Chroniques du Manuscrit au Yémen

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Sommaire

SHIFTING SANDS OF WRITING INKS IN YEMEN. THE OCCURRENCE OF SPARKLING PARTICLES IN YEMENI MANUSCRIPTS[1]

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In memory of Professor Robin Clark (UCL, d. 06.12.2018),
A pioneer in the application of Raman Spectroscopy
To the identification of pigments.

Abstract

This article focuses on the analysis of glossy inks from a body of manuscripts from Yemen preserved in the University Library of Leiden, the phenomenon having been noted for the first time in Zabīd in the 2000s. Arab sources, including Yemeni, contain ink recipes in which the sparkling effect is sought after and obtained through the use of various ingredients. Laboratory analysis, meanwhile, reveals that the shiny effect results from particles (mica and sand, sometimes with a preparation based on red pigment) spread *after* the writing exercise. The use of these particles between functionality and aesthetics, which seems to be peculiar to Yemen, is at the center of the study and opens a new field of investigation.

Résumé

Cet article porte sur l'analyse d'encres brillantes à partir d'un corpus de manuscrits du Yémen conservés à la Bibliothèque universitaire de Leyde, le phénomène ayant été noté pour la première fois à Zabīd dans les années 2000s. Les sources arabes y compris yéménites comportent des recettes d'encre dans lesquelles l'effet brillant est recherché et obtenu par le recours à des ingrédients variés. L'analyse en laboratoire révèle, quant à elle, que l'effet brillant résulte de particules (mica et sable, parfois avec une préparation à base de pigment rouge) répandues *après* l'exercice d'écriture. C'est l'usage de ces particules entre fonctionnalité et esthétique, semble-t-il particulier au Yémen, qui est au centre de l'étude et ouvre un nouveau champ d'investigation.

خلاصة

تركز هذه المقالة على تحليل الأحبار اللامعة من مجموعة من المخطوطات اليمنية المحفوظة في مكتبة جامعة ليدن في هولندا، وقد اكتشفت هذه الظاهرة لأول مرة في مدينة زبيد في العقد الأول من القرن الحادي والعشرين. وتحتوي

[1] This study was made possible thanks to: A grant from the Stichting Oosters Instituut, Leiden (supporting the lab analysis); The Leiden University Library; Brill's annual grant; Preußischer Kulturbesitz Grant at the Staatsbibliothek zu Berlin; Project for safeguarding manuscripts in Zabīd; and the Rijksdienst Cultureel Ergoed (RCE).

المصادر العربية، بما في ذلك اليمنية على وصفات لتجهيز وإعداد الأحبار، وتتم بمزج تلك المكونات المختلفة للحصول على بريق ولمعان الحبر. وفي الوقت نفسه، يكشف التحليل المختبري أن التأثير اللامع قد ينتج عن جسيمات من المعادن مثل (الميكا والرمل، وأحيانًا مع التحضير على أساس الصبغة الحمراء) المستخدمة بعد الانتهاء من الكتابة. وتستخدم هذه الجسيمات لتجفيف الحبر من ناحية وإضافة اللمعان والجمال من ناحية أخرى، ويبدو أن استخدام هذه الطريقة اقتصرت على اليمن، وهذه الدراسة تفتح الباب لمزيد من البحوث والتحقيق.

Keywords

Yemen, manuscripts, inks, *midād*, *ḥibr*, sparkling inks, *rih, altın riğ*, *altın riği*, *altın rihi*, *gold sand*, scribes/copyist, scribes and copyists practices, ink analysis, sand, blotting material, mica, Ibn Bādīs (d. 454/1062), *ʿUmdat al-kuttāb wa-ʿuddat ḏawī al-albāb*, al-Malik al-Muẓaffar Yūsuf (d. 694/1295), *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, Abū Bakr Muḥammad Zakariyā al-Rāzī (d. 313/925), *Risāla zīnat al-kitāba*, Zabīd, Leiden University Library, Staatsbibliothek zu Berlin, Bibliothèque nationale de France, Museum of Turkish and Islamic Arts, Islamic codicology and material culture, conservation

Mots-clés

Yémen, manuscrits, encres, *midād*, *ḥibr*, encres brillantes, *rih, altın riğ, altın riği*, *altın rihi*, « *gold sand* » ou « sable d'or », scribes/copistes, pratiques des scribes et copistes, analyse de l'encre, sable, matériel dessicatoire, mica, Ibn Bādīs (d. 454/1062), *ʿUmdat al-kuttāb wa-ʿuddat ḏawī al-albāb*, al-Malik al-Muẓaffar Yūsuf (d. 694/1295), *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, Abū Bakr Muḥammad Zakariyā al-Rāzī (d. 313/925), *Risāla zīnat al-kitāba*, Zabīd, Leiden University Library, Staatsbibliothek zu Berlin, Bibliothèque nationale de France, Musée d'art turc et islamique, codicologie et culture matérielle du manuscrit islamique, conservation

تعابر رئيسية

اليمن، المخطوطات، المداد، الحبر، أحبار لامعة، ريح، *altın riğ, altın riği, altın rihi*، "الرمال الذهبية"، النساخ، التذهيب، تحليل الحبر، نشّاف، ميكا، رمل، ابن باديس (ت 1062/454)، *عمدة الكتاب وعدّة ذوي الألباب*، الملك المظفر يوسف (ت 1295/694)، *كتاب المخترع في فنون من الصنع*، ابو بكر محمد زكريا الرازي (ت 925/313)، *رسالة زينة الكتابة*، زبيد، مكتبة جامعة ليدن، المكتبة الوطنية في برلين، المكتبة الوطنية الفرنسية، متحف الفنون التركية والإسلامية، كوديكولوجيا والثقافة المادّية للمخطوط الإسلامي، الحفاظ على المخطوطات

I. Introduction

In many catalogues, the material composition of manuscripts is recorded somewhat superficially. The writing substrate is often mentioned though this may not extend beyond 'paper' (or 'papyrus', or 'parchment'), and if the type of binding is noted, this may just point out that it concerns an oriental binding without any further indication of the materials used, or it may roughly sketch the covering material(s) and some decorative characteristics, rather than provide a full codicological description of structure and materials. It is possible that the calligraphic style of the copyist's hand is mentioned, however, the media with which text and illuminations were produced are often not included, although there are instances when inks are indicated as 'brown' or

'black,' and the use of different inks, like red ink for rubrication or text to be commented (*šarḥ*). No doubt this is partly due to the fact that visual examination alone is often not sufficient to identify the media. Though it is possible in some cases to state with certainty that the manuscript at hand was written with a carbon-based ink (soot ink), or an iron tannate ink (iron-gall ink and inks made with iron and tannins from other vegetal sources), more often than not the inks are not so decidedly deep black or brown that they unequivocally point to one or the other. Indeed, historically two major classes of black inks are distinguished: *midād*, the carbon inks, and *ḥibr*, tannine inks or gall inks.[2] However, writing inks could be mixtures, which necessitates additional analytical methods to establish the components. To denote the ground substance of coloured inks, even more sophisticated analytical techniques are required. It is therefore not surprising that descriptions often simply refer to colour, and refrain from adding further details. As an unintended by-effect, however, the superficial examination of the materials may cause certain specific features to go unnoticed. Or, if noticed, they may go unreported due to a lack of knowledge to understand such features fully.

An example of such a remarkable, yet understudied characteristic was found in several Yemeni manuscripts in the Leiden University Library, and then, later on, also in the Staatsbibliothek zu Berlin. The manuscripts in Leiden were studied and closely examined in 2016; while working with them in the Special Collection reading room in 2015, it appeared that the ink—or some of the inks—on some pages reflected the light in a different way than others. Careful examination revealed that the ink in places contained (traces of) glistening particles. As such sparkling ink had already been noticed in Zabīd, although in a limited number of items, and a recipe had been collected on the spot (see below, section III), the recording of these new items appeared the right action to take. [Figs. 1-2]

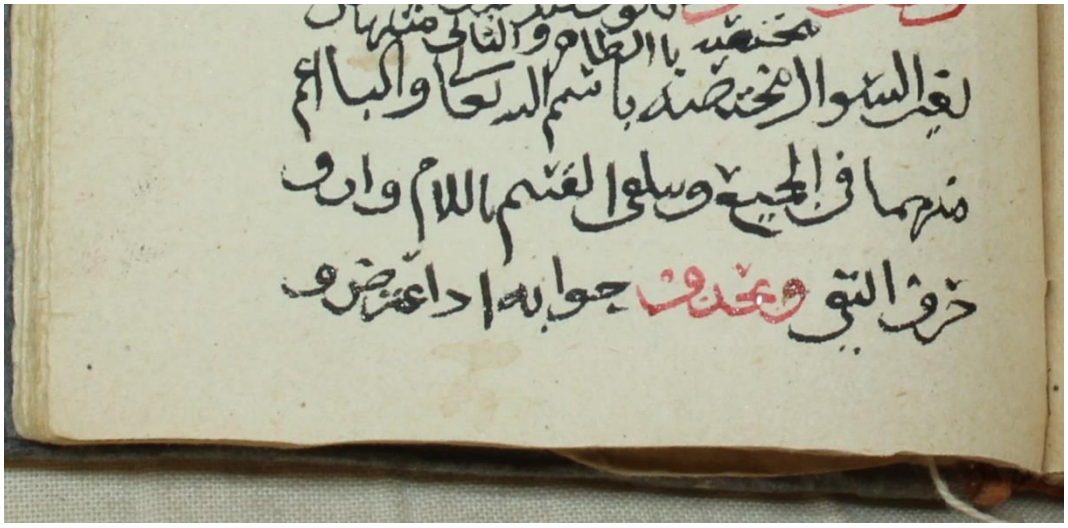

Fig. 1. UBL Or. 2722, f. 4a. Annotation with sparkling particles © Courtesy UBL.

[2] M. Zerdoun Bat Yehouda, *Les encres noires au Moyen Âge : jusqu'à 1600*, 1983, p. 124.

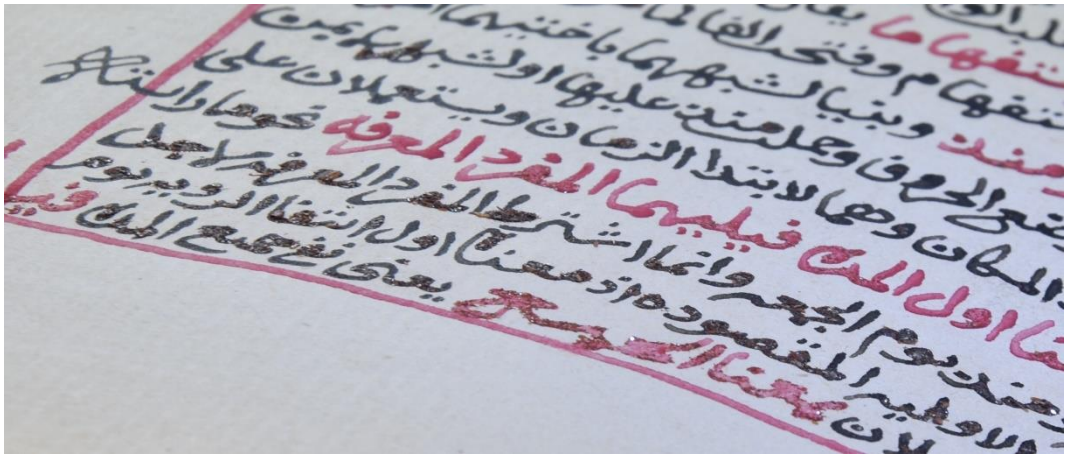

Fig. 2. UBL Or. 25.663, detail of f.109a © Courtesy UBL.

Not all glossy inks contain particles; the gloss can be caused by a high percentage gum Arabic or additives like honey or sugar. The glistening particles, however, are not part of the ink proper, but must have been added after writing. The appearance of the inks and of the particles, and the locations of the presence of these shining elements varies between one manuscript and another. The shiny particles occurred in black writing inks, and in inks of other colour, but never in all inks throughout a whole volume. In certain volumes, these particles were found only in the coloured inks and not in the black writing ink. In other manuscripts the shining particles were found in the dominant writing ink and red inks, mostly in the bottom lines of the pages, or, as in a few manuscripts, scattered over the pages. It seemed beyond doubt that these particles were applied intentionally. However, the presence of these sparkling specks could by no means be explained in a simple, unambiguous way. If they were to beautify the writing, why were they applied in these different manners? And if they had a specific, non-aesthetic function such as the drying sand, why did these particles have such lustre and why do they occur in different shapes and colours?

The purpose of this study is to address these questions above, to analyse the media and particles encountered in the manuscripts, and to examine a possible relationship between these materials and the region in which these manuscripts were made in a defined time.[3] It serves as a first attempt to include the phenomenon in Islamic codicology, and, in addition, address its consequences for the conservation of these objects.

[3] The Cultural Heritage Agency of The Netherlands (RCE) was approached for the technical analysis of the inks and particles, firstly because it holds a large collection of historic blotting materials for manuscript inks collected during a research project in 2005/2006. Secondly, RCE houses a large collection of historic inks and ink recipes. Birgit Reissland undertook ink and particle analysis in 2016 together with Annelies van Hoesel, apart from the red-ink-analysis, which was conducted by Art Nes Proaño Gaibor. The technical analysis resulted in a report: B. Reissland, A. van Hoesel & A. Proaño Gaibor, *Manuscripts from Yemen (1786-1937), Oriental collection of the University Library Leiden. Analysis of glittering particles and ink composition*, Project Report No. 2016-027, Cultural Heritage Agency of the Netherlands, Ministry of Onderwijs Cultuur & Wetenschap (OCW), February 2019.

II. No isolated phenomenon

Rih, altın riğ, altın riği or *altın rihi*, are all ways of referring to *gold sand*, a phenomenon known and occasionally mentioned in sources, yet never fundamentally explained and only rarely included in codicological reference books.[4] A definition was provided in the catalogue accompanying the exhibition "Imperial Ottoman Fermans", held in the Museum of Turkish and Islamic Arts in the second half of 1986:

> *Rıg*—Literally 'sand' and in modern Turkish *'Rıh'*; the sand used as a blotting agent by Ottoman calligraphers. When mixed with gold leaf and left attached to black ink after it had dried, it produced a subtle decorative effect.[5]

This definition covers only one type of use of *rıh*, as a functional blotting material, and only names gold as the lustrous component. The existence of several gold sand containers (a *rıhdan*), as a part of calligraphy sets with ink pots and other writing utensils, is also evidence of the use of the practice dusting fresh writing.[6] However, we currently do not know how common the practice of dusting without the addition of sparkling particles was, nor has the occurrence of decorative particles in the sand been seriously studied.[7] The usage of the gold dust, for decorative purposes, has so far been described only occasionally; it has been mentioned in relation to the beautifying of signatures of calligraphic quality on letters and other documents, and as a characteristic of owner marks or annotations as sometimes added to bound manuscripts. In the Leiden Oriental collections for example, a fair amount of decorated *tuğra*s can be found on letters in the Malay collection, and gold or other glistening particles were observed on annotations in several manuscripts in the Arabic collection. [Figs. 3a-c]

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[4] H. Busse, U. Heyd & P. Hardy, "Farmān": "Frequently gold dust (*altîn rīg*) was sprinkled on the writing before it had dried" [Consulted online on 12 December 2018].

[5] Osmanlı Padişah Fermanları – *Imperial Ottoman Fermans*, Exhibition catalogue Türk ve Islâm Eserleri Müzesi, Istanbul, 19 Sept. 1986–18 Jan. 1987; ed. Ayşegül Nadir, 1986, p. 172. A few examples are given, for instance the *tuğra* of the Berāt of Sultan Osman II, catalogue entry 30, and the *tuğra* of the Fermān of Sultan Murad V, catalogue entry 67.

[6] See: M. U. Derman, *Letters in Gold. Ottoman calligraphy from the Sakıp Sabancı collection, Istanbul*, 2000, pp. 10–13. Also: M. McWilliams & D. J. Roxburgh, *Traces of the Calligrapher. Islamic Calligraphy in Practice, c. 1600–1900*, 2007, p. 32. See also: E. Timuçin Tan, *A study of Kufic script in Islamic calligraphy and its relevance to Turkish graphic art using Latin fonts in the late twentieth century*, 1999, p. 181.

[7] An early recording of this practice, concerning its use in Egypt, is: A. Lucas, "The Inks of Ancient and Modern Egypt", 1922, p. 11–12. Lucas described ink in an Egyptian account book dating 1767: "[…] but where the film of ink is thin, the colour is grey with sometimes a slight suggestion of brown. The ink of the notes and of many of the totals is brown, but this brown is largely, though not entirely, due to the fact that the ink lines are partly covered with scales of a brown glittering material which, under the microscope, are suggestive of mica, and which are almost certainly the remains of the powder 'used to dry the ink." Two Turkish sources on the usage of *rıh* are mentioned in: N. Baydar, "Structural features and conservation problems of Turkish manuscripts and suggestions for solutions", 2002, p. 6. "According to written sources, different types of sand were poured over the fresh ink on the paper in order to accelerate drying. Although the chemical nature of these sands has not been determined, the most useful ones were obtained from the mountains of Manisa in Anatolia. The sand, originally red, turned yellow when it was baked and then could be dyed in different colours. Some sands were dyed black, violet, pink or blue, or gilding was added to a special kind of fine sand."


كتاب عنوان العبر وديوان المبتدا والخبر
تأليف الشيخ الامام العالم العلامة العمدة
أبو زيد عبد الرحمن ويلقب ولي الدين بن خلدون
غفر الله له ولجميع المسلمين
امين

Fig. 3a

Fig. 3b

Fig. 3c.

Figs. 3a-c. UBL Or. 48 (Ottoman manuscript),
autograph of Taqī al-Dīn Muḥammad b. Maʿrūf al-Šāmī al- Asadī (1526–1585).
Particles in annotation f. 1a © Courtesy UBL.

In manuscripts production and archival records in the West, we know of the use of *pounce* (a material originally prepared to improve the adherence of ink to parchment, made from ground dried cuttlefish bone), drying sand or blotting paper.[8] Historic *pounce* pots and sanders are also witnesses of such use. Other materials than sand to speed-up the drying time of writing inks were used as well. Based on sources and matter found on historic manuscripts, six groups were defined: sand, glass, bio-minerals (ivory, bone), metals, minerals, and organic material like seeds and fibres.[9] A recent study of a large number of manuscript materials from Southwest Germany and northern Switzerland also demonstrates the use of several types of sand and other minerals, artificial components such as crushed glass, and biogenic components, such as ground shells and bones.[10]

The application of a fine matter on freshly written ink thus appears to be a relatively common and widespread practice, and the phenomenon is certainly not confined to Yemen. However, from visual inspection alone it can be stated that the particles found in the Leiden Yemeni manuscripts seem to point at different functions; they differ from the specimen with glistening specks in the ink from the Ottoman world or Malaysia, and they are not solely used as blotting sand as in west manuscript practices. In the Yemeni manuscripts, the *rıh* has also been used to beautify the opening pages and colophon, but furthermore we find the particles in other parts of these bound volumes. In contrast to what has been observed and recorded so far, it is remarkable that the glistening particles are found quite consistently throughout some of the manuscripts, in the lower regions of text areas, or in coloured inks, so as to highlight specific phrases, annotations and decorative elements. When used in longer passages of texts, the *rıh* appears to be combined with or used as drying sand. It is then most prominently found on the bottom lines of pages, notably on the left hand page which surely indicates its function was to speed up the drying process of the ink so that the scribe/copyist could turn the page and continue his work. [Figs. 4-6] It is also noteworthy that the variety of particles seems rather large; differences can be seen in particle size, shape, colour, and lustre.

[8] See for a pioneering study: C. A. Mitchell & T. J. Ward, "Sediments in Ink and in Writing", 1932, particularly pp. 765–766.

[9] B. Reissland et al., "Blotting Sand on Writing Inks – An Underestimated Source of Information", 2006.

[10] R. Milke, "Geomaterials in the manuscript archive: the composition of writing sands and the regional distribution of writing-sand types in SW-Germany and northern Switzerland, 14th to 19th century", 2012.

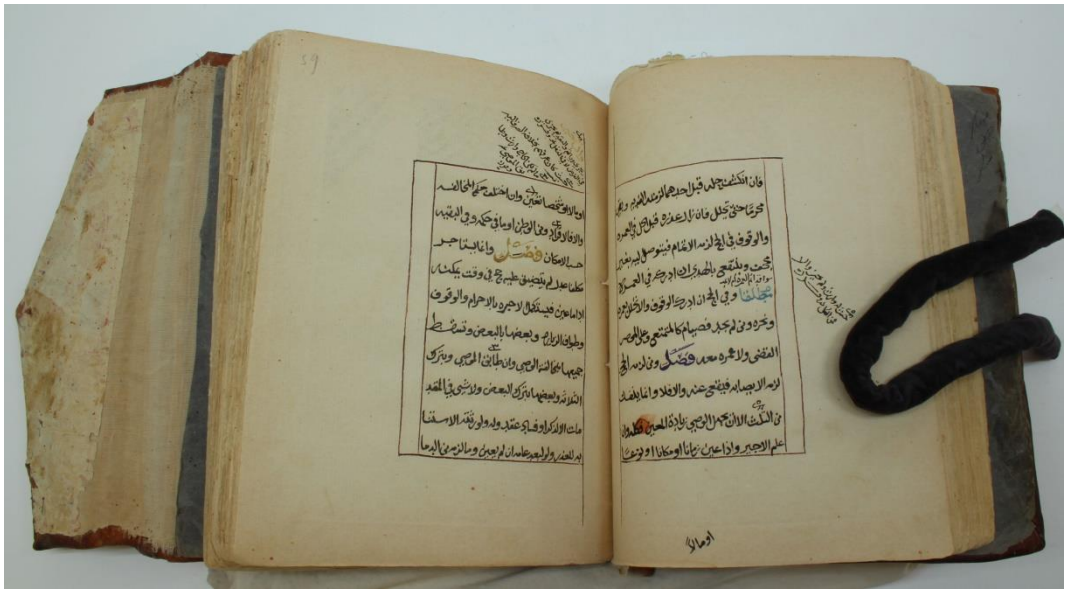

Fig. 4. UBL Or. 25.745, f. 59a. Particles scattered over the text area © Courtesy UBL.

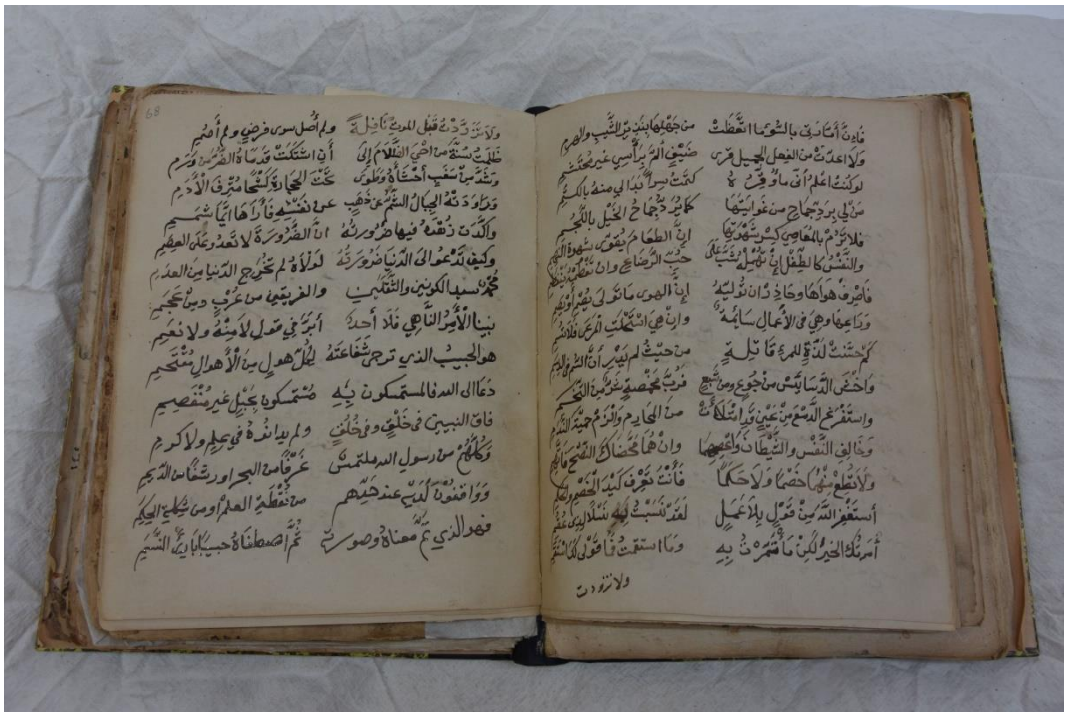

Fig. 5. UBL Or. 6333, f. 68a. Particles in the bottom lines of the page © Courtesy UBL.

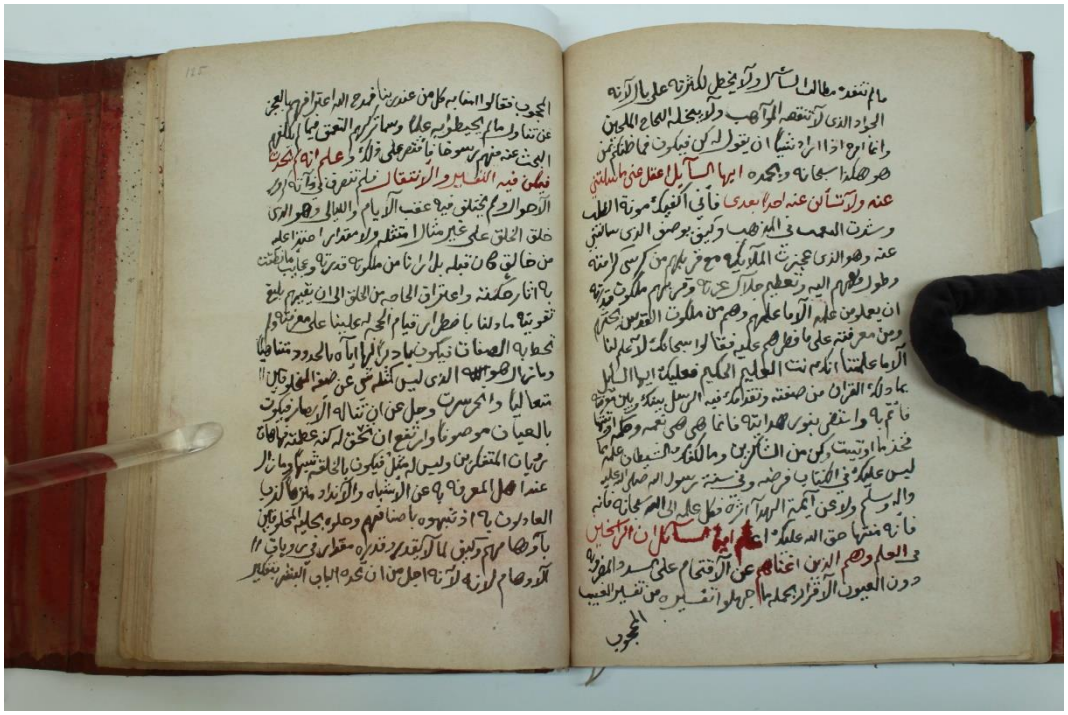

Fig. 6. UBL Or. 6353a, f.125a. Particles with a coloured coating, in lower lines © Courtesy UBL.

It is this diverging use of the application of *rıh* (from other manuscript producing regions) that first prompted us to study these particular manuscripts in Yemen. Nevertheless, it should be stressed that although the use of *rıh* in Islamic manuscripts in the Ottoman world and Malay is known, there is no in-depth study of its usage nor is it often mentioned, not even casually, when manuscripts are discussed. Since the characteristics of these elements and their manifestation carry potential information about the historical context of the manuscript, more attention should be payed to this phenomenon. Therefore, this study serves two purposes. It does address the use of the sparkling particles as a specific phenomenon in their occurrence in the Yemeni manuscript tradition, but it is also a first attempt to describe the various possible uses of *rıh* and its functions in the Islamic world in general, and the components it consists of, through analysis of the materials.

III. Yemeni ink recipes

To date, little lab analysis has been conducted on inks of manuscripts in Yemen. An analysis of dense tannic inks using micro-Raman, attenuated total reflectance Fourier transform infrared, and X-ray fluorescence was conducted by an Italian team on six fragments of early manuscripts, three on paper, three on parchment, estimated from the 7th-8th century AD, that had been found while restorers were working on the ceilings of the Great Mosque of Sanaa in early 2007.[11] The purpose of the analysis was to

[11] M. Bicchieri et al., "Non-destructive spectroscopic investigation on historic Yemenite scriptorial fragments: evidence of different degradation and recipes for iron tannic inks", 2013.

identify local plants used as ingredients for the production of tannins, but it failed to confirm their presence or absence.

The sparkling ink was first noticed in 2001 in manuscripts from Zabīd on the coastal plain of the Tihāma along the Red Sea. An example is Zabīd manuscript m/ḥ 7/16, colophon dated 1345/1926–1927; it is written on one of the papers produced by the Italian "Cartiera de Mori Vittorio", and has black sparkling ink. This special black ink was used to enhance writings with red ink for the purpose of rubrication.[12]

Once examined with a naked eye, the glistening effect of the ink seemed to be produced by particles of mica. According to our informant, a lady who attended the preparation of recipes more than once, and from whom the recipe of black soot ink was collected in the city, the sparkling effect is produced by the addition of *kuḥl* at the end of the preparation of carbon ink. The recipe is as follows:

> One has first to scratch soot from kitchen walls with the help of a knife and collect it in a container (*inā'*). Then he adds Arabic gum (*ṣamġ*) and put all ingredients together on fire. When it is cooked out, wait until the preparation becomes cold, then pour it in a glass container (*qarūra*). Then close the container with cotton. Additions can be dye and *kuḥl*.[13]

A relevant source for our study is chapter 2, "Fī ʿamal aġnās al-midād wa-ʿamal al-aḥbār wa-al-aḥbār al-mulawwana" [On the use of various kinds of black inks (*midād*, *aḥbār*) and the use of coloured inks], of the book *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ* attributed to the Rasūlid ruler in Yemen al-Malik al-Muẓaffar Yūsuf (d. 694/1295).[14] It is well-known that the books attributed to him are compilations of previous works, but they also provide new information, collected with the help of subordinates and collaborators or as additions from himself as an accurate observer.[15] In

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[12] A. Regourd (dir.), *Catalogue cumulé des bibliothèques de manuscrits de Zabid.* I. *Bibliothèque ʿAbd al-Rahman al-Hadhrami*, fasc. 1, 2006, description of inks, p. 73. For the paper "Cartiera de Mori Vittorio", A. Regourd, *Catalogue cumulé des bibliothèques de manuscrits de Zabid.* I. *Bibliothèque ʿAbd al-Rahman al-Hadhrami*. Fasc. 1, *Les papiers filigranés*, 2008, pp. 16–17, pictures nos. 050–055.

[13] A. Regourd, "Les manuscrits des bibliothèques privées de Zabîd : enjeu d'un catalogage", 2002, p. 249. *Kuḥl* is best known in all the Islamic world as eyes cosmetic and medicine (collyre), both virtues being accomplished in one use. As cosmetic, it is often a mixture of various materials finely ground together: as basic substances, we find Sb and Sb_2S_3, PbS, but also ersatz mainly derived from PB, to which sparkling ingredients are added.

[14] Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989. See ʿA. A. M. al-Ḥibšī, *Muʾallafāt ḥukkām al-Yaman*, 1979, pp. 54–56. For a historiographical discussion about the authorship of the book, see the introduction by Muḥammad ʿĪsā Ṣalḥiyya, the editor of Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, pp. 9*sq*., especially 15–16. For general considerations on the composition of works under Rasūlid auspices, see the central discussion about the "Arabic-Ethiopic Glossary", sponsored by the Yemenite Sultan of the Rasūlid dynasty, al-Malik al-Afḍal al-ʿAbbās b. ʿAlī (r. 764–776/1363–1377), the methods of its compilation, and the nature of the communication between the compiler(s) and the informants, in: M. Bulakh, "Al-Malik al-Afḍal's 14th-century 'Arabic-Ethiopic Glossary' as an Attempt at Language Documentation", 2017–2018.

[15] See the studies by A. Gacek, "Instructions on the art of bookbinding attributed to the Rasulid ruler of Yemen al-Malik al-Muẓaffar", 1997; "On the making of local paper. A thirteen century Yemeni recipe", 2002. As for al-Malik al-Muẓaffar Yūsuf works, see the introduction of *Al-muʿtamad fī al-adwiya al-mufrada*, ed. Muṣṭafā al-Saqā, ca. 1370/1951.

his *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, he mentions on several occasions the name of al-Muʿizz Ibn Bādīs (d. 454/1062), sometimes simply as "the ruler of al-Mahdiyya". A close comparison of the 24 recipes in this chapter 2 of *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, with Ibn Bādīs *ʿUmdat al-kuttāb wa-ʿuddat ḏawī al-albāb*, shows 18 corresponding occurrences.[16] The 6 recipes which were not borrowed from Ibn Bādīs are entries: 6, 11, 14, 15, 16, and 22. The recipes are subdivided into three sections. The first is devoted to black inks called "al-midād", which are followed by an ethnic (*nisba*), thus relating them to a place (*kūfī*; *fārisī*; *ʿirāqī*; *miṣrī*, and one ink is said to be "li-al-mulūk", i. e. for the kings) (the first 6 recipes, pp. 67–71). The second is on "al-aḥbār al sūd", i. e. black inks, which are characterised according to a type of use, for instance inks one needs to use immediately, and on the contrary, dried inks one need to use while travelling, inks for copying *qurʾān*s (*maṣāḥif*) etc.; at the end of this section, two recipes of combined inks (*ḥibr murakkab*) are given (10 recipes, entries 7 to 16, pp. 71–75). The third section concerns "al-aḥbār al-mulawwana", i. e. coloured inks (the last 8 recipes, pp. 75–78).[17] The 6 recipes which probably do not derive from Ibn Bādīs are scattered though the text: at the end of section one, in the middle and at the end of section two, and in section three. Most of these 6 recipes are far longer in number of lines than the recipes imported from Ibn Bādīs. One of them is said to be the most common recipe, but no details are given (entry no. 11, pp. 72–73, "Ṣifat ḥibr muǧarrab wa-huwa allaḏī yaʿmaluhu āmmat al-nās"). Entry no. 6 is said to be an Egyptian recipe: "Ṣifat midād miṣrī wa-huwa allaḏī yaʿmal fī al-waqt", it uses a Yemeni term, "salīṭ", for sesame oil, as noticed by the editor of *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*.[18]

For our purpose, the short fourth chapter on writing with gold, and silver in *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ* is very important. Two of the Rasūlid's 6 recipes which use gold are not from Ibn Bādīs, nor are 2 of the 4 recipes using silver.[19]

When we question the relationship between Ibn Bādīs and the *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, a recent study by Lutfalla Gari provides some answers. He built and explored a corpus of texts in Arabic about the removal of spots of all sorts, a subject somehow connected to the production of inks and colours, and to the idea of "beauty" in book production. Chapter 5 of the *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ* was among them, and L. Gari pointed out that, if Ibn Bādīs was indeed a main source for this chapter of the Rasūlid, the latter shared also recipes with the *Risāla zīnat al-kitāba* by Abū Bakr Muḥammad Zakariyā al-Rāzī (d. 313/925) and could have accessed them through another channel than that of Ibn Bādīs. According to the study conducted by

[16] Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, pp. 67–78. The current study is based on the printed ed. from Koweit, which is itself based on the three manuscripts known to date: Cairo, Dār al-kutub, dated 727/1327; Hyderabad, dated 876/1471, see below note 30; and Milano, Ambrosiana, dated 1184/1770, which are all anonymus.

[17] For the three subdivisions of chapter 2, see A. Gacek, *The Arabic Manuscript Tradition. A Glossary of Technical Terms & Bibliography*, 2001, entry "m.d./m.ṭ," p. 133, then entry "ḥ.b.r", p. 27.

[18] Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, p. 70, n. 1; 'salīṭ tartar', in central Tihāma, a region ruled by the Rasūlids, is for mustard oil. See M. Piamenta, *Dictionary of Post-Classical Yemeni Arabic*, part 1, 1990, p. 229a, and the related bibliography.

[19] Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, chapter 4, pp. 89–92.

L. Gari, *Kitāb al-muḫtār fī kašf al-asrār* composed by ʿAbd al-Raḥīm al-Ǧawbarī in 633/1234 appears to be an intermediary source between al-Rāzī and Ibn Bādīs on the one hand and al-Malik al-Muẓaffar Yūsuf on the other.[20]

The potential presence of Yemeni recipes in the Rasūlid book is supported by the work of Adam Gacek. In the course of his research of original accounts in Arabic sources, A. Gacek describes a recipe for papermaking from *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ* as the second oldest source of paper manufacture in the Arabic language, the first one being contained in the work of Ibn Bādīs. In other words, the recipe provided by the Rasūlid is a distinct one. Moreover, A. Gacek concludes that the recipe was really in use at the time of the Rasūlid. He stresses that in the preface, "the author ordered each craftsman to express himself in his own words, a policy which may explain the different styles of writing found in the text". Thus, he keeps *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ* away from a conventional court exercise, like a compendium of recipes, but also gives us an insight on Yemeni book manufacture.[21] It is however far beyond this contribution to dig more into Arabic sources, and examine whether the 6 recipes of the *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ,* which are not derived from Ibn Bādīs, are original Yemeni recipes, or whether they were taken from other sources, and, therefore, could have only a literary value.

Regarding the scope of our article, ingredients of high interest found in the Rasūlid source includes glass (no. 20, p. 77) and brass (no. 18, p. 76; no. 20, p. 77), but no mica. One recipe refers to dust and wind (*al-ġubār wa-al-riyāḥ*) however, to produce dry inks that can be carried when travelling.[22]

IV. Occurrences of sparkling inks in the Leiden and Berlin collections

The manuscripts under study in Leiden were initially selected in the frame of a research on papers of Yemeni manuscripts, focusing on 'Abū Šubbāk' papers. These papers were used in Yemen during a limited and clear-cut period, that of the first half of

[20] Lutfallah Gari, "Mu'allafāt qalʿ al-āṯār fī al-turāṯ al-ʿarabī" [Arabic treatises about spot removal (3rd–11th/9th–17th centuries)], 2015, pp. 112–111 [in Arabic], who relied on various editions of the sources he collected for the purpose of his research; see *CmY* 20 (July 2014), <Actualités>, 2015, pp. 14–15.

[21] A. Gacek, "On the making of local paper. A thirteen century Yemeni recipe", 2002. Quotation is from p. 80; see also the introduction to Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, by the editor Muḥammad ʿĪsā Ṣalḥiyya, p. 17. Gacek based his study on the manuscript, anonymous, Hyderabad (India), al-Ḫizāna al-Āṣafiya, dated 876/1471, which contains the recipe, and that he leans to consider as the closest to the original. When it comes to this recipe, the manuscript of Hyderabad is a unicum.

[22] Al-Malik al-Muẓaffar Yūsuf, *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, entry 10, "Ṣifat ḥibr yābis li-al-safar", p. 72. In chapter 4, p. 91, in a recipe using gold, *ġubār* and *riyāḥ* have the same meaning of dust and wind. The word *kuḥl* appears twice, but it is used as an analogy for an ingredient which should be ground very finely, pp. 72, and 92.

the 20th century.[23] Therefore, manuscripts were selected when they dated to the 19th or 20th century, according to their colophons, with some exceptions.[24]

Our sparkling inks appeared in the following Leiden manuscripts from this selection. It is worth saying that given the focus of the initial research in Leiden, it is well-possible that other relevant items are present but were not included in the study.

Table 1. Leiden University Manuscripts with the studied inks.

	Leiden Manuscripts shelfmarks	Dates collected in or from the ms.	Locations of the ink in the ms.	Type of ink (identified by visual analysis, most additionally by technical analysis
1	Or. 2722	Ownership marks 1211/1796–1797; 1212/1797–1798	Annotation f. 4a (with the date 1212, so in this case the particles are dated)	Carbon
2	Or. 6330	- 10 Muḥarram 1346/10 July 1927 - Paper Abū Šubbāk A1	Glossy ink here and there, but no particles in it	Iron-tannate ink
3	Or. 6333 5b, ff. 59v–63v	- Copies of letters addressed to Muḥammad ʿAlī Bāšā, Governor of the Yemen, dated 12 Ramaḍān 1287 (f. 62r), 13 Ramaḍān 1287 (f. 61v), 12 Ramaḍān 1287 (ff. 62v, 63r) (Ramaḍān 1287/Nov–Dec. 1870) - 1 bif. on two is written on a paper "LESCHALLAS 1878"[25]	The particles in this text are found in the lower text lines mostly	Iron-tannate ink
4	Or. 6333 5c, ff. 64r–65r	- Not earlier than 1286/1869–1870 - Paper "LESCHALLAS 1878/ PRO BONO PUBLICO"	The particles in this text are found in the lower text lines mostly	Iron-tannate ink

[23] A. Regourd, "Manuscrits de la mer Rouge (première moitié du xx^{e} siècle) : papiers Abū Šubbāk du Yémen et d'Éthiopie", 2018, specifically pp. 92–98.

[24] The oriental collections of Leiden contain approximately 170 manuscripts from Yemen; needless to say not all of them dated.

[25] For the papers watermarked "LESCHALLAS 1878/PRO BONO PUBLICO", see F. Briquel-Chatonnet, A. Desreumaux & J. Thekeparampil, *Catalogue des manuscrits syriaques de la collection du Saint Ephrem ecumenical research Institute* (*Kottayam*), 1997, p. 393, in a 19th century manuscript.

	Leiden Manuscripts shelfmarks	Dates collected in or from the ms.	Locations of the ink in the ms.	Type of ink (identified by visual analysis, most additionally by technical analysis
5	Or. 6333 10, ff. 127r–161v	A different "LESCHALLAS" paper	Different type of particles, flat and silver-blackish, strewn over the whole page	Iron-tannate ink
6	Or. 6353A, vol. 1	- 1342/1923–1924 - Paper Abū Šubbāk A2	*Matn*: 59v, 70r, 72r+v, 79v, 80r, 86r, 94r, 101r, 112r, 113r, 125r, 128v margin: 5r, 44v The bottom lines contain the particles	Black ink, but with reddish hue, caused by the particles which appear to be coloured.
7	Or. 6362, vol. 1, ff. 5–70	- Ownership mark, 27 Muḥarram 134?9 (third digit not clear)/24 June 1930 - Paper Abū Šubbāk A2	F. 5, ownership mark in fore-edge margin	Probably iron-tannate ink combined with a carbon ink
8	Or. 6362, vol. 4, ff. 106–107	*Qaṣīda*, dated 1249/1833–1834	Title page & *basmala*	Carbon ink, no glistening particles (but perhaps a lot of gum or additives?)
9	Or. 6643, vol. 1, ff. 1–25	- 13 Ǧumādā awwal 1348/17 October 1929 - Paper Abū Šubbāk A2	F. 6v, the bottom lines have particles in the ink on many pages	Black ink (soot or other), red and green. The green contains particles as well
10	Or. 23.448	- Thursday *qabl al-ẓuhr* 5 Ṣafar 1351/10 June 1932 - Paper Abū Šubbāk A1, A2	Along all the *matn*, most often the last 2 l. of the recto of each f.); in margins as well; around the colophon; both black and coloured inks. Remains of a mixture of ink and dusts in fold-lines	Iron-tannate ink combined with a carbon ink

	Leiden Manuscripts shelfmarks	Dates collected in or from the ms.	Locations of the ink in the ms.	Type of ink (identified by visual analysis, most additionally by technical analysis
11	Or. 25.662	- 24 Rağab 1338/13 April 1920 - Paper Abū Šubbāk A2; paper Andrea Galvani Pordenone		Probably irontannate ink combined with a carbon ink
12	Or. 25.663	- *Mağmūʿ*, 'b' undated - Paper Abū Šubbāk A1		Probably carbon ink
13	Or. 25.744	- *Mağmūʿ*, ms. 3, f. 143a, Copying begun in Rabīʿ II 1356, completion dated on a Sunday in Rağab 1356, - Title-page a reader's mark dated 1356 - Paper Abū Šubbāk C		Probably carbon ink
14	Or. 25.745	- 28 Ǧumādā II 1355/15 Sept. 1936 - Paper Abū Šubbāk A2		Iron-tannate ink combined with a carbon ink

A complementary research done in 2016 on the Glaser collection in the Staatsbibliothek zu Berlin, again for the purpose of paper studies, revealed some more manuscripts with sparkling ink.[26] The interest of this second excursus is more than cumulative. Eduard Glaser (1855–1908) visited Yemen between 1882 and 1894, and sold the manuscripts collected during his first and second journeys to the Königliche Bibliothek zu Berlin (now Staatsbibliothek zu Berlin). As a consequence, the age of the manuscripts he collected have a *terminus ad quem*. Moreover, E. Glaser brought back with him old items: the oldest manuscript of the collection preserved in Berlin is dated 544/1149, as expressed in its colophon. Many instances of sparkling inks were found in Berlin manuscripts.

[26] W. Ahlwardt, *Kurzes Verzeichniss der Glaser'schen Sammlung arabischer Handschriften*, 1887. And online catalogue, http://orient-digital.staatsbibliothek-berlin.de/content/index.xm

Fig. 7. Glaser 39/Ahlwardt 8761. Black and red sparkling inks
© Staatsbibliothek zu Berlin – PK, Orientabteilung.

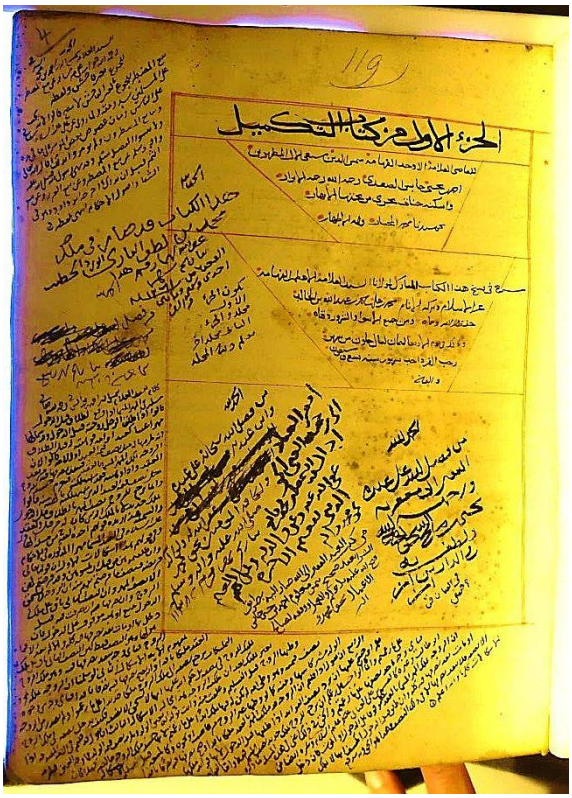

Fig. 8. Glaser 119/Ahlwardt 8761. Title page
© Staatsbibliothek zu Berlin – PK, Orientabteilung.

Fig. 9. Glaser 119/Ahlwardt 8761.
Title page, focus on a marginal note dated Muḥarram 1138/Sept.–Oct 1725
© Staatsbibliothek zu Berlin – PK, Orientabteilung.

As we can see from the excursus into the Yemeni collections of Leiden and Berlin, the presence of sparkling ink is well witnessed in Yemen, not only in Tihāma, but in the highlands too, as early as the first quarter of the 18th century (Glaser 119/Ahlward 4927). Other Glaser manuscripts which could be earlier instances of the phenomenon, deserve further study.

V. Survey of recipes in the literature

As part of the methodology, in order to better understand the observations with the naked eye and to give direction to the technical analysis, historical sources with ink recipes as described in the Islamic world were studied.[27] A subdivision was made according to the black writing inks encountered in the manuscripts (that is, carbon inks, iron-tannate inks, combined carbon-based/iron-tannate inks, and blackish inks of other colouring substances, so-called 'incomplete inks'), and the inks of different colour.[28] This was further specified for those recipes that include additives for colouring or sparkling quality. Although these recipes do not necessarily describe the inks used

[27] Sources consulted are: Ibn Bādīs (d. 404/1062), *ʿUmdat al-kuttāb wa-ʿuddat ḏawī al-albāb*, in: M. Levey, *Mediaeval Arabic Bookmaking and Its Relation to Early Chemistry and Pharmacology* 1962, pp. 6–50; al-Malik al-Muẓaffar Yūsuf (d. 694/1295), *Kitāb al-muḫtarʿ fī funūn min al-ṣunʿ*, 1989, chap. 2, pp. 67–77; C. Huart, *Les calligraphes et les miniaturistes de l'Orient musulman*, 1908; V. Minorsky, *Calligraphers and Painters. A treatise by Qāḍī Aḥmad, son of Mīr-Munshī*, 1959; M. Zerdoun Bat Yehouda, *Les encres noires au Moyen Âge*, 1983; S. Zekrgoo, "Methods of creating, testing and identifying traditional black Persian Inks", 2014, pp. 133–158.

[28] This system corresponds with M. Zerdoun Bat Yehouda's classification system in her study of 80 historic recipes for black inks, see footnote above.

in the manuscripts from Yemen, they give a good indication of the various ingredients and production methods.

The binder or dispersant mentioned for the four black ink types include gum arabic, gum of scammony and egg white. As possible colorants, lapis-lazuli and cinnabar, lac dye, henna, alkanet, azurite and woad are mentioned. Most recipes include a preservative as well and as such, salt is noted. Tannin sources listed for iron-tannate inks include gall nuts (sometimes specified as gall nuts from acacia of terebinth trees), tamarisk gall, pomegranate rind, myrtle, walnut peel and sumach. The leaves of myrtle, pomegranate rind, gall nuts and walnut peel are also included as ingredients for the combined carbon-based/iron-tannate inks. The iron sources can be vitriol with names pointing to various geographic origin such as Cypriote-, Egyptian- or Iraqi vitriol, or hinting at colour differences, such as green-, yellow or blue vitriol. Iron fillings and oxidised iron materials are also listed. The substances mentioned as components for a lustrous effect are gold for the carbon-based inks, scrapings of gold or glass for the iron-tannate inks, and gold, silver, copper and brass for the combined inks.

The fourth group of black writing inks, the incomplete inks, do neither contain a carboneous material, nor a combination of iron- and tannine compounds. Most of the incomplete inks lack iron. Their colouring matter is an extract of a tannin containing plant, usually of gall nuts. Ibn Bādīs mentions one recipe with vitriol but without tannin.[29] Zekrgoo provides one 16th-century ink recipe using aloe starch and vitriol; here, the tannin containing plant part is missing.[30] A recipe by Ibn Muqla (10th century) refers to black from petroleum (Bitumen?) as colourant.[31] In how far these inks are indeed of a black colour is questionable.

The making of decorative ink for Arabic manuscripts is well-documented in historic sources. Ibn Bādīs included 9 recipes in which ingredients for a lustrous effect or sparkling particles are added to coloured inks, and 4 to embellish black inks. The preferred mineral appears to be mica (7 recipes), then gold (3 recipes), marcasite (2 recipes) and glass particles (1 recipe). Zerdoun Bat Yehouda's text offers one further recipe, describing the use of pestled glass which is added during ink making.[32] In fact, *all* recipes mention the addition of the particles during ink making, before the ink is actually applied to the writing substrate. Then, in order not to disturb an even application and fluidity of writing, it would seem that the particles require thorough grinding, to become a constituent of the ink. Would the sparkling quality not be affected by such processing or allowed the use of a reed pen (*qalam*) somewhat coarser particles in the ink? These questions necessitate the reconstruction of some of the ink recipes. Ultimately, these recipes provide important and interesting information, however, they do not relate directly to the phenomenon we observed in the manuscript under study. As far as we have been able to establish, the practice of scattering decorative

[29] Ibn Bādīs, *Umdat al-kuttāb wa-ʿuddat ḏawī al-albāb*, in: M. Levey, *Mediaeval Arabic Bookmaking*, 1962, p. 24.

[30] S. Zekrgoo, "Methods of creating, testing and identifying traditional black Persian Inks", 2014, p. 144.

[31] M. Zerdoun Bat Yehouda, *Les encres noires au Moyen Âge*, 1983, p. 125.

[32] M. Zerdoun Bat Yehouda, *Les encres noires au Moyen Âge*, 1983, pp. 122–123.

particles in the ink after writing, possibly with the additional function of blotting purposes, is not mentioned in the historic sources.

VI. Analytical procedure

Our study of the glistening particles started with the close examination of the inks with the naked eye and under magnification. Between the manuscripts, the appearance of the inks, and the particles in them, is not uniform at all. [Figs. 10-11] The different appearances can be grouped in several ways. A distinctive division can be made between the occurrence of sparingly applied flakes, often gold-coloured specks, in specific locations, such as in coloured inks or individual words only, and the presence of clusters of particles in several lines of the text. Sometimes, these particles sit in a thick layer of the ink and can be felt easily with the tip of the fingers, whereas in other cases the flecks are thin and level with the ink and writing substrate. The concentration of particles and their size does not seem to be related to the location of their application. The thicker layers and clusters can be found both in confined locations such as individual words in a specific ink colour (suggesting a decorative function), and in the lower lines of text on a page (indicating a blotting function). The same is true for the thinly strewn particles, which were sometimes applied to single words or phrases but were scattered across pages in other instances.

Fig. 10. UBL Or. 6333, f. 127a. Thin spread of dark metal platy flakes © Courtesy UBL.

Fig. 11. UBL Or. 25.745, f. 59a. Generous spread of mica particles © Courtesy UBL.

The particles are applied as a last layer in the still wet ink, or after an additional thin layer of tacky agent was applied on the inks' surface. We examined the particles in situ; the stratification of the mediums required us therefore to test the composition of the individual components: the black inks, the coloured inks, the paper (see the results in the annex). The selected folios were examined macroscopically and microscopically, as well as under raking light.[33] A handheld digital microscope (USB, Dino-Lite 2.0) and a stereo microscope (reflected illumination) were used. The X-ray fluorescence (XRF) was performed using a Bruker handheld tracer IV SD XRF equipped with a Rh target, operated at 40kV and 10mA, and an SDD detector. This would provide data on all the materials that could be found in the cross-section on a given spot, as the XRF radiation penetrates and measures the entire paper/ink/particle composition; the XRF does not differentiate between the separate strata. As a result, individual analysis of the paper substrate, and the black ink, the red ink or whatever other colour was used, was required. Due to the setup of the machine and the low thickness of the measured ink and paper all spectra show (small) peaks corresponding to Fe, Cu, Ni and Rh. All measurements of the ink were taken of single pages, at locations with no (other) ink on the back. For reference, the paper itself was analysed as well. All XRF spectra of the ink have been corrected by subtracting the XRF spectrum of the paper.

[33] The visual, optical assessment of ink layers is important for a first indication of the ink class. Attention was given to the ink colour, the density and the morphology of ink lines. Of additional importance is the colour of areas where the density of the ink is low (in smudged ink areas for example, or word endings, and areas where particles had gone missing), and the occurrence of halos around ink, which is indicative for specific ink types.

By deducting the materials found for the inks and paper substrate for the total information found, in a spot where *rıh* was applied, it was possible to reduce the material information and shed light on the substance of the *rıh.* Finally, the red inks from 4 manuscripts were identified with High-performance liquid chromatography (HPLC). As the reds provided little information through the XRF analysis because of their organic nature, these further tests, however limited in scope, provided welcome further information.[34]

Not all manuscripts with glistening particles were included in the technical study and analysis. The laboratory examination is time consuming and costly, and with limited resources we had to make a selection. As criteria, we chose different colours of ink and different types of particles, thus hoping to at least identify a wide palette of materials used, even though this approach would limit the possibility to establish relationships between groups of ink or particles, and origin of the manuscripts. We also chose to include an equal number of manuscripts with locally used particles, apparently for aesthetic reasons, and manuscripts with the debris of particles in the bottom lines of the text, suggesting a practical use resembling drying sand.

Table 2. Manuscripts selected for technical analysis

No.	Leiden Inv. No.	Microscopy	XRF	SEM-EDX	HPLC
1	Or. 2722	x	x		
2	Or. 6330	x	x		
3	Or. 6333	x	x	x	
4	Or. 6353a	x	x	x	x
5	Or. 23.448	x	x	x	x
6	Or. 25.744	x	x	x	x
7	Or. 25.745	x	x		x
8	Or. 6362	x			
9	Or. 6643	x			
10	Or. 25.662	x			
11	Or. 25663b	x			

[34] Four ink samples were taken from 20th-century red inks present in the manuscripts Or. 6353a/f. 125a, Or. 23.448/f. 155b, Or. 25.744/f. 143a, Or. 25.745/f. 52b. The samples were taken by Art Ness Proaño, using a new technique developed by the RCE, using a pointed, fine grained, inert magnesium-oxide rod to pick up particles from the ink surface; this micro-destructive sampling technique is called Magnesium-Oxide-Micro-Swabbing (MOMS). These samples are then examined with Raman and high-performance liquid chromatography (HPLC). See B. Reissland, A. van Hoesel & A. Proaño Gaibor, *Manuscripts from Yemen (1786-1937), Oriental collection of the University Library Leiden. Analysis of glittering particles and ink composition*, February 2019.

VII. Identification of the inks and particles

The results of the black writing inks analysis show that carbon-based inks were used, as well as iron-tannate inks, and a combination of the two. The red ink in the oldest manuscript examined contained lead and therefore is most probably made of red lead [Fig. 12]. The other red inks are probably of organic origin. Whether these reds were made of a natural dye or a synthetic dye has not been determined for all specimen, though those that were analysed show that both natural sources and synthetic dyes were available.[35] The analysis of the blue and the purple inks remains inconclusive as well, yet they must consist of a synthetic dye as no pigments were found. The golden glow around the edges of some of the purplish-blue inks, a so-called 'bronzing' effect, is caused by an excess of dye. [Fig. 13] The yellow inks in Or. 25.745 contain arsenic and therefore point to the use of orpiment; it is interesting that this poisonous pigment was still in use in 1936.

Fig. 12. UBL Or. 2722, f. 4. Red ink containing lead and flake of gold © Courtesy UBL.

[35] For red ink made from natural sources, scale insects were found as a source, most likely cochineal, and a flavonoid containing plant source. Two synthetic dyes were identified, cochineal red A (colour index name Acid Red 18) and Congo red. See RCE report, p. 21.

Fig. 13. UBL Or. 23.448. Deep blue-purplish synthetic ink with a golden glow © Courtesy UBL.

The majority of the particles examined within the Yemeni manuscripts have a flat, platy shape. They appear glossy when viewed under a certain angle. The particles are translucent, have a layered sheet structure, and their colour varies between colourless to a light brown. [Figs. 14-16] They were identified as mica, a sheet silicate. A combination of red pigment with sand or mica was also found. It concerns mixtures of red iron-oxide powder with mica [Fig. 17] and of red iron-oxide powder with quartz sand. [Fig. 18] The purpose and origin of this practice remains currently undetermined. In one case, the glistening flakes appeared to be iron-metal particles; these can well have been waste materials of iron-processing crafts.

Fig. 14. UBL Or. 25.662, f. 142b. Diversity in appearances of mica particles © Courtesy UBL.

Fig. 15. UBL Or. 6362, f. 80b. Diversity in appearances of mica particles © Courtesy UBL.

Fig. 16. UBL Or. 6643, f. 37b. Diversity in appearances of mica particles © Courtesy UBL.

Fig. 17. UBL Or. 25.744, f. 143a. Black ink with particles of mica, coated with iron-oxide © Courtesy UBL.

Fig. 18. UBL Or. 6353a, f. 125a. Black ink with particles of quartz sand, coated with iron-oxide
© Courtesy UBL.

Not all particles added to the inks were glossy in appearance. Particularly the white particles, which were always found in specific parts of writing such as annotations in the margin, and not in the lower lines of the general text area, had a dull quality. The results of the analysis indicate biominerals. Comparison with reference material points to the use of crushed white egg-shells or white seashells. The chlorine content points to the use of the latter. If the material had been processed for too long, the deposit contains a white powder rather than particles. [Figs. 19a-b]

Fig. 19a. UBL Or. 6353a, f. 141a. Egg-shell or white seashell which was crushed into powder © Courtesy UBL.

Fig. 19a. UBL Or. 6333, f.120a. Egg-shell or white seashell crushed into flakes © Courtesy UBL.

VIII. Preservation issues

Although the chemical composition of these particles do not seem to cause problems to the inks or paper, their presence has implications for the condition of the manuscripts. It is clear that the attachment of the particles to the inks is not always stable. There is evidence of losses—where abrasion of the ink layer bears witness to the former presence of such particles—and in several manuscripts we found a substantial mass of particles in the spine-folds of the gatherings. This is problematic for several reasons. Firstly, as the study of this phenomenon is only starting, we need the artefacts as the primary sources for examination. Once the particles become detached, they are at risk of being removed from the textblock. A light dry cleaning process prior to digitisation and subsequent handling during the digitisation procedure for example could cause the loss of many of such particles. Though only a tiny amount of particles is needed to analyse their chemical composition, a large decrease of their presence would hinder the analysis of the method of application and the purpose of use. When almost nothing of the originally applied sparkling particles remain, it becomes difficult to point out the original areas of their incidence, and the rationale of their use.

Another preservation issue is the damage that the particles can cause themselves. In those instances where fairly thick clusters of particles were applied, and particles are multi-faceted and sand-like in nature, they can cause mechanical damage to the textblock or the ink. [Figs. 20a-c] When the particles become dislocated and are accumulating in the spine-folds, they will cause friction when the book is used, and may damage the paper fibres and sewing thread. Given the importance of the particles with respect to the codicological information they contain, this provides the conservator with a dilemma. Removal of the particles means removal of information. It is therefore crucial that measures are in place to prevent the detaching of the particles as much as possible. As a first step, it will be necessary to indicate which manuscripts contain them; in many instances, this will require a survey in the collections. The manuscripts can then be inspected and decisions will have to be made on an individual basis. It may be possible to consolidate fragile inks and particles. In other instances, it could be best to change the circumstances of storage, and change the manuscript from a vertical into a horizontal position for example, or add a clamshell box or other supportive protection. A digital surrogate may help to decrease the frequency of the physical consultation of the object, and thus diminish the risks through use of the manuscript. Additionally, a fragile condition of the inks and loose particles may also increase the urgency to study the material aspects of these items, which is another way to secure the available material information the manuscript contains. Perhaps the particles can also be safeguarded with an interventive treatment, using an agent to consolidate fragile or loose particles. More research is needed, however, to establish what sort of agent is most suitable, safe to use and does not interfere with future material analysis.

Fig. 20a. UBL Or. 23.448, f.1a. Loss of ink because of the loss of particles © Courtesy UBL.

Fig. 20b. UBL Or. 22.663b, f. 62a. Loss of ink because of the loss of particles © Courtesy UBL.

Fig. 20c. UBL Or. 25.744, f. 143a. Loss of ink because of the loss of particles © Courtesy UBL.

IX. Conclusion

This work is a first exploration of the use of glistening particles in Yemeni manuscripts. First noticed at the beginning of the 2000s while cataloguing manuscripts in Zabīd, a research on papers of Yemeni manuscripts, conducted in 2015 in the University of Leiden Library opened the opportunity to examine the phenomenon on a wider range of items and to conduct lab-analysis (2016). Particles were already used by Ottoman, as blotting material and more particularly as decoration, but not exclusively by them, as recently shown by a study of a bulk of Occidental mediaeval manuscripts. Moreover, Yemeni uses of particles have proven to be a distinct case.

Theoretically, it would seem easy to distinguish between the purpose of the application of particles. When used as blotting material, to decrease the ink's drying time, particles will mainly stick to the lower part of a page where the ink was still wet when the material was applied; the ink on the upper part of a folio is usually already dry when the last words were just written. When used as a decorative means instead, the glittering particles are strewn intentionally in specific parts of the text. In practice however, at least in the studied manuscripts from Yemen, these two different uses are not as clearly divided. Delicate amounts of flattened metal splinters (even gold) and flat grains of the mica seem to have been applied onto the text areas (and not specific words) because they sparkle when viewed under a specific angle; they do not seem to have a blotting function nor are there traces of other blotting materials. It is also remarkable that, when the amount and location of the particles clearly seem to indicate a blotting function, the particles appear too decorative to be only functional. This is

especially true for those particles that have a reddish coating, as found in Or. 25.744 and Or. 6353. Extra caution is needed when trying to establish the reason for adding the glistening particles to areas of inks added at a later stage, such as owner marks and commentaries. The decorative function of particles in these inks may seem obvious, but their use may be to absorb the ink's moisture. Interestingly, the particles, which were definitely identified as mica, but also sand, sometime in a combination with red pigment, produce their glossy effect when viewed under a certain angle, leaving space to a secret knowledge in the hands of their copyists.

It is clear, therefore, that further study into this aspect of codicology and material culture is needed, for instance hands-on research, reconstructing the inks, and replicating the writing and the use of such scattering particles. We also need further insights into Arabic and specifically Yemeni sources on scribes/copyists practices. The centralisation of information on related sources and further publications would certainly help considerably the progress of the study of the phenomenon, for all those interested. Creating a database seems the right action to be taken and would create a net of collaborators.

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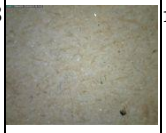
Annex

Appendix 1/Table 1: Paper (Chronologically sorted)

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF	Technical examination	Discussion
Or. 2722		1786	4a	(#P)	Small amounts of Ca, Ti or Ba, Fe. trace amounts of K, Pb	Light blue and dark blue fibres present as well as and yellow-brown fibres of different length	Lead comes most probably from the red ink present on the page
Or. 6333		19th c.	133a	(#P)	Small amounts of Ca, Ti or Ba, Fe, Zn. trace amounts of Pb	Blue-grey paper, but without blue fibres. Small brown fibres homogeneously distributed. Blue particles (probably smalt) present	Was a blue dye added to the pulp? Smalt particles consist of blue glass, containing cobalt. The measuring spot was not on a smalt particle
Or. 6330		1928	48b	(#P)	Small amounts of Ca, Ti or Ba, Fe, trace amounts of (Sr)	Some brownish coloured fibres	
Or. 23.448		1932	155b	(#P)	Small amounts of Ca, Ti or Ba, Fe, Zn. trace amounts of Pb	A few blue fibres and many brown fibres of different colour	
Or. 25.745		1936	59a	(#P)	High amount of Fe, small amounts of Ti or Ba, Zn.	Long brown fibres and blue fibres. Transparent glittering particles spread over whole surface	High amount of iron could be due to present particles

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF	Technical examination	Discussion
Or. 25.744		1937	143a	(#P)	High amount of Ca, small amounts of Ti or Ba, Fe, Zn. trace amounts of Pb	Very few brown fibres	High calcium content and low amount of brown fibres points to a good paper quality
Or. 6353a		1928	125a	(#P)	Small amounts of Ca, Ti or Ba, Fe, Zn. trace amounts of Cr, Mn, Pb	Brown fibres, some quite long. The lower part of the paper is coloured with red powder	The red powder is iron oxide which is part of the blotting sand present on the ink. This can explain the iron content

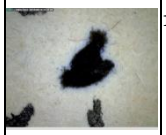
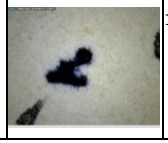
Appendix 1/Table 2: Black and brown inks

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF	Technical examination	Discussion	Ink type
Or. 6330		1928	48b	Main ink, body of the text (#1)	None	Deep black colour, opaque, low density, no gloss	Ink characteristics and XRF readings indicate a carbon ink	Carbon ink
Or. 6330		1928	48b	Main ink, last word of page (#2)	None	Deep black colour, opaque, high density, no gloss	Ink characteristics and XRF readings indicate a carbon ink	Carbon ink
Or. 6353a		1928	125a	Main ink, first line (#1)	None	Deep black colour and glossy in opaque areas, in more translucent areas grey with particles	Ink characteristics and XRF readings indicate a carbon ink	Carbon ink
Or. 25.744		1937	143a	Main ink without particles upper part (#1)	Fe, (S), (K), (Cl), (Mn), ((Ca))	Deep black colour, opaque, high density, gloss, craque-lure. Underneath missing particles and low ink density paper is grey	Ink characteristics suggest carbon ink. Presence of iron and sulphur might point to an iron-gall ink, but identified elements likely could also originate from red clay and silica sand	Carbon ink?
Or. 25.744		1937	143a	Main ink with particles and lost particles (#2)	Fe, (S), (K), (Cl), (Mn), (Ti), (Si), ((Ca))	Deep black ink colour, opaque, high density, gloss, craquelure. Underneath missing particles and low density ink areas greyish-paper colour	Ink characteristics point to carbon ink. Presence of iron and sulphur might point to an iron-gall ink, but identified elements likely originate from red clay and silica sand	Carbon ink?

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF	Technical examination	Discussion	Ink type
Or. 25.744		1937	143a	Main ink with particles (#3)	Fe, (S), (K), (Cl), (Mn), (Ti), (Si), ((Ca))	Deep black ink colour, opaque, gloss, craquelure. Underneath missing particles and low density ink areas greyish paper colour	Ink characteristics point to carbon ink. Presence of iron and sulphur might point to an iron-gall ink, but identified elements likely originate from red clay and silica sand	Carbon ink?
Or. 2722		1786	4a	Main ink, body of the text (#5)	Fe, (Ca), (Pb) no S	Deep black colour, opaque, high density, no gloss	Ink characteristics suggest a carbon ink. Iron probably originates from particles. Pb from red ink	Carbon ink
Or. 2722		1896	4a	Annotation (upper left) with particles (#3)	Fe, (K) no S	Greyish-black colour, no halos. Where ink was transferred to particles, the paper underneath is grey coloured	Ink characteristics suggest a carbon ink. Absence of sulphur but presence of iron. Iron probably originates from particles	Carbon ink?
Or. 2722		1896	4a	Annotation (lower part) with particles (#4)	Fe, (K),((Ca)),((Ti)), ((Ba)) no S	Greyish-black colour, no halos. Where ink moved to particles, paper underneath grey coloured	Ink characteristics suggest carbon ink. Absence of sulphur but presence of iron. Iron probably originates from particles	Carbon ink?
Or. 6333		19th c.	133a	Main ink, body of the text (#1)	Fe, (S), (K), (Ca)	Brown colour, varying from light to dark with some gloss in areas of high ink density. Fine brown halos around ink lines	Brown ink colour, halos around ink lines and presence of iron and sulphur point to an iron-gall ink	Iron-tannate ink
Or. 6333		19th c.	133a	Probably main ink, or annot. (#2)	Fe, (S), (K), (Ca)	Brown colour, varying from light to dark with some gloss in areas of high ink density. Fine brown halos around ink lines	Brown ink colour, halos around ink lines and presence of iron and sulphur point to an iron-gall ink	Iron-tannate ink

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF	Technical examination	Discussion	Ink type
Or. 23.448		1932	155b	Upper part of page (#2)	Fe, (S), (Ca), (K)	Deep black colour and craquelure in opaque areas, gradually changes into dark brown colour in translucent areas. Gloss in black and brown areas	Ink shows characteristics of both - carbon and iron-tannate ink. Presence of iron and sulphur point to an iron-tannate ink	Carbon ink combined with iron-tannate ink
Or. 23.448		1932	155b	Lower part of page with particles (#3)	Fe, (K), (S), (Ti or Ba)	Brown colour, translucent, inhomogeneous distribution of darker areas along paper fibres. Orange to brown mica particles	Primary ink characteristics point to iron-tannate ink. Dark brown coloured areas might contain black carbon particles	Iron-tannate ink (may be combined with a carbon ink)
Or. 23.448		1932	155b	Middle, right side, with particles (#4)	Fe, (S), (K), (Ti or Ba)	Dark brown nearly black ink colour, no gloss. Underneath lost particles brown colour	Primary ink characteristics point to iron-tannate ink. Dark brown coloured areas probably contain black carbon particles	Iron-tannate ink combined with a carbon ink
Or. 25.745		1936	59a	Main ink (#1)	Fe, (S), (Ca), (K), (Cl)	Deep black colour in opaque areas, gradually changes into dark brown colour in translucent areas. Gloss in black and brown areas. Tiny brown halos	Ink characteristics point to carbon ink. Brown coloured areas and presence of iron and sulphur point to an iron-gall ink	Iron-tannate ink combined with a carbon ink

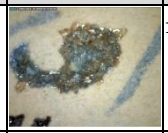
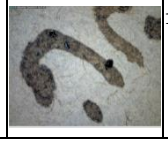
Appendix 1/Table 3: Coloured inks

Inv. No.	Photo (x30)	Year (CE)	Folio	# measure location	XRF	Technical examination	Discussion	Ink type
Or. 2722		1786	4a	(#1)	Pb, (Fe)	Dark discolorations occur on some areas. Where flat particles are missing a shiny surface has formed	Lead content suggests the use of red lead (Pb_3O_4)	Red lead
Or. 2722		1786	4a	(#2)	Pb, (Fe)	Dark discolorations occur on some areas. Where flat particles are missing a shiny surface has formed	Lead content suggests the use of red lead (Pb_3O_4)	Red lead
Or. 25.744		1937	143a	(#4)	(Fe), ((Ca)), ((K)), ((Cl)), ((S))	Translucent bright red-coloured, glossy film	Only traces of inorganic substances present, this suggests the presence of an organic red	Probably organic dye
Or. 6353a		1928	125a	(#2)	((K)), ((S))	Opaque, bright red-coloured film without gloss	Only traces of inorganic substances present, this suggests the presence of an organic red	Probably organic dye
Or. 6330		1928	48a	(#3)	Cu, (Cl), (Zn)	Dark blue ink. Lighter blue halo around edges ink shows a golden glow around outer edge (high dye concentration?)	Golden glow suggests a high concentrated synthetic dye. Phthalo blue? Methyl violet?	Probably synthetic dye
Or. 6330		1928	48a	(#4)	Cu, (Cl), (Zn)	Dark blue ink. Lighter blue halo around edges. Ink shows a golden glow around outer edge (high dye concentration?)	Golden glow suggests a high concentrated synthetic dye. Phthalo blue? Methyl violet?	Probably synthetic dye

Inv. No.	Photo (x30)	Year (CE)	Folio	# measure location	XRF	Technical examination	Discussion	Ink type
Or. 23.448		1932	23b	(#1)	-	Purple ink with golden shiny edges on top of a brown ink	Golden glow suggests a high concentrated synthetic dye. Methyl violet? Crystal violet?	Probably synthetic dye
Or. 25.745		1936	59a	(#2) ink with particles	As, (S), Fe, (K), (Ca), (Ti), (Si),	Very glossy, translucent ink with yellow colour. Fine craquelure	As, (S) suggest the use of orpiment (As_2S_3). Fe originates probably from the ink. K, Ca, Ti, Si originate from particles	Orpiment
Or. 25.745		1936	63a	(#3) ink with particles	As, (S), Fe, (K), (Ca), (Ti), (Si),	Very glossy, translucent ink with yellow colour. Fine craquelure	As, (S) suggest the use of orpiment (As_2S_3). Fe originates probably from the ink. K, Ca, Ti, Si originate from particles	Orpiment

Appendix 1/Table 4: Particles on ink surfaces

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF / SEM-EDX	Technical examination	Discussion and purpose	Particle type
Or. 2722		1786	4a	(#5) on red ink marks	Si, Fe	Flat, glittering particles. Particles only present on red ink, not on the black ink of the main text	Purpose: **decoration**	Phyllosilicates / Mica
Or. 2722		1786	4a	(#3) annotation upper left	Si, Fe	Flat, glittering particles, applied on fresh ink which then transferred to particles, leaving the paper surface with less ink	Particles applied to fresh ink. Purpose: **blotting**	Phyllosilicates / Mica
Or. 2722		1786	4a	(#4) annotation lower left	Si, Fe	Flat, glittering particles, applied on fresh ink which then transferred to particles, leaving the paper surface with less ink	Particles applied to fresh ink. Purpose: **blotting**	Phyllosilicates / Mica
Or. 23.448		1932	155b	(#3) lower part of page	Si, Fe	Flat, translucent, glittering particles of orange-brown colour	Purpose: **blotting or decoration**	Phyllosilicates / Mica / Biotite?
Or. 23.448		1932	155b	(#4) middle, right side	Si, Fe	Flat, translucent, glittering particles of orange-brown colour or colourless	Purpose: **blotting or decoration**	Phyllosilicates / Mica
Or. 25.745		1936	59a	(#3) yellow ink	Si, Fe	Many flat, translucent, glittering particles. Either colourless or yellowish orange brown	Purpose: **decoration**	Phyllosilicates / Mica

Inv. No.	Photo (x30)	Year (CE)	Folio	# XRF measure location	XRF / SEM-EDX	Technical examination	Discussion and purpose	Particle type
Or. 25.745		1936	117a	Not determined		Many flat, translucent, glittering particles. Either colourless or yellowish orange brown	Purpose: **decoration**	Phyllosilicates / Mica
Or. 6353a		1928	125a	(#3) on black ink	Fe, minor amounts of Si, S, K, Ca, Ti	Flat, glittering particles, mixed with a few round sand particles. All covered with a red powder, quite loose. Red powder distributed all over lower page	Fe content is due to the red Fe oxide powder. Location on lower part of the page. Purpose: **blotting**	Mica and quartz sand particles mixed with red iron oxide powder
Or. 25.744		1937	143a	(#3) main ink with particles	Fe (Ti), (Si)	Round sand particles covered with red powder, quite firmly attached to paper. Particles on lower part of paper. Ink did not transfer to particles but retains a dense, black layer	Particles applied to fresh ink. Purpose: **blotting**	Quartz sand particles mixed with red iron oxide powder
Or. 6353a		1928	141a	(#4) on brown ink annotation	Ca, minor amounts of S, K, Fe, Cu, Zn, traces of Sr, Cl .	White powder, directly applied to fresh ink. Ink transferred to powder when it was applied	Presence of chorine points to ground seashells. Purpose: blotting	White seashell
Or. 25.744		1937	127a	Ink on lower last line	-	White opaque particles, shiny to matte	Optically comparable to chicken-egg shell or white seashell	Egg shell or white seashell
Or. 6333		19th c.	133a	(#2) probably main ink, or annotation	Fe	Black, shiny flattened particles, applied to fresh ink which then transferred to particles leaving the paper surface with less ink	Metallic iron particles or iron oxide? Or gypsum with iron oxide? Particles applied to fresh ink. Purpose: blotting	Metallic iron particles mixed with iron oxide and gypsum