PRIMJENA METALNIH NITI U SREDNJOVJEKOVNOM PROFANOM TEKSTILU NA PROSTORU ISTOČNOGA JADRANA I ZALEĐA

USE OF METAL THREADS IN PROFANE MEDIEVAL TEXTILES ACROSS THE EASTERN ADRIATIC REGION AND ITS HINTERLAND

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Najveći broj sačuvanih tekstilnih nalaza otkrivenih u srednjovjekovnim grobovima istočnoga Jadrana i zaleđa načinjen je u kombinaciji s nitima od plemenitih metala. Takav je tekstil bio iznimno skup i dostupan samo najvišim slojevima društva. U okviru ovoga rada navedeni su dosad otkriveni nalazi, a fokus je usmjeren na 30 ulomaka tekstila ukrašenoga tankim trakama izrezanima iz iskucanoga lima spiralno obavijenim oko organske pređe (ili samostalnih metalnih traka koje su bile sastavni dio tekstilnoga predmeta čiji je organski dio propao) sa sedam srednjovjekovnih groblja: Crkvina u Biskupiji, Crkvina pod Bogdanićem, Čovini-Crikvine, Dol u Bribiru kraj Skradina, Grborezi, sv. Spas na vrelu Cetine i Štale u Bribiru kraj Novoga Vinodolskog. Prikupljeni uzorci različito su datirani; najraniji primjerak iz Crkvine u Biskupiji pripada početku 9. st., a ostali nalazi datirani su poslije, uglavnom u kasni srednji vijek. Studije uključuju primjenu fizikalno-kemijskih metoda skenirajućim elektronskim mikroskopom (SEM) s detektorom X-zraka za elementnu analizu (EDS), kojima se uz mikromorfološku obradu opsežnije analizira kemijski sastav niti. Utvrđeno je da su lamele od čistoga zlata korištene samo u najranijem srednjovjekovlju, da bi ubrzo bile zamijenjene kompozitnim, najčešće pozlaćenim srebrnim nitima obavijenima oko organske pređe. Razvoj proizvodnje niti od plemenitih metala za dekoraciju tekstila tekao je u smjeru smanjivanja težine, povećanja fleksibilnosti, kao i pojeftinjenja proizvoda. Navedenim analizama dobiva se također uvid u tehnologiju izradbe dragocjene odjeće koja je inkorporirala takve niti; čak i ako su se organski dijelovi tekstila raspali, sačuvane metalne niti, ako se pažljivo iskopaju, mogu pružiti važne podatke o odjevnome predmetu.

Ključne riječi:
arheološki tekstil, metalne niti, srednji vijek, istočni Jadran, SEM-EDS metoda, groblje, zlato, srebro, pozlata

The largest portion of textile remnants unearthed from medieval graves in the eastern Adriatic and its hinterland feature precious-metal threads, indicative of their association with the affluent echelons of society. This paper catalogues the findings thus far, focusing on 30 textile fragments adorned with delicately cut strips of pressed sheet metal spirally wound around organic yarn (or independent metal strips that were an integral part of a textile item whose organic part has disintegrated). These samples hail from seven medieval cemeteries: Crkvina in Biskupija, Crkvina under Bogdanić, Čovini-Crikvine, Dol in Bribir near Skradin, Grborezi, Holy Saviour (or Salvation) near the spring of the River Cetina, and Štale in Bribir near Novi Vinodolski. The dating of the collected specimens varies; the earliest, from Crkvina in Biskupija, dates to the early 9th century, while others are predominantly from the late Middle Ages. The studies include applying physicochemical methods with a scanning electron microscope (SEM) with an X-ray detector for elemental analysis (EDS), which, in addition to micromorphological processing, more extensively analyse the chemical composition of the threads. It is pointed out that lamellas made of pure gold were used only in the earliest medieval period. They were soon replaced by composite threads, usually gilded silver wrapped around organic yarn. The evolution of precious-metal thread production for textile adornment was aimed at reducing weight, enhancing flexibility, and lowering production costs. Furthermore, the analysis sheds light on the technology of crafting garments incorporating such threads. Even in cases where the organic components of the textile have decayed, meticulously excavated metal threads can yield crucial insights into the production of the attire.

Key words:
archaeological textiles, metal threads, Middle Ages, Eastern Adriatic, SEM-EDS method, cemetery, gold, silver, gilding

Uvod

Odijevanje je nastalo iz potrebe da čovjek zaštiti svoje tijelo od štetnih vanjskih, ponajviše klimatskih utjecaja, a s vremenom je postalo znak civiliziranosti (dokaz nadmoći razuma nad osjetilima) i udobnosti.[1] U svim su razdobljima povlašteni društveni slojevi svojim odijevanjem nastojali istaknuti razliku između sebe i širih društvenih slojeva. Odjeća je bila jedan od čimbenika kojima su se uz bogatstvo nastojali prikazati autoritet i poštovanje. Odjevni predmeti mogu biti ukrašeni na različite načine – uzorkovanim tkanjem, vezom, slikanjem, bojenjem i dr. U tome kontekstu, za dekoraciju luksuznih tkanina za društvenu i vjersku elitu upotrebljavale su se i niti od plemenitih metala. Narodni izraz *srma,* koji se isprva upotrebljavao za srebrni konac za filigranske radove i vez, a potom za označavanje svih pređa koje sadrže metal, dolazi od turske riječi *syrma* i izvorno označava srebro.[2] Proizvodnja takvih niti zasniva se na sposobnosti pojedinih metala i legura da se mogu kovanjem ili valjanjem rastanjiti u vrlo tanke folije, odnosno izvlačenjem formirati u tanke žice. Njihovom integracijom u tekstilnu pređu postižu se ugodni vizualni efekti izazvani svjetlucanjem metala među tekstilnim vlaknima. Najčešće zastupljeni metali za izradbu takvih vlakana bili su zlato i srebro (kao samostalni metali, legure ili kombinirano), koji su (posebice zlato), osim zbog prikladnih svojstava za obradbu u pogodan oblik, otporni na koroziju. Otpornost na koroziju posebno je važno svojstvo jer su tkanine izrađene s metalnim nitima bile iznimno skupe, pa je bilo važno da se vizualni efekti metala s vremenom ne izgube.[3]

Najveći broj sačuvanih tekstilnih nalaza otkrivenih u srednjovjekovnim grobovima istočne jadranske obale i zaleđa načinjen je upravo u kombinaciji s metalnim nitima, najčešće izvedenim od pozlaćenoga srebra. Boljem očuvanju takvoga tekstila u odnosu na onaj sačinjen samo od organskih vlakana zasigurno je pogodovalo postojanje metala koji može zaustaviti pojavu mikroorganizama, a time i propadanje tkanine.[4] Tomu posebno pridonosi srebro koje se, za razliku od zlata, topi i stvara metalne soli koje prianjaju na čestice tekstilnih niti te ih na određen način i konzervira.[5]

Povijesni razvoj izradbe metalnih niti

Ukrašavanje tekstila nitima od plemenitih metala ima tradiciju staru više tisuća godina. Prve niti bile su ravne, uglavnom zlatne, rjeđe srebrne trake izrezane iz čekićem iskucane folije (sl. 1: a). Kako je takva tehnika iskucavanja folije bila poznata u Egiptu već u 5. tisućljeću pr. Kr., moguće je da su egipatski zlatari, između ostaloga, iz njih izrađivali i uske trake koje su se mogle upotrebljavati u obradbi tekstila.[6] Jedan od najranijih zapisa o

Introduction

The practice of dressing emerged from the necessity for individuals to shield their bodies from external elements, particularly climate-related ones, and it gradually evolved into a symbol of civilization (demonstrating the supremacy of reason over the senses) and comfort.[1] Throughout history, the privileged social classes have consistently sought to distinguish themselves from broader society through their choice of attire. Clothing has served as a key means to assert authority, command respect, and display wealth. Clothing items can be decorated in patterned weaving, embroidery, painting, dyeing and similar. In this context, precious-metal threads have also been used to decorate luxury fabrics for the social and religious elite. The vernacular term *srma*, initially used for silver thread for filigree work and embroidery, and later to denote all yarns containing metal, comes from the Turkish word *syrma* and initially meant *silver*.[2] The production of such threads is based on the ability of certain metals and alloys to be melted into very thin foils by forging or rolling, or formed into thin wires by drawing. By integrating them into the textile yarn, pleasant visual effects are achieved because of the shimmer of metal between the textile fibres. The most common metals for producing such fibres were gold and silver (as individual metals, alloys or combined), which (especially gold), besides their suitable properties for processing into an appropriate form, are resistant to corrosion. Corrosion resistance is a significant property, because fabrics made with metallic threads are costly, so the visual effects of metal can be recovered over time.[3]

A substantial proportion of the textile remnants unearthed from medieval graves along the eastern Adriatic coast and its hinterland were intricately intertwined with metal threads, often crafted from gilded silver. The enhanced preservation of these textiles, as opposed to those composed solely of organic fibres, can be attributed to the inclusion of metal. Metal's presence acts as a deterrent to microbial growth, thereby mitigating fabric deterioration.[4] Notably, silver plays a significant role in this preservation process. In contrast to gold, silver has a lower melting point, allowing it to form metal salts that adhere to textile fibres, thus contributing to their preservation in a distinctive manner.[5]

Historical development of metal-thread production

Decorating textiles with precious-metal threads has a tradition that goes back thousands of years. The first threads were mostly straight gold, less often silver strips cut from hammered foil (Fig. 1: a). This technique of punching foil was already known in Egypt in the 5th millennium BC. It is possible that Egyptian goldsmiths made, among other things, narrow strips from them that could be used in the processing of textiles.[6] One of the earliest re-

1 Članak ***odijevanje*** u mrežnom izdanju *Hrvatske enciklopedije* Leksikografskoga zavoda Miroslav Krleža (https://www.enciklopedija.hr/natuknica.aspx?id=44736, pristupljeno 20. 5. 2024.).

2 Klaić 1985, 1260.

3 Raffaelli, Čunko, Dragičević 1982, 827.

4 Cybulska, Maik 2007, 187.

5 Petrascheck-Heim 1977, 263.

6 Járó, Gondár, Tóth 1993, 119.

1 The article *dressing* in the online edition of the Croatian Encyclopaedia of the Miroslav Krleža Lexicographic Institute (https://www.enciklopedija.hr/natuknica.aspx?id=44736, accessed on 20/5/2024).

2 Klaić 1985, 1260.

3 Raffaelli, Čunko, Dragičević 1982, 827.

4 Cybulska, Maik 2007, 187.

5 Petrascheck-Heim 1977, 263.

6 Járó, Gondár, Tóth 1993, 119.

primjeni niti od plemenitih metala kao temeljnoga i sastavnoga dijela skupocjenih tekstila poznat je iz Staroga zavjeta. Pri opisu Aronova ruha za službu (oplećak), ondje se navodi i tehnika izradbe zlatnih traka koja se rabila u 13. st. pr. Kr: „Oplećak naprave od zlata, ljubičastog, crvenog i tamnocrvenog prediva i prepredenog lana. Skuju zlatne pločice, a onda ih na niti izrežu da ih vještački uvezu u ljubičasto, crveno i tamnocrveno predivo i prepredeni lan" (Izlazak, 39: 2–3).[7] Zlatne niti koje su bile utkane u tekstil također dolaze iz srednje Europe (Bavarska, Austrija i zapadna Mađarska) i datiraju se 1200. – 1000. pr. Kr.[8]

Takve niti, zbog nepodesnih svojstava poput krutosti i nesavitljivosti, imale su ograničenu primjenu, pa su se mogle upotrebljavati isključivo kao efektne niti. Dodatno, zbog nerazrađene tehnologije proizvodnje te neobrađenih rubova bile su gruboga i oštroga opipa.[9] Niti načinjene iz folija od čistoga zlata koje su se kao samostalne upotrebljavale za ukrašavanje tekstila otkrivene su u više grobova srednje i zapadne Europe u ranome srednjovjekovlju (5. – 8. st.). Kao povlastica plemstva nalazile su se u bogato opremljenim muškim i ženskim grobovima u funkciji dekoracije različitih tekstilnih vrpci, dijelova odjeće, kao i ukrasa u vezovima.[10] Crowfoot i Chadwick Hawkes opisale su tehnički postupak dobivanja zlatnih niti procesom dugoga zagrijavanja, rastezanja, kovanja i poliranja kako bi se postigla njihova gipkost i sjaj.[11]

Prvu veliku promjenu u proizvodnji metalnih niti označilo je omotavanje zlatnih traka oko vlaknaste jezgre biljnoga ili životinjskoga podrijetla (sl. 1: c). Iako točno vrijeme te inovacije nije poznato, potvrđeno je da se tehnika upotrebljavala tijekom antičkoga razdoblja. Nalaz tekstila izrađenoga od zlatnih traka namotanih oko vlaknaste jezgre otkriven je u ženskome grobu u blizini grčkoga naselja *Pantikapej* na poluotoku Krimu (na području današnjega grada Kerča u Ukrajini) te je datiran u 3. st. pr. Kr. Organska jezgra nije se sačuvala.[12] Slične zlatne niti datirane nešto poslije, između kraja 1. st. pr. Kr. i početka 1. st., pronađene su na rimskoj nekropoli u Cádizu u Španjolskoj. Organska jezgra također nije ostala sačuvana.[13] Prema Wildu, namotavanje traka oko jezgre izvodilo se vretenom.[14] Na taj način nit se uvijala u lijevome S ili u desnome Z smjeru. Zbog sličnoga načina oblikovanja kao i organske pređe, takve su niti postale vrlo popularne jer je njima bilo znatno lakše rukovati. S obzirom na činjenicu da je u procesu proizvodnje dužina metalne niti bila ograničena, njezini nastavci načinjeni spajanjem isticali su

cords of the use of precious-metal threads as a fundamental and integral part of expensive textiles is known from the Old Testament. In the description of Aaron's robes for service (frock), there is mention of a technique of making gold bands that was used in the 13th century BC. "They made the ephod of gold, and of blue, purple and scarlet yarn, and of finely twisted linen. They hammered out thin sheets of gold and cut strands to be worked into the blue, purple and scarlet yarn and fine linen." (Exodus, 39: 2–3).[7] Gold threads that have been interwoven into textiles also come from Central Europe (Bavaria, Austria and Western Hungary), and date to 1200 – 1000 BC.[8]

Because of their unsuitable properties, such as stiffness and inflexibility, these threads had limited applications, so they could only be used as compelling threads. Furthermore, owing to the undeveloped production techniques and unfinished edges, they were rough and sharp to the touch.[9] Threads made of pure gold foil that were used independently to decorate textiles have been discovered in several graves in Central and Western Europe of the early Middle Ages (5th – 8th centuries). As a privilege of the nobility, they were found in richly furnished male and female graves to decorate various textile ribbons, parts of clothing, and decorations in embroidery.[10] Crowfoot and Chadwick Hawkes describe the technical process of obtaining gold threads as a long process of heating, stretching, forging and polishing to achieve their suppleness and lustre.[11]

The first significant change in the production of metal threads was the wrapping of gold strips around a fibrous core of plant or animal origin (Fig. 1: c). Although this innovation's exact time is unknown, it has been confirmed that the technique was used during the ancient period. The find of a textile made of gold strips wound around a fibrous core was discovered in a woman's grave near the Greek settlement of *Pantikapei* on the Crimean Peninsula (in the region now encompassing the city of Kerch, in Ukraine) and dated to the 3rd century BC. The organic core was not preserved.[12] Similar gold threads dated later, between the end of the 1st century BC and the beginning of the 1st century, were found in the Roman cemetery in Cádiz, Spain. The organic core was also not preserved.[13] According to Wild, the ribbons were wound around the core with a spindle.[14] In this manner, the thread was twisted either in the left 'S' or right 'Z' direction. Adopting a design methodology akin to organic yarns, these threads gained significant popularity, owing to their enhanced manageability. Given the lim-

7 Oplećak ili efod, dio svetoga ruha što ga je u starome Izraelu nosio veliki svećenik za vrijeme bogoslužja u hramu. Napravljen je od lanena prediva i zlata, ukrašen s 12 dragulja (simbol 12 plemena Izraelovih). Na prsima su se nalazila dva zlatna prstena koji su nosili naprsnik, a u njemu su bili kamenovi za proricanje urim i tumim (Rebić (ed.) 2002, 229).

8 Grömer 2016, 193–196.

9 Raffaelli, Čunko, Dragičević 1982, 828.

10 Járó 1990a, 40.

11 Crowfoot, Chadwick Hawkes 1967, 51.

12 Járó 1995, 35; Gleba 2008, 66.

13 Giner 2001, 78.

14 Wild 1970, 40.

7 Within the sacred vestments of ancient Israel's high priest for ceremonial duties in the Temple, the robe or ephod stands as a distinguished component. Crafted from a blend of linen yarn and gold, this attire is bedecked with twelve precious jewels (representing symbolically the twelve tribes of Israel). Adorning the chest of the ephod are two golden rings, which serve as fixtures for the attachment of a breastplate. Enclosed within this breastplate are the revered stones of divination known as Urim and Thummim (Rebić (ed.) 2002, 229).

8 Grömer 2016, 193–196.

9 Raffaelli, Čunko, Dragičević 1982, 828.

10 Járó 1990a, 40.

11 Crowfoot, Chadwick Hawkes 1967, 51.

12 Járó 1995, 35; Gleba 2008, 66.

13 Giner 2001, 78.

14 Wild 1970, 40.

se laganim zadebljanjima. Za čvrste niti metalni navoji bili su gusto poredani jedni pokraj drugih, a za labavije rađe. I jedna i druga vrsta niti upotrebljavale su se kao materijal za tkanje, vezenje i druge tehnike izradbe tekstila.[15] Zbog ograničene izdržljivosti niti u postupku tkanja upotrebljavala se čvršća nit i to najčešće u svojstvu potke, a za vezenje je bila pogodnija olabavljena nit.[16] Iako je u 5. – 8. st. većina nalaza metalnih niti za dekoraciju tekstila bila izrađena od samostalnih metalnih niti, iz istoga vremena postoji i određen broj iznimki, odnosno nalaza zlatnih ili srebrnih niti koje su bile ovijene oko vlaknaste pređe. Petraschek-Heim smatra da su takve niti u to vrijeme vjerojatno bile uvezene s istoka.[17] Járó ih također smatra neeuropskim proizvodima.[18]

Kako su zbog svoje rijetkosti zalihe zlata uvijek bile nedovoljne da bi zadovoljile potražnju, zlatari su proizvodili i legure zlata sa srebrom i bakrom, a s vremenom su počeli izrađivati predmete od manje plemenitih metala na koje su nanosili pozlatu. Usavršavanjem su pokušali razviti tehnologije koje bi im omogućile uporabu sve tanjih slojeva zlata. Postupak pozlate poznat je na Bliskome istoku već potkraj 4. i početkom 3. tisućljeća pr. Kr.[19] Iako su se pojavile i prije, pozlaćene srebrne niti u tekstilu znatnije su se proizvodile u Europi od 12. i 13. st., ponajviše za potrebe vezenja.[20]

Tehničku obradbu pozlaćenoga srebra za dekoraciju tkanine opisuje Theophilus Presbyter u djelu *Diversarum artium schedula,* nastalom početkom 12. st.[21] Autor priručnika objašnjava postupak navodeći da se srebro prvo iskucava u pravokutni oblik koji se prekriva zlatom, a potom se takvo pozlaćeno srebro izrezuje u uske trake. Na kraju navodi da se takve trake upredaju oko vlaknastih niti te se upotrebljavaju za tkanje manje skupih tkanina.[22] Osim s jednostranom (vanjskom) pozlatom, u istome razdoblju pojavljuju se i niti koje su bile pozlaćene s obje strane. Dvostrano pozlaćene niti izrađivale su se procesom valjanja pozlaćenih žica od lijevanoga srebra ili srebrne legure.[23] Uz pozlatu, u kasnome srednjem vijeku prakticirala se i tehnika posrebrivanja metala poput bakra ili bronce. Povijest te tehnike duga je koliko i korištenje srebra, ali posrebrene niti ne nalaze se toliko često kao i pozlaćene. Razlog je tomu taj što je srebro sklonije tamnjenju. Osnovne metode koje su se upotrebljavale za nanošenje srebrnoga sloja bile su slične onima koje su se upotrebljavale za zlato.[24] Niti u engleskome vezu, u razvijenome i kasnome srednjem vijeku, bile su prosječne debljine 0,25 – 0,3 mm. Pretpostavlja se da je zanat zahtijevao obuku od moguće čak od četiri do pet godina.[25]

ited length of the metal thread during production, its extensions formed by joining were distinguished by slight thickening. The metal threads were densely packed together for tighter weaves, with looser threads interspersed less frequently. Both types of threads were utilized in weaving, embroidery and various other textile production techniques.[15] Due to the limited durability of the thread, a stronger thread was used in the weaving process, most often in the capacity of a weft. In contrast, a loose thread was more suitable for embroidery.[16] During the epoch spanning the 5th to 8th centuries, the predominant mode of textile embellishment with metal threads typically entailed the utilization of discrete metallic filaments. However, amid this era, a notable subset of discoveries diverges from this prevailing norm. Specifically, instances have been documented wherein gold or silver threads were intricately wound around fibre yarn. Petraschek-Heim believes that such threads were probably imported from the East.[17] Járó also considers them non-European products.[18]

Due to the scarcity of gold, goldsmiths sought alternatives by blending gold with more abundant metals like silver and copper. Eventually, they expanded their craft to include less valuable metals, which they adorned with a layer of gold, known as gilding. Progressively, they honed techniques to apply thinner layers of gold. The art of gilding dates to the Middle East around the end of the 4th millennium BC and the beginning of the 3rd millennium BC.[19] While its origins predate this, the widespread use of gilded silver threads in European textiles emerged notably in the 12th and 13th centuries, particularly for embroidery purposes.[20]

Theophilus Presbyter describes the technical procedures involved in gilding silver for fabric adornment in his work *Diversarum artium schedula*, written at the onset of the 12th century.[21] The author of the manual explains the process, detailing how the silver is initially formed into rectangular shapes covered with gold, which are then cut into narrow strips. Subsequently, these gilded silver strips are twisted around fibre threads and employed in weaving less costly fabrics.[22] Alongside the practice of single-sided (external) gilding, there arose the production of threads gilded on both sides during the same era. Double-sided gold-plated threads were crafted by rolling gold-plated wires around cast silver or silver alloy.[23] Apart from gilding, the late Middle Ages also saw the practice of silver-plating metals such as copper or bronze. Although silver-plating dates to a period when silver was commonly used, threads plated with silver are less common than those plated with gold. This discrepancy is largely attributed to silver's tendency to tarnish. The primary techniques

15 Dragičević 1988a, 8.

16 Petrascheck-Heim 1977, 263.

17 Petraschek-Heim 1977, 270.

18 Járó 1995, 36.

19 Oddy 1993, 171.

20 Járó 1990b, 301; Járó, Gondár, Tóth 1993, 121; Karatzani 2012, 58–59.

21 Djelo je podijeljeno u tri knjige; prva obuhvaća proizvodnju i uporabu materijala za slikanje i crtanje, druga se bavi izradbom vitraja i tehnikama bojenja stakla, a treća opisuje različite tehnike u zlatarstvu i ostalim djelatnostima s metalom.

22 Karatzani 2012, 61–62.

23 Hacke, Carr, Brown 2004, 415.

24 Karatzani 2012, 64–65.

25 Reyerson 1986, 120.

15 Dragičević 1988a, 8.

16 Petrascheck-Heim 1977, 263.

17 Petraschek-Heim 1977, 270.

18 Járó 1995, 36.

19 Oddy 1993, 171.

20 Járó 1990b, 301; Járó, Gondár, Tóth 1993, 121; Karatzani 2012, 58–59.

21 The work is divided into three books: the first covers the production and use of materials for painting and drawing, the second deals with the production of stained glass and glass-painting techniques, and the third describes various techniques in goldsmithing and other activities with metal.

22 Karatzani 2012, 61–62.

23 Hacke, Carr, Brown 2004, 415.

SLIKA 1. Vrste metalnih niti za dekoraciju tekstila: samostalna metalna traka (a), samostalna metalna žica (b), metalna traka obavijena oko organske pređe (c), metalna žica obavijena oko organske pređe, tzv. tir-tir (d), pozlaćena kožna traka obavijena oko organske pređe (e; izradila M. Jelić).

FIGURE 1. Varieties of metal threads utilized in textile embellishment include: individual metal strips (a), standalone metal wires (b), metal strips encircling organic yarn (c), metal wires encircling organic yarn, also known as tir-tir (d), and gilded leather strips enfolding organic thread (e; made by M. Jelić).

Za ukrašavanje tekstila upotrebljavale su se i metalne žice izvučene pomoću posebnih ploča s koničnim rupicama (sl. 1: b). Tehnika izvlačenja žice uključivala je postupno smanjenje debljine metalne šipke na način da se provlačila kroz niz rupa sve manjega promjera. Tako se svakim prolazom duljina žice povećavala, a njezina debljina smanjivala. Iako točno vrijeme kada se ta tehnika počela upotrebljavati još nije poznato, neki autori smatraju da su žicu tako izvlačili zlatari već u starome Egiptu i Perziji.[26] Rani primjeri metalnih žica za dekoraciju tekstila izrađenih navedenom tehnikom potječu iz Birke u Švedskoj i datiraju se 9. – 10. st. Geijer pretpostavlja da nisu lokalnoga podrijetla, nego da su bile uvezene iz Bizanta preko Rusije.[27] Járó također tvrdi da su drugi rani primjeri žica pronađenih u zapadnoeuropskome tekstilu mogli biti uvezeni s istoka.[28] U izradbi tekstila samostalna vučena zlatna žica rijetko se primjenjivala jer je bila nespretna za postavljanje i vrlo teška.

Među uzorcima iz Birke Geijer je također u Europi identificirala rijetku vrstu niti. Riječ je o žicama okrugloga presjeka, najčešće od srebra i zlata, rjeđe kositra, spiralno namotanima oko vlaknaste jezgre poznate pod turskim nazivom *tir-tir* (sl. 1: d). Ona smatra da su tu tehniku poznavali Laponci na području sjever-

26 Oddy 1977, 80; Smith 1981, 38.

27 Geijer 1983, 89.

28 Járó 1990a, 43.

employed to apply the silver layer mirrored those used for gold.[24] In English embroidery during the developed and late Middle Ages, threads typically measured between 0.25 and 0.3 millimetres in thickness. It is presumed that mastering this craft necessitated a training period of potentially four to five years.[25]

Special plates with conical holes were utilized to draw metal wires, a technique employed in textile decoration (Fig. 1: b). This wire-drawing method involved gradually reducing the thickness of a metal rod by passing it through a series of holes with decreasing diameters. With each iteration, the wire's length increased while its thickness diminished. Although the precise origin of this technique remains uncertain, some scholars suggest that ancient Egyptian and Persian goldsmiths employed it.[26] Early instances of metal wires for textile embellishment created through this process have been discovered in Birka, Sweden, dating back to the 9th – 10th centuries. Geijer speculates that these wires were likely imported from Byzantium through Russia, rather than being locally produced.[27] Járó contends that similar early examples found in Western European textiles may have been imported from the East.[28] Self-drawn gold wire was seldom utilized in textile production, due to its cumbersome placement and considerable weight.

24 Karatzani 2012, 64–65.

25 Reyerson 1986, 120.

26 Oddy 1977, 80; Smith 1981, 38.

27 Geijer 1983, 89.

28 Járó 1990a, 43.

ne Švedske koji su je upotrebljavali u izradbi svoje odjeće. Njezinu poznavanju i korištenju u vikinškome području zasigurno su doprinijeli upravo trgovački kontakti između Laponaca i trgovaca iz Birke.[29]

Poseban tip tzv. membranske niti činile su trake od organskoga materijala obloženoga tankim srebrnim ili češće zlatnim slojem (sl. 1: e). Riječ je o trakama od pozlaćene, rjeđe posrebrene životinjske kože ili crijeva te papira ili pergamenta.[30] Njihova prednost u odnosu na ostale metalne niti bila je u tome što su bile lakše, fleksibilnije i jeftinije, ali s obzirom na to da se sloj zlata ili srebra lako skidao, brzo su gubile sjaj. Pozlata se izvodila zlatnim listićima ili prahom prije nego što je podloga bila izrezana na uske trake. Kao ljepilo služile su razne pektinske tvari koje se nalaze u samoj životinjskoj membrani. Tim postupkom bila je značajno povećana čvrstoća niti. Prema Schmidtu, 10. – 13. st. poznata su dva tipa membrana na koje su nanošeni zlatni listići ili prah; mliječnobijele i smeđe boje. Zlatne lamele s mliječnobijelom membranom najčešće su bile upredane u konac (ili nekoliko njih), a s obzirom na to da se kroz membranu prosijavalo zlato, bilo je svejedno na koju je stranu traka okrenuta. Zlatne trake sa smeđom membranom upotrebljavale su se tako da su bile spiralno omotane oko tekstilne pređe, najčešće svilene ili lanene, a poslije pamučne i ostalih vrsta pređa.[31] Takve su se niti upotrebljavale u vezenju, tkanju, kao i u drugim tehnikama izradbe tekstila. Pretpostavlja se da se tehnologija pozlaćivanja, odnosno posrebrivanja membranskih niti, razvila u Kini, odakle se raširila po Bliskome istoku te potom, zahvaljujući Arapima, 7. – 10. st. po Sredozemlju. Na području Europe uporaba takvih niti intenzivirala se u 11. st., dospjevši s otoka Cipra gdje su postojale radionice za njihovu izradbu.[32] Odatle i naziv ciparske zlatne niti ili ciparsko zlato. Te su niti, za razliku od bizantskih (tzv. bizantsko zlato), gdje su se također proizvodile u velikome opsegu, bile tanje i lakše jer su sadržavale manje količine zlata. Od 13. st. membranske su se niti proizvodile u europskim radionicama. Iako su dobivale naziv po mjestima gdje su bile izrađivane (bolonjske, kelnske, sicilijanske i dr.), termin ciparsko zlato ostao je dominantan za takav tip niti te se održao do današnjih dana.[33] Zbog sklonosti propadanju te vrlo tankoga sloja pozlate takve niti iz srednjega vijeka dosad nisu otkrivene na području Hrvatske.

Among the artefacts unearthed in Birka, Geijer also identified a unique type of thread in Europe: wires of round cross-section, primarily composed of silver and gold, occasionally tin, coiled around a fibrous core, known by the Turkish term *tir-tir* (Fig. 1: d). She suggests that this technique was known to the Lapps in northern Sweden, who incorporated it into their garment manufacturing. The exchange between the Lapps and traders from Birka likely facilitated the dissemination and adoption of this method in the Viking region.[29]

A specific variety, known as membrane threads, comprised strips of organic material coated with a thin layer of silver or, more commonly, gold (Fig. 1: e). These strips typically consisted of gilded animal skin or gut, less frequently silver-plated, as well as paper or parchment.[30] Their advantage over other metal threads lay in their lighter weight, increased flexibility and lower cost. However, due to the ease with which the layer of gold or silver could be worn away, they quickly lost their lustre. Gilding was achieved by applying gold leaf or powder before cutting the base material into narrow strips. Various pectin substances naturally present in the animal membrane served as adhesive, significantly enhancing the thread's durability. Schmidt notes that, during the 10th to 13th centuries, two types of membranes were known – milky white and brown – onto which gold leaf or powder was applied. Threads made from gold lamellas with a milky-white membrane were commonly twisted together; and, since the gold was sifted through the membrane, the orientation of the strip did not matter. Strips with a brown membrane were typically spirally wrapped around textile yarn, typically silk or linen, and later cotton and other yarn types.[31] These threads found applications in embroidery, weaving and various other textile production methods. It is believed that the technology for gilding or silvering membrane threads originated in China, disseminating across the Middle East, and subsequently reaching the Mediterranean region through Arab trade routes between the 7th and 10th centuries. In Europe, the utilization of such threads surged during the 11th century with their introduction from Cyprus, where workshops specialized in their production were established.[32] Thus emerged the designation 'Cypriot gold threads', or simply 'Cypriot gold'. In contrast to the Byzantine threads, also widely manufactured but known as 'Byzantine gold', Cypriot threads were characterized by their finer and lighter composition, containing lesser amounts of gold. European workshops began producing membrane threads from the 13th century onwards. While these threads were often named after the locations where they were crafted (such as Bologna, Cologne, Sicily etc.), Cypriot gold maintained its dominance in this category and continues to do so today.[33] Owing to their susceptibility to deterioration and the thin layer of gilding, threads of this nature from the Middle Ages have yet to be unearthed in Croatia.

29 Geijer 1983, 89.

30 Podlogu od papira ili pergamena obično su imale membranske niti kineskoga ili japanskoga podrijetla.

31 Schmidt 1958, 21.

32 Lewis 1953, 111.

33 Raffaelli, Čunko, Dragičević 1982, 828.

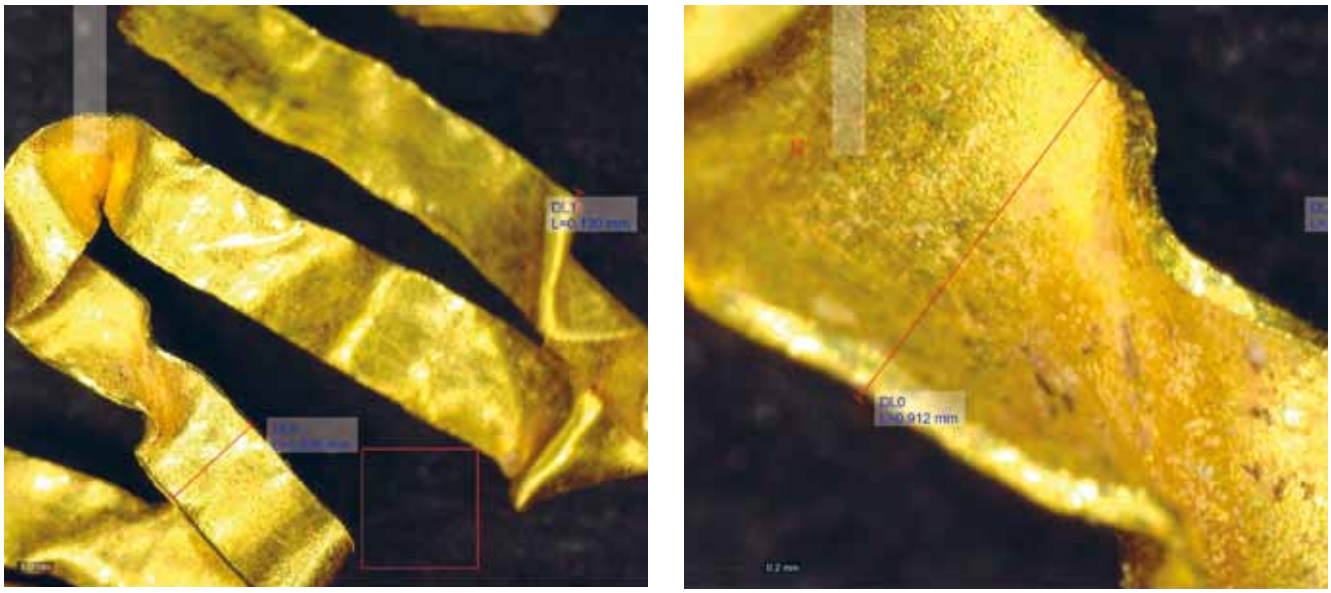
29 Geijer 1983, 89.

30 The backing, typically made of paper or parchment, commonly featured membrane threads sourced from China or Japan.

31 Schmidt 1958, 21.

32 Lewis 1953, 111.

33 Raffaelli, Čunko, Dragičević 1982, 828.



SLIKA 2. Knin-Greblje, jedna od zlatnih lamela iz groba 173 uvećana 50 (lijevo) i 200 puta (desno; Muzej hrvatskih arheoloških spomenika u Splitu, snimila O. Martinčić).

FIGURE 2. Knin-Greblje: a magnified view of one of the gold lamellas from grave 173, shown at 50 times magnification (left) and 200 times magnification (right; Museum of Croatian Archaeological Monuments in Split, photo by O. Martinčić).

Nalazi srednjovjekovnih metalnih niti na području istočne jadranske obale i zaleđa

Među najranije primjerke niti od plemenitoga metala korištenih u svrhu dekoracije tekstila na istočnoj jadranskoj obali pripadaju nalazi otkriveni u nekropoli na sjeveroistočnoj padini brda Spas u Kninu, na položaju Greblje (sl. 2).[34] Riječ je o 32 ulomka zlatnih lamela koje su pripadale inventaru ženskoga groba 173 u kojemu se nalazila i bogato dekorirana istočnogotska kopča datirana u 6. st. S obzirom na to da su nađene u predjelu oko lubanje, vjerojatno su pripadale povezu za glavu kao dijelu cjeline skupocjene odjeće. Ostatci lamela bili su širine između 0,75 i 1,25 mm, a sam je ukras geometrijskoga obilježja te predstavlja oblik slova V. Lamele su vjerojatno bile vezane površinskim vezom za tekstilnu podlogu.[35] Organski ostatci tkanine nisu se sačuvali. S obzirom na to da su na više nalazišta u Panoniji iz istoga razdoblja otkriveni slični nalazi sa sačuvanim organskim ostatcima, može se pretpostaviti da je podloga bila načinjena od svile, lana, vune ili kakvoga drugog organskog materijala.[36] Ukrasni povez pokrivao je čelo, na stražnjemu dijelu glave mogao je biti upleten u kosu, a krakovi su mogli i slobodno visjeti. Osim ukrasne, mogao je imati i funkcionalnu zadaću, odnosno moguće je da je služio i kao rubna dekoracija vela na glavi, tj.

Discoveries of medieval metal threads along the eastern Adriatic coast and its hinterland

Among the earliest instances of precious-metal threads employed in textile decoration in this region are the findings unearthed at the cemetery on the northeastern slope of the Spas hill in Knin, at Greblje (Fig. 2).[34] Approximately 32 fragments of gold lamellas were recovered from the inventory of grave 173, alongside a lavishly-adorned Eastern Gothic buckle dating back to the 6th century. Given that they were found in the area around the skull, they likely formed part of a headband within a set of opulent attire. The remains of the lamellas ranged in width from 0.75 to 1.25 millimetres, featuring geometrical patterns resembling the letter 'V'. They were presumably affixed to the textile substrate through surface bonding.[35] The organic fabric remnants did not survive. Comparable discoveries with preserved organic materials from the same period in Pannonia suggest that the substrate might have comprised silk, linen, wool, or similar organic fabrics.[36] The decorative band could be worn across the forehead, woven into the hair at the back of the head, or left to drape freely on the arms. Apart from its ornamental function, it might have served a practical purpose, such as adorning the edges of a head veil or providing support for it. Such decorative ribbons were integral to luxuri-

34 Istraživanja na Greblju provodila su se od 1966. do 1971., u organizaciji Muzeja hrvatskih arheoloških spomenika u Splitu i Arheološkoga muzeja u Zagrebu, pod vodstvom Z. Vinskoga i D. Jelovine. U 67, od ukupno 218 istraženih grobova, nađeni su grobni prilozi. (Dragičević 1985, 237; Simoni 1989, 75–119; Vinski 1989, 5–73).

35 Dragičević 1985, 238–239.

36 Geijer, Thomas 1966, 225.

34 The excavation at Greblje took place from 1968 to 1971, organized jointly by the Museum of Croatian Archaeological Monuments in Split and the Archaeological Museum in Zagreb, under the direction of Z. Vinski and D. Jelovina. Grave goods were discovered in 67 of the 218 graves investigated (Dragičević 1985, 237; Simoni 1989, 75–119; Vinski 1989, 5–73).

35 Dragičević 1985, 238–239.

36 Geijer, Thomas 1966, 225.

mogao ga je pridržavati. Takve su ukrasne vrpce bile sastavni dio raskošne svečane odjeće u merovinško doba. U prilog tomu govori, između ostaloga, i veo merovinške kraljice Arnegunde pokopane u Saint Denisu u Francuskoj, koji upućuje na zaključak da je takav tip pokrivala za glavu bio uobičajen u 6. st.[37] Prema dostupnoj literaturi, slični nalazi potpuno zlatnih samostalnih niti za dekoraciju tkanina na prostoru istočne jadranske obale dosad nisu otkriveni.

Kao što je već u uvodu navedeno, najveći broj metalnih niti u tekstilu iz srednjovjekovnih grobova istočne jadranske obale i zaleđa odnosi se na pozlaćene trake od iskucanoga srebrnog lima spiralno uvijene oko organske pređe. Prvi takvi nalazi otkriveni su već potkraj 19. st. na Crkvini u Biskupiji i Plavnu kraj Knina.[38] Prema podatcima u dokumentaciji koja se čuva u Muzeju hrvatskih arheoloških spomenika u Splitu, jedan ulomak tekstila s metalnim nitima pripadao je poznatomu bogato opremljenom grobu 4 iz Crkvine (sl. 3), međutim, za dva vrlo slična ulomka nije sigurno kojoj su grobnoj cjelini toga lokaliteta pripadala. Jedan primjerak srodan biskupijskim slučajno je nađen u Plavnu.[39] Nalazi su datirani u početak 9. st., a mjerodavnu osnovicu iz koje su izvedeni takvi zaključci pružio je nalaz iz biskupijskoga groba 4, smješten u to razdoblje zahvaljujući ostrugama s djelomično sačuvanom ostružnom garniturom za zakopčavanje ranokarolinškoga tipa koje su se u njemu nalazile.[40]

Najviše nalaza tekstila s metalnim nitima otkriveno je sredinom 20. st., odnosno tijekom istraživanja groblja uz crkvu sv. Spasa na vrelu Cetine.[41] Analiza groblja pokazala da je ono bilo u uporabi od kraja 10., odnosno početka 11. st. Iako se na groblju stalno pokapalo tijekom 11., 12. i 13. st., najznačajniji i najbogatiji nalazi pripadaju 14. i 15. st.[42] Tekstilni nalazi s pozlaćenim srebrnim nitima otkriveni su u 21 grobu (u nekim grobnim cjelinama nalazio se samo po jedan tekstilni ulomak, a u nekim grobovima bilo ih je i više, čak do 16; neki su, moguće je, pripadali jednomu tekstilnom predmetu, drugi su činili dijelove više takvih predmeta). Za desetak ulomaka uži kontekst nalaza nije poznat. Veličina tekstilnih nalaza varira, ali ni jedan dosad otkriven nije sačuvan u cijelosti. Neki su nažalost propali ili su zagubljeni.[43] Najmanji primjerci dužine jesu svega nekoliko mi-

ous ceremonial attire during the Merovingian era. This is corroborated by the veil discovered in the burial of Merovingian queen Arnegunde in Saint-Denis, France, indicating the prevalence of this style of headdress in the 6th century.[37] Notably, similar findings of pure-gold independent threads for fabric adornment along the eastern Adriatic coast have yet to be uncovered, as per available literature.

As mentioned earlier, in the introduction, the majority of metal threads found in textiles from medieval graves along the eastern Adriatic coast and its hinterland consist of gilded strips of hammered silver sheet spirally twisted around organic yarn. The earliest discoveries of such threads date back to the late 19th century at the Crkvina in Biskupija, and at Plavno, near Knin.[38] According to information documented in the Museum of Croatian Archaeological Monuments in Split, one fragment of textile with metal threads was recovered from the well-known, lavishly-equipped grave 4 at Crkvina (Fig. 3). However, the origins of two very similar fragments remain uncertain, as it is unclear which burial complex within that locality they belonged to. A copy resembling the sample from Biskupija was incidentally found in Plavno.[39] These findings have been dated to the early 9th century, with the authoritative basis for such dating drawn from the discovery in bishop's grave 4. This grave, reliably placed in that period, contained spurs with a partially preserved spur set, characteristic of the early Carolingian type.[40]

In the mid-20th century, the majority of textile discoveries featuring metal threads occurred during the examination of the cemetery adjacent to the church of the Holy Saviour near the spring of the River Cetina.[41] Analysis of the cemetery indicated its usage from the late 10th or early 11th century. While burials persisted throughout the 11th, 12th and 13th centuries, the most notable and opulent findings date back to the 14th and 15th centuries.[42] Twenty-one graves yielded textile artefacts with gilded silver threads. Some graves contained only one textile fragment, while others contained several pieces, up to sixteen in some cases. It is possible that some fragments belonged to a single textile object, while others formed parts of several items. The precise context of ten fragments remains unknown. The sizes of the textile finds

37 Croowfoot, Chadwick Hawkes 1967, 51, 63.

38 Istraživanja na Crkvini u Biskupiji proveo je između 1886. i 1908. L. Marun. Revizijska iskopavanja u dva je navrata na istome položaju proveo Muzej hrvatskih arheoloških spomenika u Splitu; 1951. – 1952. pod vodstvom S. Gunjače te 2000. pod vodstvom Lj. Gudelja (Petrinec 2009, 66). Višegodišnja revizijska iskopavanja, uglavnom na području Male Crkvine, provođena su 2012. – 2019. (Jurčević, Petrinec 2022, 169). U naselju Plavno, između 1893. i 1909., u Muzej hrvatskih arheoloških spomenika u Splitu dospio je veći broj predmeta koji potječu iz grobova, a u nekoliko su navrata iskopavanje ondje izvodili Marunovi povjerenici (Petrinec 2009, 92).

39 Od navedenih nalaza sačuvan je samo ulomak tekstila pronađen na Crkvini u grobu 4. Pohranjen je u Muzeju hrvatskih arheoloških spomenika u Splitu.

40 Petrinec 2009, 177.

41 Srednjovjekovno groblje uz crkvu sv. Spasa na vrelu Cetine istraživano je u organizaciji Muzeja hrvatskih arheoloških spomenika u Splitu 1947. – 1948. te 1952. – 1954., a pod vodstvom S. Gunjače (Petrinec 1996, 7).

42 Petrinec 2006, 108–109.

43 Nalazi s groblja uz crkvu sv. Spasa na vrelu Cetine čuvaju se u Muzeju hrvatskih arheoloških spomenika u Splitu.

37 Croowfoot, Chadwick Hawkes 1967, 51, 63.

38 Research in the Crkvina in Biskupija was conducted between 1886 and 1908 by L. Marun. Subsequent revision excavations took place at the same site on two occasions, led by the Museum of Croatian Archaeological Monuments in Split: firstly, between 1951 and 1952 under the leadership of S. Gunjača, and later in 2000 under the direction of Lj. Gudelj (Petrinec 2009, 66). Multi-year audit excavations, primarily around Mala Crkvina, were carried out between 2012 and 2019 (Jurčević, Petrinec 2022, 169). In the settlement of Plavno, between 1893 and 1909, the Museum of Croatian Archaeological Monuments in Split received numerous objects originating from graves. Marun's commissioners conducted excavations there on several occasions (Petrinec 2009, 92).

39 Of the discoveries mentioned, only a fragment of the textile unearthed in Crkvina, specifically in grave 4, has been preserved. It is currently housed in the Museum of Croatian Archaeological Monuments in Split.

40 Petrinec 2009, 177.

41 The investigation of the medieval cemetery adjacent to the Church of the Holy Saviour near the spring of the River Cetina was conducted under the auspices of the Museum of Croatian Archaeological Monuments in Split in 1947 – 1948 and 1952 – 1954, spearheaded by S. Gunjača (Petrinec 1996, 7).

42 Petrinec 2006, 108–109.

limetara, a najduži je dosad pronađen primjerak 5 milimetara uska traka dužine 25,5 centimetara (sl. 4). Znatan broj nalaza s metalnim nitima otkriven je u tome razdoblju i na srednjovjekovnome groblju srodnom cetinskom, u Mramorju kraj Grboreza nedaleko od Livna (Bosna i Hercegovina).[44] Od 14 grobova u kojima je pronađen tekstil, u većini su bili ulomci načinjeni s metalnim nitima. Kao i u groblju uz crkvu sv. Spasa, u groblju u Mramorju tekstilni ostatci pripadali su i ženskim i muškim pokojnicima i pronađeni su na različitim dijelovima tijela, a ponajviše u predjelu glave i trupa.[45]

Iako se zanimanje za proučavanje metalnih niti u tekstilu pojavilo već s prvim otkrivenim nalazima potkraj 19. st., analize su, kako u Europi, tako i kod nas, bile sporadične sve do druge polovine 20. st. Prve ozbiljnije studije (s naglaskom na razradbu metodologije analiza) nastale su potkraj 1970-ih zahvaljujući austrijskim stručnjacima Ernestu Hokeu i Ingeborg Petrascheck-Heim kao začetnicima takvih istraživanja.[46] Prateći europska kretanja u tome području, prva opsežnija ispitivanja srme sa srednjovjekovnih tekstilnih ostataka u Hrvatskoj izveli su 1982. domaći stručnjaci na Tehnološkome fakultetu u Zagrebu, pod vodstvom Dubravke Raffaelli. Osim četiriju tekstilnih ostataka s metalnim nitima – dva iz Crkvine u Biskupiji i dva iz sv. Spasa na vrelu Cetine, zbog komparacije u analize su uključili četiri primjerka srme s nošnje sinjskih alkara iz 19. st., kao i četiri takva primjerka suvremene srme.[47] Ovisno o uščuvanosti i veličini uzorka, izvedene su i kvalitativne i kvantitativne analize sirovinskoga sastava organske pređe te odvojeno metalnih komponenti.[48] Zbog oštećenosti tekstilne komponente u srednjovjekovnim uzorcima, nije bilo moguće odrediti udio metala, a za uzorke poslije taj udio iznosio je oko 70 %. Metalne niti iz srednjovjekovnoga razdoblja pokazale su postojanje zlata, srebra i bakra.[49] Srednja širina metalnih lamela na uzorcima iz svih razdoblja iznosi 0,3 mm, što upućuje na zaključak da su mogućnosti proizvodnje metalne lamele za uporabu u tekstilu bile već u ranome srednjem vijeku iste kao danas. Značajnije razlike pojavile su se ponajviše u koeficijentima varijacije širine metalnih lamela u odnosu na suvremene. Dok koeficijenti varijacije kod suvremenih uzoraka iznose svega oko 2 %, kod srednjovjekovnih uzoraka iznose i više od 10 % Kvalitativne analize udjela

vary, with none being completely preserved. Unfortunately, some specimens have deteriorated or been lost.[43] The smallest examples are only a few millimetres in length, while the longest known specimen is a 5-millimetre-wide strip measuring 25.5 centimetres in length (Fig. 4). Additionally, during this period, a significant number of textile finds with metal threads were unearthed in a medieval cemetery associated with a cemetery near the Church of the Holy Salvation, located in Mramorje near Grborezi, not far from Livno (Bosnia and Herzegovina).[44] Of the 14 graves where textiles were discovered, the majority contained fragments with metal threads. As at the cemetery near the Church of the Holy Salvation, textiles in the Mramorje cemetery were found on both male and female deceased individuals, primarily around the head and torso areas.[45]

While interest in studying metal threads in textiles emerged with the earliest discoveries towards the end of the 19th century, systematic analyses were infrequent, both across Europe and within our own country, until the latter half of the 20th century. The first substantial investigations, focusing on methodological advancements, took shape in the late 1970s, thanks to Austrian experts Ernst Hoke and Ingeborg Petrascheck-Heim, pioneering such research.[46] In following the European advancements in this field, the initial comprehensive examinations of silk from medieval textile remnants in Croatia took place in 1982. This was spearheaded by local experts at the Faculty of Technology in Zagreb, led by Dubravka Raffaelli. In addition to four textile remnants featuring metal threads – two from the Crkvina in Biskupija, and two from the Holy Saviour near the spring of the River Cetina – four samples of srma from 19th-century costumes of Sinj *alkars*, along with four contemporary srma samples, were included for comparison.[47] Depending on the preservation and size of the samples, qualitative and quantitative analyses of the raw-material composition of organic yarn and individual metal components were conducted.[48] The damage to the textile component in the medieval samples precluded the determination of the metal proportion. For later samples, however, this proportion averaged around 70 %. Metal threads from the medieval period exhibited the presence of gold, silver and copper.[49] The average width of metal lamellas across samples from all periods was found to be

44 Srednjovjekovno groblje u Mramorju kraj Grboreza istraživano je 1954. – 1956., u organizaciji Zavoda za zaštitu spomenika kulture NR Bosne i Hercegovine iz Livna, pod vodstvom Š. Bešlagića i Đ. Baslera (Bešlagić 1964, 7).

45 Bešlagić 1964, 13, 15, 17–18, 23–25, 28–29, 32–33, 35, 49.

46 Hoke, Petraschek-Heim 1977.

47 U analize su uključena dva ulomka tekstila nepoznatoga konteksta iz Biskupije te dva ulomka iz sv. Spasa na Cetini – jedan iz groba 1026, drugi iz nepoznatih okolnosti nalaza (Raffaelli, Čunko, Dragičević 1982, 827–838).

48 Analize tekstila provedene su u Laboratoriju za vlakna i ispitivanja OOUR-a Instituta za tekstil i odjeću Tehnološkoga fakulteta, a emisijska spektralna analiza izvedena je na spektrografu Carl Zeiss – Jena model Q-24 u Zavodu za kriminalistička ispitivanja i vještačenja RSUP-a SRH-a u Zagrebu (Raffaelli, Čunko, Dragičević 1982, 835).

49 Iako se u radu navodi da u oba biskupijska i u jednome uzorku iz sv. Spasa postoje i zlato i srebro u većemu udjelu (ne navodi se točno u kolikome), ne spominje se izričito da je riječ o pozlati srebra. Drugi uzorak iz sv. Spasa pokazivao je samo postojanje zlata (Raffaelli, Čunko, Dragičević 1982, 835).

43 Artefacts from the cemetery near the church of the Holy Saviour near the spring of the River Cetina are also safeguarded in the Museum of Croatian Archaeological Monuments in Split.

44 The medieval cemetery located in Mramorje, near Grborezi, underwent examination in 1954 – 1956. This endeavour was organized by the Institute for the Protection of Cultural Monuments of the Republic of Bosnia and Herzegovina, in Livno, and led by Š. Bešlagić and Đ. Basler (Bešlagić 1964, 7).

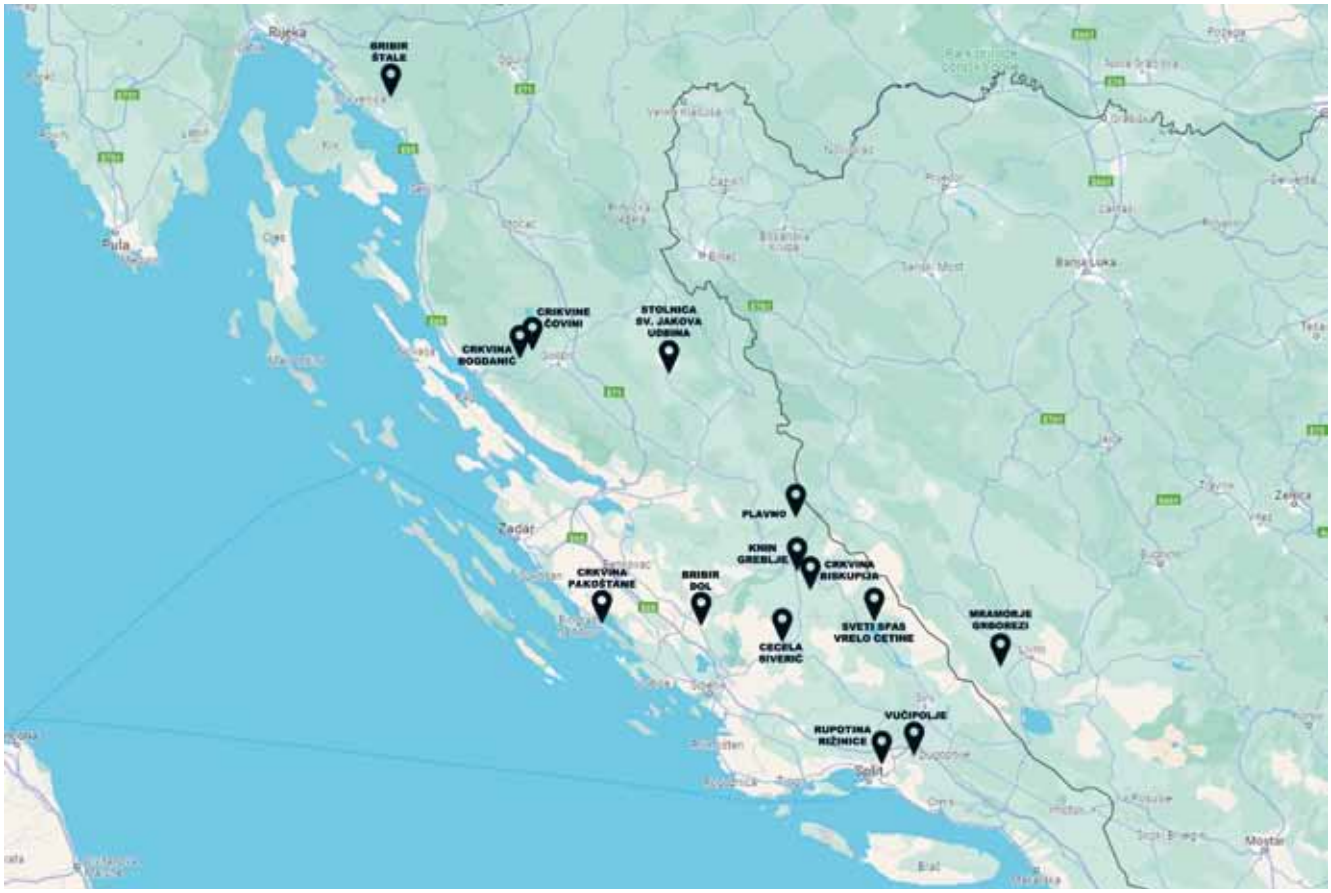
45 Bešlagić 1964, 13, 15, 17–18, 23–25, 28–29, 32–33, 35, 49.

46 Hoke, Petraschek-Heim 1977.

47 Two textile fragments, their context unknown, originated from the Biskupija, along with two from Holy Saviour on the Cetina: one from grave 1026, and another with unclear circumstances of discovery (Raffaelli, Čunko, Dragičević 1982, 827–838).

48 Textile analyses were conducted at the Fibre and Testing Laboratory of the Basic Organization of United Labour (OOUR) Institute of Textiles and Clothing, Faculty of Technology. Emission spectral analysis was carried out using a Carl Zeiss Jena model Q-24 spectrograph at the Institute for Criminal Investigations and Expertise of the Republican Secretariat for Internal Affairs (RSUP) of the Socialist Republic of Croatia (SRH) in Zagreb (Raffaelli, Čunko, Dragičević 1982, 835).

49 While the paper mentions the presence of gold and silver in larger proportions in both samples from Biskupija and in one sample from Holy Saviour, it



KARTA 1. Srednjovjekovna nalazišta (groblja) na prostoru istočnoga Jadrana i zaleđa na kojima su pronađene metalne niti za ukrašavanje tekstila (izradila O. Martinčić).

MAP 1. Medieval sites (cemeteries) in the eastern Adriatic region and its hinterland where evidence of metal threads for adorning textiles has been discovered (made by O. Martinčić).

pojedinih komponenata u srednjovjekovnome uzorku upućuju na postojanje željeza, bakra, olova, srebra i zlata. Među nalazima se nisu pokazale znatne razlike u udjelu zlata, ali preciznije podatke o tome dala bi kvantitativna istraživanja većega broja uzoraka.[50] U ovome kontekstu, iako se dosad nije bavila arheološkim tekstilom, valja istaknuti rad K. Šimić kojoj je jedno od područja znanstvenoga interesa analiza srme na novovjekovnome povijesnom tekstilu s prostora današnje Hrvatske (liturgijsko ruho i narodna nošnja). Njezine studije uključuju primjenu fizikalno-kemijskih metoda SEM-EDS (skenirajući elektronski mikroskop s energijski disperzivnom spektroskopijom), XRF (uređaj za rendgensku fluorescenciju) i PIXE (česticama inducirana emisija rendgenskoga zračenja) kojima se analizira sastav i udio metala u nitima.[51]

U posljednja dva desetljeća nalazi tekstila s metalnim nitima obavijenima oko organske pređe otkriveni su rjeđe u grobovima ranoga, a puno češće u grobovima razvijenoga i kasnoga srednjeg vijeka na još desetak nalazišta duž istočne jadranske

0.3 mm, suggesting that the capabilities of producing metal lamellas for textile use were comparable in the early Middle Ages to those of today. However, notable differences emerged, primarily in the coefficients of variation of the lamella width compared to contemporary ones. While modern samples showed coefficients of variation of around 2 %, medieval samples exhibited over 10 %. Qualitative analyses of the individual components in medieval samples revealed the presence of iron, copper, lead, silver and gold. Notably, there were no significant differences in the proportion of gold among the finds. Nonetheless, more extensive quantitative research would provide more precise data in this regard.[50] In this context, worthy of note is the work of K. Šimić, whose scientific focus lies in the analysis of silk on modern historical textiles from present-day Croatia, including liturgical vestments and folk costumes. Her studies encompass the application of physicochemical methods such as SEM-EDS (scanning electron microscopy with energy-dispersive spectroscopy), XRF (X-ray fluorescence device), and PIXE (particle-induced X-ray emission) to analyse the compositions and proportions of metal in the threads.[51]

50 Raffaelli, Čunko, Dragičević 1982, 827–838.

51 Šimić *et al.* 2013, 101–111; Šimić *et al.* 2016, 89–93.

does not specify whether it is silver gilding. Another sample from Holy Saviour indicated the presence of gold only (Raffaelli, Čunko, Dragičević 1982, 835).

50 Raffaelli, Čunko, Dragičević 1982, 827–838.

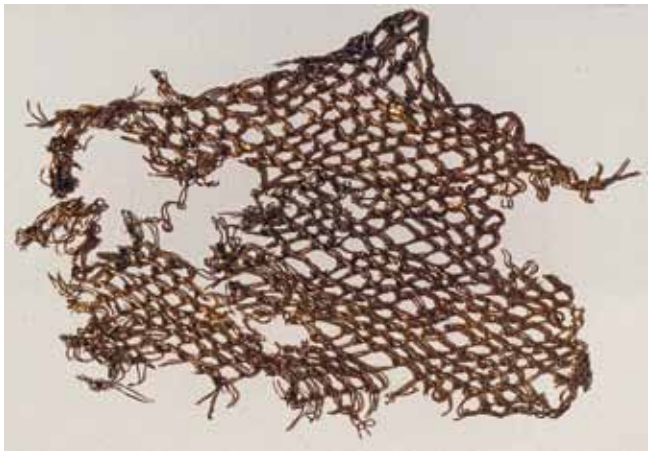
51 Šimić *et al.* 2013, 101–111; Šimić *et al.* 2016, 89–93.

SLIKA 3. Crkvina-Biskupija, ulomak tekstila sa srebrnim pozlaćenim nitima iz groba 4, 9. st. (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 2988; snimila O. Martinčić).

FIGURE 3. Crkvina-Biskupija: a segment of textile featuring gilded-silver threads from grave 4, dating back to the 9th century (Museum of Croatian Archaeological Monuments in Split, inv. no. 2988; photo by O. Martinčić).

SLIKA 4. Sv. Spas na vrelu Cetine, tekstilna traka sa srebrnim pozlaćenim nitima iz groba 658, 12 – 15. st. (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 3461; snimila O. Martinčić).

FIGURE 4. Holy Saviour, near the spring of the River Cetina: a textile strip adorned with gilded-silver threads from grave 658, dated from the 12th century to the 15th (Museum of Croatian Archaeological Monuments in Split, inv. no. 3461; photo by O. Martinčić).



SLIKA 5. Crkvina pod Bogdanićem u Smiljanu, ulomak tekstila sa srebrnim pozlaćenim nitima (Muzej Like Gospić, inv. br. A-5911; snimila O. Martinčić).

FIGURE 5. Crkvina under Bogdanić, in Smiljan: a fragment of textile embellished with silver-gilt threads (Gospić Museum of Lika, inv. no. A-5911; photo by O. Martinčić).

obale. Iako prostorno ne pripada području koje je tema ovoga rada, zbog rane datacije valja spomenuti nalaz spiralno uvijenih niti od legure zlata, bakra i srebra,[52] otkrivenih u grobu dostojanstvenika (gr. br. 4) na Brekinjovoj Kosi nedaleko od Gline, datiranomu krajem 8., odnosno u prvu polovinu 9. st.[53] Smještaj niti na trupu pokojnika implicira na luksuzni predmet u koji je pokojnik bio odjeven, a moguće je i da je riječ o kakvome ukrasu pokrova kojim je bio prekriven. Nešto prijašnjemu razdoblju, ali ne prije druge polovine 10. st., pripada i nalaz zlatnih niti otkriven u antičkome sarkofagu, za ukop pokojnika ponovno

In the past two decades, discoveries of textiles featuring metal threads wrapped around organic yarn have become less frequent in the graves of the early Middle Ages, while they have significantly increased in finds from the developed and late Middle Ages at ten additional sites along the eastern Adriatic coast. Although not geographically within the scope of this study, the discovery of spirally twisted threads composed of a gold, copper and silver alloy is noteworthy.[52] These threads were unearthed in the grave of a dignitary (gr. no. 4) on Brekinjova Kosa, near Glina, dating to the late 8th or early 9th century.[53] The positioning of the thread on

52 Zahvaljujem Hrvatskomu restauratorskom zavodu na ustupljenom izvještaju u kojemu je naveden kemijski sastav metalnih niti iz Brekinjove Kose (Zupčić 2017).

53 Tijekom dviju sezona zaštitnih istraživanja gradine Brekinjova Kosa (2011. i 2015.; voditelj V. Madiraca) otkriveni su ostatci ranosrednjovjekovnoga

52 I extend my gratitude to the Croatian Conservation Institute for providing a report which details the chemical composition of the metal threads from Brekinjova Kosa (Zupčić 2017).

53 During two seasons of protective research at Brekinjova Kosa in 2011 and 2015, led by V. Madiraca, the remains of an early-medieval building, likely a

upotrijebljenomu u srednjem vijeku,[54] otkrivenomu u Rižinicama u Rupotini.[55] S obzirom na iznimno lošu uščuvanost kostura, kao i nepostojanje grobnih priloga, nije bilo moguće ustanoviti spol, ali činjenica da su se metalne niti nalazile u području približno od ramena do koljena pokojnika upućuje da je, kao i na Brekinjovoj Kosi, riječ o odjeći pokojnika ili pokrovu kojim je bio pokriven. Razvijenomu, odnosno kasnomu srednjem vijeku pripada više nalaza metalnih niti za dekoraciju tekstila otkrivenih na grobljima na Crkvini pod Bogdanićem u Smiljanu (12. – 15. st.), Crikvinama u Čovinima kraj Smiljana (13. – 15. st.),[56] Crkvini kraj Pakoštana (12. – 16. st.),[57] Ceceli u Siveriću kraj Drniša (14. – 15. st.),[58] Vučipolju kraj Dugopolja (kraj 13. – 16. st.),[59] uz stolnicu sv. Jakova u Udbini (13. – 15. st.),[60] Dolu u Bribiru kraj Skradina (14. – 15. st.)[61] i Štalama u Bribiru kraj Novoga Vinodolskog (10. – 15. st.; karta 1).[62]

the deceased suggests it was part of a luxurious garment worn by the deceased, or possibly served as an adornment on the shroud covering them. Similarly, the unearthing of gold threads found in an ancient sarcophagus repurposed for a medieval burial, discovered in Rižinice, Rupotina,[54] belongs to a slightly earlier period, likely not preceding the latter half of the 10th century.[55] Despite the poor preservation of the skeletal remains and the absence of accompanying grave goods, the presence of metal threads spanning from the shoulders to the knees indicates they were likely incorporated into the deceased's attire or shroud, mirroring the scenario observed at Brekinjova Kosa. Several discoveries of metal threads used for textile embellishment have been made in various cemeteries across the region, such as Crkvina under Bogdanić, in Smiljan (12th – 15th centuries), Crikvine in Čovini near Smiljan (13th – 15th centuries),[56] Crkvina near Pakoštane, belonging to the developed or late Middle Ages (12th – 16th centuries),[57] Cecela in Siverić near Drniš (14th – 15th centuries),[58] Vučipolje near Dugopolje (late 13th – 16th centuries),[59] the cathedral of St Jacob in Udbina (13th – 15th centuries),[60] Dol in Bribir near Skradin (14th – 15th centuries)[61] and Štale in Bribir near Novi Vinodolski (10th – 15th centuries; Map 1).[62]

objekta (vjerojatno crkve) i nekropole s bogatim grobnim prilozima. Posebno se ističe navedeni grob 4 (unutar samoga objekta) koji je, osim spomenutih niti od legure zlata, sadržavao željezni nož, par luksuznih brončanih pozlaćenih ostruga s garniturama za zakopčavanje, privjesak od gorskoga kristala (?) obložen zlatom i solid Konstantina V (Madiraca *et al*. 2017, 181–182).

54 U radu se navodi da su u Rižinicama pronađene zlatne niti, ali nije isključeno i da je riječ o srebrnim pozlaćenim nitima. Naime, brojni autori u literaturi takav tip niti opisuju kao zlatne iako je katkad riječ samo o pozlati (Zekan 2012, 640).

55 U arheološkoj kampanji provedenoj 2011. u Rižinicama, pod vodstvom M. Zekana iz Muzeja hrvatskih arheoloških spomenika u Splitu, osim ranosrednjovjekovnoga samostanskog sklopa, otkrivena su i istražena dva sarkofaga i između njih jedan grob (br. 26). Metalne niti pronađene su u bolje sačuvanome i ukrašenome sarkofagu (Zekan 2012, 640).

56 Od 2004., na položaju Crikvine u Čovinima kraj Smiljana, u organizaciji Muzeja Like Gospić, pod vodstvom T. Kolak sustavno su istraživani ostatci srednjovjekovne crkve te kasnosrednjovjekovnoga groblja. U organizaciji iste ustanove, na položaju Crkvina pod Bogdanićem 2016. – 2019., istraženi su ostatci srednjovjekovne sakralne arhitekture, kao i više od stotinu grobova koji se prema nalazima datiraju 12. – 15. st. (Kolak 2014, 150; Kolak 2018, 565–567).

57 Sustavna istraživanja lokaliteta Crkvina na zapadnoj obali Vranskoga jezera provedena su 2006. – 2013., pod vodstvom A. Uglešića. Otkriveni su ostatci srednjovjekovnoga samostanskog kompleksa te groblje koje se okvirno može datirati 12. – 16. st. (Uglešić, Gusar 2012, 540).

58 Na lokalitetu Cecela u Siveriću pokraj Drniša, pod vodstvom T. Šeparovića i M. Petrinec iz Muzeja hrvatskih arheoloških spomenika u Splitu 2002. – 2008., istraženi su ostatci ranokršćanske crkve i crkvice s apsidom romaničkih odlika te 27 kasnosrednjovjekovnih grobova (14. – 15. st.; Šeparović 2005, 207; Petrinec 2007, 369).

59 U istraživanjima provedenima 2004. – 2005. na položaju Vučipolje kraj Dugopolja, pod vodstvom H. Gjurašina, istraženo je 170 kasnosrednjovjekovnih grobova na temelju nakita i novca datiranih od kraja 13. do 16. st. (Gjurašin 2010, 122, 127, 130).

60 U sustavnim istraživanjima ostataka krbavske katedrale i dvora krbavskih biskupa koje od 2000. na položaju Kalaurija, odnosno Karija u Udbini provodi Arheološki muzej Zadar u suradnji s Muzejom Like Gospić, otkriveno je više stotina grobova datiranih od druge polovine 13. do kraja prve četvrtine 16. stoljeća. U 33 groba otkriveni su ostatci tekstila, najvećim dijelom ukrašenoga metalnim nitima (Jurić 2015, 471; 2016, 532; Vučić 2021, 195–196).

61 Od 2014. istraživanja na Bribiru dio su međunarodnoga arheološkog projekta Varvaria/Breberium/Bribir u kojemu, pokraj Muzeja hrvatskih arheoloških spomenika u Splitu i Muzeja grada Šibenika, sudjeluju i Macquarie University iz Sidneyja te Det teologiske Menighetsfakultet iz Osla. Na predjelu Dol, gdje je još prije otkriven sklop srednjovjekovnih kuća i samostana

church, and a necropolis with abundant grave goods were uncovered. Notably, grave 4 within the building contained not only gold-alloy threads but also an iron knife, a pair of opulent bronze gilded spurs with fastening sets, a gold-plated rock-crystal (?) pendant, and a solidus of Constantine V (Madiraca *et al*. 2017, 181–182).

54 The paper mentions the discovery of gold threads in Rižinice, but it is also plausible that they could be gilded-silver threads. Some literature refers to this type of thread as golden, although it may only be describing the gilding (Zekan 2012, 640).

55 During the archaeological campaign led by M. Zekan of the Museum of Croatian Archaeological Monuments in Split in 2011, besides the uncovering of an early-medieval monastery complex, two sarcophagi and a grave between them (no. 26), metal threads were found in a better-preserved and decorated sarcophagus (Zekan 2012, 640).

56 Since 2004, at the site of Crikvine in Čovini, near Smiljan, the remains of a medieval church and a late-medieval cemetery have been systematically investigated by the Gospić Museum of Lika, under the leadership of T. Kolak. From 2016 to 2019 the same institution investigated medieval sacral architecture and more than 100 graves dating from the 12th to the 15th century at the location of Crkvina under Bogdanić (Kolak 2014, 150; Kolak 2018, 565–567).

57 Systematic research of the Crkvina site on the western shore of Lake Vrana took place from 2006 to 2013 under the guidance of A. Uglešić. This exploration revealed remains of a medieval monastery complex and a cemetery roughly dating from the 12th to the 16th centuries (Uglešić, Gusar 2012, 540).

58 At the Cecela site, in Siverić, near Drniš, under the guidance of T. Šeparović and M. Petrinec of the Museum of Croatian Archaeological Monuments in Split, 2002 – 2008, the remains of an early Christian church and a small church with a Romanesque apse and 27 late-medieval graves (14th – 15th centuries) were investigated (Šeparović 2005, 207; Petrinec 2007, 369).

59 Research conducted from 2004 to 2005 at Vučipolje, near Dugopolje, under H. Gjurašin's leadership, involved the investigation of 170 late-medieval graves, dating from the late 13th century to the 16th, based on jewellery and coins (Gjurašin 2010, 122, 127, 130).

60 In the systematic research of the remains of the Krbava cathedral and the court of the Krbava bishops, carried out by the Archaeological Museum in Zadar in cooperation with the Gospić Museum of Lika, since 2000 on the site of Kalaurija (Karija) in Udbina, several hundred graves dating from the second half of the 13th century to the end of the first quarter of the 16th century were discovered. Remains of textiles were discovered in 33 graves, mostly decorated with metal threads (Jurić 2015, 471; 2016, 532; Vučić 2021, 195–196).

61 Since 2014, Bribir has been part of the international archaeological project Varvaria/Breberium/Bribir, involving collaboration between the Museum of Croatian Archaeological Monuments in Split, the Museum of the City of Šibenik, Macquarie University of Sydney, and Det Teologiske Menighetsfakultet of Oslo. In 2014, in the area of Dol – where a complex had been discovered earli-

SLIKA 6. Bribir-Štale, *in situ* ostatci trake za glavu ukrašene srebrnim spiralno uvijenim nitima, ispod lubanje pokojnika, grob 61 (snimila A. Konestra).

FIGURE 6. Bribir-Štale: on-site remnants of a headband adorned with spirally twisted silver threads, positioned beneath the skull of the deceased in grave 61 (photo by A. Konestra).

Analizirani uzorci

Iz dosad navedenoga proizlazi da, bez obzira na nemali broj nalaza metalnih niti u srednjovjekovnim grobovima na prostoru Hrvatske, provedba jedne sustavne studije o toj temi nije naišla na znatniji interes stručnjaka. Iznimke čini već navedenih nekoliko radova Magdalene Dragičević, Dubravke Raffaelli i Ružice Čunko.[63]

U okviru ovoga rada fokus je usmjeren na 30 nalaza tekstila s metalnim nitima (ili samostalnih metalnih niti koje su bile sastavni dio tekstilnoga predmeta čiji je organski dio propao) sa sedam srednjovjekovnih groblja (Crkvina u Biskupiji, Crkvina pod Bogdanićem, Čovini-Crikvine, Dol u Bribiru kraj Skradina, Grborezi, sv. Spas na vrelu Cetine, Štale u Bribiru kraj Novoga Vinodolskog), uzoraka koji su dosad prikupljeni te detaljno analizirani (tab. 1). Studije, uz mikromorfološku analizu niti pomoću digitalnoga prijenosnog mikroskopa koji povećava od 20 do 250 puta, uključuju primjenu fizikalno-kemijskih metoda SEM-EDS uređajima kojima se uz opsežnije mikromorfološke karakteristike analizira sastav i udio metala u nitima.[64]

Ni jedan nalaz nije sačuvan u cijelosti, nego u ulomcima veličine od svega nekoliko milimetara do dvadesetak centimetara, ali neki su primjerci bolje uščuvani te se na njima može vidjeti i točno odrediti njihova konstrukcija (sl. 3–5). Izvjestan broj nalaza sačuvan je samo u vidu sitnih ulomaka metalnih niti koje su se raspale od prvotne konstrukcije (sl. 6), te u tim slučajevima

The samples analysed

From the preceding discussion, it becomes apparent that, despite the rarity of metal-thread discoveries in medieval graves throughout Croatia, there has been a lack of significant scholarly interest in initiating systematic investigation into this subject. Exceptions include the notable works by Magdalena Dragičević, Dubravka Raffaelli and Ružica Čunko.[63]

Within the scope of this paper, attention is directed towards 30 findings of textiles adorned with metal threads (or individual metal threads that formed an integral component of a textile item whose organic portion has since decayed) from seven medieval cemeteries (Crkvina in Biskupija, Crkvina under Bogdanić, Čovini-Crikvine, Dol in Bribir near Skradin, Grborezi, Holy Saviour near the spring of the River Cetina, and Štale in Bribir near Novi Vinodolski). Samples from these sites have been collected to date and meticulously analysed (Tab. 1). The studies encompass micromorphological analyses of threads utilizing a portable digital microscope, offering magnifications ranging from 20 to 250 times. Furthermore, physicochemical methods employing SEM-EDS devices have been applied to ascertain the composition and proportion of metals within the threads, along with more comprehensive micromorphological characteristics.[64]

No complete artefacts have been preserved intact; rather, there are fragments ranging from a few millimetres to about twenty centimetres in size. Some specimens exhibit better preservation, revealing their construction accurately (Figs 3–5). Certain findings exist only as small metal thread fragments detached from their original structure (Fig. 6). In such cases, determining the textile item's manufacturing technology was impossible. Various techniques, including weaving, macramé and embroidery, could have been employed with these threads. Although textile remnants with metal threads were found near all parts of the body, they were most abundant around the head area and appeared

s crkvom sv. Marije s brojnim grobovima uokolo, 2014., među ostalima, otkriven je grob 60 u kojemu su se nalazili ostatci najmanje osam odraslih osoba. Parom ostruga s dvanaestokračnom zvjezdicom grob je datiran u 14. – 15. st. Među nalazima bili su ostatci tekstilne trake s metalnim nitima (Ghica *et al.* 2018, 36).

62 Na položaju Štale u Bribiru kraj Novoga Vinodolskog, Institut za arheologiju u Zagrebu proveo je 2021. zaštitna arheološka istraživanja koja je financirala Vinodolska općina. Vodila ih je A. Konestra. Riječ je o groblju na kojemu se pokapanje odvijalo vjerojatno od 10. ili 11. st., pa sve do druge polovine 15. st. Zahvaljujem A. Konestri na ustupljenome izvještaju (Konestra 2021).

63 Raffaelli, Čunko, Dragičević 1982, 827–838; Dragičević 1988a, 8–14; Dragičević 1996: 31–35.

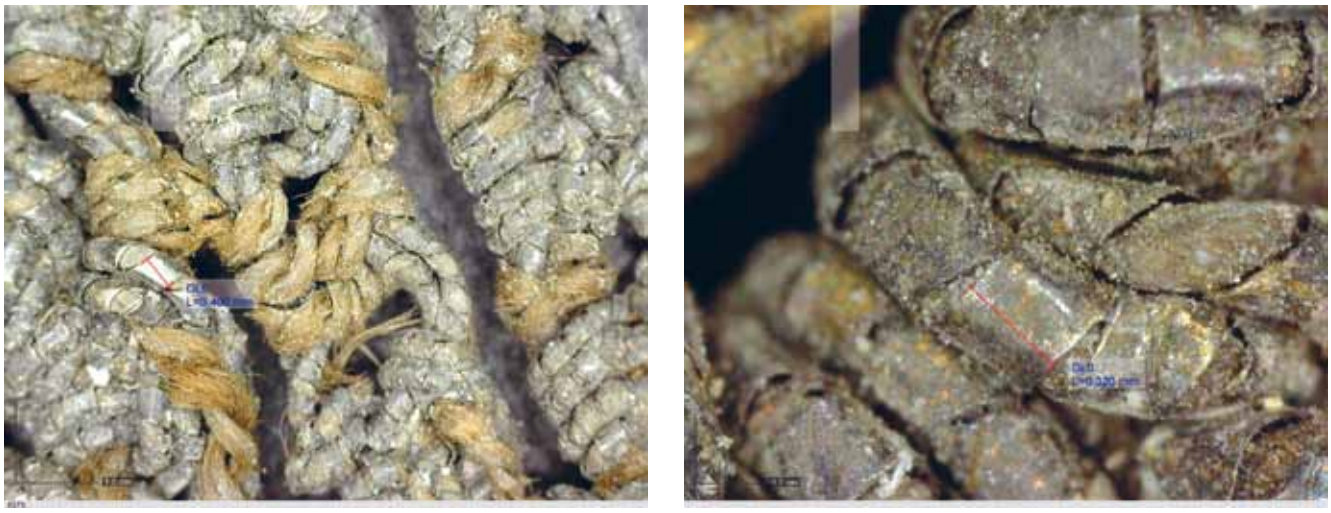
64 Analize SEM-EDS uređajima provedene su u Zavodu za tekstilnu kemiju i ekologiju Tekstilno-tehnološkoga fakulteta u Zagrebu i u Konzervatorsko-restauratorskome odjelu Arheološkoga muzeja u Zagrebu.

er of medieval houses and monasteries with the church of St Mary with numerous graves around – among others, grave 60 was discovered, which contained the remains of at least eight adults. A pair of spurs with a twelve-pointed star date the grave to the 14th and 15th centuries. Among the finds were the remains of textiles with metal threads (Ghica *et al.* 2018, 36).

62 In 2021, the Institute of Archaeology in Zagreb conducted protective archaeological research funded by the Borough of Vinodol at Štale, in Bribir near Novi Vinodolski, led by A. Konestra. This cemetery likely served as a burial site from the 10th or 11th century until the second half of the 15th century. Gratitude is extended to A. Konestra for providing the report (Konestra 2021).

63 Raffaelli, Čunko, Dragičević 1982, 827–838; Dragičević 1988a, 8–14; Dragičević 1996, 31–35.

64 Analyses utilizing SEM-EDS devices were carried out at the Department of Textile Chemistry and Ecology, Faculty of Textile Technology in Zagreb, and the Conservation and Restoration Department of the Archaeological Museum in Zagreb.



SLIKA 7. Bribir-Dol, grob 60 (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 4753), pozlaćene srebrne niti povećane 50 puta (lijevo) i 230 puta (desno; snimila O. Martinčić).

FIGURE 7. Bribir-Dol, grave 60 (Museum of Croatian Archaeological Monuments in Split, inv. no. 4753), featuring gilded silver threads magnified 50 times (left) and 230 times (right; photo by O. Martinčić).

nije bilo moguće odrediti tehnologiju izradbe tekstilnoga predmeta. Tehnike izradbe tekstilnih predmeta s takvim nitima jesu različite; upotrebljavale su se u tkanju, tehnikama makramea, veza i dr. Iako su se tekstilni ulomci s metalnim nitima nalazili pokraj svih dijelova tijela (na prsima, zdjelici, rukama i dr.), najviše ih je bilo u području glave, a bili su svojstveni i muškim i ženskim grobovima. Kako dosad nisu otkriveni cjeloviti nalazi, pretpostavlja se da je takav tekstil služio kao ukras na odjeći, pojasu, posmrtnome pokrovu, velu kao dijelu ženske nošnje, traci ili na kakvome drugom pokrivalu za glavu. S obzirom na to da se pregledom digitalnim prijenosnim mikroskopom pokazalo kako neke niti imaju intenzivan zlatni sjaj koji upućuje na čisto zlato (niti pod inv. br. 6802 nepoznatih okolnosti nalaza iz sv. Spasa na vrelu Cetine; sl. 13), a da je dio niti imao površinu tamno sive boje koja je upućivala na srebro (grob 60 iz Dola u Bribiru, sl. 7), relevantni podatci dobiveni kemijskom analizom elemenata pomoću SEM-EDS uređaja pokazali su da su u svima, osim u dvama uzorcima, niti bile srebrne s pozlatom s jedne, i to vanjske strane. Pozlaćene srebrne niti ne uspijevaju uvijek sačuvati svoj tipičan zlatni sjaj jer postojanje srebra koje je korodiralo uzrokuje razaranje i zlatnoga sloja.[65] Iznimke su nalaz srebrnih niti u grobu 61 u Štalama u Bribiru te nalaz iz groba 1026 – inv. br. 6813 iz sv. Spasa na vrelu Cetine, gdje su uz pozlaćene srebrne niti, tkanjem bile ukomponirane i niti od srebra. Zbog oštećenosti tekstilne komponente, u većini uzoraka nije bilo moguće odrediti udio metala u cjelokupnome nalazu, a zbog oštećenosti površinskoga zlatnog sloja na nitima, ispravnima se pokazuju samo kvalitativne analize jer su pogreške za kvantifikaciju prevelike.

in both male and female graves. As complete artefacts are lacking, it is inferred that these textiles likely served as ornamental elements on clothing, belts, death shrouds, veils, headbands or other head coverings. Examination under a portable digital microscope revealed that some threads exhibited a bright golden shine indicative of pure gold (threads under inventory no. 6802 from the Holy Saviour near the spring of the River Cetina; Fig. 13), while others had a dark grey surface suggesting silver (grave 60 at Dol in Bribir, Fig. 7). Chemical analysis via SEM-EDS indicated that, except for two samples, the threads consisted of silver with gilding on one side and external surfaces. However, gold-plated silver threads did not always retain their characteristic golden shine, due to corrosion of the underlying silver, which could degrade the gold layer.[65] Exceptions were found in grave 61 in Štale in Bribir, and grave 1026 (inventory no. 6813) at the Holy Saviour near the spring of the River Cetina, where silver threads were woven into the fabric alongside gilded silver threads. Damage to the textile component in most samples hindered the determination of the metal proportion in the overall find. Furthermore, due to damage to the surface gold layer on the threads, only qualitative analyses could be reliably conducted, as errors in quantification would be too significant.

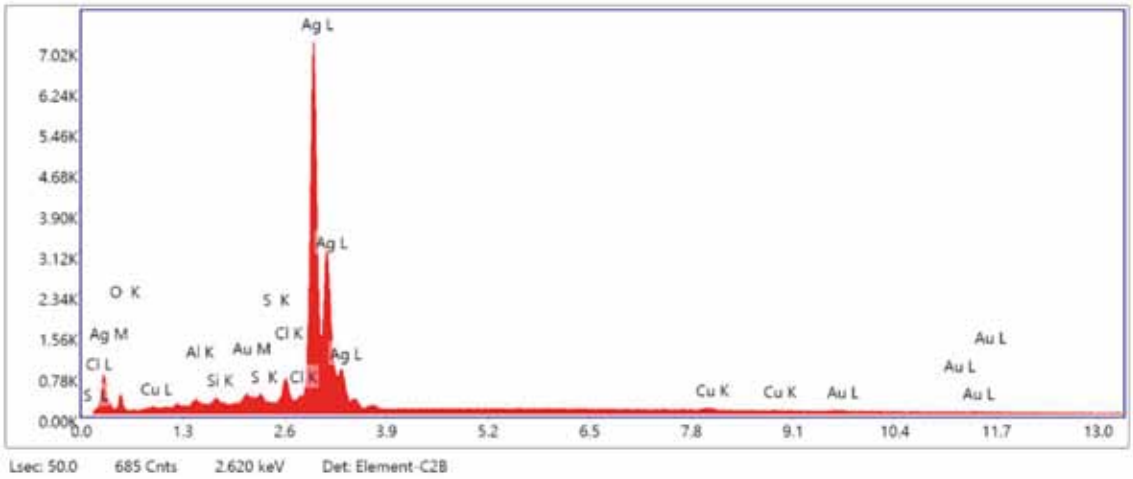
SEM-EDS is a relatively sensitive analytical method that typically identifies most lighter elements. Consequently, qualitative analyses of individual components in the samples, besides silver, copper, gold, mercury and lead, which are indicative of metal threads, revealed the presence of other elements. The majority of threads analysed were found to be composed of gilded silver, indicating

65 Raffaelli, Čunko, Dragičević 1982, 837.

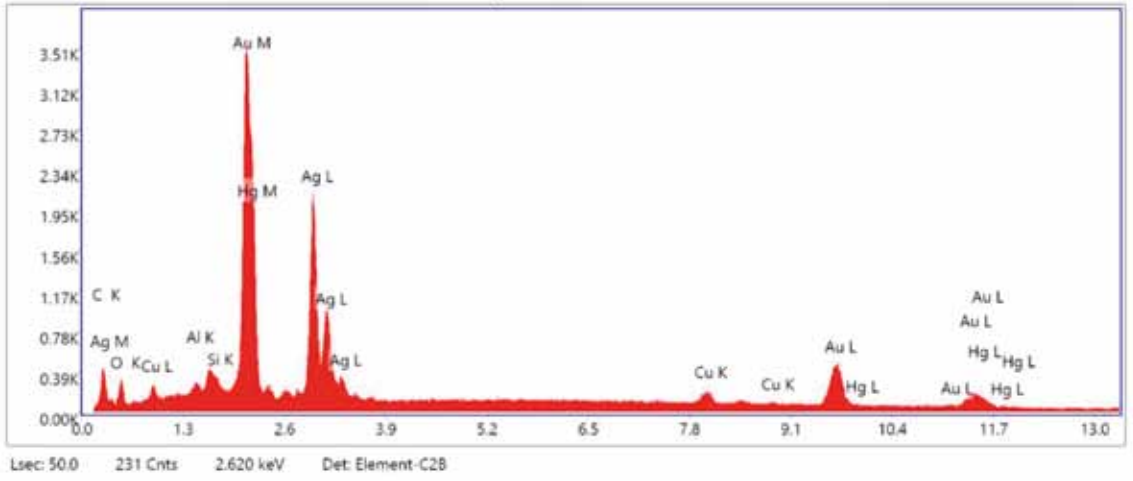
66 Vrlo male količine cinka postoje u srebrnome uzorku bez pozlate iz groba 61 u Štalama u Bribiru kraj Novoga Vinodolskog.

65 Raffaelli, Čunko, Dragičević 1982, 837.

66 Tiny amounts of zinc are present in a silver sample without gilding from grave 61 in Štale, in Bribir near Novi Vinodolski.



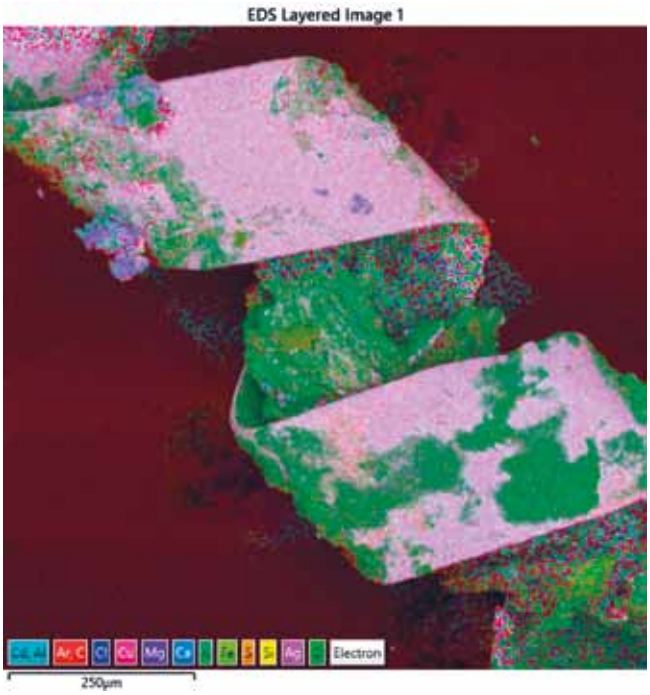
Element	Weight %	Atomic %	Net Int.	Error %	P/B Ratio	R	F
C K	4.66	28.56	47.31	17.06	0.0000	1.0000	1.0000
O K	4.93	22.68	40.68	17.22	0.0000	1.0000	1.0000
AlK	0.68	1.86	23.32	19.02	3.1837	1.0235	1.0030
SiK	0.61	1.61	23.76	19.41	3.1601	1.0303	1.0047
AgL	32.05	21.87	426.88	6.25	150.0369	1.0536	1.0048
CuK	2.68	3.10	37.22	21.60	13.5852	1.0965	1.2570
AuL	52.79	19.73	157.83	10.09	103.4234	1.1046	1.0389
HgL	1.59	0.58	2.01	78.26	2.8700	1.1058	1.0413



Element	Weight %	Atomic %	Net Int.	Error %	P/B Ratio	R	F
O K	4.80	24.14	42.65	17.17	0.0000	1.0000	1.0000
AlK	0.52	1.55	17.11	25.24	2.2580	1.0195	1.0081
SiK	0.40	1.14	15.23	27.89	1.9383	1.0251	1.0134
S K	0.95	2.37	36.87	18.75	5.3107	1.0352	1.0342
ClK	1.50	3.41	58.12	17.00	8.6270	1.0398	1.0519
AgL	83.56	62.31	1532.55	5.70	368.1962	1.0445	1.0040
CuK	1.99	2.52	19.91	29.30	9.3055	1.0801	1.1107
AuL	6.28	2.56	9.05	56.27	13.1592	1.0868	1.0471

SLIKA 8. Rezultati kemijske analize metalnih niti iz groba 4 iz Crkvine-Biskupije, dobiveni pomoću SEM-EDS uređaja, pozlata (gore) i osnova (dolje; inv. br. 2988, izradio D. Doračić).

FIGURE 8. Results of chemical analysis conducted on metal threads from grave 4 at Crkvina-Biskupija, obtained using SEM-EDS technology, displaying gilding (top) and bases (bottom; inv. no. 2988, made by D. Doračić).



SLIKA 9. Rezultati kemijske analize metalnih niti iz groba 61 iz Štala u Bribiru, dobiveni pomoću SEM-EDS uređaja (izradila Z. Kovačević).

FIGURE 9. Results of chemical analysis on metal threads from grave 61 at Štale, in Bribir, obtained using a SEM-EDS device (made by Z. Kovačević).

SEM-EDS je relativno osjetljiva metoda analize i u pravilu detektira i većinu lakših elemenata. Stoga su kvalitativne analize udjela pojedinih komponenata u uzorcima, osim na srebro, bakar, zlato, živu i olovo, koji upućuju na metalne niti, pokazale postojanje i drugih elemenata. Kao što je navedeno, većina analiziranih niti izrađena je od pozlaćenoga srebra, a za pozlatu je korištena metoda tzv. pozlate u vatri. Pri toj se metodi na metalnu površinu nanosi slitina žive i zlata, a predmet se potom zagrijava kako bi živa isparila i na predmetu ostao samo sloj zlata. To potvrđuje postojanje žive koju se u tragovima pronalazi u nekim uzorcima (sl. 8). Olovo koje se pojavljuje u nekim uzorcima može potjecati iz srebronosnih ruda i/ili iz procesa rafinacije srebra te obično postoji u srebru u malim količinama. Bakar se u povijesti često dodavao srebru zbog povećanja čvrstoće i najčešće je glavni legirni element u srebru (sl. 9). Za cink koji se pojavljuje u jednome uzorku moguće je da je bio dodan zajedno s bakrom (u formi mjedi).[66] Većina ostalih postojećih elemenata poput ugljika, kisika, aluminija, magnezija, silicija, klora, kalcija i željeza vjerojatno potječe od nečistoća, zemlje, korozije i sl. Kako je ugljik sastavni dio svih organskih materijala, ali i minerala, i EDS ga uvijek detektira. S obzirom na to da su neki od uzoraka bili lakirani zbog konzervacije, moguće je da je analizom bio zahvaćen i lakirani dio, pa se u spektru pojavila veća količina ugljika.[67]

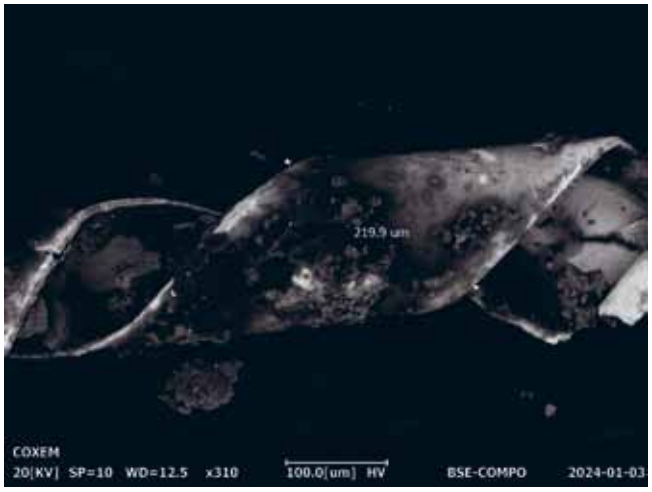
Tekstilna je komponenta, ako je uopće sačuvana, u većini primjeraka znatno oštećena iako se to prema dobivenim mikrofotografijama pri velikim povećanjima prijenosnim mikroskopom nije moglo zaključiti na prvi pogled. Identifikacija tekstilnih vlakana SEM uređajem bila je dodatno otežana s obzirom na to

the use of the fire-gilding technique. This method involves applying a mercury-gold alloy to the metal surface, followed by heating to evaporate the mercury, leaving behind a gold layer on the object. The detection of traces of mercury in some samples confirms this process (Fig. 8). The presence of lead in certain samples may stem from silver-bearing ores or the silver-refining process, as it is typically found in small amounts in silver. In historical contexts, copper was commonly mixed with silver to enhance its strength, often serving as the primary alloying component (Fig. 9). The presence of zinc in one sample suggests it might have been combined with copper (in the form of brass).[66] Other elements detected, such as carbon, oxygen, aluminium, magnesium, silicon, chlorine, calcium and iron, likely stem from impurities, soil, corrosion and similar sources. Carbon, being inherent in organic materials and minerals, was consistently identified by EDS analysis. It is worth noting that varnishing some samples for preservation could have influenced the analysis, potentially resulting in a higher carbon content in the spectrum.[67]

The textile component, where preserved, appears significantly damaged in most specimens. However, initial observations based on microphotographs obtained at high magnifications with a portable microscope did not allow for definitive conclusions. Identifying textile fibres using the SEM device proved even more challenging, primarily due to extensive preservation efforts that covered much of the material. Consequently, confirming the fibre type for any finding with certainty was not possible. Nonetheless, for several specimens, characterized by their thinness and the absence of other elements of fibre structure, it is inferred that the yarn is silk-based. Both written reports and analytical studies

67 Zahvaljujem D. Doračiću iz Arheološkoga muzeja u Zagrebu na iscrpnim objašnjenjima o razlogu postojanja pojedinih kemijskih elemenata u uzorcima.

67 I express my gratitude to D. Doračić of the Archaeological Museum in Zagreb for providing detailed explanations regarding the rationale behind the presence of specific chemical elements in the samples.



SLIKA 10. Sv. Spas na vrelu Cetine, traka na kojoj je vidljivo da je izrezana iz metalne folije (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 6802), snimljena SEM uređajem (snimio D. Doračić).

FIGURE 10. Holy Saviour, near the spring of the River Cetina: a thread revealing that it was cut from a metal foil (Museum of Croatian Archaeological Monuments in Split, inv. no. 6802), photographed using a SEM device (photo by D. Doračić).

da je većina materijala bila konzervirana te dijelom prekrivena sredstvima za konsolidaciju. Stoga se ni za jedan nalaz sa sigurnošću ne može potvrditi vrsta vlakna. Za nekoliko se primjeraka zbog njihove tankoće i nepostojanja bilo kakvih drugih elemenata strukture vlakna može zaključiti da je pređa izrađena od svile. I pisani izvještaji i analitičke studije upućuju na snažnu vezu između niti plemenitih metala i svile kao organske jezgre, za razliku od, primjerice bakrenih niti koje su češće vezane s lanenom jezgrom ili pak jezgrom od životinjske dlake.[68] Sve prikupljene i analizirane niti izrađene su od traka izrezanih iz tankih metalnih folija izrađenih iskucavanjem. Tomu u prilog svjedoče i oštri rubovi duž niti koji odbacuju mogućnost izradbe od vučene žice. Rubovi niti od vučene, potom valjane žice glatki su i zaobljeni (sl. 10).[69]

Prikupljeni uzorci tekstila različito su datirani; najraniji primjerak jest iz Crkvine u Biskupiji i pripada početku 9. st., a ostali su nalazi datirani poslije, uglavnom u kasni srednji vijek. Prema Járó, niti izrađene od pozlaćene srebrne trake spiralno namotane oko vlaknaste jezgre upotrebljavale su se sporadično već u 9. st. (kao prve spominje primjere iz Birke), ali njihova se uporaba znatnije proširila u Europi tek u 12. i 13. st.[70] U takve bi se pretpostavke uklopili i naši nalazi, s time da bi biskupijski pripali među najranije srednjovjekovne toga tipa. Naime, kako je prethodno navedeno, niti u prijašnjim razdobljima bile su izrađivane od čistoga metala, najčešće od zlata, a tek su se poslije u svrhu štednje, ali i lakše obradbe, počele izrađivati od srebra ili pozlaćenoga srebra.

Optičkom mikroskopijom utvrđeno je da širina metalnih lamela na uzorcima iznosi između 0,13 i 0,35 mm, što je otprilike srednja širina dosad pronađenih sličnih niti iz srednjovjekovnoga razdoblja na širemu geografskom području (sl. 11). Odstupanja od toga primjećuju se na nitima veza tunike rimsko-njemačkoga kralja i cara Henrika II. s početka 11. st., iz Bamberga, širina

suggest a strong association between threads of precious metals and silk as an organic core. This contrasts with copper threads, which are more commonly associated with a linen or animal-hair core.[68] All threads analysed were composed of strips cut from thin metal foils created by punching. This conclusion is supported by the sharp edges along the threads, ruling out the possibility of their being drawn from wire. The thread edges of wire that has been drawn and subsequently rolled are smooth and rounded (Fig. 10).[69]

The collected textile samples are dated variably; the earliest specimen is from Crkvina in Biskupija and dates to the beginning of the 9th century, while other findings are dated later, mostly to the late Middle Ages. According to Járó, threads made of gilded silver strips spirally wound around a fibrous core were sporadically used as early as the 9th century (with the earliest examples he mentions from Birka), but their widespread use in Europe occurred mainly in the 12th and 13th centuries.[70] Our findings would align with such assumptions, suggesting that they could be among the earliest medieval examples of this type. As previously mentioned, threads in earlier periods were typically made of pure metal, often gold, with the transition to silver or gilded silver occurring later for reasons of cost-effectiveness and easier processing.

Optical microscopy revealed that the metal lamellas on the samples have widths ranging between 0.13 and 0.35 mm, closely matching the average width observed in similar threads from the medieval period across a wider geographical range (Fig. 11). However, noticeable differences exist, such as in the embroidery threads of the tunic belonging to the Roman-German King and Emperor Henry II from early 11th century Bamberg, where the width extends to 0.6 mm, or in the threads from the bishop's

68 Karatzani, Rehren, Zhiyong 2009, 100.
69 Hacke, Carr, Brown 2004, 416.
70 Járó, Gondár, Tóth 1993, 121; Járó 1995, 38–39.

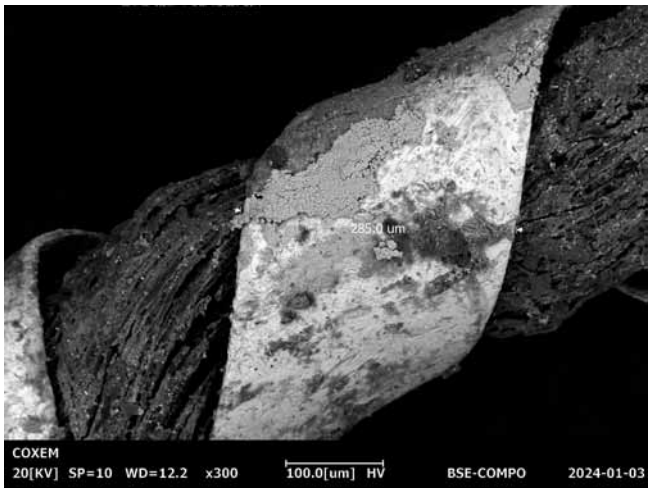
68 Karatzani, Rehren, Zhiyong 2009, 100.
69 Hacke, Carr, Brown 2004, 416.
70 Járó, Gondár, Tóth 1993, 121; Járó 1995, 38–39.

NALAZIŠTE / SITE	INV. BR. / INV. NO	BR. GROBA / GRAVE NO.	DATACIJA (stoljeće) / DATING (century)	TEHNOLOGIJA IZRADBE / PRODUCTION TECHNOLOGY	VRSTA METALA / TYPE OF METAL	ŠIRINA METALNIH NITI (u mm) / WIDTH OF METAL THREADS (in mm)	SMJER UVOJA METANIH NITI / WINDING DIRECTION OF THREADS	SPOL / SEX	VRSTA ORGANSKOGA VLAKNA / TYPE OF ORGANIC FIBRE	POLOŽAJ TEKSTILA U GROBU / POSITION OF THE TEXTILES IN THE GRAVE
Biskupija-Crkvina	2988	4	9.	makrame / macrame	pozlaćeno srebro / gilded silver	0,27 – 0,36	S	muški/male	vjerojatno svila / possibly silk	–
Bribir-Dol	4753	60	14. – 15.	pletenje/knitting	pozlaćeno srebro / gilded silver	0,24 – 0,30	S	–	vjerojatno svila / possibly silk	–
Bribir-Vinodol	–	61	11. – 15.	–	srebro / silver	0,23 – 0,33	S	–	–	ispod lubanje / under the skull
Crkvina-Bogdanić	5893	dislocirano / dislocated	12. – 15.	tkanje/weaving	pozlaćeno srebro / gilded silver	0,24 – 0,34	S	–	–	–
Crkvina-Bogdanić	5911	dislocirano / dislocated	12. – 15.	makrame / macrame	pozlaćeno srebro / gilded silver	0,13 – 0,36	S	–	vjerojatno svila / possibly silk	–
Čovini-Crikvine	5155	dislocirano / dislocated	13. – 15.	–	pozlaćeno srebro / gilded silver	0,16 – 0,35	S	–	–	–
Mramorje-Grborezi	955	1	12. – 15.	makrame / macrame	pozlaćeno srebro / gilded silver	0,18 – 0,32	S	ženski/female	vjerojatno svila / possibly silk	na lubanji / on the skull
Mramorje-Grborezi	1001	130	12. – 15.	oplitanje / entanglement	pozlaćeno srebro / gilded silver	0,16 – 0,34	S	ženski/female	vjerojatno svila / possibly silk	na lubanji / on the skull
Mramorje-Grborezi	1035	236	12. – 15.	oplitanje / entanglement	pozlaćeno srebro / gilded silver	0,20 – 0,34	S	ženski/female	vjerojatno svila / possibly silk	na lubanji / on the skull
Cetina-Sveti Spas / Holy Saviour	1353	414	13. – 15.	oplitanje / entanglement	pozlaćeno srebro / gilded silver	0,21 – 0,25	S	–	–	na skeletu / on the skeleton
Cetina-Sveti Spas / Holy Saviour	3457	515 ili / or 730	13. – 15.	–	pozlaćeno srebro / gilded silver	0,24 – 0,27	S	–	–	–
Cetina-Sveti Spas / Holy Saviour	3454	564	13. – 15.	makrame / macrame	pozlaćeno srebro / gilded silver	0.21	S	ženski/female	–	iznad lubanje / above the skull
Cetina-Sveti Spas / Holy Saviour	1422	652	13. – 15.	tkanje / weaving	pozlaćeno srebro / gilded silver	0,23 – 0,25	S	–	–	na zdjelici / on the pelvis
Cetina-Sveti Spas / Holy Saviour	–	658	13. – 15.	oplitanje / entanglement	pozlaćeno srebro / gilded silver	0,16 – 0,35	S	ženski/female	vjerojatno svila / possibly silk	iznad lubanje / above the skull
Cetina-Sveti Spas / Holy Saviour	3461	658	13. – 15.	tkanje / weaving	pozlaćeno srebro / gilded silver	0,23 – 0,29	S	ženski/female	–	na prsnome košu / on the chest
Cetina-Sveti Spas / Holy Saviour	1440	690	13. – 15.	oplitanje / entanglement	pozlaćeno srebro / gilded silver	0.27	S	ženski/female	–	ispod lubanje i desno od lubanje / under the skull and to the right of the skull
Cetina-Sveti Spas / Holy Saviour	1451	713	13. – 15.	makrame / macrame	pozlaćeno srebro / gilded silver	0,23 – 0,26	S	ženski/female	–	s obiju strana lubanje / on both sides of the skull
Cetina-Sveti Spas / Holy Saviour	1458	726	13. – 15.	tkanje / weaving	pozlaćeno srebro / gilded silver	0,20 – 0,23	S	ženski/female	–	ispod lubanje i lijevo od lubanje / under the skull and to the left of the skull

Cetina-Sveti Spas / Holy Saviour	1026	816	13. – 15.	–	pozlaćeno srebro / gilded silver	0.23	S	–	–	–
Cetina-Sveti Spas / Holy Saviour	1500	836	13. – 15.	oplitanje/ entanglement	pozlaćeno srebro / gilded silver	0,20 – 0,22	S	–	–	–
Cetina-Sveti Spas / Holy Saviour	1517	896	13. – 15.	tkanje/weaving	pozlaćeno srebro / gilded silver	0,19 – 0,27	S	ženski/female	vjerojatno svila / possibly silk	–
Cetina-Sveti Spas / Holy Saviour	1555	965	13. – 15.	makrame/ macrame	pozlaćeno srebro / gilded silver	0,26 – 0,27	S i Z / S and Z	ženski/female	–	oko desne pod-laktice kostura / around the right forearm of the skeleton
Cetina-Sveti Spas / Holy Saviour	1578	1021	13. – 15.	makrame/ macrame	pozlaćeno srebro / gilded silver	0,16 – 0,45	S	–	–	oko lakta lijeve ruke i ispod vrata / around the elbow of the left arm and under the neck*
Cetina-Sveti Spas / Holy Saviour	6810	1026	13. – 15.	oplitanje/ entanglement	pozlaćeno srebro / gilded silver	0,26 – 0,32	S	muški/male	–	na laktovima, lubanji i ispod lubanje / on the elbows and skull, and under the skull*
Cetina-Sveti Spas / Holy Saviour	6811	1026	13. – 15.	tkanje/weaving	pozlaćeno srebro / gilded silver	0,15 – 0,20	S	muški/male	–	na laktovima, lubanji i ispod lubanje / on the elbows and skull, and under the skull*
Cetina-Sveti Spas / Holy Saviour	6812	1026	13. – 15.	oplitanje/ entanglement	pozlaćeno srebro / gilded silver	0,19 – 0,25	S	muški/male	–	na laktovima, lubanji i ispod lubanje / on the elbows and skull, and under the skull*
Cetina-Sveti Spas / Holy Saviour	6813	1026	13. – 15.	tkanje/weaving	srebro i pozlaćeno srebro / silver and gilded silver	0,20 (srebrne / silver) i/and 020–0,28 (pozlaćene / gilded)	S/S	muški/male	–	na laktovima, lubanji i ispod lubanje / on the elbows and skull, and under the skull*
Cetina-Sveti Spas / Holy Saviour	1266	dislocirano / dislocated	13. – 15.	tkanje/weaving	pozlaćeno srebro / gilded silver	0.27	S	–	–	–
Cetina-Sveti Spas / Holy Saviour	6807	dislocirano / dislocated	13. – 15.	makrame/ macrame	pozlaćeno srebro / gilded silver	0,18 – 0,27	S	–	–	–
Cetina-Sveti Spas / Holy Saviour	6802	dislocirano / dislocated	13. – 15.	tkanje/weaving	pozlaćeno srebro / gilded silver	0,20 – 0,35	S	–	–	–

TABLICA 1. Nalazi metalnih niti sa srednjovjekovnih groblja na prostoru istočne jadranske obale i zaleđa (izradila O. Martinčić). * Nije poznato gdje se od navedenoga analizirani uzorak točno nalazio.

TABLE 1. Findings of metal threads from medieval cemeteries on the eastern Adriatic coast and its hinterland (made by O. Martinčić). *It is not known where the sample analysed was exactly located.



SLIKA 11. Metalne niti obavijene oko organske pređe iz groba 236 u Grborezima (Zemaljski muzej Bosne i Hercegovine u Sarajevu, inv. br. 1035) i u sv. Spasu na vrelu Cetine iz groba 1026 (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 6813), snimljene SEM-uređajem (snimio D. Doračić).

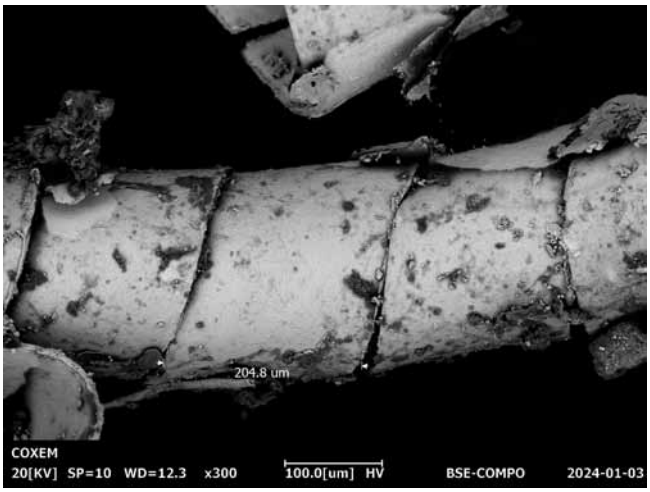


FIGURE 11. Metal threads wrapped around organic yarn were found in grave 236 in Grborezi (National Museum of Bosnia and Herzegovina in Sarajevo, inv. no. 1035) and in the Holy Saviour near the spring of the River Cetina, from grave 1026 (Museum of Croatian Archaeological Monuments in Split, inv. no. 6813). These were photographed using a SEM device (photo by D. Doračić).

koje iznose čak 0,6 mm ili nitima s biskupskih cipela iz Lyona iz 11. – 12. st., širina kojih je tek 0,1 mm.[71] Dosad analizirane metalne niti bile su prilično uredno i ujednačeno uvijene i to na dva načina; u nekim su slučajevima bile postavljene tako da nije bilo slobodnoga prostora, odnosno organska pređa nije bila vidljiva, a na drugim su bile rijetko uvijene tako da su tekstilna vlakna bila vidljiva. Čvršće niti u najvećemu broju slučajeva povezane su s tehnikom tkanja, a olabavljene niti upotrebljavale su se uglavnom u postupku izradbe makramea, odnosno u vezenju. Na manjemu broju uzoraka vidljive su neujednačenosti širine metalnih traka unutar jednoga tekstilnog nalaza; tako, primjerice, na ostatcima tekstila iz groba 658 sa sv. Spasa širina traka varira od 0,16 do 0,35 mm. Na svega četiri uzorka nije bilo odstupanja u širini traka, a u ostalim uzorcima odstupanja od srednje širine bila su između 4 % i čak 64 %, što bi sugeriralo na različite, one preciznije i nešto manje precizne proizvođače.

Gotovo sve metalne niti uvijene su oko pređe u S smjeru, što je bilo i uobičajeno u većini istodobnih nalaza sa šireg područja Europe,[72] ali različito u odnosu na antičko razdoblje u kojemu je prema dostupnim podatcima većina zlatnih niti bila uvijena u Z smjeru.[73] Izuzetak u analiziranim nalazima čini ulomak iz groba 965 iz sv. Spasa u kojemu se uz S smjer pojavljuje nekoliko niti s metalnom ovojnicom uvijenom u Z smjeru. U pojedinim su slučajevima metalne niti ovijene oko organske pređe korištene u kombinaciji s pređom od samo organskoga materijala (ulomak iz sv. Spasa nepoznatih okolnosti nalaza, inv. br. 6807; sl. 12), a u drugim slučajevima tekstilni ulomci u cijelosti su bili izrađeni

shoes from Lyon dating to the 11th – 12th century, with widths as slight as 0.1 mm.[71] The metal threads examined generally display two distinct twisting patterns: some are tightly wound with no visible space, concealing the organic yarn, while others are sparsely twisted, allowing the textile fibres to be visible. More intricate threads are typically associated with weaving techniques, whereas looser threads are primarily used in macramé or embroidery. A subset of samples shows unevenness in the metal bands within a single textile discovery; for example, textile remnants from grave 658 in the Holy Saviour showcase strip widths ranging from 0.16 to 0.35 mm. Only four samples exhibit uniform strip widths, while deviations from the average width in other samples range from 4 to as much as 64 %, suggesting the involvement of various manufacturers with differing levels of precision.

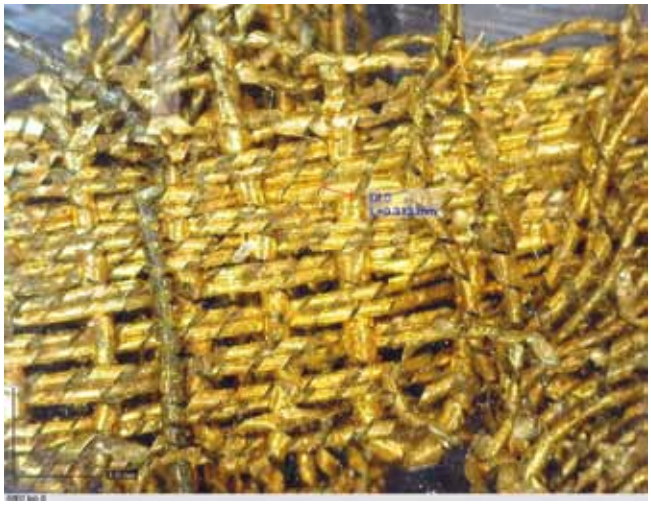
The majority of metal threads observed are twisted around the yarn in the 'S' direction, aligning with prevalent practices in contemporary discoveries across Europe.[72] This contrasts with the ancient period, where available data suggests that most gold threads were twisted in the 'Z' direction.[73] An exception within the findings analysed is the presence of several threads with a metal sheath twisted in the 'Z' direction in a fragment from grave 965 at the Holy Saviour, arranged along the 'S' direction. In certain instances, metal threads wound around organic yarn were used alongside yarn crafted solely from organic materials (as seen in a fragment from the Holy Saviour, under unknown circumstances of the find, inventory no. 6807; Fig. 12), while in other cases, textile remnants were composed entirely of metal threads entwined

71 Járó 1990, 46.
72 Járó 1990, 46.
73 Gleba 2008, 69.

71 Járó 1990, 46.
72 Járó 1990, 46.
73 Gleba 2008, 69.

SLIKA 12. Sv. Spas na vrelu Cetine – ulomak tekstila nepoznatih okolnosti nalaza, metalne niti kombinirane su s potpuno organskom pređom, uvećanje 50 puta (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 6807, snimila O. Martinčić).

FIGURE 12. Holy Saviour, near the spring of the River Cetina: a textile fragment with an uncertain discovery context, featuring a combination of metal threads and entirely organic yarn, magnified 50 times (Museum of Croatian Archaeological Monuments in Split, inv. no. 6807; photo by O. Martinčić).



SLIKA 13. Sv. Spas na vrelu Cetine – ulomak tekstila nepoznatih okolnosti nalaza, čitav izrađen od metalnih niti, uvećanje 50 puta (Muzej hrvatskih arheoloških spomenika u Splitu, inv. br. 6802, snimila O. Martinčić).

FIGURE 13. Holy Saviour, near the spring of the River Cetina: a textile fragment of unknown provenance, entirely composed of metal threads, magnified 50 times (Museum of Croatian Archaeological Monuments in Split, inv. no. 6802; photo by O. Martinčić).

samo od metalnih niti ovijenih oko organske pređe (primjerice ulomak iz sv. Spasa nepoznatih okolnosti nalaza, inv. br. 6802; sl. 13).

Mjesta proizvodnje

Vjerojatno je već tijekom helenističkoga, a svakako u rimskome razdoblju diljem sredozemnoga bazena bilo istodobno više središta proizvodnje tekstila ukrašenoga zlatnim nitima. Na temelju antičkih, kao i izvora poslije, daje se zaključiti da se umijeće tkanja i vezenja nitima od plemenitih metala širilo iz jednoga grada u drugi, u pravilu od istoka prema zapadu i sjeveru.[74] Pri određivanju pobliže provenijencije metalnih niti iz srednjovjekovnih grobova na prostoru istočnoga Jadrana, Dragičević je primjerke prijašnje datacije pripisala bizantskomu podrijetlu, a one poslije tekstilnim radionicama u Palermu.[75] Naime, u sklopu općega kulturnog utjecaja Bizanta značajnu ulogu imala je i Sicilija koja je 535. postala njegovim sastavnim dijelom. Dolazak Arapa u 9. st. uključio je Siciliju u tijekove tkalačke proizvodnje, pa je ona ubrzo postala ravnopravni suparnik Bizantu i Kairu, tada najpoznatijim središtima vještine tkanja na Sredozemlju. U 12. st. Sicilija je postigla svoj zenit kao tkalačko središte te preuzela primat Bizantu i Cipru, koji je postao značajno središte u toj djelatnosti u 11. st.[76] Tako je postala vodeća sila proizvodnje tekstila, a luka Palermo prijestolnica u kojoj su djelovali i doseljenici vrsni tkalci iz Korinta, Tebe i Atene.

with organic yarn (as exemplified by a fragment from the Holy Saviour, under unknown circumstances of the find, inventory no. 6802; Fig. 13).

Production centres

Probably as early as the Hellenistic period, and certainly in the Roman era, several centres of production of textile adorned with gold threads emerged across the Mediterranean region simultaneously. Drawing from ancient and subsequent sources, it can be inferred that the practice of weaving and embroidering with precious-metal threads disseminated from one city to another, typically moving from east to west and northwards.[74] In determining the origin of metal threads found in medieval graves in the eastern Adriatic region, Dragičević attributed earlier examples to Byzantine origins and later ones to textile workshops in Palermo.[75] Notably, Sicily played a significant role as part of the broader cultural influence of Byzantium, having been integrated into it in 535. The arrival of the Arabs in the 9th century incorporated Sicily into the stream of weaving production, positioning it as a formidable competitor to Byzantium and Cairo, the renowned centres of weaving expertise in the Mediterranean. By the 12th century, Sicily reached its pinnacle as a weaving centre, supplanting Byzantium and Cyprus to become the foremost authority in textile production in the 11th century.[76] The port of Palermo emerged as the capital, where immigrant artisans, including skilled weavers from Corinth, Thebes and Athens, also contributed to the industry.

74 Gleba 2008, 69.
75 Dragičević 1988b.
76 Járó 1990, 50–51.

74 Gleba 2008, 69.
75 Dragičević 1988b.
76 Járó 1990, 50–51.

S obzirom na to da se profilirala na izradbu skupocjenoga tekstila, kao najrafiniraniji proizvod nudila je svilu tkanu zlatnim nitima. Dolaskom kralja Karla Anžuvinskoga na prijestolje, u drugoj polovini 13. st., prvenstvo Sicilije u proizvodnji luksuznoga tekstila pomalo se gubi i nestaje, a središte proizvodnje seli se u Luccu, poslije i u druge talijanske gradove. Svilene tkanine dekorirane metalnim nitima iz Palerma prevozili su u 12. st. venecijanski trgovački brodovi u luke Francuske, sve do Njemačke i u zemlje istočnoga Sredozemlja.[77]

Glavni posrednik u trgovini tkaninama kod nas u kasnome srednjem vijeku bio je Dubrovnik, kao jedno od značajnijih pomorsko-trgovačkih središta Sredozemlja. Poznato je da su različite tekstilne proizvode Dubrovčani nabavljali iz zemalja zapadne Europe, većinom iz talijanskih gradova poput Firence i Venecije, ali i iz Francuske i Engleske, a potom ih prodavali aristokraciji na području Balkanskoga poluotoka. No iako su upravo tkanine bile najvažnija roba dubrovačke trgovine još od druge polovine 13. st., njihova je proizvodnja ondje sve do kraja 14. st. bila na razini kućne radinosti. Ipak, uočivši veliku potražnju za kvalitetnim suknom, Dubrovčani su ubrzo pokrenuli vlastitu proizvodnju vunene robe koja je tijekom 15. i 16. st. kvalitetom bila na razini zapadnoeuropske.[78] Iako su bili primarno orijentirani na izradbu sukna, ne treba isključiti da su za potrebe finijih vunenih tkanina u tome razdoblju izrađivali i niti od plemenitih metala.

Značajno središte za trgovinu tkaninama bio je u razvijenome i kasnome srednjem vijeku i Zadar. Izniman dokument koji donosi obilje podataka o trgovini skupocjenih tkanina jest inventar dobara zadarskoga trgovca i suknara Mihovila iz 1385.[79] Iz njega je vidljivo da je trgovina tekstilom kojom se Mihovil bavio općenito imala posebno mjesto u konjunkturi toga vremena, a o opsegu njegova poslovanja svjedoče brojni navedeni tekstilni proizvodi koje je u Zadar uvozio iz istih tekstilnih središta iz kojih su ih nabavljali i Dubrovčani. Bez sumnje su neki od tih skupocjenih tekstila bili ukrašeni i nitima od plemenitih metala. Stipišić smatra da je, s obzirom na to da sloj aristokracije i bogate buržoazije nije bio velik, toj maloj društvenoj skupini mogao biti dovoljan određen broj trgovaca koji su uvozili fine tkanine prema njihovim zahtjevima. Siromašniji građani, kao i seljaci, proizvodili su u domaćoj radinosti najveći dio potrebnoga tekstila koji je bio prostije kvalitete.[80]

Bez obzira na već dokumentirane podatke o uvozu tekstila, osim u kasnosrednjovjekovnome Dubrovniku, ne treba isključiti mogućnost visokoprofesionalne lokalne proizvodnje barem dijela luksuznih tkanina i u kojemu drugom domaćem središtu. Na to, primjerice, upućuje podatak da je u kasnoj antici dio Dioklecijanove palače u Splitu bio organiziran kao ginecej – tkaonica u kojoj su se proizvodile uniforme za rimsku vojsku i dr-

Given its focus on producing luxurious textiles, Sicily offered silk woven with gold threads as its most refined product. However, with the ascension of King Charles of Anjou to the throne in the latter half of the 13th century, Sicily gradually lost its leadership in luxury textile production, and the centre of production shifted to Lucca, and later to other Italian cities. Silk fabrics adorned with metal threads were exported from Palermo in the 12th century via Venetian merchant ships to ports stretching from France to Germany and across the eastern Mediterranean.[77]

During the late Middle Ages, Dubrovnik served as a central intermediary in the fabric trade, being one of the most significant maritime and trading hubs of the Mediterranean. Dubrovnik residents procured various textile products from Western European countries, predominantly from Italian cities such as Florence and Venice, as well as from France and England. These goods were then sold to the aristocracy across the Balkan Peninsula. While fabrics constituted the primary commodities in Dubrovnik's trade from the second half of the 13th century onwards, local production remained at the cottage-industry level until the late 14th century. However, recognizing the high demand for high-quality cloth, Dubrovnik residents soon commenced the production of woollen goods, which by the 15th and 16th centuries matched the standards of Western European quality.[78] Although their primary focus was on cloth production, it cannot be discounted that, during this period, they also manufactured threads from precious metals to cater to the needs of finer woollen fabrics.

Zadar was also a significant hub for fabric trade during the developed and late Middle Ages. One exceptional document shedding light on the trade in expensive fabrics is the inventory of goods belonging to Zadar's merchant and clothier, Mihovil, dating back to 1385.[79] This document offers valuable insights into the textile trade that Mihovil was involved in, underscoring its pivotal role in the economy of that era. The breadth of Mihovil's business is evident from the extensive list of textile products he imported to Zadar from the same textile centres that supplied Dubrovnik. It is reasonable to assume that some of these luxurious textiles were adorned with threads of precious metals. Stipišić suggests that, given the limited significance of the aristocratic and wealthy-bourgeois stratum, a small number of merchants who catered to their needs by importing delicate fabrics could have sufficed for that social group. Meanwhile, poorer citizens and peasants typically produced most of the necessary textiles domestically, albeit of simpler quality.[80]

Despite documented evidence of textile imports, it is plausible to consider the possibility of highly skilled local production of at least some luxury fabrics in other domestic centres, besides late-medieval Dubrovnik. This notion is supported by historical accounts, such as the organization of part of Diocletian's Palace

77 Dragičević 1988b.

78 Belamarić 2008, 343; Kodrič Kesovia, Simončič 2016, 274.

79 *Inventar dobara Mihovila suknara pokojnog Petra iz godine 1385.* objavio je 2000. Jakov Stipišić poprativši ga opsežnom studijom. Rukopis se čuva u samostanu benediktinskih sestara sv. Marije u Zadru.

80 Stipišić 2000, 25.

77 Dragičević 1988b.

78 Belamarić 2008, 343; Kodrič Kesovia, Simončič 2016, 274.

79 In 2000, Jakov Stipišić published the *Inventar dobara Mihovila suknara pokojnog Petra iz godine 1385*, following it with an extensive study. The manuscript is kept in the monastery of the Benedictine Sisters of St Mary in Zadar.

80 Stipišić 2000, 25.

žavne činovnike.[81] Osim uniformi, u ginecejima su se također mogli proizvoditi i pokrivači, kao i visokokvalitetne odore za dvor.[82] Stoga bi lokalna proizvodnja visokokvalitetnih tkanina, a uz njih moguće i metalnih niti za dekoraciju, kao nastavak tradicije organizirane tkalačke djelatnosti također mogla biti prihvatljiva.

Zaključak

Razvoj proizvodnje niti od plemenitih metala za dekoraciju tekstila tekao je u smjeru smanjivanja težine, povećanja fleksibilnosti, kao i pojeftinjenja proizvoda. Niti od čistoga zlata korištene su samo u najranijemu srednjovjekovnom razdoblju da bi ubrzo bile zamijenjene kompozitnim nitima – najčešće pozlaćenim srebrnim nitima obavijenima oko organske pređe ili pak pozlaćenim trakama od organskih materijala poput životinjske kože, crijeva, papira ili pergamenta. Zasad je moguće utvrditi da je korištenje srebrne pozlaćene, rjeđe samo srebrne niti, za dekoraciju tekstila postojalo tijekom cijeloga razdoblja postojanja rane hrvatske države, a i znatno poslije, na što upućuje i popratni arheološki materijal utvrđene datacije. No jesu li takve metalne niti isključivo uvezene ili su možda bile i proizvod kakve lokalne radionice pokazat će, nadajmo se, buduća istraživanja, jer bi na osnovi dosadašnjih spoznaja bilo preuranjeno donositi zaključke u tome smislu.

in Split during Late Antiquity as a gynaecium: a weaving factory responsible for crafting uniforms for the Roman army and state officials.[81] Not only uniforms, but also blankets and high-quality garments for the court were likely produced in the gynaecium.[82] Hence, the prospect of local production of premium fabrics, and potentially metal threads for embellishment, as a continuation of the tradition of organized weaving, remains plausible.

Conclusion

The evolution of precious-metal thread production for textile embellishment was aimed at reducing weight, enhancing flexibility and lowering costs. Pure-gold threads, prevalent in the earliest medieval period, were gradually supplanted by composite threads – typically gold-plated silver threads wound around organic yarn, or gold-plated strips of organic materials such as animal skin, intestines, paper or parchment. Currently, it is evident that the use of silver gilt and, to a lesser extent, pure-silver threads for textile ornamentation persisted throughout the entire duration of the early Croatian state and beyond, as supported by accompanying archaeological evidence with established dating. However, whether such metal threads were exclusively imported or originated from local workshops remains uncertain and warrants further investigation. It would be premature to draw definitive conclusions in this regard based solely on existing findings. Future research endeavours hold promise in shedding light on this aspect of the historical textile industry.

81 U rimskome državnom priručniku *Notitia Dignitatum,* važnomu izvoru podataka, osobito za upoznavanje vojnoga poretka u kasnome Rimskom Carstvu, pisanomu između 358. i 425., između ostaloga navedeno je da je Dioklecijanova palača u Splitu bila pod nadzorom prokuratora *Gynaecei Iovensis Dalmatiae Aspalatho* (Belamarić. 2005, 17).

82 Jones 1964, 836.

81 The Roman state manual *Notitia Dignitatum,* an essential source of information, especially for learning about the military order in the late Roman Empire, written between 358 and 425, states that, among other things, Diocletian's palace in Split was under the supervision of the procurator *Gynaecei Iovensis Dalmatia Aspalatho* (Belamarić 2005, 17).

82 Jones 1964, 836.

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