the thickest part of the hide is removed; and when this begins to dry, it is subjected to long-continued and almost incessant manipulation, to make it soft and pliable, so as to fit closely to the hoof when required. The Arabs are often observed on the march pulling, rubbing, twisting, and stretching the lately-stripped camel-skin, solely with the intention of using it as a sock for the horses or camels when they become foot-sore” (Fleming 1869, p. 60). Amongst the Achal-Teke Türkmén, König noted, “Die Männer beschäftigen sich mit der Leder- und Fellaufbereitung sowie der Fertigung von Schuhwerk (tscharyk, tschokoj) aus Kamelleder” (König 1962, 55). Thus, it appears that the use of camel leather for shoes and other types of foot protection is well-established. Interestingly, footwear is some of the only leather that has survived from the Achaemenid period. One case is that of Elephantine in Upper Egypt (Kuckertz 2006; Veldmeijer 2016), where the types of leather from which footwear was made have not been determined; the other case is that of the mummified salt-miners of Chehrābād, one of whom wore leather boots, apparently made from sheep leather (Aali and Stöllner 2015, p. 77-83).

One further consideration specific to camel hides should also be kept in mind, even if it is hardly mentioned in the sources. Historically, camel hair has always been highly prized. In 1602 István zalánkeményi Kakas (Étienne Kakasch de Zalonkemeny) noted that, in Persia, “Leurs prêtres ne portent pas de turbans blancs, mais des turbans bruns et des habits faits d’une étoffe en poil de chameau” (Schefer 1877, p. 155-56). Moreover, as Chardin stressed, camels shed their hair naturally and completely: “Le poil tombe tout à cet animal au printemps, & si entierement, qu’il paroît tel qu’un cochon échaudé... Le poil de *chameau* est la meilleure toison de tous les Animaux domestiques, on en fait des étoffes fort fines” (Chardin 1711/4, p. 79). It seems perfectly plausible that camel hair may have been processed for the fine garments or rugs for the Achaemenid élite. Indeed, a late reference (*Excerpta Constantiniana* II.474), perhaps going back to Ctesias, speaks of Indian camel wool, woven into carpets and brought by Bactrian merchants to Persia; such carpets were highly coveted and given as gifts by the Indian to the Persian king (see Henkelman and Folmer 2016, p. 195).

PF 0412: hides for leather containers?

In his 1969 edition, Richard T. Hallock gave the following translation for PF 0412, a Fortification text that had baffled him (1969, p. 20) on account of the joint appearance of flour and animal hides:

⁰¹⁻⁰⁷ 30 (BAR of) flour, supplied by Marduka, Mintezza received, and it was utilized for(?) cowhides and (sheep?) hides (and?) bread(?). ⁰⁷⁻¹⁰ Sixth month, 24th year.

In this interpretation, *ku-ri-um-ma* is taken as a transcription of Old Iranian **xvarī-*, (actually “hot food, prepared food” rather than Hallock’s “bread”) with a suffix *-ma* expressing purpose. As explained in further detail in Appendix 1, Hallock’s translation cannot stand as it is. Retaining the analysis of *ku-ri-um-ma* as *kurim* + suffix *-ma*, lines 4-7 should be interpreted as “therewith (i.e. with the flour) bovine and (caprid) hides for use with (hot) food were prepared.” The text would therefore point to the use of flour as a pre-tanning agent used to prepare hides as receptacles (table cloth, bag, etc.) for prepared food. (cf. Kawase 1986, p. 266 and below).

An alternative solution takes *ku-ri-um-ma* as a plain form (without suffix) reflecting Old Iranian **grīva-*, “a container, a dry measure of c. 10 l.” (not necessary a “bushel,” as it is often translated); this word is also loaned in Aramaic as *grw* and *gryw*. In Achaemenid Elamite, where it occurs frequently,

it is typically transcribed with indication of the final *-a*.⁷ A pertinent example of the use of *kurrima* is NN 0508, where 3 *kur-ri-ma* (**grīva-*) flour is issued and received *ku-ri-um'-na* (**xvarī-* + suffix *-na*), “for prepared food.” The indication of the final *-a* in *kurrima* is what distinguishes this form from *kurim(-na)* in the same text.

If *ku-ri-um-ma* in PF 0412 indeed transcribes **grīva-*, it logically refers to the physical container, not the dry measure derived from it. Accordingly, the text would indicate that flour was issued to process different types of animal hides with the purpose of preparing for use as containers (i.e. leather bags). The translation would then run as follows:

⁰¹ 300 (l.) flour, ⁰¹⁻⁰³ allocation from Marduka, ⁰³⁻⁰⁴ Mintezza received and ⁰⁴⁻⁰⁷ therewith bovine and (caprid) hides (for) containers (?) were prepared. ⁰⁷⁻¹⁰ Sixth month, 24th year (Sept.-Oct. 498 BCE).

NN 1680: flour for pre-tanning?

NN 1680 is another Fortification text mentioning both flour and animal hides. Part of the text is restored on the basis of parallels:

⁰¹ 500 l. flour, ⁰¹⁻⁰² allocation from Irtuppiya, ⁰²⁻⁰³ Ammazadda (Yamakšedda) received and ⁰⁴⁻⁰⁶ therewith will prepare bovine and (caprid) hides (for/at) (the) *kurrakaraš*, ⁰⁶⁻⁰⁸ (at) Hunar, at the treasury/craft center, ⁰⁸⁻⁰⁹ [under responsibility of Iršena. ⁰⁹⁻¹² Xth month, 22nd? year].

The key to understanding this text is *kurrakaraš*, a term that appears to refer to a process or facility within the *kapnuški* (“treasury, craft center”) at the place Hunar. Since Hallock first proposed so, the word has been taken as a transcription of Old Iranian **xvarakara-*, lit. “bread making.” Given that the term is marked with the locative determinative AŠ in six out of seven cases, it is likely to denote a locale or concrete object and not, at least not in most cases, a process. Hallock’s contextual interpretation “bakery” reflects this argument.⁸ It may be questioned, however, if *kurrakaraš* refers to the production of bread at all. Hallock himself (Hallock 1969, p. 20; cf. Henkelman 1997, p. 343) voiced surprise that a bakery might be situated in a treasury or craft center (*kapnuški*).

At this point another text may be introduced into the discussion. NN 1277 is the only case in which *kurrakaraš* is not marked with the determinative AŠ. According to it, one Kamšena received 500 l. flour (the same quantity as in NN 1680), *ku-ir-ra-ka₄-ráš-na ap-pa* AŠ^{ap-ti} AŠ^{har-ku-be-na hu-ud-da-man}, “for *kurrakaraš* which (is) for making bow-and-arrow cases for the place Harkupi/ the Harku-people”.⁹

⁷ Attested spellings with final *-a* are ^(GİŠ)*kur-ri-ma*, *kur-ri-man* (with adaptation to Elamite morphology), ^(GİŠ)*ki-ri-ma*, ^(GİŠ)*ik-ri-ma*, ^(GİŠ)*ik-ri-maš* (with generalized *-š* ending for Iranian loans). The spellings ^(GİŠ)*kur-ri-mi-iš* and *kur-ri-mi* are rare and must be considered inaccurate.

⁸ See Hallock 1969, p. 20, 715, followed by Hinz and Koch 1987 s.v. *h.ku-ir-qa-ráš*. Hinz’s interpretation “Speisewerk” or “das Brotbacken” (Hinz 1973, p. 82; cf. *idem* 1975, p. 140 and Tavernier 2007, p. 457-458 [4.4.19-15]) is closer to the proposed etymology, but unattractive given the preponderance of forms marked with AŠ.

⁹ Hinz and Koch 1987 s.vv. *ap-ti*, *ku-ir-ra-qa-ráš* propose the inexplicable “... für die Bäckerei, daß er Köcher nach Art der Leute von Harku anfertige”.

The interpretation of *apti* in NN 1277 as “bow-and-arrow case” is unambiguous. The word appears in the Elamite version of DNd (“Ašbazana/Aspacanā, chamberlain, holds the bow-and-arrow case of King Darius”), a caption inscription accompanying a man carrying a bow-and-arrow case (the Akkadian version has KUŠ *šal-tu*, “bow-and-arrow case,” the Old Persian *isuvām* [*hapax*]). The interpretation is further supported by Neo-Elamite contexts, in which *apti* occurs in conjunction with bows (see, e.g., MDP 9 10) and may be qualified as *karsuka*, “colored, painted”.¹⁰

Assuming that bow-and-arrow cases were not made out of bread but could indeed be manufactured from leather, NN 1277 would fit the interpretation of *kurrakaraš* as the *process* of leather making (without AŠ: NN 1277) or as a *place* of leather production (with AŠ: other texts with *kurrakaraš*). As Toyoko Kawase argued more than thirty years ago, frequent deliveries of animal hides to *kapnuškis*, “treasuries, craft center(s)”, may well point to leather production at such facilities; the same is arguably true for deliveries of flour and sesame oil at the same places.¹¹

A third text, PF 0406, provides an additional argument. This text is nearly identical to NN 1680, except for the quantity of flour, the name of the recipient and the mention of animal hides:

“250 l. flour, allocation from Irtuppiya, Pirmayabada received; he will prepare/use it (at) (the) *kurrakaraš* (^{AŠ}*ku-ra-ka₄-rāš hu-ud-da-man-ra*), at Hunar, at the treasury/craft center, under responsibility of Iršena; second month, 22nd year.”

The fact that the mention of animal hides could be omitted in an otherwise parallel context may indicate that the occurrence of *kurrakaraš* itself was enough to explain the flour delivery.

Finally, PF 0403 may be compared, a text in which an Ammakšedda receives flour (which ^{AŠ}*ku-ra-ka₄-rāš-na hu-ut-taš-da*, “he used for/at (the) *kurrakaraš*”, again without mention of hides. This Ammakšedda is probably no other than the Ammazadda who appears in NN 1680 as recipient of flour for treating animal hides (for/at) (the) *kurrakaraš* (see also Appendix 1). PF 0403 therefore strengthens the impression that the word *kurrakaraš* by itself was enough to make the purpose of the flour deliveries clear.¹²

With the above, the etymology of *kurrakaraš* may be reconsidered. The first part of the compound may actually not transcribe **xvara-*, “bread” (cf. Y.Av. *x^rar-*, “to consume, eat”), but a

¹⁰ See, e.g., MDP 9 82; further discussion in Hinz and Koch 1987 s.v. *ap-ti*; Henkelman 2003, p. 117-119.

¹¹ See Kawase 1986, p. 264, 266-267. Oil deliveries at *kapnuškis* are mentioned in PF 0128 (Tirazziš, 10 l.), PF 0129 (Parrumaturriš, 10 l.), PF 0130 (no GN, 5 l.), PF 0131 (no GN, 2 l.), PF 2017 (Matezziš, 107.5 l.), NN 0369 (no GN, 10 l.), NN 1698 (Šursunkiri, 7 l.; similar, without *kapnuški*: PF 0126, PF 0127). PF 0128, PF 0129, PF 0130, PF 0131, and NN 0369 have impressions of seals PFS 0065 and PFS 0086, suggesting an office or offices associated with oil producing and/or tanning in an area comprising at least two different *kapnuškis*.

¹² It may be useful to list all occurrences of *kur(r)akaraš* here: PF 0403 (250 l. flour, Ammakšedda used for/at *k.*), NN 1680 (500 l. flour, Ammazadda = Ammakšedda used with animal hides for/at *k.*, at the *kapnuški* at Hunar), PF 0404 (200 l. flour, Baduzarma used for/at *k.*; see n.14 below), PF 0405 (200 l. flour, Irdapuka used for/at *k.*, at the *kapnuški* of Kaupirriš), NN 2059 (200 l. flour, Irdapuka used for/at *k.*, at the *kapnuški* of Kaupirriš), PF 0406 (250 l. flour, Pirmayabada used for/at *k.*, at the *kapnuški* at Hunar), NN 1277 (500 l. flour, Kamšena used for *k.* of bow-and-arrow cases for the place Harkupi/the Harku-people). Note also PF 0323, in which flour is received by Mišuradaša, KUŠ^{MEŠ} *si-ka₄*, perhaps “to be deposited/put (on) animal hides.” Involved in the delivery of the flour is Šandupirzana, elsewhere mentioned in connection with the delivery of camel and sheep/goat hides (cf. above).

homonymic *xvara-, “scratch, scraping”.¹³ Whereas Young Avestan x^vara- means “wound, sore,” there are cognates in both NW and NE Iranian languages that mean “to scratch.” More precisely, the Paḫtō verb xriyəl/xriy- means “to shave” (as do cognates in a few other East Iranian languages) and the related noun xwar is used for “skin, bark, peel, scurf” (references in Cheung 2007, p. 150 s.v. *h₂uar⁴). In line with this semantic range, the word *kurakaraš* (*xvarakara-) may be interpreted as referring to the *process* of preparing animal hides for tanning by scraping or shaving (or a similar technique) as well as (with the determinative AŠ) to the *place* where such activities took place. With a technical term the process could be referred to as liming, the place as a liming facility.¹⁴

Use of flour in traditional tanning

Although Hallock expressed surprise at the use of flour in connection with animal hides (Hallock 1969, p. 20), flour is well-attested as an agent used in the pre-tanning stage of leather production, i.e. for liming (depilation). Mesopotamian contexts ranging from the Ur III to the Neo-Babylonian period confirm the antiquity of this practice (Stol 1983, p. 530-531) and exactly these contexts are cited by Toyoko Kawase in support of her interpretation of Achaemenid *kapnuški* as a leather production facility (Kawase 1986, p. 266). As pointed out above, the many *kapnuški* facilities were craft centers or factories in broader sense, but some indeed appear to have included leather manufacture facilities. The deliveries of flour (and oil) in conjunction to animal hides to *kapnuškis* should be interpreted in this light.

The use of flour in some tanning processes is well attested in traditional leather manufacture in Europe and the Middle East. The French Enlightenment astronomer and polymath Jérôme de Lalande (1732-1807), of whom Louis Bertrand wrote that “his curiosity extended to *everything*” (Connor 1953, p. 333), published an exhaustive treatise on tanning in which we find a discussion *in extenso* of “Des cuirs à l’orge”. Lalande wrote, “La première des deux grandes opérations du Tanneur consistoit autrefois à faire enfler les Cuirs, c’est-à-dire, à dilater, à ouvrir leurs pores par l’humidité de l’eau de chaux, pour faciliter l’opération de la stoffe qui devoit suivre: on a trouvé depuis, qu’une fermentation ménagée avec art, & conduite avec précaution, pouvoit produire cet effet en moins de temps & d’une manière plus parfaite: cette méthode consiste à faire aigrir une pâte de farine d’orge, qu’on délaye ensuite, & dans laquelle on fait tremper les Cuirs: cette eau aigre établit dans les Cuirs une fermentation acide, qui dilate & gonfle les Cuirs sans les brûler & sans les affoiblir, comme doit faire la chaux” (Lalande 1764, p. 39-40). Further, he went on to describe at length the flour-

13 WFMH would like to thank Soheil Delshad for suggesting this possibility.

14 A small dossier supporting the above interpretation of *kur(r)akaraš* may be indicated here. In PF 0408, a certain Baduzirma receives flour for making *kurram* (*kurram ha huttašda*, “therewith he made *kurram*”). *kurram* may transcribe *xvara-, “bread” (so Tavernier 2007, p. 457 [4.4.19.14]), or even be an imprecise variant of *kurrim*, “food” (compare PF 0828, NN 0508, NN 1626 [flour for making *kurrim*]). Another solution, however, takes *kurram* as a transcription of *xvara-, “scraping, shaving,” or perhaps more specifically “scraping agent, lime.” This solution is attractive since Baduzirma (written Baduzarma) recurs in PF 0404 where he receives flour and (following the interpretation advocated in this section) “used it (at) the liming facility” (*kurakaraš ha huttašda*). The same individual (written Baduzarma) is mentioned in NN 0738 which states of him *hatin karsuka pupumanra*, “he will be *pupu*-ing coloured wine bags (?)” (cf. Hinz 1967, p. 71-72; Hallock 1969, p. 694; Hinz and Koch 1987 s.v. *pu-pu-man-ra*). The location is Umpuranuš, at the *kapnuški*, “treasury, craft centre.” Contextual information places the Baduzarma/-zirma in the other two texts at Umpuranuš as well, hence confirming that he is one and the same person.

based paste used: “On sait assez que la farine détrempée avec de l’eau, telle que la pâte ordinaire dont nous faisons le pain, est sujette à fermenter & à s’aigrir; que dans cet état la pâte s’enfle, s’élève, s’échauffe; tel est l’effet que l’on produit dans les Cuirs au moyen de l’orge détrempée avec de l’eau, ce qu’on appelle un *Passement*, ou *Bassement* d’orge....On met environ cent ou cent dix livres [the livre du roi = 489 g., thus just under .5 kg.] d’orge pour faire un *passement* de huit Cuirs, en supposant des Cuirs médiocres qui pesent vingt-cinq livres quand ils sont secs à l’oreille, ou cinquante livres à la raie: les uns mettent toute la farine à la fois, lorsqu’ils veulent mettre les Cuirs en *passement*; les autres font un levain la veille avec vingt-cinq livres de farine & une chaudière d’eau chaude, & n’ajoutent le surplus de la farine que douze heures après” (Lalande 1764, p. 40; on Lalande’s treatise on tanning in general cf. Halasz-Csiba 2002). While there is no mention in any of Lalande’s discussion above of the addition of other ingredients, one traditional recipe for tanning in the Islamic Near East noted that “skins were trodden in shallow tubes containing a mixture of alum, salt, egg-yolk, flour and oil” (al-Hassan 2001, p. 161).

Tanning with barley flour (“Travail à l’orge”) was also practiced in Iran during the 19th and early 20th century. As the French chemist Louis-Joseph Olmer described the process, “Les peaux, lavées quelques heures, sont mises dans l’eau, avec de la farine d’orge en fermentation acide. On les laisse un temps qui varie entre 20 jours en été et 50 jours en hiver, car la fermentation est plus active en été....Les peaux sortent de là jaunâtres et transparentes. Ce procédé, à ma connaissance, n’est plus employé en Europe” (Olmer 1908, 102). When Hans Wulff collected data on tanning in Iran (1937-1941), however, he found no evidence of the use of any process involving flour (Wulff 1966, 230-232).

With regard to the specific quantity of flour prescribed by Lalande, 100 or 110 livres (= 48.9-53.79 kgs.) of flour was suitable for the tanning of 8 hides, hence roughly 6.1-6.7 kgs. of flour were required per hide. Compare this with the 30 BAR, i.e. between 276 and 291 liter (1 BAR = 9.2-9.7 l.), delivered in PF 0412 for the preparation of animal hides. This amount equals about 148-156 kgs. in weight. The quantity of flour mentioned in PF 0412 was thus sufficient to treat about 25 hides according to Lalande’s specifications. Similarly, the quantities of flour issued according to NN 1680 (50 BAR) and, perhaps, PF 0323 (180 BAR), would be enough for treating *c.* 40 and *c.* 145 animal hides respectively. Unfortunately, unlike the texts on deliveries of animal hides, PF 0412 (and NN 1680, PF 0323) does not actually stipulate how many hides were treated, though it does make explicit that flour was used to process them (*ha huttukka*, “therewith ... were processed/prepared”). Whether or not the purpose was to make leather bags, as suggested above, it is clear from the text that flour was used as an agent to process the animal hides. The same is arguably true for NN 1680 and PF 0323 (cf. fn. 12 above).

Finally, it is perhaps worth considering the fact that, in assessing the leather that resulted from the tanning process involving flour, Lalande noted, “le Cuir à la jusée est peu usité en France quant à présent...Au reste, si l’on en appelle au raisonnement, on peut très-bien concevoir que ce Cuir préparé avec une matière astringente, doit être meilleur que le Cuir préparé avec des substances farineuses, onctueuses, & émoullientes, telles que l’orge & le seigle; ainsi je crois que, suivant la physique de cette opération, le Cuir à la jusée doit être le meilleur” (Lalande 1764, p. 75).

Conclusion

As noted at the beginning of this paper, the Persepolis Fortification archive provides only glimpses of the tanning industry in the Achaemenid heartland. Given the enormous amount of livestock and cattle referenced in the archive, leather production must have been a major component of the economy of Pārsa. Yet, if the region indeed had a vibrant tanning industry, like that of Hamadan in the 19th and early 20th century on which so many travellers commented (see, e.g., Mounsey 1872, p. 302; Polak 1876, p. 126; Bishop 1891, p. 151; Rabino 1901, p. 276; Jackson 1906, p. 149; Wishard 1908, p. 137-138; Floor 2003, p. 377-378 with further references), it clearly must have fallen outside the direct purview of the branch of administration reflected in the Fortification archive. As Mrs. Bishop noted in this regard, “Hamadan is famous for leather, and caravans loaded with hides for its tanneries are met with on every road” (Bishop 1891/2, p. 151). The tanning industry in Iran supported subsidiary rural industries as well, like the collection and transport of gallnuts, alum, sumac and pomegranate leaves and bark, all of which were used in tanning and dyeing, and the gathering and transport of which have also been mentioned by countless travellers over the years (see, e.g., O’Donovan 1883, p. 247; Kraemer 1903, p. 51; Herzfeld 1907, p. 74; Hay 1921, p. 106; Hooper 1931, p. 333; Levey 1962, p. 16, n. 91; Landsberger 1967, p. 170ff.; for an exhaustive survey see Floor 2003, p. 376-407).

In the case of Persepolis, not only leather, but also, e.g., the wool and textile industry are largely invisible. There is no serious doubt that such branches of the centralized economy were documented in Elamite or Aramaic archives, but these simply have not been preserved. Part of the explanation for this lies in the observation that livestock management in general is only partially visible in the Fortification archive and clearly belonged to a different administrative sphere. In addition, the largely separate administration of the armed forces, again only very partially visible in the archive, plays a role here: for surely these in particular would have demanded large quantities of leather products.

Hallock’s original hunch that the deliveries of animal hides were all destined to serve as writing material is understandable given the repeated references to scribes “(writing) on hide”, but is unattractive given the different types of hides involved. It is abundantly clear that, where writing on leather (parchment, vellum) was practiced extensively, great selectivity was exercised in the choice of animal hides used for different purposes. Some of the types of hides mentioned in the Persepolis texts, from, e.g., camels or adult cows, were never used as writing material in mediaeval Europe and almost certainly were destined to be tanned for other purposes.

The glimpses we get of hides in the Persepolis Fortification archive are tantalizing and, even if they only allow the suggestion of a tanning industry or tanning centers, they remind us that these must have existed for the Achaemenid empire was no less dependent upon leather and leather products than any other pre-modern state. The laconic references to modest quantities of hides in these documents underscore the fact that, even in a corpus consisting of thousands of texts, many of the activities of daily life go unmentioned. But that, of course, does not mean that those activities were any less important to the actors mentioned in those texts and their thousands of subjects.

Appendix 1: Text editions

PF 0412 was first published by Richard T. Hallock (Hallock 1969, p. 164-165), while NN 1680 is available in a manuscript edition by his hand. Both texts have been collated by WFMH and are presented here with a (new) translation and succinct commentary. Transliteration style follows the conventions of the Persepolis Fortification Archive Project.

PF 0412 (Fig. 1)

tongue-shaped memorandum

Seal: PFS 0001* (left edge, reverse)

Obverse

- (01) 30 ZÍD.DA^{MEŠ} *kur-*
- (02) *mán* ^{HAL}*mar-du-ka₄-*
- (03) *na* ^{HAL}*mi-in-te-*
- (04) *iz-za du-šá* KUŠ.
- (05) GUD^{MEŠ} *a-ak* KUŠ^{MEŠ}
- (06) *ku-ri-um-ma ha*
- (07) *hu-ut-tuk-ka₄* ^{AN}
- (08) ITI^{MEŠ} ^{AN}*ka₄-ir-*

Lower edge

- (09) *ba-ši-ia-na*
- (10) ^{AŠ}*be-ul 24-na*

(reverse uninscribed)

⁰¹ 300 (l.) flour, ⁰¹⁻⁰³ allocation from Marduka, ⁰³⁻⁰⁴ Mintezza received and ⁰⁴⁻⁰⁷ there-with bovine and (caprid) hides (for) containers (?) were prepared. ⁰⁷⁻¹⁰ Sixth month, 24th year (Sept.-Oct. 498 BCE).

02-03 Marduka: presumably a Babylonian name, borne by a number of individuals in the Fortification archive. The occurrence of seal PFS 0001* (Persepolis region) on PF 0412 and the commodity mentioned allow for identification of Marduka in this text with a logistics (rationing) official active in Uškannaš, Ankarakkan, and a few other places (see, e.g., NN 0365, NN 0411, NN 0437). This person sometimes stepped into the role of supplier (see, e.g., PF 0863, PF 0941, PF 0942, NN 0915, NN 2075), as he did in PF 0412.

03-04. Mintezza: in this form, taken to reflect *Vindēca- (Tavernier 2007, p. 348 [4.2.1887]), the name occurs only here. Despite Tavernier's objections, it may, however, be an inaccurate variant of Mitezza (*Vīdēca-, *ibid.* p. 347 [4.2.1875]). This does not yield any individual in the Fortification archive with whom Mintezza could be identified, however.

04-05. KUŠ.GUD^{MEŠ}: although the logogram means "cowhide(s)" or "hides of bovines" and is commonly used as such (PF 0075, PF 0076, NN 0430, NN 1638, NN 1811, NN 2241, Fort. 1680), it occasionally occurs in references to hides of camels (PF 0077) or donkeys (NN 0737, NN 1996). The combination KUŠ.GUD^{MEŠ} *a-ak* KUŠ^{MEŠ},

as in PF 0412, should perhaps be translated as “hides from large livestock and from small livestock.” The mention of KUŠ.GUD^{MEŠ} in conjunction with a delivery of flour occurs only in PF 0412 and NN 1680 (below; see also n. 12 on PF 0323).

06. *kurrimma*: Hallock took ll.4-6 to mean “it was utilized for (?) cowhides and (sheep?) hides (and?) bread (?).” Implicit in this understanding is the parsing of *ku-ri-um-ma* as *kurim-ma*, hence with the suffix *-ma*, “for, as,” qualifying all three preceding elements. The problem is, however, that *kurim(-ma)* is unlikely to be the last part in a paratactic series of three given the position of *ak*, “and, also” (expected: KUŠ.GUD^{MEŠ} KUŠ^{MEŠ} *ak kurim-ma*). If *ku-ri-um-ma* is parsed as *kurim-ma*, the interpretation should be “therewith (*ha*, i.e. with the flour) bovine and (caprid) hides for/ as *kurim* were prepared.” In this, *kurim* would be the elamograph of **xvarī-*, “(hot) food” (Tavernier 2007, p. 458 [4.4.19.16]), rather than Hallock’s tentative “bread” (cf. below), giving “therewith bovine and (caprid) hides for use with food were prepared.” The Elamite dictionary, adopting a similar interpretation, freely translates (KUŠ.GUD^{MEŠ} *a-ak*) KUŠ^{MEŠ} *ku-ri-um-ma* as “Leder zum (darauf) Essen, Eßleder,” pointing to the use of leather skins as table cloth in contemporary Persian villages (Hinz and Koch 1987, p. 524 s.v. *ku-ri-um*).

A few texts offer apparent support the above interpretation. In PF 0411, barley is received for preparing food (*kurrim ha huttašda*, “therewith he made food”); this text is paralleled by two others, in which Elamite *abbebe* (written *ab-be-KI+MIN*), “(prepared) food,” replaces *kurrim*, suggesting a partial overlap in meaning (PF 0421, NN 1217). These cases, it should be noted, provide only a partial parallel to PF 0412, since that text not only mentions animal hides but also uses the form *ku-ri-um-ma*.

An alternative solution, reflected in the above translation, takes *ku-ri-um-ma* as a transcription of Old Iranian **grīva-*, “a container, a dry measure of c. 10 l.” For discussion, see above.

06. *ha*: in Achaemenid Elamite *ha* does not exclusively denote “here/there” (despite Vallat 1994, p. 273 n.70), but, in expansion of its locative function, functions as a “general oblique resumptive pronoun” (Stolper 2004, p. 76-77) that retakes inanimate referents and translates as “it, therein, thereto, therefore, therewith” (the same is arguably true for some uses of the pre-Achaemenid precursor of *ha*, *aha*). In the present example *ha* in *ha huttukka* retakes the flour issued (l.1) in instrumental mode: “therewith (hides) were prepared.” Regardless of the interpretation of *ku-ri-um-ma*, PF 0412 therefore offers a clue on Achaemenid tanning practice (cf. Kawase 1986, p. 266).



Fig. 1. PF 0412 (obverse, left edge, obverse, lower edge, reverse); images courtesy Persepolis Fortification Archive Project.

NN 1680 (Fig. 2)

tongue-shaped memorandum (baked)

Seal: PFS 0004* (left edge, twice on reverse)

Obverse

- (01) 50 BAR ZÍD.DA^{MEŠ} *kur-mán* ^{HAL}!ir-
(02) *tup-pi-ia-^rna^r* ^{HAL}am-ma-
(03) *za-ud-da du-iš-da*
(04) KUŠ.GUD^{MEŠ} ^ra^r-ak KUŠ^{MEŠ}
(05) ^{AŠ}ku-ur^r-^rra^r-ka₄-ráš^r ^rha^r
(06) *hu-ud<da>-man-ra* ^{AŠ^r}ú^r[-na]-
(07) *ir* ^{AŠ}ka₄-ap[-nu-iš]-
(08) *ki-^rma^r* [^{HAL}ir-še-na]
(09) [šá-ra-man-na ^{AN}ITI]

Lower edge

- (10) [^{MEŠ} ^{AN}x-x-x-x]-

Reverse

- (11) ^rna^r? [^{AŠ}be-ul 22[?]-um]-
(12) ^rme-man-na^r

⁰¹ 500 l. flour, ⁰¹⁻⁰² allocation from Irtuppiya, ⁰²⁻⁰³ Ammazadda (Yamakšedda) received and ⁰⁴⁻⁰⁶ therewith will prepare bovine and (caprid) hides (for/at) (the) *kurrakaraš*, ⁰⁶⁻⁰⁸ (at) Hunar, at the treasury/craft center, ⁰⁸⁻⁰⁹ [under responsibility of Iršena. ⁰⁹⁻¹² nth month, 22nd? year].

01-02. Irtuppiya: *R̥difya- (Tavernier 2007, p. 289 [4.2.1419]), a high-ranking logistics official in the western Fahliyān region who sometimes stepped into the role of supplier. See Garrison and Henkelman [forthcoming] *Appendix 7.4*.

02-03. Ammazadda: although this name has been interpreted as *Amazāta- (Tavernier 2007, p. 105 [4.2.44]), the closely related text PF 0403 shows that it is actually a variant of Yamakšedda/Ammakšedda (*Yamakšēta-; *ibid.* p. 364 [4.2.2012]). In PF 0403, a person of this name acquires 250 l. of flour for use/processing for/at (the) *kurrakaraš* (^{AŠ}ku-ra-ka₄-ráš-na *hu-ut-taš-da*); the tablet, like NN 1680, is sealed with PFS 0004*.

05. *kurrakaraš*: the word is variously spelled as ^{AŠ}ku-ra-ka₄-ráš (4x), ^{AŠ}ku-ur-ra-ka₄-ráš (1x), *ku-ir-ra-ka₄-ráš* (1x), ^{AŠ}ku-ir-ka₄-ráš (1x). For discussion see above.

06-07. Hunar: continuing older Huhnur(i), the name Hunar refers to a strategically situated town in the Zagros foothills area intervening between Khūzestān and the Iranian Plateau. It was the stage of a range of activities organized by the institutional economy. Its *kapnuški*, “treasury, craft center, factory,” is mentioned in PF 0406 (cf. above) and NN 1680, but its existence may also be inferred from the presence of a team of *pašap*, “weavers” (PF 1790). For a profile of Hunar see Garrison and Henkelman [forthcoming] *Appendix 7.4* (with references).

08. Iršena: *R̥šēna (Tavernier 2007, p. 290 [4.2.1436]), director of the so-called Fahliyān region, the westernmost part of the administration’s territory. His name is

restored from the closely related text PF 0406, but is also suggested by the use of his office seal, PFS 0004*, impressed on the tablet. Texts in which Irtuppiya assumes the role of supplier and which are sealed with PFS 0004* consistently mention Iršena (cf. PF 0847, PF 0874, PF 0876, PF 0921, etc.).

11. 22: Hallock restored the year date on the basis of the close parallel PF 0406. About half of the dated texts mentioning Iršena and Irtuppiya (in conjunction with an impression of PFS 0004*) are from Dar. 22.

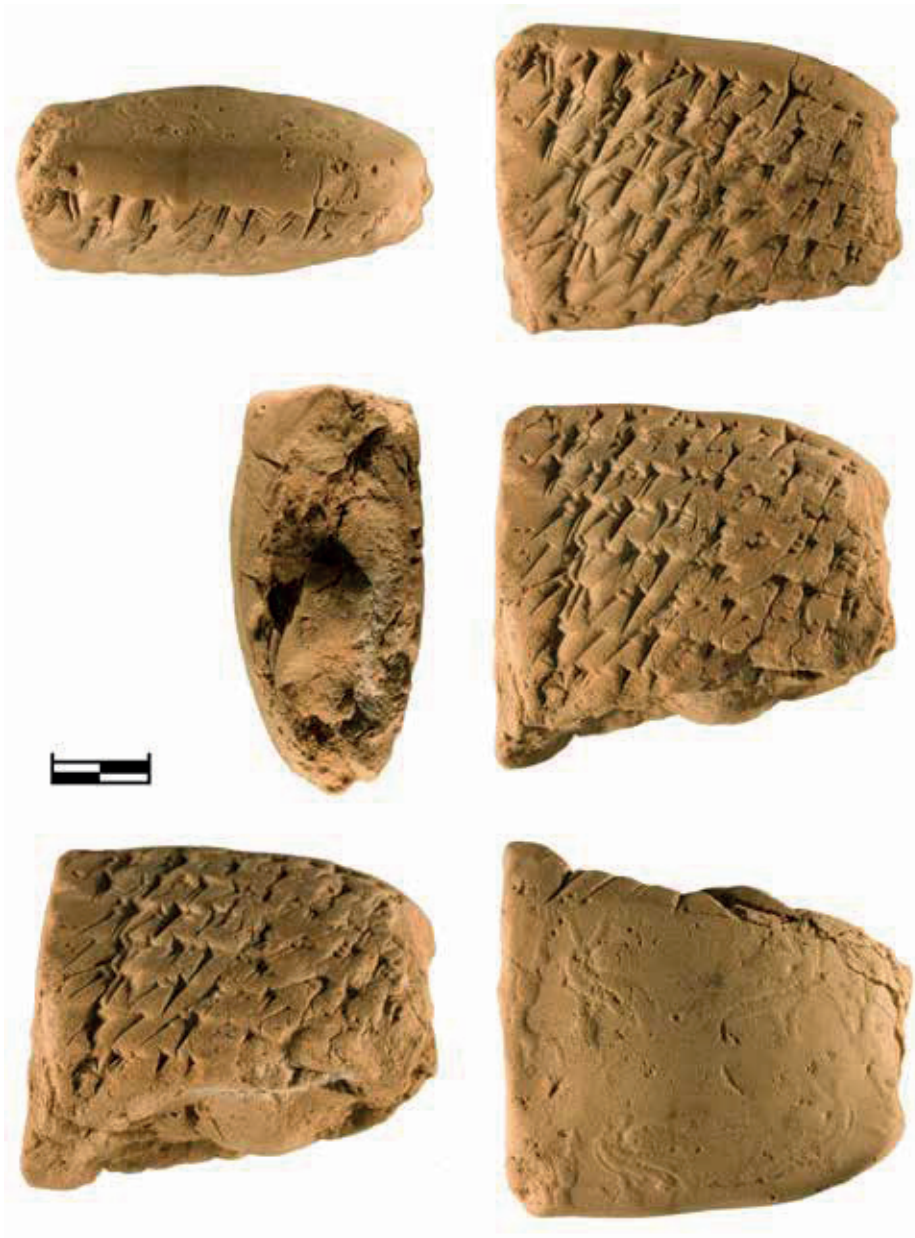


Fig. 2. NN 1680 (upper edge, obverse, left edge, obverse, reverse); images courtesy Persepolis Fortification Archive Project.

Appendix 2: Tabulated survey of texts on animal hides

Year	Supplier	Animals hides* sheep/goats (l...l)	Total [...]	Recipients/deliverers	Location of delivery	Text
17	Ušparna	sheep/goats (1M, 7F, 4K), sheep (1M, 4F)	17	Irtima	Ø	Fort. 2292-102
18	Bakabana	goats (1M, 7F, 4K), sheep (1M, 4F)	17	Ampirdauš, Šakada	Hiran, treasury	PF 0058
18	Bakuratsa	goats (1F), sheep (1F)	2	Irtima	Rak(k)an	
18	Tetukka	cattle (102)	102	Bakaduša, Ziššama, Pirtanda	'at the treasury'	PF 0075
18	Ø	cattle (11M, 6F)	17	Rauzaza (?), Irdurtiya	'at the treasury'	PF 0076
18	Ma[...]ka (?)	sheep/goats (x+26)	x+26	Bakaduša, Ziššama, companion(s)	Uškannaš (?), treasury	NN 0167
18	Zimakka	sheep/goats (91)	91	Irkamukka, Ziššama, Pirtanda	'at the treasury'	NN 0617
18	Hasaparka	donkey (1F)	1	Irtima, companion(s)	Hanamasan	NN 0737
18	Puškakka	sheep/goats (37)	37	Bakaduša, Hakišiparra	'at the treasury'	NN 1478
18 (?)	Bagizza	goat (1F)	1	Uštana, Irtima	Rak(k)an, treasury	NN 0887
19	Irtam	goats (37M), sheep (67F)	9(?)	Šakada, Irtima, companion(s)	Tirazziš, treasury	PF 0059
19	Bakabaduš	goats (14M), sheep (16M)	30	Šakada, Irtima, companion(s)	Batrakataš, treasury	PF 0062
19	Babaka	sheep (4)	4	Bakaduša, Ziššama, Pirtanda	'at the treasury'	PF 0073
19	Ø	cattle (87)	8(?)	delivery: Mušamir, Irdāšatis receipt: Akkamriš, Daziš, Išba	Dašer	NN 0430
19	Batilima	goats (22F)	22	Šakada, Irtima, companion(s)	Hanamasan, treasury	NN 0653
19	Napada	sheep (3M, 35F)	38	Irtima, Uštana	'at the treasury'	NN 0811
19	Bakabana	goats (10F, 1MK, 5FK); sheep (4F)	20	Ampirdauš, Šakada	Hiran, treasury	NN 0886
19	Ø	sheep/goats (15)	15	Ampirdauš, Bakaduša	'at the treasury'	NN 1050
		– from Mannirza: 6				
		– from Maryabaka: 6				
		– from Pirmakšiš: 3				
19	Umaka	sheep/goats (59)	59	Bakaduša, Ziššama	Uškannaš, treasury	NN 1628
19	Tetukka	cattle (48)	48	Bakaduša, Ziššama, Pirtanda	'at the treasury'	NN 1638
19	Mišumanya	sheep/goats (10)	10	Ampirdauš, Bakaduša	'at the treasury'	NN 2159
		– from Marriš: 5				
		– from Bagirabba: 5				
19	Pirtanda (?)	goats (5M), sheep (14F)	19	Šakada, Irtima, companion(s)	Rak(k)an, treasury	NN 2514
19	Battišdana	sheep/goats (130)	130	Irkamukka, Ziššama, Pirtanda	'at the treasury'	Fort. 1810-101
20	Muška	goats (6M, 3F), sheep (4M, 6F)	19	Šakada, Irtima, Mipuka	Batrakataš, treasury	PF 0063
20	Maumesa	goats (2F)	[...]	Irtima, Šakada	Rakam (Rakkan), treasury	PF 0065
20	Udana	goats (2F), sheep (13F)	15	Irtima, Šakada	Rakam (Rakkan), treasury	PF 0066
20	Ziššuka	sheep (8F)	8	Irtima, Šakada	'at the treasury'	PF 0067
20	Bakaparna	goats (5M, 10F)	15	Šakada, Irtima	'at the treasury'	PF 0068
20	Babaka	sheep/goats (18M)	18	Bakaduša, Pirtanda, Ziššama	'at the treasury'	PF 0074
20	Uratinda (?)	goat (1F)	1	Zitēya, Irbama, companion(s)	Matezziš, treasury	NN 0497
20	Makama	sheep/goats (17)	17	Bakaduša, Ziššama, companion(s)	'at the treasury'	NN 0872
		(sheep/goats: 426)	426	Manuka; Napu	Šašukana (?)	NN 0880
20	Marađa	goats (3M, 4F)	7	Irtima, Šakada	Rakam (Rakkan), treasury	NN 1231
20	Nariyapikna	sheep (2F)	2	Uštana, Irtima, companion(s)	Rak(k)an, treasury	NN 1253

Year	Supplier	Animals/hides*	Total	Recipients/deliverers	Location of delivery	Text
20	Kuduka	goats (6F)	6	Irtima, Šakada	Rakam (Rakkan), treasury	NN 1614
20	Umiša	cattle (21)	21	Bakaduša, Ziššama, Pirtanda	'at the treasury'	NN 1811
20	Pirtanda	goats (1M), sheep (1M, 1F)	3	Šakada, Irtima, Mipuka	Matezziš, treasury	NN 1977
20	Mirakama (?)	sheep (5M, 5F)	10	Irtima, Uštana	Rak(k)an, treasury	NN 2413
21	Mardunya	goats (6F)	6	Irtima, Šakada	Tirazziš, treasury	PF 0060
21	Akmakka	sheep (5M, 5F)	10	Irtima, Šakada	Tirazziš, treasury	PF 0061
21	Lakša	sheep (4M, 10F)	14	Irtima, Bakakiya	Matezziš	PF 0069
21	Puda	sheep (11F)	11	Irtima, Šakada	Matezziš, treasury	PF 0070
21	Akmašdana	goats (10F)	10	Šakada, Irtima	Matezziš, treasury	PF 0071
21	Hanuša (?)	goats (10F, 4M), sheep (1F)	15	Mišabada, Midadada	'at the treasury'	NN 1897
21	Miyal...lka (?)	goats (2F), sheep (1F)	3	Irtima, Šakada	Tirazziš, treasury	Fort. 0694-103
21	Puda	sheep (10F)	10	Irtima, Šakada	Tirazziš, treasury	Fort. 2121-008
21 (?)	Ubakziba (?)	goats (16F), sheep (20F)	36	Karme, Bakagiya	Ø	NN 0070
22	Bakaparna	cattle (1M, 2F)	3	delivery (?): Mirinzana, companion(s) receipt (?): Daturša	Harrinziš	Fort. 1680
23	Ø	donkeys (3)	3	Zirkana (Rašdama being responsible)	Ø	NN 1996
24	Turpiš	sheep (3F)	3	Pukša, [...]	Ø	PF 0072
24	Takmašbada	camels (12M/F, 7 yearlings, 2 calves)	21	Šandupirzana	Ø	PF 0077
[...]	Teutkka	cattle (15M)	15	Bakaduša, Ziššama, companion(s)	'at the treasury'	NN 2241
Ø	Ø	sheep/goats (25?)	25?	Kamtika, companion(s)	Halpin (?)	NN 0214
Ø	Ø	sheep/goats (18)	18	Bakaduša, Ziššama, Pirtanda	'at the treasury'	NN 0344
		- from Haturka: 2				
		- from Mišraddu: 4				
		- from Parnuma: 4				
		- from Muštukka: 4				
		- from Marazama: 4				
Ø	Bakagiya	sheep/goats ([...])	[...]	[...]tūmiza	'at the treasury'	Fort. 2331-101

*The following abbreviations are used in describing animals: M = male; F = female; L = lambs; K =kids

Abbreviations

<i>BSOAS</i>	<i>Bulletin of the School of Oriental and African Studies</i>
<i>JCS</i>	<i>Journal of Cuneiform Studies</i>
<i>JHS</i>	<i>Journal of Hellenic Studies</i>
<i>JESHO</i>	<i>Journal of the Economic and Social History of the Orient</i>
<i>JNES</i>	<i>Journal of Near Eastern Studies</i>
<i>MDOG</i>	<i>Mitteilungen der Deutschen Orient-Gesellschaft</i>
<i>PIHANS</i>	<i>Publications de l'Institut Historique-Archéologique Néerlandais de Stamboul</i>
<i>RIA</i>	<i>Reallexikon der Assyriologie</i>
<i>SAOC</i>	Studies in Ancient Oriental Civilization

Bibliography

- Aali, A. and Stöllner, T. (edd.) 2015, *The archaeology of the salt miners: Interdisciplinary research 2010-2014*, Bochum, Deutsches Bergbau Museum.
- al-Hassan, A.Y. 2001, "Textiles and other manufacturing industries", in : A.Y. al-Hassan (ed.), *Science and technology in Islam: Technology and applied sciences* (The Different Aspects of Islamic Culture 4), Paris, p. 135-164.
- Anonymous. 1915, "Camel Leather Was a Failure", *Boot and Shoe Recorder* 66 (March 6), p. 60.
- Anonymous. 1920, "Camel Leather at Peabody", *Shoe and Leather Reporter* 139 (July 1), p. 42.
- Bishop, I. 1891, *Journeys in Persia and Kurdistan, including a summer in the upper Karun region and a visit to the Nestorian rayahs*, vol. 2, London, John Murray.
- Briant, P. 1979, "L'élevage ovin dans l'Empire achéménide: VI^e-IV^e siècles avant notre ère", *JESHO* 22, p. 136-161.
- Chardin, J. 1711, *Voyages de Monsieur le Chevalier Chardin, en Perse et autres lieux de l'Orient*, Amsterdam, Jean Louis de Lorme.
- Cheung, J. 2007, *Etymological dictionary of the Iranian verb* (Leiden Indo-European Etymological Dictionary Series 2), Leiden, Brill.
- Connor, E. 1953, "Jérôme de Lalande: Eighteenth-century champion of astronomy", *Astronomical Society of the Pacific Leaflet* 6/292, p. 330.
- Crone, P. 2007, "Quraysh and the Roman army: Making sense of the Meccan leather trade", *BSOAS* 70, p. 63-88.
- De Vos, P. 2010, "European materia medica in historical texts: Longevity of a tradition and implications for future use", *Journal of Ethnopharmacology* 132, p. 28-47.
- Fiddymment, S. et al. 2015, "Animal origin of 13th-century uterine vellum revealed using noninvasive peptide fingerprinting", *Proceedings of the National Academy of Science* 112, p. 15066-15071.
- Fleming, G. 1869, *Horse-shoes and horse-shoeing: Their origin, history, uses, and abuses*, London, Chapman and Hall.
- Floor, W. 2003, *Traditional crafts in Qajar Iran (1800-1925)*, Costa Mesa, Mazda Publishers.
- Garrison, M.B. 2017, *The ritual landscape at Persepolis: Glyptic imagery from the Persepolis Fortification and Treasury archives* (SAOC 72), Chicago, Oriental Institute.
- Garrison, M.B. and Henkelman, W.F.M. [forthcoming], "The seal of prince Aršāma: from Persepolis to Oxford."

- Halasz-Csiba, E. 2002, “Le tan et le temps: Changements techniques et dimension historique du tannage en France (XIV^e-XVIII^e siècles)”, *Technique & Culture* 38, <http://tc.revues.org/1585>; DOI: 10.4000/tc.1585.
- Hammer, J. v. 1834, *Narrative of travels in Europe, Asia, and Africa, in the seventeenth century*, by *Evliyá Efendí*, London, Oriental Translation Fund of Great Britain and Ireland.
- Hay, W.R. 1921, *Two years in Kurdistan: Experiences of a Political Officer, 1918-1920*, London, Sidgwick & Jackson, Ltd.
- Henkelman, W.F.M. 1997, “Footnote at Foodnotes”, in : M.-F. Boussac (éd.), *Recherches récentes sur l'Empire achéménide* (Topoi 7, Suppl. 1), Lyon, p. 343-345.
- Henkelman, W.F.M. 2003, “An Elamite memorial: the *šumar* of Cambyses and Hystaspes”, in : W.F.M. Henkelman and A. Kuhrt (edd.), *A Persian perspective: Essays in memory of Heleen Sancisi-Weerdenburg* (Achaemenid History 13), Leiden, p. 101-172.
- Henkelman, W.F.M. 2005, “Animal sacrifice and ‘external’ exchange in the Persepolis Fortification Tablets”, in : H.D. Baker and M. Jursa (edd.), *Approaching the Babylonian Economy* (Studies in the Economic History of First Millennium Babylonia 2 = AOAT 330), Münster, p. 137-65.
- Henkelman, W.F.M. 2017a, “Anhang: Egyptians in the Persepolis archives”, in : M. Wasmuth (ed.), *Ägypto-persische Herrscher- und Herrschaftspräsentation in der Achämenidenzeit* (Oriens et Occidens 27), Stuttgart, p. 273-299.
- Henkelman, W.F.M. 2017b, “Imperial Signature and Imperial Paradigm: Achaemenid administrative structure and system across and beyond the Iranian plateau”, in : B. Jacobs, W.F.M. Henkelman and M.W. Stolper (edd.), *Administration in the Achaemenid Empire – Tracing the Imperial Signature* (Classica et Orientalia 17), Wiesbaden, p. 45-256.
- Henkelman, W.F.M. and Folmer, M.L. 2016, “Your Tally Is Full! On wooden credit records in and after the Achaemenid Empire”, in : K. Kleber and R. Pirngruber (edd.), *Silver, money and credit: A tribute to Robartus J. van der Spek on the occasion of his 65th birthday on 18th September 2014* (PIHANS 128), Leiden, p. 133-239.
- Henkelman, W.F.M., Jones, C.E. and Stolper, M.W. 2006, “Achaemenid Elamite Administrative Tablets, 2: The Qašr-i Abu Našr tablet”, *ARTA* 2006.003.
- Herzfeld, E. 1907, “Eine Reise durch Lüristān, Arabistān und Fārs”, *Petermanns Geographische Mitteilungen* 53, p. 49-90.
- Hinz, W. 1967, “Elams Vertrag mit Narām-Sîn von Akkade”, *Zeitschrift für Assyriologie* 58, p. 66-96.
- Hinz, W. 1971, “Achämenidische Hofverwaltung”, *Zeitschrift für Assyriologie* 61, p. 260-311.
- Hinz, W. 1973, *Neue Wege im Altpersischen* (Göttinger Orientforschungen 3.1), Wiesbaden, Otto Harrassowitz.
- Hinz, W. 1975, *Altiranisches Sprachgut der Nebenüberlieferungen* (Göttinger Orientforschungen 3.3), Wiesbaden, Otto Harrassowitz.
- Hinz, W. and Koch, H. 1987, *Elamisches Wörterbuch*, 2 vols. (AMI Ergänzungsband 17), Berlin, D. Reimer.
- Hooper, D. 1931, “Some Persian drugs”, *Bulletin of Miscellaneous Information (Royal Botanic Gardens, Kew)* 6, p. 299-344.
- Hoskins, W.G. 1963, *Sheep farming in Saxon and Medieval England*, London, Palgrave Macmillan.
- Jackson, A.V.W. 1906, *Persia past and present: A book of travel and research*, New York, Macmillan.
- Johnson, C. 1983, *Dialogus de Scaccario / The Course of the Exchequer by Richard, Fitz Nigel and Constitutio Domus Regis / The Establishment of the Royal Household*, Oxford, Clarendon Press.

- Jördens, A., Kiyarad, S. und Quack, J.F. 2015, "Leder", in : T. Meier, M.R. Ott und R. Sauer (edd.), *Matériale Textkulturen: Konzepte – Materialien – Praktiken*, Berlin, De Gruyter, p. 323-335.
- Kawase, T. 1980, "Sheep and goats in the Persepolis royal economy", *Acta Sumerologica Japonica* 2, p. 37-51.
- Kawase, T. 1986, "Kapnuški in the Persepolis Fortification texts", in : L. De Meyer, H. Gasche et F. Vallat (edd.), *Fragmenta historiae elamicae: Mélanges offerts à M.-J. Steve*, Paris, Recherche sur les Civilisations, p. 263-275.
- Khanna, N.D. and Rai, A.K. 1991, "Camel rearing in the Indian arid zone", *Annals of Arid Zone* 30, p. 1-10.
- König, W. 1962, *Die Achal-Teke: Zur Wirtschaft und Gesellschaft einer Turkmenen-Gruppe im XIX. Jahrhundert* (Veröffentlichungen des Museums für Völkerkunde 12), Leipzig.
- Krahmer, G. 1903, *Die Beziehungen Russlands zu Persien* (Russland in Asien 6), Leipzig.
- Lalande, J.J. le F de. 1762, *Art de faire le parchemin*, Paris, H.L. Guerin and L.F. Delatour.
- Lalande, J.J. le F de. 1764, *Art du tanneur*, Paris, Desaint & Saillant.
- Kuckertz, J. 2006, "Schuhe aus der persischen Militärkolonie von Elephantine, Oberägypten, 6.5. Jhd. v. Chr.", *MDOG* 138, p. 109-156.
- Landsberger, B. 1967, "Über Farben im Sumerisch-akkadischen", *JCS* 21, p. 139-173.
- Leese, A.S. 1927, *A treatise on the one-humped camel in health and in disease*, Stamford, Haynes & Son.
- Levey, M. 1962, "Mediaeval Arabic bookmaking and its relation to early chemistry and pharmacology", *Transactions of the American Philosophical Society* NS 52/4, p. 1-79.
- Minns, E.S. 1915, "Parchments of the Parthian period from Avroman in Kurdistan", *JHS* 35, p. 22-65.
- Mounsey, A.H. 1872, *A journey through the Caucasus and the interior of Persia*, London, Smith, Elder & Co.
- O'Donovan, E. 1883, *The Merv Oasis*, vol. 1, New York, G.P. Putnam's Sons.
- Olivier, G.-A. 1807, *Voyages dans l'Empire othoman, l'Égypte et la Perse, Fait par ordre du Gouvernement, pendant les six premières années de la République*, vol. 3, Paris, H. Agasse.
- Olmer, L.-J. 1908, "Rapport sur une mission scientifique en Perse", *Nouvelles Archives des Mission Scientifiques et Littéraires* 16, p. 1-110.
- Polak, E. 1876, "Persische Lederindustrie", *Oesterreichische Monatsschrift für den Orient* 8 (15 August), p. 126.
- Rabino, J. 1901, "An economist's notes on Persia", *Journal of the Royal Statistical Society* 64/2, p. 265-291.
- Schefer, C. 1877, *Iter Persicum ou Description du voyage en Perse entrepris en 1602 par Étienne Kakasch de Zalonkemeny, Envoyé comme ambassadeur pour l'empereur Rodolphe II, à la cour du grand-duc de Moscovie et à celle du Châh Abbas, roi de Perse*, Paris, Ernest Leroux.
- Sigrist, M. 1981, "Le travail des cuirs et peaux à Umma sous la Dynastie d'Ur III", *JCS* 33, p. 141-190.
- Stol, M. 1983, "Leder(industrie)", *RIA* 6, p. 527-543.
- Stolper, M.W. 2004, "Elamite", in : R.D. Woodard (ed.), *The Cambridge encyclopedia of the world's ancient languages*, Cambridge, p. 60-94.
- Tuplin, C. 2008, "Taxation and death: certainties in the Persepolis Fortification archive?", in : P. Briant, W.F.M. Henkelman et M.W. Stolper (éds.), *L'archive des Fortifications de Persépolis: État des questions et perspectives de recherches* (Persika 12), Paris, De Boccard, p. 317-386.
- Vallat, F. "Deux tablettes élamites de l'Université de Fribourg", *JNES* 53, p. 263-274.

- Veldmeijer, A.J. 2016, *Leatherwork from Elephantine (Aswan, Egypt): Analysis and catalogue of the ancient Egyptian & Persian leather finds*, Leiden, Sidestone Press.
- Watt, G. 1889, *A dictionary of the economic products of India*, vol. 2. Calcutta, Superintendent of Government Printing.
- Wilson, J.A. 1923, *The chemistry of leather manufacture*, New York, The Chemical Catalog Company, Inc.
- Wishard, J.G. 1908, *Twenty years in Persia: A narrative of life under the last three Shahs*, New York/Chicago/Toronto, Fleming H. Revell Company.
- Wulff, H.E. 1966, *The traditional crafts of Persia: Their development, technology, and influence on Eastern and Western civilizations*, Cambridge, MIT Press.