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## The Aegean Wool Economies of the Bronze Age

Marie-Louise Nosch

This paper explores aspects of wool in the Aegean during the Bronze Age (ca. 3000 to 1100 BCE). The Bronze Age Aegean was characterized by the centralized palace cultures of the Minoans in Crete (ca. 2700 to 1450 BCE) and Mycenaeans (ca. 1600 to 1100 BCE) in Mainland Greece and after 1450 BCE also in Crete, both of which had collapsed and disappeared by the end of the Bronze Age. I will take the Late Bronze Age palace at Knossos on the island of Crete as the prime example of the palace wool economy.

The Bronze Age Aegean witnessed the emergence of a highly particular system of wool economy, beginning with the Minoan and followed by the Mycenaean centralized palace economies with strict administration of flocks, herders, wool, and textile production by thousands of women and children. This system monitored annual wool production targets and breeding strategies ensuring that the palaces' needs were met. Wool textile production was the largest sector of the palace economy and employed the highest number of people, organized according to a strict division of labor.<sup>1</sup>

At Knossos on Crete, the palace economy focused on wool as a means of achieving standardized textile products; other secondary products from sheep and goats, such as milk, skins, horn, sinew, lanolin, and meat, only occur sporadically in the palace records. The Knossos palace monitored 100,000 sheep, primarily wethers for optimal wool production since castration provides more homogeneous fleeces. Other flocks of sheep grouped female animals and their lambs. Some 700 shepherds tended these flocks throughout central and western Crete. In the villages, and around the palace of Knossos, ca. 1000 women and children were occupied with a wide range of tasks related to textile production, primarily wool. We know this, thanks to the so-called Linear B inscriptions, an ancient syllabic form of Greek, and an astonishing source for the ancient wool economy.<sup>2</sup> Wool textiles are recorded by logograms, and in large numbers. Each year the Mycenaean flocks provided ca. 50-75 tons of raw wool; after cleaning this amounted to 25-40 tons for textile production. Mycenaeans use logograms to designate a piece of textile, and each of these pieces are woven from 1-10 kilograms of clean wool. Thus the annual yield of raw wool would provide fiber resources for between 2500 and 25,000 textiles.

Bone material already attests to the presence of sheep and goats in Aegean settlements from

<sup>1</sup> For a more comprehensive discussion of Aegean wool economies: B. Burke, "Purple and Aegean Textile Trade in the Early Second Millennium B.C.," in *Meletemata: Studies in Aegean Archaeology Presented to Malcolm H. Wiener as he enters his 65<sup>th</sup> year*, ed. P.P. Betancourt, et al. (Liège and Austin: Université de Liège and University of Texas, 1999); P. Militello, "Textile industry and Minoan Palaces," in *Ancient Textiles. Production, Craft and Society*, ed. C. Gillis and M.-L.B. Nosch (Oxford: Oxbow Books, 2007); M.-L.B. Nosch, "The Wool Economy in Greece in the end of the II millennium BCE." In *Wool Economy in the Ancient Near East and the Aegean: From the Beginnings of Sheep Husbandry to Institutional Textile Industry*, ed. C. Michel and C. Breniquet (Oxford: Oxbow Books, 2014).

<sup>2</sup> M. Del Frio, M.-L. B. Nosch, and F. Rougemont, "The Terminology of Textiles in the Linear B Tablets, Including Some Considerations on Linear A Logograms and Abbreviations," in *Textile Terminologies in the Ancient Near East and Mediterranean from the Third to the First Millennia BC*, ed. C. Michel and M.-L.B. Nosch (Oxford: Oxbow Books, 2010).

the 7th millennium BCE.<sup>3</sup> At Knossos, analyses of sheep bones from the Neolithic strata demonstrate that that sheep are slaughtered at a young age (between 6 months and 2 years for 50% of the bone material), and this suggests that the Neolithic Knossians favored meat consumption over wool production; only few mature adult animals are attested archaeologically, and there is a predominance of adult females in the bone material.<sup>4</sup> In contrast, the Bronze Age faunal remains at Knossos show a rapid increase in adult and male bones remains.<sup>5</sup> This means that by the Bronze Age more sheep were kept for their wool properties and that the Knossians started to produce wool textiles. From a textile and clothing perspective, we are tempted to call their period, not the Bronze Age but the Wool Age.<sup>6</sup>

McCorriston calls this shift the *Fibre Revolution*, and emphasized the socio-economic changes that this shift engendered.<sup>7</sup> One such change is the strengthening of the shepherd 'profession', including the knowledge and know-how shepherds would need to monitor wool production. The Linear B tablets attest to a highly specialized pastoralism. In Mycenaean Greek, there is an early specialist vocabulary on herding: the shepherd is called *po-me/poimēn*, while the goat herd is *a<sub>3</sub>-ki-pa-ta/\*aigipástās*, the swine-herd *su-qo-ta/ subotās* and the cow herd *qo-u-ko-ro/boukolos*. In classical Greek, *poimēn* continues in use but as a more general designation for someone herding animals of all kinds.

The Linear B records thus testify to this highly specialized pastoralism, on a large scale, and with wool production as its primary goal. This same extensive focus on wool can also be found in 3<sup>rd</sup> and 2<sup>nd</sup> millennium BCE palace cultures of the ancient Near East.<sup>8</sup> In Greece, however, it seems to be a quite unique situation, and therefore, in many respects, parallels from ethnographical sources or comparative studies of herding in Greece or the Balkan cultures<sup>9</sup> cannot be used as comparanda for the Mycenaean herding practices.<sup>10</sup> They may be

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<sup>3</sup> J. Cherry, "Pastoralism and the role of animals in the pre- and protohistoric economies of the Aegean," In *Pastoral Economies in classical antiquity*, ed. C.R. Whittaker (Cambridge: Philological Society, 1988); Halstead, P. and V. Isaakidou, "Revolutionary secondary products: the development and significance of milking, animal-traction and wool-gathering in later prehistoric Europe and the Near East," in *Interweaving Worlds: Systemic Interactions in Eurasia, 7th to 1st Millennia BC*, ed. T. Wilkinson et al. (Oxford: Oxbow, 2011), 67-8. For Knossos, see V. Isaakidou, "Ploughing with cows: Knossos and the 'Secondary Products Revolution'," in *Animals in the Neolithic*, ed. D. Serjeantson and D. Field (Oxford: Oxbow, 2006); the Franchthi Cave, see S. Payne, "Faunal change at Franchthi Cave from 20,000 B.C. to 3,000 B.C.," in *Archaeozoological Studies. Papers of the Archaeozoological Conference 1974, held at the Biologisch-Archaeologisch Instituut of the State University of Groningen*, ed. A.-T. Clason (Amsterdam: Elsevier Publishing Company, 1975); Thessaly, see P. Halstead, "Counting Sheep in Neolithic and Bronze Age Greece," in *Pattern of the Past. Studies in Honour of David Clarke*, ed. I. Hodder, et al. (Cambridge: Cambridge University Press, 1981). The increase in the number of ovicaprids and the increase in their age form a part of what Sherratt coined the Secondary Products Revolution: A. Sherratt, "Plough and pastoralism: aspects of the secondary products revolution," in *Pattern of the past: studies in honor of David Clarke*, ed. N. Hammond et al. (Cambridge: Cambridge University Press, 1981); A. Sherratt, "The secondary exploitation of animals in the Old World," *World Archaeology* 15 (1983): 90-104.

<sup>4</sup> Isaakidou, "Ploughing with cows," 101.

<sup>5</sup> Isaakidou, "Ploughing with cows," 107.

<sup>6</sup> M.-L. Nosch, "The Wool Age: Textile Traditions and Textile innovations," in *Tradition and Innovation in the Mycenaean Palatial Polities. Veröffentlichungen der Abteilung für Ägäische und Mykenische Forschungen, Österreichische Akademie der Wissenschaften, Philosophisch-historische Klasse, Denkschriften, XXX. Band* ed. F. Ruppenstein and J. Weilhartner (Wien: Academy of sciences, forthcoming).

<sup>7</sup> J. McCorriston, "The fiber revolution: textile extensification, alienation," *Current Anthropology* 38 (1997).

<sup>8</sup> C. Breniquet and C. Michel, eds., *Wool Economy in the Ancient Near East and the Aegean: From the Beginnings of Sheep Husbandry to Institutional Textile Industry*, (Oxford and Philadelphia: Oxbow Books, 2014).

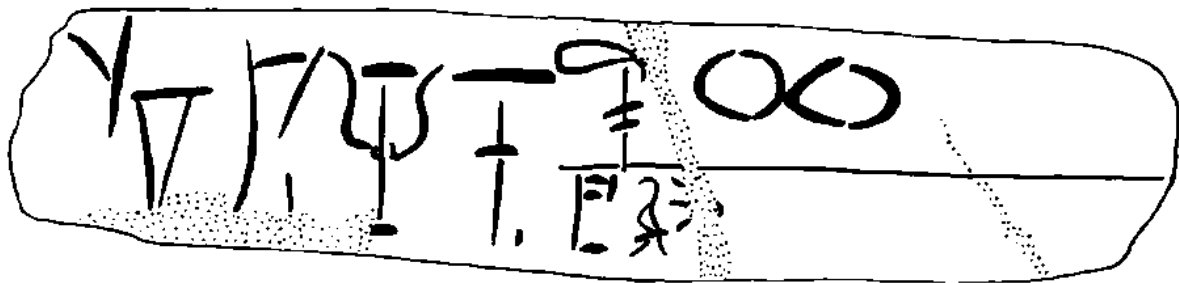
<sup>9</sup> For example the Sarakatsani herding cultures of northern Greece and Albania as reported by Høeg in the 1920s: C. Høeg, *Les Saracatsans: une tribu nomade grecque*, (Paris, É. Champion; Copenhagen, V. Pio-P.

introduced for analyses of ancient farming methods, but no reliable historical or ethnographical parallels exist for the highly specialized Mycenaean pastoralism in Greece.

There are several important strategies of herding management of flocks of sheep, and these are clearly employed in the Late Bronze Age Aegean as we can read in the Linear B tablets from Knossos:

- *Castration*: male sheep are castrated and gathered in flocks for wethers only.<sup>11</sup>
- *Isolation*: female sheep – ewes – and their lambs are isolated.<sup>12</sup> They could then be joined with rams of the right properties in order to monitor reproduction.
- *Separation of genders*: probably soon after birth. There are two different logograms for the two genders: ewes are recorded as OVIS<sup>f</sup> and rams/wethers as OVIS<sup>m</sup>.
- *Division into age groups*: the shepherds and the scribes group the animals according to their age and classify them as lambs (*ki*), yearlings (*WE*) and adult animals (OVIS).
- *Homogeneity of flocks*: in domestic settings and smaller societies a variety of different domestic animals live together. In the Mycenaean palaces this seems not to be the case. Sheep are kept in flocks alone, without goats (although in Pylos, sheep and goats are recorded together); oxen, horses and pigs also seem to be herded in mono-species flocks.

Figures 1 and 2 are drawings of Knossos Linear B tablets recording these different aspects of wool and sheep administration.<sup>13</sup>



**Figure 1: Tablet KN Da 1108, written by scribe 117, found in East Corridor. Drawing by L. Godart in Chadwick et al., *Corpus of Mycenaean Inscriptions from Knossos*, 1986-1998.**

### Transcription:

- .A                      OVIS<sup>m</sup> 200  
 .B    ki-ta-ne-to , / su-ri-mo

Branner, 1925-26). Hodkinson 1988 also mentions the Sarakatsani shepherds who conducted large flocks over long distances, but who were acting in a particular geo-political and socio-economic framework of concentrated powers and resources in Ottoman or Orthodox monastic estates in 19th and 20th century Greece: S. Hodkinson, "Animal husbandry in the Greek polis," in *Pastoral Economies in Classical Antiquity*, ed. C.R. Whittaker (Cambridge: Philological Society, 1988).

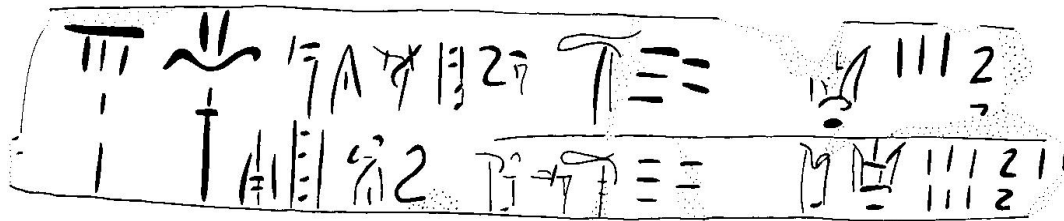
<sup>10</sup> See discussion of ethno-archaeology in Cherry, "Pastoralism and the role of animals," 19-20.

<sup>11</sup> Da-Dg and Dn series.

<sup>12</sup> Dk and Dl series.

<sup>13</sup> These herding praxes are internalized in the Mycenaean palace administrations since different scribes record each of these modalities on tablets stored in separate departments; thus, not only are ewes and lambs recorded by different scribes (120, 119, 118) than scribe 117 who records the castrated wethers; their tablets too, are stored in different places in the palace, the North Entrance Passage (I2 and I3), and in the East West Corridor, respectively.

**Translation :** *Ki-ta-ne-to* (shepherd's name), at *Su-ri-mo* (place name) (has a flock of) 200 wethers.



**Figure 2:** Tablet KN DI(1) 930, written by scribe 118, found in N Entrance Passage.  
Drawing by L. Godart in Chadwick et al., *Corpus of Mycenaean Inscriptions from Knossos*, 1986-1998.

**Transcription:**

] po-ti-ni-ja-we-jo OVIS<sup>f</sup> 50 LANA 3 M [  
]ma-di-qo /si-ja-du-we o ki OVIS<sup>m</sup> 50 o LANA 6 M 2[

**Translation:** *Ma-di-qo* (shepherd's name), at *Si-ja-du-we* (place name), under the goddess Potnia (*po-ti-ni-ja-we-jo*):

50 ewes (logogram OVIS<sup>f</sup>) (yielding) 10+ kilos of wool;  
50 lambs (*ki* OVIS<sup>m</sup>) and 20+ kilos wool are missing.

Following the domestication of sheep and goats in the Neolithic, strategies of out-breeding and cross-breeding were used on animals with desirable traits to develop wool with new qualities.<sup>14</sup> Breeding had become a specialization and knowledge accumulated by shepherds; it is tempting to assume that the shepherds' experience and knowledge of these processes and properties would enhance their status in Bronze Age societies.<sup>15</sup>

- *Decreased hairiness and increased volume of under-wool.* This made the wool more spinnable and allowed more yarn options, which in turn could be used to produce different types of fabric.
- *Increasing amounts of fibers in the fleeces.* The use of wethers increases quantities of fibers.
- *Increasing uniformity in the fleeces*
- *Increasing amounts of fine fibers in fleeces.*
- *Gradual stop or control of the natural moulting of the coat.* This means that a shepherd would be able to collect the wool at a certain season instead of combing and plucking the wool throughout the year. Control over the moulting process places sheep herding in a more organized and seasonal scheme in which wool collection becomes fixed in time.

<sup>14</sup> M.L. Ryder, "Changes in the fleece of sheep following domestication," in *The domestication and exploitation of plants and animals. Proceedings of a meeting of the research seminar in archaeology and related subjects held at the institute of archaeology, London University*, ed. P.J. Ucko and G.W. Dimbleby, (Chicago: Aldine Pub. Co., 1969; A. Rast-Eicher and L. Bender Jørgensen, "Sheep Wool in the Bronze Age and Iron Age Europe," *JAS* 40 (2013).

<sup>15</sup> For a critical discussion: B.D. Shaw, "Eaters of Flesh, Drinkers of Milk: the Ancient Mediterranean Ideology of the Pastoral Nomad." *Ancient Society* 13 (1982-83).

- The natural pigmentation could be altered via breeding to achieve lambs of desired colors. Sheep's wool can be black, brown, reddish, grey and yellowish to white. White wool is especially desirable in order to apply dyes.<sup>16</sup>

### *Archaeological, terminological and technological evidence for woolen textiles in the second millennium BCE Aegean*

In the Eastern Mediterranean, certain fragments of wool textiles found in Turkey, Syria and Egypt had been dated to the Bronze Age, but new analyses and recent research especially by Orit Shamir, have reclassified most of these wool pieces to Roman times.<sup>17</sup> The bulk of wool textile evidence is now from the Late Bronze Age, 1500-1100, with only very few samples securely dated earlier. Also from Central Europe, wool textiles occur from the Hallstatt Middle Bronze Age<sup>18</sup> (ca. 1500-1245 BCE, which is contemporary to the Aegean Late Bronze Age).

Wool textiles are rarely preserved from Bronze Age Greece. When they are, it is always from the later part of the Bronze Age, always tabbies, and often from a funerary context.<sup>19</sup> However, compared to the mono-fiber tradition of sheep wool textiles in the many Knossos tablets, it is exciting to realize that the archaeological record of textiles, even when very sparse and limited, provide us with an entirely different image of Bronze Age textile production. In archaeological textiles, indeed, we find evidence for the use of sheep's wool, but also goat hair,<sup>20</sup> linen and perhaps even nettle as textile fibers.<sup>21</sup>

In the scholarship on ancient textile fibers there has been a tendency to see wool development as a linear evolutionary trend, and in binary scheme between northern and southern Europe.<sup>22</sup> Models such as 'center *versus* periphery' and 'primitive *versus* modern' are employed to pinpoint levels and cross roads of wool evolution and capacities of innovation. It is assumed that the primitive peripheries become the keepers of the finer qualities, while the core areas decrease in quality and instead obtain more uniformity and average qualities. This is clearly a model taken from linguistics where peripheral languages conserve the oldest terms.

A similar conclusion, this time based on sheep genetics, was recently reached by textile experts Antoinette Rast-Eicher and Lise Bender Jørgensen who identify a 'Nordic' sheep type

<sup>16</sup> The basic shades in wool result in a wide spectrum of hues when over-dyed with plant dyes. This again enlarges the range of yarn and fabric qualities. Thus, white wool only is not necessary for dyeing, and e.g. grey wools will turn green when dyed yellow.

<sup>17</sup> O. Shamir, "Textiles, Basketry, and Other Artifacts of the Chalcolithic Period in the Southern Levant," in *Masters of Fire: Copper Age Art from Israel* ed. M. Sebbane et al. (Princeton: Princeton University Press, 2014).

<sup>18</sup> Rast-Eicher and Bender Jørgensen, "Sheep Wool in the Bronze Age and Iron Age Europe."

<sup>19</sup> The earliest wool threads in Greece were used in the site of Akrotiri before the Santorini eruption in the middle of the 17th century BCE, see C. Moulherat and Y. Spantidaki, "Première attestation de laine sur le site protohistorique d'Akrotiri à Thera," in *Purpureae Vestes II. Estudios sobre la producción de bienes de consumo en la antigüedad*, ed. C. Alfaro and L. Karali, (València: University of València, 2008); Y. Spantidaki and C. Moulherat, "Greece." In *Textile and Textile Production in Europe from Prehistory to AD 400*, ed. M. Gleba and U. Mannering, (Oxford: Oxbow Books, 2011), 189.

<sup>20</sup> At Arslantepe in Anatolia, the "Royal Tomb" revealed one of the world's oldest pieces of what is probably a goat hair textile, dated to 3000-2900 BCE. M. Frangipane et al., "Arslantepe, Malatya (Turkey): Textiles, Tools and Imprints of Fabrics from the 4th to the 2nd millennium BCE," *Paléorient* 35 (2009), 19-20.

<sup>21</sup> At Late Bronze Age Chania in Crete, a tiny carbonized textile ribbon was recovered combining nettle (uncertain identification), linen, and goat hair, see C. Moulherat and Y. Spantidaki, "Cloth from Kastelli Khania." *Arachne* 3 (2009): 8-15; Spantidaki and Moulherat, "Greece," 189.

<sup>22</sup> Ryder, "Changes in the fleece of sheep following domestication," 110.

with finer wool qualities and which differs genetically from central European and Near Eastern sheep types.<sup>23</sup>

If we only consider archaeological textiles, it seems that the Wool Age starts in the Middle Bronze Age but really takes off in the Late Bronze Age. This is based on the archaeological evidence in central and southern Europe and the Levant. However, we are fortunate to have written records from the 4<sup>th</sup> and 3<sup>rd</sup> millennia with detailed records of wool and wool textiles.<sup>24</sup>

Wool has a common root in the Indo-European languages, *wool* in English, *Wolle* in German, *lēnos* in classical Greek, *lana* in Latin, *hulana* in Hittite etc. and this suggests that the Indo-Europeans shared this word before they parted to different parts of central Asia and Europe.<sup>25</sup> However, the Mycenaeans also use another term for 'wool', *eiros*, attested in Linear B through its adjective *we-we-e-a/werweheha/* meaning 'woolen'.<sup>26</sup> It is very interesting that some linguists suggest that this new wool-term is perhaps related to the term for castrated sheep, the wether, in Greek *arēn*.

It may suggest that with the intensive breeding activities, the Mycenaeans needed a new word for the fine fibred wool from wethers which had become different in terms of colors, fiber qualities and use, from the original animal fibers that their forefathers could pull off their mixed flocks of sheep and goats.

A fundamental question to ask concerning wool is: can the appearance of wool in the Neolithic and Early Bronze Age be inferred through the study of the type and morphology of textile tools?

Since 2005, the Danish National Research Foundation's Centre for Textile Research has asked this question, and the answer is still not straightforward.<sup>27</sup> Overall, spindle whorls are bigger and heavier in the Neolithic and become smaller towards the Late Bronze Age. This could suggest an increased use of wool fibers. However, more detailed studies of textile tools show no linear evolution but a much more complex development of textile technology in the 3<sup>rd</sup> and 2<sup>nd</sup> millennia BCE. Two examples: in some areas there are hardly any spindle whorls, in other areas no loom-weights; in the Early Bronze Age when we would expect the introduction of wool, spindle whorls become bigger than in the late Neolithic. Regarding textile tools for weaving, today represented by extant loom weights, we do not have an uninterrupted use throughout the Bronze Age although it is unlikely that weaving ever

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<sup>23</sup> Rast-Eicher and Bender Jørgensen, "Sheep Wool in the Bronze Age and Iron Age Europe." This conclusion is based on finds from Norway, Sweden, and Austria.

<sup>24</sup> Breniquet and Michel eds., *Wool Economy in the Ancient Near East and the Aegean*.

<sup>25</sup> E.J.W. Barber, *Prehistoric Textiles: The Development of Cloth in the Neolithic and Bronze Ages with Special Reference to the Aegean* (Princeton: Princeton University Press, 1991); P. Chantraine, *Dictionnaire étymologique de la langue grecque* (Paris: Librairie Klincksieck, 2009), 612; C. Michel and M.-L.B. Nosch eds., *Textile Terminologies in the Ancient Near East and Mediterranean from the Third to the First Millennium BC* (Oxford: Oxbow Books, 2010); Breniquet and Michel eds., *Wool Economy in the Ancient Near East and the Aegean*.

<sup>26</sup> KN L 178 and L 870. Chantraine, *Dictionnaire étymologique*, 309-310.

<sup>27</sup> L. Mårtensson, E. Andersson Strand, M.-L.B. Nosch, "Shape of Things: Understanding a Loom Weight." *Oxford Journal of Archaeology* 28.4 (2009): 373-398; M. Siennicka, "Textile Production in Early Helladic Tiryns," in *KOSMOS. Jewellery, Adornment and Textiles in the Aegean Bronze Age. Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010*, ed. M.-L.B. Nosch and R. Laffineur (Leuven-Liège: Peeters, 2012); J. Cutler, E. Andersson Strand, M.-L.B. Nosch, "Textile production in Quartier Mu," in *Fouilles exécutées à Malia. Le Quartier Mu V. Vie quotidienne et techniques au minoen Moyen II*, ed. J.-C. Poursat (Athens: École française d'Athènes, 2013).

stopped. Rather, it suggests that other loom types which do not employ loom weights, such as the tubular loom, the two-beam loom or the horizontal loom, were used along with the warp weighted loom. Generally we associate twill with wool textiles and this chronology could actually match the archaeological evidence, since there are very few wool textiles and very few twills until the Late Bronze Age: only the Middle Bronze Age twill textile fragment found in Alishar, Anatolia,<sup>28</sup> as well as a 2/2 twill from the Hallstatt Middle Bronze Age.<sup>29</sup> In iconography, twills seem to occur in 2<sup>nd</sup> millennium iconography.<sup>30</sup> No word for twill, however, has so far been identified in any written records, and this seems frankly surprising: did it not exist, or do the philologists not recognize it? Another significant example is tapestry weave: images from Egypt depict tapestry looms from the 18<sup>th</sup> dynasty,<sup>31</sup> and the 2<sup>nd</sup> millennium Semitic term for tapestry is probably identified in the Akkadian textile term *mardatum*,<sup>32</sup> attested in Old Assyrian private documents from Kanish<sup>33</sup> and also in the palace of at Mari,<sup>34</sup> and in Ugaritic it appears as *mrđt*.<sup>35</sup> Tapestry can be made in linen, but the technology unfolds fully with colors and dyes, and therefore it is technologically associated with wool.

The archaeological and technological evidence thus suggest that wool would arrive late in the Bronze Age and be associated with specialized weaving techniques, while the epigraphical evidence lists an extensive production of standardized wool fabrics already early in the Bronze Age. Bronze Age wool itself is difficult to grasp. But in the Bronze Age wool generates a series of innovations, which leave indirect evidence of the existence of wool. These wool-based innovations include:

- Cultivation and extraction of plant dyes.<sup>36</sup> Plant dyes are closely connected to wool, and these plants generate innovations in agriculture and plant diversification. Madder,

<sup>28</sup> Barber, *Prehistoric Textiles*, 167.

<sup>29</sup> K. Grömer, "Austria: Bronze and Iron Ages," in *Textiles and Textile production in Europe. From Prehistory to AD 400*, ed. M. Gleba and U. Mannering (Oxford: Oxbow Books, 2012), 32.

<sup>30</sup> A. Wisti Lassen, "Tools, Procedures and Professions: a review of the Akkadian textile terminology," in *Textile Terminologies in the Ancient Near East and Mediterranean from the Third to the First Millennia BC*, ed. C. Michel and M.-L. B. Nosch, (Oxford: Oxbow Books, 2010), 159-179.

<sup>31</sup> B.J. Kemp and G. Vogelsang-Eastwood, *The Ancient Textile Industry at Amarna* (London: Egyptian Exploration Society, 2001).

<sup>32</sup> J. Smith, "Tapestries in the Mediterranean Late Bronze Age," in *KOSMOS. Jewellery, Adornment and Textiles in the Aegean Bronze Age, Proceedings of the 13th International Aegean Conference, University of Copenhagen, Danish National Research Foundation's Centre for Textile Research, 21-26 April 2010*, ed. M.-L.B. Nosch and R. Laffineur (Leuven-Liège: Peeters, 2012), 242.

<sup>33</sup> K.R. Veenhof, *Aspects of Old Assyrian Trade and its Terminology* (Leiden: Brill, 1972), 160, 179; C. Michel and K.R. Veenhof, "The textiles traded by the Assyrians in Anatolia (19th-18th centuries BC)," in *Textile Terminologies in the Ancient Near East and Mediterranean from the Third to the First Millennia BC*, ed. C. Michel and M.-L.B. Nosch, (Oxford: Oxbow Books, 2010), 235-236; Wisti Lassen, "Tools, Procedures and Professions," 279.

<sup>34</sup> J.M. Durand, *La nomenclature des habits et des textiles dans les textes de Mari. Matériaux pour le Dictionnaire de Babylonien de Paris I. Archives Royales de Mari 30*, (Paris: CNRS Editions, 2009), 61-65; Smith "Tapestries in the Mediterranean Late Bronze Age," 242; J. Smith, "Tapestries in the Bronze and Early Iron Ages of the Ancient Near East," in *Textile Production and Consumption in the Ancient Near East*, ed. M.-L.B. Nosch et al. (Oxford: Oxbow Books, 2012), 161, note 19.

<sup>35</sup> J.P. Vita, "Textile terminology in the Ugaritic texts," in *Textile Terminologies in the Ancient Near East and Mediterranean from the Third to the First Millennia BC*, ed. C. Michel and M.-L.B. Nosch (Oxford: Oxbow Books, 2010), 330-331. Smith, "Tapestries in the Bronze and Early Iron Ages of the Ancient Near East," 166, note 66, 172, note 120.

<sup>36</sup> See R. Hofmann-de Keijzer, "Färben," in *Prähistorische Textilkunst in Mitteleuropa. Geschichte des Handwerkes und der Kleidung vor den Römern*, ed. K. Grömer (Wien: Naturhistorisches Museum, 2010), 143-6; D. Cardon, *Guide des teintures naturelles. Plantes, Lichens, Champignons, Mollusques et Insectes* (Lausanne: Delachaux et Niestlé, 1990); L. Roth, K. Kormann and H. Schweppe, *Färberpflanzen*,



safflower and saffron are attested as crops in Mycenaean palace records (*po-ni-ki-jo*, probably madder; *ka-na-ko*, safflower, a yellow dye; the logogram CROCus denotes saffron).<sup>37</sup> In Minoan and Mycenaean frescoes we can see the concrete results of plant dyes: red and yellow garments and saffron-gatherers are depicted.

- Mineral exploitation of alum stone for mordanting wool textiles. Alum and alum stone is available in several parts of Greece, especially in the island of Melos.<sup>38</sup> It is an excellent mordant to fix dyes especially to wool fibers. Alum is recorded in palace archives in Tiryns and Pylos as Linear B *tu-ru-pte-ri-ja*, classical Greek *struptionia*, and at Ugarit alum is termed 'stone for coloring' *abn srp*.<sup>39</sup>
- Extraction of purple dye from murex.<sup>40</sup> Murex is found in Neolithic excavations but from around 2000 BCE. the amount of murex shells increases, especially in Crete. A Linear B tablet records *po-pu-re-i-jo*, probably purple dyers who are also recorded as 'royal' *wa-na-ka-te-ro*.<sup>41</sup> Murex yields an intense and extremely colorfast dye on woolen textiles.<sup>42</sup>
- Fulling and felting. In Mycenaean palaces, men with the professional title *ka-na-pe-u*, *knapheus* 'fuller' are located. Fulling is a specialist occupation for the treatment and maintenance of wool textiles. There is even a 'royal fuller' called *Pe-ki-ta* at the court of Pylos.<sup>43</sup>

### Final remarks

Wool textiles are nearly absent from the archaeological record, but their presence can be inferred from other sources, especially the Linear B inscriptions, and to a lesser degree studies of sheep bones and textile tools. Wool was an innovation which had a significant

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*Pflanzenfarben. Botanik, Färbermethoden, Analytik. Türkische Teppiche und ihre Motive* (Landsberg-Lech: Ecomed, 1992); M.-L.B. Nosch, "Textile crops and textile labour in Mycenaean Greece," in *Land, Territory and Population in the Ancient Greece: institutional and mythical aspects, Colloqui Internacional: "Terra, territori i població a la Grècia antiga: aspectes institucionals i mítics,"* ed. C. Varias Garcia et al. (Barcelona: University of Barcelona, forthcoming).

<sup>37</sup> C. Murray and P. Warren, "*po-ni-ki-jo* among Dyeplants of Minoan Crete," *Kadmos* 15 (1976): 40-60; E.D. Foster, "*po-ni-ki-jo* in the Knossos Tablets Reconsidered," *Minos* 16 (1977): 52-66; J.L. Melena, "La producción de plantas aromáticas en Cnoso," *Estudios Clásicos* 78 (1976), 195-6; J. Killen, "On the Mycenaean Tablets," in *Res Mycenaeae, Akten des VII. Internationalen Mykenologischen Colloquiums in Nürnberg 1981*, ed. A. Heubeck and G. Neumann, 216-33 (Göttingen: Vandenhoeck and Reprecht, 1983), 216; M.-L.B. Nosch, "Red Coloured Textiles in the Linear B Inscriptions," in *Colour in the Ancient Mediterranean World*, ed. L. Cleland and K. Staers (Oxford: John and Erica Hedges, 2004).

<sup>38</sup> A. Michailidou, *Weight and Value in Pre-Coinage Societies. Vol. 2, Sidelights on Measurement from the Aegean and the Orient* (Athens: Research Centre for Greek and Roman Antiquity, National Hellenic Research Foundation, 2008), 203-204; R. Firth, "Reconsidering Alum on the Linear B Tablets," in *Ancient Textiles: Production, Craft and Society*, ed. C. Gillis and M.-L.B. Nosch (Oxford: Oxbow Books, 2007), 130-138.

<sup>39</sup> PY An 35, Un 443 and TI X 6. W. Van Soldt, "Fabrics and Dyes at Ugarit," *Ugarit-Forschungen* 22 (1990).

<sup>40</sup> B. Burke, "Purple and Aegean Textile Trade in the Early Second Millennium B.C.," in *Meletemata: Studies in Aegean Archaeology Presented to Malcolm H. Wiener as he enters his 65<sup>th</sup> year*, ed. P.P. Betancourt, et al. (Liège and Austin: Université de Liège and University of Texas, 1999); Militello, "Textile industry and Minoan Palaces." On purple dyes in Ugarit: F. Thureau-Dangin, "Un comptoir de laine pourpre à Ugarit d'après une tablette de Ras-Shamra," *Syria* 15 (1934): 137-46; Van Soldt, W. "Fabrics and Dyes at Ugarit."

<sup>41</sup> P. Carlier, *La royauté en Grèce avant Alexandre* (Strasbourg: Etudes et travaux association pour l'étude de la civilisation romane, 1984), 52; T.G. Palaima, "Maritime Matters in the Linear B Tablets," in *Thalassa. L'Egée préhistorique et la mer. Actes de la troisième Rencontre égéenne internationale de l'Université de Liège, Calvi, Corse, 23-25 avril 1990*, ed. R. Laffineur and L. Basch (Liege: Université de Liège, 1991), 291; Nosch, "Red Coloured Textiles in the Linear B Inscriptions."

<sup>42</sup> H. Landenius Enegren and F. Meo eds., *Treasures from the Sea. Sea-silk and Shell purple dye in Antiquity* (Oxford: Oxbow Books, forthcoming).

<sup>43</sup> PY En 74,3 and 23;Eo 160,3; Eo 276,2.

impact on the societies of the Aegean Bronze Age. It appears slowly in the Early Bronze Age, but rapidly gained importance from the Middle Bronze Age.

At the beginning of this paper we asked whether it is appropriate to refer to the Bronze Age as the Wool Age. We cannot confirm wool's importance in the early part of this period in the Aegean, but texts and images suggest its presence in the ancient Near East. However, wool's importance should not be measured according to the time of its appearance only, but according to the changes and innovations that it brought to Bronze Age societies. These included technical innovations in clothing (wool textiles and felt combined with plant fiber clothing and skin)<sup>44</sup> and in the visual appearance (dyes and fulling); morphological and environmental changes due to landscape use (grassing sheep, plenty of manure); and social changes in the specialization of shepherds and textile producers. It is plausible that during this process, the practical know-how of spinning, weaving and herding which traditionally was passed on in families, would become a more systematic knowledge, shared and distributed among practitioners by other means. We could see this as an innovation in the technology of organization and of knowledge dissemination.

On a final note, we could also consider what imagery, myths and narratives wool would generate in Bronze Age societies. The tablet shown in figure 2 records that certain flocks of sheep, in particular ewes and lambs, stood in a special relationship to the Mycenaean goddess Potnia. Wool plays a role in some significant founding myths of ancient Greece. Jason travels to Colchis in search of the Golden Fleece. The legendary king of Athens, Erichthonios, was son of Hephaistos and Athena but born out of a tuft of wool: Hephaistos attempted to rape Athena, but his semen fell on her thigh. Athena wiped it away with a tuft of wool, threw it on the ground, and Erichthonios was born from this encounter of semen, wool and earth. He was raised by the daughters of the first king of Athens, Kekrops. One of the daughters is Herse, who gave her name to the Athenian weaving festival, *Hersephoria* or *Arrhephoria*, during which a magnificent peplos was woven for the Athena statue on the acropolis.



Figure 3: Drawing of ram, from medieval manuscript dated 1250-1260 AD.  
With kind permission from the Getty Foundation

<sup>44</sup> S. Harris, "From the Parochial to the Universal: Comparing Cloth Cultures in the Bronze Age." *EJA* 15 (2012).

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