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„New Perspectives of (Multi-)Spectral Manuscript Analysis“
von Jost Gippert (2013).

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Brockmann, Christian / Deckers, Daniel / Koch, Lutz / Valente, Stefano (eds.),
Handschriften- und Textforschung heute. Zur Überlieferung der griechischen Literatur.
Festschrift für Dieter Harlfinger aus Anlass seines 70. Geburtstages,
Wiesbaden 2014 (Serta Graeca, 30), 165–176 und [331–350]
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Jost Gippert, Frankfurt 2016

New Perspectives of (Multi-)Spectral Manuscript Analysis

Jost Gippert

When Constantin von Tischendorf undertook his strolls in search of manuscripts in the Near East between 1840 and 1844, it was not only Bible codices such as the Codex Sinaiticus he was interested in. Many of the items he carried home and deposited in Leipzig,¹ for the first time registered in his “Anecdota sacra et profana” of 1855,² contain not Biblical but other matters, and quite a number of them are palimpsests, a manuscript type which obviously aroused special interest in Tischendorf himself and his epigons. The visible result of this was the severe contamination of many palimpsest pages by chemical substances, which were applied in order to enhance the readability of the lower texts and which left behind a blueish or greenish stain as in the case of the Codex graecus 2 of the Leipzig University Library,³ a Graeco-Arabic palimpsest that was exposed a few years ago in an exhibition devoted to Tischendorf’s activities⁴ (cf. fig. 1).⁵

Today we are in a position indeed to get rid of the ‘Barbarian’ methods of the 19th century, given that excellent techniques of photographic analysis have been developed in recent years which render the usage of noxious chemistry in the investigation of palimpsests unnecessary. It is especially the application of multispectral imaging⁶ – of which Dieter Harlfinger has been a true pioneer – that has yielded a great lot of remarkable achieve-

¹ Cf. Constantin Tischendorf, *Notitia editionis codicis bibliorum Sinaitici auspiciis Imperatoris Alexandri II. susceptae*, Lipsiae 1860, 5–10 and Viktor Gardthausen, *Katalog der griechischen Handschriften der Universitäts-Bibliothek zu Leipzig*, Leipzig 1898, XVII–XIX as to the come about of Tischendorf’s inheritance.

² Constantin Tischendorf, *Anecdota Sacra et profana ex Oriente et Occidente allata*, Lipsiae 1855, 17–75; editio repetita, emendata, aucta, Leipzig 1861, 17–75.

³ In the given case, the chemical substance applied was most probably the so-called “Giobert Tincture”; cf. Felix Albrecht, *Between Boon and Bane. The Use of Chemical Reagents in Palimpsest Research in the Nineteenth Century*, in: *Care and Conservation of Manuscripts 13: Proceedings of the thirteenth international seminar held at the University of Copenhagen 13th–15th April 2011*. Ed. Matthew James Driscoll, Copenhagen 2012, 147–165.

⁴ Exhibition of the Leipzig University Library, 18.2.–5.6.2011; cf. <http://www.ub.uni-leipzig.de/tischendorf/home.html> for the exhibition and <http://www.ub.uni-leipzig.de/tischendorf/img/4> (all web sites quoted here and in the following were last accessed on Mar. 2nd, 2013) for an image of f. 22b of Cod.gr. 2. — Gardthausen’s *Katalog* (see n. 1) provides a *terminus ante quem* for the application of chemistry as it states (p. 4) that the “Greek script shows multiple traces of *potassium hexacyanoferrate*” (“Blutlaugensalz”), which is the main ingredient of Giobert tincture. Tischendorf himself witnesses to the use of chemistry elsewhere in his *Anecdota sacra* (p. 38: “chemicis adhibitis haec legi [...]”).

⁵ Photograph (turned by 90°) © 2011 Universitätsbibliothek Leipzig. — All photographs whose provenance is not explicitly stated are mine, J.G.

⁶ Cf. Jost Gippert, *The Application of Multispectral Imaging in the Study of Caucasian Palimpsests*, in: *Bulletin of the Georgian National Academy of Sciences / Sakartvelos mecnierebata erovnuli ak’ademiis moambe* 175/1 (2007): 168–179 (online available in <http://www.science.org.ge/moambe/2007-vol1/168-179.pdf>) as to the features of the multispectral imaging method.

ments, among them the decipherment of the ‘Archimedes’ palimpsest,⁷ the Old Georgian palimpsest Cod.Vind.georg. 2,⁸ and the ‘Albanian’ palimpsests of Mt. Sinai.⁹ In the following pages, I intend to demonstrate how (multi-)spectral photography can help improve the analysis of handwritten sources of many types, not only ‘classical’ palimpsests.¹⁰

1. Medieval palimpsests, i.e., parchment manuscripts that were erased (after their contents had become obsolete) and rewritten with more ‘up-to-date’ content, are indeed the ‘classical’ use case of multispectral imaging, no matter where they originate from. In the course of the past twelve years, I have been able to apply these photographic techniques¹¹ to palimpsests of various types and contents, far beyond the examples mentioned above and other palimpsests of ‘Caucasian’ origin,¹² among them the Gothic palimpsest Cod. Guelf. 64 Weiss. of the Herzog-August-Bibliothek Wolfenbüttel¹³ as well as several palimpsest codices of the St. Gall Stiftsbibliothek and the University Libraries of Frankfurt and Leipzig. In nearly all these cases, the application of multispectral imaging has immediately brought about new insights with respect to the study of the underwritings, either with a view to verifying and improving upon the results of former investigations, or by facilitating their identification for the first time. A few examples may suffice to illustrate this.

1.1 Under the signature ‘Fragm.lat. I 50’, the Frankfurt University Library hosts the fragment (two bifoliate) of a Latin palimpsest codex, the lower text of which (of allegedly the 10th–11th cc.) has been determined to pertain to the Xth book of Virgil’s Aeneid. According to the relevant catalogue, only four verses (nos. 562, 588, 614, and 640) of the underwriting have remained readable, all of them hidden in the folds of the bifoliate.¹⁴ A preliminary multispectral analysis of fol. 2^v undertaken on Feb. 5th, 2010 (cf. fig. 2) has clearly revealed the wording of four more verses (639 and 641–643; cf. Table I), as well as the existence of a – hitherto undeciphered – interlinear gloss above *euntis* (v. 640).

⁷ Cf. Reviel Netz, William Noel, Nigel Wilson and Natalia Tchernetska. *The Archimedes Palimpsest*, I–II. Cambridge 2011..

⁸ Cf. Jost Gippert (ed.), *The Old Georgian Palimpsest Codex Vindobonensis georgicus 2*, Turnhout 2007.

⁹ Cf. Jost Gippert, Wolfgang Schulze, Zaza Aleksidze and Jean-Pierre Mahé, *The Caucasian Albanian Palimpsests of Mount Sinai, I–II*, Turnhout 2009; Jost Gippert, *The Caucasian Albanian Palimpsests of Mount Sinai, III: The Armenian Layer*, Turnhout 2010.

¹⁰ My thanks are due to the administration and the staff of the institutions named below for their kind support of the investigations here reported on.

¹¹ The necessary equipment (the ‘MuSIS’ system developed by Forth Photonics, Athens) has been available in connection with the projects “Neue Wege zur wissenschaftlichen Bearbeitung von Palimpsesthandschriften kaukasischer Provenienz” (funded by the Volkswagen Foundation, 2004–2008) and “Handschriftenanalyse und -edition” (funded within the LOEWE priority program ‘Digital Humanities’ by the Ministry of Science and Arts of the state of Hesse, since 2010). Between 2003 and 2010, the equipment was upgraded, esp. with respect to image quality (resolution increased from 1280 × 960 to 1600 × 1200 pixels) and (automatical) registration (mapping of images within a spectral cube).

¹² Cf. Jost Gippert, *Palimpsests of Caucasian Origin: State of The Art and Future Prospects* (to appear in a conference volume, Paris 2013), 7f. as to recent findings concerning Caucasian palimpsests.

¹³ *Codex Guelferbytanus 64 Weissenburgensis*; cf. 1.4 below as to details.

¹⁴ Cf. Gerhard Powitz, *Mittelalterliche Handschriftenfragmente der Stadt- und Universitätsbibliothek Frankfurt am Main*, Frankfurt 1994: 11: “lesbar nur die Verse 562, 588, 614, 640 (nicht getilgt, da – wie vorhersagbar – im Falz der Doppelbl. später verborgen)”.

1.2 Of the more than 1.500 palimpsest pages contained in the codices of the St. Gall Stiftsbibliothek,¹⁵ a set of ten specimens were inspected in co-operation with the e-codices project run by Chr. Flüeler¹⁶ on June 26th, 2010, in order to elicit the prospects of a thorough multispectral analysis. The test-run has yielded promising results indeed: for most of the items in question, the contents of the lower layer could be determined with certainty. E.g., the underwriting of p. 78 of Cod. Sang. 213 (cf. fig. 3) was confirmed to pertain to Lactantius' *Divine Institutes* as proposed earlier,¹⁷ the passage in question being part of his *liber secundus: de origine erroris*; it comes up with two remarkable *variae lectiones*: instead of *mundum qui de (materia est)* in line 7, it repeats *mundum quidem* of line 2, and instead of *ego* in line 8 it has *ergo* (cf. the transcript in tab. II).¹⁸ In a similar way, the inspection confirmed that the underwritings of pp. 107 and 116 of Codd. Sang. 193 (cf. fig. 4) and 194 (cf. fig. 5) represent Old Testament texts, viz. Dan. 3.93 ff. and Prov. 5.18 ff., resp. (cf. tabb. IIIf.). And of the many palimpsest pages of Cod. Sang. 908, the so-called 'king of palimpsests',¹⁹ two deriving from a manuscript containing the Pauline Epistles²⁰ have been confirmed²¹ to contain the Vulgate text of I Tim. 1.10 ff. and Phil. 1.2 ff. (ff. 78 and 114, cf. figures 6f.), the restitution (cf. tabb. Vf.) permitting to calculate that each column of the original manuscript comprised 24 lines at an average of 12 letters. A special case among the St. Gall palimpsest folios investigated so far is f. 13 of Cod. Sang. 912, one of a total of 23 pages of this codex that are double palimpsests²² and one that has been badly contaminated by the application of chemistry (cf. fig. 8). Of the two underwritings, only the second one, which appears turned by 90° vs. the upper layer, has been identifiable so far as pertaining to a grammatical treatise by Donatus²³ (the beginning of his *De partibus orationis ars minor*; cf. tab. VII); the prospects to determine the contents of the lowest layer by applying multispectral imaging are not bad either, provided the textual heritage of late Antiquity will be accessible for more sophisticated searches one day.

1.3 The same is true for the underwriting of the palimpsest Codex graecus no. 22 of the Leipzig University Library, a layer that is well perceivable even with the naked eye (cf.

¹⁵ The most important items are: cod. nr. 193 (303 palimpsest pages), 194 (233), 213 (175), 567 (12), 722 (252), 872 (75), 908 (410), 912 (55), 1394 (8).

¹⁶ Cf. <http://www.e-codices.unifr.ch/>. The (excerpts of) colour images of St. Gall codices displayed below are reproduced from this site.

¹⁷ Cf. Gustav Scherrer, *Verzeichniss der Handschriften der Stiftsbibliothek von St. Gallen, Halle 1875*, 77: "Die primitive Schrift des Codex enthielt in röm. Uncial einen grossen Theil von Lactantii Div. institutiones, wovon noch einige Stellen p. 43, 83 und 122 lesbar sind".

¹⁸ The corresponding passage is contained in col. 304 A-B in the edition in J.-P. Migne's *Patrologia Latina*, VI, Parisiis 1844.

¹⁹ Cf. the 'Manuscript summary' in <http://www.e-codices.unifr.ch/en/list/one/csg/0908>; according to Scherrer, *Verzeichniss* (see n. 17): 324, the lower layer comprises parts of nine different original codices.

²⁰ Nr. 3 in Scherrer, *Verzeichniss* (see n. 17): 327, consisting of "21 Blätter zwischen den Seiten 77–219" of which pp. 77, 81, and 106 are "am besten erhalten".

²¹ The identification was first proposed by Ildefons von Arx whose handwritten notes have been interleaved in the codex (ff. '78a' and '114a').

²² Cf. Elias Avery Lowe, *Codices Latini Antiquiores. A palaeographical guide to latin manuscripts prior to the ninth century*, VII: Switzerland, Oxford 1956: 36; Scherrer, *Verzeichniss* (see n. 17): 331 speaks of but one "ausgewaschene oder ausradirt untere Schrift, die auf einigen Seiten durch Reagentien gelitten hat".

²³ Cf. Lowe, *Codices* (see n. 22): 36: "(1) Donatus, uncial saec. VII ex., pp. 13–20,47/48 (these leaves are all ter scripti and contain in the lowermost script (2) an unidentified medical text, uncial saec. VII".

fig. 9) but has resisted all attempts of identification so far.²⁴ Even after correcting obvious errors as in the case of τῆς ἀκήσεως in line 7 of the excerpt (cf. tab. VIII), which must stand for τῆς ἀσκήσεως (a word that might indicate the genre of the text), we are far from being able to identify it. Another Leipzig palimpsest whose lower layer has not been identified so far is Codex graecus no. 69, one of the fragmentary manuscripts acquired by Tischendorf (cf. fig. 10).²⁵ Albeit the number of lines read by Tischendorf himself²⁶ can easily be extended (cf. tab. IX), the author's expectation that the source of the text might well be determinable²⁷ has not yet fulfilled itself. A peculiar item of the Tischendorf collection is ms. V 1096,²⁸ a bundle comprising an Ethiopian Psalter fragment (3 foll.), a catechism-like Georgian fragment (3 foll.), an Armenian fragment containing a passage from the Prologue to the Pauline Epistles by Euthalius (1 fol.), one more Georgian fragment displaying I Pet. 1.11–22, plus a set of four palimpsest folios written in Georgian minuscules over a lower layer in the same script. The peculiarity about this lies in the fact that the underwriting of at least one of the folios ('7r', cf. Figure 11) can be proven to be identical with the upper layer of the following page (fol. '7v', cf. Figure 12), both representing the same chant sung at the ritual of the foot-washing at Maundy Thursday (cf. tab. X); the two layers were not written by the same hand, however.²⁹

1.4 Different from the palimpsests discussed above, the eight Gothic pages (ff. 255, 256, 277, 280) of the so-called Codex Carolinus (Cod. Guelf. 64 Weiss. of the Herzog-August-Bibliothek Wolfenbüttel, probably of Italian provenance)³⁰ have been the object of many studies indeed, and their text (comprising Rom. 11.33–12.5, 12.17–13.5, 14.9–20, and 15.3–13 in a parallel arrangement of Gothic and Latin) has been established with great reliability.³¹

²⁴ Cf. Gardthausen, Katalog (see n. 1): 29, who provides a few (fragments of) lines of ff. 1 and 4.

²⁵ The former designation was 'Cod. Tisch. III'; cf. Gardthausen, Katalog (see n. 1): 84 and Tischendorf, Anecdota (see n. 2): 19.

²⁶ Tischendorf, Anecdota (see n. 2): 19f.; first publication in the same author's Die Manuscripta Tischendoriana in der Universitäts-Bibliothek zu Leipzig, in: Serapeum 4 (1847): 49–61 and 65–78: 56f..

²⁷ Manuscripta Tischendoriana (see n. 26): 56: "gehört wohl einem Kirchenvater zu, was eine weitere Prüfung wird näher bestimmen lassen".

²⁸ Cf. Karl Vollers, Katalog der islamischen, christlich-orientalischen, jüdischen und samaritanischen Handschriften der Universitäts-Bibliothek zu Leipzig, Leipzig 1906: 432.

²⁹ Cf. Gippert, Palimpsests (see n. 12): 7f. as to a more detailed analysis of the Leipzig fragment, the upper layer of which was obviously written by the most productive Georgian convictual of St. Catherine's monastery in the second half of the 10th century, Ioane Zosime.

³⁰ Cf. <http://diglib.hab.de/edoc/ed000006/index.php> for a digital online edition of the manuscript (provided by Thorsten Schaßan, Stefanie Gehrke and Fabian Schwabe).

³¹ The first edition was published (in Gothic letters) by Franciscus Antonius Knittel in Brunswick, 1758, under the title "Ulphilae versionem Gothicam nonnullorum capitum epistolae Pauli ad Romanos ... orbi litterato annuntiat"; Knittel published the same content (in Latin letters) in the same year in his article "Entdeckung einiger uralten Fragmente von 2 merkwürdigen Handschriften des griechischen neuen Testaments, und von des Bischofs Ulfilae gothischer Uebersetzung der Epistel an die Roemer, in der Herzogl. Bibliothek zu Wolfenbüttel, nebst einer vorläufigen Nachricht, was seither von dieser Uebersetzung bekannt geworden ist", in: Nova acta historico-ecclesiastica 1 (1758): 200–255 (continued under the title "Praeconium Ulfilanum alterum Illustrioribus Scientiarum Academiis legitimis nascentium litterarum tutoribus", *ibid.* 2 [1760]: 678–694). A revised edition of his edition (in Latin letters) by Johannes Ihre appeared three years later under the title "Fragmenta Versionis Ulphilanae" (Upsaliae 1763). The latest treatise is by Carla Falluomini, Der sogenannte Codex Carolinus von Wolfenbüttel, Wiesbaden 1999.

However, the multispectral imaging undertaken in 2004 and 2013³² revealed some interesting new insights into details that have not been dealt with sufficiently so far. This is true, first of all, for the remnants of letters cut off at the edges of the palimpsest folios, which may be taken seriously as indicating the original wording as in the case of the top of f. 255^r where we can clearly make out the descenders of two letters, obviously the *w* and the *a* of *wisan* as the equivalent of Latin *esse* in Rom. 14.14 (cf. fig. 13). Together with the information provided by the Latin column the remnants of which (*quid com...*) reveal that the line in question was indented, we can thus confirm with certainty that the cut-off line must have read *hva unhrain wisan*, equivalent to *quid commune esse* (cf. the reconstruction in tab. XI). Another feature that can now be studied in much better detail is the shape and distribution of additional (i.e., non-textual) information contained in the codex, viz. punctuation and abbreviation marks, section signs, and numerical information. As a matter of fact, only the *editio prima* of the Gothic text by F.A. Knittel³³ seems to have taken notice of these elements in an appropriate manner, which is all the more astonishing as they may conceal valuable hints as to the function as well as the chronological and regional provenance of the text in question. In the given context, it is especially three types of signs that deserve our attention, viz. a) a long horizontal arrow-shaped marker and b) a sign mostly shaped like a single guillemet, ‘>’, both assumed by Knittel to indicate quotations from the Old Testament;³⁴ and c) an arrangement of arrows, guillemets and zigzag-lines surrounding letters that were used to denote numbers. The interplay of these elements is best illustrated by the bottom lines of f. 256^v where they occur all together at the transition from Rom. 12.19 to 13.1 (cf. fig. 14).

1.4.1 It is obvious that in Rom. 12.19, the guillemet-like signs (appearing to the left of both the Gothic and the Latin columns) denote, in the sense of a ‘diple’, the (inexact) quotation from Deut. 32.35, which is clearly announced by *gameliþ ist auk ~ scribtum (!) est enim* before. In the Latin Vulgate, the text of the former verse runs *mea est ultio et ego retribuam*, vs. *mihī uindictam ego retribuam* in the Epistle, which is what the palimpsest shows.³⁵ It is further obvious that in Rom. 12.20, the guillemets mark the text as a quotation from Proverbs (25.21f.), again with minor differences in the wording (in the Latin Vulgate: *si esurierit inimicus tuus ciba illum et si sitierit da ei aquam bibere; prunam enim congregabis super caput eius vs. sed si esurierit inimicus tuus ciba illum si sitit potum da illi; hoc*

³² The first attempt to analyse the Gothic underwriting was undertaken on March 2nd and 3rd, 2004, during the preparation for the work on the Albanian palimpsests of Mt. Sinai; cf. <http://titus.uni-frankfurt.de/didact/idg/germ/gotbeisp.htm> for images of two of the palimpsest pages. – A complete set of multi-spectral images of the palimpsest pages was produced on Jan. 25th, 2013; the images are currently being processed for an independent publication.

³³ Knittel, *Ulphilae versionem* (1758) (see n. 31).

³⁴ Knittel, *Ulphilae Versionem* (see n. 31): 381 § 198: “Testimonia veteris Testamenti in Carolino codice occurrentia ad marginem sedulo notata sunt signis >>> >>>”.

³⁵ The Gothic text remains peculiar here in adding the passive subjunctive form *leitaidau* ‘may (vengeance) be left (lit. *let*) (to me)’, which cannot be motivated even by assuming a Greek model (cf. ἐμοὶ ἐκδίκησις, ἐγὼ ἀνταποδώσω Rom. 12.19 vs. ἐν ἡμέρᾳ ἐκδίκησεως ἀνταποδώσω Deut. 32.35). Cf. Falluomini, Carolinus (see n. 31): 99 as to an attempt of its explanation. — Another quotation of Deut. 32.35 in the Epistles is Heb. 10.30, which reads *mihī vindictam ego reddam* in the Vulgate while the Greek text has the same wording as in Rom. 12.19. From the OT, we may further adduce Jer. 50.15 (27.15 LXX) and 51.11 (28.11 LXX), which have the phrase *ultio domini est* / ἐκδίκησις παρὰ θεοῦ / κυρίου ἐστίν.

enim faciens carbones ignis congeres super caput eius in the Epistle; note that the palimpsest confirms the form *sitierit* of the Old Testament).³⁶ For the text of Rom. 12.21, however, there is no immediate source discernible, even the allusion to Mt. 5.39 remaining vague (cf. *noli uinci a malo sed uince in bono malum vs. non resistere malo; ni gajiucaizau af unþiuþa ak gajiucais af þiuþa unþiuþ vs. ni andstandan allis*³⁷ þamma unseljin in the Gothic text).³⁸ Knittel's assumption³⁹ must therefore be revised. This is all the more true as the palimpsest seems to contain a second variant of the "diple" sign in an *s*-like shape, which marks lines 2 and 3 of fol. 280r in both the Gothic and the Latin column (cf. Figures 15 and 16). Here, too, we have to deal with a quotation from the Old Testament, the wording of Rom. 15.3 reflecting Ps. 68 (69).10, with but minor differences again (in the Latin Vulgate: *inproperia inproperantium tibi ceciderunt*⁴⁰ *super me* in the Epistle, cf. Table XIII, vs. *obprobraria exprobrantium tibi ceciderunt super me* in the Psalter). It would be natural to assume that the *s*-shaped sign was especially designed to mark Psalms; this, however, is disproved by the fact that in two further quotations from the Psalter (Ps. 18.50 in Rom. 15.9 and Ps. 117.1 in Rom. 15.11), we have to note the "usual" shape again. And there is no reason off-hand why the two other quotations on the same page (fol. 280v), Deut. 32.43 in Rom. 15.10 and Is. 11.10 in Rom. 15.12, are marked by neither the guillemet-like "diple" nor its *s*-shaped variant (cf. Figure 17). This cannot be explained by assuming that the signs were only used for chanted texts; for Deut. 32 was part of the OT "Odes" that were chanted indeed, and other passages from "unchanted" Isaiah (40.13 quoted in Rom. 11.34 and 45.23 quoted in Rom. 14.11) do have the guillemets (fol. 255v, lines 10–4).⁴¹ A similar picture is, by the way, provided by the Caucasian Albanian palimpsests of Mt. Sinai where we meet with guillemet-like signs marking the quotations of Ps. 2.7, Is. 55.3, Ps. 16.10 and Hab. 1.5 within the lectionary text of Acts 13.17–42.⁴² The actual function of the signs therefore remains doubtful for the time being.

1.4.2 Knittel's assumption that the long horizontal arrow-shaped marker (for the actual shape cf. Figure 16) was related to quotations, too, is even more questionable. It is much more likely that it was simply used to denote the end of paragraphs, given that it usually appears together with the initial of the next line being outdented and enlarged.⁴³ This is true, e.g.,

³⁶ Cf. Falluomini, Carolinus (see n. 31): 100 for the distribution of the two verbal forms in the Latin witnesses.

³⁷ Goth. *allis* ~ Gk. ὄλος is likely to have been copied from Mt. 5.34; cf. Wilhelm Streitberg (ed.), *Die Gotische Bibel, II: Gotisch-Griechisch-Deutsches Wörterbuch*, Heidelberg 41965: 7.

³⁸ With a similar degree of vagueness, Mt. 5.44 is related to Prov. 25.21f. (and Rom. 12.20): *diligite inimicos vestros benefacite his qui oderunt vos*.

³⁹ Cf. Falluomini, Carolinus (see n. 31): 53 for a similar statement ("In den gotischen Hss. werden die Zitate aus dem Alten Testament durch Zeichen angezeigt...").

⁴⁰ *caeciderunt* in the palimpsest is a remarkable orthographical variant.

⁴¹ This is the complete list of marked passages in the Gothic palimpsest (mere allusions are indicated by square brackets, missing sources, by '—'): f. 277^r, ll. 7–10 (Rom. 11.34; Is. 40.13); 11–13 (11.35: [Job 41.3]); 14–18 (11.36: —); f. 256^v, 13f. (12.19: Deut. 32.35); 15–22 (12.20: Prov. 25.21f.); 23f. (12.21: —); f. 255^v, 10–14 (14.11: Is. 45.23); f. 280^r, 2f. (Rom. 15.3: Ps. 68.10); 280^v, 9–11 (15.9: Ps. 18.50); 17–19 (15.11: Ps. 117.1).

⁴² Acts 13.33, 34, 35, and 41; cf. Gippert et al., *Caucasian Albanian Palimpsests* (see n. 9), II: VII–21–23 (ff. B27^b and A73^fab of the lectionary). Cf. Charles Renoux, *Le lectionnaire albanien des manuscrits géorgiens palimpsestes N Sin 13 et N Sin 55 (X^e–XI^e s.)*. Essai d'interprétation liturgique, Turnhout 2012: 113f. on the lection in question.

⁴³ Cf. Falluomini, Carolinus (see n. 31): 54f. for an appropriate account of the interplay of the two features.

for the initials of all the four quotations on f. 280^v – which implies that the quoted passages were treated as paragraphs –, but also for Rom. 15.13, which is not preceded by a quotation. It goes without saying that the paragraphs in question need not coincide with ‘verses’ of modern usage, given that ‘our’ system of text division was invented long after the Gothic-speaking community had dissolved; and indeed, two of the markings do not coincide with a modern verse boundary, viz. that on fol. 256^v, l. 19, which falls into Rom. 12.19 at the position before the quotation from Deut. 32.35 begins, and that on f. 280^v, line 12, which stands before the beginning of the quotation of Ps. 18.50 within Rom. 15.9.⁴⁴ Instead, it is probable that the markings relate to the division system developed by Euthalius of Sulca,⁴⁵ which was widespread in the early Middle Ages.

1.4.3 Clear evidence for the Euthalian “stichometry” having been used in the Gothic tradition is provided by the few numerical data the palimpsest contains; a finding that goes back to Knittel’s edition again.⁴⁶ A striking case is the number $\epsilon = '5'$ that is conceivable in the margin where Rom. 13 begins (on f. 256^v, cf. above); it obviously denotes the 5th sub-chapter of Euthalius’ chapter 17 of the Epistle, which extended from Rom. 12.1 to 14.26. The division into ‘subchapters’ is not thematised in Euthalius’ own treatise⁴⁷ but is well traceable in other medieval manuscripts that contain the Pauline Epistles, such as the 11th c. Georgian codex 176 of the Kutaisi Historico-Ethnographical Museum where Rom. 13.1 is marked (on fol. 103^r) as *tavi ē*, i.e. ‘chapter 5’, while *tavi d̄* = ‘chapter 4’, with an additional *l̄z* = ‘17’ referring to the superordinate division, denotes the beginning of the quotation from Prov. 3.7 within Rom. 12.16 (cf. Figure 17).⁴⁸

1.4.3.1 In contrast to this, the second ‘Euthalian’ number contained in the Gothic palimpsest remains doubtful. This is the number appearing in the margin next to Rom. 12.1 on f. 277^r (cf. fig. 18 with tab. XIV), which is clearly discernible as the letter $\iota \sim '10'$ off-hand. It was Knittel again who claimed that “iunctae erant dextrorsum huic I litterae quaedam, quarum deletionis vestigia exstant”;⁴⁹ different from this, C. Falluomini proposed to read at the given position a ‘z (z = 7)’ with an ‘i (i = 10)’ below,⁵⁰ which might be taken to indicate together, albeit in an usual form, ‘17’ as the expected number of the 17th main division of the

⁴⁴ This is the complete list of lines marked by the long arrow (indicated is in each case the verse it is assumed to mark the end of): fol. 277^r, l. 6 (Rom. 11.33); 18 (11.36); 277^v, 8 (12.2); 256^v, 3 (12.17); 19 (first part of 12.19, before quotation from Deut. 32.35); 25 (12.21); 255^v, 9 (14.10); 14 (14.11); 23 (14.13); 280^r, 3 (15.3); 25 (15.7); 280^v, 7 (first part of 15.9, before quotation of Ps. 18.50); 12 (second part of 15.9); 15 (15.10); 19 (15.11); 24 (15.12). In l. 10 of 255^v (end of Rom. 14.18), the arrow is present in the Latin column (with the following initial outdented) but not in the Gothic (with no visible outdenting of the following initial).

⁴⁵ Cf. Louis Charles Willard, *A Critical Study of the Euthalian Apparatus*, Berlin / New York 2009: 131 who summarises the present state of knowledge on the author.

⁴⁶ Cf. Knittel, *Versionem* (see n. 31): 381–384, §199–200.

⁴⁷ Cf. the *editio princeps* in Laurentius Alexander Zacagnius, *Collectanea Monumentorum Veterum Ecclesiae Graecae, ac Latinae*, I, Romae 1698: 537f. Zacagni’s edition was the basis for the text printed in Jean-Paul Migne, *Patrologia Graeca*, LXXXV, Parisii 1864, albeit in abridged form.

⁴⁸ The ‘Euthalian’ evidence of Old Georgian manuscripts is compiled in the edition of the Pauline Epistles by Ketevan Žoceniže and Kornelia Danelia, *Pavles epistoleta kartuli versiebi / Gruzinskie versii poslanij Pavla*, Tbilisi 1974.

⁴⁹ Cf. Knittel, *Versionem* (see n. 31): 381, §199.

⁵⁰ Cf. Falluomini, *Carolinus* (see n. 31): 48: “Auf f. 277r Z. 9 liest man z (z = 7) und unten i (i = 10)”.

Epistle. In favour of Knittel's view, the $z = '7'$ might be found in the element right to the $\iota = '10'$ ⁵¹ but this might as well be regarded as one of the ornamental elements accompanying the numerical data in the Wolfenbüttel palimpsest, in the given case a guillemet-shaped "diple" again. Unfortunately even the multispectral images do not admit of a final decision here due to the fact that the number is hidden deep in the fold of the codex, which would have to be unbound in order to facilitate further evidence.

1.4.3.2 The actual shape and arrangement of the "ornamental" elements around 'numbers' is best visible in the numerical information provided in the middle of the bottom of f. 280^v, which yields another example of the letter e denoting '5' (cf. fig. 19c). Knittel was right once more in supposing that this number denotes "quaternionem V codicis, cuius fragmentum est Carolinus noster",⁵² i.e., the last page of the 5th quire of the original codex.⁵³ This item not only allows us to reconstruct the codex, proving that it cannot have comprised any other text before the Epistle to the Romans⁵⁴ and that it consisted of quaternions, not ternions⁵⁵ (cf. tab. XV), but also provides clear evidence for the ornaments used together with numerical data. They consist of the arrow-shaped mark applied above the 'number', one guillemet-shaped sign each to its left and right, and a zig-zag-shaped sign (resembling a 'long z ', \mathfrak{z})⁵⁶ below it.⁵⁷ The same elements are clearly discernible surrounding the e which marks Rom. 13.1 as beginning the 5th (sub)chapter.⁵⁸ For the numerical information accompanying Rom. 12.1, this speaks in favour of the assumption that the element right to the ι letter is the guillemet-like ornament, too.

2. Other cases where the application of (multi-)spectral imaging may lead to new insights are manuscripts with bleached inks and colours, handwritten texts on special support materials, and erased and struck out passages. A few examples may suffice to show what can be achieved in these cases.

⁵¹ In this case, the z seen by Falluomini would have to be regarded as part of the ornamentation; cf. below.

⁵² Cf. Knittel, *Versionem* (see n. 31): 385, §201.

⁵³ Cf. Jost Gippert, *Mravaltavi – A Special Type of Old Georgian Multi-Text Manuscripts*, in: Michael Friedrich and Cosima Schwarke (ed.), *One-Volume Libraries: Composite and Multiple-Text Manuscripts*, Berlin / Boston 2016: fig. 7 for similar quire markings in Georgian manuscripts; the assumption by Falluomini, *Carolinus* (see n. 31): 53 (and 56) that the marking of the last folio of a quire was reserved for the Latin 'Schriftgebiet' must be revised.

⁵⁴ Correctly calculated also by Knittel, *Versionem* (see n. 31): 385, §201.

⁵⁵ The assumption by Falluomini, *Carolinus* (see n. 31): 47 that the surviving folios were part of a ternion with ff. 256 and 255 representing the innermost bifolium is erroneous as in this case, the text would have to be continuous on the two folios. Instead there must have existed one more bifolium inside, which comprised Rom. 13.5–14.9.

⁵⁶ This may well be related to the \mathfrak{z} -like shaped element appearing in the marginal 'numbers' of the *Codex Argenteus*.

⁵⁷ The description of the ornaments by Falluomini, *Carolinus* (see n. 31): 53 ("links und rechts von Punkten oder kleinen Haken, oben und unten von Strichen eingerahmt") must be revised in this respect. The same is true for the description given by Wilhelm Braune, *Gotische Grammatik*, Tübingen 171966: 10 ("Als Zahlzeichen werden die Buchstaben zwischen zwei Punkte gesetzt oder sie erhalten einen übersetzten Querstrich").

⁵⁸ I fail to find the "eingerahmtes Zeichen, das dem lateinischen Buchstaben V ähnelt" in the Latin column facing the Gothic number $e = '5'$ according to Falluomini, *Carolinus* (see n. 31): 48.

2.1 Erased and struck out passages can be regarded as a special subtype of palimpsests, the difference only consisting in the fact that the overwriting is not a ‘script’ in the proper sense of the word. The applicability of multispectral imaging to this kind of ‘hidden’ texts was tested in 2011 in the course of a project dedicated to the edition of the letters of Ludwig Börne, a German publicist of the early 19th c., to his friend, Jeanette Wohl(-Strauß).⁵⁹ The preliminary multispectral analysis of the many passages in the letters that were struck out by the addressee before she handed the letters over to the public, brought to light⁶⁰ that these passages contained either Yiddishisms, which she obviously considered to be too revealing of Börne’s Jewish provenance (as in the idiom *Die Kränk auf den Guj*, i.e. “[May] the illness [fall] on the unbeliever”, in letter 135, cf. fig. 20 and tab. XVI), or characterisations of herself deemed improper (as in the address *Moppel*, i.e., ‘podge’, in letter 156, cf. fig. 21 and tab. XVII). Different from the ‘typical’ case of medieval palimpsests the decipherment of which can mostly be successful by contrasting images from different ranges of the visible light (ultraviolet, violet or blue vs. yellow, orange, red) in order to highlight the erased (yellowish or brownish) underwriting, we here had to experiment with images in the infrared range, too, depending on the ink used to cover the original text. This method turned out to be successful even in the case of overwritings applied with a typewriter as in a letter by Hugo von Hofmannsthal (cf. fig. 22a-d),⁶¹ due to the fact that only the carbon ink of the ribbon remains visible in the infrared range (cf. fig. 22c).

2.2 Spectral imaging in the higher ranges may also be useful for the analysis of texts inscribed with evaporating inks on certain supports that tend to stain darkly in the course of time. A good example of this is the Tocharian inscriptions on wooden boards that are stored in the Turfan Collection of the Berlin-Brandenburg Academy of Sciences.⁶² In many of these artefacts, the written lines on the boards can hardly be made out by the naked eye but the visibility and even readability can be greatly enhanced by photographing them in the infrared range (cf. fig. 23 showing the monument THT 4064). In a similar way, infrared photographing can be successfully applied to badly discoloured palm leaf documents as shown in Fig. 24.⁶³

2.3 In other cases of unreadability caused by the bleaching of inks or the heavy discolouration of support materials, some more experimenting with photographs in different ranges of the visible and invisible light may be necessary to yield remarkable results. This is true, e.g., for some of the Sogdian manuscripts on paper preserved in the Berlin Turfan Collection, esp. those with larger amounts of text in red ink; cf. fig. 25 showing an excerpt of

⁵⁹ Cf. Anne Hardy, Ein Frankfurter Publizist und seine Muse, in: *Forschung Frankfurt* 1/2008: 62–65 for details as to the edition project, and <http://publikationen.ub.uni-frankfurt.de/volltexte/2008/104057/> and <http://edocs.ub.uni-frankfurt.de/volltexte/2007/9999999/> for the digitised letters.

⁶⁰ The project (directed by W. Schmidt of the University Library, Frankfurt) is part of the LOEWE priority program ‘Digital Humanities’.

⁶¹ The project (directed by A. Bohnenkamp-Renken of the Freies Deutsches Hochstift, Frankfurt) is part of the LOEWE priority program ‘Digital Humanities’.

⁶² Cf. <http://www.bbaw.de/en/research/turfanforschung> as to the Turfan Studies project and <http://titus.fkidg1.uni-frankfurt.de/texte/tocharic/tht.htm> for a documentation of the Tocharian manuscripts of the Berlin collection.

⁶³ Private collection; images of July 4th, 2004.

the Christian Sogdian fragment no. n 107 the readability of which was well enhanced by photographing in the yellow range, due to the yellowish stain of the paper.⁶⁴

2.3.1 A similar case is p. 321 of the St. Gall codex no. 911, which contains one of the oldest versions of the Apostles' Creed in Old High German. The multispectral analysis of this page undertaken on June 26th, 2010, has clearly revealed that the title of the Creed is not, contra Latin grammar, *credo in deo* as propagated since 1844⁶⁵ but regular *credo in deum*, with the *nomen sacrum* abbreviated as *d̄m*; cf. the images displayed in fig. 26.

2.3.2 A special case is the Behaim Globe of ca. 1492, the oldest globe extant world-wide, today preserved in the Germanisches Nationalmuseum at Nuremberg. Due to negligent storage in former times, the surface of the globe has been badly stained and damaged, leaving much of the textual information unreadable that had been applied on it by either its creator, Martin Behaim, or, possibly, his epigons.⁶⁶ An preliminary investigation undertaken in Nuremberg on March 1st, 2010, has revealed that images taken in different ranges of the spectrum may well enhance the missing contrast of the colours used for the legends and the geographical areas (land or sea) they were written on. E.g., the legend written over the western part of present-day Egypt, hardly discernible because the yellowish ink used for it no longer stands out from the brownish colour indicating the desert land, becomes well evident in images in the red range (cf. fig. 27). Different from this legend, the content of which (cf. tab. XVIII) had by and large been established before,⁶⁷ the spectral images in some cases facilitated even the first decipherment. This is true for a legend applied over the oceanic area north of *Cipangu insula*, i.e., Japan.⁶⁸ Of the two parts of the legend (cf. fig. 28), only the first one, comprising five lines (cf. fig. 29), was readable so far (cf. the actual

⁶⁴ Images of July 6th, 2004.

⁶⁵ Cf. Heinrich Hattemer, *Denkmale des Mittelalters*, I, St. Gallen 1844: 324 and afterwards, among others, Karl Müllenhoff and Wilhelm Scherer, *Denkmäler deutscher Poesie und Prosa aus dem VIII–XII Jahrhundert*, Berlin ²1873): 164; id., 3. Ausg. von Elias von Steinmeyer, I, *Texte*, Berlin 1892: 209; Richard Kienast (ed.), *Ausgewählte althochdeutsche Sprachdenkmäler*, Heidelberg 1948: 43; Heinz Mettke (ed.), *Älteste deutsche Dichtung und Prosa*, Frankfurt 1976: 140. Elder accounts of the St. Gall Creed do not mention the Latin title; cf., e.g., Marcus Zuerius Boxhorn, *Historia universalis sacra et profana, a Christo nato ad annum usque 1650*, Francofurt-Lipsiae 1675: 101; Georgius Eccardus, *Incerti monachi Weissenburgensis Catechesis Theotisca seculo IX. conscripta*, Hannover 1713: 189; Johannes Schilter, *Thesaurus antiquitatum Teutonicarum, ecclesiasticarum, civilium, literarium*, I/2, Ulmae 1726: 85 (= Johannes Georgius Scherzsius, *Keronis, monachi S. Galli, interpretatio Regulae S. Benedicti Theotisca, ex Msc. antiquissimo Bibliothecae incltyi Monasterii S. Galli nunc primum cruta per R.P. Bernardum Franckium, recensuit, notisque illustravit*); Ildefons von Arx, *Geschichten des Kantons St. Gallen*, I, St. Gallen 1810: 203 and id., *Berichtigungen und Zusätze*, St. Gallen 1830: 35; Karl Lachmann in Friedrich August Pischon, *Denkmäler der deutschen Sprache von den frühesten Zeiten bis jetzt*, I, Berlin 1838:8.

⁶⁶ Cf. Ernst Georg Ravenstein, *Martin Behaim, his life and his Globe*, London 1908 as to the most comprehensive account.

⁶⁷ The following items must be corrected as against Ravenstein's transcript (Behaim [see n. 66]: 97): instead of 'konik' read → *konig*, 'herr' → *her*; 'über' → *vber*, 'konikreich' → *konigreich*, 'arabia' → *arabien*, 'egypten' → *egiptē*, and 'damasco' → *damasko*.

⁶⁸ Note that the Globe was produced just before the discovery of the Americas so that the ocean east of Asia spans right up to Iceland and Western Europe.

transcript in tab. XIX),⁶⁹ and its source was determined to have been an early edition of Marco Polo's *Travels*;⁷⁰ it clearly refers to East Siberia.⁷¹ After thorough editing of the infrared images (cf. fig. 30), the second part, comprising five lines as well, can now be restored at least to a certain extent, too (cf. tab. XX). It obviously refers to the river named Pulisanghin that Marco Polo mentions in his report on the capital of China, Cambaluc; cf. the following excerpt of chapter XXXV of book II of his *Travels*, with items that reappear in the legend marked in italics:

“When you leave the City of Cambaluc and have ridden ten miles, you come to a very large *river* which is called *Pulisanghin*, and flows into the ocean, so that merchants with their merchandise ascend it from the sea. Over this River there is a very fine stone *bridge*, so fine indeed, that it has very few equals. The fashion of it is this: it is *300 paces in length*, and it must have a good *eight paces of width*, for ten mounted men can ride across it abreast. It has *24 arches* and as many water-mills, and 'tis all of very fine *marble*, well built and firmly founded. Along the top of the bridge there is on either side a parapet of *marble slabs* and columns, made in this way. At the beginning of the bridge there is a marble column, and under it a marble lion [...].”⁷²

The very fact that the legend is based upon Marco Polo's report is indicated at the end of the fifth line of the legend where the traveller's name appears. In comparison with Marco Polo's name of the river, which has for long been correctly identified with Persian *pul-i sangin* ‘stony bridge’,⁷³ the form *Bolisachius* given in Behaim's legend is much closer to

⁶⁹ Cf. Ravenstein, Behaim (see n. 66): 92; the following corrections are necessary: instead of ‘die’ read → *di*; ‘dasselbe’ → *das selb*; ‘wollen das köstlich fehwerk zu holen’ → *wollen umb das kostlich fechwerck*; ‘fahren’ → *faren*; ‘um’ → *umb*; ‘tieffen’ → *difffen*; ‘hunden’ → *hunttē*; ‘gezogen’ → *gezogē*; ‘werden’ → *werde*. Of the alternative readings ‘wesser (mosser)’ proposed by Ravenstein, it is clearly the latter that is correct.

⁷⁰ Cf., e.g., the English edition by Henry Yule, *The Book of Ser Marco Polo, The Venetian*, II, London 1875: 479 (book IV, ch. XX): “You find in their country immense bears entirely white [...]. This difficult country is 13 days in extent, and at the end of every day's journey there is a post for the lodgement of the couriers who have to cross this tract. At each of these post-houses they keep some 40 dogs of great size, in fact not much smaller than donkeys, and these dogs draw the couriers over the day's journey from post-house to post-house, and I will tell you how. You see the ice and mire are so prevalent, that over this tract, which lies for those 13 days' journey in a great valley between two mountains, no horses (as I told you) can travel, nor can any wheeled carriage either. Wherefore they make sledges, which are carriages without wheels, and made so that they can run over the ice, and also over mire and mud without sinking too deep in it. Of these sledges indeed there are many in our own country, for 'tis just such that are used in winter for carrying hay and straw when there have been heavy rains and the country is deep in mire. On such a sledge then they lay a bear-skin on which the courier sits, and the sledge is drawn by six of those big dogs that I spoke of.”

⁷¹ Ravenstein's English translation can be maintained with a slight adjustment (“Item, when the Russians wish to go to this country, to fetch the valuable peltry, they are obliged to travel on sledges drawn by big dogs, because of the *swamps* and the deep snow”).

⁷² Cf. Yule, Marco Polo (see n. 70): II, 3–4. The German edition of 1477 of Marco Polo's *Travels* (*Hie hebt sich an das puch des edeln Ritters vnd landfarers Marcho Polo, in dem er schreibt die grossen wunderlichen ding dieser welt*; Norimberg) contains but an abridged reference to the bridge on p. [33].

⁷³ Cf. Yule, Marco Polo (see n. 70): II, 4, n. 1. The bridge in question is usually identified with the Lugou-Qiao Bridge over the Yongding River near Peking (cf. http://en.wikipedia.org/wiki/Marco_Polo_Bridge) at the location of 39° 50' 57" N and 116° 12' 47" E.

the forms *Polisanchiu* appearing in Fra Mauro's World map of 1457⁷⁴ and *Polisacus* as used in Johann Ruysch's "Universalior Cogniti Orbis Tabula ex recentibus confecta observationibus" printed in the 1508 edition of Ptolemy's Geography⁷⁵ and Thoma D. Aucupario's "Totius Europae et Asiae Tabulae Geographica"⁷⁶ of 1522;⁷⁷ Behaim's testimony can now be registered as the second oldest in this chain.

3. In the present paper, I have tried to show how (multi-)spectral imaging methods can support scholarly work on medieval palimpsests, but also other manuscripts and inscribed artefacts of various kinds. While for parchment palimpsests, best results are usually provided by multispectral analyses that are based upon the contrast between images from different ranges of the visible light (ultraviolet, violet or blue vs. yellow, orange, red) in order to highlight the erased (yellowish or brownish) underwriting, other objects may require special treatment, and the best settings to be applied (including the infrared range) cannot always be predicted. However, the experimentation necessary in such cases may always prove to be worth our while.

⁷⁴ Cf. Edward Luther Stevenson, *Genoese World Map 1457*. Facsimile and critical text incorporating in free translation the studies of Professor Theobald Fischer revised with the addition of copious notes, New York 1912.

⁷⁵ Cf. *Geographia: in hoc opere continentur geographia Cl. Ptolemaei a plurimis viris utriusque linguae doctiss. emendata et com archetypo Graeco ab ipsis collata. Schemmata cum demonstrationibus suis correcta a M. Beneventano, Romae 1508.*

⁷⁶ Reproduced in Nicolaes Witsen, *Noord en Oost Tartarye*, I, Amsterdam 1692: pl. D. Cf. Yule, *Marco Polo* (see n. 70): I, clvi, § 84 as to the identification of *Polisacus* with *Pulisanghin*.

⁷⁷ Cf. Alexander von Humboldt, *Kritische Untersuchungen über die historische Entwicklung der geographischen Kenntnisse von der Neuen Welt*, aus dem Französischen übersetzt v. Julius Ludwig Ideler, I, Berlin 1836: 118 n. * and Henry Stevens, *Historical and Geographical Notes on the Earliest Discoveries in America 1453 –1530* [...], New Haven 1869: 34 n. * as to the various name forms appearing in early maps, and Richard Hakluyt, *Voyages in Search of the North-West Passage*, London-Paris-New York-Melbourne 1886: 51 as to a Portuguese witness of *Polisacus*.



Fig. 1 – Graeco-Arabic palimpsest Cod.gr. 2, fol. 22b, with traces of Giobert tincture applied

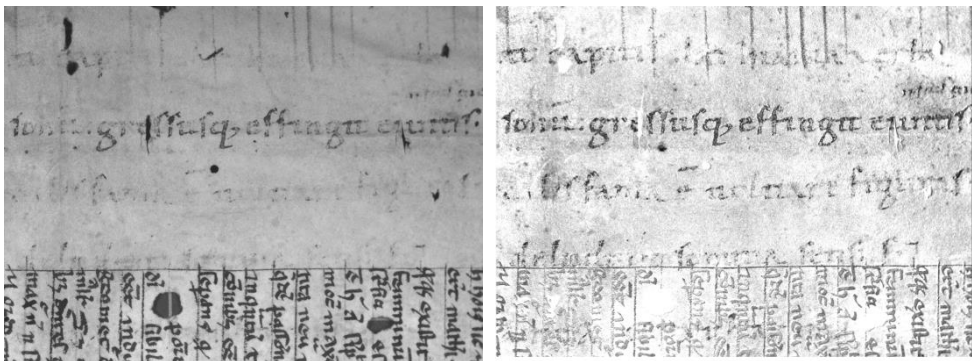


Fig. 2 – Latin palimpsest Fragm.lat. I 50, 2v

(excerpt; left: 560nm; right: multispectral image, edited)

- 639 *diuini adsimulat capitis dat inania uerba*
 640 *dat sine mente sonū gressusq, effingit euntis .*
 641 *morte obita qualis fama ē uolitare figuras*
 642 *aut quae sopitos deludunt somnia sensus .*
 643 *at primas laeta ante acies exultat imago*

Tab. I – Vergil, Aeneis LX, 639–643 in the Latin palimpsest Fragm.lat. I 50, 2v

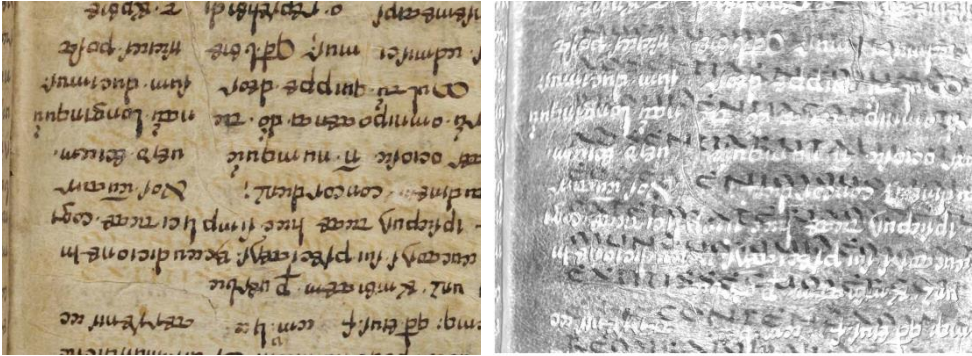


Fig. 3 – Latin palimpsest Cod. Sang. 213, p. 78
(excerpt; left: colour; right: multispectral image, edited)

- (1) *numquam fuit quae si docuerit tum demum*
- (2) *adsentiar ne mundum quidem divina*
- (3) *providentia constitutum et tamen sic*
- (4) *adsentiar ut aliis illum laqueis teneam.*
- (5) *eodem enim quo nolet revolvetur, ut di-*
- (6) *cat et materiam de qua mundus est et*
- (7) *mundum quidem (!) materia est natura*
- (8) *extitisse cum ergo (!) ipsam naturam deum*
- (9) *esse contendam nec enim potest face-*
- (10) *re mirabilia id est maxima ratione ...*

Tab. II – Lactantius, *Divinae institutiones*, lib. 2: *De origine erroris* (PL 6, 304 A-B)

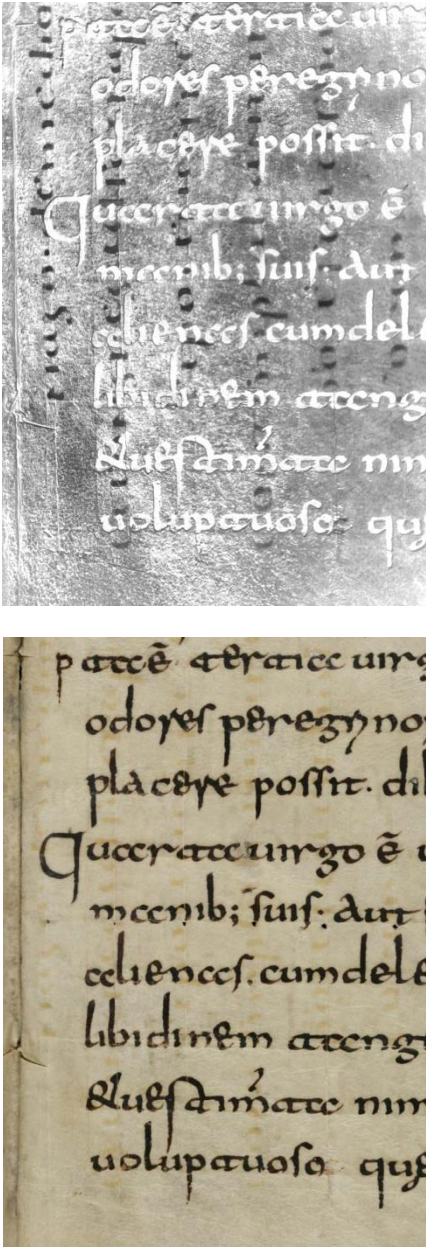


Fig. 4 – Latin palimpsest Cod. Sang. 193, p. 107 (excerpt; left: colour; right: multispectral image, edited)

	... <i>stai</i> <i>que</i> <i>egressi</i> <i>sunt</i> <i>Sedrac</i> <i>Misac</i> <i>et</i> <i>Abde-</i>	93
(1)	<i>nago</i> <i>de</i> <i>medio</i> <i>ignis</i>	
(2)	<i>et</i> <i>congregati</i> <i>satrapae</i> <i>magistratus</i> <i>et</i> <i>iudices</i>	94
(3)	<i>et</i> <i>potentes</i> <i>regis</i>	
(4)	<i>contemplabantur</i> <i>viros</i> <i>illos</i> <i>quoniam</i> <i>nihil</i>	
(5)	<i>potestatis</i> <i>habuisset</i> <i>ignis</i> <i>in</i> <i>corporibus</i>	
(6)	<i>eorum</i>	

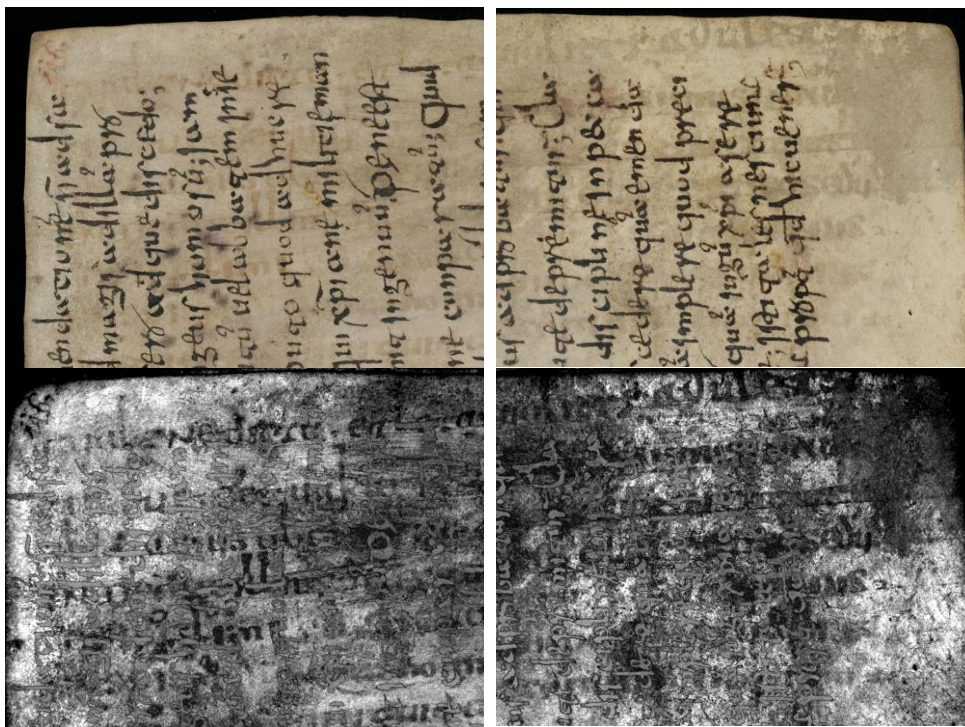


Fig. 5 – Latin palimpsest Cod. Sang. 194, p. 126
(excerpts; top: colour; bottom: same at 420 nm, edited)

	<i>sit vena</i>	18
(1)	<i>tua benedicta et laetare cum muliere adolescen-</i>	
(2)	<i>tiae tue . cerua karissima et gratissimus hinu-</i>	19
(3)	<i>lus eius ubera inebrient te omni tempore</i>	
(4)	<i>in amore illius delectare iugiter . quare sedu-</i>	20
(5)	<i>ceris fili mi ab aliena et foveris sinu alterius .</i>	
(6)	<i>respicit $\overline{\text{d}}\text{ns}$ vias hominis et omnes gressus illius</i>	21
(7)	<i>considerat . iniquitates suae capiunt impium</i>	22

Tab. IV – Prov. 5.18–22

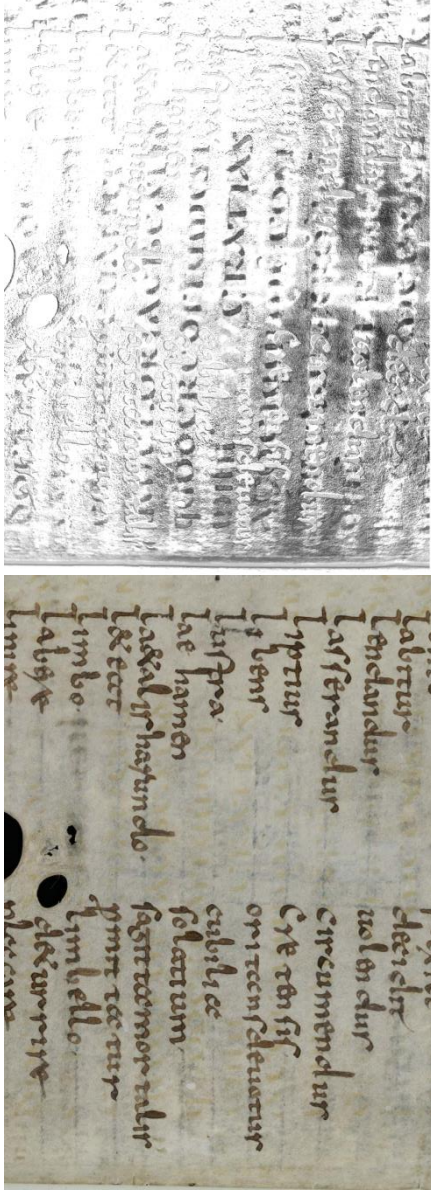


Fig. 6 – Latin palimpsest Cod. Sang. 908, p. 78 (excerpt; left: colour; right: multispectral image, edited)

(1)	10	... si quid aliud sanae								
(2)		doctrinae aduer-	Fidelis sermo et o-							
(3)		satur quae est se-	gni acceptione di-	15	(1)					
(4)		cundum euangeli-	gnus quia xps ihs ue-		(2)					
(5)		um gloriae beati dī	nit in mundum		(3)					
(6)		quod creditum est	peccatores sal-		(4)					
(7)		mihī gratias	uos facere quoru-		(5)					
(8)		ago ei qui me con-	m primus ego sum		(6)					
(9)		fortauit xpo ihu	sed ideo misericor-	16	(7)					
(10)		dno nostro · quia	diam consecutus		(8)					
(11)		fidelem me existi-	sum ...		(9)					
		mauit ...			(10)					
					(11)					

Tab. V – I Tim. 1.10–12 and 15–16

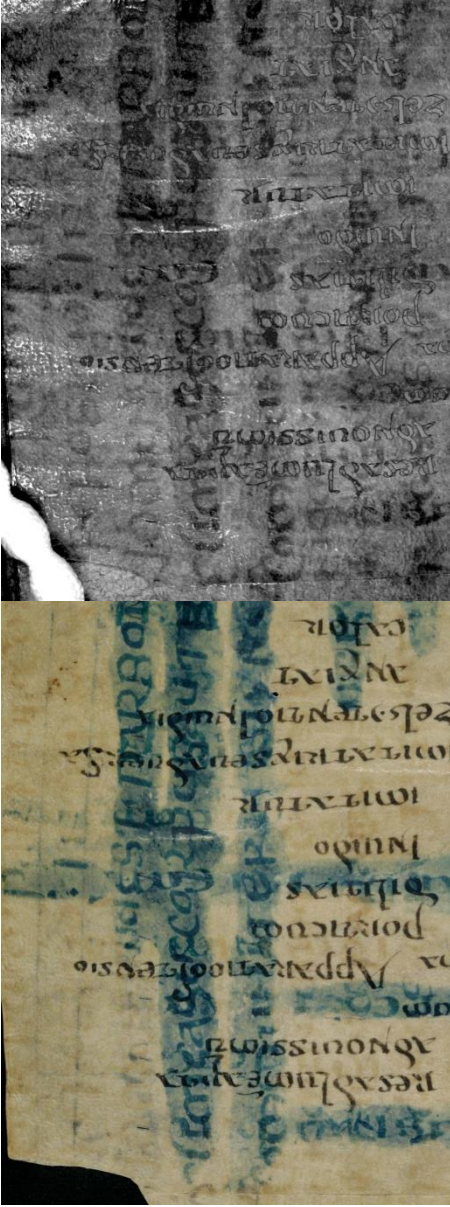
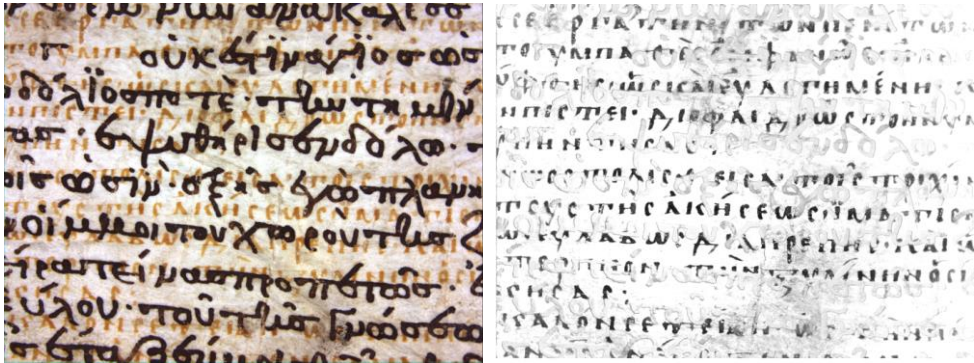


Fig. 8 – Latin palimpsest Cod. Sang. 912, p. 13 (excerpt; left: colour; right: 420nm)

(1)	<i>Partes orationis quot sunt octo quae</i>	(1)
(2)	<i>nomen pronomen verbum adverbium participium coniunctio</i>	(2)
(3)	<i>praepositio interiectio · de nomine</i>	(3)
(4)	<i>nomen quid est pars orationis</i>	(4)
(5)	<i>cum casu corpus aut rem proprie</i>	(5)
(6)	<i>communiterue significans .</i>	(6)
(7)	<i>nomini quot accidunt sex quae qualitas comparatio genus numerus figuratus</i>	(7)
(8)	<i>casus · qualitas nominum in quo est</i>	(8)

Tab. VII – Donatus, De partibus orationis ars minor, beginning

Fig. 9 – Greek palimpsest Cod. gr. 22, p. 4^f

(excerpt; left: colour; right: multispectral image, edited)

(1)	c ce εργατην τῶν πενίτων	(1)
(2)	το συμπαθὲς ἐμφανιὸς · οἱ λε*	(2)
(3)	ύφθης · ὡς καὶ ἐυλογημένη · κ	(3)
(4)	ν πιστει · διο φαιδρῶς τοῖν νυν	(4)
(5)	υπηνητας :	(5)
(6)	νωσ στολιθεισα · τοῖς τριχίν	(6)
(7)	τους τῆς ἀκήσεως · ἱματιμ	(7)
(8)	ω · ἐυλαβως διαπρεπης · και ὦ	(8)
(9)	τερπνον · τὴν ζ ὑ μνην ὀσί	(9)
(10)	σησας :	(10)
(11)	καλόν ce θεϊαν · ὡς τὴν πᾶ	(11)
(12)	αν ...	(12)

Tab. VIII – Tentative transcript

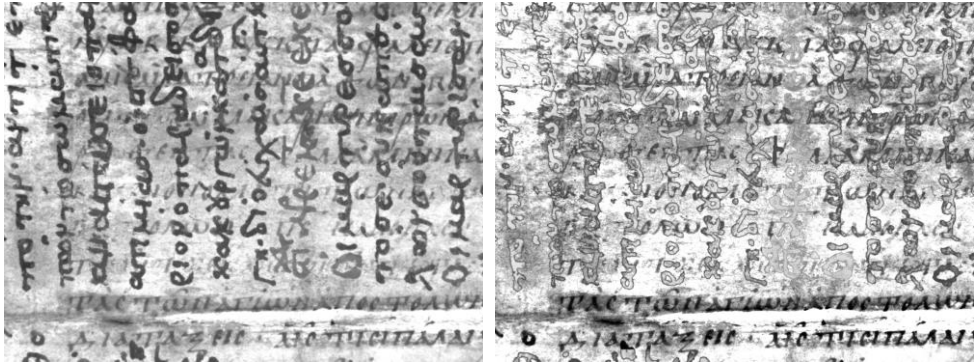


Fig. 10 – Greek palimpsest Cod. gr. 69, p. 2^v (excerpt; left: 440 nm; right: same, edited)

(1)		(1)
(2)	καὶ ἀσφαλεῖς π	(2)
(3)		(3)
(4)	ἐν μακαριῶν π̄ρων	(4)
(5)	θεντας λαλλήν κα	(5)
(6)	ν ονοματι τῶν α	(6)
(7)	ολῶν π̄ κανόνας	(7)
(8)	τ** ὑπ	(8)
(9)	τὰς τῶν ἁγίων ἀποστολῶν δια κλημεντος	(9)
(10)	διατάξεις · ἁΐστισι πάλαι υπο ετεροδο-	(10)

Tab. IX – Tentative transcript

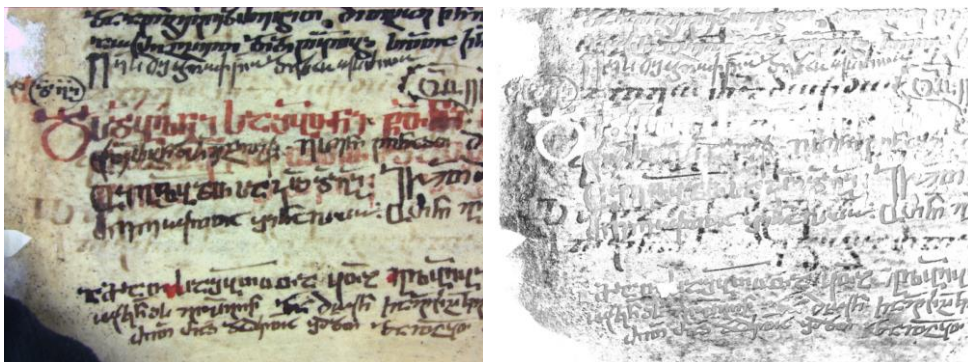


Fig. 11 – Georgian palimpsest V 1096 / II, f. 7
(excerpt; left: colour; right: multispectral image, edited)

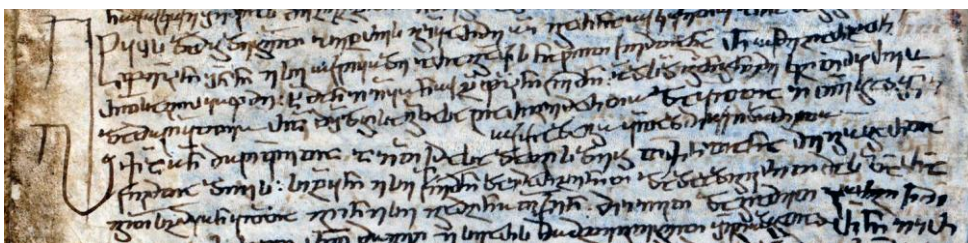


Fig. 22 – Georgian palimpsest V 1096 / II, f. 7 (excerpt)

(1)	<i>kctm̄q̄reo da moçq̄-</i>	<i>k(a)ctm(o)q̄(ua)reo da</i>	(3)
(2)	<i>aleo r̄a m̄šwidobisa</i>	<i>moçq̄aleo r(ayt)a m̄š(w)d(o)bisa</i>	(4)
	<i>gzsa çrvemarto</i>	<i>gzasa çarvemarto</i>	
(3)	<i>d* ***a ***** **</i>	<i>da q̄(ove)lta ġ(mr)te(e)bay š(e)ni</i>	
	<i>*****</i>	<i>ukadago</i>	(5)
(4)	<i>q̄lad miucdomelo .—</i>	<i>q̄(ov)lad miucdomelo .—</i>	
(5)	<i>Hrk̄a *n</i>	<i>H(r)k(u)a o(wpalma)n</i>	(6)
	<i>m̄çpt* ***** *****</i>	<i>moç(a)peta aġtk(u)masa davsdeb</i>	
(6)	<i>t̄kn̄ t̄n̄ megobarta</i>	<i>tk(ue)n tana megobarta</i>	
	<i>č****</i>	<i>čemta dġes : siq̄(ua)ni ese ...</i>	(7)

Tab. X – The lower and upper texts of fols. 7^v of the Leipzig ms. V 1096 / II contrasted

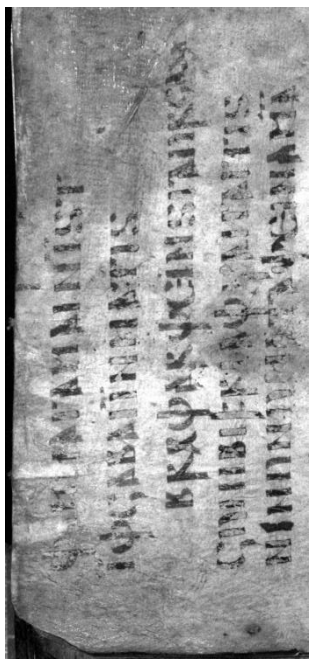
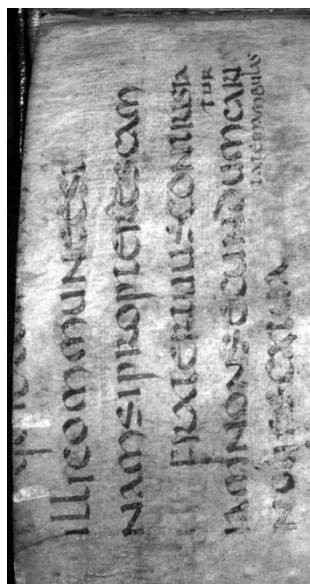


Fig. 13 – Gothic palimpsest Cod. Guelf. 64 Weiss., f. 255^r (excerpts, 420 nm)

(1)	14.14	<ΘΑ ΠΗΗΑΙΝ> [γ is> ρ <N>	[quid com]<mune esse>	14.14	(1)
(2)		ΦΑΗΗΑ ΓΑΗΑΙΝ ΙΣΤ	illi commune est		(2)
(3)	14.15	ΪΨ ΘΑΒΑΙ ΪΝ ΗΑΤΙΣ	nam si propter ^a escam	14.15	(3)
(4)		ΒΚΑΦΑΡΚ ΨΕΙΝΣ ΓΑΠΚ _{ΡΑΡ}	frater tuus contrista _{tur}		(4)
(5)		ΘΠ ΝΙ ΒΙ ΞΡΑΨΥΑΙ ΓΑΓΓΙΣ	iam non secundum cari ^{tatem} ambulas		(5)
(6)		ΝΙ ΝΠΠΠ ΗΑΤΑ ΨΕΙΝΑΗΑ	noli esca tua		(6)

Tab. XI – Rom. 14.14–5 with first line restored

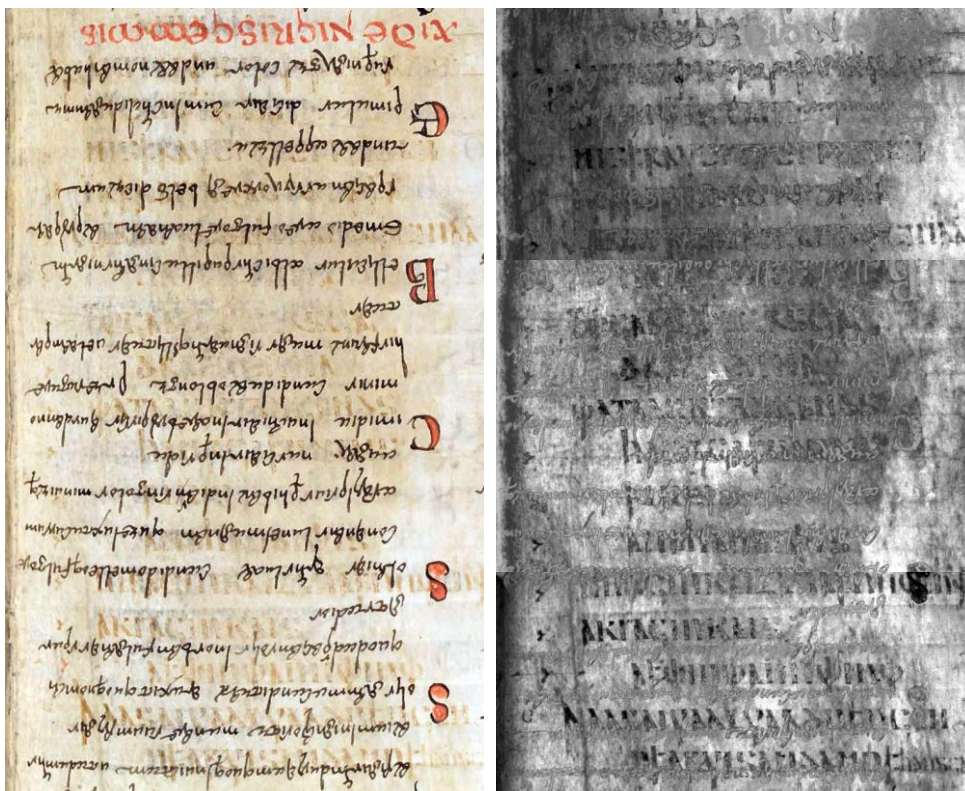


Fig. 14 – Gothic palimpsest Cod. Guelf. 64 Weiss., f. 256^v
 (excerpts, left: colour; right: multispectral images, edited)

(1)	12.19	ΛΙΠΒΑΝΣ	[c]arissimi	12.19	(1)
(2)		↔ ακ ριψι σταφ φυαικ[ειν]	↔ sed date locum irae		(2)
(3)		Γηελιψ ιστ απκ	Scribunt enim		(3)
(4)		> ηις ηκαρειτ λειταιαρπ	> mihi uindictam		(4)
(5)		> ικ ηκαγιαρ υιψιφ ηα	> ego retribuam dicit dñs		(5)
(6)	12.20	> Σαβαη ηκαεα ηεαηα φειηαα	> Si esurierit inimicus tuus	12.20	(6)
(7)		> ηα[τ ρι]φ ιηηα	> ciba illum		(7)
(8)		> ιψ σαβαη φηηκαεα	> et si siterit		(8)
(9)		> ακαηκει ιηα	> po[tum] da illi		(9)
(10)		> φατα απκ ταηεαηα	> hoc enim faciens		(10)
(11)		> ηαηκαεα ηηηηηα	> [c]a[r]bones ignis		(11)
(12)		> ηηηηα	> co[n]g[ere]s		(12)
(13)		> ηηα ηαηηηα ις	> [super] ca[put] eius		(13)
(14)	12.21	> ηη ηαεηηαηαηα ηε ηηηηηα	> noli [uin]ci a malo	12.21	(14)
(15)		> ακ ηαεηηαηα	> sed uince		(15)
(16)	13.1	↔ ηε φηηα ηηηηηα	↔ in bono malum	13.1	(16)
(17)		> ηαα ηαηαηα ηαηαηαηα	> mnis anima potestati-		(17)
(18)		> ηεαηαηαηα ηε ηαηαηαηα	> sublimibus subdita sit		(18)

Tab. XII – Rom. 12.21–13.1 with additional marks



Fig. 15 – Gothic palimpsest Cod. Guelf. 64 Weiss., f. 280^r (excerpts, 420 nm)

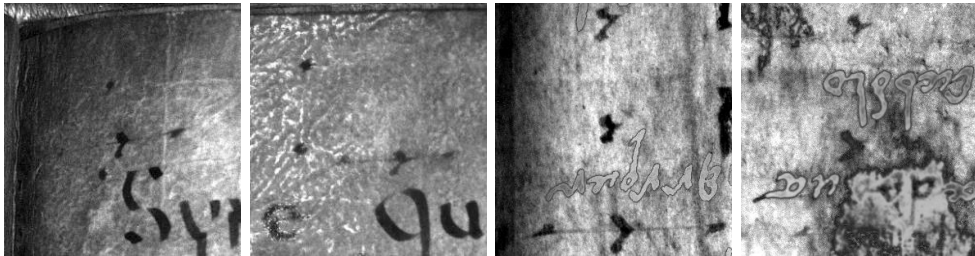


Fig. 16 – Extra marks contrasted (fol. 280^{ra}, 280^{rb}, 256^{va}, 256^{vb})

(1)	15.3	<ia>[γ]<ειρα>	<inproperia>	15.3	(1)
(2)		ϕιζε ιαγειτϵρναρ(η)ε φηκ	inproperantium		(2)
(3)		↔ ραρκησπη ρηρ ηικ	↔ tibi caeciderun ^t super		(3)
(4)	15.4	Συρ ριαν ρηκ	Quaecumq· enim	15.4	(4)

Tab. XIII – Rom. 15.3–4 with additional marks

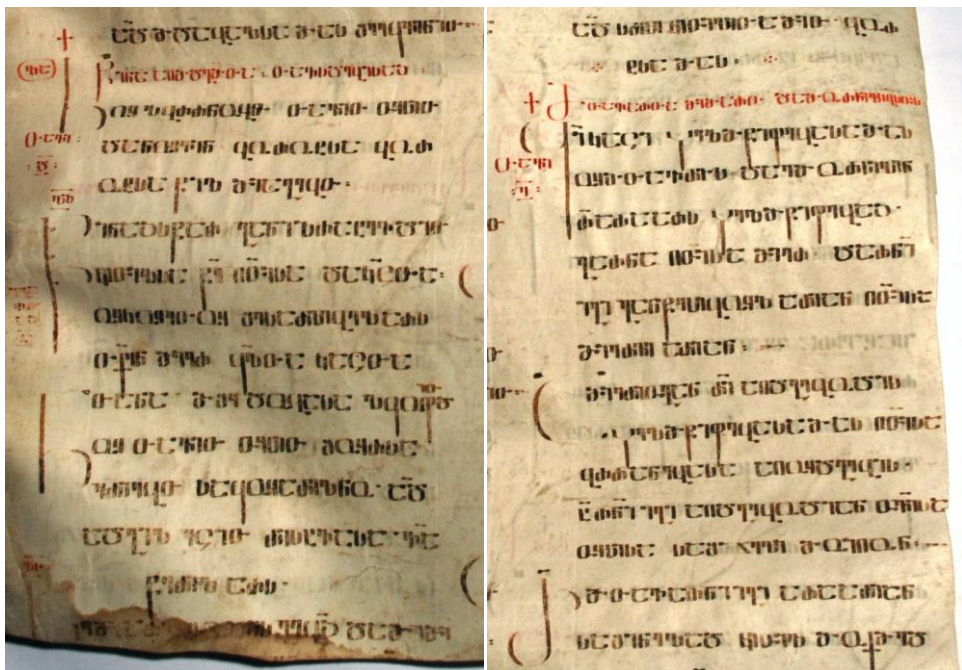


Fig. 17 – Euthalian ‘chapters’ 4 and 5 ~ Rom. 12.16 and 13.1 in the Georgian ms. Kut. 176, f. 130^r



Fig. 18 – Gothic palimpsest Cod. Guelf. 64 Weiss., fol. 277^r (excerpts, 420 nm)

(1)	11.36	>	ορη εν ενθα αλλα	>	et in ipso omnia	11.36	(1)
(2)		>	εννηη υπλφης	>	ipsi gloria		(2)
(3)		↔	αη αιων η αην η	↔	in saecula · amen ·		(3)
(4)		↔ > ιζ >	Βι[α]γα ηη εζυις βρωφκγης		Obsecro itaq· uos fratres		(4)
(5)		ξ	φαικη βλειφειν γψς		per misericordiam dī		(5)
(6)	12.1		ησγιβαν λεικα εζυρακα		ut exhibeatis corpora uestr<a>	12.1	(6)
(7)			σαπα υιγανη γειθανα		hostiam uiuam scam		(7)
(8)			γαλα γαλεικαριανα γψα		placentem dō		(8)
(9)			αναρφαητανα		rationabile		(9)
(10)			βλατινασση εζυρακα		obsequium uestru		(10)

Tab. XIV – Rom. 11.36–12.1 with additional marks

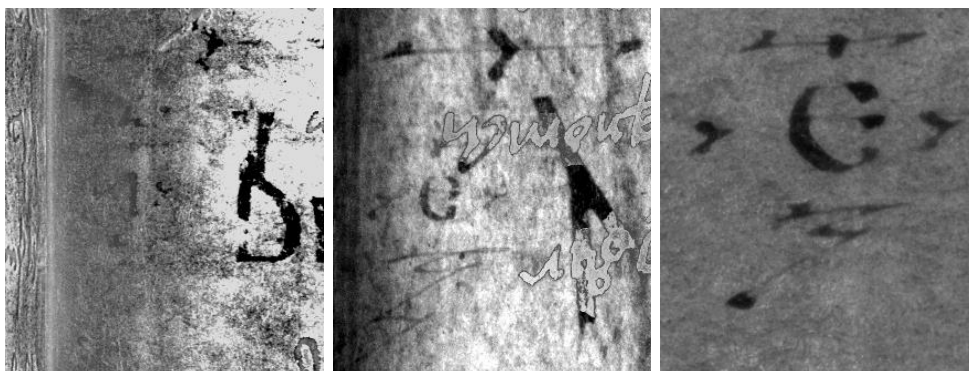


Fig. 19a-c – Numerical marks contrasted (fol. 277^{ra}, 256^{va}, 280^v)

	1.1–		–3.12	
I				
	3.13–		–6.14	
II				
	6.15–		–9.9	
III				
	9.10–		–11.33	
IV				
	11.33–12.5		15.3–13	
277 ^{rv}	12.5–17		14.20–15.3	280 ^{rv}
	12.17–13.5		14.9–20	
	256 ^{vr}	13.5–14	14.1–9	255 ^{vr}
V				E

Tab. XV – The Gothic codex reconstructed

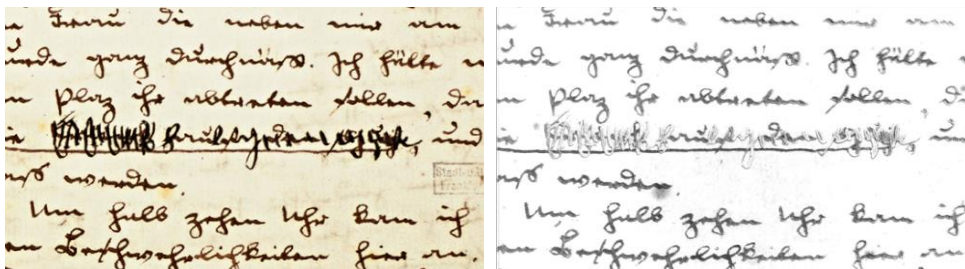


Fig. 20 – Börne letter no. 135 (of 1819) (excerpt, left: colour; right: multispectral image, edited)

- | | | |
|-----|---|-----|
| (1) | Eine Frau die neben mir am Schlege saß | (1) |
| (2) | wurde ganz durchnäßt. Ich hätte meinen trock= | (2) |
| (3) | nen Platz ihr abtreten sollen, dachte aber: | (3) |
| (4) | <u>Die Kränk auf den Guj</u> , und ließ sie | (4) |
| (5) | naß werden. | (5) |
| (6) | Um halb zehn Uhr kam ich nach gro= | (6) |
| (7) | ßen Beschwerlichkeiten hier an. Ich sagte | (7) |

Tab. XVI – Tentative transcript

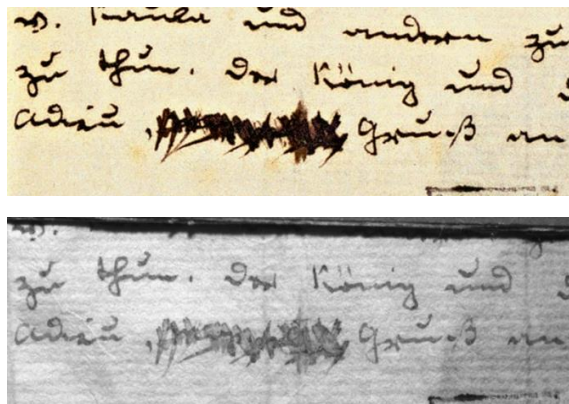


Fig. 21 – Börne letter no. 156 (of 1820) (excerpt, left: colour; right: 920 nm)

- | | | |
|-----|--|-----|
| (1) | Morgen habe ich die Gallerie zu sehen, ins Theater, zur Frau | (1) |
| (2) | v. Kraule und anderen zu gehen, alle Beine habe ich wohl | (2) |
| (3) | zu thun. Der König und die Königin lassen Sie grüßen. | (3) |
| (4) | Adieu, Moppel, Gruß an alle. | (4) |

Tab. XVII – Tentative transcript

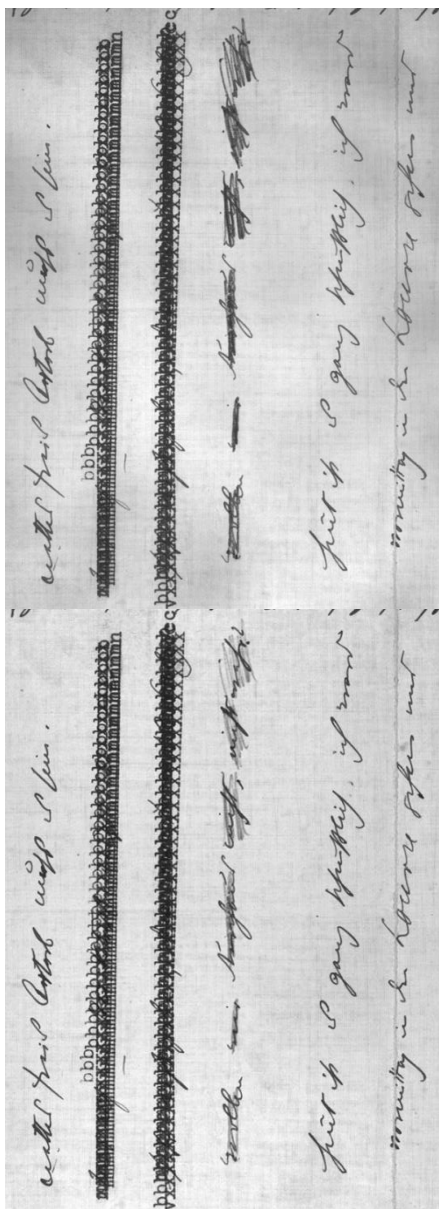


Fig. 22a-b – Hofmannsthal letter no. 8/1 (excerpt; left: 480nm; right: 600nm)

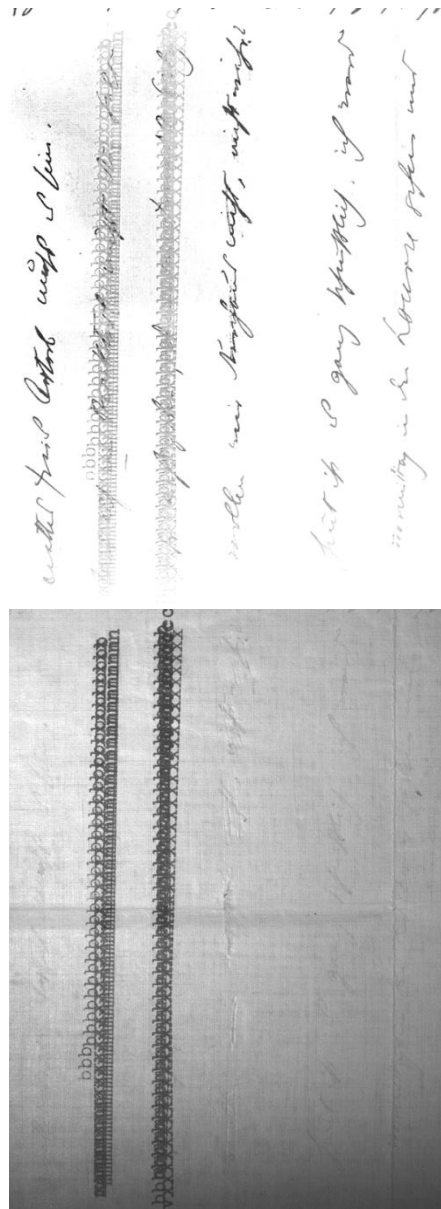


Fig. 22c-d – Hofmannsthal letter no. 8/1 (left: 940nm; right: multispectral analysis)

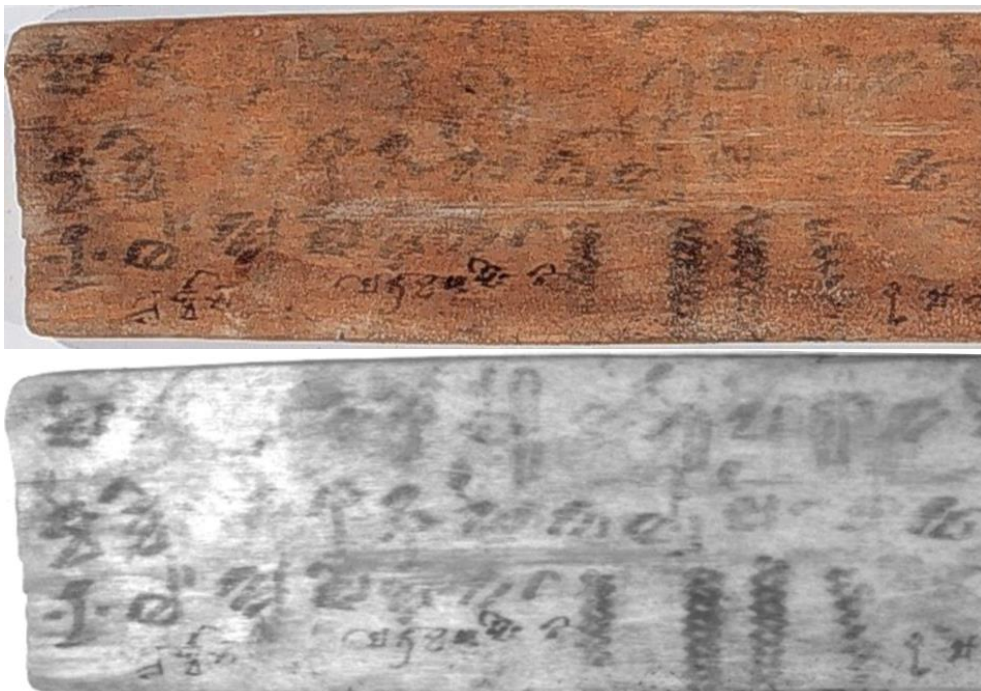


Fig. 23 – Tocharian monument THT 4064 (excerpt; upper image: colour; lower image: 820 nm)

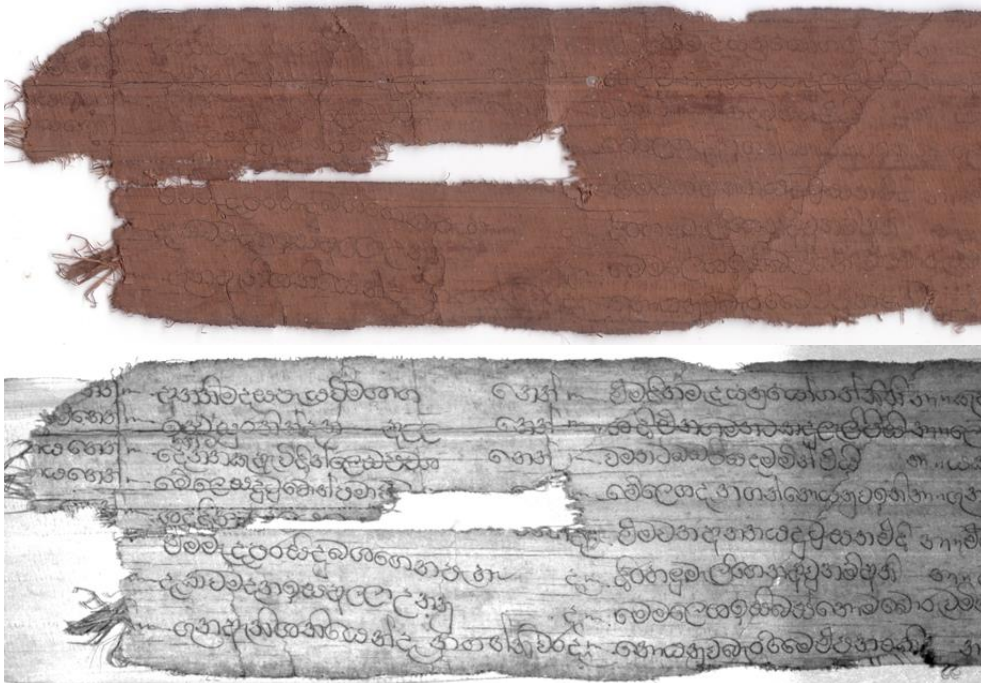


Fig. 24 – Sinhalese palm leaf document (excerpt; upper image: colour; lower image: 820 nm)



Fig. 25 – Sogdian manuscript no. 107 (excerpt, left: colour; right: 560 nm, edited)



Fig. 26 – St. Gall codex no. 911, p. 321 (excerpt, left: colour; right: 560 nm, edited)



Fig. 27 – Behaim Globe, Egypt (excerpt, left: 580 nm, right: 660 nm)

- | | | |
|-----|------------------------------|-----|
| (1) | <i>Soldan</i> | (1) |
| (2) | <i>ein konig des heiligē</i> | (2) |
| (3) | <i>lands ein her vber</i> | (3) |
| (4) | <i>vil konigreich</i> | (4) |
| (5) | <i>arabien egiptē vnd</i> | (5) |
| (6) | <i>damasko</i> | (6) |

Tab. XVIII – Transcript

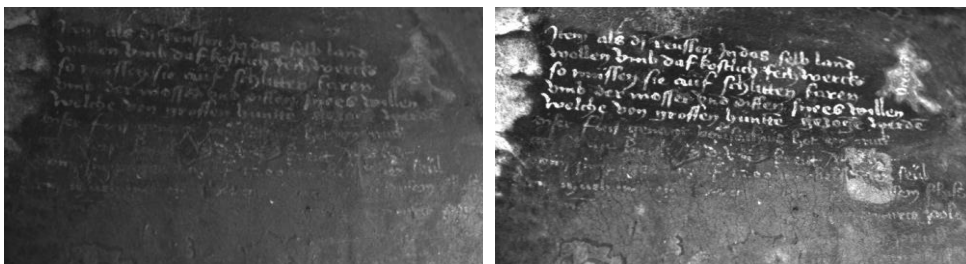


Fig. 28 – Behaim Globe, legend east of Northern Asia (excerpt, left: 660 nm, right: 900 nm)

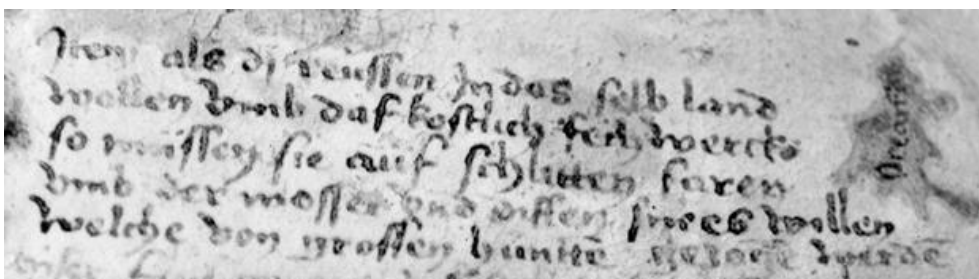


Fig. 29 – Same, first part (900 nm, edited)

- | | | |
|-----|--|-----|
| (1) | <i>Item als di reussen in das selb land</i> | (1) |
| (2) | <i>wollen umb das kostlich fechwerck</i> | (2) |
| (3) | <i>so müssen sie auf schlitten faren</i> | (3) |
| (4) | <i>umb der mosser und diffen snees willen</i> | (4) |
| (5) | <i>welche von grossen hunttē gezogen werde</i> | (5) |

Tab. XIX – Transcript (first part)

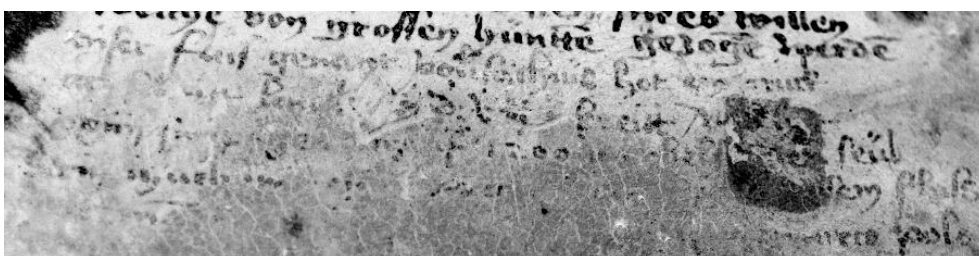


Fig. 30 – Same, second part (900 nm, edited)

- | | | |
|-----|---|-----|
| (1) | <i>diser flus genant bolisachiüs hot ein bruck</i> | (1) |
| (2) | <i>ccc schritte lanck vnd viii breitt vnd [ihr</i> | (2) |
| (3) | <i>bogen sind getragen] auf 1200 marbelsteinen seül</i> | (3) |
| (4) | <i>die disem flusz</i> | (4) |
| (5) | <i>... .. marco polo</i> | (5) |

Tab. XX – Transcript (second part)