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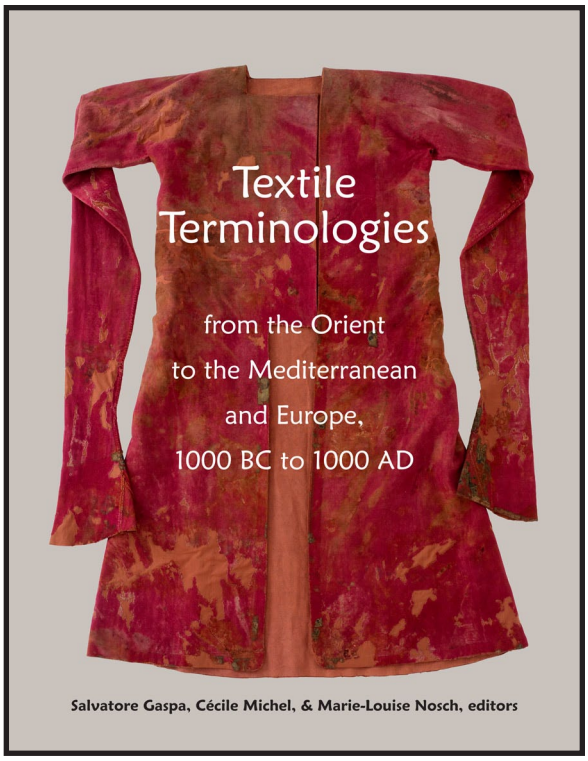

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A Diachronic View on Fulling Technology in the Mediterranean and the Ancient Near East: Tools, Raw Materials and Natural Resources for the Finishing of Textiles

Elena Soriga

Among the operations required in the overall cycle of the ancient production of textiles, Greek and Roman sources refer to the fulling of woollen fabrics as the most complex and expensive technical process performed both in the 1st millennium BC and the 1st millennium AD. Indeed, the finishing of woollen clothes needed a large amount of time, energy and labour, as well as involving the use of specialized skills and costly raw materials. Fulling fulfilled two functions that were necessary for the proper finishing of cloth, namely the scouring and consolidation of the fibres in the fabric. Woven cloth straight from the loom has a rather open, loose texture and the woven threads needed closing or tightening. The fulling process was intended to consolidate and thicken the structure of the fabric by matting the fibres together more thoroughly and by shrinking them. Thus the process transformed the cloth from a loose 'net' of threads into a compact, tight, textural whole. This is why in ancient economies, fulled textiles, proof against water and the wear inflicted by weather and time, were considered among the most luxurious and prestigious of fabrics.

Textual, iconographical and archaeological evidence from the Greek and, especially, Roman civilizations provide together quite a complete picture of the procedures, the tools and the raw materials involved, with special emphasis on their natural and geographical origins.[1] In contrast, for pre-Classical fulling, archaeological and epigraphical evidence on the technical phases in the finishing of textiles are unfortunately very scanty, deficient and often of doubtful interpretation. This situation applies to Mesopotamia too. Here the earliest cuneiform texts related to the finishing of woollen textiles date back to the end of the 3rd millennium BC, while seals and sealings representing scenes of fullers at work attest the presence of this technology even around the middle of the 4th millennium BC according to some historians.[2] In fact the terminology of the cuneiform texts limits itself to the name of the textile workers involved, the woollen fabrics undergoing the different operations, and a few raw materials, but they do not describe how technical operations were carried out and the sources of the materials the fullers utilized. Therefore, the study of natural resources mentioned

1. Zawadzki 2013. See in general Flohr 2013; Forbes 1956, 80-89; Singer *et al.* 1962, 216-221.

2. Algaze 2008, 81, 85, 86 and figs. 14, g-h provides as evidence of that seals and sealings of the Uruk periods (ca. 3500-3200 BC). Nonetheless, these iconographical data constitute only a circumstantial evidence because the representations of the men at work are ambiguous: they are interpretable as tanners or other artisans not engaged in textile manufacturing. The first evidence in support of the hypothesis of activities for finishing wool fabrics in Bronze Age Mesopotamia is some Early Dynastic Period texts dated to the middle of the 3rd millennium BC. See also Peyronel 2004, 72.

in 1st millennium Classical texts is extremely useful: it helps first to close the loopholes in both earlier and contemporary cuneiform documentation, and then to better understand the economic and cultural role played by specific plants, animals and minerals belonging to the Near Eastern ecosystems before the advent of mechanized fulling. Several scholars have stressed the substantial uniformity of the technology of fulling, whose procedures and raw materials remained unchanged from Classical antiquity until the end of the Early Middle Ages, when the fulling of cloth was carried out in a textile water mill.[3] It is hence believable that even before the 1st millennium BC Near Eastern fullers were exploiting the same or analogous natural resources for cloth-making, using them in the finishing of woollen fabrics in the same technical operations.

Therefore, this present research employs 1st millennium BC and AD sources to draw an ethnographic parallel with the fulling operations, tools and raw materials recorded in Near Eastern textual documentation during the two previous millennia. Sumerian and Akkadian terminology linked to technical procedures, but also to the names of plants, animals and minerals occurring in the cuneiform texts concerning the finishing of woollen textiles, will be analysed in the light of the historical and anthropological comparisons with the Greco-Roman world. This should reveal new or overlooked aspects of the Mesopotamian and Near Eastern fulling as performed in the Bronze and Iron Ages.

Terminology and technology. Names of procedures, tools and textiles

Archaeological, iconographical and textual sources of the Classical times prove that the fulling of woollen fabrics had its own *chaîne opératoire*, entailing the performance of consecutive and different steps of finishing: washing, felting, rinsing and drying and often, but not always, raising, shearing of the nap and cropping of the resulting hair.[4]

Some of these technical operations are recorded by various cuneiform texts of the early 2nd millennium BC: a few tablets from the Old Assyrian city of Kanesh (modern Kültepe), in Cappadocia, and an Old Babylonian text, whose provenance remains unknown, provide very accurate instructions on how to full textiles.[5] These cuneiform texts demonstrate that many of the technical processes, as well as the greater part of tools and raw materials, required in Middle Bronze Age finishing of textiles were essentially comparable to those employed in the fulling of woollen cloth during the Iron Age and further described by Greek and Roman sources.

Nonetheless, the textual evidence of some techniques is sometimes ambiguous because several verbs exist to describe common processes occurring in diverse finishing treatments. For instance, the *washing* of fabrics was conducted by fullers in many different tasks: in the scouring and the rinsing of the woollen textiles intended to be fulled, in the ordinary cleaning of soiled garments, in the bleaching of linen items and finally in the partial or comprehensive restoration of damaged fabrics.[6]

This indistinctness in terminology applies too to the very occupational name of the fullers themselves and thus on the how the technical processes they performed was known. Indeed, the elusive nature of the ancient fuller's work has already been often stressed by eminent scholars who intermittently have translated this occupational name as 'laundryman', 'bleacher' or more simply as 'finisher' or 'textile worker'.[7]

3. Uscatescu 2010. Around the 10th century AD, Muslim engineers invented water-powered fulling mills and introduced them throughout the Mediterranean area. See also Peyronel 2004, 73.

4. Smith 1875, 551-553; Flohr 2013, 99-180.

5. For the Old Assyrian text TC 3/I 17, see Veenhof 1972, 104 and Michel & Veenhof 2010. For the Old Babylonian tablet AO 7026, see Lackenbacher 1982.

6. See Firth 2013.

7. Starting in the mid-3rd millennium BC, cuneiform texts mention a professional class of artisans engaged in the finishing of textiles. Since the Early Dynastic period, the Lexical lists record the Sumerian aš la$_2$ g GIŠ.TÚG.(PI.)KAR.DU and ^{lú}azlág/^{lú}azlag as professional designations for the finisher of textiles. Cf. Lexical List Diri III (*ašlāku*) in MSL XV; see also discussion in CAD A/II, 447

It is well known that being derived from cellulose, flax lacks scales and thus its fibres are not able to felt. Nonetheless, from the end of the 3rd millennium BC, cuneiform texts list, among the textiles delivered to the fullers, cloths marked with the determinative for linen.[8] Vocabularies and lexical texts equate the term *ašlāku* 'fuller' and the writing LÚ.TÚG.UD, used since the 1st millennium BC by Neo-Babylonian texts to denote exclusively the craftsmen entrusted to whiten new and used linen (LÚ *pūṣayu*).[9] The occupational name *pūṣāya* (LÚ.TÚG.BABBAR) 'launderer', linked with the term *peṣû* (BABBAR) 'white' but also 'clear, shining', actually occurs only in the Neo-Assyrian and Neo-Babylonian texts concerning the working and finishing of linen and not before.[10] It seems thus reasonable that among his many offices the *ašlāku* was originally in charge of the bleaching of linen and the ecru wool either through the use of fuller's earth or glassworts dissolved in lye or by treating them with sulphur vapours. Moreover, mineral and vegetal alkalis can be useful also to brighten and to freshen the dyed textiles that have faded due to sulphur or to the caustic action of the lye.[11] During the 1st millennium BC, as the availability of flax in Mesopotamia increased, this specialization became more significant until it was separated and identified as a profession apart, namely the *pūṣāya*. The issue remains still controversial but there is no doubt that the equivocation of the occupational terminology is due both to the wide range of activities performed by the fullers and to the lack of information about the raw materials and tools used in their activities.[12]

Moreover, there is evidence of a metonymic use of some verbs, where a single operation within the overall finishing process is used to indicate the complete process of the fulling of woollen textiles. This latter suggestion is confirmed by the original meaning of the two verbs used in the ancient Greek terminology to indicate the work of the fullers: πλύνω, reserved for linen, means 'to wash, to clean, to scour', whilst κναφεύω, used with reference to the woollen cloths, means 'to teasel, to raise, to card'. Yet, both verbs mean *lato sensu* 'to full, to launder'. Similarly the Latin *carmĭno* 'to card the wool', and related to *carmĕn*, 'carding, wool comb', means also 'to soak

sub *ašlāku*. Both terms are equated with the Akkadian *ašlāku* 'fuller', a calque of the latter Sumerian word. Cf. LEX/ED IIIa/Fara azlág SF 070 o iii 7; LEX/ED IIIb/unknown azlag; Early Dynastic Lú E, 33. See also Lackenbacher 1982, 137: "On traduit parfois LÚ.ASLAG = *ašlākum* par «blanchisseur» ou «foulon», mais certains auteurs ont déjà souligné qu'une traduction plus vague comme «travailleur du textile» serait bien préférable, car les tâches de cet ouvrier sont plus étendues que celles que désignent ces deux termes". With regard to the fulling terminology in the Middle Assyrian texts, Postgate (2014, 408) states: "I know of no Middle Assyrian terminology which would refer to the fulling (fouler, walken) of cloth. The one reference to 'fuller' (written lú-túg) is in the law code (fragment M), and he here appears more to be concerned with cleaning of an already manufactured garment, than with an interim stage in the production of cloth".

8. Waetzoldt 1972, 155.

9. CAD A/II, 447 sub *ašlāku*.

10. CAD P, 538 sub *pūṣaya* 'launderer'. The πλυνῆς 'washers', recorded in a stele of the 4th century BC found in a stadium of Athens, were entrusted with tasks analogous to those of the Mesopotamian *pūṣāya*. In the Roman world, the corresponding term for the *pūṣaya*-profession was the *nacca*. These occupational names designate fullers skilled in scouring and whitening linen, whereas the Akk. *ašlāku*, Gr. κναφεύς and Lat. *fullō* indicate fullers engaged chiefly in wool-cloth treatments.

11. CAD P, 538 records few passages in the text where the activity of the *pūṣāya* concerns some wool items. GCCI 1 145:4 records the delivery of wool to a 'launderer' for a handiwork (*ana dullu*); in UCP 9 103 No. 41:6 the *pūṣāya* receives instead one mina of green-yellowish wool (SÍG *ḫaṣašti*), besides two minas and 15 shekels of a sail.

12. With regard to this, the greatest part of terminological information is supplied by some cuneiform texts of the early 2nd millennium BC. The recensions B and D of the Old Babylonian series Lú known as ^{lú}azlág = *ašlāku*, lists a huge number of occupations, whose greatest part is otherwise unknown in contemporary texts; therefore these names have been interpreted as a roll of the numerous activities of the fuller's craft (Sum. nam-azlag; Akk. *ašlākūtu*) rather than different professional designations. See MSL XII, 158, 177, 204; MSL XII, 151: "The name of professions listed in OB Lu designates usually the performer of specific tasks within a given profession (examples of this are the azlag-group in Rec. B I 1-21…)"; see Lackenbacher 1982, 137. The comparison of ^{lú}azlág = *ašlāku* with tablet XIX of the series HAR-ra = *ḫubullu*, a lexical text concerning the names of textiles, enlightens the different technical operations concerning washing, thickening, teaseling and cropping of wool textiles, whose names are recorded in contemporary and earlier cuneiform texts dealing with the production of cloths by fullers.

linen'.[13] Such an overlap between different technical operations belonging to subsequent stages of the same *chaîne opératoire* is attested also in the Bronze Age cuneiform texts where, for instance, Akkadian *mašādu* is alternately translated 'to full a cloth, to finish a wool textile' and 'to comb' because of its relation with *mušṭu* 'comb'.[14] Thus, in my view, the verb *mašādu* has a metonymic function: it can be used to indicate the operation of the fulling in cases when the woollen item is intended to be "combed" with brushes and teasels in order to raise the nap.[15]

Terminology of finishing treatments and technical operations

Washing cloths

Washing was instrumental not only in cleaning the fibres by eliminating oils, dirt and other impurities but also, as has already been said, in consolidating and thickening the structure of the fabric. In ancient Greece and Rome, textiles were immersed and then scoured in a hot solution of water and a lump of some fatty or chemical substance with alkaline, bleaching or absorbent and degreasing properties. This soapy lye, named in Greek κονία 'dust, ashes, chalk, lime whitewash, lye, gypsum' (from κονιάω/κονιάζω 'to sprinkle with ashes/to plaster with lime') and in Latin *lixa* or *lixivium* 'ashes, lye' (from *ēlixo* 'to boil, to drench in hot water') was rubbed on the surface of the fabrics in order to felt together the threads of the weave, give thickness and strength to the fabric and thus increase its waterproofing properties.[16] The connotation of the 1st millennium BC terms for 'lye' (Gr. κονία; Lat. *lixa*/*lixivium*) as dust, ashes or lime suggests that these detergents were obtained in the form of powder from sources of alkali (sodium- or potassium-carbonates) belonging to the mineral or vegetal kingdom.[17]

Bronze and Iron Age cuneiform texts attest the occurrence of mineral powder and vegetal ashes among the raw materials used by Near Eastern fullers to wash the woollens intended to be fulled, the linens to be bleached and the soiled garments that needed to be simply cleaned.[18]

The alkaline ash, earth or ground preparation was put in a vat with boiled (still hot but not boiling) water together with the fabrics and vegetal oil or animal grease or, more likely, was mixed with these fatty substances until it reached the form of a homogeneous paste and then rubbed on the textiles soaked in hot water.[19] This last suggestion is supported by a lexical text dating back the mid-2nd millennium BC where the Akkadian verb *sêru* (Sum. ŠÚ, šu-ùr) 'to rub down, to plaster, to cover with a clay slip' is listed in a group with other two verbs describing two major tasks mastered by the fuller: *mêsu* (Sum. LUḪ) 'to wash, to clean' and *kabāsu* (Sum. GIRI US) 'to step upon, to full cloth'.[20] Thus, as well as the Greek

13. Smith 1875, 553; Rocci 1516, πλύνω: 'lavo, risciacquo; netto lavando'; Rocci 1058, κναφεύω: 'scardasso, cardo, lavo i panni, fo il lavandaio' most likely derived from κνάω 'to scrape, to scratch, to tear'. IL, 151, *carmĭno* 'cardare la lana' e 'macerare il lino', see Pliny, NH 9, 134 and 19, 18.

14. For *mašādu*, see the above-mentioned Old Assyrian text TC 3/I 17, 12-14 and 19-22 in Veenhof 1972, 104 and in Michel & Veenhof 2010, 249-252. In his first edition of the text, Veenhof (1972, 106) prefers to translate *mašādu* 'to comb, to teasel', linking it with the substantive *mušṭu* (Sum. ^{giš}ga-ríg) 'comb', but *AHw* 687a he rejected this etymology. Waetzoldt 1972, 116 mentions also the ^{giš}ga-ríg-ak with the meaning 'carding comb'. Michel & Veenhof (2010, 249) translate the verb with the original meaning 'striking/biting' and reject the translation 'to comb' since *mašādum* "is applied to wool and hair, not to a fabric".

15. A metonymic use of *mašādum* was proposed first by B. Landsberger (1965, *OLZ* 60, col. 158, on no. 299) in Michel & Veenhof 2010, 252. Regarding this, Veenhof (1972, 106) states: "K. Balkan presents Landsberger's ideas on this terminology. He warns one to distinguish between similar treatments applied to the wool, the threads and the woven tissue. In the latter case the subject of the present letter - he distinguishes three treatments: a) *mašādum*; b) *mašārum*; c) *qatāpum*" and n. 179.

16. Fosbroke & Lardner 1833, 342-345; Aristophanes, *Batrakhoi*, 712.

17. Levey 1959, 125-129; Forbes 1965, 140-141; Waetzoldt 1972, 159.

18. Waetzoldt 1972, 172; Zawadzki 2006, 61-65; Firth 2013.

19. Waetzoldt 1972, 159; Waetzoldt 1985, 83-86; Rougemont 2011, 374-375; Firth 2013; Quillien 2014, 285-286.

20. Erimḫuš = *anantu* II, 42-44 in MSL XVII, 28; MSL XVII, 1: "This series seems, like the similarly structured series Antagal, to aim less at analysing the various meanings of a Sumerian word (whether by contrasting it with other Sumerian words or by enumerating different Akkadian equivalents) than at collecting a set of words from one semantic field: synonyms, homonyms, complementary concepts (black/white), etc."

κονιάω/κονιάζω, the verbs *sêru* and šu-ùr describe the felting of the threads of the textiles with the aid of a cleaning powder or lump rubbed on their surface.[21]

Walking cloths

In the fulling of woollen fabrics and cloth-making process, the next step is widely attested by textual and iconographical sources produced by the Classical civilizations. The soaked and soaped textiles were beaten, wiped off and wrung out by hand, pounded by cudgels or trodden by feet.[22] The detergents were pushed through the cloth and penetrated deep into the threads by the trampling of the fabrics and by their scrubbing. The microscopic barbs on the surface of the wool fibres hook together, making the textile softer, thicker and more resistant.[23]

A passage from the *Corpus Hippocraticum* describes the fulling of cloth as an alternation of trampling (λακτίζουσι), striking (κόπτουσιν) and pulling (ἕλκουσι).[24] In the first half of the 3rd century BC, the Roman poet Titinius describes in his comedy *Fullones* the work of the textile craftsmen as *argutarier pedibus* 'nattering, making a noise with the feet'.[25]Around the middle of the 2nd century BC, Cato the Elder described the Roman *fullones* engaged in all these operations.[26] Seneca described the movements of the fullers at work: with a certain amount of irony he likened them to dance steps (Lat. *saltus fullonicus*).[27] Contemporary archaeological and iconographical sources confirm the textual references. A fresco from the fullery of Veranius Hypsaeus in Pompeii shows one fuller trampling clothes in a tub placed on the floor and three other workers scrubbing and wringing them to facilitate their felting (Fig. 1).

It is very probable that the actual fulling process was performed by trampling the soaped cloths throughout the Mediterranean and Near East long before the Roman period, though the little direct evidence collected so far does not clarify where and when this technique had its origin.[28] In the 5th century AD Horapollo, in his *Hieroglyphica*, mentions that the Egyptian symbol to indicate a fuller consisted of two feet in a tub filled with water.[29] At the beginning of the 2nd millennium BC, a Middle Kingdom depiction from Beni Hassan shows three textile workers standing in what seems to be a large vat, but it is unclear whether they were actually walking on the clothes.[30]

The philological study here presented on the Akkadian and Sumerian terminology in cuneiform texts related to the cloth-making process is able to demonstrate that the technique of fulling underfoot was performed by Mesopotamian fullers of the same period as the Egyptian picture of Beni Hassan. Old Assyrian and Old Babylonian texts dealing with the finishing treatments of different kinds of woollen textiles describe the fulling procedure by using the verbs *mašādu* 'to press, to walk upon, to full cloth', *maḫaṣu* 'to strike, to weave' and *kamādum* 'to weave and prepare cloth in a specific way'.[31] The modalities of this 'specific treatment of the cloths' are disclosed

21. CAD S 227, sub *sêru*; Rocci 1071.

22. Moeller 1976, 20.

23. Flohr 2013, 101.

24. The use of the present tense emphasizes the continuity and alternation of the treatment, Flohr 2013, 100 and n. 12.

25. Titinius, *Ful.,* fr. X; Flohr 2013, 101; IL 97 sub *argūtor*: "fig. *argutarier pedibus*: saltellare", 'to hop'.

26. Cato, *De agri coltura* X, 5; XIV, 2; Hippocrates, *De diaeta*, I, 14.

27. Seneca, *Epistulae,* XV, 4.

28. Flohr 2013, 101 remarks that fulling with the feet was efficient "as the pressure a human can generate below his feet is much higher than that which he can generate with his hands". Fulling with this technique was still performed until the early modern period and in some Mediterranean regions even over the last century such as in Crete where fulling by foot was done until the 1950-1960s (Doniert Evely, personal communication). Indeed mechanized fulling in water mills (Lat. *molendinum ad fullandum*; *molendinum fullonum*) did never fully replace the traditional foot-fulling carried out by physically trampling the cloths in tubs. In Anglo-Saxon countries and particularly in Scotland the cloth-making process was called walking/*waulking* still after it became mechanized. See Uscatescu 2010.

29. Nonetheless M. Flohr (2013, 101) states: "the symbol does not seem to be known from any hieroglyphic text".

30. Forbes 1955, 84, fig. 3; Flohr 2013, 101.

31. Probably a difference in meaning distinguishes the tree verbs *kabāṣu*, *mašādu* and *kamādu* but it is perhaps too subtle to have been

Fig. 1. Lower section of the fresco of the so-called *Pilastro dei Fullones* from the *fullonica* of Veranius Hypsaeus in Pompeii (House VI 8, 20-21.2), depicting some fullers busy to scour the cloths rubbing by hands and trampling on them. 1st century AD, Museo Archeologico Nazionale di Napoli (inv.nr. 9774 b). Photograph courtesy of Miko Flohr.

by the contemporary OB series lú where the *ka-mi-du* is described as lú túg-šu-dúb-da 'the craftsman who strikes the cloth by hand' or, more vaguely, as lú túg-dúb-da 'the man who kicks/smites (dúb = *napāṣu*) the cloths'.[32] Another Akkadian verb *kabāsu* 'to step upon something on purpose, to trample, to walk upon, to make compact, to full cloth' is related with the Biblical professional designation for fuller, the Hebrew *kōbēs*. That suggests that the technique of fulling by walking the cloths was common practice through the ancient Near East still during the 1st millennium BC.[33]

Raising, shearing and polishing the nap

Following the washing treatments, the soaked textiles had to be presumably rinsed, then wrung thoroughly and hung out in the sun or in a place with enough fresh air circulating through the textile.[34] These stages were essential tasks to be carried out before subsequent processes of the raising, shearing and polishing of the nap.

Several Roman frescos testify to the performance of these operation: the paintings from the House of the Vettii at Pompeii represents a cupid brushing a

understood by the ancient scholars, who were unfamiliar with the material world of textile production. It is, however, noteworthy that in TC 3/I 17 and in contemporary lexical texts, *kamādum* is directly followed by *qatāpum* 'shearing', thus overlooking the step of the teaselling, whilst, when *kamādu* is preferred to *mašādu* as in the case of text AO 7026, it is immediately followed by *mašārum* 'teaseling'. Thus, I propose that the verb *mašādu* might denote a kind of synthesis of the two technical operations indicated by the verbs *kamādum* and *mašārum*. For a terminological study of the technical operations described by the verbs *kamādum* "foulage à la main" and *mašārum* "lainage", see AO 7026 in Lackenbacher 1982. See also Michel & Veenhof 2010, 252; Veenhof 1972, 105-109. CAD K, 108, sub *kamādu* and 121 sub *kamdu* and *kāmidu*; CAD M/I, 71, sub *maḫaṣu*.

32. MSL XII, 177:13; 204:9.

33. CAD K, 5 sub *kabāsu*; see also the substantive *gabaṣu* "contraction" (CAD G, 3) and the verb *kapāṣu* "to bend over, to curl" (CAD K, 181).

34. The rinsing in fresh water was to wash the excess chemicals out and with them the greases and the lye's stink they had released. Unfortunately, there is no evidence from Classical antiquity for this stage of the fulling process: rinsing is not discussed in literature,

Fig. 2. Upper section of the fresco of the *Pilastro dei Fullones* (9774 b) from the *fullonica* of Veranius Hypsaeus in Pompeii depicting textile finishers working in the *fullonica*; on the left a teaseler raises the nap of the cloth with a brush whilst a woman and a little girl inspect the processed textiles; on the right a men carries the *viminea cavea* and a bucket with sulphur or another bleaching substance. 1st century AD, Museo Archeologico Nazionale di Napoli, after De Albentiis 2002, 137.

piece of cloth; the fresco from the fullery of Veranius Hypsaeus (VI 8, 20-21.2) depicts a fuller busy performing the same procedure (Fig. 2).[35]

Flohr, one of foremost authorities on Roman fulling, stated that these technical operations "seem to have belonged to the core business of *fullones*".[36] Perhaps for this very reason, metonymic overlapping between the verbs describing the actual fulling (as performed first during the washing) and those related to the raising, shearing and polishing of the nap is found both in Bronze and Iron-Age texts. Classical texts report that fulled textiles were treated with gentle brushes or special combs named teasels (Gr. κνάφος; Lat. *aena fullonia*) able to raise the nap of the woollen cloth without damaging its weave. From the ancient Greek word κνάφος 'teasel' come the terms κνᾰφεῖον 'fulling workshop; laundry' and κναφ/γναφεύς 'fuller'. This latter noun is descended from the occupational name Myc. *ka-na-pe-u* 'fuller' found in the Linear B tablets from Pylos and Mycenae in relation with sheep wool and not vegetal fibres.[37] This fact suggests that even before the 1st millennium BC, in the Aegean area, the raising, shearing and polishing of the nap of woollen textiles underwent a fulling process so important as to lend its name to the profession as a whole.[38]

In the ancient Near East, the textile terminology applied to some finished products provides evidence that the fulling of woollens included the performance of these following steps, at least since the end of the 3rd millennium BC. Among the different woollen items delivered to the fullers of the Ur III texts, the

nor is it depicted in paintings or reliefs. Regarding the drying, depictions of the fulling process from Pompeii, Ostia, Roma and Sens show clothes hanging out over beams. Seneca describes a fullo, 'fuller', as sprinkling water over a garment stretched out to be brushed in order to moisten it: this suggests that fulled textiles were usually dried before polishing. See Flohr 2013, 104-105 and 108-109. Ethnographical comparison with the fulling of pre-industrial Europe attests the importance of this practice: wet or damp woollens had to be dried in a place with a sufficiency of circulating fresh air, by hanging them over beams or spreading them out over a large wooden frame called a 'tenter' to prevent their shrinkage, as well as stopping the development of a rather unpleasant fusty smell. As noted by Quillien (2014, 286), in ancient Near Eastern religions, the (pleasant) smell of something in part denotes the god's radiance. Thus fullers and bleachers often are recorded as recipients of aromatics and scented resins to perfume the clothes, thereby covering any residual stench of the chemicals used in fulling and dyeing processes.

35. Flohr 2013, 113-115 and Fig. 26 and Fig. 27.

36. Flohr 2013, 113.

37. PY Cn 1287, En 74/Eo 267, Eo 269; My Oe 129, Oi 701. See Del Freo *et al.* 2010.

38. Some tablets from Pylos testify to the importance of this profession in the Mycenaean world. One text records a man named Pekita, a craftsman from Cyprus, as fuller of the king (Myc. *ka-na-pe-u*, *wa-na-ka-te-ro*). See Palaima 1997. Pekita may be a nickname linked to the task performed by this craftsman: it is related to the Mycenaean *pe-ki-ti-ra*, the occupational name designating 'female combers, carders' and to the finished fabric named *te-pa pe-ko-to*, a very heavy wool cloth most likely first undergone to the thickening and fulling processes and then intended to be teased until reaching an hairy appearance resembling the sheep fleece (Myc. *po-ka*). Yet, with regard to the weight of the *te-pa pe-ko-to* textiles, Del Freo et al. 2010, 357 state: "How and whether this fact is technically related to combing is still an open issue". The above-mentioned Mycenaean terms are all connected to the root **pkt-en* from which derive Lat. *pecten* and Gr. κτείς 'comb' and πέκω 'to comb', whose meaning "in Mycenaean Greek therefore seems to cover both the treatment of wool and also a treatment of textiles" (Del Freo et al. 2010, 358).

túg guz-za is described as 'a special fabric of flocky and shaggy texture'.[39] The tablets of Girsu prove that this fabric underwent the túg sur-ra and túg kin-DI-a treatments performed with oil and alkali and hence it can be considered a kind of fulled textile.[40] Furthermore, in the early 2nd millennium BC, túg guz-za (akk. túg*gizzu*) *"étoffe poilue ou rêche"* is the only type of textile qualified in the texts of Mari as bar-kar-ra or *barkarrû*, an adjective denoting a coarse waterproof fabric.[41]

Around the same time the Old Babylon tablet AO 7026 and a lexical text demonstrate unequivocally that the shagginess of the túg guz-za resulted from the raising of the nap of the cloth (Akk. *mašāru*) by the fullers with at least two different kind of teasels.[42]

The contemporary Old Assyrian text TC 3/I 17 gives the following instructions: "Let them full/comb/prepare for raising one side of the textile (*ša ṣubātim pānam*); they should not shear it (*lā iqattupūšu*); its weave should be close (*šutûšu lu mādat*) … the other side (*pānam šaniam*) one should full slightly (*i-li-la limšudū*). If it is still hairy (*šumma šārtam itaš'û*), one should shear it (*liqtupūšu*) like a *kutānum*".[43] The text records therefore the shearing of a formerly brushed side, perhaps the outer one, in order to clip the hair extracted by the teasels and to get an even and smooth surface. The verb utilized is *qatāpu* 'to shear, to crop' rather than 'to pluck', found also in the series Lú as LÚ.TÚG.PA.KU_5.RU/DU = *qá-ti-pu*.[44] In the Old Babylonian text AO 7026 the same procedure is performed in the finishing of the TÚG BAR.DIB (*nanbû*) and TÚG *šē-e-tim* under the name of *laqātum* 'to gather, to pick up', a verb sometimes written with the logogram KU_5, which occurs in two different operations (*laqātum pānum* and *laqātum lā pānum*) performed on the surface of a fabric.[45]

These cuneiform texts demonstrate that many of the technical processes required in the Middle Bronze Age finishing of textiles were actually comparable to those described by Greek and Roman sources in the 1st millennium BC. Furthermore, túg guz-za, *kutānum* and other woollen fabrics produced by Mesopotamians fullers show several analogies with some thick, water-resistant woollen cloths still manufactured in Europe with traditional techniques as the *loden*, the *panno casentino* and the Sardinian *orbace*: these fabrics, renowned for their sturdiness and endurance, first undergo the shrinking and fulling treatments and subsequently are brushed with a fuller's teasel; then the nap is cropped.

If the textile terminology of Bronze Age cuneiform texts provides evidence that the technical operations carried out by 1st millennium fullers and described by Classical sources were already performed in the

39. Oppenheim 1948, 32, G1 n.3; Waetzoldt 1972, 291.

40. Firth 2013.

41. Durand 2009, 35 and 99. Two texts from Mari (T.518: 4 and T.519: 4 in Durand 2009, 35) connect the túg guz-za with a cloth named túg *hu-ru-ru*. The name of this textile might be related to a technical procedure listed also in the contemporary AO 7026. In the Old Babylonian text, the finishing operation is closely linked with another (*neṣûm u hurrurum*). Lackenbacher (1982, 142) translates the term *nesûm*/*našûm* "racler, enlever en grattant et même arracher" and *hurrurum* "rayer, mettre (les fibres) parallèlement". The French scholar distinguishes the use of the D form *hurrurum*, applied to hair and fibres, from the G one *ḫarārum*, whose primary meaning is 'to dig'.

42. MSL XII, 177: 5-8; 204: 4-5; 194-195 in MSL X, 133; Lackenbacher 1982.

43. *šumma šārtam itas'û kīma kutānim liqtupūšu* "if it (*pānam šaniam*) proves still to be hairy let one shear it like a *kutānum*", in Michel & Veenhof 2010, 250-252. See also TC 3/I 17, 12-14 and 19-22 in Veenhof 1972, 104.

44. MSL XII 177: 14, 204: 10, Veenhof 1972, 106; Michel & Veenhof 2010.

45. Lackenbacher 1982, 144 rejects the translation of laqātum as with the meaning 'to crop, to trim' and thus as an equivalent of *qatāpu*, because the former verb is also found in a context of linen bleaching; she prefers to translate it as "enlever (les impurités)", considering *pānum* "une partie cousue et donc amovible" rather than one of the two sides of the cloth. Therefore, I suggest that *laqātum pānum* and *laqātum lā pānum* are detailed instructions to trim one side of the cloth and to leave the other without shearing, and thus that this is a parallel of TC 3/I, 17. Indeed, these two operations are both performed only on the surface of bar-dib sig MA IM TE NA, the *ṣubāt šētim* ÚŠ and bar-dib ÚŠ, whilst the different qualities of GUZ.ZA and the wool cloth named TÚG BAR.DIB SIG *lahāritum* had to undergo an alternative kind of teaseling named *šartum leqûm* "tirer pour (obtenir) le poil". Since *šartum leqûm* is one of the last operations before the seizing (Akk. *puššuru*) of the cloth, in this step the hair has to be further brushed and curled. This finishing treatment of the cloth, is still performed in Italy where is named *rattinatura* and was carried out in Tuscany until recent times to produce the *panno casentino*; the hair of the inner side was merged into flakes, dumplings, knots and waves by rubbing and pressing them with a stone until an appearance similar to the animal fur was attained.

ancient Near East during the previous two millennia, then too the study of the raw materials and the natural resources involved in the cloth-making process can demonstrate how similar were the treatments of fulled textiles across the millennia.

Terminology of natural resources exploited as raw materials and tools

Minerals as alkali sources and detergents

Among the mineral sources of alkali, natron (Lat. *nitrum*; Gr. νίτρον, λίτρον) was in ancient times the most coveted. It is a natural mixture of sodium carbonate, sodium bicarbonate and sodium sulfate along with small amounts of other salts (halite, sodium chloride), and was used to perform many different tasks. The use of natron was advantageous because it was found ready for use in nature: no further costs of extraction of the soda carbonates accrued, as was the case for other sources of alkali.

Even so, natron is found only in contexts with specific pedological and ecological conditions. The most famous provenances were localities in Egypt, where the word used was *ntrj*, 'to be pure, clean'. Here, the flood waters of the Nile permeated the soil and, once evaporated, deposited incrustations of carbonates of soda.[46] Sodium carbonates used by Greek and Roman fullers had to be imported from far away and were thus rather expensive: during the Ptolemaic period, Egyptian natron formed an important state monopoly, proving that it was a very profitable business.[47] Strabo and Pliny report that in the period straddling the 1st century BC to the 1st century AD, natron (Lat. *nitrum*; Gr. νίτρον, λίτρον) was still imported from Egypt.[48]

During the 1st millennium BC the use of natron in textile manufacturing is attested in Near Eastern textual documentation too: Neo-Babylonian and Neo-Assyrian tablets record the importation of natron (Akk. *nitiru*/*nitru*) from Egypt in abundance beside alum (Akk. ^{na4}*gabû*, *aban gabî*), another substance used in the finishing of textiles. In the Bible, natron (Heb. *neter*) is mentioned for its cleansing power alongside the *bōrît*-grass, a kind of soapwort used by fullers of the ancient Israel.[49]

Classical sources quote however fuller's earth (Lat. *creta fullonia*) as the detergent *par excellence* used by fullers in textile laundering, whitening and presumably in cloth-making. Under this generic label are collected several mineral substances very different from each other in their sedimentological and chemical qualities. These soft clay-like materials, actually often derived from powdered rocks, share alkaline and smectic properties: once rubbed onto the fabric, they absorbed and removed the greases, imparting a lustre and brightness to the cloth.[50]

The variable amount of the component substances (iron, magnesium, alkaline metals, alkaline earths) naturally contained in these washing powders confers on them absorbent, cleaning and, eventually, whitening properties as in the case of the bentonite, montmorillonite, kaolinite and saponite 'clays'.[51] In his *Naturalis Historia*, Pliny the Elder mentions several qualities of fuller's earth (Lat. *creta fullonia*) that possess different properties and, consequently, different purposes.[52]

The most appreciated species of fuller's earth came from the Eastern Mediterranean: straight after the first-rate 'tobacco-pipe clay' (Lat. *terra cimolia*; Gr. κιμωλία γῆ) from Kimolos in the Cyclades, Pliny mentioned the 'clays' from Thessaly and Epirus and those from the islands of Cyprus, Samos and

46. Brunello 1973, 44-45.

47. Brunello 1973, 44.

48. Brunello 1973, 44.

49. Oppenheim 1967, 243; Jeremiah II, 22; Malachi, II, 2.

50. Cf. Rougemont 2011, 375; Firth 2013, 140: "Although the wool would have been washed before it was spun, there would have some residual natural oils in the wool. In addition, oil may have been used to lubricate the threads during weaving."

51. Pliny, NH, 17, 4.

52. For instance, Pliny (NH, 35, 196) refers to the use of fuller's earth from Sardinia (*creta sarda*) which was used with sulphur (*sulpur*) and employed in the cleaning or bleaching of white fabrics, Moeller 1976, 20; Robertson 1949.

Lemnos.[53] The first reference to the use of the kaolin gypsum from Κίμωλος is found in a comedy of Aristophanes and dated to the year 405 BC.[54] In the 4th century AD, a kind of mineral powder from the Cyclades is also mentioned by the *Papyrus Graecus Holmiensis*. Because of its 'astringent' and 'caustic' power, this mineral was compared to the alum used both in the tanning of skins and as a mordant in the dyeing of textiles; hence it was called *stupteríōdes gē* — Greek, "earth containg alum" — a denomination used by Aristotle, Strabo and Pliny some centuries earlier.[55]

In Mesopotamia, it seems highly likely that the identification of this mineral detergent should be with the raw material named in cuneiform texts ^{na4}im-babbár (Akk. *gaṣṣu* 'gypsum, plaster'), literally "white earth", because since the end of the 3rd millennium BC it was delivered in large quantities to the fullers for the finishing of cloths.[56] At present, the sedimentological composition of this substance has not yet been elucidated, though the most recent studies have shown that this earth is probably not a kind of clay, but an alkaline powder obtained by crushing minerals such as limestone or chalk together with other cleansing substances like sulphur or another kind of mineral powder named ^{na4}im-sa$_5$ 'red earth'.[57]

Vegetal detergents and sources of alkali

The use of alkalis in the bleaching of linen and in glass and soap-making makes these raw materials important and expensive, especially when they were imported from far away like the above-mentioned natron. There were other and cheaper sources for such. Classical sources refer to the use of stale urine: animal or human excrement undergoing the nitrification process on the way to becoming ammonia.[58] It is not clear where the *fullones* procured this matter for their workshops, whether from nearby stock-farms or even from the urban public toilets.[59] According to R. J. Forbes, "in ancient Mesopotamia, like in modern India, it [potassium nitrate used in glass-making] was obtained as an efflorescence of the soil in certain places where organic matter decayed (cattle yards and stables)" but no cuneiform text suggests a use of urine (Akk. *šīnātu*; Sum. kàš) in the washing or finishing of textiles.[60]

Therefore it is probable that alkalis were obtained from other sources in Mesopotamia before the introduction of Egyptian natron, and later again as its low-priced surrogate. Neo-Sumerian texts show the delivery of a great quantity of vegetable ashes, besides animal and vegetal oils, to the fullers of the city of Girsu for the túg šà-ha, túg kin-DI-a and túg sur-ra treatments of cloths.[61] Actually, the greatest part of the modern and ancient terms denoting soda or, more extensively, lye-wash, are in some ways linked with the incineration of vegetal matters and the resulting cinders. For instance, the English *alkali*, a modern synonymous for *potash* 'vegetal lye made by burning wood to ashes in a pot', derives from the Ar. *al-qalīy* 'calcined ashes', in its time related both to the Akkadian verb *qalû* 'to burn, to roast' and with the term *qīltu* used in Neo-Assyrian tablets to indicate both the

53. Rocci 1718 sub στυπτηριώδης; Pliny, NH 35, 195-201.

54. Arist. *Batrakhoi*, 713. See Robertson 1949.

55. Healy 1999, 286; the adjective *stupteríōdes* used to denote this kind of earth indicates it was 'alum containing' or 'astringent'.

56. Firth (2011) carried out an accurate analysis on the sedimentological and chemical properties of the different candidates proposed for the identification of ancient fuller's earth, determining the use of the im-babbar$_2$ and its usage by the fullers in the Mesopotamian textile industry; Firth 2013, 146.

57. See Firth 2011. CAD G, 54 sub *gaṣṣu*. Note that Pliny (NH, 35, 195) with reference to the *creta cimolia*, in Roman times the most generally used type of fuller's earth, distinguished too between a white (*candidum*) and a reddish (*ad purpurissum inclinans*) variety.

58. Pliny, NH 38, 66, 91 and 174; Moeller 1976, 13, 20 and 96; Flohr 2013, 103-104.

59. Martial, VI, 93; Moeller 1976, 20; *contra* Flohr 2013, 171: "Thus, on closer inspection, there is no literary evidence for public urine collection by fullers".

60. Forbes 1965, 181. Once dissolved in boiled water and washed and refined for days this mixture of salt and saltpetre gave some crystals of an alkaline mineral (Akk. *mil'u* and *anzaḫḫu*) used in the glass-making.

61. Waetzoldt 1972, 172; Firth 2013.

lye and the plant from which alkaline ashes were obtained during the 1st millennium BC.[62]

It seems likely too that the Biblical *bōrît*, the 'vegetal ashes' obtained by burning a grass or bush named *gasûl,* and used by fullers of ancient Palestine to prepare the lye and to clean clothes, has to be related to the Heb. *bārar* 'to purify, to cleanse' and to the Spanish word *barrilla* and its anglicization *barilla*, a term used since the Middle Ages to denote soda ash and saltworts, glassworts and seaweed, plants that contain widely varying amounts of sodium carbonate and some additional potassium carbonate.[63] In fact, only a few centuries ago, the chief source of alkali consisted of some prickly plants growing by the sea or in saline localities such as salt marshes and commonly named glassworts or saltworts (*Salicornia* spp., *Arthrocnemum* spp., *Halocnemum* spp. *Salsola* spp. and *Kali* spp.). When dried and burnt, these succulent and halophyte plants, mostly belonging to the *Amaranthaceae* family (Fig. 3), produce the best alkaline cinders used in soap- and glassmaking and in bleaching linen.[64]

In the Eastern Mediterranean and Mesopotamia *Salicornia europaea*, *Salsola soda*, *Salsola kali*, *Kali tragus* and *Halocnemum strobilaceum* grow along the brackish swamps, in the saline semi-deserts and obviously nearby the seashores.[65] A philological analysis of the terminology actually highlights the link between the term for alkali (Sum. ^{na4}naĝa; Akk. *uḫultu*/*uḫūlu*; Hitt. *ḫas*(*s*)) to some plant species grouped under the hypernym Ú.NAGA/ ^{ú}teme 'saltwort, alkaline plant'.[66]

Lexical lists of the 2nd millennium BC record among these the *šāmiṭu*, *mangu* and *qaqqullu* plants,

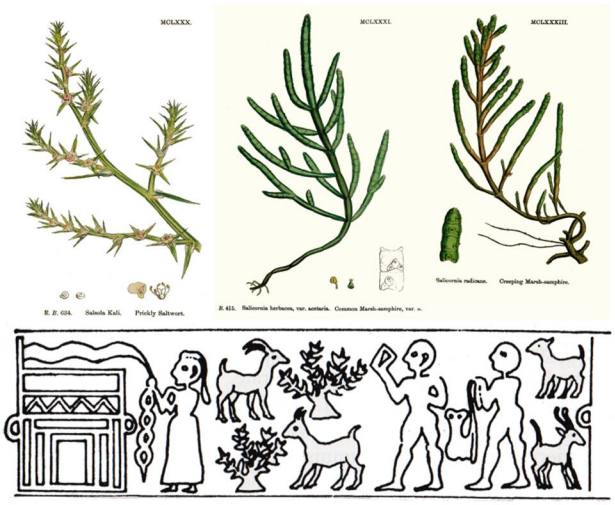

Fig. 3. On the top: *Salsola kali* and *Salsola herbacea*. *Salicornia rudicans* in En. Bot. 1180, 1183, 1868. On the bottom: Uruk sealing with a possible representation of a prickly saltwort, likely belonging to *Salsola* sp. After Liverani 1988, 137, fig. 25-3.

though the plant mostly quoted in glass-making is the *uḫūlu* -plant (Sum. ^{ú}naĝa).[67] The ashes from the *uḫūlu* can be found mixed with oil, fuller's earth or alum according to the use.[68] Sometimes the texts qualify *uḫūlu* with the epithet *qarnānû* (SI) 'sprouted'; the relation of the term with the Akk. *qarnu* 'horn' could support the identification of *uḫūlu qarnānû* (Sum. Ú.NAGA SI/ ^{ú}naĝa-si-e$_3$) as a species belonging to the *Salicornia* or *Salsola* genera, characterized by plants with succulent branches similar to horns (Fig. 3).[69] Another species of saltwort could be denoted by the phytonym *qīltu* that in 1st millennium BC denoted a soda plant and its derived lye. Indeed,

62. CAD Q, 252 sub *qīltu*. In the Mari texts the term *ammidakku* perhaps refer to a kind of lye used in the early 2nd millennium BC for the purification of metals, CAD A/II, 75 sub *ammidakku*. Differently from *qīltu* it is not sure whether *ammidakku* is made from vegetable ashes, CAD A/II, 75 sub *ammidakku*.

63. Malachi III, 2; Jeremiah II, 22. See Forbes 1955, 179-180; Forbes 1965, 140-141; *contra* Brunello 1973, 54 who, though, refers to the use of *Salsola kali* among the fullers of ancient Palestine, and interpreted *bōrît* as a botanical term and not as vegetable product. Moreover, he identified it with the common soapwort (*Saponaria officinalis*).

64. Levey 1959, 128; Brunello 1973, 54; Moorey 1999, 212.

65. Levey 1959, 122 uses the old nomenclature *Salsola kali* "the soda plant, grows near the Dead Sea today and is common in Syria, Egypt and Arabic"; see CAD Q, 69 sub *qalû*.

66. Forbes 1965, 141.

67. See CAD S/1, 313 sub *šāmiṭu*; CAD M/1, 211 sub *mangu*; CAD Q, 124 sub *qaqqullu*.

68. CAD U-W, 48-50 sub *uhūlu*.

69. CDA, 419 sub *uhulu*(*m*): NB also *uḫḫulu*, Ug. *uhhunu* m. & f. (an alkali-rich plant) 'potash', Bab. [(Ú.)NAGA]; as mineral; for soap; in glass recipe; esp. *u. qarnāti*/*qarnānu* [(U.)NAGA.SI] '*Salicornia*' and similar plants for glass, drug. See CAD U-W, 49 sub *uḫūlu* d; CAD Q, 134 sub *qarnu* and 133 sub *qarnānû*.

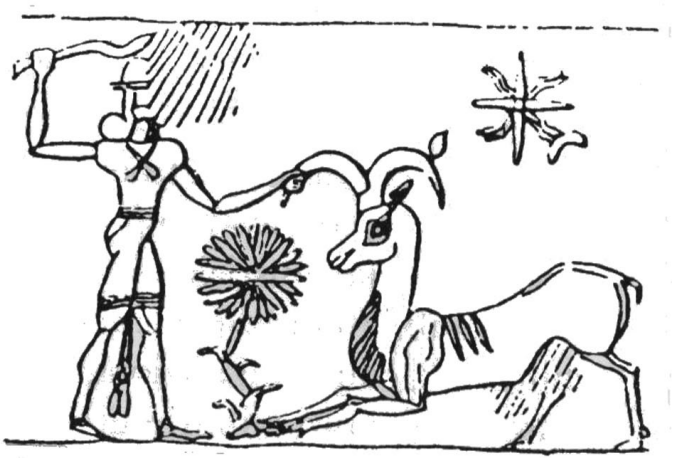

Fig. 4. Plant belonging to the wild thistle's group (*Carduus* sp.), photo by Elena Soriga. Its possible representation appears in a scene of sheep shearing from a Middle Assyrian seal, 13th century BC, after Liverani 1988, 595, fig. 110-4.

the term could be linked both to the verbal adjective *baqlu*/*baqiltu* 'sprouted, horned', and to its staple product, the burnt material (Akk. *qilûtu;* Sum. gibíl KI.NE) used as alkali.[70]

On the other hand, the soda plant named *uḫultu* (Ú AN.NU.ḪA.RA) is never qualified as sprouted; it produces a salt quoted in the texts as *aḫussu* or *alluḫaru*/*annuḫaru* used also in tanning of skins and as a mineral dye or mordant to produce a white colour.[71] In Mari texts, dating back the beginning of 2nd millennium BC, the *annuḫarum* used in the finishing of textiles has been interpreted as 'white alum' in opposition to another substance named *qitmu* 'black alum'.[72] In the 1st millennium BC *aḫussu*, interpreted as by-form of both *uḫulu* and *uḫultu*, is found in Neo-Babylonian texts from Ebabbara relating to the bleaching of the linens.[73]

The tablets of the same archive record another phytonym, denoting a plant used by fullers as a bleaching agent, whose name is composed by the sign NAGA: the GIŠ.NAGA plant.[74] According to Zawadzki this sign has to be read gad-šu-naga (Akk. *bīnu*) 'tamarisk' and "not alkali".[75] The tamarisk (*Tamarix aphylla*) is an evergreen tree growing on beaches by the sea and along watercourses in arid areas throughout the Near East. Its occurrence in the above-mentioned texts can be explained by the fact that it is *per se* a source of alkali: its leaves are able to accumulate and exudate sodium carbonate, thereby allowing plant to tolerate saline soils and alkaline conditions; hence its name 'salt cedar' in the vernacular. In addition to producing the soda ash, the burning of the plant could itself be used to bring to the boil the water for the lye; and to assist in the long, drawn-out incineration of the

70. CAD Q, 252 sub *qīltu* "a plant from which lye is extracted: Ú NAGA (ŠE+SUM+IR): ú *qi* (*var. qí*)-*il*-*tu*[*m*], Ú NAGA.SI, Ú SA.AD.GAL : Ú MIN *qar*-*ni*, Uruanna II 271-273"; CAD B, 100 sub *baqlu*: naga(ŠE.SUM+IR).ḫu-tul, MIN-gu-li = *ba*-*q*[*i*]-*il*-*tum* in Hh. XXIV 288f.; CAD Q, 252 sub *qilûtu* 'firewood, burnt material'.

71. CAD U-W, 48 sub *uḫultu*; CAD A/I, 216 sub *aḫussu*; CAD A/I, 359-360 sub *alluḫaru*.

72. Joannés 1984, 142.

73. Zawadzki 2006, 63 and n. 129.

74. BM 84054 and BM 83647 in Zawadzki 2013, 65 and n. 39; Zawadzki 2006, 61, n. 128 reports the case of a bleacher named Balassu and a fuller named Šamaš-šu-iddin who receive tamarisk for producing alkali. This indicates that the *ašlāku* can occasionally act as *pūṣāya*. See also Quillien 2014, 285 and n. 102.

75. Zawadzki 2006, 63 and n. 129.

saltworts for producing alkali, mentioned in Neo-Babylonian texts beside tamarisk and sesame oil.[76]

Because of its high alkali content, the tamarisk was considered in Mesopotamia and the Levant as a holy (Akk. *quddušu*) tree: in the *The Date Palm and Tamarisk* disputation poem, the tamarisk claims itself to be the chief exorcist for purifying the temple.[77] Indeed in Mesopotamia as well as in the rest of the ancient Near East, cleaning, personal hygiene and ritual cleansing are closely linked aspects. Cuneiform texts quote other plants used in cleansing rituals, in medicine and in magic whose name suggests their exploitation in soap-making as a source of alkali.

The Syrian or wild rue (*Peganum harmala*) is for instance a succulent aromatic plant, rich in alkaloids, and known in Mesopotamia (Akk. *šibburrātu*) mainly as a drug.[78] Its Sumerian phytonym Ú.LUḪ.MAR.TU(.KUR.RA), literally meaning 'cleaning/cleansing plant of the highland Amorites', however suggests that wild rue was known for its detergent properties too.[79]

Vegetal oils and animal fats for detergents

Homer's epic poems describe not only wool but also fabrics and garments with different adjectives and expressions related to the idea of a treatment with oil or fat.[80] In the Bronze Age texts dealing with the finishing of woollen textiles, alkalis are mentioned alongside vegetal oils or animal greases.[81] These fatty substances could be made up into a soapy lump which was rubbed on the surface of woollen fabrics. when they were scoured in the washing.[82]

The most ancient evidence for the exploitation of animal fats and vegetal oils in the production of soapy detergents to be used for the finishing of textiles comes from Southern Mesopotamia and dates to the end of the 3rd millennium BC.[83] Indeed cuneiform texts from the Sumerian cities ruled by the 3rd Dynasty of Ur record different kinds of fatty stuffs (Sum. Ì; Akk. *šamnu*) related to different treatments of cloths performed by fullers.[84] The tablets from Girsu, modern Tello in Iraq, listed sesame oil (Sum. ŠE.GIŠ.Ì) and swine fat (Sum. Ì. ŠAḪ) for textiles intended to undergo the túg šà-ha, túg sa-gi$_4$-a and túg-ge ak(-dè) finishing treatments.[85]

Vegetal oil (Ì.GIŠ literally 'oil of three') was the chief fatty stuff used by fullers.[86] *Šamaššammū* (Sum. ŠE.GIŠ.Ì/ ŠE.Ì.GIŠ literally 'seeds of the plant of oil') was the main source of vegetable oil in Mesopotamia.[87] This oleiferous plant is traditionally identified

76. Zawadzki 2006, 63-65.

77. Umbarger 2012. Tamarisk is also known with the phytonym ^{ú}*túllal*, related to the verb *ullulu* "to purify, to cleanse".

78. CAD Š/II, 376-377 sub *šibburrātu*: "For a possible cognate, Syr. *šabbāra* 'rue' (*Peganum harmala*)".

79. In Hittite cuneiform texts this plant, named *ḫasuwāi*^{SAR}, occurs indeed among the species of soda plants (ŠE+NÁG) used in soap-making. Forbes (1955, 180) refers to a Mesopotamian lye obtained by burning rue (*Ruta graveolens*) but no alkaline property is known for this plant. A species of rue is mentioned for soap-making by Pliny (NH 28, 191) too: "*prodest et sapo; Gallorum hoc inventum rutilandis capillis*".

80. Shelmerdine 1995, 101-102.

81. Mycenaean texts report the use of *e-ra-wo* (Gr. *elaion*) in the manufacturing and finishing of some pieces of cloth, see Shelmerdine 1995, 103-104. More often olive oil is indicated on the Mycenaean tablet by the ideogram OLE. During the Minoan period, the Linear A sign L49 indicated most likely olive oil, see Melena 1983. The fragmentary tablet Xe 7711 from Knossos might record the treatment of woollen cloths with perfumed or unscented oil, given to a fuller by a perfumer. Tablet Fr 1225 from Pylos records the offering of an ointment for smearing the garments - thus woven fabrics - of the *u-po-jo* Potnia, maybe the 'Goddess of the Weaving', see Rougemont 2011, 338-381 and Del Freo *et al*. 2010, 360-361.

82. Levey 1959, 125-129; Waetzoldt 1972, 159.

83. Waetzoldt 1972, 159.

84. Waetzoldt 1972, 153-174; Waetzoldt 1985, 83-86; Firth 2013. The Akkadian word *šamnu* denotes generically both animal and vegetable oil meaning 'oil, fat or cream', see CAD Š/I, 321 sub *šamnu*.

85. Waetzoldt 1972, 158-159. The túg šà-ha, túg sa-gi$_4$-a and túg ge ak(-dè) treatments will be analyzed in the next paragraph that concerns the terminology of the verbs denoting technical operations.

86. The above-mentioned tablets from Girsu report that 56% of the total of fat substances used by fullers in the manufacturing of cloths undergoing the túg šà-ha, túg sa-gi$_4$-a and túg-ge ak(-dè) processes was sesame oil; sesame oil even accounted for 98% of the total of fat substances suitable for royalty, see Firth 2013, 140.

87. CAD Š/I, 301 sub *šamaššamū*. In the early 2nd millennium BC two varieties of the ideogram for *šamaššammū* have been noticed:

as sesame (*Sesamum indicum* or *S. orientale*) because of the similarity of the Akkadian term with the Semitic *smsm*, Greek σήσαμον and Latin *sēsăma*. The term (Myc. *se-sa-ma*) appears furthermore already in the Linear B documentation from the Late Bronze Age Aegean, but sesame seeds recorded on tablets of the Ge series (602, 605, 607) from Mycenae seem to have been used as spices and not as an oil source.[88]

Nevertheless, the botanical identification of *šamaššammū* is still a controversial issue, since the etymology of the most ancient Semitic terms (Akk. *šamaššammū*; Ug. *šmn*; Heb. *šemen*), as well as the Sumerian še-ĝiš-ì, simply point to the main product derived from this vegetable resource: the *šaman šammi* 'oil of plant'. Thus, it can refer to several other plants with oleaginous seeds.[89]

In the Mediterranean area, where the main oil-producing plant is the olive tree (*Olea europaea*), olive oil was used also for industrial purposes. The olive tree was cultivated in the Near East too, in Syro-Palestine, from at least the Chalcolithic Age. Palaeoecological investigations have proved the presence of its cultivation in Syria in the Early Bronze Age. Its first textual attestation (Sum. GIŠ.Ì.GIŠ) comes from the archives of Ebla and dates back to the second half of the 3rd millennium BC. The Neo-Sumerian texts from Girsu, at the end of the 3rd millennium BC, provide the first evidence of the importing of olive oil in Mesopotamia.[90] Cuneiform tablets from Mari inform us that the imported olive oil (Akk. *šaman sirdi*; Sum Ì.GIŠ ZI.IR.DUM/ Ì.GIŠ ZI.IR.DU(.UM) was produced in the Amuq valley and the most valued comes from the coastal city of Alalakh, whence a text records the delivery of 2000 litres of oil.[91] The coeval and neighbouring site of Pyrgos-Mavroraki on the southern coast of Cyprus preserved vestiges of a Middle Bronze Age industrial and commercial complex, where both olive oil and textiles were produced.[92] During the Late Bronze Age, the textual sources show that the amount of olive oil (Ug. *šmn*) produced at Ugarit per year was so much (5,500 tonnes) that the surplus from this Canaanite city was exported to Egypt and Cyprus.[93]

In cuneiform texts, olive oil appears listed among other precious foodstuffs, or was used as an ingredient in precious perfumes, ointments for the body or medicine.[94] Therefore, it seems to be a luxury good and an industrial purpose is perhaps therefore to be ruled out. Only in a single text is olive oil associated with a textile context: a text from Mari records the delivery of olive oil to women weavers (Akk. *ana pašāš išparātim*) as an 'ointment'.[95] It seems more

in the kingdoms in which the scribal traditions of the Upper Mesopotamia prevailed (Mari, Tell Rimah, Nuzi and Assur) the writing še.ì.giš is preferred to that of še.giš.ì used in Babylonia, see Reculeau 2009.

88. Rougemont 2011, 355.

89. CAD Š/I, 301 and 306 proposes to identify *šamaššamū* with *Linum* sp. "since no sesame seeds have so far been found in Mesopotamia in archaeological contexts earlier than the Sassanid period, whereas there is an abundance of linseed remains…the name [for *Linen* sp. = *šamaššamū*] was later transferred to the newly introduced oleiferous plant, sesame". Oppenheim (1967) is of the same opinion; *contra* Bedigian & Harlan 1986. Nevertheless, linseeds are recorded in cuneiform documentation by the Sumerian noun numun-gu and the Akkadian term *zēr kitî*. For a more recent and comprehensive reassessment of the longstanding debate over the identification of *šamaššamū*, see Reculeau 2009.

90. Waetzoldt 1985, 77; Potts 1997, 66-68.

91. ARM IX, 9: Michel 1996; Reculeau 2009. The territory of Alahtum (=Alalakh) was purchased by the king Zimri-Lim at the end of his reign in order to satisfy internal needs without being dependent on commercial exchanges. Other texts record imports of olive oil from Aleppo: ARM IX 6, ARM VII 238 and ARMT XXVI/l, 22.

92. A large olive press for oil production was found during the excavations. The function of the Cypriote press is confirmed by the discoveries of a great number of jars containing residues of olive oil and of some olive-stones. The so-called Olive Press Room is next to the metallurgical area of the complex and contiguous to the room of perfumes and textiles, suggesting that this precious stuff could be used in the finishing of textiles, perhaps the sizing of the cloths with scented oils. The only parallel known for this period is found in Tell Hazor whilst others, a little later, come from Larnaca and Ugarit. See Heltzer 1987; Callot 1993; Belgiorno 2004; Karageorghis & Belgiorno 2005; Belgiorno 2009, 49-54.

93. The discovery of oil presses in the archaeological levels of Ugarit and Tell Hazor confirmed the production of olive oil in the Canaanite area, Heltzer 1987; Callot 1993.

94. CAD S, 312 sub *serdu* e.; see Stol 1985; Postgate 1985; Waetzoldt 1985.

95. Oil allotments granted as rations are called *piššatu* (Ì.BA/ Ì.GIŠ.BA/Ì.ŠEŠ$_4$), CAD P, 431 sub *piššatu*. The verb *pašāšu* could be

reasonable, however, that Ì.GIŠ ZI.IR.DU was given to the women as rations or remuneration for their work: its function as ointment has therefore to be interpreted as a body-lotion for the weavers and not as a product destined to be smeared on textiles.[96]

Furthermore, Akkadian and Sumerian terminologies supply evidence for the use of fatty substances of animal origin too. The above-mentioned texts from Girsu list swine fat (Sum. ì- šaḫ) beside alkali for the finishing of several textiles. According Waetzoldt, the use of swine fat was reserved for textiles of inferior quality.[97] In a recent paper, however, Firth proves that the swine fat used for finishing of textiles intended for the túg-ge ak(-dè) process may sometimes be classified as of royal quality (lugal). Since these texts are always gauged ì-šaḫ in sìla, it is likely that swine fat was used not in its solid physical shape, but in the form of a lard.[98]

In the second half of the 2nd millennium BC, a cuneiform text from the private archive of the prince Šilwa-Teššup of Nuzi testifies instead to the use of sheep fat (Akk. *lipû*; Sum. ì-udu) in close connection with the finishing of textiles.[99] In modern Mesopotamia and the Levant, this fat is extensively used in cooking. It is obtained in large part from the caudal appendage peculiar in the Awassi and the other fat-tailed sheep breeds. Iconographical and epigraphical sources demonstrate the preference for these breeds (Sum. udu-gukkal, literally 'sheep with the big tail'; Akk. *gukkallu*) since the 3rd millennium BC; the texts moreover record their presence at Nuzi in the period when *lipû* was used by fullers.[100]

Vegetal and animal teasels

Greek and Latin authors report that brushes to raise the nap of fulled textiles had spikes made of the prickles of a kind of thorn-bush (Lat. *spina fullonia*; Gr. γναφικὴ ἀκάνθη) or the spines of hedgehog skins (Lat. *erinaceus*; Gr. ἐχινῆ).[101] Actually the natural origin of the raw materials used to made teasels is suggested by the ancient terminology too: etymological studies related κνάφος and the verbs κναφ/γναφ-εύω 'to card, to wash, to full the wool', κνάπτω 'to comb, to card' and κνάω 'to scratch, scrape' to a common root linked with the spinose structures of bristly plants (Gr. άκαν 'thistle'/ άκανθα 'thorn, prickle, spine') and the stings of spiky animals (Gr. ἐχῖνος; ἀκανθίων 'hedgehog, porcupine').

The use of vegetable teasels is well-documented in the Middle Ages and later (Fig. 4).[102] Nowadays, this practice (It. *guernissaggio*) is still carried out in the teaseling of special woollen cloths like those made in cashmere, camel, alpaca, vicuna and guanaco. Unlike wire brushes, the thorns of prickly plants, mostly belonging to the genus of the thistle known as *Dipsacus fullonum*, raise the nap in a gentle way, breaking up the yarns rather than tearing the weave of the textile. Botanical terms (En. *thistle*/*teasel* and *cardoon*; Fr. *chardon à foullon*; German *Kardendistel*; It. *cardo dei lanaioli*/*scardaccione*) used to name this plant in modern European languages confirm this ancient custom of employing its spiny heads in the carding and teaseling of the wool.

The terminology of the Middle Bronze Age cuneiform texts demonstrate that Mesopotamian fullers too

used however also with the meaning of the sizing of textiles, CAD P, 245 sub *pašāšu*: [túg].ì.udu.ak.a = *pa-ša-šu šá* TÚG 'to treat a cloth with tallow', Nabnitu XXIII 330.

96. We find analogous ambiguities in the Aegean documentation: in the tablet MY Fo 101, OLE+WE 'oil for anointing' is allocated to various recipients, including *a-ke-ti-ri-ja-i* women (specialists in finishing or decorating textiles), but it is not clear whether the oil delivered was used by these workers in their labours. A similar situation arises from the tablet KN Fh 1056 where a tailor *ra-pte-re* receives 4.8 litres of oil. With regard to the text F. Rougemont (2011, 380) suggests that workers given this professional designation could be performing more operations than sewing alone.

97. Waetzoldt 1985, 83.

98. Firth 2013, 159.

99. Rougemont 2011, 374-375.

100. Breniquet 2010; Waetzoldt 1972, 5, 47-48. Fat-tailed sheep are still well-attested in the Middle Assyrian texts but later "became extinct in the first millennium" (CAD G, 126 sub *gukkallu*), since the *gukkallu*-breed occurs solely in Standard Babylonian and Neo-Babylonian literary texts. Local fat-tailed sheep breeds are still found in most of the Near East countries today as well as they are common in northern parts of Africa, Pakistan, Afghanistan, Iran, North India, Western China, Somalia and Central Asia.

101. Dioscorides, *De Mat. Med.* IV, 160; Pliny NH, 24, 111, 26, 244 and 17, 92. See Flohr 2013, 114.

102. Ryder 1994.

used two different types of teasels to raise the nap of the woollen cloths and that at least one was made of a thorny plant.

The lexical lists Lú B and Lú D, dating back to the early of 2nd millennium BC, provide information about at least two different modalities, or more properly tools, used by the fuller 'to teasel cloths' (Akk. *mašārum*), a finishing treatment recorded for the túg guz-za and túg bar-dib cloths immediately after the walking of the textiles (Akk. *kamādum*) in the contemporary tablet AO 7026.[103] In Lú B the fuller in charge of raising the nap is designated both as lú (túg)-giš-kiši$_{16}$-ùr-ra, thus the textile worker *ša i-na a-ša-gi-im i-ma-aš-ša-ru* 'who raises the nap with the *ašāgu*' and lú (túg)-bar-sig$_6$-ùr-ra, the artisan *ša i-na ku-un-ši-li-im i-ma-*[*aš*]*-ša-ru* 'who teasels with the *kunšillu*'.

The vocabularies used consider the *ašāgu* (GIŠ.Ú.GÍR/ ki-ši GIŠ.Ú.GÍR) as 'a common spiny plant' and identify it with a kind of acacia – like the *Prosopis farcta*, or a camel thorn – like the *Alhagi maurorum*.[104] Even so, in the lexical list ḪAR -ra = *ḫubullu* XIX, cloths are teaseled (Akk. *mašru*) with a plant named Ú.GÍR, an alternative writing of giš-kiši$_{16}$ but also a kind of hypernym for thorny plants in general.[105] In lexical texts, spiny shrubs or weeds with an evil smell or a bitter taste as the *apû*, *dadâ*, *dadānu* and *kurbasi* are glossed as Ú.GÍR and equated with the *ašāgu* plant.[106] The *kurbasi* is sometimes recognized with a kind of thistle, suggesting that the *Dipsacus* sp. could have been involved in finishing also in Mesopotamia.[107] Furthermore, the above-mentioned text TC 3/I, 17, 20 that gives instructions to comb 'slightly' (*i-li-la li-imšu-du*) one side of a woollen textile may suggest the carrying out of a 'gentle' brushing of cloth through the hispid trichome of vegetal teasels.[108] The verb *mašādu* has already been analysed above in connection with *mušṭu* 'comb' but in this case the use of the adverb *illillā* 'slightly' proposed by Veenhof could suggest a link with the *maša'tu*, a thorny plant identified by Uruanna with the ^{ú}*amumeštu* or ^{ú}*baltu* thornbushes.[109]

On the other hand, the identification of the *kunšillu* with a natural resource exploited in brush-making is a rather more problematic issue.[110] Other than ^{giš}kiši$_{16}$/Ú.GÍR, no determinative sign marks the term bar-sig$_6$/BAR-síg and thus it is not possible to understand whether it is a vegetal rather than an animal or mineral substance. Vocabularies provide three meanings for *kunšillu* (ba-ar BAR/ bar): 1) thorn used as teasel, carding-comb or teasel for fabrics; 2)

103. Lú D, 3-4 in MSL XII, 204 and Lú B, 5-6 and 7-8 in MSL XII, 177. See CAD M/I, 359 sub *mašāru* and CAD K, sub *kamādu* "to weave and prepare cloth in a specific way".

104. Halloran 2006, 34: $^{(giš)}$kišig(Ú.GÍR$_2$-*gunû*), $^{(giš)}$kiši$_{16}$ "a kind of acacia, *ašāgu*…*shok* (Arabic *shauk*), a thorny bush, prosorpis farcta"; CAD A/II, 410-411 sub *ašāgu*: "The *ašāgu* can be identified with the modern Arabic *šok* (*Prosorpis farcta* or *stephaniana*) a kind of acacia, one of the most widespread thorny shrubs of southern Iraq"; CDA 27: "camel thorn". To my knowledge, the only camel thorn that could be interpreted as *ašāgu* is *Alhagi maurorum*, a species of legume that grows in the saline, sandy, rocky, and dry soils across the Near East (Cyprus, Syria, Jordan, Lebanon, Israel, Iraq, Turkey and Iran). An Akkadian passage seems, however, to identify this thorn bush with another plant since it reads: "the plant whose appearance is like the sap of the *ašāgu* thornbush and whose seed is like the seed of lettuce is called 'sweet plant' " (CAD U-W 179, sub *upāṭu* c). Indeed, *Alhagi maurorum* is mentioned in the Qur'an as a source of sweet manna and its healing and sweetening properties are still well-known in local folk medicine and in cookery.

105. Hh. XIX, 194-195 in MSL X, 133.

106. Uruanna I, 79.

107. CAD (D, 17, sub *dadâ* and *dadānu*) identifies *dadâ* and *dadānu* as "stinking" subspecies of the *ašāgu*, in its turn interpreted a kind of false carob. Apart from the *ašāgu*-group is found another evil-smelling thorny plant, the *daddaru* "thistle-bush". This phytonym could be related to Heb. *dardar* "thistle" and according to my studies to the Sum. dar-dar = Akk. *tukkupu* "to puncture, to stitch". Another name for this plant is *kurdinnu*.

108. Veenhof 1972, 104.

109. Veenhof (1972, 106) admits, however, that the translation of the adverb *illillā* 'slightly' and its connection with *lillum* 'weak' is doubtful. CAD M/I, 360, sub *maša'tu*; CDA 201 "a plant with thorns"; Uruanna I, 192; CAD B, 65-66, sub *baltu*: "perhaps a camel thorn".

110. The Akkadian tool *kunšillu* and the noun *kunšu* (síg-peš-gilim-ak-a, síg-bar-tab) 'flock, wad of wool' are related in the same ways as the Greek terms κνάφᾱλλον 'teasel, carding-comb' and κνάφος 'hank of wool'.

textile worker using the teasel, carder, also abbreviated *kun*$_8$; 3) a part of the body, a piece of meat.[111]

With this last connotation, Akkadian *kunšillu* and Sumerian bar could therefore indicate the part of an animal, likely the back, used by the fullers as a teasel in the raising of the nap of the woollen cloths. In fact the logogram BAR means 'outside, exterior; outer appearance; body; back, edge; fleece' and moreover, the lexical text Hh. XV lists the *kunšillu* (^{uzu}bar-sig) among different kinds of leather: it is recorded after the *pāru* (^{uzu}bar) 'skin, hide' and *qinburu* (^{uzu}bar-kun), an animal skin used as well as for its bristles as tools.[112] The identification of the *kunšillu* with a spiny animal skin would explain why this teasel or 'thorn' is neither preceded by the determinative for plants Ú or semantic class marker for the wooden instruments GIŠ.

Furthermore, according to some scholars, the sign BAR should have a taxonomical function and be interpreted as a faunal term designating several *genera* of hedgehog endemic to the Near East (*Erinaceus concolor, Hemiechinus auritus, Paraechinus aethiopicus*).[113] It could be used as an abbreviation for some Sumerian faunal epithets, such as šaḫ-bar-gùn-gùn-nu and šaḫ-zé-da-bar-šur-ra, whose Akkadian equivalent is *burmāmu* 'hedgehog'.[114] Literally the Sumerian šaḫ -bar-gùn-gùn-nu could be translated as 'pig whose back is spotted/stitched', whilst šaḫ -zé-da-bar-šur-ra gives 'piglet whose back bristles/teasels'.[115] The sign šur-ra is a compound of the sign šu 'by hand' and ùr-ra (Akk. *mašāru*) 'to brush, to raise the nap with a teasel', namely the verb which in Hh. XIX, 194-195 designates the function of the *ašagū* and the *kunšillu* (túg Ú.GÍR.úr-ra and túg bar-síg-úr-ra = *mašru*).[116] This reading seems to be confirmed by the equivalence lú túg-šu-ùr-ùr = *ma-a-še-e-rum* denoting the fuller busy in teaseling by hand.[117]

The identification of the *kunšillu* with an animal teasel obtained from the skin of a Near Eastern species of hedgehog can be confirmed by Classical sources referring to the same involvement of hedgehog skins in 1st century AD Rome.[118] Pliny the Elder refers that the importance of the hedgehog skins

111. CAD K, 542 sub *kunšillu*; CDA 167 sub *kunšillu*.

112. Hh. XV, 288-289 in MSL IX, 14; CAD Q, 254 sub *qinburu*: "probably a bristle, used also as a tool".

113. Nevertheless, the identification of the plants and animals designated by Akkadian and Sumerian terms with the phytonyms and zoonyms of the modern taxonomy is very torturous and not certain. Even the name of the hedgehog cannot escape this kind of methodological problems. On the one hand, the cuneiform documentation classified the *burmāmu* among rodents and among swine. On the other, further Akkadian animal names, such as those of some piglets or rodents or even reptiles, have a corresponding Sumerian faunal epithet that make them good candidates for the hedgehog: the *arrabu* (šaḫ -giš-ùr-ra/peš-giš-ùr-ra) perhaps 'dormouse otherwise 'jerboa', the *ḫurbabillu* (bar-gùn-gùn-nu) maybe 'chameleon' and the *apparrû* (šaḫ -bar-guz) meaning literally 'pig having wiry hair'. See Bodenheimer 1960, 108: Hh. XIV, 205-206 in MSL VIII/2, 24; CAD identifies the bar-gùn-gùn-nu and the bar-gùn-gùn-nu-kur-ra with species of chameleon, CAD H, 248 sub *ḫurbabillu*; Qumsiyeh 1996, 59-69.

114. Hh. XIV 162-164 in MSL VIII/2, 19-20. In Hh. XIV 190a (MSL VIII/2, 22) *burmāmu* is instead classified among rodents (péš-giš-gi-a). See CAD B, 330, sub *burmāmu*.

115. In Hh. XIV 48, MSL VIII/2, 74 is found the equivalence *burmāmu* = *šaḫḫu* "pig, hog". Note that modern languages too bring out the resemblance between these two animals: En. *hedgehog*; Ar. *šayham*; It. *porcospino* and the related En. *porcupine*, Fr. *porcupine*, *porc-épic* designating *Hystrix* sp. The reduplicated sign gùn probably refers to the most characteristic feature of this animal namely its speckled (Akk. *burrumu*) back, to which is also related the etymology of the Akkadian zoonym *burmāmu*.

116. CAD K, 298, sub *katāmu*; Hh XIX 178 and 194-195 in MSL X, 133.

117. Lú B 12, in MSL XII, 177. This meaning seems to be further supported by the reading of šu-ùr as *se-ru* 'rubbed' and šu-ùr-ra as *pašāṭu* 'to erase, to scratch out'. See CAD P, 249 sub *pašāṭu*. Hh XIX, 178 in MSL X, 133 records the equivalence túg-šu-ùr-ra = MIN (= *tak-ti-mu*), where *katāmu* (Sum. šu; dul) means 'to cover with garments, to provide with garments, to cover', perhaps suggesting that this kind of finishing was intended for the fabrication of fulled textiles for overcoats, blankets, curtains or tents.

118. The third of the so-called Kedor-laomer texts provides further indications referring to the nature of the *kunšillu*: here it appears as a living being with links to the *āribu* bird - the former seemingly the 'prey' of the latter. The translation of this passage considered the *āribu* as a 'rook' with the *kunšillu* as a thistle, since it is qualified as *kīnu* 'firm in place' and the scholars knew its involvement in the raising nap of the fulled textiles. Indeed thistles are very hard to eradicate. Nevertheless, in my opinion the term *kunšillu* could indicate a small animal that does not draw back in front of the threat of predators and raptors, rather than a motionless plant. Actually the bird most famed as the sworn 'enemy' of the thistle-bushes is not the crow but the goldfinch (*Carduelis carduelis*) or thistle finch (Gr. ἀκανθυλλίς/ἀκανθίς; Lat. *carduēlis*; It. *cardellino*, Fr. *chardonneret*), a bird greedy for the seeds of these plants, and probably identifiable with the Akkadian *iṣṣūr ašāgi* 'bird of the *ašāgu*-bush'.

Fig. 5. Teasels of hedgehog skin worn by the man named S'Erittaju, Orotelli, Sardinia. Photo courtesy of Luisa Zoroddu.

in the finishing treatments of woollen fabrics led the Roman Senate to impose a monopoly on the hedgehog trade and the skin of the animal became one of the most sought-after commodities in ancient times.[119] Nevertheless a mandible of *Erinaceus europaeus* was found in the Augustan deposit of the *forum* of Pompeii during the excavations: it might be linked with this economical exploitation of the animal described by Pliny.[120] Unfortunately the only archaeological evidence of the tool used as teasel in the Roman age - a couple of brushes found at *fullonica* I 6, 7 at Pompeii - has not been published and does not seem to have been preserved, so it is not clear what they exactly looked like.[121] Indeed there is no evidence for the use of hedgehog skins in textile finishing after the 1st century AD, other than Pliny's statements. Yet, an indication of how the hedgehog teasels used by Roman fullers were made is provided by the ethnography: these tools made in leather, cork and hedgehog skin (Fig. 5) are still attested today in Sardinia, albeit in a symbolic and ritualized sphere no longer directly related to fulling and cloth-making processes. In fact, a Sardinian Carnival character called s'Erittaju 'the Hedgehog-bearer' - a grotesque personification of a fuller - carries hedgehog-skin brushes, attesting to their use until recent times.[122] The clear parallels between the apotropaic rituals performed in the Mediterranean island during the Carnival and those practiced by Romans on

119. Pliny NH, 8, 135: "*hac cute expoliuntur vestes. magnum fraus et ibi lucrum monopolio invenit, de nulla re crebrioribus senatus consultis nulloque non principe adito querimoniis provincialibus*".

120. King 2002, 426: "but it is more likely that the bones derive from a natural death".

121. See Flohr 2013, 115. Unlike the vegetal thistles well attested until recent times, the exploitation of hedgehog skins in raising the nap and polishing of woollen cloths seems to have been lost or at least forgotten. Nowadays, tenuous reminiscences of the ancient use of hedgehogs in cloth finishing can be traced in the attempt to imitate its speckled back in the manufacture of clothes-brushes. This of the little mammal was common until the last century in Denmark (M.-L. Nosch, personal communication). Ulla Mannering has carried out experimental research on the rubbing of hedgehog skins on fulled textiles for The Danish National Research Foundation's Centre for Textile Research.

122. *S'Erittaju* 'the Hedgehog-bearer' is one of the main characters of the traditional '*Thurpos'* Carnival' of Orotelli, a little village of the Barbagia, a very conservative area of the inner Sardinia and romanized only from 1st century AD. During the Carnival processions at Orotelli, the *thurpos* characters wear a traditional *orbace* cowl and as a caricature represent the ancient professions of the rural world with disturbing personifications of the peasants, the plough oxen and craftsmen. The *orbace* (Sar. *orbaci*, *furesu*, *fresi*) is a well-known woollen cloth subjected to fulling and polishing processes; its production is one of the most important economic activities in the Barbagia region. *S'Erittaju* wears a white *orbace* cloack and some brushes made from hedgehog skins on the chest and abdomen; he has to be considered the grotesque personification of a fuller. The masquerade costume of S'Erittaju had sunk into oblivion; only thanks to the careful and scrupulous research of writer and historian Lorenzo Pusceddu is it now exhibited in the Ethnographical Museum of Nuoro as part of the Sardinian cultural heritage. From a linguistic point of view the term *erittaju* is related to the Proto-Indo-European root *ǵʰér 'to bristle, to raise the nap' to from which derive the Gr. χήρ 'hedgehog' and the Lat. *ēr* and *ērīcĭus* 'hedgehog' as well as to Lat. *cārere* 'to card' and Gr. κείρω 'to shear, to smooth', the two technical operations performed by the fuller right after the fulling of the wool fabrics. See IL 392-293; Rocci 2023.

the occasion of Lupercalia festival, at the same time of the year, suggest that tools and techniques used by Roman fullers might have reached the Sardinian inland over the course of the 1st century AD, when the reason was colonised.[123]

In the documentation of the ancient Near East, besides the afore-mentioned lexical texts, no direct evidence of the exploitation of hedgehogs and hedgehog skins in fulling and finishing processes of woollen textiles is found. The only archaeological sources documenting a certain importance of the animal in Bronze Age Mesopotamian and Eastern Mediterranean cultures, where wool is the chief fibre and the textile industry is the driving element behind the economy, are iconographic: representations of hedgehogs in the shape of offering vessels, figurines (Tell Mozan), amulets (Tell Brak) and on seals and seal impressions (Isin-Larsa) are indeed pretty numerous.[124] Amongst these, the Early Cycladic III (2300-2100 BC) offering vessel found at Chalandriani on Syros, in the north-west area of the Cycladic islands, could have some connection to the fuller's craft. This little island is not far from Kimolos, the place from where the most renowned quality of fuller's earth in antiquity was quarried. The ancient place name of Kimolos was Echinousa, namely the island of the ἐχῖνος 'hedgehog', or the island of the ἐχῖνῆ 'hedgehog's skin'. The terracotta vessel has the hedgehog sitting and holding a bowl: it is considered a kind of 'prototype' of the Aegean hedgehog *rhyton* found in the Eastern Mediterranean at the end of the 2nd millennium BC.[125] It is perhaps possible to correlate the diffusion of the Mycenaean type of hedgehog *rhyton* and the introduction of new techniques of finishing of cloths from the Near East, but more detailed studies are needed.[126]

It is quite probable that the carding ability offered by the bracts of the teasels was originally observed in the fields when the sheep were shedding. Before the anthropogenic selection of sheep against natural

123. During the Carnival processions *s'Erittaju* chases and hugs the fertile women of the community, pricking their breasts with the brushes. It is believed that the 'teaseling' of these girls with the itchy pricks of the Fuller/Hedgehog-bearer would stimulate the flow of the milk in the women's breasts, increasing the fecundity of the earth, animals and human beings, and so secure the affluence of the community. This ceremony can be interpreted as a rite of passage for the girls who have reached the adult age: the 'fertilization' should transform the virgins into goodwives and wise mistresses of the household, whose economic contribution in a large part was based on the domestic weaving and working of wool. Such an apotropaic ritual recalls the description of the Roman *lupercalia*-festival. The *lupercalia*-festival took place in the culmination of the winter, around the middle of February, when the hungry wolves approached sheepfolds and threatened flocks. The festival was celebrated by the *luperci*, young priests with half-naked limbs smeared with grease and a mud-mask on the face; they wore only a goatskin around the hips, obtained from animals sacrificed during the rites. From these skins they cut some strips of leather named *februa* or *amiculum Iunonis* and used them as whips. After a hearty meal, all the *luperci* had to run around the hill. During the race, they jumped about and struck out at both the ground and the women with their whips. Originally the women offered voluntarily their bellies to the *februa* of the priests in order to increase their fertility.

124. The earliest hedgehog representations in the Near East may date as far back as the 7th millennium BC, with examples from Bouqras in Syria (dated 6400-5900 BC). The first known 'hedgehog *rhyton*' - a specific type of vessel with two openings used for libations (Gr. ῥυτόν from the verb ῥεῖν, 'to flow') - is probably the vessel from Arpachiyah from the Halaf period (6100-5100 BC). A hedgehog *rhyton* dated 3500-3300 BC was found in Jebel Aruda. In the 2nd millennium, hedgehog *rhyta* were used Chagar Bazar and Tell Chuera. In the Late Bronze Age (LH III A2-LH IIIB) hedgehog *rhyta* became a Mycenaean production: a small group was found on Mainland Greece (Prosymna, Tanagra and Vari), other examples in Cyprus (Myrtou-Pigades and Maroni) and in the Levant (Tell Abu Hawam, Kamid el-Loz, Tell Sera' and Ugarit). A Philistine hedgehog vessel was found at Ekron and it is the only known LH IIIC example. See Ben-Shlomo 2010, 143-144; Recht 2014; Collon 1986, 159, n. 388.

125. See Recht 2014; Von Bothmer *et al.* 1979, 61:18 and 26.

126. In the 1st millennium AD, the Romans believed that fulling was a finishing process originating in the Eastern Mediterranean. Pliny the Elder (NH 7, 196) attributed the invention of the techniques of *ars fullonia* to the Greek Nicia of Megara, see Flohr 2013, 101. For the links between the hedgehog and the symbolism of death and rebirth, see Ben Shlomo 2010, 144 and n. 48. Moreover the matter is further complicated by the fact that at the end of the 2nd millennium BC, Mycenaean iconographic sources from Eastern Mediterranean show another use of the hedgehog skins: lots of Late Helladic Period III C (1200-1100 BC) pottery fragments portray warriors and mariners wearing a distinctive spiky headdress, the so called "hedgehog" helmet. This cap has been interpreted as being made of leather or raw-hide or some other perishable material reinforced with bronze bosses and a central short crest to resemble the body of a hedgehog, but some scholars have also suggested that similar helmets could have been actually made of hedgehog skins, see Yasur-Landau 2014, 184-186; D'Amato & Salimbeti 2016, 32.

fleece loss, the specimens of *Ovis orientalis* moulted at the first signs of the height of summer.[127] The wool would stay entangled in the thorns of thistle-bushes, the commonest plant of the grazing lands. Shepherds sought out the tufts of wool, plucking and gathering them one by one. Collecting the wool in this way had the advantage of obtaining it with relatively minimal expenditure of time and energy and, not less important, of it having undergone a first cleaning and sorting of the fibres. In the first half of the 2nd millennium BC in Mesopotamia the gathering was performed without any cutting involved: it was sufficient to pluck the flocks by hand or to use the teeth of a comb (Akk. *mušṭu šipāti*) to obtain the wool.[128] The pulling out of the hair of the fleece with combs or any prickly tool can explain the use of the shearing terminology in the context of the finishing of fabrics and also the ambiguity of many verbs that could be used to mean 'to shear, to comb, to card, to teasel, to crop, to full'. The above-mentioned Gr. κναφεύω and Akk. *mašādu* have already been analysed, but the Latin terminology also records this same linguistic phenomenon: the tool *carmĕn* 'teasel, carding-comb' and the natural resource exploited to construct it (Lat. *carduus* 'thistle, teasel') are both related to the Lat. *cārere* 'to card', in turn linked with Gr. κείρω 'to shear, to smooth'.[129]

In Akkadian the verb *qatāpu* (Sum. kud) has the chief meaning 'to pluck' and is used not only to indicate the harvesting of the wool by plucking, but to designate also the cropping of a hairy fabric. The synonymous *qarādu* (zé) 'to pluck wool' and its related verbal adjective *qerdu* 'plucked wool', often written GÍR-*du*, could therefore be linked with Lat. *cārere* and Gr. κείρω by a common root. As seen above, Sumerian GÍR (Akk. *seḫlu*, *ṣillu*) means 'thorn, sting, needle', suggesting that all these operations may be associated with the use of a sharp, natural tool. The sign GÍR has been connected with the Proto-Indo-European root **ĝhēr* 'to bristle' linked both with thistles and thorny plants and with prickly animals like hedgehogs (Gr. χήρ; Lat. *ēr*, *ērerīcius*; *ērināceus*) or pigs (Gr. χοῖρος).[130]

Conclusions

In ancient times, fulled textiles were precious and expensive goods. Already in the Bronze Age many Mesopotamian textiles in their finishing processes were designated as 'royal', as were certain oils and fats used for scouring; some texts from Pylos, in Messenia, refer instead to a fuller in the sovereign's service. The fulled textiles' value has to be understood according to the number of treatments that they needed and the time and raw materials required in each technical operation. I have focused in this analysis on the natural resources involved in the ancient fulling technology, as raw materials or tools. The study of the archaeological and textual sources of the 1st millennium BC gave me the opportunity to investigate too the technology used during the Bronze Age in the finishing of woollen textiles and to compare it with the fulling craft performed in Roman and Greek times, better-known thanks to a richer evidence. Even allowing for differences due to the diverse availability of natural resources from such varied ecosystems and times, the terminology of the 3rd and 2nd millennia BC cuneiform texts reveals that the fulling of woollen fabrics was performed by Near Eastern textile workers with the same techniques and similar tools as described by Greco-Roman sources in Classical antiquity.

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127. Breniquet 2010.

128. The *magzazu* 'shearing blade' is known from the middle of the 2nd millennium BC, but only in lexical texts. Iron shears are documented from the 1st millennium BC, see Lassen 2010. CAD (M/I, 49, sub *magzazu*) translates *magzazu* as 'shears', referring to its equivalence with the sign gi-ir GÍR 'thorn'.

129. Rocci 1027; IL 151.

130. Whittaker 2012, 585, 590-600.

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Abbreviations

CAD	*The Assyrian Dictionary of the Oriental Institute of the University of Chicago*. Chicago 1956-2010
CDA	J. Black, A. George & N. Postgate (eds.) *A Concise Dictionary of Akkadian, 2nd (corrected) printing*. Wiesbaden 2000
Eng. Bot.	J. Sowerby (ed.) *English Botany or, Coloured Figures of British Plants, with their Essential Characters, Synonums and Placed of Growth*. London 1790-1813
Hh.	B. Lansberger (ed.) *The Series ḪAR-ra=ḫubullu, Materials for the Sumerian lexicon*. V, VI, VII, IX, X and XI. Rome 1957-
IL	L. Castiglioni & S. Mariotti (eds.) *Vocabolario della lingua latina*. Milano 1996.
JCS	*Journal of Cuneiform Studies*. New Haven-Boston-Ann Arbor.
LH	Late Helladic
MSL XII	B. Landsberger, E. Reiner & M. Civil, M. (eds.) *Materials for the Sumerian lexicon. The series lú = ša and related texts.* Roma 1969.
MSL VIII/2	B. Landsberger (ed.) *The Fauna of Ancient Mesopotamia. Second part. ḪAR-ra=ḫubullu Tablets XIV and XVIII.* Roma 1962.
MSL X	B. Landsberger, E. Reiner and M. Civil (eds.) *Materials for the Sumerian Lexicon. The series ḪAR-ra =ḫubullu. Tablets XVI, XVII, XIX and related texts*. Roma 1970.
Rocci	L. Rocci (ed.) *Vocabolario Greco-Italiano*. Roma 1993 (Thirty-seventh edition).
Uruanna	Pharmaceutical Series uruanna: *maštakal*

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