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Union Yarn and Union Fabric in Talmudic Literature from the Roman Era

Introduction

Modern era fabrics and the garments or textile products manufactured from them are often bi-component or multi-component fiber blends, e.g. cotton, polyester, and spandex - in various ratios. The selection of these fiber blends emanates from various considerations, such as factors of production cost, consumer demand and product performance. These mixture-fabrics may be produced by two methods:

1) Union yarn – wherein the different fibers are blended together and in turn spun. A variation – union plied yarn wherein several spun yarns, each consisting of one different textile material, are plied together, and in turn woven or knitted – is out of the scope of the current paper. 2) Union fabric – wherein two different yarns, each consisting of a single type of fiber, are woven or knitted together.

This is a *longue durée* phenomenon. Historically, mixture-fabrics have been documented and their preserved remains found. The Edict of Diocletian mentions various garments of half-silk (Laufer 1971, 150-152). Nevertheless, detailed descriptions of these garments' respective construction are lacking. Archaeological materials of this category in hand include those that originate from Roman era Palmyra in Syria, and from various locales in the Byzantine and Medieval periods. This paper will focus on the literary evidence for these fabrics from the Roman period, as presented in Talmudic literature.

The Talmudic sages (ca. 150-450 CE¹) demonstrate remarkable familiarity with textiles and their manufacturing processes. A wide gamut of fibers is recorded, i.e. sheep wool, goat hair, camel hair, rabbit hair, linen, hemp, various silks, and sea silk (*bisso marino*). For example, the following *halakha* (Talmudic law) lists the fibers that were in minor use:

One who takes outside on Shabbat [one of the following fibers]: grape wool [cotton], *kalakh* wool, camel wool, rabbit wool, wool from a sea creature, or any other [fiber] which is to be spun... (Tosefta Shabbat 9:3, literal translation of the Hebrew text's terminology).

The production of union yarn both spun and plied, of various fiber blends and ratios is described in this literature, as are various permutations of union fabrics. The aforementioned secular considerations for these products do not apply in Talmudic literature. Instead, legal ("halakhic") contexts are the principle impetus for the description of contemporaneous textiles.

It is important to emphasize that the exact dating of Talmudic sources is a complex task. Although estimated dates of final redaction for the various works indeed provide a relative *terminus ante quem* ("date before which") in the 3rd to 5th centuries CE, nevertheless these works embody many layers of historic excerpts offering a much earlier *terminus post quem* ("date after which"). This entire period may encompass 500 years or more. In the current paper, we will adhere to the *terminus post quem* (TPQ), this being the firmest ground.

This paper will elaborate upon the composition and structure of these mixture-fabrics as the sages describe them, and their respective halakhic connotations.

The two halakhic contexts in which Talmudic literature describes textiles of this type are: 1) the laws of forbidden mixtures (or: diverse kinds), and 2) eruptive affections (explained below) of garments. The familiar King James Version Bible translation of the latter: "A plague of leprosy... in a garment" (Leviticus 13:47, *passim*) is misleading, and has been rejected by contemporary scholars (Rabinowitz 2007, 650). Obviously, Hansen's disease is irrelevant



in this context (Milgrom 1991, 809 translates as “mold disease”). The current paper has adopted the terminology of the Jewish Publication Society Bible translation – “eruptive affection,” and applied it in turn to the Talmudic sources.

Both of these halakhic contexts are of Biblical origin (Iron Age), and the sages of the Talmud (Roman Era) relate to them from their own contemporary viewpoint, reflecting current textile technological capabilities and practices. According to *halakha*, the Biblical law of forbidden mixtures and its Rabbinically-decreed additions (or: safeguards) are binding and practiced in every era. Eruptive affections of garments may not have been a contemporary phenomenon in the sages’ time. Nevertheless, they are dealt with by them as if they were. Half-silk garments are mentioned in the various Talmudic genres - *halakha*, exegetics, and homiletics (*midrash aggada*). In this paper, the term wool – with no added descriptive modifier (e.g. camel, rabbit etc.) – indicates sheep wool. Flax and linen, in our context, are interchangeable terms.

Palmyra

Both union yarns and union fabric components were identified in some of the textiles retrieved from Palmyra (Schmidt-Colinet et al. 2000, *passim*). These textiles are relatively similar both geographically and chronologically to those mentioned in the Talmudic literature, and often provide correlative physical evidence. Union yarns of the following compositions are documented: wool-cashmere (probably from Mongolia; Schmidt-Colinet et al. 2000, 10), and cotton-flax (Schmidt-Colinet et al. 2000, 13). Both of these mixtures preserve the uniform animal fiber or vegetable fiber composition of the yarn. Similar, in this aspect, yarn blends are found in Mishna *Kil’ ayim*² (*infra*), i.e. wool-camel hair, and flax-hemp. In contrast, Rashi suggests the existence of a flax-wool union yarn. Union fabrics of the following structures and materials are documented at Palmyra:

- Warp: cultured silk (*Bombyx mori*), weft: cashmere or wool, cotton or flax.
- Warp: tussah silk, weft: cotton.
- Warp: flax, weft: wool.

These may be balanced weaves, warp-faced or weft-faced (Schmidt-Colinet et al. 2000, 10-13, *passim*). Many similar characteristics of material and structure in union fabrics are found in Talmudic literature.

The presence of both cultured silk from China and tussah silk (probably from India) in Palmyrene textiles, adds corroboration to their presence in the Land of Israel at that time, arriving via the overseas silk route. Although Asiatic camel hair was not identified (Schmidt-Colinet et al. 2000, 11), the fact

that cashmere goat hair appears lends credibility to the proposition that Bactrian camel hair may very well have been imported from the East, via the overland route. These issues will be discussed below in their respective halakhic contexts.

Kil’ ayim – The Law of Diverse Kinds

The Biblical sources for this prohibition are as follows:

A garment, which is a combination of two kinds of material - *sha’atnez*³, shall not be placed upon you (Leviticus 19:19).

You shall not don *sha’atnez* - a combination of wool and flax (Deuteronomy 22:11).

Talmudic literature provides additional parameters and detail. It is possible to ‘neutralize’ one of the components of the forbidden combination, either wool or flax, by blending it at the fiber stage with a non-forbidden material. The ratio of 51% (or more) non-forbidden material to 49% (or less) forbidden material renders the resulting yarn exempt from this prohibition, and from susceptibility to eruptive affection (see below).

Wool and flax exclusively are subject to the [Biblical] prohibition of diverse kinds, and wool and flax are exclusively susceptible to eruptive affection.... Camel wool and sheep wool which have been blended together [before spinning] – if the majority is from the camels it is permitted [to be combined with flax]. If the majority is from the sheep, then it is forbidden to be combined with flax. If they are of equal quantities, then it is forbidden to be combined with flax. Likewise, [this ruling applies] to blends of flax and hemp [fibers] (Mishna *Kil’ ayim* 9:1).

Regarding camel wool, as specified in the Mishna, the indigenous camel of the Land of Israel is the one-humped Dromedary. Dromedary hair is relatively coarse in contrast to indigenous Awassi sheep wool. In color, Awassi is usually white and Dromedary varies from cream to dark brown. It can be assumed that this local, readily available material would naturally be used for this blend. Nevertheless, the softer and finer Asiatic two-humped Bactrian camel hair may also have been available via the overland silk route (*cf.* Palmyra above), thus producing a finer quality union yarn. Bactrian camel hair is also available in a variety of shades.

In some instances, the sages expand Biblical prohibitions. These are referred to as Rabbinic decrees,



and offer safeguards which distance the observant from the danger of transgressing the original Biblical prohibition. One of these appears in our context:

The *Shir 'ayim* and the *Kalakh* are not subject to the Biblical prohibition [of the law of diverse kinds], but are forbidden [by Rabbinic decree] because they present a misleading impression (Mishna Kil 'ayim 9:2).

These materials - *Shir 'ayim* and *Kalakh* - are **not** *sericum* (cf. Sifra Tazria' 5:13:1, *infra*) which can be identified as silk (*Bombyx mori*), but rather sea silk (*bisso marino*), as identified by Maimonides (cf. Tosefta Shabbat 9:3 "wool from a sea creature"). Sea silk is yellow-gold in color and might well be mistaken for flax. In addition, wild silks also offer a similarity to wool and/or flax both in their off-white to beige colors and in their variegated texture – due to being spun, as opposed to *Bombyx mori*, which is white, shiny, and smooth – a reeled continuous filament. Furthermore, *shirayim*, *sericum*, and *kalakh* appear together in a parallel source (Sifra Tazria' 5:13:1), indicating that they are not the same material. These wild silks may include tussah (or tasar), muga, and eri from India or China (Fig. 1), and may well have arrived in the Land of Israel in the 3rd century CE via the overseas silk route (Albaladejo Vivero 2013; cf. Palmyra above).

Shir 'ayim and *Kalakh* are kinds of silk and look as if they are wool and flax, being that one of them is soft like flax and the other is hard and

hairy like wool. (Maimonides – Commentary to the Mishna *ad loc.*). In coastal towns, there is a kind of wool which grows on undersea rocks. Its appearance is that of gold and it is very soft. It is called *Kalakh* and is forbidden to combine with flax because of the misleading impression, as it is similar to wool. Therefore, *Shir'ayim* and *Kalakh* are forbidden because of their misleading appearance (Maimonides – *Mishneh Tora, Hilkhhot Kil 'ayim* 10:1).

Maimonides' description of wool as "hard and hairy", as opposed to the "soft" flax requires explanation. In modern conditions we are generally accustomed to the opposite. Evidently the local medieval Spanish or Egyptian breeds of sheep produced coarse carpet wool, which could be described as hard and hairy, as opposed to pulled-early fine-fiber flax, in turn well-retted and beetled – which can subsequently be smooth and soft. Indeed, the indigenous Land of Israel Awassi sheep, which Ryder (1983, 130, 228) classifies as the probable descendant of Roman-era fat-tailed breed, produce medium diameter wool with the above characteristics.

The Biblical prohibition of combining these diverse kinds has its specific regulations regarding textile-production procedure, as follows:

The prohibition of diverse kinds [a combination of wool and flax] applies only to spun and woven material, as is written: "You shall not don '*sha'atnez*' - a combination of wool and



Fig. 1. Eri, Tasar, Muga and *Bombyx* silk cocoons (Photo: Richard Pieglar, used with permission).



flax" (Deuteronomy 22:11). [This Biblical *hapax legomenon* is subsequently interpreted as an acronym [*notarikon*.] [*'Shaátnez'* indicates] a material which is *shūa* ' *tavūy* and *nūz* (Mishna *Kil 'ayim* 9:8).

The definition of the above three terms is subject to difference of opinion among Talmudic exegetes and halakhic decisors. Rashi, in his commentary to Babylonian Talmud *Nidda* 61b, defines the above acronym-derived terms as follows: *shūa*'-combed, *tavūy* – spun, *nūz* – woven. According to Rashi's opinion, in order to be forbidden by Biblical law, the combination of these two diverse kinds, i.e. wool and flax, must be in all three stages of production. This is union yarn. Being already blended at the fiber stage, there is no distinct textile component identity, neither of the flax nor of the wool.

In contrast, the Tosafist Rabbenu Tam's opinion (*ad loc.*) is that *nūz* (indeed a *hapax*) means plied, not woven. Therefore, when the flax and wool are combed, spun and plied separately, and these two separate yarns (wool and flax) are woven together, the resulting union fabric is forbidden by Biblical law. In other words, when the flax and wool components each have attained their distinct textile identity, as a plied yarn before being combined, the woven fabric is subsequently considered a Biblically forbidden mixture. Rabbinic decree further forbids combinations of wool and flax made by any means, including felting or sewing (*Arba 'a Turim, Yoreh De 'a*, ch. 300).



Fig. 2. Tussah warp - Awassi weft (Photo: Nahum Ben-Yehuda).

Experimental Archaeology

Experimental archaeology was implemented in order to concretize the Rabbinic decree prohibiting the combination of various fibers with wool and/or flax due to their misleading appearance, as indicated in Mishna *Kilayim* 9:2. The goal was to gauge the degree of similarity between these fibers, in parameters of color and texture. An additional goal was to aid in the corroboration of these fibers' actual identities. A balanced-weave tabby union fabric was woven using a tussah silk warp, and alternating weft sections of dry-spun flax, wet-spun flax, hemp, tussah, and Awassi wool. Preliminary results indicate that the section combining Awassi wool and tussah (Fig. 2) is indeed misleading to the nonprofessional, as the cream-colored semi-rough tussah resembles flax, and misleadingly appears as the Biblically prohibited wool-flax combination.

In another experiment, yarns of various mixtures were prepared – in accordance with Mishna *Kil 'ayim* 9:1. Awassi sheep (Fig. 3) fleece was obtained from a local flock, at April shearing time. Dromedary camel hair (Fig. 4) was obtained from a local herd, at the July molting season. Mr. David Mallin, of Cashmere Fibres International Bradford UK, kindly provided de-haired Bactrian camel roving. These fibers were further processed and spun by Mrs. Toni Friedman of Moshav Nir Etzion. Three different single-fiber yarns were produced (Figs. 5a-d): 100% Awassi, 100% Dromedary, and 100% Bactrian. And two union yarns: 2/3 Dromedary + 1/3 Awassi, and 2/3 Bactrian + 1/3 Awassi. This blend over-fulfills the halakhic demands of the aforementioned Mishna, which requires "a [simple] majority of camel wool", and halakhically permits the combination of these union yarns with flax, and correspondingly renders them **insusceptible** to eruptive affection. Difficulties were experienced in several processes: In de-hairing the Dromedary in order to obtain clean noils, and in blending and spinning together the two fibers of different lengths. Nevertheless, the results are usable yarns.

Nega 'im – The Eruptive Affection of Garments

The Biblical phenomenon, eruptive affection of garments, appears in Leviticus chapter 13. Talmudic literature in turn offers detailed *halakhot*, including ramifications in our context of union yarn and union fabric:

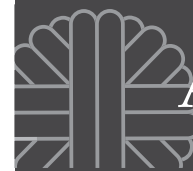


Fig. 3. Awassi sheep before shearing - Kibbutz Ein Harod Ihud (Photo: Nahum Ben-Yehuda).

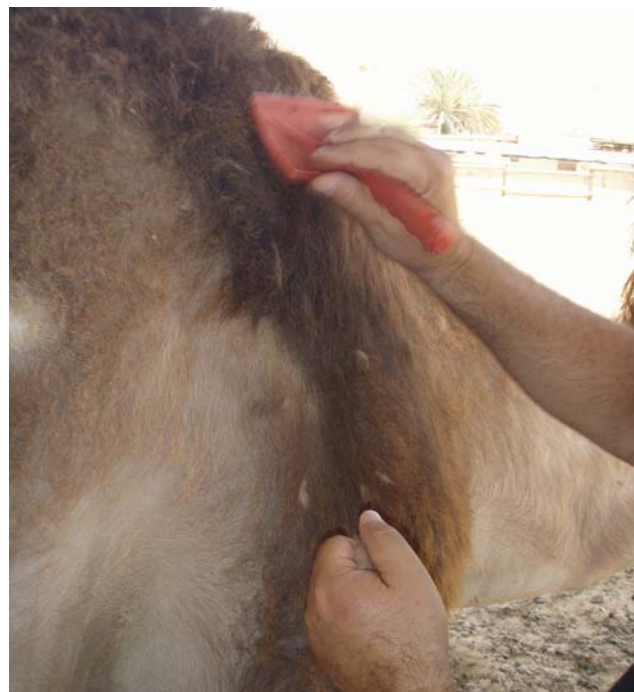


Fig. 4. Combing off Dromedary hair. Negev Camel Ranch, Mamshit (Photo: Nahum Ben-Yehuda).

When an eruptive affection (*nega' sara'at*)⁴ occurs in a cloth of wool or linen fabric, or in the warp or in the weft of the linen or the wool... if the affection (*nega*) in the cloth or the skin, or in the warp or the woof, or in any article of skin, is intense green (or: yellow) or intense red, it is an eruptive affection... Such is the procedure for eruptive affections of cloth, woolen or linen, or in warp or in woof... for pronouncing it pure or impure (Leviticus 13:47-48, 59).

Talmudic literature addresses five specific aspects of this topic.

1) Textile materials which are susceptible to this phenomenon. In contrast, many of the **insusceptible** fibers are listed:

“And the garment” – Is it possible that this refers to a garment made of any of the following materials: *shirayim*, *sericum*, *kalakh*, grape wool [cotton], camel wool, rabbit wool, or goat feathers (*sic* = hair)? [No, because] Scripture states: “In a garment of wool or in a garment of flax” (Sifra Tazria' 5:13:1).

2) Halakhic standings of various blends of susceptible and **insusceptible** materials. This ruling is identical to the parameters indicated for the law of diverse kinds:

Camel wool and sheep wool which one blended together [before spinning], if the majority is from the camels, then they [the warp or weft yarn spun from this blend, or the garment woven from it] are **insusceptible** to [the] impurity [of eruptive affection]. If the majority is from the sheep, then they are susceptible to [the] impurity [of eruptive affection]. If they are of equal quantities, then they are susceptible to [the] impurity [of eruptive affection]. Likewise, [this ruling applies] to blends of flax and hemp [fibers] (Mishna *Nega'im* 11:2).

3) The effect of coloring (or dyeing) upon the susceptibility of otherwise relevant materials. This aspect is an exclusive characteristic of the *halakhot* of eruptive affections:

Hides and clothing which are dyed (or colored) [by any means] are **insusceptible** to [the] impurity [of eruptive affection]... Rabbi Shim'on says, “Those materials which are colored in their natural state [e.g. brown or black sheep wool] are susceptible, and those that have been dyed by man are **insusceptible**” (Mishna *Nega'im* 11:3).

Is it possible that [garments] will be susceptible to [the] impurity [of eruptive affection] whether



Fig. 5a. Awassi Yarn - 100%
(Photo: Nahum Ben-Yehuda).



Fig. 5b. Dromedary yarn - 100%
(Photo: Nahum Ben-Yehuda).

they are colored (dyed) or non-colored (non-dyed)? [No, because] Scripture states: "In a garment of wool or in a garment of flax". Just as flax is used in garments as it was created (non-dyed) [This is based upon the precept that flax was used exclusively in a non-dyed state. It was, however, used both bleached and unbleached], so [in this case] wool – only as it was created (non-dyed). [These two fibers are mentioned adjacent to one another in Scripture in order to parallel this characteristic.] (Sifra *Tazria* 5:13:3). [Is it possible] that I will exclude from [susceptibility wool] which was dyed by man, but will not exclude that which is colored in its natural state? [No, both will be excluded] because Scripture states: "Of flax or of wool". Just as flax is white, so [in this case,] wool only when it is white. [As above, these two fibers are mentioned adjacent to one another in order to parallel this characteristic.] (Sifra *Tazria* 5:13:4).

4) How colored components in various weaving structures, i.e. bi-colored fabrics in balanced, warp-faced, and weft-faced structures, affect garment susceptibility. The colored (dyed) materials referred to in the following *halakhot* are characteristically wool, as flax was used exclusively in a non-dyed state (see above):

A garment – the warp of which is colored [an insusceptible condition] and the weft of which is white [a susceptible condition], or *vice versa* – the halakhic status [of the garment] is according to the appearance [*i.e.* whether the white or color is apparent as in a weft-faced or warp-

faced cloth] (Mishna *Nega'im* 11:4).

A garment – whose warp is colored [an insusceptible condition] and whose weft is white [a susceptible condition] or *vice versa* – the halakhic status is determined by the weft [This indicates a weft-faced weave. As a result, dyed warp renders the garment susceptible, while dyed weft renders it insusceptible]. In the case of pillows and bolsters – it is determined by the warp [This indicates a warp-faced cloth.] Both of these follow the rule of "appearance" (Tosefta *Nega'im* 5:4).

Worthy of notice is the more detailed information conveyed in the Tosefta, which is based upon the principle of appearance as established in the previous Mishna. While the Mishna does not indicate which types of weaves are common, the Tosefta reflects interesting data in the framework of bi-colored dyed/white fabrics, i.e. they are generally (or exclusively?) weft-faced. In contrast, pillow and bolster cases are generally (or exclusively?) warp-faced. The halakhic status of a balanced bi-color dyed/white weave is not indicated in these excerpts; although a probable extrapolation would be that it is insusceptible, being that a contiguous white surface, such as the faced structures, is required to enable susceptibility.

5) The influence that insusceptible textile components in the fabric have on its halakhic standing:

A garment – whose warp is *sericum* and whose weft is wool, or *vice versa* – both of these [cases] are insusceptible to [the] impurity [of eruptive affection] (Tosefta *Nega'im* 5:5).



Fig. 5c. Bactrian yarn - 100%
(Photo: Nahum Ben-Yehuda).



Fig. 5d. Bactrian 2/3 + Awassi 1/3
(Photo: Nahum Ben-Yehuda).

This halakhic ruling encompasses both balanced weaves and *sericum*-faced or even wool-faced weaves, and is not dependent on appearance. Here is an obvious discrepancy between the bi-color undyed/dyed case in which the appearance of the fabric determines the halakhic standing and the bi-component *sericum*/wool case in which, under any circumstances, the garment is unsusceptible. The shortcoming of dyed wool in this halakhic context (susceptibility) is only its appearance, not its base material. Once that appearance is concealed, the base material – wool – still serves as a viable component, therefore creating a susceptible garment. In contrast, *sericum* (or any other unsusceptible fiber) even when concealed, is not considered a component of the fabric, and is legally nonexistent. As a result, one of the essential components of this fabric is lacking and it therefore is **insusceptible**:

A garment which has flax warp and hemp weft, or vice versa, is not susceptible to the impurity of eruptive affection. The same is true of a garment whose warp or weft is flax or wool, and the other component is goat hair or any of the other fibers [aside from wool and flax] – it is not susceptible (Maimonides, *Mishneh Tora*, *Hilkhot Tum'at Zara* at 13:3).

It is notable that Maimonides deletes (or only alludes to) the Tosefta's sole example – *sericum* + wool – and only offers others, which are not mentioned in Tosefta but nevertheless meet the appropriate criteria. It is dubious to suggest that the *sericum* + wool combination was uncommon in early 13th century CE Egypt, where Maimonides composed this

work. Nevertheless, the Tosefta's exclusive use of this *sericum* + wool example does tend to indicate that the phenomenon was familiar at that time in the Land of Israel.

Half Silks - Diocletian and Midrash Aggada

Subserica or *semisericum* (half-silk) and *holoserica* (pure silk) are mentioned in several contexts in the Diocletian's Price Edict. *Subserica* is a mixed-fiber fabric, consisting of silk and an additional fiber. They are listed there as garments: neckbands (7:49-50), shirts (9:10, 18), and dalmatics (9:12-16). In addition, they appear in relation to wages for those engaging with them: tailors (7:49-50), embroiderers (20:1-2), silk workers (20:9-11) and fullers (22:8-15). No details are provided regarding the construction of these fabrics, neither is the identity of the supplemental component in *subserica* nor its function as warp or weft. The Edict consistently demonstrates the relationship between the cost of a *holoserica* garment which is higher than the cost of the *subserica* version. In parallel, the fee for services rendered by various artisans is higher for *holoserica* than it is for *subserica*. Miko Flohr (in personal correspondence) postulates that this does not necessarily reflect a more difficult or time-consuming process, but rather a relatively greater liability for damages which may be caused to the more expensive material. Here we observe, that in this case the mixture-fabric is inferior to the single-fiber material. The addition of, perhaps, wool or linen to the pure silk decreases production costs at the expense of reduced quality.

The very same comparison, between the less expensive and less prestigious *semisericum* and the more prestigious *holosericum* is echoed in Talmudic literature:



Rabbi Yirmia Ben El 'azar says: "In the future, the Holy One Blessed be He will renew [in the sense of enhance] the brightness (or: glory) of the righteous ones' faces, as it is written: [Judges 5:31] 'And those who love Him [God] will be as the sun rising in might!' And just as he renews their faces, he will renew their garments. Today – *semisericum*, tomorrow – *'olosericum*" (Midrash Qohelet (Ecclesiastes) Rabba 1:9).

In addition this fabric is mentioned in the Jerusalem Talmud in an exegetic context. The prophet Isaiah (Iron Age) admonishes the "Daughters of Zion" for their vanity (or: arrogance), and warns that the Lord will punish them by "stripping off their finery". Subsequently, the prophet lists those items of dress and ornamentation that will be stripped off (Isaiah 3:16-23). Today, some of the articles in this list are difficult to identify. The Jerusalem Talmud presents a detailed list in which each article is identified. Here, the Biblical text's intentions have been contemporized and compatible items of dress, familiar to 5th century CE sages, are presented. One of these is half-silk:

"...v'HaHaritim." ⁵ (Isaiah 3:22) – These are decorated belts and decorated *'oloserica* (Jerusalem Talmud Shabbat 6:8:2).

It is difficult to ascertain why these specific two decorated items were selected as identification for the Biblical item. Evidently, they were contemporaneous expressions of vanity. The specific garment or ornament made of *'oloserica* is not mentioned by name, indicating that the material itself was the focal point, or that the garment was referred to by the name of its material.

Conclusions

In this paper, we have presented and analyzed Talmudic literary sources regarding union yarn and union fabric. Certain parallels from the Palmyra textiles and the Diocletian's Price Edict have been identified and compared to the Talmudic ones. Preliminary experimental reconstruction has been performed in accordance with these sources, and additional experiments are planned. Further research will encompass the union-plied yarns mentioned in this literature.

Notes

1. The calendar era "CE" (Common Era) is the accepted culturally-neutral alternative to "AD" and refers to identical years.
2. " ׁ " (= Modifier letter right half ring) indicates the Hebrew consonant *Aleph* – a glottal stop.
3. " ׀ " (= Modifier letter left half ring) indicates the Hebrew consonant *Ayin* – a voiced pharyngeal fricative.
4. "Š" indicates the Hebrew consonant *Šaddi* – an emphatic "S".
5. "H" indicates the Hebrew consonant *Het* – a voiceless uvular fricative, pronounced as the Spanish "J" in "Juan".

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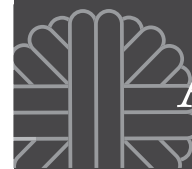
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