Flocks and herds: animal skin and hide exploitation for the manufacture of Nubian leather

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Survival of leather in archaeological contexts

Typically leather, made from vertebrate animal skins, similar to many other organic materials, will completely decompose in damp burial conditions, becoming unrecognisable from the surrounding earth, and so it is often difficult to assess how much was processed and in use during antiquity, or originally entered the archaeological record.

Egypt and Nubia

Nevertheless, long-term burial conditions are consistently dry enough in certain areas and sites in Nubia and Egypt to preserve organic material, allowing for an assessment of the level and frequency of skin-product usage along the Nile valley in antiquity. Animal hide and skin and leather[1] have been found in fluctuating quantities in Nubian and Egyptian burials from the Predynastic/Pre-Kerma and pre-A-Group period, throughout the Egyptian dynastic periods and Nubian Kerma and A-C group periods, to the Late Antique/Christian era.

During the predynastic periods in Nubia and Egypt, animal hides and skins,[2] commonly with the hair still attached, were used as grave linings and body coverings, in lieu of a coffin or perhaps as cloaks, fastened with bone, teeth or tusks (Petrie 1920, pl. XXXIII). Sometimes powdered red ochre was applied to the hide grave linings as a bright colourant. Because ochre is an inorganic mineral, the pigment can survive even when the organic components (the hide itself is composed of protein) disappear, leaving behind deposits of red pigment in a layer where the hide used to be (Welsby 2012, 24).

Differing leather traditions

It is noteworthy that once Egypt was unified *c*. 3000 BC, skin-product usage became more limited. Rawhide continued to be used for lashings and thick sandal soles and leather remained an indispensable material for making certain hardwearing items such as bags, quivers, chariot encasements and sandal straps. However, in Egyptian burial contexts, it appears that hide burial linings and clothing were almost entirely replaced by matting and woven textile wrappings. This appears to coincide with increasing archaeological evidence for Egyptian clothing made from linen. In comparison, evidence from Nubian burial contexts at sites such as Abu Fatima (Tombos), Kerma, Hierakonpolis and Mostagedda indicates that skin products continued to be exploited by Nubian populations throughout the entire A-C group and Kerma periods, although archaeological evidence from Hierakonpolis suggests that within Egypt, animal hide was not used by the C-group for burial linings, perhaps suggesting that the Nubians had adopted some Egyptian burial customs (Friedman 2012, 26).

Rawhide

Nubians found many uses for animal skin, and the most basic form – rawhide - required very little processing beyond removing the skin from the animal and scraping the inside (flesh) surface clean.

Rawhide was used anywhere where vegetable fibre cordage lacked the required strength - for instance straps and lashings on tools and animal harnesses. At Kerma, during the *Kerma Classique* period high-status people were often buried lying on beds – such as the example excavated by Reisner, which has been reconstructed at the Boston, Museum of Fine Arts.[3] Often the bed legs were carved to resemble ox legs, with hooves at the base of the legs, and rawhide strips were typically woven together to form the bed strings (Reisner 1924, 208-227).

Recent investigations

As part of the author's research into Nubian and Egyptian skin-processing technology (at the British Museum and

[1] Animal skin that has been processed/tanned, to render it non-putrescible in prevailing local environmental conditions.
[2] Animal 'skin' originates from smaller animals such as sheep, goat and gazelle. Animal 'hide' is used to describe the skin of a larger animal such as cattle.
[3] *https//collections.mfa.org/objects/148205.*

Figure 1. Fragment of EA63210 – Pangrave culture hairy rawhide container with rawhide strips used for joining seams from Mostagedda, Egypt (photo L.-A. Skinner taken courtesy the Trustees of the British Museum).

University of Northampton, Institute for Creative Leather Technologies), physical investigation and scientific analysis has been carried out to find out which animal species were used and the methods and technologies employed to make skin and leather products.

Experimental skin processing and reconstruction of select items have been carried out in order to gain greater insight into the motivations behind the leather-making practices of ancient Nubian craftspeople. Only by actually experiencing the processing technologies, and working with the skins of different animals, can one hope to understand why a certain animal species or technique may have been preferred to another, for certain uses.

In order to make a rawhide strap, the skin is flayed from the animal and the flesh and fats cleaned from the inside surface. Hair can be removed from the skin either by loosening the hair from follicles using an alkali solution such as lye (a solution made from leached wood ash), or by 'sweating' (leaving it in warm, humid conditions) the skin to induce decomposition of the surface (skin slippage) and relaxation of hair follicles. The disadvantage of dehairing, particularly by sweating, is that the structure of the skin is damaged in the process, resulting in weakening of the rawhide. So sometimes, for this reason, hair was left attached – as in Figure 1. Following this stage, the skin is partially dried, and a strap cut to the desired width and length. It has been noted by the author that when fully wet, raw-animal skin is thick, swollen and rubbery. It cuts easily but will shrink and distort a great deal as it dries. On the other hand, when fully dry, thick rawhide is stiff and tough and extremely difficult to cut, and so it is easiest to work with it while it is partially hydrated.

The most economical method of forming a long strap (while retaining the maximum area of the hide for other uses) is to cut a strip of the desired thickness from around the outside edge of the animal hide. In this way, long lengths of rawhide strapping can be fashioned, and either used straight away or as demonstrated in Figure 2, wound up, dried to stiffness and then re-wet and used at a later stage.

The advantage of using rawhide for purposes such as lashing handles to tool blades is that when bound around in its partially hydrated form, rawhide is pliable and stretchy - easily conforming to the shape of the handle. As it dries, rawhide shrinks, and stiffens, tightening in position and fastening the binding securely to the blade. Long rawhide strips would have been ideal for weaving into strings on the Kerma ancien beds, because as the hide dried, it would have tightened up, stabilising the bed frame. The tightened bed strings would be strong but also retain some springiness, making the bed comfortable to lie on.

Figure 2. Rawhide strapping – made from the outer edge of a sheet of cattle rawhide.

Sandals

Rawhide also appears to have been the preferred material for forming the thick, single layered sandal soles, of the classic Nubian sandal type as in Figure 3 (Veldmeijer and Skinner 2019, 499-501).

Often the straps were made from thick hide, similar to the sole, but sometimes finer, softer leather was used for the straps, for example in Figure 4.

One of the items recreated by the author, is a pair of 'Earred sandals' of the swayed type (Veldmeijer 2011, 3-4), with hide straps

Figure 3. EA55441 sandals from *Kerma classique* 1750-1450 BC (photo L.-A. Skinner taken courtesy the Trustees of the British Museum).

like EA55441 in Figure 3. The sandal soles and straps, in Figure 5, have been fashioned from a single sheet of (cattle) rawhide.

The hide was cut out while partially hydrated, the 'ears' shaped by lifting them up, and straps fitted before the hide dried. Parallel line decorations were engraved into the upper surface with a sharp tool, like an awl, also while the rawhide was still soft. The finished sandals were made to fit the feet of the author. By wearing the sandals throughout the drying process, the hide became moulded to the foot shape. Dirt, from wearing the sandals outside, accumulating in the engraved decoration has caused the lines to darken in colour. Wearing the sandals also resulted in abrasion on the base of the sandal sole, so much so that it is now possible to clearly discern that the sandals have been worn.

Once dry, the sandal soles offered no grip on any smooth surface, making them quite treacherous to wear, and even though animal fat was rubbed into them to soften and lubricate the fibres, the rawhide straps became quite uncomfortably stiff and sharp against the skin.

These observations are all useful, and might offer an explanation why sandals such as EA63215 in Figure 4, from a Pangrave burial, were made with more pliable leather straps rather than from rawhide. Of course, the modern foot is not used to wearing rawhide footwear and a Nubian in 1600 BC might have had more resilient skin on their feet. Also, Nubians may have used emulsified fat to

Figure 4. EA63215 sandals with thin blackened straps from a Pangrave tomb, Mostagedda (photo L.-A. Skinner taken courtesy the Trustees of the British Museum).

Figure 5. Nubian sandals reconstruction, fashioned from cattle hide, in 2020.

lubricate the straps - such as egg or brain - that is not hydrophobic like lipids such as lard or castor oil, and so they penetrate and soften more effectively. It has been of particular value, for the author, to observe how quickly signs of wear appeared on the reconstructed sandals. This knowledge enables one to infer with greater confidence whether or not rawhide sandals found in the archaeological record were worn during life or manufactured specifically for burial.

Picking the right animal for the job

Rawhide used for different purposes can be made from any kind of animal skin, but for many purposes, cattle-hide is preferred, due to the mechanics of animal skin. As raw skin dries, the space between the collagen in the grain and corium (Figure 6) shrinks and the fibres stick together, resulting in a large decrease in thickness. Experiments carried out by the author to recreate rawhide have found that sheep and goat rawhide is extremely thin (less than 0.3mm), becoming almost like parchment. Fresh, hydrated cattle hide is around 5mm in thickness, and has a dense structure, and so shrinkage upon drying is not as dramatic with cattle rawhide (shrinking to *c.* 2mm), making it generally preferable to the skin of smaller animals. Sandal soles made from a single layer of raw sheep or goatskin would be so thin that they would be floppy and almost paper-like, not affording any protection to the feet and would quickly wear through.

Nevertheless, raw goatskin and sheepskin can be processed by 'tanning' or 'leathering'[4] to form leather. Processing prevents stiffening of the skin by stopping the collagen fibres from sticking together (Thompson 2006, 2). After being converted to leather, goat and sheepskin become smooth, pliable and soft. The denser structure of goatskin, compared to sheepskin means that goatskin is strongest and most elastic of the two animal species and the leather perfectly suited to making sandal straps. While sheepskin sandal straps may be adequate for the purpose, the looseness of the fibres in the grain and corium (Figure 6) in sheepskin could cause the straps to stretch, becoming loose and baggy after a period of use. Furthermore, there could have been other reasons for these different material choices, such as stylistic preferences, or cultural/religious beliefs.

It is clear from archaeological evidence at Kerma (Chaix *et al.* 2012) that cattle played a significant economic and ceremonial function in society during the Kerma period. Perhaps burial beds with strings fashioned from rawhide possessed more significance than if made from vegetable fibre, and sandals fashioned solely from cattle hide could have been bestowed with greater importance than sandals made with the skin of another species of animal. It is possible that the sandals were made specifically for burial, and not for daily use, so whether or not they were comfortable may not have mattered.

Other uses for leather

Besides the uses for rawhide and leather straps already described, Nubians had a multitude of other uses for tanned leather. The archer's armguard (Figure 7) from a Pangrave burial at Mostagedda is made from a thick sheet of leather (2mm thick), curved to conform to the shape of the wrist and would have been worn in order to protect the inside of the forearm from injuries, caused by the rebounding bowstring. The leather of the armguard was prepared by scraping it to remove as much of the natural fat as possible, and then pounding the flesh side with emulsified fats, working it until it dried. The physical working of the leather makes it flexible, soft and fibrous on the 'flesh' side (see Figure 6 to understand the anatomy of mammalian skin), while retaining a smooth and dense outer 'grain' surface which would reduce the possibility of the leather catching on the bow when the archer shot an arrow. In this example, the grain surface has been inscribed with a sharp tool (in a similar manner to the sandal sole, described above), to decorate it. The score-marks now appear blackened – probably due to dirt accumulating inside the cut or to deterioration induced by moisture accumulated inside the grooves, rather than an intentional black colouration being added, but this supposition has not been investigated. Cattle hide is ideal for the purpose of making leather, as it produces a dense, thick leather, similar but with more flexibility than rawhide. Other uses for cattle leather might be as flexible straps – such as animal harnessing or whenever leather is needed that doesn't stretch or fail under tension. The thickness of leather made from adult cattle hide can also be a limiting factor, making it hard to stitch and

[4] Tanning hide or skin is the process used for converting raw animal skin into a durable and imputrescible material known as leather. Leathering is a term used to describe processes such as alum tawing and oil dressing/curing. Leathering processes produce a leather-like material with many properties similar to tanned leather. However, leathering may be reversed by washing out, unlike tanned leather.

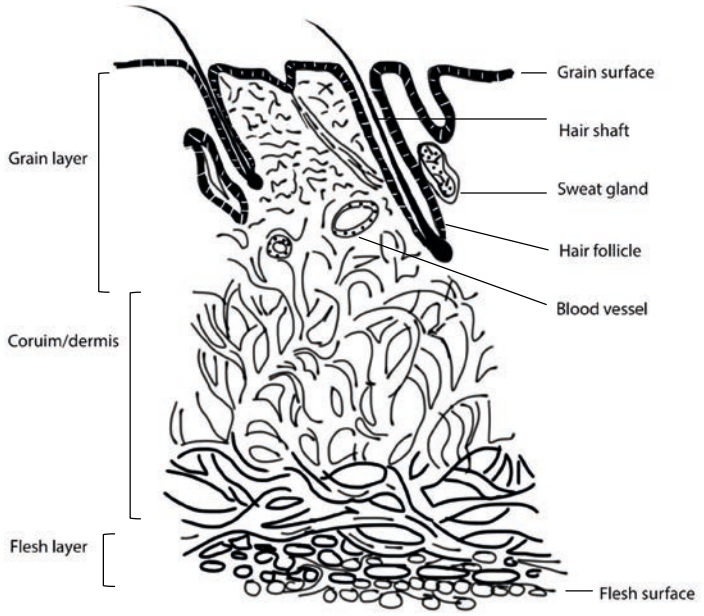

Figure 6. Cross-section through skin identifying morphological features.

meaning it lacks flexibility and drape. Even calf skin is stiff compared to goat or sheep skin. While it is possible to reduce the thickness of a leather sheet by shaving down the flesh surface, this would take a lot of effort and seem unnecessary when skins from small animals such as sheep or goat are thinner and much easier to use for manufacturing decorative items such as quivers, or leather garments.

Nubian garment leather

Perhaps the most characteristically 'Nubian' use for small animal skins was to create super-fine garment leather (Dunham 1982, 28; Williams 1983, 65). It had the appearance of very fine suede or chamois leather,[5] exceptionally thin and although now stiff and brittle, judging by the intricate folds it has formed (and now solidified into), evidently it was originally light and highly supple. To create this soft fibrous, suede-like leather, the smooth grain layer (see Figure 6) of the skin has been removed during processing. 'Grain-off', garment leather has been found in male and female Nubian burials, sometimes in contact with the body but often, because of looting, scraps of the leather are found strewn around inside the grave-pit, making reconstruction of the original appearance of garments, challenging. Excavated Nubian garment leather is generally light to mid-brown in colour or sometimes red or beige, although one cannot be certain of the original colour as it is likely that it has darkened due to age and

Figure 7. EA63225 an archer's armguard (photo L.-A. Skinner taken courtesy the Trustees of the British Museum).

Figure 8. M1407 from Abu Fatima, Sudan (photo L.-A. Skinner taken courtesy the UCSB-Purdue Tombos Project).

[5] Although modern chamois leather is made from sheepskin, it was traditionally made from the chamois goat/antelope.

deterioration. It has been possible to identify different types of garment made from the fine leather, including 'skirts' in female burials. The skirts are formed from narrow panels or small patches of brown, red and beige leather, stitched together along straight seams as shown in Figure 8. The panelled skirts found at Hierakonpolis were gathered at the waist by a leather thong (Skinner and Rogge 2016, 22).

Recreating 'grain-off' leather

Male burials usually contained lower volumes of leather but often in the form of larger sheets, without seams as in Figure 9. These strips or sheets of leather were used as sashes, kilts and loincloths (Friedman 2004, 47-50). To create Nubian 'grain-off' leather is no mean feat and requires extensive processing. In order to understand the process, and the value of removing the grain layer, the author has experimented with deer, sheep and goatskins to produce grain-off leather. Processing starts by taking the fresh skin and scraping clean the flesh surface, to remove all material, including the membrane. Next, the hair and grain layer on the outer surface is completely removed. Two approaches can be taken to removing the grain surface – dry or wet scraping. Dry scraping involves stretching a skin out in a frame, allowing it to dry, and then effectively shaving off the hair and the grain surface using a scraping tool, such as a semi-circular knife. After the grain is gone, the remaining part of the skin (the corium) can be rehydrated, in preparation for the next stage.

For wet scraping, the hair follicles and junction between the grain and corium needs to be loosened, so that the grain can be scraped off. This can be achieved by inducing sweating (allowing the putrefaction process to start) or by swelling the skin using a strong alkali (as described above for dehairing rawhide). Once swollen, the grain surface can be scraped off, using a scraping tool, made of stone, metal or bone.

Both dry and wet scraping leave the fibres in the remaining portion of the skin (the corium) open and receptive for the application of fat, such as brain, eggs or emulsified oils, which are rubbed into the skin, in several applications, to lubricate the collagen fibres. After the fats have penetrated the structure, the skin is ready for drying. It is important that while the skin dries, it is constantly stretched and staked to keep it soft and supple, otherwise it will stiffen. The dry softened skin turns from a grey colour to creamy white. To make it more resistant to moisture, the skins can be smoked over a smouldering fire. As well as protecting the skin, smoke has the effect of making it turn brown. This may be how Nubian garment leather ends up brown, but smoking is difficult to detect analytically because the aldehyde compounds in smoke that 'tan' the skin are volatile and so unlikely to survive after burial. After rubbing down the skin with an abrasive stone (pumice was used in the experiments), the final result is fine, smooth and flexible, with similar properties to Nubian garment leather.

The product of the experiments varied depending on the animal species tested; deer 'buckskin' turning out soft, but relatively thick. A fine result was achieved using a thin goatskin – although perhaps the goatskin still lacked some of the lightness and drape of Nubian garment leather. Wool-bearing sheepskin also produced a thin, soft skin, but the high fat content and loose collagen fibres and unevenness inherent in wool-bearing sheep made processing the skin very challenging and the final result loose and baggy in some areas and thicker and fibrous in other parts. This was not surprising because wool-bearing sheep are not known to produce good leather. However, not all sheep are woolly, and it is likely that ancient Nubian sheep were a hardy desert sheep breed, long legged, with coarse hair-coats (Brewer *et al.* 1994, 91). The preferred sheep breeds in modern Sudan are hair-sheep. Unfortunately, the author has not been able to obtain a hair sheep skin in the UK, for experimental tanning, but it is known that hair sheep has fine, non-fatty, smooth skin, making strong leather similar to goatskin, but finer and smoother in texture.

Figure 9. M1407 from Abu Fatima, Sudan.

One might wonder what would induce people to wear leather clothing in a hot climate. Interestingly, as well as being very thin and light, grain-off, oil-tanned leather

Figure 10. EA 2564 loincloth (photo L.-A. Skinner taken courtesy the Trustees of the British Museum).

is super absorbent and so sweat is quickly wicked away from the skin, evaporating and helping to keep the body cool in hot temperatures. Also, when night-time temperatures dropped into single digits, as they will during winter months in the desert, the layers of leather clothing, and animal hide bedding, must have provided welcome insulation.

So far, this paper has identified the purposes of, and the physical differences between, products made from skin and hide of different animals, but has not demonstrated how one can scientifically distinguish between animal species. Distinguishing between the skins of the three domesticated animals typically used by Nubian populations (cattle, sheep and goat) (Chaix, 1993, 89), is rarely as straight forward as simply comparing their thicknesses, especially when dealing with deteriorated leather.

In the first instance, the author employed a simple method, to taxonomically identify leather and rawhide. This involved examining the hair follicle pattern (the spacing, grouping and size of the holes left in the skin after the hair has been removed) on the grain (outer surface) of a piece of leather or skin, under magnification. By comparing this species-specific grain pattern with known reference leather samples, it may be possible to find a match, and identify the animal species (Skinner *et al.* 2020).

Perforated leather

However, as described above, the grain-surface was entirely removed from Nubian garment leather during processing, so it is not possible to identify the animal species using the grain pattern identification method. Garment-type grain-off leather was sometimes processed even further, by making a series of parallel rows of cuts through the leather, each row staggered so that when the skin is pulled out sideways it forms a net-like arrangement – as seen in Figure 10. By piercing the leather in this manner, the breathability and the flexibility of closefitting garments such as loincloths and head coverings was increased. The perforated leather loincloth is one item of Nubian leather clothing that seemed to have been adopted by Egyptian populations during the pharaonic era (Marazzi 2018, 2). There are tomb depictions of people (specifically workmen) wearing perforated leather loincloths, while working in the fields or rowing river craft, and several examples of loincloths have been discovered in Egyptian contexts (Vogelsang-Eastwood 1993, 17-20). This is a testament to how hardwearing a material grain-off garment leather is. It has been suggested by John Waterer (leather technologist and founder of the National Leather Collection, in Northampton) that to make this fine perforated leather, gazelle skin was used (Waterer 1946, 30). However, this assumption was not based on scientific evidence, and since perforated leather is made from grain-off leather and lacks identifying grain-pattern features, warranted further investigation if it was to be trusted.

Scientific analysis using ZooMS

Developments in recent years, in the scientific field of 'Proteomics' is now putting an end to speculation and uncertainty regarding the identification of animal taxonomy exploited for producing skin products. Zooarchaeology by Mass Spectroscopy (ZooMS), a term coined by the BioArCh department at the University of York, is a method using collagen samples taken from bone, parchment and leather objects (Buckley *et al.* 2009). The samples are processed in the lab, using an enzyme to digest the collagen and the fragmented collagen analysed using MALDI-TOF (Matrix assisted laser desorption ionisation – time of flight, mass spectrometry). A 'Protein Mass Fingerprint' (PMF) is produced, which is specific for different animal types, to the genus level. As long as the sample is neither contaminated, nor too degraded, ZooMS is often able to identify cattle hide, to distinguish between sheep and goatskin and to identify exotic and wild animal species such as gazelle (Buckley *et al.* 2010). Using a methodology adapted for analysing leather

(Fiddyment *et al.* 2015), ZooMS has been carried out by the author on skin products from various museums and sites containing Nubian collections,[6] including sandals, garment leather and perforated leather.

ZooMS has confirmed that, as suspected, cattle hide was used (in all samples tested that produced viable results), to make rawhide tool lashings, bed strings, burial linings and for the soles of all Nubian Eared-type sandals. Generally, from the Meroitic period onwards[7], grain-on goatskin was preferred for making fine functional items such as quivers and bags. Of the samples tested that produced viable results, sheepskin was used almost exclusively for the fine, grain-off garment leather used to make skirts and loincloths made of solid (unperforated) leather sheet. It is likely, for practical reasons (as discussed above) that the sheepskin leather originated from hair-sheep, not wool-bearing sheep, but this cannot be confirmed using ZooMS, as the technique cannot detect differences between the PMF of different breeds in the same genus. *C.* 10% of the grain-off leather was made from goatskin, and these fragments are thin and fine but the surfaces do not appear to be as soft as those made from sheepskin.

Unfortunately, the collagen in ancient leather is often highly degraded and ZooMS does not always work, or the results are not clear enough to define the animal beyond taxonomic 'family'. This is especially so for leather buried in contact with a decomposing body, because of contamination (by human proteins) and oxidative biodeterioration of collagen which is accelerated through contact with moisture and bacteria (Larsen *et al.* 2012, 62). Of the five perforated leather loincloths, tested using ZooMS, only one produced a viable result. This is not wholly surprising given that the loincloths were probably worn in the grave, wrapped around the waist and groin of the human cadaver. The single viable ZooMS result indicated that EA2564 was made from gazelle skin, which is interesting. The British Museum object catalogue states that this particular loincloth was from Thebes in Egypt, and so it could have been from an Egyptian, not a Nubian burial. The author has found that Egyptian leather was only very rarely made from sheepskin, and so this might explain why this loincloth was (probably) made from the skin of a gazelle.

If the body that this loincloth belonged to was eviscerated, desiccated and mummified, in typical Egyptian style, then there would not have been much moisture in the burial, which might explain why the collagen was better preserved in this loincloth than the others tested.

Exotic animal skins

Where Nubians are depicted in Egyptian tomb paintings, such as in a parade scene in the tomb of Huy (in the Valley of the Nobles, at Thebes), they are usually wearing leather items such as sashes, kilts and panelled skirts. Also, sometimes Nubians were draped in exotic animal pelts of leopard and cheetah or appearing to bear offerings of exotic skins. So far, this author has not seen any archaeological evidence from the objects studied, nor revealed any ZooMS results to indicate the presence of exotic animal skins in Nubian burials. Possibly they have not survived burial or rather than ever being interred with the dead, they were passed on as heirlooms. It is likely that exotic animals were only rarely hunted and their skins processed in Nubia – at least at Kerma. Excavations by the French team at Kerma have revealed that hunting activities were rare, and they have discovered only scarce remains of gazelles, hippopotami and small game in the ancient city and cemeteries (Chaix *et al.* 2012, 189).

Exceptional leatherworking expertise

It has been proposed, from archaeological evidence at sites such as Hierakonpolis in Egypt, that Nubians were acknowledged by their Egyptian neighbours to be leathermaking specialists, and even that isolated Nubian communities were established within Egypt in order to provide Egyptians with leather (Veldmeijer and Skinner 2019). Whether or not this is true cannot be verified. Nevertheless, Nubians were irrefutably highly skilled at skin-processing.

Links between pastoralism and leathermaking

The question of why Nubians were so closely linked to processing and wearing of animal skins is an interesting one and there are undoubtedly many reasons for this. One hypothesis is that Nubian leatherworking expertise and the wearing of leather garments are a natural result of early populations living and learning to endure the harsh desert

[6] Nubian leather samples originate from the British Museum, the National Leather collection, Northampton, the Sudan National Museum (National Corporation for Antiquities and Museums), and Abu Fatima (Tombos, Sudan).
[7] Judging from leather items tested from Qasr Ibrim.

environment and droughts in Nubia.

Constant low rainfall and high summer temperatures meant that at least until the Meroitic period (when methods of irrigation were introduced) most Nubians were not able to grow arable crops all year round – being limited to the winter months, after the annual floods of the Nile (Clapham 2019, 86). This restricted their ability to grow flax and create linen. The Egyptian preference for clothing made from linen, which is derived from the flax plant, shows that they on the other hand were growing crops year-round and able to harvest and process them at a sufficient volume for textile manufacture.

The Nubian climate was (and still is) arid and better suited to semi-nomadic pastoralism than sedentary farming. Semi-nomadic pastoralists need to move their herds and flocks during the dry season, to seek fresh pasture. These pastoralists kept animals, for milk and meat. Skin, for producing leather clothing would have been a convenient biproduct. Hardy animal breeds such as the hair-sheep suited the desert fringe environment in which they lived. More arid environmental conditions in the second millennium BC meant that Nubians were even more reliant on larger numbers of caprine (sheep and goats) in the *Kerma Classique* period (Chaix *et al.* 2012, 189). The semi-nomadic pastoralist lifestyle could also offer some explanation for the possible preference in Nubia, during this period, for herding sheep rather than goats. Flocks of sheep are easier to direct and control than herds of goats, with goats more likely to wander off, making them vulnerable to predation. Also, whereas goats are opportunistic browsers and will eat the kind of shoots and fruits from trees which might also be fit for human consumption, sheep tend to feed mostly by grazing on grasses, meaning that humans are not in competition with their sheep, in times when there is little food available.

Something that this research has made clear so far, is that Nubians had very defined uses for animal hides and skins. The choice of which kind of animal skin was put to which of these uses was precise and depended on a number of predominantly practical, but also culturally relevant factors. There is still much to discover in the area. It will be interesting for ZooMS to be used more commonly for taxonomic identification of faunal collections from Nubia. The technique circumvents a common problem for archaeologists, which is distinguishing between the bones of sheep and goats, so would provide much greater clarity in this area, allowing the different branches of faunal analysis to integrate more effectively in the future.

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