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2002

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The Archaeology of Early Silk
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*Centuries before the initiation of formal silk trade with Han China ca. 200 BC, silk appeared as far west as the Baden-Württemberg region of Germany. The use of wild (*Antheraea* sp.) silks has also been documented for western Asia and the Mediterranean region since early medieval times, but the extent and antiquity of this fiber technology is presently unclear. The domesticated silkworm *Bombyx mori* is derived from a species native to northern India, Assam and Bengal, known as *Bombyx mandarina* Moore. It was in China that this moth was domesticated, and the process of de-gumming developed at some point during the second half of the third millennium BC. Accurate discernment between silk made from *Antheraea* and that made from *Bombyx* sp. is thus essential to understanding the real extent of pre-Han silk exchange in antiquity. Study of ancient silk fragments based on morphological observations is often hampered by poor preservation. The employment of biochemical analyses offers definitive confirmation of silk in archaeological samples, as well as the identification of the silkmoth species from which they derived, allowing a more accurate reconstruction of the nature and extent of early sericulture, and of the long-distance exchange of this important luxury commodity.*

Recently, a discovery of a silk thread was made from a 21st Dynasty (ca. 1000 BC) mummy's hair which was excavated from Deir al Medina by Czerny in the 1930's and is presently on display in the Hrdlička Museum in Prague (Strouhal, personal communication; Lubec et. al., 1993). A subsequent examination of the Deir al Medina mummy¹ has thrown serious doubt on the interpretation of this find, however, which is most likely a remnant of a 20th century conservation treatment. Nevertheless, evidence for early silk outside of China before the Han period exists, and the list of occurrences continues to grow (see figure 1). In considering the amount of silk or possible silk in mid-first millennium Europe, the Near East and South Asia (for thorough review see Good 1995), it is important to consider what might have been made from wild silkmoths, either through indigenous discovery, or possibly as imitation of inaccessible Chinese silk.

1. I was given permission to study and sample the Deir al Medina mummy in Prague in 1995. Thanks are due to Dr. Eugen Strouhal and to the Charles K. Williams Fund for this study.



Figure 1. Incidence of Early Silks Outside China in pre-Han to early Han times.

- | | | |
|---------------|-----------------|--------------------|
| 1. Altrier | 7. Gordion | 13. Loulan |
| 2. Hochdorf | 8. Toprak Kale | 14. Lop Nor |
| 3. Hohmichele | 9. Sapalli Tepe | 15. Edsen Gol |
| 4. Chiusi | 10. Niya | 16. Noin Ula |
| 5. Kerameikos | 11. Pazyryk | 17. Deir al Medina |
| 6. Sardis | 12. Ukok | 18. Nevassa |

Silk is a highly crystallized polymer protein, which at the molecular level resembles cellulose, because of the highly repetitive sequence of molecules which make up the chains. It is an animal protein. Wild silk is biochemically distinct from domesticated silk, primarily due to the different composition and ratio of amino acids between different species. Wild silk is from one of several commercially viable species of the *SATURNIIDAE*, *Antheraea pernyi* (Chinese tussah) or *Antheraea mylitta* (Indian tussah), among others (Lucas and Rudall 1968:478-479; Peigler 1993; Watt 1893). There is a species from another family of moths and butterflies which produces a workable silk, whose present natural range is in the Mediterranean, known as *LASIOCAMPIDAE* *Pachypasa otus* (see figure 2) (Lucas and Rudall 1968:485; Freina and Witt 1987:379-380), which was quite probably the source of the so-called silks of Cos of fifth century BC Greece (Leggett 1949:56; Richter 1929:28; Braun, 1993; Zeuner 1968:484-485).



Figure 2. Present Distribution of LASIOCAMPIDAE *Pachypasa otus*

Although the domestication of the *Bombyx mori* silkworm seems unquestionably a Chinese development, the natural range of the wild tussah spinning moth *Antheraea pernyi*, possibly a more ancient source for silk spinning (Sylvan 1949:17), is also in China, particularly in the province of Shandong, and farther south (Jolly 1974:12). The ancestor of *Bombyx mori*, *B. mandarina* Moore, however, goes well beyond the borders of China (Barraclough 1979:70). *B. mandarina* Moore is native to a region as far west as the Himalayas and south as Assam and Bengal (ibid.). This insect was domesticated in northern China, probably in the province of Shandong (Boulnois 1966:18), which is also where the white mulberry (*Morus alba*) was probably first cultivated, although its natural range follows closely that of *B. mandarina* Moore, from the Himalayas in the West through Indo-China and northeastward into northern China (Anon 1980:1). The white mulberry was cultivated so that branches of this tree are low-lying, allowing silk workers easy access to the cocoons, and so that the leaves became highly nutritious for the silkworms (Xia 1983:52). The silk which is produced from this exclusive diet is pure white and exceptionally strong (Leggett 1949:70; Xia 1983:52), although there is also a genetic component to yellow vs white colour determination (Goldsmith,² personal communication). It was in northern China that the practice of boiling cocoons was probably developed. It appears that it was not so much the *Bombyx* moth itself but the technology of degumming which was so carefully guarded by the Chinese. In all likelihood the degumming process occurred before the domestication of the silkworm, as it is unclear as to how or why the silkworm became domesticated if processing the fiber to remove sericin was not practiced beforehand. Silk threads and fabrics that did manage

2. Dr. Marion Goldsmith, Dept. of Zoology, University of Rhode Island.

to cross China's borders into the hands of elites from western societies, however, proved to be one of the ultimate luxuries and an effective symbol of power and status.

The earliest tangible archaeological evidence for domesticated silk use in China dates back to 3300-2250 BC, as evidenced by remains from Qianshanyang, a Liangzhu neolithic site in the Zhejiang province of southern China. One of the samples from this site (whose radiocarbon dates actually put it around 2750±100 BC) is of *Bombyx mori*, woven in a tabby weave (Kuhn 1982:369; Nunome 1992:74). An earlier neolithic find of silk cocoons is from a Yangshao culture site ca. 5000-3000 BC (Chang 1960:110), called Xiyin Cun, in northern China's Shanxi Province. This early twentieth century discovery was that of an "artificially cut" cocoon of what was reported to be *Bombyx mori* (Kuhn 1982:370; Barber 1991:31; see also Chang 1960:241) but there is no description of how this was determined. Indeed, later analysis of this silk cocoon resulted in its being identified as *Ronditia menaciana* Moore, another wild species native to China but not presently existing in the North, rather than *B. mori* (Kuhn 1982:370). The earliest textual evidence for the knowledge of silk as an economic fiber is found among the earliest written records in China, the Shang Period oracle bone inscriptions ca. 1600 BC (Riboud 1977:253). The domestication process had become highly developed, as evidenced by microscopic examination of silk fibers in textile pseudomorphs (mineralizations of former textiles) adhering to Shang period bronzes (Kuhn 1982:383-386). Silk weaving in China had by that time achieved a very high level of quality, apparent from the high thread count and untwisted threads of the weaves, some with cross-warps (leno) and crepe fabrics from the Shang site of Taixicun (Kuhn 1982:384-85; Xia 1979:101).

The presence of silk in the Hallstatt D1 period grave VI of the Hohmichele Tumulus has justifiably attracted the attention of European scholars ever since the initial study was done on the textiles in 1969 (Hundt 1970; 1971). The silk has been interpreted as further evidence for the burgeoning trade being conducted between west-central Europe and the Mediterranean. The marked shift in social organization, settlement pattern, distribution of wealth and its display during the latter half of the Hallstatt period (C and D) is believed to be a direct result of this increased contact with Greece and Etruria, and the concomitant increase in the demand for finished products of these two societies (Champion et al. 1984:293; see also Härke 1989). Did the silk from the Hohmichele come to Germany from somewhere in the Mediterranean? The present hypothesis is that it was transported from Syria across the Mediterranean and up through established Etruscan and Greek trade routes on the Rhône-Doubs (Collis 1980:84; Wild 1984:18). Another possibility, however, is that it came via a more northerly route across Asia through Cimmerian nomads, bypassing the Mediterranean altogether, with some silk getting to Greece through the Balkans as well.

Gift trade, imperial gift-giving, and bribery are concepts which have been variously used to explain how early silks were exported from China before official trade was initiated. Han Period textual evidence clearly demonstrates that the Chinese had a thorough knowledge of the economic needs of neighbouring pastoral nomadic tribes (Yü 1967:169), and that they used this knowledge to their political advantage. There are

historical documents also describing instances where silk cloth was given to rulers of India, for example, which were subsequently sold to more westerly countries for profit, via intermediaries in Central Asia (*ibid.*, p. 169-170). The Cimmerian and later Scythian nomads of Central Asia and the Eurasian³ steppe were highly mobile and had access to trade with more easterly nomadic peoples such as the Xiongnu, a western “barbaric” tribe mentioned in Chinese texts of the Zhou Period, and known to the West later as the Huns (Hucker 1975:41; Menges 1968:17; Gernet 1982:120). The Xiongnu were located in northern Mongolia, the northeastern part of the Central Asiatic steppe zone. Other peoples possibly involved were the Sogdians of Ferghana and the settled Yuehzhì (Yueh Chih) of Khotan, known to the Greeks as Indo-Skythoi (Gernet 1982:120).⁴ There were proto-Hunnic, Altaic, and proto-Mongolian peoples from the eastern part of the northern steppes in Eastern Mongolia (Menges 1968:18), who may each have played a role in the long distance movement of silks, bronzes and other objects of value. Among these tribes were the Wuhuan (Avars) of southern Manchuria and the Xianbi (Sānbì) of Manchuria who resided along the northern frontier border of China. The Donghu (“Eastern” Hu) and Wuhuan tribes were horsebreeding peoples of southeastern Mongolia and southern Manchuria known to the Chinese during the Warring States period (Gernet 1982:121).

These peoples may have played a role in obtaining silks, both yardage as well as processed fibers, from the Chinese and passing them along to neighbouring tribes to the west, as their interest in horses may have brought them into contact with the horsebreeding tribes in the regions of Ferghana and Khotan (Boulnois:1966:34-37). Indeed there is mention of the Xiongnu in one text called the *Qian Han Shu* (History of the Former Han) [HS943:2 a-b], where there is a detailed description of the Chinese giving this tribe silk fabrics and silk floss, a by-product of silk from the innermost part of cocoons, for protection against invasions by other nomadic tribes (Yü:1967:45-46). This kind of transaction goes back to at least the sixth century BC (*ibid.*, p. 5).

There are Chinese texts which allude to the rather low value the Chinese placed on silk at this time; and it would appear that cloth made of hemp was considered more prestigious because it was not as common (Boulnois 1966:19; Varron 1938:350-351). This might explain how some silk or clues concerning the technology of processing may have been exported. By the Han period, however, silk was equivalent to cash, as taxes were paid in silk to the government (Boulnois 1966:21). Perhaps the silk technology was only highly guarded during Zhou and Han times, and during periods of political instability and lack of internal political cohesion this became less of a priority. It is believed that in the early 8th century BC the first nomadic horsemen were reported in Chinese annals, attacking from the north during the reign of emperor Xuan (Gernet 1982:680).

It is well established that the Cimmerians had close contact with West-Central Europe (Pauli 1985:29; Grakow 1980:52; Collis 1980:81). The idea of contact between the

3. Eurasia is defined here as the western half of the semi-arid steppe belt of Asia and Eastern Europe (following Menges 1968:11).

4. Note, however, that Menges (1968:17) warns that ancient western historians often obscured ethnicity between different groups, and would not differentiate between the Huns and the Scythians, for example.

northern Black Sea region and Western and Central Europe during the early iron age is not new. As early as the nineteenth century scholars had been interested in the evidence for contact between Cimmerian and Scythian nomadic tribes and the Hallstatt cultures (Bouzek 1983:177; Janse 1930). The location of the Hohmichele and Heuneberg tumuli is such that the Danube is even more accessible for trade than the Rhône-Doubs. The Greek settlement at Massalia ca. 600 BC is the only reason that most European scholars point to Mediterranean importation as the explanation for silk in a Hallstatt grave (Collis 1980:84; Wells 1980:56). If one were to look to the Danube as an alternative access route for trade with the Heuneburg and Hohmichele region, the Ukraine, the steppes northwest of the Black Sea, the Caucasus and the Balkans, (in other words, the territory of the Scythians), become other feasible areas of contact. More recent attention paid to the Hallstatt presence of silk has brought up this possibility in the literature (Barber 1991:205; Wild 1984:17-19). Recent re-evaluation of Hallstatt C and D chronology, as well as the dates for the initial settlement at Masalia possibly as late as 540 BC, (Vickers 1984), reinforce the idea that the silk may not have reached the Baden-Württemberg region from the south.

The Scythians were well documented by Herodotus ca. 450 BC (Rolle 1989:133). At the time of the Hohmichele burial, the Scythians had just recently entered the homeland of the Cimmerians north of the Black Sea; displacing them and forcing at least some of them to move into Anatolia, where Cimmerian presence has been documented at Gordion in Phrygia (Young 1958:154). Scythian burials have been reported as far west as Germany (Grakow 1980:52; Jettmar 1964:30), and it is also recognized that some of the Greeks imitated the kurgan mode of interment (Barber 1991:206). The timber-lined tumulus graves with horsegear and wagons of Hallstatt Germany must have been a direct influence of the Scythian or related peoples. This must hold true for the very similar tumulus graves of Phrygia as well. By examining the material cultural data from such diverse regions as the Caucasus, Anatolia, Greece, Central Asia, China and the High Altai, archaeological indications for cultural contact between East and West during the Hallstatt C and D periods do begin to appear. However, despite the very real possibility of trade connections between western Europe and Scythia in the mid-first millennium BC, the silk fibers in the embroidered textile fragments from the Hohmichele tumulus grave 6, are *not* of Chinese origin (Good 1995; Good and Kim, n.d.; Good, Meadow and Kenoyer, forthcoming); but rather come from a wild silkmoth species. By studying the biochemistry of archaeological silk fibers, their identification becomes more reliable, thus enabling a more accurate assessment of the long-distance movement of goods .in prehistory.

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