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Scribes and Writing Practices in Egypt's *Ala Veterana Gallica*: A Preliminary Study of Inks from a Military Roll

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***Abstract* – This article reports on the preliminary study of the inks from a military roll belonging to the archive of the veteran (Lucius) Iulius Serenus, dated to 179 CE. The papyrus contains receipts for payments for hay for soldiers of the *ala veterana Gallica*, and features different writing hands and inks of various appearances. The analysis using a combination of infrared reflectography and X-ray fluorescence spectroscopy, revealed that the inks are carbon-based, but also contain varying amounts of copper and calcium depending on the writing hand and the section of the roll. These results shed light on the development and diversity of ink production and use in Egypt from the late second century CE in the context of the Roman army.**

I. Introduction

Recent research on the technology of ink production has emphasised the role of the period ranging from the Hellenistic to the early-Byzantine time for the development of iron-gall inks, a type of inks produced by the reaction of divalent iron ion (Fe^{2+}) with tannic or gallic acid in a water-soluble binding medium. Although most of the inks of that time are still carbon inks, made of carbon pigments (from soot or charcoal) dispersed in water with a binding agent, a growing number of cases of "mixed inks", containing copper and/or iron in addition to the carbon pigments have been recorded in recent publications [1-5]. A project at the Centre for the Study of Manuscript Cultures from the University of Hamburg aims at better understanding the development of such inks by investigating the composition of inks from securely dated and provenanced papyri from Hellenistic and Roman Egypt [6]. In this regard, the case of the military roll from the archive of the veteran (Lucius) Iulius Serenus, kept at the Staats- und Universitätsbibliothek Hamburg Carl von Ossietzky (*P.Hamb.graec.* 184 = *P.Hamb.* I 39 [7]), is particularly interesting since it is not only securely dated, but also features several writing hands associated with inks of various appearances. In a preliminary study, we analysed the inks from one fragment (*P.Hamb.graec.* 184.I) of the military roll.

II. Description of the papyrus

This official receipt booklet made of papyrus, measuring 22 x 36,5 cm, was written sometime in the year 179 CE. It is a fragment of a 4,33 m long roll with receipts for *faenarium*, namely payments for hay, for soldiers of the *ala veterana Gallica* in Alexandria. The Greek text is written in two columns along the papyrus fibres. The papyrus bought on the antiquarian market together with 15 other documents, was probably found in a village of the *nomos* Arsinoites (Fayyum region) named Karanis, near the modern settlement of Kom Aushim. The roll belongs to the private archive of (Lucius) Iulius Serenus, former *summus curator* of the *ala*, who retired from active service in the village of Karanis in the first decades of the third century CE. The papyrus dates to the time of his active service in the village of Nikopolis (modern Sidi Gaber). This military roll provides an insight into the multicultural panorama of the Roman army [8] thanks to the over forty entries recording the name of soldiers of this auxiliary unit [9]. The individuals mentioned in this fragment have names predominantly of Latin (Iulius Marcus, Valerius Nepotianus, Marcus), Greek (Amerimnos, Theophilos, Menodoros, Dionysios, Melanos, Nephos) and Egyptian (Nepheros, Onnophris) origins. However, the onomastic data do not entirely clarify the ethnic and cultural identity of the individuals mentioned, as remarked by the patronymics (i.e. fathers' names) accompanying some of these individuals. For instance, while the name of Amerimnos' father, Ammonios, is a typical anthroponym derived from the name of the Egyptian god Ammon, it probably has its roots in the Greek colony of Cyrenaica (today Libya) [10]. On the other hand, Onnophris (Egyptian *Wn-nfr*, "the one who is perfect") and his father Colluthos (Egyptian *Klḏwꜣ*) bear indigenous names. Another soldier bearing the Greek theophoric name Menodoros (Greek

Μηνόδωρος, “gift of Men”) [11] is mentioned as the son of Marcus, who has a typical Latin name. Names’ origins did not necessarily reflect the ethnicity of their bearers and, for instance, many of the soldiers having Greek names might have been Egyptians or Romans. In fact, the onomastic data recorded throughout the entire roll, as well as the evidence of bilingualism traceable in the morphology of the receipts, allow us to identify soldiers whose origins span from the western provinces of the Roman empire to Mesopotamia, who were speakers of Greek as well as Semitic languages [12].

Each section is marked by a Greek letter visible on the left margin of the roll’s columns, the end of which is highlighted by a horizontal line running between the different entries. In addition, in several occurrences, this division apparently marks textual segments written by various scribes. Five authors can be identified according to the examination of writing hands. Most of these writers seem to have a certain grade of experience and were perhaps accustomed to writing on a regular basis, although the level of each scribe varied greatly. Nonetheless, not all of them seem professional scribes, and perhaps we might identify the authors as soldiers selected for their writing skills to write on behalf of their colleagues.

III. Method

The papyri were analysed following the standard method for non-invasive and non-destructive analysis of inks developed by the Centre for the Study of Manuscript Cultures and the Bundesanstalt für Materialforschung und -prüfung (BAM) for the last twenty years. It consists of two steps [13]:

A preliminary screening is performed with a Dino-Lite USB microscope (model AD4113T-I2V) equipped with built-in near infrared (NIR) and ultraviolet (UV) lights at 940 nm and 395 nm respectively, and an external custom-made LED white light source. At this stage, some details can be observed at high magnification (20x to 200x) for further investigation, and the typology of the inks can be quickly identified, based on the comparison of the inks’ opacity under white (i.e. visible) and NIR light. Indeed, while carbon inks keep the same opacity independent of the wavelength, iron-gall inks gradually lose opacity at higher wavelengths, before turning totally transparent at around 1400 nm [14]. To ascertain the presence of carbon in the ink, this preliminary investigation was complemented with infrared reflectography (IRR) at longer wavelengths. This was performed with an Osiris Apollo infrared camera, equipped with a 128 x 128 pixels area InGaAs detector sensitive in the range from 900 to 1700 nm, and with a 150 mm, f/5.6–f/45 lens, in front of which a long-wave pass (LWP) filter at 1510 nm was mounted.

An investigation of the elemental composition of the inks is then performed by X-ray fluorescence. At this stage, different instruments can be used depending on the object and the requirements for precision, degree of mobility required (on-site measurement or analysis in the lab), and time constraints. In this case, since it was possible to bring the fragment to the lab, we could use an M6 Jetstream (Bruker GmbH) imaging µ-XRF spectrometer. This device has an adjustable measuring spot ranging from 50 to 650 µm, is equipped with a low-power (30 W) Rh X-ray tube, polycapillary X-ray focusing optics, a 50 mm^2 Xflash SDD detector, and two microscopes for positioning. The scans were performed directly under air atmosphere, so only elements heavier than magnesium (Mg) could be securely identified. All the measurements were performed at 50 kV and 600 µA, with a spot size of 50 µm, an acquisition time of 30 ms per pixel, and a pixel (step) size of 150 µm. For this part of the analysis, the glass in which the papyrus fragments are stored had to be opened. Areas of interest for semi-quantitative comparisons of inks from the different sections were extracted with the Bruker M6 Jetstream software.

IV. Results and discussion

As already noted, *P.Hamb.graec.* 184 was evidently written by various scribes. This can be stated not only considering the evidence provided by palaeographic analysis, but also examining the appearance of the inks. This is particularly striking on some of the fragments, such as *P. Hamb.graec.* 184.I, where especially the inks from the top and bottom sections of the right column appear with blurry and brownish edges (Fig. 1, top). The inks from these areas resemble much those from *P.Berol.* inv. 13501, and *P.Berol.* inv. 5026, both from the Ägyptisches Museum und Papyrussammlung in Berlin, dated to 284 BCE and to the second or third century CE respectively. The inks from both papyri have been analysed recently and were found to contain an addition of copper in the case of *P.Berol.* inv. 13501 [4], and of iron with some copper in the case of *P.Berol.* inv. 5026 [5]. Some Coptic fragments from the monastery of Apa Apollo in Bawit (inv. 345, 357, 399 from the Roca Puig collection in Barcelona) dated to the seventh-eighth century CE also bear inks containing carbon and copper and have similar aspects [15].

For all the spots observed, the ink does not fade under NIR light, strongly suggesting that the inks contain carbon (Table 1). The presence of carbon in all the inks of the fragment was unequivocally proved with IRR imaging (Fig. 1, bottom), as the text remains visible everywhere at wavelengths beyond 1510 nm.

Micrographs of selected areas from the left and right columns are presented in Table 1. A good example of inks with blurry and brownish edges can be seen on the micrographs of the first letter (τ) of the last line of the right column (spot R6): many cracks are visible in the letter, and the surface of the ink seems to be flaking off in some areas, leaving a brownish mark on the papyrus' surface. The cracks are even more visible under the NIR illumination.

The use of an imaging XRF spectrometer allowed us to obtain maps of spatial distribution of elements. The main elements detected were potassium, calcium, manganese (traces), iron, and copper. Elemental distribution of calcium (Ca), iron (Fe), and copper (Cu) for the left part of the left and right columns are presented in Fig. 2 and Fig. 3 respectively, along with an image in visible light on which spots of interest are indicated. The text is perfectly legible in the distribution map of copper for the right column, and somewhat legible in the upper and middle sections of the left column. For the bottom section of the left column, only some letters are recognisable in the map of copper distribution. Therefore, it seems that the inks of the right column contain a significant amount of copper, while the inks from the left column only contain some. Iron, although present everywhere, is not clearly associated with the ink, as the text cannot be read in the elemental distribution map of this element, except perhaps for the upper section of the left column. Additional spot analysis suggested that the majority of the iron detected comes from the modern cardboard support to which the papyrus is attached. Finally, the text of the bottom section of the right column, and the text of the top section of the left column are somewhat legible in the distribution map of calcium, proving its presence in the ink. Concerning the other sections, some characters are also, although barely, recognisable in the map of calcium distribution, suggesting the corresponding ink might also contain traces of this element. The top section of the right column is particularly intriguing: the background around the whole paragraph appears somewhat darker, as if the surface was wiped out (for example with a sponge) and the papyrus was rewritten in this area. Furthermore, some strikes are visible in the calcium distribution map of this section. Could it indicate that the original text was erased, and new text written over it?

Fig. 4 and Fig. 5 present XRF spectra of the selected spots (averaged per pixel) indicated in Fig. 2 and Fig. 3 respectively. The spots were selected where the ink was the thickest in order to be able to more easily separate the contribution of the ink from that of the papyrus substrate. They correspond to areas where the concentrations of copper, calcium and iron are the highest, and are therefore not representative of the average composition in these areas. However, even when looking at these extreme cases, differences in copper concentration are clearly visible, with inks from the left column containing much less copper than the inks of the right column. The inks from the top and bottom sections of the right column are the richest in copper. The inks of the section markers of the right column contain a comparable amount of copper to the inks of the text from the middle section. By contrast, the inks of the section markers of the left column seem to contain only traces of copper, as for the text. In both cases, these section markers were probably written at the same time as the corresponding sections.

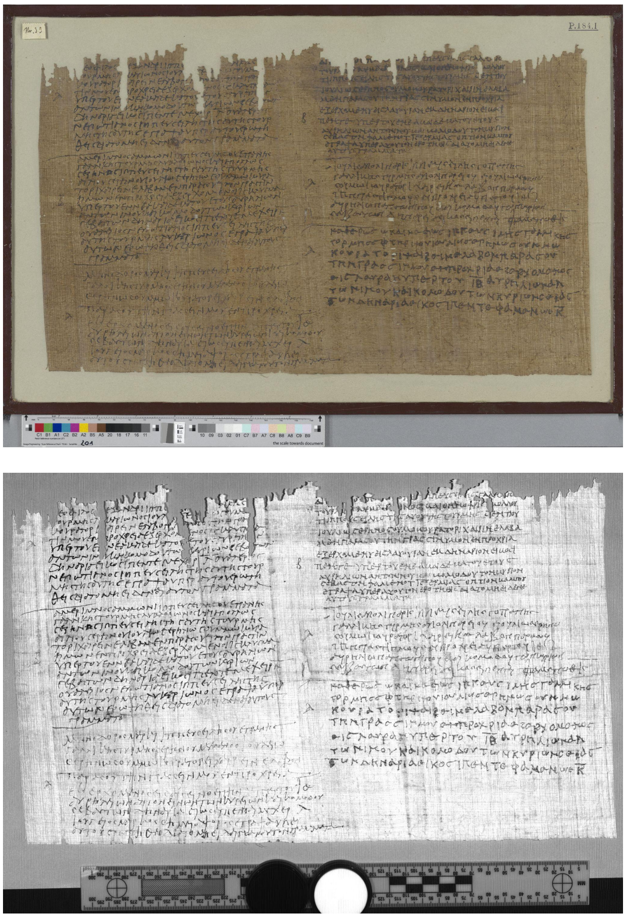
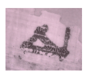
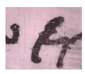
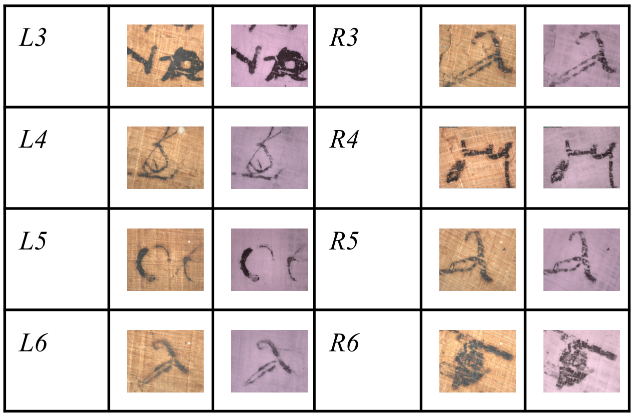


Fig. 1. Picture of fragment P.Hamb.graec. 184.I under visible light (top, © Staats- und Universitätsbibliothek Hamburg Carl von Ossietzky) and IR light (bottom, captured with the Osiris Apollo camera with a long wave pass filter at 1510 nm)

Table 1. Micrographs under visible and NIR (940 nm) light of details of P.Hamb.graec. 184.I at 40x magnification.

Spot left	*Vis*	*NIR*	*Spot right*	*Vis*	*NIR*
L1			*R1*		
L2			*R2*		



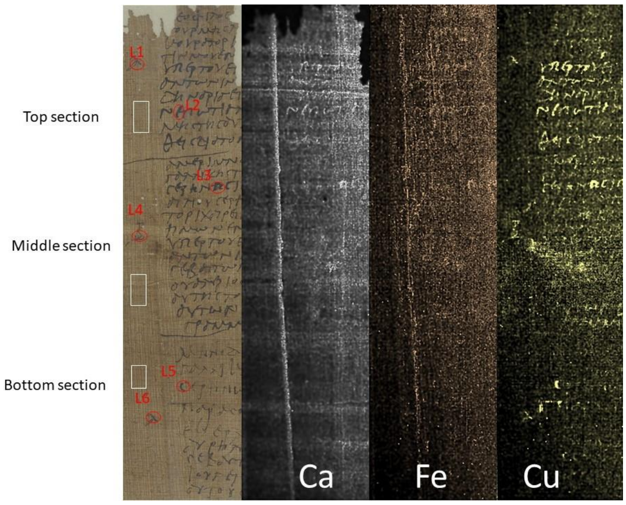


Fig. 2. Photo (left) and distribution of Ca, Fe and Cu of a portion of the left column of P.Hamb.graec. 184.I obtained by XRF scanning (Scan parameters: 50 kV, 600 μA, 50 μm spot size, 30 ms/pixel, 150 μm step size). Spots of interest of ink and papyrus are indicated in red and white respectively.

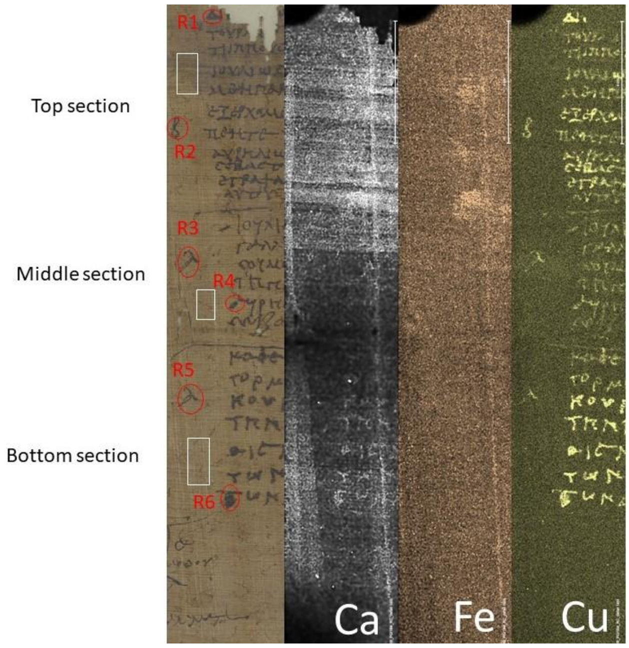


Fig. 3. Photo (left) and distribution of Ca, Fe and Cu of a portion of the right column of P.Hamb.graec. 184.I obtained by XRF scanning (Scan parameters: 50 kV, 600 μA, 50 μm spot size, 30 ms/pixel, 150 μm step size). Spots of interest of ink and papyrus are indicated in red and white respectively.

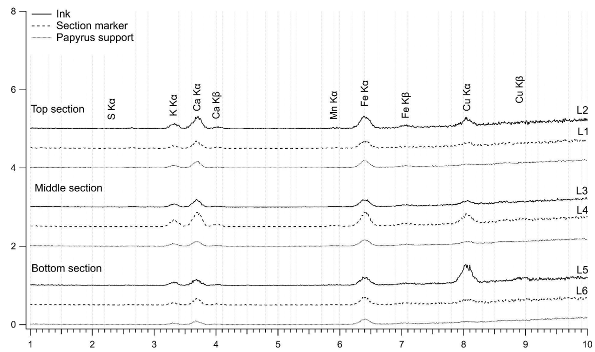


Fig. 4. XRF spectra of selected spots from the left column.

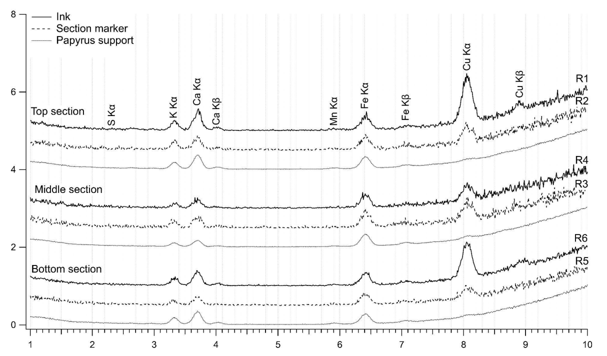


Fig. 5. XRF spectra of selected spots from the right

column.

V. Conclusion

This article aimed to present the results of the application of a multidisciplinary research approach to the study of a fragment of the military roll belonging to the archive of the veteran (Lucius) Iulius Serenus. The analysis revealed that the inks, although all carbon-based, also contain copper and calcium, only in traces for the left column, and in high amounts in the right column. There is also a weak correlation between the ink and iron for the upper section of the left column. Alphas and betas serving as markers of the different sections, visible on the left margin of the columns seem to have been written at the same time as their corresponding sections. This is suggested, among others, by their similar ink compositions. In addition, traces of possible erasure in the top section of the right column, associated with calcium in the elemental mappings, have been identified. These findings contribute to the understanding of the development and diversity of ink production and the study of writing practices in use in the context of the Roman army in Egypt during the late second century CE. Furthermore, they constitute additional proof that mixed inks made of carbon and copper were occasionally used in parallel to pure carbon inks during the whole period extending from the third century BCE up to the seventh-eighth century CE. An in-depth study of other fragments of the roll as well as documents of the present archive is planned. The examination of writing hands, morphological features of the texts, and onomastic data provided by these documents combined with ink analysis might help us in reconstructing the different stages of production of this document and the actors involved in the process. The results of this interdisciplinary study of the military roll might potentially shed new light on writing practices within the military domain in Roman Egypt.

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