CHAPTER 2. THE CODEX ZACYNTHIUS PROJECT (H.A.G. HOUGHTON)

The different aspects of the Codex Zacynthius Project enabled the work to be subdivided into a series of connected tasks, each undertaken by members of the project with specialist expertise. Its duration of twenty-four months was a relatively short period of time for the creation of new images, the transcription of both manuscripts, the identification of the extracts, a preliminary study of the significance of the catena and the and the translation of the catena into English, which meant that efficient project management was key to its successful delivery.

The key to the investigation of the undertext was the multispectral imaging of the palimpsest. While arrangements were being made for this, transcribers were able to begin work on the overtext from the beginning of the project in February 2018. A fresh set of images of the lectionary was produced by Amélie Deblauwe of the Digital Content Unit at Cambridge University Library, while Amy Myshrall, transcription co-ordinator for the International Greek New Testament project, prepared an electronic base text in XML of the passages in a Greek gospel lectionary. Two postgraduate students at Birmingham, Gavriil-Ioannis Boutziopoulos and Thomas William Ruston, were recruited to make independent transcriptions of the overtext of Codex Zacynthius using the Online Transcription Editor (developed as part of the Workspace for Collaborative Editing) to edit the base text. In fact, the size of the transcription was such that the lectionary was split into eight separate files (five for the Synaxarion and three for the Menologion) in order to avoid overloading the interface. The complexity of the material meant that the preparation of these initial transcriptions by part-time contributors took fourteen months. On the completion of each portion of the text, the two versions were compared by Myshrall using automated comparison software in an environment developed by Catherine Smith, ITSEE's technical lead. Myshrall then reconciled the differences with reference to the images and proofread each page within the Online Transcription Editor. The full draft of the lectionary transcription was completed in August 2019, and it was proofread again in its final form before the release of the electronic edition.

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¹ See further H.A.G. Houghton, M. Sievers and C.J. Smith, 'The Workspace for Collaborative Editing,' *Digital Humanities 2014 Conference Abstracts, EPFL-UNIL, Lausanne, Switzerland, 8–12 July 2014*, 210–11; H.A.G. Houghton and C.J. Smith, 'Digital Editing and the Greek New Testament,' in *Ancient Worlds in Digital Culture* (ed. Claire Clivaz, Paul Dilley and David Hamidović, Digital Biblical Studies 1. Leiden: Brill, 2016), 110–27.

Outhwaite, as the lead on the project for Cambridge University Library, arranged for the imaging of the undertext to be carried out by the Early Manuscripts Electronic Library (EMEL), led by Michael Phelps, in collaboration with the Centre for the Study of Manuscript Cultures at the University of Hamburg directed by Ira Rabin. A team of image capture and processing specialists, consisting of Roger Easton, Keith Knox and Damianos Kasotakis, took up residence in Cambridge for three weeks in July 2018.² Various members of the project from ITSEE, including Alba Fedeli who had worked extensively on palimpsests, were able to be present during the imaging process in order to offer feedback on the initial results and identify places where further processing might be necessary. The imaging was undertaken in climate-controlled conditions within the University Library itself. Each page was photographed fifty-one times, using different wavelengths of light (from infrared to ultraviolet) as well as X-ray. Care was taken to ensure that there was no movement of the manuscript during the photographic sequence, which took around seven minutes for each page, as the multispectral image was to be created from a combination of these images. The camera was a MegaVision E7, with an Apo-Digitar M26 lens: the raw greyscale images were available in flattened forms as TIFF files of 100MB each and JPEGs of around 10MB.

The initial processing of the images was undertaken soon after their capture by Easton and Knox in the neighbouring room. Using high-performance computers, they used a variety of techniques in order to obtain the greatest legibility of the undertext. Four sets of images were produced during the first week.3 The first was a 'pseudo-colour' set, in which the ink of the undertext was coloured red (an example is provided in Image 2.1). As the black and red of the overtext remained, this often interfered with the legibility of the undertext. The second were known as 'sharpies', in greyscale, with the black ink of the overtext removed entirely (Image 2.2). These were helpful to provide an overall sense of the page, but the obliteration of most of the overtext meant that joining the traces of the undertext was not always easy; the red ink from the overtext, such as the ekphonetic notation in the lectionary, continued to be visible. The third was a set of colour images combining all the wavelengths, comparable to the appearance of the manuscript in normal light. Finally, a fourth folder consisted of images in raking light, which offered an overview of the surface of the parchment, and a set of 'transmission ratio' images. The latter took the ratio of the infrared transmission and reflectance images (both at 940 nm). This ratio often shows up characters from the flesh side where the erased ink has eaten into the parchment, leaving cavities in the shape of the characters but with no surviving stains from the ink: without the stains, there is little or no response to ultraviolet illumination, yet the cavities allow more light through the parchment and thereby reveal the missing text as characters that are brighter than the parchment. Prior to the imaging, the team had

² In addition, Amélie Deblauwe and Dale Stewart assisted Kasotakis with the handling of the manuscript. A second camera operator, Ivan Shevchuk, was unable to obtain a visa to enter the UK in time. Michael Phelps himself was present for the final week.

³ For more on multispectral imaging by the members of this team, see Roger L. Easton, Keith T. Knox and William A. Christens-Barry, 'Multispectral imaging of the Archimedes palimpsest,' *Proceedings of 32nd Applied Imagery Pattern Recognition Workshop* (2003): 111–16. A video about the process for Codex Zacynthius, produced during the first week of imaging, may be viewed at https://www.youtube.com/watch?v=XxXb8qBYgPQ.

expected that the transmission ratio images would be the most successful in revealing the undertext of Codex Zacynthius. Unfortunately the results were disappointing, despite multiple attempts at combinations incorporating the transmission ratio images, and ultimately they did not form part of the final distribution.

During the final week of imaging, Knox's attention was drawn to an unexpected glitch in one of the combined images. Examining this further, he discovered three pairs of wavelengths in which one member of each pair could be divided into the other to suppress the overtext, making the undertext particularly prominent. The combination of these led to a new set of images, known as 'triples', which were a significant improvement on all of the previous attempts: the ink on the flesh side of the parchment was normally easily legible, while on the hair side it had sometimes been rubbed away but was still more evident than before (see Image 2.3). Again, pseudo-colouring was applied to assist with distinguishing the different types of ink. The majority of the undertext was coloured purple or dark blue, although where red ink had been used for titles or initials, this appeared as a mid-blue. The black ink of the overtext was coloured in a light blue or cyan colour, which made it less noticeable to the human eye and easier to distinguish from the undertext, while the rubrics for the neumes and lectionary indications became a slightly redder purple than the undertext. Within these images, it was also possible to use Adobe Photoshop to change the hues or to invert the colours: the latter sometimes improved legibility by enhancing the outline of letters where the ink had eaten away at the parchment. The quality of the triple images was such that the project decided to use them alone for transcription purposes and display in the electronic edition, rather than presenting users with a series of options. 4 Nevertheless, the original set of the raw image data for each page has been made available through the University of Birmingham's Institutional Research Archive to allow the possibility of re-use and further processing in the future.5

As the multispectral images consisted of a file for each individual page of the current manuscript, in order to facilitate the transcription of the undertext (and the final edition) the pages of the original manuscript had to be reconstituted by joining together the two relevant images from within the quire. This task was undertaken by Alba Fedeli during the autumn of 2018. For this, she relied on a concordance of the overtext and undertext leaves prepared by Amy Myshrall, presented as Appendix 1 in the current volume. As it was impossible to predict how much text might be missing in the middle of each page, where the leaves were bound in the central gutter of the manuscript, the images were not cropped at this point. In fact it seems that relatively few lines are obscured, so these images are slightly taller than the original pages would have been. To avoid any loss of quality and follow the practice of the Cambridge University Digital Library, these files were kept in TIFF format.

⁴ Contrast the presentation of the Sinai Palimpsest project, where users are presented with a range of images at different combinations: https://sinai.library.ucla.edu/.

⁵ See further the Project Outputs listed on page xvi above.

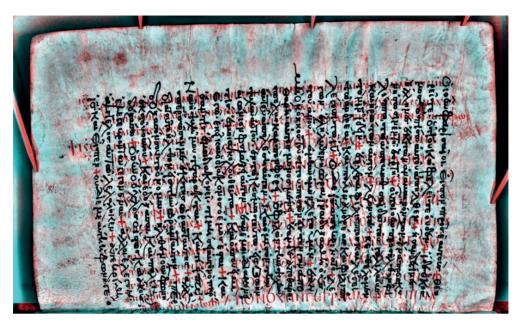


Image 2.1: Pseudocolour image of modern fol. 119v (catena fol. XXVIIIv)



Image 2.2: 'Sharpie' image of modern fol. 119v (catena fol. XXVIIIv)

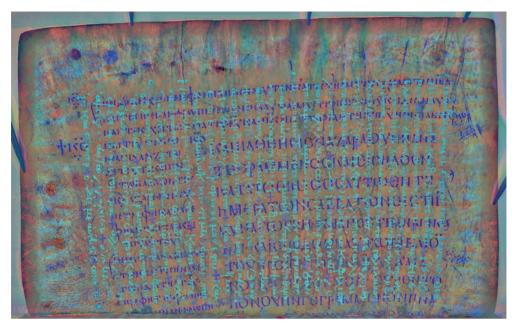


Image 2.3: Triple image of modern fol. 119v (catena fol. XXVIIIv)

The two transcribers of the undertext, Rachel Kevern and Panagiotis Manafis, joined the project in September 2018. Initially, they made two independent transcriptions of the biblical text, using the Online Transcription Editor, in order to standardise their practice. After completing thirty-four pages in this way, they switched to a single initial transcription of each page, which was reviewed by the other transcriber. Comparison was made with Tregelles' 1861 edition, as well as Greenlee's list of corrections. With the new multispectral images, not only was it now possible to resolve the questions raised by Greenlee, but three further readings could be established in the biblical text where Tregelles' edition was in error. For the catena, Greenlee's typescript was transcribed using basic markup in a standard text editor. Although the amount of text that Greenlee had been able to read or reconstruct was remarkable, his transcription did not include lineation. During the first comparison with the new images, Kevern added the formatting information to this text file. Manafis then proofread Greenlee's transcription against the manuscript. The similarity between the catena of Codex Zacynthius and Paris,

⁶On this method of working, see H.A.G. Houghton, 'Electronic Transcriptions of New Testament Manuscripts and their Accuracy, Documentation and Publication,' in *Ancient Manuscripts in Digital Culture: Visualisation, Data Mining, Communication* (ed. Claire Clivaz, David Hamidović and Sarah Bowen Savant. Digital Biblical Studies 3. Leiden: Brill, 2019), 133–53.

See Chapter 4 below.
 On Greenlee's work, see further pages 4–5.

Bibliothèque nationale de France, supplément grec 612 (GA 747)—which is discussed extensively in Chapter 8 below—had already been noted by Greenlee: this was also established independently by the CATENA project. The Paris manuscript, along with printed texts of the patristic scholia (where these existed), was therefore used by Manafis to supply small portions of text in Codex Zacynthius which remained illegible. The first draft of the catena transcription was completed in July 2019.

While the transcription was in progress, William Lamb used Greenlee's typescript to examine the identification of each of the scholia. Although many of the extracts in the manuscript are assigned a heading with an indication of the source—down even to the number of individual sermons or letters within a corpus—these are not always accurate. Lamb used the electronic corpus of the *Thesaurus Linguae Graecae* to identify the text, compiling a concordance as an online spreadsheet, which enabled other project members to contribute information from their own research on the catena. It proved possible to locate the source of the majority of the extracts, including those whose attribution was listed as anonymous (ἐξ ἀνεπιγράφου). Nevertheless, although the TLG includes a full text of Cramer's transcription of the Catena on Luke, some of the key publications in this field are still missing from this corpus. Sickenberger's collection of material from Titus of Bostra and Clement of Alexandria and, most importantly, Reuss' assembly of material from commentaries on Luke therefore had to be cross-checked manually. The final set of identifications deriving from this spreadsheet is presented at the end of Chapter 5, while the sources are discussed in Chapters 6–8.

The English translation of the catena, undertaken by Hugh Houghton, was created by replacing the Greek text in the transcription file but preserving the layout and paratextual features. While an attempt was made to conform the translation to the lineation of the manuscript, details such as the size of characters, unclear letters and text obscured by the gutter were not retained. Instances of non-standard orthography were not reproduced, although corrections were translated when they resulted in a change of meaning. The initial translation was made directly from Greek, which acted as a first check on the transcription of the undertext: unexpected readings and potential typographical errors were compared with the images of the manuscript, and any discrepancies corrected. This literal version was reviewed by Lamb, who drew Houghton's attention to Payne-Smith's translation of the Syriac text of Cyril of Alexandria's *Homilies on Luke* and some of the Greek fragments assembled by Mai. ¹³ This provided a helpful comparison for a

⁹ J.H. Greenlee, 'The Catena of Codex Zacynthius,' *Biblica* 40 (1959): 992–1001, 1000. Unfortunately, the CATENA project did not examine the Codex Palatinus until several months after the end of the Codex Zacynthius Project (see pages xvi and 70).

¹⁰ See further Chapter 6.

¹¹ On this designation, see pages 63 and 100 below.

¹² On these editions, see page 5–6 above.

¹³ Robert Payne Smith, *The Gospel according to S. Luke by S. Cyril, Patriarch of Alexandria. Now first translated into English from an Ancient Syriac Version.* 2 vols. (Oxford: OUP, 1859). The text of this translation had been made available online by Roger Pearse in 2008 [http://www.tertullian.org/fathers/cyril_on_luke_00_eintro.htm]. This searchable version

substantial amount of the text. Likewise, Lienhard's translation of the Latin version of Origen's *Homilies on Luke* and various Greek fragments was used for cross-reference. Nevertheless, the fact that most of the catena had not previously been translated from Greek meant that careful review was required in order to enable the production of something that was sufficiently literal enough to assist users with some Greek but also readable in English. The translation of the gospel text was produced by editing the existing transcription of Luke in a similar fashion. This was done by Robert Ferro, a pupil at King Edward's School, Edgbaston, Birmingham, during a period of work experience in July 2019. The biblical text was supplied from the New Revised Standard Version: where the text of Luke in Codex Zacynthius differed from the editorial text of Nestle-Aland 28 (taken to represent the basis of the NRSV), the translation was amended to try to reproduce this difference: this included word order, but not orthography.

On the completion of the catena transcription and translation in the plain-text editor, they were converted into XML by Catherine Smith using a set of Python scripts. The resulting XML conformed to the TEI P5 Guidelines in order to enable it to be easily manipulated and also archived in a standard encoding. 15 Information such as the actual identification of each of the patristic scholia (from Lamb's spreadsheet) and the equivalent page numbers in the overtext was added as attributes to the XML, both for reference purposes and to enhance the electronic edition. Smith developed the web presentation of the transcription (and the translation) by creating a single HTML file for each page of the undertext by combining the XML transcriptions of the biblical text and the catena. The resulting layout in a browser aims to mirror the manuscript page as closely as possible using HTML and a cascading style sheet (CSS). As the undertext was written in majuscule, even though the transcription had been made using standard lower-case Greek letters, the project decided to use an uncial font for its display (GFS Decker) in order to resemble the appearance of the manuscript. The marginalia required the creation of various zones on the page in order to display each in its correct location. In addition, the varying width of the columns required some manual adjustments to be made to the CSS for individual pages: although smaller script is used on certain pages in the manuscript, it was decided to maintain the same font size throughout. To assist with maintaining the original column width, only the first hand reading was displayed for corrections, while abbreviations were indicated by a symbol (°): mouseover boxes were used to present the full information to users. Smith was also responsible for converting the XML of the lectionary transcription into individual HTML pages to the specification of the project. Again, the XML was

greatly facilitated the identification of the Greek fragments within the complete text. However (as Pearse notes in his preface) it was necessary to refer to Payne-Smith's original publication in order to confirm the exact source of each portion.

¹⁴ Joseph T. Lienhard, *Origen: Homilies on Luke, Fragments on Luke.* Fathers of the Church 94 (Washington DC: Catholic University of America, 1996).

¹⁵ See further the Project Outputs listed on page xvi above.

enhanced by the addition of translations of the lection indications and marginalia as attributes, to assist users of the electronic edition. The first version of the web presentation for both the undertext and overtext was proofread by Amy Myshrall in December 2019, with adjustments to the undertext being incorporated into the files of both the transcription and translation. As observed in the course of the Codex Sinaiticus Project which had run at ITSEE over a decade earlier, the full electronic presentation brought to light some of the inconsistencies of the production of the original document, and it was occasionally necessary to compromise in the display of the text. ¹⁶

The creation of the electronic edition within the Cambridge University Digital Library was prepared by Huw Jones in the Digital Content Unit at Cambridge in December 2019 and January 2020. The simplest form of presentation was to treat the overtext and undertext as two independent manuscripts, but provide links to the corresponding folios between the two witnesses. This was initially accomplished by means of a concordance document with hyperlinks, hosted on the University of Birmingham Institutional Research Archive along with detailed tables of contents for each manuscript. 17 As envisaged in the original project proposal, upgrades to the Digital Library meant that the functionality was added to rotate the images in order to examine what is visible of the undertext on images of the lectionary. However, as the Digital Library itself remained restricted to the display of a single image at a time, links were provided to a Mirador interface for users wishing to compare photographs taken under normal light with the multispectral images. An alternative is to open multiple browser windows, one for the overtext and undertext: pending further development of the Digital Library interface, this also remains the most straightforward way to compare the transcription and translation of the catena. The electronic edition was released in the Cambridge University Digital Library shortly before the conclusion of the project at the end of January 2020.

The challenges of producing and still more importantly maintaining an electronic edition meant that during the course of the project it was also decided to produce a printed edition of the transcription of the undertext. Catherine Smith developed a workflow for exporting the XML into a series of tables which was then incorporated into the Microsoft Word template for the *Texts and Studies* series and adjusted manually as required. The print format allowed additional flexibility with the placing of marginalia and the reproduction of the page layout as well as a further opportunity to proofread the online edition. The translation was included on each facing page of the printed edition as a continuous text in order to provide space to include notes on the transcription and text at the foot of each page.

¹⁶ See Peter Robinson, 'The Making of the Codex Sinaiticus Electronic Book,' in *Codex Sinaiticus*. New Perspectives on the Ancient Biblical Manuscript (ed. by Scot McKendrick, David Parker, Amy Myshrall and Cillian O'Hogan. London: British Library and Peabody MA: Hendrickson, 2015), 261–77 and, more broadly, H.A.G. Houghton, 'The Electronic Scriptorium: Markup for New Testament Manuscripts,' in *Digital Humanities in Biblical, Early Jewish and Early Christian Studies* (ed. Claire Clivaz, Andrew Gregory and David Hamidović. Leiden: Brill, 2014), 31–60.

¹⁷ See http://epapers.bham.ac.uk/3280 as well as http://epapers.bham.ac.uk/3278 and http://epapers.bham.ac.uk/3279.

As the project was in progress, a variety of additional material came to light. Although Parker already had Birdsall's copy of Greenlee's transcription, it was only during the digitisation of Birdsall's correspondence in March 2019 that Parker rediscovered Greenlee's letters to Birdsall describing his working practices at the Bodleian. In the following month, J.K. Elliott informed Parker that he had come across a typescript entitled 'Codex Zacynthius: The Catena and the Text of Luke' among the papers of G.D. Kilpatrick. It was clear from internal references, as well as the format of the document, that this was Greenlee's introduction to his edition. Elliott provided a copy which was scanned for use by members of the project team and transcribed by Megan Davies in order to be included as Appendix 2 in the present volume. In June 2018, the project was contacted by two descendants of General Colin Macaulay, Lucinda Smith and Colin Ferguson Smith, who lived near the University of Birmingham. They kindly shared material from the biography which they were preparing of their ancestor prior to its publication in December 2019.¹⁹

The lead in planning the exhibition associated with the Codex Zacynthius Project, to be held in the Milstein Exhibition Centre at Cambridge University Library between October 2020 and February 2021, was taken by Ben Outhwaite and Chris Burgess, Head of Exhibitions and Public Engagement at Cambridge University Library. A variety of palimpsests were lined up for display, including fragments of the Archimedes Palimpsest held by the University Library and the Mingana-Lewis Qur'anic fragment. In August 2019, as part of a separate editorial project on Latin papyrus documents, Houghton identified the undertext on two small fragments of a sixth-century Italian manuscript which had been overwritten with Masoretic texts in Hebrew in the ninth century and discovered in the Cairo Genizah: these turned out to be the oldest surviving witnesses to Augustine's *Against the Sermon of the Arians* and the expanded text of his *Sermon* 225, the latter by some six hundred years.²⁰ Accordingly, these were added to the list for the exhibition.

Another event at Cambridge University Library inspired by the project was the HandsOn Digital Humanities hackathon in July 2019. This was a joint venture between the Library and the History department of Queen Mary's University, London, directed by Eyal Poleg. Three teams of postgraduate students and software developers competed to design and develop apps to enable members of the public to engage with palimpsest manuscripts. Images from the Codex Zacynthius Project were used by one team, which developed an innovative 'slider' enabling users to move between the undertext and overtext.²¹

¹⁸ See Chapter 1 above, especially note 23.

¹⁹ Colin Ferguson Smith, A Life of General Colin Macaulay, Soldier, Scholar and Slavery Abolitionist (privately printed; Birmingham, 2019).

²⁰ H.A.G. Houghton, 'New Identifications Among the Sixth-Century Fragments of Augustine in Cambridge University Library,' *Sacris Erudiri* 58 (2019): 171–80.

²¹ https://trnka.korpus.cz/~lukes/the-reagents/ (see also https://github.com/dlukes/the-reagents); for links to the other projects and more information about the hackathon, see https://twitter.com/HandsOnDH.

The project held a Study Day at Oriel College, Oxford, on 5 November 2019, in conjunction with the Centre for the Study of the Bible in the Humanities, to disseminate its initial findings and consult on the presentation of the digital and printed editions. In addition to papers delivered by members of the project team, Nigel Wilson offered an assessment of the script of the overtext. He brought to the project's attention a further liturgical manuscript copied by the scribe Neilos (Vatican City, BAV, Vat. gr. 788) which included a palimpsest. Could this provide further missing pages of Codex Zacynthius? During the lunch break, participants consulted the Vatican's website of digitised manuscripts and the question was soon answered thanks to the high-quality images provided there. ²² While Neilos had copied the majority of the manuscript (Vat. gr. 788 pt. A), the seven palimpsest pages (Vat. gr. 788 pt. B) had been overwritten by a later, fourteenth-century hand on a manuscript in minuscule script, which could not be Codex Zacynthius. Nevertheless, in addition to images of these pages taken under ultraviolet light, the website also provided an identification of the undertext, fragments of the gospels of Matthew and John from a lectionary written around the end of the tenth century. With no record of this manuscript in the online version of the Kurzgefasste Liste, the Codex Zacynthius Project passed these details to the INTF in Münster in order to determine whether the manuscript should be registered among the witnesses to the Greek New Testament.

Given the challenges of dating the undertext, as described in Chapter 3, the Codex Zacynthius Project did explore the possibility of subjecting part of the manuscript to Carbon 14 dating, a procedure which Greenlee had suggested some seventy years earlier.²³ The destructive nature of the present form of this analysis, however, meant that the decision was taken not to proceed. Just as the refusal of earlier generations to apply chemical reagents to enhance the legibility of the palimpsest had enabled successful results to be achieved in the present day through multispectral imaging, so it is hoped that advances in the dating of ancient artefacts will in the not-too-distant future bring new information to apply to these questions without damage to the documents themselves.

²³ See page 294 below.

²² http://www.mss.vatlib.it/guii/scan/link.jsp.