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НАЦИОНАЛЬНАЯ АКАДЕМИЯ НАУК РЕСПУБЛИКИ АРМЕНИЯ
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CORRELATIONS BETWEEN ARMENIAN, IRANIAN AND SYRIAC MANUSCRIPT ART

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Continuing research in the field of dyes, inks and papers used in medieval manuscripts, the department of restoration of the Scientific Research Institute after M. Mashtots *(*Matenadaran*)* tries to decode various materials typical of the manuscript culture of neighboring countries and find the edges of the interaction of cultures. For this purpose, the Matenadaran's restoration department started researching comparative structures of Iranian, Syriac and Armenian manuscripts in the XVII-XX centuries. This study reveals the interplay of cultures in neighboring countries, which also enriches historical knowledge in the field of paints, inks and calligraphy. Studies performed with the help of modern equipment have revealed numerous similarities in the structures of these materials*;* unique materials specific to individual cultures have also been found.

Fig.12, Tab 6., Ref. 4.

Key words: dyes, ink, paper, structure, parchment.

Problem setting and timeliness.

In recent years, as a result, of the re-equipment of the Matenadaran's restorationdepartment, it has become possible to begin deciphering the structure of the materials used inmedieval Armenian manuscripts.The main goals of the works are:

- Conduct a new comprehensive survey, equipped with modern methods of dataprocessing,

- Proper interpretation of conclusions, using a database that allows not only to search fordata related to the material, but also can technically relate to descriptions of Armenianmanuscripts around the world.

In the Matenadaran's restoration department, the researches of the paints, inks, paper, parchment and covers of the medieval manuscripts of about 180 medieval manuscripts written in the Artsakh writing centers and preserved in the Matenadaran manuscript have been successfully completed[1].

These researches have given rise to new ideas, which are based on comparisons between the ink of other manuscripts of regional peoples near Armenia and among other writing materials (Fig. 1) [2].

Fig. 1 Armenian, Persian, Assyrian Empires about 600 B.C.

At the initial stage of the research, paper manuscripts written in the XVII - XX centuries were selected from the Matenadaran collection, which represent the Armenian (Tab. 1), Iranian (Tab. 2) and Syriac (Tab. 3), manuscript art.

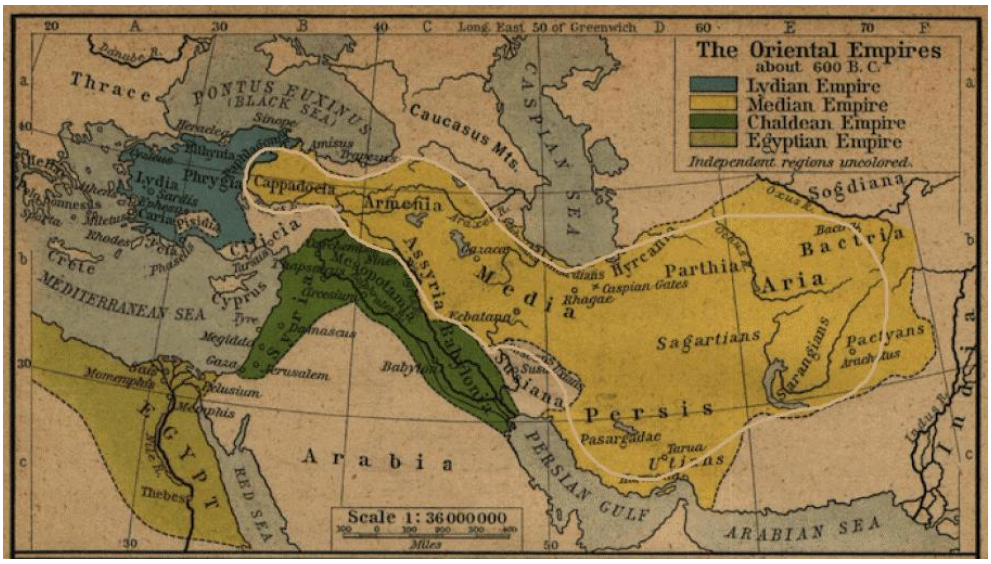

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Table 1

Armenian Manuscripts

Property number of the manuscript (Mashtots Matenadaran MM Collection of Armenian Manuscripts)	Manuscript name	Year of creation	Location
3542	Gospel	1659	Papchan village (Verin Zagam)
7840	Gospel	1693	Khanatsakh Village
8505	Collection	1699	Datei Monastery,(Syunik)
3971	Mashtots Ordination	1766	Gandzasar(Artsakh)
2990	Hovsep Artsakhetsi, a book on theoretical philosophy	1835	St. Jacob
10107	Collection	1868	Khankand (Shushi)

Table 2

Iranian Manuscripts

Property number of the manuscript (MM Arabic manuscript collection)	Manuscript name	Year of creation	Location
7	Picture from the collection after Luiza Aslanyan	XVII C	Iran, Isfahan
548	Nizami (Khamsa)	1677	Probably Iran
1744	Nizami, Makhzan al-Asrar, Hafr Peykar, Eskandar Name	1825-26	Probably Iran
503	Muhammed Taghi Tupshi, bazm ara	1842	Probably Iran
535	Firdousi, Shahnameh	1830	Probably Iran

Table 3

Syriac Manuscripts

Property number of the manuscript (MM foreign language collection)	Manuscript name	Year of creation	Location
9	Turgame, ostsyrisch	1705	Unknown
203	Monastisches Gebetbuch, westsyrisch	1956	unknown
179	Calendar	XIX C	Unknown
180	Missal	XIX C	Unknown

Methodology

The study of dyes, inks, paper and patchment was performed in different light absorption ranges, as well as with the help of spectral analysis. IR-spectroscopy techniques are very suitable for investigating historical materials, especially for studying the composition of inks, dyes, paper, etc. FT-IR spectroscope provides nondestructive research.

Regarding the practical part. The pages of the manuscripts that are being studied are placed on the XYstage of the spectroscope, with a careful touch of the detector, the infrared light passes through a crystal of a certain material (germanium) and interact with the sample, which is pressed onto the crystal. Be advised, that good contact between sample and crystal is very important!

From this a spectrum is obtained, that shows all substance specific characteristics.

Studies were performed with:

1**. Digital Microscope Dino LightAD** 411377 3T-12 V (R4) with resolution 1.3 megapixels

2. FT-IR Bruker's "LUMOS" Spectrometer equipped with Germanium cell detector in spectral range at 4000 - 600cm^{-1} at 4cm^{-1} resolution. Compounds have been recognized by comparison with spectra of pure minerals and/or databases [3].

3. **Iodine Method (Herzberg Reactive) for Determination of Fibrous Composition,** consisting of dyeing paper fibers on an object glass with a solution of chlorine-zinc-iodine and inspection with constant lighting of the dyeing of the fibers[4].

4. **Optical Microscope, Biolam, MBI 3** with 20X magnification in constant lighting

Results

1. Study of inks

The following comparative features and matches with the inks used in the manuscripts of the three different cultures.

For example, in the case of black ink, there are three types of inks in Armenian manuscripts. Syriac lacks pure carbon ink, and Iranian manuscripts make the most of the carbon ink version, except for the mixture of green walnuts and charcoal ink found in Shahnameh (Tab. 4).

Tab. 4

The inks of the manuscripts under study

Ink	Armenian	Syriac	Iranian
	Pigment		
Black	Walnut-Carbon mix. Iron-Carbon mix. Carbon	Walnut-Carbon mix. Iron-Carbon mix.	Carbon few Pages of Manuscript No.548 are used Walnut-Carbon mix.
Red	Armenian Cochineal	Cochineal	Cochineal
Green	Verona Green Earth	-	-
Blue	Lazurite Ultramarine Blue	-	-
Yellow	Gold	-	-

In the IR spectra below, the absorptions of the inks are clearly visible, revealing the differences and coincidences of the raw materials used.

Black ink in all cases of walnut ink, the absorption corresponds to the range 1318-1324 cm^{-1} (Fig. 2).

In the case of Iron gall ink, which is found in Armenian-Syriac manuscripts, the result of the spectrum study is as follows. Considering only the spectra for inked areas, the chemical [S $(O=)_2$] exhibit transmittance band at the region between a, b (1456, 1461 – 1329, 1322) cm^{-1} (Fig. 3).

Examination of carbon ink in Armenian and Iranian manuscripts in IR light shows that carbon ink is completely absorbed (Fig. 4).

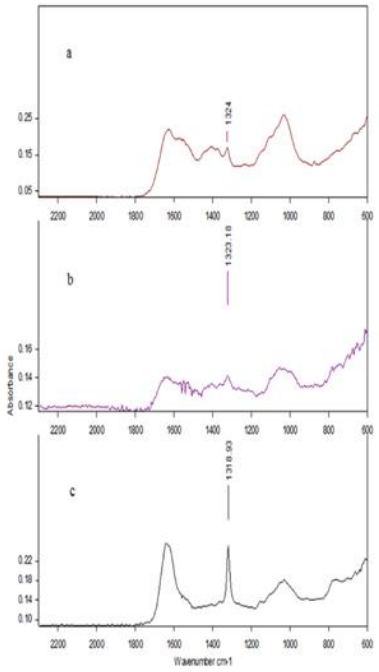


Fig. 2 Walnut ink.

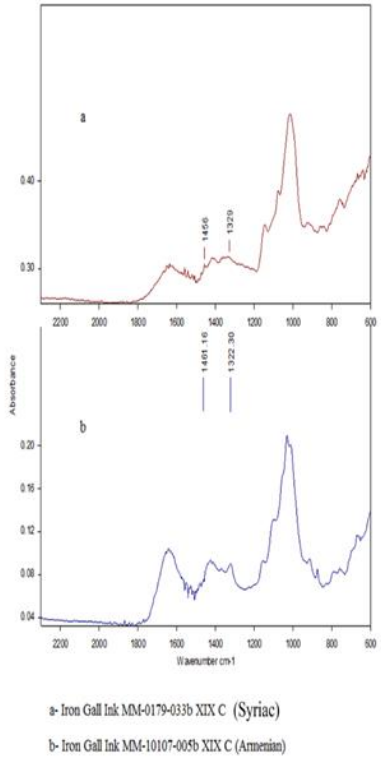


Fig. 3 Iron gall ink.

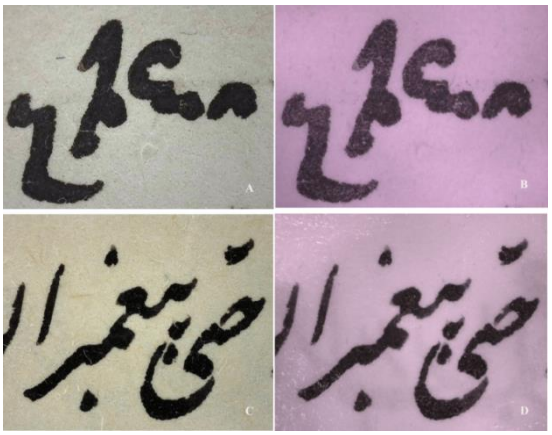


Fig. 4 Carbon ink under ordinary light (A, C) and IR light (B, D),
MM-2990-009 XIX C (A, B) (Armenian),
MM-503-026a XIX C (C, D) (Iranian).

Red ink in all the manuscripts examined, the red ink was identified as Cochineal (Fig. 5).

Since the Armenian Cochineal is one of the most common red paints in Armenian manuscripts, therefore, we have thoroughly studied it, the coincidence of the Syriac-Iranian Cochineal absorption with the Ararat can be a basis for assuming the purchase of a Cochineal used in neighboring countries from Armenia in the middle Ages.

This hypothesis still needs to be refined, which should be based on in-depth studies with a combination of modern equipment.

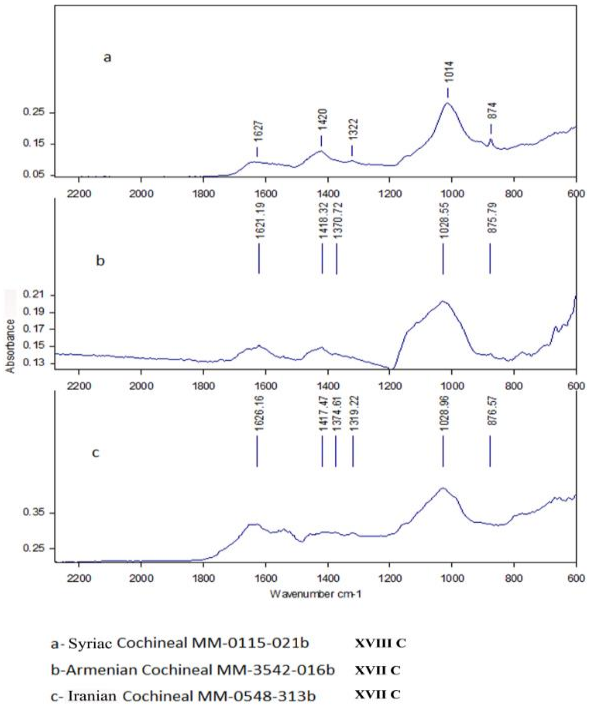
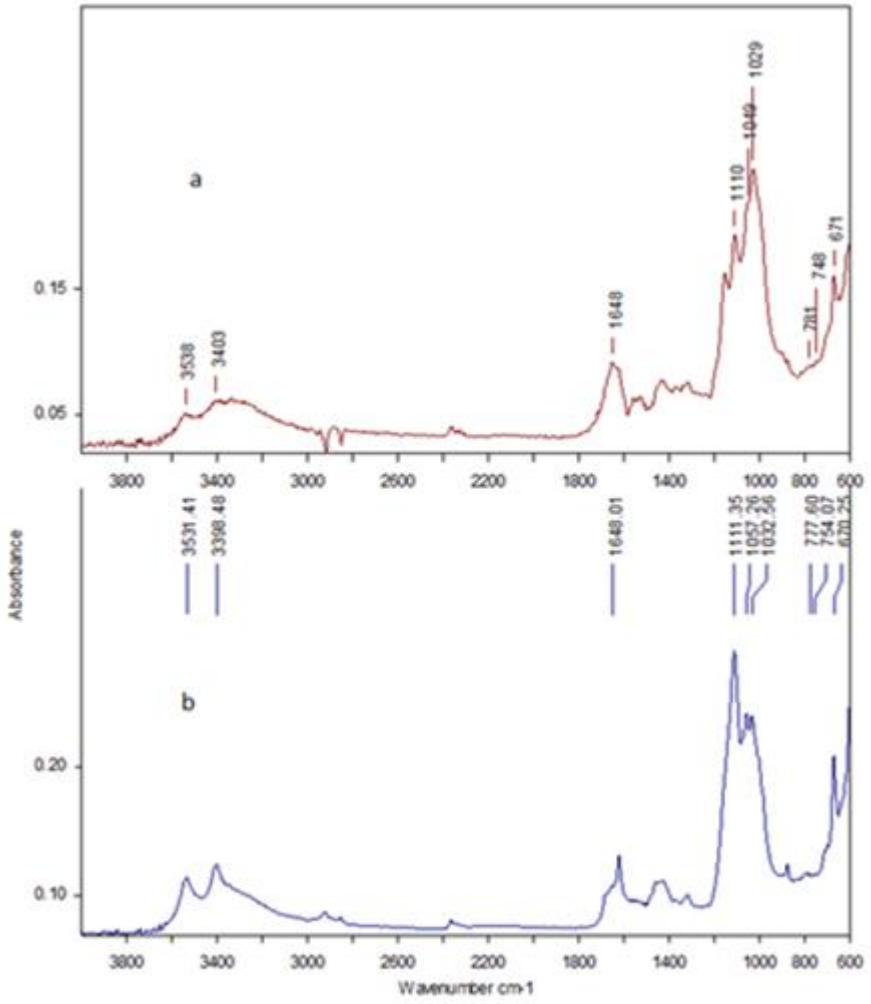


Fig. 5 IR-Spectrum Cochineal (Syriac, Armenian, Iranian)

The result of the spectrum study is as follows: {3,5,6,8-tetrahydroxy-1-methyl-9,10-dioxo-7- [3,4,5-trihydroxy-6- (hydroxymethyl) oxan-2-yl] anthracene-2-carboxylic acid}. a,b,c (874,875,876) cm^{-1} deformated vibration of (CH) groups. a, b, c, (1014, 1028, 1028) cm^{-1} stretching vibration of (C–O) groups. a,b,c, (1322, 1370, 1319 – 1420, 1418, 1417) cm^{-1} deformated vibration of (CH_2–CH_3) groups. a,b,c, (1627, 1621, 1626) cm^{-1} absorption double bonds of anthracene.

Green ink was found only in Armenian manuscripts as Verona Green Earth (Fig. 6).



a-Verona Green Earth MM-0007-007a XVII C (Iranian)

b-Verona Green Earth MM-8508-115a XVIII C (Armenian)

Fig. 6 IR-Spectrum Verona Green Earth {K [(Al, FeIII), (FeII, Mg)] ($AlSi_3$, Si_4) O_{10} $(OH)_2$}

Blue ink found in the form of lazurite ink only in Armenian manuscripts absorption 968 cm^{-1} and Ultramarine Blue also in Armenian manuscripts absorption 1028.56 cm^{-1}. Yellow ink, in the form of gold was found only in the Armenian manuscript.

2. Study of pigments

Fig. 7 A (Armenian MM-7840-027b), B (Iranian MM-0548-222a), C (Syriac MM-0009-028a) illustrated manuscripts

Table 5

Pigment component of Manuscripts

Color	Armenian	Syriac	Iranian
	Pigment		
Red	Armenian Cochineal	Cochineal	Cochineal
Green	Verona Green Earth	Verdigris	Verona Green Earth Verdigris Emerald Green
Blue	Ultramarine Blue Lazurite Prussian Blue	Ultramarine Blue	Ultramarine Blue Azurite Prussian Blue
Yellow	Gold	-	Gold
White	Pigment White	Pigment White Crushed egg crust	Pigment White Crushed egg crust Gypsum

The table above shows many similarities between the materials used in the manuscripts of neighboring countries, from which pigments of the same name were obtained in the Middle Ages.

The red color as in the inks was in all cases identified as Cochineal (Fig. 5).

Green color in Armenian and Iranian miniatures, which coincides with Verona Green Earth pigment. The result of the spectrum study is as follows: a, b (3538/ 3403, 3531/ 3398) cm^{-1} (Hydroxyl stretching). a, b(1648,1648) cm^{-1} (Hydroxyl bending). a, b (1110/ 1049/ 1029, 111/ 1057/ 1032) cm^{-1} (Si–O

stretching). a, b (781/ 748/ 671, 777/ 754/ 670) cm^{-1} (R–O–H) bending (Fig. 6).

Verdigris is found in Syriac and Iranian manuscripts.The result of the spectrum study is as follows: the bands at a, b (1559/ 1415, 1567/ 1400) cm^{-1} are due to the presence of the (COO–) group and correspond to the asymmetric stretching and symmetric stretching vibrations of the (C–O) bond in the acetate group. Bending modes of the (C–H) bond are observed at a ,b (1014, 1010) cm^{-1} (Fig. 8).

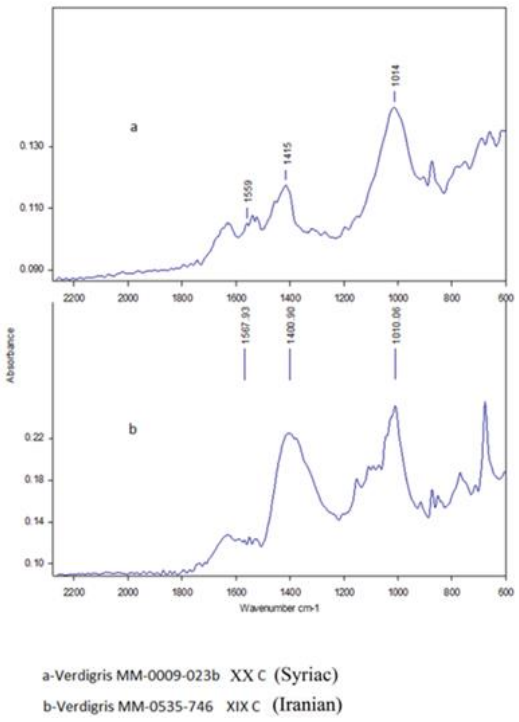


Fig. 8 IR-Spectrum Verdigris (copper acetate).[Cu $(CH_3COO)_2$+$Cu(OH)_2$+H_2O]

Emerald Green is also present in Iranian manuscripts as a green pigment. The result of the spectrum study is as follows: the presence of the ester absorption group (C-O) and the absorption group (CH_2) at wavelength 688 cm^{-1},the presence of a metal carboxyl absorption group (COO) at wavelength 1556 cm^{-1}, a strong absorption group (As-O) at wavelength of 633 cm^{-1},and the group (OH) at the wavelength 1450 cm^{-1} (Fig. 9).

The color blue was identified in all manuscripts as Ultramarine Blue in the range

1012-1028 cm^{-1}.

Prussian blue pigment is present in Armenian and Syriac manuscripts in the range of 2085 cm^{-1}.

Lazurite was found in Armenian manuscripts in the range of 968 cm^{-1}.

Azurite is in Iranian manuscripts. The result of the spectrum study is as

follows: 3420 cm^{-1} stretching vibration of hydroxyl unit, 1488–1406 cm^{-1} Carbonate antisymmetric stretching vibration, 1026–949 cm^{-1} (CH_2) Deformation mode, 833–815 cm^{-1} Bending mode for carbonate (Fig. 10).

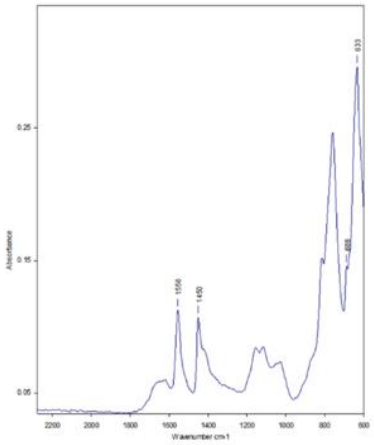


Fig. 9 IR- Spectrum Emerald green [Cu(CH3COO) 2.3Cu (AsO2)2]

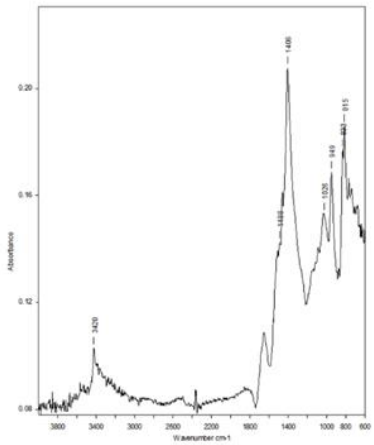


Fig.10 IR-Spectrum Azurite $[2CuCO_3 \cdot Cu(OH)_2]$

The yellow color in the form of gold was found in Armenian and Iranian manuscripts.

The color white as Pigment White (White lead) is found in all manuscripts.

The result of the spectrum study is as follows: Shows a strong band near a, b, c (1398, 1397, 1391)cm^{-1} due to the antisymmetric stretch of the carbonate group, plus bands near a, b, c (680 /1044, 678/1027, 679/1043)cm^{-1} which are due to the carbonate group and a hydroxyl (O-H) stretching band near a, b, c(3528, 3526, 3535)cm^{-1} (Fig. 11).

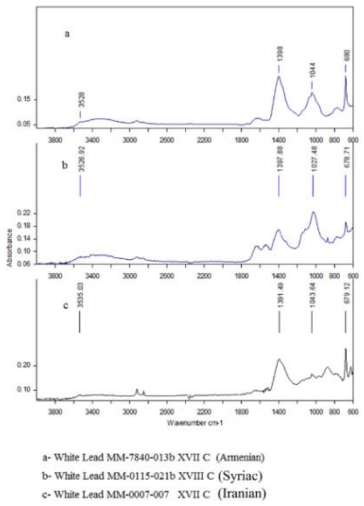


Fig. 11 IR-Spectrum White Lead $[2PbCO_3 \cdot Pb(OH)_2]$

Crushed egg crust is found in Syriac and Iranian manuscripts, and in Iranian Gypsum is also found.

3. Study of Papers

The study of the paper was carried out with the help of Herzberg reactive and as a result it turned out that in all cases the Writing material was Cotton-flax mix, in Persian there is also pure Flax (Fig. 12), Armenian manuscripts were also written on parchment (Tab. 6).

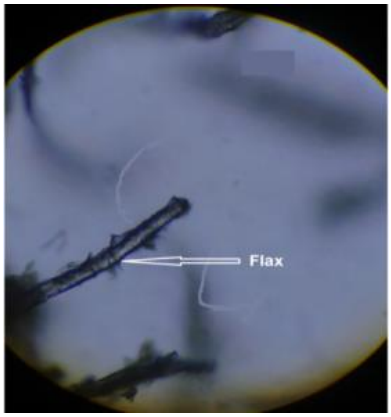


Fig. 12 Microscope Picture from manuscript paper
MM-535-746 XIX C

Table 6

Sheet Components of Manuscripts

	Type of Sheet
Armenian	Cotton-Flax mix. Parchment
Syriac	Cotton-Flax mix.
Iranian	Cotton-Flax mix. Flax

Conclusion

The researches lead to the fact that medieval Armenia, being in a geographical position, being at cultural crossroads, had economic relations with the neighboring countries and therefore the mutual influences of the three neighboring cultures studied took place. This is reflected in the inks, paints, and writing raw materials mainly used in Armenian, Syriac, and Iranian manuscripts, but there are some exceptions.

Work is underway to distinguish the properties of dyes in more detailed studies.

Acknowledgementes

The autors would like to thank Prof. Dr. Erich Renhart (VESTIGIA – Manuscript Research Centre &Special Collections Department), Art critic Yvette Tayryan and orientalist E. Petrosyan for their help for bibliographic and important clarifications of the manuscripts.

ՀԱՅԿԱԿԱՆ, ԻՐԱՆԱԿԱՆ ԵՎ ԱՍՈՐԱԿԱՆ ՁԵՌԱԳՐԱԿԱՆ ԱՐՎԵՍՏԻ ՓՈԽԱՌՆՉՈՒԹՅՈՒՆՆԵՐԸ

Ա.Կ. ԽՈՐՈԶՅԱՆ, Գ. Ա. ԷԼԻԱԶՅԱՆ

Շարունակելով գիտահետազոտական աշխատանքները միջնադարյան ձեռագրերում օգտագործված ներկանյութերի, թանաքի և թղթերի ոլորտում՝ Մ.Մաշտոցի անվան գիտահետազոտական ինստիտուտի (Մատենադարան) վերականգնման բաժնում փորձ է արվում կատարելու հարևան երկրների ձեռագրային մշակույթին բնորոշ տարբեր նյութերի վերծանում և գտնելու մշակույթների փոխազդեցության եզրերը։

Այդ նպատակով Մատենադարանի վերականգնման բաժնում սկսվել են հետազոտություններ XVII-XX դարերում իրանական, ասորական և հայկական ձեռագրերի նյութերի կառուցվածքների համեմատականների ուղղությամբ։

Նշված ուսումնասիրությունը բացահայտում է հարևան երկրների մշակույթների փոխադարձ ազդեցությունը, ինչը նաև հարստացնում է պատմական գիտելիքները ներկերի, թանաքի և գրչության արվեստի առնչարեզում։

Ուսումնասիրությունները, որոնք կատարվել են ժամանակակից սարքավորումներով, բացահայտել են բազմաթիվ համընկնումներ նշված նյութերի կառուցվածքներում, սակայն հայտնաբերվել են նաև չկրկնվող նյութեր, որոնք բնորոշ են առանձին մշակույթներին։

КОРРЕЛЯЦИЯ МАТЕРИАЛОВ АРМЯНСКИХ, ИРАНСКИХ И АССИРИЙСКИХ РУКОПИСЕЙ

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Продолжая исследования в области красителей, чернил и бумаги, использованных в средневековых рукописях, в отделе реставрации института древних рукописей им. М.Маштоца (Матенадаран) сделана попытка идентификации различных материалов, характерных для рукописной культуры соседних с Арменией стран и найти грани взаимодействия культур.

С этой целью в реставрационном отделе Матенадарана проведен сравнительный анализ структур материалов иранских, ассирийских и армянских рукописей XVII – XX вв. Указанное исследование раскрывает культурное влияние соседних стран, обогащая этим знания в области средневековых красок,чернил и бумаги. Исследования, проведенные с помошью современного оборудования, выявили множество совпадений в структурах упомянутых материалов, а также обнаружили неповторяющиеся элементы, характерные для отдельных культур.

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