Trends in Statistical Codicology

Studies in Manuscript Cultures

Edited by
Michael Friedrich
Harunaga Isaacson
Jörg B. Quenzer

Volume 19

Trends in Statistical Codicology

Edited by
Marilena Maniaci

DE GRUYTER

ISBN 978-3-11-071142-4
e-ISBN (PDF) 978-3-11-074383-8
e-ISBN (EPUB) 978-3-11-074387-6
ISSN 2365-9696
DOI https://doi.org/10.1515/9783110743838

Library of Congress Control Number: 2021943314

Bibliographic information published by the Deutsche Nationalbibliothek
The Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliografie; detailed bibliographic data are available on the Internet at http://dnb.dnb.de.

Printing and binding: CPI books GmbH, Leck

www.degruyter.com

To Denis Muzerelle (1945–2021)

Contents

Layout and text formatting

Scripts and scribes

The English translations reproduce the original state of the texts, without changes, additions, cross-references to specific contents of the contributions printed in this same volume or bibliographic updates (apart from rare exceptions).

Marilena Maniaci

Statistical Codicology. Principles, Directions, Perspectives

In an extended, content rich 'overview of twenty years of research', added as an afterword to an equally voluminous collection of reprinted contributions in French and Italian, Ezio Ornato, at the end of the last millennium, carried out a critical retracing of the basic steps involved in a novel approach to the study of the Latin (and Greek) medieval book—an approach that was successfully termed 'quantitative codicology' (also known as 'statistical codicology' or 'experimental codicology').[1] The origin, prerequisites, areas of application and principal results of this particular way of addressing the history of the book—both manuscript and printed—are amply and meticulously described in the aforementioned essay; here it should therefore suffice to provide a brief outline of the main principles:

1. The basic rationale underlying the 'quantitative' approach is a conceptualisation of the book as a 'device that functions in a complex way' ('machine au fonctionnement complexe'),[2] which is to say a handcrafted object designed to transmit a text in the most enduring and legible way, whilst at the same time serving as an expression of a specific 'cultural and social fabric', as well as being the material product of a complex interaction between factors lying within the artisanal sphere (e.g. level of technology, labour ergonomics, the need to economise on materials and production times, etc.) and external factors (e.g. political, historical-social and cultural influences, etc.).
2. This fundamental premise gives rise to the need to study the book-object as a comprehensive whole—a global entity composed of multiple interactions between all of its basic characteristics (e.g. constituent materials and structure, script, images, annotations, content, etc.); all aspects of its genesis and subsequent development (e.g. planning, production, dissemination, uses, transmission, storage and, perhaps, eventual destruction); and

1 Ornato 1997. In addition to the cited essay and the collection in which it appears, the reader should also refer to its bibliography (that of the current contribution being limited to essential references), and most recently also to Ornato 2020.

2 Bozzolo et al. 1989.

https://doi.org/10.1515/9783110743838-001

finally, all the actors involved in that history (e.g. authors, copyists, illuminators, binders, printers, commissioning patrons, readers, etc.).

3. From this scenario arises the necessity to adopt a specific methodology that entails the systematic investigation of entire populations of volumes or statistically significant samples of 'normal' codices ('foule anonyme de manuscrits'),[3] rather than the learned study of individual books as unique objects, exceptional for their rarity, importance and beauty. This approach—which demands a radical change of perspective, from the 'history of books' to the 'history of the book'—compels one to conduct systematic surveys of large groups of variables, and then to subject the resulting data to multidimensional statistical investigation techniques. For this purpose, it is necessary to break down complex information into simple elements, and then to codify them into measurements (in the case of dimensional parameters, for example), counts (e.g. the number of leaves or quires, the number of holes in the parchment, the number of lines, characters or abbreviations, and so forth), and observations made on the basis of qualitative considerations (e.g. the quality of parchment or decorations, etc.).[4]
4. From the 'quantitative' standpoint, interest is focused on repetitive and routine information (rather than on exceptional and unique features), which has to undergo experimental analysis of a functional kind. The statistics are not used, in a purely descriptive way, to illustrate the propensity of single variables or phenomena, but rather as a means to highlight the book's operating mechanisms (i.e. overall phenomena and long term trends) set up in its structures and general evolutionary lines by factors which are both internal and extraneous to the artisanal world (e.g. technological, functional, cultural, social and economic), and to attempt to explain the genesis and consequences of the same.[5]
5. Given that the essential aims of the book—the transmission of readable content and the fulfilment of specific needs vis-à-vis social and cultural representativeness—and the tensions it is subject to are common to products that differ in terms of technology, form and book tradition, the statistical approach breaks down the barriers that separate the study of manuscript volumes from that of printed books, and the study of codices from

3 Bozzolo / Ornato 1980, 9.

4 On the composition of the relevant samples and the selection and survey methods applied to the investigation parameters, see Maniaci / Ornato 1993a.

5 On the 'experimental' and 'exploratory' nature of the investigative techniques and data interpretation, see Maniaci / Ornato 1993b.

that of other forms of book, and can be applied, taking into account the specific characteristics of different contexts, to objects belonging to a wide range of 'book cultures'.

From the 1970s onwards, these preconceptions gave rise to a (methodologically speaking) highly cohesive research strand, albeit one that fanned out into a wide range of themes, in addition to being characterised by a progressive enrichment and refinement of selection, surveying and data analysis techniques. Notwithstanding a belief that the statistical approach finds in the history of the manuscript and printed book almost unlimited potential for its application, quantitative research has favoured several areas in which the variables to be surveyed and analysed are easier to identify and to manage;[6] these are:

1. The study of production trends and of the book market (manuscript and printed volumes), based on a perusal of surviving books, or on a census of indirect sources (e.g. catalogues and registers/inventories).
2. The study of writing materials (e.g. parchment and, above all, paper).
3. The analysis of manuscript and incunabula production techniques.
4. The study of the construction and utilisation of the page, only seemingly ascribable to matters of taste, but which in reality are the result of an interaction, often conflictual, between functional needs (e.g. legibility) and economic requirements (e.g. exploitation of the available space).
5. With respect to the writing, an exploration of 'perigraphic' factors (e.g. subdivision of the text into chapters and paragraphs, separation of words, abbreviations, line management, punctuation, and so forth) and their correlation to the 'decipherability' of the text, taking into account the readers' proficiency.

In contrast to codicology, palaeography has remained (and still remains) at the fringes of the field of statistical analysis, due to the difficulty of translating the characteristics of handwriting into relevant quantitative variables (the definition of an individual letter requires the selection, surveying and evaluation of a large number of parameters), and on account of strong ideological resistance stemming from the presumed 'reduction' of a manifestation of the human spirit to a mere sequence of numbers and tallies.[7] Some initial attempts—an example of which is

6 For copious examples of the same, the reader is directed to the chapters by [Ornato et al.] 1997 and to the aforementioned afterword by Ornato 1997.

7 Opposition that reasserts itself, in an equally unreserved way, with respect to manifestations of so-called 'digital palaeography', regardless of its relative merit and the results it yields.

provided in this volume—offer a glimpse of the potential that systematic analysis holds not only for the study of the evolution of individual characters and their interaction with the surface upon which they are written, but also of the operating mechanisms of the graphical system and of the variables which they are subject to (e.g. the sharpness of the pen and the way in which it was held, the position of the leaf, and the gesture described in space by the scribe, of which the visible trace left by the pen constitutes only a partial representation).[8]

***

After the almost fifty years which have passed since the first application of statistical analysis in the field of codicology, what, then, inspires the publication, in English translation, of a collection of contributions that have already appeared in other settings over the last twenty years or so?

An important reason is the desire to call to the attention of a wider audience on a research strand whose results, which have been published in French and Italian in the main, have polarised the scientific community, eliciting, on the one hand, clear recognition and enthusiasm for their innovativeness, and on the other, equally sharp criticism.[9] At a time when digital media are increasingly embraced in the sphere of the humanities (encompassing a broad range of applications is only approximately covered by the blanket term 'digital humanities'), quantitative codicology deserves to be recognised for its pioneering role, not only in relation to its innovativeness as an approach to the history of the book, but also for the way in which it favours collegial work (often the result of team work in the form of collaboration between established scholars and neophyte researchers), and for the great potential it holds for the sharing of corpora of data gathered

8 Muzerelle 1999. See also, on the same topic, Muzerelle 2013. In addition, see the pioneering critical analysis by Ornato 1975 on the use of the 'modular ratio' by Gilissen 1973 as a key criterion for distinguishing between copyists.

9 Not by chance, the sharpest criticism has come from scholars of recognised calibre, albeit ones who have little or no expertise in mathematical procedures and digital technology. See, for example, the harsh assessment of Radiciotti 1999, which accuses statistical codicology of oversimplification ('reducing matters to true/false binary logic', 62), or of ambitiously positioning itself ('In this sense, counting for a humanist [and even more so for a historian or a palaeographer] is a way of placing themselves on the "winning" evolutionary trajectory, and hence of identifying themselves as being part of a wider intellectual community, along with other scientists, thereby avoiding isolation, and at the same time gaining social currency [...]', 69–70). See also the reservations expressed by Agati 2017.

during individual investigations, and subsequently made freely available and used for successive research projects.

Over the past twenty years, research on the manuscript book—not solely in relation to the better-known codex format—has greatly broadened its horizons by drawing on methods developed for the practice of Greco-Latin codicology, with the objective of fostering a more systematic and scientifically advanced knowledge of the book cultures established around the Mediterranean basin and in neighbouring regions (e.g. Arabian, Jewish, Syrian, Coptic, Ethiopian, Armenian, Slavic, and Georgian),[10] and more recently also of the book traditions found in more distant regions of Asia and Africa (involving not only the study of paper, but also of wood, bamboo, palm leaves, tree bark and silk as writing supports).[11] This all-inclusive and comparative interest in manuscript culture in all its historical-geographical manifestations provides the opportunity to apply statistical analysis to an almost unlimited range of prospective research. Notwithstanding the advances already made and the work still in progress, in the majority of cases (with the important exception of the Hebrew codex)[12] the available knowledge only concerns single books or groups of books and suffers from a lack of broad overviews—which only the adoption of statistical analysis as a working method would make possible—upon whose backgrounds one could evaluate the results of specific observations, and by means of which progress could be made in understanding the underlying logic of individual traditions and in interpreting the similarities and differences between them. The openness to a wide range of book forms makes it possible to ascertain whether or not and to what extent the same investigation protocols devised for the codex might be applied to each of them, and at the same time encourages experimentation with certain analysis protocols and new ways of examining data.

It seems reasonable to suppose that the application of statistical analysis to the study of ancient manuscript and printed books—which in the meantime has continued to follow its traditional path—could gain new momentum from the opening up of new areas, which up until now have remained unexplored. The es-

10 See the recent summary of results and orientation provided by Bausi et al. 2015.

11 An awareness of the activities of the Centre for the Study of Manuscript Cultures at the University of Hamburg and the related Sonderforschungsbereich 950 'Manuscript Cultures in Asia, Africa and Europe', along with the Cluster of Excellence 'Understanding Written Artefacts. Material, Interaction, and Transmission in Manuscript Cultures', is indispensable.

12 Thanks to Malachi Beit-Arié's more than fifty years of strong commitment, Hebrew codicology enjoys in *Sfardata* (http://sfardata.nli.org.il) an incomparable body of documentation based on an in-depth critical examination of all the dated Hebrew manuscripts that bear the names of their scribes.

sential prerequisite for any such endeavour is the availability of quantitatively and qualitatively representative corpora of data, which for most book traditions remain a distant objective, whether with regard to the building of databases resulting from a close examination of manuscripts, or on account of the lack of availability of detailed scientific catalogues from which second-hand information can be drawn. In a world where science is moving, not unhindered, towards interoperability and data sharing for the purposes of research, it becomes ever more necessary to give thought to surveying protocols and ways of codifying variables shared by manuscripts, and to creating synergy between projects that are pursuing similar ends, and likewise to setting up research trajectories that encompass several traditions (focused, for example, on specific materials or literary content, or on single aspects of the history of materials or book manufacturing techniques). When scrutinising the composition of open collections of data that can be freely used for research of various kinds—in a working environment which increasingly tends towards comparative studies—one has to ask whether, and to what extent, the ever-greater availability of digital data (e.g. descriptions, reproductions and transcriptions) might contribute to the creation of corpora useful for the statistical investigation and serial analysis of their characteristics. At the present time, whilst there is a growing offer of digital catalogues that can freely be made use of online and the possibility of remotely accessing full manuscript digitisations has made locating specific data much easier than before for the scholar, the serial exploitation of these resources is hindered by the impossibility of directly accessing the underlying databases, which can only be consulted by means of the templates provided by those responsible for individual projects. Similarly, the personal use of images, even when they can be freely downloaded, is impeded by the lack of universally shared standards for the capture and codification of digital reproductions.[13]

Methodological and technological problems aside, one has to wonder how statistical codicology will be able to find its place in the sphere of 'digital humanities'. At present, the automation of techniques for the extraction of parameters from images and digital descriptions—which for certain kinds of research certainly represents an advance vis-à-vis the manual execution of measurements and counts—still does not equate to the emergence of genuinely original heuristic prospects, apart from some interesting progress that has been made with respect to ways of gathering, codifying and representing data.[14]

---

13 For clear-headed criticism of the current limitations of cataloguing and digitisation initiatives, see Ornato 2012b.

14 Even in its most ambitious and well-developed manifestations, 'digital codicology' has mostly concentrated on the realisation of applications aimed at simplifying and rendering more objective

The present collection of essays is aimed at fulfilling several goals:

– In the first place, to assemble and offer in English translation—so as to facilitate wider accessibility—a selection of contributions which have appeared over the last twenty years or so, in order to take stock of the current 'state of the art', thereby providing the most varied and multi-faceted picture possible of recent advances in quantitative codicology, with respect to the various aspects of manuscript book production and use.[15]
– Then to propose further potential applications of the statistical approach—in a synergetic relationship and not in conflict with other methods and research strands—to traditions for which the currently available data are quantitatively and qualitatively very uneven, and about which there is still a lack of general knowledge—even rudimentary—with respect to their corresponding book heritages and the principles underlying their production.
– And finally, to favour the comparison of the preferences and technical solutions devised in different contexts, albeit ones that broadly speaking share the same basic needs, which in various ways conform to a sort of 'universal grammar'[16] whose rules could become easier to understand if studied from a comparative standpoint.

---

the work of traditional (i.e., analogue) scholars. For a broad overview, see Stokes 2015; for a specific case study see, most recently, Stokes / Noël 2019. On a recent project dedicated to the automatic analysis of the *mise en page*, see Busch / Chandna 2017, and above all Krause / Hegel 2018, in which a thorough synthesis of the history and objectives of quantitative codicology follows an attempt to identify the basic principles underlying a new theoretical perspective, where the statistical analysis of codicological parameters gleaned from catalogues or acquired first-hand is placed side-by-side with a 'visual analysis' of digital reproductions. On the current potential and limitations of 'digital palaeography', see, for example, Maniaci et al. 2011 and Hassner et al. 2013.

15 On account of limited space, the contributions exclusively dedicated to printed books were not taken into consideration (with the single exception of Ornato 2004, whose focus is on dating documents through watermarks); among these Coq / Ornato 1987, Coq / Ornato 1988 and, more recently, Ornato 2010a, and Albiero 2013 are worth mentioning. See also the monograph by Hermand / Ornato / Ruzzier 2012, which contains a lengthy contribution by Ornato 2012 dedicated to the methodology applicable to the quantitative study of incunabula.

16 The notion of a 'universal grammar of the codex book' has on several occasions been brought up and theorised by Malachi Beit-Arié (here it will suffice to cite Beit-Arié 1993, 5).

For various reasons, the task of selecting the essays to be included in the present compilation proved to be a less than easy one and entailed a certain amount of deliberation and rethinking. In the first place, the application of statistical methods to manuscript history is borne witness to by a significant number of scientific papers that fall into the category of 'quantitative codicology', most of which are long or very long contributions, and sometimes of remarkable complexity. In the wake of the works ascribable to the rather fertile period ushered in by Carla Bozzolo and Ezio Ornato, and further built on by the works of the Quanticod[17] group, younger scholars have produced some new and interesting results.[18]

Thanks to the achievements of almost fifty years of research, 'quantitative codicology' has in fact become a well-established approach, whether with regard to epistemological presuppositions (the book viewed as the product of a compromise between certain requirements and conditioning of various kinds), or the techniques employed. Such techniques are chiefly those associated with classical statistical analysis, and are based on the subdivision of a corpus according to a number of variables held to be hypothetically relevant, identifying the ones that are correlated and studying in greater depth the observed relationships.[19] On the other hand, the richness and relative homogeneity of this research strand, the role played by a number of leading figures, and the use of a strongly characterised and familiar argumentative structure and language[20] have tended to mo-

17 Quanticod – CNRS 1985.

18 In the current setting, it is not possible to provide details of the bibliography relating to all the research themes addressed, which include (the following are intended purely as examples and by no means represent an exhaustive list): writing materials, i.e. parchment (Marilena Maniaci) and paper (Paola Munafò and Maria Speranza Storace, in conjunction with Ezio Ornato); the thickness and composition of quires (Paola Busonero and Marilena Maniaci); the structure of miscellaneous codices (Octave Julien); the *mise en page* of Greek and Latin volumes, with particular attention to glossed codices (Marilena Maniaci and Luciana Devoti); the characterisation of volumes of specific content, such as the Bible (Marilena Maniaci, Chiara Ruzzier) or liturgical codices (Laura Albiero); the working principles of graphic systems in the Late Middle Ages (Maria Gurrado); the statutes governing medieval copyists in the French context and the reconstruction of the copying process (Émilie Cottereau-Gabillet); and the composition of medieval French and Italian private libraries (Annie Tournieroux). For one of the most unusual applications of statistical analysis to book traditions other than Greek and Latin, see, for example, the work carried out by Arianna D'Ottone Rambach on Yemeni codices (D'Ottone 2006).

19 See Maniaci / Ornato 1993a and 1993b. Somewhat less represented are clustering techniques and factorial analysis, experimented with above all by Denis Muzerelle (see, for example, Bianchi et al. 1993 and Muzerelle 2012).

20 In addition to concepts and tools foreign to the usual formation of scholars, the adoption of a highly technical and not very pedagogical expository style is one of the reasons that have

nopolise the quantitative ground, resulting in a rather negative effect on the visibility of some other interesting approaches that have developed independently: we have therefore sought provide some space for them in this collection.

The selection of the twenty essays included in the volume was based on the following elemental criteria:

– Coverage of a wide range of themes, including the characterisation of individual book typologies; the study of techniques and manufacturing materials (e.g. quiring, ruling, codex structure, etc.); the layout and utilisation of the page; and even various matters appertaining to the working conditions and methods adopted by medieval copyists.
– Documentation (alongside the most represented branch of the works that spearhead 'quantitative codicology' in the French and Italian tradition) of some other approaches which have developed independently; sometimes of striking originality.
– Exemplification of topics and analytical strategies applicable to manuscript volumes belonging to traditions other than the Latin and Greek, which up until now have been the only book cultures represented by the discipline.

***

The quantitative approach finds particularly fertile ground in its application to the evolution of individual book typologies, as borne witness to by the first three essays presented in the collection.[21]

Specifically, the first two contributions share the theme of the Bible, a favourite subject for codicological investigations on account of the central position it occupies in manuscript production in the three great civilisations of the Holy Book (Greek, Latin and Hebrew), the exceptional number of surviving examples, and the large variety of its uses, which in turn spawned a wide range of material manifestations. From a systematic survey of the structural characteristics of a corpus of giant Latin Bibles manufactured between Rome and Tuscany over the span of a

contributed to intensifying the disagreement between the 'quantitativists' (even if they are of humanist derivation) and advocates of more traditional methods.

21 See, in particular, the contributions of Frank M. Bischoff (17), Lucien Reinhout (19) and Michel Trigalet (3). Among the pioneers of a serial approach to the study of the manuscript book (albeit limited to the application of statistical analysis to the synthesis and description of the collected data), certainly worthy of mention are Albert Derolez (of whom, see, in particular, Derolez 1984) and Malachi Beit Arié (whose theoretical positions—in contraposition with those outlined out in [Ornato et al.] 1997—are summarised in Beit-Arié 2003).

little more than a century (1),[22] a picture has emerged of a production type characterised by a number of features that guarantee its recognition (e.g. size, script, decorative typology, arrangement in text blocks corresponding to an exclusive sequence of quires, and the stability of certain textual series), but at the same time one which is marked by peculiarities that make it possible to characterise individual specimens in synchrony and to identify clusters of Bibles. Additionally, the said picture makes it possible to document, materially, the transition between two distinct periods and production contexts. The first was focused in the 'Umbro-Roman' area, which remained strongly attached to monastic production methods, and was driven by a specific doctrinal and political agenda, whereas the second was oriented towards an urban context and entrusted to a team of professional artisans employed by specific patrons so as to satisfy the wishes of communities of worshippers attracted by the prestige to be gained through the acquisition of a single 'codex-monument'.

The second contribution (2),[23] part of a wider research project,[24] rests on a corpus of more than 1,500 manuscripts (approximately 350 of which have been examined first-hand), and entails the study of pocket-sized Latin pandects, the portable one-volume Bibles intended for individual rather than institutional use that began to appear at the beginning of the 13th century. Thousands of these were disseminated, above all in France (especially in Paris, the centre of the most advanced experimentation), and in England and Italy as well. The miniaturisation of the entire Bible called for the successful combination, in the academic setting, of specific manufacturing techniques—ranging from the production of extremely thin parchment to the assembly of rather thick quires, and a very dense *mise en page*—aimed at minimising a volume's size without compromising its legibility. Such techniques can undergo comparative analysis by referring to the manuscripts' places of origin (by means of serial analysis, which makes it possible to reveal important differences, small ones included), thereby providing valuable clues for establishing the attribution of specimens which lack explicit details vis-à-vis place of origin. This is the case with regard to quiring preferences, the presence and frequency of interruptions (i.e. *caesurae*) in both material and textural continuity (e.g. in the centre of the volume, between AT and NT, or preceding final paratexts), as well as graphic and perigraphic strategies employed to accommodate particularly long texts in a volume of small size.

22 Maniaci 2000a.

23 Ruzzier 2013.

24 The author's doctoral thesis (Ruzzier 2010), currently awaiting publication in the form of a monograph.

If the Bible represents a favourite subject for quantitative research, the same approach can be applied with equal success to other types of content, such as Latin hagiographic literature (e.g. biographies, *passiones,* histories of relics, miracle collections) dating from Antiquity up to the end of the Middle Ages. The presentation of a project (3)[25] based on a vast quantity of data[26] has the virtue of clearly articulating a series of pertinent issues specifically related to the creation and systematic exploitation of a hagiographic dossier based on secondary sources, but in large part also shared with texts of different content. Such issues include the dearth of codicological and textual descriptions in the oldest catalogues (often the only ones available); uncertainties in relation to the dating and geographical pinpointing of texts and manuscripts; the challenge of deducing from descriptions the nature of manuscripts (e.g. unitary or 'complex', organised or random ensembles); the instability of texts owing to frequent revision and updating; the absence of adequate critical editions; the difficulty of assessing survival and loss rates; and the necessity to combine the evidence provided by manuscripts with that originating from other types of sources. More specific problems have to do with the delimitation and treatment of hagiographic texts often handed down within thematic collections (legendaries), but also in broader contexts (e.g. hagiographical manuscripts, Bibles, collections of an encyclopaedic nature), or in the form of abridged collections of various sizes. Notwithstanding the limitations of the sources, the statistical treatment of the available data facilitates the reconstruction of the dissemination of manuscripts recounting the life histories of individual saints, and the overall production trends of different types of hagiographical text produced between the 13th and 15th centuries in various areas of Europe, in relation to the changes that occurred in the general public and in the liturgy.[27]

A second group of essays exemplifies the potential for the application of statistical analysis to the two predominant writing supports employed in the Greek and Latin manuscript traditions: parchment and paper.

One of the contributions (4)[28] is dedicated to the characteristics of the parchment used by Byzantine artisans. The essay exploits 'peripheral' information gathered as part of wider research into the underlying principles and

25 Trigalet 2001.

26 The *Legendiers* database, conceived by Guy Philippart and subsequently merged with the electronic version of the *Bibliotheca Hagiographica Latina manuscripta* (*BHLm)* (http://bhlms.fltr.ucl.ac.be/; last accessed 07/09/2021).

27 Some preliminary results from the research are reported in Philippart / Trigalet 2008.

28 Maniaci 2000b.

layout techniques of parchment codices dating from the 11th and 12th centuries.[29] The study addresses, in particular, the relationship between support quality (assessed on the basis of the frequency and distribution of defects—viz. holes and *lisières* (i.e. untrimmed edges)—and the gauging of sheet thickness), and the basic data for the characterisation of a codex (i.e. data, origin, content). Close study of the strategies adopted by artisans for the handling of defects also forms part of a general assessment of writing support quality. The contribution shows how a seemingly secondary aspect of book manufacture can in fact represent a rich source of information from a statistical perspective, owing to the highly variable distribution of defects in manuscripts and the possibility of counting them, by means of a very simple procedure (i.e. the tallying up the 'number of bifolia affected by holes'). The count does not merely establish the total number of defects, but also their distribution throughout the codex, in single quires, and on the surfaces of individual pages. Aside from an obvious (and rather predictable) correlation between defects and textual types—amongst of which the Bible, across its many witnesses of different shapes and production levels, appears always to have been made using the best available material—the data analysis reveals a general tendency towards a reduction in the quality of the parchment used during the transition between the two centuries in question, as part of a global decline in book production quality, of which it constitutes (along with a tendency for an increase in page filling) a clear indication. An examination of defects also makes it possible to, as it were, step into the artisan's workshop, and draws attention to the effort he made to minimise hindrances to the reader (by discarding, whenever possible, parchment marred by holes within the writing area), and to safeguard the book's aesthetic qualities by 'hiding' bifolia disfigured by the presence of holes and *lisières* in the middle of quires and towards the end of a codex. Generally speaking, the analysis shows how, already at the moment when the artisan selected his material, he oriented his choices in relation to the content and the overall quality of the volume to be made, at the same time as adopting in a fully conscious way a series of measures aimed at minimising the functional and aesthetic impact of the defects.[30]

29 Maniaci 2002a.

30 For an example of the sheer quantity of information on artisanal practices that can be gleaned from the statistical 'exploitation' of a seemingly minor detail, such as parchment thickness, see Bianchi et al. 1993.

Medieval paper produced in Italy is the subject of two contributions by Ezio Ornato, one of the founders of quantitative codicology.[31] In contrast to parchment, paper—a handcrafted product that could be made to meet any specifications required by the scribes and printers—is a material that has a lot more to 'say', since sheets bear in their weft and warp a quantity and variety of information particularly suitable for systematic study and a sophisticated historical reading, facilitated by the intersection between archaeological data and the information that can be gleaned from written sources. Among the characteristics of Western paper originating from Italy, which from the end of the Middle Ages onwards was distributed widely throughout Europe, the watermark stands out because of the close attention it has received, chiefly thanks to the power of suggestion exerted by the motifs employed and the potential they hold for the dating of written documents. In contrast to traditional dating procedures, which are susceptible to inaccuracies and uncertainties and are dependent upon other criteria related to palaeographical and philological expertise, the application of statistical analysis makes it possible to obtain more accurate and reliable results, as demonstrated by an experiment carried out on a sample consisting of more than 60 'letter P' watermarks drawn from a database of motifs identified in incunabula originating from the Low Countries (5).[32] The method calls for the definition, based on a set of specifically defined measurements, of a 'dissimilarity index' for each of the dated watermarks within the corpus in comparison to all the others (calculated on the basis of a predefined number of 'nodal points'), and the coupling of a 'chronological gap' to each comparison. Such a procedure enables one to construct a grid within which it is possible to insert the undated watermarks (with a level of accuracy and reliability that can be measured through empirical tests, depending on the size and relevance of the comparison sample, as well as on the number of watermarks surveyed for a given motif). Also in this instance, the efficacy of the method is linked to the capacity of the scholar to recognise and to control the factors that can compromise reliability (such as the quality of the image, measurement errors, the choice of relevant points, and the use of other similarity criteria—e.g. the distance between the chain lines / laid lines—and the statistical validation of results).

The potential of the quantitative study of watermarks extends far beyond the 'auxiliary' function offered by dating procedures, as the second of the two

31 Standing out amongst the plentiful contributions dedicated to the topic is Ornato et al. 2001.

32 Ornato 2004.

essays of a methodological nature focused on paper shows (6).[33] Born of the need to endow paper produced in the various paper mills with a specific 'maker's mark', the custom of distinguishing between sheets by means of a wide variety of motifs, grouped into types exhibiting obvious morphological differences, became enhanced over time with a multiplicity of features of a qualitative nature aimed at specifying a sheet's dimensions, its level of whiteness, and other characteristics of a manufactured material used for an increasingly wide range of applications, especially at a point in time when the artisanal context of manuscript production ran parallel to, and was progressively replaced by, the new system for printed book manufacture. If it seems reasonable to suppose that the paper stocks that the copyists had access to were not only quantitatively smaller, but also typologically more uniform than those purchased by printers through middlemen who obtained their supplies from a number of different paper mills, the comparison of two series of incunabula belonging to two different editions printed in Venice highlights the complexity of the notion of 'stock heterogeneity', and reveals how the mixture of motifs and paper types served to assist wholesalers in regulating both the gradation of paper hues and the homogeneity of the consignments of paper sold to the printers, depending on the quality of the edition to be manufactured (i.e. the needs and financial resources of potential buyers). Not by chance, the stocks of paper used in the most popular editions show a higher degree of heterogeneity, but it is also the case that the same watermark motif can correspond to different degrees of whiteness and hence to different quality grades, even within one and the same print run. The ability of the scholar to formulate new questions and to apply them to sufficiently populated corpora of watermarks makes it possible to shed light on an aspect of the organisation of the printer's work which otherwise could not be reconstructed. When addressed in this way, the systematic study of watermarks proves itself to be rich in further potential—potential which is still far from being fully investigated.

The quantitative approach proves itself to be particularly well suited to the study of book manufacturing techniques, given the conservative nature of artisanal practices, the slowness with which innovations emerged and developed, and the necessity to work on large corpora so as to be able to follow, diachronically, evolutionary trends and to account for individual synchronic variations in relation to internal and external factors to the world of books. Unfortunately, the codicological information offered by the available descriptions is generally rather thin on the ground, lacking in detail and presented in different ways from

33 Ornato 2014.

one catalogue to another (when not within one and the same catalogue), and therefore renders very difficult the planning and realisation of specific research projects, even when based on parameters which are intrinsically easy to count and measure.

An exemplary case is found in the study of the evolution in the 'thickness' of quires (i.e. the number of bifolia) in Europe from the middle of the 12th century up until the end of the Middle Ages, when a centuries-long domination of the quaternion comes to an end in the manufacture of the Latin codex (7).[34] The investigation is based on a representative corpus drawn from catalogues of different ages, quality and structure. Its set-up represented a serious challenge, not so much as regards the detection of the most widespread form of quiring, mainly provided for by the descriptive protocols, but above all on account of the erratic mention of and inconsistent way in which other variables considered relevant for the evaluation of the phenomenon are recorded (e.g. the sheet folding format, the ruling technique, or the presence of quire signatures or catchwords). In spite of the severe constraints imposed by the nature of the sources, quantitative analysis makes it possible to better define the various stages in the transition from the widespread use of the quaternion to a significantly greater variety of quire typologies, at rates and preferences that differ in the various areas of Europe: the early acceptance and establishment of the senion in the English context (starting in the first half of the 13th century) is followed by its later adoption in France (with the return of the quaternion, in both contexts, in the middle of the 14th century), whilst in Italy, from the 15th century onwards, the use of the quinion clearly prevails. The analysis of the relationship between quiring and content shows how innovations matured in the university context and tended to spread in the production of paper volumes, probably on account of the perception that the new support was not very robust. In this case just as in other cases, a shared reflection on the current cataloguing rules and codifying criteria and a standardisation of the data could facilitate, or indeed make it entirely possible to conduct research that is currently impeded by the absence or paucity of available information.

A study devoted to quire making methods in parchment codices (8)[35] offers just one example of the results that can be obtained solely through the systematic collection of seemingly 'silent' data and their statistical processing. Whilst in paper the weaving together of chain lines and laid lines and the position of the watermark normally make it possible to determine the folding format, in the

34 Busonero 1999.
35 Maniaci 1999a.

case of parchment the clues that allow us to reconstruct the relationship between the bifolium and the original animal skin are far less conspicuous and are not always visible on the material's surface. The clues to look for are the dorsal axis, the *lisières*, the marks left by holes, the streaks that sometimes straddle multiple surfaces, and above all the areas around the *axillae*, which are thinner and more porous than elsewhere on the skin. Indeed, it was the systematic surveying of the last mentioned—the *axillae*—in a sample of Greek codices that enabled to challenge, on an objective basis, Gilissen's rather shaky 'deterministic' hypothesis on the creation of bifolia by means of one or more successive folds of parchment sheets (i.e. folio, quarto, octavo), thereby revealing the possibility of an asymmetric division (i.e. sexto) which makes it possible to obtain from a single skin three bifolia instead of two, in such a way so as to maximise the simultaneous use of skins of different sizes. This hypothesis is supported by the distribution trend of the *axillae*, which do not consistently appear in the same position within one and the same volume (as Gilissen's reconstruction implies), and by the relative frequency of their attested locations. Quantitative verification, albeit confined to a limited sample, allows us to place parchment manufacture in a context where the available skins—obtained from animals that were first and foremost raised for other purposes—were not all of uniform size, and the craftsmen were not overly concerned about saving time or limiting the steps necessary to make quires; rather, they were more interested in optimising their use of the material available to them.

A seemingly causal and 'silent' element such as the number of horizontal lines ruled within the writing area (or rather the frequency of even and uneven multiples of *n* lines) can also serve as the subject of sophisticated statistical analysis, with the aim of uncovering information concealed behind a distribution pattern that clearly differs with the frequency predicted by the laws of probability (9)[36]—on condition, again, that the information drawn from the catalogues be in a form which is eminently suitable for processing. Once again, the explanation for an unexpected phenomenon lies in a careful examination of a pre-existing corpus of volumes in which a number of parameters have already been revealed (to fulfil various other objectives), whose relationship with the writing lines trend can prove interesting to analyse. Such parameters include the ruling type and technique (especially the presence, in certain places, of 'overrun' lines, extending beyond the normal writing lines); the position of the writing either above or below the top line; and the height of the writing area (which in larger codices probably afforded the artisan a greater degree of flexi-

36 Muzerelle 2012.

bility in the distribution of the writing lines). Indeed, the trend observed in the figures reveals some clear correlations which, broadly speaking, are easy to explain. Conspicuous amongst these is a significant concentration of types without 'overrun' lines in codices ruled in ink, among which predominate layouts with an even number of writing lines. One can infer, indirectly, the widespread use of a 'rake', that is to say a comb-like tool, endowed with an even or uneven number of teeth, which when used successively in a sequence produces a rate of 75% for rulings with an even number of lines and a rate of 25% for rulings with an uneven number of lines. The analysis reveals some further significant correlations, such as the relationship between the positioning of writing either above or below the top line and the technique used for drawing lines, for which, however, it is less easy to provide a plausible explanation.

The manufacturing theme also encompasses the study of the 'complex' ('modular' or 'open') nature of the book in the form of a codex, where structuring into quires made it possible (and easy) to modify content by adding or removing material, or through its alternative arrangement. Given the difficulty of carrying out direct examinations and in-depth investigations of samples of a statistically significant size, if we wish to make a preliminary assessment of the various manifestations of complexity in the codex and to devise a nomenclature for its description, it is necessary to utilise the available—although unsatisfactory—information that can be gleaned from catalogues. A contribution that focuses on the Byzantine manuscript (10)[37] provides a broad view of the textual typologies on the basis of which such volumes can be lumped together (albeit limited to materially unitary volumes). In particular, the relationships between the size, thickness of the book, number, length and position of texts, textual typology and degree of thematic consistency, and the exploitation of the page are observed. Also drawn attention to are factors which, depending on the various eras, influenced the unification of content, a phenomenon that shows obvious growth in the closing centuries of the Middle Byzantine period. Far from being a chance phenomenon, the simultaneous presence of multiple texts within one and same codex seems to be determined by material concerns, and is governed by the essential antinomy between the length of texts (expressed as the number of leaves) and the aesthetic and functional requisites that the book in the form of a codex cannot disregard.

If the topic of the complexity of the codex, which centres on the analysis of the interrelationship between the book's materiality and its content, has been afforded ample space in the codicological literature in recent years, the contri-

37 Maniaci 2004.

bution on the 'third dimension of the book' (11)[38] addresses it from a hitherto unexplored perspective, namely the thickness of the book block, corresponding to the height of the 'box' that contains the text (i.e. the stack of quires). In contrast to the other two dimensions—the height and width of the page—thickness is never mentioned in catalogues (it is not by chance that a specific and unambiguous term to describe the same is lacking). An indirect estimate of it, even if approximate, is however provided by the block's number of leaves or bulk. By scrutinising a composite sample derived from a perusal of a large number of catalogues of Latin codices (already assembled to carry out previous research), the authors of the essay draw on elements useful for pondering the dialectical relationship between the codex's volumetric value and its capacity, which is to say the amount of text it can accommodate, understood as the number and length of the texts it contains. If the bulk of the Latin codex tends to increase over time in relation to changes in intellectual requirements and manufacturing contexts which occurred during the 12th century with the shift from monastic to urban production, the evolution tends to take place in line with an aesthetic link that ties the number of leaves (i.e. the bulk of the book block) to the other two dimensions of the page. On average, large codices contain a greater number of leaves in comparison to smaller ones, and the exceptions (which present in the form of very 'chunky', small codices) can be accounted for, in the Late Middle Ages, by the necessity to pack a large amount of text into 'containers' of a readily manageable or pocketable size, with attention paid to the number of leaves, as well as to the exploitation of the page. The constraints in relation to the capacity of the codex are also reflected in the rate of multi-textuality that resulted from the merging of slim texts; such texts predominated throughout the Middle Ages and could not be circulated as single volumes. In addition, slim texts were for the most part grouped together around a 'flagship' text, usually placed at the beginning of a volume. This, and other findings presented in the article, demonstrate an interest in an area of study that remains little explored, but one which certainly holds potential for further development.

The immediate availability of readily measurable parameters, together with the intrinsic richness of the subject matter and the challenge presented by the scarcity of written sources, explains the huge success of the layout (or *mise en page*) among the fields of interest addressed by statistical codicology.

Dedicated to the vanishingly small number of ancient layout 'recipes' that survive today is an analysis (12)[39] that highlights operating mechanisms and

38 Muzerelle / Ornato 2004.

39 Maniaci 2015, which builds on and delves further into Maniaci 1995.

compares their characteristics, thereby uncovering the existence of some important constants (in relation to the distribution of written and unwritten spaces or the relationships between margins), as well as some equally significant differences between the rules attributable to different historical periods and book cultures. On the methodological plane, the difficulty of interpreting the small number of surviving texts—not infrequently rather obscure and omissive ones—and above all of recognising the application of the directions they prescribe in individual codices or in specific groups of manuscripts, emerges. The work that has to be done in order to understand the canons applied by medieval artisans certainly entails a dimensional analysis of layouts borne tangible witness to in ancient manuscripts. Such an analysis poses complex—and as yet unresolved—problems vis-à-vis the appraisal of margins of error caused by an accumulation of craftsmen's inaccuracies, imprecise measuring instruments, deformations induced (in parchment manuscripts) by the passage of time, and dimensional changes caused by trimming.[40]

The limitations mentioned above do not preclude the possibility of following diachronically, at a macroscopic level, the 'graphical presentation' of manuscripts (starting from the earliest parchment books in the form of a codex, all the way up to the end of the 12th century), and comparing, era-by-era, the working methods established in the Greek East and the Latin West (13).[41] Once again, it is

40 The interpretation of the most recent of the surviving sources—that of the 16th-century mathematician Sigismondo Fanti—has been challenged by Agati / Gavrila 2015, who more generally have criticised the presuppositions upon which the method I used for the analysis of the recipes was based. The expository tone and style of the article—which presents observations of a prosopographical-codicological nature (weighed down by lengthy scholarly digression) alongside abstract mathematical considerations, bearing no relation to the subject in question—have up until now led me to rely on the reader's capacity to independently appraise the quality and validity of the arguments formulated by the two authors. Regarding the reconstruction, here I shall confine myself to remarking that their reading (a) stretches the meaning of the stipulations set down in Fanti's text (in which the phrase 'it should be as much white as black' must unquestionably be understood to refer to a two-column volume and interpreted in linear rather than superficial terms—the comparison between surfaces not by chance being absent from all the recipes); and (b) violates a number of the most consistent features of the *mise en page* in Greek and Latin codices (verified across several thousand manuscripts), assuming a writing area of more ample proportion than that of the book, a page filling rate of more than 54%, and a relationship between the lower and external margins equal to 1:2, which is not seen in the Late Middle Ages. Above all, the purely theoretical reconstruction advanced by the two authors is not supported by any experimental verification apart from an essentially insignificant reference to the measuring of the writing area in five (!) printed specimens of Fanti's treatise (p. 135).

41 Maniaci 2012.

the availability of corpora, no matter how disparate, already assembled for previous research projects, in association with the systematic perusal of invaluable collections such as Elias Avery Lowe's *Codices Latini Antiquiores*, which makes it possible to create a database of sufficient magnitude so as to be broken down into sub-groups of a significant size, formed through the intersection of variables considered to be potentially meaningful. By means of a comparative analysis of the basic characteristics of the *mise en page*—i.e. size, ruling, delineation and utilisation of the spaces—some shared trends emerge in the evolution of the codex's form, in addition to some significant structural differences. In relation to the page's appearance and the techniques used in laying out its content, one observes (in particular) a tendency for the Greek artisan to remain faithful to the practices developed in Late Antiquity, in contrast to the greater dynamism seen in the Latin context from the beginning of the Middle Ages. If the reference sample does not enable one to venture beyond the identification of a few general trends, the results obtained should be further examined in relation to specific contexts, and research should be extended to the centuries of the Late Middle Ages and to other book traditions, based on specific perusals.

A contribution that focuses on a particular type of content and an especially complex form of layout is based on an analysis of 41 manuscripts and 163 annotated incunabula of the *Codex Justinianeus*, in which the main text is accompanied by a large amount of commentary (14).[42] When designing and realising the layout of an annotated book (on any subject), the artisan had to manage, simultaneously, two streams of text; in other words, he had to tackle the dual problem of synchronising them (i.e. keeping the gloss as close as possible to the corresponding passage), whilst at the same time accentuating the link, thereby easing the toing and froing of the reader's eye from one text to the other.[43] These problems present themselves afresh, albeit in very different technical circumstances, in the realm of printing, thus giving rise to alternative solutions in the two distinct manufacturing contexts. The example of the juridical book, and in particular the volumes containing the *Codex*, in which a relatively standardised commentary is arranged as a sort of 'frame' around the work to which it refers (in accordance with a highly codified layout), facilitates the characterisation and comparison of solutions devised in the different contexts in which manuscripts and incunabula were produced, whose apparent visual similarity in fact conceals significant differences, owing to the peculiarities of the respective

42 Devoti 1999.

43 For a theoretical discussion of the analytical parameters applicable to the pages of glossed codices, see Maniaci 2002b.

manufacturing techniques. In the case of the manuscript, synchronisation between the text and the gloss is achieved page after page; the central area, reserved for the main text, is kept stable, whilst the surrounding and marginal glosses are added in a more flexible way. Conversely, in the printed book, whose manufacturing technique called for a preliminary distribution of the text throughout the entire volume, the marginal area remain fixed, while the internal area—particularly the columns of script—varies, in order to withstand the burden, as it were, of the adjustments necessary for the synchronisation of the text and gloss.

The proposed analysis model for juridical codices—based on the subdivision of the page into sectors and on the measurement of the respective surfaces—lends itself to being extended, when suitably modified, to other types of glossed codex. An example of the method's extended application can be found in the investigation of a small group of manuscripts of Homer's *Iliad* which present—as is normal in the Middle Byzantine period—the commentary arranged as a 'frame' around the central text, and in particular along its three 'free' sides (15).[44] This layout technique calls for a patient and laborious measuring and counting process aimed at establishing the length of the individual scholia, their position on the page, the distance from the annotated passage, the presence and frequency of abbreviations, the density of the commentary in relation to the main text, the alternation between glosses of different lengths, and so forth. The application of a highly detailed analysis protocol to an individual book, endowed with particularly heavy annotation, makes it possible to identify the ways in which the scribe tackled the problem of synchronising the two bodies of text and then making the necessary adjustments between individual glosses and the corresponding passages of text through the use of various linkage mechanisms, such as symbols, numbers, or lemmata that reiterate the opening words of the glossed text. If the comparative examination of 'twin' manuscripts, carried out during a previous study,[45] facilitates an assessment of the skill of the respective scribes, the comparison of two later codices, of smaller size, brings to light the problems raised by the reduction in the area of the available surfaces and the various solutions adopted by the copyists in order to address them, whether through a more intensive exploitation of the available space, or by drastically cutting back on the amount of commentary (unless part of the omitted annotation is recovered later on, with an inevitable alteration of the original sequence).

44 Maniaci 2006a.
45 Maniaci 2006b.

Irrespective of its content and the complexity of its spatial arrangement, the construction of a page tends primarily to favour the legibility of the text—a rather complex notion, but one which can nonetheless be broken down into quantifiable and measurable elements.[46] Among these we can include the division or 'splitting' of words at the end of lines. This is a widespread phenomenon, and an only seemingly negligible one: indeed, the division of words constitutes an obstacle to an uninterrupted reading flow, and therefore constrains the copyist to adopt strategies aimed at minimising the necessity to start new lines or to signal their presence to the reader. The study of the frequency of split words, whose distracting influence on the reader varies depending on their position on the page and in relation to the quire, necessitates the development of a model that makes it possible to compare the actual frequency with that predicted by a probability calculation. When applied to a corpus of Byzantine manuscripts (16),[47] the comparison confirms, overall, an awareness of the phenomenon on the part of the Greek scribes and makes it possible to observe how they approached it, depending on the interaction—not always easily interpretable—between other characteristics of the codex (e.g. the number of characters per line, the arrangement of the text, the writing's features, the frequency of abbreviations, content, and the degree of the layout's development), thereby enabling us to recognise in the more learned and well-informed readers (i.e. those who read secular codices and heavily annotated ones) keener attention paid to limiting word division. Clear confirmation of the 'non-neutrality' of the phenomenon also emerges from the study of word splits, which prove to be distinctly less frequent in relation to the final line of the writing area, and above all are avoided between the *recto* and *verso* of a page (where the visual unity of the word faltered), but also with the transition from one quire to the next, which was clearly perceived as a sort of boundary.

The last section of the collection gathers together a small selection of works that pivot on the figure of the scribe, observed as a distinct individual in the act of writing, or as a member of a group working within specific contexts.

The contribution dedicated to a precious Latin Gospel Book produced by the Benedictine monk Herimann at Helmarshausen Abbey in the second half of the 12th century (17)[48] sheds light—by means of an innovative application of the statistical analysis of time series to micro-variations observed in the graphic trail—on the ways in which an individual scribe was able to control the spaces between letters in a conscious effort to vary the density of his script in relation to the tran-

46 For a theoretical framework on the issue of legibility, see Bergeron / Ornato 1990.
47 Maniaci 1997.
48 Bischoff 1996.

scription needs. In addition to shedding light on the strategies adopted by Herimann for the optimal management of the link between content and the page, by taking into account the internal divisions within the evangelical text and the ornamental elements, the analysis of cyclical fluctuations reveals voluntary and involuntary phenomena that elude a simple visual inspection—for example, the systematic compression of the script in the opening lines of each page and the first part of a quire (an expedient that afforded Herimann a degree of flexibility when it came to respecting his own text distribution plan), or alternatively, more spaced out lettering on the flesh side than on the hair side, which was probably more resistant to the smooth passage of the writing instrument.

Analysis of the factors that influence the writing rhythm represents a fascinating area of study, and one which could take advantage of emerging technologies in digital palaeography in order to automate and examine more closely the data to be processed.

In the successive contribution (18),[49] we shift from observing the behaviour of an individual scribe to an analysis of the dynamics underlying the copyist's gesture. The theme is addressed through a re-examination of the somewhat controversial notion of the 'modular ratio', that is to say the relationship between the width and height of the *nuclei* of letters, identified by Léon Gilissen as the distinguishing feature among the hands of a group of copyists executing one and the same type of script. Picking up afresh on the main argument in Ezio Ornato's criticism of Gilissen's approach,[50] Denis Muzerelle delves into the reasons why the modular ratio cannot be considered a constant characteristic of individual scribes; in fact, it depends on the size of the writing, in the sense that the proportion of characters is consistently wider in scripts of smaller module size. The phenomenon, which is of a geometric nature, can be attributed to the interaction between the nib of the pen, which in small writing cannot be reduced proportionally to the size of the *nuclei*, and the angle of the cut edge of the pen's nib in relation to the sheet, depending on the way in which the pen was held by the copyist. If, then, the analysis of the modular ratio proves to be of little importance on the palaeographical plane, the study of the correlation between the modular ratio and the page's characteristics, verified in a sample of the output of some Late Medieval scribes working for Malatesta Novello, lord of Cesena, demonstrates how the most prolific copyist of the local scriptorium, Jean d'Épinal, spontaneously adapted the proportions of his less formalised writing to the layout of the text, tending to

49 Muzerelle 1999.

50 See above, note 8.

'compress' it in two column manuscripts, and contrarily to stretch it out in full page layouts, in the presence of a broader space over which his pen could run.

The next essay in the collection is dedicated to subscription *formulae*—, in other words, colophons added by scribes at the end of their transcriptions. Colophons are documents that contain a wealth of information on the circumstances, key actors and methods employed in the production of manuscript books. Colophons can vary in their structure and content. They are chiefly used as sources of single items of information, and are only seldom the subject of serial analyses, such as the one conducted by Lucien Reynhout, subsequently presented in a volume dedicated to the presence of (and changes undergone by) around thirty *formulae* identified in works dating from Late Antiquity up until the age of Humanism,[51] whose methodological premises are illustrated in the contribution reproduced here (19).[52] The author underscores the necessity to work on a representative population, identifying within the attested *formulae* typological groups based on potentially significant variables; he then goes on to interpret the results based on historical-cultural factors and the endogenous mechanisms underlying the first appearance and evolution of the *formulae*. As well as the analysis of the *formulae*, the study of colophons offers the quantitative codicologist an almost virgin field of application vis-à-vis the analysis of their content and structure, the transformations they underwent over time, the relationship between the information they provide and the content (or other aspects) of the codex, and graphical and codicological presentation criteria. The adoption of a comparative approach, aimed at revealing similarities and differences, and loans from one book tradition to another, appears to be of particular interest.

Amongst the information offered by colophons, albeit to a lesser extent in comparison to dating, we find the geographical pinpointing of manuscripts' origins, data whose systematic exploitation can be useful when reflecting on the notion of a scriptorium, which constitutes, in the Latin production context, and particularly up until the end of the 13th century, an inescapable point of reference, albeit one whose profile remains somewhat vague (20).[53] The large quantity of data extracted from the French catalogues of dated manuscripts (*CMD*), combined with information drawn from the corpus of French cartularies, enabled the essay's author to re-evaluate, on a firmer footing, despite being affected by inevitable distortions, the geographical distribution of surviving codices: Northern France stands out for its density of copying centres, in contrast to the country's south-

51 Reynhout 2006.
52 Reynhout 2001.
53 Muzerelle 2015.

central regions, which were less favourable—for geographical, historical-religious and economic reasons—to the establishment of monasteries. Alongside geographical mapping—which paints a highly complex picture of the notion of a scriptorium—a close perusal of the *CMD* series provides the raw material that makes it possible to conduct a comparative analysis of monastic and episcopal production centres, and deepens, within a 'palaeographic landscape' which has been substantially redefined in comparison to previous research, our knowledge of individual entities made distinct by an important legacy of geographically pinpointed codices.

***

The broad selection of essays assembled in the present volume offers a rich panorama—albeit an inevitably incomplete one—of specific contexts and themes for which statistical analysis has proved to be a particularly worthwhile and productive approach. Indeed, it is perhaps the only one capable of revealing phenomena which would otherwise elude approaches based on the analysis of individual cases and scenarios, with the aim of characterising trends and investigating underlying motivations.

As well as testifying to the wide range of elements and aspects of the history of the manuscript book that can be tackled through quantitative analysis, the essays presented here in translation are intended to contribute to the exemplification of a methodology which, despite being unitary in its fundamental principles, defines and adapts, time after time, strategies and investigation tools in accordance with specific themes and objectives, on the grounds that

> [...] every research project comes with its own set of characteristics; therefore each project calls for specific observation protocols, the formulation of ad hoc investigation and validation procedures, and hence the creation of specific tools, which sometimes even have to be invented from scratch.[54]

If it is up to individual scholars to pose any relevant questions, to select the necessary materials to address them, and to identify the most suitable approaches to

54 '[...] chaque recherche possède ses propres caractéristiques; elle requiert donc l'élaboration de protocoles d'observation particuliers, la construction de procédures ad hoc d'enquête et de validation, ainsi que la constitution d'outils spécifiques qu'il faut chaque fois littéralement inventer' (Ornato 2013, 203).

deliver scientifically based answers,[55] the indispensable prerequisite lies in a mastery of methods, and hence in the possession of a basic knowledge of the techniques and associated tools that are part and parcel of statistical analysis, but which unfortunately are almost entirely absent from humanities study programmes, and in particular in the training of book historians.[56]

All the contributions included in this collection are focused on the book in the form of a (mostly manuscript) codex, whether it be of the Greek or Latin tradition. One of the most important challenges to meet in the future with respect to the quantitative approach will consist in conducting experiments to determine the potential for its application to other book traditions, and above all to manuscripts of different book forms, so as to verify whether, to what extent, and in what way the positive results obtained in the sphere of Greek and Latin codicology might be extended to writing supports other than parchment and paper, that is to say, books in scroll form, books written on palm leaf or other materials, books in concertina or fan form, and so on; in other words, extended to cultural contexts very different from those of the medieval West and Byzantium. Only the development of research of a systematic kind, based on the gathering of samples of sufficient size and composition, and on the use of adequately detailed surveying protocols, will make it possible to demonstrate, in a broader perspective, the fecundity of a 'universal grammar of the codex' and its potential for application to other manuscript forms.[57] As the theme of 'open data' becomes ever more present and central in scientific debate, the need also arises to encourage a willingness to make available all the data generated by various research projects within the

55 Not because they are vitiated by an a priori assumption of objectivity, but rather because they are verified using tools appropriate to the discipline, within the margins of error considered acceptable by the researcher.

56 An interesting experiment is the *Le livre médiéval au regard des méthodes quantitatives* summer school, which has been organised on an annual basis in Paris since 2016, and is the fruit of a collaboration between the Laboratoire de Médiévistique Occidentale in Paris, the Institut de recherche et d'histoire des textes, and other scientific institutions. The school provides, for graduate and post-graduate students, a general introduction to the concepts, tools and operating procedures relevant to quantitative codicology. Similar advocacy for the necessity of training, with specific reference to digital palaeography, can be found in Stokes 2010.

57 Similar questions are posed, in reference to digital methods, by Stokes 2015, 2: 'Can there be a universal model for the representation of books and handwriting? For handwriting and print? For decoration? Are modern and medieval books as different as scholarly practice seems to suggest, or can the same methods be applied to both? Can paleographers learn from typographers, and vice versa? Or is even asking these questions part of a vain "quest for universalism" [...]'. See also Krause / Hegel 2018, 350–352.

book historians' community—a development which would necessitate a shared reflection on surveying formats and methods.[58]

***

I owe a debt of gratitude to Michael Friedrich—the tireless and visionary driving force behind an ambitious programme of comparative research on the writing cultures of Europe, Africa and Asia[59]—for the stimulus he has provided in encouraging me to assemble this collection, not to mention the support he has given me throughout its realisation. I am also grateful to Cosima Schwarke for the acuity, painstaking care and readiness with which she has taken on the monumental task of editing the volume. This project benefited considerably from Mark Livesey's commitment to the translation process, not least his willingness to tackle some linguistic conundrums posed by the rendering of technical terms into a key language for scientific communication, but one which up until now has curiously lacked a standardised vocabulary;[60] last but not list, I wish to thank Edmondo Colella, long-time collaborator and friend, for the care and elegance put into the realization of the numerous tables and graphs.

As this book was going to press, Denis Muzerelle sadly passed away on April 14, 2021, leaving us deprived of his vast knowledge, brilliant intellect and warm humanity. He was not only an outstanding expert and a sophisticated connoisseur of manuscripts, statistics and numerous other things, but also a dear friend to me and to many of the authors who have contributed to this volume, which is wholeheartedly dedicated to him.

58 See, in relation to this matter, Ornato 2010b, 100–113, in particular 111–113.

59 As the founder and director of the 'Centre for the Study of Manuscript Cultures' at the University of Hamburg, and the spokesperson of DFG Forschergruppe 963 'Manuscript Cultures in Asia and Africa', 2008–2011, the Sonderforschungsbereich 950 'Manuscript Cultures in Asia, Africa and Europe', 2011–2020 (the deputy spokesperson in both cases being Jörg B. Quenzer), and the 'Understanding Written Artefacts' Cluster of Excellence (the co-spokespersons being Alessandro Bausi and Kaja Harter-Uibopuu).

60 Concerning the problems posed by the translation of codicological terminology into the principal languages of scientific communication, see Maniaci 2012–2013 (with previous bibliography) and Jakobi-Mirwald 2009.

References

Agati, Maria Luisa / Gavrila, Caius (2015), 'A proposito di un articolo recente: i precetti di *mise en page* di Sigismondo Fanti', in: *Scriptorium*, 69: 114–144.

Agati, Maria Luisa (2017), *The Manuscript Book. A Compendium of Codicology*, Roma: L'Erma di Bretschneider (Studia archaeologica, 214).

Albiero, Laura (2013), 'Les livres liturgiques à l'épreuve de la presse. Le cas du bréviaire de Beauvais', in *Gazette du livre médiéval*, 60: 28–53.

Bausi, Alessandro et al. (2015), *Comparative Oriental Manuscript Studies. An Introduction*, Hamburg: Tredition.

Beit-Arié, Malachi (1993), 'Why Comparative Codicology?', in *Gazette du livre médiéval*, 23: 1–5.

Beit-Arié, Malachi (2003), *Unveiled Faces of Medieval Hebrew Books. The Evolution of Manuscript Production – Progression or Regression?*, Turnhout: Brepols.

Bergeron, Réjean / Ornato, Ezio (1990), 'La lisibilité dans les manuscrits et les imprimés de la fin du Moyen Âge. Preliminaires d'une recherche', in *Scrittura e civiltà*, 14: 151–198.

Bianchi, Francesco et al. (1993a), 'La structure matérielle du codex dans les principales aires culturelles de l'Italie du XI^{e} siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi 357–358), II, 363–456.

Bianchi, Francesco et al. (1993b), 'Facteurs de variation de l'épaisseur du parchemin italien du VIII^{e} au XV^{e} siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi 357–358), I, 95–184 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 275–345).

*Bischoff, Frank M. (1996), 'Le rythme du scribe. Analyse sérielle de la densité d'écriture dans les évangiles d'Henri le Lion', in *Histoire et mesure*, 11, 1–2: 53–91.

Bozzolo, Carla et al. (1989), 'Une machine au fonctionnement complexe: le livre medieval', in Bady, Paul / Laufer, Roger (eds), *Le texte et son inscription*. Actes du colloque organisé par le Centre d'études de l'écriture de l'Université de Paris VII et le Groupe Paragraphe de l'Université de Paris VIII, Paris: CNRS, 69–78 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 87–95).

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS: (Publications de l'équipe de recherche sur l'humanisme français des XIV^{e} et XV^{e} siècles. Textes et études, 2).

*Busonero, Paola (1999), 'La fascicolazione del manoscritto nel basso medioevo', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 31–139.

Busch, Hannah / Chandna, Swati (2017), 'eCodicology: The Computer and the Mediaeval Library', in Busch, Hannah et al. (eds), *Kodikologie und Paläographie im digitalen Zeitalter 4 / Codicology and Palaeography in the Digital Age 4*, Norderstedt: BoD, 3–23.

Coq, Dominique / Ornato, Ezio (1987), 'Les séquences de composition du texte dans la typographie du XV^{e} siècle: une méthode quantitative d'identification', in *Histoire et mesure*, 2: 87–136.

Coq, Dominique / Ornato, Ezio (1988), 'La production et le marché des incunables. Le cas des livres juridiques', in Aquilon, Pierre / Martin, Henri-Jean (eds), *Le livre dans L'Europe de la Renais-*

sance. Actes du colloque international d'études humanistes (Tours 1988), Paris: Promodis, 1988, 305–322 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 227–243).

Derolez, Albert (1984), *Codicologie des manuscrits en écriture humanistique sur parchemin,* I. *Texte*, II. *Catalogue*, Turnhout: Brepols (Bibliologia, 5–6).

D'Ottone, Arianna (2006), *I manoscritti arabi dello Yemen: una ricerca codicologica*, Roma: La Sapienza Orientale – Ricerche.

*Devoti, Luciana (1999), 'Un rompicapo medievale. L'architettura della pagina nei manoscritti e negli incunaboli del *Codex* di Giustiniano', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 143–206.

Gilissen, Léon (1973), *L'expertise des écritures médiévales. Recherche d'une méthode avec application à un manuscrit du XI^e siècle : le lectionnaire de Lobbes, codex Bruxellensis 18018*, Gand: Ėditions Story-Scientia.

Jakobi-Mirwald, Christine (2009), 'Lost in Translation. Manuscript Terminology between Languages', in *Gazette du livre médiéval*, 55: 1–8.

Krause, Celia / Hegel, Philipp (2018), 'Überlegungen zur quantitativen Kodikologie: Systematische und historische Perspektiven', in: Bernhart, Toni et al. (eds), *Quantitative Ansätze in den Literatur- und Geisteswissenschaften. Systematische und historische Perspektiven*, Berlin: de Gruyter, 335–354.

Maniaci, Marilena (1995), 'Ricette di costruzione della pagina nei manoscritti greci e latini', in *Scriptorium*, 49: 16–41.

*Maniaci, Marilena (1997), 'Alla fine della riga. Divisione delle parole e continuità del testo nel manoscritto bizantino', in *Scriptorium*, 51: 189–233.

*Maniaci, Marilena (1999a), 'L'art de ne pas couper les peaux en quatre', in *Gazette du livre médiéval*, 34: 1–12.

*Maniaci, Marilena (1999b), 'L'art de ne pas couper les peaux en quatre', in *Gazette du livre médiéval*, 34: 1–12.

*Maniaci, Marilena (2000a), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino, Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, [Milano]: Centro Tibaldi, 47–60.

*Maniaci, Marilena (2000b), 'La pergamena nel manoscritto bizantino dei secoli XI e XII: caratteristiche e modalità d'uso', in *Quinio. International Journal on the History and Conservation of the Book*, 2: 63–92.

Maniaci, Marilena (2002a), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Maniaci, Marilena (2002b), '«La serva padrona». Interazioni fra testo e glossa sulla pagina del manoscritto', in Fera, Vincenzo / Ferraù, Giacomo / Rizzo, Silvia (eds), *Talking to the Text. Marginalia from Papyri to Print*. Proceedings of a Conference held at Erice, 26 September – 3 October 1998, as the 12th Course of International School for the Study of Written Records, Messina: Centro Interdipartimentale di Studi Umanistici, I, 3–35.

*Maniaci, Marilena (2004), 'Il codice greco 'non unitario'. Tipologie e terminologia', in: Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni.* Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino, 2004 (=*Segno e testo,* 2), 75–107.

*Maniaci, Marilena (2006a), 'Words within Words: Layout Strategies in some Glossed Manuscripts of the Iliad', in *Manuscripta*, 50, 2: 241–268.

Maniaci, Marilena (2006b), 'Problemi di mise en page dei manoscritti con commento "a cornice". L'esempio di alcuni testimoni dell'Iliade', in *Segno e testo*, 4: 211–298.

*Maniaci, Marilena (2012), 'Costruzione e gestione dello spazio scritto fra Oriente e Occidente: principi generali e soluzioni specifiche', in *Scrivere e leggere nell'alto medioevo*, Spoleto: Fondazione Centro italiano di studi sull'alto medioevo (Settimana di studio, 59), 473–514.

Maniaci, Marilena (2012–2013), 'Manuscript Terminology: a Plurilingual Perspective', in *Manuscript Cultures*, 5: 3–10.

*Maniaci, Marilena (2015), 'Ricette e canoni di impaginazione del libro medievale. Nuove osservazioni e verifiche', in *Scrineum. Rivista*, 10: 1–48.

Maniaci, Marilena et al. (2011), 'Table ronde. Applications actuelles de l'informatique à la paléographie : quelles méthodes pour quelles finalités ?', in *Gazette du livre médiéval*, 56–57: 119–130.

Maniaci, Marilena / Ornato, Ezio (1993a), 'Che fare del proprio corpus? I. Costituzione e descrizione di una popolazione di libri a fini statistici', in *Gazette du livre médiéval*, 22: 27–37 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 67–75).

Maniaci, Marilena / Ornato, Ezio (1993b), 'Che fare del proprio corpus? II. L'osservazione "sperimentale" e l'interpretazione dei risultati', in *Gazette du livre médiéval*, 23: 18–27 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 76–83).

*Muzerelle, Denis (1999), 'Le geste et son ombre : essai sur le 'rapport modulaire' des écritures', in *Gazette du livre médiéval*, 35: 32–45.

*Muzerelle, Denis (2012), 'L'approche analytique des schémas de réglure. D'après l'exemple des manuscrits humanistiques', in *Gazette du livre médiéval*, 59: 41–63.

Muzerelle, Denis (2013), 'Jeux d'angles et jeux de plume. I. Retour sur l'hypothèse du biseautage de la plume', in *Gazette du livre médiéval*, 60: 1–27.

*Muzerelle, Denis (2015), 'À la (re)découverte des scriptoria : l'exemple du Catalogue des manuscrits datés français', in Nievergelt, Andreas et al. (eds), *Scriptorium: Wesen – Funktion – Eigenheiten.* Comité international de paléographie latine, XVIII. Kolloquium, St. Gallen 11.–14. September 2013, München: Bayerische Akademie der Wissenschaften, in Komm. beim Verlag C.H. Beck (Veröffentlichungen der Kommission für die Herausgabe der mittelalterlichen Bibliothekskataloge Deutschlands und der Schweiz), 25–50.

*Muzerelle, Denis / Ornato, Ezio (2004), *La terza dimensione del libro. Aspetti codicologici della pluritestualità*, in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni.* Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino, 2004 (=*Segno e testo,* 2), 43–74.

Ornato, Ezio (1975), 'Statistique et paléographie : peut-on utiliser le rapport modulaire dans l'expertise des écritures médiévales ?', in *Scriptorium*, 29: 198–234 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 567–605).

Ornato, Ezio (1997), 'L'histoire du livre et les méthodes quantitatives: bilan de vingt ans de recherche', in [Ornato, Ezio et al.], *La face cachée du livre médiéval. L'histoire du livre vue*

par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci, Roma: Viella (I libri di Viella, 10), 607–679.

*Ornato, Ezio (2004), 'Un esperimento di datazione tramite le filigrane: le "lettere p" negli incunaboli dei Paesi Bassi', in Graziaplena, Rosella, with the assistance of Livesey, Mark (eds), *Paper as a Medium of Cultural Heritage: Archaeology and Conservation*. 26th Congress IPH, Roma: Istituto centrale per la patologia del libro, 2004 (Addenda, 5), 225–243.

Ornato, Ezio (2010a), 'Division du travail et pratiques de composition dans l'atelier de Günther Zainer (Augsburg, 1469)', in Aquilon, Pierre / Claerr, Thierry (eds), *Le berceau du livre imprimé : autour des incunables*. Actes des Rencontres Marie Pellechet, 22–24 septembre 1997 et des journées d'étude des 29 et 30 septembre 2005, Turnhout: Brepols, 57–105.

Ornato, Ezio (2010b), 'La numérisation du patrimoine livresque médiéval : avancée décisive ou miroir aux alouettes ?', in Fischer, Franz et al. (eds), *Kodikologie und Paläographie im digitalen Zeitalter* 2 / *Codicology and Palaeography in the Digital Age* 2, Norderstedt: BoD (Schriften des Instituts für Dokumentologie und Editorik, 3), 85–115.

Ornato, Ezio (2012), 'L'évaluation quantitative des stratégies éditoriales. Problèmes méthodologiques et techniques', in Ruzzier, Chiara / Hermand, Xavier / Ornato, Ezio, *Les strategies éditoriales à l'époque de incunable: le cas des anciens Pays-Bas*, Turnhout: Brepols (Bibliologia, 33) 2012, 133–204.

*Ornato, Ezio (2014), 'Filigranes à gogo. Observations sur le nombre et l'homogénéité des papiers employés dans les manuscrits et les incunables', in *Gazette du livre médiéval*, 60: 54–82.

Ornato, Ezio (2020), 'The Application of Quantitative Methods to the History of the Book', in Coulson, Frank T. / Babcock, Robert G. (eds), *The Oxford Handbook of Latin Palaeography*, Oxford / New York: Oxford University Press, 651–668.

Ornato, Ezio et al. (1997), *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella (I libri di Viella, 10).

Ornato, Ezio et al. (2001), *La carta occidentale nel tardo medioevo.* I. *Problemi metodologici e aspetti qualitativi;* II. *Misure strumentali, tipologia e struttura delle forme*, Roma – Milano: Istituto centrale per la patologia del libro – Editrice Bibliografica (Addenda, 4).

Philippart, Guy / Trigalet, Michel (2008), 'Latin Hagiography before the Ninth Century: A Synoptic View', in Davis, Jennifer R. / McCormick, Michel (eds), *The Long Morning of Medieval Europe. New Directions in Early Medieval Studies*, Burlington: Ashgate, 111–129.

Quanticod – CNRS (1985), 'Un programme d'étude quantitative du livre médiéval', in *Gazette du livre médiéval*, 6: 7–13.

Radiciotti, Paolo (1999), 'Osservazioni di un paleografo attorno alle origini ed al significato della codicologia quantitativa', in *Punti critici*, 1: 57–70.

*Reynhout, Lucien (2001), 'Codicologie quantitative et paradigmes scientifiques: une typologie des formules latines de colophons de manuscrits occidentaux', in *Gazette du livre médiéval*, 39: 1–11.

Reynhout, Lucien (2006), *Formules latines de colophons.* I. *Texte*, II. *Annexes*, Turnhout: Brepols (Bibliologia, 25).

Ruzzier, Chiara (2010), *Entre Université et Ordres mendiants: la miniaturisation de la Bible au XIII^e siècle.* Thèse de doctorat en Histoire médiévale, sous la direction de Jean-Philippe Genet, soutenue en 2010 à l'Université de Paris 1 – Panthéon Sorbonne.

Ruzzier, Chiara (2013), 'The Miniaturisation of Bible Manuscripts in the 13th Century. A Comparative Study', in Light, Laura / Poleg, Eyal (eds), *Form and Function in the Late Medieval Bible*, Leiden, Boston: Brill (Library of the Written Word, 27), 105–125.

Stokes, Peter A. (2010), 'Teaching Manuscripts in the "Digital Age"', in Fischer, Franz et al. (eds), *Kodikologie und Paläographie im digitalen Zeitalter* 2 / *Codicology and Palaeography in the*

Digital Age 2, Norderstedt: BoD (Schriften des Instituts für Dokumentologie und Editorik, 3), 229–245.

Stokes, Peter A. (2015), 'Digital Approaches to Palaeography and Book History: Some Challenges, Present and Future', in *Frontiers in Digital Humanities* 2, 5: 1–3.

Stokes, Peter A. / Noël, Geoffrey (2019), 'Exon Domesday: méthodes numériques appliquées à la codicologie pour l'étude d'un manuscrit anglo-normand', in *Tabularia. Les sources des mondes normands à l'heure du numérique*, http://journals.openedition.org/tabularia/4118

*Trigalet, Michel (2001), 'Compter les livres hagiographiques. Aspects quantitatifs de la création et de la diffusion de la littérature hagiographique latine (II^{e} – XV^{e} siècle)', in *Gazette du livre médiéval*, 38: 1–13.

Forms and typologies

Marilena Maniaci

The Structure of Atlantic Bibles

Sacred text *par excellence* and supreme attestation of the Divine Word, the Bible enjoyed a wider dissemination than any other text throughout the entire Western Middle Ages. Without doubt, it was the most read—and probably the most transcribed—text of the time, even if we still lack an exhaustive census of Latin Bibles. The transposition of the 'Book'—a message laden with profound meanings—into the 'book', an object bearing less explicit but in any event equally important cultural connotations, did not countenance imprecise or amateurish solutions; rather, it constituted the ultimate expression of professionalism in the creation of a manuscript. This insistence on the utmost quality also represents an aspect of conservatism—in fact, more than any other book the Bible had to conform scrupulously to the ideals of uniformity and harmonious proportions that were customarily aimed at by book manufacturing artisans. Such an objective demanded as little deviation as possible from the precepts established by tradition, as well as a high degree of presentational uniformity.

The tendency towards stability can be seen as part of a dialectical process; indeed, given that in the medieval West the Bible never ceased to play a lively and integral role in the cultural fabric of society, its omnipresence meant that from time to time it had to be adapted to prevailing material, graphic and decorative canons and, above all, to the functional requirements of different historical periods. Thus the way in which the Bible manifested itself more generally represents a faithful reflection of the evolution of the book structure, writing and ornamental elements.

Additionally, the Bible constitutes a sort of 'geometric place', around which one can observe a continual intertwining of the various expressions emanating from the development of Christianity and the Church. Marked by doctrinal disputes, issues relating to spiritual renewal and, not least, the struggle for power, the history of the Bible is replete with profound and conspicuous changes—changes which, although sometimes very apparent, are not always easy to interpret. The physical object acts as a vehicle, and even, on occasion, as an

---

Translated from the Italian into English by Mark Livesey. Original published as Maniaci, Marilena (2000), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione.* Catalogo della mostra, [Milano]: Centro Tibaldi, 47–60.

https://doi.org/10.1515/9783110743838-002

instrument of such changes. The appearance of a biblical text differing from previous ones with respect to content, sequence and internal articulation, and operating simultaneously as a support for new aims and functions, is almost always inseparable from the appearance of specific *mises en livre*, conceived of in order to maximise the spread of spiritual and cultural innovations.[1]

For all the above reasons, the Bible has always represented a great source of interest to scholars. However, the attention paid to the text and its decorative elements has not been matched by an equally close analysis of the more material-related implications concerning the transmission of the sacred text—in other words, a close analysis of the interaction between the objectives of the commissioning patrons and promoters and the object itself, which substantiated such goals and gave them value. Such interactions are directly reflected in various constituent elements of the book (such as the structuring of volumes and the presentation of the written page), in ways which can vary depending on the particular historical period or context concerned.

Precisely on account of its textual specificity, the Bible is also of huge interest to scholars when viewed from a codicological perspective. With its almost three million constituent characters, it can unquestionably be included among the world's lengthiest texts (even if it is in fact articulated into a series of independent textual units, or books within the book). Its full transcription into one or two volumes therefore represents, in technological terms, a not inconsiderable challenge which has seldom been tackled and, even when it has been, one which has yielded very different results. On the one hand, one thinks of the massive dimensions (505 mm × 340 mm) and extraordinary bulk (1,030 leaves) of the Amiatina Bible (Florence, Biblioteca Medicea Laurenziana, Laur. Amiat. 1), which is the oldest fully transcribed Latin Bible that has come down to us, while on the other, at the opposite end of the scale, one thinks of the extreme miniaturisation which in the 13th and 14th centuries accompanied (even if it was neither the cause nor the sole effect of) the penetration into the scholarly world of the revision of the biblical texts in the University milieu. Indeed, it is also worthwhile to point out the fact that within the same cultural 'universe' different problems and objectives can sometimes lead to diametrically opposed solutions. Thus, in Bibles with commentaries dating from the same period, one can encounter extreme fragmentation of the text, which is reduced to serve merely as a support for a rambling exegesis, and is therefore split up into a remarkable number of separate volumes. This phenomenon is accompanied by the appearance of *mises en page* which are as complex as they are rational, having been devised in order to address problems

1 Maniaci / Muzerelle / Ornato 1999.

in relation to the synchronisation of the basic text with one or more 'layers' of corresponding annotation.

Viewed from this perspective, the appearance of the Atlantic Bibles, around the middle of the 11th century, should also be seen—as in fact it has been—as something highly innovative, not only in textual and artistic terms but also in material terms, with the new approach being expressed through the radical decision to create volumes of truly massive dimensions in comparison to the already large, albeit more contained, Turonian Bibles of the Carolingian age. This extreme solution cannot be accounted for by the purely mechanical necessity to 'compress' the text into monolithic volumes. It also served, perhaps more than anything else, to highlight the central role played by the Book in the propagation of a religious Reform, whose penetration found in the book one of the most representative and effective tools.

However, the exceptionally large dimensions of Atlantic Bibles is only their most striking structural feature, and perhaps not their most important. When subjected to close codicological examination, several phenomena which are not immediately obvious to the 'common' reader do not evade detection, namely the density of the text; the solutions adopted for the *mise en page*; the relationship between textual units (i.e. individual books or series of scriptural volumes) and the subdivision of copying tasks; and various 'quantitative' aspects of decoration (e.g. the size, frequency and distribution of miniatures and ornamental initials in relation to the text). These factors reveal, when more closely and systematically examined, an evolutionary process which remains more or less consistent through time. The same factors pose, also from a codicological perspective, some of the most central questions raised in the field of Atlantic Bible research. For example, to what extent should the volumes be considered the product, continuing over time, of a single project matrix, and to what extent do they conserve a memory of their original link to the Reform which acted as their propelling force?

Answers—albeit partial—to these questions cannot be arrived at simply by performing an indirect global assessment of the Atlantic Bibles corpus, but instead call for a deep and systematic analysis of many different specimens. If the currently known Atlantic Bibles number around one hundred, those upon which the results presented here are based total around sixty (i.e. almost two thirds of the known corpus), with the main group represented by two major funds held in important Italian libraries, namely the Vatican Library in Rome, and the Medicea Laurenziana in Florence. Despite the absence of some of the most ancient and renowned specimens (the Admont, Genova, Munich, Sion and San Daniele Bibles, almost all of which are present in this catalogue [i.e. *Le Bibbie Atlantiche* 2000]), the available documentary basis is sufficiently large and representative

so as to make it possible to arrive at an initial 'portrait' of Atlantic Bible production. The chronology of the manuscripts examined is conveniently scattered over a long period of time and they originate from the two main geographical production areas—Umbria-Rome and Tuscany—as defined by palaeographic and art historical critical studies. In addition to the list published as an endnote to this essay, for the complete shelfmarks the reader can refer to the catalogue's descriptions, from which, wherever possible, additional information on the Bibles that were not directly examined was drawn.

Conceived of with public display and common reading in mind, the Atlantic Bibles are striking, above all, for their exceptional size (somewhat reduced, in many cases, due to fairly drastic trimming). Volumes which measure any less than 500 mm in height are very scarce (Laur. Conv. Soppr. 307, and Laur. Plut. 15.18), with the bulk of witnesses measuring about 550 mm, and not a few exceeding 600 mm in height (Laur. Conv. Soppr. 630; Laur. Plut. 15.13; Lucca 1; Monac. Clm 13001; Vallic. A 2; Vat. lat. 4220–4221 and 12958; Vat. S. Maria Maggiore 4; and Cividale I–II). Of truly monumental dimensions are the Riccard. 221 and Ambros. B 47 inf. Bibles, whose heights exceed 650 mm. The widths of Atlantic Bibles, likewise impressive, range from between 300 mm to over 400 mm.

If the overall dimensions of these volumes provide an initial impression of their great size, their visual impact is defined in a more precise and complete way by the relationship between their width and height (i.e. 'proportion'), which can be expressed as a decimal number which increases as a page's form moves closer towards being a perfect square (with a proportion of 1). Almost all Atlantic Bibles have proportions ranging from roughly 0.60, in the case of the narrowest witnesses (Ambros. B 47 inf.), to 0.707 (Casanat. 720; Laur. Plut. 15.19; and Vat. Ross. 617), the average value being 0.67 (2/3). The widest volumes (such as Casanat. 723, proportion 0.74) are rare exceptions. The shape is far from square; rather, it is distinctly slender (narrower, indeed, than the average commonly seen in the Latin world). However, it would be a mistake to attribute this slender appearance to a specific aesthetic predilection: on the contrary, the makers of the Bibles simply respect the original proportions of animal skins which, being naturally wide, if folded in-folio (i.e. in half, along the minor axis) produce a shape with narrow proportion. (It is not by chance that the large format Bolognese law codices of the 13th and 14th centuries, also featuring an in-folio fold, exhibit precisely the same characteristic, despite the presence of a 'framework' formed by extensive annotation around the main text).

From a dimensional viewpoint, the appearance of the Atlantic Bibles constitutes an outright novelty in the overall panorama of Holy Scripture codices. In fact, both the celebrated Amiatina Bible and the Tours Bible—justifiably cited as

the inspirational model for the Atlantic Bibles—are of decidedly smaller dimensions;[2] the St Gall Bible, Stiftsbibliothek, 75, 545 mm × 401 mm, is the only exception. However, it cannot unequivocally be stated that the massive dimensions of the Atlantic Bibles constitute a singularity, since large format volumes (not solely in Latin script) manufactured in the course of the Middle Ages can also be seen, albeit seldom. Such volumes were destined to be used for the celebration of the liturgy at the church altar or for common reading, and include lectionaries, homiliaries, hagiographical collections, and lengthy patristic texts (such as the *Moralia in Iob* of Gregory the Great, and the *Enarrationes in Psalmos* of Augustine).[3] All the same, such dimensions should be seen as extreme limits, if one excludes the exceptional case of a particular type of codex whose height can exceed 750 mm: such volumes were only produced in the Late Middle Ages (starting in the 15th century), and were the result of a standardised and sustained production (continuing up until at least the end of the 17th century) of large choir books, graduals and antiphonaries endowed with musical notation—intended for display rather than for reading from—in which the creation of each sheet required the sacrifice of an entire beast, hence each bifolium is the product of the splicing together of two whole animal skins.

By contrast, in the case of Atlantic Bibles, as already mentioned above, each skin, folded in two perpendicularly to the dorsal axis, was used to create a single bifolium. This approach resulted in the sacrifice of at least 165 animals for the manufacture of one complete Bible (Parma 386), with the total sometimes rising to a maximum of 260 slaughtered beasts (Laur. Edili 125–126). The method used to fold the skins is readily discernible thanks to the position of the spinal line (which subdivides the bifolium in two, in parallel with the skin's width), and by the position on sheets of the *axillae* (i.e. the four semi-circular areas of the skin coinciding with the leg joints), which have a translucent quality and a more porous grain. In the case of in-folio assemblages, these areas are located in the middle of the upper and lower margins of each page.

Whilst a somewhat vigorous processing of skins reduced the visibility of the spinal line, the *axillae* remain fairly evident, hence the way in which skins were folded can be determined with a high degree of confidence. It can be deduced that the parchments (or perhaps better to say, the 'usable surface' of sheets that remained after the elimination, always thorough in the case of Atlantic Bibles, of irregular edges) measured, on average, around 550–600 mm × 700–800 mm, and can therefore be included among the largest skins employed in the history of

2 Ganz 1994, 61–62.

3 Bischoff / Maniaci 1995, 314–315.

medieval book production.[4] The skins, if not all, were for the most part derived from sheep and goats (although the occasional use of calfskin cannot be excluded), as can be deduced from an overall assessment of the physical characteristics of the support (to include colour, consistency, surface texture and flexibility), which should be verified using high precision scientific instrumentation. In the making of the Bibles there seems to have been a clear preference for sheepskins of a yellowish hue which are smooth on both sides and highly flexible (in almost 50% of the identifiable cases), rather than goatskins, which tend to be somewhat grey and a bit stiffer, and have a slightly velvety texture on the hair side of the skin (20%). Not by chance, the manuscripts created using skins adjudged to be of ovine origin are slightly larger in size.

The in-folio folding method was widely employed, but not exclusively so. Indeed, a brief, unsystematic preliminary analysis has revealed examples where the aforementioned *axillae* are not located along the upper and lower margins of a bifolium, but instead in the middle of the two outer margins of each of its two halves, as is typical of an in-quarto folding arrangement. This made it possible to obtain two bifolios from each skin (Angel. 1273, ff. 100–104 and 113–118; Casin. 515, pp. 393; 394–401; 402; Laur. Mugell. 1, ff. 224–225; Parma 386, ff. 194–199 and 256–257; Riccard. 221, ff. 79–82 and 106–111; Sessor. 2, ff. 164–167 and 322–327; Vat. Pal. lat. 5, ff. 1–7; Vat. lat. 10511, ff. 255–260; and Mantova 131, ff. 57–64 and 58–63, perhaps obtained from the same skin, which represent the only cases of an in-quarto bifolium positioned on the outside of a quire). It can therefore be deduced that the Atlantic Bible craftsmen occasionally made use of exceptionally large skins (up to 800 mm × 1200 mm in the case of Angel. 1273), and also that within this largely 'standardised' and highly developed book production artisans did not hesitate to mix them with more average ones, even if only sporadically, in common with a practice employed in the Greek context, which has recently come to light.[5]

Even if Atlantic Bibles are extraordinarily large tomes, the full text of the Holy Scriptures is of such great length that a large quantity of leaves is required in order to produce a full transcription. The fully intact Bibles examined during the course of this study are composed of a minimum of 329 leaves (equating to 658 pages, in the case of Parma 386), and a maximum of 518 (more than 1,000 pages, in the case of Laur. Edili 125–126), with the average number of leaves numbering roughly 400 (somewhat fewer than those seen in 13th-century 'pocket Bibles', whose pages are eight times smaller but which, in contrast to Atlantic Bibles,

4 Maniaci 1999.
5 Maniaci 1999.

reach and not infrequently exceed some 600 leaves). When the Bible was not subdivided into two volumes (which the massive Laur. Edili 125–126 was), the text block became exceptionally thick, and therefore the handling challenge it posed became even greater. Maximum bulk is reached in some of the most ancient examples, such as the very thick Casin. 515, consisting of some 458 pages. Later on we shall see how the problem was already very apparent to the artisans who created the first Atlantic Bibles, which were designed to be bound as one volume (as revealed by the quire numbering in the Cividale Bible), but structured in such a way so as to allow its division into two volumes (or more rarely three, such as Vat. Pal. lat. 3–4–5, of even four, as in the case of the Bible of Calci, and originally, in all likelihood, the Volterra Bible), without compromising the integrity of the sacred text. Subdivision of the text into two volumes—often preferred in the original arrangements—has been maintained in some cases up to the present day (Admont C–D, Barb. lat. 589–590, and Vat. lat. 4220–4221), or alternatively abandoned in favour of binding the entire text block into one volume (Vat. lat. 4217, 10404, 12958, with traces of an earlier division into two volumes; this was perhaps also the case with Genève 1; Vallic. A 2; Vat. Barb. lat. 587; and Vat. lat. 10511). The numerous Bibles of which sadly only one volume has come down to us—either the first part (Genesis to the Minor Prophets), or the second (up to the New Testament)—were in all likelihood originally envisaged as two volumes.

Regardless of the fact that the Bible was bound as one or two volumes, it was impossible to escape the need to limit the thickness (and by extension, the weight) of the quire block. In theory, the most obvious solution lies in using the thinnest possible parchment. However, the problem would have seemed more complex to a medieval artisan, given that he had to address various conflicting needs: the use of thinner parchment would make it necessary to employ skins flayed from younger animals (which would be too small for an Atlantic Bible), or require a more vigorous processing (with a consequent greater expenditure of time and effort) of skins sourced from mature beasts. Additionally, the use of excessively thin parchment would have resulted in leaves that were too limp, but more than anything would have jeopardised the integrity of pages and the compactness of quires, which at the time normally did not contain more than eight leaves.

It is probably for this reason that the average thickness of leaves found in Atlantic Bibles measures approximately 210 microns (thousandths of a millimetre), more than double that of a today's standard A4 sheet. This figure is not all that different from the figures recorded for codices of the same period originating

from both Italy[6] and Germany (twelve Evangelaries of the 11th–12th centuries).[7] However, the average value obscures quite significant variations between one Bible and another (even if such variations can be accentuated by the fact that the thickness measurement involved only one quire in each volume). Indeed, codices that are distinctly thick (up to 240–250 microns: Ambros. B 47 inf.; Angel. 1273 and 1274; Casanat. 723; Firenze, B. N. Magl. Cl.XL.1; Lucca 2; Riccard. 221; Vallic. A 2; and Vat. Barb. lat. 589–590), contrast with distinctly thin ones (160–170 microns: Angel. 1272, I and II; Firenze, B. N. II.I.510; Laur. Conv. Soppr. 295; Laur. Edili 125–126; Laur. Plut. 15.1 and 15.12; and Vat. Barb. lat. 587).

The decision to use either a thicker or thinner support—but never a *very* thin one—does not seem to have been contingent on other factors, such as the size of the codex or the number of pages contained in a volume. However, the apparently fickle nature of the variations observed does not necessarily mean that the artisans who created the Atlantic Bibles were entirely indifferent to the thickness of the parchment they used. A systematic gauging of all the leaves in a single quire (with six measuring points located along the borders of each bifolium) revealed that the craftsmen were in the habit of protecting the outside of a quire with a bifolium that was thicker (on average 226 microns) than successive bifolia (with thicknesses of 202, 213 and 205 microns). This technique has already been revealed in various other types of manuscript dating from different periods.[8]

The exceptional care taken by artisans in the manufacture of giant Bibles also becomes clear through an examination of the overall flatness of the skins employed, which is to say their more or less consistent thickness, depending on the amount of time and effort expended on smoothing out any unevenness. In fact, it has been noted that points located close to the spinal line of the animal (where skins tend to be thicker) do not differ all that much in thickness from other points, a good indication that particular attention was paid to producing skins of uniform thickness.

With respect to the structuring of quires, the technique employed for the assembly of Atlantic Bibles did not differ at all from that used in coeval Latin codex production. Quires were composed of regular quaternions, starting with the parchment's hair side (except in the case of the late manuscript Lucca 1), in conformity with the so-called Gregory's Rule. Exceptions to the dominant quiring structure, which can seem quite numerous (around 20% of the total number of quires in the Bibles that were directly examined), are mostly related—as we shall

6 Bianchi et al. 1993, 390.

7 Examined by Bischoff 1991, 103.

8 Bischoff 1991, 129; Bianchi et al. 1993, 144.

see later on—to the interaction between the codicological structure and textual articulation of the Bibles.

In the case of pricking, too, it would seem that the most widespread system was used. This consisted in making the pricks on already folded and assembled quires, working from the outside towards the inside of each quire. However, it is possible that a closer analysis of the pricking method employed may reveal additional, as yet unidentified, techniques. In particular, in the Bibles that were examined, it was sometimes noted that the alignment of pricks, which is normally distinguished by more or less severe irregularities, is repeated in sequences of two or more quires (Casanat. 720; Casin. 515; Firenze, B. N. II.I.510; Laur. Plut. 15.13; Laur. Edili 125–126; Mantova 131; Vallic. A 2; Vat. lat. 4217 and 10404). One might ask, then, whether it would have been technically possible to pierce so many leaves (one placed on top of another) simultaneously, or if other possible working methods should be hypothesised (for example, pricking carried out on one quire and then 'transferred' to the next, using it as a 'template' in order to repeat the pattern established by the 'pilot' leaf; or, alternatively, the use of a prepierced guide made from a strip of parchment or some other material). As regards the ruling systems employed, these reflect, in the range of choices encountered, the difficulty of tracing the horizontal ruling on to very large writing surfaces. In conformity with the systems used in the period, all the Bibles were blind ruled, using a fairly sharp instrument that scored a furrow on the surface of the parchment, thereby creating a raised ridge on the *verso* of the sheet. As is well known, what is generally referred to as 'new style'—where ruling was directly traced on to the hair side of each component bifolium of a quire—was the most widespread system used in Latin codices dating from the 11th and 12th centuries. It is not surprising, then, to discover that such a system was also widely adopted in the production of Atlantic Bibles (approximately two thirds of the codices examined), although it was not the sole system employed. Also observed is a system that involved scoring one page in every two (1r, 3r, 5r, 7r), with the verticals often worked over again on all the hair sides of leaves. According to the most plausible reconstruction of this system, scoring of individual folded bifolia would have produced such a result (Casin. 515; Firenze, B. N. Magl. Cl.XL.1; Genève 1; Laur. Fesul. 4; Laur. Mugell. 1; Laur. Plut. 15.1, 15.10 and 25.1; Mantova 131; Par. lat. 104; Parma 386; Riccard. 221; Sessor. 1; Vat. Barb. lat. 588; Vat. Pal. lat. 3–4–5; and lat. 4217A and 10511).

Concerning the 'rationalisation' of work (meaning here a reduction of labour intensity), upon first consideration the two systems might seem equivalent (in both cases it was necessary to trace the ruling four times for each quire). In reality, the system that involved working on individual leaves was less arduous, since

it essentially halved the area that had to be ruled, which also, importantly, simplified the process of tracing writing lines on large format pages. It is yet to be understood how, in practical terms, it was possible to rule pages when the only reference points available to the artisan were the external pricks, given that none of the volumes show evidence of pricking in the fold margin. One possible explanation could be that a set square was employed, or, alternatively, a ruler that the artisan could slide along an axis vertically aligned with the internal justification. Only a systematic survey would make it possible to verify the simultaneous presence of multiple ruling systems used in the production of a single Bible (occasionally observed in more than one *exemplar*), or the incidence of systems different from those described above (in Laur. Plut. 15.1, for example, where the ruling was executed on the hair side of the parchment on pairs of bifolia, with the scoring clearly visible on 1r/8v and 4v/5r).

Ruling forms a grid of horizontal and vertical lines on each page, known as a 'ruling type'. The *mise en page* of Atlantic Bibles, devoid of systematic commentary, did not call for a particularly complex type. To ensure the orderliness and regularity of a page's layout, vertical delimitation of columns was sufficient (though this was generally bolstered by a second proximate vertical line so as to create double bounding lines for the positioning of initials), together with writing lines for the script (starting, as usual, above the first horizontal grid line). Sometimes a horizontal guide line that bisects the header margin for the alignment of running titles can also be seen.

None of the Bibles presents other marginal lines, and all the volumes examined conform closely to the basic ruling pattern, differing only in the presence or absence of double bounding lines and guide lines for running titles (visible in 60% of the Bibles examined). Differences can also be seen in the extension of the writing lines. In fact, in two thirds of the inspected volumes, these are contained within the borders of the writing area (and therefore traverse the inter-column space), whilst in the remaining third they run from the inner margin (gutter) all the way across to the outer justification. In exceptional cases (i.e. in only two of the volumes examined, Laur. Conv. Soppr. 307 and Vat. lat. 4216), the writing lines are ruled within the two columns, without crossing the intercolumnium. As regards delimitation of the said columns, the two main typologies used four simple lines or four narrow double bounding lines that defined (to the right and to the left) both text columns. Less frequently seen is the presence of a single pair of double binding lines positioned at the inner and outer sides of the writing area (Casanat. 722 and 723; Laur. Edili 124; Laur. Plut. 25.2; Lucca 2; and Sessor. 3), enhanced in only two Bibles (Laur. Plut. 15.18 and Sessor. 2) by a single vertical line that sub-divides the inter-column space. The distribution of these different

types is not a product of pure chance, but instead follows a logical pattern, which will be further explored later on.

All the Atlantic Bibles present with two-column layouts. However, this is not a specific characteristic of this particular type of text, nor does it represent the application of a prevalent aesthetic principle, but rather—as will become clearer later on—a functional characteristic, imposed by the volumes' dimensions and the parameters dictated by the *mise en page*.

The writing area is rather narrow, despite the necessary presence of an inter-column space. Its proportion (on average 0.60, or 3/5) is inferior to that of the full page. This aspect of Atlantic Bibles is also in line with coeval manuscript production. In fact, this characteristic is typical of Western manuscripts and endured up until the advent of modern typography, probably on account of a desire to leave plenty of space in the lateral margins, the natural place to position any subsequent annotation.

With respect to the 'relative' surface area of the margins (considered, that is, independently from the page size), this, needless to say, varies from one codex to another (and often, as we shall see, according to systematic criteria), but in any event presents a certain number of constants which correspond to the dominant choices made during the production of manuscripts of the period. Above all, the relationship between the written surface area and the total surface area of the page (the 'black' or 'page filling') usually does not exceed 50%. This value only seemingly implies an unusual waste of space; in fact, it more or less tallies with the values seen in Western manuscript production before the Late Middle Ages. Indeed, is rather high when considered in relation to the very high production quality seen in Atlantic Bibles.

As is consistently observed in ancient manuscript production, and not solely in the West, from the Early Middle Ages onwards the surface areas of the four margins were not made equal and were instead conformed to a fixed hierarchical criterion which was destined to last almost up until the present day: the two outer and lower margins are always more spacious than the inner and upper ones. Once again, it is likely that a choice seemingly dictated by purely aesthetic criteria was in fact rooted in a practical need (i.e. the desire to position the writing space as far away as possible from the irregular periphery of the skin).

In any event, investigations carried out on large groups of codices have revealed the existence of systematic variations within the basic hierarchical model that governed margin ratios. The variations are confirmed by the prescriptions found in the two best known surviving documents containing so-called 'recipes'. The most ancient source—the Saint-Remi 'recipe', preserved in Par. lat. 11884—establishes, in particular, parity between the outer and lower margins. The later

source—dating from the Humanist era, and attested to by the Munich codex Clm 7775, stipulates parity between the opposite pairing, namely the inner and upper margins. The progressive substitution of the earlier canon with the later one, a widespread phenomenon which has already been brought to light in a work dealing with Latin manuscript production,[9] also affected the Atlantic Bibles. It is perhaps not by chance, then, that the Bibles which conform more closely to the Paris 'recipe' can be placed amongst the most ancient (Genève 1; Parma 386; Vat. Barb. lat. 587; Vat. Pal. lat. 3–4–5; and Vat. lat. 10405), and that other Bibles of later production (Vat. Barb. lat. 589–590; Vat. lat. 10404) conform more closely to the Munich prescriptions. However, this can only be regarded as a rough observation, given the frequently drastic trimming the Bibles have been subjected to in the past. Additionally, there exists the possibility that other canons, different from the ones that have come down to us, were employed. In the absence of explicit documentation, such formulae cannot easily be reconstructed.

Even if, as has already been observed, the written surface of Atlantic Bibles does not exceed 50% of the total page area, the writing area contains a large quantity of text. In fact, the manuscripts consistently present an elevated number of lines, varying from a minimum of 45 (Sessor. 2), to a maximum of 69 (Angel. 1273), with an average line count of around 55 (with the exception of Laur. Conv. Soppr. 295, which has only 39). Consequently, the ruling unit, calculated by dividing the height of the writing area by the number of lines (minus one), is also very 'compressed': in fact, it ranges from 6.5 mm to 9.5 mm, the average value being 7.8 mm. These values are entirely analogous with those recorded in Turonian Bibles which, however, as has already been mentioned, are somewhat smaller in size.

The Psalter and Four Gospels represent a case apart. A well-established tradition often required the transcription of such texts on to a greater number of lines, generally between 60 and 70 (see, among the most ancient examples, Casin. 515; Vat. Barb. lat. 587; Vat. Pal. lat. 3–4–5 and Vat. lat. 10511, and also the later Laur. Edili 125–126). The number of written lines occasionally reached, or even exceeded, 80 (Angel. 1273; Parma 386; and Vallic. A 2). In a few cases—Vat. Barb. lat. 587, and Vat. lat. 10510 and 4218—the Psalter is even laid out in three columns (in 65 lines per column in the first two volumes, and 53 lines per column in the third).

The codices' large dimensions and elevated number of written lines justified the universal adoption of a two-column layout, a solution dictated by the need to contain the length of lines and to assist the eye's transit from the beginning to the

9 Maniaci 1995.

end of each line.[10] The two columns of text are generally of uniform size, ranging from 98 mm to 134 mm in width (with an average measurement of 115 mm), although in some cases a consistent variation in the widths of paired columns can be observed. Each line of the biblical text (with the exception of the *capitula*, which generally adopt a smaller module) contains an average of around 36 characters; however, the figure can vary considerably, with a minimum of 24 (Laur. Plut. 15. 12), and a maximum of 44 (Riccard. 221). An 'average' page provides space for almost 4,000 characters, though in effect the number is greater if one takes into account the fact that included in the writing are a certain number of commonly used abbreviations (on average ranging from 2–10%).

All the elements discussed up to this point serve to place the Atlantic Bibles in a contextual setting of coeval craftsmanship. Their distinguishing features have been highlighted, but on the other hand adherence to a set of shared 'technical conventions' inspired by the period's prevailing traditions (and in accordance with clear functional requirements) has also been described. If one abandons this 'monolithic' perspective—inspired by the Bibles' exceptional dimensions—one can pose the question as to whether, within a set of volumes of seemingly consistent structures, significant differences can in fact be identified, and, above all, if any differences can be placed in relationship with the chrono-geographic phases proposed in previous studies (in particular, those of Edward B. Garrison, Knut Berg and Larry Ayres, on the decoration of the Bibles).

Archaeological investigation alone is not a sufficient means to arrive at new and more precise dating and/or geographical pinpointing of individual witnesses, nor to clarify (still numerous) uncertainties vis-à-vis their attribution. Instead, the more modest aim is primarily to verify whether or not, and to what extent, the structural characteristics of Atlantic Bibles broadly tally with the dichotomy that essentially rests on the findings of an art historical investigation that opposes a compact 'Umbro-Roman' area (centred on the city of Rome) with a less well-defined and far more spread out constellation of Tuscan centres—and, at a more detailed level, with the chronological stratifications identified within each of these two typologies. Secondly, by focusing attention on the 'prototypical' phase of the phenomenon, the aim is also to exploit the contribution made by codicological analysis so as to verify the hypothesis which holds that the majority of ancient Bibles either originated from a single centre, or alternatively from a cluster of nearby production centres unified by shared and strictly codified manufacturing directives.

10 Bozzolo et al. 1984.

Limiting, for now, the discussion to the unanimously pinpointing Bibles, an immediately evident datum is the fact that the unquestionably 'Umbro-Roman' codices are somewhat larger than the Tuscan ones (with a significant difference of an additional 2.5 cm in height and 1 cm in width). The difference in the volumes' total dimensions is also reflected in the size of the writing area, with the result that the text of the 'Umbro-Roman' Bible is contained in a smaller number of pages. If one takes the Octateuch as an example—a series that is well represented among the manuscripts examined—it can be observed that the first eight biblical books occupy an average of 173 pages in the 'Umbro-Roman' Bibles, and an average of 213 pages in the Tuscan volumes. This difference cannot be attributed solely to the variance in page dimensions and writing areas (which overall is quite moderate), but instead has to do with the different use of space. This can readily be seen by examining the way in which pages were filled (the written surface occupies 48% of a page's surface in the 'Umbro-Roman' specimens, as opposed to 44% in the Tuscan Bibles), and by contrasting the number of lines in a column (an average of 59 and 50, respectively), and consequently the interlinear space (or ruling unit) (7.2 mm, as opposed to 8.2 mm). The tendency to 'lighten' the page is also made apparent by the fact that in the Tuscan Bibles the script module remains almost constant (with round letters measuring 32 mm in height), notwithstanding an increase in the space between lines. The greater space required for the transcription of the Tuscan Bibles explains their structuring into two volumes, a specification that was regularly foreseen in the planning phase of production (as is expressly stated in the colophon of the Fonte Avellana Bible, Vat. lat. 4216). For this reason, very few complete Bibles survive (Laur. Plut. 15.1; and Laur. Edili 125–126).

The differences in size observed between the two groups is complemented by to variations in the characteristics of the support that was employed: the animal species used and thickness of the parchment in particular. Irrespective of the not insignificant number of doubtful cases (at least a third of the total number of volumes), the 'Umbro-Roman' Bibles seem to have been made from parchment derived predominantly from sheepskin (of a yellow hue and flexible consistency), whilst those manufactured in the Tuscan zone make extensive use of goatskin parchment. In addition, the parchment sheets found in the 'Tuscan' Bibles are on average thicker (214 as opposed to 202 microns), and this despite the fact that sheepskin generally possesses the quality of being somewhat thinner.

Another difference in approach can be seen in the dimensional characteristics of ornamental initials, which represent the most significant decorative element in the Bibles. Whilst the majority of the 'Umbro-Roman' volumes bear large letters regularly placed at the beginning of each book of the Holy Scriptures

(adding up to a total of around 70 initials in complete Bibles), in those which are of unequivocally Tuscan origin the average size of initials is smaller, but their number greater, with additional ornamental letters positioned at the beginning of prologues or forming internal partitions within individual books of the Bible.

Needless to say, comparisons drawn between the two groups have a statistical value, but the possibility should not be excluded that individual copies may not reflect the overall trends seen across the board. In other words, the fact that average values might be higher in one of the two sub-groups does not necessarily mean that the same remains true of the entire block of codices to which they belong. Thus, for example, the Tuscan Bibles Angel. 1272 and Laur. Plut. 15.1 present, respectively, 58 and 59 written lines (with the interlinear spaces measuring 6.9 mm and 7.7 mm, respectively), whilst in the Bibles of Santa Cecilia (Vat. Barb. lat. 587) and Montecassino (Casin. 515) the number of written lines is 55–56, both volumes representing early examples of the typology and originating without doubt from the 'Umbro-Roman' zone.

Additionally, among the 'Umbro-Roman' Bibles, the cluster of volumes concordantly ascribed to the 'prototypical' phase of Atlantic Bible history stands out for its overall consistency. The said volumes can be dated to the decades immediately following the middle of the 11th century, and today are generally believed to originate from Rome. All the examples examined (Admont C–D; Angel. 1273; Ambros. B 47 inf.; Casin. 515; Genova; Genève 1; Monac. Clm 13001; Parma 386; Sessor. 1; Vallic. A 2; Vat. Barb. lat. 587; Vat. Pal. lat. 3–4–5; Vat. lat. 10405 and 10511) appear to have been used more intensively, not only in comparison to the volumes of Tuscan origin, but also with respect to the later 'Umbro-Roman' ones, as is made evident by the average number of lines (60 and above) and the ruling unit (measuring approximately 7 mm, as opposed to 8.3 mm in the Tuscan Bibles, and 7.5 mm in the 'Umbro-Tuscan' volumes produced after the first appearance of the phenomenon).

Two other codicological characteristics relate to the material preparation of leaves and the typology of the *mise en page*. Broadly speaking, these features can help us to distinguish between manuscripts made before the beginning of the 12th century and those of later manufacture, and seem to be linked to the Bibles' chronological rank rather than to where they were produced. Typical of the older Bibles is the previously described ruling system applied to single folded bifolia, which initially definitely prevailed over the so-called 'new style' system. This system is associated, in an almost systematic way, with the type of ruling that involved the presence of double bounding lines at both sides of each column. Among the volumes that were examined, the following were found to present both characteristics: Casin. 515; Genève 1; Laur. Fesul. 4; Laur. Mugell. 1; Laur.

Plut. 15.10 and 25.1; Mantova 131; Riccard. 221; Sessor. 1; Vat. Barb. lat. 588; Vat. Pal. lat. 3-4–5; Vat. lat. 10511; Parma 386, in addition to Firenze, B.N. Magl. Cl.XL.1 and Vat. lat. 4217, both of later manufacture.

A fundamental aspect of any manuscript volume's structure concerns the relationship between its textual content and quire sequence. Before examining the Bibles' quire structure, it is necessary to determine (and summarise) the text sequences they contain. The 'canonical' order of the 'Italian' Bibles stipulated the following succession of texts, as defined by Henri Quentin:[11] the Octateuch, Kings, the Book of Prophets, Psalms, the Books of Wisdom, Paralipomenon, Job, Tobias, Judith, Esther, Esdras, Maccabees, and the New Testament. Later on, the so-called 'University Bible' adopted a different sequence: the Octateuch, Kings, Paralipomenon, Esdras 1–4, Tobias, Judith, Esther, the Books of Wisdom, the Book of Prophets, Maccabees, and the New Testament.

In effect, most of the Atlantic Bibles contain a sequence of texts similar to that defined by Quentin, notwithstanding the existence of a number of variants which show, in particular, differences in the two sequences of the books of Tobias, Judith and Esther, and of Jeremiah, the Lamentations, and Baruch (the last mentioned often being absent from the most ancient Bibles, which is also true of the Carolingian Tours Bibles). The fact that some of the Bibles present a different sequence which corresponds more closely to the one seen in 'modern' Bibles does not necessarily mean—as will become apparent—that the said sequence corresponds to the original one, given that many of the inconsistencies are attributable to binding errors, or alternatively to a desire to restructure the biblical texts in compliance with the new order that became established in the 13th century.

The possibility of modifying the original sequence of books, but at the same time safeguarding the integrity of quires and not overwriting portions of the text, was made achievable thanks to the Bibles' specific structure, which probably represents their most characteristic feature.

Two particular features of the quire structure are shared by almost all the Bibles (independent of their age or place of origin), with only a few very rare exceptions. The first is the systematic presence of a caesura—or 'junction' (Italian 'snodo')—between the Old and New Testaments. Here, the term 'junction' is intended to mean the concomitance between the end of a work and the end of a quire which is not a product of pure chance. Such 'junctions' are all the more apparent in quires that are not quaternions, but rather groupings of bifolia which are of irregular structure or consistency (perhaps a quaternion that has been mutilated, or one which has had one or more leaves added to it, or even an altogether

11 Quentin 1922.

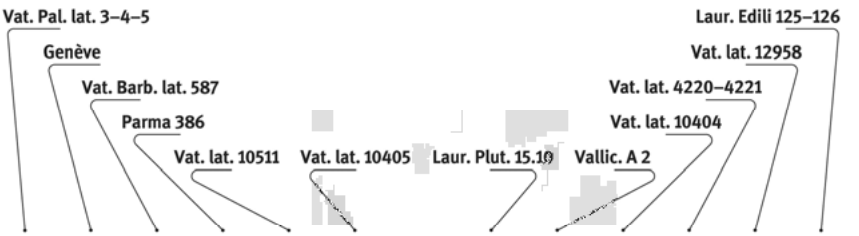
differently structured quire composed of groups of two, three or five bifolia). Furthermore, the caesura can be accentuated by the fact that the written text terminates before the end of the quire is reached, thereby leaving the final page partially or completely blank. The division between the Old and New Testaments is generally positioned at the beginning of the St Matthew's Gospel, but it is often accompanied by a separate transcription of the Prologues, sometimes associated with the Canon Tables. Among the Atlantic Bibles examined, only a few do not follow this general pattern, but instead present with no caesura between the Old and New Testaments (Casanat. 721 and 723; Laur. Plut. 15. 10 and 25.2; Vat. lat. 4217 and 10405). Whatever the case may be, the 'junction' between the Old and New Testaments never coincides with a physical division of the Bible into two tomes: in fact, in comparison with the Old Testament, the New Testament consists of too few pages for it to be conceived of as a separate volume when considered in the context of a complete Bible.

The second peculiarity is found in another 'junction' which is regularly located at the end of the sequence formed by the Books of the Prophets—that is, to say at the conclusion of the Book of Malachi. In contrast to the previous case, the caesura placed at the end of the Minor Prophets serves a clear 'strategic' function, in that it makes it possible to subdivide into two volumes of virtually the same length the biblical text arranged in the sequence devised for the Atlantic Bibles. It is not by mere chance that almost all the Bibles of which only one half has survived conclude with the end of the Books of the Prophets or commence with the Books of Wisdom.

The subdivision of the Old and New Testaments and the caesura occurring at the end of the Book of Malachi represent the two most immediately apparent features of a 'modular' structural approach which, in a significant number of the Atlantic Bibles, is further deployed in a much more sophisticated way.

The most noteworthy examples—here limited to the fully intact Bibles that underwent examination—are listed in the following table (the 'junctions' are identified by a double line; those which are associated with irregular quires are shaded). As already stated, the anomalous sequence in a few of the Bibles (Genève 1; Vallic. A 2; Vat. Pal. lat. 3–4–5; and lat. 10404) can be ascribed to successive 'shufflings' of the texts, whilst Laur. Edili 125–126 must be assumed to represent the original sequence.

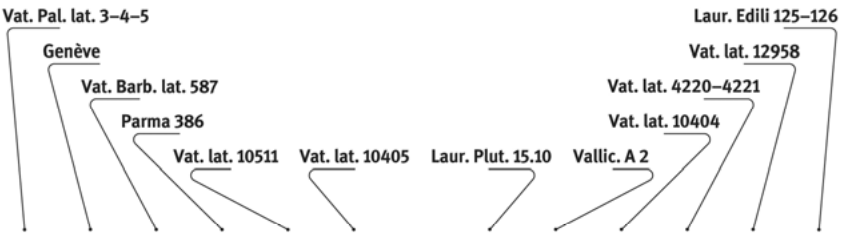
Order of biblical books and distribution of caesurae in a sample of Atlantic Bibles (tab. 1.1)



Gn	Gn	Gn	Gn	Gn	Gn	Gn	Gn	Gn	Gn	Gn	Gn
Ex	Ex	Ex	Ex	Ex	Ex	Ex	Ex	Ex	Ex	Ex	Ex
Lv	Lv	Lv	Lv	Lv	Lv	Lv	Lv	Lv	Lv	Lv	Lv
Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm	Nm
Dt	Dt	Dt	Dt	Dt	Dt	Dt	Dt	Dt	Dt	Dt	Dt
JHo	JHo	JHo	JHo	JHo	JHo	JHo	JHo	JHo	JHo	JHo	JHo
Jdg	Jdg	Jdg	Jdg	Jdg	Jdg	Jdg	Jdg	Jdg	Jdg	Jdg	Jdg
Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt	Rt
Ho	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm	1 Sm
Jl	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm	2 Sm
Am	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs	1 Kgs
Ob	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs	2 Kgs
Gn	Jb	Is	Is	Is	Is	Is	1 Ch	Pr	Is	Is	1 Ch
Mi	Ps	Jr	Jr	Jr	Jr	Jr	2 Ch	Eccl	Jr	Jr	2 Ch
Na	Pr	Bar	Lm	Lm	Lm	Bar	Exdr	Cant	Bar	Lm	Is
Ha	Ec	Lm	Bar	Bar	Bar	Lm	Ne	Ws	Lm	Bar	Jr
Zep	Cant	Ez	Ez	Ez	Ez	Ez	Pr	Sir	Ez	Ez	Lm
Hag	Ws	Dn	Dn	Dn	Dn	Dn	Ec	1 Ch	Dn	Dn	
Zec	Sir	Ho	Ho	Ho	Ho	Ho	Cant	2 Ch	Ho	Ho	Ez
Ml	1 Ch	Jl	Jl	Jl	Jl	Jl	Ws	Ps	Jl	Jl	Dn
Is	2 Ch	Am	Am	Am	Am	Am	Sir	Is	Am	Am	Ho

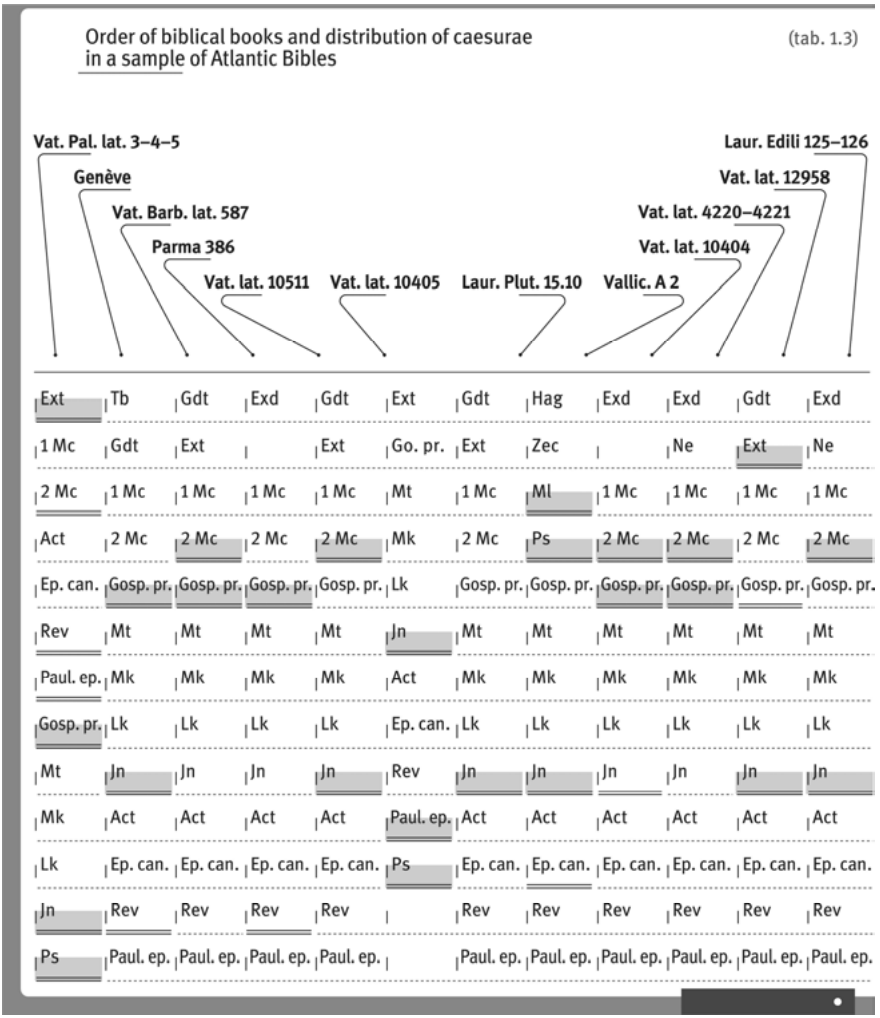
→

Order of biblical books and distribution of caesurae in a sample of Atlantic Bibles (tab. 1.2)



Jr	Is	Ob	Ob	Ob	Ob	Ob	Jb	Jr	Ob	Ob	Jl
Lm	Jr	Jon	Jon	Jon	Jon	Jon	Tb	Bar	Jon	Jon	Am
Bar	Lm	Mi	Mi	Mi	Mi	Mi	Iud	Lm	Mi	Mi	Ob
Ez		Na	Na	Na	Na	Na	Ext	Ez	Na	Na	Jon
Dn	Ez	Ha	Ha	Ha	Ha	Ha	1 Mac	Dn	Ha	Ha	Mi
1 Sm	Dn	Zep	Zep	Zep	Zep	Zep	2 Mac	Ho	Zep	Zep	Na
2 Sm	Ho	Hag	Hag	Hag	Hag	Hag	Is	Jl	Hag	Hag	Ha
1 Kgs	Jl	Zec	Zec	Zec	Zec	Zec	Jr	Am	Zec	Zec	Zep
2 Kgs	Am	Ml	Ml	Ml	Ml	Ml	Lm	Ob	Ml	Ml	Hag
1 Ch	Ob	Ps	Ps	Jb	Pr	Jb	Bar	Jon	Ps	Ps	Zec
2 Ch	Gn	Pr	Pr	Ps	Ec	Ps	Ez	Mi	Pr	Pr	Ml
Pr	Mi	Ec	Ec	Pr	(Cant)	Pr	Dn	Na	Ec	Ec	Jb
Ec	Na	Cant	Cant	Ec	(Ws)	Ec	Ho	Ha	Cant	Cant	Ps
Cant	Ha	Ws	Ws	Cant	Sir	Cant	Jl	Zep	Ws	Ws	Pr
Ws	Zep	Sir	Sir	Ws	1 Ch	Ws	Am	Hag	Sir	Sir	Ec
Sir	Hag	1 Ch	1 Ch	Sir	2 Ch	Sir	Ob	Zec	1 Ch	1 Ch	Cant
Jb	Zec	2 Ch	2 Ch	1 Ch	Exd	1 Ch	Jon	Ml	2 Ch	2 Ch	Ws
Exd	Ml	Jb	Jb	2 Ch		2 Ch	Mi	Jb	Jb	Exd	Sir
	Exd	Exd	Tob	Exd	Jb	Exd	Na	Tb	Tb		Tb
Tb			Gdt	Ne	Tb	Ne	Ha	Gdt	Gdt	Jb	Gdt
Gdt	Ext	Tb	Ext	Tb	Gdt	Tb	Zep	Ext	Ext	Tb	Ext

→



Tab. 1: Order of biblical books and distribution of caesurae in a sample of Atlantic Bibles

Each of the Bibles listed in the table contains a number of 'junctions', ranging from a minimum of nine (Genève 1 and Vat. Barb. lat. 587) to a maximum of fifteen (Pal. lat. 3–4–5). The main caesurae, which are common to the majority of volumes, are found at the end of the Octateuch (8 cases in 12), Kings (9 in 12), the Minor Prophets (11 in 12) and/or Paralipomenon (7 in 12), Maccabees (7 in 12), between the Old and New Testaments (in full, with or without introductory texts, 10 in 12), and between the Gospels and the Acts of the Apostles (8 in 10).

This modular arrangement is also found (in similar ways) in many of the (presently) incomplete Bibles (Ambros. B 47 inf.; Mantova 131; and Par. lat. 50 and 104), and is frequently accompanied by various other peculiarities. The Psalms, when present, are often transcribed as independent units (two quaternions in Laur. Plut. 25.1 and Vat. lat. 12958; two ternions in Par. lat. 104 and Vat. lat. 10404 and 10511; one quaternion plus one ternion in Vat. Barb. lat. 587 and 588, Vat. Pal. lat. 5, and Vat. S. Maria Magg. 4; one ternion plus one binion in Vallic. A 2; and finally, one binion coupled with two quaternions, one of which is irregular, in Casanant. 723). The same treatment was often reserved for the Book of Job, which was generally accommodated in an independent quaternion of varying position (Monac. Clm 13001; Vallic. A 2; Vat. Barb. lat. 587; Vat. Pal. lat. 4; and Vat. lat. 12958; and a quinion in Genève 1), and for the introductory material to the Gospels (Mantova 131; Vat. Barb. lat. 587; and Vat. lat. 10404). In both cases, this explains the 'shifting' of the texts. Furthermore, the Psalms usually follow the Book of Job, falling between the Books of the Prophets and the Books of Wisdom, but can also be found inserted between the Old and New Testaments (Laur. Plut. 15.1; Vallic. A 2), before the Book of the Maccabees (Vat. S. Maria Maggiore 4), or at the end of the New Testament (Vat. lat. 10405 and Vat. Pal. lat. 3). As regards the Book of Job, this is most often found positioned after the Minor Prophets, but is sometimes seen in other positions, often following Paralipomenon (for example, in Par. lat. 104; Parma 386; Vat. Barb. lat. 587; Vat. lat. 4217, 4218 and 4221; and Vat. S. Maria Maggiore 4), or following Esdra (Angel. 1274; Vat. lat. 10405 and 12958), and finally, at the end of the Books of Wisdom (Sessor. 3).

Additional caesurae which can be defined as being of secondary importance can be found marking the end of the two books of Paralipomenon and the Book of Esther. Further occasional caesurae—whether they are intentional or not is difficult to say—appear in various other places: for example, at the end of the Pentateuch (Laur. Edili 125–126; Vat. lat. 4217A, 10405 and 12958); within the long sequence formed by the Prophets (Ambros. B 47 inf.; Angel. 1272; Casanat. 722; Casin. 515; Laur. Edili 125–126; Laur. Mugell. 1; Laur. Plut. 15.10; Laur. Fesul. 4; Par. lat. 50; Vat. Pal. lat. 3; Vat. lat. 4217, 4220, 10404, 10405, 10511 and 12958); and following Proverbs (Angel. 1274; Casanat. 721 and 723; Laur. Edili 124 and 126; Laur. Plut. 15.1 and 15.10; Lucca 2; Par. lat. 104; Parma 386; Vat. Barb. lat. 587 and 588; Vat. Pal. lat. 3; Vat. lat. 4127, 4218, 4221, 10405, 10511 and 12958). Finally, the Books of Isaiah (Laur. Edili 125; Laur. Plut. 15.10; Vat. lat. 4217 and 10405) and Ezekiel (Laur. Fesul. 4; Laur. Mugell. 1; Par. lat. 50; Vat. lat. 10404), and the sequence which forms the Minor Prophets (Laur. Edili 125; Par. lat. 50; Vat. Pal. lat. 3), can also coincide with similarly autonomous modules, each composed of two or three quires.

The modular nature of the quires composing the Bibles (as described above) endowed them with a high degree of 'interchangeability', which can only be the product

of conscious choices made at the time of the volumes' assembly. More than anything, the evidence strongly suggests the adoption of a strategy of intentionally convergent choices, in that the caesurae almost always coincide with the end of the same scriptural texts. In addition, the caesurae are not infrequently made evident by two or more 'deviant' quires in sequence, rather than one quire of anomalous structure, the obvious intention being to prepare in advance for the caesura (Laur. Plut. 25.1; Vallic. A 2; Vat. lat. 10404). If this capability resulted in binding errors as a consequence of 'creative' textual sequences, it also made it possible, from the earliest phases in the giant Bibles' history, to reassemble text blocks in accordance with changing needs and historical developments.

In addition, the apparently 'abnormal' succession of biblical books could be accounted for by the existence of an original 'model sequence', as is quite evident in cases where the Books of Wisdom were placed (sometimes with, sometimes without, intervening books) after Kings and before the Books of the Prophets, in conformity with the typical sequence found in the Bible of the 13th century (Angel. 1273; Genève 1; Laur. Edili 124; Laur. Plut. 15.12 and 15.18; Vat. lat. 10404). This does not mean that all the Bibles that contain the same caesurae are completely interchangeable in relation to the textual sequence, inasmuch as variations exist in the succession of the books that compose entire and indivisible text blocks. This is certainly the case in the sequence Esdra-Tobias-Judith-Esther, where Esdra can either precede or follow the other three books, and Tobias-Judith-Esther can be arranged in the sequence Tobias-Judith-Esther, or, less frequently, Esther-Tobias-Judith, in accordance with the Alcuinian trend (Genève 1; Casanat. 721 and 723; Casin. 515; Vat. Barb. lat. 588; Sessor. 1; and Mantova 131).

This last-mentioned peculiarity provides us with indirect evidence which excludes the possibility that the modular structure of the Bibles was solely intended to facilitate the creation of different sequential permutations; indeed, had this been the case, caesurae should have appeared to coincide with the particularly 'unstable' sequence composed of Tobias, Judith and Esther. On the other hand, it is interesting to note that a very frequent caesura—that which separates the Octateuch from Kings—is positioned within a sequence that is particularly stable and which was almost never modified.

It is altogether likely, then, that in reality the phenomenon has more complex roots and was the result of several concomitant factors.

In the first place, the possibility should be considered that the text's assembly into blocks did not serve only as an indispensable means to mitigate an excessive 'rigidity' in the textual flow, but was also a result of the need to divide tasks among multiple scribes (and possibly multiple miniaturists as well) working simultaneously on the production of a single volume. Such a possibility presupposes that the caesurae correspond to a commensurate number of changes in artisans' hands. In order to

verify this hypothesis, in addition to a thorough analysis of the kind carried out by Marco Palma,[12] a precise survey of any irregularities in the density of the writing and the number of abbreviations employed in proximity to the caesurae (the frequently encountered phenomenon of blank columns and pages nudges research in this direction) would have to be carried out.

Should the hypothesis of simultaneous transcription prove to be valid following a suitable palaeographic analysis (hints of 'strategic' changes in artisans' hands can be gleaned, for example, from the descriptions of the Ambros. B 47 inf.; S. Ambrogio M 55; Vat. lat. 4218, 4220–4221, 10510, 10511; Vat. Ross. 617 Bibles, although it should be pointed out that not all the caesurae coincide with the turnover of copyists), it would be necessary to look closely at the functional implications and historical significance of such a copying method. In fact, a method of this kind finds its place in a context in which the transcription of a text of considerable length over a period of a few months represented a routine practice, the aim being to disseminate the new 'product' in as shorter time as possible. However, within the context of such a hypothesis, the incompatibility of the Bibles' modularity with the so-called *pecia* system, which was deployed two centuries later for the dissemination of texts in the main university cities, should immediately be emphasised, not only on account of the obvious difference in the cultural context, but also for material reasons. In fact, it has been noted that in contrast to what can be observed in Atlantic Bibles, copies made using this system, transcribed by only one copyist, do not present any signs of modularity, which was characteristic of the sole *exemplar* held by the university stationer. Furthermore, it is worthwhile to recall that the goal of the *pecia* system was not that of speeding up an individual volume's preparation, but rather the practically simultaneous production of identical copies, thanks to the sequential sharing of a unique model authenticated by the relevant university's authorities. Even if we limit the comparison to the most ancient specimens, the Atlantic Bibles exhibit, on the contrary, in both their structural and their textual characteristics, considerable differences.

To these two principal factors we can add a few more: in the first place, the nature of the textual models adopted for the Atlantic Bibles, which in all likelihood consisted (in the initial phase, at least) of independent groups of biblical books, rather than of complete Bibles contained in one volume. In addition, we must consider the weight of a secular tradition which conceptualised the Bible as a *bibliotheca*, composed of an association of books or groups of distinct and autonomous books (i.e. booklets), sometimes gathered together within the same binding, but also subject—frequently, in fact—to being circulated separately. Indeed, it is not by chance that the most recurrent caesurae coincide with the main textual partitions in the Vulgate. In this

12 Braga / Orofino / Palma 1999.

connection, it would be necessary to verify the presence of caesurae in the oldest Bibles—Turonian ones, above all—which stand out, it seems (though a more in-depth analysis would be desirable so as to reinforce this impression) on account of a more 'stable' sequencing of the Holy Scriptures. However, the 'tendency to harmonise the internal organisation of the work with the material composition of the codex' is neither a new nor characteristic feature in the manufacture of the Bible, since it can already be observed towards the middle of the 8th century in a volume of Augustin's *De trinitate* (Oxford, Bodleian Library, Laud. misc. 126) originating from Northern France.[13]

This question, for now, has to remain unanswered. However, it is no small thing (even if the reasons lying behind the phenomenon remain unclear) that the modularity of the Bibles is essentially a characteristic found in the most ancient witnesses originating from the 'Umbro-Roman' zone, and that the phenomenon diminished with the passage of time and the shifting of centres of production towards Tuscany, until it entirely disappeared in the first half of the 12th century. Among the Bibles of unquestionably Tuscan origin, only Laur. Edili 125–126 presents a conspicuous number of caesurae, which furthermore only partially coincide with the ones observed in 'Umbro-Roman' volumes. There is a complete absence of caesurae in many Bibles produced after the first quarter of the 12th century (Casanat. 720; Sessor. 2; Laur. Conv. Soppr. 307 and 630; Laur. Plut. 15.12 and 15.19; and Vat. lat. 4216). In at least one case (that of the Ávila Bible, Matrit. Vitr. 15.1), the absence of some of the more 'classical' caesurae contributed significantly to the splitting up of the volume and a consequent duplication of the opening and closing sections of some of the scriptural books when it was deemed necessary to 'modernise' the textual sequence.

In any event, no matter how the influence of various factors is assessed when interpreting the structural evolution which has been brought to light, it seems reasonable to deduce that a shift took place between two distinctly different production approaches: an older, 'intercommunity', multi-participatory approach composed of initiatives emanating from one or more scriptoria, coordinated and organised in accordance with very precise final objectives; and a later 'intercommunity' approach in which the transcription of a single Bible would be the product of an isolated effort made within a specific collective, whose members might also share the financial burden associated with the volume's production (as attested to by a lengthy colophon in the Giant Bible of Calci, and by marginal glosses present in Casanat. 722). In the first instance, the goal was to maximise the dissemination of a ground-breaking form of the Bible that was intended to serve as a vehicle for new political and doctrinal messages and was aimed at a variety of uses and users. This represented an operation that made it necessary not only to draw on multiple textual sources, but also to adopt

13 Palmer 1989, 54.

ad hoc organisational methods and manufacturing techniques (in addition to calligraphic and decorative work), and was therefore considered 'abnormal' and innovative in comparison to those adopted in the past. In the second instance, the goal was simply to reproduce (faithfully, and in a practical way) an already existing model of the Bible, so as to bestow prestige on a community. This less ambitious goal could be entrusted to accomplished professionals who were not necessarily cloistered within monastic environments. Such artisans tended to employ the most convenient, tried and trusted techniques. Hence, in this second scenario, the manufacturing technique was limited to merely retracing the natural reading sequence, rather than paying attention to the interaction between the structure of the text and that of the book. In other words, the Bible was treated in precisely the same way as other texts, and therefore in a sense somewhat 'trivialised'. It is not by pure chance that, in an analogous and contemporaneous evolutionary process, the copying of Evangeliaries received the same treatment.[14]

It is fairly obvious that the questions posed by the appearance of the Atlantic Bibles in the history of the dissemination of the Holy Scriptures cannot be answered simply by conducting a codicological analysis. Nevertheless, it is also possible that a more in-depth investigation of the surviving volumes could uncover further elements which might usefully contribute to enriching chrono-geographical expertise. In addition, such research could also improve our knowledge of the particular techniques that were employed during the preparation of these remarkable volumes.

The various pieces of evidence gathered so far have contributed to allowing us to isolate a core group of 'ancient' Bibles, the creation of which proves beyond a shadow of a doubt that it represents the result of a carefully planned project. However, it is difficult to establish whether or not individual volumes were the product of a single scriptorium or—as I believe to be the case—of a group of neighbouring production centres operating in a coordinated way. The issue is further complicated when one considers the diachronous dimension: in the development of Atlantic Bibles, the associated chronological and geographical data become indissolubly intertwined, thus it is not always possible to determine whether or not the changes observed are attributable to changes occurring in the production centres and in techniques—and by extension in the history of the biblical texts—or alternatively to changes of a more general kind which, starting in this period, exerted an impact on book artisans, clear evidence of which is provided by the Bibles. Even if, when looked at from the perspective of a relatively circumscribed history of the Bible, this second element is perhaps not the most central, the contribution that Atlantic Bibles could make to the history of the book (between the Early and Late Middle Ages) in a wider perspective should

14 Bischoff 1991.

not be neglected, inasmuch as the circumstances of their production represented a crucible of artisanal, graphic and 'peri-graphic' innovation aimed at reconciling the contradiction arising from the considerable size of the 'textual mass' and the desire to contain it within a monolithic block.

Hence, in this wider panorama the potential value of a comparative diachronic/synchronic analysis of the Bible's numerous 'materialisations' as a book—and not only in the Latin context—should be emphasised, since such 'materialisations' constitute on the one hand a focus of interest of primary importance for scholars of sacred texts, and on the other, in virtue of the text's fixedness and the need for it to be adapted to unavoidable and frequently conflicting exigencies, an invaluable 'observational laboratory' for today's codicologists.

Irrespective of the specific goals of any research, it is obvious that, in order to bear fruit, any investigation calls for a systematic examination and description of the greatest number possible of surviving specimens, as well as a pooling of various disciplines (namely, history, philology, art history, palaeography and codicology). Seen from this standpoint, then, with respect to Atlantic Bibles, the organisation of the present exhibition[15] and its accompanying catalogue constitute not only an indispensable introduction to the subject but also a significant advance in it. However, it now seems clear that an in-depth analysis of the fresh insights that these achievements represent, not only in terms of the history of the tradition and criticism of the sacred text, but also in relation to the manufacture of the Bible as a book—and, indeed, of the book in general—cannot exclude, for the earlier period, an investigation of Carolingian Bibles, and for the later phase, an in-depth study of the so-called 'University Bibles'. Similarly, research into the reception of the Atlantic model beyond the Alps over the course of the 12th century should not be neglected.

A list of the Bibles examined:

Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Arch. S. Pietro A 1
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Barb. lat. 587
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Barb. lat. 588
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Barb. lat. 589–590
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 10404
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 10405
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 10510
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 10511
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 12958
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4216

15 *Le Bibbie Atlantiche* 2000.

Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4217
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4217A
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4218
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4220–4221
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Pal. lat. 3–4–5
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. Ross. 617
Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. S. Maria Maggiore 4
Firenze, Biblioteca Laurenziana, Laur. Conv. Soppr. 295
Firenze, Biblioteca Laurenziana, Laur. Conv. Soppr. 307 (I)
Firenze, Biblioteca Laurenziana, Laur. Conv. Soppr. 630
Firenze, Biblioteca Laurenziana, Laur. Edili 124
Firenze, Biblioteca Laurenziana, Laur. Edili 125–126
Firenze, Biblioteca Laurenziana, Laur. Fesul. 4
Firenze, Biblioteca Laurenziana, Laur. Mugell. 1
Firenze, Biblioteca Laurenziana, Laur. Plut. 15.1
Firenze, Biblioteca Laurenziana, Laur. Plut. 15.10
Firenze, Biblioteca Laurenziana, Laur. Plut. 15.12
Firenze, Biblioteca Laurenziana, Laur. Plut. 15.13 (I)
Firenze, Biblioteca Laurenziana, Laur. Plut. 15.18
Firenze, Biblioteca Laurenziana, Laur. Plut. 15.19
Firenze, Biblioteca Laurenziana, Laur. Plut. 25.1
Firenze, Biblioteca Laurenziana, Laur. Plut. 25.2
Firenze, Biblioteca nazionale, II.I.510
Firenze, Biblioteca nazionale, Magliab. Cl..XL.1
Firenze, Biblioteca Riccardiana, 221
Genève, Bibliothèque publique et universitaire, 1 (= Genève 1)
Lucca, Biblioteca capitolare, 1 (= Lucca 1)
Lucca, Biblioteca capitolare, 2 (= Lucca 2)
Mantova, Biblioteca comunale 131 (= Mantova 131 [A V 1)
Milano, Biblioteca Ambrosiana, Ambros. B 47 inf.
Montecassino, Archivio dell'abbazia, Casin. 515
Paris, Bibliothèque nationale de France, Par. lat. 50
Paris, Bibliothèque nationale de France, Par. lat. 104
Parma, Biblioteca Palatina, 386 (= Parma 386)
Roma, Biblioteca Angelica, Angel. 1272 (I)
Roma, Biblioteca Angelica, Angel. 1272 (II)
Roma, Biblioteca Angelica, Angel. 1273
Roma, Biblioteca Angelica, Angel. 1274
Roma, Biblioteca Casanatense, Casanat. 720
Roma, Biblioteca Casanatense, Casanat. 721
Roma, Biblioteca Casanatense, Casanat. 722
Roma, Biblioteca Casanatense, Casanat. 723
Roma, Biblioteca nazionale, Sessor. 1
Roma, Biblioteca nazionale, Sessor. 2
Roma, Biblioteca nazionale, Sessor. 3
Roma, Biblioteca Universitaria Alessandrina, 1
Roma, Biblioteca Vallicelliana, A 2

References

Ayres, Larry M. (1994), 'The Italian Giant Bibles: Aspects of their Touronian Ancestry and Early History', in Gameson, Richard (ed.), *The Early Medieval Bible. Its Production, Decoration and Use*, Cambridge: Cambridge University Press, 125–154.

Berg, Knut (1968), *Studies in Tuscan Twelfth-Century Illumination*, Oslo: Universitetsforlaget.

Berger, Samuel (1893), *Histoire de la Vulgate pendant les premiers siècles du Moyen Âge*, Paris.

Bianchi, Francesco et al. (1993), 'Facteurs de variation de l'épaisseur du parchemin italien du VIII^{e} au XV^{e} siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano (Studi e Testi, 357–358), I, 95–184.

Bischoff, Frank M. (1991), 'Pergamentdicke und Lagenordnung. Beobachtungen zur Herstellungstechnik Helmarshausener Evangeliare des 11. und 12. Jahrhunderts', in Rück, Peter (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Torbecke, 97–144.

Bischoff, Frank M. (1994), 'Systematische Lagenbrüche: Kodikologische Untersuchungen zur Herstellung und zum Aufbau mittelalterlicher Evangeliare', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel, 12th–14th November, 1990, Marburg: Institut für Historische Hilfswissenschaften (Elementa diplomatica, 2), 83–110.

Bischoff, Frank M. / Maniaci, Marilena (1995), 'Pergamentgröße, Handschriftenformate, Lagenkonstruktion. Anmerkungen zur Methodik und zu den Ergebnissen der jüngeren kodikologischen Forschung', in *Scrittura e civiltà*, 19: 277–319.

Bozzolo, Carla / Coq, Dominique/ Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

Braga, Gabriella / Orofino, Giulia / Palma, Marco (1999), 'I manoscritti di Guglielmo II, vescovo di Troia, alla Biblioteca Nazionale di Napoli: primi risultati di ricerca', in Avarucci, Giuseppe / Borraccini Verducci, Rosa Maria / Borri, Giammario (eds), *Libro, scrittura, documento della civiltà monastica e conventuale nel basso Medioevo (secoli XIII – XV)*. Atti del Convegno di studi, Fermo, 17–19 settembre 1997, Spoleto: Centro italiano di studi sull'alto Medioevo (Studi e ricerche, 1), 437–470.

Fischer, Bonifatius (1985), *Lateinische Bibelhandschriften im frühen Mittelalter,* Freiburg i. Br.: Herder (Vetus Latina. Aus der Geschichte der lateinischen Bibel, 11).

Ganz, David (1994), 'Mass production of Early Medieval Manuscripts: the Carolingian Bibles from Tours', in Gameson, Richard (ed.), *The Early Medieval Bible. Its Production, Decoration and Use*, Cambridge: Cambridge University Press, 53–62.

Garrison, Edward B. (1953–1962), *Studies in the History of Mediaeval Italian Painting* (Vol. 1-4), Firenze: Olschki.

Light, Laura (1984), 'Le moyen âge et la Bible', in Riché, Pierre / Lobrichon, Guy (eds), *Bible de tous les temps 4*, Paris: Editions Beauchesne, 55–93.

Maniaci, Marilena (1995), 'Ricette di costruzione della pagina nei manoscritti greci e latini', in *Scriptorium*, 69: 16–41.

Maniaci, Marilena (1999), 'Suddivisione delle pelli e allestimento dei fascicoli nel manoscritto bizantino', in *Quinio*, *International Journal on the History and Conservation of the Book*,1: 83–122.

Maniaci, Marilena / Muzerelle, Denis / Ornato, Ezio (1999), 'Une bible ... mais encore? Le portrait des manuscrits bibliques dans la catalographie moderne', in Schlusemann, Rita / Hermans, Jos M.M. / Hoogvliet, Margriet (eds), *Sources for the History of Medieval Books and Libraries*, Groningen: E. Forsten, 291–309.

Maniaci, Marilena / Orofino, Giulia (eds) (2000), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, [Milano]: Centro Tibaldi.

Quentin, Henri (1922), *Mémoire sur l'etablissement du Texte de la Vulgate*, Paris: Octateuque (Collectanea biblica, 6).

Palmer, Nigel F. (1989), 'Kapitel und Buch. Zu den Gliederungsprinzipien mittelalterlicher Bücher', in *Frühmittelalterliche Studien*, 23: 43–88.

Chiara Ruzzier

The Miniaturisation of Bible Manuscripts in the 13th Century: A Comparative Study

Biblical production in the 13th century is characterised by the development of two types of books that completely differ from one another in both their format and intended use. These are: the glossed Bible,[1] composed of numerous large-size volumes that circulated not only as a long set of volumes making up a complete Bible but also as individual books or groups of books; and the portable Bible, consisting of a single small volume, copies of which were disseminated throughout Europe in their thousands. If portable Bibles have attracted the attention of scholars for their decoration and their text, their strictly physical attributes and the techniques used to make this type of book have been up to now mostly overlooked.[2] However, these innovative features are the very elements that can highlight the production mechanisms of the codex. Although there are examples in earlier centuries, it is only in the 13th century that the single-volume format was adopted as standard. These new pandects became the predominant format throughout the western Christian world and many of these one-volume Bibles were small enough to be easily carried within a saddle bag or even a pocket.

The results that are discussed here are the outcome of a census of small-size biblical manuscripts, almost comprehensive in scope, which has led to the development of a database including nearly 1800 items.[3]

For purposes of clarity, it should be stated that there is no definition of a portable Bible that establishes a precise size limit. Therefore, I decided to extend the census to include all complete Bibles with overall dimensions of less than 450 mm. (This figure is the sum of the page height and width, a measurement which is known as the *taille* in quantitative codicology; this measurement is used here when

First published in Light, Laura / Poleg, Eyal (eds), *Form and Function in the Late Medieval Bible*, Leiden, Boston: Brill (Library of the Written Word, 27), 105–125. Republished with kind permission of Brill.

1 Although most of the text of the *Glossa Ordinaria* was created in the 12th century, the majority of surviving manuscripts date from the 13th century. See Zier 2004, 157–158.

2 For a general introduction to portable Bibles see de Hamel 2005, 114–139; see also Case Schnurman 1960, and Miriello 2004, 47–77.

3 These results are based on the evidence presented in my PhD thesis, Ruzzier 2010a, for the methodological basis of this research see 42–50, 55–68.

https://doi.org/10.1515/9783110743838-003

discussing the size of manuscripts.) This choice enabled me to observe the incidence of size vis-à-vis the physical attributes of the manuscript, on the one hand, and the type of biblical text, on the other. Nevertheless, my analysis focuses on Bibles measuring less than 380 mm. Obviously, it is an arbitrary choice, that does, however, allow me to include in the corpus both extremely small Bibles and those that are slightly bigger (used, most probably, for preaching and studying). These latter Bibles, although not very small, would have still been easy to carry in a saddle bag.[4]

I have directly examined 357 of these Bibles (20% of the census) and I have carried out a statistical analysis of the data collected. This analysis is based on the examination of two groups of data. The larger group, which includes manuscripts known to me only through catalogue descriptions, is the basis for a large-scale study of a limited number of characteristics. The smaller group of Bibles examined directly supports an in-depth study of textual and material aspects. The large number of surviving portable Bibles makes them ideal for adopting a quantitative and comparative approach to the analysis, and, above all, allows me to highlight the different modalities of textual compression developed in the three main countries where portable Bibles were produced: France, Italy and England.[5]

The localisation of the manuscripts in this study requires further explanation: for the larger group, I accepted the places of origin given by the catalogues, even if the older catalogues are sometimes unreliable concerning origin and date.[6] In particular, the non-Parisian production has often been underestimated in the past. Therefore the place of origin was corrected when necessary during the direct analysis of the manuscripts; a comparison between the geographical distribution of the two groups indicates that the two distributions differ by only a few percentage points. The small number of manuscripts that still cannot be localised, due to the high standardisation of the production, were excluded from comparative analysis. In a second phase, statistical analysis of data from the smaller group made it possi-

4 Some references to *biblie portatiles* present in medieval inventories are in accordance with the size limit selected, e.g. the Bible described as 'Biblia integra cum exposicione nominum Hebreorum secundum Remigium, portatilis, littera parisina, in columnis, carta bona, tabulis et corio rubeo obvoluta' in Cantoni Alzati 1982, 70. This manuscript has been identified with Venice, Biblioteca Marciana, MS I. 60 which measures 209 × 140 mm.

5 The production of portable Bibles outside these areas is extremely small and starts later, with the exception of Spain. Fifteen portable Bibles of Spanish origin have been identified, which copy the Parisian model to various extents. The limited availability of Spanish catalogues makes it impossible to evaluate the magnitude of production in Spain, which has therefore been excluded for now from my analysis.

6 However, within a quantitative analysis, a small number of errors among many hundreds of entries is statistically insignificant.

ble to formulate criteria for localisation based on material attributes, in addition to textual and decorative aspects. The particular features that characterise the production of this type of medieval book can be viewed from several perspectives. First, in terms of numbers: there are over 1,500 portable Bibles,[7] defined here as Bibles with an overall size of less than 380 mm, as currently preserved, and these manuscripts account for at least half of the entire 13th-century production of complete Bibles.[8] Secondly, from a textual point of view: portable Bibles have been seen as a means for disseminating the new biblical text, the Paris Bible.[9] Finally, from a material perspective: the desire to miniaturise the Bible, to make it handier and easier to carry, required the integration of new handicraft techniques and new types of layout. Such innovations made it possible to reduce the whole biblical text into a single volume, smaller in size than a modern paperback. Indeed, the overall dimensions of these new Bibles could be reduced to as little as 250 mm.

The miniaturisation of the Bible required an overall restructuring of the physical attributes of the book, including the parchment, the quire structure, the layout, and the script. The size of script could be reduced to as little as one millimetre. Material and graphic innovations were introduced to reduce the size without jeopardising the functionality of the book and the legibility of the written page. It is important to underline that these new techniques were not used to produce a few deluxe copies; on the contrary, they were applied widely to produce a remarkable number of Bibles. This rapid production was possible thanks to the sophisticated system of commercial manufacture that developed in Paris and in other university towns. The production of University books in particular—most probably including the Bible—depended on the *pecia* system, which was the only solution that made it possible to reproduce a great number of manuscripts in a very short time starting from a limited number of exemplars.[10]

---

7 By assuming a survival rate of 4.2% (in the absence of an estimation of the survival rate of medieval manuscripts, I am applying here the hypothetical survival rate of incunabula developed by Uwe Neddermeyer) I suggest that the output of portable Bibles could have exceeded 30,000 copies. See Neddermeyer 1998, 72–81.

8 According to a partial census of extant complete Bibles of the 13th century that I have conducted consulting all catalogues of French libraries, portable Bibles represent about 53.5% of all surviving complete 13th-century Bibles.

9 In relation to the 'Paris Bible' I cite only Laura Light's papers, which also provide some discussion of portable Bibles: Light 1984, 75–93; Light 1987, 275–288; Light 1994, 155–176.

10 I have found no evidence to support the dissemination of the biblical text through the *pecia* system in the portable Bibles that I have consulted. Nevertheless, since copying such a lengthy text might have taken as long as two years, it is highly improbable that there could have been sufficient exemplars including the entire Bible to satisfy the tremendous demand of scribes, especially in Paris in 1220s–1250s, when Bible production reached its peak. See in particular Rouse / Rouse 1988, 57–58.

In this paper, I will focus on an analysis of the material aspects of the portable Bible, a topic that has largely been neglected in studies of this type of book up to now. Therefore, I will leave aside questions concerning the text, as well as the decoration and the dissemination of portable Bibles, themes that would be worthy of a separate in-depth analysis. Nevertheless, I would like to call attention to the fact that, although in the majority of cases portable Bibles report the Paris Bible text or a text with a strong Parisian influence, the correspondence of textual innovations with the reduction in size is by no means absolute,[11] nor does it necessarily mean that the Bibles were written in Paris. In fact, some portable Bibles include a non-Parisian text.[12] These have been found mainly in Italy and in England, but also in France, mostly dating from the first half of the century. This confirms that portable Bibles were needed across Europe, independent of different textual traditions, and can be analysed, as they are here, without considering their biblical text.

Although half of the Bibles in the sample whose place of production has been determined[13] are of French, and mainly Parisian,[14] origin (Chart 1), the manuscript census and analysis have shed light on the importance of English (20%) and Italian Bibles (16%). It should also be pointed out that my research indicates that both the percentages of English production and, to an even greater extent, of Italian production are underestimated, because cataloguers rarely note down the place of production when it is not Paris itself. In fact, among the Bibles that I have directly consulted the percentage of Italian manuscripts rises considerably, reach-

For biblical manuscripts (none a small portable Bible) that include evidence of *pecia*, see Murano 2005, 318–319.

11 Only 30% of the portable Bibles examined manuscripts contain the Paris Bible text; 4% use an archaic text; 12% include only the modern chapter divisions; more than half (53%) were written using a mixed text which, in addition to the modern chapter divisions, integrates the textual criteria of the Paris Bible in various ways (new order of biblical books and the characteristic set of prologues). The use of the Parisian text seems, in any case, correlated with the book size. In the corpus the use of the Parisian text decreases progressively from 60% in manuscripts of smaller size (size below 230 mm) to 24% in those of a bigger size (size between 380 and 450 mm).

12 In my corpus, there are fourteen portable Bibles that do not include any characteristics of the Paris Bible, not even the modern chapter divisions; among these, e.g., of Parisian origin, BnF, MS lat. 16267 (162 × 115 mm), and of Italian origin BAV, MS Vat. Lat. 6026 (187 × 130 mm).

13 Unfortunately, only 2% of the manuscripts of my census have a colophon and any mention of the place of origin is very rare.

14 It seems that there were no other centres of production of portable Bibles in France that are as important as Paris. Nevertheless, the exact localisation of many manuscripts remains uncertain in the absence of objective indicators, especially if such manuscripts do not have historiated initials and report a text that mixes ancient and modern characteristics. Still I believe it probable that the majority of manuscripts that have been classified as French are of Parisian origin.

ing 26%. The important localities for the copying of Bibles in Italy were much more dispersed than in France, and were concentrated primarily in the North of the country, in particular in the Veneto (twenty-five manuscripts), and to a lesser extent in Naples (seven manuscripts). In Bologna, in contrast, very few small-format Bibles were produced, despite the fact that it was an important centre for the copying of Bibles. These groups of manuscripts differ from the Parisian production both in their biblical text[15] and in their physical attributes, as I will discuss later on.

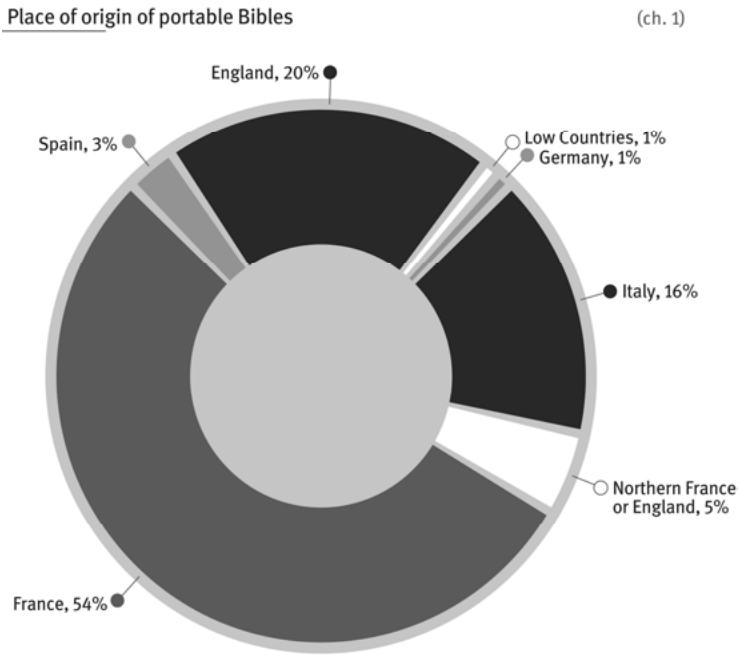


Chart 1: Place of origin of portable Bibles

The production of portable Bibles began during the third decade of the 13th century (Chart 2),[16] increased significantly up to the middle of the century, reached its peak

15 In reference to the characteristics of the biblical text of Italian manuscripts, see in particular Magrini 2007, 209–257 and Lobrichon 1998, 23–33; repr. in Lobrichon 2003, 173–180.

16 The oldest dated Bible of relatively small size seems to be New York, Pierpont Morgan Library, MS M.163 (216 × 162 mm), dated 1229, followed by the Dole, BM, MS 15 (162 × 108 mm), dated 1234, which is also the first dated copy that includes the text of the Paris Bible. The first portable Bible of

during the second half and then rapidly collapsed at the beginning of the 14th century. Compared to the French and English production, which were nearly contemporaneous, the Italian production started slightly later and developed mainly during the second half of the 13th century.

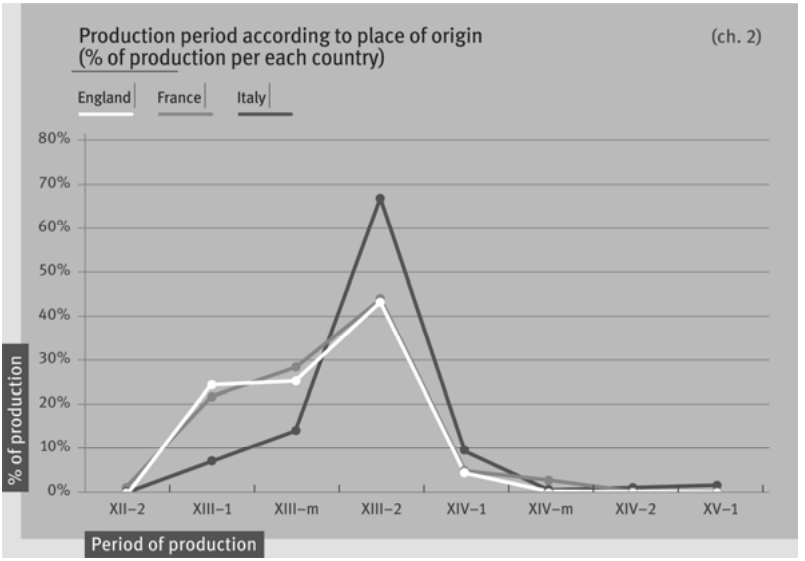


Chart 2: Production period according to place of origin (% of production per each country)

The complete abandonment of the production of portable Bibles at the end of the century can possibly be explained by the very long usable lifetime of these objects: Bibles, and indeed most medieval manuscripts, were designed to last a long time, and were passed on from generation to generation. When the number of potential owners stabilised or decreased, the number of Bibles already circulating became sufficient to meet the demand. The long lists of possession notes from the 14th and 15th century confirm the fact that many Bibles were used for centuries. Moreover, it is also true that Bible production almost parallels the trend observed in global manu-

Italian origin dates back to 1250: BAV, Otto. lat. 532 (154 × 109 mm). Unfortunately, dating the Bibles included in this study is difficult, especially since their production was so standardised and so concentrated over a short timespan; only 1.3% of the recorded manuscripts include a date. This dating ratio corresponds to the average one observed in the 13th century; see Bozzolo / Ornato 1979, 51–75, repr. in [Ornato et al.] 1997, 182–185.

script production, which reaches its peak in the 13th century, and decreases during the second half of 14th century due to the economic recession and the plague.[17] The production of portable Bibles, however, presents peculiar features: an explosion in output, followed by a sudden collapse some decades before that of manuscript production in general.[18] Moreover, this collapse was not followed by the recovery in output in the 15th century that is observable in manuscript making as a whole.

1 Analysis of manuscripts

The groups of French, Italian and English origin present some disparities in term of size (Chart 3).[19] The clearest contrast is between France and Italy, while England occupies an intermediate position. France shows a clear preference for the 'pocketbook' format, measuring less than 280 mm, while relatively bigger formats, which we could call 'saddle-bag' Bibles, are much less common. If we restrict our analysis to Bibles of known Parisian origin among size-classes, there is an evident preference for smaller-size formats: 70% of manuscripts of the corpus are below 330 mm, with a significant preference for the size-class of 230–280 mm. The data curve referring to Italy is practically the opposite: none of the manuscripts is really small and the majority belongs to the size-class of 281–330 mm. Finally, in England a few very small book were produced, but the country seems not to show any particular preference for a specific size.

Although the variation in size may have been partly due to local prefer- ence (indeed, it is not at all improbable that tiny Bibles became a fashion in Paris), the differences in dimensions can also be explained by the handicraft practices unique to each country. In fact, given that the biblical text was always, or nearly, the same length,[20] and that the miniaturisation of the text faced clear physical limits, the question of why different geographical regions preferred certain sizes is an important one.

---

17 The phenomenon is discussed in Bozzolo / Ornato 1980, 84–109, and Bozzolo / Ornato 1979, 188–195. In addition, according to Bozzolo and Ornato nearly 50% of the biblical manuscripts still extant date back to the 13th century (see Bozzolo / Ornato 1980, 53).

18 These different patterns are probably to be linked with the stabilisation, in the late 13th century, of the number of mendicant Friars, probably the main users of these manuscripts. See Ruzzier 2010b (first online edition, 2011), 73–111. See also Bozzolo / Ornato 1980, 93–96.

19 This analysis is based only on the 357 Bibles that I have seen in person.

20 Minor variations in length, due to the presence or absence of the *Oratio Manasse* and of the third book of Esdras, do not have a statistical influence in the study of the physical construction of the manuscript.

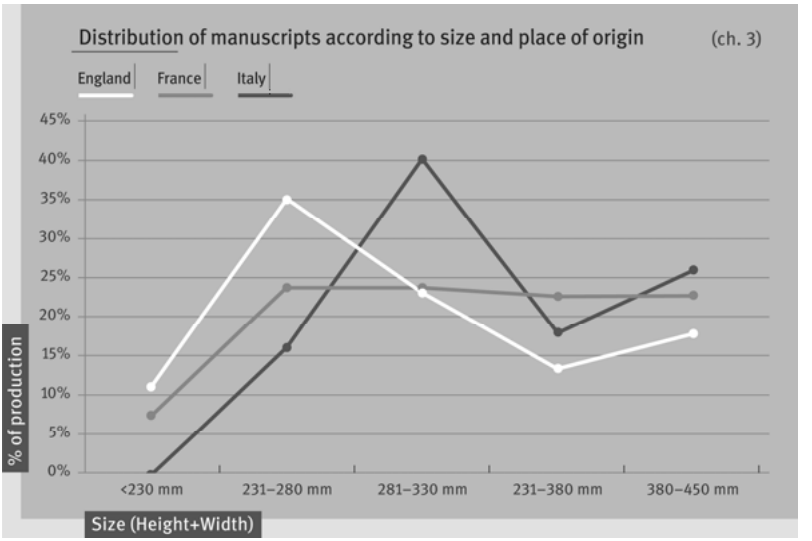


Chart 3: Distribution of manuscripts according to size and place of origin

In order better to understand the mechanisms that lay behind the variations in size, we need to consider the fact that the main element which determines the dimensions of a manuscript is the number of leaves, and that these two parameters—i.e. number of leaves and the overall size—are interdependent. In the absence of other types of restrictions, the aim of the artisan was to make a manuscript that was neither too thick nor too thin for its size.[21] The two common manuscript formats are small manuscripts with few leaves and large manuscripts with many leaves. This latter type was normally adopted for longer texts; Carolingian Bibles, and the giant Bibles of the 11th and 12th centuries are excellent examples.

In the case of portable Bibles, in contrast, the manuscripts are very small, but they include a very large number of leaves.[22] The average number of leaves in the corpus is in fact 492, but some examples include as many as 600–700. These are very high figures compared to those found in 'ordinary' types of texts, which might include an average of between 100 and 200 leaves. Moreover, in the case of small Bibles, the relationship between the size of the manuscript and the number of leaves is reversed: the smaller the size of the book, the larger the number of leaves (Tab. 1).

21 See primarily Muzerelle / Ornato 2004, 43–74.

22 The only other exception among the manuscript production is that of Breviaries.

Relation between size and number of leaves (tab. 1)

Size	<300 leaves	301–450 leaves	451–600 leaves	>600 leaves	Total
<230 mm	0.0%	7.5%	46.8%	45.7%	100.0%
231–280 mm	0.3%	20.2%	52.8%	26.7%	100.0%
281–330 mm	2.4%	52.1%	36.3%	9.2%	100.0%
331–380 mm	4.7%	50.0%	40.2%	5.1%	100.0%
381–450 mm	1.3%	56.3%	37.4%	5.0%	100.0%
All sizes	1.8%	40.0%	42.7%	15.5%	100.0%

Tab. 1: Relation between size and number of leaves

Average number of leaves according to size and place of origin (tab. 2)

Size	England	France	Italy	Other countries or unknown origin	Total
<230 mm	689	618	0	570	620
231–280 mm	510	569	427	513	531
281–330 mm	437	511	392	441	449
331–380 mm	472	482	443	496	473
381–450 mm	468	488	451	391	463
All sizes	481	538	420	471	492

Tab. 2: Average number of leaves according to size and place of origin

As a result, portable Bibles of Italian origin, which are generally larger in size, have fewer leaves (420 on average), contrasting with those of French origin, which are smaller and have a greater number of leaves (538 on average) (Tab. 2). We need to keep in mind that, in general, an increase in the number of leaves leads automatically to a significant increase in the thickness of the book, unless the text is divided into two volumes. This latter option was not preferred by

readers, and was therefore only rarely adopted.[23] The solution to this problem was to use very thin parchment: in this way it was possible to increase the number of the leaves in a book without making the book excessively thick. This procedure compensated for the decrease in size by increasing the overall space available. Another possible solution was to accept a slightly bigger size, and thus to limit the number of leaves.

The relationship between the average number of leaves and the place of origin corresponds, in fact, to the different thickness of parchment made in the three countries studied here: very thin in Paris, average thickness in England, and relatively thick in Italy.[24] This is explained by the fact that to the north of the Alps, parchment was probably made from calf skins, which were highly processed on both sides to produce very thin leaves, rendered soft to the touch, white in colour and with no contrast between the hair side and the flesh side. In Italy, by contrast, we find a thicker and more rigid parchment, often yellowish in colour and with a marked contrast between the two sides, obtained probably from goat skin. Therefore, it is the relatively thicker parchment in Italy which prevented an increase in the number of leaves, and therefore made it impossible to produce extremely small Bibles.

The thickness of the parchment and the number of leaves also influenced the quire structure. In fact, in order to ensure a solid long-lasting binding with numerous very thin leaves, it was important to adopt a structure that could ensure greater stability than the traditional quaternions (four bifolia). This was achieved by increasing the number of bifolia per quire, since if the parchment is too thin and there are too few bifolia, the action of sewing can cause the loss of leaves. During the 13th century, quaternions were progressively dropped in favour of senions (six bifolia) or of even thicker structures, which are more stable and possibly also saved the bookbinder time.[25] Therefore, the type of quire used

23 Only 1.4% of the portable Bibles in the corpus are divided into two or three volumes.

24 The thickness has been measured using a micrometre on a sample of thirty-nine manuscripts. The average measure obtained was of 0.088 mm, with a minimum of 0.064 mm recorded from smaller manuscripts of Parisian origin. The figures used for the rest of the corpus are only an estimate. The terms 'thin' and 'thick' have to be interpreted within the context of our type of book production: even the thickest parchment of a portable Bible will appear extremely thin compared with that of a larger manuscript. The studies to date conducted on the thickness of parchment in fact list measurements which are always more than 0.14 mm. See in particular Bianchi et al. 1993, 95–184; repr. in [Ornato et al.] 1997, 275–345.

25 For an overall analysis of quires of the late Middle Ages, see Busonero 1999, 33–139 [in this volume, 205–307]. Concerning the factors behind the choice of a quire structure and for a few hypotheses concerning portable Bibles, see Ornato 2000, 51–77.

depended essentially on the thickness of the parchment and, consequently, it is also linked to the manuscript size and the number of leaves. In particular, the use of quires of twelve bifolia is seen almost invariably in Bibles that include more than 600 leaves, but it is already a common feature in manuscripts with more than 500 leaves. Hence, it is only in France that we often find quires of twelve bifolia (Tab. 3).

Quire structure according to place of origin (tab. 3)

Quire (most common structure)	England	France	Italy	Other countries or unknown origin	Total
Quinions	0 0.0%	1 0.9%	14 17.1%	1 1.7%	16 5.4%
Seniones	16 42.1%	19 16.4%	60 73.2%	28 46.7%	123 41.6%
Quires of 8 bifolia	14 36.8%	17 14.7%	5 6.1%	14 23.3%	50 16.9%
Quires of 10 bifolia	7 18.4%	11 9.5%	2 2.4%	9 15.0%	29 9.8%
Quires of 12 bifolia	1 2.6%	68 58.6%	1 1.2%	8 13.3%	78 26.4%
Total	38 100.0%	116 100.0%	82 100.0%	60 100.0%	296 100.0%

Tab. 3: Quire structure according to place of origin

In Italy, by contrast, we find mainly senions and, less frequently, quinions (five bifolia), which in the 13th century can be considered a fairly reliable indicator of Italian origin. Lastly, in England the structures preferred for smaller manuscripts were the quires of eight or ten bifolia. The quire of eight bifolia seems to be an intermediate solution, characteristic of England, which was well suited to the intermediate parchment thickness and manuscript size used in this country. Quires of eight bifolia can also be found in France, but only in larger manuscripts; therefore, when used in portable Bibles, they are a clear indication of

English origin. Thus, as a result of my analysis, it emerges that the type of quires is an important factor in establishing the origin of a portable Bible.[26]

An increase in the number of bifolia per quire also led to the elaboration of new techniques including the use of leaf signatures, which were especially important in the workshops of commercial illuminators and bookbinders, where many similar manuscripts were present at the same time, to avoid confusion among copies.[27] In particular, a primitive leaf and quire signature is typical of Parisian production (indeed, it is unique to Paris). These signatures consisted of letters, in alphabetical sequence, for each leaf in the first half of the quire, and marks, each different, labelling each quire. The system kept track of the order of the leaves within a quire but did not keep track of the order of the quires. These primitive leaf and quire signatures are found in 50% of manuscripts with longer quires (eight bifolia or more), and we can suppose that their absence in the remaining 50% of manuscripts may be due to trimming. I have found no primitive leaf and quire signature in quires structured in senions or quinions. This suggests that they were not in use in Italy—where the percentage of catchwords is much higher.

The data indicate that portable Bibles did not usually have a modular structure. This is a structure—observed by Marilena Maniaci in the so-called Atlantic or Atlas Bibles[28]—in which the end of quires corresponds with the end of textual units. The aim was to isolate, through caesurae, blocks of biblical books which have a homogeneous content. This practice is rarely applied to biblical production in the 13th century, and is completely absent in the portable Bibles of Parisian origin where the text flows continuously from St. Jerome's general prologue to the end of the Apocalypse, and often to the end of the Interpretations of Hebrew Names. However, it is possible to find some caesurae in French Bibles of non-Parisian origin at the beginning and/or at the end of the book of Psalms, between the Old and the New Testament and before the Interpretations of the Hebrew Names. I have noticed that the distribution of such caesurae represents an important indicator of the origin of a manuscript: the most common caesura in all countries is that which isolates the extra-Biblical text of the glossary (present in 56% of cases); this is followed by a caesura between the Psalms and the

26 The origin of Bibles used in the analysis was never determined only from the quire structure. Instead, it is the quantitative analysis that has highlighted the importance of this factor. Changes in the quire structure depending on the origin of manuscripts also appear, regardless of the type text, in the study of Busonero 1999, 50–61.

27 See Stirnemann 1982, 959–960.

28 See Maniaci 2000, 47–60.

Proverbs (35% of cases), which, in theory, could lead to a division of the biblical text into two volumes. A caesura of this type is present in 56% of the manuscripts of Italian origin, but in only 27% of manuscripts of French and English origin. Finally, it is the presence of a caesura between the Old and New Testaments which turns out to be significant: it appears in 61% of Bibles of Italian origin, but only in 12% and 23% of French and English Bibles, respectively, and is thus an important indication of origin.

Italian and English deviation in (difference of) average number of leaves with respect to the French production (tab. 4)

Size	France	Italian deviation	English deviation
<230 mm	618	0	+10%
231–280 mm	566	-24%	-10%
281–330 mm	504	-21%	-13%
331–380 mm	482	-16%	-1%
381–450 mm	491	-10%	-9%
All sizes	535	-22%	-9%

Tab. 4: Italian and English deviation in (difference of) average number of leaves with respect to the French production

Returning to the problem of the miniaturisation of the biblical text, we can see in Tab. 4 that when Bibles of the same sizes are compared, the average number of leaves is systematically smaller in Italy (about 22% fewer) than in France, and that the difference in number of leaves between these two countries is more significant in manuscripts that are smaller than 330 mm. In larger manuscripts, by contrast, there is no correlation between geographical differences and the average number of leaves. What are the reasons for these variations? It seems clear that increasing the number of leaves was not by itself sufficient to produce the biblical text as a portable book. The second device used concerns the layout of the page. Differences in layout could theoretically be applied at three levels: 1) increasing the dimensions of the written space in relation to the dimension of the page;[29] 2) compressing the writing within the written

29 One should note that nearly all portable Bibles have a text written in two columns, a solution widely used in the 13th century, which allowed for an increase in the density of graphic signs on one

space by increasing the number of lines—depending therefore, on the unit of ruling (i.e. the average height of a line area, measured in millimetres) and on the size of the writing; and 3) acting on the length of the text itself, by using abbreviations.

It is important to highlight that the mechanism of these dynamics is identical in all the countries studied here; what varies according to the place of production is the material condition. For example, if the number of leaves can be increased, according to preference, thanks to thin enough parchment, one can have fewer restrictions in filling the page. In France, for the same size manuscripts, producers were free to choose between 'rarefied', that is non-densely written manuscripts with many leaves, and manuscripts with fewer leaves (which were consequently less expensive, since less parchment was needed) but with a more densely packed written space (Tab. 5).

In Italy, the material constrictions were more severe: given the use of thicker parchment, it was not possible to increase the number of leaves, since this would result in a manuscript that was too bulky. An available option, however, was to expand the dimensions of the written area (noir) in relation to the dimensions of the whole leaf. Nevertheless, this solution was not adopted in Italy,[30] probably because the outcome would have been aesthetically poor and far less advantageous in terms of gaining space, than reducing the size of the writing.[31] Choosing to reduce the size of the writing, in fact, leads to increasing the number of lines per page. An intensive use of abbreviations also allowed a further decrease in the length of the text.[32]

page without compromising the legibility of the text. For an analysis of the functional needs which lay at the basis of such a choice, see Bozzolo / Ornato 1980, 318–330. Nevertheless, I have reviewed more than ten portable Bibles copied in a single column.

30 On the contrary, in the Italian manuscripts, the ratio of written space compared to the rest of the page turns out to be slightly lower than the average of my corpus, which is 42%. This figure is in any case lower than the average reported in the manuscripts of French origin from the 13th century (between 45% and 50%). Concerning this issue, see mainly Bozzolo / Coq / Muzerelle / Ornato 1984, repr. in [Ornato et al.] 1997, 473–508.

31 Due to a greater reduction in the size of the text, the average number of characters per line is systematically higher in the Italian Bibles (on average 12% more) than in the French ones of the same size.

32 According to a survey conducted on a fixed sequence of text, it emerges that Italian Bibles use 9% more abbreviated words than the French ones.

Average number of lines and average unit of ruling according to place of origin (tab. 5)

Size		England	France	Italy	Total
<230 mm	Average number of lines	40	46		45
	Average unit of ruling	2.28	2.06		2.10
231–280 mm	Average number of lines	46	47	52	48
	Average unit of ruling	2.27	2.23	2.08	2.21
281–330 mm	Average number of lines	53	49	54	51
	Average unit of ruling	2.43	2.62	2.25	2.45
331–380 mm	Average number of lines	50	50	52	51
	Average unit of ruling	2.89	2.95	2.81	2.88
381–450 mm	Average number of lines	46	50	51	50
	Average unit of ruling	3.29	3.35	3.13	3.26
Total	Average number of lines	49	48	53	50
	Average unit of ruling	2.64	2.58	2.57	2.58

Tab. 5: Average number of lines and average unit of ruling according to place and origin

In the case of French and Italian Bibles, two opposite solutions were adopted. The outcomes of these different solutions are especially evident in Bibles that are smaller than 280 mm. As examples of the different solutions adopted in the two countries, one can compare BnF, MS lat. 211 (167 × 111 mm) and BnF, MS lat. 232 (169 × 112 mm) (Figs. 1–2). The two Bibles, the former of Parisian origin and the latter of Italian origin (coming most probably from Padua or Venice), were both produced to high standards and are nearly the same size. Nevertheless, the written area of the Italian Bible contains fifty-three lines, while that of the Parisian one contains 'only' forty-four. In any case, as the book size increases, the differences between the countries vanish and the solutions adopted everywhere are more varied. The reason for this trend is that there is a tendency to go back to a more traditional type of manuscript, where the material constrictions do not exercise the same pressure as is the case in extremely small manuscripts. Outside the context of portable manuscripts, it was possible to choose whether to give preference to a rarefied page and accept a heavy manuscript or the opposite.

It is worth asking whether France or Italy found the optimal solution. On the one hand, it seems that the French solution is more satisfactory from the point of

view of aesthetics and legibility. To preserve a rarefied page and a text of an acceptable size, artisans found the means to reduce the thickness of the parchment, and consequently were able to increase the number of leaves without compromising the functionality and solidity of the book. On the other hand, we need to recognise that despite the need to exploit as much of the available surface-area as possible, the Italian page offers an acceptable compromise between the density of the page and its legibility. In addition, we should not forget that a smaller quantity of thicker parchment would have definitely been less costly.

English production nearly always positions itself between the French and the Italian solutions. Nevertheless, the outcomes in England are often closer to the former than to the latter, especially where the nature of parchment is concerned. In other aspects, which are less closely linked to the material restrictions, including the type of ruling patterns and the *mise en texte*, English Bibles do exhibit some unique characteristics. Although it goes beyond the limits of this survey to discuss these in depth, they include ruling with a thick brown plummet, frequent use of vertical and horizontal marginal lines, and frequent use of the colour blue for running titles and chapter numbers.

Finally, as far as the production of Bibles of known Parisian origin is concerned, the solutions adopted stand out both for their specific features and for their homogeneity. It is in Paris, in fact, that one can find the most innovative and refined skills, both concerning the processing of parchment and the making of quires, and consequently the density of the written space was not brought to an extreme. On the contrary, the preference for limiting the density of the page necessarily led to wasting a certain amount of parchment—which is fully compatible with the wealth associated with most of this production. The homogeneity and the innovations are indicators of a 'mass-production', probably found within the circles of the Parisian stationers from *c*.1230–40. This is confirmed by the fact that most of the material innovations which we have discussed are directly correlated with the text of the Paris Bible.[33]

33 Of the Bibles of the corpus reporting the text of the Paris Bible, 94% have quires with more than six bifolia; quires of this size are totally absent in manuscripts having an archaic text or only the modern chapter divisions.

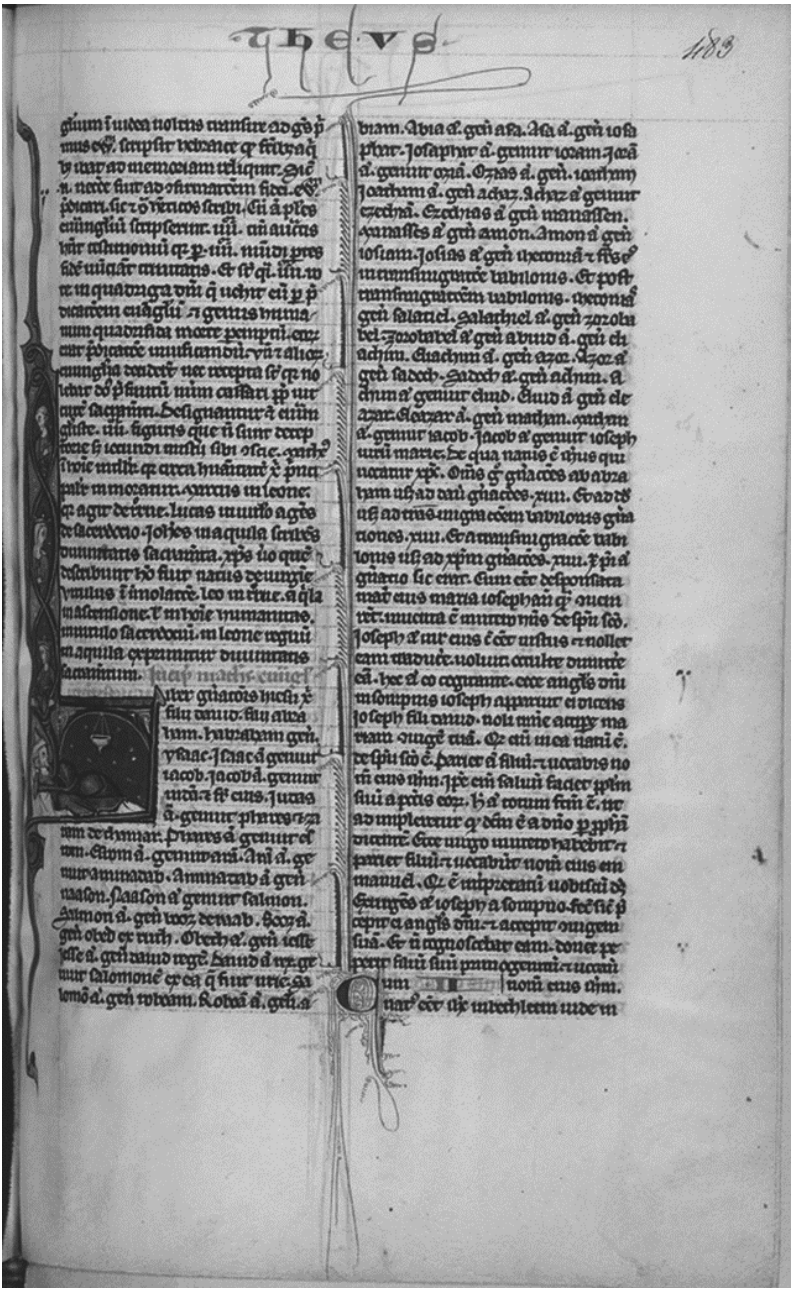


Fig. 1: Paris, Bibliothèque nationale de France, MS lat. 211, f. 483r

Fig. 2: Paris, Bibliothèque nationale de France, MS lat. 232, f. 193r

Given this evidence, it is time to ask ourselves whether, at least from the strictly material point of view, there were other localities with productions as standardised as that in Paris. On the one hand, the answer is no: from a material point of view, no other group of manuscripts is as easily identifiable as the Parisian one, nor is there one that presents such innovative features. On the other hand, we need to recognise that elsewhere producers seem to have been inspired by the Parisian model, without slavishly copying it, and achieved outputs of equal aesthetic value, despite adapting them to the constraints of local materials. In this regard, if the English work, from a strictly material point of view, differs only slightly from the Parisian model, in Italy we find different and more clearly distinguishable solutions, especially in terms of the layout. Even in the cases where the Parisian model was followed more strictly in terms of text and decoration,[34] the material structure remains rigidly anchored to the Italian tradition. This confirms that specific material features, and in particular, the type of the parchment, were a determining factor over the construction of the object and the final output.

Indeed, it is in Italy that we can isolate a group of Bibles according to a set of easily recognisable features. Bibles from Veneto, which from a textual point of view are related to other Italian Bibles, are characterized by some recurrent codicological features, which are worth listing. They are all of high quality and range in size between 250 and 330 mm, use a senion structure with three caesurae (after the Psalms, between the Old and the New Testaments, and before the Interpretations of Hebrew Names), feature quite a high exploitation of the page surface (the number of lines is often higher than fifty-five) and a characteristic decorative structure (Fig. 2).[35] Even if we are still very far from Parisian standardisation, these Bibles form a specific and easily recognisable type. In addition, it should be pointed out that the production of biblical manuscripts in this region in the third quarter of the 13th century was almost exclusively confined to portable manuscripts, probably linked with the flourishing convents of the mendicant friars in Veneto.

In addition, I would like to draw the attention to how geographically localised is most of the production of portable Bibles: Paris, Southern England and Northern Italy. This clearly highlights the fact that it required highly developed technical skills to produce these Bibles, and such work was feasible only in towns which had already established an efficient system of manuscript production, linked with the development of universities.

---

34 For an example of Naples production, see Toubert 1980.

35 For general information, see Baldissin Molli / Canova Mariani / Toniolo 1999, 16–18.

Obviously the craft practices which I have indicated should be considered as overall trends which naturally embraced some individual exceptions. Nevertheless, I believe that it is important to highlight the role of the thickness of parchment as an indicator that can help explain the differences in approach. In addition, the study of the physical attributes of a large number of manuscripts enables us, on the one hand, to clarify the modes of production of manuscripts in the 13th century in general, and on the other hand, enables us to establish some reliable criteria that can help determine the place of origin to be used side by side with fundamental analysis of the biblical text and its decoration. Indicators of this codicological kind could, in fact, be particularly useful in the analysis of the majority of manuscripts which lack historiated initials,[36] and which, up to now, have been mostly overlooked. What is highlighted through this type of analysis is not only the importance of the Parisian production and the innovative character of the solutions adopted in that town, but also the development, mainly in Italy, of different solutions to achieve the same results: the compression of a very long text into a single small-size Bible appropriate for private and sometimes even itinerant usage.

References

Baldissin Molli, Giovanna / Canova Mariani, Giordana / Toniolo, Federica (eds) (1999), *La miniatura a Padova dal Medioevo al Settecento*, Modena: Panini.

Bianchi, Francesco et al. (1993), 'Facteurs de variation de l'épaisseur du parchemin italien du VIIIe au XVe siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 95–184 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 275–345).

Bozzolo, Carla / Coq, Dominique/ Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

36 35% of the manuscripts of the corpus have only flourished initials. The rest of the manuscripts have all or part of the initials ornamented, but only 22% of the total have historiated initials for all the books of the Bible.

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIVe et XVe siècles. Textes et études, 2).

*Busonero, Paola (1999), 'La fascicolazione del manoscritto nel basso medioevo', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 31–139.

Cantoni Alzati, Giovanna (1982), *La Biblioteca di S. Giustina a Padova. Libri e cultura presso i benedettini padovani in età umanistica*, Padova: Antenore (Medioevo e Umanesimo, 48).

Case Schnurman, Josephine (1960) *Studies in the Medieval Book Trade from the Late Twelfth to the Middle of the Fourteenth century with Special Reference to the Copying of the Bible*, unpublished B.Litt. Thesis, Oxford.

de Hamel, Christopher (2005), *The Book: The History of the Bible*, London: Phaidon Press.

Light, Laura (1984), 'Versions et révisions du texte biblique', in Riché, Pierre / Lobrichon, Guy (eds), *Le moyen âge et la Bible,* Paris: Editions Beauchesne (Bible de tous les temps, 4), 55–93.

Light, Laura (1987), 'The New Thirteenth-Century Bible and the Challenge of Heresy', in *Viator*, 18: 275–288.

Light, Laura (1994), 'French Bibles c. 1200–30: a New Look at the Origin of the Paris Bible', in Gameson, Richard (ed.), *The Early Medieval Bible. Its Production, Decoration and Use*, Cambridge: Cambridge University Press, 155–176.

Lobrichon, Guy (1998), 'Pour l'étude de la tradition et du texte de la Vulgate latine en Italie (XIIIe siècle)', in Leonardi, Lino (ed.), *La Bibbia in italiano tra Medioevo e Rinascimento*. Atti del Convegno internazionale, Firenze, Certosa del Galluzzo, 8–9 novembre 1996, Firenze: SISMEL – Edizioni del Galluzzo (Millennio Medievale, 10), 23–33 (repr. in Lobrichon, Guy [2003], *La Bible au moyen âge*, Paris: Picard, 173–180).

Magrini, Sabina (2007), 'Production and Use of Latin Bible Manuscripts in Italy during the Thirteenth and Fourteenth Centuries', in *Manuscripta*, 51/2: 209–257.

*Maniaci, Marilena (2000), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino, Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, [Milano]: Centro Tibaldi, 47–60.

Miriello, Rosanna (2004), 'La Bibbia portabile di origine italiana del XIII secolo. Brevi considerazioni e alcuni esempi' in Cremascoli, Giuseppe / Santi, Francesco (eds), *La Bibbia del XIII secolo. Storia del testo, storia dell'esegesi.* Convegno della Società Internazionale per lo studio del Medioevo Latino (SISMEL), Firenze, 1–2 giugno 2001, Firenze: SISMEL – Edizioni del Galluzzo, 47–77.

Murano, Giovanna (2005), *Opere diffuse per exemplar e pecia*, Turnhout: Brepols (Textes et études du Moyen Âge, 29).

*Muzerelle, Denis / Ornato, Ezio (2004), *La terza dimensione del libro. Aspetti codicologici della pluritestualità*, in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni.* Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino (=*Segno e testo,* 2), 43–74.

Neddermeyer, Uwe (1998), *Von der Handschrift zum gedruckten Buch. Schriftlichkeit und Leseinteresse im Mittelalter und in der frühen Neuzeit; quantitative und qualitative Aspekte*, Wiesbaden: Harrassowitz (Buchwissenschaftliche Beiträge aus dem Deutschen Bucharchiv München, 61).

Ornato, Ezio (2000), *Apologia dell'apogeo. Divagazioni sulla storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 22).

Ornato, Ezio et al. (1997), *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella (I libri di Viella, 10).

Rouse, Richard H. / Rouse, Mary A. (1988), 'The Book Trade at the University of Paris, ca. 1250-ca. 1350', in Bataillon, Jacques Henri / Guyot, Bertrand / Rouse, Richard H. (eds), *La production du livre universitaire au Moyen Âge. Exemplar et pecia*. Actes du symposium tenu au Collegio San Bonaventura de Grottaferrata en mai 1983, Paris: CNRS, 41–114.

Ruzzier, Chiara (2010a), *Entre Université et Ordres mendiants: la miniaturisation de la Bible au XIII^e siècle*. Thèse de doctorat en Histoire médiévale, sous la direction de Jean-Philippe Genet, soutenue en 2010 à l'Université de Paris 1 – Panthéon Sorbonne.

Ruzzier, Chiara (2010b), 'Des armaria aux besaces. La mutation de la Bible au XIII^e siècle', in Iogna-Prat, Dominique (ed.), *Les usages sociaux de la Bible*, *XI^e-XV^e siècles* (Cahiers électroniques d'histoire textuelle du LAMOP, 3) (first online edition, 2011).

Stirnemann, Patricia D. (1982), 'Nouvelles pratiques en matière d'enluminure au temps de Philippe Auguste', in Bautier, Robert-Henri (ed.), *La France de Philippe Auguste. Le temps des mutations*. Actes du Colloque international organisé par le C.N.R.S. (Paris, 29 septembre – 4 octobre 1980), Paris: CNRS (Colloques internationaux du Centre national de la recherche scientifique, 602), 955–980.

Toubert, Hélène (1980), 'Influences gothiques sur l'art frédéricien: le maître de la Bible de Manfred et son atelier' in Romanini, Angiola Maria (ed.), *Federico II e l'arte del Duecento italiano*. Atti della III settimana di studi di storia dell'arte medievale dell'università di Roma (15–20 maggio 1978), 2 vols, Galatina (LE): Congedo (Collana di saggi e testi, 6), II: 59–76.

Zier, Mark (2004), 'The Development of the Glossa Ordinaria to the Bible in the Thirteenth Century: The Evidence from the Bibliothèque Nationale, Paris', in Cremascoli, Giuseppe / Santi, Francesco (eds), *La Bibbia del XIII secolo. Storia del testo, storia dell'esegesi.* Convegno della Società Internazionale per lo studio del Medioevo Latino (SISMEL), Firenze, 1–2 giugno 2001, Firenze: SISMEL – Edizioni del Galluzzo, 155–184.

Michel Trigalet

Making a Count of Hagiographic Books. Quantitative Aspects of the Production and Dissemination of Latin Hagiographic Literature (2nd–15th Centuries)

Guy Philipparts's desire to create a vast database of hagiographic volumes lies at the root of the present research, which can be set within the wider framework of an initiative aimed at renewing the history of hagiographic literature. Philipparts's project is centred on *Hagiographies*, an international history of hagiographic literature which thus far numbers three volumes. Our focus of interest tempted us to combine Latin hagiographic literature with the history of the book.[1] The cultural, social and religious foundations of the history of the dissemination and reception of the saints' legends made it impossible for us to evade some fundamental questions that can only be addressed by means of a numerical evaluation: which legends were most read and why; what were the freedoms and constraints experienced by the editors of the *Lives of the Saints*; and when did hagiography as a genre begin to wane? Many other questions have since been added to this list.

1 The *Légendiers Latins* database

In 1994, a project for the creation of a database of manuscript hagiographies was launched by Guy Philippart. Subsequently, the project has gradually been enriched by the participation of several co-contributors. Part of the database which has already been published (in collaboration with the *Société des Bollandistes*) can be consulted online. The database was originally conceived of both as a means to study the dissemination of Latin hagiographies and as a heuristic tool to spare researchers the need to carry out time-consuming counts

Translated from the French into English by Mark Livesey. Original published as Trigalet, Michel (2001), 'Compter les livres hagiographiques. Aspects quantitatifs de la création et de la diffusion de la littérature hagiographique latine (IIe - XVe siècle)', in *Gazette du livre médiéval*, 38: 1–13.

1 Philppart 1996.

https://doi.org/10.1515/9783110743838-004

in about forty manuscript catalogues. The heuristic aspect, which has raised a number of problems, has previously been addressed in an article that was published in *Le Médiéviste et l'ordinateur*.[2]

The Bollandists described approximately 4,500 Latin hagiographical manuscripts in their specialised catalogues.[3] Frankly speaking, from a purely opportunistic standpoint the prospect of extracting something useful from this windfall was rather attractive—technical challenges notwithstanding. The Bollandists' descriptions were encoded in (more or less) full form, which entailed the provisional encoding of some 48,700 examples of manuscripts bearing hagiographic texts.

It was not difficult to foresee that this sample would prove inadequate, not simply because of its size, but for far more fundamental reasons. The first steps taken by the Bollandists towards a census of hagiographic manuscripts were totally lacking any *a priori* scientific foundation. We therefore set out to assemble our sample by adopting a dual approach: first, by adding to it hagiographic manuscripts originating from regions of Europe that had been scarcely (or not at all) explored by the Bollandists; second, by creating a systematic inventory of all surviving hagiographic manuscripts, and therefore including all those whose descriptions had not been not published by the Bollandists. However, several hundred uncatalogued funds have yet to be scrutinised, a process that would necessitate engaging two or three full-time researchers for several years. Consequently, this 'ideal' census had to be curtailed and was ultimately limited to 7,463 manuscripts, hence about three quarters of the total number of items described in detail.

2 The hagiographic 'genre'

For the description of manuscripts, consultation of the *Bibliotheca Hagiographica Latina* and its *Novum Supplementum* (from now on we shall refer to this source by its customary acronym: *BHL*),[4] which collects data on the ensemble of devotional texts that narrate the *Lives of the Saints*, is utterly indispensable. Moreover, this repertory offers the enormous advantage of making it easier to manage electronic data by identifying each text by means of a numerical code.

---

2 De Vriendt / Trigalet 1996–1997.

3 *Bibliotheca Hagiographica Latina manuscripta* 1998. http://bhlms.fltr.ucl.ac.be (last access 08/03/2020).

4 *Bibliotheca hagiographica latina* 1898–1901; Fros 1986.

The question concerning genre is not without importance. The gathering together in the *BHL* of texts which at first glance appear rather disparate, consisting of biographies, passion manuscripts, relic histories and miracle collections, in actual fact fully reflects a medieval reality that legendaries bear tangible witness to. Looking beyond formal or documentary differences, the specific milieu that commissioned and appreciated this form of literature, and those who manufactured and disseminated it, belong to practically the entire range of genres comprising medieval literature. One sees authors at the forefront of humanism mingling with monks who rather uncouthly defend their material interests. Mere compilers are found in the same echelon as the most creative and innovative writers. A few well-paid professionals who accepted commissions from aristocratic clients probably represent an exception among the majority of occasional, non-professional writers.

The poet Henri d'Avranches (who died in 1260) represents an untypical example: he was paid to write by a pope, two emperors, three kings and six archbishops, in addition to twelve bishops and numerous other ecclesiastical dignitaries and laymen across Europe. Among his commissioned works we find some *Lives of Saints*; these were disseminated as manuscripts in very small numbers which bore no relation to their literary merit.

Hagiographic works that occupy an entire volume on their own are quite rare. The most favoured vehicle for hagiographies, though not the only one, is a form of literary anthology—the so-called 'legendary'. Most of the time, the texts are arranged in an order based on the calendar. Sometimes, though not always, they were divided into lessons at the time of the project's conception, or alternatively at a later date. In addition to well-documented readings at religious services, refectory readings were also made, as well as private readings or study sessions aimed at bolstering sermons and meditation, or simply to satisfy an interest in history.

Different types of manuscript correspond to different uses. The size, number of units, and sometimes non-hagiographic context are all elements which play a clear role within the setting of a history of the spread of culture. We have endeavoured to highlight these aspects within the framework of our thesis. Here, we shall not be furnishing any definitive results; instead, we have chosen to focus on some key methodological issues.

3 Information collected in the *Légendiers Latins* database

Accordingly, we shall start out by providing a brief overview of the information contained in the database. We will distinguish between data on the 'saints', data on the texts, and data on the manuscripts. For the first two categories, the *BHL* represents a practically exhaustive repertory.

When we speak of 'saints', we are not referring to all the figures that the Church developed a cult around. Instead, we are limiting ourselves to those for whom Latin biographies were written before the year 1500. We have treated these figures as 'heroes on paper', so to speak. Above all, it is the legend that has attracted our interest; only secondarily does the historical figure emerge more or less clearly as a sort of 'by-product'. We have therefore chosen to employ the expression 'literary dossiers' (a concept that should be interpreted in its broadest sense as a collection of narrative texts dedicated to a saint or a group of saints, or figures recognised as such), rather than 'saints'. The Latin dossiers total 3,318, if one excludes duplicates. The saints are described according to their basic typology, geographical origin and date, based on information gleaned from literary sources, which can vary considerably depending on the tradition concerned.

In addition, basic information on the 13,600 Latin texts that are currently known and on their authors is collected. Essentially, such information includes the level of certainty vis-à-vis the attribution of a text, the date and place of its composition, and its end-user. However, for the majority of texts it is not possible to collect any information that is in the least bit reliable.

The relative paucity of descriptions dating from the beginning of the 20th century, which represented the culmination of the Bollandists' cataloguing activity, impeded us from gathering more detailed information of a codicological nature. We have therefore considered the following (readily available, on the whole) details: support type, size, number of leaves, dating, presence or absence of a colophon, mention of date, copyists, and historical owners. Wherever it proved possible to identify codicological components, we have done so. In most cases, we applied the concept of 'editorial sections' in order to indicate clear changes in datings within a codex which cannot be attributed to a change in 'codicological section', nor to a simple change of scribe's hand. Our aim was to make it possible to assign datings to groups of witnesses of hagiographic texts.

The manuscript witnesses of works are distinguished through their foliation, which can be identified by the presence within a manuscript of a discontinuity, usually marked by a table of contents. Each witness is identified by one or more *BHL* codes, in accordance with established practice.

4 Methodological challenges specific to the hagiographic book

4.1 Loss of hagiographic patrimony

Research on liturgical manuscripts has revealed a very high loss rate. Hagiographic manuscripts, despite their liturgical use, should not be considered equivalent. Their historical dimension and their role in identity construction account for their being spared many vicissitudes over the course of time. All the same, we still cannot confirm that, more than other types of manuscript, they were carefully preserved, although there is a good possibility that they were.

In a genre where rewriting was a very widespread practice, periodic updating could explain the disappearance of large numbers of books, especially those which hosted ancient texts. We can only second the opinion of Joseph-Claude Poulin (formed after twenty years of research carried out within the framework of the *SGH - Sources Hagiographiques de la Gaule* project and based on the list of manuscripts identified), when he says:

> Today, about half the manuscripts are found in Paris; the remainder are dispersed throughout France and Europe, particularly in Italy and Great Britain. In light of the information acquired up till now, it can be confirmed that the ancient texts are usually best preserved in regions quite distant from the places where worship actively took place.[5]

This consistent finding can be supplemented by another: a certain number of hagiographic texts were scarcely circulated outside their region of origin. Whenever one scrutinises funds of a markedly local character, one is virtually guaranteed to discover some rare texts. This provides a measure of their 'fragility'. The loss of a local collection can simultaneously result in the disappearance of a unique textual patrimony. However, these peripheral phenomena only have a very small effect on the overriding production trends.

5 Poulin 1996.

4.2 Counting units: collections, editorial sections, witnesses

Most specimens are concentrated in specialised books—traditional legendaries, abridged legendaries, martyrologues, and *libelli* dedicated to particular saints. The remainder serve as a vehicle for a rather mixed bag: a body of works by a single author, liturgical manuscripts, collected letters, encyclopaedias, and Bibles. Pure chance, or the opportunity presenting itself to complete a quire or to place a note in a margin or on a flyleaf undoubtedly provide the explanation for the large number of unusual bedfellows.

Hagiographic collections have been the subject of in-depth analyses ever since the works of the Bollandist Albert Poncelet first appeared. Their quantitative studies raise many questions. The first conundrum to address is how to distinguish collections from each another with sufficient accuracy. In fact, today it can be the case that such collections have been broken up and scattered among several different libraries. Non-specialists will not always be particularly concerned about investigating the completeness of a collection of legends when they are compiling a catalogue of manuscripts, given the considerable difficulty presented by such a task. This would require expert knowledge of each item, and almost always a direct examination of the different parts of a collection. Even when this is possible, there is no guarantee that a researcher will be able to locate missing items, assuming they still exist.

In addition, the complementariness of collections can be positioned parallel with the overall corpus of legends that was at the disposal of a religious institution. Thus, a traditional passionary could be completed by a collection of lives of confessors of local origin. Signs of complementariness can be found in certain manuscripts, thanks to the instructions for their use left by scribes. For example, in the Bodleian Library's Latin manuscript 285 (13th century), inscribed on f. 165v we find: *Perlectis itaque passionalibus, legatur Vita sancti Martialis episcopi. Queratur in armario, in veteri libro spisso et paruo qui intitulatur 'Diadema monachorum*'. The opposite phenomenon, namely the formation of factitious collections, is equally difficult to detect.

The reconstruction of an ancient book collection requires the expertise of an accomplished researcher even to tackle a single case. It is quite simply impossible to process several thousand cases in a database, unless one resorts to using artificial intelligence. Such an undertaking may soon be possible for historians with appropriate IT skills. In the meantime, we have come up against a temporary 'roadblock' as far as questions on the typology of manuscripts and completeness of collections are concerned. During the initial examination, all manuscripts containing hagiographic texts will be considered hagiographic. Therefore, any conclusions based on

the rough count of manuscripts must be viewed with a degree of caution. Accordingly, we shall by preference concentrate on the number of text witnesses.

What has been stated above is true of collections said to be 'traditional', which reached their zenith in the 12th and 13th centuries. These contrast with collections of abridged legends—known from the Middle Ages as *legendae novae*—which appeared towards the end of the 12th century and enjoyed huge popularity, almost entirely due to the *Golden Legend*. This is borne witness to by about a thousand surviving witnesses, representing about two centuries of their dissemination in manuscript form. The corpus of texts found in these can vary quite a lot from one manuscript to another and, even if most of the time one can identify a common nucleus, many collections were completed by adding other legends so as to adapt them to local needs. On the whole, one can quite easily verify the completeness of collections of the *Golden Legend* type; indeed, they are generally contained within a single volume.

The difficulty, however, lies elsewhere. The *Golden Legend* volumes are never described in detail. Omitted chapters are rarely mentioned, and appended legends owe their description to their rarity or to the unusualness of their presence in the collection. This consistent finding applies to all the Bollandist catalogues, as well as to many others. Now, it is impossible to overlook the role played by the *Golden Legend* in the dissemination of a legend.

By attributing to each abridged collection an average number of witnesses of works, estimated on the basis of surviving copies and a few described manuscripts, some rough calculations on the number of examples can be applied to the entire corpus of works contained within the database, with an acceptable margin of error. Meanwhile, we must wait until the complete descriptions of the 275 *Golden Legends* in the corpus have been put together, either on the basis of data contained in Barbara Fleith's catalogue,[6] or through a direct examination of the relevant manuscripts.

4.3 The hagiographic text: description and dating

We have the good fortune to possess a highly detailed census of Latin hagiographic texts, but the 13,600 identification numbers contained in the *BHL* do not all convey the same meaning. A number might be allocated to a recension, which is sometimes represented by a sole manuscript, a part of a recension, in the case of works divided into multiple volumes, or even to a miracle text contained within a miscellany, whilst in similar cases, a collection of miracle texts can be identified by a single

6 Fleith 1991.

number. A simple variant of an incipit may, in certain intricate manuscripts, justify the creation of an identification number. Finally, several thousand abridged texts, often resembling the records of historical martyrologues, but sometimes in the form of more fully developed writing, are entirely bereft of numbers.

Take the *Golden Legend*. The work as a whole is given the number *BHL* 9035. However, 110 chapters are not allocated with their own numbers, despite the fact that they appear in the catalogue. The remaining 54 chapters all have individual numbers; for example, the abridgement of the Life of Saint Dominic (*BHL* 3130). In the *BHL* catalogue, this issue has been dealt with in a practical way. In the manuscripts, what is called the *Legenda aurea*, or which resembles the same, leaves us faced with about a thousand more or less different collections.

In order to factor in this diversity, we came up with the somewhat vague concept of a 'textual unit' to describe the particular object allocated with a *BHL* number. Should one forgo counting these? Because of the sheer number of texts, one might naturally be concerned that inconsistencies may have been generated over and over again. Now, if one takes a step back and examines the matter from a greater distance, it is largely speaking the homogeneity of the process that prevails when determining the numbers that are allocated. A number generally equates to an apparently complete work (rather than to part of a larger one), which is simultaneously an autonomous one (circulated in different types of manuscript).

As a result, it becomes possible to offer a statistical insight into several of the phenomena linked to the creation of a literary work, rather than solely to its production in manuscript form. Accordingly, in an article published in the proceedings of the Medieval Latin symposium held in Cambridge in 1998, we attempted to shed some light on the trends observed in the creation of Latin hagiographies dating from the 15th century.[7] In order to accomplish this, we did not utilise the entire corpus, which would represent an excessive quantity of data to process, but instead used (provisionally) two samples each composed of two hundred texts drawn at random from the total of 13,600. The present results still do not provide the degree of certitude one might hope for. To achieve an acceptable margin of error, one would have to analyse a sample composed of at least a thousand texts, a task that would obviously entail a great deal of work. With only 400 texts, there is a considerable risk that the small differences between time periods will be insignificant.

7 Philippart / Trigalet 2002.

4.4 Old saints, new saints, duration of textual tradition

In hagiography, as in other genres, although perhaps more so than in other genres, accumulation phenomena may have played a role in several ways. The more time passes, the more the number of potential protagonists of hagiographic texts increases. Even allowing for the fact that some saints fall into relative obscurity, it has to be admitted that the most ancient saints and martyrs enjoy an advantage. The compilers insisted on a wider (and certainly earlier) dissemination of such texts. Consequently, the relative success of a manuscript can only be expressed in relation to the total number of 'available' saints at a given moment in time.

The dossiers known for a long time and which enjoyed wide dissemination may have satisfied the need for hagiographic books. Fresh demand may have been partly fulfilled by the second-hand market, through exchanges, or simply by the continuing use of old books. Accordingly, any interpretation of a legend's success must factor in the duration of its dissemination. Given that it is generally unknown when a legend first started to be disseminated, the date of a given saint's death provides us with a handy *terminus ante quem non*.

When the *Lives of Saint Francis* arrived on the hagiographic book 'market', they might have been copied separately or added to a new collection. The *Life of Saint Martin* was known and disseminated for eight centuries. By the 13th century it was no longer the only hagiographic text on Martin—indeed, far from it. In addition, about 90% of the dossiers were already known, and the biographies relating to these were copied for a period stretching from the 2nd century to the third decade of 13th century. A part of these dossiers would subsequently accompany each copy of a *Life of Saint Francis* within the overall framework of a general legendary (this occurs in about one case in five, for biographies of Saint Martin), thereby continuing to increase their significance in absolute numbers.

5 Production trends of the hagiographic book

The sample of manuscripts that we based our research on includes 5,050 items selected from the 7,463 manuscripts which constitute the *Légendiers latins* database, their current place of preservation being the main selective criterion. The different trends evidenced by the book production curve are striking when one compares the funds originating from Northern France (1,034 mss), Western Germany (318 mss), and Northern Italy (644 mss). The funds compared are individuated based on the location where they are currently held. Sources of perturbation were kept at bay by injecting exogenous manuscripts, such as those originating from Vatican funds in the case of

Italy, and those from the Bibliothèque nationale in the case of France. Our ideal was to build samples related to the manuscripts' places of production, but so far this has proved impossible because the data are too fragmentary (Chart 1).

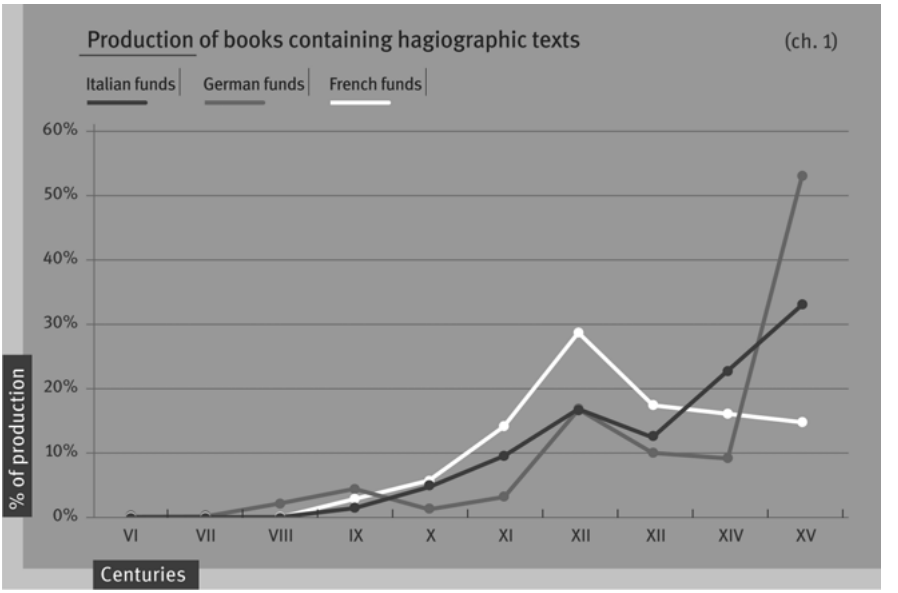


Chart 1: Production of books containing hagiographic texts

The 'German' growth in the 15th century is entirely characteristic of the concentration of production within the Empire, including, albeit to a lesser extent, in the provinces that constitute present day Belgium. French growth appears to draw to a halt in the 13th century, and then stagnates for the rest of the period. This reduction would have been less noticeable if the manuscripts of the Bibliothèque nationale had been taken into account, given the large number of copies of the *Golden Legends* it holds. Once again, this finding is scarcely different to what was observed in book production taken as a whole. Northern Italy is the only region in Europe which saw an increase in hagiographic book production in the 14th century. A number of successful compilers originated from late 13th- or early 14th-century Italy, among whom we find Jacob of Voragine and Bartholomew of Trent. Upstream, in the 13th and 14th centuries, Italy was the geographical area in Europe that spawned the highest number of saints, some of whom were canonised.

Presented in this way, these trends do not make it possible for us to distinguish between what is peculiar to hagiographic book production and what one observes in

book production trends in general. Furthermore, we have placed an emphasis on the caution one must exercise vis-à-vis calculations based on the number of sections. By using witnesses as counting units, the results appear rather more meaningful (Chart 2).

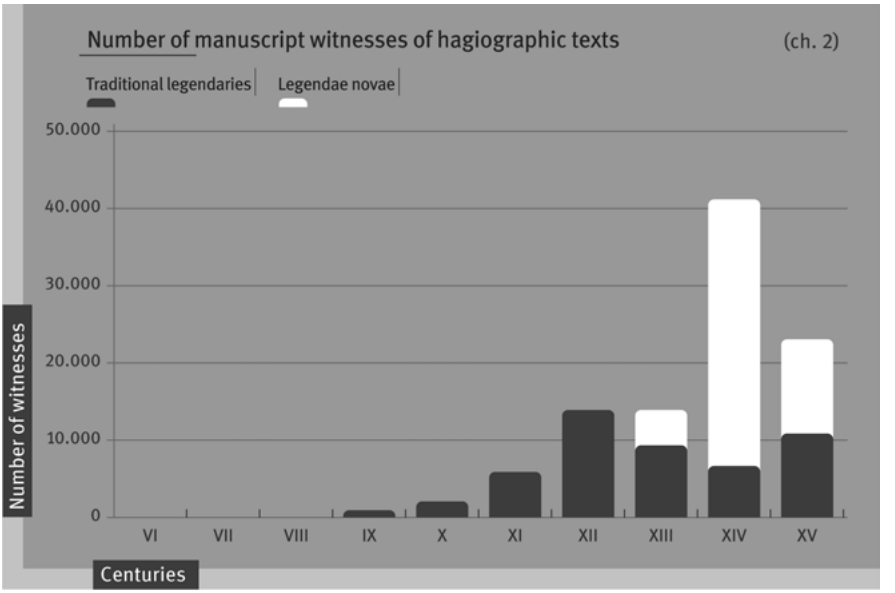


Chart 2: Number of manuscripts containing hagiographic texts

The copying of manuscripts faltered during the 13th century, a period that coincides with the apogee of the compilation of traditional collections. Such collections were very expensive to produce because they consumed large amounts of parchment and sometimes comprised several volumes.

The increase in the number of manuscript witnesses betrays an interest in them in the Late Middles Ages in particular; this phenomenon is well documented, thanks to the prologues written by the authors of abridged legendaries (see the recent study by François Dolbeau on this subject).[8] The *Golden Legend*, together with any potential supplements attuned to the sanctoral cycle specific to a particular diocese, was quickly able to satisfy (in a cost-effective way) the new needs generated by the appearance of a fresh audience, and the necessity

8 Dolbeau 2000.

to replace ageing collections and those which had deteriorated as a result of being used for too long.

For the 15th century, we shall concern ourselves with an output which only affected a little more than half of it. It is difficult to gauge the precise impact that printing had on manuscript production. Indeed, one cannot simply add the number of early printed books to the figures collected for manuscript production. Therefore, the decrease that occurred in the 15th century is perhaps not an entirely real one when viewed in relation to the 14th century. The decrease only becomes evident when one considers other factors, such as the overall production of all genres combined. One solution could be to examine intervals composed of half a century or less.

Here, we are tempted to see the effect of several factors which may have resulted in a reduction of interest in Latin hagiographic literature commencing in the 13th century:

1. The movement towards centralisation and unification of the liturgy and the way in which the veneration of saints was recognised—canonisation in particular. This reduced the total number of saints and, more than anything, focused attention on a small number of them.
2. The diversification of areas of interest and fields of knowledge must have had the effect of weakening a literature that struggled to renew itself.
3. The traditional clerical readers of hagiography gradually turned away from a genre thenceforth considered utilitarian. Preaching and providing religious instruction to parishioners were given priority by the compilers of abridged legendaries. In the long run, the vulgarisation of the genre eroded its success in the sphere of literature.
4. The changes that occurred in dissemination methods—which is to say the standardisation of sanctorals and the abbreviation of texts—acted to reduce the size and number of pages in hagiographical books and, as a result, the total number of books, whilst at the same time maintaining sufficient access to essential information. Consequently, a void was created which those of an encyclopaedic mind took advantage of by assembling the largest possible number of saints (Petrus Calò, Petrus Natali, Johannes Gielemans, Boninus Mombritius) in learned and documentary manuscript summae of rather restricted dissemination.

6 Strengths and weaknesses of a quantitative study

We shall conclude this brief overview by underscoring some of the more glaring omissions of quantitative studies in the sphere of book history. We should mention, above all, the difficulty experienced in comparing results. The majority of research projects have been carried out in an isolated way and even if their starting points have often been identical (i.e. a corpus of undated and dated manuscripts) they have produced rather different results that are sometimes incompatible.

Here, we shall examine a specific example to illustrate our point. Currently, it is impossible to compare the production figures of one region with those of another, because one can only examine trends rather than analyse absolute values. It would be rather rash to put forward any estimates of manuscript loss rates based in part on the rates observed in the world of the incunabula. Such an approach, proposed by Uwe Neddermeyer,[9] led to an estimate of 1.1 million manuscripts produced in the Empire during the 15th century, based on 75,000 surviving specimens. Even more problematic are the loss rates inferred from the previous centuries, for which we have no reference points.

Without entering into this thorny debate, here we will simply point out that absolute values would provide the advantage of making it possible to compare the production rates for different genres, without having to examine the overall production of all the genres combined. One could certainly profit from taking a closer look at methodological matters. However, the most important issue remains the correct cataloguing of the numerous funds which are still inaccessible to researchers up to the present day.

Should the reader now wish to compare these conclusions and extrapolations with those advanced by previous studies carried out on the same subject, he/she would certainly notice that many of them had already been stated before the present research programme was set forth. The examination of many legendaries and the scrutiny of numerous hagiographic manuscripts produced results and prompted hypotheses which were, in large part, confirmed by our work. Non-quantitative explanatory models of the production and dissemination of hagiography are not something entirely new, and therefore it is only to be expected that our count should in part match others. Researchers familiar with these issues will therefore not be altogether surprised to discover that, for example, the *legendae novae* played

9 Neddermeyer 1998.

an important role in the wider dissemination of the *Lives of the Saints* in the Late Middle Ages. Nevertheless, here we consider it important to underscore three points: the highlighting of the range of phenomena—even in the absence of absolute values—and, above and beyond differences and similarities in relation to what was 'expected', the formulation of new questions and the shedding of light on unexpected phenomena, even if of these there are only a few.

References

Bibliotheca Hagiographica Latina antiquae et mediae aetatis (1898–1901), 2 vols, Bruxelles: Société des Bollandistes —latest supplement: Fros 1986.

Bibliotheca Hagiographica Latina manuscripta. Index analytique des Catalogues de manuscrits hagiographiques latins publiés par les Bollandistes (*BHLMs*) (1998), http://bhlms.fltr.ucl.ac.be/.

De Vriendt, François/ Trigalet, Michel (1996–1997), 'Littérature hagiographique et bases de données. À propos de deux projets en cours à l'Université de Namur', in *Le médiéviste et l'ordinateur*, 34: 5–16.

Dolbeau, François (2000), 'Les prologues des légendiers latins', in Hamesse, Jacqueline (ed.), *Les prologues médiévaux*, Turnhout: Brepols (Textes et Etudes du Moyen Âge, 15), 345–393.

Fleith, Barbara (1991), *Studien zur Überlieferungsgeschichte der lateinischen Legenda Aurea*, Bruxelles: Société des Bollandistes (Subsidia hagiographica, 72).

Fros, Henryk (1986), *Bibliotheca Hagiographica Latina antiquae et mediae aetatis*. Novum supplementum, Bruxelles: Société des Bollandistes (Subsidia hagiographica, 70).

Neddermeyer, Uwe (1998), *Von der Handschrift zum gedruckten Buch. Schriftlichkeit und Leseinteresse im Mittelalter und in der frühen Neuzeit; quantitative und qualitative Aspekte*, Wiesbaden: Harrassowitz (Buchwissenschaftliche Beiträge aus dem Deutschen Bucharchiv München, 61).

Philippart, Guy (1996), 'Pour une histoire générale, problématique et sérielle de la littérature et de l'édition hagiographiques latines de l'Antiquité et du Moyen Âge', in *Cassiodorus*, 2: 197–213.

Philippart, Guy / Trigalet, Michel (2002), 'L'hagiographie latine du XI^{e} siècle dans la longue durée. Données statistiques sur la production littéraire et l'édition médiévales', in Herren, Michael W. / MacDonough, Christopher James / Arthur, Ross G. (eds), *Latin Culture in the Eleventh Century: Proceedings of the Third International Conference on Medieval Latin Studies*, Cambridge, September 9–12, 1998, 1–2, Turnhout: Brepols.

Poulin, Joseph-Claude (1996), 'Le projet de recherche sur les sources hagiographiques de la Gaule antérieures à l'an Mil (SHG)', in *Scriptorium*, 50: 196–197.

Materials and tools

Marilena Maniaci

Parchment in Byzantine Manuscripts of the 11th and 12th Centuries: Characteristics and Use

Summary: An examination of the various qualitative characteristics met with in the parchment of a sample corpus composed of 700 Greek manuscripts dating from the 11th and 12th centuries sheds light on the working practices of Byzantine book manufacturers, in comparison to those employed by their Latin 'colleagues'. The first section of this study reveals the existence of a close relationship between the quality of parchment and the fundamental characteristics of any manuscript, i.e. date, origin and content. The second section describes the methods devised by book manufacturers in order to limit or conceal defects in parchment surfaces by positioning them, whenever possible, outside the written area, or alternatively by 'hiding' them in the inner bifolia of quires. A close analysis of the parchment also makes it possible to reconsider Léon Gilissens's well-known theory on the composition of quires.

Scholars of medieval paper and its use in books have at their disposal ensembles of sheets of standard dimensions and regular weft and warp that can yield precise information on the manufacture, date and provenance of the material. Conversely, parchment is, naturally, a far less homogeneous material, being the product of a series of artisanal operations handed down over the centuries, even if such processes underwent various changes over time (the precise details of which are unknown). This resulted in the production of a wide range of parchment types that differ greatly in appearance and quality. Nevertheless, parchment also presents several characteristics which, largely speaking, lend themselves quite well to systematic surveying, quantification and classification, an awareness of which has grown in recent years. Such characteristics include the animal species from

---

Translated from the Italian into English by Mark Livesey. Original published as Maniaci, Marilena (2000), 'La pergamena nel manoscritto bizantino dei secoli XI e XII: caratteristiche e modalità d'uso', in *Quinio. International Journal on the History and Conservation of the Book*, 2: 63–92.

The earliest draft of this article dates to the autumn of 1996; the bibliography takes into account, as far as possible, the results obtained from subsequent research projects [until 2000].

https://doi.org/10.1515/9783110743838-005

which the parchment was derived, its colour, surface attributes (i.e. porosity, consistency, transparency, elasticity, etc.) and, above all, the size of the skins and their thickness. In addition, irregularities and defects of various kinds are highly relevant, since they could compromise the aesthetic quality and/or functionality of a book,[1] and always reduced its value.

It is natural to suppose that in the world of the medieval book the perception of 'defects' in parchmented skins—to the extent they were actually regarded as such, which is of course difficult to establish—was not consistent across all categories of texts and at all levels of production. Even so, we can still hypothesise the existence of—in certain settings and for certain types of book, at any rate—artisanal practices aimed at minimising the visual impact of the most conspicuous irregularities typically encountered in parchment.

The aim of the present contribution is to verify the general criteria and specific manner of use of parchment employed in a predetermined context, namely Byzantine manuscript production in the 11th and 12th centuries.[2] For practical reasons, only the most conspicuous, immediately quantifiable and least ambiguous irregularities, which is to say holes and *lisières* (i.e. natural, untrimmed edges of the skin),[3] will be focused on. This approach excludes, on the one hand, an analysis of the disadvantages that resulted from the support's incapacity to receive writing and retain in it an unaltered state (i.e. the interaction between parchment and inks), and on the other a phenomenon—the presence of stitches—which is of relatively low occurrence and is difficult to interpret. In fact, such stitching equates to a 'repaired defect' (originally a tear or a hole), and it is not easy to ascertain which of the two characteristics prevailed in the minds of the artisans[4] during their initial evaluation of the raw material, without taking into account the fact that the repairs themselves are not always very aesthetically pleasing and are

1 The selection criteria applied to parchment in relation to its main characteristics (animal species, thickness, defects) for the manufacture of medieval books are comprehensively described in Bischoff 1993. The most up-to-date current knowledge on parchment (its history, manufacture, histology, preservation and restoration) can be found in Rück 1991; the book is supplemented by a sizable and well-thought-out bibliography (415–476).

2 Remarks on the parchment of Latin codices of the 13th and 14th centuries can be read in Casagrande Mazzoli / Ornato 1999, 240–243.

3 The French word is currently used by all those concerned with the study of parchment.

4 Here, the term is employed in a generic way to mean anyone—from the scribe (this would have been the norm in the historical period concerned) to any other artisan other than the scribe—who participated in the selection of raw materials for, and subsequent planning and fabrication of, a volume.

never perfectly functional. The decision, instead, to focus our attention on holes and *lisières* can be justified by the following considerations:

1. As soon as holes and *lisières* cannot be ignored and the disadvantages they present become obvious,[5] both phenomena can (without ambiguity) be classified as 'defects'. In contrast to the way in which other peculiarities were appraised (for example, variations in the structure of quires or the *mise en page*, which can be the result of deliberate choices whose interpretation is not immediately obvious),[6] the presence of holes and/or *lisières* was always perceived as a disadvantage, hence their absence implies careful judgement at the time of the procurement or selection of skins. The purchase of unmarred skins would have involved additional financial outlay; it therefore seems reasonable to suppose that the number of holes and/or *lisières* present on sheets represents a reliable gauge of the overall quality of the parchment, and by extension of the codices in which the sheets served as a writing support.
2. The presence of holes and *lisières* is a phenomenon that provides a wealth of statistical information, since they can be observed in almost all codices, albeit at highly variable rates. Furthermore, both types of defect are readily classifiable into specific categories, and can therefore also be the subject of simple counts, even if such reckonings are not entirely free from classification uncertainties. Furthermore, both holes and *lisières* can be observed in a wide range of different positions and situations within codices and quires and on the surface of each page.

5 Quite apart from the negative aesthetic issue, a hole located within the writing area not only causes an interruption in the written line's continuity but also introduces the possibility of confusing the affected text with that on underlying page. *Lisières* reduce the space reserved for margins, which in theory should provide space for glosses and annotation.

6 For example, one thinks of many Evangelaries—both Latin and Greek—in which the end of a text partition is intentionally made to coincide with the end of a quire, which as a result often presents a structure that deviates from that of the overall volume: see Bischoff 1994. More recently, I have analysed the use of an analogous 'modular' structuring technique in a group of so-called 'giant' Latin Bibles dating from the 11th to 12th centuries (Maniaci 2000, 47–60). In addition, I have been able to identify occasional recourse to the same practice in various Greek Evangelaries dating from the 9th to 12th centuries, which I intend to analyse in a systematic way. Purely as examples, I would point towards a number of codices held in the Biblioteca Apostolica Vaticana, Pal. gr. 220, 9th–10th centuries; Vat. gr. 1159, 10th century; Ott. gr. 297, 10th–11th centuries; Pal. gr. 227, 12th century; and the manuscript held in Rome at the Biblioteca Vallicelliana, B 133, 12th century. The noteworthy variations in the parchment sheets contained within a single volume, which correspond to the different uses to which pages were put (text or illustration), could be intentional: see Bischoff 1991, 127–129, and Bischoff 1993, 77–82.

When the holes and *lisières* were examined it made sense to record, albeit in an approximate way, an additional parameter, namely the thickness of the parchment. Even if this feature does not, in and of itself, represent a defect, it is closely related to the definition of the 'quality of the support'.[7] In fact, it can be presumed that parchment that was considered either too thick or too thin—in relation to one or more standards which will have to be predefined[8]—was considered detrimental to the aesthetics and/or functionality of a volume. The same is also true of variations in thickness found within the same codex or on the surfaces of individual bifolia.

The results presented here are the fruit of surveys carried out as part of a wider research project on the material characteristics of Byzantine book production in the 11th and 12th centuries.[9] The manuscripts that form the main group total 385, approximately two thirds of which date from the 11th century, with the remaining third dating from the 12th century.

1 Holes

1.1 Distribution of holes and typology of manuscripts

A truly exhaustive observation of the typology, frequency of occurrence and distribution of holes should be both qualitative and quantitative in relation to all the ways in which they can present. Accordingly, the following characteristics have to be assessed:

7 This connection previously emerged during an examination of a corpus of Lucchese parchments produced before the year 800: see Bianchi et al. 1994, 175–183.

8 It is necessary, at the outset, to hypothesise the existence–both synchronically and diachronically–of different standards (contingent on the era concerned) in relation to dimensions and the intended use of the material.

9 The reference regards a doctoral thesis on Greek and Latin palaeography developed over a three-year period (1995–1998) at Rome's Sapienza University. The text is currently being revised for inclusion in a monograph [editor's note: appeared as Maniaci 2002]. The realisation of this work was made possible in large part by the kind cooperation of the Direction of the Biblioteca Apostolica Vaticana–in particular, by the then Prefect, Father Leonard E. Boyle, and his deputy Monsignor Paul Canart, who enabled me to acquire the necessary data, a task which entailed consulting, over a relatively short period of time, a huge number of manuscripts. I would like to emphasise my gratitude to Monsignor Canart, who generously provided me with access to his personal card index of Greek manuscripts in order to help me assemble my own sample corpus.

1. The number of holes present in each bifolium, taking into account their positions within the quire and within the codex.
2. The position of each hole in relation to the writing area (outside, inside, straddling, distant).
3. The occasional repair by stitching of all or some of the holes.
4. The occasional demarcation of holes inside the writing area by the copyist by means of unbroken lines, series of dots or sketches of various kinds.[10]
5. The diameter (and hence 'surface area') of each hole, which is a useful datum for quantifying the severity of damage and determining the precise extent of a holed 'surface' on the overall writable surface.

The surveying protocol ultimately decided on—within the framework of a wider research project, as already mentioned—turned out to be rather less thorough than the theoretical framework described above. Indeed, instead of counting all the holes present on each bifolium, only the number of bifolia presenting with at least one hole was determined, regardless of the number of holes concentrated on individual bifolia and their dimensions. Nevertheless, a systematic survey of the coordinates of all the holed bifolia was not foregone (i.e. their positions in quires and in codices), neither was the recording of the positions of holes on pages, based on whether they were located inside or outside the writing area. In all cases, counts were carried out on the entire codex.[11]

Needless to say, a basic count of the holed bifolia present in a manuscript has no value *per se*; indeed, such a count only becomes significant when placed in relation to the total number of bifolia a volume is composed of.[12] Hence the number of holed bifolia will always be expressed in relative terms (i.e. as a percentage of holed bifolia with respect to the total number of bifolia).

The distribution of manuscripts in relation to the percentage of holed bifolia is shown in Chart 1.

10 As has been noted previously, this practice was particularly common among insular scribes: see Brown 1991, 62 and footnote 27.

11 This surveying procedure differs from a rudimentary one adopted more than 10 years ago as part of an investigation of Italian book production in the 11th century, the results of which are presented in Bianchi et al. 1993b. Given that the research only entailed the calculation of the total number of holes and *lisières* on three quires in each codex, it is not possible to use such data to make a direct comparison.

12 It is obvious that the calculation would be more accurate if it were based on the *original* number of constituent bifolia in the manuscript. Nevertheless, the distortion can be considered tolerable, given that it was decided to limit the research–as far as possible–to practically intact volumes, the bulk of which have only lost, at most, a few initial and/or final bifolia.

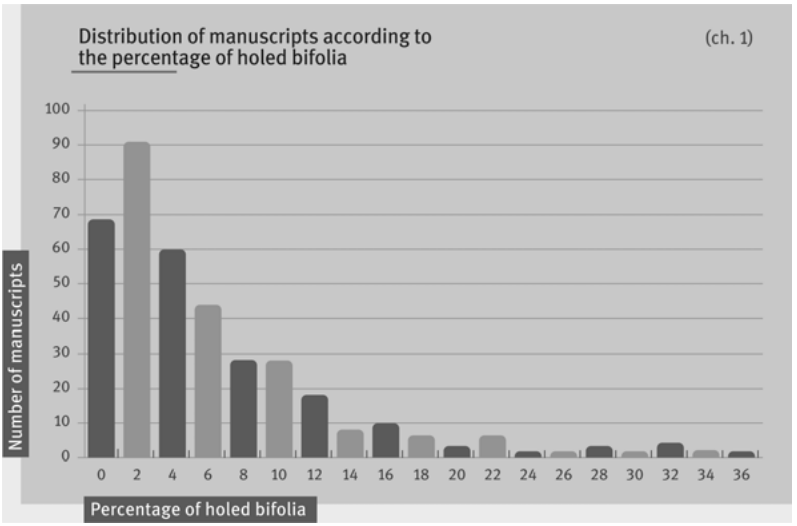


Chart 1: Distribution of manuscripts according to the percentage of holed bifolia

A general tendency to maintain, within certain limits (a figure that can be termed 'reasonable') the number of holes is clear: 69 codices—roughly one fifth of the total—were found to be completely free of holes, whilst in the largest group a rate of between 0 and 2% was observed.[13] Conversely, the codices presenting with holes at a rate in excess of 12% totalled 48, whilst those with holes occurring at a rate exceeding 22% numbered just 17.[14]

Even if it is not possible to know the holing rate in the skins that the artisans handled from time to time, it seems reasonable to suppose that, based on the situation examined, there was a widespread desire to select, as far as possible, skins affected by the least number of defects. If this were not the case, one would not encounter many codices that are entirely hole-free.

13 This means–to provide a concrete example–that a manuscript composed of 200 leaves would entail only two bifolia affected by holes. It is important to note that the distribution pattern–which is to say the individual or combined recurrent values that occur most often–is lower by far than the average, which is 5.76%, whereas the median (i.e. the mid-value) is 3.06%. Definitions of the main 'position parameters' or 'central trend measurements' (mean, median, trend...), together with information on their application can be found in the opening chapters of any primer on statistics: see, for example, Blalock 1984[2], 83–105.

14 Returning to the previous example, such a threshold corresponds to a rate of 22 holed bifolia per 200 leaves.

If, then, parchment holes contribute to determining (in a negative way) the perceived quality of a codex, it is likely that their distribution within the corpus will not be uniform, but instead related to various other typological and qualitative characteristics.

Naturally, when it comes to typologies, the fundamental categories to consider are (a) content and writing, and (b) dating and geographical origin. However, it should be borne in mind that while the application of a 'blanket' classification approach in relation to content typology should not result in any serious problems (provided that a certain number of ambiguous cases can be tolerated and, to a certain extent, overlapping of the fringes of one class with another),[15] when it comes to the writing, the formation of broad groups which are at one and the same time both relevant and methodical would likely create difficulties, and therefore render such an approach impractical.[16] Similarly, with respect to dating and geographical origin, it is far easier to correlate manuscripts on a simple chronological grid—conveniently divided into successive centuries—than it is to attribute their provenance to precise geographical locations. Indeed, in the Byzantine context, based on our current codicological and palaeographic knowledge, the only group whose features can (largely speaking) be said to be clearly definable is that which encompasses manuscripts originating from southern Italy, which therefore represents the only sizable and statistically applicable geographical cluster.

15 Needless to say, one is referring to a classification system that functions purely in the context of our statistical investigation of parchment defects. Clearly, the problem would have been more complicated if the research had directly concerned the content of the relevant codices. For our purposes, it seemed sufficient to adopt (whilst consolidating some of the smaller categories of minimal effect) the classification system proposed in Sautel 1995, which represents a valuable source of information on almost 4,000 Greek manuscripts, many of which have not (as yet) been catalogued in a scientific way.

16 The scribal landscape in the 11th and 12th centuries is very diverse: it is marked–as is widely known–by the predominance and progressive dissolution of scripts that can be placed in the so-called 'Perlschrift' category (an definition devised by Hunger 1954), and by the establishment of cursive scripts employed by learned men, as well as the emergence of new styles based on them. Within each category the intertwining of local variants with different execution levels is still (broadly speaking) rather difficult to 'disentangle', and seems destined to remain so. An attempt to define a script typology for the 11th and 12th centuries can be found in Canart / Perria 1991. The authors expressly state (102–103) that the limit of this operation consisted in the superimposition of a rather rigid scheme (one which is to a certain extent removed from the living reality of the scribes and their graphic forms). Suffice to say that some groupings are exemplified by a very small set of codices (or even by a sole example!), and therefore have a purely classificatory value.

The average percentage of holes varies greatly between one category of text and another (Tab. 1).[17]

Percentage of holed bifolia in relation to textual typology (tab. 1)

	Average	Deviation	Median
Ascetic	10.31%	7.07	9.24
Bible	4.62%	8.02	1.42
Biblical	5.22%	6.42	2.11
Hagiography	3.89%	3.28	3.31
Homiletical	4.28%	5.70	2.56
Liturgical	6.35%	8.70	3.53
Patristic	4.50%	4.68	2.93
Secular	8.68%	9.74	5.23
Theology	6.46%	9.28	2.76
Total	5.67%	7.44	3.68

Tab. 1: Percentage of holed bifolia in relation to textual typology

The parchments of ascetic and secular manuscripts show a conspicuous number of holes, whereas on the other end of the quality scale we find Bibles, homilaries, hagiographies and patristic works, in which roughly half as many holes are seen. Although the differences between one typology and another seem to be quite clear, it should be noted that the individual items within the groups are not at all homogeneous, as can be deduced from the generally high standard deviation (SD) value. In fact, it is obvious that the same textual content can be found in codices of varying quality, depending on the readership and their intended use. In such a situation, there is a danger that the sporadic presence of codices that are highly anomalous (in one way or another) in relation to prevailing trends within the reference group will result in a significant distortion of the average profile, to the extent of invalidating its representative value.

As a control, it can be helpful to establish a second parameter to place alongside the average figure, namely the median, which is less sensitive to the input of

17 The line displaying the totals represents the average value for each column.

extreme values. Calculation of the median, whilst leaving unchanged the first rank position held by the ascetic and secular works, highlights the premium quality of the parchment support normally reserved for Bibles[18] and related commentaries. The discrepancy between the average and median values leads us to suppose that, coexisting within the two textual typologies in question, there were two distinct sub-groups. It is surely not by chance that an in-depth analysis demonstrated that almost all codices of poorer quality can be localised within the Western Greek context.[19] More broadly speaking, the quality of the Italo-Greek volumes is shown to be of distinctly poorer quality in comparison to the average value, with a holing rate of 10.65%, in contrast to a value of 4.11% for all the other manuscripts.

Based on the observations made up to this point, the existence of very strict criteria for the selection of the writing support in relation to textual typologies has emerged. Such criteria were applied consistently, regardless of the range of qualitative values observed within each type.

If it has emerged that the presence or absence of parchment holes represents an important factor that should not be neglected when assessing a codex not solely from an aesthetic viewpoint, it is also clear that characterizing quality cannot be limited to appraising the artisan's choice of parchment. Rather, the definition of quality is dependent on a combination of multiple elements that the artisan knew how to adapt to the particular content of a volume and its potential end users. It is altogether likely, however, that the assessment criteria of the period were at least in part different from those applied today, and so it is no simple task to identify all the qualitative aspects that might have appeared relevant to the eyes of a medieval craftsman, commissioner or reader, and even less so to reconstruct the hierarchy[20] and evolution over time of such aspects. Therefore, in order to shed some light on the occurrence of parchment holes and the overall quality of

18 Here, this 'blanket' term indicates, in line with convention, all manuscripts that contain any part of the biblical text without annotation. In our case, codices containing the four Gospels are also included.

19 The average percentage of bifolia affected by holes is 10.53% for Italo-Greek manuscripts and 2.25% for non-Italo-Greek volumes.

20 The hierarchy varies probably in relation to the 'style' concerned, which is to say a precise combination of material and formal elements used to define a certain kind of presentation, thereby distinguishing it from others. This is somewhat similar to what happens today (although only in relation to formal aspects) with the predefined–or individually definable–styles offered by the most widely employed electronic publishing and word processing systems.

a codex, we must confine ourselves, in such circumstances, to the application of a very rough indicator, namely the presence or absence of gilding in decoration.[21]

In effect, when gold is present, the quality of the support is (as a rule) clearly superior, with an average holing rate of 2.38% per bifolia, in contrast to a rate of 6.89% per bifolia in volumes without any gilding. The difference—which is quite clear—is reflected in all the textual typologies where the use of gold is sufficiently documented (Tab. 2).[22]

Presence of gold according to textual typologies (tab. 2)

	MSS without gold	MSS with gold	Total
Ascetic	11.98%	6.55%	10.31%
Bible	6.90%	1.49%	4.62%
Biblical	6.35%	2.98%	5.22%
Hagiography	5.65%	1.26%	3.89%
Homiletical	5.38%	2.35%	4.28%
Liturgical	8.73%	2.18%	6.35%
Patristic	4.74%	1.28%	4.50%
Secular	8.66%	8.89%	8.68%
Theology	6.92%	0%	6.46%
Total	7.01%	2.40%	5.67%

Tab. 2: Presence of gold according to textual typologies

21 As a differentiating factor, gold has an advantage: that of either being present or absent. However, it also presents a disadvantage because whilst its presence normally identifies a manuscript of superior quality, its absence does not necessarily indicate the opposite–in fact, there are numerous codices in which the absence of gilding can be interpreted as a carefully considered stylistic choice. Even without gilding, such volumes stand out on account of the high quality of their decorative elements. The same problem arises, and further complicates matters, where colours are used: one has only to think of the diffusion, in the Byzantine context, of monochrome decorations that were realised exclusively in deep red (carmine) in a wide range of styles and levels of skill.

22 The calculation of medians instead of means produces analogous results, for which reason it was considered unnecessary to report the latter in the table. The shaded background indicates intersections of a statistically insufficient value (fewer than five volumes).

An analysis of Tab. 2 clarifies two issues: the presence of gold, which implies, in and of itself, a higher standard, is necessarily accompanied by an overall improvement in quality, which attenuates differences related to content. On the other hand, in the groups of manuscripts which do not include gilding, a clear hierarchy persists among the various textual types whose modalities are not very dissimilar—albeit to a lesser extent—to those observed at a general level. In other words, a biblical codex which is not embellished with gold is still, on average, of superior quality (at least in relation to the support employed) compared to, on average, a secular codex.[23]

The quality of the support is also subject to changes with the passage of time: in fact, the overall holing average rises from 4.57% in the 11th century to 7.39% in the 12th century. The phenomenon traverses, more or less uniformly, the textual partitioning previously examined, with the exception of the Bibles—which maintain their superior[24] quality—and the patristic works (Tab. 3).

Presence of holes according to textual typologies (tab. 3)

	Average		Median	
	11th c.	12th c.	11th c.	12th c.
Ascetic	10.45%	10.10%	9.70	6.99
Bible	4.47%	4.76%	1.38	1.56
Biblical	3.59%	8.20%	1.14	6.53
Hagiography	3.96%	3.53%	3.83	0.77
Homiletical	3.94%	5.60%	2.06	4.67
Liturgical	4.07%	9.09%	1.75	5.94
Patristic	4.46%	4.61%	3.13	3.35
Secular	7.08%	10.67%	4.91	8.28
Theology	7.38%	5.08%	2.48	4.58

Tab. 3: Presence of holes according to textual typologies

23 When the Italo-Greek volumes are subtracted from the two, the difference becomes much more pronounced (2.21% of holed bifolia, as opposed to 8.41%).

24 Also in this case, the premium quality of the Bibles becomes much clearer if one considers the median rather than the mean. Using this indicator reduces the 'hefty' influence of the poor quality Italo-Greek volumes.

If the quality of parchment declines over the two centuries in question, one can safely assume that this phenomenon was accompanied by a reduction in various other qualitative parameters, the use of gold included, which in theory ought to be seen less often.[25] In effect, the frequency with which gold is employed in our sample manuscripts undergoes, proportionately, a decline, although the reduction in its use is less pronounced than one might expect: a gilding rate of 33.6% in the 11th century declines to a rate of 20% in the 12th century. However, as regards the quality of the support, in the 12th century the number of codices in which gold was still used remains at the same level as was seen in the previous century, whilst the deterioration in support quality occurs only in volumes where the use of gilding is absent (Tab. 4).

Percentage of holes according to the presence of gold (tab. 4)

	MSS without gold	MSS with gold	Total
11th c.	5.71%	2.31%	4.62%
12th c.	8.66%	2.55%	7.52%
Total	7.01%	2.40%	5.67%

Tab. 4: Percentage of holes according to the presence of gold

It is quite clear that in the category of texts where decorated volumes that include the use of gilding are greater in number, the reduction in their numbers in the 12th century determines a clearer imbalance in the occurrence of holes between the averages of the two centuries. Even so, a separate analysis of the distribution of manuscripts in which gilding is absent leads one to conclude that the imbalance that disadvantages the 12th century is not dependent on the lower number of gilded codices that are found in the different groups: on the contrary, the reduction in the number of such volumes fits into an overall picture which shows a decline in the quality of the codex, and represents a particularly striking aspect of the same.

One can therefore quite reasonably conclude that the deterioration in qualitative standards does not appear to correspond to a general decline in

25 And/or quantitatively less plentiful or qualitatively less refined (our surveying criteria precluded verification of these two possibilities).

the quality of the parchment produced, but rather to a crisis that made it rather costly to produce and to purchase parchment of superior quality (and therefore probably also reduced the demand for it). Quality standards only remain unchanged in the finest volumes, for which a support of optimum quality clearly represented an indispensable feature.[26]

The decline in the writing support's quality from one century to the next does not spare, when viewed at an overall level, the Italo-Greek manuscripts included in the sample, although in the antecedent centuries these already exhibited (as observed when analysing the Bibles) a much higher occurrence of holed bifolia.[27]

The problem raised by the relationship between the presence of gilding and the rate at which holes occur does not arise in the case of Italo-Greek manuscripts, where the use of the precious metal remains highly sporadic in all periods.

26 The diminution of qualitative standards is, in fact, a phenomenon of more global proportions that affects other aspects of codex manufacture, including (in particular) their dimensions, which undergo a considerable reduction, and the use of available page space, which increases. A survey carried out on dated codices and on those attributable (on a firm basis) to the first and second halves of the 12th century leads one to believe that the worsening of qualitative standards is in fact concentrated towards the end of the century, during a phase of increasing difficulty and grave economic crisis that presaged the fall of Constantinople into Latin hands. It is surely not by chance that this period marked the advent, albeit a gradual one, of the production of paper codices, which only in the second half of the following century became solidified (Prato 1984, 75).

27 This result is skewed by a distortion in the sample due to the composition of the Italo-Greek fund held in the Vatican Library which, for the 12th century, is more representative of the scriptorium associated with Grottaferrata than of the more advanced Siculo-Calabrian book manufacture inspired by Constantinopolitan models. For example, many of the Sicilian and Calabrian volumes of larger dimensions and superior quality are concentrated in the Biblioteca Regionale Universitaria at Messina, where the rich collection originating from the Monastery of San Salvatore *in lingua Phari* is held (see the monograph by Foti 1989; one notes, for example, that the average height of the codices that the author attributes to the 12th century is 502.17 mm, which is greater than the overall average height of codices in our sample corpus, which is 490 mm). In addition, with respect to the support, the quality of the Siculo-Calabrian volumes of the 12th century is usually superior to that of codices dating from earlier periods (Canart 1978, 115).

Percentage of holes according to manuscripts' origin (tab. 5)

	Italo-Greek	Other	Total
11th c.	9.14%	3.84%	4.57%
12th c.	11.59%	4.80%	7.39%
Total	10.63%	4.11%	5.58%

Tab.5: Percentage of holes according to manuscripts' origin

To confirm the hypothesis that a general decline in the quality in Byzantine manuscripts took place between the 11th and 12th centuries, an analysis of a parameter less conspicuously linked to the sumptuousness of a codex, but nonetheless closely linked to consumption of raw materials, can be helpful. The parameter in question is the filling of pages, which can be quantified by establishing the proportion of so-called 'blackness' (French *noir*, i.e. the percentage of the surface area written on in relation to the overall surface area of a page).[28] In effect, the degree of 'blackness' underwent an average increase of roughly 6% between the 11th and 12th centuries, shifting from 0.421 to 0.445. In order to evaluate the relationship between the relative number of holed bifolia and the filling of pages it is necessary to subdivide the 'blackness' into a series of separate classes of ascending average values (in our case five quintiles) (Tab. 6).[29]

28 In practice, the 'blackness' value is obtained by dividing the surface occupied by the writing area (excluding the portion taken up by the intercolumnium in the case of pages of two-column volumes) by the total page area.

29 A quintile is defined as a submultiple of a distribution divided into five equal parts of equal value and of growing average (in a sufficiently regular way, according to the trend set by the distribution concerned). More generally speaking, subdivisions can be made in the form of percentiles or quantiles of equal size (Blalock 1984², 102).

Percentage of holes according to blackness (tab. 6)

	Blackness a (0.33)	Blackness b (0.39)	Blackness c (0.43)	Blackness d (0.46)	Blackness e (0.53)	Total (0.43)
11th c.	2.63%	3.77%	4.98%	5.84%	6.28%	4.57%
12th c.	6.63%	7.55%	7.09%	8.61%	7.11%	7.39%
Total	3.63%	4.81%	5.95%	6.77%	6.67%	5.58%

Tab. 6: Percentage of holes according to blackness

The difference in the trend revealed by the figures compels us to consider the two centuries separately. In the 11th century an undeniable correlation existed between the filling of the page and the percentage of bifolia marred by holes, in the sense that the volumes made using materials of inferior quality also contain pages with a greater surface area filled with script (or, stated more precisely, pages with the narrowest margins). This correlation wanes in the following century, when the quality of the support—as we have already seen—definitely declines, whilst the opposite occurs in the case of page filling. As soon as parchment that is less marred by holes becomes scarcer and/or costlier, its use is apparently reserved for the manufacture of products of superior quality. On the other hand, the decline of quality standards is so extreme—the worst parchment of the 11th century is of better quality than the best parchment of the 12th century—that it reaches, even in carefully made codices (i.e. those with pages which are less filled) the minimum acceptable standard, and therefore prevents the use of an even poorer quality support in the 'shoddiest' volumes.

1.2 Distribution of holes on individual pages and throughout quires and codices

Before focusing our attention on the distribution of holes throughout individual volumes, we can safely assume that when the quality of a book is sullied by the presence of defects two consequences arise, as follows:

1. All defects have a negative impact on a book's functionality, given that they affect its material structure and the way in which individual pages and the writing on them appear.

2. Visible defects will result in an unfavourable reaction to the page on the part of readers, and therefore have an overall negative impact on the way a volume is adjudged.

If the book craftsman is conscious of these two issues, he will act to limit the most serious drawbacks and try to conceal from the eye's view any defects which cannot be entirely eliminated. In the case of holes, it is obvious—as has already been pointed out—that their presence is, objectively, far more detrimental when they are located within the confines of the writing area, not only because they impede the progress of writing instruments on the surface of a page, but also because they expose the text on the underlying page, which raises the possibility of misreading.[30]

From a subjective standpoint, a displeasing impression will be all the more pronounced when holes are visible to the eye of the reader: this occurs—above all—when holes appear in the opening leaves of a codex, which are often those which are seen when a volume is consulted for the first time.[31] On the other hand, since individual quires were perceived as complete structural units in themselves (above and beyond serving as part of a greater whole), it is altogether likely that the visual impact of the outermost bifolia was considered more important than that of successive ones, so an effort was made to ensure that the former were as defect-free as possible.[32]

As regards the distribution of defects on leaves, the bifolia with holes located in the writing area amount to a little less than half of those in which holes appear solely in the four marginal areas (29.8%, as opposed to 55.81%).[33]

With an occurrence rate of 3.18%, the bifolia that present with holes both within and without the writing area represent a small minority. This figure seems all the more modest when one considers that it is some five times lower than the theoretical

30 This was (in all probability) the practical, rather than purely aesthetic, reason which led copyists to 'fence in' with ink the contours of holes situated within the writing area (see above, 107 and footnote 10).

31 In general, the first part of a book is the most heavily consulted: one can call to mind, for example, the widespread phenomenon of volumes that are heavily annotated in the first few chapters, but whose leaves gradually become almost free from marginal notes in successive ones.

32 For that matter, it is surely not by chance that in the Late Middle Ages it was still considered a good idea to improve the presentation of (and to protect) certain paper codices by enclosing each quire within a bifolium of parchment (and sometimes even adding another one at the centre of the quire). The ways of presenting and geographical diffusion of this peculiar 'mixed support' quire typology–also met with, albeit very seldom, in the Greek context–are illustrated in Bianchi et al. 1994.

33 All percentages are calculated with respect to the total number of holed bifolia, without taking into account those which are free of holes.

probability.[34] In practice, bifolia affected by holes both within and without the writing area—or at least, their defective halves—were condemned and rejected.

The variation in the proportion of holes lying within and outside the writing area (i.e. in a leaf's margins) varies in relation to the overall incidence of holed bifolia within the manuscript volume as a whole. In order to better understand the phenomenon, the total percentage of holed bifolia in relation to the total number of bifolia has been divided into five sub-classes which reflect the imbalance in proportions,[35] arranged thus: codices entirely free of holes (obviously absent from the table); codices with up to 2% of leaves affected by holes; codices with up to 5% of leaves affected by holes; codices with up to 10% of leaves affected by holes; and finally, codices with more than 10% of leaves affected by holes.

Distribution of holes on the page according to their frequency (tab. 7)

	Internal	External	Int. + Ext.
0–2%	24.81%	76.85%	1.67%
2–5%	37.09%	64.73%	1.83%
5–10%	40.59%	63.23%	3.82%
+10%	44.70%	65.53%	9.72%

Tab. 7: Distribution of holes on the page according to their frequency

The table makes clear that as the number of holed sheets increases, so too, does a certain indifference on the part of the craftsmen to holes lying within the writing area, with the said holes not being avoided as before. Indeed, more than 10% of the holed bifolia are accepted, with the inclusion of even the worst affected bifolia marred by the presence of holes both in the writing area and in the margins.

34 The theoretical probability, obtained by calculating the sum of the two occurrence rates (and dividing the number by one hundred), is 16.6%. Actually, this is a commonly agreed on reference figure and is only valid if one supposes that every affected bifolium contains at least two holes; in our case, since we did not envisage a count of individual leaves, we were not able to determine the theoretical rate at which holes appear in each bifolium.

35 The classes are of unequal size because they take into account the true distribution of holes which, as the reader will recall, is skewed towards the lowest values.

One can readily imagine that the degree of attention paid to the position of holes on pages also varied in relation to content and script types, and to chronological and geographical factors. This hypothesis is fully confirmed in Tab. 8.

Distribution of holes on the page according to textual typology (tab. 8)

	Internal	External	Int. + Ext.
Ascetic	32.81%	67.19%	3.97%
Bible	37.08%	62.92%	2.31%
Biblical	28.14%	71.86%	3.08%
Hagiography	29.19%	70.81%	5.72%
Homiletical	33.09%	66.91%	0.98%
Liturgical	31.91%	68.09%	2.94%
Patristic	38.13%	61.87%	3.33%
Secular	45.57%	54.43%	4.28%
Theology	35.49%	64.51%	6.75%
11th c.	33.59%	69.63%	3.21%
12th c.	40.06%	65.18%	4.96%
Italo-Greek	40.11%	58.77%	7.88%
Others	31.45%	71.17%	2.47%

Tab. 8: Distribution of holes on the page according to textual typology

The imbalance between holes located within and outside the writing area remains virtually invariable in the overwhelming majority of subdivisions. The only exceptions, on account of an almost complete lack of concern in relation to the position of holes, are volumes containing secular texts and Italo-Greek texts, both of which—as the reader will recall—are particularly affected by holes.

The clearest tendency to discard bifolia marred by holes located within the writing area is found—needless to say—in the highest quality production contexts. This tendency can be demonstrated by applying the presence of gilding as a discriminating factor (Tab. 9).

Distribution of holes on the page according to the presence of gold (tab. 9)

	Internal	External	Int. + Ext.	Total
MSS without gold	39.29%	65.54%	4.68%	7.01%
MSS with gold	26.64%	74.90%	1.54%	2.40%

Tab. 9: Distribution of holes on the page according to the presence of gold

The same attitude can be observed if one applies the filling of pages as a reference gauge: a lack of concern in relation to holes within the writing area increases commensurately with the amount of the surface it occupies in relation to the total area. Realistically, we cannot exclude the possibility that part of the phenomenon is 'automatic' in origin, in the sense that an expansion of the area intended for writing on will lead to an increase in the probability that a good number of the holes will appear within it. Even so, the occurrence of this 'automatic' factor does not represent the chief cause of the observed phenomenon, inasmuch as enlargement of the writing area is, overall, limited in scope, and the actual increase in holes proportionately greater than the anticipated theoretical increase (Tab. 10).[36]

36 The extreme variations seen in the distribution of holes both within and outside the writing area are attributable to the non-uniform distribution of the codices within the various classes. In essence, this is a 'structural effect', which is to say a result that is only seemingly significant–and therefore difficult to 'unmask' as such–produced by the particular characteristics of the sample corpus. This means that the seemingly direct link between the two variables does not in fact exist, or alternatively is induced by a third variable not identified as being the one which is truly responsible (see Maniaci / Ornato 1993, 22).

Distribution of holes on the page according to blackness (tab. 10)

	Internal	External	Int. + Ext.	Total
Blackness a (0.33)	29.66%	73.60%	3.26%	3.63%
Blackness b (0.39)	27.45%	74.32%	1.77%	4.81%
Blackness c (0.43)	35.35%	67.10%	1.93%	5.95%
Blackness d (0.46)	43.05%	65.88%	8.93%	6.77%
Blackness e (0.53)	43.73%	59.89%	3.61%	6.67%

Tab. 10: Distribution of holes on the page according to blackness

Still to be examined is the thinking behind the way in which artisans distributed bifolia marred by holes within quires.[37] An examination of the distribution of holed bifolia in each of the four possible positions—external (1), intermediate (2, 3), and internal (4)—makes it possible to identify the existence of a 'rule' of a negative kind, namely the holed bifolia were *not* normally assigned the outermost position, but instead distributed in a roughly uniform way in the other three positions. The 'rule' is less closely adhered to when the parchment is particularly marred, which is to say in codices that contain holed bifolia at a rate in excess of 10%. This abatement phenomenon also characterises, as the reader will recall, the other tendencies brought to light, and—in this case as well—can be explained by hypothesizing a growing lack of concern on the part of artisans who, just as they adapted to using parchment of lower quality, worried less and less about concealing defects in the material.[38] On the other hand, it is not possible that the overabundance of holed bifolia will, for purely 'automatic' reasons, impede application of the 'rule', inasmuch as it is in theory always applicable, provided that the percentage of holed bifolia does not exceed 75%. This is a very high value and is never attained in the manuscripts included in our corpus (Tab. 11).

37 Only the complete and regular quires were examined, all of which are quaternions.

38 It is impossible to ascertain whether or not this apparent indifference to defects was 'voluntary', or instead due to a paucity of artisanal skill (i.e. an inability to plan, in a competent way, the work to be carried out), or perhaps even to a total ignorance of the 'rule'.

Distribution of holes according to the position of the bifolium within the quire (tab. 11)

Percentage of holes	Bifolium 1	Bifolium 2	Bifolium 3	Bifolium 4
0–2%	10.56%	30.37%	32.41%	26.67%
2–5%	13.30%	30.67%	30.04%	25.99%
5–10%	12.85%	29.69%	29.01%	28.44%
+ 10%	17.20%	28.00%	29.80%	25.52%
Total	13.20%	29.80%	30.41%	26.70%

Tab. 11: Distribution of holes according to the position of the bifolium within the quire

Verification of a widespread awareness of this new 'rule' in relation to the usual typological subdivisions provides us with some new assessment criteria (Tab. 12).

No category exists in which the rule was totally ignored. Moreover, the degree to which it was applied appears to have been quite generalised and remained relatively constant over time, which leads one to believe that the practice was more widely diffused than was a tendency to prevent holes from being located within the writing area. The difference between the two phenomena is also confirmed by the fact that the repositioning of holed bifolia within a quire did not conform to the same criteria as those applied for the selection of bifolia affected by holes both within and outside the writing area. In fact, if we consider secular codices, which contain many holes and betray an apparent lack of concern on the part of the artisans as regards the position of the holes on pages, there appears to be a much greater propensity to 'hide' defective bifolia within quires. The same is true, but to a lesser extent and for different reasons, in the production of biblical, liturgical and homiletical typologies.

Distribution of holes within the quire according to textual typology, date and origin (tab. 12)

	Bifolium 1	Bifolium 2	Bifolium 3	Bifolium 4
Ascetic	20.04%	25.27%	29.26%	25.44%
[illegible]	[illegible]	25.02%	31.13%	32.23%
Biblical	13.08%	29.23%	33.06%	24.63%
Hagiography	17.94%	31.71%	32.77%	18.12%
Homiletical	12.45%	26.30%	32.48%	28.77%
Liturgical	10.46%	33.74%	29.81%	25.99%
Patristic	20.43%	32.34%	27.45%	19.78%
Secular	7.22%	27.18%	29.93%	35.67%
Theology	18.71%	33.97%	21.19%	26.13%
11th c.	14.22%	28.06%	30.43%	27.29%
12th c.	11.49%	32.71%	30.37%	25.71%
Italo-Greek	13.06%	35.38%	26.99%	24.56%
Others	13.24%	27.86%	31.60%	27.44%

Tab. 12: Distribution of holes within the quire according to textual typology, date and origin

It is particularly interesting to establish that the percentage of holed bifolia occupying the first position (i.e. the outermost bifolium of the quire) does not exhibit noteworthy variations within the subdivisions based on the usual indicators of overall codex quality—i.e. page filling and the presence or absence of gilding—which, on the contrary, exerted a very discriminating effect on the distribution of holes over the surface of the page (Tab. 13).

Distribution of holes within the quire according to presence of gold and blackness (tab. 13)

	Bifolium 1	Bifolium 2	Bifolium 3	Bifolium 4
MSS without gold	13.45%	29.70%	30.45%	26.55%
MSS with gold	12.48%	30.10%	30.29%	27.13%
Blackness a	11.18%	27.65%	27.31%	33.86%
Blackness b	11.42%	33.73%	31.01%	23.85%
Blackness c	12.00%	31.33%	27.86%	29.33%
Blackness d	15.31%	28.91%	31.36%	24.42%
Blackness e	15.81%	27.30%	34.06%	22.83%

Tab. 13: Distribution of holes within the quire according to presence of gold and blackness

Finally, the regularity with which the bifolia most severely compromised by holes are found in the second or third positions, rather than at the centre of the quire, merits some attention:[39] indeed, one can discern the existence of a more complete rule—albeit one which is less clearly established, and above all too 'watered down' within the corpus to make it possible to identify the concrete ways in which it was applied. This additional rule can be explained when one pauses to remember that the internal bifolium is the only one in which one of the sides is fully visible (when the volume is open).[40] The rule does not exclude the existence of an alternative practice for the handling of the most defective bifolia which envisages 'concealing' them innermost within quires. The preference for this second solution is particularly evident in volumes that contain sacred texts.

A final verification step concerns the distribution of holed bifolia within the manuscript, which is to say between the first and second halves of a volume,

39 Of 2,024 holed bifolia, 310 occupy the first place, 571 the second, 588 the third, and 527 the fourth. Taking into account a deficit of 12% in the first rank, the theoretical distribution for the three other positions should be 29%, which equates to 587 bifolia. The difference with respect to the true value is significant for the fourth place ($\chi^2 = 6.3$; using Pearson's chi-squared test, which makes it possible to compare the compliance of an observed distribution to a theoretical one; see Blalock 1984[2], 349–364.

40 In hindsight, it is to be regretted that the surveying of holes was carried out on bifolia rather than on individual leaves, since it would have been interesting to confirm the possible existence of a 'rule' aimed at avoiding the simultaneous presence of holes on two facing leaves.

calculated on the basis of the collected data. The average value for the two halves (respectively 47.06 and 52.93) turns out to be roughly equal,[41] and there is no significant variation in this ratio among any of the typological subdivisions.

2 *Lisières*

2.1 *Lisières* and skin structure

The detailed survey of the *lisières* posed, from the outset, problems of greater magnitude than those presented by holes, due to uncertainties stemming from the following three factors:

1. *Lisières* which only appear along the three 'open' edges of a codex, were subject to being trimmed (precisely on account of their being 'open'), an operation which could result in their partial or complete removal. In the event of partial removal, residual traces of a *lisière* can easily be confused with other kinds of irregularities (e.g. stiffened areas of the parchment, folded and split corners, etc.) attributable to events following the manufacture of volumes, and their present-day state of preservation.
2. The exact location of a *lisière* along any of the three 'open' edges of a codex is not always easy to describe in a precise and unambiguous way.
3. Different kinds of irregularities correspond to different areas of a skin (i.e. flank, neck, axillae) and are often indistinguishable because of the way in which they manifest themselves along the edges of a bifolium, and also on account of a dearth of precise information on the relationship between the entire skin and the portion represented by a single bifolium. Problematic issues of this kind become particularly apparent in the event of irregular edges situated in proximity to the corners of a bifolium.

Taking into account all of the above problematic factors, the *lisières* were surveyed, just as were previously the holes, in all the bifolia of each volume composing the corpus. As in the case of the holes, the survey encompassed all the bifolia affected by *lisières*, rather than individual irregularities present on each bifolium (Chart 2).

41 Student's *t*-test, which verifies hypothetical parity between the averages of two small samples (see Blalock 1984[2], 241–247) for paired up samples gives a result of 1.27, which is insignificant (the bilateral *t* threshold being 1.97).

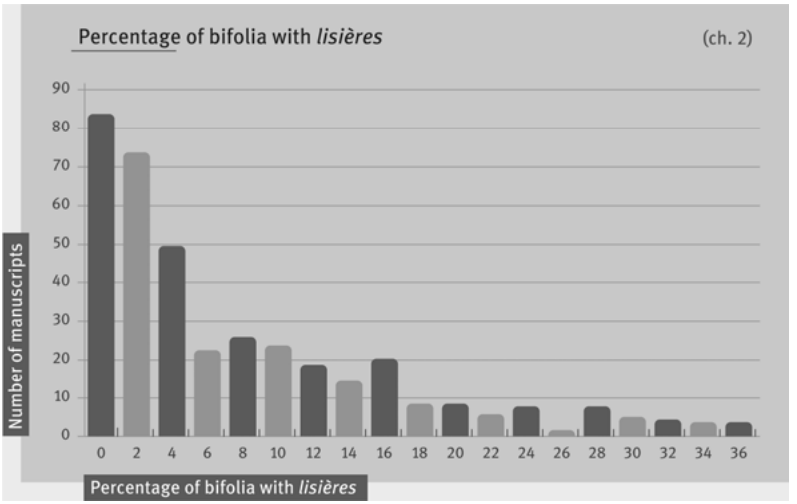


Chart 2: Percentage of bifolia with *lisières*

The average percentage of bifolia presenting with *lisières* was found to be 7.8%, and their distribution within the corpus proved to be very similar to that of the holes.

Although the average value for the *lisières* is higher than that of the holes, the majority of codices affected fall into the 0-2% range, as was also the case with holes. The disparity between the two averages relating to *lisières* and holes respectively is attributable to a wider dispersion of the distribution of *lisières*: indeed, if the number of manuscripts entirely free of *lisières* is higher than the number of those without holes (85 volumes, equating to 22%), more than 12% of the *lisières* are met with in 96 codices (23.8%), and in another 40 volumes (10.3%) 17% of sheets are affected. The difference between the two distribution rates can be accounted for, at least in part, by the fact that *lisières* are necessarily situated along the edges of codices; for this reason, if desired, they can easily be eliminated, albeit at the cost of slightly reducing a volume's size. On the other hand, such irregularities can also be tolerated without resulting in any serious impact on writing or reading functionality.

2.2 Distribution of *lisières* and manuscript typologies

As we have already done in relation to holes, the problem of identifying the existence of possible relationships between the rate of occurrence of *lisières* and the different textual typologies included in our study now has to be addressed. Once again, we shall start out by subdividing the sample corpus into different textual classes (Tab. 14).

Distribution of *lisières* according to textual typology (tab. 14)

Textual typology	Average	Median
Ascetic	7.90%	6.09
Bible	6.79%	1.15
Biblicaî	6.27%	2.21
Hagiography	5.20%	2.09
Homiletical	6.95%	3.28
Liturgical	9.93%	4.55
Patristic	8.10%	4.58
Secular	10.13%	5.75
Theology	8.21%	1.24
Total	8.04%	3.34

Tab. 14: Distribution of *lisières* according to textual typology

Overall, the distribution of *lisières* is more uniform than that of holes. The distribution of *lisières* is, however, consistent with the distribution of holes when it comes to their distinctive characteristics. In particular, if one considers the median value relative to each group, it can be seen that Bibles and theological codices on the one hand, and secular texts on the other, stand apart respectively for defects and for a profusion of bifolia affected by *lisières*.

In contrast to holes, *lisières* are not subject to variations over the course of time. Indeed, between the averages relating to the 11th and 12th centuries—respectively 7.23 and 8.74—no significant difference can be seen.[42] Additionally, cross referencing of date and textual types produces—unlike in the case of holes—inconsistent results (Tab. 15).

Distribution of *lisières* according to century and textual typology (tab. 15)

	Average		Median		Total
	11th c.	12th c.	11th c.	12th c.	
Ascetic	8.26%	7.32%	4.42	8.55	7.90%
Bible	7.86%	5.82%	1.41	0	6.79%
Biblical	5.68%	7.35%	1.06	3.39	6.27%
Hagiography	4.84%	7.24%	2.40	1.53	5.20%
Homiletical	6.86%	7.29%	3.27	3.75	6.95%
Liturgical	5.68%	15.03%	2.25	9.28	9.93%
Patristic	8.57%	6.84%	4.58	4.25	8.10%
Secular	13.28%	6.19%	10.58	3.46	10.13%
Theology	5.86%	11.74%	1.25	7.57	8.21%
Total	7.14%	9.62%	3.13	4.04	8.04%

Tab. 15: Distribution of *lisières* according to century and textual typology

Unlike the chronological factor, the localisation of codices—once again limited to the East-West antithesis—represents an effective discriminating factor, inasmuch as codices originating from southern Italy reveal, with respect to *lisières*, a broadly speaking far more careless attitude.[43] As has already been ascertained at a global level, the distribution of *lisières* in Byzantine southern Italy was not subject to significant variations with the passage of time (Tab. 16).

42 Student's *t*-test result = 1.22 (the bilateral *t* threshold being 1.97).

43 For example, also in this instance one observes an enormous difference between non-Italo-Greek biblical manuscripts (average percentage of *lisières* 2.79%) and Italo-Greek ones (16%).

Distribution of *lisières* according to century and origin (tab. 16)

	Italo-Greek	Others
11th c.	16.16%	5.80%
12th c.	15.26%	4.72%

Tab. 16: Distribution of *lisières* according to century and origin

As regards the relationship of *lisières* with other qualitative aspects of the codices, one notes, above all, that they—just like holes—were more sedulously avoided in manuscripts whose decoration was embellished with gold than in those without any gilding (Tab. 17).

Distribution of *lisières* according to century and the presence of gold (tab. 17)

	MSS without gold	MSS with gold
11th c.	9.23%	3.27%
12th c.	10.29%	2.87%

Tab. 17: Distribution of *lisières* according to century and the presence of gold

Conversely, the partitions created on the basis of the page filling rate result in only slight and insignificant variations.[44] However, it should be noted that there is a positive correlation—limited to the 11th century—between the number of *lisières* and the expanse of ink coverage. This correlation does not, however, apply to the most 'filled' codices. One explanation—albeit partial—for this phenomenon could lie in the fact that the presence of *lisières,* which 'eat' into the edges of a leaf, hampers the unfettered expansion of ink coverage (Tab. 18).

44 Student's *t*-test applied to the *a*-*b* classes of 'blackness' on the one hand and the *d*-*e* classes on the other (so as to maximise any possible differences) gives a result of 0.68, which is much lower than the bilateral *t* threshold of 1.97.

Distribution of *lisières* according to century and blackness (tab. 18)

	Blackness a (0.33)	Blackness b (0.39)	Blackness c (0.43)	Blackness d (0.46)	Blackness e (0.53)	Total
11th c.	5.63%	5.66%	7.58%	9.57%	8.25%	7.23%
12th c.	8.02%	12.29%	6.65%	8.94%	8.99%	8.74%
Total	6.22%	7.49%	7.15%	9.36%	8.60%	7.77%

Tab. 18: Distribution of *lisières* according to century and blackness

All things considered, the comparison of the distribution of the holes and the *lisières* reveals the existence of similarities and differences in the way in which bifolia affected by the two types of blemish were selected. If it cannot be doubted that *lisières* constitute, objectively, defects in the raw material and were perceived as such, at the same time they do not share the same (negative) categorisation as holes—indeed, their presence, given that it is common to all skins, does not diminish *per se* the quality of the raw material, and therefore should not be included among the criteria applied when appraising the value of skins.[45] This probably accounts for a greater indifference on the part of artisans—as well as owners and readers of volumes—when confronted by a, so to speak, natural feature of the writing support. Furthermore, since *lisières* necessarily coincide with the outermost edges of a book, they do not have a negative effect on its functionality, apart from in a few exceptional cases.

2.3 Distribution of *lisières* within volumes and quires

On account of their categorisation as 'defects' (albeit of a particular kind), artisans were sometimes tempted to conceal *lisières*, just as in the case of holes, within a volume or quire. It should be interesting, then, to determine whether or not the strategies followed by artisans in this regard coincided with their attitude towards holes, with which up until now *lisières* have shown themselves to be only partly comparable.

In effect, the division of a codex into a first (I) and second (II) half reveals a tendency to concentrate *lisières* in the bifolia positioned after the midpoint of a

45 See Denis Muzerelle's analogous reflections, in Bianchi et al. 1993b, 403.

volume, although only in codices with a limited number of *lisières*.[46] Gradually, as the percentage increases, one notes a progressive lack of concern on the part of artisans in relation to *lisières*.[47] This attitude seems to coincide with a tendency to select the best skins among those available, leaving to last, if possible, the use of the most blemished ones (Tab. 19).

Distribution of *lisières* in the two halves of the codex according to their frequency (tab. 19)

Lisières b (> 2%)		*Lisières* c (2-5%)		*Lisières* d (5-10%)		*Lisières* e		Total	
I	II	I	II	I	II	I	II	I	II
36.84%	63.13%	46.82%	53.18%	43.54%	56.46%	48.72%	51.28%	44.41%	55.59%

Tab. 19: Distribution of *lisières* in the two halves of the codex according to their frequency

In any event, cognizance on the part of artisans concerning *lisières*, up to this point addressed in a rather broad way, was not expressed in a sufficiently marked form so as to warrant a more in-depth analysis. All the investigations carried out—in relation to text type, date, geographical origin and codex quality—yielded non-contradictory results with respect to the underlying tendency, although they present a certain number of inconsistencies of unclear cause.

46 The *lisières*, like the degree of 'blackness', were divided into classes of ascending percentages (*listot a, b, c, d, e*). The *lisière*-free codices, for obvious reasons, are not shown in the table.

47 The total χ^2 is 6.93 (significant, with a 2% margin of error). As regards the individual classes, the χ^2 value is significant for class *c*. Also in class *b* a difference is observed between the two halves of the codex, which follows the same trend, even if it is not statistically insignificant.

Distribution of *lisières* according to the position of the bifolium within the quire (tab. 20)

Percentage of *lisières*	Bifolium 1	Bifolium 2	Bifolium 3	Bifolium 4
0–2%	6.80%	39.91%	27.85%	28.07%
2–5%	9.88%	28.82%	25.59%	35.97%
5–10%	7.17%	37.25%	28.91%	27.13%
>10%	10.05%	30.38%	28.52%	27.96%
Total	6.79%	26.35%	21.76%	23.09%

Tab. 20: Distribution of *lisières* according to the position of the bifolium within the quire

Still to be confirmed—as was done in the case of holes—is a possible tendency to 'conceal' bifolia affected by *lisières* towards the innermost part of a quire, instead of locating them in the outermost position. Such a tendency is effectively shown to be more marked than it was for holes, above all in codices affected by a limited number of *lisières*. However, the trend shows a slight attenuation when the percentage of *lisières* is higher, even if the descending progression is not altogether consistent. All the bifolia positioned after the first have an average percentage of *lisières* which is slightly higher than the random distribution, even if one can discern a slight propensity—analogous with that revealed for holes—to shift to the second position the *lisières* removed from the external position (Tab. 20).

In the case of *lisières*, too, the tendency to spare the outermost bifolium of a quire represents a widespread and generalised practice. Indeed, the practice extends across all the customary typological subdivisions, without showing any significant variation.

Distribution of *lisières* within the quire according to textual typology, date and origin (tab. 21)

	Bifolium 1	Bifolium 2	Bifolium 3	Bifolium 4
Ascetic	6.95%	34.99%	20.51%	37.55%
Bible	9.16%	32.18%	26.45%	32.22%
Biblical	10.87%	37.93%	23.47%	27.73%
Hagiography	1.44%	39.57%	38.46%	20.53%
Homiletical	8.80%	35.69%	27.78%	29.23%
Liturgical	9.60%	35.57%	24.99%	29.84%
Patristic	9.15%	28.06%	32.30%	30.48%
Secular	5.65%	33.87%	35.91%	24.56%
Theology	11.85%	15.75%	37.52%	34.89%
11th c.	8.32%	35.10%	26.16%	29.97%
12th c.	9.35%	31.10%	30.82%	28.66%
Italo-Greek	7.95%	33.75%	30.53%	26.09%
Others	8.96%	33.66%	26.79%	30.78%
MSS without gold	8.63%	32.61%	28.52%	29.46%
MSS with gold	8.87%	37.30%	25.41%	29.69%
Blackness a	7.94%	39.72%	25.77%	26.32%
Blackness b	14.28%	34.70%	26.15%	22.78%
Blackness c	8.02%	34.61%	25.82%	33.54%
Blackness d	6.06%	27.69%	32.05%	32.70%
Blackness e	8.08%	33.02%	28.59%	30.18%

Tab. 21: Distribution of *lisières* within the quire according to textual typology, date and origin

2.4 *Lisières*, quire construction and codex format

The very considerable imbalance between *lisières* situated in the first and successive positions within the quaternions raises the problem concerning the utilisation of skins in the construction of the bifolium. As is well known, a successful hypothesis—formulated by Léon Gilissen—attributes to the late medieval Latin artisans the practice of creating medium-sized quaternions by juxtaposing two skins folded in two perpendicular to the spinal axis, and then folded a second

time in parallel with the same axis.[48] More recent research—based on a direct examination of the traces of the original morphology of the skin, which are often still visible in parchment—has cast doubt on the possibility of adopting, wholesale, the Belgian codicologist's conclusions and using them to automatically extrapolate information from different historical periods and contexts.[49]

In reality, whatever the actual extent of its diffusion might have been, the procedure hypothesised by Gilissen, despite having (in theory) the merit of rendering the construction of quires a more rational and ergonomic process, presupposes the availability of whole skins of virtually identical dimensions, in addition to being free of defects that would prevent them from being fully utilised. As is well known, this certainly was not the norm in the context of medieval manuscript production. Indeed, as anyone possessing the slightest familiarity with manuscripts knows, the skins, on the contrary, presented in a wide range of sizes and often, because of their poor quality, could only be partially utilised. Furthermore, Gilissen's hypothesis contains an additional flaw: starting with a single skin, its systematic application would result in the automatic creation of bifolia all of which are of the same size and, starting with a group of identically sized skins, the creation of manuscript volumes likewise all of the same size, or alternatively conforming to a descending geometric progression in relation to the size of the skin in question.

Instead, it seems quite reasonable to suppose—given on the one hand the size variations seen in animal skins and in the manuscript volumes that have come down to us, and on the other the need on the part of medieval craftsmen to utilise to the maximum the available material, wasting as little as possible—that quire construction techniques were far more varied and subject to improvisation according to specific needs and the characteristics of the available material. This supposition has, moreover, been further validated by the results obtained from a sample of Greek and Latin codices dating from different historical periods, which have shed light on a variety of relationships—albeit

48 See Gilissen 1977, 14–122. In effect, the favourable reception the hypothesis has enjoyed and continues to enjoy up to the present (with its consequent blanket application) far exceeds the bounds and purpose of its original formulation.

49 See Bischoff / Maniaci 1996, a work, with respect to the Greek section, based on the results obtained from the doctoral thesis mentioned in footnote 9, and therefore on the same data employed for the production of the present article. Doubts in relation to the universal validity of Gilissen's hypothesis had already been raised independently, in a brief intervention by Dennis 1993, 166–173; however, the examples furnished by the author are not altogether convincing from the methodological standpoint. To the problematic issue of folding, with specific reference to Greek manuscripts, I have dedicated an in-depth analysis (Maniaci 1999).

not always easily interpretable—between the surface represented by the bifolium and the original animal skin from which it was derived. In particular, with respect to Byzantine production, the existence of a method of subdividing skins different from that described by Gilissen has come to light, namely an approach that consists in cutting the skin twice in a 'T' form,[50] a procedure that yields three bifolia, two of which are created by the division of the skin along its dorsal axis, and the third resulting from a further subdivision parallel with it.

As might be expected, the positioning and orientation of bifolia on a skin's surface affected the position in which any (possible) *lisière* would be situated. Graph 3 shows the overall distribution of *lisières* throughout the examined sample corpus. It is quite striking that the vast majority are located in the lower margins of leaves, whereas the percentage of those located in the upper margins appears to be very small.

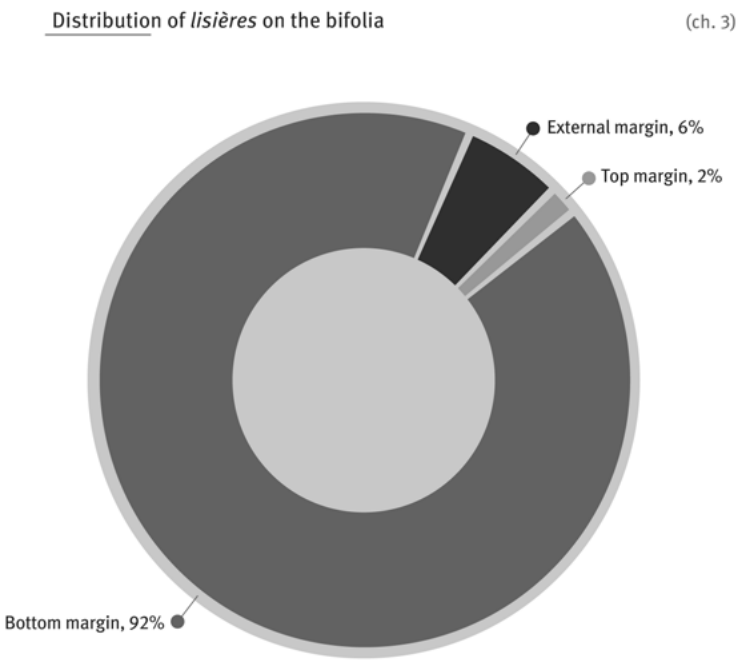


Chart 3: Distribution of *lisières* on the bifolia

50 Maniaci 1999, 101–110.

The unequal distribution of *lisières* along the open edges of bifolia (Chart 3) confirms, above all, the existence of a very widely diffused tendency to place them (preferably) on the tail edge of a volume. This practice, picked up on by Gilissen in order to prove the construction of bifolia by folding is, in reality, too generalised to allow for its attribution wholly to 'automatic' causes. However, it is true that the phenomenon appears to be in line with the habit—quite recently noted—of dividing skins in two along their dorsal axes, a practice which up to the present only Byzantine book craftsmanship has provided us with evidence of. The scarcity of laterally positioned *lisières* would instead suggest an approach favoured by Byzantine artisans that consisted in the subdivision of skins perpendicular to their spinal axes, thereby generating two bifolia from each skin.

Conversely, the remarkable rarity of codices—a sum total of 17—which present with *lisières* on both the upper and lower margins[51] is quite surprising. This should in fact be the norm in the bulk of large codices of in-folio format, each of whose bifolia were produced using one entire skin. To account for this incongruity, we can hypothesise that the rectification of a skin's edges was carried out above all on the upper margin of a the rectangle that was destined to become a bifolium, positioning—if deemed necessary in order to economise on the material—any *lisières* on the lower margin, which was normally somewhat wider. It is more likely, however, that the scarcity of *lisières* situated along the top edge of volumes simply reflects an almost total absence of in-folio manuscripts in the sample corpus studied. Therefore, the largest of the Greek volumes should be of in-quarto format obtained from large skins.[52]

3 Holes and *lisières*

If, by now, we have ascertained that holes and *lisières* belong—albeit in different ways—to one and the same category (i.e. defects), we have yet to establish the kind of relationship in which the two phenomena coexist in manuscripts. In more specific terms, we have to ask whether or not it is possible to confirm that, in general, the rate at which holes occur evolves in parallel with that of *lisières*.

In order to answer this question, it is necessary to cross-reference the percentage of bifolia that are affected by *lisières* with the percentage of bifolia that

51 Furthermore, many of the *lisières* recorded as being situated on the upper margin are, in fact, located on corners (where the upper and outer margins meet).

52 Maniaci 1999, 110–121.

are affected by holes by grouping the two variables in five classes in order to compare them. The percentage of volumes corresponding to each of the intersection points is reported in Tab. 22 in the individual boxes, as follows:

Distribution of manuscripts according to the frequence of holes and *lisières* (tab. 22)

Percentage of holed bifolia	Percentage of bifolia with *lisières* a (0)	b (0–2%)	c (2–5%)	d (5–10%)	e (>10%)	Total
a (0)	**10.4%**	4.7%	1.6%	0%	1.3%	69
b (0–2%)	8.0%	**6.5%**	4.4%	2.8%	1.6%	90
c (2–5%)	2.6%	5.7%	**4.7%**	3.9%	4.9%	84
d (5–10%)	1.3%	4.1%	1.8%	**4.7%**	8.5%	79
e (>10%)	0%	3.1%	2.3%	2.1%	**11.4%**	64
Total	86	84	57	52	107	386

Tab. 22: Distribution of manuscripts according to the frequence of holes and *lisières*

The diagonal series of figures that links the two most extreme situations—i.e. a total absence of holes and *lisières*/maximum number of holes and *lisières*—corresponds to cases where there is a perfect correlation between the two variables. This diagonal captures 37.7% of the corpus—140 manuscripts—and no other linear combination of five boxes results in a similarly high value. Conversely, the opposite diagonal series—where cases of maximum dissociation between holes and *lisières* are situated—captures only 12.9% of the total, equating to 50 manuscripts.[53]

The 'correlation diagonal'—taken as a reference point and excluded—divides the table into two opposing triangles, with the upper representing the evolution of holes in relation to *lisières,* and the lower representing the

53 The second diagonal does not possess the same discriminating power of the first, since it is not exclusively composed of homothetic cases; one notes, among other things, that the central box is shared by the two diagonals. It should also be pointed out that the highest value of all of any combination of five boxes (bold figures in the table) is symmetrically concentrated at the extreme limits of the table, in proximity to the correlation diagonal.

evolution of *lisières* in relation to holes. The two triangles equate to 33.7% and 32% of the total, respectively. This result provides us with the definitive answer to our initial question: the evolution of holes and *lisières* can be considered symmetrical, which means that neither of the two phenomena received preferential treatment on the part of artisans when they were selecting skins to utilise in the making of manuscripts. Unfortunately, as soon as data relating to holes and *lisières* are registered separately, it is impossible to examine in detail the attitude adopted by the artisans towards bifolia which presented with both *lisières* and holes simultaneously.

4 Parchment's thickness

Given that parchment is naturally a rather uneven material, its thickness can be subject to considerable variations. For this reason, in order to obtain a reliable estimate, it is necessary to calculate the average thickness value of a large number of spot measurements, instead of relying on a single spot value. Therefore, for each manuscript, the thickness of the parchment in all the constituent bifolia of three complete quires was ascertained by measuring each of them at ten different points scattered along its four sides.

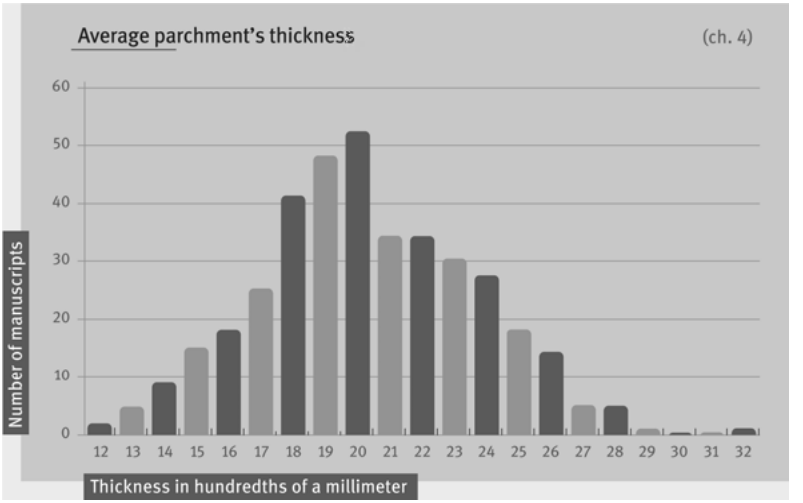


Chart 4: Average parchment's thickness

The 4,632 bifolia measured (for a total of 46,320 points), when taken as a whole, yielded an average overall parchment thickness value of 20.80 hundredths of a millimetre. Needless to say, this average value conceals considerable variations, even if extreme values do not occur very often: in fact, the minimum thickness determined in the corpus was 11.98 hundredths of a millimetre, while the maximum value was found to be 36.55 hundredths of a millimetre.[54]

Chart 4—where average thickness is calculated for all the bifolia contained in the three quires measured for each manuscript volume—shows that the distribution is relatively symmetrical and presents a single peak between 20 and 21 hundredths of a millimetre.

Research carried out to determine systematic factors capable of influencing in a consistent way choices made by the craftsmen in relation to parchment thickness proved entirely fruitless, as documented in the breakdown of typologies investigated (Tab. 23).

It is clear that parchment thickness is entirely unaffected by chronological and geographical divisions. On the other hand, the absence of variations attributable to the content and quality of the codex[55] suggests that the thickness of skins did not constitute a discriminating criterion in the fabrication of codices of different types and qualities, and that, as a result, a differentiated supply (i.e. a range of quality grades) did not exist.

54 These absolute values can usefully be compared with those relating to other groups of manuscripts: 11th-century Greek and Latin volumes of Italian origin (average thickness 22.7, with values ranging from 14.2 to 32); 14th- and 15th-century Latin volumes of Italian origin, 18.16 and 18.47, respectively see Bianchi et al. 1993b, 390, and Bianchi et al. 1993a, 109.

55 In actual fact, there is no significant difference in the thicknesses also when the size of the codices varies. However, we forwent looking further into this problematical issue, given that it lies behind the relationship–far from being clarified–between the dimensions of bifolia, skin sizes and animal species.

Distribution of thickness according to textual typology, presence of gold, defects, origin, century (tab. 23)

	Average
Ascetic	19.32
Bible	21.81
Biblical	20.62
Hagiography	20.69
Homiletical	20.34
Liturgical	20.91
Patristic	20.35
Secular	21.37
Theology	22.08
11th c.	20.81
12th c.	20.79
Italo-Greek	21.24
Others	20.68
MSS without gold	20.84
MSS with gold	20.74
0 defects[56]	20.38
>25% defects	20.89

Tab. 23: Distribution of thickness according to textual typology, presence of gold, defects, origin, century

The wide range of thicknesses borne witness to in the manuscripts should not exclude, at the outset, the existence of a certain degree of skin selection based on thickness within each manuscript volume. However, if, on the part of the artisans, there existed any desire to select (from time to time) batches of skins of

56 The 'blanket' definition 'defects' refers to the percentage of bifolia presenting with holes and/or *lisières* in relation to the total number of bifolia. The two classes included in the table correspond to the extremes of the distribution, represented, respectively, by 39 and 58 manuscripts. The absence of significant differences exempts us from presenting the data relating to the codices affected by an intermediate percentage of defects.

equal thickness, the average variation[57] in thickness of the inner bifolia of each manuscript should prove to be significantly smaller than the overall variation in thickness observed throughout the entire corpus. On the contrary, the variation turns out to be almost identical in both cases.[58] One can therefore deduce that the artisans, as a rule, were not able to acquire batches of skins of uniform and predetermined thickness. It should be recalled, in this regard, that the same test produced completely different results for two groups of typologically homogeneous[59] Latin late medieval codices, a period and context in which it is reasonable to suppose that parchment was marketed in a different and quite likely more highly developed way.

Based on these findings, it would be a mistake to suppose that on the part of artisans there was a total indifference to the thickness of the parchment they used. That this was clearly not the case can be gleaned from the results of a second test conducted on the variations in thickness of individual manuscripts and individual quires—indeed, the average variance in the latter is significantly smaller.[60] The very clear result of the test is explained only in part by the fact that bifolia belonging to one and the same quire can originate from the cutting up—in-quarto or in-sexto—of only two skins, and implies, on the part of the artisans, a desire to achieve uniform thickness. This provides confirmation of the fact that the organisation of a codex into quires was not a purely material operation aimed at structuring a volume based on its writing, reading and future storage. In fact, in addition to this primary function—as already ascertained in relation to defects in the support material—there were secondary aesthetic functions or motivations whose existence is not immediately perceptible (upon first inspection of a volume), and whose significance is not always easy to interpret with certainty.

If the preferential distribution of holes and *lisières* in certain bifolia of a quire can be accounted for by the desire to conceal imperfections from the eye

57 The variance–definable as the average of squared differences from the mean–is a measurement of the degree of variability (in other words, of the dispersion) of a distribution: see Blalock 1984^2, 114.

58 The average variance in the group of three quires examined in each manuscript volume is 21.97, whereas the overall variance within the corpus is 22.28.

59 The reference is to two corpora of codices of Italian origin–one composed of 14th-century law codices originating from Bologna, and the other composed of volumes of humanist inspiration prepared at Cesena for Malatesta Novello–analysed in Bianchi et al. 1993a.

60 The average variance is 21.97 for the manuscripts, and 16.87 for the quires. When one is not dealing with variances, but instead with *means of variances*, Student's *t*-test can be applied, which yields a result of 4.13, which is highly significant. The two Latin corpora mentioned in the previous footnote exhibit, largely speaking, the same characteristics.

of the reader, it is altogether less easy to identify the rationale behind another of the artisans' practices, the diffusion of which has already been well investigated in relation to Latin manuscripts,[61] namely the tendency to distribute bifolia within a quire according to parchment thickness. In this case, too, our corpus attests to a similar 'rule': average thickness varies in a systematic way when the bifolia are distributed according to the 'rank' they hold within a quire (Tab. 24):

Distribution of thickness according to the position of the bifolium within the quire (tab. 24)

	Average
Bifolium 1	21.14
Bifolium2	20.69
Bifolium 3	20.61
Bifolium 4	20.78

Tab. 24: Distribution of thickness according to the position of the bifolium within the quire

The external bifolium is thicker than the following three, among which no variation in thickness is observed. Even if the difference is fairly small, the sample is large enough to consider it statistically significant. The fact that the discrepancy, despite being significant, is quite small, clearly does not mean that it can be attributed to a greater sensitivity on the part of the artisans to even the slightest variations in thickness, but rather to the fact that the 'rule' identified was not strictly adhered to in the manufacture of all the codices.

5 Conclusions

The results presented in this study constitute a preliminary analysis of the parchments used in Byzantine codices and is aimed at fulfilling two different objectives: (a) the acquisition of a deeper knowledge of various aspects of a manufactured product whose material characteristics have received little attention; and (b) a comparison of artisanal practices employed in different contexts—in our case,

61 Bischoff 1991, 129 onwards; Bianchi et al. 1993a, 144 onwards.

Greek and Latin—with the aim of bringing to light similarities and differences, and of identifying, wherever possible, the reasons behind the same.

The first part of the investigation was aimed at outlining a distribution typology for various parchment characteristics—holes, *lisières* and defects—in relation to three fundamental elements—chronology, geographical origin and content—which define, as it were, the identity of every manuscript. In this way, the existence (primarily) of a close relationship between book and text (understood as container and contents) has emerged. Indeed, from the moment he selected his parchment support, a manuscript craftman's subsequent choices were all made taking into account the type of text the codex would ultimately contain, its function, and its targeted readership. If it has become clear—as was foreseeable—that in all the periods investigated the least defective parchment was reserved for the finest codices, at a more general level it has also come to light that when choosing his support a craftsman respected a rather clear qualitative hierarchy in relation to textual typologies: in particular, while the best parchment was reserved for codices bearing biblical content—sacred books *par excellence*—the poorest quality material was employed for the manufacture of volumes containing secular texts.

Adherence to a basic typological criterion has been identified as an underlying constant, and one which is not obscured by the emergence, with the passage of time, of a considerable qualitative difference between the output of the 11th and 12th centuries, to the disadvantage of the latter. Indeed, considered overall, the more recent manuscripts are those which suffer the most from material defects. It is interesting to note that a decline in the quality of the support affects, albeit it in a non-uniform way, the entire production—a reflection of a growing crisis which would eventually culminate, in 1204, with the seizure of Constantinople by the Latins.

Of the three supporting columns of the typological investigation—content, geographical context, and period of manufacture—beyond doubt the most problematic remains the place of origin. In fact, as has already been noted, Byzantine book production in the period under examination is resistant to attempts to define the relevant fundamental geographic coordinates. Nevertheless, it has in any event been possible to verify, through an investigation of the way in which defects were 'managed', the peculiar character of Italo-Greek production which, in addition to belonging to the qualitatively inferior group, presents remarkable shortcomings in relation to the range of technical solutions employed, which were generally less advanced and applied in a less consistent way.

Passing from typological choices to artisans' strategies, the analysis has demonstrated that Byzantine craftsmen—who were no less capable than their Latin 'colleagues' in this regard—were aware of and applied a series of expedient measures so as to mitigate (or mask) the presence of defects. Such expedients

suggest (in a far less rigidly structured production context than the Latin one) a remarkable level of technical knowledge and widely shared *savoir-faire*. In particular, the comparison of results previously obtained from sample groups of Latin codices has made it possible to identify the existence of a comparable awareness with regard to some fundamental aesthetic and functional standards, as well as some widely shared artisanal practices—albeit characterised by different modalities—such as limiting the number of holes appearing within the writing area, hiding holes and *lisières* in the inner bifolia of quires, and using thicker—and presumably more robust—bifolia in the outermost position. The task remains, in the sphere of comparative codicology, to determine the periods and contexts in which such practices were applied, and their possible correlation with shared traditions, or alternatively their spontaneous emergence as solutions to similar problems.

Finally, the considerable imbalance seen in the distribution of *lisières* along the three open edges of bifolia has further confirmed the reservations that have been expressed, in recent studies, in relation to the generalised application of the quire construction method hypothesised by Léon Gilissen twenty years ago. Direct examination of parchment leaves dating from 11th- and 12th-century Byzantine production reaffirms the existence of more complex—and above all, less uniform—methods of creating bifolia starting out from whole skins: methods determined primarily by the need to exploit in an optimal and well-thought-out way the available raw material.

References

Bianchi, Francesco et al. (1993a), 'Facteurs de variation de l'épaisseur du parchemin italien du VIIIe au XVe siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), II, 95–184 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 275–345).

Bianchi, Francesco et al. (1993b), 'La structure materielle du codex dans les principales aires culturelles de l'Italie du XIe siecle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), II, 363–456.

Bianchi, Francesco et al. (1994), 'Les manuscrits à cahiers mixtes (papier + parchemin)', in *Scriptorium*, 48, 2: 256–289.

Bischoff, Frank M. (1991), 'Pergamentdicke und Lagenordnung. Beobachtungen zur Herstellungstechnik Helmarshausener Evangeliare des 11. und 12. Jahrhunderts', in Rück, Peter (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Thorbecke, 97–144.

Bischoff, Frank M. (1993), 'Observations sur l'emploi de différentes qualités de parchemin dans les manuscrits médiévaux', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 57–94.

Bischoff, Frank M. (1994), 'Systematische Lagenbrüche: Kodikologische Untersuchungen zur Herstellung und zum Aufbau mittelalterlicher Evangeliare', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel, 12th–14th November, 1990, Marburg: Institut für Historische Hilfswissenschaften (Elementa diplomatica, 2), 83–110.

Bischoff, Frank M. / Maniaci, Marilena (1996), 'Pergamentgröße, Handschriftenformate, Lagenkonstruktion. Anmerkungen zur kodikologischen Forschung am Beispiel südeuropäischer Pergamente und Handschriften', in *Scrittura e civiltà*, 19: 277–319.

Blalock, Hubert M. (1984[2]), *Statistica per la ricerca sociale*, Bologna: Il Mulino.

Brown, Michelle P. (1991), 'Continental Symptoms in Insular Codicology: Historical Perspectives', in Rück, Peter (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Torbecke, 57–62.

Canart, Paul (1978), 'Le livre grec en Italie méridionale sous les règnes normand et souabe: aspects matériels et sociaux', in *Scrittura e civiltà*, 2: 103–162. (Italian translation in Cavallo, Guglielmo [ed.], *Libri e lettori nel mondo bizantino. Guida storica e critica*, Roma-Bari 1982, 103–153).

Canart, Paul / Perria, Lidia (1991), 'Les écritures livresques des XIe et XIIe siècles', in Harlfinger, Dieter / Prato, Giancarlo (eds), *Paleografia e codicologia greca.* Atti del II colloquio internazionale (Berlin-Wolfenbüttel, 17–21 ottobre 1983), with the collaboration of D'Agostino, Marco / Doda, Alberto, Alessandria: Edizioni dell'Orso (Biblioteca di Scrittura e civiltà, 3), 67–118.

Casagrande Mazzoli, Maria Antonietta / Ornato, Ezio (1999), 'Elementi per la tipologia del manoscritto quattrocentesco dell'Italia settentrionale', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 207–287.

Dennis, Rodney G. (1993), 'Notes concerning "le pliage"', in *Scriptorium*, 47: 166–173.

Foti, Maria Bianca (1989), *Il monastero del S.mo Salvatore "in lingua Phari". Proposte scrittorie e coscienza culturale*, Messina.

Gilissen, Léon (1977), *Prolégomènes à la codicologie*, *Recherches sur la construction des cahiers et la mise en page des manuscrits médiévaux*, Gand: Éditions scientifiques Story-Scientia, 14–122.

Hunger, Herbert (1954), 'Die Perlschrift, eine Stilrichtung der griechischen Buchschrift des 11. Jahrhunderts', in Hunger, Herbert (ed.), *Studien zur griechischen Paläographie,* Wien: Hollinek (Biblosschriften, 5), 22–32, reprinted in Hunger, Herbert, *Byzantinische Grundlagenforschung,* London: Variorum Reprints.

Maniaci, Marilena (1999), 'Suddivisione delle pelli e allestimento dei fascicoli nel manoscritto bizantino', in *Quinio. International Journal on the History and Conservation of the Book*, 1: 83–122.

*Maniaci, Marilena (2000), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino, Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, [Milano]: Centro Tribaldi, 47–60.

Maniaci, Marilena (2002), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Maniaci, Marilena / Ornato, Ezio (1993), 'Che fare del proprio corpus? I. Costituzione e descrizione di una popolazione di libri a fini statistici', in *Gazette du livre médiéval*, 22: 27–37 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 67–75).

Prato, Giancarlo (1984), 'La presentazione del testo nei manoscritti tardobizantini', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 69–84.

Rück, Peter (1991) (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Thorbecke.

Sautel, Jacques-Hubert (1995), *Répertoire de réglures dans les manuscrits grecs su parchemin. Base de données établie par Jacques-Hubert Sautel à l'aide du fichier Leroy et des catalogues récentes*, Turnhout: Brepols (Bibliologia, 13).

Ezio Ornato

Watermarks Galore. Observations on the Number and Homogeneity of Papers Used in Manuscripts and Incunabula

It is common knowledge that all sheets of paper made by hand bear—on their left- or right-hand side—a watermark, which, from the 14th century onwards, was considered a trademark.[1] When sheets are folded to form an individual quire and a group of quires then assembled into a manuscript or a printed book, the position and integrity of the visible watermark will vary depending on the book's format. Accordingly, the entire watermark appears in half of the leaves of an in-folio manuscript, whereas it is divided in two by the quire's fold in half of the leaves of an in-quarto manuscript, and divided into four in one of the inside corners of half of the leaves of an in-octavo manuscript, and so on. Consequently, if N_f equals the number of leaves, the total number of whole watermarks appearing in books will be, respectively, $N_f/2$, $N_f/4$, $N_f/8$.

That being said, one can go on to pose a very simple question: how many *different* watermarks might one expect to find in a book? This question, which ostensibly seems simple enough, is actually rather ambiguous. What is meant, exactly, by the phrase 'different watermark'? The differences one meets with can be broken down into three essential types:

– The motifs encountered represent different objects (*scales*, *ox head*, etc.).
– The motif represents one and the same object, but the designs show obvious morphological differences (e.g. *scales* with round or triangular trays;

Translated from the French into English by Mark Livesey. Original published as Ornato, Ezio (2014), 'Filigranes à gogo. Observations sur le nombre et l'homogénéité des papiers employés dans les manuscrits et les incunables', in *Gazette du livre médiéval*, 60: 54–82.

A highly abridged and simplified version of the present work was published under the title *Si les filigranes m'étaient comptés… Les statistiques au service de l'histoire du livre et du papier* (Ornato 2012, 2013).

1 In his treatise *De insignis et armis*, the jurist Bartolus de Sassoferrato mentions the existence and function of the watermark: 'Et, ut vidimus, quodlibet folium carte suum habet signum propter quod significatur cuius edificii est carta. Dico ergo, quod isto casu apud illum remanebit signum in quo fit, sive iure proprietatis sive iure conductionis, sive quovis alio titolo…'. This text is often quoted by paper historians: see Rückert 2006, 10–11.

https://doi.org/10.1515/9783110743838-006

an unadorned *ox head*, or alternatively one wearing a *crown*; a plain *anchor*, or alternatively one contained within a circle, etc.). Therefore, from hereon in we shall speak of *types* to designate the categories that each design can be placed in.

– Watermarks of one and the same type are very similar, but they are not positioned on the same half of the paper sheet, and/or they are orientated differently (e.g. a *pot* with a handle turned towards the centre rather than towards the edge of the sheet), and/or they present minor differences of either a morphological or dimensional kind. In such cases, we can speak of *variants*.

Unfortunately, in the first two cases it is practically impossible to ascertain the original place of origin of sheets, and to know, in particular, whether or not they are all the product of the same paper mill: it is known, in fact, that one and the same mill could simultaneously produce sheets marked with different motifs (for quality differentiation purposes),[2] and that, conversely, two different paper mills could manufacture sheets bearing the same motif, but enhanced with differences in accessory elements so as to totally eliminate the possibility of counterfeiting.

In the third case, one is often, but not always, dealing with 'twin watermarks'. The optimisation of work cycles in paper mills involved the contemporaneous use of two moulds in the same vat of paper pulp. Twin watermarks, positioned on different halves of the two moulds, are never identical, so one can easily distinguish the difference between them. Given that the sheets produced by the two moulds were immediately added to the same heap—the so-called *post*—it follows that an entire document will normally contain at least two twin watermarks, provided that it is composed of a sufficient number of leaves.[3] However, in reality the situation is a little more complicated, since not infrequently, and above all in printed books, one can encounter multiple variants closely mixed together within one and the same document,

2 This function is stipulated as an obligation in the Bologna Ordinance of 1398, so as to make it possible to distinguish premium quality paper from second-rate product (known as *fioretto*) and wrapping paper. For the published text, see Gasparinetti 1963; for a critical analysis, see Ornato et al. 2001.

3 When there are more than ten leaves—which is to say five paper sheets in an in-folio folding—the probability that one of the twins will be missing does not exceed 1/32, which is to say approximately 3%. This estimate is not valid if the twins are randomly distributed in the paper stock. In actual fact, this is not true: cases in which the same twin appears more than once in a row occur more often than the law of probabilities predicts (see Bozzolo / Ornato 1980, 135–145).

and it is impossible to match them up without running the risk of making an error. One can nevertheless establish that the variants always originated from the same paper mill, whatever their place of origin might be.

Given the existence of some doubtful factors, for now it makes sense to simplify matters by assigning to the term 'different' its more widely understood and strictly visual connotation, without considering the nature of the differences observed and, above all, the historic substratum underlying them.

Now, if we pose the question 'How many different watermarks might we expect to find in a book?' to two different researchers—one who regularly examines manuscripts, the other incunabula—we will certainly be surprised by their respective answers. The first will complain of a paucity of watermarks, whereas the second will speak of an abundance of them. However, it is highly likely that both will express reservations about the pertinence of such a question, and will tend to limit the field of inquiry to that which they are most familiar with, namely the dating of written documents through watermarks. It is well known, in fact, that the dating of a document is far more accurate and reliable when it contains numerous watermarks. Yet the question posed is far from irrelevant to paper historians, since it relates to the composition of paper stocks and, indirectly, to the structure of markets.

1 Measuring the heterogeneity of paper stocks

First of all, can one place one's trust in two manifestly subjective and contrary points of view? The answer is yes, but at the same time, no. Yes, if one is prepared to settle for a rough estimation based on a concrete experience; no, if one wishes to understand the significance of any potential differences, and above all to explain the reasons lying behind them. It is plain to see that in the latter case a complete answer, prompted by the question posed, can only be arrived at by means of a systematic and quantitative approach. Here, the term 'systematic' is intended to mean the opposite of 'anecdotal' (i.e. limited to single cases). In fact, one cannot content oneself by simply tallying up the number of watermarks observed in a few books and pronounce the outcome as the result of a count. The term 'quantitative' means that one has to provide a quantified synthesis of the results in statistical terms that makes it possible to arrive at a reliable conclusion. Now, even when the statistical concept is reduced to its simplest terms, this type of approach is not lacking in problems. The term 'statistic' means calculation, and calculation means measurement, in the broadest sense of the word. Therefore, one has to establish whether or

not a simple count is the best measuring system for making a tally of the different watermarks present in a document and, if not, whether it can be replaced by another indicator.

In statistical terms, one can consider a document, whether it be handwritten or printed, as a sample drawn from a larger population of paper. It is therefore admissible to state in advance that, tendentially, a document that contains more different watermarks than the population from which it is drawn—i.e. the paper stock—is qualitatively heterogeneous. Intuitively, one can equally suppose that the number of watermarks detected will depend on the size of the sample, which is to say the number of paper sheets contained in the document. Can one likewise affirm that, the size of the sample being the same, the number of watermarks detected in it will depend on the size of the paper stock? If one is speaking of a direct influence, the answer is negative, but one can nonetheless state that a large stock of paper has a greater chance of being heterogeneous.

In addition, if the number of watermarks detected in a document depends on the number of paper sheets it contains, we need a unit of measurement which is independent of that parameter and makes it possible to compare documents of different 'thicknesses': so one automatically thinks of the relationship between the number of different watermarks revealed and the number of paper sheets in a document, which is to say the percentage of different watermarks, a figure that should provide a *heterogeneity index* for the stock. The maximum value of such an index is obviously 100, a figure which would indicate that all the watermarks in the document are different. Unfortunately, as we shall see, it is necessary to raise some questions about the operational character of the said index.

Now that the theoretical aspects of the problem have been defined in a fairly concise way, we must ask ourselves whether, in practice, we are really able to provide an answer to our question by means of systematic investigations. The answer depends on the existence of repertories that provide a census of all the watermarks contained in a corpus of documents and which at the same time furnish the necessary elements that will enable one to determine the number of paper sheets, the format and the number of leaves in each document. Happily, such repertories exist, because on the one hand Martin Wittek has carried out a census of all the watermarks appearing in dated manuscripts held in the Royal Belgium Library (this repertory has been sys-

tematically perused, and the information entered into a spreadsheet),[4] whilst on the other we have available to us on the Internet a complete repertory of the watermarks contained in incunabula produced in the Middle Ages in the Low Countries.[5] In both cases, information on the format and number of leaves in individual documents is readily accessible to researchers.

Does the number of watermarks increase with the number of sheets contained in a book? Tab. 1, which concerns manuscripts, reveals that this is indeed the case (Tab. 1):

Manuscripts – Number of watermarks surveyed in relation to number of sheets (tab. 1)

Format	Number of paper sheets			
	1–25	26–50	51–75	>75
In-folio	3	7	9	14
In-4°	3	6	(nd)	(nd)

Tab. 1: Manuscripts – Number of watermarks surveyed in relation to number of sheets

This result is not altogether surprising: if a ream of paper contains *N* different watermarks, the probability of seeing them appear at least once increases with the number of sheets used to make a book. Not surprisingly, one also observes that the result is the same for both of the formats most frequently employed.

Conversely, one finds (Tab. 2) that the heterogeneity index of the stock tends to decrease, which seems to contradict the previous result:

4 Wittek 2003–2006. This repertory contains 1,183 reproductions (tracings). The systematic perusal was carried out by Anne Tournieroux within the framework of the European programme denominated 'Bernstein' (2003–2006), which culminated in the integration of four databases now available on the Internet (http://www.memoryofpaper:eu8080/Bernstein Portal/appl_start.disp). Last access 20/06/2020.

5 *Watermarks in Incunabula Printed in the Low Countries (WILC)*: http://watermark.kb.nl/index.html (last access 20/06/2020). This repertory, created by Gerard van Thienen, contains more than 16,000 reproductions of watermarks (radiographs and rubbings) which are not all different, since the same watermark can appear in more than one edition.

Manuscripts – Heterogeneity index in relation to number of sheets (tab. 2)

Format	Number of paper sheets			
	1–25	26–50	51–75	>75
In-folio	41.24	15.03	11.38	7.15
In-4°	32.13	16.16	(nd)	(nd)

Tab. 2: Manuscripts – Heterogeneity index in relation to number of sheets

The percentage of different watermarks, which exceeds 40% in the thinnest in-folio volumes, is no more than 7% in the thickest ones.[6] This is only an ostensible paradox, since if a stock of paper contains *N* different watermarks, once all those watermarks have appeared once, any introduction of a new sheet into the sample will not result in the introduction of a new watermark. Thus, the number of sheets in a document always increases faster than the number of new watermarks it contains, on condition, that is, that all the watermarks in the original stock of paper are different. In fact, statistical laws show that if a stock of paper contains four different watermarks in equal numbers, it will suffice to draw sixteen sheets in order for the observer to be certain of seeing all four watermarks emerge.[7] In such circumstances, if a book extracted from that stock is composed of fifty, or better yet one hundred sheets, the number of watermarks will never exceed four, and the percentage of different watermarks can only decrease.

In fact, this result makes it impossible to use the paper stock heterogeneity index as a universal estimation tool, because the comparisons are only reliable for volumes in which the number of sheets is more or less equal. For example, we notice that, within the same stock of completely homogeneous paper that contains only two twin watermarks, the index ranges from 20% for a volume that comprises ten sheets, to just 2% for a volume which comprises one hun-

6 In the latter case, one is necessarily dealing with in-folio volumes, because there are too few in-quarto volumes in which the thickness exceeds 75 sheets: indeed, such a volume would have to be composed of more than 300 leaves.

7 To obtain this result, it is sufficient to calculate the probability of one watermark represented at a rate of 25% in a stock of paper never appearing in a sample of sixteen sheets. Binomial law tells us that that this probability is 1%; given that the stock contains four watermarks, the probability that at least one of them will not appear is 4%.

dred. It is plain to see that this index is just as biased as a full count of watermarks, and does not furnish any new information.

Actually, it would seem that there is no clear answer to the question 'How many different watermarks are there?' which is valid both in the general sense and in operational practice; indeed, all comparisons made between two documents of different thicknesses must necessarily be viewed with caution. Equally, we can see that, even if it were not biased, our index proves itself to be rather crude—as a matter of fact, it does not inform us on the degree of uniformity of the mixture of sheets. Indeed, one and the same result can conceal some very different situations: the frequency of the appearance of watermarks can be roughly the same or, conversely, one watermark might be massively represented whilst others only appear sporadically. Furthermore, we are no better informed on how 'close-knit' the mixture is: on the one hand, the same watermark can appear on a succession of consecutive sheets, but on the other changes might occur according to a sustained rhythm.

Estimates that take into account the various situations can certainly be envisaged, but they will run afoul of the fact that the requisite variables—the number of occurrences of each watermark, and the distribution of watermarks throughout the document—cannot be calculated by starting out from the data present in the specialised repertories. One should not, of course, blame their authors: it is not difficult to grasp how such surveys—which require a not negligible amount of additional work to compile—can be adjudged useless when the goal is to reproduce the greatest number possible of different watermarks. In fact, this process can only be put to work in targeted investigations.

Incunabula – Number of watermarks surveyed in relation to number of sheets (tab. 3)

Format	Number of paper sheets			
	1–25	26–50	51–75	>75
In-folio	6	13	19	28
In-4°	6	14	18	19

Tab. 3: Incunabula – Number of watermarks surveyed in relation to number of sheets

Whatever the case may be, the same tendencies are observed in the corpus of incunabula of the Low Countries whose watermarks have been censused in *WILC* (Tab. 3 and 4). The tendencies are the same, but they are revealed on a different level. In addition, the highly divergent subjective estimates concerning the manuscripts and printed books are confirmed by statistical analysis: for books of the same thickness, roughly two times fewer watermarks are found for the manuscripts than for the incunabula:

Incunabula – Percentage of watermarks surveyed in relation to number of sheets (tab. 4)

Format	Number of paper sheets			
	1–25	26–50	51–75	>75
In-folio	47.60%	35.07%	30.79%	20.29%
In-4°	70.98%	40.55%	29.39%	19.21%

Tab. 4: Incunabula –Percentage of watermarks surveyed in relation to number of sheets

Now that the difference between manuscripts and printed books has been confirmed, it seems only natural to ask what the reason behind it is, and to what extent it is representative of the composition of paper stocks.

If one disregards the reproduction technique, the manuscript document (book, register, etc.) and the incunabulum are two objects composed of bifolia assembled into quires, with clusters of such quires then being assembled into a book by means of a sewing process. From a structural point of view, they are similar objects in all ways; indeed, in both cases one is speaking of a *codex*. Even so, appearances can be deceptive, and where paper sheets are concerned, the difference is enormous.

By way of illustration, we can consider on the one hand an in-folio manuscript composed of 200 leaves—which is to say 100 sheets of paper (with the presumption that all the paper was purchased in one transaction)—and on the other hand a printed volume of the same format and with the same number of leaves, representing one copy of an edition of 500. In the hypothetical manuscript, any one of its constituent bifolia can be considered a sample which represents 1/500 of the ream of 500 sheets from which it was drawn. In turn, a bifolium in a quire of the hypothetical manuscript represents a 1/500 of the *same* ream, and so forth, so that the entire manuscript ultimately represents 20% of a *single* ream composed of 500 sheets.

In the hypothetical incunabulum, a bifolium always represents 1/500 of the ream. However, since our imaginary edition is composed of 500 copies, the immediately successive bifolium of the same quire represents 1/500 of a *second* ream, and so on, so that the total of 100 bifolia examined represents 0.2% of 100 reams, which is to say 50,000 sheets of paper. Therefore, each sheet of paper that forms the volume represents the tip of an iceberg, because in relative terms it is as small as the edition is large. Under these conditions, it should come as no surprise that in a less concentrated sampling a consistently larger number of different watermarks appears.

2 The composition of paper stocks: appearances and reality

Confronted with the disparity seen between the two types of document, can one argue, *ipso facto*, that the paper stocks used in the making of the manuscripts were more homogenous than those used to make the incunabula? Certainly not: such a hypothesis is quite simply not verifiable. Its verification is hindered by the fact that a manuscript document represents a *sequential* drawing of sheets from a *small* portion of stock, whilst an incunabulum is the product of a *systematic* drawing of sheets from a large portion of stock which, due to the fact that the printed sheets were not assembled into a volume strictly in accordance with the order in which they were drawn from the stock itself, can in practice equate to a random drawing of sheets.[8] Therefore, in the imaginary example described above, it will be sufficient for the paper stock to be composed of reams of strictly homogeneous content, with each ream carrying a different watermark, for our manuscript composed of 100 sheets to contain only one pair of twin watermarks, whilst all the sheets of the incunabulum, issuing from the same stock, should bear different watermarks. Consequently, all we can affirm is that the stocks of paper consumed in the manufacture incunabula were very far from being homogeneous.

That being said, from a historical perspective, it is legitimate to suppose that, prior to the rise of printing, small stocks of paper sold retail by a *cartolaio* ('paper merchant') were intrinsically more homogeneous than they were later on when massive stocks were purchased by wholesalers from paper mills and

8 In other words, in the theoretical case under consideration, the sheet marked *a1* is the first of the first ream, with no guarantee that the sheet marked *a2* represents the first of the second ream.

subsequently resold to printers, because in the absence of the ravenous monster that the printing industry represented, the market was undoubtedly much less open and the supply sources more concentrated. Nevertheless, precisely towards the end of the 15th century, when the consumption of paper had greatly increased, the number of watermarks one can detect in manuscripts and chancery registers is still rather low, and so the quandary remains: one cannot be sure whether this dearth can be accounted for by a greater homogeneity of stocks, or by the sampling characteristics that hinder carrying out a deeper analysis.[9]

If one is prepared to trust the data presented in the repertories, a printed volume contains, on average, two times more watermarks than a manuscript volume of the same thickness. However, this observation is a little too simplistic, because the term 'volume', although being formally correct in both cases, does not reflect the same reality. Here, a concrete example provides proof that the situation is rather more complicated than one might first imagine. In 1481, the printer Johann von Paderborn[10] published in Louvain an in-folio volume composed of 132 leaves containing the treatise *Epitoma primae partis Dialogi de haereticis a Guilielmo de Ockam compositi*, compiled by Henri de Zoemeren, of which there are today 50 surviving copies (*ISTC*: ih00053000). The watermarks in this edition have been thoroughly surveyed and reproduced in *WILC*, but if one consults another repertory—Piccard on line (*POL*), which collects the reproductions made by the paper historian Gerhard Piccard[11]—one can see that certain watermarks originate from somewhere other than the 1481 edition.[12] *WILC* inventories

9 This problem is far from being of little importance, because if the stocks were of different types, the existence of separate markets could quite reasonably be postulated, and by extension also that of different manufacturing standards in relation to the expected use.

10 Also called Johannes de Westphalia in repertories of incunabula.

11 This database, which contains more than 90,000 watermark reproductions, the majority of which are different, is not a simple duplication of the printed repertory (Piccard 1961–1997, 23 tomes collected in 17 volumes). On the one hand, the latter is not complete, whilst on the other it is not possible to establish a term-to-term correspondence between the two repertories, on account of the identification system being different (and parallel). Recently, *POL* has been merged with a much larger catalogue: *WZIS* (*Wasserzeichen—Informationssystem*: http://www.wasserzeichen-online.de/wzis/; last access 07/09/2021), which also contains a census of watermarks originating from a certain number of German libraries. Today, the number of watermarks reproduced in this new database totals 103,033.

12 Entered in Piccard's card index as 'Joh. De Westphalia 1481' and/or by the shelf number of the copy held in Stuttgart's Landesbibliothek: 8435.

29 different watermarks, and *POL* 30.[13] In strictly quantitative terms, the concordance between the two sources is excellent and the heterogeneity index of the stock (45%, as opposed to 31% for volumes of the same thickness) seems to be quite remarkable for an incunabulum composed of 66 paper sheets.

However, we are in for a bit of a surprise, because when one superimposes the images originating from the two watermark repertories, one notices that this pleasing concordance vanishes. To be sure, the list of motifs remains precisely the same: the letter *C*,[14] the letter *Y*, the letter *P*, the *pot*, the *crown*, the *wheel*, and *heraldic coats of arms*, and one can say the same of the types, with one exception,[15] but as soon as one 'drills down' to the level of variants, one notices that there are only 14 watermarks shared by the two sources; 16 watermarks do not appear in the *POL* catalogue, and 15 are not found in *WILC*.[16]

Is it the case, then, that the authors of the repertories were rather careless when it came to making reproductions of the watermarks? This hypothesis is certainly plausible: quite simply, it turns out that the copies examined were not the same, since one is kept in The Hague, and the other in Stuttgart. If one considers the total number of watermarks in one and/or the other copy, the number of variants reaches 45, and the disparity between the printed volume and manuscript increases by a considerable amount. This result is particularly impressive, but at the same time it serves to underline the futility of drawing a comparison between objects when the processes used to generate them have nothing in common: in one case a unique example, and in the other a vast ensemble composed of many hundreds of examples. What is important is the fact that the examination of a single copy is far from providing an exhaustive panorama of the paper stock used to manufacture an entire edition. It is this aspect of the problem that we shall examine in greater depth from now on.

13 In fact, *POL* provides 50 reproductions drawn from this incunabulum, in which about twenty are in all likelihood duplicates.

14 Classed as the letter *D* in *POL*.

15 KB1721: a heraldic *coat of arms* containing a *fleur-de-lis surmounted by a cross*.

16 These numbers are necessarily somewhat subjective; in fact, when the watermarks are not definitively identified, it is not always possible to know whether one is dealing with different objects, or deformed versions of the same object.

3 The paper stock used in two Venetian editions

If the examination of a second copy implies a not inconsiderable enrichment of the watermarks surveyed, it is only reasonable to ask what would happen if the examination were carried out on a greater number of copies. Unfortunately, there are no other surveys of the Johann von Paderborn edition available to us. Nevertheless, we can still attempt to answer the question thanks to a specific investigation carried out 15 years ago on two editions, as part of the research project *Progetto Carta*[17] (the results of which have never been published).[18] The project consisted in surveying all the watermarks present in multiple copies of two incunabula published in Venice:[19]

BOCCACCIO, Giovanni, *Genealogiae decorum; De montibus, silvis, fontibus, lacubus, fluminibus, stagnis seupaludibus, de noniminibus maris*. Venice: Bonetus Locatellus for Octavianus Scotus, February 23rd, 1495 (*ISTC*: ib00753000). Six copies examined.

APULEIUS MADAURENSIS, Lucius. *Opera*. Ed: Johannes Andreas, Bishop of Aleria. Venice: Philippus Pincius, April 30th, 1495 (*ISTC*: ac00936000). Eight copies examined.

The two editions are in-folio format. The first is composed of 162 leaves, the second of 118. Since the volumes are in-folio, it follows that the printing of each volume required, respectively, 81 and 59 sheets of *reçute* or 'chancery' format paper, which was by far the most common size used throughout Eu-

17 Concerning this work, which was carried out under the aegis of Carlo Federici, the former director of the Istituto centrale per la patologia del libro (now known as the Istituto Centrale per il restauro e la conservazione del patrimonio archivistico e librario), see Ornato et al. 2001.

18 An anticipated second publication, focused this time on the watermark-related aspects of the research project, foresaw further collaboration with the abovementioned institute, but sadly never materialised due to the unforeseen premature departure of its director. The data harvested from the edition of Boccaccio cited below were nevertheless used in a different perspective: (a) the validation of instrumental measurements (thickness, whiteness) carried out within the framework of *Progetto Carta* (could it be that the variability of the results, inevitably linked to states of preservation, more or less positively in relation to the history of each copy, compromises the measurements carried out on individual specimens? [see Ornato et al. 2001, II, 3–38]); and (b) an investigation of the systematic reduction of the whiteness observed in the second half of the edition (Ornato et al. 2001, II, 255–259).

19 The survey was carried out by Paola Franca Munafò and Maria Speranza Storace.

rope. A copy of the edition of Boccaccio is therefore approximately 28% thicker than a copy of the work by Apuleius.

This observation is not sufficient to evaluate the thickness of the entire stock used for the printing, as this feature depends not only on the number of sheets in an edition, but also on the number of copies printed, that is to say the overall edition. Now, the latter datum remains unknown for almost all editions dating from this period. Nevertheless, we are not completely helpless when faced with a lack of this information. The two international repertories of incunabula—the *Incunabula Short Title Catalogue* (*ISTC*), and the *Gesamtkatalog der Wiegendrucke* (*GW*)—in effect provide the most complete list possible of the surviving copies.[20] Accordingly, one can count 215 conserved copies of the edition of Boccaccio, and 103 of the work by Apuleius.[21] In both cases, the numbers are very high, but the disparity observed between our two editions—a twofold difference—is too great to be the product of mere chance. Given that the two volumes were most likely targeted at the same readership, and that this factor to a large extent influenced the survival rate of the copies,[22] it is quite reasonable to suppose that the disparity observed reflects a significant difference in the number of copies printed of each edition, in a ratio of about two to one in favour of Boccaccio's work. As the edition of Boccaccio contains a greater number of leaves, the relationship between the thickness of the paper stocks should in fact be approximately 2.75/1.

Given that the paper stock used for the printing of the Boccaccio is much thicker, one would expect to find a greater number of different watermarks in it than in the edition of Apuleius. However, precisely the opposite turns out to be the case (Tab. 5).

20 The two catalogues can be consulted online (http://www.bl.uk/catalogues/istc/index.html; http://www.gesamtkatalogderwiegendrucke.de/; last access 07/09/2021).

21 The number of surviving copies is probably not definitive. However, the possible future discovery of a few more copies which have not been surveyed up till now would not change the situation in a significant way.

22 Within the framework of the present contribution, it would take too long to examine in-depth the question of edition numbers and the survival of copies. For a list of editions for which the original number of copies is known, see Neddermeyer 1998, II, 753–762; for a diachronic overview of average edition numbers, see Neddermeyer 1996; for some more recent insights, see Ornato 2012, 178–187.

23 Although the examination of the edition of Apuleius was carried out on eight copies, the figures presented in the table relate to the first six, and therefore allow for an immediate comparison with the edition of Boccaccio.

Number of motifs, types and variants in six copies of editions of Boccaccio and Apuleius[23] (tab. 5)

Watermark	Boccaccio	Apuleius
Motifs	5	7
Types	14	29
Variants	39	101

Tab. 5: Number of motifs, types and variants in six copies of editions of Boccaccio and Apuleius

Overall, the paper stock used for the printing of the Apuleius is 2.7 times more varied than the stock used to print the Boccaccio, even if, as we have seen, the stock used for the Apuleius is thinner. The greater heterogeneity of the paper stock in the edition of Apuleius manifests itself elsewhere at all levels: indeed, one counts 4.1 types per motif, as opposed to 2.8 in the edition of Boccaccio, and 3.5 variants per type, as opposed to 2.8.

Due to the rather particular characteristics of the paper making cycle, variants of one and the same type tended to be thoroughly mixed into all the stocks, because the watermarks originated from the same mill. Since the moulds were used in pairs, one should only count two variants per type: indeed, this is what one almost always observes in manuscripts. Conversely, in the incunabula one often encounters multiple variants of a type, because for a single stock of very important paper multiple pairs of moulds were produced which were used alternately or successively and could become muddled up over time.[24] Although the total number of variants is not without interest, if the aim is to evaluate the heterogeneity of the stock as a blend of papers of different origins, in the first place it is the melange of different types of watermark that we must pay attention to. Viewed from this standpoint, it is undeniable that the stock used for the Boccaccio printing is more homogeneous than that used for the Apuleius.

If one examines, sheet-by-sheet, the paper in six copies of the Boccaccio edition, one finds that, whilst not being entirely homogeneous, the succession of watermarks nevertheless exhibits a certain degree of consistency (Tab. 6).

24 The superabundance of variants of the same type in one paper stock cannot be accounted for by the presence of moulds used in two or more pulp vats at the same mill, because at the end of the 15th century paper mills were equipped with only one vat.

Edition of Boccaccio: distribution of watermark types within the volume (tab. 6)

Motif	Type	Quires a–g	h–o	p–u
Scales	A1	54	18	6
	A2	6	6	14
	A3	18	96	2
	A4	–	5	7
	A5	–	–	10
	A6	–	–	7
	A7	–	–	18
Crown	B1	51	–	–
Ox head	C1	37	1	4
Hat	D1	1	42	61
	D2	–	–	2
Bell	E1	–	–	18

Tab. 6: Edition of Boccaccio: distribution of watermark types within the volume

This is the case, above all, for the composition of the stock. In fact, one observes that certain types are massively represented in the 484 sheets examined (Tab. 6): the *scales A3* (116 occurrences, equating to 24%), the *hat D1* (103, equating to 21%), and the *scales A1* (78, equating to 16%). Thus, three types alone monopolise 60% of all occurrences. If one considers each copy taken alone, the *scales A3* presents in a minimum of 18 occurrences, and the *hat D1* 15. This situation is stable: the hierarchy among the types remains the same, irrespective of the copy examined. Additionally, 70 sheets of the 81 that constitute the edition, equating to 86% of the total, present with the same type of watermark in the six volumes examined. What is more, the 'invariable' sheets (or, stated more precisely, those carrying the same watermarks) often succeed one another without a continuity solution. It is worth noting that this is the case with the *hat D1* and *scales A3* types: the former appears in two

blocks, one of seven and the other of five consecutive sheets;[25] the latter in a block of four sheets and in two blocks of three.

In addition, with the exception of the *scales A2* (which is actually rather sparsely represented), one observes that none of the types is equally distributed throughout the volume: the *scales A1*, the *crown B1*, and the *ox head C1* appear above all in the first third, the *scales A3* in the second, and the *hat D1* in the second and third, with the other types surveyed only appearing in the third, which therefore presents the most varied configuration (twelve types are present, as opposed to six in the first part, and five in the central part). In essence, we can confirm that the stock used for the edition was composed of fairly homogeneous blocks that succeed one another in a more or less orderly progression. The homogeneity of blocks is seldom disrupted, since only eleven sheets are not 'invariable', and in this instance they never involve more than two types of watermark.

The picture that the edition of Apuleius provides us with is altogether different. The most represented type (*hat C1*) only registers 32 occurrences in total (at best seven per copy), equating to 10%, and in order to reach 60% of the total one has to add the occurrences of nine types, even if three suffice for the edition of Boccaccio. More than anything, though, it seems that the mixture of types within the stock is much more 'intimate' than in the edition of Boccaccio: the proportion of 'invariable' sheets in the six copies does not exceed 41% (as opposed to 86%), and in fifteen sheets, equating to 25%, one finds three or four different types of watermark (Tab. 7).

Edition of Apuleius. Distribution of watermark types within a volume (tab. 7)

Homogeneity	Occurrences	Percentage
Invariable sheets	24	41%
2 types per sheet	20	34%
3 types per sheet	6	10%
4 types per sheet	9	15%

Tab. 7: Edition of Apuleius. Distribution of watermark types within a volume

25 Sheets *n2-04* and *s2-t1*. Leaf *n2* is the second in the quire marked *n*, and so on, following the same pattern. Each volume is composed of quaternions.

The degree of heterogeneity is all the more remarkable given that, in the edition of Apuleius, the paper stock used to print one sheet represents, as we have seen, almost half that which was required to print one sheet of the Boccaccio. If we suppose that one sheet of the edition represents a sample of 600 to 1,000 paper sheets, the presence in one such sheet of three or four types of watermark in the six copies examined implies that the reams themselves contained more than one type of watermark, and therefore must have been 'reconstituted' at some point or another whilst *en route* from the paper mill to the producer, and ultimately to the consumer.

All the above having been said, just like in the edition of Boccaccio, the most represented types of watermark appear successively in a consistent way within each copy (Tab. 8).

Edition of Apuleius. Distribution of watermark types within a volume (tab. 8)

Motif	Type[26]	Quires a–g	h–n	o–t
Scales	A4	27	1	1
Hat	C1	20	12	0
Scales	A6	16	1	0
Scales	A2	15	1	1
Ox head	B2	14	0	0
Hat	C2	13	8	0
Scales	A5	11	0	0
Scales	A8	0	4	31
Ox head	B5	0	0	19
Scales	A3	0	0	18
Ox head	B1	0[27]	3	18

Tab. 8: Edition of Apuleius. Distribution of watermark types within a volume

26 These occurrences appear in an initial binion lacking a signature that contains the preface by Jean André, Bishop of Aleria and the editor of the text, which could have been printed last.

4 Watermarks galore

How reliable are the results, then? Put another way, to what extent can a survey carried out on just six copies provide a complete picture of the composition of a stock (i.e. motifs, type and variants) used to print hundreds of copies?

In the first place, one can measure the input of variants collected through the analysis of six copies compared to the data one would obtain if one were to settle for one or two copies (Tab. 9).

Number of variants surveyed in relation to the number of copies examined (tab. 9)

Edition	1 copy			2 copies			6 copies	Gain realised from 1 to 6 copies (%)		
	min.	max.	av.	min.	max.	av.	total	min.	max.	av.
Boccaccio	19	26	24	24	34	27	39	50%	105%	63%
Apuleius	37	42	40	58	67	62	101	140%	173%	153%

Tab. 9: Number of variants surveyed in relation to the number of copies examined

The average gain[28] (Tab. 9) is not negligible, but one can immediately see that it is much greater for the edition of Apuleius than for that of Boccaccio. Furthermore, Chart 1 shows that if one were to examine a greater number of copies, the number of variants would very likely continue to increase; this is the case for the edition of Apuleius in particular, where the addition of two new copies to the six already examined results in an increase of 20% of the number of variants already recorded.

Is it possible, then, to predict the extent to which the examination of additional copies might be worthwhile? In practice, the number of different watermarks found in a single copy can certainly provide a useful indication in

27 It goes without saying that these types are all different from those surveyed in the edition of Boccaccio, even if they bear the same names.

28 When one examines six copies, the average number of different watermarks per copy is obtained, quite obviously, by calculating the average for the six copies. The average number when one examines two copies is obtained by calculating all the pairs that can be made starting out from six copies (in this case 15, according to the general formula $N\,(N\text{-}10/2)$).

the first instance: the larger the stock, the more likely it is, in fact, that it will be heterogeneous.[29]

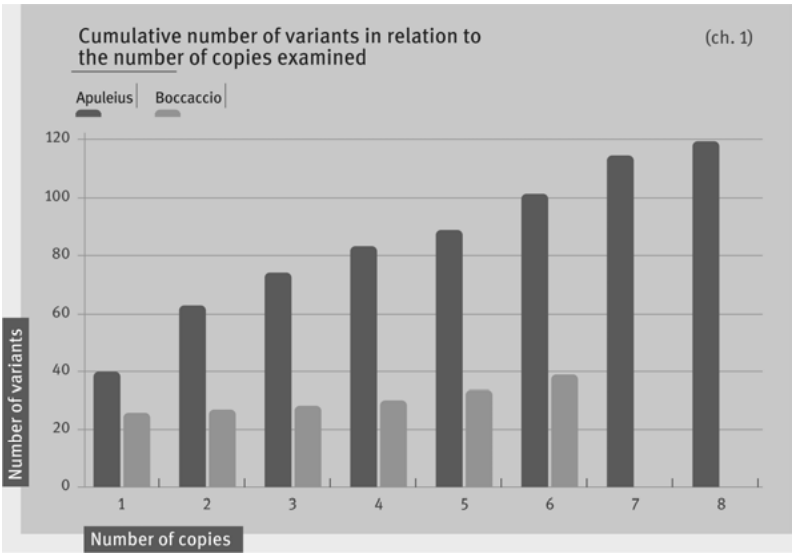


Chart 1: Cumulative number of variants in relation to the number of copies examined

Starting immediately from the first copy, one can see that the paper stock of the edition of Apuleius appears more varied that that used for the Boccaccio, and this remains the case when one examines the new copies. Nevertheless, the edition of Henri de Zoemeren discussed above (p. 158 ff.) contradicts what common sense would normally suggest: it carries more motifs (10) than the other two editions (Apuleius 7; Boccaccio 5), but considerably fewer types (10, as opposed to 29 and 14), and both of the two copies examined present 30 different variants, in contrast to 40 and 24 on average for the edition of Apuleius and that of Boccaccio respectively. Thus, one can see that, in absolute terms,

29 This is not so in theory: one can well imagine a volume composed of 100 sheets in an edition of 500—the printing of each sheet would thus require one ream of paper—where the paper of each ream would bear a different watermark, but the contents of each ream would be perfectly homogeneous. In this case, one would survey 100 different watermarks in one copy, but the gain made by examining other copies would be strictly nil.

the edition of Zoemeren finds its place between the two other editions, although it is closer to the that of Boccaccio than that of Apuleius.[30]

However, this situation changes when one considers two copies; indeed, the gain made when a second copy is examined is only 13% on average for the edition of Boccaccio, whereas it increases to 55% for that of Apuleius. For the edition of Zoemeren, the gain is 50%, a figure which is much closer to the Apuleius than to the Boccaccio. One can therefore reasonably assume that the examination of several copies of the Zoemeren would be more profitable in terms of the acquisition of new watermarks, whereas the same operation would be much less rewarding for the edition of Boccaccio.

In fact, the foreseeable gain can be estimated by measuring the degree of similarity between two copies. This can be calculated by using a simple formula[31] (Tab. 10): a weak resemblance presages a heterogeneous stock, and vice versa.

Coefficient of similarity between two copies[32] (tab. 10)

Editions	Resemblance coefficient between two copies		
	min.	max.	average
Boccaccio	47%	75%	64%
Apuleius	24%	43%	32%
Zoemeren			31%

Tab. 10: Coefficient of similarity between two copies

30 We note that the number of paper sheets is not very different in the three editions (Zoemeren: 66; Apuleius: 59; Boccaccio: 89). It follows that this parameter cannot exert an influence on the number of watermarks surveyed.

31 Statistical literature offers several formulae which make it possible to measure this kind of resemblance. For our purposes, it seems to me that the most relevant among these is Jaccard's Index: *NFC/NFT*, where *NFC* is the number of watermarks shared by the two editions, and *NFT* the number of different watermarks surveyed in both of the copies.

32 The coefficient is calculated for each of the pairs of copies, which can be obtained using the formula *N.(N-1)/2*—in our case, 15 pairs. The value of the coefficient is variable, as the copies do not all resemble each other to the same extent. The table presents the largest and smallest degrees of similarity observed between two pairs, as well as the average value of all the coefficients obtained.

In essence, if one takes into account the fact that the edition of Zoemeren, of which 50 copies are conserved, was without doubt smaller than those of the other two works, which would imply that a smaller amount of paper was consumed, one can reasonably suppose that the stock used by Johann von Paderborn was less heterogeneous than that used for the Apuleius. This kind of estimate therefore seems to be fairly good, but it presupposes that the watermarks in two copies are surveyed. Now, this happens to be the case for a good number of editions whose watermarks have been surveyed by *WILC*, which therefore clears the way for a systematic investigation of the nature and structure of the stocks of paper imported by the Low Countries.

Once it has been established that stocks of paper delivered to the printer were as often as not heterogeneous to varying degrees, a question naturally comes to mind: how many copies would have to be examined in order to arrive at a more or less exhaustive picture of a stock of paper? Common sense provides an initial answer: the more a stock is heterogeneous, the more the number of copies to examine becomes important—which means, in fact, that the number of copies to examine is negatively correlated to the frequency with which a particular watermark appears in a stock. Thus, a watermark that only appears a few times in a hundred reams of paper would very likely pass unnoticed if one were only to examine a few copies. To this obvious objective criterion, we can add another (which depends on the exigencies of the observer), namely the number of copies to examine depends equally on the level of certainty one wishes to attain. In the sphere of the human sciences, a threshold of certitude which is considered acceptable for statistical purposes is broadly speaking 95%.[33]

This problem is easy enough to model: one has only to apply the binomial probability law. Thanks to this law, we can know in advance the probability of an occurrence of a *P* probability—called a 'success'—occurring *N* times (or at least *N* times, or none at all) in a series of repeated tests. Thus, we can know in advance the probability of the tails side of a coin coming up ten times in a series of fifteen coin tosses, given that the probability of tails appearing with each coin toss is 50%. Now, one can liken the examination of a sheet of paper in a copy of a book to a test in which a variant of a watermark has a *P* probability of appearing in accordance with its frequency in the stock, and pose the following question: how many copies must one examine for a particular variant of *F* frequency in the stock to appear at least once with a 95% degree of certitude?

33 This threshold can only increase to the extent that the making of an error will not result in any serious consequences. Most people would not board an aircraft if they knew the risk of it crashing was 5%, though!

The answer to this question is rather surprising: if one examines six copies, to be almost certain that one variant will appear at least once in a given sheet,[34] the frequency in the stock has to be at least 40% (32% if one examines eight copies, as we did in the case of the edition of Apuleius). Clearly, the variant can also appear when the frequency is lower, but not with a level of certitude of 95%. Likewise, the calculation demonstrates that one would have to examine at least 26 copies in order to be practically certain of seeing a variant appear at least once should its frequency in the stock used to print a sheet be 10%, and 59 copies should its frequency be 5%. One might object that a rate of 10% is not very high, but despite this, in an edition of one thousand copies one is speaking of one hundred sheets of paper that would be far more likely to escape detection if one were limited to six copies—indeed, the probability of detecting their presence in a stock would only be 47%. Finally, the fact that six attested specimens of the same sheet all carry the same watermark almost guarantees that the frequency of the latter in the stock will not be lower than 60% (70% if one examines eight copies), but it will not guarantee that it will reach 100%. To be 95% certain, one would have to examine at least 50 copies.

All this leads us to make a simple observation: in many cases, taking into account the fact that the number of known copies is very seldom sufficiently high, it would be impossible to know with a satisfactory degree of certitude the full composition of a stock of paper, even if one could examine all the surviving copies. In any event, given that (practically speaking) it is not feasible to examine a large number of copies of each edition, it is pointless to dig any deeper, since one would only lose one's breath (as it were) in an impossible quest to achieve an exhaustiveness whose benefits are far from being clear. All that one must remember is that in certain cases, such as the edition of Apuleius, the examination of one copy alone will only provide access to a little more than a third of the number of variants represented in the stock, and without doubt fewer if one considers that the addition of each new copy will be accompanied by its share of new variants.

34 One must be beware of the fact that this probabilistic reasoning should not be applied to the entire copy, but instead to individual sheets, because the examination is performed sheet-by-sheet. Indeed, let us consider the imaginary case of a volume composed of 100 sheets printed in an edition of five hundred copies, where each ream would bear a different and unique watermark. Each watermark would therefore have an overall frequency of 1/100, and so (in theory) would have very little chance of appearing if one were not to examine a large number of copies. However, the theory is only valid if the watermarks are distributed uniformly throughout the stock. Now, since its frequency varies, depending on the sheets, from 0 to 100%, from a logical standpoint it is a sure thing that it will appear as soon as the first copy is examined.

That being said, the examination of just one copy is already sufficient to allow one to form an idea of the fundamental structure of the stock, and to know the motifs and types of watermark that form its 'backbone'. In fact, the paper stock cannot be likened to a pack of cards which is perfectly shuffled: observation shows that it is 'structured', in that a certain number of motifs and types predominate, whereas others only appear sporadically, and the same is true of the variants; for each type of watermark there is always a pair of twins whose frequency of appearance is overwhelmingly in the majority. In fact, the stock is almost always composed of 'blocks', namely reams containing a predominant watermark which are used in succession in accordance with the progress of the work (assuming that the work proceeded in tune with the natural sequence of the text). Thus, certain types of watermarks appear at the beginning of a volume and then disappear, to be replaced by others.

Accordingly, the degree of heterogeneity of the stock can be broadly understood and approximated by examining just one copy. The examination of several copies serves to determine how 'close-knit' the mixture is within the blocks. All the data can be presented in a matrix that can be read both vertically (the succession of watermarks within one and the same copy) and horizontally (an overview of the watermarks in the same sheet in the copies examined). In this way, one can clearly apprehend the high degree of fragmentation of the stock used in the edition of Apuleius (Tab. 11).

Edition of Apuleius. Survey of the types of watermark in eight copies (excerpt) (tab. 11)

Sheets	Copies 1	2	3	4	5	6	7	8
i1	C1	C1	B6	B6	C1	C2	B3	B6
i2	C1	C1	C1	C1	C1	B3	C1	B3
i3	E1	E1	C2	C2	C2	C2	C2	C2
k1	A2	B1	C2	B4	C2	B4	B4	C2
k2	B4	B1	B1	B7	B4	B4	B4	B4
k3	B3	B3	B3	B3	B3	C1	B3	B6
l1	A7	A7	B6	B6	B8	B6	A7	B6
l2	F1	B6	B6	B8	A7	F1	B6	B8
l3	F2	E1	E1	E1	A7	B9	F2	E1

Tab. 11: Edition of Apuleius. Survey of the types of watermark in eight copies (excerpt)

5 Heterogeneity of stocks, paper quality, publishers' strategies

Once it has been established that the stocks used in the incunabula were practically always heterogeneous, and above all to some extent varied, one should enquire what the underlying logic of the phenomenon might be (if, indeed, one exists).

The heterogeneity of the stocks is not the result of a strategy employed by printers who, by scattering their financial outlay, preferred to purchase relatively small amounts of paper in accordance with their needs. This hypothesis does not hold water, for a simple reason: the division of labour was highly developed in the printshops; several editions could be in production on multiple presses at the same time, and two or more parts of one and the same edition were often distributed among two or more teams that worked in concert. On the other hand, archive documents confirm that printers planned in advance the amount of paper that would be required to realise a publishing project, as well as procurement methods. In fact, the work of a printing shop of any importance never ceased, so an uninterrupted flow of paper was required.

Heterogeneity is therefore an intrinsic characteristic of stocks assembled in advance, without doubt by wholesale merchants. The production of a single mill—which was not reserved for an individual customer, a fact shown, in the repertories, by the wide geographical distribution of documented usages of identical sheets—was insufficient to satisfy significant needs in a very short period of time. Additionally, it was essential to harness the output of several mills.

Nevertheless, as we have seen, certain stocks exhibit a closer-knit mix than others. Why? To answer this question, we will have to examine the overall composition of the stock used in the editions of Boccaccio and Apuleius. If one considers the motifs represented, a good number of them are shared by both editions: *scales within a circle*, *ox head*, *cardinal's hat*, *crown*. In both cases, the *scales* motif is sweepingly predominant. This should come as no surprise: the bulk of Venetian incunabula produced in the last decades of the 15th century present with the same design (to which one must add, albeit rarely, the *anchor within a circle*). All the motifs are widely documented in the output of mills located on Lake Garda,[35] which not only supplied Venice, but also Austria, southern Germany, Dalmatia and the Ottoman Empire (Tab. 12).

35 The watermarks originating from this region have been catalogued by Leonardo Mazzoldi (Mazzoldi 1990–1991).

Watermark content of Venetian incunabula (over the period spanning from 1491–1500) compared with editions of Boccaccio and Apuleius (tab. 12)

Motifs	Editions 1490–1500	Apuleius	Boccaccio
Scales	53%	46%	55%
Ox head	13%	26%	9%
Hat	14%	15%	22%
Anchor	4%	0%	0%
Crown	3%	4%	10%
Other motifs	13%	8%	0%

Tab. 12: Watermark content of Venetian incunabula (over the period spanning from 1491–1500) compared with editions of Boccaccio and Apuleius

Even if the basic trends roughly correspond to the physical make-up of the Venetian market, one nevertheless observes that the structure of the stock in the two editions is not exactly the same. The frequency of the *ox head* is higher, on average, in the edition of Apuleius, and lower in that of the Boccaccio; similarly, the frequency of the *hat* and the *crown* is higher, on average, in the edition of Boccaccio. Can this be the product of pure chance? Perhaps not.

Within the framework of *Progetto Carta*, the examination protocol for papers involved two measurements which were carried out with precision instruments: thickness and degree of whiteness.[36] Now, concerning the latter parameter, it appears that watermarks are not all on an equal footing. Indeed, one notices that the sheets bearing the *hat* and the *crown* are, on average, whiter than those bearing the scales motif and, above all, the *ox head* (Tab. 13). At a global level, then, there exists a correlation between the watermark motif and the whiteness of sheets. To be sure, this is a statistical trend: one cannot expect that every sheet bearing the *crown* will be whiter than every sheet bearing the *ox head*.

36 For details of the instrumentation and the measuring protocol employed, see Ornato et al. 2001, I, 39–61.

Venetian editions (1491–1500). Whiteness of sheets in relation to watermark motifs[37] (tab. 13)

Watermark	Whiteness
Scales	71.83
Ox head	70.39
Hat	73.79
Crown	72.24

Tab. 13: Venetian editions (1491–1500). Whiteness of sheets in relation to watermark motifs

Now, one will notice that in the edition of Boccaccio the watermarks linked to the whitest papers are better represented. Likewise, one notices that, irrespective of the number of each watermark in a copy, the paper of that edition is whiter overall (75.57 as opposed to 73.39, the difference being 1.78). If one calculates the weighted average, which takes into account the effect of each watermark, the difference increases to 3.45 (75.98 as opposed to 72.53). There is therefore clearly a form of synergy at play between the two phenomena: in the stock of the two editions, the watermarks represented are roughly the same, but the quality is consistently better in the Boccaccio (see Tab. 14), which furthermore favours the watermarks linked overall to the whitest paper.

Editions of Boccaccio and Apuleius: average whiteness of paper in the most frequent motifs (tab. 14)

Watermark	Boccaccio	Apuleius
Scales	76.18	73.22
Ox head	77.02	69.93
Hat	74.43	74.55
Crown	77.19	73.86

Tab. 14: Editions of Boccaccio and Apuleius: average whiteness of paper in the most frequent motifs

37 The data concern the period covered by our two editions. However, the same trend is seen in the preceding years.

The sole exception is represented by the paper bearing the *hat* motif, whose quality in the edition of Boccaccio seems rather mediocre compared with the papers bearing the other motifs. This contrasts with what one observes in the edition of Apuleius, and in the production in general. This exception is, however, easily explained: indeed, starting from quire *n*, which corresponds to the second half of the edition, the *hat* motif ceases to appear. In this second half, the whiteness of the paper is markedly lower. This decrease affects all the copies examined, and above all affects the watermarks that were already present in the first half (Tab. 14).[38]

One must therefore conclude that the quality hierarchy applies just as much, if not more so, within each watermark motif as it does between the motifs themselves. In other words, the printer of the edition of Boccaccio chose, for each watermark motif, the superior quality product and used more paper whose watermarks are normally associated with better quality.

Now, even though the watermark content is not all that different in the two editions, given that the quality gap is so obvious, one must ask oneself whether or not the degree of homogeneity of stocks, which is different in the two editions, is linked to the whiteness of the paper.

In Chart 2, which relates to the Venetian editions examined during the course of *Progetto Carta*, the curves have been plotted by separating the editions into two categories: those in which the relationship between the number of watermarks (motifs and types, without taking into account the variants) and the number of sheets of paper is less than 15% (homogeneous stocks), and those in which the percentage is higher (heterogeneous stocks).[39] The qualitative difference between the stocks is quite clear.

38 Concerning this issue, see Ornato et al. 2001, I, 255–261. The cause of the phenomenon cannot be identified, but there can be no doubt that it is not related to the intrinsic quality of the paper stock.

39 These percentages only relate to the sole copy that was examined.

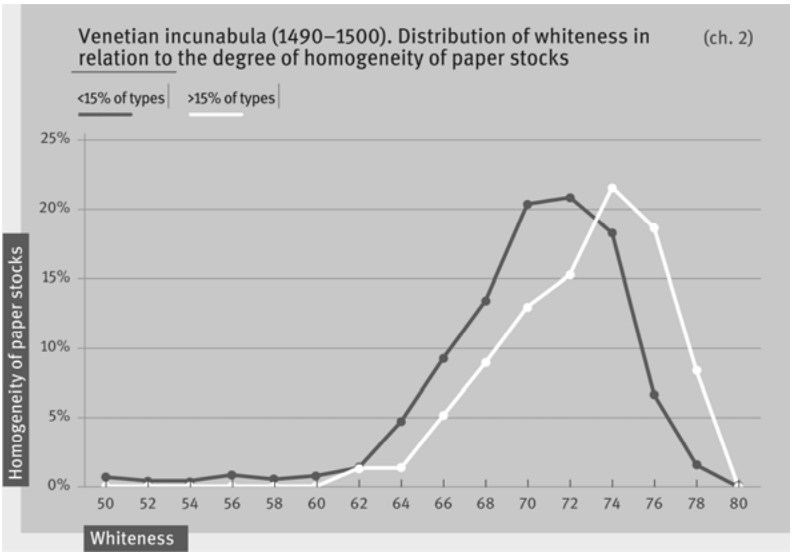


Chart 2: Venetian incunabula (1490–1500). Distribution of whiteness in relation to the degree of homogeneity of paper stocks

Tab. 15 helps us to better understand the way in which the phenomenon operates. One notices that the effect of the variable 'homogeneity/ heterogeneity' manifests itself in all cases, irrespective of watermark motif, and irrespective of the quality of the edition:[40] the *ox head*, whose whiteness is lower than the average, is far more frequent in the heterogeneous stocks, as in the edition of Apuleius, whereas the *hat*, whose whiteness is superior, is above all frequently seen in the homogeneous stocks, as in the edition of Boccaccio. Likewise, the stocks are a lot more heterogeneous in the 'standard' editions than in the 'ambitious' editions. Finally, one notes that the effect of the 'heterogeneity' factor does not eliminate the impact of the other factors, but instead constitutes a sort of aggravating circumstance: the 'ambitious' editions always exhibit the best whiteness values,

40 The two categories—'ambitious editions' and 'standard editions' (editions of lesser quality being absent from the corpus examined)—were defined on the basis of four 'editorial parameters'. Judged to be 'ambitious' are Venetian editions which present at least three of the following characteristics: more than 80 surviving copies (disseminated); less than 48% of the copies currently situated in Northern Italy (exportation); pages holding fewer than 50 lines (line density); space reserved for opening initial that occupies vertically more than 15% of the number of lines per page (overt sumptuousness). The editions of Boccaccio and Apuleius both belong to the 'ambitious' category, albeit according to different parameters and to varying extents.

regardless of the homogeneity of the stocks. Concerning the qualitative hierarchy of the watermarks, namely the gap between the watermark motif which is on average the whitest (*hat*) and the least white (*ox head*), this is far more pronounced when the stocks are heterogeneous (gap = 1.06, as opposed to 3.06). This would seem to indicate that the quality loss mainly affects the watermarks usually associated with 'good paper', which was mixed with 'second class' product with the aim of creating roughly uniform stocks.

Venetian incunabula (1490–1500). Whiteness variation in relation to the homogeneity of paper stocks (tab. 15)

	Frequence in the stocks		Whiteness	
	Homogeneous stocks	Heterogeneous stocks	Homogeneous stocks	Heterogeneous stocks
Total sheets	39.59	60.41	74.12	71.19
Scales	38.10	61.90	74.21	70.84
Ox head	32.89	67.11	72.01	70.79
Hat	49.44	50.56	75.07	71.85
'Ambitious' editions	40.38	59.62	73.62	72.53
'Current' editions	29.84	70.16	71.19	69.88

Tab. 15: Venetian incunabula (1490–1500). Whiteness variation in relation to the homogeneity of paper stocks

All of these observations point towards the same finding: whilst being rendered necessary by the difficulty of procuring paper from a sole local supplier, the mixing of different papers in stocks also provided a way of standardising the characteristics of sheets, although the end result was in any event inferior (even if it should be remembered that we are speaking of Venice, the domain of high end products). Mixing was in all ways the rule: of the few dozen editions printed in Venice from 1490 to 1500 and examined during *Progetto Carta*, only three were printed on a paper stock which, in the section of the volume examined, proved to be entirely homogeneous.[41] It should come as no surprise that these volumes score

41 *Etymologicum magnum* (in Greek). Venice, Zacharias Calierges, 1499 (*ISTC*: ie00112000), *fleur de lis*; Albertus Magnus, *Summa de creaturis*. Venice, Simon de Luere, February 16th, 1499

the best values with respect to whiteness. However, in the majority of cases the stocks show a rate of fragmentation higher than 15% and, from this standpoint, the edition of Apuleius sits at the top of the scale, with 23 types on 59 sheets, equal to 39%.[42] Given that the examination of this edition revealed that the same sheet could be marked by two or more types of watermark, and taking into account that it can be safely estimated that between 600 and 1000 copies were printed,[43] there can be no doubt that the reams themselves did not always contain a unique watermark type, which suggests that they were repackaged (partially, at least) subsequent to leaving the paper mill.

How, then, was the mixing process carried out? Obviously, it is impossible for us to know, because we are completely ignorant of what actually took place between the moment when the paper left its place of manufacture and the moment it arrived at the printers. Furthermore, we do not know what happened within the paper mill prior to the product being delivered to the buyer. To be sure, we know that one and the same mill could produce writing paper, intermediate quality paper (known as *fioretto* in Italy), and packing paper,[44] all in at least two formats. However, within the 'writing paper' category, production quality was far from homogeneous, even within one and the same paper mill; indeed, business contracts of the period show us that, for sheets of the same dimensions, variations in the weight of reams—the only objective parameter that could be measured at the time—and therefore also of price, could be considerable.[45] Furthermore, it was likewise difficult to guarantee a highly standardised output, since numerous factors could exert an influence on the whiteness of sheets, such as the quality of rags, water purity, sizing and drying. Seasonal factors in particular must have played an important role.[46] It is therefore quite reasonable to suppose that the output emanating from the same pair of moulds could have been hierarchically hand-selected by the paper maker in accordance with a pre-determined quality standard which had to be met. If the sheets bearing the mark of the *hat* or the *crown* were generally whiter than those bearing the *scales* and, above all, the *ox head*—since that was the aim—the least successful of the *scale* sheets could be

(*ISTC*: ia00334000), *scales*; Theodorus de Gaza, *Grammatica introductiva* (in Greek), Venice, Aldus Manutius, December 25th, 1495 (*ISTC*: id00426000), *hat*.

42 In the first copy examined. Only four editions fared worse.

43 Taking into account the likely rate of conservation for this type of edition; the rate lies towards the top end of the scale.

44 As well as more specific products, such as packing boxes, playing cards, and window paper.

45 For the variations observed in the Salò region—which supplied Venetian printers with paper—see Ornato et al. 2001, I, 388–389.

46 See Ornato et al. 2001, II, 205–212.

less white than the best *ox head* sheets (Chart 3). This is exactly what one observes in the two editions under discussion in the present contribution.

From the printers' perspective, more than anything it was necessary to offer paper whose overall quality was well adapted to the needs and financial capacity of readers. That being said, it was of equal importance to prevent readers from being disappointed by visible differences in the quality of sheets within one and the same edition.[47]

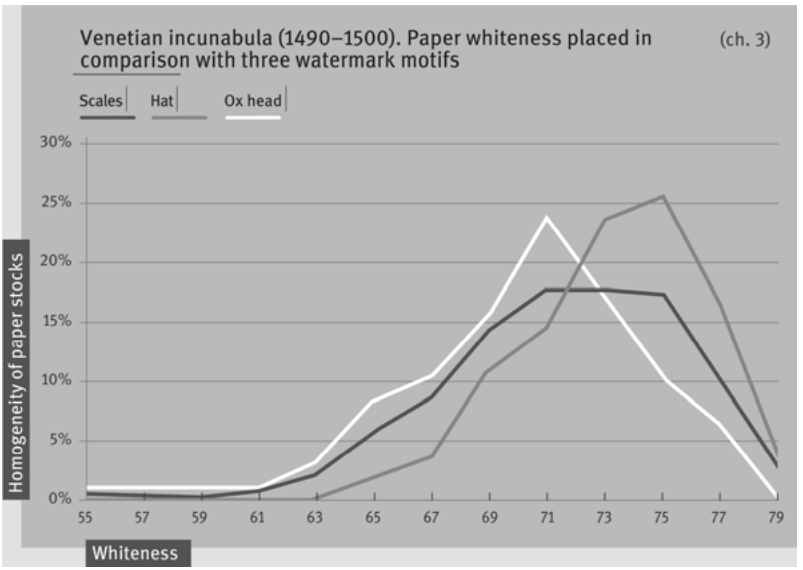


Chart 3: Venetian incunabula (1490–1500). Paper whiteness placed in comparison with three watermark motifs

To achieve this end, there were only two possible solutions available: (a) to set about buying a good number of reams of homogeneous paper, or (b) to have access to a stock of paper which had been mixed beforehand and consisted in sheets

47 In any event, a selection was carried out so as to eliminate waste material (scrap paper) which, proscriptions notwithstanding, people tried to introduce to the marketplace. The introduction of a certain amount of scrap paper into reams of good quality product—strictly prohibited in the 14th century in Bologna—was a common practice starting from the 16th century. The phenomenon was also recognised and regulated in the 18th century in the Grand Duchy of Tuscany. Concerning this matter, see Ornato et al. 2001, I, 200–204.

originating from different sources. The second solution was not available to printers, but it could be implemented by wholesalers who obtained their supplies from mills located in the Garda region.

The first solution was not easy to achieve, on account of the fact that it was difficult to monopolise the entire output of a mill over a not inconsiderable length of time. This solution was therefore only practicable when a project made it worthwhile: namely when pursuing very ambitious editorial goals, which was the case, in particular, for volumes in Greek. Therefore, the printer's investment in paper could be very heavy, which explains the rarity of homogeneous stocks in the corpus assembled for *Progetto Carta*. In fact, in the majority of cases, printers had to settle for essentially heterogeneous stocks, available as and when they were required, whose quality decreases with the degree of intimacy of the mix.

So, the printers procured their paper supplies from a marketplace that was adapted to their needs. It is for this reason that, the origin of the paper being the same, roughly the same watermarks were present in all the printing ateliers—*scales*, *ox head*, *hat*, and sometimes a small complement of the *crown* and the *anchor*—but with an overall predominance of the *scales* which, as can be seen on the chart, covers a quality range which also extended to that covered by the *hat* and the *ox head* combined. In the stocks assembled by the wholesalers, calibrated in accordance with the quality standards sought by the printers, the only variation was the diversity of the mixture and the respective share of the principal watermark motifs, as we have seen in the editions of Boccaccio and Apuleius.

In conclusion, the tally of different watermarks in the manuscripts, owing to the small quantity of paper used and in the absence of economic considerations, is only of secondary interest. On the other hand, the same issue is in an entirely different league of interest when it comes to printed books, where the financial outlay negotiated was always considerable and three parties were involved: the papermaker, the middleman and the printer (the readers being the ultimate judges). Therefore, this qualitative parameter should be considered an accurate source of information both for the history of paper and for that of the book. Even though the analysis provided in the present study focuses on Venice, there can be no doubt that the practice of mixing different papers was not restricted to that city alone—indeed, given that the same problem requires the same solution no matter where it is encountered, this approach without doubt represented the rule in all the important printing cities whose production was fed by the chief papermaking centres. Consequently, it is easy to notice at first glance the existence of the same phenomenon in the *WILC* repertory. The whiteness of sheets is not included among the data collected, but since we have established that the degree of intimacy of the mix is partly correlated to this pa-

rameter, we could use it as an indirect indicator to serve as a starting point to conduct a wide-reaching enquiry into the qualitative characteristics of the paper used in various cities and within different printing ateliers, both synchronically and diachronically. Despite being less detailed than the study conducted during *Progetto Carta*, such a research project would have the advantage of addressing a much larger number of volumes.

References

Bozzolo, Carla / Ornato Ezio (1980), *Pour un histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, 2nd edition, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIVe et XVe siècles. Textes et études, 2).

Gasparinetti, Andrea F. (1963), 'Documenti inediti sulla fabbricazione della carta nell'Emilia', in *Rivista Industria della carta*, 5–39.

Mazzoldi, Leonardo (1990–1991), *Filigrane di cartiere bresciane*, 2 vols, Brescia: Ateneo di Scienze, Lettere ed Arti.

Neddermeyer, Uwe (1996), 'Möglichkeiten und Grenzen einer quantitativen Bestimmung der Buchproduktion im Spätmittelalter', in *Gazette du livre médiéval*, 28: 23–32.

Neddermeyer, Uwe (1998), *Von der Handschrift zum gedruckten Buch. Schriftlichkeit und Leseinteresse im Mittelalter und in der frühen Neuzeit; Quantitative und qualitative Aspekte*, Wiesbaden: Harrassowitz (Buchwissenschaftliche Beiträge aus dem Deutschen Bucharchiv München 61).

Ornato, Ezio / Busonero, Paola / Munafò, Paola F. / Storace, M. Speranza (2001), *La carta occidentale nel tardo Medievo*, 2 vols, Roma: Istituto centrale per la patologia del libro.

Ornato, Ezio (2012), 'L'évaluation quantitative des strategies éditoriales. Problèmes méthodologiques et techniques', in Ruzzier, Chiara / Hermand, Xavier / Ornato, Ezio, *Les strategies éditoriales à l'époque de l'incunable: le cas des anciens Pays-Bas*, Turnhout: Brepols (Bibliologia, 33), 133–203.

Ornato, Ezio (2012, 2013), 'Si les filigranes m'étaient comptés… Les statistiques au service de l'histoire du livre et du papier', in *Papiers*, 5 (January 2012), 4–9; 6 (January 2013), 2–8.

Piccard, Gerhard (1961–1997), *Findbücher*, Stuttgart: Kohlhammer (Veröffentlichungen der staatlichen Archivverwaltung Baden-Württemberg, Sonderreihe: Die Wasserzeichenkartei Piccard im Hauptstaatsarchiv Stuttgart).

Rückert, Peter (ed.) (2006), *Wasserzeichen des Mittelalters: Ochsenkopf und Meerjungfrau. Papiergeschichte und Wasserzeichen vom Mittelalter bis zur Neuzeit* (Ausstellung, Stuttgart und Wien, 2006–2007), Stuttgart: Landesarchiv Baden-Württemberg, Hauptstaatsarchiv.

Wittek, Martin (2003–2006), *Inventaire des manuscrits de papier du XVe siècle conservés dans la Bibliothèque Royale de Belgique et de leurs filigranes*, 4 vols, Bruxelles: Bibliothèque Royale de Belgique.

conduct a wide-reaching enquiry into the qualitative characteristics of the paper used in various cities and within different printing ateliers, both synchronically and diachronically. Despite being less detailed than the study conducted during *Progetto Carta*, such a research project would have the advantage of addressing a much larger number of volumes.

References

Bozzolo, Carla / Ornato Ezio (1980), *Pour un histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, 2nd edition, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIVe et XVe siècles. Textes et études, 2).

Gasparinetti, Andrea F. (1963), 'Documenti inediti sulla fabbricazione della carta nell'Emilia', in *Rivista Industria della carta*, 5–39.

Mazzoldi, Leonardo (1990–1991), *Filigrane di cartiere bresciane*, 2 vols, Brescia: Ateneo di Scienze, Lettere ed Arti.

Neddermeyer, Uwe (1996), 'Möglichkeiten und Grenzen einer quantitativen Bestimmung der Buchproduktion im Spätmittelalter', in *Gazette du livre médiéval*, 28: 23–32.

Neddermeyer, Uwe (1998), *Von der Handschrift zum gedruckten Buch. Schriftlichkeit und Leseinteresse im Mittelalter und in der frühen Neuzeit; Quantitative und qualitative Aspekte*, Wiesbaden: Harrassowitz (Buchwissenschaftliche Beiträge aus dem Deutschen Bucharchiv München 61).

Ornato, Ezio / Busonero, Paola / Munafò, Paola F. / Storace, M. Speranza (2001), *La carta occidentale nel tardo Medievo*, 2 vols, Roma: Istituto centrale per la patologia del libro.

Ornato, Ezio (2012), 'L'évaluation quantitative des strategies éditoriales. Problèmes méthodologiques et techniques', in Ruzzier, Chiara / Hermand, Xavier / Ornato, Ezio, *Les strategies éditoriales à l'époque de l'incunable: le cas des anciens Pays-Bas*, Turnhout: Brepols (Bibliologia, 33), 133–203.

Ornato, Ezio (2012, 2013), 'Si les filigranes m'étaient comptés… Les statistiques au service de l'histoire du livre et du papier', in *Papiers*, 5 (January 2012), 4–9; 6 (January 2013), 2–8.

Piccard, Gerhard (1961–1997), *Findbücher*, Stuttgart: Kohlhammer (Veröffentlichungen der staatlichen Archivverwaltung Baden-Württemberg, Sonderreihe: Die Wasserzeichenkartei Piccard im Hauptstaatsarchiv Stuttgart).

Rückert, Peter (ed.) (2006), *Wasserzeichen des Mittelalters: Ochsenkopf und Meerjungfrau. Papiergeschichte und Wasserzeichen vom Mittelalter bis zur Neuzeit* (Ausstellung, Stuttgart und Wien, 2006–2007), Stuttgart: Landesarchiv Baden-Württemberg, Hauptstaatsarchiv.

Wittek, Martin (2003–2006), *Inventaire des manuscrits de papier du XVe siècle conservés dans la Bibliothèque Royale de Belgique et de leurs filigranes*, 4 vols, Bruxelles: Bibliothèque Royale de Belgique.

Ezio Ornato

An Experiment in Dating Documents through the Analysis of Watermarks: The Letter 'P' in Incunabula of the Low Countries

Summary: The systematic application of dating methods through the analysis of watermarks in a large number of documents not only requires the automation of comparison procedures (i.e. the matching of identical or almost identical watermarks), but also necessitates the rigorous and effective processing of evaluation criteria, the validity of which can be confirmed through statistical analysis. With this objective in mind, the present contribution sets forth the very encouraging results of an experiment conducted on examples of the letter 'P' collected in the *WILC* database (*Watermarks in Incunabula printed in the Low Countries*), which should facilitate the dating of a large percentage of early printed editions within a margin of error of less than t ± 12 months.

1 Problems associated with dating documents through watermarks

Leaving aside the physico-chemical procedures currently employed in the field of archaeology, the dating of documents through the analysis of watermarks is perhaps the only method based on objective criteria that can be applied in the sphere of the human sciences, despite being susceptible to an inevitable degree of inaccuracy. Although its application is necessarily limited to paper-based documents produced in the West in the Late Middle Ages, the method appears to hold great potential, given on the one hand the tens of thousands of undated manuscripts and printed books conserved in libraries, and on the other the remarkable degree of accuracy that seems, in theory, to be achievable.

Translated from the Italian into English by Mark Livesey. Original published as Ornato, Ezio (2004), 'Un esperimento di datazione tramite le filigrane : Le "lettere P" negli incunaboli dei Paesi Bassi', in Graziaplena, Rosella, with the assistance of Mark Livesey (eds), *Paper as a Medium of Cultural Heritage: Archaeology and Conservation*. 26th Congress IPH, Roma: Istituto centrale per la patologia del libro (Addenda, 5), 225–242.

https://doi.org/10.1515/9783110743838-007

Yet, despite their undeniable potential, the methods used for dating documents through the watermarks they contain have never been applied on a large scale. Furthermore, even when such methods are used in individual cases, the datings obtained do not have any independent value—indeed, their currency is always subordinate to the results obtained through philological and palaeographical studies, so even at the best of times they only constitute supplementary evidence. It is scarcely necessary, then, to underscore the fundamentally unscientific and risk-laden nature of such methods: the concordance of doubtful conclusions does not, *per se*, increase their accuracy, since the margin of error is not quantified. Several reasons behind lie behind this paradoxical state of affairs, which are as follows:

- Comparison procedures are onerous and have to be carried out by hand on multiple catalogues.
- The chances of finding watermarks that are identical to the one being dated are slim.
- Working methods are of low accuracy and have not been significantly improved on since Charles-Moïse Briquet first presented the fundamentals of his approach in the early twentieth century.
- The potential for making serious errors exists, due to the impossibility of establishing reliability criteria that are statistically quantifiable.

Is it possible, then, to proceed any further? Happily, the answer to this question is in the affirmative.

In 1996, at the IPH congress held in Leipzig, the *Progetto Carta* collective[1] proposed a comparison and dating method based on morphometric criteria—i.e. type and size of watermarks—applied to a corpus of 'scales enclosed within a circle' specimens surveyed in the inventories of Briquet and Piccard, but above all in a corpus of a few dozen Venetian incunabula studied during the course of *Progetto Carta* itself.[2] If the results obtained from the inventories had already proved quite satisfactory, the datings of printed books delivered highly accurate results—to within ± 1 year in the best cases—with a margin of error of less than 5%.

The conclusions reached through the experiment conducted on the 'scales enclosed within a circle' probably appeared a little too optimistic to some scholars, chiefly because of the chronological distribution of incunabula included in the corpus, which was heavily concentrated on the years 1493 to 1494, and

1 Concerning this research project, which was instigated by the ex-director of the *Istituto Centrale per la Patologia del Libro* in Rome, see Ornato et al. 2001.

2 Ornato et al. 2000, 61–75.

therefore tended to minimise the variation between estimated and actual numbers. The new experiment—which no longer focused on the 'scales' watermark, but instead on the letter 'P' in a corpus of incunabula widely distributed over the last three decades of the 15th century—confirmed, and even improved on the results obtained in the previous experiment.

The experiment was only made possible thanks to the existence of a new database—*WILC (Watermarks in Incunabula printed in the Low Countries)*—which now contains more than 4,500 watermarks harvested from incunabula of the Low Countries (in the broad sense, i.e. Belgium and Holland). The databank was developed by Gerard Van Thienen, and supported by the Koninklijke Bibliotetheek in The Hague. Reproductions of the watermarks, most of which are radiographs, have been made freely accessible to scholars on the library's website.[3] The databank presently contains more than 1,700 letter 'P' watermarks.

Apart from the strictly watermark-related aspects of the database, it should be emphasised that *WILC* represents a very rich virtual source of knowledge and information, just as much on Western paper as on the 'primordial' days of the printed book. A visit to the website, where the purpose and characteristics of the database are clearly explained, as well as, of course, instructions for its use, will certainly be more worthwhile to the reader than any written description. Without getting lost in minutiae (which in any case are often pointless, given the existence of images), suffice to say that *WILC* adopts an approach precisely opposite to that of Piccard's catalogue, which is very rich in images but equally poor in providing information on the characteristics of watermarked leaves. In fact, the Dutch website provides a wealth of indispensable information for the benefit of scholars,[4] added to which is all the relevant data concerning the particular incunabulum that the leaf originates from.[5] When an exact date is not provided, a rough estimate is made, together with a justification for it.

But there is more: Gerard Van Thienen had already embarked on the monumental and painstaking task of comparing a large number of watermarks by hand, work which led him to establish some 'equivalents categories' (about

3 https://watermark.kb.nl/page/index/title/Introduction (last access 07/09/2021).

4 Identification of the imprint side (i.e. the side of the sheet that was in contact with the woven surface of the mould during the manufacture of the sheet), which makes it possible to determine the position of the watermark on either the right- or left-hand side of the mould; the orientation of the motif in relation to the vertical axis in the presence of asymmetry (the 'belly' or 'bowl' of the letter 'P') on the right or on the left; the gap between two chain lines where the watermark is located; the distance between the chain lines that surround the watermark; and finally, the height of the watermark itself.

5 Format, place and date of publication, information about the printers.

which more will be said later on) which group together watermarks that appear to be identical, or are at least very similar. This important preliminary contribution made it possible to provide considerably more detailed verifications than had been possible in the experiment on the 'scales enclosed within a circle' motif.

All methodological verification experiments on the dating of documents through the watermarks they contain are based on a simulation procedure: the assumption is made that the date of a given sheet containing a watermark is unknown, whilst in reality it is, in fact, known, thus making it possible to confirm, *a posteriori*, the accuracy of the estimated date.

In broad terms, the following steps are required in order to carry out the simulation procedure:

- The establishment of a 'reference group', which is to say a corpus of watermarks of sufficient size so as to be significant.
- The definition of a gauging criterion to establish the similarity—or more easily, dissimilarity—between two watermarks, to be represented by a quantitative index.
- The application of the gauging criterion to all the watermarks contained in the corpus. In practice, this involves comparing each watermark in the corpus with all the others. If *N* is the size of the corpus, a total of *N* x (N-1)/2 comparisons have to be carried out.
- For each comparison, two pieces of data are obtained, namely an index of dissimilarity (or 'morphometric gap'), and a 'chronological gap', which is to say the difference in absolute terms between the dates of the two documents containing the watermark.
- The statistical distribution of the chronological gaps in relation to the morphometric gaps will show the probability that, for a morphometric gap 'MG', the chronological gap 'CG' will be either higher or lower than a predetermined value.
- The assumption is made that the results obtained through the simulation carried out on watermarks whose dates are known (i.e. in dated books and documents) are equally valid for watermarks whose dates are unknown. In other words, for a given 'MG' value, it should be possible to deduce the likelihood that the unknown date of a watermark lies within the time range arrived at experimentally, for that value, in the reference group whose date is known.

The above being said, both the dating procedure and the simulation experiment have to be carried on the basis of some specific criteria. The fundamental postulate that guarantees the validity of the method is the fact that two sheets of paper originating from one and the same mould, but which appear in different written

documents, cannot, statistically speaking, be very distant from each other in chronological terms. In fact, the average 'CG' among the various attestations is dependent on the duration of the mould's 'usage cycle' (i.e. the length of time it was in service), and the duration of the 'consumption cycle' of the paper produced from it (i.e. the timeframe within which all the sheets made with that particular mould were consumed).

These two parameters—which can vary over time, and also in synchrony according to different rates of consumption—jointly determine the maximum theoretical degree of accuracy that the method can achieve when one is estimating the date of a sheet devoid of chronological data. However, since a document to be dated is not usually composed of a single sheet of paper but instead consists of an entire volume, the level of accuracy achieved by examining a single sheet can be increased when one and the same volume is made from sheets that emanated from different moulds. The concomitant presence of different sheets within one and the same stock of paper necessarily lasts a shorter length of time than the consumption cycle of each of the individual sheets.[6] In particular, it should be emphasised that a document's date cannot be set earlier than the moment in time when the most recent mould (represented by the sheets emanating from it) entered the production cycle.

A second postulate—whose significance has already been confirmed during the experiment performed on the 'scales' motif—presupposes that, even in the absence of a perfect match, the 'similarity' between two watermarks is, within certain limits, negatively correlated to the average chronological gap between their attestations in different volumes: in other words, the more two watermarks resemble each other, the more their attestations tend to be chronologically close to each other.[7] This second postulate makes it possible to justify the use, in the dating procedures, of non-identical watermarks, and also makes it unnecessary to worry about knowing in advance whether or not two watermarks are identical.[8]

---

6 The principle had already been well understood and applied by Briquet; see Briquet 1968 (1907).

7 Needless to say, this does not imply the opposite, which is to say the more different the watermarks are, the more chronologically distant from each other they will be.

8 It should be borne in mind that in cases where similar watermarks were used contemporaneously on different moulds employed in the same paper mill, the accuracy of the estimate will be almost the same as that in a situation where the watermarks are identical. If, on the other hand, one is dealing with watermarks sewn on to moulds scattered over the same time vector (i.e. new moulds which substituted their worn out predecessors), the level of accuracy will clearly be lower. The problem here is that one is not normally able to differentiate between the two

If one were able to have at his or her disposal a 'perfect' database containing all the attestations of each and every occasion a particular mould was utilised over a period of time, the level of accuracy achieved by the dating method based on watermarks would in every instance match the theoretical maximum degree of accuracy. For a single watermarked sheet, this would depend on the length of time the usage and consumption cycles lasted. For an entire volume, it would also depend on the number of different sheets present in the document to be allocated with a date.[9]

Alas, the aforementioned 'perfect' database does not exist. This is principally because such a database simply *cannot* exist, given the vast number of sheets of paper that have been lost over the course of time. However, if one considers the methods currently employed in the field of statistics, it goes without saying that it would not in fact be necessary to have at one's disposal all the attestations which have ever existed. Instead, for each mould, a sufficiently representative number, which is to say the number that would be necessary in order to allow one to reconstruct (in an accurate way) the chronological distribution curve in question, would suffice.

In all likelihood, even in the best of cases this criterion could never be fully satisfied—indeed, in order to obtain a reliable curve, it would be necessary to have at one's disposal at least thirty independent attestations for each mould. However, if one considers that the total production emanating from a single mould approached a million sheets, it is quite likely that at least one dated attestation of every mould used in the paper mills still exists today and, not infrequently, a relatively large number of attestations exist. One has only to consider the fact that Theo Gerardy did not have too much trouble in identifying all the alternating moulds that were used over a period of more than a hundred years at the Arensberg paper mill.[10] On the other hand, the comparisons carried out by Gerard Van Thienen demonstrate that one and the same watermark can appear at least ten times in different editions, and to these attestations can be added those originating from archives. All this leads one to deduce that for each 'uncharacterised' sheet (i.e. a sheet not endowed with a date and geographical

---

situations, except for when one is dealing with obviously 'twin' watermarks (a situation, moreover, which is not always easy to identify with the utmost certitude).

9 For a given watermark, the chronological distribution curve for attestations will be strikingly asymmetrical. It will rapidly reach a maximum when the mould ceases to be serviceable, and therefore to supply the market. Subsequently, the curve shows a gradual diminution and heads towards zero little by little as the stocks in circulation gradually dwindle.

10 See Gerardy 1964.

origin), somewhere or other at least one corresponding characterised attestation must exist, which should, in theory, make at least one verification possible.

It is fairly obvious that the best approximation (in concrete terms) of the original situation, which is to say all the individual attestations of use that are currently known, would in itself be sufficient to produce datings within a time range very close to the maximum accuracy permitted by the method. Needless to say, we are very far from enjoying this ideal situation. The 'watermark universe' which is currently available to us in the form of reproductions—the bulk of which, unfortunately, consist in tracings—is still inadequate, and indeed would remain so even if one succeeded in combining in a single database all the material surveyed up to the present, both published and unpublished.

If the accuracy of dating depends on the objective factors listed above, which are bound by insuperable limits and are entirely independent from the wishes of scholars, it also depends on the richness of the dated reference group of comparison and its geographical and/or chronological relevance with respect to the material to be dated. Unlike the former, these latter factors are dependent on human initiative. If the gridwork in the reference group points to consumption areas which lie outside those relevant to the document to be dated, the number of 'effective' comparisons (i.e. those which correspond to morphometric gaps that are sufficiently small) will rapidly diminish, whereas if the gridwork is too wide, their quality (i.e. the degree of similarity revealed between the watermark to be dated and those present in the reference group) will decrease.

Consequently, even when the material to be dated corresponds perfectly, on the chronological level, with the reference group, the accuracy and reliability of a dating can never exceed the limits set its richness, and therefore what we can define as the 'degree of internal datability'. This 'degree of internal datability' can be ascertained through experimental tests; indeed, the results of such tests are used to define the efficacy, reliability and accuracy of the dating procedure.

How, then, does the 'degree of internal datability' test work? We have already seen how a comparison with all the watermarks in the reference group makes it possible to determine the statistical distribution of the chronological gaps 'CG', corresponding to the different values of the morphometric gaps 'MG'. The said distribution can be represented by a cumulative frequency curve, which at the same time will define the accuracy of the dating and its reliability.

For example, let us suppose—needless to say, we are dealing with fictional values—that the 'MG' category is 0–5, and that 90% of the 'CG' falls within the ±6 months range, while 95% falls within the ±12 months range. This means that if the comparison between an undated watermark and one or more watermarks in the reference group produces an 'MG' that ranges from 0–5, one can state that its

probable date is the same as the comparison watermark ±12 months, with a bilateral margin of error of 10%. However, if the 'MG' value is higher, in the range of 6–10, the experimental test will necessarily produce less accurate results, e.g. ±18 months, with a margin of error of 5%. Finally, if the 'MG' value is even higher—e.g. ranging from 20–30—the level of accuracy will fall to ±84 months, and therefore the comparison will be practically useless for the purposes of dating.[11]

The advantage of this empirico-statistical procedure is that on the one hand it provides the possibility of automatically deciding whether the results of the comparison between two watermarks are usable for dating purposes, and on the other that of quantifying—and adjusting according to one's needs and specific concerns—the accuracy of dating and margins of error. Once the characteristics (in due course we shall see which) of a watermark are fed into the computer and automatically compared with all the others in the reference group, and the results then evaluated against the dated material within that group, the researcher has nothing further to do, other than, if necessary, interact with the options proposed by the software.

2 An experiment in dating on the '*WILC*-Letter P' corpus

The journey towards the 'promised land' is, however, full of pitfalls. The first problem to tackle consists in obtaining, with as little wasted energy as possible and the maximum degree of accuracy, an 'MG' measurement that has the necessary characteristics. Given that no procedure currently exists (despite ongoing research into the same) which makes it possible to automatically define the morphological and dimensional properties of two drawings, whilst at the same time providing a numerical assessment of their degree of similarity, one is constrained to work in a purely manual way. Such an approach is hampered by severe constraints.

A necessary condition for two watermarks to be judged identical is that they be exactly superimposable upon each other. Using software that enables one to manage different 'levels'[12] makes it possible to manually confirm that two motifs can be precisely superimposed upon each other. However, the manual

11 This degree of accuracy is achievable using other methods, above all when one is dealing with printed editions.

12 The 'levels' can be defined as two or more 'strata' of the image rendered 'transparent' by the software. The 'levels' can then be superimposed on each other so as to form a single image.

procedure—which is useful for confirming the results of research aimed at grouping together different attestations of an identical watermark—is a long and drawn-out process when it has to be systematically applied to hundreds of different watermark designs. On the other hand, it is impossible to easily, objectively and rapidly measure the morphometric gap 'MG' when two images cannot be exactly superimposed upon each other.

The most practical solution consists in avoiding a graphics-based approach, and instead employing a numerical and dimensional representation of the watermark in question, consisting of a series of dimensional measurements. The comparison between two numerical representations will provide, *ipso facto*, an immediately usable morphometric gap. For a given watermark motif—such as the letter 'P'—in the preliminary phase a certain number of key points are pre-selected whose reciprocal positions are then measured in all the watermarks to be compared. Needless to say, it is necessary for the key points to be fairly numerous in number so as to minimise the risk of chance matches, but at the same time there should not be too many of them in order to avoid hampering the measuring procedure.

In theory, the ideal approach would be to compare the coordinates of one and same point in relation to a fixed reference point in two variants of a particular watermark design.[13] The weakness in this type of approach lies in its vulnerability to two phenomena that often affect watermarks, namely their rotation around a geometric barycentre and their 'drift' towards one of the two adjacent chain lines. An alternative procedure, which is simpler and quicker to carry out, consists in measuring a certain number of arbitrarily pre-selected spaces between pairs of points—always the same ones, of course. However, the latter method is less selective than the former.[14] In order to measure the gaps between each pair of points—10, for example—it would be necessary to make 45 measurements, which besides (obviously) being impractical, would of course result in a large surfeit of data.

The solution settled on consisted in pre-selecting 13 points called 'nodes'—located at the meeting point of two segments of the letter 'P'—and then measuring 10 distances, with all 13 of the points included at least once. Given that radiographs and betagraphs are susceptible to a certain number of 'visual impurities'

13 The coordinates of a point are defined by its distance in relation to a system of Cartesian axes, or by the gap in relation to the reference point and the angle formed by the segment which unites the two points with one of the two Cartesian axes.

14 In fact, when presented with four points—A and B, and A' and B'—arranged in the same way in two different watermarks, if the two points A and A' coincide, the distances A-B and A'-B' can clearly be the same even if points B and B' do not coincide. One has only to think of an isosceles triangle, in which points B and C in its base, despite not coinciding, are positioned at equal distances from the triangle's apex.

which sometimes make it impossible, when taking measurements, to define the aforementioned points with sufficient accuracy (such as in the case of the meeting point between the two 'legs' of the 'Gothic P'), a certain number of nodal points were eliminated at the outset. Here, it should be emphasised that these nodal points probably do not represent a purely abstract entity: the rather sketchy information we possess on watermark technology—all very recently acquired, besides—describes pegs driven into a wooden board, around which a wire strand was arranged so as to form the watermark's motif.[15] This observation is important, since the watermark makers could, if necessary, save a peg system and reuse it at a later date. This phenomenon represents an important 'disruptive' factor.

Irrespective of this possibility, it should not be forgotten that the representation of a design using only 13 geometric points constitutes a drastically reductive step which is highly vulnerable to the so-called 'first type' error, namely considering two motifs to be identical when in fact they are not. Conversely, errors in measurements caused by insufficient definition of the nodal points raises the risk of the 'second type' error occurring, namely considering two watermarks to be different when in fact they are identical. The first type of error introduces a 'noise' capable of seriously skewing the results of the dating procedure, while the second eliminates useful information and could potentially hinder the dating procedure or reduce its degree of accuracy.

In addition, the selection of 13 nodal points and 10 gap measurements made it necessary to choose from a range of preliminary options. The most important among these concerns the inclusion or exclusion of 'superfluous information', which is to say of all the details of the design that are of no great consequence to the basic structure of the letter 'P'. The exclusion of 'superfluous' details increases the risk of the 'first type' error occurring, since two watermarks that are characterised by the same essential structure, but which can be distinguished from one another at first glance due to the presence or absence of 'superfluous' elements, will be judged identical by the computer. On the other hand, inclusion of such details does not come without certain drawbacks on the historical level, since it eliminates *per se* the possibility of identifying the presence of basic construction patterns, and as a consequence the possibility of recognising the re-use and/or sustained use over time, or in a particular geographical setting, of the same watermark design. Since it is important to reduce to a minimum the risk of the 'first type' error, one has by necessity to align a metrical representation with a somewhat simplified typological classification system, which can then be usefully applied as a discriminating factor.

15 See Grosse Stoltenberg 1965, 73–79.

From the aforesaid, it becomes clear that two designs, judged as identical from a morphological point of view, can in fact be related to two different material objects based on the same archetypal model, but sewn on to different moulds and separated by a considerable period of time. For this reason, the typological classification has to take into account certain factors, namely the position of the watermark on the mould (on the left-hand or right-hand side), and the orientation of the motif (normal or specular).[16] In a scenario of this kind, another discriminating parameter can be found in the density of the laid lines, which makes it possible to reveal even minor differences in a mould's weave pattern, and therefore also to eliminate the misleading effects of any chronological 'mirages'. In the matter in question, the assessment of laid line density was greatly aided by an automatic counting program devised by Vlad Atanasiu.[17]

The metrological distance between two watermarks is obtained in a very simple way: the difference between the pre-selected distances in the two watermarks placed in comparison is automatically calculated by the computer. The difference between the figures is then squared (so as to prevent variations in the opposite direction from being cancelled out). The metrological distance is equal to the sum of the variations calculated in 10 segments. Just how reliable, then, are such measurements?

First, the problem of errors occurring during the measuring procedure has to be considered. In this regard, the working conditions are almost perfect thanks to the use of graphics software such as Photoshop. Such software enables one to work on images at life-size and to measure, on the computer screen, the distance between two points to within 0.10 mm. In addition, by using the Photoshop option called 'levels', it becomes possible to superimpose any two images upon each other with a very high degree of precision for the purposes of verification.

One naturally assumes that the measurements obtained from radiographic reproductions should be more reliable than those obtained from motifs of the watermark designs found in the catalogues. In reality the situation is not, in fact, quite so rosy, for the following reasons:

– A watermark's motif can be affected by various inaccuracies. Indeed, poorly defined areas are often observed in proximity to some of the nodal points, and these inevitably result in discrepancies in measurements.

16 All these elements are noted in the *WILC* database, but unfortunately are absent from the two extensive watermark catalogues that have been published to date.

17 Atanasiu 2004, 172–184.

– The radiographic image may not be perfect, due to the presence of decorated initials situated over the watermark motif, or simply because the image is out of focus.[18]
– The limited skill or dexterity of the operator can cause problems. However, the impact of this issue can be assessed, later on, by measuring the same image a second time.[19] Tests have been carried out which demonstrate that the variation between two successive measurements on the same image are entirely within the bounds of acceptability, on condition that the radiograph in question is of optimal quality.

All of the above drawbacks result in a sort of 'background noise' which cannot be eliminated. Consequently, the morphometric gap between two watermarks can never be valued at zero. One may imagine that the schematic drawings provided in the catalogues would make it possible to eliminate, or at least reduce, errors in measurements, but it should not be forgotten that one is often presented with simplified sketches (obtained through tracing) of the original watermark, and therefore errors start occurring at the outset, and worse still, cannot be identified.

As has already been mentioned earlier on, the *WILC* database currently contains roughly 1,700 letter 'P' watermarks. The ultimate goal of the project is to date *all* the editions published in Belgium and Holland whose dates are unknown, making use also of other watermark motifs that are well represented in the *WILC* database. However, since the experiment was focused above all on verifying the comparison method's potential, it was conducted under the most favourable conditions. Therefore, only 625 letter 'P' watermarks reviewed in 88 folio editions explicitly dated by their printers, and belonging to 'equivalents groups' previously identified by Gerard Van Thienen,[20] were measured. For the 625 chosen watermarks it was necessary to carry out 6,250 manual measurements and 195,000 automatic comparisons.

What, then, on the statistical plane, is the theoretical dating potential of the database '*WILC*-letter P'?[21] In order to answer this question, attestations of each

18 The lines forming an image can become 'swollen' when an image is out of focus, which results in imprecise measurements being taken.

19 Although not the same watermark in two different sheets, because the use of the mould, deformations in the watermark, and the handiwork of the vat workers can all exert an influence on a watermark's characteristics.

20 'Identical' watermarks found in one and the same edition were not included because, needless to say, their simultaneous presence is of no consequence.

21 In other words, the degree of accuracy it is possible to achieve for individual watermarks when the comparison is limited and includes only specimens that are considered 'identical'.

watermark within an 'equivalents group' were arranged in chronological order, and for each group the chronological gaps between the oldest and most recent attestations were measured.

Tab. 1 presents the results of the operation: in essence, the chronological gap within one and the same group exceeds 36 months in only 5% of cases. This means that when it is possible to compare an undated watermark with at least two others belonging to the same 'equivalents group', the most probable date will be provided by the arithmetic mean lying between the two temporal extremes, with a level of accuracy of ±18 months. It goes without saying that this result cannot be interpreted as an absolute fact—indeed, this level of accuracy relates specifically to the rate of paper consumption on the part of printers in the last thirty years of the 15th century in the Low Countries.

Probability interval between the earliest and latest examples of two 'equivalent' watermarks (tab. 1)

Months range	Cumulative percentage of watermarks
0–6	31.56%
6–12	55.67%
12–18	74.82%
18–24	86.52%
24–30	91.13%
30–36	94.33%
36–42	96.10%
42–48	96.45%
48–54	97.52%
54–60	97.87%
60–66	98.94%
66–70	99.29%

Tab. 1: Probability interval between the earliest and latest examples of two 'equivalent' watermarks

2.1 Description of the morphometric method and its efficacy

Alternatively, let us suppose that in the absence of any kind of preliminary comparison, nothing whatsoever is known about the typology and morphology of the watermarks, and therefore one has to proceed in a different way, with the following objectives in mind:

- The morphometric comparison procedure must be rapid, thorough and systematic, which means it has to be automated.
- For each watermark, the probable dating has to be suggested by the computer and interactively accepted by the scholar/researcher.
- The dates adjudged to be most likely for each simultaneously present watermark in a given edition have to contribute to its dating, thanks to the application of an automated and interactive algorithm.

As part of the experiment conducted on the letter 'P', and thanks to the descriptions provided in the *WILC* database and an autopsy of the images, all the watermarks were initially classified on the typological level. The classification was based not only on the characteristics of additional elements or the presence/absence of the same, but also according to the position and orientation of the watermark motif in relation to the mould. Information on the density of the laid lines was added to the typological data. The ten measurements were then fed into a database, together with information about the incunabulum in which the watermarks were found, with particular regard to its date. Next, the measurements obtained for each watermark were grouped into hierarchical classes and arranged in descending order (i.e. from the best to worst result) so as to ease data processing.

In a preliminary phase, all the watermarks which resulted in at least one comparison showing a morphometric gap of <21 were deemed 'useful watermarks' for dating purposes. The results obtained are presented in Tab. 2. It should be emphasised that the <21 morphometric gap criterion (MG<21) alone proved to be entirely worthless. On the other hand, the concordance of several criteria—which correspond to a situation of presumed morphometric similarity (the last column in the table)—makes it possible to improve the estimate, raising it to a ±30 months level of accuracy, with a margin of error of 5%. However, the watermarks that simultaneously fulfil all the necessary criteria represent only 28% of the total.

Results of morphometric comparisons made between 'useful watermarks' (for the purpose of dating) (tab. 2)

Morphological distance	indifferent	0	0	0	0
Morphometric distance	<21	<21	0–5	0–5	0–5
Chain lines distance	indifferent	indifferent	indifferent	≤ 0.2mm	≤ 0.2mm
Watermark position	indifferent	indifferent	indifferent	indifferent	identical
Orientation of 'P'	indifferent	indifferent	indifferent	indifferent	identical
% of useful watermarks	76.4%	51.6%	45.3%	33.2%	28.3%
Months error +/- (prob. 5%)	114	90	70	42	30

Tab. 2: Results of morphometric comparisons made between 'useful watermarks' (for the purpose of dating)

A closer analysis demonstrates that the criteria which exert the greatest influence on the accuracy of dating are the morphometric gap 'MG' and the density of laid lines. In cases where no more than two exceptions are permitted among the criteria, the level of accuracy remains practically unchanged, whilst the percentage of watermarks considered useful for dating purposes rises to 58%.

The ±30 months (i.e. ±2.5 years) level of accuracy cannot be considered very satisfactory. This relatively unimpressive result is chiefly due to an insufficient differentiation of the typological elements and the low degree of variability in the design of the letter 'P'.[22] It should not be forgotten, however, that the objective is to date not just a single sheet but an entire printed volume which almost always contains watermarks of different types (i.e. motifs) and variants within each motif type. Tab. 3 presents the results obtained from 78 editions, representing about 90% of the books included in the experiment.[23]

22 If this second factor is partly intrinsic in nature—a letter 'P' does not hold much potential for creative interpretations—it also suggests a prolonged use of the same construction patterns. In other words, for the letter 'P' there does not appear to exist a deliberate tendency to distinguish watermarks of same the design in an ever more elaborate way, whilst the opposite is observed in the watermarks found in papers originating from the Garda region used by Venetian printers.

23 The remaining 10% did not contain any letter 'P', or at least none which were useful for the purposes of dating.

Edition datings. Degree of accuracy depending on the estimation method employed (tab. 3)

Months error	Truncated averages	Overall averages
-30 -24	1.28%	2.50%
-24 -18	3.85%	5.13%
-18 -12	5.13%	7.69%
-12 -6	2.56%	7.69%
-6 -0	24.36%	23.08%
0 +6	38.46%	26.92%
6 +12	15.38%	17.95%
12 +18	6.41%	3.85%
18 +24	0.00%	1.28%
24 +30	2.56%	2.56%
36 +42	0.00%	1.28%
Total	-18 / +18 = 92.31%	87.18%

Tab. 3: Edition datings. Degree of accuracy depending on the estimation method employed

The final column in the table presents the results obtained when the likely date of an edition is reckoned to be the arithmetic mean of the dates of all the letter 'P' present on its leaves. The confidence interval at approximately 95% is ±24 months. This result, although not entirely negligible, is not altogether satisfactory. The situation improves if the mean is calculated by subtracting, respectively, the earliest and most recent dates of the simultaneously present watermarks (i.e. a truncated mean), just like in ice skating and ski jumping competitions. In the case of watermarks, this expedient makes it possible to mitigate the effect of what we can term 'motif inertia', which is to say the 'recycling' of a motif over an extended period of time. The application of this expedient makes it possible to reduce the dating range to around ±18 months (the shaded area in the table).

A further analysis of the data discloses the fact that dating errors are closely linked to the number of usable watermarks simultaneously present in a given edition. In particular, the mean error decreases considerably as soon as three or more different watermarks are available. The application of this criterion (Tab. 4) allows for the dating of 50% of the volumes to within -6/+12 months, or in practical terms, ±9 months.

Dating of editions containing more than three useful watermarks (tab. 4)

Months error	Actual percentage	Editions
-6 -0	34.09%	15
0 +6	40.91%	18
+6 +12	20.45%	9
+12 +18	4.55%	2
Total	-6 / +12 = 95.45%	44 = 50%

Tab. 4: Dating of editions containing more than three useful watermarks

This new result is truly excellent, and can only be improved on—not because the method implicitly allows for greater accuracy, but rather because it makes it possible to significantly increase the percentage of datable editions. Indeed, on the one hand, in the case of the letter 'P', the watermarks dated through the application of this method could be used, with due caution, to date other editions, whilst on the other hand other watermark motifs sufficiently represented in the *WILC* database can be subjected to the same experimental investigation.

On a trial basis, a simpler procedure was applied to the same 625 watermarks, taking as an established fact the similarities between various elements within one and the same 'equivalents group' observed during the manual comparisons carried out by Gerard Van Thienen. Excluding, as before, the dates at the extreme ends of the temporal scale, all the watermarks of a single group had allocated to them the average attestation date of the group itself, and the date of an edition was then estimated by calculating the truncated mean of all the watermarks present in it.

Tab. 5 shows that 90% of the editions can be dated with a 95% degree of likelihood to a time range of -12/+18 months (shaded area), or in practical terms, ±15 months. The result is better than that obtained using the morphometric method. There are two reasons for this: (a) the greater reduction in the 'design inertia' effect, and (b) the almost certain similarity among the watermarks belonging to one and the same group. It should be borne in mind, however, that the manual work required to sort 'similar' watermarks into groups is very time-consuming.

Dating of editions through 'equivalence groups' (tab. 5)

Months error	Actual percentage	Editions
-36 -30	1.28%	1
-18 -12	3.85%	3
-12 -6	8.97%	7
-6 -0	26.92%	21
0 +6	34.62%	27
6–12	15.38%	12
12–18	8.97%	7
Total	-12 / +18 = 94.90%	78 = 88.60%

Tab. 5: Dating of editions through 'equivalence groups'

If one considers only the editions that include three different equivalents groups (Tab. 6), the result obtained will improve considerably, with the range decreasing to ±8 months, with scarcely any margin of error.

On the other side of the coin, since the simultaneous presence of numerous groups is even more improbable than that of numerous watermarks (a group, in fact, includes two or more watermarks), the percentage of datable editions descends to just 25%.

Dating of editions through 'equivalence groups'. Editions involving at least three groups (tab. 6)

Months error	Actual percentage	Editions
-8 -4	13.64%	3
-4 0	31.82%	7
0 +4	40.91%	9
4 +8	13.64%	3
Total	-8 / +8 = 100%	22 = 25%

Tab. 6: Dating of editions through 'equivalence groups'. Editions involving at least three groups

Even so, broadly speaking it may be said that the results obtained are rather encouraging.

References

Atanasiu, Vlad (2004), 'Assessing Paper Origin and Quality by Means of Large-Scale Laid Lines Density Measurements', in Graziaplena, Rosella, with the assistance of Mark Livesey (eds), *Paper as a Medium of Cultural Heritage: Archaeology and Conservation*. 26th Congress IPH, Roma: Istituto centrale per la patologia del libro (Addenda, 5), 172–184.

Briquet, Charles-Moïse (1968 [1907]), *Les Filigranes. Dictionnaire Historique Des Marques Du Papier Dès Leur Apparition Vers 1282 Jusqu'en 1600. A Facsimile of the 1907 Edition with Supplementary Material Contributed by a Number of Scholars*, I–IV. Edited by Allan Stevenson, Amsterdam: Paper Publications Society, 1968, 1st edition, Genève, Paris: Alphonse Picard et fils.

Gerardy, Theo (1964), *Datieren mit Hilfe von Wasserzeichen*, Bückeburg: Grimme.

Grosse-Stoltenburg, Robert (1965), 'Beiträge zur Wasserzeichenforschung. Technische Varianten bei der Fertigung der Drahtform', in *Papiergeschichte*, 15: 73–79.

Ornato, Ezio / Busonero, Paola / Munafò, Paola F. / Storace, Maria Speranza (2000), 'Un procédé de datation des documents graphiques fondé sur la resemblance morphométrique entre les filigranes', in *Papiergeschichte als Hilfswissenschaft*, 23, Kongreß der Internationalen Arbeitsgemeinschaft der Papierhistoriker (Leipzig 30th August – 5th September 1996), Marburg: IPH Editions (IPH Congress Book, 11), 61–75.

Ornato, Ezio / Busonero, Paola / Munafò, Paola F. / Storace, Maria Speranza (2001), *La carta occidentale nel tardo medioevo*, I–II, Roma: Istituto centrale per la patologia del libro (Addenda 4).

Manufacturing techniques

Paola Busonero

Quiring in Manuscripts of the Late Middle Ages

1 Introduction

Over the last few decades, ever increasing attention has been paid to the codex's various material characteristics. Codicology, which is to say 'la discipline qui étudie le livre manuscrit en tant qu'objet matériel', has produced noteworthy results in a number of areas.[1] In the present contribution, we would like to address a particular aspect, namely the structure of the quire,[2] whose importance in the domain of the archaeology of the book should not be overlooked. Indeed, every codex is the product of an ensemble of elements which are closely correlated, and therefore the choice of a particular type of quire is inevitably linked to other constituent parts of the manuscript—the writing support being the most obvious one.

In reality, the study of quiring can be pursued in order to fulfil a number of different aims. These may lie within the ambit of wide-ranging research and be focused on the history of the codex in general, or instead on a certain type of manuscript.[3] Alternatively, the study of quiring may constitute the subject of an *ad hoc* analysis aimed at investigating the composition of quires in specific

Translated from the Italian into English by Mark Livesey. Original published as Busonero, Paola (1999), 'La fascicolazione del manoscritto nel basso medioevo', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 31–139.

This research was originally envisaged as a specialisation thesis at the 'Scuola di specializzazione per conservatori di beni archivistici e librari della civiltà monastica' at the University of Cassino (April 1995). Particular thanks are due to Ezio Ornato, who oversaw the planning and preparation of this work, and to Marco Palma, who inspired its conception and followed its realisation at every step of the way.

1 For a *status quaestionis* on codicological studies, see Derolez 1995, *passim*.

2 Here, we do not wish to enter into the lively debate as to whether the bifolium or the quire represents the basic 'building block' of the codex. For an overview of the topic, see Zappella 1994, 17–54 *passim*.

3 Turner 1997, 55–71; Derolez 1984, I, 33–39.

https://doi.org/10.1515/9783110743838-008

manuscripts whose origin and date are known; on the other hand, it may be part of research focused on the construction of the quire itself.[4] In many instances, the structure of a codex is studied primarily with the aim of solving problems in relation to textual tradition.

Before providing some basic information on the development of quiring from the birth of the codex up until the 12th century, so as to acquaint ourselves with the period that will be the focus of this contribution, it will be useful to mention some works dedicated to the quire viewed as a material product, and therefore as a manufactured object which came into being as a result of a series of carefully considered technical choices. The first research initiatives carried out in this area are closely associated with Léon Gilissen, who proposed a theoretical quire construction technique consisting in the folding of skins. Simply stated, the scholar held the opinion that the quaternion, which is the gathering most commonly observed in parchment codices, derives from a single skin folded thrice so as to create an in-octavo format, or from two skins each folded twice to create an in-quarto format.[5] Providing evidence for the initial solidarity of the skin were, supposedly, various irregularities (also present in non-contiguous leaves), such as striations and holes, etc., the observation of which should make it possible to ascertain the way in which the skins were worked and folded so as to create the quire.

As Bozzolo and Ornato have shown, such a hypothesis regarding the prefolding of skins is not only logical but also entirely compatible with the trend in size and proportion seen in Latin codices,[6] which 'vary in such a way so as to present average values that largely speaking correspond to the variations in height and width produced in the original unit of writing support after successive folding'.[7]

The sequence of steps by means of which one can produce a quire according to Gilissen's reconstruction was subjected to scientific verification by Piero Bozzacchi and Marco Palma,[8] who in it exposed a number of weaknesses. Assuming to be valid the fundamental proposition that a quire is formed from a

4 Bozzolo / Ornato 1980, 123–212 ('La constitution des cahiers dans les manuscrits en papier d'origine française et le problème de imposition'); Gilissen 1977, *passim*; Bozzacchi / Palma 1985.

5 Gilissen outlines four folding possibilities for the in-octavo types, to which an equal number of formulas correspond, and two for the in-quarto types, formulas A^2 and C^2.

6 Bozzolo / Ornato 1980, 215–351 *passim*.

7 Bozzacchi / Palma 1985, 328.

8 Bozzacchi / Palma 1985, 325–336.

pair of skins,[9] the two scholars hypothesised that the sequence of steps deemed to be the most natural with respect to those imagined by Gilissen was preceded by the cutting of the parchment[10]—in a perpendicular direction along its main axis—so as to immediately obtain two bifolia. This expedient, whilst respecting the formula proposed by Gilissen, would also make it possible to carry out with greater ease the steps required to prepare the quire to receive script (i.e. ruling and pricking).

A series of studies by Frank M. Bischoff[11], which will be discussed in due course in the current contribution, is dedicated to parchment as a constituent element of the quire; as such, parchment is closely linked to the qualitative choices made during the manufacture of a volume. These choices will also be examined in the present contribution. Bischoff, in collaboration with Marilena Maniaci, has also recently undertaken an investigation of the dimensions of skins and the formats derived from them, and of the folding methods which lead to the formation of quires.[12]

Up to this point, we have spoken of the archaeology of the quire from an experimental perspective, but in order to set the study of quiring within a historical context we will have to refer to the research carried out by Bozzolo and Ornato, who were the first scholars to examine the variability of quire formation from a quantitative perspective by linking it to other parameters. We have already mentioned their contribution to the validation of the hypothesis as regards skin folding for the construction of quires, but it should be added that the same verification procedure was also applied to paper manuscripts.[13] Indeed, the two scholars carried out an *ad hoc* study of the making of quires in French paper codices, the results of which will be examined later on in the section dedicated to the relationship between quire formation and book format.[14]

An attempt to form an overview of the development of quiring from the birth of the codex up until the Late Middle Ages can certainly adopt as its starting point, with respect to the first centuries of manuscript production, Eric Turner's observations. It is to him that we owe, as part of the vast amount of

9 The verification was carried out using Gilissen's formula A^2, which relates to the in-quarto types.

10 According to Gilissen, the leaves were delivered to the scribe either one at a time or progressively, depending on his need for them during the copying process, or even at the time of binding, if the quire was copied using the 'imposition' method. See Gilissen 1977, 15–41.

11 Bischoff 1991; Bischoff 1994; Bischoff 1993.

12 Bischoff / Maniaci 1995.

13 Bozzolo / Ornato 1980, 254–263.

14 Bozzolo / Ornato 1980, 123–212.

research on the oldest papyrus and parchment codices, a picture of the various types of quiring employed in the period extending from the 2nd to 6th centuries CE.

From this overall picture one can infer the extent to which the choice of quaternions was favoured from the earliest times. We can count 14 examples in papyrus and 8 in parchment, even if quinions 'are in the early period a strong rival to fours',[15] with 8 examples in papyrus, and 3 in parchment, whilst senions start to appear from the 3rd century CE onwards. According to Turner, at a certain point in time the quaternion became the standard structure in the manufacture of codices[16], to the extent that almost all the codices dating from the 4th to 6th centuries included in the *CLA* (*Codices Latini Antiquiores*)[17] lists are composed of quaternions. However, this predominance manifests itself over an extended period of time: in fact, based on Turner's data, no codex structured entirely in quaternions emerges before the 4th century CE.

In actual fact, Lowe, in the introduction to the first volume of the *CLA*,[18] where he provides some information on the categories that appear in the descriptions of codices, affirms that, for the period he studied, the quaternion represents the rule. The quinion is seen in only a few very ancient classical codices,[19] and in codices originating from insular production centres.[20]

For our part, we carried out a perusal of the *CLA* listings, with the aim of determining the number of codices that present with structures other than the quaternion: 36 examples formed from quinions were found, and 6 from senions.

To these we can add 23 codices which are mostly formed of quaternions, but in which quinions and senions also appear (or both), and 20 codices that do not contain a predominant type of quire structure, but which in the bulk of cases contain both quaternions and quinions. As is plain to see, apart from a certain number of instances in which quinions present in the majority (as has already been mentioned), and except for some very ancient codices, or ones which originate from the insular context, the overall picture is rather uniform, with a struc-

15 Turner 1977, 62. According to Colette Sirat, a link may exist between the use of papyrus and the structuring of codices in quinions. On this subject, see Sirat 1998, *passim*.

16 In fact, the word quaternion would be assigned the generic definition 'quire'. In the 15th century, on the other hand, the humanists used the terms *quaternion*, *quaternus*, *quinternio*, *quinternus* and *sexternus* indiscriminately to mean 'quire'. See Rizzo 1973, 42–47.

17 An overview of the exceptions to quiring in quaternions that appear in the *CLA* will be provided in due course.

18 Lowe, *CLA* I, p. X.

19 Lowe, *CLA* I 12, 74, 115.

20 Lowe, *CLA* I 78, 87.

ture based on quaternions proving overwhelmingly to be the most widely adopted one.

Jean Vézin's observations, which can be read in his essay of 1978 on *La réalisation matérielle des manuscrits latins pendant le haut Moyen Âge*, are largely speaking in agreement with what has been stated up to this point. In particular, regarding senions, the scholar makes it clear that this type of quire was frequently adopted from the 13th century onwards, attributing the increase in the number of leaves per quire—reaching twenty-four, in the case of Bibles—to the use of parchment which was thinner and less rigid.[21] Quaternions, on the other hand, would continue to be used even in the printed book.

The history of the manufacture of the codex from the 9th to 11th centuries —at least with respect to the question of quiring—does not seem to present any radical changes. As regards the end of Early Middle Ages, we can adopt as a foundation the information that emerged in *La structure matérielle du* codex *dans les principales aires culturelles de l'Italie du XIe siècle*, a research initiative aimed at investigating the material characteristics of codices produced in Italy in the 11th century. In a sample composed of 326 codices (11 Atlantic Bibles, 100 Beneventan manuscripts, 94 Carolingian, 61 Greek, and 60 volumes in so-called 'romanesca' script), the quaternion proves to be the rule in 95.06% of cases, with no appreciable differences between one group and another, or within sub-groups—created by subdividing the overall sample based on certain characteristics, such as size, thickness, and so on.[22]

In order to obtain a further glimpse of the situation as it was in the 11th and 12th centuries, the latter being the so-called 'Renaissance century',[23] still in relation to the manufacturing choices that prevailed in codex production, it will be useful to refer to Birger Munk Olsen's well-known work *L'étude des auteurs classiques latins aux XIe et XIIe siècles* for the period in question. His review, besides offering a highly pertinent reference point for those wishing to carry out philological studies, enables one to gather information about the physical characteristics of the codices, since each of them—either fully or partially, as the case may be—is provided with a codicological description. In the present con-

21 These notions were briefly revisited in Vézin 1998, 99–100.

22 Bianchi et al. 1993b, 412–413.

23 Haskins 1972, *passim*. In the 12th century, among the large number and multifarious aspects that characterised the flowering of culture were the revival and development of an interest in the Latin classics (though it should be acknowledged here that the true rediscovery of classical heritage occurred in the 11th century), resulting in a remarkably high production of manuscripts, which Munk Olsen provides a detailed panorama of in his work (Munk Olsen 1982–1989).

text, we should emphasise the fact that the vast majority of manuscripts described are composed of quaternions.

Now that these initial observations have been made, we have almost arrived at the threshold of what will be the domain of the present contribution. The overall picture of manufacturing techniques used in books appears to be fairly uniform throughout the entire 12th century, even if the said period is particularly rich in cultural stimuli and presents new *facies* with respect to the institutions involved in the oversight of high culture. In fact, over the course of the 12th century, a revolution in education and the organisation of knowledge took place which saw the emergence of the first universities, and therefore the shifting—so to speak—of the scriptoria from the monasteries to the cities. This change saw its most tangible results in the 13th century, the moment a decisive crossroads was reached in the production and use of knowledge. Also seen were considerable changes in the preparation and manufacturing techniques used in the codex: one has only to think of the *pecia* system to get an idea of the innovations that occurred. The book increasingly became an indispensable work tool; hence it was produced using methods that were very different from those employed in the Early Middle Ages.

The new significance taken on by the codex and the modifications that this brought to its various components—be they textual, graphic or material[24]—have been amply studied from many different points of view. During the course of the present contribution, we shall seek to deepen our knowledge of quiring, a rather particular aspect of the codex which is perhaps somewhat peripheral, but not entirely secondary, inasmuch as it exerts an impact on the way the manufactured object-book presents. Anyone with an interest in the archaeology of the book will certainly be aware of how, in the 13th and 14th centuries, the structure of the codex underwent various changes. Indeed, side-by-side with quaternions, different types of quire appear, such as quinions and senions—although the quinion proves to be indissolubly linked to the humanistic codex of the 15th century.[25] Other forms appear too. In fact, in various studies—not least in those which we have just taken a look at—it is possible to find some indications regarding the manufacture of codices in the Late Middle Ages or, more particularly, the quiring of a certain type of manuscript. However, what appears to be lacking is an overall picture of the phenomenon that takes into account the evolution of quiring in relation to the various countries of Europe,[26] and also in

24 Le Goff 1979, 87–90.

25 Derolez 1984, I, 33–39.

26 The investigation chiefly covered England, France, Italy, Germany and the Low Countries.

relation to the codex's other components. Therefore, starting out from these observations, we have posed the following questions:

a. What was the make-up of the quiring 'landscape' in Europe starting from the end of the 12th century and extending up until the end of the 15th?
b. When and where—in other words, in which countries—did the shift from quaternions to other types of quires occur? And why did it occur?[27]
c. What was the role played by some widely employed typologies, such as quinions and senions?
d. Does quiring interact—and to what extent—with specific variables, such as the support, textual typology, and others?

To answer such questions, it was necessary to base our research on a rather large sample of manuscripts—indeed, the largest sample possible, so as to be able to obtain a sufficiently broad view of the situation, both synchronically and diachronically. Accordingly, the method that seemed most appropriate to employ in order to fulfil the requirements of the present contribution was the quantitative one, given its particular degree of adaptability when working with large corpora, even if the subject of the present research is best known from the qualitative standpoint.[28] In fact, the analysis that will be carried out here does not call for the use of well-known statistical parameters,[29] which broadly speaking form the basis of quantitative analyses.[30]

1.1 Description of the corpus. Choice of variables. Database design

Given the broad scope of the investigation, it is obvious that the corpus of manuscripts to be examined would potentially have to include all the parchment or paper codices produced in England, France, Italy, Germany and the Low Countries between the mid-12th and 15th centuries.[31] Such a sample—which can only

27 Concerning this issue, see Derolez 1995, 377.

28 Even if one is still dealing with a *quantity*: in other words, the number of bifolia that make up a quire.

29 The distribution of the frequency, the average, the variance, etc.

30 In fact, in order to work in the field of quantitative codicology it is not sufficient merely to apply statistical methods or to use particularly large samples. Regarding the notion of quantitative codicology, the purposes to which it is put, and the methods employed, see Ornato 1997, *passim*.

31 This topic has already been addressed by Busonero in Busonero 1995, *passim*.

be conceived of in theory—is out of the reach of an individual researcher who wishes to carry out his or her inquiry within an acceptable length of time. Therefore, in order to combine the need to provide answers to the questions posed above (without renouncing the possibility of working on a sufficiently large and representative corpus, since only one of this kind is suitable for our purposes), and to make it possible to contain the work within a reasonable timeframe, it was necessary to make use of 'second-hand' data—that is to say information gleaned from manuscript catalogues.

In truth, foregoing the possibility of scrutinising the relevant material was not easy to accept without feeling a certain amount of regret, since only a *de visu* examination of the codices would make it possible to guarantee the disclosure of 'all the variables considered pertinent to the research, based on an unambiguous surveying protocol established in advance',[32] so as to obtain a sample of uniform and compatible data. Therefore, in this initial phase of the study the decision was made to forego investigating the phenomenon in the most complete and exhaustive way. Instead, it was decided to collect all the details which seemed, at the outset, to be noteworthy, with the goal of building a comprehensive overview of the situation to serve as a background for all further hypotheses or in-depth analyses.

Once the 'catalogue' option had been embraced as the only feasible way of identifying and analysing a sufficiently large, and at the same time accessible sample of manuscripts, the second step consisted in the selection of the sources to sort through. The sorting process was based on the prerequisite of identifying the variables that were considered indispensable—or at least useful—to the research, since the choice could only be based on the presence or absence of these.

The discriminating criterion initially applied to identify useable material was, needless to say, information on quiring, either expressed in a complete form (i.e. through the provision of information on each constituent quire type present in the codex), or by specifying the predominant quire type.

Following an initial survey carried out on a few hundred volumes, approximately 190 catalogues emerged which met the aforementioned essential prerequisite.[33] How, then, could this number be further whittled down to arrive at a

32 See Busonero 1995, 13.

33 The reader should note that since 1994 (the year in which data collection was completed) the number of available printed catalogues has greatly increased, and therefore also the possibility of identifying suitable material for this type of research. To provide an example, we can cite Clairvaux's catalogue, in which it was possible to consult, in draft form, the codicological descriptions of volumes listed under the letters, C, F, I, thanks to the acquiescence of the authors.

definitive corpus to focus on? Clearly, the basic precept for achieving this goal consisted exclusively in assessing the richness (greater or lesser) of the catalogue descriptions with respect to the information considered indispensable, or at least relevant, to the present investigation—in other words, with respect to the variables it was presumed might usefully be correlated to quiring.

This consideration naturally implies the need to devise a survey form to gather all the variables in question, and the drafting of an examination protocol which determines the way in which data is collected. As we have already pointed out, a codex represents a combination of elements which are intimately connected to each other, and therefore one should not—in the first place, at least—neglect or omit any parameter, given that all of them could potentially interact with a volume's quiring. Therefore, it was decided to include in the datasheet the largest possible number of variables, compatible, of course, with the type of information that one can reasonably expect to find in a catalogue (in the sense that a characteristic like pricking might seem to be of great interest, but the possibility of investigating it in the absence of a first-hand examination of the item would be virtually nil).

Needless to say, among the variables there exists a hierarchy of importance. Therefore, along with information on quiring, it was considered indispensable that the catalogues should furnish information on both the codex's country of origin and a dating accurate to within, at minimum, half a century.[34]

In theory, the development of a survey form and an appropriate surveying protocol might on first consideration seem like a task that should not present many problems. However, in our case it turned out to be a rather complicated proposition, to the extent that, despite having attempted to foresee all the possible scenarios, it proved necessary to make adjustments and revisions as the work progressed.

Here, we present a summarised version of the variables covered by the survey form (the reader can find a completed specimen form and the surveying protocol in the Appendices attached to this contribution).[35]

---

34 Initially, it was thought that it would be enough to date works to within a century, but it was soon realised that this would make it impossible to track the evolution of quiring in a sufficiently precise way. On the other hand, one obviously cannot expect that all datings in a catalogue be accurate to within half a century; rather, the basic criterion should be to indicate datings as accurately as possible. At the time of the data collection, datings that fulfil this prerequisite were taken into consideration (apart from a few exceptions which, indeed, relate to the initial phase of the research).

35 See Appendices II and III.

a. General information on the codex (shelf mark, catalogue, writing support, size).
b. Information useful for locating the volume in time and space (dating, place of production, scribe).
c. Information regarding the text and language (text typology, principal author, principal text, language of the text, prose or verse form).
d. Material characteristics (number of leaves, dimensions of the leaf and written area, layout type, number of lines, quiring, catchwords, quire signatures, ruling technique).
e. Information on the type of script employed and on decorations (presence of initials, illustrations, framing etc.).
f. The codex's 'life history' (patron, client, first owner).
g. Observations.

The definitive corpus of the catalogues to be employed is therefore composed of the elements that best match the parameters summarised above. As we have previously stressed,[36] included among the criteria that guided the choices we made was a balanced representation of all the countries taken into consideration, a variety of manuscript typologies, and a good representation of the entire period examined—i.e. from the middle of the 12th century up to and including the entire 15thcentury.

Given that we obviously could not demand that each individual catalogue should conform to all the requirements, an effort was made to ensure that the sample as a whole met them.[37]

Once the corpus to be examined has been identified and the survey data form transferred into a database,[38] one might reasonably expect that the next step—the acquisition of data—would be an essentially mechanical process, in that it consists in simply applying, with due diligence, the observation protocol. In reality, though, the process of extrapolating data from catalogues is subject to limitations arising from the initial premise, namely the decision to utilise second-hand information that originates from very different sources and was obtained using a different set of criteria and collection methods.

36 Busonero 1995, 14–15.

37 See Appendix I.

38 The survey form was computerised using the Dbase IV program to create a database. Once they had been collected, the data were transferred on to a spreadsheet using Excel 5.0 software. Further data processing was carried out using the same software.

1.2 Variables

The difficulties that one may encounter are roughly speaking three:

- Variables that are very seldom encountered (e.g. the leaf format—in folio, in quarto, etc.—or ruling).
- Variables identified though uneven descriptive criteria (e.g. script type, decoration, catchwords, quire signatures).
- Non-systematically surveyed variables within one and the same catalogue (e.g. catchwords, quire signatures, ruling).

This classification is intended only for illustrative purposes, given that the various issues frequently appear interspersed among each other.

In order to clarify what has been said above, we can briefly focus on the description of ruling as a concrete example. In some catalogues, this parameter is entirely absent,[39] whilst in others, even if it is mentioned, it is not always specified, in cases where two different techniques are indicated, which technique refers to the horizontal ruling, and which to the vertical justification. In Ker's four catalogues, which without doubt figure among the most important sources of information for this research, the ruling technique is regularly indicated only for the period when the shift from 'blind ruling' to 'colour ruling' occurs. Catchwords and quire signatures are also only referred to by Ker in certain cases: catchwords only get mentioned in the period when they were introduced, which occurred roughly between 1100 and 1150. From then on, according to the scholar, their use became so generalised that their possible absence can be attributed to a mechanical blunder, such as excessive trimming.[40]

Quire signatures are recorded by Ker mainly for the period spanning the mid-12th up to the 14th century. It is obvious that in both this and the previous case (i.e. catchwords) the choices made by the author were determined by unquestionably valid historical and palaeographical considerations, but unfortunately they are not applicable (or at least not usable) in a systematic study of the phenomena based on statistical methods that call for comparable information which is consistently and 'aseptically' surveyed—i.e. without making an *a priori* selection.

By and large, neither catchwords nor signatures are included among the data present in catalogues. When they are indicated, this is done in several ways:

39 For example, ruling does not appear in Mynors, *Balliol*, and in Thurn, *Würzburg II–1–2*, whilst in Kuttner I and II it is not indicated in a systematic way.

40 See Ker I, IX–X.

these range from a simple mention of their existence—in Mynors, *Balliol*, one sees the terms 'catchwords and signatures'—to more accurate descriptions, such as those which appear in the *M.C.L.P.D.F.*, where not only the presence but also the absence of such parameters is noted. In order to be able to study the phenomena and their development by applying the appropriate distinctions—both synchronically and diachronically—it would be necessary to know, in the case of catchwords, at least their position in the margin,[41] whilst for signatures their type would have to be specified (quire signatures, quire and leaf signatures, and so on).[42]

The approach to illumination—which will be taken up again later on in the data analysis section—merits its own discussion: in fact, the decorative apparatus of a codex, whenever it is endowed with one, is described in practically all catalogues. Unfortunately, though, it is not easy to obtain readily comparable data from such descriptions, because not only is the lexicon not unambiguous, but it is also possible that one and the same definition—for example, 'illuminated initial', often employed in concise descriptions—can refer to two very different situations.[43] Better characterised typologies, too, such as historiated initials, can be referred to in different ways, but even where descriptions are very precise, it is still difficult to establish, beforehand, valid criteria to group them into typologies. In fact, depending on what one wishes to learn from decorations—such as, for example, an assessment of the greater or lesser quality of a codex—it is advisable to define case-by-case comparison parameters, whose application would obviously necessitate a hands-on examination of the sample under consideration.[44] In the present research, given that we had to deal with a very wide range of situations—which cannot, moreover, be confronted directly—it became necessary, as can be seen by looking at the observations protocol, to create drastically simplified groups, both with respect to initials[45] and to the other parameters relating to the decorative apparatus, so as to avoid losing information (in the acquisition phase, at any rate).

41 See Kuttner I and II.

42 Sufficiently precise descriptions of signatures can be found in: Frioli, *Aldersbach*; *M.C.L.B.P.F.*; Leonardi, *Vaticani*; Wilmart, *Vaticani*.

43 For a definition of the term 'ornamental initial', see Maniaci 1996 (1998[2]), 320. One finds this term used in a generic way for initials executed with differing degrees of graphic complexity, and sometimes for those which can be given a more specific definition.

44 This is also the case when one wishes to use more detailed records of ornamental initials, but ones which have already been codified–see Maniaci 1996 (1998[2]), 317–322. A direct examination of the codex is necessary, in any event.

45 Rubricated, pen-flourished, illuminated and historiated initials.

1.3 Data analysis

The fundamental condition that any kind of quantitative analysis requires, namely to be based on data that are uniform and which can readily be compared, makes it necessary to homogenise information (so that it 'fits' into the fields on the survey form) when the data prove not to be immediately usable in the form in which they are provided in catalogues.

In other words, there are a several variables, such as the size of leaves and of the written area which, when they appear, are readily usable in the form in which they present,[46] whilst others, such as those discussed above, have to undergo a simplification process.

As an example, we can again use the subject of ruling: the captions 'leadpoint', 'pencil lead', 'graphite' or 'pencil' are all included under the all-encompassing entry *lead*.

Once the collection of the relevant material has been completed, at the point where one moves on to the next phase of data analysis, which is to say the discovery of the relationships that link the individual variables to one another, and in particular to quiring, it is necessary to make a further effort to rationalise the data in order to render them comparable and therefore analysable.

For our research, then, the main expedients adopted were as follows:

a. Datings, straddling two centuries, were always placed in the last quarter of the earlier of the two.[47] This was chiefly done to avoid introducing excessive deviations in the overall sample, with respect to the 12th century. For the 13th and 14th centuries the problem does not arise, since, as we shall see, the last decades of the former and early part of the latter are frequently comparable in terms of quantity and modes of production. Needless to say, when the earlier century is chosen, one runs the risk of ante-dating certain manu-

46 Mynors', *Balliol*, measurements in inches have (obviously) been converted to millimetres.

47 In the case of codices straddling the two centuries, four possible strategies can be adopted: The exclusion of this type of manuscript. In this way one can eliminate at source any possibility of committing an error, although a large number of volumes would be overlooked. Choosing by coin toss the century to date the manuscript to. From the statistical point of view, this is the ideal solution, since it guarantees a success rate of 50%, and above all eliminates the possibility of systematic distortions occurring. The inclusion of the manuscripts in the sample twice (for each century). Needless to say, this solution would create problems when processing the data, chiefly when surveying each century, since the same manuscript will always appear twice. Choosing, consistently, one of the two centuries. This was the solution settled on: in fact, it results in the same probability of success as the second option (i.e. 50%). See Bozzolo / Ornato 1980, 234–235.

scripts, and potentially, as a consequence, some of the phenomena, but this does not invalidate the results obtained.[48]

b. The geographic areas considered in the present research are: England, France, Italy, Germany and the Low Countries. In effect, we also inserted codices produced in other countries, but which in any event can be included in same area of origin so as not to create an excessively fragmented corpus and to always generate sub-groups of a certain size.
The countries were grouped together in the following way:
e = England, Wales and Scotland
f = France
i = Italy
pb (Paesi Bassi, i.e the Low Countries) = Belgium (broadly speaking, i.e. without distinguishing between Flanders and Wallonia), Flanders, Holland and Wallonia
pg = (Paesi germanici, i.e. Germanic countries) = Austria, Bohemia, Moravia, Germany, Slovakia, Switzerland.[49]

c. The textual typology was limited to the few classes listed in the surveying protocol. Some choices were made at the outset, such as including among the theological manuscripts only university scholastic works, since these are very well characterised from both textual and codicological standpoints in the strict sense—e.g. parchment, size, *mise en texte*, *mise en page*—or by placing a work such as the *Legenda aurea* within the sacred literature category rather than within theology *lato sensu*, for the reasons stated above. Thus, all the works, and hence all the codices, which could not be defined as scholastic, were listed among the sacred literature.

d. An effort was made to standardise the given name and surname of the author/authors by recording them, wherever possible, in their Latin form (e.g. Torquemada becomes Turrecremada, and so on).

e. With respect to quiring, in cases where there was no predominant quire type—i.e. half the volume plus one element—the decision was made to consider the most represented type of quire the predominant one. This was done because at the data analysis stage it is in any event useful to have a

48 See Bozzolo / Ornato 1980, 235. However, it should be borne in mind that the break between the two centuries is artificial, and furthermore that the manuscripts produced in the early years of the century would broadly speaking exhibit the same codicological characteristics and manufacturing techniques of the previous century.

49 Throughout the contribution, we shall adopt the terms 'German area' and 'Germany' when referring to the relevant geographical area.

benchmark that represents the favoured type of quire, even if it is not in the majority. In the case of codices presenting with large and irregular quires (generally those made from paper), the decision was made to indicate them as -1.

f. Concerning the script, a sort of merging strategy was adopted which could potentially raise serious doubts. However, this approach did not remotely presume to represent a script classification model; rather, it was merely intended as a way of rendering the collected data comparable by starting out from a few assumptions. It seemed appropriate to unite within a single group—generically named *textualis*—all the varieties of 'slow' *testuales* (*textualis posata*) encountered (that appear in the catalogues in various wordings), with the exception of *rotunda*. On the other hand, the group named *textualis corsiva* includes all the scripts that share a cursive *ductus*, apart from *mercantesca*, which is considered separately. The humanist scripts are collected into two large categories, namely *umanistica rotunda* and *umanistica corsiva*.

Accordingly, the following categories were adopted:

t = *textualis*, which includes: Gothic, *gotica libraria*, French Gothic, Italian Gothic, *Parisiensis*.
rot = *rotunda*, which includes *Bononiensis*,[50] *textualis rotunda*.
tc = *textualis corsiva*, which includes *anglicana*,[51] bastarda, business hands, chancery hand, cursive, library cursive, *textualis cursiva*, secretary hands.[52]
umr = *umanistica rotunda*, which includes *antiqua*, proto-humanistic script, humanistic, *umanistica libraria*
umc = humanistic cursive.
mer = mercantesca.

50 Concerning the possibility (or impossibility) of characterising the *littera Bononiensis* in the context of the *rotunda*, see Tomiello 1992–1993, *passim*.

51 Concerning the definition of *anglicana*, see Ker I, XI. This cursive script originated in the 12th century as 'the ordinary hand of correspondence' and does not exhibit, at least initially, any characteristic which could justify calling it 'English'. However, with the passage of time it became more uniform and developed some peculiar characteristics. In the 14th and 15th centuries, in its model forms, it was adopted in place of Gothic script to lay down texts in codices: it is precisely this form, the so-called non-current anglicana', that Ker refers to using the generic term *anglicana*. To learn more about the history of this kind of script, see Parkes 1979[2].

52 *Business hands* and *secretary hands* are definitions that appear in Ker's catalogues I–IV.

Before examining the results obtained, it should be made clear that not all the information collected has been used in the present research, and that not all the analysed data will be taken into account.[53]

Harvested but unused information includes specifics on the origin of the manuscript—in fact, in addition to its country of origin, details concerning its geographical zone (e.g. northern, southern, etc.), region of origin, city and associated institution are sought—as well as data relating to its history, which is to say details on the scribe, patron, client, owner, etc. Such data were not directly used in the current phase of the research, but could serve as a useful foundation in the future to develop and conduct a closer and more in-depth investigation, once an overall picture has been drawn.

Catchwords are an example of a feature which has been analysed, but will not be discussed in this contribution. In fact, merely their presence or absence was noted; any statistic that locates them within a margin would not be significant, since there are too few cases in which their position is explicitly specified. Thus, such a generic parameter was not considered particularly relevant in relation to quiring.

In the case of quire signatures, too, we were unable to make any comparisons because the collected data proved to be too patchy and lacking in uniformity.

Concerning the script, notwithstanding the groups created, it was not possible to identify any sufficiently clear trends, because in spite of the large number of manuscripts considered, this parameter is only furnished in a few catalogues, and therefore the number of instances surveyed was not sufficient to identify meaningful divisions that were not due to structural effects.[54] Additionally, one should always bear in mind that the script can depend on the type of text, which in turn—as we shall see—seems to be more directly correlated to quiring than to the writing itself.

Decoration, too, does not appear to be a parameter that can immediately be correlated to quiring, in that it seems to be (and in fact is) linked, above all, to the type of text. Practically speaking, in order to ascertain whether or not links exist between quiring and the decorative apparatus, it would be necessary to isolate all the other variables which could potentially—or explicitly—interact with quiring, so as to be able to demonstrate the extent to which the two parameters exert a

53 Data which do not reveal sufficiently significant trends are not closely analysed.

54 The differences observed could stem from the composition of the sample in its subdivisions. For example, in the 15th century quinions made from paper and quinions made from parchment written in Humanistic script.

direct reciprocal influence. This is a task that would cause us to stray too far from our stated objective.

2 The evolution of quiring

2.1 The corpus

The corpus of manuscripts upon which our investigation is based is composed of some 3,410 individual codicological units. Specifically, the items representing each century number as follows:

- 12th century = 386 manuscripts
- 13th century = 637 manuscripts
- 14th century = 620 manuscripts
- 15th century = 1,767 manuscripts

It should be borne in mind that in these total numbers are included a number of codices—albeit very few—dated to within a century, rather than to within half a century.[55] It can therefore happen that in the analysis phase when, for example, the items from the 15th.1 and 15th.2 centuries are added together, a total of 1,767 is not reached, but instead a slightly lower number.

It can also happen that for a given century a number of units lower than the one listed above can appear. This may occur in instances where only certain variables are considered rather than all of them—for example, codices formed exclusively from quaternions, quinions or senions, excluding the presence of other types of quire.

2.2 The overall diachronic picture

The picture that emerges from the analysis of the collected data relating to the 12th century largely confirms what we had expected, namely that this period, despite being replete with cultural turmoil and harbingers of great changes in relation to the institutional oversight of cultural activities, did not produce any particularly noteworthy innovations with respect to the material structure of the codex. The predominance of the quaternion over other types of quire is over-

55 See what has previously been stated regarding the variables.

whelming (see Chart 1), even if a small presence of quinions appears, representing 3% of the total sample.

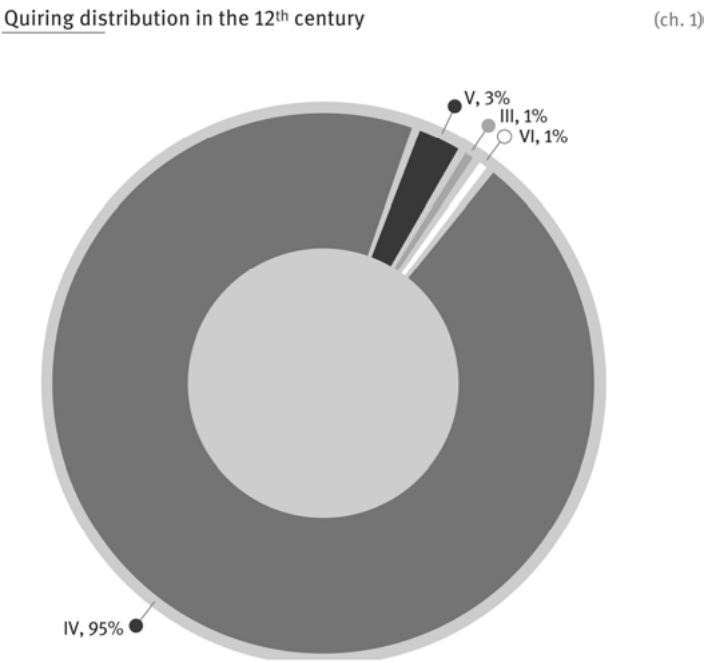


Chart 1: Quiring distribution in the 12th century

By contrast, the 13th century introduces a clear change in the choices that guide the manufacture of the codex. The situation appears very different in comparison to the previous century: indeed, one is struck by both the clear decline in the use of the quaternion, which falls from 95% to less than 40%, and the appearance of new types of quire (see Chart 2). One notes, in particular, a strong presence of seniones—whose usage rate proves to be greater than that of quaternions—together with a certain quota of quinions, representing 10% of the total sample. The remainder of the output centres on other types of quire, among which particularly thick ones stand out (these are formed from eight, ten or twelve bifolia).

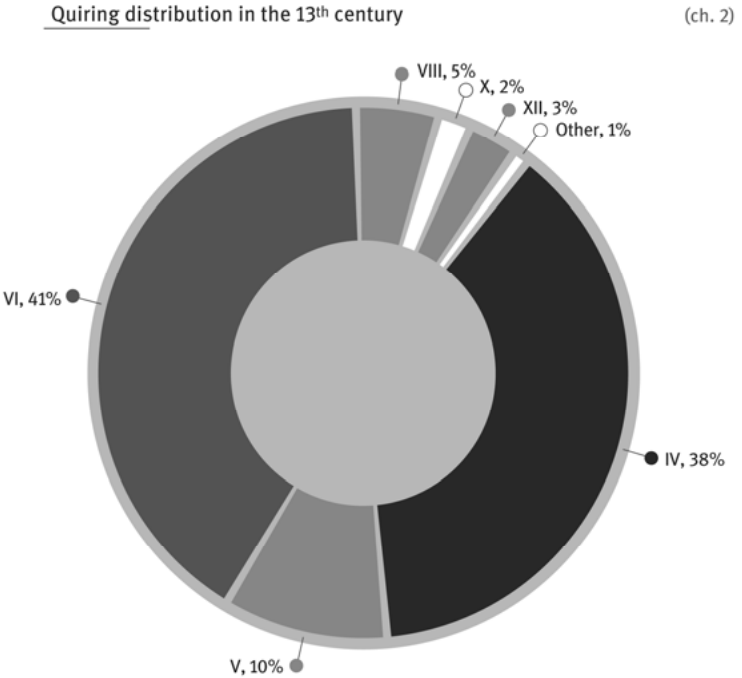


Chart 2: Quiring distribution in the 13th century

Clearly, we find ourselves in the presence of a sort of 'revolution' in the techniques used to manufacture codices: in fact, one passes from an absolute predominance—in the 12th century—of the quaternion, to a clear propensity in favour of the senion, a type of quire which, based on testimony dating from antiquity onwards, had not been used up until then, if not in a rather sporadic way.

In the 14th century, the diffusion of quaternions and senions appears to be almost unchanged with respect to the 13th century. In fact, the distribution of the two types of quire within the sample represents about 40% of the total production (see Chart 3). Therefore, a situation where the use of each type of quire is equal emerges. However, a strong increase in the use of quinions should be noted; this proves to be almost double that seen in the preceding century. A closer analysis of this period, carried out by creating subdivisions in centuries and regions, will allow us to better illustrate the phenomenon in due course.

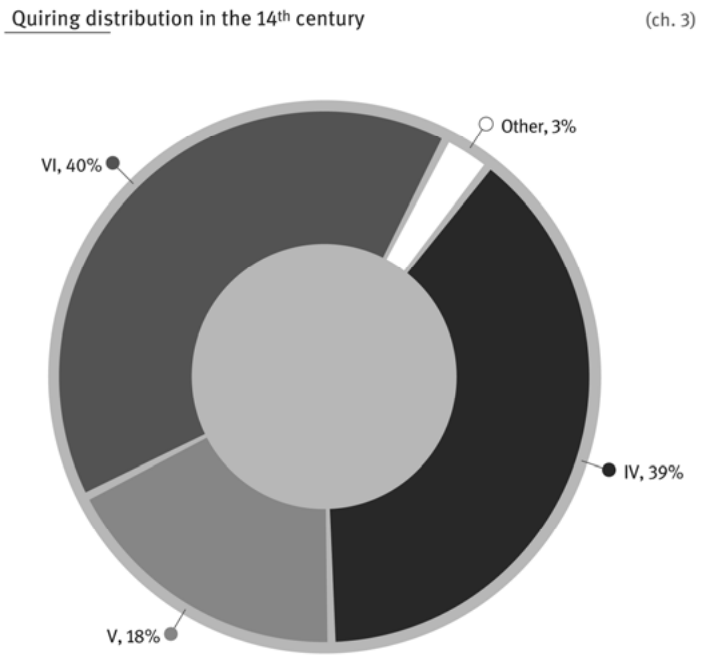


Chart 3: Quiring distribution un the 14th century

From an examination of the data relating to the 15th century (see Chart 4), the following characteristics emerge quite clearly:

a. The level of diffusion of quaternions is the same as that seen in the preceding century.
b. Quinions show an ever-increasing rate of production, so much so that it moves from 18% in the 14th century to some 31% in the 15th.
c. Seniones show a visible decline, decreasing to a level of 26%.
d. One notes a minimal presence of other types of quire, among which stand out octonions, which account for 2% of the output.

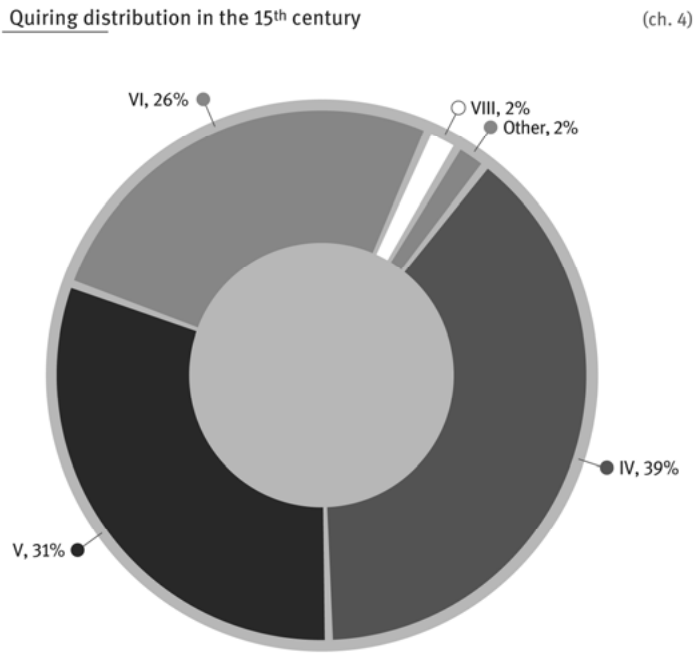


Chart 4: Quiring distribution in the 15th century

Needless to say, with respect to the 15th century—and to a certain extent also the 14th—one should not speak of manuscript production in general without distinguishing between parchment and paper.[56] However, we have decided to dedicate a separate discussion to the writing support and its influence on quiring, when addressing the parameters that are more clearly correlated to quiring.

At this point, then, we have at our disposal a picture of the diachronic development of quiring based on an initial perusal of the data. It is a very broad picture, since it represents several centuries and encompasses the entire output of the countries included in the research. In fact, in order to verify where, when, and possibly why specific phenomena occurred, it is necessary to carry out a more detailed analysis of our corpus. This entails an examination of each country by subdividing production into shorter time spans, namely fifty-year intervals.

56 Along with parchment and paper manuscripts, we must also consider 'mixed' ones—i.e. manuscripts composed of paper quires in which either the external or internal bifolium (or both) are made from parchment—and those made using partly parchment and partly paper quires.

2.3 Country-by-country specific pictures

2.3.1 England

In the 12th century, manuscripts in England were mostly structured in quaternions, even if it should be pointed out that quinions were also used to a certain extent—in fact, quinions are present in about 9% of the total number of manuscripts—whilst only two codices are structured in senions. In effect, the portion of codices made using quires other than quaternions is extremely low, but in any event consistent with the numbers recorded in the other countries examined (see the column that relates to England in Tab. 1).

12th century, second half (tab. 1)

Predom. quiring*	England	%	France	%	Italy	%	Low Countries	%	German area	%	Total	%
III	0	0	2	1.4	0	0	0	0	0	0	2	0.6
IV	95	88.8	144	97.2	14	93.3	3	100	60	100	316	94.9
V	10	9.3	2	1.4	1	6.7	0	0	0	0	13	3.9
VI	2	1.9	0	0	0	0	0	0	0	0	2	0.6
Total	107	100	148	100	15	100	3	100	60	100	333	100

*Predominant quiring

Tab. 1: Quiring 12th century, second half

In the first part of the 13th century a shift is already beginning to be seen: quaternions are still predominant, in that they represent well over half of the total number of items (56.7%), but quinions and senions start to become a significant alternative, to the extent that they appear at a rate in excess of 20%.

On the other hand, production in the second half of the century is entirely orientated in favour of senions, which reach a 64% level of diffusion. The rate at which quaternions are used descends sharply to 14%, but quinions also register a considerable contraction and represent only 8.2% of the total number of units.

In the meantime—as revealed through the analysis of data relating to the 13th century—new types of quire composed of ten and twelve bifolia start to appear (see Tab. 2).

England, 13th century, first / second half (tab. 2)

Predominant quiring	First half	%	Second half	%	Total	%
-1	0	0	1	0.6	1	0.4
III	0	0	1	0.6	1	0.4
IV	38	56.7	22	14	60	26.7
V	15	22.4	13	8.2	28	12.5
VI	14	20.9	101	64	115	51.1
VIII	0	0	12	7.6	12	5.3
X	0	0	4	2.5	4	1.8
XII	0	0	4	2.5	4	1.8
Total	67	100	158	100	225	100

Tab. 2: Quiring England, 13th century, first / second half

It is plain to see, then, that already in the first half of the century a certain tendency to employ thicker quire types is observed, but this choice seems to involve in equal measure both quinions and senions. Later on, however, senions become the indisputable quire of choice, not only in relation to the quaternion but also with respect to the quinion.

In the first half of the 14th century one can immediately see some differences in comparison to the preceding fifty-year period: the senion still represents the prevailing quire type, accounting for almost 60% of the total output, but at the same time a clear revival of the quaternion emerges—indeed, its diffusion triples to about 36%—whilst there is a further reduction in the use of the quinion.

Conversely, in the second half of the century, a complete inversion of the trend is observed: the quaternion once again becomes the quire of choice, so much so that it accounts for 56.5% of production, whilst the senion declines by some 23 points, clearly to the advantage of the quaternion, given that the rate of the quinion's diffusion shows no change, and that the other types of quire certainly do not achieve levels worthy of note (see Tab. 3).

England, 14th century, first / second half (tab. 3)

Predominant quiring	First half	%	Second half	%	Total	%
-1	1	1.5	2	1.3	3	1.4
III	0	0	2	1.3	2	0.9
IV	24	36.4	87	56.5	111	50.4
V	2	3	6	3.9	8	3.6
VI	39	59.1	56	36.4	95	43.2
VIII	0	0	1	0.6	1	0.5
Total	66	100	154	100	220	100

Tab. 3: Quiring England, 14th century, first / second half

England, 15th century, first / second half (tab. 4)

Predominant quiring	First half	%	Second half	%	Total	%
-I	0	0	2	0.9	2	0.5
III	1	0.7	0	0	1	0.3
IV	113	74.8	151	69.9	264	71.9
V	4	2.6	10	4.6	14	3.8
VI	28	18.6	35	16.2	63	17.2
VII	0	0	4	1.9	4	1.1
VIII	3	2	8	3.7	11	3
X	0	0	3	1.4	3	0.8
XII	2	1.3	3	1.4	5	1.4
Total	151	100	216	100	367	100

Tab. 4: Quiring England, 15th century, first / second half

The first part of the 15th century shows a marked preference for the quaternion, which presents a rate of diffusion equivalent to almost three quarters of the total production. The balance of the sample is composed of seniors, which appear at a rate of 18.6%, and other types of quire, including quinions and

octonions. In the second half of the century the range of choices that prevails in the manufacture of codices remains, largely speaking, almost unchanged: one observes a decline in both quaternions and senions, and a slight increase in quinions, whilst other types of quire composed of more than six bifolia reappear in a more substantial way (see Tab. 4).

2.3.2 France

Twelfth-century France shows a clear preference for the quaternion, which accounts for over 97% of the total production, accompanied by a small percentage of ternions and quinions (see the column that relates to France in Tab. 1).

In the first half of the 12th century the quaternion is still the predominant quire of choice, accounting for more than three quarters of the total production, even if the senion begins to appear in a significant way—above all in relation to its total absence in the previous century—accounting for more than 15% of the total. The minimal presence of quinions and octonions should be noted.

During the second half of the century in France one also sees, albeit to a lesser extent, a decisive establishment of the senion, which achieves a rate of dissemination in excess of 38%. In France, the phenomenon is certainly less pronounced than in England during the same period, but in any event one cannot fail to notice a rather marked preference for this type of quire. The rate of production of codices structured in quaternions falls to 31.6%, whereas very substantial quires composed of eight, ten, or twelve bifolia appear, whose presence has already been pointed out when we sketched an overall picture of the 13th century (see Tab. 5 and Chart 2).

France, 13th century, first / second half (tab. 5)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	44	75.9	49	31.6	93	43.7
V	2	3.4	9	5.8	11	5.1
VI	9	15.5	60	38.7	69	32.4
VIII	2	3.5	14	9	16	7.5
X	1	1.7	6	3.9	7	3.3
XI	0	0	1	0.7	1	0.5
XII	2	0	16	10.3	16	7.5
Total	58	100	155	100	213	100

Tab. 5: Quiring France, 13th century, first / second half

France, 14th century, first / second half (tab. 6)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	10	26.3	41	54.7	51	45.1
V	5	13.2	3	4	8	7.1
VI	23	60.5	30	40	53	46.9
XII	0	0	1	1.3	1	0.9
Total	38	100	75	100	113	100

Tab. 6: Quiring France, 14th century, first / second half

The first half of the 14th century sees a reversion to the predominant choice of the senion for the manufacture of codices. Indeed, the senion becomes the most commonly used quire, appearing in more than 60% of the total production. The number of quaternions shows a further decline—of about 5 percentage points—in comparison to the preceding period, whilst the number of quinions reaches 13.2%. Compared with the second half of the 13th century, one

sees the disappearance of quires made from eight or more bifolia, which overall accounted for almost a quarter of the total French production (23.9%), and well over a tenth of English (12.6%), where, indeed, one observes the same phenomenon (see Tab. 6; for England Tab. 2 and 3).

In France, too, in the second half of the century one sees an inversion of the trend: the quaternion's presence increases by about 28 percentage points (54.7%) compared with the preceding half-century, whilst the senion decreases to 40% of the total production (see Tab. 6).

If one compares this trend with the one seen in England during the same period, it becomes clear that in reality there are no great differences between the two countries: the percentages of codices composed of quaternions, quinions and senions register values that are on the whole comparable in both areas of production (see Tab. 3 and 6).

In the first half of the 15th century, too, we observe a considerable convergence of the choices made in the two countries. In fact, broadly speaking, French manuscript production breaks down into the same figures for quaternions and quinions as those we have identified in the English manuscript, with the former representing 74% of the total and the latter 20%. There are no quinions in the sample of French manuscripts of this period, whereas we find some quires composed of more than six bifolia—among which octonions in particular.

In the second half of the century the 'balance of power', so to speak, between the various types of quiring remains almost unchanged, apart from the reappearance of a small percentage of quinions and a decline in the number of 'heftier' quires (see Tab. 7).

France, 15th century, first / second half (tab. 7)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	3	1.6	3	1.1
IV	52	74.3	134	70.1	186	71.3
V	0	0	7	3.7	7	2.7
VI	14	20	41	21.5	55	21.1
VII	1	1.4	1	0.5	2	0.8
VIII	2	2.9	4	2.1	6	2.3
X	1	1.4	1	0.5	2	0.7
Total	70	100	191	100	261	100

Tab. 7: Quiring France, 15th century, first / second half

2.3.3 Italy

With respect to Italian production in the 12th century and in the first half of the 13th, our sample is extremely limited,[57] but a preference for the quaternion seems unquestionable.

In the second half of the 13th century, however, a rather singular picture emerges in which quaternions, quinions and senions are abundantly represented. Or rather, the last-mentioned account for a 41% rate of production, whilst quaternions account for 34.5%. In fact, one could hypothesise that Italy, too, during the 13th century, was affected—perhaps following an influx from beyond the Alps—by the widespread 'vogue' for senions in England and France. The percentage of quinions, however, should not be underestimated (21.3%), since they are used far more than in the other European countries (see Tab. 8).

57 In actual fact, Italian manuscript production in the first half of the 13th century is not at all sparse; rather, the number of catalogued codices is low, and among these the number of explicitly localised and dated to the half century is commensurately low.

Italy, 13th century, second half (tab. 8)

	Second half	
Predominant quiring		%
III	1	1.6
IV	21	34.5
V	13	21.3
VI	25	41
VII	1	1.6
Total	61	100

Tab. 8: Quiring Italy, 13th century, second half

A few comments about the first half of the 14th century, despite the rather small size of the sample, may be of some value. The numbers of codices composed of quaternions, quinions and senions in the sample are roughly equal:[58] in fact, in comparison to the preceding half-century, one sees a reduction of both the percentage of quaternions and, above all, of senions, whilst at the same time the percentage of codices composed of quinions increases.

In the second half of the 14th century the leading role played by the quinion by now becomes clear, to the extent that it is employed in some 46% of Italian production, whereas the quaternion is seen in about 29% of volumes, and the senion's presence declines to 19.4% of the total. Quires composed of eight or more bifolia also appear, even if their overall percentage is of no great significance (see Tab. 9).

58 In fact, the quaternions' score is about 28%, whilst the senions and quinions each score roughly 33%.

Italy, 14th century, first / second half (tab. 9)

	First half		Second half		Total	
Predominant quiring		%		%		%
II	1	2.8	1	0.8	2	1.2
III	0	0	1	0.8	1	0.6
IV	10	27.8	37	28.7	47	28.5
V	12	33.3	60	46.5	72	43.7
VI	12	33.3	25	19.4	37	22.4
VII	1	2.8	0	0	1	0.6
VIII	0	0	2	1.5	2	1.2
IX	0	0	1	0.8	1	0.6
X	0	0	2	1.5	2	1.2
Total	36	100	129	100	165	100

Tab. 9: Quiring Italy, 14th century, first / second half

Production in the first half of the 15th century is mostly centred on the quinion, which accounts for 64% of the total. In contrast to England and France, where the quaternion showed a robust resurgence, in Italy we see the quinion fully embraced, where it not only consolidates itself as the technical solution of choice, but even increases its dissemination in the second half of the 15th century, and ultimately reaches a level of 72.2%.

As far as other types of quire are concerned in the first half of the 15th century, quaternions represent 17% of the total production and senions 15%, whereas in the second half of the century they descend to around 14% and 9%, respectively. The percentages of the other types of quire—disregarding octonions, which top 2% in both halves of the century—are virtually irrelevant (see Tab. 10).

Italy, 15th century, first / second half (tab. 10)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	5	1.1	5	0.8
III	1	0.7	1	0.2	2	0.3
IV	25	17	64	14.1	89	14.8
V	94	63.9	327	72.2	421	70.2
VI	22	15	41	9.1	63	10.5
VII	1	0.7	2	0.5	3	0.5
VIII	4	2.7	11	2.4	15	2.5
X	0	0	1	0.2	1	0.2
XII	0	0	1	0.2	1	0.2
Total	147	100	453	100	600	100

Tab. 10: Quiring Italy, 15th century, first / second half

2.3.4 Germany

12th-century Germany seems to be entirely oriented towards the quaternion—at least with respect to the sample at our disposal (see the column that relates to Germany in Tab. 1). For the 13th and 14th centuries we have too few codices at our disposal[59] to allow us to draw any hard and fast conclusions. A mere glance at the data allows one to see that, in the first half of the 13th century, the quaternion is the most frequently employed quire type, to the extent that it is present in 10 of the 11 attested manuscripts.[60] In the second half of the century one still sees a predominance of quaternions: in fact, of 14 manuscripts attributed to this period 7 are composed of quaternions, 2 of quinions, 4 of senions, and 1 of octonions.

The available sample of codices for the 14th century is also very limited: for the first half of the century we can only report that 2 of the 5 codices that date from this time span are composed of quaternions, 2 of quinions, and one of octonions,

59 A very small number of manuscripts dating from the 13th and 14th centuries emerged from a perusal of catalogues in the first phase of this research.

60 A twelfth instance is represented by a codex structured in senions.

whereas for the second half of the century, of the 16 representative codices, 5 are structured in quaternions, 4 in quinions, 6 in senions, and one is composed of thick and irregular quires.

As regards the 15th century, thanks to a rather substantial sample, it is possible to identify some trends with a reasonable degree of accuracy. In fact, Germany presents, for the first half of the century, a totally different situation in comparison to that observed in England and France—where there was a resurgence of the quaternion—and in Italy, where the quinion prevailed. Indeed, one observes an absolute predominance of the senion, which accounts for some 71.2% of the total production, whereas the quaternion and quinion account for 9.1% and 15.2% of the output, respectively.[61] It should also be pointed out that quires composed of more than six bifolia account for 4.5% of the total sample. Largely speaking, in the second half of the century the overall picture of the choices made remains unchanged, apart from a small growth in the number of manuscripts structured in quaternions, which increases by about 5%, to reach 14.4%, and a slight decline (2 points) in codices composed of quinions (see Tab. 11).

German area, 15th century, first / second half (tab. 11)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	6	9.1	34	14.4	40	13.2
V	10	15.2	31	13.2	41	13.6
VI	47	71.2	170	72	217	71.9
VIII	2	3	0	0	2	0.7
IX	1	1.5	0	0	1	0.3
XII	0	0	1	0.4	1	0.3
Total	66	100	236	100	302	100

Tab. 11: Quiring German area, 15th century, first / second half

61 Rhineland production of the 15th century exhibits a quiring distribution pattern which is essentially similar to that described here. See Bozzolo 1994, 232.

2.3.5 The Low Countries

In our corpus, the number of codices produced in the Low Countries reaches a sufficient value only in the 15th century, particularly in its second half. In the first half of the century manuscripts are predominantly composed of quaternions, which account for around 61% of the total output. A more modest number of codices structured in senions also appears (28.6%), whilst about a tenth of the output opts for the quinion. In the second part of the century—for which we have a decidedly more representative sample—one meets with an almost identical situation to the one just described. There is a slight increase in the diffusion of quaternions (64.2%), whilst the quinions and senions lose a some of their ground—2.3 and 6.5 points, respectively. A small number (2.1%) of codices composed of ternions and octonions is also present (see Tab. 12).

Low Countries, 15th century, first / second half (tab. 12)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	1	1.1	1	0.8
III	0	0	2	2.1	2	1.6
IV	17	60.7	61	64.2	78	63.4
V	3	10.7	8	8.4	11	9
VI	8	28.6	21	22.1	29	23.6
VIII	0	0	2	2.1	2	1.6
Total	28	100	95	100	123	100

Tab. 12: Quiring Low Countries, 15th century, first / second half

2.4 Conclusions

Clearly, it is the 13th century that introduces significant changes to the techniques used for the preparation of quires. The country on the cutting edge of innovation is England, whose production, already in the first half of the century, includes a noteworthy number of codices structured in quires other than quaternions, those being quinions and senions. This tendency to favour thicker quires becomes dominant in the second half of the 13th century, but the preference—as we have already

stressed—is mostly for the senion, whose rate of dissemination is overwhelming. In French production one initially notices the presence of quires other than quaternions in the first half of the century; it is in the second half of the century, however, that the number of codices composed of senions becomes more substantial and accounts for almost two fifths of the total output. However, a substantial establishment of the senion took place in France in the first half of the 14th century—indeed, based on an examination of this trend, one can reasonably suppose that in adopting the technical innovation of the senion, France lagged behind England by a few decades. In fact, despite still being the quire of choice in English production, senions show a slight decline in the first half of the century, in contrast to an increase in the quaternion, whilst in France the use of the senion reaches its apogee.

In the second half of the 14th century there is a change in the criteria employed for the manufacture of codices, due in all likelihood to changes that occurred in the concept of the book. The quaternion fully regains the upper hand, accounting for well over half of the items included in the sample—even if the percentage of codices composed of senions remains quite significant[62]—just as much in French production as in English which, as we have pointed out, largely speaking share (proportionately) the same percentages of codices composed of the various quire types. In the 15th century the quaternion is the most widely used quire in both French and English codex production (more than 70%), whilst the percentage of senions accounts for about a fifth of the total output.

By contrast, Italian production follows a distinctive course. Whilst in the second half of the 13th century one observes a rather fluid situation (in that the percentage of codices composed of senions is slightly higher than those composed of quaternions), starting in the first half of the 14th century, one sees a gradual establishment of the quinion, which was already well represented in the previous half century (when it accounted for more than a fifth of the total output), and it progressively consolidates its position. In fact, after a few decades, the quinion shows an increasing level of diffusion, until it accounts for almost three quarters of the total production in the second half of the 15th century. It is therefore reasonable to suppose that the share of quinions in the overall diachronic picture mostly originated from Italy.

With regard to production originating from 13th- and 14th-century German area, we are unable to offer anything other than a few basic observations. Quinions and senions only begin to appear in the second half of the 13th century, but owing to the meagreness of the data we have at our disposal, we can only verify a mod-

62 The rate for senions in England is 36.4%, whereas in France it is 40%.

erate predominance of senions during the second half of the 14th century. On the other hand, the scenario seen in the first half of the 15th century is entirely in favour of the senion—which at this point had progressively been abandoned in the other countries and relegated to a secondary role. The senion is in fact employed in the bulk of production, even if there is no lack of codices composed of quaternions and, above all, of quinions. In the second half of the century the overall distribution of quire types remains essentially unchanged, apart from a small increase in codices structured in quaternions.

In the Low Countries in the 15th century production follows the same general pattern as that identified in France and England (in fact, the quaternion is the predominant choice), even if the percentage of codices composed of senions amounts to a little less than one quarter of the total.

At this point, then, we are in a position to provide answers to some of the questions we have posed. As regards the shift from quaternions to senions, we can say where and when it happened, but the reason why this great change in the manufacture of the codex occurred remains a mystery.

With respect to the quinion, the places and ways in which it spread are clear enough, despite the lack of an explanation for what spurred such a decisive orientation towards this type of quire in Italian production, whilst in the rest of Europe other choices were made.

The period when manuscripts composed of senions were at their peak stretches from about 1250 to 1350. The phenomenon first emerged in England and spread rapidly in France, subsequently reaching Italy and Germany. In the German area, the senion, even if it was introduced at a rather late date, would never be abandoned, whereas in Italy quinions began their ascent from the 14th century onwards.

Clearly, a change in a manufacturing solution that led to the rejection of a choice consolidated for centuries, namely the construction of codices in quaternions, was not merely the product of chance; rather, it was undoubtedly determined by specific causes, both economic and cultural, which provided an impetus for change. As regards the phenomenon that interests us here, the period in which the spread of the senion reaches its peak coincides roughly with the maximum growth of the university, therefore the relationship between the senion and the university environment appears to be altogether plausible. Additionally, the link between the Italian quinion and higher culture also seems to be undeniable.[63] Unfortunately, the university statutes studied up till now—those of the universi-

63 We will revisit the discussion regarding the birth of the senion in England when we address the link that exists between quiring and textual typology.

ties of Paris and Bologna in particular—have not yielded any information on norms relating to the composition of codices, whereas, in the case of Bologna at least, the regulation of manuscript production through the *pecia* system is very well documented. In fact, as recent studies on Bolognese writing contracts have shown,[64] the terms *pecia* and *quaternus* were employed to refer to units employed to measure text—the term *quaternus* in particular is used as a unit of measurement, both in agreements drawn up between scribes and patrons and in tax schedules[65]—but the connection between the said terms and the manufactured object that derives from the copying process, or better to say with its material structure, is unknown. To be sure, a *pecia* does not correspond exactly to a specific part of a quire (for example, half of one, in the case of a quaternion). Indeed, in manuscripts produced by the system, *pecia* markings can be found at the halfway point or three quarters of the way through a quire. Therefore, all suppositions about the relationship which might exist between *pecia* and quinion or between *pecia* and senion remain purely hypothetical.

With respect to the French area, information about the remuneration of scribes is sparse and difficult to interpret. In many instances, it is impossible to discern a relationship between fees and the number of leaves and/or lines copied. Additionally, when the unit of measurement is a quire, one is often unable to apprehend its thickness. A few attestations of copying fees exist that point to a certain type of quire—quaternions or senions, as the case may be—but they are very limited in number and relate to the end of the 14th century,[66] and therefore do not help to shed much light on the matter.

In fact, it is likely that the use of a different quire structure—a thicker one—is rooted in the new role that was assigned to it: 'the university book is an entirely different object from the book of the Early Middle Ages. It forms part of a completely new technical, social and economic whole, an expression of an elevated civilisation'.[67] With these words, Jacques Le Goff introduces the new *facies* of the late medieval book, which at this point had become a study tool and a vehicle for the transmission of new ideas. The book's format changes and becomes smaller and more manageable. It also becomes 'poorer', with a more restrained decorative apparatus, as in the case of philosophical and theological codices, whilst juridical manuscripts remained rather lavish on account of their wealthier readership.

64 For an examination of the problem relating to Bolognese book production and an up-to-date bibliography on the subject, see Devoti 1994, *passim*.

65 See Devoti 1994, 89.

66 Bozzolo / Ornato 1980, 37–40.

67 Le Goff 1979, 86–90.

One possible hypothesis that could be put forward to explain the change has to do with a technical factor, namely the capacity to produce thinner parchment,[68] and a need that might have arisen from the growth in university studies, namely the necessity to enclose a given text within a more compact unit. At the same script density, a quire made up from six bifolia contains a larger amount of content, making it possible to collect a higher number of texts in a lower number of units, and therefore perhaps easier to handle and carry around.[69] It is also likely that the labour required to assemble a codex would be less costly, since the same number of texts would call for fewer quires if a volume were composed of seniones rather than quaternions. It is quite possible that ready-made quires were sold that were composed of a larger number of bifolia as a response to this particular need; a need arose from the spread of many works that became an indispensable 'package' for university studies.

Needless to say, these are merely suppositions which could, perhaps, be confirmed only after a first-hand examination of a large number of codices, which would make it possible to evaluate and correlate, wherever possible, the textual and material characteristics of the various pieces of evidence. With respect to the latter, among the most obvious changes observed we can include the starting of a quire with the flesh side of the parchment, a phenomenon which is seen consistently from 1250 onwards—and therefore in concomitance with the appearance of the senion—as well as writing below the first line, which appears to occur contemporaneously with the aforementioned phenomenon.[70] A direct analysis of the material would also make it possible to focus attention not only on all the variables that we have classed as being potentially correlated to quiring, but also, and in particular, on the thickness of the parchment.

Recent studies have shown how a parameter such as thickness, which at first glance might not seem to be particularly significant in the context of the medieval book, is actually of considerable archaeological interest. Indeed, an investigation carried out on four corpora of manuscripts and documents of very different da-

68 In the 13th century parchment became a lot thinner compared to that seen in the previous century. For information on the evolution of parchment thickness over the centuries, see Bianchi et al. 1993, 152, and Bischoff 1993, 72–77, although in reference to documents of the Papal Chancellery.

69 It has been noted that the university environment not only generated a great demand for texts, but also resulted in a heavy circulation of works both *in loco* and between one university and another. The figure of a teacher or travelling student is a commonly seen *topos*.

70 See Palma 1988, *passim*.

tings and origins[71] demonstrated that, by starting out from a knowledge of leaf thickness, it is possible to verify—by processing data using established statistical parameters—the uniformity of both the component bifolia within a quire and of one and the same bifolium internally. Additionally, by analysing such data, it becomes possible to ascertain the different manufacturing techniques employed—such as the arrangement of quires of similar thickness; the criteria applied for placing bifolia in order in relation to their thickness; skin folding methods used for the making of quires, and so on—which lie at the heart of the objects produced in different places and at different times.[72]

The fact that the thickness of parchment was not an entirely irrelevant parameter for the medieval artisan has been amply demonstrated by Frank Bischoff in various studies,[73] among which a contribution on a sample of evangelaries dating from the 11th and 12th centuries, where he identifies a clear preference for thicker parchment for the creation of quires destined to host miniatures (illustrations, decorated initials, and so on) so as to prevent colours from bleeding through from one side of a leaf to the other.[74] Clearly, the structuring of a codex in this way represents the outcome of a specific choice which on the one hand can result in obvious disturbances in the arrangement of the text within the quires (if the structure of the volume is not planned with sufficient foresight),[75] and on the other, more simply, a modification of the typical structure of the quire, which generally seems to entail positioning thicker bifolia on the outside and thinner ones on the inside.[76]

Needless to say, the points clarified above represent overall trends that are worthy of closer investigation, and which certainly present exceptions: for exam-

71 Fifty-six Italian juridical manuscripts dating from the 14th century; 121 codices produced for Malatesta Novello around the middle of the 15th century; 20 in-quarto codices dating from the 9th to 15th centuries; a sample of charters from Lucca (292 items) dating from the 13th to 14th centuries, together with the Lucca 490 codex, of the same period. See Bianchi et al. 1993b, 99–104.

72 See Bianchi et al. 1993a, *passim*. In particular, see p. 183 of the same title. It should also be emphasised that with respect to the Lucca charters, the thickness seems to be closely linked not only to factors of a material nature (dimensions and script type), but also to geographic (city, rural area) and social factors (the social status of authors and writers). Regarding the significance of the subscriptions on the documents from Lucca, see also the opinion of Supino Martini 1992.

73 Bischoff 1991; Bischoff 1993.

74 Bischoff 1991, 127–129; Bischoff 1993, 77–82.

75 Bischoff 1994, 92.

76 Bischoff 1991, 129–133; Bischoff 1993, 86–89.

ple, Casin. 132,[77] the noted Cassinese *exemplar* of Rabanus Maurus, strays very far from the general standards known to us up to now, since it contains exceedingly thin parchment[78]—much thinner, indeed, than its majestic decorative apparatus would lead one to suppose, and a far cry from the average value recorded in many codices dating from the same period. Indeed, the parchment of the Rabanus Maurus codex is thinner not only than the average gauge recorded in a group of about 300 manuscripts (during an investigation of Italian production of the 11th century),[79] but also than that of Beneventan codices of the same size[80] studied in the same research project.[81] We are not yet in a position to provide a comprehensive picture of 11th-century Cassinese production, but through the study of a particular type of object—the liturgical rolls of the *Exultet*, which are typical products of the Beneventan area—we have certainly learnt how the good quality of a product of this type does not depend on its greater or lesser thinness, as much as on the average degree of uniformity of the various parts it is composed of, whether these be considered individually or as a whole.[82]

This brief overview of the potential that the study of a variable such as thickness holds is intended simply to encourage an investigation into the various quiring types and, above all, to provide us with another key that may contribute to explaining the shift from employing quaternions to the use of thicker quires.

3 Quiring and other parameters

One of the questions that we posed when planning our research concerns the way and extent to which quiring interacts with other variables. In the present contribution, it seems sensible to limit our discussion to those parameters which have shown themselves to be of the most significance in relation to quiring, or at least indicative enough to enable us to identify sufficiently clear trends. Such parameters include the manuscript's support, format, text typology and layout. Size will also be considered, since it may be helpful and of some interest to report the re-

77 The particular conditions under which this example was studied, as well as the use of a magnetic induction micrometer made it possible to carry out a very detailed archaeological investigation. See Di Majo et al. 1994, *passim*.

78 The average thickness is 174.01 thousandths of a millimetre. See Di Majo et al. 1994, 91.

79 Bianchi et al. 1993b, 390.

80 The size of a manuscript is determined by its semi-perimeter (L+H).

81 Bianchi et al. 1993b, 393.

82 Palma 1994, *passim*.

sults obtained, even if our attempt to compare this parameter with quiring did not turn out to be particularly fruitful.

3.1 Quiring and the writing support

Among the characteristics that appear to be directly correlatable to quiring is the writing support. Indeed, we have already stressed its importance when we outlined a picture of the development of quiring in the 14th and 15th centuries.

If we create a sub-category of codices that date to the 14th century based on the material they are composed of, in parchment ones—given the prevalence of this support in the sample—we observe exactly the same quiring trend as the one that emerged from the overall picture. In fact, in the first half of the century the senion was still used in well over half of the total output, whereas in the second half its use declined drastically (29.4%) in the face of an increase in the use of the quaternion, which rose from 30.2% to 50.1% (see Tab. 13).

Parchment, 15th century, first / second half (tab. 13)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	1	0.6	1	0.3	2	0.4
II	1	0.6	1	0.3	2	0.4
III	0	0	2	0.6	2	0.4
IV	54	30.2	179	50.1	233	43.5
V	22	12.3	65	18.2	87	16.2
VI	99	55.3	105	29.4	204	38
VII	1	0.5	0	0	1	0.2
VIII	1	0.5	3	0.8	4	0.7
XII	0	0	1	0.3	1	0.2
Total	179	100	357	100	536	100

Tab. 13: Parchment, 15th century, first / second half

The landscape with respect to paper manuscripts looks very different in the second half of the century.[83] The adoption of paper as a writing support involved manufacturing solutions based on manifestly different thinking from that applied during the same period for parchment manuscripts. In fact, an incontrovertible tendency to favour thicker quires emerges, to the extent that senions are employed in 46.4% of overall production, whilst quinions account for 32%, whereas quaternions do not even amount to 9% of the total output. Quires composed of nine or more bifolia also appear (see Tab. 14).

Paper, 14th century, second half (tab. 14)

	Second half	
Predominant quiring		%
-1	2	3.6
III	1	1.8
IV	5	8.9
V	18	32.1
VI	26	46.4
IX	1	1.8
X	3	5.4
Total	56	100

Tab. 14: Paper, 14th century, second half

In the first half of the 15th century the phenomenon becomes more apparent, inasmuch as parchment codices are mostly composed of quaternions (approximately 68%), whilst quinions and senions are adopted in a little more than 18% and 13% of cases, respectively. The second half of the century sees a slight decrease (of about 10%) of codices composed of quaternions in the face of a clear increase in the use of quinions, which, as we know, is chiefly owed to the Italian context. On the other hand, the senion assumes an ever more marginal position in the sphere of parchment production (see Tab. 15).

83 The number of items in the sample for the first half of the century is insufficient for the purposes of statistical analysis.

Parchment, 15th century, first / second half (tab. 15)

	First half		Second half		Total	
Predominant quiring		%		%		%
III	1	0.3	2	0.3	3	0.3
IV	207	68.1	412	58.3	619	61.2
V	55	18.1	238	33.7	293	29
VI	40	13.2	52	7.3	92	9.1
VII	0	0	1	0.1	1	0.1
VIII	1	0.3	2	0.3	3	0.3
Total	304	100	707	100	1011	100

Tab. 15: Parchment, 15th century, first / second half

The distribution of quiring in paper codices shows the opposite trend. In the first half of the 15th century the senion is employed in almost half of the total production (48.3%). Quinions are also frequently used, accounting for 37.2%, whilst quaternions represent just 7.1% of the total. In the second half of the century we see some variation in the numbers of the different kinds of quire (for example, quinions decrease from 37.2% to 32.3%), but the overall trend remains unchanged (see Tab. 16).

To complete the picture of 15th-century production, we have only to consider the codices which present a *mélange*, more or less rationally structured, of two supports, which is to say manuscripts composed of mixed quires,[84] and those with some quires made of paper and others of parchment.[85] In our sample, the number of manuscripts assembled in one or the other way is not particularly significant in the first half of the century.[86]

84 In other words, paper codices with the outer and/or inner bifolium made from parchment.

85 For an in-depth analysis of the set of problems in relation to codices containing mixed quires, see Bianchi et al. 1994.

86 The use of mixed quires is exceedingly rare up until the last decades of the 14th century. See Bianchi et al. 1994, 265.

Paper, 15th century, first / second half (tab. 16)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	11	2.3	11	1.6
III	1	0.6	1	0.2	2	0.3
IV	13	7.1	34	6.9	47	7
V	67	37.2	159	32.3	226	33.6
VI	87	48.3	258	52.4	345	51.4
VII	1	0.6	4	0.8	5	0.8
VIII	9	5	17	3.5	26	3.9
X	1	0.6	4	0.8	5	0.7
XII	1	0.6	4	0.8	5	0.7
Total	180	100	492	100	672	100

Tab. 16: Paper, 15th century, first / second half

However, it should also be noted that in codices whose quires are made either from paper or from parchment, their composition ranges from quaternions to nonions, whereas in those composed of mixed quires there appears to be a preference for the senion. During the second half of the 15th century the former are still made from a wide range of quire types—ranging from quaternions to octonions—whereas the latter continue to favour senions, and then octonions[87] (see Tab. 17). Therefore, the codices formed from mixed quires follow the same pattern as that seen in the paper ones.

Once the overall trend in quiring in relation to the material has been examined, we shall attempt to discover the way in which the phenomenon manifested itself at a local, or rather, national level, by means of an analysis of each country's production in the 15th century.[88] Production of parchment manuscripts in England mostly centres on the quaternion, whose diffusion increased in the second part of the century—shifting, in fact, from 78.1% in the first half of the 15th century to 82.4% in the second—whilst the number of codices structured in senions decreased and accounts for around 10% of the overall sample (see Tab. 18).

87 To get an idea of the distribution of the various types of quires used in mixed Latin, Greek and Hebrew manuscripts, see Bianchi et al. 1994, 276–280.

88 For the 14th century, the sample of paper manuscripts is too sparse, hence it is not possible to create subdivisions between countries.

Parchment / paper and mixed, 15th century, first / second half (tab. 17)

Predom. quiring	First half						Second half						Total	
	P–P*	%	Mi*	%	Tot.	%	P–P*	%	Mi*	%	Tot.	%	15th	%
IV	1	12.5	0	0	1	6.2	4	25	1	4	5	12.2	6	10.5
V	2	25	1	12.5	3	18.8	5	31.3	2	8	7	17.1	10	17.5
VI	2	25	5	62.5	7	43.8	3	18.7	15	60	18	43.9	25	43.9
VII	1	12.5	0	0	1	6.2	1	6.3	1	4	2	4.9	3	5.3
VIII	1	12.5	0	0	1	6.2	3	18.7	4	16	7	17.1	8	14
IX	1	12.5	1	12.5	2	12.6	0	0	0	0	0	0	2	3.5
X	0	0	0	0	0	0	0	0	1	4	1	2.4	1	1.8
XII	0	0	1	12.5	1	6.2	0	0	1	4	1	2.4	2	3.5
Total	8	100	8	100	16	100	16	100	25	100	41	100	57	100

*P–P= Parchment / paper *Mi= Mixed

Tab. 17: Parchment / paper and mixed, 15th century, first / second half

England. Parchment, 15th century, first / second half (tab. 18)

Predominant quiring	First half		Second half		Total	
		%		%		%
III	1	0.6	0	0	1	0.3
IV	107	78.1	141	82.4	248	80.5
V	3	2.2	9	5.3	12	3.9
VI	25	18.3	19	11.1	44	14.3
VII	0	0	1	0.6	1	0.3
VIII	1	0.7	1	0.6	2	0.7
Total	137	100	171	100	308	100

Tab. 18: England. Parchment, 15th century, first / second half

The distribution of quires in paper codices certainly does not change in a radical way, since quaternions remain very well represented (this observation relates to the second half of the century, given that the sample for the first half of the

century is of little statistical significance).[89] Indeed, they account for almost one quarter of total production, but in any event it is possible to confirm that more than a third of the codices are composed of senions, and that about another third contain quires formed from seven or more bifolia (see Tab. 19).

England. Paper, 15th century, first / second half (tab. 19)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	2	6.1	2	4.8
IV	5	55.6	8	24.2	13	30.9
VI	1	11.1	12	36.3	13	30.9
VII	0	0	2	6.1	2	4.8
VIII	2	22.2	4	12.1	6	14.3
X	0	0	2	6.1	2	4.8
XII	1	11.1	3	9.1	4	9.5
Total	9	100	33	100	42	100

Tab. 19: England. Paper, 15th century, first / second half

In France, parchment codices are typically assembled from quaternions, whose level of diffusion exceeds 90% in the second half of the century, whereas the percentage of codices composed of different types of quire—senions included—is very limited (see Tab. 20). Production in paper is not represented in the first half of the century in our sample, which is rather poor in this respect. Nevertheless, one can identify a considerable preference for the senion, which is seen in 7 out of 12 cases. In the second half of the century the tendency to adopt the senion in paper is plain to see: indeed, the number of codices composed of senions exceeds 60% of the total, whilst manuscripts created from quaternions and quinions both account for a little under 12%. Also seen are quires consisting of eight or more bifolia, and very thick and irregular quires which are typical of paper manuscripts (see Tab. 21).

89 Although of 9 paper codices dating to this period 5 (more than half, then) are composed of quaternions, one is composed of senions, 2 are composed of octonions, and one is composed of quires assembled from twelve bifolia.

France. Parchment, 15th century, first / second half (tab. 20)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	50	87.7	129	90.9	179	90
V	0	0	2	1.4	2	1
VI	7	12.3	10	7	17	8.5
VIII	0	0	1	0.7	1	0.5
Total	57	100	142	100	199	100

Tab. 20: France. Parchment, 15th century, first / second half

France. Paper, 15th century, first / second half (tab. 21)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	3	7.1	3	5.5
IV	2	16.7	5	11.9	7	13
V	0	0	5	11.9	5	9.3
VI	7	58.3	26	61.9	33	61.1
VIII	2	16.7	2	4.8	4	7.4
X	1	8.3	1	2.4	2	3.7
Total	12	100	42	100	54	100

Tab. 21: France. Paper, 15th century, first / second half

The situation outlined above, for both parchment and paper production, largely confirms what Bozzolo and Ornato illustrated in their essay *La constitution des cahiers dans les manuscrits en papier d'origine française et le problème de l'imposition*:[90] in the section dedicated to an examination of various typologies of quire, the two scholars show how the senion is by far the predominant type in

90 Bozzolo / Ornato 1980, 124–211.

paper manuscripts, whereas it is almost absent in parchment production, which remains dominated by the quaternions.[91]

Parchment codices originating from Italy are mostly composed of quinions, whose presence increases from 63.1% in the first half of the 15th century to 78.2% in the second, obviously subtracting the share of quaternions, which decrease from a rate of 32.3% to one of just 19% (see Tab. 22). The preference for the quinion also manifests itself in paper codices: in fact, in the first half of the century 65% of these were made of quinions, and a little under 64% in the second half. However, the considerable difference between paper and parchment codices manifests itself in the type of quire that fills the share of production left free by the quinion: in fact, the number paper codices composed of quaternions proves to be markedly low, whilst those composed of senions reappear in both halves of the century, at rates of diffusion of 23.8% and 17.9%, respectively. One can therefore reasonably suppose that the introduction of paper changed the quiring landscape in Italy as well: the quinion is certainly the preferred option for both parchment and paper, but in the former case it is flanked by the quaternion, whilst in the latter by the senion. Other types of thick quire are met with in paper manuscripts, such as octonions and those composed of an even greater number of bifolia, which were not utilised in parchment volumes.

Italy. Parchment, 15th century, first / second half (tab. 22)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	21	32.3	50	19.1	71	21.7
V	41	63.1	205	78.2	246	72.5
VI	3	4.6	7	2.7	10	3.1
Total	65	100	262	100	327	100

Tab. 22: Italy. Parchment, 15th century, first / second half

91 Bozzolo / Ornato 1980, 131–132.

Italy. Paper, 15th century, first / second half (tab. 23)

	First half		Second half		Total	
Predominant quiring		%		%		%
-1	0	0	5	2.7	5	1.9
III	1	1.2	1	0.5	2	0.8
IV	4	5	14	7.6	18	6.8
V	52	65	118	63.8	170	64.1
VI	19	23.8	33	17.9	52	19.6
VII	1	1.2	2	1.1	3	1.1
VIII	3	3.8	10	5.4	13	4.9
X	0	0	1	0.5	1	0.4
XII	0	0	1	0.5	1	0.4
Total	80	100	185	100	265	100

Tab. 23: Italy. Paper, 15th century, first / second half

A well-delineated situation emerges from our examination of the German area: manuscript production is centred on paper volumes, and these are largely structured in senions.[92] In the first half of the century manuscripts composed of senions account for 87% of production. Quaternions are almost completely absent, whilst quinions amount to almost 9% of production, and subsequently exceed 10% in the second half of the century (see Tab. 24). As soon as one turns one's attention away from paper and focuses on parchment, quaternions reappear. These prove to be the quire of choice both in the first half of the century, where they are seen in 6 out of 14 items,[93] and in the second half, in which they account for 57% of the total production. Quinions are also well represented: we find 5 occurrences in 14 in the first half of the century, whereas they reach a rate of diffusion of about 22% in the second half (see Tab. 25). The strong presence of senions in the German area is therefore linked to the need to produce paper codices, because as the type of support changes, quaternions return and play a dominant role.

92 See Bozzolo 1994, 230–232.

93 The total number of parchment codices in the sample that date from this period is rather low, but the predominance of codices structured in quaternions and quinions in comparison to those composed of senions is indisputable.

Germany. Paper, 15th century, first / second half (tab. 24)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	0	0	5	2.8	5	2.2
V	4	8.7	20	11	24	10.6
VI	40	87	156	86.2	196	86.3
VIII	2	4.3	0	0	2	0.9
Total	46	100	181	100	227	100

Tab. 24: Germany. Paper, 15th century, first / second half

Germany. Parchment, 15th century, first / second half (tab. 25)

	First half		Second half		Total	
Predominant quiring		%		%		%
IV	6	42.9	28	57.1	34	54
V	5	35.7	11	22.5	16	25.4
VI	3	21.4	10	20.4	13	20.6
Total	14	100	49	100	63	100

Tab. 25: Germany. Parchment, 15th century, first / second half

With respect to the Low Countries, our sample is mostly composed of parchment codices—paper codices are scantly represented—which, as in the rest of Europe, are mostly composed of quaternions (see Tab. 26). The number of paper codices in the sample is statistically insignificant in the first half of the century; however, we can confirm that the 8 volumes dating from this period are all composed of senions. In the second half of the century the bulk of codices are composed of senions (76.2%), with the number of volumes structured in quinions amounting to 20%.[94]

94 The number of codices that represent this period is 29.

Low Countries. Parchment, 15th century, first / second half (tab. 26)

	First half		Second half		Total	
Predominant quiring		%		%		%
III	0	0	2	3	2	2.3
IV	17	85	60	88.2	77	87.5
V	3	15	3	4.4	6	6.8
VI	0	0	3	4.4	3	3.4
Total	20	100	68	100	88	100

Tab. 26: Low Countries. Parchment, 15th century, first / second half

The fundamental role played by the type of support in determining the choices made in the manufacture of a codex has emerged very clearly from the analysis we have just carried out. The period of the senion's diffusion—as we have already highlighted—stretches from about 1250 to 1350. In the second half of the century the quaternion again reaches an apogee (this type of quire was the most commonly used in codices made in the early centuries of the first millennium).

Needless to say, the observations that we shall now put forward relate to the manufacture of parchment codices, given that paper codices seem to have been conceived of based on a different way of thinking. Indeed, the tradition of structuring codices in quaternions was not embraced by the world of paper, which chiefly focused on thicker types of quire, such as senions and quinions, and eventually adopted truly substantial and irregular ones.

What, then, were the considerations which led to certain choices being made? Could it be—as Bozzolo and Ornato have shown at various times[95]—that paper was considered a second-rate material (and certainly less robust and much more perishable compared to parchment), and therefore the making of thicker quires might have fulfilled the need for greater durability and solidity?

In fact, if we observe this process through the eyes of the modern restorer, in relation to the solidity of the binding in particular, such a hypothesis does not appear to be altogether sustainable, given that the thicker the quires are, the harder it is to assemble them into a single block that will have a certain amount of strength. In actual fact, we are not able to establish with certainty the reasons

95 Bozzolo / Ornato 1980, 70–72, 133.

that led to the preference for heftily constructed quires. One can hypothesise that a quire composed of multiple bifolia offered a guarantee—or at least, the impression—of greater stability and durability, regardless of the challenges presented by the binding process.[96]

However, we should not forget that the paper codex developed an entirely different appearance—one which was 'poorer' in comparison to its parchment cousin. Having its roots in the rough book or notebook, the paper codex enjoyed freedom from the laws that governed the production of the parchment manuscript, which had a more noble, and perhaps, precisely for this reason, more 'codified' use. For this reason, the paper codex was not affected by the traditional preference for quires structured as quaternions, and instead assumed forms that seemed better suited to the purpose to which it would be put, or, perhaps, to the status it held.

The remarks made above relate to Latin paper books, because, as we well know, the Greco-Byzantine world remained closely wed to the quaternion, also when it came to paper codices, even if the appearance of the new material contributed to generating an increased number of assembly techniques. In the Renaissance the panorama of Greek codices—which is predominantly populated by paper volumes—also presents other types of quire, although the quaternion remains the most widespread option.[97] Jean Irigoin has noted how some Greek scribes who were active in Italy during the 15th century adopted the quinion when they were writing on parchment, but reverted to the quaternion for paper manuscripts.[98]

A recent investigation of the characteristics and typologies of Islamic manuscripts[99] has revealed how Eastern and Western Muslims adopted different materials for the manufacture of books.[100] In the context of this contribution, it should be pointed out that one of the most important differences between the two areas of production concerns the composition of quires in parchment manu-

96 Indeed, the application of parchment reinforcement along the fold in paper quires could support the hypothesis that little confidence was placed in the strength of paper. See Bozzolo / Ornato 1980, 133.

97 See Canart 1980–1981, 77; Bianchi et al. 1994, 105, relating to a survey of 100 Greek Vatican codices dating from the 13th to 16th centuries.

98 Irigoin 1998, 7. In this contribution, the scholar examines the way in which quires were arranged in Greek codices in relation to the support (parchment, paper, mixed).

99 Orsatti 1993, 325–326.

100 The West encompassed the areas lying to the west of Egypt extending as far as Spain. The East remains undifferentiated, although in this region, too, one can identify different codicological zones. See Orsatti 1993, 323–324.

scripts. In the East, these prove to be predominantly structured in quinions, whereas in the Western area they are assembled from ternions, a use that seems to be peculiar to the Islamic codex.[101] Indeed, Jewish production in the same area is characterised by the quaternion, with the sole exception of Toledo, where parchment codices composed of ternions were produced.[102] Conversely, Western Hebrew codices made from paper favoured thick quires; indeed, manuscripts composed of senions and octonions predominate, even if there is no lack of codices constructed from quires composed of 4, 5, 7 and more bifolia.[103] One also encounters a remarkable variety of different types of quire in paper manuscripts of Arab origin,[104] which distinguish themselves from manuscripts of North African origin where, at least in the case of the Koran, trust was largely placed in the quinion.[105] In the East, Jewish production—as much in paper as in parchment—was also centred on the quinion, as it was in Islamic production, with the exception of codices originating from Iran and Uzbekistan, which were for the most part assembled from quaternions.[106] Paper therefore provides a rather varied panorama in the Western Jewish and Islamic worlds, but one which in any event leans towards rather thick quires (this observation is valid, above all, with respect to Hebrew manuscripts, which have been studied more closely).

The hypothesis that holds paper to be more perishable and less reliable than parchment appears to be supported by the creation of codices made from mixed quires—that is, as we have already said, of paper quires, but with the inner or outer bifolium, or both, made from parchment, most likely with the aim of endowing the quire with greater solidity and durability.[107] The authors of *Une recherche sur les manuscrits à cahiers mixtes* say of France and Italy (the former favouring the senion, the latter the quinion): 'Mais on peut se demander si le glissement vers le septénions et les octonions constaté chez les mixtes ne

101 See Orsatti 1993, 325–326.

102 Hebrew parchment manuscripts are essentially composed of quaternions in Ashkenaz and Sefarad (which of course includes Spain) and in Byzantium; meanwhile, in Italy and the East (with the exception of Persia and Uzbekistan) manuscripts are composed of quinions. See Beit-Arié 1981, 12–19 (for the definition of areas) and 43–49.

103 See Beit-Arié 1981, 41–49, and in particular p. 47: 'Paper quires adhere to the same local practice [which is to say the technique used for parchment] in the Orient [5 bifolia] and Ashkenaz [4 bifolia], while they show a variety of compositions in Sefarad, Italy and Byzantium: 4–10 and 12 sheets in Sefarad, 5–10 and 12 sheets in Italy, 4–8 sheets in Byzantium'.

104 See Orsatti 1993, 307–308.

105 See Orsatti 1993, 312–313.

106 See Beit-Arié 1981, 44 and 48.

107 Irigoin offers this explanation for the Greek context too. See Irigoin 1998, 12.

s'explique pas par le fait qu'on a ajouté deux bifolia aux quinions et sénions de papiers des cahiers normaux'.[108] In fact, this hypothesis is not applicable to the senion: 'pour les sénions, il est plus difficile de chosir une hypothèse parmi toutes celles possibles'.[109] Another possible hypothesis could be that the aim was to create a sort of 'reinforced' senion, that is to say a quaternion made from paper, but protected on the outside and inside by a bifolium made from parchment.[110]

3.2 Quiring and format

In this section, only paper codices will be examined, since any study of the formats of parchment codices in the absence of an opportunity to conduct a hands-on examination of such material would be rather pointless.[111]

We have already ascertained that there was a preference for thicker quires where paper was concerned. Now we propose to investigate the nature of the relationship between quire typology and *format*, by which we mean the type of folding a sheet underwent in order to form the bifolia used to make quires. With this aim in mind, we shall analyse paper manuscript production of the 15th[112] century in its entirety by subdividing it into two distinct sub-groups: in-quarto and in-octavo codices on the one hand, and in-folio and large in-folio[113] codices on the other.

Based on an examination of the data relating to European production considered overall, it emerges that the rate of diffusion of senions is the same whether it be for in-folio or large in-folio formats, and likewise for in-quarto and

108 Bianchi et al. 1994. Here, it should be pointed out that the same sort of hypothesis has been proposed in relation to Hebrew manuscripts: 'Tout se passe donc come si l'octonion mixte était un sénion de papier auquel on ajoute deux bifolia de parchemin' (278).

109 Bianchi et al. 1994, 279.

110 In the case of a single bifolium of parchment it could just as easily be postulated that one is dealing with a reinforced paper quinion.

111 Concerning the particular set of problems encountered in relation to the formats of parchment manuscripts, see Bischoff / Maniaci 1995, *passim*.

112 In our sample, the output from the first part of the 14th century is almost irrelevant.

113 The definition of the terms in-folio and large in-folio in this instance serves a purely functional purpose. In fact, the two subdivisions were arrived at based on the height and width of codices. The first group includes all manuscripts attaining a maximum height of 340 mmm and a maximum width of 240 mm, whilst the second group includes all manuscripts of larger size, i.e. of a size (H + W) exceeding 560 mm.

in-octavo[114] (52.3%) formats. The quinion, on the other hand, despite being well represented among the small formats (approximately 25%), certainly proves to be more common in the larger ones (37%). The quaternion, as we have already seen, does not appear to be a quire structure particularly well-suited to paper—in the Latin context, at least. Indeed, in the in-quarto and in-octavo formats, it is adopted in 12.5% of production, whilst in the in-folio or large in-folio formats its rate of occurrence declines to just 3.2%. In both groups a certain percentage of codices are composed of either octonions or thick and irregular quires, which are indicated by -1 (see Tab. 27 and 28).

14th and 15th centuries. In-quarto and in-octavo. First / second half (tab. 27)

Predom. quiring	14th century			15th century				Total	
	1st half	2nd half	Total	1st half	2nd half	15th*	Total	14th and 15th	%
-1	0	0	0	0	6	0	6	6	2.2
III	0	0	0	1	1	0	2	2	0.7
IV	0	2	2	9	24	0	33	35	12.5
V	0	6	6	8	54	2	64	70	25.1
VI	1	7	8	25	112	1	138	146	52.3
VII	0	0	0	[illegible]	[illegible]	[illegible]	1	1	0.4
VIII	0	0	0	3	[illegible]	[illegible]	[illegible]	[illegible]	4.7
X	0	1	1	1	[illegible]	0	[illegible]	[illegible]	1.4
XII	0	0	0	1	[illegible]	0	[illegible]	[illegible]	0.7
Total	1	16	17	48	210	4	262	279	100

* The century half is not specified

Tab. 27: 14th and 15th centuries. In-quarto and in-octavo. First / second half

114 We shall be adopting the following abbreviations: in-folio = in-f; large in-folio = lf, in-quarto = in 4°, in-octavo = in 8°.

14th and 15th centuries. In-folio and large in-folio. First / second half (tab. 28)

Predom. quiring	14th century			15th century				Total	
	1st half	2nd half	Total	1st half	2nd half	15th*	Total	14th and 15th	%
-1	0	2	2	0	5	0	5	7	1.6
III	0	1	1	0	0	0	0	1	0.2
IV	0	3	3	3	8	0	11	14	3.2
V	0	12	12	57	92	1	150	162	37
VI	0	20	20	64	144	1	209	229	52.3
VII	1	0	1	1	3	0	4	5	1.1
VIII	1	0	1	6	7	0	13	14	3.2
IX	0	1	1	0	0	0	0	1	0.2
X	0	2	2	0	0	0	0	2	0.5
XII	0	0	0	0	3	0	3	3	0.7
Total	2	41	43	131	262	2	395	438	100

* The century half is not specified

Tab. 28: 14th and 15th centuries. In-folio and large in-folio. First / second half

At this point we should verify the way in which production rates are distributed in each individual country,[115] since in the case of the support (for example) we discovered how the choice of a certain kind of quire does not depend solely, broadly speaking, on the choice of material (paper or parchment), but also on its use in different locations.[116]

In French production, the senion proves to be by far the most frequently used quire in both small and large formats (62% and 65%, respectively), although the latter's rate of diffusion is slightly higher. Conversely, the percentage of quinions is striking. Evidently these are seldom used in the smaller formats (3%), but are well represented in larger formats, where they account for 19% of production. With respect to quaternions, precisely the opposite situation emerges: these are seen in 20% of the production of small format volumes,

115 In particular, French, German and Italian output will be analysed, given that the number of English paper codices is insufficient for the purposes of a statistical analysis.

116 Italian paper codex production mainly employed the quinion (as it did in parchment production as well), whereas in the rest of Europe the preference was for senions.

whereas they play a fairly insignificant role in the production of in-folio and large in-folio format ones (3%). Thick and irregular quires prove to be more frequent in the small formats than in the large ones,[117] whilst the codices composed of octonions are seen in both types of production, even if they appear to be adopted more often in the larger in-folio and large in-folio formats (see Charts 5 and 6).

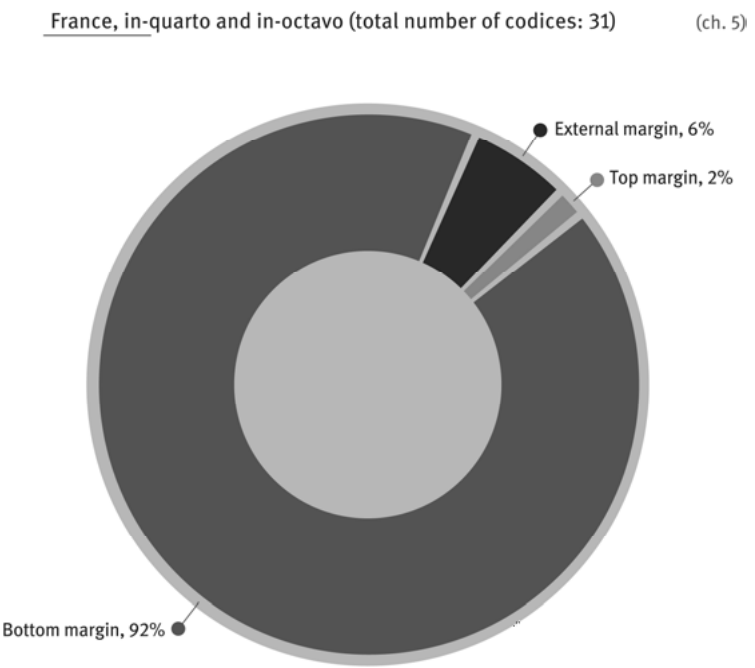


Chart 5: France, in-quarto and in-octavo (total number of codices: 31)

117 Clearly, among the smaller formats there is a larger percentage of codices of not particularly high quality.

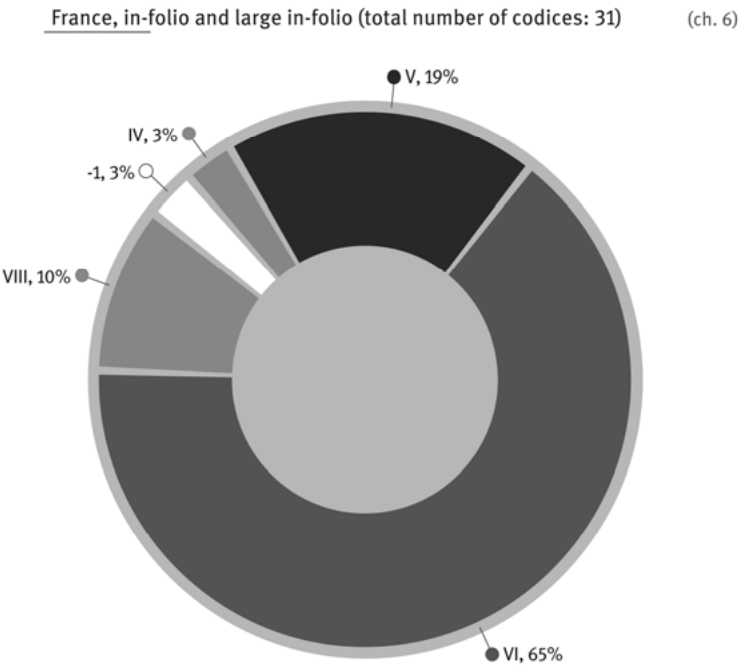


Chart 6: France, in-folio and large in-folio (total number of codices: 31)

To account for a distribution of this kind of the various types of quire, one could hypothesise that quires composed of an even number of bifolia were used to assemble small format codices, given that the quinion was seldom used in in-quarto and in-octavo volumes, whilst it is in precisely these volumes that quaternions appear. A possible explanation for a choice of this kind may lie in the way in which in-quarto volumes were fabricated. In them, if the quires had been made from an odd number of bifolia—quinions, for example—it would have been necessary to cut a sheet of paper in two (so as to obtain a fifth bifolium), a step that would have required more time and effort than would be necessary if the quires were formed by carrying out an even number of folds.[118]

In small format volumes of Italian origin, the quinion—which was used in the vast majority of production, both parchment and paper—proves to be the preferred option, even if the quaternion and senion reach levels of diffusion equating to 14% and 15%, respectively. On balance, then, 'even numbered'

118 Bozzolo / Ornato 1980, 145–147.

quires are seen in 38% of the total production of small format volumes. Moreover, the effect of thicker quires composed of seven bifolia or more should not be underestimated, since it amounts to more than 10%[119] overall (see Chart 7).

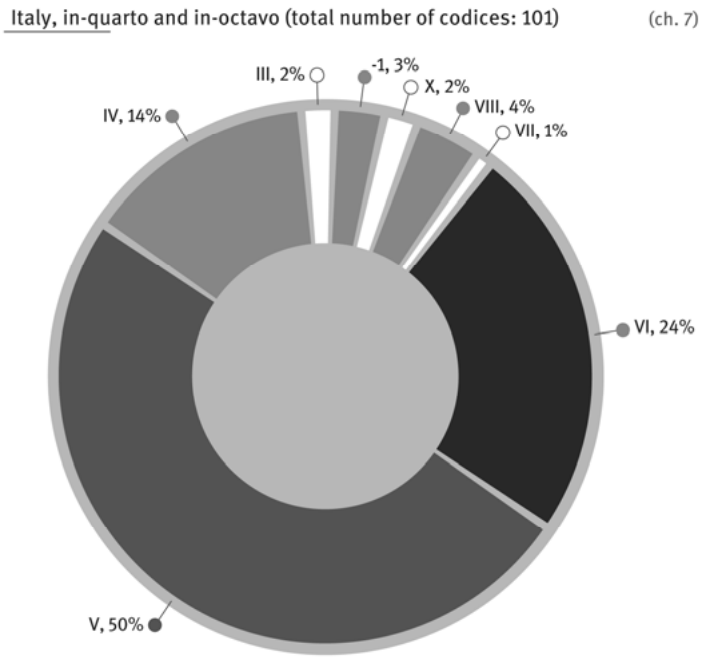


Chart 7: Italy, in-quarto and in-octavo (total number of codices: 101)

Conversely, large format codices present an entirely different kind of distribution: above all, quinions prove to be much more widely diffused, accounting for 68% of the total production (i.e. 18% more than in small format manuscripts), whilst the use of quaternions decreases to the point where it just scrapes 2%. On the other hand, senions show a more or less stable distribution, amounting to 21% of the overall sample. The presence of codices made from quires composed of eight bifolia remains steady at 4%. Septenions reach a level of 2%, whilst the number of thicker quires[120] decreases to a rate of 3% (see Chart 8).

119 The only codices composed of octonions are present at a rate of 4%.
120 Quires composed of nine, ten and twelve bifolia.

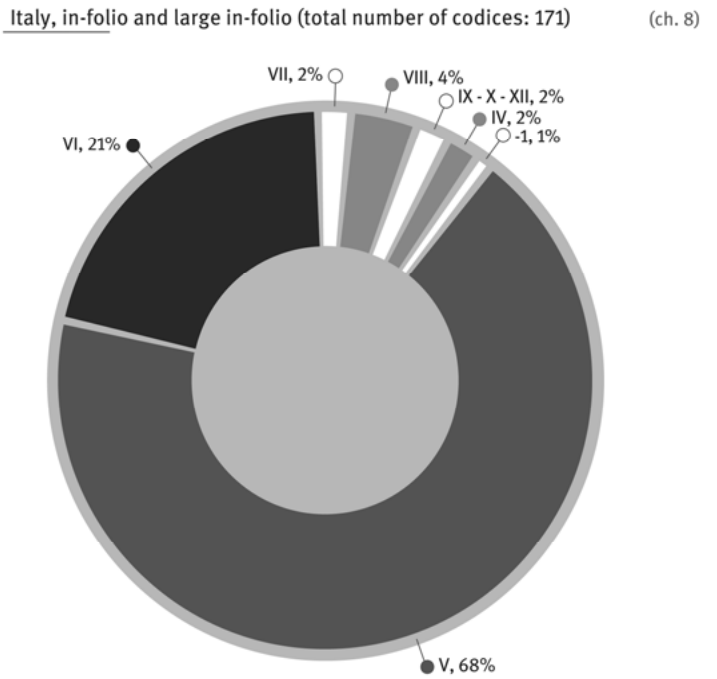


Chart 8: Italy, in-folio and large in-folio (total number of codices: 171)

Therefore in Italian production, too, one sees a certain tendency to use quires composed of an even number of bifolia in small format volumes, even though the quinion remains the preferred quire for the making of in-quarto and in-octavo books, where it still achieves a usage level of 50%.

Large format volumes could be further subdivided to distinguish between in-folio and large in-folio formats in order to obtain a more accurate picture of the distribution of quires, above all with respect to quinions. In fact, it emerges that the quinion, notwithstanding its frequency of use in in-folio volumes (in the production of which they reach a level of diffusion of almost 61%), appears to be by far the most favoured structure in the large in-folio volumes, to the extent that they comfortably achieve a diffusion rate of 80% (see Tab. 29). Here, it might be helpful to point out that in our sample 46 out of 55 large in-folio volumes composed of quinions are juridical manuscripts.

Italy, in-folio and large in-folio. 15th century. First / second half (tab. 29)

	Predominant quiring		Total 15th century	
In-folio	1st half	2nd half		%
-1	0	2	2	2.2
IV	1	2	3	3.4
V	14	40	54	60.7
VI	7	13	20	22.5
VII	1	1	2	2.2
VIII	3	4	7	7.9
XII	0	1	1	1.1
Total	26	63	89	100
Large in-folio				
V	31	24	55	83.3
VI	9	2	11	16.7
Total	40	26	66	100

Tab. 29: Italy, in-folio and large in-folio, 15th century. First / second half

In Germany, paper codices prove to be mainly composed of senions; indeed, this is true as much for the smaller formats, where they achieve a level of diffusion of 88%, as for the larger ones, where they account for some 84% of the total production. The share of codices formed from quaternions is the same in both groups (2%), as is also—roughly speaking—that of quinions, where it amounts to 10% in small format volumes and 11% in large ones (see Charts 9 and 10). In the German area, then, based on what can be inferred from our analysis of these data, there appears to be no difference in the manufacturing strategies adopted for both small and large format volumes.

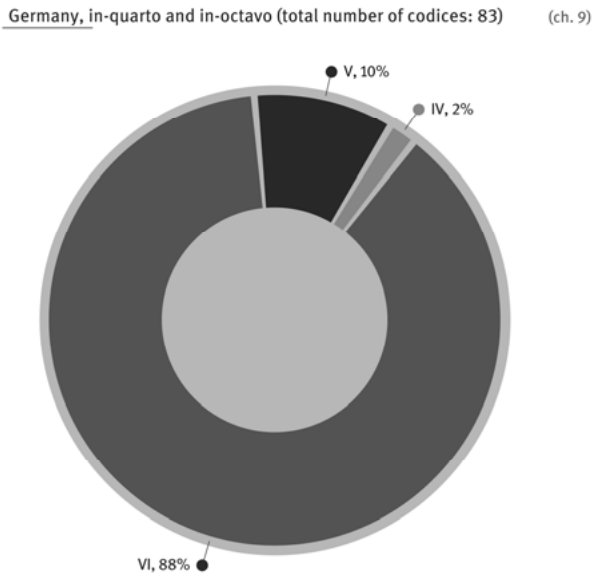


Chart 9: Germany, in-quarto and in-octavo (total number of codices: 83)

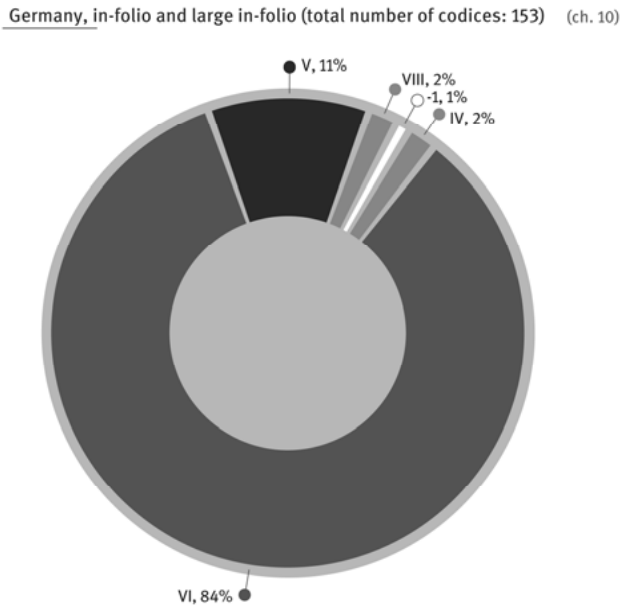


Chart 10: Germany, in-folio and large in-folio (total number of codices: 153)

3.3 Quiring and textual typology

In order to highlight a possible link between textual typology and quiring we considered it practical—in the first phase, at least—to limit the investigation to the 13th and 14th centuries, which is to say the period when the widespread use of the quaternion declined and left the field open to other types of quire, including the senion and quinion, the latter above all in Italy.

The task of illustrating the relationship between textual typology and quiring is a rather complex one, given that the subdivision of textual types is not evenly distributed within one and the same country, and even less so among different countries.[121] Furthermore, despite limiting our analysis to specific national contexts,[122] the presence of different textual types varies considerably in relation to the time intervals examined.[123] It is therefore obvious that in a situation where such disparate data have to be analysed some problems will arise, even if within the context of each individual nation some clear tendencies have emerged. Here, it seems worthwhile to shed some light on them.[124]

3.3.1 England

In England in the first half of the 13th century one already finds a certain percentage of codices composed of senions. However, these do not seem to be linked to any specific textual type, apart from Bibles, which appear to be composed of senions in a just under half of all instances.[125] Starting from the second half of the 13th century, senions are seen throughout English production, to the extent that they were used in codices that acted as vehicles for all textual types. In theological texts, senions account for 84%[126] of the total sample, whilst in

121 This happens not only because each country may have favoured different disciplines—indeed, it is well known that at that time France produced a large amount of theological manuscripts, while Italy predominated in other sectors, including juridical studies—but also on account of the limitations of the sample which, as we have pointed out, was assembled using catalogues.

122 With the passage of time, needs changed in each country and therefore production types changed as well. Furthermore, our sample has intrinsic limitations, as we have pointed out previously.

123 13th.1, 13th.2, 14th.1, 14th.2.

124 The subdivision of codices according to textual typology and quiring was deemed impractical for Germany because the total number of representative items in the sample for the 13th and 14th centuries was not sufficient to permit the creation of subdivisions.

125 Out of a total of 11 occurrences, 5 are composed of senions.

126 Out of a total of 25 occurrences, 2 are composed of quaternions, 2 of octonions, and 21 of senions.

liturgical and patristic texts[127] they are present in three quarters of the production. The same is true of sermons and histories.[128] As for Bibles, senions account for almost half of the output, whilst in the other half more substantial quires of eight or more bifolia were employed.[129] Needless to say, our observations regarding the various textual types do not all have the same value, given that in some instances we can count on plentiful numbers—theological, liturgical, patristic and biblical texts—whereas in other instances, such as collections of sermons and histories, a rather restricted sample meant that it was only possible identify some general indications.

The first half of the 14th century is marked by production strategies that see the revival of the quaternion (observed in 34% of the total sample), although the senion remains the most commonly used quire. University texts—i.e. theological and philosophical works, and sermons—are still composed entirely of senions, as are juridical texts.[130]

With respect to quaternions,[131] these appear most frequently in codices containing the *Statuta Angliae*,[132] of broadly speaking, though not wholly, juridical content, and in liturgical volumes, which are almost exclusively assembled from quaternions.

In the second half of the 14th century, the quaternion is by now favoured in the bulk of production (56.5% of the total), although the senion is still seen above all in specific types of manuscript. In fact, it is quite noticeable how senions continue to represent the quire of choice (62.5%) in theological texts. This is also the case with the collections of sermons (57.7%). In addition, for this period the only two philosophical codices in the sample are composed of senions.

The remainder of the output is predominantly formed from quaternions, which in liturgical volumes amount to 71% of the total production. Quaternions

127 In the liturgical volumes, out of a total of 16 manuscripts, 12 are composed of senions, whereas in the patristic books 9 out of 12 are composed of senions.

128 The total number of occurrences for each of these two groups is under ten units.

129 Out of a total of 38 occurrences, 18 are composed of senions and 18 of quires assembled from eight bifolia and above.

130 In this last instance, the number of items in the sample is particularly low (only 4 occurrences), which furthermore are all composed of senions.

131 Out of a total of 24 occurrences, 14 are composed of quaternions, 9 of senions, and 1 of quinions.

132 These codices are indicated using the label *giu2*. Concerning the labels that indicate the various types of textual typology, see Appendix I, Surveying Protocol, in the sub-section 'Textual typology'.

are also represented in 59% of sacred texts, 71% of codices containing statutes and related material, 51% of histories, and 66% of glossed gospels.

Bibles as a textual typology merit a separate comment, even if very few of them are present in the sample.[133] These seem to exhibit a distinct change in their physical structure: indeed, some 90% of them are formed from quaternions. The change of manufacturing strategy with respect to quiring probably reflects a production context and functionality which no longer targeted the single user, but instead a community.[134]

3.3.2 France

In the first half of the 13th century French manuscript production is still concentrated on the quaternion, even if a few examples of codices composed of senions have already begun to appear among the theological and juridical works, and Bibles.

Starting in the second half of the century, production of volumes composed of senions, as we have already seen, accounts for almost two fifths of the total: in particular, theological (71.4%), philosophical (76%), and almost half of sermon collections are structured in senions. Volumes of a juridical nature are by preference fabricated using senions, although there is no lack of examples assembled from quinions and quaternions.

The book of the Bible, in particular, is assembled using decidedly thick structures, including quires of six, eight and ten, but most of all twelve bifolia.[135]

On the other hand, the quaternion is the preferred quire for liturgical codices, and those containing sacred texts, texts on medicine, the classics and history, although in the first four typologies other kinds of quiring can be observed.[136]

A sample of sufficient size was not available for the first half of the 14th century. However, in our opinion it is still possible to put forward some general observations. The manuscripts originating from universities present with a structure that had already been trialled in the previous century—in fact, the theological volumes are composed of senions in 75% of cases. In the codices containing sacred texts, qua-

133 Out of a total of 9 occurrences, 8 are composed of quaternions, and 1 of senions.

134 Bozzolo / Ornato 1980, 265.

135 We will return to the Bibles later on in this contribution.

136 Liturgical works: out of a total of 13 occurrences, 8 are composed of quaternions, 1 of quinions, and 4 of senions; Sacred literature: out of a total of 12 occurrences, 7 are composed of quaternions, 2 of senions, and 3 of octonions; Medical texts: out of a total of 8 occurrences, 5 are composed of quaternions, 1 of quinions, and 2 of senions; Classical texts: out of a total of 7 occurrences, 5 are composed of quaternions, 1 of quinions, and 2 of senions.

ternions and senions are used in equal measure, whereas the production of juridical codices seems always to favour the use of senions.

The use of quaternions in more than half of the output is taken up again in the second half of the century. This is the case, above all, in liturgical texts, where this type of quire becomes practically invariable (90% of the total)[137]. Sacred texts are produced in equal measure in quaternions and senions, as in the previous half-century. Needless to say, a certain percentage of manuscripts composed of senions survive in various other textual typologies, such as, for example, the classics, but to a greater degree only in juridical codices, which are composed of senions in 70% of cases.

Therefore, both in France and in England the senion is mainly linked to the printed university book, where it endures even when book manufacturing strategies change at a more generalised level. Other types of codices, such as liturgical ones in England, adopted the senion only for a limited period of time, which more or less coincides with the period of maximum diffusion, and subsequently reverted to the traditional structure, namely the quaternion.

3.3.3 Italy

In the first half of the 13th century the population of our sample is not particularly representative. Nevertheless, as we have already stressed, a clear preference for the quaternion in Italian production is plain to see.

Starting in the second half of the century, we meet with quaternions and quinions as much as with senions, with the latter not being linked to a specific genre of codex, apart from Bibles, in which they reign supreme. The same is true of quaternions which, apart from in liturgical codices where, broadly speaking, they prove to be the predominant quire type, appear in almost all textual typologies. Quinions, on the other hand, despite being in a minority in our sample in relation to the aforementioned other two quire types, appear to be the preferred solution for the structuring of juridical texts, to the extent that they appear in eight out of twelve codices (66.6% of the total).[138]

In the first half of the 14th century the number of instances of codices composed of quaternions, quinions and senions is almost the same. The three types of quire are distributed more or less equally among the various textual typologies, with the exception of juridical codices, which are predominantly com-

137 Out of a total of 20 occurrences, 18 are composed of quaternions and 2 of senions.

138 We can also report 2 codices composed of quaternions and 2 of senions.

posed of quinions (7 examples in 8), and the small number of theological volumes, which are all composed of senions.

The second half of the century is set against a contextual backdrop in which the quinion is fully established. Once again, the juridical codex in particular is fully in tune with this type of quire: indeed, 18 volumes of 22 (about 82%) present with this structure. In codices containing profane texts, and in theological and liturgical volumes, the quinion predominates, and indeed plays, from this time onwards, a fundamental role in manuscript production, both in parchment and in paper.

Quaternions, used in the production of all textual typologies, hold a subordinate position compared with quinions, apart from in books containing the classics, in which they are used to a greater extent.

In liturgical and theological codices, and in volumes of sacred and profane texts, one continues to find volumes composed of senions, even if this choice is not the preferred solution in any particular textual typology.

In Italian production, then, following a period of even distribution in the utilisation of the various types of quire, the quinion became the preferred structure in all textual typologies, with juridical codices leading the way, where they make their first strong appearance.

3.3.4 Bibles

In the early centuries of the Middle Ages up until and including the entire 12th century, the Bible[139] represented the embodiment of the word of God and functioned as a symbol of the spiritual identity of a monastery, a bishop's office, or the religious duties of a sovereign. It therefore took on a public meaning which was reflected in its physical characteristics—majestic, multi-volume, lavishly illustrated. By contrast, in the 13th century a new type of Bible appeared—of small format, with the text of the Old and New Testaments contained in one volume—that clearly signalled a new conception of the Bible, which by now had become a book intended for strictly personal use.[140] This does not mean to say that large format

139 Here, we are not referring to a particular type of Bible, but rather to an ideal notion. See Light 1987, 276: 'Before the thirteenth century, the Bible, whether we are speaking of the great English and French twelfth-century romanesque Bibles, the Italian giant Bibles of the eleventh and twelfth centuries, the lavish Ottonian gospel books, or the ninth-century products of the scriptorium at Tours, was an impressive embodiment of the word of God [...]'.

140 Light 1987, *passim*.

Bibles were no longer produced; on the contrary, at this time in northern France we find multi-volume large format Bibles, and in Italy large format single-volume Bibles. Among all the types of Bible produced in the 13th century, the so-called 'pocket Bibles'[141] are beyond doubt the most original, above all because they represent the change that occurred in the very conception of the Bible, which had previously been seen as a symbolic object laden with extra-textual significance but now became an object for personal use—a book for reading and for referring to specific passages in. The first Bibles of this type seem to emerge simultaneously in France and England in about 1230, and a few years later they spread to Italy and Spain.[142] The hypothesis regarding the advent of pocket Bibles and, above all, their likely users, points towards universities, since the small format seems to fulfil the need of students and teachers to possess an easily transportable text. The same is true of mendicant monks, who also needed to have at their disposal an easily consultable and transportable sourcebook.[143]

This is not the appropriate place to fully explore a topic of this kind, which not only encompasses the physical materiality of the book-Bible object, but also the very concept it implies. Instead, what we wish to stress here is the extent to which the transformation of an intellectual representation—in this case, of the Bible—resulted in material changes in its 'vehicle', namely the book as an object. The most direct result of this new concept—if we leave to one side the novelty of the presentation of the sacred text in a single volume, which affects both large and small formats equally—is without doubt the so-called pocket Bible. The material characteristics of this product are well known to all: a single volume with a large number of leaves made from exceedingly thin parchment structured into particularly thick quires; minute script (*textualis* or Gothic bookhand); and a decorative apparatus that varies from volume to volume, and which sometimes was executed with extraordinary care.

This description—which clearly is not exhaustive—has the sole purpose of calling to the reader's mind the image that is most often associated with the concept of a pocket Bible. This typology accounts for some 54 witnesses[144] in our cor-

141 Not to be confused with 'Paris Bibles', in other words Bibles of a different format—ranging from pocket-sized to monumental—which reflect a very clear textual tradition that originated in Paris in around 1230 and spread throughout the rest of France and Europe. See Light 1994, *passim*.

142 Light 1987, 277.

143 Light 1987, 279.

144 The definition of the term 'pocket Bible' is subject to arbitrary interpretations, but in our case we are dealing only with Bibles defined as such based on the characteristics indicated by Light 1987, 278, which is to say not exceeding 200 mm in leaf height and 150 mm in written area height.

pus. The volumes originate from various countries (see Tab. 30), and all present with rather thick quires:

- 5 bifolia 1 (1.8%)
- 6 bifolia 15 (27.8)
- 8 bifolia 11 (20.5%)
- 10 bifolia 9 (16.7%)
- 11 bifolia 1 (1.9%)
- 12 bifolia 17 (31.4%)[145]

Pocket Bibles (tab. 30)

Predom. quiring	England	France	Italy	Low Countries	German area	Total
V	1	0	0	0	0	1
VI	8	2	4	1	0	15
VIII	6	4	0	0	1	11
X	3	6	0	0	0	9
XI	0	1	0	0	0	1
XII	3	14	0	0	0	17
Total	21	27	4	1	1	54

Tab. 30: Pocket Bibles

The Bible's new function meant that it had to be re-conceptualised from a material standpoint as well: the need to house both the Old and New Testaments in one small format volume calls for a series of well thought out choices being made. These choices concern the *mise en texte* and the *mise en page*, just as much as the support that hosts them. In fact, the parchment used had to be particularly thin in order to make it possible to contain the entire biblical text within a single volume.

In all likelihood, it was precisely the thinness of the parchment which, from a technical point of view, made the creation of this new type of Bible possible.[146]

145 These percentages are presented in Chart 11, in which rounded values are shown.

146 'Two technical innovations—extremely thin, almost translucent parchment, and a minute, very compact gothic book hand—opened the way for a Bible that was not only very small in

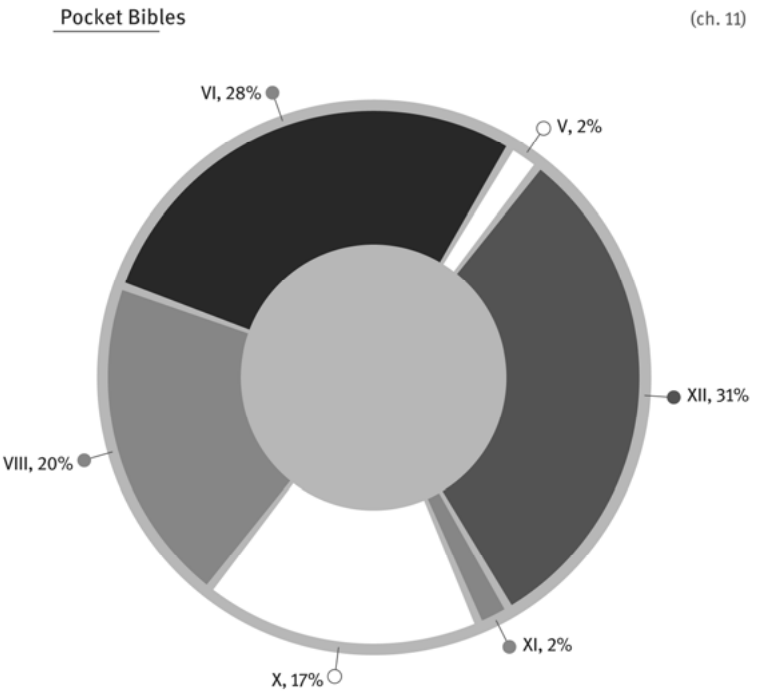


Chart 11: Pocket Bibles

At the same time, the parchment's extreme thinness may account for the decision to assemble particularly thick quires, a choice which would assure a certain amount of robustness over time. We should not forget that for paper, too, similar hypotheses have been proposed: thicker quires could be related to materials—both paper and parchment—that were particularly thin, and which were considered less robust.

Naturally, thicker quires were also employed in larger format Bibles (see Tab. 31, which lists all the 13th-century Bibles present in our corpus). Indeed, Bibles contained within a single volume—be they of medium or large format—called for carefully considered solutions, both with respect to page construction and the organisation of the relevant support.

terms of the size of each page, but also one which was not cumbersomely thick when bound in one volume'. See Light 1987, 278.

Bibles, 13th century. First / second half (tab. 31)

Predom. quiring	First half			Second half					Total
	England	France	Total	England	France	Italy	German area	Total	
IV	2	0	2	1	1	0	0	2	4
V	4	0	4	2	0	0	0	2	6
VI	5	3	8	18	6	6	1	31	39
VIII	0	1	1	9	7	0	1	17	18
X	0	1	1	4	6	0	0	10	11
XI	0	0	0	0	1	0	0	1	1
XII	0	0	0	4	16	0	0	20	20
Total	11	5	16	38	37	6	2	83	99

Tab. 31: Bibles, 13th century. First / second half

The number of 14th-century Bibles in our corpus is distinctly low. Nevertheless, one can quite easily ascertain that the quaternion reclaimed its position as the predominant type of quire,[147] thereby once again altering the concept of the Bible as a product, and therefore the manufacturing solutions associated with it.

3.4 Quiring and layout

It is well known that in the Latin context a correlation exists between the size of manuscripts[148] and their proportions,[149] in the sense that, as the centuries pass, one observes an attempt to rationalise codices so as to produce, roughly speaking, volumes of consistent proportions, irrespective of the number of folds the skin undergoes.[150] The arrangement of the text on the page proves to be linked to the volume's size, insofar as in all eras layouts in one column are more com-

147 Out of a total of 13 occurrences, 9 are composed of quaternions, 1 of quinions, 2 of senions, and 1 of quires assembled from 12 bifolia.

148 Regarding the term 'size, see note 80.

149 The term 'proportion' refers to the width/height relationship.

150 For some hypotheses on how this correlation works, see Bozzolo / Ornato 1980, 253–261; Bianchi et al. 1993b, 386–390.

mon in 'small' manuscripts, whereas layouts in two columns are more common in 'large' ones.[151] Most likely, the correlation that exists between the size of codices and the layout of the text overshadows the relationship which unites the latter with the dimensions of the written area, and therefore the dimensions of the leaves themselves.[152]

Therefore, the proportion of the page is correlated to the layout of the text in either one or two columns,[153] and the choice of one or the other solution seems to depend on the dimensions of the written area and line spacing.[154] In particular, the adoption of a two-column layout is embraced more quickly as the line spacing decreases. Like line spacing, the type of script also exerts a certain influence over the speed with which the shift is made from one type of *mise en page* to the other. Clearly, legibility plays a fundamental role in this connection: in fact, the layout of the text in two columns makes it possible to preserve maximum usability without sacrificing the overall 'performance' of the page.[155]

We shall not concern ourselves here with the reason why one form of layout was chosen over another; rather, we shall try to determine whether a link exists between the layout of the text and quiring—in other words, whether or not a certain type of quire proves to be used more frequently for full-page layouts or two-column ones.

Also in carrying out this part of the investigation we shall examine the 13th and 14th centuries in relation to the production of England, France and Italy[156] (we have already explained the reasons behind this choice vis-à-vis textual typologies). We should immediately make it clear that the data with respect to the 13th and 14th centuries will be placed in comparison with an added degree of caution, since they relate to unequal numbers of items in the sample and, above all, to different textual typologies—or at least ones which are present in different numbers.[157]

151 Here, we are referring to essentially high width/height values.

152 Bozzolo / Ornato 1980, 322.

153 Bozzolo / Ornato 1980, 326.

154 Bozzolo / Ornato 1980, 318–330.

155 Bozzolo et al. 1984, 215–221.

156 There are not enough 13th- and 14th-century codices originating from Germany and the Low Countries in our sample to enable us to make further subdivisions.

157 Earlier on we ascertained that some textual typologies are linked to the use of specific quires, hence a strong presence of codices on certain subjects can affect the representativeness of the sample.

3.4.1 England

Already in the first half of the 13th century, for which the population of manuscripts structured in senions in our sample of codices is not very high, the link between this type of quire and the layout of the text in two columns seems to be clear, to the extent that 32% of the codices in question present with quires formed from six bifolia. On the other hand, the arrangement of bifolia into quaternions is the preferred solution for manuscripts laid out in a single column (70.4% of the total), in which the percentage of senions is very low. The quinion appears to be adopted for both single block and two-column layouts, although in the latter the percentage is higher (see Tab. 32). In the second half of the 13th century the use of senions is very widespread. However, one notices a small difference which favours the two-column layout (65%) over the full-page layout (59.1%). Here, it must be remembered that the two-column layout, despite the fact that it was used in all periods, and from the 11th century onwards took on an increasingly preponderant role, was adopted as a favoured technical solution starting, indeed, in the 13th century.[158] Full-page codices, even if they are in a clear minority in comparison to two-column manuscripts, and are chiefly quired in senions, are composed of quaternions in 27.3% of the sample. The two-column / senions association is mainly represented in the first half of the century, whereas the link between the full-page and quaternions seems rather strong in the second half of the 13th century, when the use of senions is widespread (see Charts 12 and 13). A final observation concerns the thickest quires (i.e. quires containing eight, ten or twelve bifolia), which are consistently correlated to two-column layouts (see Tab. 32, and Chart 13).[159]

158 Concerning the spread of two-column layouts and what motivated their use, see Bozzolo / Ornato 1980, *passim*.

159 Often one is dealing with pocket Bibles, for which a two-column layout became necessary so as to render them legible.

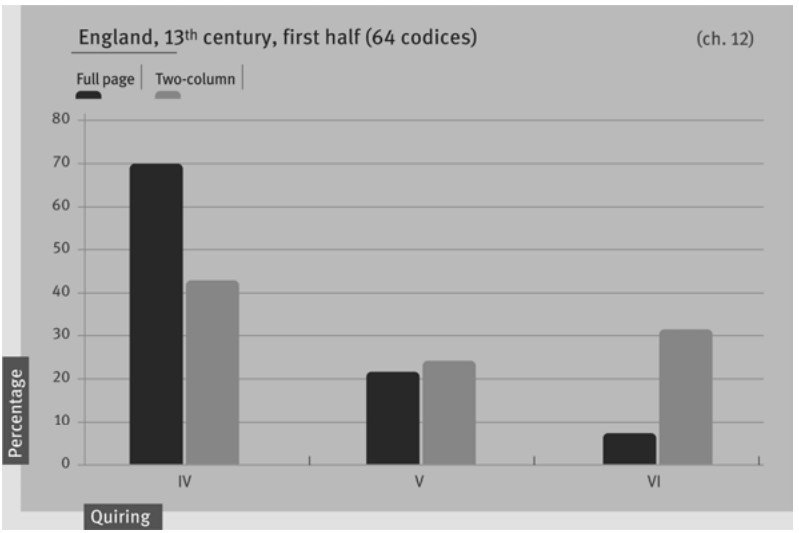


Chart 12: England, 13th century, first half (64 codices)

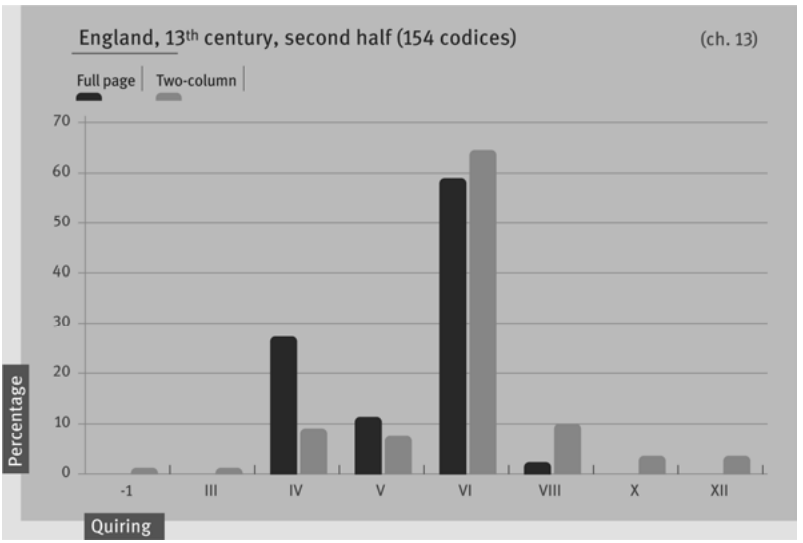


Chart 13: England, 13th century, second half (154 codices)

England, layout, 13th century. First / second half (tab. 32)

	Predominant quiring					Total	
Full page		1st half	%	2nd half	%		%
	IV	19	70.4	12	27.3	31	43.7
	V	6	22.2	5	11.3	11	15.5
	VI	2	7.4	26	59.1	28	39.4
	VIII	0	0	1	2.3	1	1.4
Total		27	100	44	100	71	100
Two-column							
	-1	0	0	1	0.9	1	0.7
	III	0	0	1	0.9	1	0.7
	IV	16	43.3	10	9	26	17.7
	V	9	24.3	8	7	17	11.5
	VI	12	32.4	71	65	83	56.4
	VIII	0	0	11	10	11	7
	X	0	0	4	3.6	4	3
	XII	0	0	4	3.6	4	3
Total		37	100	110	100	147	100
Total		64		154		218	

Tab. 32: England, layout, 13th century. First / second half

During the first half of the 14th century, even if full-page layouts can be associated as much with quaternions as with senions, the close link that exists between two-column layouts and quiring in senions (84%) once again emerges very clearly (see Tab. 33 and Chart 14). The mechanism that governs the latter type of association is not readily identifiable. However, it seems fairly clear that in the case of full-page manuscripts—even if one cannot deny a preference for the quaternion—there is certainly more flexibility in the choice of the quiring structure. We already know that, starting in the second half of the 14th century, a change took place in the manufacturing techniques used for manuscripts. This change re-focused attention on the quaternion, notwithstanding a certain tendency to associate the quaternion with full-page layouts and the senion with two-column ones, though in a less marked way than in the antecedent periods (see Tab. 33 and Chart 15).

England, layout, 14th century. First / second half (tab. 33)

	Predominant quiring					Total	
Full page		1st half	%	2nd half	%		%
	-1	1	2.4	1	1.3	2	1.7
	III	0	0	1	1.3	1	0.8
	IV	20	48.8	49	62	69	57.5
	V	2	4.9	4	5	6	5
	VI	18	43.9	24	30.4	42	35
Total		41	100	79	100	120	100
Two-column							
	-1	0	0	1	1.4	1	1.1
	III	0	0	1	1.4	1	1.1
	IV	4	16	35	50.8	39	41.4
	V	0	0	2	3	2	2.1
	VI	21	84	29	42	50	53.2
	VIII	0	0	1	1.4	1	1.1
Total		25	100	69	100	94	100
Total		66		148		214	

Tab. 33: England, layout, 14th century. First / second half

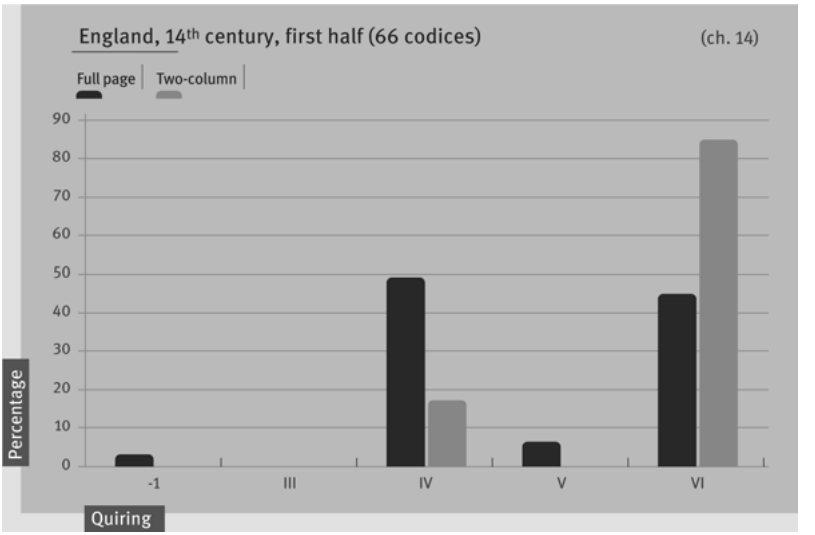


Chart 14: England,14th century, first half (66 codices)

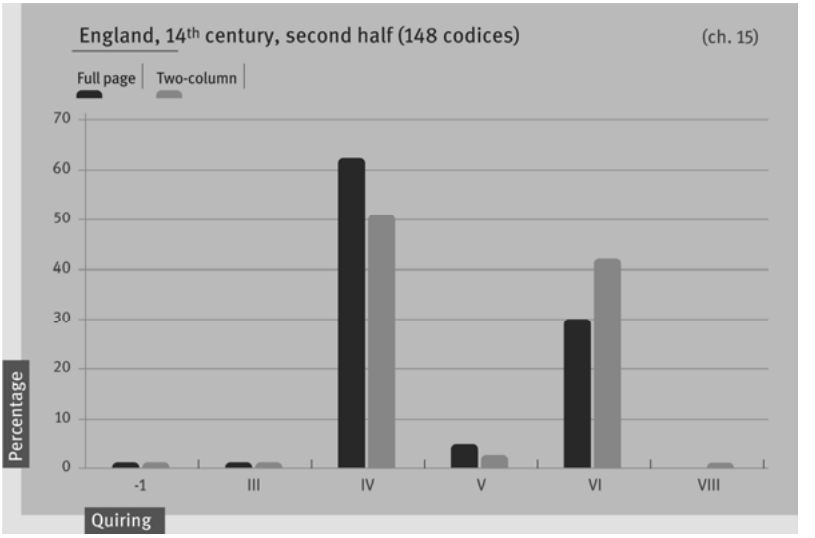


Chart 15: England, 14th century, second half (148 codices)

3.4.2 France

In the first half of the 13th century French manuscript production is for the most part based on the quaternions, which are seen as much in full-page layouts as in two-column ones. However, we should not fail to point out that almost all the codices composed of senions, in addition to the small number composed of thicker quires, have two-column layouts. Starting from the second half of the 13th century, layouts in two-columns became the norm and are associated with very thick quires composed of six, eight, ten or twelve bifolia, although some of the production is structured in quaternions (approximately 22%). Pages laid out in one column are almost always seen in volumes composed of quaternions (71.4%), apart from a few instances of senions and other types of quire (see Tab. 34 and Charts 16 and 17).

France, layout, 13th century. First / second half (tab. 34)

	Predominant quiring					Total	
Full page		1st half	%	2nd half	%		%
	IV	17	89.4	20	71.4	37	78.7
	V	1	5.3	2	7.1	3	6.4
	VI	1	5.3	5	17.9	6	12.8
	VIII	0	0	1	3.6	1	2.1
Total		19	100	28	100	47	100
Two-column							
	IV	25	57.6	27	21.9	52	32.5
	V	1	2.7	7	5.7	8	5
	VI	8	21.6	54	43.9	62	38.8
	VIII	2	5.4	12	9.8	14	8.7
	X	1	2.7	6	4.9	7	0.6
	XI	0	0	1	0.8	1	53.2
	XII	0	0	16	13	16	10
Total		37	100	123	100	160	100
Total		56		151		204	

Tab. 34: France, layout, 13th century. First / second half

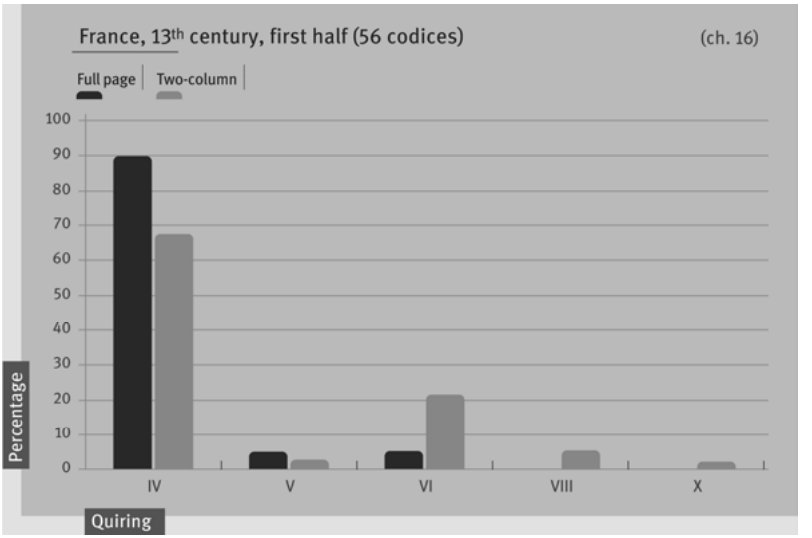


Chart 16: France, 13th century, first half (56 codices)

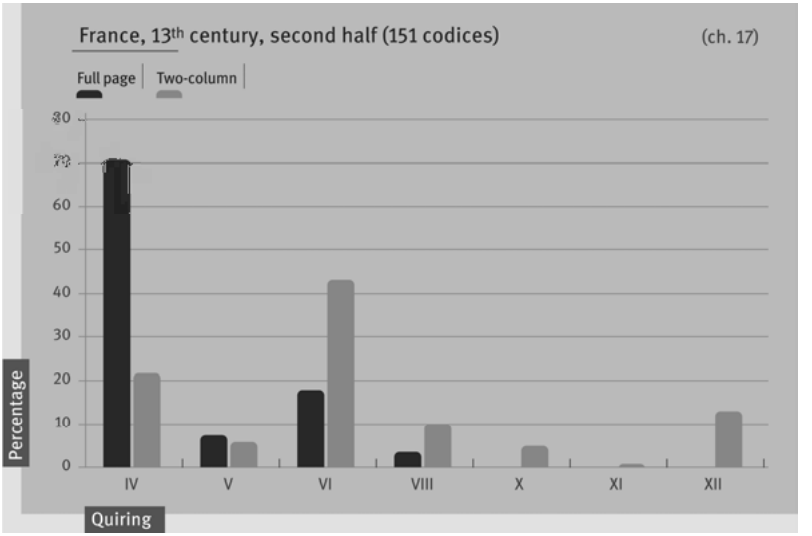


Chart 17: France, 13th century, second half (151 codices)

The number of codices included in our sample that were manufactured in the first half of the 14th century is not particularly high, and these mostly consist of volumes presenting with two-column layouts (31 instances in a total of 38). In most cases, these are structured in senions, even if examples of volumes composed of quaternions or quinions can also be observed (see Tab. 35 and Chart 18). Starting in the second half of the 14th century, the senion is used less than the quaternion, which also tends to host two-column layouts. Nevertheless, the association typologies—*full-page layout/quaternions, two-column layout/ senions*—identified earlier on, are still respected[160] (see Tab. 35 and Chart 19).

France, layout, 14th century. First / second half (tab. 35)

	Predominant quiring					Total	
Full page		1st half	%	2nd half	%		%
	IV	3	42.9	26	70.3	29	65.9
	V	1	14.2	3	8.1	4	9.1
	VI	3	42.9	8	21.6	11	25
Total		7	100	37	100	44	100
Two-column							
	IV	7	22.6	15	40.5	22	32.3
	V	4	12.9	0	0	4	5.9
	VI	20	64.5	21	56.8	41	60.3
	XII	0	0	1	2.7	1	1.5
Total		31	100	37	100	68	100
Total		38		74		112	

Tab. 35: France, layout, 14th century. First / second half

160 In the second half of the 14th century we find that 70.3% of full-page codices are composed of quaternions and 21.6% of senions, whilst in the case of two-column layouts 40.5% of codices are composed of quaternions, and 56.8% of senions.

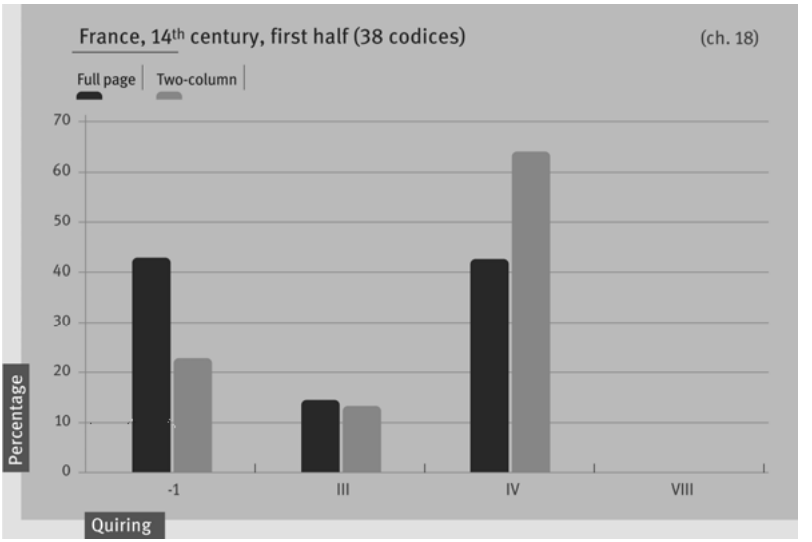


Chart 18: France, 14th century, first half (38 codices)

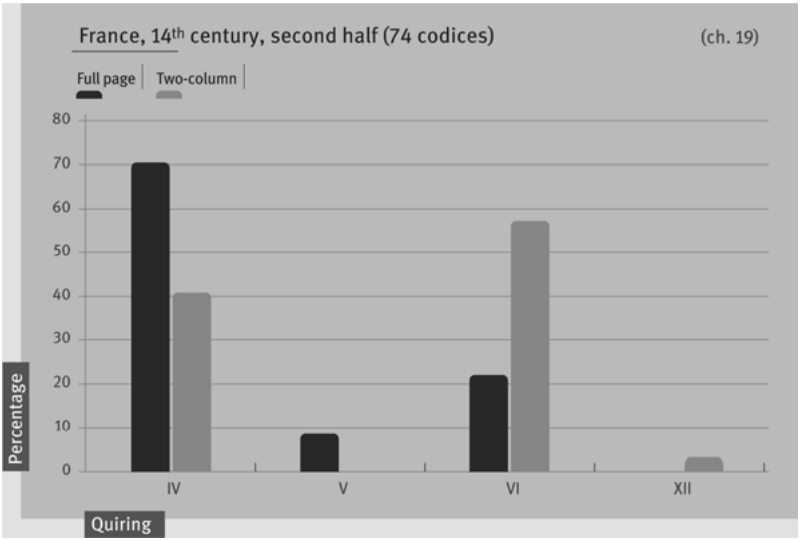


Chart 19: France, 14th century, second half (74 codices)

3.4.3 Italy

From the second half of the 13th century[161] onwards Italian manuscript production also leans towards favouring two-column layouts over full-page ones. With respect to quiring, codices with full-page layouts are, above all, composed of quaternions, whereas those with two-column arrangements show a preference for the senion. The quinion is worthy of a separate comment, since it is used as much in full-page layouts as in two-column ones, although in the latter it appears in decidedly larger numbers (see Tab. 36 and Chart 20).

Italy, layout, 13th century. Second half (tab. 36)

	Predominant quiring	2nd half	%
Full page			
	IV	11	55
	V	3	15
	VI	6	30
Total		20	100
Two-column			
	III	1	2.6
	IV	8	21.1
	V	10	26.3
	VI	18	47.4
	VIII	1	2.6
Total		38	100
Total		58	

Tab. 36: Italy, layout, 13th century. Second half

161 For the first half of the 13th century the number of items in the sample is statistically insignificant.

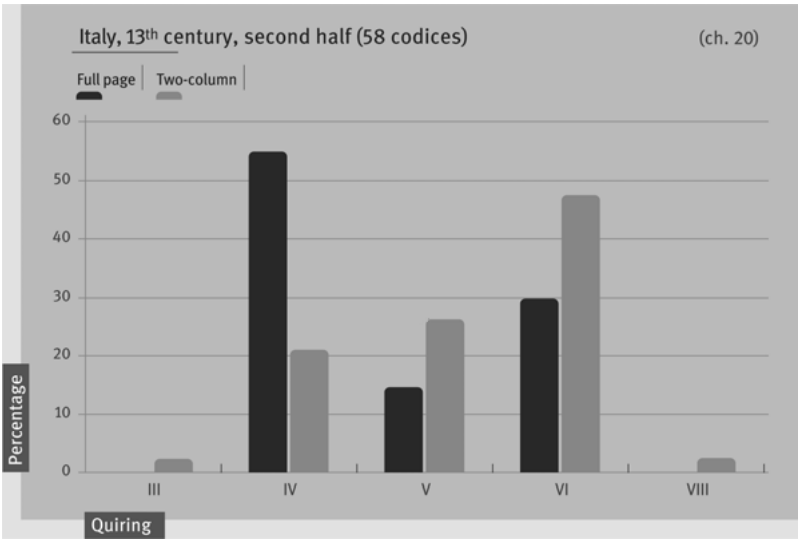


Chart 20: Italy, 13th century, second half (58 codices)

The number of full-page codices dating from the first half of the 14th century is not representative, given that this type of layout is totally overshadowed by the two-column one. Senion or quinion quire types appear to have been better suited—in the view of artisans and, perhaps, end users—to the layout of texts in two columns, even if the quaternion, despite being less used, still accounts for 20.7% of production (see Tab. 37 and Chart 21).

In the second half of the 14th century there is no longer a marked discrepancy between the number of full-page codices and two-column ones, to the extent that the two options appear to be made use of equally, although two-column layouts remain the preferred option.

Italy, layout, 14th century. First / second half (tab. 37)

	Predominant quiring					Total	
Full page		1st half	%	2nd half	%		%
	III	0	0	1	1.8	1	1.6
	IV	2	40	16	29.1	18	30
	V	2	40	24	43.7	26	43.3
	VI	0	0	11	20	11	18.3
	VII	1	20	0	0	1	1.7
	VIII	0	0	1	1.8	1	1.7
	IX	0	0	1	1.8	1	1.7
	X	0	0	1	1.8	1	1.7
Total		5	100	55	100	60	100
Two-column							
	II	1	3.4	1	1.6	2	2.2
	IV	6	20.7	17	27.4	23	25.3
	V	10	34.5	32	51.6	42	46.1
	VI	12	41.4	11	17.8	23	25.3
	VIII	0	0	1	1.6	1	1.1
Total		29	100	62	100	91	100
Total		34		117		151	

Tab. 37: Italy, layout, 14th century. First / second half

Both quaternions and senions are used at the same rate for full-page layouts and two-column ones, but it is clear that the quinion is becoming the preferred technical option for all manuscript production, although at this juncture it appears to be more widely used in the manufacture of codices with two-column layouts (see Tab. 37 and Chart 22).

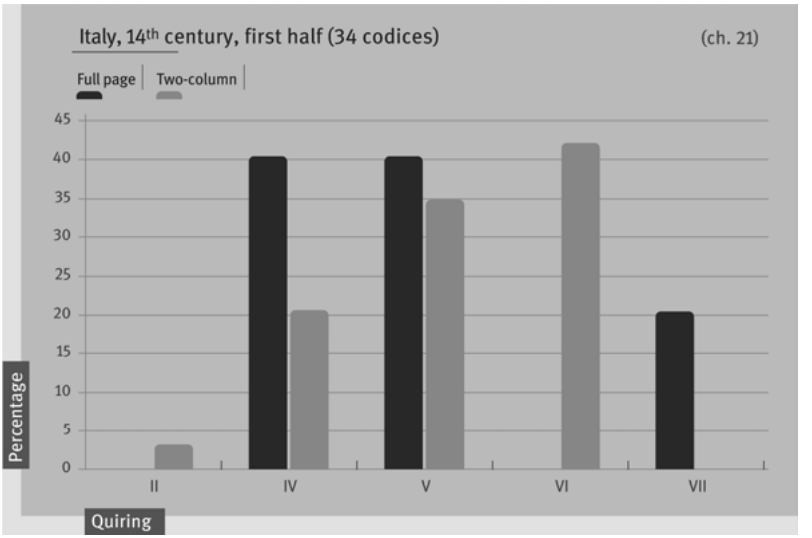


Chart 21: Italy, 14th century, first half (34 codices)

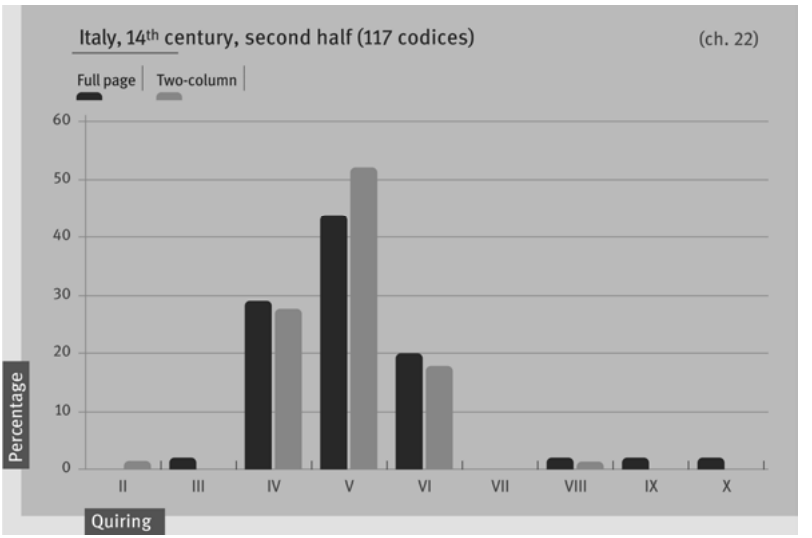


Chart 22: Italy, 14th century, first half (117 codices)

3.5 Quiring and size

It has been demonstrated that a link exists between the size of manuscripts and the layout of texts[162]—up until the 14th century, at least[163]—and we have already confirmed that some textual typologies go hand in hand with certain types of quire, whilst a given type of layout is more often than not associated with a specific type of quire. At this point, it is not easy to attempt to identify the mechanism lying behind the correlation between textual typology, size and layout, and no less so to associate them with quiring.

With the goal of evaluating whether or not a link exists between size and quiring, and if so, what it may be (in other words, whether the latter undergoes modifications in relation to the former), we will have to 'neutralise' all the other parameters, namely period, country of origin, textual typology and layout—which, as we have already established, exert an influence on quiring.

To clarify, then: if our aim is to discover the extent to which size exerts an influence on quiring, for any given period we will have to be able to isolate a sample of codices produced in one country that belong to one textual typology, and which also have the same kind of layout in common. In spite of the fact that our sample, taken as a whole, is quite large, as soon as subdivisions are made with the aim of maintaining all the variables listed above, numbers decrease so much that it becomes very difficult to draw any firm conclusions. Leaving aside the fact that, in all likelihood, the most conspicuous differences should emerge between *large* and *small* manuscripts,[164] these always prove difficult to compare, since by choosing a specific textual typology from a particular period and for a given country—for example, 13th-century theological codices in England[165] and France—we find ourselves looking at an essentially standard size.[166]

---

162 The 'small' manuscripts are full-page, the 'large' ones two-column.

163 Starting in the 15th century, one begins to see very large full-page manuscripts.

164 For the sake of brevity, we shall adopt the following classes: size< 320 mm = small manuscripts, size 320 mm - 490 mm = medium-small manuscripts, size 490 mm - 670 mm = large manuscripts. See Bozzolo / Ornato 1980, 268.

165 With respect to England, though only with the aim of providing an example (since the reasons behind the phenomenon are difficult to explain), here we present an experiment carried out on the 13th and 14th centuries using theological and philosophical codices, and collections of sermons with two-column layouts. The results are summarised in Tab. 38 and 39. Maintaining all the variables cited above, it would appear that in the second half of the 13th century the medium-large manuscripts present with a higher number of senions (90%) than the medium-small ones (50%). However, it should be noted that the former are far more numerous than the latter. It is clear that, no matter how much effort was made to link quiring to size in an attempt to separate the other parameters, these always exert a certain influence. In

3.6 Conclusions

In carrying out this research, it has been our aim to study a particular aspect of the codex, namely quiring—which is to say the way in which the support that bears the text, be it parchment or paper, is arranged. This parameter, even if it might seem rather marginal with respect to the codex considered overall and the text that it acts as a vehicle for, is in actual fact very closely linked to the conception of the manufactured object—be it a university codex, pocket Bible, or notebook—as an ensemble of elements that contribute to the creation of a specific type of book-object conceived of in order to fulfil a primary purpose (in that it functions as a vehicle for a given message).

Therefore, the aim of our research has been to provide a picture of the various configurations that quiring assumed in the Late Middle Ages—our reasons for choosing this period for a closer study have been explained earlier on in the text—by examining the changes that led to one type of quire being favoured over another, depending on the era and context (either geographical or cultural, or both) concerned. Within this setting, we have attempted to identify the characteristics that appear to be most directly linked to quiring, and the extent to which they exerted an influence over it. Naturally, it was necessary to focus on different spans of time, depending on the variables examined.

The evolution of quiring forms a broad and multiplex panorama, hence it is difficult to describe it in brief. Therefore, given that we would like to offer the reader some useful observations, we think it will be helpful here to focus on only the most salient aspects, or at least the most characteristic ones.

Book manufacturing techniques, in particular with respect to the one that interests us here, remained essentially unchanged until the end of the 12th century. Indeed, it is in the 13th century that one sees a change in manufacturing solutions. This resulted from the emergence of new requirements in relation to the usability of certain texts, and therefore the use to which the manuscript would be put. The first country in which the 'symptoms' of this change are seen is England, where in the first half of the century codices composed of senions start to appear, although this type of quire only became fully established from 1250 onwards. In France, the adoption of the senion starts a few decades after its first appearance in

---

this case, we can hypothesise that the two-column theological volumes were in any event fabricated in the largest size, and therefore the presence of senions could be linked not so much to size, but instead to the layout chosen for that size. With regard to other periods, here we cannot add anything, because no distinct phenomenon has emerged.

166 Medium-small, and medium-large manuscripts. See footnote 164.

England. Indeed, in the period when the senion reaches its maximum diffusion in French production, at the same time in England it has already begun its downward trajectory. In the second half of the 14th century a reversal in the trend is seen in both countries which spurs the revival of the quaternion, a strategy that will achieve its full expression during the 15th century.

In the second half of the 13th century Italian production does not yet show a pronounced orientation towards a particular type of quire, although we should acknowledge the senion's not insignificant role, and likewise that of the quinion, which proves to be far more widely represented in Italy than elsewhere. Starting in the 14th century, the use of the quinion becomes increasing widespread, until finally it prevails in all types of codex, to the extent that, whilst in the rest of Europe (with the exception of Germany) one sees the revival of the quaternion from the 14th century onwards, in Italy manuscripts for the most part will continue to be structured in quinions up until the advent of printing.

In our sample, the number of codices produced in Germany in the 13th and 14th centuries is rather low, and therefore does not enable us to identify a trend, whereas in the 15th century the senion was heavily used and became the most widely employed quire in Germany precisely at the time when its use in English and French production began to decline.

Returning for a moment to the establishment and dissemination of quiring in senions in the 13th century, it may be just as well to remind the reader of the close link that existed between quiring and textual typology. Regardless of all the hypotheses, technical and otherwise, put forward to account for the reasons lying behind this change in the structure of the codex, the senion—which at the time of its appearance in England did not seem to be linked to a specific type of book—proves to be inextricably linked to the English and French[167] university codex. In the period of its maximum diffusion (1250–1350, approximately), the senion was used, albeit to varying degrees, for virtually all textual typologies, but it is in the university context, and primarily in the theological codex, that it holds its ground even when the quaternion is once again the favoured option.

The juridical codex deserves a special mention here, chiefly where Italy is concerned. Indeed, in the second half of the 13th century, when the quinion was still used to a lesser extent than the other quire types, the bulk of juridical production is structured in quinions. One can therefore hypothesise that the debut of the quire composed of five bifolia is linked to the juridical manuscript, a typology that would retain this structure in the centuries to come.

167 Chiefly theological codices, but also philosophical and juridical ones.

That there exists a relationship between quiring and specific textual typologies seems undeniable. Indeed, in the case of 13th-century pocket Bibles we can venture to say that a close link exists between the function of a certain kind of book and its material execution, to the extent that the change in the concept of the Bible, which became a book to be used by individuals, coincides with a modification of its 'architecture'.

Another characteristic that we have linked to quiring (again, in the period spanning the 13th and 14th centuries) is the layout of the text. We have previously noted the way in which this is related to other variables, including a volume's size. Here, we will try to assemble some overall observations. We should state at the outset, however, that the said observations will be compared with the reality seen in each individual country, where the various phenomena may have manifested themselves in different ways. The correlation that we want to draw attention to here is as follows: senions are frequently employed in cases where the text is laid out in two columns, whereas a full-page layout is preferred for codices structured in quaternions. Even in England, in the second half of the 13th century, when the use of the senions was widespread in volumes with full-page and two-column layouts, the use of quires composed of six bifolia in the latter occurred at a greater rate. Conversely, when manufacturing techniques once again shifted towards the use of quaternions—in the second half of the 14th century—a certain tendency to associate, by preference, quaternions with full-page layouts and senions with two-column ones persisted. In French production, too, above all from the second half of the 13th century onwards, codices with two-column layouts as a rule present with thick quires that contain more than six bifolia, whereas full-page manuscripts appear to be mainly composed of quaternions. In the first half of the 14th century the most widely distributed type of codex presents with a two-column layout and is composed of senions. However, starting in the second half of the century the quaternion, accompanied by both types of layout, again reached an apogee, and even the full-page/quaternion and two-column/senion associations retain a certain relevance.

Italy presents a somewhat different landscape compared with the other countries. In fact, even if the abovementioned basic solution remains valid, we should not underestimate the role played by the quinion, which, starting in the first half of the 14th century, is used in the making of a not negligible number of codices, above all ones with two-column layouts. In addition, in the second half of the century onwards, one encounters a very particular situation: the percentage of full-page codices quired in quaternions is not all that different from those with two-column layouts, and the same holds true for the senion, which one sees used as much for two-column layouts as for full-page ones. Instead, it is the

quinion that, despite being widely employed in both cases, seems to be more frequently used in codices laid out in two columns.

Among the variables that we have linked to quiring is the writing support, whose usage trend presents unmistakable characteristics, to the extent that, already in the 14th century, a clear dichotomy emerges between parchment and paper production: the former being focused on the quaternion, apart from in Italy, where the quinion also holds the upper hand with this support, whereas the latter favours the senion or quinion, or in any event, fairly thick quires. As for the 15th century, we have examined the output of each country, and regardless of the fact that the overall trends outlined above remain steady, the technical choices made in the different countries examined were not the same. In England, the quaternion is used in both parchment and paper production, but it is precisely in the context of the latter that the senion survives, above all in the second half of the century. French production, in turn, presents a very clearly delineated picture, since codices made from parchment are for the most part composed of quaternions, whereas those made from paper lean much more towards senions, or in any event, towards fairly thick quires. As regards Italy, here we can only repeat what we have already affirmed, namely that the quinion accounts for the lion's share of manuscript production, be it in parchment or in paper, the only proviso being that in the first case one also sees the use of the quaternion, and in the second (probably on account of the 'paper effect', which we have already discussed) a good percentage of senions. Examination of production originating from the German area also reveals a very clear association between parchment and the quaternion, and paper and the senion. Indeed, the bulk of German production of the 15th century is in paper, so it is therefore mostly structured in senions. However, as soon as one takes into account parchment-based production, quaternions once again emerge as the preferred option.

In addition, in the context of paper-based production, we have identified the link that exists between format and quiring type.[168] When one looks at the European situation overall, the senion appears to be equally distributed, be it in large or small format works. On the other hand, the quaternion is seen in large format works, but it is almost absent in small format ones. For its part, the quinion, despite being represented in both large and small format books, appears to be encountered more often in the latter. Naturally, if one examines the situations seen

168 With this aim in mind, we subdivided our sample into two groups: small formats (i.e. in-octavo and in-quarto) and large formats (i.e. in-folio and large in-folio).

in each individual country,[169] different behaviours will be observed. In France, the senion is utilised in both large and small format volumes, without much difference between the two, whilst the quinion appears chiefly in in-folio and large in-folio books. In the case of quaternions, one sees precisely the opposite situation: these are used in the manufacture of small format books, and seldom in large ones. We have already offered an explanation for this behaviour: the decision to use quires made from an even number of bifolia for in-quarto volumes is probably related to issues to do with efficiency, given that the making of small format volumes using quinions would have entailed a greater expenditure of energy.

Such a need to economise and rationalise the production process does not appear to have been particularly important in Italy. Indeed, despite meeting with a higher percentage of quinions in large format volumes, here we must report that almost half the output of small format works is based on quires composed of ten leaves. Senions are used in almost equal measure in both formats, whereas quaternions once again chiefly appear in in-octavo and in-quarto volumes. It should be noted that in Italy, when one considers in folio and large in folio codices separately, in the manufacture of the former, despite the fact that quinions played a predominant role, other types of quire were utilised, whereas in the latter the rate of quinion usage exceeds 80%, and most of these are juridical manuscripts.

The German area shows almost no difference in the choices made with respect to the making of small and large format volumes. Broadly speaking, the senion predominates, whilst the percentage of quaternions is minimal in both groups. Quinions are also seen in more or less equal numbers in both large and small format codices.

From the picture which has emerged, it seems obvious that there exists a correlation between quire type and support, be it parchment or paper, whilst with respect to the latter, format also appears to exert a certain degree of influence on manufacturing solutions, which always reflect local ways and means.

In concluding this brief *excursus*, which is not exhaustive by any means, and which has the sole aim of calling to mind the various issues to be addressed by arranging them alongside each other as multiple aspects of a unitary object as it comes into being, we have to leave many questions unanswered. In any event, here we hope to have contributed to shedding some light on the historical development of an important constituent component of the manuscript, and at the same time to have kindled an interest in conducting further research.

169 With respect to England and the Low Countries, there were too few paper codices in our sample to enable us to carry out any kind of statistical analysis.

Appendix I: Surveying protocol

General information on the codex

SHELFMARK. In the case of a composite codex, the leaves taken into consideration must be indicated.

CATALOGUE. Abbreviated reference to the catalogue.

SUPPORT. Information on the type of support is provided using the following abbreviations:

C = Paper (Italian 'Carta')

P = Parchment

MI = Mixed (quires made from paper with the outer or the outer and inner bifolia made from parchment).

FORMAT: The format of paper manuscripts is mentioned wherever it is indicated in the catalogue. In reality, this datum is almost always established at a later stage (during the data analysis phase), and is based on a manuscript's dimensions.[170]

170 In this case, we are referring to the number of folds undergone by a sheet to form the constituent bifolia of a quire, even if it must be said that the simple broad term 'format' is ambiguous, since it can be taken to mean different things. Jacques Lemaire, in his *Introduction à la codicologie* (Lemaire 1989) states: 'Une fois que la feuille de papier est dégagée de la forme, elle présente les dimensions délimitées par le chassis, c'est-à-dire des mesures que le papetier peut fixer arbitrairement (alors que les feuilles de parchemin offrent des surfaces variables selon la nature et la taille de l'animal). Ces dimensions définissent le format du papier suivant le premier sens que l'on attribute à ce vocable [...] Mais le mot format désigne aussi, depuis les origines de l'usage du papier, le mode du pliage que l'on fait subir aux feuillets pour constituer les cahiers d'un livre, c'est-à-dire la façon dont une feuille est pliée un certain nombre de fois en deux pour former un cahier (qui comprendra un total de feuillets équivalents à deux élevé au carré du nombre de pliages)'. The writer goes on to propose, in order to avoid any misunderstanding on account of the word's polysemy, the terms adopted by Charles and Victor Mortet: '[...] ont proposé autre fois de réserver le mot format à la designation des dimensions du papier transformé en volume, d'appeler format commercial la dimension-type du papier qui sort de la forme et format bibliographique la dimension du papier plié pour composer les cahiers' (Lemaire 1989, 34-35). In Denis Muzerelle's *Vocabulaire codicologique* we find two definitions for the term 'format': (a) in the section headed *Pliage*: 'la façon dont une feuille est plié une fois en deux pour former 2^n feuillets' (Muzerelle 1985, 92); and (b), in the section headed *Dimensions*: 'les dimensions du volume en hauteur et en largeur' (Muzerelle 1985, 100). J. Peter Gumbert, for his part, identifies a material format: 'the fraction the leaf is of the whole sheet', an *apparent format* of a manuscript; 'the way its leaves are paired'; and a *working format*: 'the way the material was, or was not folded upon entering the

Dating, localisation, scribe

DATING TYPE. Whether or not the dating is attested (= A) or estimated (= E) is indicated.

CENTURY 1. The century to which the manuscript dates is indicated in Arabic numbers.

CENTURY 2. This option is used to indicate manuscripts which straddle two centuries.

HALF-CENTURY. The half-century is mentioned using the figures 1 or 2.

QUARTER-CENTURY. The quarter-century is mentioned (if it is explicitly indicated, or readily deducible) using the figures 1, 2, 3, 4.

THE TERMS *A QUO* AND *ANTE QUEM*. The farthest limits of the dating are indicated, or, in cases where the codex is dated to the year, the same date is entered into each field (e.g. 1455–1455).

LOCALISATION TYPE. An attested localisation is indicated by the letter A, an approximated one by the letters (AL).

COUNTRY. The country of origin of the codex is indicated using the following initials:

A = Austria
B = Belgium
E = England
F = France
FN = Flanders[171]
G = Germany
I = Italy
H = Holland
Sc = Scotland

---

quire—which is, in essence, the sense of "format" familiar to bibliographers' (Gumbert 1993, 227–244). Albert Derolez has the following to say about format: 'Le mot format est employé avec trois significations qu'il faut bien distinguer. D'abord pour indiquer la taille du livre, c'est-à-dire sa hauteur et éventuellement sa largeur, exprimables en centimetres ou millimetres (format absolu); ensuite pour exprimer la proportion entre la largeur et la hauteur du livre: ainsi on parle de format étroit, format large, format carré; nous utiliserons l'expression proportion du feuillet (PF) pour indiquer ce format relatif; finalment, on distingue le format bibliographique (in-folio, in-4°, in-8°, etc.), qui indiquet comment les bifeuillets des cahiers ont été obtenus par le pliage de la feuille ou de la peau)' (Derolez 1984, I, 26). A series of definitions, which broadly speaking include all the cases covered here, can be found in Maniaci 1996 (1998[2]), in the section headed *Modalità di piegatura* (127).

171 Some catalogues make specific mention of Flanders, whilst others refer more broadly to Belgium, without specifying the precise region of origin. The data were inserted in accordance with the way that they were found in the catalogues.

Sv = Sweden
Cz = Czechoslovakia
W = Wales

QUADRANT. North (= N), South (=S), etc.

REGION. The region where the codex was produced should be indicated in cases where it is explicitly cited in the catalogue or can be deduced.

CITY. The place of manufacture is specified, in the original language, if possible.

INSTITUTION. The place where the codex was produced is specified (e.g. the Monastery of Saint Denis).

ATTESTED SCRIBE. Whether or not the copyist is attested (=A) or deduced (=D) is specified.

SCRIBE'S NAME. The name of the scribe, to be transcribed in the standardised Latin form.

Text

TEXTUAL TYPOLOGY. This is indicated by means of the following initials:

bi = Bible
bi2 = glossed biblical texts (e.g. *Epistulae Pauli cum glossa*)
cl = classics
ph = philosophy
jr = juridical
jr2 = codices containing legal arguments, such as statutes, etc.
gr = grammars
hl = humanistic literature
li = liturgical
prl = profane literature
sal = sacred literature
me = medicine
pa = patristic
sc = science
se = sermons
hs = history
te = theology

LANGUAGE OF TEXT. The language in which the text is written is specified, together with a second language, should it be present. Languages are identified as follows:

fr = French
en = English
it = Italian
la = Latin
du = Dutch
ge = German

Material characteristics

NUMBER OF LEAVES. The number of leaves, excluding flyleaves.
LEAF HEIGHT. To be measured in millimetres, in common with all the other dimensions that follow.
WIDTH OF LEAF.
HEIGHT OF WRITTEN AREA.
WIDTH OF WRITTEN AREA.
FULL-PAGE/TWO-COLUMN. A full-page layout is indicated by '1', a two-column layout by '2'.
ORGANISED GLOSS. Indicate whether the codex was endowed with the possibility of having glosses added (in practice, whether or not it presents with *ad hoc* ruling).
NUMBER OF WRITTEN LINES.
D1. QUIRING
PREDOMINANT QUIRING. The quire type (quaternion, senion, etc.) that represents at least half of the quires in a codex is specified.
QUIRING 1. The minority quires are specified in descending order based on their thickness, or, in the absence of a predominant quire, the types of quires present, again in descending order based on their thickness.
QUIRING 2.
QUIRING 3.
QUIRE ORGANISATION. In the absence of predominant quiring, the arrangement of quire types is specified:
irr = irregular
succ = successive quires, which is to say small groups of one type of quire followed by small groups of another type of quire.
MIX = mixed, which is to say sometimes small, successive groups, and sometimes an individual quire of one type followed by another constructed in a different way.
D.2 OTHER ELEMENTS

CATCHWORDS. The presence or absence of catchwords, based on what is explicitly recorded in catalogues, is indicated by 'yes' or 'no'. In cases where more detailed information is provided on the position or orientation of catchwords, the following initials are used:
ce = centred
rt = right-hand side
lt = left-hand side
ve = vertical

QUIRE SIGNATURES. The presence or absence of quire signatures, based on what is explicitly recorded in catalogues, is indicated by 'yes' or 'no'. Wherever possible, Derolez's number should be supplied (if it is deducible).

LEAF SIGNATURES. See above.

AD HOC SIGNATURES. This specification refers to the presence or absence of internal numeration within a quire that indicates the sequence of bifolia within the same, but which does not serve to identify the position of the quire within the codex, nor to establish to which quire any erroneously positioned bifolia belong[172].

RULING TECHNIQUE. The technique used for the main ruling is indicated, and where relevant, secondary ruling[173], by means of the following initials:
HP = blind (hardpoint)
P = lead
I = ink
C = colour[174]

FRAME RULING. Under this heading (the English term employed by Ker) details of the ruling used to create the written area are noted. This ruling consists

172 In order to clarify the notion of *ad hoc* signatures, we can provide an example drawn from Ker I: in the Gray's Inn 16 manuscript, the first six leaves of each quire are countermarked by the letters a-f, accompanied by a graphic symbol—depending on the case in question, this might be a vertical stroke preceding or following the leaf signatures, or a horizontal stroke, or a 'toppled' C, etc.—which indicates the quire. Derolez refers to this kind of signature as *Type 5* in his classification of *signatures des feuillets* (Derolez 1984, I, 48).

173 Some catalogues list two kinds of ruling—lead and ink, for example—which are inserted in the survey form under the heading 'Ruling types 1 and 2'. Unfortunately, in most cases it is not made clear which of the ruling types was used for the horizontal ruling, and which for the delineation of written areas.

174 Here, the term 'colour ruling' should be taken to mean ruling carried out page by page, rather than using drypoint. The drawing medium (lead, ink, etc.) is not specified. On issues of this kind, see Canart et al. 1991, 205–225.

in just four lines (two vertical, two horizontal) that form the frame which contains the text.

Writing and decoration

SCRIPT TYPE. The script type, as indicated by the catalogue, is reported in an abbreviated form.

PRESENCE OF ILLUSTRATIONS. If indicated by the catalogue, the presence of illustrations is mentioned.

PRESENCE OF BORDERS/FRAMING. See above.

INTIALS. Only the presence of an initial and/or the most elaborated type of initial is noted using the following abbreviations:

- ru = rubicated
- pf = pen-flourished
- de = decorated (all the decorated initials which are not historiated are placed in this class, with a certain degree of stretching of the boundaries).
- hs = historiated[175]

HISTORY OF THE CODEX

PATRON.

CLIENT.

FIRST POSSESSOR/OWNER. Here, the first known owner (individual or institution) is reported.

DATE OF POSSESSION

MEMO. This space, as has already been stated, is reserved for various items of information which cannot be inserted into the survey form, such as remarks, observations, etc.

175 For a summarised subdivision of initials, such as the one used for this investigation, see Pace 1990, 91–101, *passim*, and in particular, 94–97. It should be borne in mind that the *decorated* initials category is regarded as being 'in opposition' to the *simple* and *filigranated* categories on the one hand, and the *historiated* one on the other, inasmuch as it encompasses everything that does not fit into these classes, such as *zoomorphic*, *kaleidoscopic*, *figurative* and *populated*, etc., initials.

Appendix II: Specimen of a completed survey form

Survey form

SHELFMARK: Arras B. M. 870 (349)
CATALOGUE: *M.C.L.B P.F.* FORMAT:
SUPPORT: p

Dating, localisation, scribe

TYPE OF DATING: S
CENTURY 1: 13
CENTURY 2:
HALF-CENTURY: 1
QUARTER-CENTURY:
TERMINUS A QUO: TERMINUS ANTE QUEM:
LOCALISATION TYPE: s
COUNTRY: F
QUADRANT:
REGION:
CITY:
INSTITUTION:
ATTESTED SCRIBE:
SCRIBE'S NAME:

Text

TEXTUAL TYPOLOGY: cl
MAIN AUTHOR: Solinus
MAIN TEXT: *Collectanea rerum memorabilium*
LANGUAGE OF TEXT: 1 la
PROSE OR VERSE FORM: p

Material characteristics

NUMBER OF LEAVES: 73
HEIGHT OF LEAF: 305
WIDTH OF LEAF: 230
HEIGHT OF WRITTEN AREA: 175
WIDTH OF WRITTEN AREA: 105
FULL PAGE/TWO-COLUMN: 1
ORGANISED GLOSS:
NUMBER OF WRITTEN LINES: 18

Quiring

PREDOMINANT QUIRE: 6
QUIRING 1:
QUIRING 2:
QUIRING 3:
ORGANISED QUIRING:
CATCHWORDS: yes
QUIRE SIGNATURES:
LEAF SIGNATURES:
AD HOC SIGNATURES:
RULING METHOD: 1i
FRAME RULING:

Script and decoration

SCRIPT TYPE:
PRESENCE OF ILLUSTRATIONS:
PRESENCE OF FRAMING:
MAXIMUM COMPLEXITY OF INITIALS: pe
USE OF GILDING:

History of the codex

PATRON:
CLIENT:
FIRST OWNER: Arras, Saint-Vaast
DATE OF POSSESSION: 1628
MEMO (SPACE RESERVED FOR REMARKS AND OBSERVATIONS)

References

Beit-Arié, Malachi (1981), *Hebrew Codicology: Tentative Typology of Technical Practices employed in Hebrew Dated Medieval Manuscripts*, Jerusalem: Israel Academy.

Bianchi et al. (1994), 'Une recherche sur les manuscrits à cahiers mixtes', in *Scriptorium*, 48: 259–286.

Bianchi, Francesco et al. (1993a), 'Facteurs de variation de l'épaisseur du parchemin italien du VIII[e] au XV[e] siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 95–184 (repr. in [Ornato et al.] [1997], 275–345).

Bianchi, Francesco et al. (1993b), 'La structure matérielle du codex dans les principales aires culturelles de l'Italie du XI[e] siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), II, 363–456.

Bischoff, Frank M. (1991), 'Pergamentdicke und Lagenordnung. Beobachtungen zur Herstellungstechnik Helmarshausener Evangeliare des 11. und 12. Jahrhunderts', in Rück, Peter (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Thorbecke, 97–144.

Bischoff, Frank M. (1993), 'Observations sur l'emploi de différentes qualités de parchemin dans les manuscrits médiévaux', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 57–94.

Bischoff, Frank M. (1994), 'Systematische Lagenbrüche: Kodikologische Untersuchungen zur Herstellung und zum Aufbau mittelalterlicher Evangeliare', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel 12th–14th November, 1990, Marburg: Institut für Historische Hilfswissenschaften (Elementa diplomatica, 2), 83–110.

Bischoff, Frank M. / Maniaci, Marilena (1995), 'Pergamentgröße, Handschriftenformate, Lagenkonstruktion. Anmerkungen zur Methodik und zu den Ergebnissen der jüngeren kodikologischen Forschung', in *Scrittura e civiltà*, 19: 277–319.

Bozzacchi, Giampiero / Palma, Marco (1985), 'La formazione del fascicolo nel codice altomedievale latino: ipotesi e verifiche sperimentali', in *Scrittura e Civiltà*, 9: 325–336.

Bozzolo, Carla (1994), 'La production manuscrite dans les pays rhénans au XV[e] siècle (à partir des manuscrits datés)', *in Scrittura e Civiltà*, 18: 184–242.

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIV[e] et XV[e] siècles. Textes et études, 2).

Busonero, Paola (1995), 'L'utilizzazione sistematica dei cataloghi nelle ricerche codicologiche: uno studio sulla fascicolazione nel basso Medio Evo', in *Gazette du livre médiéval*, 27: 13–18.
C.G. VI = *Catalogue général des manuscrits latins*. VI. *(3536-3775 B) Bibliothèque Nationale*, Paris, 1975.
C.G. VII = *Catalogue général des manuscrits latins*. VI. *(3776-3835) Bibliothèque Nationale*, Paris, 1988.
Canart, Paul (1980–1981), *Lezioni di paleografia e di codicologia greca*, Città del Vaticano: Biblioteca Apostolica Vaticana.
Canart, Paul et al. (1991), 'Recherches préliminaires sur les matériaux utilisés pour la réglure en couleur dans les manuscrits grecs et latins', in *Scriptorium*, 45, 2: 205–225.
Casanatense 1 = Moneti, Elena / Muzzioli, Giovanni / Rossi, Innocenza / Zamboni, Mercedes (eds) (1949), *Catalogo dei manoscritti della Biblioteca Casanatense*. I, Roma: Istituto poligrafico e Zecca dello Stato.
Casanatense 2 = Santovito, Emma / Ceresi, Maddalena (eds) (1956), *Catalogo dei manoscritti della Biblioteca Casanatense*. II, Roma: Istituto poligrafico e Zecca dello Stato.
Casanatense 3 = Ceresi, Maddalena (ed.) (1952), *Catalogo dei manoscritti della Biblioteca Casanatense*. III, Roma: Istituto poligrafico e Zecca dello Stato.
Casanatense 4 = Ceresi, Maddalena (ed.) (1961), *Catalogo dei manoscritti della Biblioteca Casanatense*. IV, Roma: Istituto Poligrafico dello Stato.
Casanatense 5 = Moricca Caputi, Ada (ed.) (1958), *Catalogo dei manoscritti della Biblioteca Casanatense*. V, Roma: Istituto poligrafico e Zecca dello Stato.
Casanatense 6 = Saitta Revignas, Anna (ed.) (1961), *Catalogo dei manoscritti della Biblioteca Casanatense*. VI, Roma: Istituto poligrafico e Zecca dello Stato.
Clairvaux = Bouhot Jean-Paul / Genest, Jean-François / Vernet, André (1997), *La Bibliothèque de l'abbaye de Clairvaux du XII^e^ au XVIII^e^ siècle*, II. *Les manuscrits conservés. Première partie. Manuscrits bibliques, patristriques et théologiques*, Turnhout, Brepols.[176]
Codici latini del Petrarca = Feo, Michele (ed.) (1991), *Codici latini del Petrarca nelle biblioteche fiorentine*. Mostra 19 maggio – 30 giugno 1991, Firenze: Casa editrice Le Lettere / Cassa di Risparmio di Firenze.
Colker, Trinity = Colker, Marvin L. (1991), *Trinity College Library, Dublin. Descriptive Catalogue of the Mediaeval and Renaissance Latin Manuscripts*, I-II, Scolar Press, Aldershot.
Daneu Lattanzi, *Sicilia* = Daneu Lattanzi, Angela (1965), *I manoscritti ed incunaboli miniati della Sicilia*, Roma: Istituto Poligrafico e Zecca dello Stato.
Derolez, Albert (1984), *Codicologie des manuscrits en écriture humanistique sur parchemin*, I. *Texte*, II. *Catalogue*, Turnhout: Brepols (Bibliologia, 5–6).
Derolez, Albert (1995), 'La codicologie et les études mediévalés', in Hamesse, Jacqueline (ed.), *Bilan et perspectives des études médiévales en Europe*. Actes du premier Congrès européen d'études médiévales (Spoleto, 27–29 mai 1993), Louvain-La-Neuve (Fédération internationale des études médiévales. Textes et études du Moyen Âge, 3), 371–386.
Devoti, Luciana (1994), 'Aspetti della produzione del libro a Bologna: il prezzo di copia del manoscritto giuridico tra XII e XIV secolo', in *Scrittura e civiltà*, 18: 77–142.

176 The codicological descriptions of manuscripts collected under the letters C, F and I were consulted in draft form (thanks to the generosity of the authors) in 1993, during a visit to the IRHT in Paris.

Di Majo, Anna et al. (1994), 'Il codice Cassinese 132 di Rabano Mauro: nota tecnica', in Cavallo, Guglielmo (ed.), *Rabano Mauro, De rerum naturis. Cod. Casin. 132 / Archivio dell'Abbazia di Montecassino. Commentari*, Pavone Canavese: Priuli e Verlucca, 89–98.

Filosofici 1 = De Robertis, Teresa et al. (eds) (1980), *Catalogo di manoscritti filosofici nelle biblioteche. 1. Firenze, Pisa, Poppi, Rimini, Trieste*, Firenze: Olschki.

Filosofici 2 = Frioli, Donatella et al. (eds) (1981), *Catalogo di manoscritti filosofici nelle biblioteche*, 2. *Busto Arsizio, Firenze, Parma, Savignano sul Rubicone, Volterra*, Firenze: Olschki.

Filosofici 3 = Garfagnini, Gian Carlo / Pagnoni Sturlese, Maria Rita / Pomaro, Gabriella / Zamponi, Stefano (eds) (1982), *Catalogo di manoscritti filosofici nelle biblioteche*, 3. *Firenze, Pisa, Pistoia*, Firenze: Olschki.

Filosofici 4 = Avarucci, Giuseppe et al. (eds) (1982), *Catalogo di manoscritti filosofici nelle biblioteche*, 4. *Cesena, Fabriano, Firenze, Grottaferrata, Parma*, Firenze: Olschki.

Filosofici 5 = Casarsa, Laura et al. (eds) (1985), *Catalogo di manoscritti filosofici nelle biblioteche,* 5. *Cesena, Cremona, Lucca, S. Daniele di Friuli, Teramo, Terni, Trapani, Udine*, Firenze: Olschki.

Filosofici 6 = Cau, Gian Mario et al. (eds) (1992), *Catalogo di manoscritti filosofici nelle biblioteche*, 6. *Atri, Bergamo, Cosenza, Milano, Perugia, Pistoia, Roma, Siena*, Firenze: Olschki.

Filosofici 7 = Cao, Gian Mario et al. (eds) (1993), *Catalogo di manoscritti filosofici nelle biblioteche*, 7. *Novara, Palermo, Pavia*, Firenze: Olschki.

Frioli, *Aldersbach* = Frioli, Donatella (1990), *Lo scriptorium e la biblioteca del monastero cisterciense di Aldersbach*, Spoleto: Centro Italiano di studi sull'alto medioevo.

Gilissen, Léon (1977), *Prolégomènes à la codicologie*, *Recherches sur la construction des cahiers et la mise en page des manuscrits médiévaux*, Gand: Éditions scientifiques Story-Scientia.

Gumbert, Johan Peter (1993), 'Sizes and Formats', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 227–263.

Haskins, Charles Homer (1972), *La rinascita del XII secolo*, Bologna: Mulino (Italian translation. Originally published as *The Renaissance of the Twelfth Century*, Cambridge: Harvard University Press 1927).

Irigoin, Jean (1998), 'Les cahiers des manuscrits grecs', in Hoffmann, Philippe (ed.), *Recherches de codicologie comparée. La composition du codex au Moyen Âge, en Orient et en Occident,* Paris: Presses de l'École Normale Supérieure, 1–19.

Ker I = Ker, Neil R. (1969), *Medieval Manuscripts in British Libraries*. I. *London,* Oxford: Clarendon Press.

Ker II = Ker, Neil R. (1977), *Medieval Manuscripts in British Libraries*. II. *Abbotsfield-Keele*, Oxford: Clarendon Press.

Ker III = Ker, Neil R. (1983), *Medieval Manuscripts in British Libraries*. III. *Lampeter-Oxford*, Oxford: Clarendon Press.

Ker IV = Ker, Neil R. / Piper, Alan J. (1992), *Medieval Manuscripts in British Libraries*. IV. *Paisley-York,* Oxford: Clarendon Press.

Kuttner I = Kuttner, Stephan / Elze, Reinhard (1986), *A Catalogue of Canon and Roman Law Manuscripts in the Vatican Library*, I. *Codices Vaticani latini 541-2299*, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 322).

Kuttner II = Kuttner, Stephan / Elze, Reinhard (1987), *A Catalogue of Canon and Roman Law Manuscripts in the Vatican Library*. II. *Codices Vaticani Latini 2300-2746*, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 328).

Le Goff, Jacques (1979), *Gli intellettuali nel medioevo*, Milano: Mondadori.
Lemaire, Jacques (1989), *Introduction à la codicologie*, Louvain-La-Neuve, Université Catholique de Louvain (Publications de l'Institut d'études médiévales. Textes, Études, Congrès, 9).
Leonardi, *Vaticani* = *Codices Vaticani Latini 2060-2117,* recensuit Claudius Leonardi operam dante Maria Magdalena Lebreton, indicibus instruxerunt Ambrosius M. Piazzoni et Paulus Vian, Città del Vaticano: Biblioteca Apostolica Vaticana, 1987.
Light, Laura (1987), 'The New Thirteenth-Century Bible and the Challenge of Heresy', in *Viator. Medieval and Renaissance Studies*, 18: 275–288.
Light, Laura (1994), 'French Bibles c. 1200–30: a New Look at the Origin of the Paris Bible', in Gameson, Richard (ed.), *The Early Medieval Bible. Its Production, Decoration and Use*, Cambridge: Cambridge University Press, 155–176.
Lowe, Elias Avery (1934–1966), *Codices Latini Antiquiores. A Palaeographical Guide to Latin Manuscripts Prior to the Ninth Century.* Oxford, The Clarendon Press.
M.C.L.B.P.F. = Jeudy, Colette / Riou, Yves-François (1989), *Les manuscrits classiques latins des bibliothèques publiques de France*, I. *Agen-Évreux*, Paris, CNRS.
Maier, *Vaticani Burghesiani* = Maier, Anneliese (1952), *Codices Burghesiani Bibliothecae Vaticanae,* Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 170).
Maniaci, Marilena (1996 [1998^2]), *Terminologia del libro manoscritto,* Milano, Roma: Istituto centrale per la patologia del libro.
Munk Olsen, Birger (1982–1989), *L'étude des auteurs classiques latins au XI^e et XII^e siècles*, 4 vols, Paris: CNRS.
Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*. Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).
Mynors, Balliol = Mynors, Roger A. B. (1963), *Catalogue of the Manuscripts of the Balliol College Oxford*, Oxford: Clarendon Press.
Ornato, Ezio (1997), 'La codicologie quantitative, outil privilégié de l'histoire du livre médiéval', in Ornato, Ezio et al., *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues*. *Avec une préface d'Armando Petrucci*, Roma: Viella (I libri di Viella, 10), 375–402.
Orsatti, Paola (1993), 'Le manuscrit islamique: caractéristiques matérielles et typologie', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), II, 269–331.
Pace, Valentino (1990), 'Miniatura e decorazione dei manoscritti', in Jemolo, Viviana / Morelli, Mirella (eds), *Guida a una descrizione uniforme di manoscritti e al loro censimento*, Roma: ICCU, 91–102.
Palma, Marco (1988), 'Modifiche di alcuni aspetti materiali della produzione libraria latina nei secoli XII e XIII', in *Scrittura e civiltà*, 12: 119–133.
Palma, Marco (1994), 'La struttura fisica degli Exultet' in Cavallo, Guglielmo (ed.), *Exultet. Rotoli liturgici del medioevo meridionale*, Roma: Istituto Poligrafico e Zecca dello Stato, 39–51.
Parkes, Malcom Beckwith (1979^2), *English Cursive Book Hands,* 1250-1500, Hampshire: Taylor & Francis.
Rizzo, Silvia (1973), *Il lessico filologico degli Umanisti*, Roma: Edizioni di Storia e Letteratura.
Saenger, *Newberry* = Saenger, Paul (1989), *A Catalogue of the Pre-1500 Western Manuscript Books at the Newberry Library*, Chicago/London: The University of Chicago Press.

Sirat, Colette (1998), 'Pour quelle raison trouve-t-on au Moyen Âge des quinions et des quaternions? Une tentative d'explication', in Hoffmann, Philippe (ed.), *Recherches de codicologie comparée. La composition du codex au Moyen Âge, en Orient et en Occident,* Paris: Presses de l'École Normale Superieure, 131–135.

Supino Martini, Paola (1992), 'Le sottoscrizioni testimoniali al documento italiano del secolo VIII: le carte di Lucca', in *Bullettino dell'Istituto storico italiano per il medio evo,* 98: 87–108.

Thurn, *Würzburg* II.2 = Thurn, Hans (1986), *Die Handschriften der Universitätsbibliothek Würzburg*. II.2, Wiesbaden: Harrassowitz.

Thurn, *Würzburg* II.I = Thurn, Hans (1973), *Die Handschriften aus benediktinischen Provenienzen*. II.1, Wiesbaden: Harrassowitz.

Tomiello, Antonella (1992–1993), 'Per un esame della scrittura testuale italiana : la cosiddetta "littera bononiensis"'. PhD thesis, Università degli studi di Padova.

Turner, Eric Gardner (1977), *The Typology of the Early Codex*, Philadelphia: University of Pennsylvania Press (Hanley Foundation Series, 18).

Vézin, Jean (1998), 'Les cahiers dans les manuscrits latins du haut Moyen Âge', in Hoffmann, Philippe (ed.), *Recherches de codicologie comparée. La composition du codex au Moyen Âge, en Orient et en Occident*, Paris: Presses de l'Ecole Normale Superieure, 99–104.

Wilmart, *Vaticani* = Wilmart, André (1937), *Codices Reginenses latini*. I. *Codices 1-250*, in Biblioteca Apostolica Vaticana.

Zamponi, *Manoscritti petracheschi* = Zamponi, Stefano (1984), *I manoscritti petracheschi della Biblioteca Civica di Trieste. Storia e Catalogo*. Padova, Antenore (Censimento dei codici petracheschi, 8).

Zappella, Giuseppina (1994), 'Il fascicolo nella struttura del libro antico', in *Accademie e Biblioteche d'Italia*, 1: 17–60.

* Busonero = Busonero, Paola, *teologici*

* Devoti = Devoti, Luciana, *giuridici*

* *Notices = Notices*

The final three entries, marked with an asterisk, are not printed catalogues. The first entry refers to a *corpus* of 18 theological and philosophical codices drawn from the third volume of the *Catalogue des manuscrits datés,* which was scrutinised in person by the author. The second is composed of 16 juridical manuscripts (held in French and Italian libraries). Their descriptions were kindly supplied by Luciana Devoti, who personally examined them while carrying out a research project on glossed juridical manuscripts (published in the present volume). The *Notices* are descriptions of manuscripts, still in hand- or typewritten form, compiled by various authors (among whom we should mention Élizabeth Pellegrin) and held by the Institut de Recherche et d'Histoire des Textes in Paris.

Marilena Maniaci

The Art of Not Quartering Skins

Techniques Employed for the Subdivision of Bifolia in Byzantine Manuscripts

More than twenty-five years* have passed since Léon Gilissen proposed, in his *Prolégomènes à la codicologie*, a reconstruction of the manufacturing process used for making quires in Western parchment manuscripts. According to the scholar's hypothesis, quaternions were obtained by folding a skin one or more times along its perpendicular axis. The success enjoyed by this proposition was considerable, so much so that today, extrapolating from Gilissen's postulate, it is commonly supposed that the leaves of *all* manuscripts *always* represent fractions of one skin which has been subdivided in a symmetrical way.

The theory's popularity is certainly due, in large part, to the very natural—indeed, *instinctive*—nature of the steps that it envisages. However, this fundamental plausibility is not the only argument that works in favour of the hypothesis: Gilissen himself, and some other codicologists following in his footsteps, have come up with a body of convergent arguments which, implicitly, can be read as convincing proof of the sound footing of the reconstruction. But what has actually been found? Not the irrefutable evidence presented by bifolia which, over the course of time, have remained materially consubstantial, but rather a series of observations that at best follow the overall direction of the hypothesis, and which ultimately do not contradict it. To be sure, such clues are not lacking in weight, but it is not possible in all instances to reconstruct, based on the 'static' situation one is presented with today, the sequence of manoeuvres performed by the artisan in the past, which obviously remains far out of our view.

In actual fact, Gilissen's hypothesis does not represent an organic whole in which the various elements connect in an almost 'automatic' way. It is appropriate, therefore—and this is particularly important if one is to achieve a better approach to the set of issues addressed in the present contribution—to split up the problem into its constituent parts. Parts taking in-quarto folding as an example.

Translated from the French into English by Mark Livesey. Original published as Maniaci, Marilena (1999), 'L'art de ne pas couper les peaux en quatre', *Gazette du livre médiéval*, 34: 1–12.

---

* At present (2020) more than fourty years.

https://doi.org/10.1515/9783110743838-108

According to Gilissen:

- The bifolia are necessarily the result of *n* symmetrical subdivisions which *always* produce a number of bifolia equal to 2^n ($2^0 = 1$; $2^1 = 2$; $2^2 = 4$, ...). This remains true for all 'formats'.
- The subdivisions of the sheet were *always* realised by adhering to a prestipulated sequence of folds. This remains true for all 'formats'.
- The succession of folds was *always* the same: the skin was first folded perpendicular to the spine, so that the latter coincides with the bifolium's fold. This remains true only for in-quarto examples.
- Because the bifolia that are generated from one and the same skin remained materially consubstantial throughout the operation, they necessarily coexist within one and the same quire. This remains true only for in-quarto and in-octavo examples.
- The assembly of folded skins could be carried out either by arranging them on top of each other (formula *A2*) or by inserting one folded skin inside another (formula *C2*).

This reconstruction is rather seductive. However, if one gives the matter some thought, there is nothing to prevent the possibility that, whilst leading to the same material configuration, the degree of liberty enjoyed by the artisan may in fact have been greater. For example, it would be perfectly feasible to reverse the order of folds by beginning at the spinal axis. One would obtain, also in this case, two bifolia united along the upper edge, which, when suitably joined, could form a demi-quire. It is true that this demi-quire would not 'automatically' obey Gregory's rule, but one cannot safely deduce that respect for the rule was the automatic consequence of a particular practice and was not dictated by other considerations. Similarly, nothing constrained the artisan to divide bifolia along the short axis (i.e. perpendicular to the spine). Indeed, by dividing them contrarily along the long axis, *landscape* format volumes could be obtained; or perhaps (since this possibility has not been confirmed) a portion of skin could have been cut off and set aside for a different purpose, so as to obtain *portrait* format volumes that no one, at first glance, would be able to distinguish from 'normal' volumes. Finally, no one says—and Gilissen certainly never said—that the quaternions of all manuscripts were obtained in the way prescribed by his hypothesis, or that all the quaternions within an individual manuscript were obtained in this way. But above all, no one says that the potential confirmation of one of his theorised series of steps implies, *ipso facto*, the overall validity of the suggested reconstruction.

Apart from Gregory's rule (too wide-ranging to be reduced to a simple by-product of a particular *savoir-faire*) and the unmistakable signs of historic material consubstantiality among bifolia (too seldom observable to represent proof *per se* of the existence of a very widespread practice), the fact that *lisières* appear almost exclusively along the margins of the leaves, which, according to the folding hypothesis, correspond to the edges of the skins, occupies a prime position in Gilissen's reasoning. Yet one can demonstrate that the absence of *lisières* along the top edge of a bifolium is entirely compatible with other procedures.

Lisières serve as an irrefutable means of identifying, on a bifolium, the original orientation of the animal skin. Unfortunately, because they represent a nuisance both materially and aesthetically, there was a tendency for them to be eliminated. Nevertheless, as research led by Frank Bischoff has shown,[1] other equally useful reference points on skins exist which, being less bothersome and, above all, further away from the edges of the bifolium, had a much better chance of survival. Known as *brisets* in French, *Flämen* in German, *scalfi* in Italian,[2] these are rounded areas that correspond to the *axillae* (as we will therefore call them), located at the junctions of the four legs of the living animal (Fig. 1). They can be identified thanks to the fact that animal skin has an almost translucent appearance, and because hair follicles are more visible in these areas than elsewhere.

If one accepts Gilissen's hypothesis and imagines the creation of quires taking place without any mishaps occurring and perfectly in line with the canon, the position of the *axillae* on a bifolium makes it possible to reconstruct the type of folding process employed:

- In an in-folio folding, one should normally observe four *axillae* per bifolium: two on the upper edge, two on the lower.
- In-quarto folding, on the other hand, is characterised by the presence of two *axillae*, namely on each lateral edge of the bifolium.
- In an in-octavo folding, one *axilla* can be seen on the lower edge of each of the four bifolia, straddling the fold.

The observation of *axillae* is not always entirely satisfactory because for various reasons (the nature of the skin, the age of the animal it was obtained from and, above all, the drastic trimming of edges) they are not visible in all instances.

1 Bischoff 1991 and Bischoff 1993.

2 Muzerelle 1985, 42; Bischoff 1991; Maniaci 1996 (1998[2]), 31.

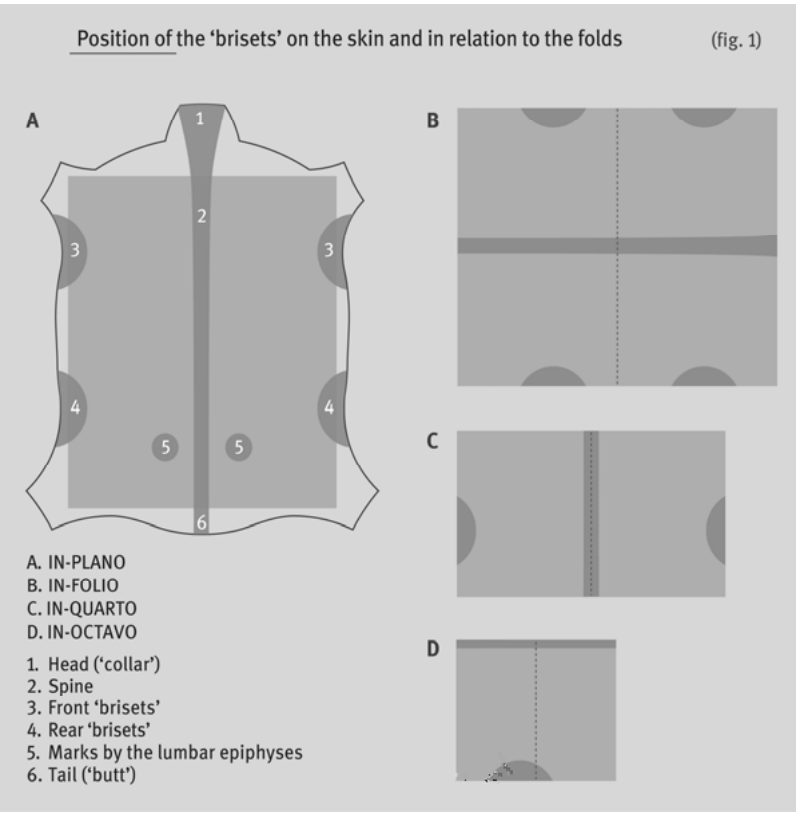


Fig. 1: Position of the 'brisets' on the skin and in relation to the folds

Nevertheless, one can still enounce a firm rule: if the constituent quires of a manuscript were created according to the procedure postulated by Gilissen, the visible *axillae* on a bifolium should *necessarily* be located in one of the positions indicated in Fig. 1.

During the course of research recently carried out on a mixed corpus of codices, *Exultet* rolls and archival documents of various origins aimed at establishing the dimensions of skins used for medieval writing,[3] it was noted that certain Byzantine manuscripts do not obey this rule: in fact, the *axillae* are found on the lower edge of each of the two halves of the bifolium. In order to explain this unexpected phenomenon, one has to imagine a lengthwise in-quarto subdivision, thereby making the top margin coincide with the spinal axis. The end result of this approach has been termed

3 Bischoff / Maniaci 1996.

Längs-quartformat (Fig. 3). Nevertheless, because this procedure generates a 'landscape' format volume (i.e. one of greater width than height) which, in order to be reduced to the 'portrait' format, would always necessitate the sacrifice of a portion of the skin, this hypothesis does not seem very convincing to us, since it would be devoid of any functional purpose.

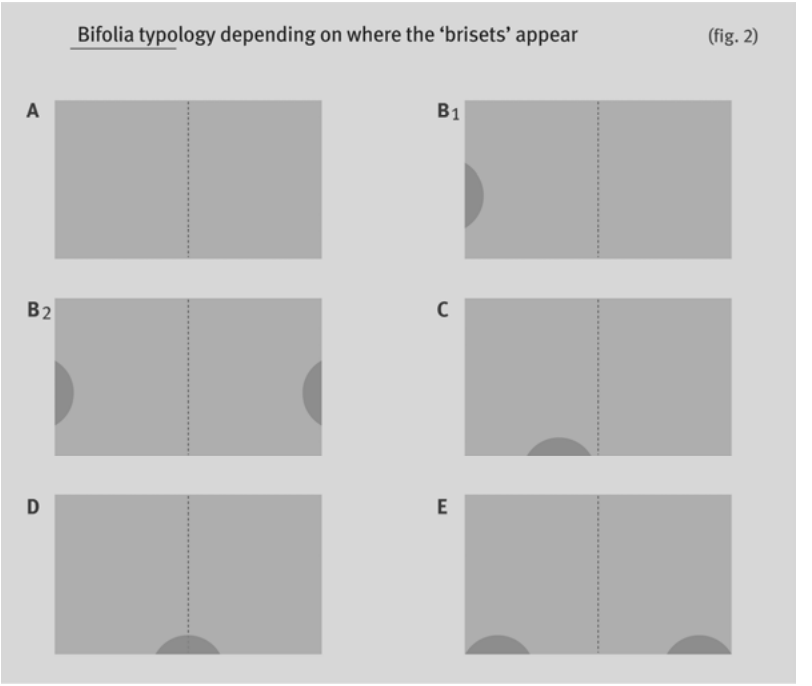


Fig. 2: Bifolia typology depending on where the 'brisets' appear

Given that the phenomenon has been observed in Byzantine production, it seemed like an interesting proposition to analyse, bifolium-by-bifolium, a certain number of Greek manuscripts in the group under examination, with the aim of determining where the *axillae* are found. Accordingly, almost 500 quaternions from 20 pre-13th-century volumes were meticulously scrutinised (corpus A). It should be emphasised that this small corpus is not intended to be seen as a faithful representation of Byzantine production from a chrono-geographical standpoint, nor from a dimensional one: in fact, on account of the difficulty of identifying the positions of *axillae*, the small manuscripts (< 400 mm) were excluded from the investigation, at least for the time being.

The data collected through this operation made it possible to arrange the bifolia into five different categories. Each category was assigned a letter (Fig. 2):

A: 'Silent' bifolia, which is to say those without *axillae*.
B: Bifolia in which at least one lateral edge presents with an *axilla*.
C: Bifolia with an *axilla* on the lower edge, positioned off-centre to the left or right of the fold.
D: Bifolia with an *axilla* on the lower edge, centred on the fold.
E: Bifolia with two *axillae* on the lower edge; specifically, one on each half.

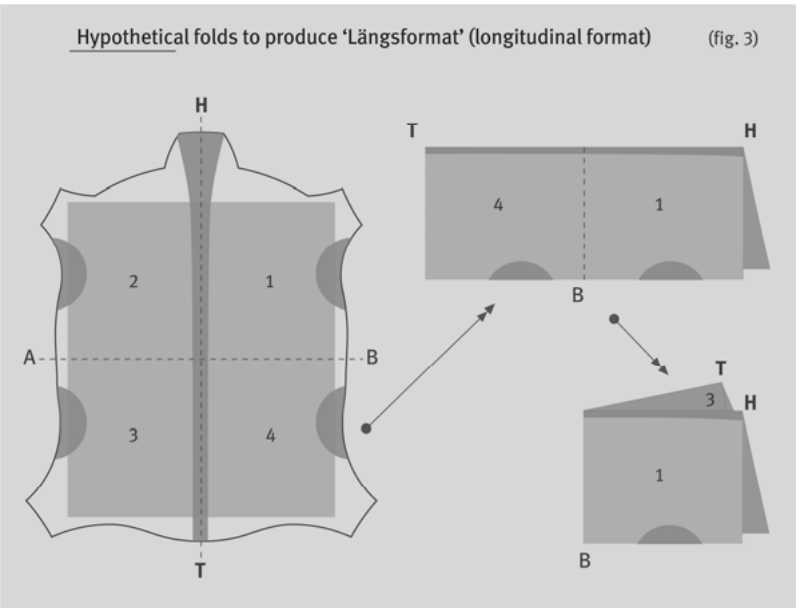


Fig. 3: Hypothetical folds to produce 'Längsformat' (longitudinal format)

Alongside the main corpus, a larger population (327 manuscripts, corpus B) underwent a less detailed and non-quantitative study. The manuscripts were divided into just two categories: those which present with *axillae* on the lower edge, and all the rest.

The results of the investigation carried out on corpus A as a whole are as follows:

– The 'silent' bifolia (A-type) represent practically half of the total corpus; their frequency varies from one volume to another.
– The B-type bifolia, which are compatible with Gilissen's in-quarto formulae, constitute approximately a third of the corpus.

– The D-type bifolia, which conform to the in-octavo formulae, are not numerous, but are far from being absent. This result is surprising if one considers the large size of the volumes included in the corpus.
– The E-type bifolia represent a very small minority.

As regards the C-type bifolia, which are incompatible with Gilissen's formulae, their numbers are far from insignificant, given that they represent around 20% of the total population. We shall take a further look at these later on.

The variety of forms observed in one and the same volume is the most surprising thing that one notices when taking a first look at the results. Indeed, only six volumes present with very homogeneous arrangements: these, in all cases, are composed of B-type bifolia, characteristic of the in-quarto format, which can be considered 'traditional'. This type of subdivision is therefore very representative of Byzantine artisanal practice.

Given that one does not observe a large presence of E-type bifolia, it must also be concluded that the hypothetical *Längs-quartformat* was not favoured in the Byzantine world. This is understandable, since not only would volumes made in this way be, as we have already said, of greater width than height, they would also have a rather stumpy appearance: in fact, their height could not exceed half the width of the skin.

This being so, an effort was made to explain the number of C-type bifolia with one *axilla* positioned on the lower edge in corpus A. What characterises the manuscripts that contain these is the fact that C-type bifolia never appear alone: even where they are in the majority, they are always mixed with B-type bifolia. The necessity to account for this coexistence gave rise to a new hypothesis which not only explains the results obtained but also perfectly fits the size and proportion canons that characterise Byzantine manuscript production. However, the hypothesis presupposes that one is prepared to renounce the dogma that insists on the symmetrical subdivision of a skin into an even number of bifolia, and postulates that the artisan was able to obtain not two or four, but *three* bifolia starting out from the original skin (*in-sexto* division).

In applying this method, the skin would have been divided into a T-form. One would obtain in this way two 'Siamese' (i.e. conjoined) C-type bifolia, which is to say bifolia united with the spine of the skin, and one B-type bifolium, perpendicular to the former, whose fold does not necessarily coincide with the remaining part of the spine (Fig. 4).

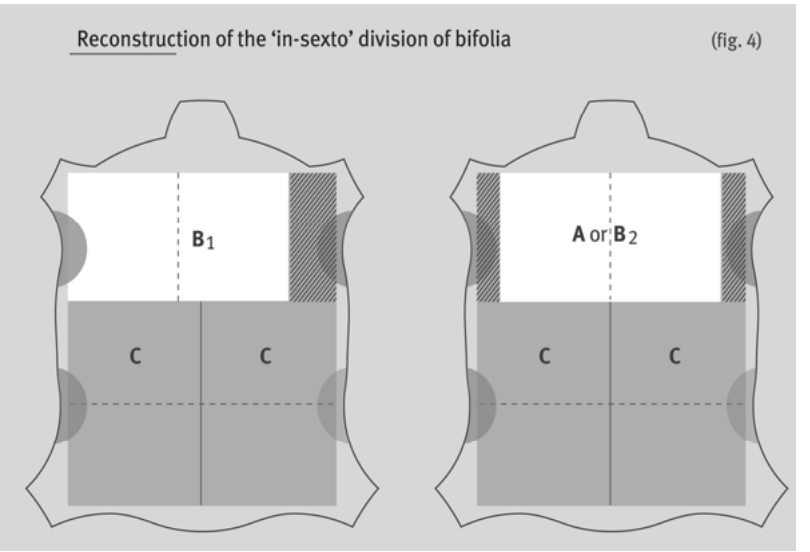


Fig. 4: Reconstruction of the 'in-sexto' division of bifolia

In theory, in an entirely in-sexto volume one should find 2/3 C-type bifolia and 1/3 B-type bifolia. In practice, however, one observes a greater difference: in fact, in the B-type bifolium, the position of the *axillae* coincides with the portion that should have been cut off in order to obtain the same width of the other two bifolia. It follows, then, that the only in-sexto compatible volumes are those in which by adding to the percentage of B-type bifolia a sufficient number of 'silent' bifolia one can achieve a level of 33%.

Corpus A contains just three volumes in which the frequency of different bifolia types is compatible with these criteria. However, it is very likely that the in-sexto option was used partially, if not predominantly, in other manuscripts—indeed, in all volumes, C-type bifolia are distributed in equal numbers among those in which the *axilla* is situated on the right half and those in which it is situated on the left half. This distribution fits very well with the coexistence of 'Siamese' bifolia originating from the same skin placed symmetrically in relation to the spine.

Needless to say, when one resorts to an in-sexto subdivision, some of the raw material will be wasted, owing to the fact that the B-type bifolium is larger than the other two, and therefore has to be trimmed. However, it should be pointed out that all the skin subdivision options result in the sacrifice of a certain amount of raw material whenever cultural imperatives required that leaves should be endowed with proportions that do not naturally result from the division of skins, which there-

fore had to be trimmed in a systematic way. (It is not possible to expand on this issue in the present contribution.)

In the case of a traditional in-quarto format, each leaf replicates the original proportions of the skin: hence there is no sacrifice of material when those proportions coincide with the canonical criteria imposed on the leaf. What of the in-sexto format, then? In order for there to be no sacrifice of raw material, the three bifolia must be contained within the usable rectangle. It can be shown that this will only happen when the proportion of the skin is 2/3 and the leaves of the manuscript are square. These are conditions that neither correspond to the reality of animal skins nor to the working practice of artisans.

In the absence of such conditions, the minimum loss (approximately 10%) can be achieved when the skin's proportion is 4/5 and that of the leaves 3/4. Now, these proportions represent, respectively, the average proportion of skins and the predominant trend observed in the proportion of leaves in the Byzantine world, irrespective of the size of manuscripts. It should be noted that, under such conditions, the loss amounts to 6% for the in-quarto format and 17% for the in-octavo. One can see, then, that an in-sexto subdivision yields the best results precisely in routine artisanal practice, and that in this context it holds a position which can almost compete with the traditional in-quarto solution. However, since this does not represent a decisive advantage, it is insufficient to exert a serious impact on the latter option.

Most of the 20 volumes examined (a detailed analysis of which cannot be provided here) were made using a range of different methods. Nevertheless, one is not necessarily dealing with a chaotic jumble: in two of the manuscripts, extensive homogeneous portions are plain to see. In order to propose a plausible explanation for this concomitance of different practices, it is necessary to address the question concerning the sizes of volumes and skins in the Byzantine world.

The size (*taille*) of the manuscripts in corpus A range between 436 and 715 mm. If the lower limit is due to a limitation being deliberately pre-imposed on the sample (see below), the upper limit represents a ceiling that is typical of Byzantine production as a whole. On the other hand, it is astonishing to see that, in contrast to what happens in other countries and in other eras, even the largest volumes never present with in-folio folding.

Given that the large manuscripts in corpus A are in-quarto, it is easy to confirm that the 'useful' size of the skins used to make them ranged from 1250 to 1450 mm. These are certainly large skins, but this should come as no surprise: skins of such dimensions are well documented in medieval production, and even more so among today's parchments. That being said, it is very likely that skins of these dimensions were not used exclusively for the largest volumes. Subdivided in-octavo, the same

skins could have yielded leaves measuring between 400 and 470 mm in size. Indeed, D-type bifolia are present in the smallest volumes of corpus A, but the sample was not sufficient to carry out a deeper analysis of this finding. Subdivided in-sexto, the skins could have produced sizes ranging from 485 to 560 mm. Now, two of three presumed in-sexto manuscripts fit precisely within this range.

One will observe that the in-quarto or in-octavo subdivision of large skins produces manuscripts of very different sizes. However, such a gap does not exist in the size distribution of Byzantine manuscripts. This void could certainly have been filled by using skins of different sizes, but also through the adoption of different subdivision techniques, such as, indeed, the in-sexto option. The filling of this size gap could therefore represent one of the incentives that encouraged the development of this technique. However, some other advantages arising from this approach can also be considered:

– Avoidance, as far as possible, of resorting to an in-octavo subdivision. Poorly suited to leaves of wide proportion, this solution always involves a not negligible sacrifice of raw material in Byzantine manuscripts.
– The standardisation of the leaves in one and same volume when the available batches of skins are of very mixed sizes. This would explain why one encounters a considerable number of volumes containing a medley of different techniques. Chart 1—in which the percentage of different types of bifolium in relation to the size of volumes is shown—demonstrates very clearly a sort of 'no man's land' around the average sizes, a kind of 'crossroads' where the various possibilities vis-à-vis the subdivision of skins would intersect. In large volumes, there are longer skins that are large enough to make in-sexto books, and in small ones, where the in-sexto format would produce books that are too large, the in-octavo format takes up the baton.
– The possibility of better exploiting the raw material by obtaining three bifolia from a skin which is a little larger, rather than two bifolia from a slightly smaller skin. It can be demonstrated that skins measuring 1450 and 1250 mm in size, subdivided in-quarto and in-octavo respectively, produce pages of very similar dimensions, with a significant gain of usable surface (an absolute value) in the in-sexto format. In general, from the economic standpoint, artisans preferred to divide a large skin into a greater number of smaller rectangles, rather than to divide a small skin into fewer larger rectangles. Could this be the justification for the use of larger skins in the period preceding the 13th century? The idea is rather attractive, but at present there is nothing to prove it.

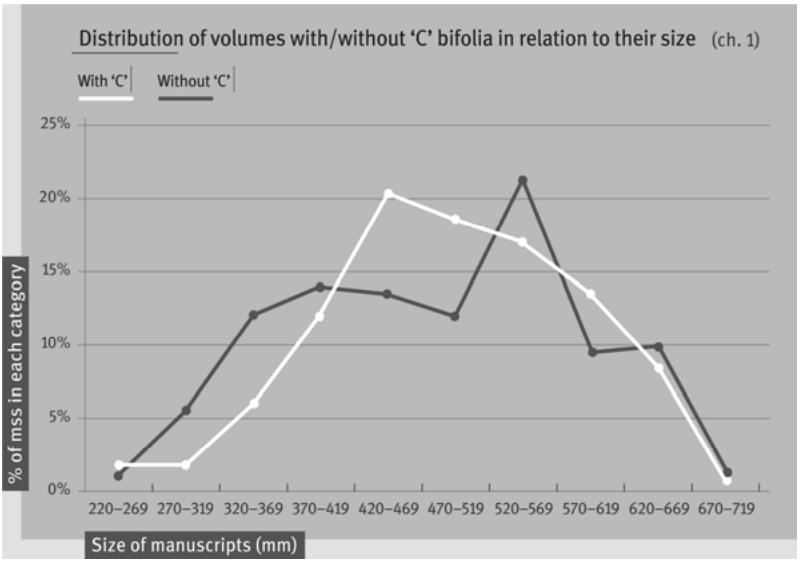


Chart 1: Distribution of volumes with/without 'C' bifolia in relation to their size

A close look at corpus B supports the hypothesis of 'the filling of a size gap', as formulated above. In fact, Chart 2 shows that the maximum concentration of C-type bifolia is found precisely in a space less occupied by manuscripts in which this type of bifolium is absent. One also notes, as in Chart 1, that the frequency of C-type bifolia decreases in correspondence with size—the data are therefore consistent. On the other end of the curve, the decrease in correspondence with small sizes hints towards the adoption of other solutions (i.e. in-octavo and in-quarto treatment of small skins) that the insufficient sample in corpus A makes impossible to discern.

In conclusion, the existence of an in-sexto subdivision rests on the rigorous and irrefutable observation of certain irregularities in parchment whose position on the bifolium is totally incompatible as much with the 'traditional' formulae proposed by Gilissen as with a hypothetical 'oblong' orientation of the skin. The consistent coexistence of B-type and C-type bifolia in one and the same volume, as predicted by our reconstruction, further substantiates the existence of such a subdivision.

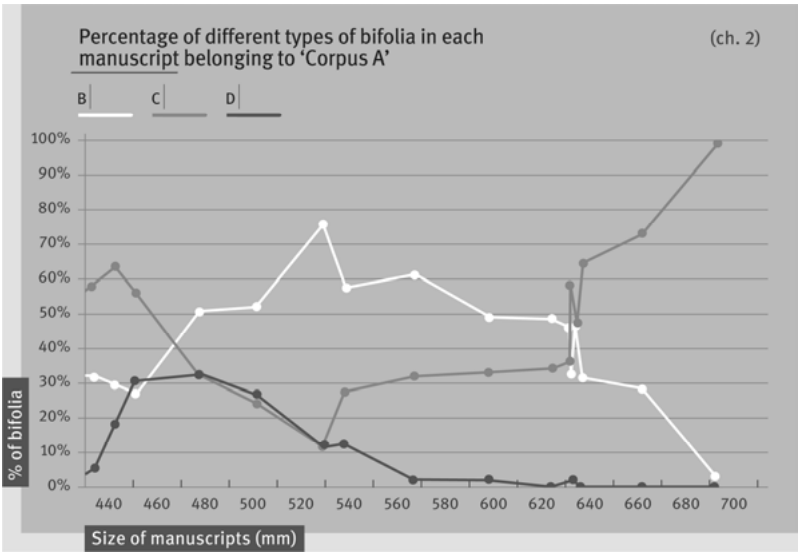


Chart 2: Percentage of different types of bifolia in each manuscript belonging to 'Corpus A'

Furthermore, this method appears to be well suited to the material and artisanal context typical of the Byzantine manuscript. When one wishes in all cases to obtain wide bifolia without taking into account the 'natural inclination' of the animal skin, the in-sexto option, thanks to its geometrical characteristics (which we cannot elaborate on here), is easy to achieve and allows for a greater exploitation, relatively speaking, of the usable area of the skin. Additionally, inasmuch as it represents an intermediate size solution lying between the in-quarto and in-octavo solutions, this kind of subdivision makes it possible to vary the size of volumes when starting out from typologically uniform skins, usually of large size. Finally—and this does not represent a contradiction—the method could just as easily play a role in the opposite way, namely by contributing to the regularisation of bifolia when the abovementioned large skins do not form sufficiently uniform batches.

These considerations presuppose a civilisation in which the slaughter of livestock was never carried out with a view to producing parchment, at least in the pre-13th-century Byzantine world: in other words, the artisans had to make do with what was at hand. Such an agro-technological background is not at all unlikely, but it certainly ought to be corroborated through further observations. At the same time, a new question automatically arises: given that the artisanal circumstances and technical *savoir-faire* were not the same, can it be said that

the practice of in-sexto subdivision did not take place in the Western Middle Age? On this matter we shall have to reserve judgement, given that up to the present nobody has set out to examine Latin manuscripts from this perspective. A well-targeted investigation would therefore be welcome.[4]

References

Bischoff, Frank M. (1991), 'Pergamentdicke und Lagenordnung. Beobachtungen zur Herstellungstechnik Helmarshausener Evangeliare des 11. und 12. Jahrhunderts', in Rück, Peter (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Torbecke, 97–144.

Bischoff, Frank M. (1993), 'Observations sur l'emploi de différentes qualités de parchemin dans les manuscrits médiévaux', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Modern Book Materials and Techniques* (Erice, 18–25 September 1992), Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 57–94.

Bischoff, Frank M. / Maniaci, Marilena (1996), 'Pergamentgröße, Handschriftenformate, Lagenkonstruktion. Anmerkungen zur kodikologischen Forschung am Beispiel südeuropäischer Pergamente und Handschriften', in *Scrittura e civiltà*, 19: 277–319.

Maniaci, Marilena (1996 [1998²]), *Terminologia del libro manoscritto*, Milano, Roma: Istituto centrale per la patologia del libro.

Maniaci, Marilena (1999), 'Suddivisione delle pelli e allestimento dei fascicoli nel manoscritto bizantino', in *Quinio. International Journal on the History and Conservation of the Book*, 1: 83–122.

Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*, Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).

4 For a more detailed analysis of these phenomena, the interested reader can refer to Maniaci 1999.

Denis Muzerelle

The Arithmetic Properties of Lineation in Humanistic Manuscripts

The counting of lines is a necessary task that codicologists and cataloguers feel obliged to perform in a diligent way, but one which many would happily eschew. It is a thankless and tedious operation that requires close, uninterrupted attention. Indeed, if one loses count an error or a slight hesitation might occur that would force one to start from scratch, and often to repeat the operation afresh, so as to guarantee the accuracy of the result. To this it should be added that it is generally necessary to perform the count on several different leaves in order to identify possible fluctuations, which can often be observed.

Such an irksome chore would certainly be carried out with more enthusiasm if the final product of the procedure were more immediately obvious, and if one could persuade oneself that the counting of lines may potentially yield useful information. However, bringing to mind Lao Tzu's subtle observation that 'a pot's usefulness lies in its emptiness', lines often seem to become more significant when they are missing rather than when they are in plain view. To attempt to estimate the number of lines borne by a specimen was a procedure that philologists experimented with very early on, in an effort to account for lacunae or other accidents of textual transmission. It should be pointed out that this approach more than once led to the said philologists rather recklessly exceeding the restricted limits that the state of codicology at the time would have permitted them to reach. Here, as a reminder to the reader, I shall cite only the speculations of Albert Curtis Clark in relation to the exemplar of Cicero's philosophical treatises,[1] and those of Léon Herrmann on the tradition of Tibullus and other Latin poets.[2] Finally, mention should also be made of a theory put forward by the same author, which was developed in 1932.[3]

Translated from the French into English by Mark Livesey. Original published as Muzerelle, Denis (2009), 'Les propriétés arithmétiques de la linéation dans les manuscrits humanistiques', in *Gazette du livre médiéval*, 55: 20–31.

1 Clark 1918 (repr. 1969, 2004), chap. X, 182–363.

2 See in particular Herrmann 1967, 1015–1020.

3 Herrmann 1978.

https://doi.org/10.1515/9783110743838-009

Other than the aforementioned cases, interest in the number of lines in manuscript volumes appears to be rather limited. To be sure, it is an element that combines with numerous others to define the material form of a book, and hence deserves to be included as part of any meticulous description. However, the immediate utility of such an observation is far from obvious. It can certainly be used to make an instant estimate of the text density on a page, but a similar result could be obtained by examining the relationship between the length of the text and the number of leaves it occupies. It can also be combined with the height of the justification so as to deduce the ruling unit, and thus to estimate the writing module. However, this is merely an approach that enables one conveniently to obtain a result which could be reached in other ways.

Rather than descending into numerological delirium, it is not easy to admit that the number of lines is purely the product of chance and does not contain a shred of usable information. Anyone who has ventured to systematically survey codicological data furnished in catalogues has not failed to come across, at one point or another, series of numbers that appear to possess a certain coherence, which subsequently inspire them to construct an explanatory hypothesis—until a new and totally incompatible series of numbers eventually emerges which sadly demolishes their pet theory.

Nevertheless, one can still formulate the hypothesis that if the same process is employed to set down the lineation of a certain number of manuscripts—even in those which exhibit a variable number of lines—the resulting ruling types will have certain arithmetic properties in common, such as being composed of an odd or even number of lines, or multiples of this or that number of lines.

Some other arithmetic properties can also be considered. Accordingly, if one imagines a scribe who starts out by establishing the justification at the top and bottom of the page, and then subdivides the resulting space in two, and then in turn divides these two spaces in two, and so on until the desired density is attained, the number of lines will necessarily assume the form $2^n + 1$. Of course, this is an artificial example, because such a protocol would only allow one to generate a very limited range of values (17, 33 or 65, with regard to the 'useful portion'). This example is cited merely to illustrate the range of hypotheses that can be envisaged. Although it is not possible to determine all such hypotheses a priori, divisibility by various numbers remains the least difficult property to grasp, and so it is the one that we shall confine ourselves to examining here.

In order to verify the proposed hypothesis, the most natural propensity would be to apply statistical analysis in its most classical form. But in the present context we come up against a major problem: in order to be applicable, statistical analysis requires that each item/subject should belong to a category of the group under

examination, and to one only. If, for example, we were to set about amassing statistics based on people's occupations, the case of an individual who practices palaeography in the morning and acrobatics in the afternoon would clearly pose a problem. If it were a unique case, it could be resolved in a one-off way, and would then become submerged in the overall mass of observations; but if it were a more widespread phenomenon or became more complex, one would have to forego applying the criterion of a defined profession. Now, this is the kind of situation that we are faced with here, because if one is dealing with multiples of 12, one is also dealing with multiples of 2, 3, 4 and 6. A statistical approach is therefore only feasible if one limits oneself to considering solely prime numbers (2, 3, 5, 7, 11, etc.), and a quick glance will suffice to show that this restriction would prevent us from reaching any useful conclusions.

One must therefore proceed in an alternative way and return to the previous stage of the statistical approach—a stage where one is not yet concerned with the global distribution of occurrences, but instead only with the individual probability of each occurrence. Switching from a synthetical approach to an analytical one clearly will not simplify the task; in fact, it will considerably increase the number of calculations that would have to be performed. But that would be the only way to get around the problem, since by proceeding on a case-by-case basis it becomes irrelevant if a case happens to be a combination of two basic ones.

The underlying principle for this is as follows: by knowing the theoretical frequency $\boldsymbol{f}$ of an occurrence (or the frequency which one can consider normal), it is possible to calculate the probability of seeing it occur $\boldsymbol{x}$ times in a series of $\boldsymbol{n}$ random experiments. This value is directly provided by binomial law, which constitutes one of the fundamental basis the calculation of probabilities. By applying this model, one can compare each batch of $\boldsymbol{n}$ manuscripts exhibiting a total of $\boldsymbol{x}$ times the characteristic in question to a series of $\boldsymbol{n}$ random drawings from an urn in which the proportion of winning balls equals $\boldsymbol{f}$. One can then ask what the probability would be of observing such a result purely by chance, and draw conclusions based on the particular context concerned.

To interpret that probability, it must first and foremost be compared to a fixed reference point. Now, it has been demonstrated that in an experiment of this kind, the most likely result tallies with a *mathematical expectation*, namely with the product of $\boldsymbol{n}$ multiplied by $\boldsymbol{f}$. Even so, the probability of this result is not constant: it depends on $\boldsymbol{n}$ and on $\boldsymbol{f}$ by virtue of binomial law. One can therefore assess the more or less exceptional character of a given situation by comparing its probability to that of the mathematical expectation. Accordingly, a ratio of 0.5 indicates that one is in the presence of a situation more or less two times less probable than the 'normal' one; a ratio of 0.1, ten times less probable, and so on.

Here, a concrete example will help us to better understand the logic governing this procedure. The natural frequency of multiples of 5 is one in five, or 0.2. Therefore, in 20 manuscripts, the most likely situation that one will encounter is $20 \times 0.2 = 4$ where the lineation is a multiple of 5, and the probability of obtaining this result is 0.218. If the count is 6, the probability of this different situation occurring is 0.109, which is to say in a 0.5 ratio with the previous one. Such a scenario is therefore only two times less likely to occur, and so it would be prudent to consider that this may be the product of pure chance. However, if we are dealing with a count of 10, the probability of obtaining such a result falls to 0.002, and the ratio to 0.009, indicating a probability of 107 times below the average. Thus, there is a less than one in a hundred chance that the phenomenon can be ascribed to pure chance, and one can legitimately enquire what this outcome means. To render the results easier to understand for readers unfamiliar with probabilities, it is the last value (in the example given above, 107) that will be used below to record the observed values, which will be arbitrarily given a *plus* (+) sign if higher than the mathematical expectation, and a *minus* (-) sign in the opposite case.

The question of what one must consider the 'normal' frequency still has to be cleared up. One's first inclination would be to compare it to the natural frequency, which has the advantage of being relatively easy to calculate: one number in two is a multiple of 2, one in three of 3, and so on. However, a quick analysis of the data immediately makes it clear that the frequencies observed across the entire corpus under investigation stray markedly from the 'natural' frequencies. They consist as follows (in percentages) (Tab. 1):

Divisibility frequencies (tab. 1)

	Pr.	2n	3n	4n	5n	6n	7n	8n	9n	10n	11n	12n	13n
Nf	ca 25	50.0	33.3	25.0	20.0	16.7	14.3	12.5	11.1	10.0	9.1	8.3	7.7
Of	21.2	54.9	33.6	28.1	22.0	19.9	15.7	13.8	10.4	11.4	9.3	10.0	7.0

Nf=natural frequency; Of = observed frequencies — 2n, 3n,... = multiples of 2, of 3, and so on

Tab. 1: Divisibility frequencies

Despite being low in terms of absolute values, these intervals exhibit some massive disparities in comparison to the probabilities generated by binomial law. On

the other hand, given that we know that the manuscripts were made using several different techniques, it is of little help to learn that all these procedures taken as a whole lead to a bias in either this or that direction, without being able to know how to explain which of them is responsible for what. Conversely, the opposite approach, which aims to identify the consequences stemming from the use of different procedures, can make it possible to apprehend the overall situation. As a result, the frequencies to which it is most appropriate to refer are those that one observes in the corpus as a whole, which we can call the 'local norm'.

Prime numbers present a particular problem. As is well known, their distribution among all numbers is not consistent, since they gradually become scarcer as one ascends towards larger numbers. This irregularity is already quite noticeable within the small interval that we are dealing with here: 6 prime numbers can be counted between 6 and 29 (30%), 5 between 30 and 49 (25%), and 4 between 50 and 69 (20%). The density of the distribution of prime numbers remains a mathematical conundrum which lacks a solution, so one can do no better than to adopt an average value and to factor in the phenomenon when interpreting results.

We have now reached a suitable point where questions can be posed about the codicological characteristics that are liable to have a direct impact on the practice of lineation, or which indirectly result in significant differences to it.

Needless to say, the particular ruling technique employed occupies the first rank. Even if the use of this expression—ruling technique—seems to have imposed itself among codicologists, it is not in fact very satisfactory, since it simultaneously refers to the tool employed to draw the ruling, the way in which the tool was handled, and the trace it left on the writing support. In actual fact, only the last aspect can be observed, since the other two are open to subjective interpretation, and are far from being unambiguous. The most important area of ambiguity concerns the techniques that leave an embossed impression (that is a sequence of ridges and furrows) on the support, which one can ascribe (with respect to later periods) either to the use of drypoint or of a ruling board. Often, only a close examination will enable one to distinguish between the two. Nevertheless, where embossed lineation is accompanied by a complete sequence of marginal pricking, one can be sure that it was drawn line-by-line, and therefore by drypoint. In the paragraphs that follow, these clear-cut cases are referred to using the term 'drypoint', whilst the others are referred to using the term 'blind (ruling)'.

The ruling type can also be suspected as having a direct influence on the number of lines. The distribution of vertical lines certainly exerts no influence, but the presence of overrun lines, either alone or in pairs, at the top or bottom of the lineation can exert a direct influence on the number of lines they frame. Here, layouts will be reported in accordance with the conventions set out by the 'universal

formula':[4] [0-0] for a total absence of overrun lines; [1-0] for the presence of a single overrun line at the top of the page but absent at the bottom, and so on.

By the same token, the use made of the ruling type—above or below top line [ATL, BTL], in accordance with the established nomenclature—should certainly be taken into account.

Finally, codex size is probably not without some significance—not because larger manuscripts make it possible to align a higher number of writing lines (the distribution of divisibility is not perceptible), but because a greater page height affords the artisan more flexibility to work. Indeed, one can imagine that the scribe would have chosen the number of lines (if it were not stipulated beforehand) in the following way: first he set the order of magnitude (in relation to his script and the size of the manuscript), then he established the precise number of lines so as ensure compatibility with the line-tracing method. In such circumstances, large manuscripts offer greater flexibility than is the case with smaller ones. The fact that the extent of this flexibility is most likely not in harmony with the optimal value—given that it is easier to broaden the script and increase the distance between lines than to do the opposite—is irrelevant in this context.

***

To put this hypothesis to the test, one must have at one's disposal a collection of data that censuses a large number of manuscripts by including all the aforementioned parameters, and above all one which furnishes a 'standardised' number of lines, rather than minimum-maximum values. Albert Derolez's work on the codicology of Humanistic manuscripts[5]—a resource which remains largely underexploited—is beyond doubt the only source that draws together the requisite conditions.

The application of the foregoing defined protocol to our corpus yielded the results that are presented in Tab. 2.

4 Muzerelle 1999.
5 Derolez 1984.

Divisibility of lineation: compared to the probable norm (inverse) (tab. 2)

	Nb	Pr.	2n	3n	4n	5n	6n	7n	8n	9n	10n	11n	12n	13n	Σ/x/
Size															
Large	**388**	-1.9	1.3	1.1	1.0	1.2	1.0	1.9	1.0	2.3	1.0	1.0	1.0	**-13.3**	*29.0*
Medium	**384**	2.1	-1.0	-1.2	1.0	-1.2	-1.5	-1.1	-1.2	2.3	-1.6	1.0	-6.9	1.5	*22.6*
Small	**399**	1.1	-1.1	-1.2	-1.0	-1.1	-1.8	-1.5	-1.2	-1.0	-1.1	-1.2	**7.3**	2.8	*23.4*
Overrun lines															
0–0	**543**	-4.1	**27.5**	**7.7**	**23**	-1.1	**7.5**	-1.1	2.0	**7.3**	1.5	-1.1	5.1	1.8	***90.8***
1–0	**105**	**276**	**-60**	1.0	-3.7	-1.1	-1.1	-1.0	-3.2	1.3	1.0	-1.1	-1.0	-1.3	***353.6***
1–1	**165**	1.6	-1.7	-1.0	-1.1	-1.5	-1.0	-1.4	2.8	-1.3	1.4	-1.8	-1.1	-1.0	*18.9*
2–0	**12**	-1.1	2.4	-1.1	1.1	3.5	1.2	-1.0	1.9	-1.4	**11.5**	1.0	-1.3	-1.1	*29.8*
2–1	**8.0**	1.0	1.0	**-7.3**	1.3	-1.0	-1.7	1.5	1.0	-1.1	-1.0	1.0	-1.1	-3.0	*23.1*
2–2	**338**	1.0	-2.0	-4.2	**-14.5**	1.2	-3.3	2.0	-3.1	-5.4	-3.6	2.3	-2.0	-1.0	*45.5*
Utilisation (above/below top line)															
ATL	**452**	-1.5	6.9	3.0	**28.7**	1.0	**14.6**	-2.3	**7.2**	**17.3**	2.0	-1.2	**85**	-2.5	*173.1*
BTL	**719**	1.8	-3.0	-1.5	**-10.4**	1.0	-3.7	1.4	-2.7	-5.4	-1.2	1.0	**-18**	2.0	*53.1*
Technique															
Ink	**492**	-2.1	**12.5**	**12**	**10.6**	1.0	**19.7**	-1.0	-1.0	**7.4**	3.5	1.1	4.7	-1.1	***77.8***
Leadpoint	**75**	4.4	**-104**	1.3	**-9.0**	1.0	-2.6	-3.0	1.0	1.0	-1.1	-1.2	-1.3	1.0	***131.8***
Drypoint	**252**	3.8	-2.0	-3.4	-1.1	1.0	-1.9	-1.1	1.6	-3.0	-1.0	1.0	1.0	-1.0	*23.0*
Blind	**352**	-1.0	-1.0	-2.3	-2.3	1.0	-1.5	1.7	-1.1	-1.6	-1.9	-1.9	-2.8	1.6	*21.6*
Pricking system															
None	**676**	1.0	1.1	1.3	-1.3	1.0	1.2	-1.1	-1.0	1.0	1.4	-1.3	-1.1	1.4	*15.2*
Complete system	**278**	2.5	-5.9	-2.4	-1.8	1.1	-3.3	-1.0	1.3	-4.7	-1.1	1.3	-1.1	-1.0	*28.6*
Vertical	**185**	-2.2	1.4	2.1	3.8	1.2	1.9	1.0	-1.0	5.5	1.0	1.0	2.6	-1.3	*26.1*
Single	**35**	-1.1	3.6	-1.5	12.5	-2.9	1.0	7.8	1.0	1.1	-3.1	1.2	1.6	1.0	*39.4*

Tab. 2: Divisibility of lineation: compared to the probable norm (inverse)

An initial observation can immediately be made by looking at the raw data: the situation is far from being neutral or 'flat'. Even if many figures lie within bounds that can be ascribed to pure chance, many others denote phenomena that are clearly significant. At the same time, one can see that different lines present similar 'profiles',

which is to say that in the same columns a few lines distant one observes minimums and maximums that are comparable. This is a direct reflection of the lack of independence between techniques belonging to distinct categories—for example, ink lineation enjoys an overwhelming majority in the layout type [0-0]. Tab. 3 presents the co-occurrences observed among all the modalities.

Co-occurrence of modalities in B(ig), M(edium) and S(mall) manuscripts (tab. 3)

	Ink			Leadpoint			Drypoint			Blind		
	B	M	S	B	M	S	B	M	S	B	M	S
0–0												
ATL	45	57	56	7	9	5	1	4	3	5	7	5
BTL	57	81	116	2	4	10	2	—	1	24	18	24
1–0												
ATL	3	9	3	—	2	3	8	3	1	1	2	3
BTL	7	24	20	2	4	1	2	2	—	4	1	—
1–1												
ATL	—	—	2	1	3	5	18	20	14	12	15	14
BTL	—	2	2	—	5	4	10	10	2	13	7	6
2–0												
ATL	—	—	—	—	—	—	1	—	—	—	—	—
BTL	—	1	1	2	—	2	—	2	—	2	1	—
2–1												
ATL	—	—	—	—	—	—	2	2	—	—	—	—
BTL	—	—	—	—	—	—	—	1	1	1	—	1
2–2												
ATL	1	1	—	—	—	1	23	20	13	23	9	10
BTL	1	2	1	2	—	1	42	21	23	64	35	45

Tab. 3: Co-occurrence of modalities in B(ig), M(edium), S(mall) manuscripts

This situation is not easy to analyse, since each phenomenon observed simultaneously in two correlated lines makes it necessary to carry out further tests in order to determine which of the two techniques exerts an effect on the other.

This question immediately arises with respect to the two lines where we can see that the strongest figures gather in the same columns: the first relates to ink lineation; the second to ruling types without overrun lines ([type 0-0]). By examining, respectively, what happens in all the ink rulings and in the type [0-0] ruling types drawn by other means (it would take too long to present the relevant figures here), one can establish that it is the use of ink which is largely responsible for these gaps in the expected norm, and not vice versa.

Now, the cardinal characteristic that distinguishes ink lineation from other techniques is the fact that it is likely to have been executed using a so-called 'rake', as a certain number of specific observations show.[6] This helps us to recognise in this technique the reasons for the deviations from the expected norm.

In order to verify this assertion, it is necessary to examine the arithmetic properties which are allied to the use of a rake. These are easy to demonstrate. If the rake has an even number of tines, it will produce, in one fell stroke, an even number of lines. If its tines are of an uneven number and the lines drawn any number of times on the page, one time out of two it will produce an even number of lines. All in all, the even numbered lineations will always be in the majority, and that is precisely what we observe here.

But we can stretch our reasoning even further: if the choice between an even numbered rake and an odd numbered one is governed entirely by chance, the average share for each of the two types will be 50%, resulting in a final tally of 75% even-numbered lineations and 25% uneven. What, then, do we find in our corpus? The manuscripts ruled in ink total 492, from which we must exclude the 93 cases that correspond to a prime number, and which therefore cannot be included within the envisaged framework (we shall meet with them again in due course). Of the 399 that remain, 295 present an even-numbered lineations, and 104 an uneven one, being 73.9% and 26.1% respectively. It is hard to imagine a better match of the facts with the theory. With respect to ink rulings, one can only deduce that there was widespread and massive use of rakes in which the number of tines was not standardised.

This conclusion is not entirely unexpected: as we have already said, the use of rakes has long been demonstrated through the archaeological approach. But what one is often forced to merely suspect (in the absence of hard evidence) is now confirmed in a dramatic way. The main evidence is provided by the pricking

6 See, in particular, Gumbert 1986.

system, a single lateral pricking (System 4, according to Derolez's classification) can be considered indicative of the use of a rake. But alas, this is a rather vulnerable indicator, since it can be eliminated through trimming or is impossible for the observer to discern. Only 7.1% of manuscripts ruled in ink exhibit such pricking, but 91.7% of these lack a complete system of lateral pricking, which indisputably suggests the drawing of lines one-by-one. Analysis of the lineation reveals that the vast majority of these were ruled using a rake.

Another issue that draws our attention concerns the [1-0] ruling types. This type is characterised by a significant sparsity of even numbers. The relationship inclines necessarily in this direction, because no algorithm exists that enables us to consistently generate prime numbers, or to generate a predominance of them. Evidence for this can be seen in the huge effort mathematicians have to make to discover, by trial and error, new prime numbers for data encryption purposes. And what is true of large numbers is also true of small ones, apart from the fact that a change in scale reduces the amount of experimentation required.

The foregoing observation leads one to think that the sparsity of even numbers is, so to speak, 'accidental', and not a direct result of the multiple ruling method. All the evidence suggests that it is caused by the addition of a supplementary line—the initial overrun line—to a lineation generated through a procedure which largely produces lines in even numbers.

The use of a rake provides the most satisfactory explanation because, on the one hand, it predominantly generates even-numbered lineations (as shown), whilst on the other it can only draw lines of a consistent length, so that the overrun line must necessarily pre-exist and be added to the tally. Strictly speaking, this interpretation can only partially explain the phenomenon, since manuscripts ruled in ink only in fact represent two cases in three (39 out of 62, or 63%). However, such a proportion is perfectly adequate to ascertain the overall situation.

We can now return to the case of the manuscripts with a prime number of lines and without overrun lines, which we had previously left aside. What we have just established allows us to suppose that in actual fact these manuscripts do have an overrun line, which can we term 'an overrun line of reduced length' or a 'crypto-overrun line'—in other words, a writing line which is the same length as the others but was traced prior to the execution of the actual ruling drawn by means of a rake.

Naturally, one would be pleased to be able to furnish solid proof for these hypotheses by analysing the case of ruling types exhibiting three overrun lines—because when they are of an even number (two or four, configured as [1-1], [2-0], or [2-2]) the phenomenon does not occur. Unfortunately, the [2-1] types are

too rare (only 11 examples) to have any statistical value; furthermore, some of them are not ruled in ink.

The second major phenomenon which can be gleaned from Tab. 2 concerns the use of 'above top line' (ATL) or 'below top line' (BTL) ruling, where the distribution departs significantly from that which pure chance should allow.

Interpretation of this phenomenon is far less immediate and requires that one first establishes statistics for the correlation between the parity in lineation and its use across the overall corpus. In order to avoid needlessly complicating matters, the following table only presents figures in relation to BTL. Regarding the opposite use (i.e. ATL), it is simply the mirror image of that presented in the table.

Overall, the use of BTL predominates in the corpus viewed as a whole, and this preference is appreciably stronger in the uneven-numbered lineations compared to the even-numbered ones. However, this situation changes if one considers one-by-one the subsets corresponding to the various techniques taken into account up till now (Tab. 4).

Correlation between odd/even numbers and utilisation BTL (tab. 4)

	All	Difference in comparison to the entire group	Odd lineation	Even lineation	Odd/Even difference
Entire group	61.4%	—	65.4%	58.1%	*+ 7.3%*
Ink	64.0%	***+ 2.6%***	67.5%	61.7%	*+ 5.8%*
Leadpoint and drypoint	48.6%	***- 12.8%***	54.1%	42.7%	***+ 11.4%***
Leadpoint	52.0%	*- 9,4%*	**48.9%**	57.1%	*- 8.2%*
Drypoint	47.6%	***- 13.8%***	56.0%	39.5%	***+ 16.5%***
Blind	69.7%	*+ 8.3%*	75.0%	65.3%	*+ 9.7%*
Type 0–0	62.4%	*+ 1.0%*	66.0%	60.1%	*+ 6.0%*
Type 1–0	63.8%	*+ 2.4%*	62.9%	65.1%	*- 2.2%*
Type 1–1	37.0%	***-24.4%***	46.9%	27.4%	***+ 19.5%***
Type 2–2	70.1%	*+ 8.7%*	73.6%	66.9%	*+ 6.8%*

Tab. 4: Correlation between odd/even numbers and utilisation BTL ('below top line')

If one does not dwell on minor variations, one will more than anything notice the following phenomena become clear: the predominance of the use of BTL diminishes considerably in parallel with the two techniques that involve the ruling being drawn line-by-line, regardless of whether this is done using drypoint or leadpoint, and the tendency is even reversed, albeit very slightly, when the latter technique is employed. But the effect on the preference between uneven- and even-numbered lineation is radically different in the two cases: uneven-numbered lineation is preferred when ruling is drawn in drypoint, whereas the advantage shifts to even-numbered lineation wherever leadpoint is used.

One observes the 'echo' of this phenomenon, considerably amplified, in the [1-1] types. It would be tempting to conclude that this is due to the effect of the line-by-line techniques, which are largely predominant in this group (54%), and all the more so given that almost all of the balance (43%) is composed of blind ruling, in which a not negligible proportion (albeit indefinable) is attributable to drypoint. Nevertheless, this interpretation is contradicted by the case of the [2-2] types, where drypoint and blind ruling are also over-dominant—but in opposite proportions: 43% and 55% respectively—without producing the same effects. Therefore, it is the presence of a single overrun line at the top and the bottom of the justification which is responsible for producing this situation.

To summarise: the [1-1] type brings about an increasing scarcity of the use of BTL and its focus on uneven-numbered lineation. Thus, there exists a natural link between the two characteristics, whose mechanism, for now, remains obscure.

***

The preceding material, which we have intentionally confined to addressing only the most immediate aspects of the problem, obviously does not purport to have fully exhausted the subject matter. There is undoubtedly more to be learned through the arithmetic analysis of the number of lines in manuscript ruling, but any endeavour to do so will certainly prove to be a considerably more arduous task. All the same, this preliminary exploration should have succeeded in highlighting the utility of carrying out accurate censuses of the number of lines in manuscripts, and above all of recording the resultant observations in a useful form.

One must commend the zeal with which Jean Mallet and André Thibaut, in their *Manuscrits en écriture bénéventaine de la Bibliothèque capitulaire de Bénévent*,[7] provide meticulous details of lineation, recording variations observed on a leaf-by-leaf basis. However, one obviously should not impose a similarly

7 Mallet / Thibaut 1984 (1997[2]).

stringent model on all cataloguers. At most, one should encourage them to report their observations in a readily interpretable way, above all by abandoning the erroneous notion that a piece of information is more pertinent when it is presented in a strict numerical formula than when it is written in a discursive manner. An indication such as '48 lines, barring exceptions' is a thousand times preferable to '48-50 lines'—or even '48-72 lines', if the exception constitutes an anomaly: only collectors of oddities will feel aggrieved. In fact, if the cataloguer can take responsibility for ascertaining the figure which he deems to best coincide with reality, the statistician remains powerless when faced with a value expressed in the form of a range, whose precise extent is impossible for him to surmise. To be sure, in this regard we will have to wait for cataloguing practice to undergo a certain amount of reform—which undoubtely will take a long time at the end—before the research embarked upon here can be extended to other sectors of the codicological domain.

References

Clark, Albert Curtis (1918), *The Descent of Manuscripts*, Oxford: at the Clarendon Press [repr. in 1969, 2004].

Derolez, Albert (1984), *Codicologie des manuscrits en écriture humanistique sur parchemin*, I. *Texte*, II. *Catalogue*, Turnhout: Brepols (Bibliologia, 5–6).

Gumbert, Johan Peter (1986), 'Ruling by Rake and Board: Notes on some Late Medieval Ruling Techniques', in Ganz, Peter (ed.), *The Role of the Book in the Medieval Culture*, Turnhout: Brepols (Bibliologia, 3), 41–54.

Herrmann, Léon (1967), 'La règle des dix-huit vers et les livres XIII et XIV de Martial', in *Latomus*, 26: 1015–1020.

Mallet, Jean / Thibaut, André (1984 [1997^2]), *Manuscrits en écriture bénéventaine de la Bibliothèque capitulaire de Bénévent*, Paris: CNRS [Turnhout: Brepols 1997^2].

Muzerelle, Denis (1999), 'Pour décrire les schémas de réglure: une méthode de notation symbolique applicable aux manuscrits latins (et autres)', in *Quinio. International Journal on the History and Conservation of the Book,* 1: 123–170.

Marilena Maniaci

The 'Non-Unitary' Greek Codex: Typologies and Terminology

If we exclude—as we probably must—book production in roll format,[1] the notion of a 'unitary book' is only widely applicable and entirely free of ambiguity in the world of modern publishing: a world in which a volume containing a single text by a single author, printed in a continuous and unmodifiable sequence of consecutively sewn (or glued) leaves or quires, represents the norm. The quality of being 'unitary' is, in fact, an intrinsic and essential characteristic of a 'prepackaged' product reproduced in a series of identical copies aimed, from the outset, at an audience composed of indeterminate potential buyers. Such an audience has no direct control over the selection of content or the way in which it is arranged, and is therefore quickly destined to lose any awareness—and hence any interest—in the material peculiarities of the 'container'. The absence of such a 'functional' interaction between a book's content and the sequencing of its quires—which was a fundamental characteristic of the manuscript volume's structure—firmly establishes, with only a few exceptions, the cohesion and immutability of the textual sequence, and therefore the impossibility on the part of the readers to carry out personal modifications (e.g. deletions of, and/or adjuncts to, the book's structure, or its sequential rearrangement) subsequent to their acquisition of it.[2]

Translated from the Italian into English by Mark Livesey. Original published as Maniaci, Marilena (2004), 'Il codice greco "non unitario". Tipologie e terminologia', in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni*. Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino (= *Segno e testo*, 2), 75–107.

1 Even if not always in relation to its content, because of its particular structure, a 'book' in roll form is always, by its very nature, 'unitary', in the sense that no examples appear to exist of rolls composed of multiple parts that were originally conceived of as autonomous 'segments' which were later on spliced together to form a continuous and unbroken sequence.

2 This characteristic, which represents a radically new situation with respect to the manuscript book, cannot be attributed to purely technical issues: after all, it has been noted that late medieval readers and librarians widely employed (in printed books as well) the technique of 'bundling together' in loose successions editions of different dates and origins, and that they did not hesitate to combine in one and the same book both printed and handwritten quires

https://doi.org/10.1515/9783110743838-010

Conversely, the manuscript codex has—by its very nature as a unique, individually handcrafted, 'custom-made' object—the potential to be 'non-unitary'. Its 'non-crystallised' content and a natural tendency towards a modular structure endows it with a high degree of 'flexibility'. It is therefore somewhat surprising that, up until now, very little attention (with a few exceptions) has been paid to these two characteristics which constitute, throughout the Middle Ages, a fundamental feature of the codex. This scant level of attention is made all the more evident by the vagueness and overall confusion that prevails in the use of specific terminology, and the obvious inadequacy of the majority of codicological descriptions provided in catalogues, including those produced in recent times and in accordance with modern rules.[3]

It seems appropriate to preface the following series of observations on the overall characteristics of the Byzantine 'non-unitary' manuscript with some theoretical insights vis-à-vis the basic concept of a 'non-unitary' codex. (These remarks and observations are intended as a contribution to the shared effort to systematise matters, which the *Il codice miscellaneo* conference bears ample testimony to.)[4]

My first observation concerns the meaning—or rather, meanings—which can be attached to the term 'non-unitary'. In fact, the 'non-unitary' nature of a codex can be assessed on two different levels:

– The *material* level, concerning the 'structural units' which combine to form a codex and the various ways in which such units are assembled (structural

(this could be one of the reasons that made it possible for printers, in contrast to today's practice, to print editions composed of only one or two quires).

3 The following contributions (listed in chronological order) form part of the essential bibliography specifically dedicated to this theme (excluding references that are occasionally met with in works containing other material): Thorndike 1946; Robinson 1980; Hanna 1986; Kienhorst 1996 (which the present author was unable to consult); Munk Olsen 1998; Gumbert 1999, and Kwakkel 2002. Only subsequent to drafting the present contribution did I become aware of Nichols / Wenzel (eds) 1996, in which see, in particular, Shailor 1996, and Kienhorst 2002 [2003].

4 I refer, above all, to Gumbert 2004, a bountiful contribution which picks up on and examines in greater depth some food for thought presented in a previous essay (Gumbert 1999, referred to in the foregoing note), and on other occasions (Gumbert 1989). I also refer to some observations presented in the work by Muzerelle / Ornato 2004 [in this volume, 377–412]. The ideas developed in both essays, regardless of their independent origins, which makes them difficult to place within a common framework, contain significant concordant elements. A contribution to the description of the miscellaneous codex in Latin script (to be understood as 'a codex containing more than one text', without additional qualifications) can also be found in Cartelli / Palma / Ruggiero 2004. Despite being essentially palaeographical in nature, also of interest in relation to the material characteristics of codices is Bianconi 2004.

units may be 'codicological units', 'booklets', 'production units' and 'usage units', all of which are similar entities, but which at the same time do not fully coincide, partly due to the difficulty of defining their exact significance in a stringent way).[5]

5 Here, it may be helpful to the reader to make an attempt at briefly summarising the meanings of the various terms, even if they are not all defined with equal clarity within the relevant bibliographies: 'codicological unit' = 'volume, parte di volume o insieme di volumi la cui esecuzione può essere considerata come un'operazione unica, realizzata nelle stesse condizioni di tecnica, di luogo e di tempo' (Maniaci 1996 [1998[2]], which picks up on Muzerelle 1985; 'codicological element' = 'l'unité la plus petite qui ait pu mener une existence indépendante dans la mesure où la fin d'un texte coïncide avec la fin d'un cahier' (Munk Olsen 1998, 105). On p. 108 one can find the following clarification: 'même si l'unité codicologique et l'élément codicologique coïncident souvent, celle-là est plus vaste que celui-ci'); 'booklet' = 'a small but structurally independent production containing a single work or a number of short works' (Robinson 1980, 46). This definition is followed by a series of helpful pointers on how to identify a 'booklet', which can be composed of one or more quires and can be of different dimensions and structural forms, and can also bear scripts and decorative elements different from the rest of the codex it forms a part of. A 'booklet' is often endowed with independent quire signatures or catchwords and concludes with a quire of anomalous composition. A 'booklet' can also show signs of previous independent circulation, such as soiled or faded/discoloured outer leaves; 'production unit' = 'group(s) of quires that formed a material unity at the time of production [...] copied 'in one go', by either one or more scribes' (Kwakkel 2002, 13–14; the author underscores an affinity with the definition of a 'booklet', albeit making it clear that while the latter is of limited thickness, a 'production unit' has no limit to its bulk and can even represent an entire codex); and finally, 'usage units' = 'an abstract notion that refers to the manner in which a production unit was used: separately or bound together with other production units' (Kwakkel 2002, 14, further specifying that 'a group of quires <that> form a production unit are also part of a particular usage unit'). All the definitions provided are intended to address the need to distinguish, within a codex or portion of a codex that was planned to be unitary (i.e. a 'codicological unit' in its traditionally accepted sense), quires or coherent sequences of quires that are structurally independent. In contrast to the 'codicological element' (which I do not believe is automatically comparable–as Gumbert 2004, 25 seems to contend–to the 'codicological unit' and the 'production unit'), the 'booklet' is characterised by greater textual autonomy and a more marked propensity towards independent circulation. Establishing the degree of collaterality between the notions of (a) 'codicological unit' and (b) 'usage unit' is, to my mind, more difficult, since these tend to be equivalent to each other in cases where multiple 'production units' were originally conceived of to be combined (sooner or later) to form a single volume, but not in cases where 'usage units' composed of multiple 'production units' were created using different techniques in different places at different times. As will become apparent, the specific nuances of meaning carried by each of the terms make it impossible to establish clear parallels between them. As regards the 'meeting points' between concepts and terms suggested later on in this contribution and the copious, well-formulated terminology proposed by J.P. Gumbert, I shall confine myself to referring back to the material found in the notes accompanying his contribution.

– The *content* level, where the notion of 'non-unitary' is characterised by multiple gradations—frequently perceived of and described in incorrect, or at least inadequate, ways—both among 'mono-textual' and multi-textual' codices.

With regard to the script—which should naturally suggest a third approach to examining the 'non-unitary' codex, quite distinct from the two listed above—clearly, the simultaneous presence of different scribes' hands has to be regarded as a factor that is far from irrelevant to the creation of a codex, but at the same time one which does not represent, within the framework of the subject presently under examination, an operative criterion, inasmuch as it is compatible with the entire spectrum of possible situations (ranging from the alternation of different scribes working on a 'unitary' codex, to the merging of units originating from different or independent projects). The interaction of the script with a volume's material structure and its content must therefore be assessed on a case-by-case basis, and does not constitute, within the framework of a codicological investigation, a fundamentally and systematically relevant variable.[6]

The two levels—materiality and content—interact in complex ways which cannot easily be reconciled with universally valid interpretative frameworks, as demonstrated by the highly variegated nature of the available documentary evidence. However, these interactions can be evaluated not only on a case-by case-basis, but also in terms of overall trends, frequency of occurrence and degrees of cohesion, and therefore the underlying extent of planning.

From the material point of view, the 'non-unitary' codex always represents the final product of an operation that we can define as an *assemblage*, which is to say the result of the merging into one entity of a unique sequence of multiple groups—or *blocks*—of quires. Irrespective of the fact that these *blocks* were conceived of from the outset with the intention of uniting them into a single aggregation,[7] the necessary prerequisite in order to adjudge a volume as being materially 'non-unitary' is that the quires or groups of quires that compose such

6 This is not in any way intended to diminish the value of a specific study of what have been defined as 'miscellaneous hands' (Bianconi 2004, 315), whose motivation and working dynamics are very effectively summarised in Cavallo 2001. Needless to say, whenever a change of writing hand is associated with the appearance of a new text and/or quire, this can represent a valuable 'clue' for the analysis, but at the same time can also simply be the result of the collaboration of multiple scribes alternating during a volume's production, and therefore does not constitute, *ipso facto*, a determining factor in the present discussion.

7 This is something that cannot always be established with absolute certainty, as it will be shown later in this article.

blocks be arranged in a series of textually autonomous, *modular units*. A *modular unit*—which in essence corresponds to the *élément codicologique* of Birger Munk Olsen[8]—is a quire or group of quires that opens with the beginning of a text or a clearly defined textual partition, even if it is not necessarily an autonomous one (such as an individual biblical book), and concludes, likewise, with the end of a text (although not necessarily the same one), or with one of its internal partitions.[9] The caesura between individual *modular units*, which is often visually highlighted by the presence of one or more quires of different thickness (i.e. number of leaves) in comparison to the others, can persuasively be identified by the term *junction* (Italian: *snodo*).[10]

Meanwhile, an *assemblage* can be observed as the visible product of several distinct processes (which may have accumulated during the production of a single volume). These processes include:

– *Accretion,* in cases where single quires or groups of autonomous quires have been transcribed separately by one or more scribes—possibly on the impulse of an 'inspirer' or 'coordinator'—in multiple, more or less contem-

8 See footnote 5, above.

9 In truth, the question as to whether or not the 'textual completeness' criterion (which is to say the possibility of identifying this element by using a concise term that neatly summarises a work's content) is sufficient for the purpose of defining a *modular unit* ought to be examined in greater depth. The answer to this question depends on the exact definition of the term *modular unit*, which may or may not subsume the concept of *interchangeability*. For example, three quires in succession which start with the 4th canto of the Iliad and conclude with the end of the 6th canto of the same work present as a synthetically definable *modular unit,* but form part of a textual sequence that cannot be altered. In other cases, the *modular unit* is textually and codicologically autonomous, but was not *planned* to be this way if the quires bear a (quire) signature (a strictly coeval one, needless to say), or if the preceding and successive quires bear a catchword. It is therefore necessary to distinguish between codicological autonomy and textual autonomy, and in the latter case between 'virtual' autonomy (in theory the sequence of elements is 'open', but in actual fact is as good as pre-established during the planning stage), and 'real' autonomy (where users of the volume are afforded the possibility of shuffling the order of the texts). On the other hand, autonomy can be understood as exclusively 'internal' (i.e. interchangeability is limited to being *intra codicem),* or sometimes 'external' (i.e. when interchangeability means *inter codices*). Defining these criteria is not an entirely superfluous task, but instead represents a valuable tool to assist in reconstructing the 'genetic dynamics' of a book.

10 *Snodo* is a term that I have previously introduced and defined in Maniaci 2000, 54 [in this volume, 35–63]. It is the same phenomenon for which Peter Gumbert coined the term 'caesura' (Gumbert 2004, 24, although the same term had already been employed in Gumbert 1989). The phenomenon is referred to by Frank Bischoff as a 'Lagenbruch' (Bischoff 1994). It seems to me that the term 'junction' more aptly describes the interruption in continuity between two blocks, not only in terms of a 'breakage' but also in the sense of an 'intersection'.

poraneous stages, or alternatively when quires were transcribed over time, with the original intention of combining them and ultimately binding them together to form a single volume.

– *Convergence*, when single pre-existing quires or groups of quires, both contemporary or produced at different times, pre-existing quires, and having different origins (perhaps even previously inserted within other structure) are merged to form a new volume on the initiative of a user or librarian. In these instances, we can further distinguish between:
– *Functional convergence*, if the merging of the quires was made on the basis of a clearly identifiable, or alternatively, presumptive logical criterion, already during the Middle Ages.
– *Practical convergence*, if the merging took place without the application of any specific criteria and was carried out simply to preserve the relevant material in the post-medieval period.

Here, it should be pointed out that *assemblages* of modular units are not all attributable to *accretion* and *convergence* phenomena. In other words, modularity does not necessarily only correspond to a specific aim, but can also represent the spontaneous result of a specific transcription method, which is to say a *distributed copying* process aimed at achieving an efficient division of labour amongst multiple scribes working contemporaneously. In this instance, one can speak of *concomitance*.

Looking beyond specific contexts such as the Latin *pecia* system,[11] it is difficult to attribute the result of a *concomitant* transcription project purely to the desire to organise labour in an efficient way. One has only to recall the case of many of the Latin 'Atlantic' Bibles which, even if they are characterised by an obvious unitariness in their planning (inasmuch as the individual *modular units* were destined from the outset to be merged into a single volume), present a material configuration that consists of blocks of quires that correspond to definite textual sequences whose precise purpose can probably be ascribed to the

11 Here, it is perhaps not entirely pointless to emphasise that the *pecia* system was based on the preparation of structurally unitary *exemplaria* (given that individual binions do not coincide with the subdivision of the text and are not necessarily configured as modular units), which in turn result in perfectly unitary apographs (in theory, at least). Therefore, we are dealing with a purely material modularity 'of convenience', and hence one which is completely different from the modularity that characterises the 'non-unitary' manuscript.

simultaneous presence of multiple motivations, the interrelationships of which have yet to be determined with greater clarity.[12]

Finally, additional *assemblage* processes can be placed within the sphere of preservation and 'restoration' activities: for example, a tattered or lacunae-riddled codex might have been completed by adding substitute, purpose-made quires or, more rarely, pre-existing ones. These instances—which can be referred to by the technical term *reintegration*—do not consist in 'constructing' a new volume or even in completing an already existing one, but rather in reinstating an existing volume's (or series of volumes') integrity.

Convergence is usually quite easy to recognise, inasmuch as it often results in considerable negative consequences for the aesthetic quality of a volume; indeed, only rarely (above all in parchment codices) do the dimensions of sheets match up sufficiently well so as to avoid the need for unsightly trimming. Similarly, it only seldom happens that dimensions match well and that the layout and script are free from obvious irregularities.

By contrast, *accretion* and, above all, *concomitance* can intentionally be hidden, even if surviving codices clearly demonstrate that concern for this issue was not as great for medieval artisans as it is for us in modern times. Thus, in parchment codices, where there was a tendency to avoid waste, modularity often involved variations in the 'normal' quire structure, not infrequently accompanied by, in the case of *concomitance*, simultaneous changes of scribes' hands, and therefore irregularities in the transcriptional flow (e.g. variations in the rate of abbreviations, drafting or 'compression' of the script, and oscillations in the number of lines, or other components of the *mise en page*). In the paper codex, because of the lower cost of the raw material, the 'normal' quire structure tends to be maintained, with the result that empty leaves are often found at the end of the final quire in a *modular unit*. Such empty leaves were often quite rapidly occupied by *microtexts* of various kinds that were inserted in the blank spaces in order to fill them.

If confined to the 'archaeology' of the codex, the strict dichotomy suggested by the terms 'unitariness' and 'non-unitariness' can in any event be split into an

12 In any event, it would be excessively reductive to attribute the Atlantic Bibles' 'articulated' structure purely to the necessity to create rational subdivisions so as to distribute transcription tasks among multiple scribes working simultaneously. The legacy of a tradition accustomed to viewing the Bible as the sum of independent parts rather than as a unified whole; the availability of different models to base individual sections on; and the desire to facilitate (even if only to a limited extent) the 'decomposition' and 'recomposition' of the textual sequence in relation to specific requirements, could all have played their respective roles: roles which are now difficult to determine with any degree of certainly. See Maniaci 2000, 57 [in this volume, 35–63].

array of tangible possibilities. However, drawing a correct and precise distinction between these represents an essential prerequisite, regardless of whether one's aim is to carry out a descriptive task or alternatively to reconstruct the 'genesis' of individual items, with related operative and functional implications, or implications of a cultural nature in the broader sense. (I do not believe that the two contrasting points of view should be seen in opposition, but rather as being complementary to each other.) The situation is further complicated whenever the antinomy 'unitary' codex / 'non-unitary' codex is applied not to a volume's structure, but instead to its content.

It is only natural to consider the 'mono-textual' codex as an example of 'unitariness' *par excellence*. The classic model of a 'mono-textual' codex is, of course, one which contains a single work by a single author, but the definition can be extended to manuscripts that contain one or more internal partitions within one and the same work—in other words, one or more *textual units* that have the quality of seeming textually complete and whose separate circulation is deemed acceptable (e.g. a complete edition of the *Odyssey*, a sequence of its constituent books, or even a single book). The most representative example of this phenomenon is, of course, the coupling of the sequence of writings composing the Old and New Testaments. Indeed, based on the criterion set out above, a codex containing the entire Bible would clearly have to be termed 'mono-textual', just like one that contains a single book of the Bible (a classic case being the Psalms), or a specific sequence of books, such as the Octateuch or Prophets.

Quite distinct from codices that are purely 'mono-textual' (but which at any rate are similar to these), are volumes that, despite containing multiple independent texts, share a 'unitariness' in terms of authorship which is normally associated with a 'unitariness' of genre (e.g. the Tragedies of Aeschylus, Plato's *Dialogues*, etc., but also a combination of theological treatises and homilies of Basil the Great or Gregory of Nazianzus).

Conversely, the association of multiple works or multiple textual units by different authors gives rise to a *multi-textual* codex, which can be identified by the following key requisites:

1. The individual units that make up the codex do not form part of the same work, nor is it composed of different works by the same author.
2. The sequence in which the units are arranged is not indispensable to understanding the text, and can therefore be altered without resulting in any serious consequences with regard to the text's proper use.

In cases where textual units are particularly slim, which is to say ones that are materially underdeveloped, recourse to the *multi-textual* codex can be seen as a necessity in order to permit the transmission of units which on their own could not constitute an autonomous codex. The 'automatic' reaction to the apparent contradiction between codex thickness and text length consists in putting together in one and the same volume two or more textual units in order to reach a minimum thickness threshold (or *overall thickness*), which then makes it acceptable to produce an independent volume. The threshold—both on an individual basis and systematically—varies over time and in relation to the dimensions of volumes (this point will be further addressed later on when examples will be given).[13] This approach has often been the 'default' method employed by librarians in modern times, who in this way have indiscriminately assembled entire codices, incomplete texts, and even mere fragments, thereby creating *jumbled composite* or *incoherent multi-textual sequences*.

However, in the historical period when the codex had an intrinsic value to its users, and hence its content was conditioned by readers' needs, the aforementioned purely 'automatic' approach represents an exception. Instead, the tendency was to favour the production of *organised multi-textual sequences* or *semi-organised multi-textual sequences*—in other words, textual juxtapositions inspired by some logical principle or another (which remains more or less evident and comprehensible even many centuries later).

When one and the same sequence of textual units 'crystallises' and is reproduced in identical form over a period of time, we can speak of a corpus, or *sylloge* (although the use of the latter term should be limited in order to avoid confusion).[14] Here, the term *sylloge* can be defined as an arrangement of intellectually and 'genetically' independent textual units which are more or less firmly canonised in the manuscript tradition, and sometimes identified by a title explicitly inscribed in the actual volumes, or simply codified by oral use (e.g. anthologies of epigrams, series of 'thematic' orations, compilations of legal rights, etc.).

Within the framework of the set of problems presently being addressed, it is very important to differentiate between *sylloges* and *multi-textual sequences*, be they *fragmentary* or *organised* or *semi-organised* (i.e. collections/compilations of

13 See below.

14 In fact, it is important to clearly distinguish, both conceptually and terminologically, between the 'bundling together' of *complete* texts by one or more authors in one and same volume, and the compilation of *excerpta*, which is also known as a *sylloge* (see, for example, Odorico 1990), which I would prefer to define as a 'compendium'.

rhetorical, grammatical or medical texts, etc., or lives of the saints, epistolary works, collections of apophthegms, etc.) in the form of improvised and variable juxtapositions of textual units which, being more or less loosely related, but in any event not sufficiently so to engender—intentionally, at least—a new and enduring tradition (such as a textual typology, or the tastes/needs of a particular milieu or circle of cultured readers, or even the personal interests of a specific learned figure).

The *sylloge* is rather more difficult to qualify with respect to the concepts of *work* or 'mono-textual' codex. In the first place, here it should be reiterated that the internal segments of a work of unitary conception, such as the aforementioned books of Homer (even if they can be transcribed separately and could potentially become part of a *sylloge*) do not constitute, when taken as a whole, the elements of the *sylloge,* inasmuch as they have never enjoyed a fully independent existence. The same applies:

– To textual units that can be defined as *open*, such as chronicles—which are often subject to one or more continuations (which almost always, in the manuscript tradition, end up being incorporated in the antecedent text without interruption).
– To so-called *satellite* texts (i.e. indexes, prefaces, brief introductory biographies, etc.) which, despite not being 'genetically' coeval with the 'planet' they relate to, enjoy only an—as it were—'reflected' existence and circulation.

The juxtaposition of *open* textual units and their continuations, or that of 'planets' and their 'satellites', does not in actual fact generate truly *multi-textual* sequences.

A particular case concerns textual commentaries, which it seems logical to regard as being an integral part of a 'mono-textual' codex when they coexist on the same page as the text to which they refer in the form of a gloss, irrespective of its layout (i.e. as an interlinear gloss or one framing the principal text). The situation is different with respect to commentaries attributable to specific authors, which may have a materially autonomous tradition, or could possibly be associated with the text in the form of a separate textual unit, hence in *multi-textual* contexts.

The above being said, a *sylloge* (which is marked by varying degrees of internal organisation) can be characterised, on a strictly typological level, according to its 'genetic' features. This gives rise to the following instances:

– An *original sylloge*: when a series of 'excessively' slim textual units (i.e. epistles, homilies, epigrams, fables, eclogues, etc.), which were not envis-

aged to be grouped together in an intentionally unitary scheme, are collected, placed in order and disseminated by the author himself or by his circle, and thereafter perpetuated in an almost unchanged form.

– A *sylloge of erudition*: when a series of textual units that have already been circulated separately within the tradition (but not independently as autonomous units) is intentionally collected, arranged in order and disseminated by a learned figure (or circle) on the basis of one or more common denominators that ensure the cohesion (of author, themes, literary genre, study or reading interest) and various other criteria that justify the chosen order (chronological sequence, pericope, etc.). Such *syllogai* were also meant to fulfil specific ends (liturgical services, religious devotion, teaching etc.).
– A *sylloge of transmission:* when a series of textual units that are already circulating independently of each other are for the first time juxtaposed in a codex for reasons of mere convenience (in other words, without the application of any predetermined cultural criteria), and are subsequently transmitted in exactly the same way purely on account of inertia (i.e. the lack of sufficient material or intellectual impetus to give rise to the creation of a more satisfactory alternative).

To the first two categories of *sylloge* (*original* and *of erudition*), we can attach the interdependent notions of *pertinence* and *stability*. The *repletion* of a *sylloge* depends on the strength and cogency of the (internal and external) criteria that determine its fundamental cohesion and justify the chosen order of its content. The notion of *stability* has to do with the quantity and sequencing of the textual units merged into a *sylloge*: this will be at its maximum when the various writings in a given *sylloge* occupy the same number of textual units arranged in the same order.

With regard to the relationship between the concept of a *sylloge* and that of *work* (and of 'mono-textual' codex), original *sullogai* can unquestionably be likened to individual works, since their component textual units have never enjoyed independent dissemination, or at least independent 'publication'.

The situation becomes more complicated as far as *syllogai of erudition* and *syllogai of transmission* are concerned. In particular, the identification of a *sylloge of erudition* cannot be based on a purely codicological criterion: perception of its textual units as an inseparable whole that cannot be modified does not necessarily presuppose the materially unitary nature of a codex, quite apart from the fact that even a simple *improvised multi-textual sequence* can sometimes be the result of the direct copying, into a materially unique object, of individual textual units drawn from different codices. In the absence of information

that cannot be reduced to a simple enumeration of texts and their sequence within a codex, the only realistic possibility is to apply a statistical criterion, namely positive ascertainment that the tradition records a certain number of copies containing exactly the same arrangement of texts. However, boundaries in the world of statistics are always somewhat blurred—indeed, what is actually meant by 'a certain number'? In the strict sense, one can only speak of a *sylloge* when at least two *multi-textual* (and normally, though not *necessarily*, 'unitary') codices exist that present sufficiently similar textual sequences—in terms of type, number and order of the texts—so as to be able to exclude the possibility of chance convergences. This definition of a sylloge is technically satisfactory on condition it is accompanied by accurate and detailed historical and philological analyses.[15]

Finally, the dynamic implication inherent to the concept of *sylloge* should be stressed here. An extemporaneous collection can, in fact, be transformed into a *sylloge* if the personality behind its creation is sufficiently authoritative on the intellectual plane and has at his/her disposal a library, or is in charge of an institution capable of functioning as a dissemination hub. A *sylloge of transmission* can be transformed into a *sylloge of erudition* if it is purposefully introduced into a study and teaching circle, perhaps then becoming the object of glosses and added commentaries. In turn, *syllogai of erudition* can be compared to living organisms—indeed, they can continue to develop when further textual units are added, subsequent to new discoveries or the acquisition of new texts, or if new demands emerge. Conversely, they can 'die' if the texts they are composed of cease to be relevant to the 'active' interests of a particular community or intellectual circle. Additionally, they can become 'fossilised' as a result of the tradition's intrinsic mechanisms.

The tentative effort made to keep the two levels (i.e. material and textual) separate from one another during the analysis of the pairing 'unitary' codex / 'non-unitary' codex is the reason why all references to the current Italian terminology have deliberately been avoided up to this point. Indeed, it seems to me that the Italian terminology is even more inadequate and misleading than I judged it to be a few years ago, when I was working on the Italian version of Denis Muzerelle's *Vocabulaire codicologique*.[16]

---

15 In any event, it is clear that for the purposes of defining a sylloge the co-presence of four textual units in two almost contemporary copies originating from the same production centre is not as compelling as the co-presence of fifteen textual units in numerous copies transcribed over an extended period of time in places or contexts distant from each other.

16 Muzerelle 1985; Maniaci 1996 (1998[2]).

The problematic ambiguity arises from the fact that the lexicon currently employed implicitly codifies a double juxtaposition between the terms 'unitary' and 'miscellaneous' (in reference to content) and 'unitary' and 'composite' (in reference to the physical structure of codices, and specifically to their subdivision into independent, juxtaposed units). Instead of helping to fully define, from two complementary viewpoints, one and the same thing, the two attributes 'miscellaneous' and 'composite' are mistakenly perceived of as opposites (i.e. a codex is *either* 'miscellaneous' *or* 'composite'). Further confusion arises due to the lack of a clear correspondence between the Italian terminology and terminologies established in various other languages, including Latin, in which the term *miscellaneous* is applied (in the catalogues of Greek codices held in the Vatican Library's collections, for example) to volumes traditionally described in Italian as 'factitious composites' (*compositi fattizi*, *jumbled composites*).[17]

Only a simultaneous examination of the two levels—material and textual—will lead to the development of a nomenclature that satisfactorily takes their interrelationship into account. A complete and fully fit for purpose terminology—which would be premature to propose in the present context[18]—should take into account, as far as the *mono-textual* codex is concerned, the following possibilities:

– A *mono-textual, mono-block* codex, unitary both from a material and structural point of view. This represents the least complicated situation, and equates to the transcription of mono-textual content (a complete work, portion of a work, group of works by the same author, or sylloge) in a single codicological unit, conceived of from the outset in such a way so as to make subsequent dismantling and reassembly in sequences different from the original impossible, or at any rate not without causing irreversible damage to the original structure of the volume (i.e. dismemberment of quires that were originally all of the same composition and complete).
– A *mono-textual, multi-block* codex, that is a structurally 'non-unitary', *mono-textual* codex, which is to say one that is composed of 'adjustable' units which have the potential to be reassembled into forms different from the original (in response to the later emergence of new, collective or indi-

17 Maniaci 1996 (1998[2]), 76.

18 The terms employed here–which are aimed at achieving conceptual clarity rather than linguistic elegance–have the sole objective of presenting the fruits of a first attempt at the conceptual organisation of a set of problems that requires further, in-depth reflection before it will be possible to 'crystallise' matters on a terminological level (see, in relation to the danger of an excessively hasty definition of phenomena based on a still unclear scientific picture, the remarks made in the *Introduzione* to Maniaci 1996 [1998[2]], 16).

vidual, cultural needs). From a 'genetic' perspective, this typology can in turn correspond to two distinct situations:

– A *mono-textual, multi-block synchronic* codex, consisting of a juxtaposition of independent codicological elements (i.e. *blocks*), which were distinct from each other from the moment of their creation, both on account of a respect for a pre-existing tradition and as a result of the application of specific practices regarding the division of labour and/or in anticipation of other uses (such as in the case of pre-12th-century Latin Evangelaries, in which each of the four Gospels are perceived of as separate units,[19] and, likewise, in the case of the aforementioned Atlantic Bibles).[20]
– A *mono-textual, multi-block diachronic* codex, which presents in the form of a sylloge whose circulation is attested to within the tradition (also in partial forms). Such volumes could be expanded through the successive addition of fresh elements (e.g. in the case of corpora of philosophical, theological, homilary and literary writings etc., by one and the same author).

In the case of a *multi-textual* codex, the following instances have to be considered:

– A *multi-textual, mono-block* codex: unitary, from a structural standpoint, in which a succession of texts is housed within a single, coalescent container, without any intentional correspondence between the ends of individual texts (or portions of the same) and the ends of quires, thereby making it impossible to alter the original sequence, if not at the cost of causing irreversible changes to the volume's original structure.[21]
– A *multi-textual, multi-block* codex: non-unitary, from a structural standpoint, composed of a juxtaposition of *modular units* that are materially independent and textually autonomous (codicological units; 'elements', each of which corresponds to one or more coherent units of text; booklets which have enjoyed independent circulation from the time of their original production).

In turn, the *multi-textual, multi-block* category includes a host of other possible situations which, in order to be accurately defined, have to be broken down by drawing further distinctions.

19 See Bischoff 1994, *passim*.

20 Possible (and I would say highly likely) evidence of similar practices in the Byzantine sphere has yet to be investigated.

21 This typology is commonly identified by the current Italian terminology as a *miscellaneous volume*, or *miscellany*: Maniaci 1996 (1998[2]), 211.

The first distinction concerns the presence (or absence) of an underlying plan which unfortunately is not always recognisable after-the-fact) behind what we have defined as the *assemblage* (by means of *accretion* or *convergence*) of individual parts. Accordingly, we have:

– *Organised multi-textual, multi-block* codices (whose governing logic and degrees of internal organisation have to be evaluated in separate steps), which the current glossary/lexicon, in an apparent contradiction of terms, would have us define as 'unitary composites', although in fact it would be preferable to define them as *planned composites*.
– *Random multi-textual, multi-block* codices, generated by purely external needs and conservation objectives. Otherwise referred to as *random composites*.

Upon closer inspection, a similar distinction—based on the 'underlying plan' criterion—could be extended to the *multi-textual, multi-block* codex, even if such volumes generally tend to exhibit a certain degree of organisation of their content, on condition they are not merely the 'automatic' result of the copying of a *random multi-block* antigraph.

On the other hand, it should be emphasised that—contrary to what one might expect—the difference between *multi-textual, mono-block* codices and *organised multi-textual, multi-block* codices has no discriminating value, if the goal is to analyse the general tendencies lying behind the association of the texts, as determined by their quality, quantity, or position in the sequence, and defined by the scribes or by their commissioning clients. Needless to say, the histories of individual *organised multi-textual, multi-block* codices are another matter altogether: for these, only individual detailed analyses—inseparable from a specific knowledge of the historical figures and cultural contexts that each witness is rooted in—opens the way to understanding the original driving force behind their planning and development, and the working methods employed in their design and preparation.[22]

Another distinction stems from the fact that the formation of a *multi-textual, multi-block* codex is not necessarily always the product of work carried out at a fixed point in time. In fact, it can sometimes be the case that a particular juxtaposition of texts and structural units reaches its definitive form by means of a process of 'stratification' occurring over an extended period of time (ranging from a few months to many years), but this does not mean that such a juxtaposition is ascribable purely to chance. In the case of this phenomenon, then, one

22 See, for example Bianconi 2004.

can speak of a *stratified (or cumulative) multi-textual, multi-block* codex (*random* or *organised*). Such a cumbersome definition corresponds to a highly varied and rather fuzzy 'category of convenience', and is therefore emblematic of the complex phenomenology of the 'non-unitary' codex.

Here, it is not superfluous to point out to the reader that the distinctions made, despite being useful as a general frame of reference, fall far short of exhausting the entire range of possibilities which have been documented, especially when one considers the fact that an originally *mono-* or *multi-textual* codex can be the product of an accumulation of multiple, concomitant circumstances.

Finally, in order to complete our review of the 'desired' terminology, it only remains to touch on an issue that will be revisited in the second part of this contribution, namely the characterisation of the 'non-unitary' codex from the standpoint of the texts it contains, both in terms of their organic arrangement (i.e. homogeneity/heterogeneity), and of what we could call the *index of multi-textuality* (i.e. the number and lengths).[23]

The complexity of the picture which has emerged above could easily lead one to conclude that any hypothetical approach to the 'non-unitary' codex based on descriptions provided in catalogues would in all likelihood be a futile endeavour, given that such descriptions do not remotely furnish, in a clear, exhaustive and, above all, systematic way the requisite information on the relationship between the 'physical book' and the 'intellectual book'.[24]

Despite the fact that, in general, the information found in them is fairly scant and rather heterogeneous in terms of quantity and quality, catalogues nevertheless remain—given the impossibility of directly examining, in detail, the structure and content of meaningfully large samples of codices—the only available resource that makes it possible to attempt a first broad approach to attaining a better understanding the physiognomy of the Byzantine 'non-unitary' codex. Necessarily richer in useful data as regards the associations of texts found in codices, catalogues also provide the basis, albeit not an optimal one, to assemble some observations on the material structure of the 'non-unitary' codex.

The following observations are based on a systematic perusal of a large part of the modern catalogues of Byzantine manuscripts held in the Vatican Library (totalling approximately 1,500 shelfmarks), which made it possible to compile a

23 The issue is amply addressed, in respect to the Latin codex, in Muzerelle / Ornato 2004, 61 ff. [in this volume, 377–412].

24 Gumbert 1999, 27.

database of some 1,435 items (excepting post 16th-century codices and a certain number of difficult-to-define cases).[25]

Besides essential chronological data (i.e. the dating of the entire codex or of its constituent parts, either to a specific century, or sometimes straddling two successive centuries) and basic codicological data (i.e. support type, number of leaves, prevailing quire structure, total dimensions, layout and number of lines), for each 'non-unitary' codex the following details were recorded: the number of texts contained in the volume; the length (in number of leaves) and the position of each of these in the sequence (limited to the first five texts); and the total number of 'brief' texts, i.e. (according to established conventions) texts composed of fewer than five leaves.[26]

The trickiest operation—and one which unfortunately is subject to a wide margin of uncertainty—consisted in the classification of codices into three groups, namely *unitary* codices; *multi-textual, mono-block* codices (so-called *miscellaneous* codices); and *multi-textual, multi-block* codices (so-called *composite* codices). Given the impossibility of carrying out a direct verification of all the individual codices, it cannot be excluded—indeed, it is altogether likely—that both the *mono-textual* and *multi-textual, mono-block* categories contain, from a strictly material point of view, an indeterminate number of 'non-unitary' volumes. Even more complex, and only partially inferable from catalogue descriptions, was the identification, within the *multi-textual, multi-block* codex category (without question the most varied) of the various documented phenomena, ranging from the aggregation of multiple blocks transcribed by one or more copyists that were intended from the outset to form part of a single volume, to the merging of coeval (or almost coeval) originally autonomous codicological units (produced by one or more hand); and from the stratification of elements dating from different epochs on an original 'core', to the artificial 'compaction' of codices or fragments of codices of different origins. Accordingly, this category was (provisionally) excluded from the

25 The following, in chronological order of publication, are the catalogues that were found to be usable: Mercati / Franchi de' Cavalieri 1923 [329 mss]; Franchi de' Cavalieri 1927 [27 mss]; Devreesse 1950 [263 mss]; Giannelli 1950 [199 mss]; Capocci 1958 [163 mss]; Giannelli / Canart 1961 [61 mss]; Canart 1966 [14 mss]; Canart 1970 [218 mss]; Lilla 1985 [93 mss]; Schreiner 1988 [66 mss]; Mogenet / Leroy / Canart 1989 [118 mss].

26 Clearly, the 'five leaves' represent an approximation, since, given the variations in format and page utilisation, they can potentially bear a highly variable amount of text. In any event, one is dealing with texts that can safely be defined as 'brief'.

study, thus limiting it—for now—to volumes characterised in catalogues as *mono-block*.[27]

As has already been stressed, the 'non-unitary' manuscript is clearly a complex product in which needs and motivations of an intellectual nature have inevitably to be reconciled with the characteristics and structural limitations of the codex form. Prior to carrying out an examination of content, which is to say an examination of the aggregations of texts represented in codices, and of their reciprocal relationships and evolution over time, it seems appropriate to start with an evaluation of the 'non-unitary' codex from the purely material standpoint, that is to say as a parallelepiped whose visual impact and functionality are determined by the combination of its three dimensions[28]. While the first two dimensions (height and width) are normally noted in catalogues, the third dimension—i.e. the *thickness of the quire block*—can be indirectly and roughly estimated by means of the 'number of leaves' (*overall thickness*) parameter, which very likely served as a rough and ready indicator of the thickness of the book block for medieval artisans too.[29]

A first point to underscore is that during the planning phase of a Byzantine manuscript, whether it be 'unitary' or 'non-unitary', the thickness of the quire block was not a parameter left purely to chance[30]: this can be clearly demonstrated by the fact that in the highly disparate collection of 1,435 (both 'unitary' and 'non-unitary') manuscripts taken into consideration (distributed over a timeline traversing some eight centuries), the most representative[31] *overall thickness* value, which is quite pronounced, registers at 200 leaves (Chart 1), whilst only 3% of the codices surveyed were found to be composed of fewer than 40 leaves.[32]

---

27 This limitation, albeit an inevitable one, proved particularly disappointing, given that the presence or absence of an underlying plan and, in the affirmative case, degrees to which and ways in which such a plan manifests itself, are indispensable elements for understanding (partially, at least) the relationship that the medieval user had with the miscellaneous book, which otherwise remains incomprehensible to the modern scholar.

28 Concerning this approach to the problem, Muzerelle / Ornato 2004, to which one can usefully refer for more detailed information on its theoretical implications.

29 It is obvious that the two parameters—*thickness of the quire block* and *overall thickness*—do not fully coincide, owing to the wide variation in thickness of the paper or parchment sheets from which they were formed.

30 The same affirmation is also valid for the Latin codex: see Muzerelle / Ornato 2004, 56 ff [in this volume, 377–412].

31 Or alternatively, in statistical terminology, the distribution's mode.

32 In roll production, the limitations imposed by the material's structural characteristics (normally resulting in a total length not exceeding 5 metres) in all likelihood exerted some degree of

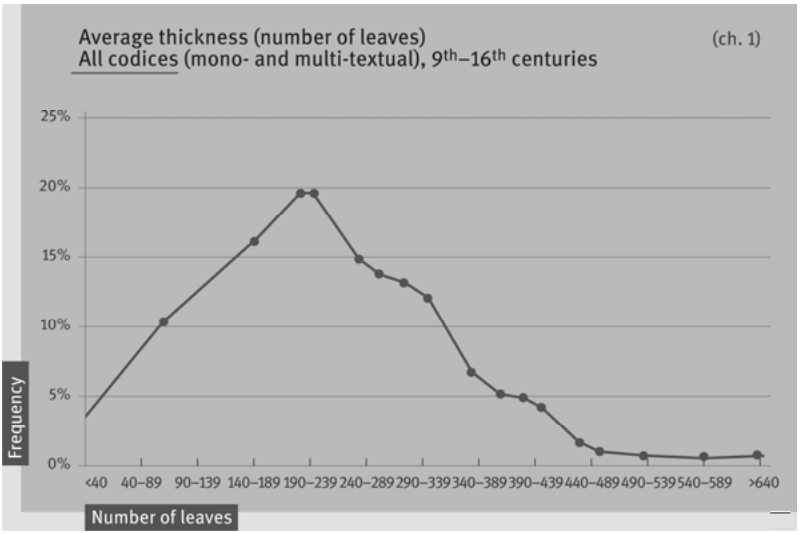


Chart 1: Average thickness (number of leaves). All codices (mono- and multi-textual), 9th–16th centuries

Needless to say, the *thickness* parameter has to be assessed not only in absolute terms but also in relation to a volume's other two dimensions, which can be expressed in condensed form through their sum (semi-perimeter, or *size*).[33] The relationship between *thickness* and *size* shows that *thickness* is always greater in larger codices. The variation in the number of leaves in relation to volume size does not, however, follow a linear trend: in fact, *thickness* proves to be relatively

influence on authors as regards the length and internal structuring of texts—judging, that is, from the correspondence between individual rolls and composite units (e.g. the books of Homer, orations/sermons, history tomes, etc.). The progressive positive reception of the codex opened the way to new possibilities for the aggregation of multiple texts in the form of *sylloges* or corpora, whilst at the same time apparently resulting in a progressive, although not total, disappearance of codices 'bearing a single text or *corpuscula*-codices'. For a thorough and well-documented examination of this process, albeit limited to Greek manuscripts, see Cavallo 1986, 83–172 and 246–271, text quoted from 162 (also in Cavallo 2002, 49–175).

33 It has been noted that *size* is not the only possible compact indicator which serves to represent the dimensions of a codex (for a list of possible alternatives, see Gumbert 2001). Though not without limitations, the use of this parameter is in any event encouraged on account of the ease with which it can be calculated, in addition to its wide diffusion in bibliographies concerning the *mise en page* (see also Maniaci 2002, 72–73).

lower in the largest volumes and relatively higher in the smallest ones.[34] The explanation for this phenomenon probably lies in the fact that below a given page size threshold the length of the text to be transcribed (*text mass*) inevitably has an effect on the number of leaves required to contain it, which as a result is greater (Chart 2).

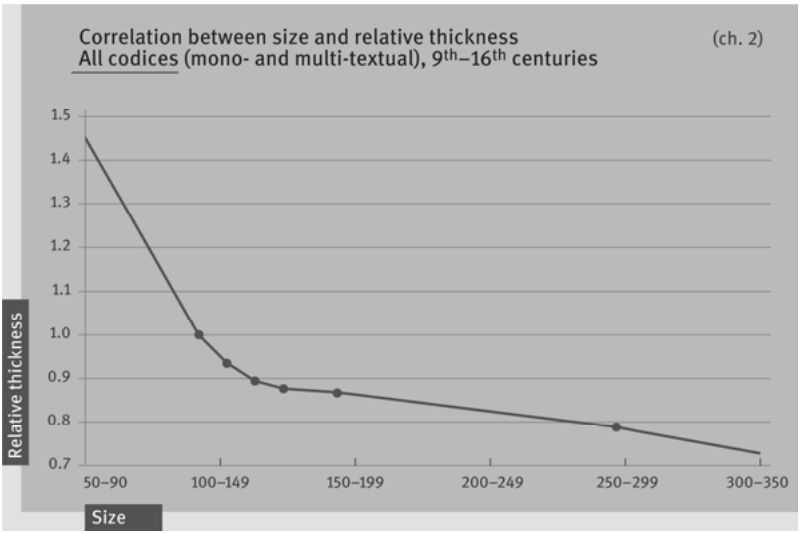


Chart 2: Correlation between size and relative thickness. All codices (mono- and multi-textual), 9th–16th centuries

The analysis of the thickness of Byzantine manuscripts—both 'unitary' and 'non-unitary'—also uncovers a significant diachronic evolution over time. Unfortunately, the only approximate dates provided in catalogues compel one to adopt a rough timeline divided into centuries that fails to convey the 'epochal' shifts which occurred during the course of Byzantine history, especially with respect to the halt in output (in the middle of the 15th century) caused by the fall of Constantinople, which resulted in the migration of Greek manuscript production centres towards the West. Nevertheless, even a cursory scanning of the rather rudimentary timeline allows one to make out some reasonably well-defined basic trends occurring over time.

34 The situation discerned for the Latin codex is comparable; see Muzerelle / Ornato 2004, 58 [in this volume, 377–412].

The first of these trends consists in a progressive reduction in the average *thickness* of codices over time. This phenomenon is already quite evident in the period spanning the 9th to 11th centuries, and becomes distinctly more pronounced in the late- and, above all, post-Byzantine period (Chart 3).

If the appearance of volumes containing fewer than 40 leaves that occurs between the 13th and 14th centuries can be interpreted as the result of an overall reduction in the average size of codices, the reduction in thickness bears all the hallmarks of an independent phenomenon in the post-Byzantine period (i.e. 15th–16th centuries) (Tab. 1).[35]

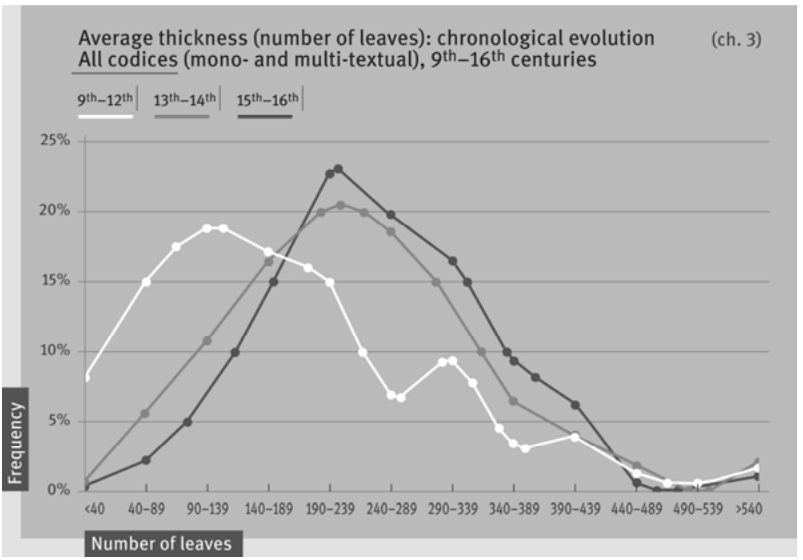


Chart 3: Average thickness (number of leaves): chronological evolution. All codices (mono- and multi-textual), 9th–16th centuries

35 Given that a significant portion of book production after the middle of the 15th century took place in the West, it would be interesting to evaluate the tendency towards a reduction in size in relation to the working habits adopted in the Latin context (unfortunately, this parameter is not included among those taken into account in the essay by Cartelli / Palma / Ruggiero 2004).

Average dimensional characteristics of mono- and multi-textual codices (tab. 1)

Century	Overall thickness	Size	Height / number of lines	Thickness of longest text
9th–12th	253.69	514	10.36	174.42
13th–14th	238.11	434	9.77	163.61
15th–16th	188.65	433	10.61	119.05
Totality	223.10	457	10.29	148.53

Tab. 1: Average dimensional characteristics of mono- and *multi-textual* codices

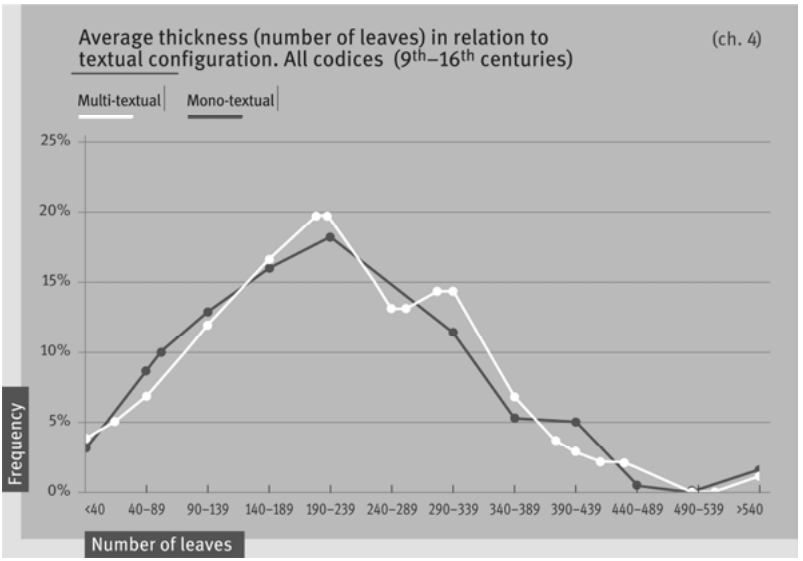


Chart 4: Average thickness (number of leaves) in relation to textual configuration. All codices (9th–16th centuries)

How, then, from the standpoint of thickness, can the difference between codices containing a single text and those consisting of a juxtaposition of multiple texts be expressed? At an overall level, whether they be *mono-textual* or *multi-textual* codices does not seem to exert a significant influence on their average thickness, apart from those which exceed the threshold of 10 texts—an infrequent

occurrence—which, not surprisingly, is accompanied by an increase in the thickness of the quire block (Chart 4).

However, one can observe that at lower degrees of thickness, the *multi-textual* volumes tend to contain a greater number of leaves in comparison to *mono-textual* ones: clearly in the Byzantine context the aggregation of multiple texts offered the possibility of regulating the number of leaves so as to reach the minimum number considered ideal for the thickness of the quire block, whilst on the other hand the desire to produce 'unitary' codices made it acceptable to craft slimmer volumes. The earliest periods (from the 9th to 12th centuries), in which *multi-textual* volumes of greater thickness are proportionately higher in number, represent an exception: in a context where the production of *mono-textual* volumes tended to be the rule, codices composed of multiple texts appear (in contrast with those produced in successive centuries) as associations between lengthy 'core' texts and a group of shorter textual elements 'orbiting' around them (Charts 5, 6, 7).[36]

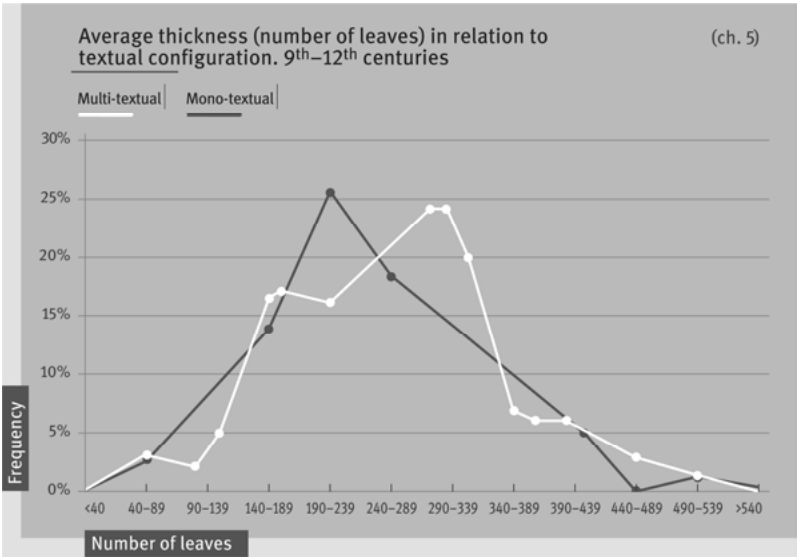


Chart 5: Average thickness (number of leaves) in relation to textual configuration. 9th–12th centuries

36 In 75% of the *multi-textual* codices datable to the 9th–12th centuries, the longest text consumes more than 50% of the volume's overall thickness. In 51.3% of cases the figure exceeds 75%.

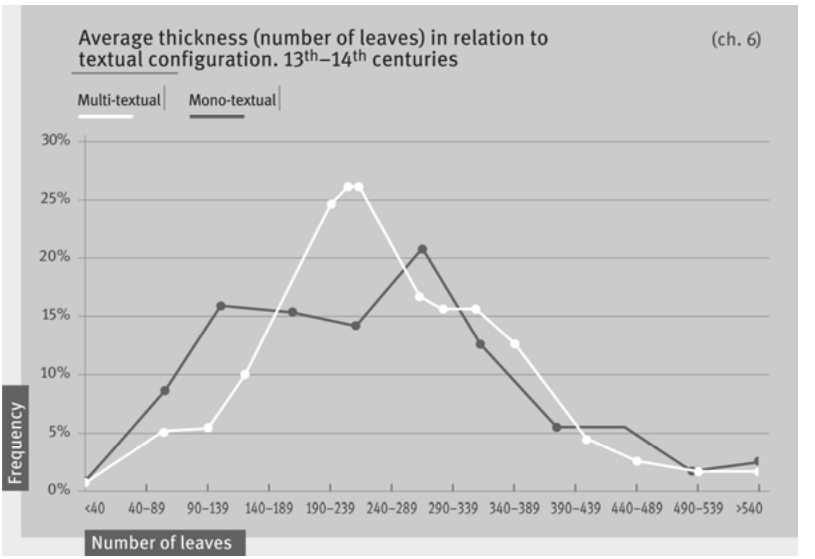


Chart 6: Average thickness (number of leaves) in relation to textual configuration. 13th–14th centuries

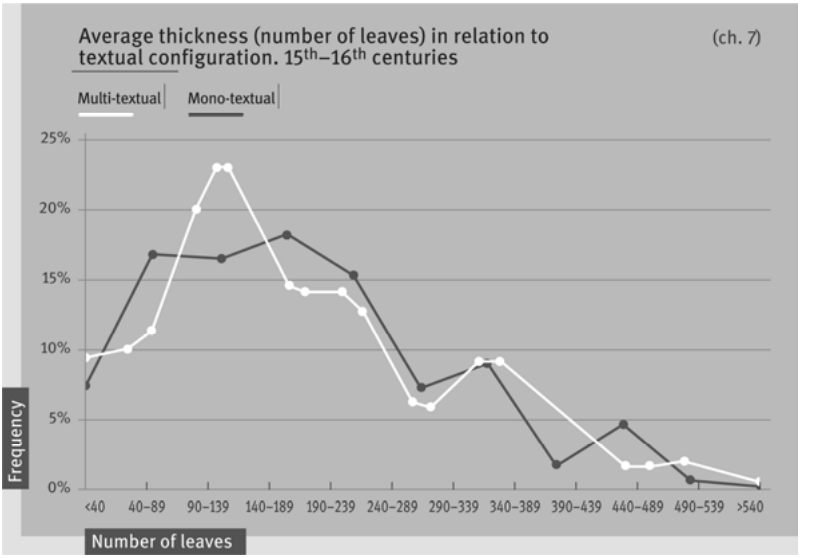


Chart 7: Average thickness (number of leaves) in relation to textual configuration. 15th–16th centuries

At a statistical level, the simultaneous presence of more than one text is accompanied by a greater density of writing; indeed, in all the centuries examined, the inter-line space is smaller in the volumes with a higher *index of multi-textuality* (Chart 8).[37]

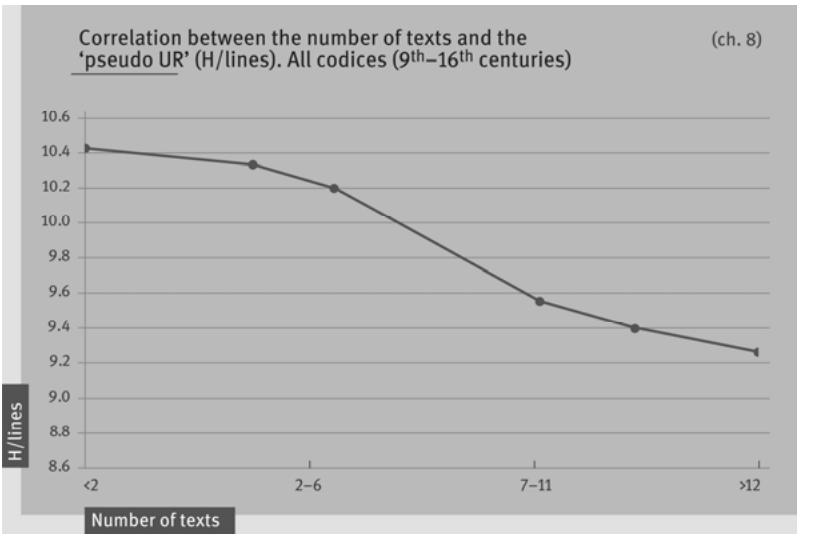


Chart 8: Correlation between the number of texts and the 'pseudo UR' (H/lines). All codices (9th–16th centuries)

Conversely, the data analysis does not reveal any clear link between the multi-textual nature of a volume and its page size, nor between the former characteristic and the arrangement of texts, in the sense that the number of texts accommodated

37 It should, however, be made clear that the number of *multi-textual* codices dating from the 9th to 10th centuries is too low for the result to be of statistical significance. In reality, the value shown on the chart does not represent an inter-linear measurement, nor that of a unit of ruling (UR = *unité de réglure*, as it is currently defined), which corresponds to the relationship between the height of the writing area and the number of horizontal spaces it is divided into), but instead—in the absence of details on the written area's height, which is not always provided in catalogues—to a 'pseudo-UR', obtained by calculating the relationship between the height of a page and the number of writing lines ruled on it. Even if the correspondence between the two parameters is not perfect (given the considerable variability seen in the sizes of upper and lower margins), they still tally very well at a statistical level.

by a volume does not appear to be correlated in a clear and linear way to the size of a codex, nor to its layout.

Having determined that thickness, and therefore the height of the page block, is in all respects one of the material constraints imposed on a codex's design, it can be deduced that the odds of a single text entirely monopolising a given codex (of set size) are strictly correlated to its length, measured by the number of leaves it contains: in other words, its specific *unitary thickness*.

In the case of the Greek codex, the thresholds for *unitary thickness* that determine the choices made with respect to the merging of texts can vary quite significantly, depending on the historical period they date from. In all cases, the incidence of *mono-textual* codices in relation to the total grows at the same rate as the increase in the number of leaves required for the transcription of a single text (Tab. 2). For *multi-textual* codices this finding remains the same, whether one considers the length of the first text (as in the table), or the longest documented text, given that the two—as will become clear later on—are essentially equivalent.

Frequency of mono-textual codices in relation to the length of the first text (tab. 2)

Number of leaves of the first text	9th–12th	13th–14th	15th–16th
> 40	4.35%	1.18%	22.35%
40–70	28.57%	18.52%	51.11%
70–100	60.0%	45.83%	60.47%
100–130	69.23%	60.61%	67.50%
130–160	76.19%	50.0%	77.14%
160–190	74.19%	58.06%	92.11%
190–220	90.70%	55.56%	88.0%
220–250	92.11%	81.48%	83.33%
> 250	91.20%	76.0%	85.33%
Totality	78.48%	47.64%	64.51%

Tab. 2: Frequency of *mono-textual* codices in relation to the length of the first text

In any event, with respect to the overall trend, the output of the 13th to 14th centuries stands out because the phenomenon is less pronounced and, as it were, 'delayed'—in fact, in the periods spanning the 9th to 12th and 15th to 16th centu-

ries, the percentage of *mono-textual* codices rapidly increases and reaches its maximum level for texts of lengths ranging from 190 to 220 leaves. Conversely, during the 13th to 14th centuries, *mono-textual* codices represent the clear majority only in volumes containing more than 220 leaves.

Above all, it should be noted that in the same period the relative percentage incidence of *mono-textual* volumes is still lower than in previous and successive centuries, irrespective of the overall thickness of individual volumes (Tab. 3).

Frequency of mono-textual codices in relation to the overall thickness of the codex (tab. 3)

Total number of leaves	9th–12th	13th–14th	15th–16th
< 100	85.71%	54.84%	63.55%
100–129	81.82%	64.52%	56.25%
130–159	76.19%	50.0%	60.0%
160–189	79.31%	45.00%	79.55%
190–220	81.25%	32.61%	63.89%
> 220	77.20%	47.57%	64.95%
Totality	78.48%	47.64%	63.51%

Tab. 3: Frequency of *mono-textual* codices in relation to the overall thickness of the codex

One can readily deduce that in the earliest phase (i.e. the 9th to 12th centuries), and subsequently in the post-Byzantine phase, the manufacture of bulkier volumes was not, as a rule, the result of multiple texts being merged, but instead served to accommodate the ampleness of a single, particularly long text. In other words, a propensity towards the production of *mono-textual* codices prevails, whereas the merging of multiple texts was seen as a secondary option, which from time to time was necessary to resort to in order to transmit texts of shorter length, rather than as a result of a deliberate plan based on specific intellectual demands.

It is not by mere chance, then, that the output of the 13th to 14th centuries is characterised, overall, by a significantly greater percentage of *multi-textual* codices, amounting to some 52%, as opposed to 21% in the 9th to 12th centuries, and 35% in the 15th to 16th centuries. Therefore, one can deduce that there was effectively a change in habits, which consisted in abandoning the clear predilection for

mono-textual codices that prevailed in the previous centuries, and which subsequently reappeared, albeit to a much lesser degree, at the end of the Middle Ages.

Regardless of such a well-delineated chronological evolution, multi-textualism in Byzantine book production is a phenomenon whose overall occurrence should not be overstated. Above all, it is worth noting that most *multi-textual* volumes—roughly half—in all periods take the form of juxtapositions of only two or three texts, whereas the percentage of codices containing more than five texts is rather limited, apart from in the period stretching from the 13th to 14th centuries, a peculiar situation which, once again, is plain to see (Tab. 4).

Frequency of textual aggregations (from 1 to more than 5 texts) according to centuries (tab. 4)

Number of texts	9th–12th	13th–14th	15th–16th
Mono-textual	78.57%	48.39%	64.93%
2–5 texts	17.21%	30.79%	27.25%
More than 5 texts	4.22%	20.82%	7.82%
Totality	100%	100%	100%

Tab. 4: Frequency of textual aggregations (from 1 to more than 5 texts) according to centuries

On the other hand, one should be aware that the number of texts gathered in a single codex is not, in and of itself, a sufficient basis to define it as being *multi-textual*, but instead has to be associated with a close examination of the length of each component text. Here, the chief point to note is that the longest text (or *principal text*) on average occupies, up until the 14th century, a significant portion of the entire codex—equivalent, in fact, to a little over 60% of the total space.

If, from this standpoint, there is no great difference between the middle-, late- and post-Byzantine periods, there is, on the other hand, a rather marked disparity in relation to the number of 'mini-texts' (i.e. texts with a *unitary thickness* of fewer than five leaves), which is distinctly higher in the 13th and 14th centuries.

In this period, then, the increase of *multi-textual* volumes manifests itself as a very hierarchical phenomenon, characterised by the positioning of one or more smaller units around a dominant 'core' text. Only at the end of the Mid-

dle Ages does the aggregation of multiple texts appear to take a more 'equal' footing, in the sense that the percentage of space occupied by the dominant text descends from 61% to 49% (Tab. 5).

Typology of multi-textual codices on the basis of the number and length of the texts they contain (tab. 5)

Century	Average number of texts	% of space occupied by the main text	% of texts of fewer than 5 leaves
9th–12th	4.83	62.12%	1.93%
13th–14th	6.81	61.36%	6.22%
15th–16th	4.86	49.32%	2.80%
Totality	5.73	56.92%	4.19%

Tab. 5: Typology of *multi-textual* codices on the basis of the number and length of the texts they contain

If one examines only *multi-textual* codices in which a single text (out of a minimum total of three) occupies at least 60% of the available space, it also appears that the *principal text*, in all periods, was placed in first position (i.e. represents the opening text). This preference becomes all the more clear in the 9th to 12th centuries, but is also maintained in the successive centuries, whilst middle position incidence remains more or less consistent. On the other hand, an increased incidence of the principal text in the last position can be affirmed, perhaps due to the tendency to equip the dominant text with one or more introductory 'mini-texts' (Tab. 6).

Position of the longest text (*principal text*) (tab. 6)

Position of the longest text	9th–12th	13th–14th	15th–16th
Opening section	77.78%	59.18%	57.14%
Central section	11.11%	14.29%	14.29%
Final section	11.11%	26.53%	28.57%
Totality	100%	100%	100%

Tab. 6: Position of the longest text (*principal text*)

Finally, a fundamental aspect of the 'physiognomy' of the *multi-textual* codex remains to be examined, namely the way in which texts were juxtaposed based on a volume's content.

The following observations are intended to provide some hints that would be worthwhile to further develop as part of a more in-depth evaluation of a phenomenon which is difficult to tackle solely on the basis of descriptions of content provided in catalogues.

An initial subdivision of the corpus based on a dichotomy set up between the 'sacred/secular' typologies confirms the impression that the *multi-textual* codex, even if it was widely adopted, represents a phenomenon which is more specific to the secular realm.

In all the chronological groups investigated, the percentage of volumes containing sacred texts (i.e. Bibles, commentaries on the Bible, liturgical works, theological works, hagiographies and homilaries, etc.), is indeed greater among 'unitary' volumes than in those which contain associations of multiple texts. Between the mid- and late-Byzantine eras the phenomenon is accentuated by a generalised increase in the output of books of a secular nature (i.e. philology and rhetorics, poetry, historiography, science, philosophy, law etc.), exemplified, in *multi-textual* volumes, by a clear reduction in the number of sacred texts among the first five texts surveyed in each individual codex (Tab. 7).

Frequency of textual aggregations (from 1 to more than 5 texts) according to the centuries (tab. 7)

Codices	9th–12th	13th–14th	15th–16th
All	77.07%	35.30%	19.58%
Mono-textual	85.08%	48.89%	26.49%
Multi-textual	67.62%	31.89%	15.44%

Tab. 7: Frequency of textual aggregations (from 1 to more than 5 texts) according to the centuries

In addition, starting from the 13th century, the *multi-textual* codex of secular content is characterised by a marked propensity to unite a greater number of texts (in the 'five or more texts' category) in comparison to the other content typologies. This tendency can be ascribed at least in part to material factors—on average, the secular texts are shorter and encourage or necessitate unification—and to a certain extent, in all likelihood, to the reading and academic habits of the learned circles within which such codices were produced (Tab. 8).

Frequency of textual aggregations.
Difference between sacred and secular codices (tab. 8)

Century	Number of texts	Frequency		Number of leaves in longest text	
		Secular	Sacred	Secular	Sacred
9th–12th	Mono-textual	14.92%	85.08%	215.08	256.82
	2–4 texts	30.23%	69.77%	53.69	175,22
	5 and more	26.09%	73.91%	33.50	149.62
	Totality	17.83%	83.17%	158.16	240.26
13th–14th	Mono-textual	51.11%	48.89%	210.33	259.70
	2–4 texts	59.21%	40.79%	106.78	187.32
	5 and more	71.30%	28.70%	69.54	111.32
	Totality	59.03%	40.97%	136.33	212.73
15th–16th	Mono-textual	73.51%	26.49%	182.13	216.08
	2–4 texts	72.62%	27.38%	101.81	123.76
	5 and more	87.93%	12.07%	54.91	52.93
	Totality	75.37%	24.63%	145.28	183.75

Tab. 8: Frequency of textual aggregations. Difference between sacred and secular codices

Concerning the simultaneous presence of sacred and secular texts within a single codex, full homogeneity (i.e. either exclusively secular or exclusively sacred texts) represents the norm in all periods, whereas the mixing of texts—as in *unorganised multi-textual* codices—should be considered an exception (Tab. 9).

Homogeneity / heterogeneity of textual associations (sacred and secular content) (tab. 9)

Century	Homogeneity	Mixed
9th–12th	86.36%	13.64%
13th–14th	76.44%	23.56%
15th–16th	85.92%	14.08%
Totality	81.45%	18.55%

Tab. 9: Homogeneity / heterogeneity of textual associations (sacred and secular content)

Characteristics of multi-textual codices in relation to the prevailing textual typology (tab. 10)

Typology of the longest text	13th–14th		15th–16th	
	% multi-textual	% mini-texts	% multi-textual	% mini-texts
Bible	7.14%	1.16%	16.67%	0%
Hagiography	20.0%	1.93%	25.0%	4.50%
Historiography	26.32%	2.86%	13.64%	0.31%
Bible commentaries	29.17%	2.29%	11.11%	0%
Philosophy	40.54%	1.38%	22.22%	0.35%
Theology	44.44%	0.20%	40.0%	0,17%
Liturgy	45.45%	2.71%	40.0%	0%
Homiletics	48.15%	0.30%	22.22%	0%
Literature	58.82%	4.16%	40.30%	0.89%
Science	64.52%	11.20%	52.08%	1.94%
Philosophy ad rhetorics	70.59%	10.28%	37.84%	4.15%
Totality	51.48%	5.46%	34.63%	2.84%

Tab. 10: Characteristics of *multi-textual* codices in relation to the prevailing textual typology

That being said, the tendency towards 'non-unitary' content is not the same in all text typologies (Tab. 10).[38]

Up until the 12th century, the minority representation of *multi-textual* codices makes it impossible to carry out a sufficiently detailed analysis; one must therefore limit oneself to observing that the number of such texts exceeds 10% of the total only in the cases of theological and homiletic writings.

In the succeeding 13th and 14th centuries, if we use the longest type of text as a benchmark, it becomes clear that the widespread increase in *multi-textual* codices encompasses, albeit in a non-uniform way, all text categories. However, the increase is seen at its maximum in volumes of literary and scientific content and is clearly related to the proliferation of the aforementioned 'mini-texts', usually arranged around a 'core' text.

Conversely, in the post-Byzantine period one observes a fresh reduction in the overall number of *multi-textual* volumes which affects—albeit to a variable extent—the majority of content typologies. This trend can be ascribed, at least in part, to the drastic reduction in 'mini-texts', in addition to, more generally speaking, the already mentioned reduction in the average thickness of the individual transcribed texts.

The observations made up to this point represent a first attempt to apply a codicological approach to the particular set of problems associated with the 'non-unitary' codex. As such, they can be regarded as suggestions for further research, and therefore represent issues that require greater clarification, in-depth study and verification. What, then, are the overall conclusions that we can draw at this stage, albeit only tentatively?

Even if the production of *multi-textual* codices has to be assessed in the light of the particular circumstances and historico-cultural contexts that it was an expression of, it also necessarily has to be examined within the material setting that governed the length of texts (measured by the number of leaves in a volume) and the inescapable functional and aesthetic influences that the book in the form of a codex was subject to. If a text was too short, it would not have been able to 'monopolise' an entire codex; if, on the other hand, it was very long, the addition of further texts had to be curbed so as to avoid the risk of spoiling the aesthetic appeal and handling characteristics of the volume.

38 The textual typologies that appear in the table are similar to those employed by Maniaci 2002, which in turn (after a certain amount of simplification) were drawn from those adopted by Sautel 1995. For the present investigation, it was decided to augment the level of detail for the classification of secular texts.

In the 9th to 12th centuries, when, taken as a whole, the creation of volumes of a sacred nature prevailed, multi-textuality should be seen as a marginal phenomenon—albeit significant in individual cases—within the overall panorama of manuscript production in the Greek language. The ideal aimed at certainly seems to have been the *mono-textual* codex—an ideal whose fulfilment was made easier by the fact that the percentage of codices of limited *overall thickness*, which is to say containing fewer than 150 leaves, totals only 11% (in comparison to 20% in the 13th to 14th centuries, and 35% in the 15th to 16th centuries).

The 13th and 14th centuries can be clearly distinguished by a considerable increase of the number of *multi-textual* codices produced. Without doubt, this was the consequence of profound changes of an intellectual nature that translated, in turn, into changes in book production, given that the increased presence of volumes containing multiple texts is relatively independent from their overall thickness and affects almost all content typologies, albeit in a rather heterogeneous way and not without exceptions (for example, the number of multi-textual codices is lower among those containing solely or predominantly biblical, hagiographical or homiletic material).

The phenomenon is, however, magnified by various factors that produce convergent effects. Above all, this process manifests itself through a great emphasis among manuscripts containing secular material, the production of which in this period prevails. On average, in this type of codex the length of texts is lower, which favours—when it does not indeed dictates—the production of *multi-textual* volumes. Furthermore, there is a significant increase in the presence of 'mini-texts' consisting of fewer than 5 leaves.

In the 15th to 16th centuries, a considerable reduction is once again seen in the number of *multi-textual* codices. This reduction coincides with a drastic diminution in the percentage of 'mini-texts', including in the typologies in which these were previously used in significant numbers. If the contraction in *multi-textual* codices does not assume vast proportions, this is partly because the average length of texts underwent an obvious reduction, which provided—as has already been pointed out—impetus for their unification. This represents a real phenomenon (independent, that is, from a greater exploitation of the available space on pages) and is made evident the quantitative analysis, although its significance cannot be investigated in greater depth using this tool alone.

In essence, only during the 13th and 14th centuries did the multi-textual form, in Byzantine manuscripts, amount to a fully autonomous phenomenon; that is to say one which enjoyed genuine independence from the material constraints that exerted an influence on the manufacture of codices. From the historico-cultural standpoint, Guglielmo Cavallo's studies have richly documented the

activities of writing circles in the Palaeologan Age, when 'often more than one hand participated in the editorial set-up of texts',[39] and the reciprocal relationships between reading, study and transcription were very close, particularly—but not solely—in relation to Greek literature of the Classical Age.

Not by chance, it is among volumes dating from the Palaeologan Age that one encounters the highest number of volumes that we have previously defined as *organised multi-textual multi-block* codices. These include volumes that are the result of the stratification of multiple parts transcribed at different times by one and the same copyist; volumes transcribed by two (or rarely more than two) copyists operating in concert, most likely to divide labour (although probably not exclusively for this reason); and the *convergence* of multiple booklets that were originally circulated as independent items, including those dating from different historical periods, if such a *convergence* can be attributed to the editorial work of a learned 'inspirer', or alternatively to the shared academic activities of a particular group of erudite people.

A phenomenon that is quite distinct from the *multi-textual* book is that of the codex's 'structural modularity', independent of the number of texts (ranging from one to many) that it contains. The view that, in the absence of external constraints, the, as it were, 'spontaneous' choice on the part of the artisan would have been to produce a 'monolithic' volume (i.e. a structurally 'unitary' one) has been too hastily arrived at. If we reject this vision, which is informed by modern expectations that identify the 'unitary' codex with a more finished, stable and, in essence, 'beautiful' product, we could even support the hypothesis that the 'modular' manuscript constituted, in the eyes of the medieval man, a more 'sophisticated' product than today's 'unitary' book, precisely on account of its intrinsic potential to be dismantled, re-aggregated, modified and added to according to the specific tastes and needs of individual users. Various pieces of evidence (e.g. quire signatures or sequences of medieval corrections or comments juxtaposed in different series in one and the same codex, or in a single series, but one which is different from that seen today), suggest that, in contrast to our modern notion of a book as a unitary and indissoluble entity, and hence an inexorably 'fixed' entity (i.e. impossible to dismantle and/or to merge with other books or parts of books), the medieval volume was instead seen as a 'dynamic' object harbouring the potential, from the moment of its creation, to be arranged or rearranged according to particular needs or circumstances—and was indeed often treated in this way.

39 Cavallo 2001, 606.

However, only by examining different historical eras and text typologies by means of a systematic application of the analytical tools used in codicological research would it be possible to substantiate such a hypothesis.

References

Bianconi, Daniele (2004), 'Libri e mani. Sulla formazione di alcune miscellanee dell'età dei Paleologi', in Crisci, Edoardo / Pecere, Oronzo (eds) (2004), *Il codice miscellaneo. Tipologie e funzione*. Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino (= *Segno e testo*, 2), 311–363.

Bischoff, Frank M. (1994), 'Systematische Lagenbrüche: Kodikologische Untersuchungen zur Herstellung und zum Aufbau mittelalterlicher Evangeliare', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel, 12th–14th November, 1990, Marburg: Institut für Historische Hilfswissenschaften (Elementa diplomatica, 2), 83–110.

Canart, Paul (1966), *Catalogue des manuscrits grecs de l'Archivio di San Pietro*, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 246).

Canart, Paul (1970), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Pauli VI Pontificis Maximi [...]. Codices Vaticani Graeci. Codices 1745–1962 recensuit Paulus Canart*, Tomus I. *Codicum enarrationes*, in Bibliotheca Vaticana.

Capocci, Valentino (1958), *Bibliothecae Apostolicae Vaticanae codices manuscripti recensiti iussu Ioannis XXIII Pontificis maximi [...]. Codices Barberiniani Graeci*, Tomus I. *Codices 1–163 recensuit Valentinus Capocci*, in Bibliotheca Vaticana.

Cartelli, Antonio / Palma, Marco / Ruggiero, Silvia (2004), 'I codici miscellanei nel basso medioevo', in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni*. Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino (= *Segno e testo*, 2), 245–309.

Cavallo, Guglielmo (1986), 'Conservazione e perdita dei testi greci: fattori materiali, sociali, culturali', in Giardina, Andrea (ed.), *Tradizione dei classici, trasformazioni della cultura*, Roma-Bari: Istituto Gramsci (Seminario di antichistica. Società romana e impero tardoantico, 4), 83–172 and 246–271 (also in Cavallo, Guglielmo [2002], *Dalla parte del libro. Storie di trasmissione dei classici*, Urbino: QuattroVenti, 49–175).

Cavallo, Guglielmo (2001), '"Foglie che fremono sui rami". Bisanzio e i classici', in Settis, Salvatore (ed.), *I Greci. Storia Cultura Arte Società*, III. *I Greci oltre la Grecia*, Torino: Einaudi, 593–628.

Devreesse, Robert (1950), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Pii XI Pontifici Maximi [...]. Codices Vaticani Graeci*. Tomus III. *Codices 330–603 recensuit Robertus Devreesse*, in Bibliotheca Vaticana.

Franchi De' Cavalieri, Pio (1927), *Bibliothecae Apostolicae Vaticanae codices manuscripti recensiti iussu Pii XI Pontifici Maximi [...]. Codices Graeci Chisiani et Borgiani recensuit Pius Franchi De' Cavalieri*, Romae.

Giannelli, Cyrus (1950), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Pii XI Pontifici Maximi [...]. Codices Vaticani Graeci. Codices 1485–1683 recensuit Cyrus Giannelli*, in Bibliotheca Vaticana.

Giannelli, Cyrus / Canart, Paul (1961), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Ioannis XXIII Pontificis maximi [...]. CodicesVaticani Graeci. Codices 1684–1744 recensuit Cyrus Giannelli †. Addenda et indices curavit Paulus Canart*, in Bibliotheca Vaticana.

Gumbert, Johan Peter (1989), 'L'unité codicologique, ou: à quoi bon les cahiers?', in *Gazette du livre médiéval*, 14: 4–8.

Gumbert, Johan Peter (1999), 'One Book with Many Texts: The Latin Tradition', in Jansen-Sieben, Ria / van Dijk, Hans (eds), *Codices Miscellanearum*. Brussels Van Hulthem Colloquium / Bruxelles Colloque Van Hulthem 1999, Bruxelles (Archives et bibliothèques de Belgique. Numéro spécial, 60), 27–36.

Gumbert, Johan Peter (2001), 'Livre grand, livre petit: un problème de taille', *in Gazette du livre médiéval*, 38: 55–58.

Gumbert, Johan Peter (2004), 'Codicological Units: Towards a Terminology for the Stratigraphy of the Non-Homogeneous Codex', in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni*. Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino, 2004 (= *Segno e testo*, 2), 17–42.

Hanna, Ralph (1986), 'Booklets in Medieval Manuscripts: Further Considerations', in *Studies in Bibliography*, 9: 100–111.

Kienhorst, Hans (1996), 'Middelnederlandse handschriften als codicologisch object', in Sonnemans, Gerard (ed.), *Middeleeuwse Verzamelhandschriften uit de Nederlanden*, Congres Nijmegen 14 oktober 1994, Hilversum: Uitgeverij Verloren (Middeleeuwse Studies en Bronnen, 51), 39–60.

Kienhorst, Hans (2002) [2003], '"Nach der Lektüre das Buch bitte umgehend zurückbringen". Über die merkwürdige Entstehungsgeschichte der mittelniederländischen Sammelhandschrift Wiesbaden, Hessisches Hauptstaatsarchiv, Hss.-Abt. 3004 B 10', in *Das Mittelalter*, *Perspektiven mediävisticher Forschung. Zeitschrift des Mediävistenverbandes*, 7/2 [repr. in Schubert [ed.] 2003], 48–73.

Kwakkel, Erik (2002), 'Towards a Terminology for the Analysis of Composite Manuscripts', in *Gazette du livre médiéval*, 41: 12–19.

Lilla, Salvatore (1985), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Iohannis Pauli II Pontificis Maximi [...]. Codices Vaticani Graeci. Codices 2162–2254 (Codices Columnenses) recensuit Salvatore Lilla*, in Bibliotheca Vaticana.

Maniaci, Marilena (1996 [1998²]), *Terminologia del libro manoscritto*, Milano, Roma: Istituto centrale per la patologia del libro.

*Maniaci, Marilena (2000), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino, Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, [Milano]: Centro Tibaldi, 47–60.

Maniaci, Marilena (2002), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Mercati, Giovanni / Franchi de' Cavalieri, Pio (1923), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Pii XI Pontifici Maximi [...]. Codices Vaticani Graeci recensuerunt Iohannes Mercati et Pius Franchi de' Cavalieri*. Tomus I. *Codices 1–329*, Romae: Typis Polyglottis Vaticanis.

Mogenet, Joseph / Leroy, Julien / Canart, Paul (1989), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Ioannis Pauli II Pontificis Maximi [...]. Codices Barberiniani Graeci,* Tomus II. *Codices 164–281 recensuit Iosephus Mogenet †, enarrationes complevit Iulianus Leroy †, addenda et indices curavit Paulus Canart*, in Bibliotheca Vaticana.

Munk Olsen, Birger (1998), 'L'élément codicologique', in Hoffmann, Philippe (ed.), *Recherches de codicologie comparée. La composition du codex au Moyen Âge, en Orient et en Occident*, Paris: Presses de l'École Normale Supérieure, 105–129.

Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*, Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).

*Muzerelle, Denis / Ornato, Ezio (2004), *La terza dimensione del libro. Aspetti codicologici della pluritestualità*, in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni*. Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino, 2004 (= *Segno e testo,* 2), 43–74.

Nichols, Stephen G. / Wenzel, Siegfried (eds) (1996), *The Whole Book. Cultural Perspectives on the Medieval Miscellany*, Ann Arbor: University of Michigan Press (Recentiores: Later Latin Texts and Contexts).

Odorico, Paolo (1990), 'La cultura della Συλλογή: 1. Il cosiddetto enciclopedismo bizantino; 2. Le tavole del sapere di Giovanni Damasceno', in *Byzantinische Zeitschrift*, 83: 1–21.

Robinson, Pamela R. (1980), 'The "Booklet": A Self-Contained Unit in Composite Manuscripts', in Gruys, Albert / Gumbert, Johan Peter (eds), *Codicologica*, 3. *Essais typologiques*, Leiden: Brill (*Litterae textuales*), 46–69.

Sautel, Jacques-Hubert (1995), *Répertoire de réglures dans les manuscrits grecs su parchemin. Base de données établie par Jacques-Hubert Sautel à l'aide du fichier Leroy et des catalogues récentes*, Turnhout: Brepols (Bibliologia, 13).

Schreiner, Peter (1988), *Bibliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Ioannis Pauli II Pontificis Maximi [...]. Codices Vaticani Graeci. Codices 867–932 recensuit Petrus Schreiner*, in Bibliotheca Vaticana.

Schubert, Martin J. (ed.) (2003), *Der Schreiber im Mittelalter*, Berlin: Akademie Verlag.

Shailor, Barbara A. (1996), 'A Cataloger's View', in Nichols, Stephen G. / Wenzel, Siegfried (eds), *The Whole Book. Cultural Perspectives on the Medieval Miscellany*, Ann Arbor: University of Michigan Press (*Recentiores*: Later Latin Texts and Contexts), 153–167.

Thorndike, Lynn (1946), 'The Problem of the Composite Manuscript', in *Miscellanea G. Mercati*, VI, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 126), 93–104.

Denis Muzerelle and Ezio Ornato

The Third Dimension of the Book: Codicological Aspects of Multi-Textuality

Over the last few decades we have witnessed, in the fields of philology and palaeography, a growing re-evaluation of the book as a manufactured product. This development represents a change from the traditional viewpoint which largely down-played a volume's existence as an object of study, instead reducing it to a mere 'container' of texts, images and scripts. In the now distant past, a conference dedicated to 'miscellaneous' codices would have taken place in a totally impalpable context in which textual content would have been seen solely as the product of intellectual activity and the codex considered a purely abstract entity: at most a useful 'label' to serve as a reminder that a certain number of texts arranged in a specific order happen to be found grouped together in one and the same 'container'.

Assigning to the codex a merely 'virtual' existence also entails relegating it to an intrinsically 'passive' role. In this rather narrow perspective, the codex cannot be viewed as anything other than a dimensionless and unbounded container that slavishly adapts itself to whatever the authors and users of the texts it contains require of it. Moreover, it seems entirely pointless to enquire as to whether or not such an adaptation is always possible, and to what extent and in what ways it might be so.

In a perspective that many years of research have greatly contributed to diversifying by progressively expanding the field of view, the 'ideal box' can no longer be overlooked, and therefore has to become a 'real box'. In this new context, the duty of the codicologist is certainly not to overturn the ideological priorities which have always characterised this area of study and its history: indeed, the text obviously remains the ultimate goal and true driving force behind the production and transmission of culture, even if the book as an object itself is, in reality, the *indispensible* and almost exclusive 'protagonist' in this process.

However, it should be pointed out that the text / book coupling is far more complex than it appears upon first inspection, and that, in particular, the book in

---

Translated from the Italian into English by Mark Livesey. Original published as Muzerelle, Denis / Ornato, Ezio (2004), 'La terza dimensione del libro. Aspetti codicologici della pluritestualità', in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni*. Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino (= *Segno e testo,* 2), 43–74.

https://doi.org/10.1515/9783110743838-011

the form of a codex—definable as a 'volume' not solely on etymological grounds but also through the essentially metrical meaning of the word—is not lacking in its capacity to propose, or even impose, its requirements.

For the 'so-called 'quantitativist', the particular set of problems implied by the title chosen for the conference, *Il codice miscellaneo*, is even more enthralling and far-reaching than one might imagine. Indeed, in this setting, the number and order of texts assembled within one and the same volume, even if these are sometimes the product of pure chance or choices dictated by idiosyncratic and unpredictable needs, will as a rule, and, indeed, necessarily contain information of a recurrent nature which, implicitly, is of relevance to the history of written culture.

When this approach is adopted, the following questions inevitably arise: do all these pieces of information lend themselves to being systematised, in the sense that they can be 'measured' and classified in an objective way; and, should this prove be the case, to what extent is it so? Additionally, to what extent will such information reflect, without excessive aberration, an underlying 'substrate'—succinctly termed the 'cultural fabric'—whose basic components and essential forms, seen in different historical eras and cultural centres, it contributes to clearly delineating? But above all, on the epistemological level we cannot avoid posing a fundamental question: can this 'parametrisation', which is per force simplified, of intellectual activity really prove to be useful for the history of written culture? Or, on the contrary, is it too reductive from the very outset, and therefore unusable, if not actually detrimental to the cause?

The quantitative analysis of the cultural fabric—a vast new area of research—does not, as yet, have at its disposal an exhaustive list of the principal and most pertinent phenomena to formalise, nor is there a complete panoply of statistical methods and indicators which can successfully be applied to the collected data. Also lacking is a well-reasoned, coherent and universally agreed upon terminology. Furthermore, the truth be known, there is no overall classification system that defines the characteristics and aims of the said research with sufficient precision and exhaustiveness—indeed, the usual term 'bibliometry' seems altogether too reductive, inasmuch as it traditionally covers the measurement of book production rates, as well as the analysis of text typologies and the sociological echelon of readers.

However, this is perhaps not the best place to expand on such matters. Instead, here we shall confine ourselves to addressing, in the first place, the interrelationship between the materiality of the book—which is ruled with a firm but sensitive hand by tendential laws—and the multiplicity of texts, which cannot 'live' and survive if they do not assume a tangible form in three dimensions and find their place, either individually or in groups, within the physical boundaries

set by the volume and the page. By adopting the Western Middle Ages as a model case, we shall then briefly examine the different aspects of the phenomena of mono- and multi-textuality.[1]

Our investigation is based on the analysis of two distinct corpora. The first corpus is composed of manuscripts deriving from a broad range of origins, though chiefly French and British, whose dates are scattered across the 9th and 15th centuries. The corpus is for the most part assembled from two different sources, namely the manuscripts held in the Municipal Library of Cambrai,[2] and some of the codices held in various minor British libraries and described by Neil Ker in his *Medieval Manuscripts in British Libraries*.[3]

A full perusal of the Cambrai catalogue together with *Medieval Manuscripts in British Libraries* generated a grand total of approximately 1,600 volumes. The total length of each manuscript, expressed as the total number of leaves forming its constituent texts, was determined.[4] In addition to this parameter, the basic codicological data which characterise, in broad terms, the material nature of the manuscripts were also recorded.[5]

On the codicological level, the descriptions in the Cambrai catalogue, which do not number among the most deficient of the French catalographic series known as 'octavo', are obviously rather concise, although in this particular case the dearth of information turns out to be less of a problem than it would have been in other circumstances, inasmuch as the material characteristics which could interact with the quantity and content of texts do not appear to be large in number. By contrast, far richer, of outstanding calibre, and marked by great observational intelligence of both the textual and material characteristics of the manuscripts concerned, are Neil Ker's descriptions.[6]

---

1 The question of the relationship between multi-textuality and the material structure of the codex (i.e. the presence or absence of 'blocks' consisting in one or more quires that coincide with the beginning or end of text units) will not, however, be addressed. This aspect of the problem is in any event examined, at a theoretical and terminological level, in another contribution presented at this conference, Maniaci 2004 [in this volume, 337–375], to which we can also refer for its related bibliography (*ibid*., footnote 2).

2 Molinier 1891.

3 Ker 1969–1992.

4 The titles of the relevant works were not recorded. This would have called for an expenditure of time disproportionate to the declared objectives of the survey.

5 That is: date, origin, writing support, number of volumes, total number of leaves, completeness of volume, dimensions, and text layout.

6 It should be made clear that the collection of data originating from Neil Ker's work was largely facilitated by an earlier survey carried out by Paola Busonero, as part of a wide-reaching research project on the configuration of quires in late medieval manuscripts (Busonero 1999 [in this vol-

To this corpus, assembled from modern catalogues, an additional group composed of 140 volumes originating from the famous Saint-Amand-en-Pévèle Abbey in the far north of France was added. Today, these volumes are held in the Bibliothèque Municipale de Valenciennes and the Bibliothèque nationale de France. This complementary source helped to bolster the number of volumes dating from the 9th to 10th centuries. The codices originating from Saint-Amand constitute the 'sub-product' of a second corpus, assembled in order to tackle the problem from a slightly different angle, perhaps more 'qualitative' than, strictly speaking, 'quantitative'. This second corpus is formed from two different medieval catalogues dating prior to the 13th century, namely that of the Saint-Amand monastery, containing 315 listings (of which approximately 40% are extant), and that of the Cluny monastery, which contains 571 listings. In the case of the latter corpus, both on account of an elevated level of dispersion, and because of the lack of a systematic, focused investigation, up till now very few constituent volumes have been identified. Both of the said catalogues were published by Léopold Delisle[7] in the 19th century. Even if this second corpus was not employed during the first phase of the investigation presented here, it will be worthwhile to explain, in brief, the reasons behind the use of this kind of source in the wider context of addressing issues relating to multi-textuality.

Surveys of medieval catalography have been shaped by three different needs. In the first place, data gathering campaigns carried out on this type of source make it possible to analyse the ways in which the content of manuscripts were described, and therefore to evaluate the way in which librarians of the period perceived and interpreted the phenomenon of multi-textuality.

Continuing in the same vein, such information makes it possible to compare the descriptions of the texts entered into the catalogues with the actual content of the codices. In fact, it is widely known that the number and accuracy of data mentioned in the catalogues are quite distant from the criteria used to shape modern catalography (criteria which, in turn, are a far cry from being consistent and universal), and that a survey's level of accuracy depends in large part on the goals aimed at by the catalogue.[8]

---

ume, 205–307]). Our gratitude is owed to Paola Busonero for having permitted us to utilise the collected data.

7 Delisle 1874, 449–458; Delisle 1884.

8 It has been noted that in practice the behaviour of the compilers of medieval catalogues oscillated between two extreme poles in the following way: (a) a count of the books was made in order to implicitly underscore ownership; in this instance it was sufficient to mention only the general content of books in order to identify them, without the need to list, one-by-one, each of the individual texts that each volume contained; and (b) a census of the books on an

Finally, since catalogues can be thought of as 'photographs' of the library's holdings at the time they were compiled, it is possible, up to a point, to travel back through time and 'recover' a less distorted picture of the medieval cultural fabric than can be seen through the prism of codices preserved today, whose survival, as we know, can be attributed to various more or less consciously chosen phenomena.

The corpus drawn from modern catalogues is sufficiently ample to make it possible to highlight the basic components of the book/text interaction and to explain its mechanisms. On the other hand, from the qualitative point of view—that is to say the actual ways in which the phenomenon evolved—the situation is different: on the geographical level, Italian production is very poorly represented, whilst that of the German-speaking countries is practically non-existent. Moreover, on the chronological level, the total number of items dating from the 14th century is rather low.

Finally, the specific characteristics of the two populations brought together in the corpus need to be considered. The library at Cambrai holds the greater part of the codices that originate from the chapter's library, with a large percentage of volumes dating from the Carolingian era (these represent donations to the chapter made over the course of time by church canons from their own collections). For this reason, the group of codices of this provenance can be adjudged as being quite representative of manuscript production in France north of the Loire and in the southern part of the Low Countries during the last three centuries of the Middle Ages. Alongside these codices of urban origin and production, the library also received a certain number of funds originating from monasteries located at Cambrai or in its immediate vicinity, in particular that of Saint-Sépulcre, the seat of a scriptorium that was very active in the 11th and 12th centuries, and again during the 15th century.[9] However, it should not be taken for granted, in this particular case, that the trends observed always represent an accurate reflection of prevailing attitudes in the rest of France.

The corpus drawn from *Medieval Manuscripts* is also not without defects: excessive dispersion on the one hand, and excessive concentration on the other. The excessive dispersion is due to the fact that the book funds held in the minor British libraries are almost always the result of a progressive juxtaposition of a

individual basis was carried out so as to enable readers to locate them (i.e. to guarantee accessibility). In this second instance, it became a central rather than peripheral task to list all the individual constituent texts, given that the purpose of the catalogue was to answer the fundamental question 'Which volume has to be opened in order to find a certain text?'

9 Regarding this information, see Muzerelle (ed.) 2000.

large number of private collections, within which the provenance of constituent volumes is in the main heterogeneous. In most instances, an excessive concentration is the result of a pronounced specialisation in preferences vis-à-vis the selection of books, or alternatively can be ascribed to the conformism which not infrequently afflicts the world of bibliophilia.

The end result of the two phenomena is ultimately the same, though: in both instances, statistical analysis is hampered. Indeed, the excessive subdivision of typologies and provenances obstructs the creation of homogeneous groups of sufficient size, whereas the focus on one typology inevitably results in over-represented groups emerging. In the particular case being examined for the purposes of our study, the presence of a very conspicuous number of Books of Hours contributes to the effective 'sterilisation' of the 'terrain' undergoing investigation.

1 The text 'box': characteristics

The set of problems vis-à-vis mono- and multi-textuality does not belong exclusively to the intellectual realm. Indeed, one cannot disregard the fundamental contradiction that places the 'text' and the 'book' (as objects) in opposition, which effectively consists in the difficulty of crystallising the *verba volant* into the *scripta manent*: a 'textual mass' composed of a given number of words that play out in a given order has to be transformed into a sequence of graphic signs inscribed on a page divided into lines, which in turn are distributed over a certain number of leaves which, one laid upon another, constitute a volume of predetermined dimensions.

This superimposition of leaves means that, apart from the two dimensions which immediately strike the eye (height and width), when books are catalogued or the geometric characteristics of the page are analysed, a third dimension has to be considered, namely the thickness of the text block. Indeed, it is contingent on a book's thickness—and therefore, in effect, on the number of leaves it contains—that in a large part it can fulfil its role as a vehicle of written culture, both in functional (i.e. handling characteristics and robustness) and economic terms (i.e. the cost of raw materials, which, for each material, varies in relation to the amount of it used).

Needless to say, the solutions settled on will vary according to the priority placed on one or another of the various requirements. In this connection, the purchasers and makers of codices had at their disposal a full range of regulatory 'tools' that allowed them (in theory) to achieve the best compromise possible.

However, regardless of the reproduction methods employed and the production and distribution systems in place, the problem manifested itself in an almost identical way throughout time and space; therefore, once the objectives, priorities and impossibilities were defined, the search for the best compromise was entrusted to common sense and the experience of those who planned and manufactured the book. In more than a few cases, the height and width of a volume—i.e. the values which are today incorrectly referred to as its 'format'—are for the most part predetermined by the way in which the book was intended to be used (e.g. for consultation *in loco*, for collective or individual readings, or for transportion from one place to another, etc.). One of the considerations with respect to the dimensional categories imposed by a volume's intended use was the interaction between the length of the text and the factor represented by the 'cost of the raw materials' (which is to say the number of leaves that were required to construct the volume, and consequently, given the variations in the thickness of paper or parchment, the thickness of the text block). Minor adjustments in size and, above all, control exercised over the density of the written page (i.e. the size of the written area and the body of characters) made it possible, in most instances, to decide on priorities at the outset, and to satisfactorily fulfil predetermined objectives.[10]

The above having been said, none of the constituent components of the book is *per se* infinitely 'elastic'; indeed, the page cannot expand or shrink to any significant extent: the writing must remain legible, and the text block must not disintegrate. On the other hand, 'virtual elasticity' cannot always be fully taken advantage of: there are instances where per force the volume has to be issued as a pocket-sized edition, hence its text must be contained within a single volume, and so on. When, for one reason or another, the conflict between the length of the text and the material characteristics of the book under preparation starts to become more strained, the manufacture of a book has to submit to artisanal routines and will demand, in some cases, the application of unprecedented, and sometimes even 'experimental' solutions.

The observations made up to this point have the effect that a pre-established element such as the length of a text materialises as a series of physical characteristics which can sometimes differ. The materialisation of a text is as pliable as the

10 In the medieval context, an important factor should not be underestimated, namely the possibility of intervening on the 'graphic mass' of the text, thereby more or less drastically reducing the number of characters through the use of a system of abbreviations. This element is not, however, directly linked to the set of problems being addressed in the present contribution, and can therefore be overlooked.

limits of its abstract existence are rigid. In particular, with respect to the interaction between the book and the text, it should be made clear that, depending on specific requirements and necessities, one and the same text can occupy, in a codex, a greater or lesser number of leaves. Therefore, the quantity of leaves required for the transcription of a given text is a variable and hereafter will be referred to as *volumetry*. Naturally, the volumetry of one and the same text will exhibit synchronic variations because from time to time different solutions were applied, but it will also consistently show diachronic variations, if some of the solutions that were applied became established norms in artisanal practice.

Appearances notwithstanding, here it should be pointed out that the third dimension of a book presents, intrinsically, characteristics which are more complex than its other two dimensions (i.e. height and width). This becomes apparent as soon as the need to furnish a quantitative representation arises. The overall parameter known as 'volume thickness' combines an arithmetic datum of an analytical type (which it is useful and, indeed, necessary to get to grips with) with a 'man-made' datum of a syntetical type whose value is appraised by eye by the book manufacturer or reader. It is highly probable that to the medieval craftsman the number of leaves in a book had a value that its thickness did not have, and vice versa. Based on specific needs, he would reason either in geometric terms (when seeking to harmonise the volumetric proportions of a book) or in numeric terms, which is to say in terms of leaves, or rather, quires: the latter approach was more useful where planning was concerned, in that the number of leaves and quires was objectively assessable, could be established in advance, and above all could be physically 'bound'.

Because a volume's thickness has these two different aspects, ideally one would measure it in two different ways: in millimetres, and in terms of the number of leaves it contains. However, in practice the first solution is not achievable, for the simple reason that no catalogue mentions the thickness of volumes.[11] Therefore, one is constrained to limit oneself to evaluating the third dimension of a volume using the number of leaves as a unit of measurement. it contains. Thus we shall define the *capacity of a volume* as the number of leaves it is composed of.[12]

11 To this we must add the challenge of obtaining a reliable measurement of the overall thickness: the thickness of a volume can, in fact, vary to a surprising extent due to a number of factors which, in the present context, can be regarded as 'parasites', namely the flatness of the support and the characteristics of the binding. Another factor that hampers the possibility of establishing a linear correlation between the measurement in millimetres and the leaf count is of course the thickness of the writing support, which can show considerable variations in different situations and historical periods (see footnotes 25 and 27).

12 This is the *capacity* that, should the need arise, we can define as *conventional*, whereas we can define the *geometric capacity* as the measurement in millimetres of the thickness of the volume.

The problem as regards the book/text interrelationship presents, from the outset, as a conflict between *volumetry* and *capacity*: not only must the 'box' adapt itself to the texts it has to contain, but the texts, in order to attain a material existence, must in turn adapt themselves to the 'box' they are to be accommodated in. Both parts of the contradiction presuppose that both the texts and the 'box' are endowed with a certain degree of elasticity, but it is easy to see that their elasticity cannot be infinite. In particular, we can liken the 'box' to a flexible container whose depth can vary up to a point, and upon which the volume of the text exerts, as it were, a certain 'pressure' (*textual pressure*). If the volumetry is insufficient, the textual pressure will not be sufficient to make it possible for the 'box' to be created. Conversely, if the volumetry is too great, the pressure will be excessive and the 'box' may 'explode'. Here, it should not be necessary to point out that one is speaking metaphorically, and furthermore that the chosen metaphor is perhaps not the most fitting.[13]

In order to ensure that the 'box' came into being, the artisan could be encouraged to increase its volumetry artificially—a not altogether judicious expedient, since it entails wasting space[14]—just as, conversely, he could be encouraged to 'compress' it as much as possible so as to ensure that it was not too thick. The latter solution was adopted per force in not a few instances. When both of these solutions proved to be impractical, the only way forward was to bundle together two or more texts in the same text block, or alternatively to bind one and the same text into two separate volumes. Viewed from this perspective, the multi-textuality of a book can therefore be considered the result of *artisanal necessity* before it can be regarded as an expression of *intellectual free will*, even if, naturally, the two points of view are not mutually exclusive.

The limits which, when exceeded (by excess or by default), mean that a book cannot take physical form, or would result in it being unusable, cannot be predefined in abstract terms. Instead, they can only be ascertained through direct visual observation.

---

13 The 'explosion' of a book—which obviously cannot be taken literally as the detonation of a bomb—can be roughly represented by the breakage of sewing threads and / or the splitting of boards.

14 The possibility should be considered, however, that the waste of space—and therefore of material—might become a functional necessity (i.e. the user has little reading aptitude) and / or fulfil a 'social representation' objective (i.e. the ostentatious nature of the waste reflects the financial standing of the purchaser within the social hierarchy). A less extravagant solution, which could be applied when it did not create a conflict with the way in which the book was to be used, consisted in transcribing a text on to pages of small dimensions.

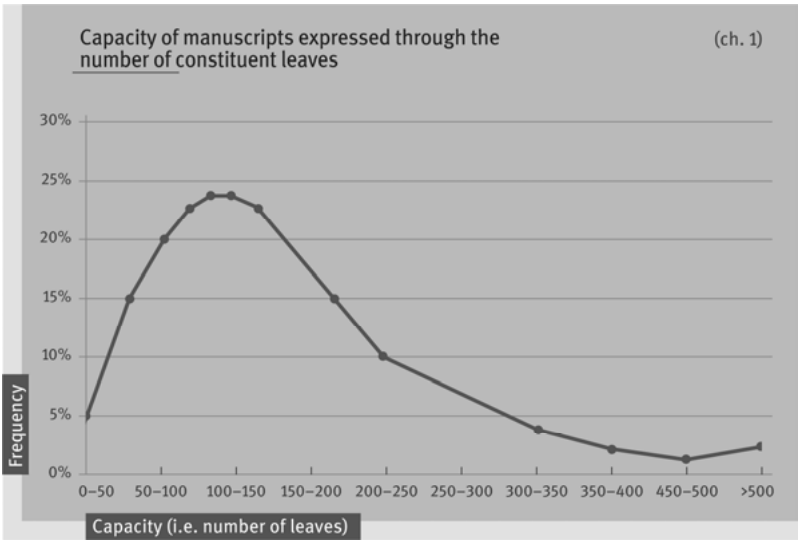


Chart 1: Capacity of manuscripts expressed through the number of constituent leaves

Chart 1 shows the overall distribution of the Western manuscript's capacity from the 9th to 15th centuries. One can immediately apprehend that there is an *optimal zone* where the majority of the codices—composed of between 100 and 200 leaves—are found. Conversely, if one arbitrarily sets as the threshold of viability at the two ends of the distribution a frequency of 5%, the acceptance range where the text block enjoys an independent existence will vary from 50 to 300 leaves.

The picture does not change if the global curve is broken down into centuries, as shown in Chart 2. However, a difference will be noticed between the 'monastic' period and the centuries that followed: at the end of the Middle Ages—and above all in the 13th and 14th centuries—the percentage of codices with a capacity exceeding 200 leaves is consistently higher, and descends to 5% only when the leaf count exceeds 350. During the 9th to 12th centuries, the frequency rate is already nearly 5% when the leaf count exceeds 250, a value greater than that seen in the 13th century in 32% of volumes.

If one 'zooms in' on the codices with a capacity of fewer than 50 leaves at the lower end of the curve (Tab. 1), it will be plain to see that the volumes whose capacity is under 30 leaves are truly a rarity, although they constantly increase in number from one century to the next. Once again, it cannot be excluded that some of these are in fact *disiecta membra* (i.e. scattered fragments) sourced from larger codices.

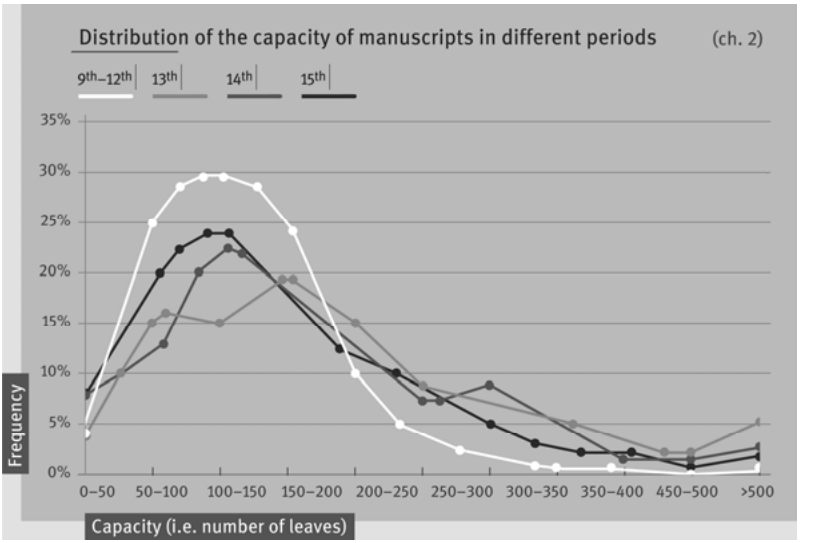


Chart 2: Distribution of the capacity of manuscripts in different periods

Distribution of the capacity of manuscripts (tab. 1)

Capacity of manuscripts	9th–12th	13th	14th	15th
10–20 leaves	0	0	0	10.0%
20–30 leaves	0	8.3%	13.3%	7.5%
30–40 leaves	10.0%	25.0%	33.3%	35.0%
40–50 leaves	90.0%	66.7%	53.3%	47.5%
30–50 leaves	100.0%	91.7%	86.7%	82.5%

Tab. 1: Distribution of the capacity of manuscripts

Concerning the capacity of volumes, once it has been established that the propensity curve is not uniform, one has to ascertain whether or not extra-textual factors (of a material or other nature) exist that influenced the choices made by craftsmen in this regard. One of these factors could be the size of pages. It is known that almost all the elements that contribute to the appearance of a codex are positively correlated to this parameter—above all, the exploitation of the written area, and as a result the volumetry of the texts—owing to the so-called 'principle of propor-

tionality'.[15] One must therefore pose the following question: is the optimal capacity of a book—which is to say the peak of the statistical distribution observed in Chart 1—always the same, no matter what the dimensions of the leaves happen to be?

To answer this question, the population was divided into two size categories,[16] namely 'small' (<400 mm), and 'medium-large' (>400 mm), the respective distributions of which are shown in Chart 3. The two distributions differ significantly: the peak for small codices is located at between 50 and 150 leaves, whilst for the larger codices it is located at between 100 and 200 leaves[17]. The existence of a correlation is confirmed by the evidence furnished by Chart 4, which sets out in parallel, at a global level, the evolution of the manuscripts' capacity, together with that of their size. However, the curve representing all the codices shows an irregular trend among the smaller ones, owing to the (not to be overlooked) presence of volumes that are small but which have large capacities (essentially pocket or so-called 'saddlebag' Bibles and breviaries). Such anomalies tend to disappear as soon as these typologies are eliminated from the sample.[18]

15 For an earlier formulation of this principle, see Ornato 1994, 10.

16 In order to be consistent with previous investigations and established usage, the dimensions of codices are represented by the parameter 'size' (French *taille*, Italian *taglia*), or semi-perimeter, a term which is certainly less well suited than others (e.g. surface area, diagonal) to summarising the concept and representing variations (Gumbert 2001). However, the solution put forward by Peter Gumbert—which is to consider only a volume's height—seems excessively reductive.

17 The divergence seen in the two distributions becomes even more evident if the period spanning the 9th to 11th centuries is considered separately. During this time 'textual pressure' almost never reaches excessive levels.

18 Likewise, one observes a reduction in the capacity of very large codices, which is very likely ascribable to factors of a functional nature (a volume's weight and ease of handling).

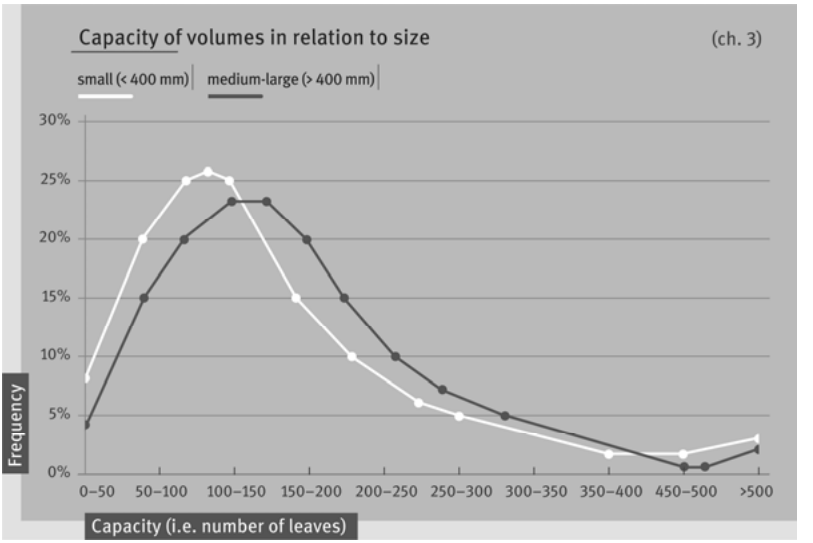


Chart 3: Capacity of volumes in relation to size

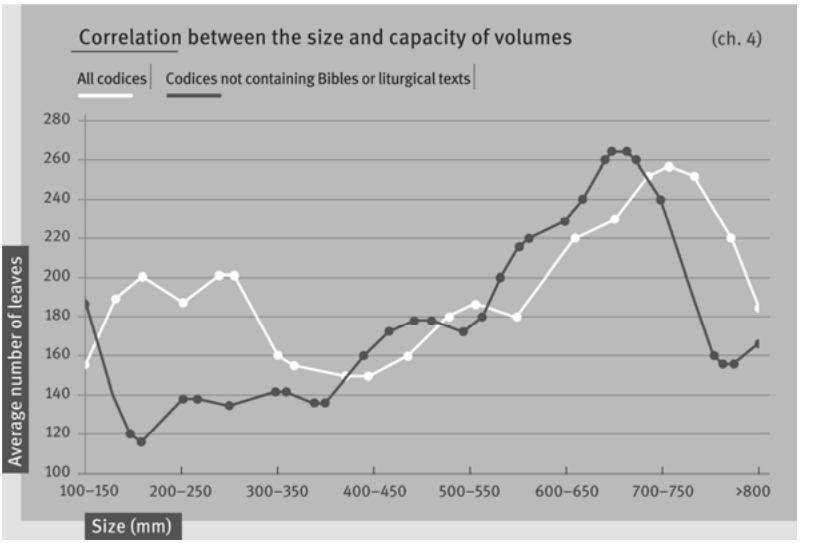


Chart 4: Correlation between the size and capacity of volumes

What, then, is the explanation for the correlation between the number of leaves contained in a book and its size? Two hypotheses can be posited straight away, as follows:

– One is dealing with a mechanical effect exerted by the text block mass: large tomes contain texts of greater volumetry, and therefore the increased textual pressure tends to swell the capacity of the codex.
– The correlation is due to a 'basic principle' effect, which to a certain extent exerted its influence on artisanal practices. Thus, just as in the proportion represented by the two edges of a sheet—which evolves over a small range[19]—one can assume that the proportion of the rectangle formed by the top edge (or bottom edge) of a volume will also be subject to limitations of a not well-defined nature (lying on the boundary between aesthetics and functionality), which prevent the parallelepiped-book from assuming proportions considered in advance to be aberrant. The proportion of the 'edge rectangle', and hence the relative importance of the third dimension of the book, will from now on be termed *bulk* and will be expressed—in the absence of a reliable measurement of the thickness of the text block—by the relationship between the number of leaves a volume contains and its width.[20] Figure 1 illustrates the concept of *bulk* in a clear way: notwithstanding their different sizes, the three volumes shown schematically have the same proportional value and are perceived by the observer as the same object, in the sense that the two larger volumes represent enlarged versions of the small one.[21]

19 In the Western manuscript, the majority of volumes very seldom deviate from the so-called 'invariable proportion' (1/ √2= 0.707). The phenomenon is particularly apparent in paper codices (see Bozzolo / Ornato 1980, 287–318).

20 The numerical value representing the *bulk* will therefore be interpreted as '*N* leaves per centimetre of width'.

21 Needless to say, Fig. 1 cannot illustrate the dual value that represents the concept of capacity as defined above. In fact, just as in the case of capacity, we can distinguish a *geometric bulk*, calculated on the basis of the thickness of the volume, and a *conventional bulk*, calculated on the basis of the number of leaves it is composed of. In this case, too, one is dealing with interdependent parameters, but neither one can be substituted by the other.

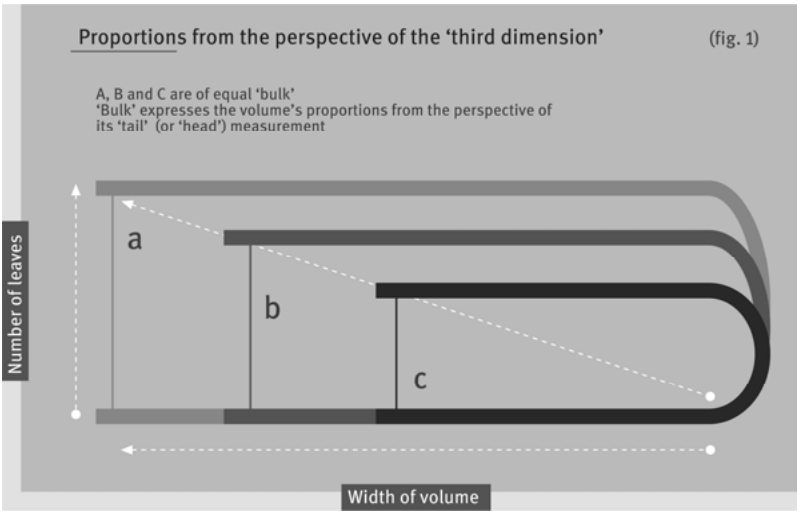


Fig. 1: Proportions from the perspective of the 'third dimension'

If one is dealing with the mechanical consequences produced by exceptional circumstances, the correlation should only occur in larger book sizes, and above all in the 13th and 14th centuries when, as has already been indicated, a remarkable degree of textual pressure can be observed. If, on the other hand, one is dealing with a sort of widespread 'principle', the phenomenon should manifest itself in a linear fashion among all book sizes and throughout all codex production periods.

Chart 5[22] shows, century-by-century, how the phenomenon develops, and confirms the second hypothesis. One can readily see that the period spanning the 9th to 10th centuries stands out owing to a lower capacity value, irrespective of the volumes' sizes. What really counts, though, is the fact that all the curves exhibit the same trend, and above all that their slopes are identical. This indicates that the phenomenon is not dependent on the textual pressure that weighs on the capacity of the volume. If this were not the case, the slope of the curve would be more pronounced for the 13th and 14th centuries, owing to the presence of a not insignificant number of very long texts.

22 In order to eliminate incidental distortions, the chart does not include Bibles or liturgical codices.

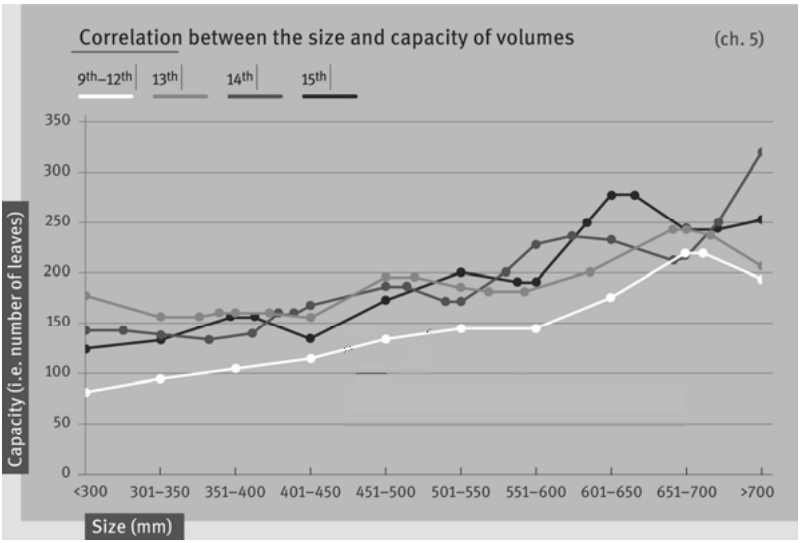


Chart 5: Correlation between the size and capacity of volumes

However, if one is indeed dealing with a principle, what exactly is the 'rule' that had to be respected?

In order to answer this question, it is no longer necessary to verify how a volume's capacity evolves, but instead how its *bulk* evolves in relation to its size.

At first glance, it would seem that the third dimension, despite increasing in its absolute value in relation to a volume's size (Chart 5), decreases in its relative value (Chart 6, lighter line): in other words, a codex tends to be less corpulent as it increases in size. It should be noted, however, that this trend decreases significantly as soon as Bibles and liturgical tomes are removed from the corpus, and that in any event, the *bulk* remains almost constant when a volume's size exceeds 300 mm.

The period-by-period representation (Chart 7) confirms that the excessive *bulk* seen in small volumes is not a result of the 'rule', but instead should be interpreted as an unusual phenomenon arising from exceptional circumstances: the curve corresponding to the period spanning from the 9th to 12th centuries—during which textual pressure was kept within reasonable limits—is, in fact, completely flat, and shows levels that are consistently lower than those seen in the centuries that followed. In essence, one can deduce that in normal circumstances the 'ideal box' tended towards the same optimum proportions, irrespective of its size.

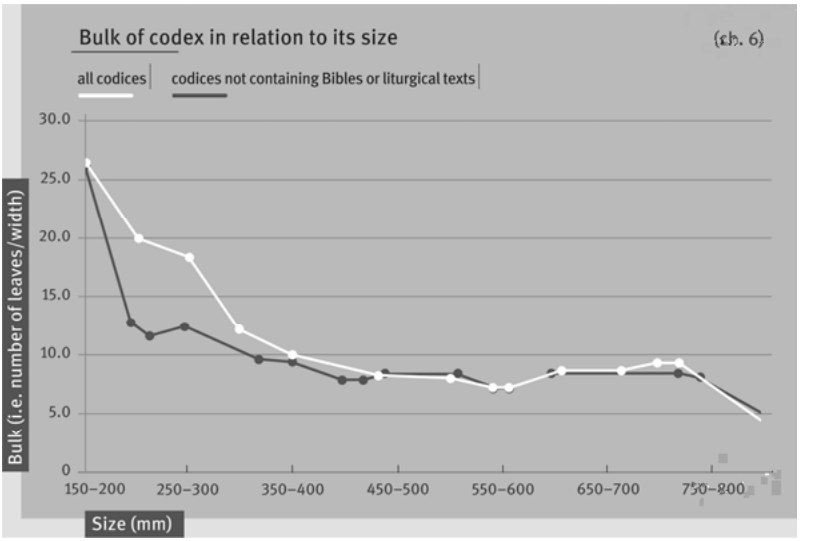


Chart 6: Bulk of codex in relation to its size

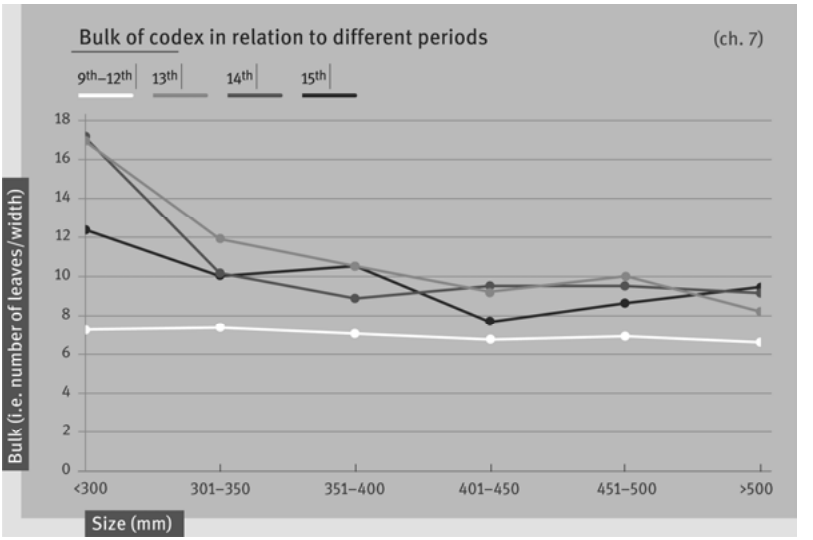


Chart 7: Bulk of codex in relation to different periods

Therefore, the goal aimed at was that of homogeneity (see Fig. 1), tied, however, to relatively low *bulk* values: the constant for the 9th to 12th centuries is, in fact,

roughly 7-7.5 leaves per centimetre of volume width. This means that, for the period in question, a volume measuring 200 mm × 300 mm contains, on average, from 140 to 150 leaves, which is to say 280 to 300 pages, a value that would not seem particularly low or excessively high even in modern times. Thus, the medieval artisan shunned, unless constrained by factors beyond his control, extreme solutions. This is represented in schematic fashion in Figure 2 (i.e. the *blade-form* book, and the *tower-form* book).

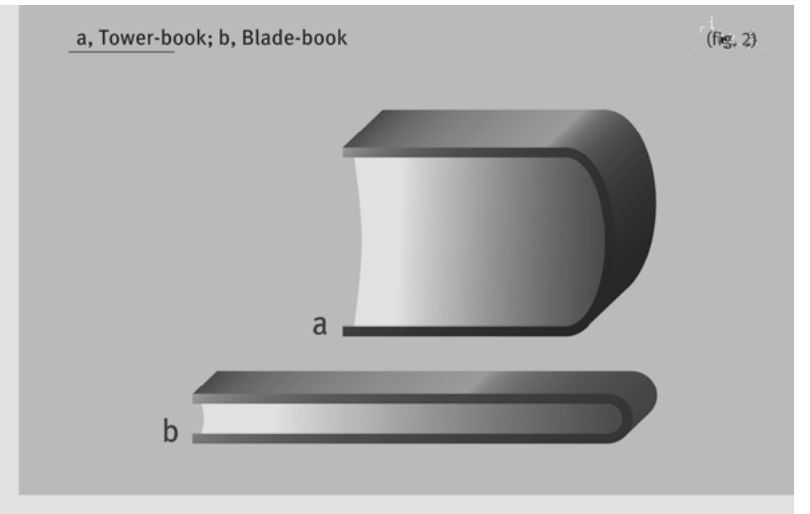


Fig. 2: Tower-book and Blade-book

It is difficult to establish exactly why a volume's *bulk* tended to stabilise around values that to the modern reader seem 'normal'. The simplest explanation—but at the same time the most convenient, and without doubt the most tautological—is based on a sort of 'harmony principle' that is inherent to the aesthetics of the book, and which is ultimately analogous to those which govern the beauty of the human form. In fact, just like our bodies, ideally the book should neither be too fat nor too thin. However, even if it is undeniable that both blade-form and tower-form books do not sit well with the sensibilities of habitual readers or craftsmen,[23] one should also not forget that a blade-form book is not at all cost-

23 Here, the term 'sensibility' is used intentionally in order to highlight the equivocal nature of the users' reaction. Indeed, the line that divides poor taste from an artisan's lack of skill is

efficient (because it unnecessarily increases the number of bindings required) and is inadvisable from a functional standpoint (the splitting up of a long text into numerous volumes increases the risk of their becoming scattered or lost). In the same way, but for different reasons, the fat book (i.e. tower-form) is not well received, since excessive *bulk* increases its weight and has a negative impact on handling characteristics. In addition, an increase in the number of quires certainly jeopardises the solidity of the text block and introduces the risk of splits between the spine and boards occurring. *Bulk* stability can therefore also be interpreted in terms of the optimisation of the book's weight/surface area ratio.

Chart 7 poses a second question: what can we make of the fact that, under the same conditions, the Western codex's *bulk* is consistently greater from the beginning of the 13th century? There can be no doubt that the growth in the number of leaves is attributable to an increase in textual pressure in a straitened economic setting which, simultaneously, is at the root of a far more intensified and carefully calculated exploitation of the written page.[24] However, it is not necessarily the case that the increase seen in the visual *bulk* of volumes was accompanied by an increase in their material *bulk*, inasmuch as it is possible that the parchment used in the 13th to 15th centuries was on average thinner than that employed in previous centuries.[25]

often difficult to identify, and not infrequently even those who make such judgements are unable to distinguish between the two. In any event, it is quite likely that such assessments are made on the basis of a synthesis of aesthetic, economic and technical elements whose individual contributions are no longer clearly identifiable. Also relevant is the fact that aesthetic judgements are often based on a tradition that at one and the same time is seen as a rule and a benchmark of good taste (which those concerned would find 'troubling' to deviate from). In turn, such a rule can itself be the residual product of functional needs, an awareness of which has been lost in the mists of time. A good example of this process is the dimensional hierarchy which can be observed in the four margins of a page (the outer and lower margins are always wider than the inner and upper ones). This hierarchy, in all likelihood dictated by the presence of *lisières* located at the edges of parchment leaves, survived over time and can also be seen in paper codices and printed books, even where it is no longer strictly necessary.

24 See Bozzolo et al. 1984, 197–221.

25 Unfortunately, measurements of parchment thickness carried out (according to the same criteria) on geographically and chronologically targeted corpora are lacking. Nevertheless, the few measurements that are available seem to confirm the hypothesis (see Bianchi et al. 1993, 152–153). On the other hand, it is altogether likely that the use of thinner parchment was motivated by a desire to not increase in an excessive way the visual *bulk* of a volume (see footnote 27).

2 Texts in 'boxes'

Up to this point, we have seen how the text 'box' attempts to adapt itself to different circumstances, either by increasing or reducing its capacity. But we have also seen how its 'elasticity' is far from unlimited, and how, on the formal and functional level, the parallelepiped-book has to adapt itself to proportional rules that it cannot ignore unless compelled to do so by specific cultural imperatives. Needless to say, as has been indicated above, it is more common to see an exception made in favour of a tower-form book than for a blade-form one: only rarely, in fact, does necessity demand the fabrication of large volumes of very low capacity, even if such volumes do in fact exist.[26] On the other hand, it is easy enough to understand that texts which have a very high volumetric value struggle to find their place in the canonical forms preferred by book artisans.[27]

Having carried out a general analysis of the interrelationship between the book and text from the standpoint of the book, it is now time to examine the problem from the standpoint of the text—or rather, from the standpoint of witnesses, given that the volume of one and same text can vary in relation to the material characteristics of the 'box' (i.e. dimensions and *mise en page*), and also because different transcriptions of the same text often exist contemporaneously in different books. (Here, the term 'witness' is borrowed from the lexicon of textual criticism, and is intended to mean any copy of a given text.)

On a more abstract and general level—which does not, to be sure, correspond to the actual dynamic of a process where no space yet exists for planned cultural initiatives—the quantitative increase in the cultural fabric presupposes the production and distribution of a certain number of text witnesses, be they ancient, recent or 'unknown'. But precisely how many? The answer, which is

26 These are choir books which date from later times (the 16th to 18th centuries) which, in order to be within the eyeshot of the members of a choir, make use of very large script and 'super-Atlantic' volume dimensions (up to a metre in height!). Naturally their *bulk* can only be very low, otherwise their excessive weight would make them impossible to handle.

27 The best-known examples are the pocket-sized University Bibles of the 13th to 14th centuries, which often contain as many as 600 leaves. Pocket breviaries can also be remarkably thick, but in contrast to the abovementioned Bibles (which at that time were read, in theory, in their entirety, but not necessarily in a strict sequence, by individuals), these were usually subdivided into two or more volumes (i.e. Santoral-Temporal and / or summer-winter) which could be used separately. It should be borne in mind–even if accurate measurements are still lacking–that the visual 'stress' and physical heaviness of the volume experienced by the readers of such Bibles was mitigated by the use of very thin parchment which, by contrast, was not used in breviaries.

dictated by common economic sense and pure reason, is simple and immediate, namely as few as possible, which is to say only the number that is necessary in order to satisfy needs. Essentially, one is dealing with the difference between already usable volumes—which are kept in libraries or circulate on the market—and the unsatisfied demand at a given time and place. The overall situation is the direct result of individual behaviours: a witness is acquired—and usually only one—exclusively when it is not already possessed.[28]

The situation does not appear to be very different when one no longer considers the problem in textual terms, but instead in material terms. In fact, it is not enough to determine the number of witnesses needed to accomplish a rapid and efficient spread of the cultural message: it is also necessary to define the optimal number of books that make it possible to perform this role at low cost to individuals and to society. However, the problem and its various aspects and are, of course, rather more complex than outlined above.

As is practically always the case, extreme solutions prove to be unfeasible: the fabrication of a quantity of books which is equal to the number of text witnesses would be unviable from an economic standpoint, since it would involve the manufacture of numerous bindings, and raise the risk of their becoming scattered or lost. Such a strategy is also undesirable from an aesthetic perspective, since it would result in a proliferation of blade-form volumes. Equally unsound is the 'Solomonic' solution, which without doubt is the most satisfactory from the standpoint of the box's 'interests'. This consists in placing the total number of text witness leaves into volumes of optimal capacity—a strategy rather similar to the one employed by librarians when they had to jumble together a large number of *membra disiecta*[29] in a miscellaneous codex.

---

28 A concrete example of the way in which the said process functioned can be seen in the evolution of library heritage in 14th-century Paris. In the antecedent period, professors and students individually purchased a large number of witnesses of the most 'in vogue' texts that they required in order to carry out their studies. Many years later, the bequest system led to the merging of the witnesses into one reservoir, into which professors and students could dip at their pleasure without having to spend a king's ransom. Very soon, though, the accumulated material exceeded the 'overall reading capacity' of the members of the collective (whose constituent numbers stagnated or diminished due to demographic slippage). As a result, the collective decided to get shot of the surfeit, either so as to purchase witnesses of less well-disseminated texts, or in order to be able to focus on more pressing financial outgoings. The surfeit ended up on the second-hand market, which in fact made it necessary to produce new witnesses (see Bozzolo / Ornato 1980, 89 onwards and 113).

29 Yet, even if it was not feasible at a collective level, this approach was certainly employed by individuals, as is borne witness to by paper codices (above all, those originating from German areas). Alongside the anticipatory planning of a book whose characteristics were defined in

It goes without saying that the relationship between the number of witnesses and the quantity of books can only be the result of a compromise struck among various needs. It also goes without saying that—and it is important to make this point—no matter what dynamic leads to the birth of a book, the filling of the 'box' is not based solely on economic, functional and/or volumetric reasoning, but also on essential cultural needs. The juxtaposing of texts is not a purely random process; rather, it has to respect a certain logic, namely typological affinity and the fulfilment of common objectives, etc. In addition, it should be remembered that the total separation of witnesses results in an excessive fragmentation of the cultural fabric. Conversely, the combination in one and the same volume of related or complementary texts can generate a synergy that would not otherwise exist if the same texts were circulated separately.[30]

The above having been said, irrespective of the pressure they might exert on the book-object, cultural demands cannot overlook the fundamental laws that govern the interaction between books and witnesses. In concrete terms, we can make a simple observation: the overall distribution of the 'number of leaves' parameter (see Chart 1) shows that almost all the texts composed of fewer than 50 leaves were considered of insufficient volume to create an independent codex. Conversely, almost all the texts composed of more than 200 leaves—which is to say those that exceed the optimal capacity of the 'box'—tended to monopolise the entire capacity of a codex, insofar as the addition of further texts would have resulted in a violation of the canons of proportion with respect to a volume's *bulk*. On the other hand, regardless of the degree of affinity or 'attraction' between two texts, it is obvious that two witnesses, each composed of 10 sheets, if put together would not be able to properly occupy an entire codex, just as two witnesses each composed of 300 leaves could only with considerable difficulty be placed together within a single volume. In such circumstances, irrespective

---

advance, and which had to contain one or more predetermined works, we can place a concept that views the book as an object *in fieri* composed of quires transcribed at different times (sometimes even years apart), and grouped together—not necessarily in chronological order—once the critical capacity of the 'virtual box' had been reached (either optimal or maximum). This did not simply represent a last ditch practical solution applied by someone who was not able to bear the financial burden of the planned production of a book. As a strategy, it did however have the advantage of modularity, because each text corresponds materially to one or more quires, and therefore the book presents as an object that can be assembled and disassembled according to specific needs.

30 Since the cultural aspects of multi-textuality lie outside the scope of this contribution, we refer the reader to all the other articles published in the proceedings of the *Il libro miscellaneo* conference.

of any cultural considerations, the presence and number of multi-textural codices depends, essentially, on two factors:

– The number of necessarily 'gregarious' witnesses, which is to say ones that cannot enjoy an independent existence. As we have already seen, this effectively means witnesses composed of 50 or fewer leaves. These 'gregarious' witnesses have to be distributed among a certain number of volumes, which results in an increase in the number of multi-textual codices.[31]
– The number of witnesses with volumetric values greater than the optimal capacity of the codices (200 leaves). These tend to stand alone, a9nd therefore give rise to unitary codices. This factor has the opposite effect of the previous one.

The rate of multi-textualism will be as high as the percentage of the first category is large, and in the second category as small as the percentage is low.

What, then, in the Western Middle Ages, does the distribution of the length of witnesses look like? The rather telling answer can immediately be apprehended in Chart 8. The curve refers to the 9th to 12th centuries, but its shape is almost identical to that seen in all the other periods: the number of witnesses with a volumetry of fewer than 50 pages always exceeds 50%, whereas that of codices of equal capacity is lower than 5%.

Such a preponderance of short texts is rather surprising and defies common sense, insofar as scholars of intellectual history and text editors are generally inclined to focus on the most well-known works, which as a result are more widely disseminated and have text masses that are quite large. However, as is often the case, the reality is very different from one's expectations, and regard-

31 Once the need to bundle together short texts within a single volume had been established, their agglomeration could be accomplished in two different ways. Either the short pieces could be bundled together to form one volume, or alternatively they were distributed among several codices containing relatively long texts. The choice between either of these two options did not depend purely on chance, but was also contingent on the content of the texts in question. Indeed, not only could the texts be considered 'gregarious' from a material point of view, but also culturally 'subordinate', if they were regarded as being unsuitable for independent circulation (such texts could also be seen as 'semi-subordinate'; for example, the biographies of authors presented in their works). Any evaluation of 'multi-textuality' should take these somewhat hazy distinctions into account. Here, it should be mentioned that the choices described above were often determined by a number of concurrent reasons, and that the material aspect always exerted its influence: for example, analytical indexes were treated in the same way as 'subordinate' texts, and are normally found agglomerated with the main text. However, if such indexes happened to be particularly large, they tended to take up an entire codex (more often than not this was the case with concordances).

less of the subject being examined—be it the craters of the moon, the volume of gold nuggets, or the length of texts—and regardless of causes, the principle of *minimum frequentius* never ceases to impose its universal rule.

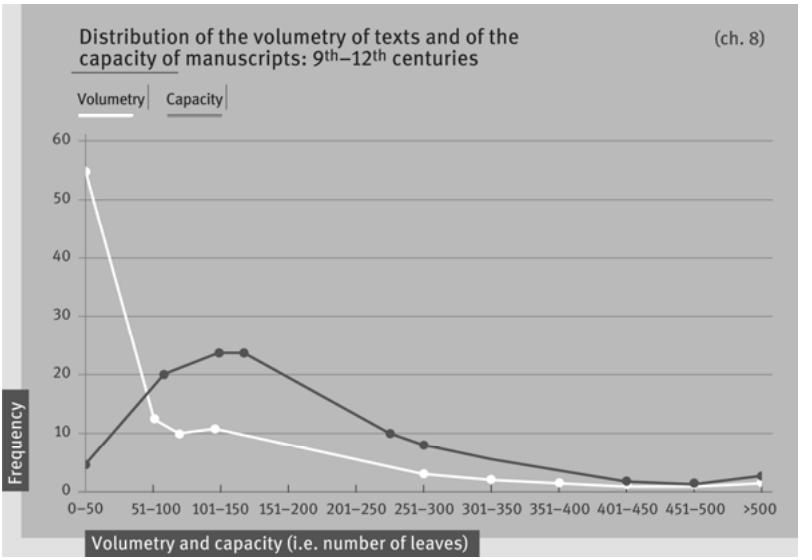


Chart 8: Distribution of the volumetry of texts and of the capacity of manuscripts: 9th–12th centuries

However, an important issue has yet to be clarified: to what extent does the phenomenon observed reflect fundamental tendencies in intellectual output, or instead basic trends in manuscript production? In other words, is the superabundance due to the fact that there was an overall preference for the production of short texts, or instead to the fact that short texts were copied more frequently?

This question leads directly to the practically 'virgin' terrain represented by textual statistics.[32] Up till now, nobody has bothered to evaluate in statistical terms the textual mass of the writings handed down to us from Antiquity and

32 Still lacking, unfortunately, is a foundation of data that would make it possible to carry out a methodical exploration of this terrain. For example, it would be indispensable to have at one's disposal a fund of reliable statistics relating to textual mass (i.e. number of characters) and volumetry (i.e. distribution of the number of leaves in manuscript witnesses) of several representative works originating from different historical eras and contexts.

the Middle Ages. In theory, this is not an impossible task. However, it would be impossible to fulfil the objective by counting one-by-one all the characters in each and every work. One is therefore constrained to substitute a comprehensive count for faster (albeit less accurate) methods, using already available statistical indicators.

The less imperfect solution consists, according to us, in surveying the space occupied by all the texts in a single collection which is as complete as possible, and which has a high degree of typographical homogeneity. Thus, the number of columns occupied by a large number of texts was measured in the *Patrologia Latina*. The *Patrologia Latina* certainly has the drawback of being partial in chronological terms, in addition to being increasingly less complete with the passage of time. Furthermore, the global count is not without distortions. However, these shortcomings are not sufficiently severe as to be detrimental to the validity if the estimate.

The results of the complete survey of the writings of quantitatively significant authors—in the sense that their complete works occupy at least a hundred columns of the *Patrologia Latina*—for a total of approximately 2,000 texts are shown in Chart 9 and reproduced in a more complete form in Tab. 2. The selection was based above all on practical considerations and was aimed at eliminating from the outset the large number of texts whose status has not been clearly defined (such material represents texts, but not 'works' in the true sense of the word).[33] The choice therefore reflects, in its totality, the output of fully fledged authors, rather than mere occasional writers. The exclusion of 'occasional writings' inevitably generates a distortion. However, it should be noted that the inclusion of (whether rightly or wrongly) rejected texts, far from reversing the observed trend, would have disproportionately amplified it, given that they all belong to the category which encompasses short texts.[34]

33 The *Patrologia Latina*—which comprises a total of about 6,000 texts—contains, as is commonly known, a not negligible number of acts, public epistles and other archival documents.

34 So pronounced is the phenomenon that it is not at all easy to represent in graphical terms. In fact, in order to obtain a readable graph, it was necessary to subdivide the length of the texts, expressed as columns of the *Patrologia Latina*, into several logarithmic classes. In practice, this means that the extension of the length classes is not constant, thus the first class includes all the texts of 1–8 columns in length (extension = 8); the second includes all the texts of 9–24 columns in length (extension =160), and so on.

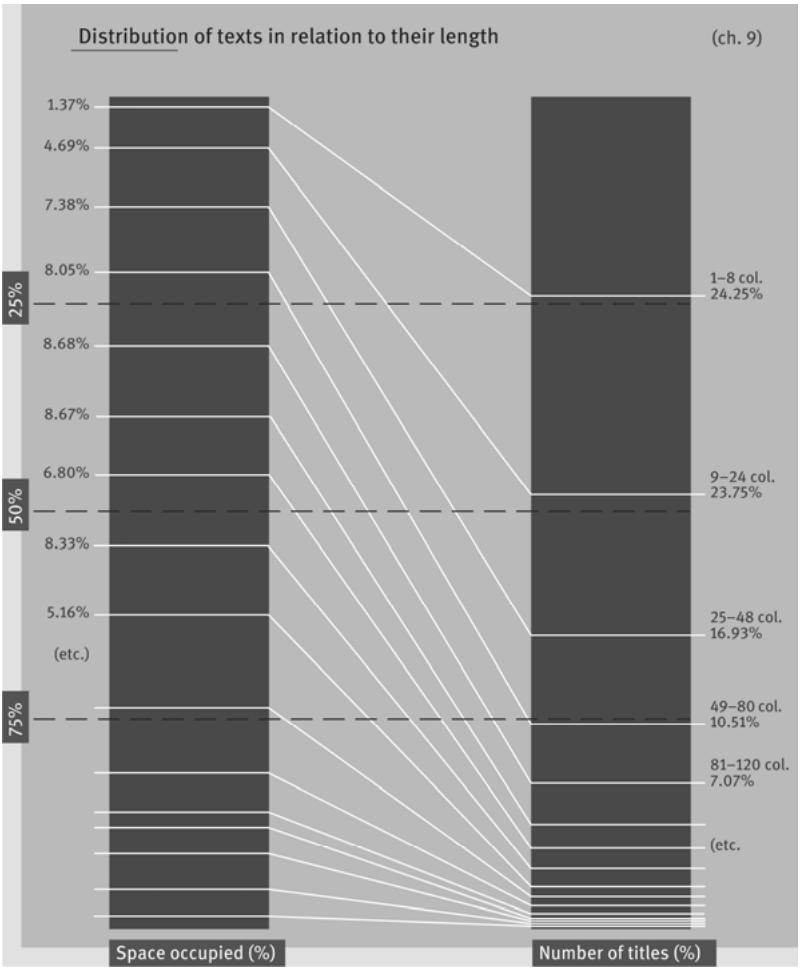


Chart 9: Distribution of texts in relation to their length

The upper sequence in Chart 9 represents the distribution of works in relation to their textual mass. It can be seen, in this connection, that the class of texts which occupy fewer than eight columns constitute, on their own, some 25% of the total.

Distribution of texts in relation to their length (tab. 2)

Length of texts (Columns in the *Patrologia Latina*)	Number of texts		Space occupied	
	% per class	Cumulative %	% per class	Cumulative %
1–8	24.3%	24.3%	1.4%	1.4%
9–24	23.8%	48.0%	4.7%	6.1%
25–48	16.9%	64.9%	7.4%	13.4%
49–80	10.5%	75.4%	8.1%	21.5%
81–120	7.1%	82.5%	8.7%	30.2%
121–168	5.0%	87.5%	8.7%	38.8%
169–224	2.8%	90.3%	6.8%	45.6%
225–288	2.7%	93.0%	8.5%	54.1%
289–360	2.1%	95.1%	8.3%	62.4%
361–440	1.1%	96.2%	5.2%	67.6%
441–528	1.1%	97.2%	6.2%	73.8%
529–624	1.1%	98.3%	7.5%	81.3%
625–728	0.6%	98.8%	4.7%	86.0%
729–840	0.2%	99.0%	1.9%	87.9%
841–960	0.0%	99.3%	3.3%	91.2%
961–1088	0.4%	99.7%	4.3%	95.5%
1089–1224	0.2%	99.9%	2.9%	98.4%
1225–1368	0.1%	100.0%	1.6%	100.0%

Tab. 2: Distribution of texts in relation to their length

When combined with the successive class, which includes texts that are necessarily 'gregarious', one arrives at a figure of almost 50%. The lower sequence represents, on the other hand, the space taken up in the *Patrologia Latina* by each of the classes of texts in the upper sequence, thus one can see that the two previous classes—which are the most numerous by far—occupy only 6% of the total space.[35]

35 In reality, this discrepancy is not at all surprising: it is far quicker and easier to compose a text consisting of only a few pages than to plan, compose and perfect a work of considerable length. In order to invert the distribution presented in Chart 1, it would be necessary for the vast majority of authors to have produced only medium to long texts, which, needless to say,

The large number of texts of low or very low volumetry found in our corpus is in any event a faithful reflection of the fundamental trends seen in intellectual output when viewed from a quantitative perspective. Such trends obviously had repercussions for manuscript production. Indeed, the superabundance was sufficient to render multi-textuality a necessity, rather than merely the result of a free and premeditated choice.

The data presented in Tab. 3 confirm the validity of the two previously defined criteria, namely that the respective number of witnesses that tend to be 'gregarious' and of those which tend to be 'solitary' determines the percentage of multi-textual texts. Indeed, in the 9th to 12th centuries, where one observes the maximum number of witnesses that are necessarily 'gregarious' and the minimum number of 'solitary' ones, the highest degree of multi-textuality is reached, whereas the 14th century, where the situation is reversed, presents the lowest percentage of multi-textual volumes.

It is plain, however, that the percentage of multi-textual codices dating from the 13th and 15th centuries does not coincide with one's expectation: the value for the 15th century should be greater than for the 13th, and this implies that the result obtained is in part attributable to the contribution of factors besides the two already defined basic criteria.

In reality, if multi-textuality is above all an inevitable phenomenon, it cannot be reduced to a mere arithmetical problem.

represents a rather unlikely scenario. To this it should be added that the difficulty of producing and publishing long texts is not proportionate to the number of characters they contain, but certainly increases more rapidly: the more the amount of time to produce a work increases, the more likely it is that circumstances within or beyond the control of the author will intervene and hamper its completion.

Percentage of multi-textual codices and factors which exert an effect on the rate of multi-textuality (tab. 3)

Volumetry of witnesses	9th–12th	13th	14th	15th
'Secondary' (< 50 sheets)	77.3%	60.5%	55.9%	62.8%
'Solitary' (> 200 sheets)	4.5%	21.0%	22.2%	15.3%
Predominance of 'secondary' (variation in the percentages)	72.8%	39,5%	33.7%	47.5%
Percentage of multi-textual codices	44.0%	23.2%	17.2%	21.5%

Tab. 3: Percentage of multi-textual codices and factors which exert an effect on the rate of multi-textuality

In fact, a propensity exists to group together two or more witnesses in one and the same codex that cannot be explained simply by the way in which the 'boxes' and texts interact. This propensity is most apparent in a sort of 'liberty zone', which is to say in codices whose capacities make it possible, in theory, for a not necessarily 'gregarious' witness to either monopolise an entire volume, or to be agglomerated with other witnesses.

The phenomenon can be seen in Tab. 4,[36] which relates to the 9th to 12th centuries. The first column represents the number of codices in the corpus whose capacities are shown in the second column. The third column represents the number of witnesses in the corpus whose volumetry is indicated in the second column. The fourth and final columns show, for a given volumetric value, the number (total and percentage) of witnesses which monopolise an entire codex or which, conversely, share space with other witnesses.

36 The total number of codices in the classes that exceed 300 leaves is too low, for which reason the corresponding percentages were not calculated.

Use of texts in the 9th–12th centuries[36] (tab. 4)

Codices	Leaves	Witnesses	Witnesses forming a unitary codex		Witnesses assembled into multi-textual codices	
11	0–50	687	9	(1.3%)	678	(98.7%)
81	50–100	122	42	(34.4%)	80	(65.6%)
111	100–150	92	58	(63.0%)	34	(37.0%)
89	150–200	73	54	(74.0%)	19	(26.0%)
36	200–250	24	20	(83.3%)	4	(16.7%)
10	250–300	10	9	(90.0%)	1	(10.0%)
3	300–350	3	3		1	
1	350–400	1	1		0	
1	400–450	1	1		0	
343	Total	1014	197	(19,4%)	817	(80.6%)

Tab. 4: Use of texts in the 9th–12th centuries

Clearly, the contradiction between textual volume and 'box' capacity at the opposite ends of table is, for one reason or another, too extreme, so the degree of liberty is practically non-existent. However, in the intermediate classes, where the volumetry of witnesses coincides with optimal capacity, or is at least compatible with the 'elasticity' of the 'box', the choice between mono-textuality and multi-textuality is not automatically determined: over 100 leaves, all the witnesses could be contained within a single codex. Now, this is not in fact what we see: the artisans who created the codices never utilised to the utmost the theoretical leeway they enjoyed to create a mono-textual codex for each of the witnesses whose volumetry would allow for this. Certainly, as the volume of witnesses gradually increases and coincides with the optimal and maximum capacity zone of the volumes, the percentage of mono-textual codices increases, but in any event there remains a fringe element of multi-textual codices that could have been mono-textual volumes but which are not.

It is unnecessary to dwell on the fact that the quantitative analysis of multi-textuality, if one places a stress on material factors of not negligible importance, does not represent an exhaustive treatment of the entire set of problems being addressed. Multi-textuality is a phenomenon which is neither—and indeed cannot be—entirely constrained, nor is it entirely arbitrary; nor, indeed, is it a totally chance phenomenon: in fact, texts obey, in some sense, a sort of 'gravitation-

al force' that generates an attraction, if not a symbiosis, based on affinities of various kinds. If, from a material standpoint, it was necessary to group together texts that were too slim to occupy a full volume, or expand the space available to accommodate a very substantial witness, cases also exist where the agglomeration of texts occurs for purely cultural reasons. Providing an explanation for when, how and why the liberty to group together multiple texts was or was not exercised is the province of historians of intellectual life.

Tab. 5, which presents, for all periods and volumetric classes, the percentage of witnesses that are collected in a mono-textual codex, clearly shows the effect of the freedom to choose: for the two volumetric classes (highlighted in the table) where textual pressure does not spur mono-textuality, nor, indeed, compel it, the 14th century nevertheless presents a higher rate of the same.

Percentage of witnesses that form mono-textual codices (tab. 5)

Volumetry	9th–12th	13th	14th	15th
0–50 sheets	1.3%	2.8%	6.1%	4.9%
50–100 sheets	34.4%	35.5%	45.5%	50.2%
100–150 sheets	63.3%	60.0%	81.1%	74.4%
150–200 sheets	74.0%	71.9%	91.9%	77.3%
200–250 sheets	83.3%	75.0%	85.2%	86.5%
250–300 sheets	90.0%	82.1%	80.0%	80.7%
300–350 sheets	75.0%	95.0%	95.0%	79.4%
350–400 sheets	100.0%	100.0%	100.0%	100.0%
400-450 sheets	100.0%	90.0%	100.0%	92.3%
450–500 sheets	—	100.0%	80.0%	100.0%
> 500 sheets	—	100.0%	100.0%	100.0%
Total	19.4%	33.9%	43.8%	35.1%

Tab. 5: Percentage of witnesses that form mono-textual codices

Before reaching a conclusion, it will be useful to pose three further questions with respect to our corpus. The first question no longer concerns the overall spread of the 'multi-textuality' phenomenon, but instead has to do with how it presents in individual manuscripts. For historians of culture, in fact, the term 'miscellaneous' often conjures up an image of a codex containing a wealth of texts whose grouping together is the product of an individual who was very committed, often actively so, in the cultural sphere. This rather whimsical notion—which we could call a 'Zibaldonesque' syndrome—is thoroughly demolished by quantitative analysis. In Chart 10, the curve described by 'textual diversity' can be seen, which is to say the distribution of the number of texts contained in a single volume. Overall, half of the multi-textual codices—which are already in a minority in relation to the total number of surviving codices—contain fewer than 5 texts and, in the best of cases, the percentage does not fall below 40% (in the 15th century). As for manuscripts that contain more than 10 texts, their numbers range from 11% (in the 9th to 12th centuries) to 16% of multi-textual codices—a real paucity of instances, then.

The final two questions to pose regard the ways in which multi-textuality manifests itself when viewed from two different standpoints.

The first standpoint concerns the concept of *volumetric equilibrium*: a codex can contain *N* texts that each have an almost equal volumetric value, or alternatively it might contain the same number (*N*) of texts, whose volumetric values are unequally distributed, in the sense that there is a *dominant* text (which occupies more than 50% of the available space), or a *prevailing* text (which enjoys a relative but significant majority position).

The second perspective concerns the concept of *textual gravity* in the codex; in other words, if there is a dominant text, one must ask whether or not it occupies a preferential position (i.e. at the beginning, middle or end of a volume), and if so, which.

The answer to the first question can be found in Tab. 6, which shows the average percentage of the rate of occupation in a codex by the majority text and the two successive texts it contains in terms of length in descending order.

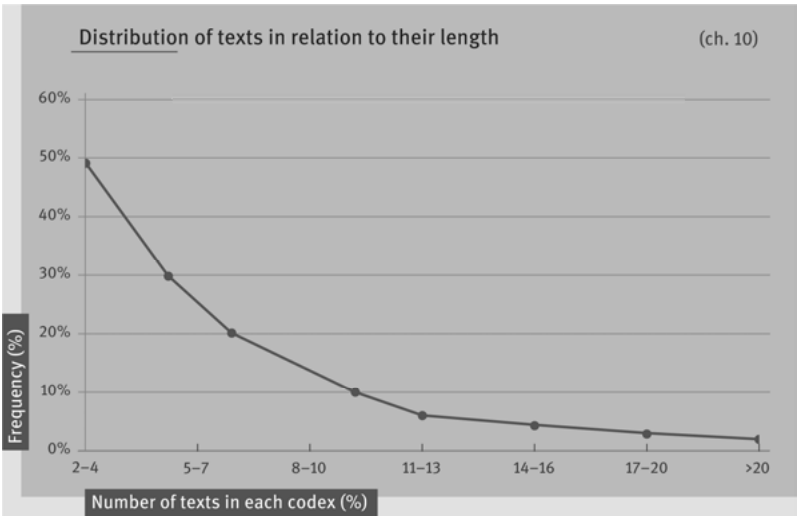


Chart 10: Distribution of texts in relation to their length

In all the periods concerned, multi-textuality is associated with the presence of a dominant text, which reveals a codex's degree of content diversity. A less clear trend is seen only in the 9th to 12th centuries. Indeed, this phenomenon merits being subjected to a more in-depth investigation, but our corpus is not large enough to permit one.

Percentage of space occupied by the three texts of greatest volumetry (tab. 6)

Volumetry	9th–12th	13th	14th	15th	Totality
Predominant text	57.9%	81.3%	77.5%	78.9%	78.9%
Second text	27.2%	40.2%	36.7%	43.7%	37.1%
Third text	11.9%	17.5%	14.2%	15.4%	14.6%

Tab. 6: Percentage of space occupied by the three texts of greatest volumetry

Tab. 7 allows us to verify whether or not a codex really has a 'gravitational centre': the longest text precedes, predominantly, the second in order of importance, and the second precedes the third. The dominant text is *princeps* in all

senses, inasmuch as a volume's textual gravity is in most cases positioned at the beginning of the codex.

Average 'rank' (i.e. hierarchical position) of texts of greatest volumetry (tab. 7)

Volumetry	9th–12th	13th	14th	15th	Totality
Predominant text	1.7	1.4	2.0	1.2	1.4
Second text	2.4	2.2	3.0	2.4	2.4
Third text	2.8	3.1	2.3	3.1	3.0

Tab. 7: Average 'rank' (i.e. hierarchical position) of texts of greatest volumetry

The Western Middle Ages are therefore characterised by hierarchical multi-textuality, which often presents in the form of a 'flagship' text associated with several 'satellite' texts. However, even if the evidence for, and stability of, the phenomenon leaves one in no doubt, the fact that the hierarchy not only of the first, but also of the three principal texts affected their rank within a codex is rather perplexing. We could go so far as to say that when the makers of a codex were filling the text 'box' they were in a sense playing a game of Black Jack, or alternatively they were acting on a spontaneous impulse which induced them to transcribe the texts in order, based on decreasing length. Could it also be possible that the hierarchy observed is simply a reflection of other factors which continue to elude us? Only an analysis of the nature of the texts or the way in which they are associated would allow us to shed more light on this aspect of the problem.

The highly variegated nature of the corpus assembled for the purposes of the current contribution makes it impossible to proceed any further. In particular, the sampling is not qualitatively and quantitatively sufficient so as to penetrate a very treacherous 'swamp' of textual typologies. Indeed, as soon as a sample has been subdivided into chronological, geographical and typological classes, the number of items within each of these declines precipitously, and therefore any inference made becomes questionable. Added to this problem is the difficulty of defining, in advance, a series of fully pertinent typological categories.

The analysis carried out has been quite revealing in a number of unexpected ways: in the Western world, the pinnacle of multi-textuality can without doubt be placed in the centuries preceding the 13th, and very probably—irrespective of the fact

that their effect on the corpus is rather feeble—in Carolingian codices as well. Seen from this perspective, the 14th century seems veritably monolithic. Even if the phenomenon is facilitated by the relatively low volumetric value of component texts, the centuries preceding the 13th represent the focal point of fully fledged multi-textuality, in the sense that the hierarchy among agglomerated texts is not very pronounced. At first glance, this finding is rather surprising, given that on the typological level the cultural fabric is a lot more 'monotonous' than it would be in the following centuries.

One would have thought that by adopting new linguistic, literary and scientific horizons, and by introducing new areas of interest, urban culture, in contrast to the cultural fabric, should have given rise to a proliferation of relatively short and precise texts. Rather, the 13th and 14th centuries are dominated by the birth of new knowledge and the development of new centres of learning which, in addition to centralising the production and transmission of culture, resulted in an *ex nihilo* cultural renewal, based on the production of long or very long texts, a phenomenon that constituted the foundation of a university education system. This state of affairs is perfectly represented by the *pecia* system, which not by chance was born of a necessity to rationalise the concurrent availability of an *exemplar* for high volume texts which otherwise, on account of having to be transcribed into hundreds of apographs, and therefore requiring very long copying times, would have been pointlessly monopolised for months on end by a single copyist.

On the other hand, far more surprising is the relatively contained rate of multi-textuality that characterises the 15th century. However, we must remind ourselves that the population analysed in our corpus is almost exclusively composed of French and British volumes. It is likely that a large presence of Italian and, above all, German codices would have created a rather different landscape. Since this initial phase of the investigation was essentially aimed at exposing the fundamental properties of the third dimension of the codex and its impact on multi-textuality, the poor representativeness of the corpus on a geographical level does not constitute a great problem. Needless to say, the situation would change radically if one sought to frame the evolution of unitary or miscellaneous manuscript production within a historical perspective.

References

Bianchi, Francesco et al. (1993), 'Facteurs de variation de l'épaisseur du parchemin italien du VIII[e] au XV[e] siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi 357–358), II, 95–184 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma; Viella [I libri di Viella, 10], 275–345).

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIV[e] et XV[e] siècles. Textes et études, 2).

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

*Busonero, Paola (1999), 'La fascicolazione del manoscritto nel basso medioevo', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 31–139.

Delisle, Léopold (1874), *Le Cabinet des manuscrits de la Bibliothèque Nationale,* II, Paris: Imprimerie impériale.

Delisle, Léopold (1884), *Inventaire des manuscrits de la Bibliothèque Nationale. Fonds de Cluni*, Paris: Champion.

Gumbert, Johan Peter (2001), 'Livre grand, livre petit: un problème de taille', in *Gazette du livre médiéval*, 38: 55–58.

Ker, Neil Ripley (1969-1992), *Medieval Manuscripts in British Libraries*. I-IV. Oxford: Clarendon Press.

*Maniaci, Marilena (2004), 'Il codice greco 'non unitario'. Tipologie e terminologia', in Crisci, Edoardo / Pecere, Oronzo (eds), *Il codice miscellaneo. Tipologie e funzioni.* Atti del convegno internazionale (Cassino, 14–17 maggio 2003), Cassino: Università degli studi di Cassino (= *Segno e testo,* 2), 75–107.

Molinier, Auguste (1891), *Catalogue général des manuscrits des bibliothèques de France*, XVII. *Cambrai*, Paris: Librairie E. Plon, Nourrit et Cie.

Muzerelle, Denis (ed.) (2000), *Manuscrits datés des bibliothèques de France*, I. *Cambrai*, avec la collab. de Geniviève Grand, Guy Lanoë, Monique Peyrafort-Huin, Paris: CNRS Éditions.

Ornato, Ezio (1994) 'Exigences fonctionnelles, contraintes matérielles et pratiques traditionnelles dans le livre médiéval: quelques réflexions', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit*. Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel, 12[th]–14[th] November, 1990, Marburg: Institut für Historische Hilfswissenschaften (Elementa diplomatica, 2), 7–31.

Layout and text formatting

Marilena Maniaci

Canons and 'Recipes' for the Layout of the Medieval Book

New Observations and Verifications

1 The *mise en page*—balancing aesthetics with functionality

'A book's format is determined by its function, and therefore is naturally related to the average stature of an adult and the size of his/her hands. Folio-sized books should not be produced for children, as they would be too difficult for young readers to handle. A high, or at least adequate degree of comfortable handling characteristics should always be strived for. A book as large as a table would be an absurdity, whilst books the size of postage stamps are considered pure whimsy. Similarly, cumbersome books are not readily accepted, since elderly people can find them difficult to handle without assistance. Giants would naturally require large books and newspapers; on the other hand, many of our everyday books would be considered far too large for dwarfs to handle.'[1]

These, together with various other observations made by Jan Tschichold (an important figure in 20th-century European typography)[2] on the anything but

Translated from the Italian into English by Mark Livesey. Original published as Maniaci, Marilena (2013), 'Ricette e canoni di impaginazione del libro medievale. Nuove osservazioni e verifiche', in *Scrineum. Rivista*, 10: 1–48.

The overall subject matter of this research was anticipated in a paper titled *Medieval Book Design: Layout Canons and Recipes,* which was presented at the conference *Writing Europe before 1450. A Colloquium* (Bergen, University of Bergen, 3–5 June, 2012). I received some highly thought-provoking notes, observations and suggestions from two anonymous reviewers (and by one of them in particular), which for the most part I judged to be legitimate. These led me to re-think to a significant extent a number of issues; thus I was able to improve both the form the and the substance of the results of my work. I am grateful to the people concerned; at the same time I remain solely responsible for the opinions expressed in the present text, and for any errors it may contain.

1 Tschichold 1948 (1975, 2003) [slightly revised English version].

2 See the recent bibliography dedicated to Tschichold by McLean 1997.

https://doi.org/10.1515/9783110743838-012

accidental 'physiognomy of the book' can be extended to the medieval codex. Indeed, it is not purely by chance that the polymath German designer—a theorist, artist, artisan and graphic designer—exhorts us to 'tirelessly study in a scientific way the impeccable works of the past',[3] with the aim of reviving the fundamental 'rules' that underlie the harmonious layouts seen in ancient manuscripts, and then to apply them in their modern, printed counterparts. Tschichold himself engaged in this activity, which led him to come up with some rather ingenious designs. However, such designs are perplexing to scholars of the medieval book, owing to the flimsy theoretical suppositions they are based on, and a lack of archaeological validation.[4]

It is also true, however, that while the world of contemporary graphics has held an open and lively debate and devised numerous tenets and guidelines for the production of reasonably sized and aesthetically pleasing books with well-balanced layouts, on the technical matters, in common with all of his 'trade secrets', the medieval manuscript maker remains highly reticent. Furthermore, allusions to such matters in literary sources are sporadic and rather vague, and consequently of little help in defining the technical criteria that the artisans applied, and by extension the basic principles underlying them.

In any event, despite the dearth of technical and non-technical documentation, analysis of the spatial organisation of the page has long held an irresistible attraction for scholars, since the intellectual implications of the *mise en page*—which is to say its capacity to 'shape' the text, and therefore to 'steer' its reception—are intertwined (often indissolubly) with the irrational allure of numbers. The geometry of the page—'terre d'élection des codicologues'[5]—is, after all, among the various aspects of medieval codex production, the one in which the primary function of a book is expressed to a maximum degree: that is, to accommodate and transmit literary content, and above all to render it usable and sufficiently legible. For the same reason, it is also a 'terrain' characterised by rather delicate and fickle balances, thanks to the consciously or unconsciously exerted influences determined by different tastes and traditions, and

3 Tschichold 1948 (1975, 2003), 60.

4 A critical assessment of Tschichold's theories on the *mise en page* of (late) medieval manuscripts is not the subject of the current work and merits a separate discussion. Here, I shall limit myself to pointing out the difficulty of following the thread of fragmentary reasoning in publications that are not always easy to penetrate, and which are characterised by *a priori* judgements on the presumed aesthetic qualities of specific constructions (see below, footnote 11).

5 Muzerelle 1991, 370.

various requirements imposed by the need to contain economic costs and to assure legibility.[6]

The history of studies on the design of medieval manuscripts is dominated by a clear contraposition between two antithetical approaches. One approach is devoted to the purely theoretical search for abstract 'models of spatial balance' that would have influenced the artisans' production, whilst the other is fuelled by the conviction that aesthetics played an entirely secondary role in comparison to far more concrete and pressing demands of a functional and economic kind. Such criteria can be retroactively reconstructed (in terms of overall trends) by analysing the synchronic and diachronic evolution of the page's basic parameters, namely its relative and absolute dimensions; the ratio between the page's total surface area and its written surface area (and the degree of exploitation of the latter); and the arrangement of text into one or more columns. If the first approach reflects a 'strongly idealised vision of the aesthetic of the *mise en page*',[7] in the second the written page is seen as a 'consequence of the various contradictions that weigh upon the text transmission process'—in other words, the result of a preliminary planning phase aimed at defining the degree to which information is concentrated and optimising the usability of the message, in accordance with the means and expectations of the commissioning client, and also with his reading ability and needs. From a methodological standpoint as well, descriptions of individual specimens of particular appeal or graphic complexity are contrasted with statistical analyses of measurements taken from a broad range of codices.

Proponents of the idea that the geometric harmony of the medieval page derives from the combination of so-called 'remarkable rectangles' (among whom one cannot fail to mention, besides Jan Tschichold, the Belgium codicologist Léon Gilissen)[8] have been challenged by some pertinent counter arguments in the form of 'statistical' or 'quantitative' codicology. Such arguments range from a questioning of the intrinsic vagueness of the idea of a 'remarkable relationship' ('formule remarquable'),[9] to pointing out the abundance of relationships identified as such by medieval sources, and the relative ease of identifying a certain number of more or less 'remarkable' rectangles (based on acceptable margins of tolerance) among the many formed by the ruling grids laid out on

6 The implications of this dialectic are persuasively presented, with due reference to a previous bibliography, in Ornato 1997, 648–654.

7 *Ibid.*, 651.

8 Gilissen 1977, 123 onwards.

9 Gilissen 1977, 126.

the actual pages of ancient manuscripts, or even on pages generated artificially by applying random criteria.[10] Quite apart from the theoretical issues, the chief objection to the theory of the 'remarkable rectangles' consists, on the practical level, in the lack of convincing results following the repeated application of 'significant' combinations of relationships (and not just from one or another of them, taken on its own).[11]

Whilst it is rather easy to highlight the limitations of mere numerological speculation—which in any event has not ceased to exert its seductive influence over scholars of the *mise en page*, and even extends into spheres other than the Greek and Latin world[12]—it is less easy to identify and support with hard facts (based on a sufficient amount of directly obtained data, or data gleaned from existing catalogues) the general inclinations, or possible canons, adhered to by artisans. Likewise, it is difficult to define the circumstances and extent of their use.

10 See Bozzolo et al. 1990.

11 The most important example is found in the emphasis placed on the so-called 'Golden Ratio' or 'Divine Proportion', based on the definition proposed by the Franciscan mathematician Luca Bartolomeo de Pacioli (for further information about Pacioli, see Tristano 2010). As is well known, this is the proportion of a quadrangle–obtained through various procedures–whose sides have the irrational numerical relationship 0.618, approximating to 3/5 (0.600) and 5/8 (0.625). Irrespective of the intrinsic beauty and peculiar balance attributed to it (above all by Renaissance theoreticians), the 'Divine Proportion' is, in fact, very seldom found in the layouts of Western manuscripts of any era (in both Northern and Southern Europe), and practically unknown (at least continuing through the 12th century) in Greek book production (see below). The suggestions implied by the 'Golden Ratio' also influenced Tschichold's speculations about the 'canons' that were supposedly devised in late medieval book crafting workshops, and subsequently 'inherited' by proto-typographers in order to attain an opportune positioning of the written area on the surface of the page, which is to say a geometric balance regarded as being particularly in harmony with the four blank margins surrounding it (see, for example, Tschichold 1948 [1975, 2003], 44–52).

12 References to the presence of 'remarkable rectangles' in the layout of manuscripts can be found in the works of Giorgio Montecchi (cit. below, footnote 28), and Paolo Cherubini (cit. below, footnote 27), and also in publications dedicated to the *mise en page* of codices written in Arabic script, which seem to be consistently ignored in bibliography relating to the Western book: Polosin 1999; Polosin 2001; Porter 2004. A paragraph (not by chance) is dedicated to remarkable rectangles in Déroche et al. 2000, 180–182, and largely reproduced in the recent new Italian edition of the manual (Sagaria Rossi / Déroche 2012, 126 ff.). Also inspired by the construction methodology devised by Tschichold is the purely theoretical procedure hypothesised for the shaping of the page by Tristano 1991, 61–71. The reconstruction by Batlle (undated), is entirely without scientific foundation.

2 The notion of a 'recipe'

In an attempt to systematise and build on the findings of recent research into the present topic, it is only natural to start out from the explicit pieces of evidence that have been collected from various sources, even if these (despite being bolstered in recent years by some fortuitous discoveries) remain quite scarce and scattered through space and time, in addition to frequently being rather obscure in their stipulations and therefore difficult to interpret, if not highly problematical or even downright perplexing. These clear constraints notwithstanding, it does not seem an entirely pointless exercise to attempt a synoptic analysis of the texts that have been identified up to the present, drawing attention to consistent as well as inconsistent points, and re-examining, wherever necessary, their various interpretations; and, within the limits of feasibility, their actual level of dissemination (where this has not already been done).

Before introducing the texts that will be placed under scrutiny, it should be made clear that—regardless of the fact that their blanket definition as 'recipes' is widely accepted—not all of them conform to the specific definition of the term that I proposed a number of years ago, which has been embraced in subsequent research and handbooks, namely 'a recipe is a coherent collection of tenets which, by establishing a systematic link between the various elements of a page, aims to facilitate the construction of an unambiguously defined grid. In addition to not being ambiguous, a recipe must also be of universal value: in other words, it must be applicable, without any degree of uncertainty, to any size of manuscript. It is for this reason that dimensional prescriptions can only be expressed in terms of fractional relationships, that is to say in the form of *proportions* (i.e. ratios) between the various components of the page'.[13]

Actually, there is no need for such a stringent definition to exclude from the surviving group of recipes the common-sense recommendations formulated at the end of the 13th century by the Swiss *magister* Corrado de Mure in his *Summa de arte prosandi*, which does not in fact refer to the layout of books, but rather to that of documents (*litere seu epistole*):[14]

> Sic quadranguletur, ut latitudo longitudini respondeat convenienter, et ne latitudo nec longitudo modum debitum excedant et mensuram, sicut archa Noe in longitudine, latitudine, altitudine jussu dei artificialiter et proportionaliter composita fuit et compacta. [...] Item scriptura litere seu epistole tam a capite quam a fine secundum debitam quadraturam cum spaciis ab

13 Maniaci 1995, 17–18.

14 The piece can be found in Wattenbach 1896, 188–189, edited by Kronblicher 1968, 62.

> omni latere, scilicet superius inferius dextrorsum sinistrorsum, competentibus habere debeat ductum seu terminos lineales, ita ut scriptura margines carte seu extremitates fugere videatur modo debito et decenti. Alioquin carta sic detruncata proprietatem littere deformaret. Unde carta seu carte forma non sit nimis longa, non sit nimis lata, spaciis ut dictum est regulariter ordinatis.

The indications transmitted through an Arabic book by the learned Andalusian Abū Bakr Muhammad ibn Muhammad al-Qalalūsī al-Andalusi, who was active in the second half of the 13th century,[15] are more clearly aimed at describing the various steps involved in a specific procedure for the 'construction' of a page. It would seem that the ancient text has come down to us in a partially corrupted ('omise ou déformée') form—or that, at least, that is certainly the impression one gets when reading it in translation:

> The paper is folded lengthways; the fold serves as a guide to fix the lower margin, which is defined by the line linking two points pricked with a compass on the two edges of the sheet. There are two margins running widthwise, starting from the prickings of the first two points; heightwise, the upper margin is parallel to the lower margin. The block of text is divided into two parts, determined by the shīḥa which is obtained [as follows]: mark a point parallel to the point marking the middle of the first line traced lengthways, based on three semi-circles; starting from two equidistant points on this semi-circle, trace two arcs that meet at a point; a straight line is drawn between these two points. This is the figure of the shīḥa, which divides the block of text into equal parts. The guidelines are established half-by-half, starting from the lateral prickings.

The rather mysterious sequence of steps described by the treatise's writer—which have no equally explicit[16] parallel in the Arab contest—involve, in addition to folding, the use of a compass, mention of which ostensibly recurs centuries later (although in an entirely different context) among the final recommendations provided in Sigismondo Fanti's recipe.[17] The use of a compass involves adopting a construc-

---

15 See Sauvan 1989, 49–50. See also Déroche et al. 2000, 179, and Sagaria Rossi / Déroche 2012 (the recipe's text, as reproduced here, can be found on p. 127). The treatise was edited by Abbady 2005.

16 Worth pointing out, however, in Sagaria Rossi / Déroche 2012, 127, is a reference to a rather unspecified norm, which stipulates that 'the upper space should be larger than that in the lower margin, in such a way so that the said spaces, once the script has been laid down, are equal'. In the absence of any systematic investigations, it seems imprudent to speculate on this issue, just as it is on other features, actual or presumed, of the *mise en page* of the codices written in Arabic script.

17 See. below, 438 and 443, and footnote 66. It has been well noted how often the compass, employed since ancient times, appears in Byzantine miniatures (though more rarely in Latin ones predating the 15th century) as a generic element of the iconography showing the evange-

tion technique based on irrational geometric relationships, which differs from other possible approaches that depend on the relationship between whole numbers or the multiplication of a determinate basic unit. Despite providing us (albeit in translation) with valuable food for thought, the Andalusian's recipe remains highly mysterious, thanks to a complete lack of explicit information on measurements or proportions that would make it possible to identify a specific *mise en page* template.[18]

Much more detailed, although not exhaustive or free from vagueness in their stipulations, are the currently known sets of instructions for codices in Greek and Latin script, which it will be worthwhile to pay particular attention to here. Specifically, these are two texts in Latin and two in vernacular Italian—very distant from each other chronologically and in relation to their transmission backgrounds and geographical contexts and a single, represent an unparalleled (and still unpublished) Byzantine source, whose contents have only recently been made the subject of an initial and only partial examination (the preparation of an annotated edition is currently underway).

It seems appropriate to begin with a few remarks about the aforesaid source, as it will not be referred to again in the present essay. In the Greek context it remains a unique source and is of considerable interest, not for this reason alone. It was transcribed by an anonymous Greek Aristotelean copyist in the second half of the 14th century and came down to us as a unit in a composite codex (Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. gr. 604).[19] Although Daniele Bianconi—who pointed out the text's existence and initiated its study—recognised the booklet (which consists of nine densely-written pages) as a recipe, likening it to the already known Latin ones,[20] it is more similar to a detailed template[21] for a *mise en texte* and

list engaged in his copying tasks. Not even references in written sources, including 16th-century treatises on writing, provide details on the use of the instrument in the production of books and documents (here, it should suffice to direct the reader to the meagre information offered by Rosenfeld 2002, 168, and to the dossier edited by Gumbert (undated), which can be viewed at http://www.palaeographia.org/outils/outils.htm, with additional bibliography).

18 Not concerning the *mise en page*, but rather the *mise en texte* (understood as the combination of steps that contribute to the distribution of the content within a book and to its visual and functional organisation), are 29 interesting prescriptions with respect to the treatment of the text of the Koran (1279 AH / 1862 CE) analysed by Witkam 2002. It would seem that no similar indications are offered by any Western sources.

19 The text, which is briefly described in Devreesse 1950, 1–7, here 6 (but previously pointed out by Mercati 1931, 158–159) was recently presented, in broad terms, by Bianconi 2010, a contribution that foreshadows a more detailed study.

20 Bianconi 2010, 406; Bianconi observes correctly, however (*ibid*., 407), that the text lacks the universality that sets the other texts apart.

mise en page intended for the complicated manufacture of an annotated manuscript, in which a variable portion of the text of Aristotle's *Organon* is framed, on each page, by a suitable exegesis.[22] The minutely detailed instructions provided by the unknown compiler of the text not only stipulate the number of written lines (varying from 12 to 24) to be copied, page-by-page, on to the block of quires destined to accommodate the group of treatises that comprise the *Organon*, but also the exact sequence of words to appear, on the *recto* and *verso*, at the end of every page, and the position of the blank spaces that signal the transition between one text and another, or between different sections of the same text. The drawn-out and rather monotonous sequence of instructions concludes, in the lower third of the penultimate sheet of the 'booklet', with a revealing description of the ruling diagram for the Aristotelian volume, together with a visualisation of the distribution of spaces in the form of independent perpendicular segments, as follows: horizontally, the inner margin, the width of the written area, the distance between this and the marginal notes, the width of the space reserved for commentary, the outer margin (respectively equating to 31, 116, 10, 47 and 28 mm); and vertically, only the width of the upper and lower margins (22 and 30 mm), while the height of the written area is omitted (probably because it is variable) (Fig. 1).[23] On a single straight line that diagonally traverses the *recto* of the final sheet there is reproduced, most likely in life-size, (which would explain its unusual positioning), the sequence of segments corresponding to the width of the codex whose *mise en page* is described. The segments measure, in sequential order, 28, 114, 9, 46 and 28 mm, for a total of 225 mm (Fig 2).[24]

21 The term denotes, in the technical jargon used for traditional printing, a model employed for the layout of printed works consisting of multiple pages.

22 This interpretation would appear to be validated by the incipit *ex abrupto* of the text, which is entirely devoid of literary ambition.

23 The *mise en page* described by the anonymous copyist is of the 'variable balance' type, in which the dimensional relationship between the areas, or zones, set aside for commentary and the written area (in the strictest sense of the term) is defined, page-by-page, in relation to the size of the two text masses. This is in contrast to what happens in the case of 'fixed balance' typography, in which the relationship between the two areas is fixed for once and for all when the volume is first planned. For a more detailed description of the two techniques and of the consequences resulting from choosing between either one or the other approach, see Maniaci 2006, 217, 244–253 and *passim*.

24 The measurements of the individual segments roughly replicate those already furnished by the copyist on the previous page.

Figs. 1 and 2: Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. gr. 604, f. 186r–187r.

The absence of a crucial piece of data, namely the height of the written surface (which prevents us from being able to define with accuracy the height of the codex), and the peculiarity of the layout referred to in the source, make it impossible to draw a comparison between the *mise en page* so meticulously described by the Byzantine copyist (or artisan-copyist) and the reality of coeval Greek manuscripts. It is not surprising, then, that up to the present day no Aristotelian volume (or volume of different content) has emerged which conforms perfectly to the guidelines preserved in the Vatican manuscript. Indeed, if one takes a closer look, it seems difficult to believe that one, or perhaps even several copyists were able to follow to the letter such a rigid set of instructions. In fact, it seems more reasonable to suppose that the text concerned constitutes a description made after the fact, perhaps with a certain degree of smugness, following the completion of a doubtless very demanding task.

3 The Latin recipes

Whilst awaiting a more in-depth analysis and the complete edition of the Byzantine source, it seems sensible to move on to a comparative examination of the four recipes known in the Latin context, namely:

– the so-called 'Saint-Remi' recipe, jotted down at the beginning of the 10th century in the lower margin of a codex originating from Northern France, of which only a small fragment survives (Paris, Bibliothèque nationale de France, Par. lat. 11884, f. 2v) (Figs. 3a and 3b);[25]
– the 'Munich recipe', discovered by Bernhard Bischoff in a 15th-century Bavarian miscellany of predominantly medical content (München, Bayerische Staatsbibliothek, Clm 7755, f. 199r), as part of a series of instructions for the manufacture of dyes and colours (Fig. 4);[26]
– a recipe written in the middle of the 15th century (approximately) in vernacular Italian by an unknown hand (possibly of Emilian origin), on the *recto* of the front parchment flyleaf of a paper-supported compendium of accounting and commercial matters dating to 1429 (Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4825, f. Iv) (Fig. 5);[27]
– a detailed series of instructions, also in vernacular Italian, formulated at the beginning of the 16th century by Sigismondo Fanti, a multi-talented mathematician, astronomer and astrologer of Ferrara, in the introduction to his *Theorica et practica… de modo scribendi fabricandique omnes litterarum species* (Figs. 6a and 6b).[28]

25 This consists of only three surviving leaves from a codex of miscellaneous content originating from the Saint-Remi Abbey at Reims, where it was probably produced after the year 882. For further information and a detailed study of the recipe, see Muzerelle 1989, with earlier bibliography, and in particular, 127, footnote 8.

26 The recipe was briefly referred to by Bischoff 1984, 239–240. A full reproduction can be viewed at https://bildsuche.digitale-sammlungen.de/index.html?c=viewer&bandnummer=bsb00069150&pimage=00003&einzelsegment=&v=2p&l=it. In addition, the brief and rather antiquated description printed in *Catalogus* 1873 (1968), 196, is available to view online at https://daten.digitale-sammlungen.de/bsb00008267/images/index.html?fip=193.174.98.30&seite=200&pdfseitex= (last access 07/09/2021).

27 Credit for the discovery is owed to Cherubini 2004, 241–258.

28 The *Theorica et pratica perspicacissimi Sigismundi de Fantis Ferrariensis in artem mathematice professoris de modo scribendi fabricandique omnes litterarum species*, Venetiis 1514 (the reproduction of the text, below, 438–439, was transcribed from the exemplar held in Rome at the Biblioteca Casanatense, Rari 783). The text was studied by Montecchi 1995 (1997), previously appeared in Mon-

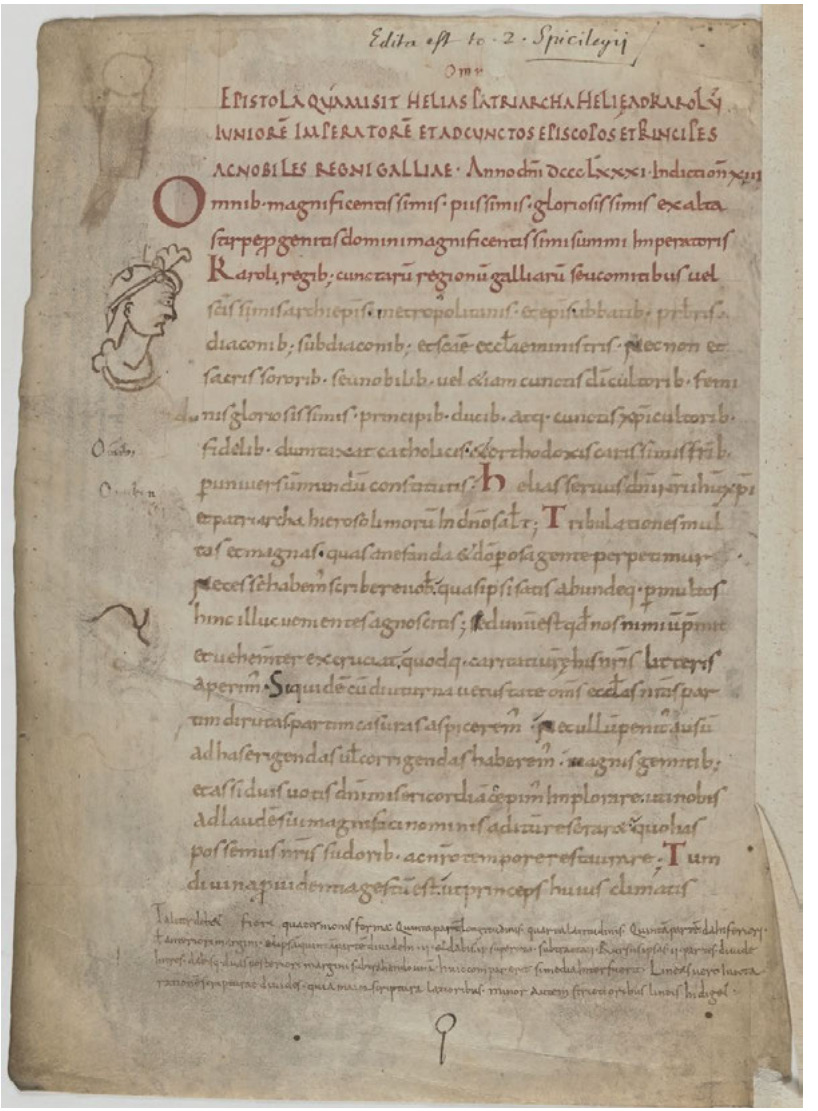


Fig. 3a: Paris, Bibliothèque nationale de France, Par. lat. 11884, f. 2v. With permission of the Bibliothèque nationale de France

tecchi 1994). On Fanti's multifaceted disposition, see Ernst 1994, also online at http://www.treccani.it/enciclopedia/sigismondo-fanti (Dizionario_Biografico; last access 07/09/2021). Concerning the role played by Sigismondo Fanti in 16th-century treatises on writing, see Casamassima 1996, 24–26, 84, Tables V–VIII.

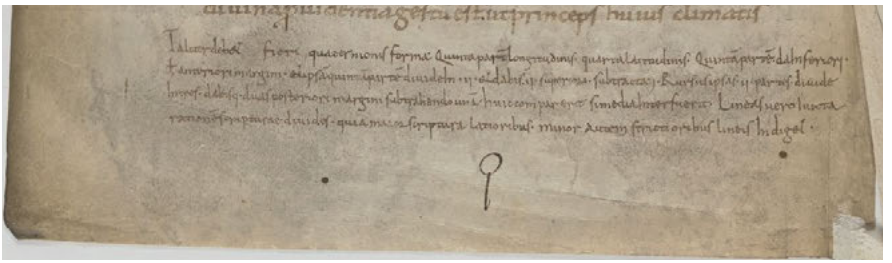


Fig. 3b: Paris, Bibliothèque nationale de France, Par. lat. 11884, f. 2v detail. With permission of the Bibliothèque nationale de France

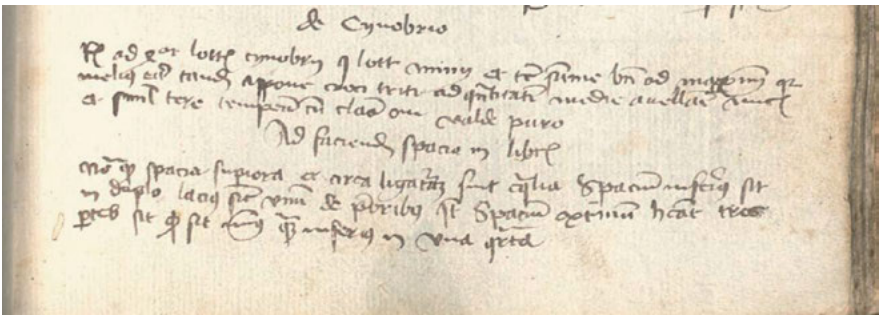


Fig. 4: München, Bayerische Staatsbibliothek, Clm 7755, f. 199v, detail. © Bayerische Staatsbibliothek München

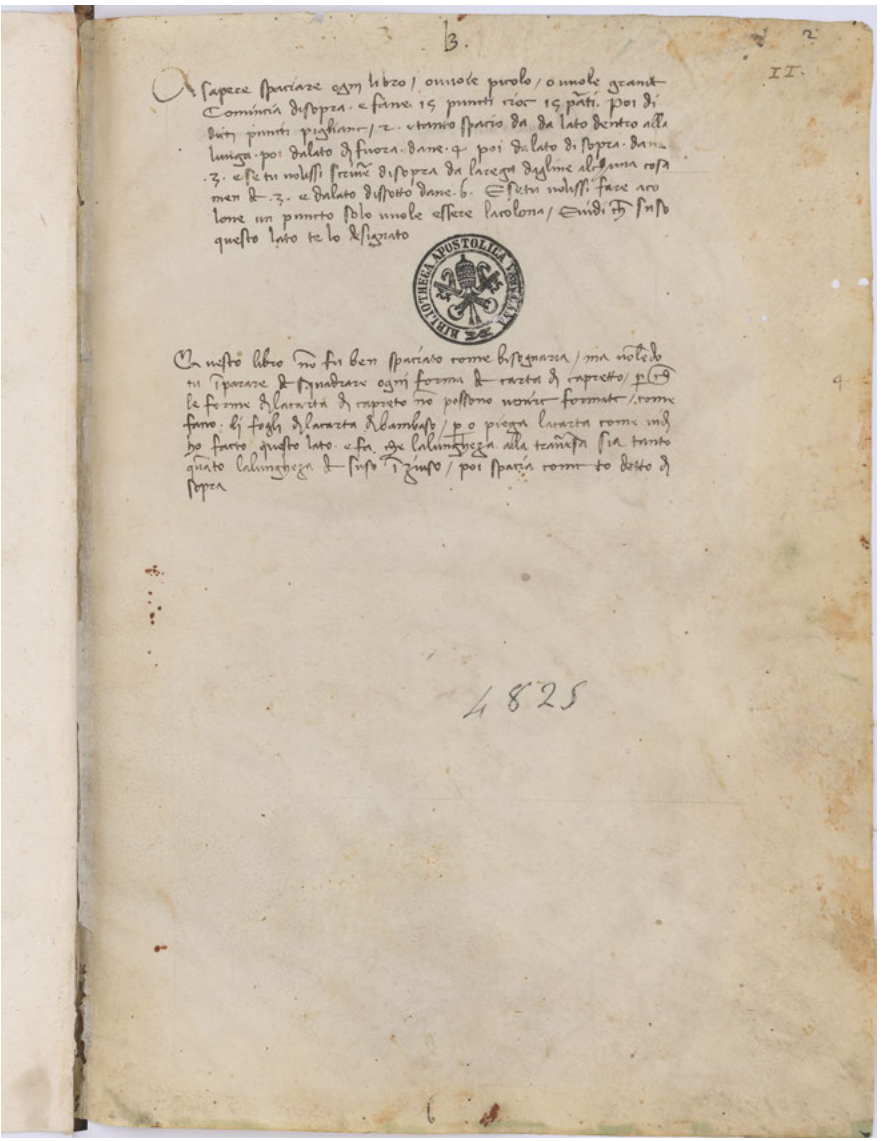
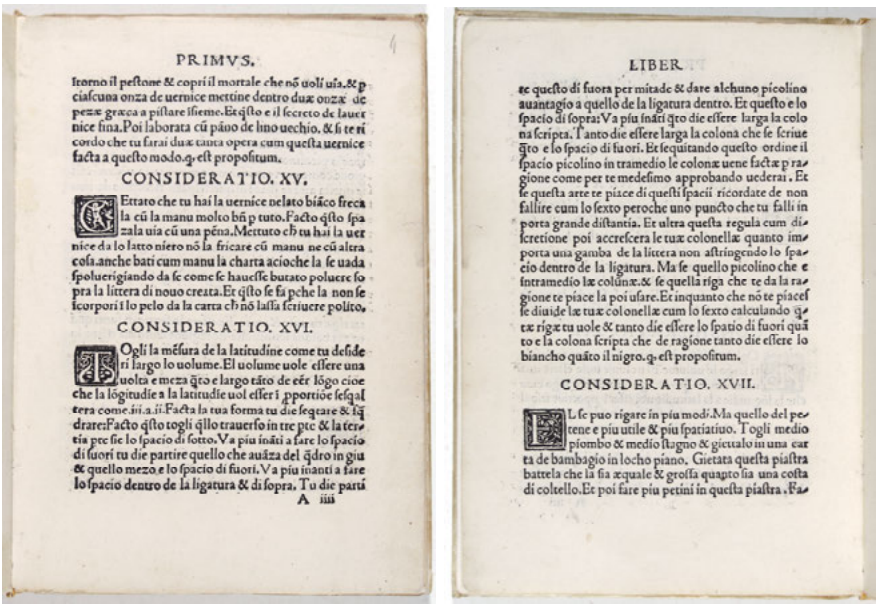


Fig. 5: Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4825, f. 2r. © Biblioteca Apostolica Vaticana



PRIMVS.

Itorno il pestone & copri il mortale che nõ uoli uia. & p ciascuna onza de uernice mettine dentro duæ onzæ de pezæ graeca a pistare insieme. Et ẽsto e il secreto de lauernice fina. Poi laborata cũ páno de lino uechio. & si te ricordo che tu farai duæ tanta opera cum questa uernice facta a questo modo. q. est propositum.

CONSIDERATIO. XV.

Ettato che tu hai la uernice nelato biãco freca la cũ la manu molto bñ p tuto. Facto ẽsto spazala uia cũ una pẽna. Mettuto ch tu hai la uernice da lo latto niẽro nõ la fricare cũ manu ne cũ altra cosa. anche bati cum manu la charta acioche la se uada spoluerigiando da se come se hauesse butato polucre sopra la littera di nouo creata. Et ẽsto se fa pche la non se scorpori. Ilo pelo da la carta ch nõ lassa scriuere polito.

CONSIDERATIO. XVI.

Ogli la mẽsura de la latitudine come tu desideri largo lo uolume. El uolume uole essere una uolta e meza q̃to e largo tãto de eẽr lõgo cioe che la lõgitudie a la latitudie uol esser i ꝓportiõe seqal tera come .iii. a .ii. Facta la tua forma tu die seqeare & lq̃drare: Facto ẽsto togli ẽllo trauerso in tre ptẽ & la terẽtia ptẽ sie lo spacio di sotto. Va piu inãti a fare lo spacio di fuori tu die partire quello che auãza del q̃dro in giu & quello mezo e lo spacio di fuori. Va piu inanti a fare lo spacio dentro de la ligatura & di sopra. Tu die parti

A iiii

LIBER.

te questo di fuora per mitade & dare alchuno picolino auantagio a quello de la ligatura dentro. Et questo e lo spacio di sopra: Va piu inãti q̃to die essere larga la colona scripta. Tanto die essere larga la colona che se scriue q̃to e lo spacio di fuori. Et sequitando questo ordine il spacio picolino in tramedio le colonæ uene factæ p ragione come per te medesimo approbando uederai. Et se questa arte te piace di questi spacii ricordate de non fallire cum lo sexto peroche uno puncto che tu falli in porta grande distantia. Et ultra questa regula cum discretione poi accrescera le tuæ colonellæ quanto importa una gamba de la littera non astringendo lo spacio dentro de la ligatura. Ma se quello picolino che e intramedio læ colũnæ. & se quella riga che te da la ragione te piace la poi usare. Et inquanto che nõ te piacesse diuidi læ tuæ colonellæ cum lo sexto calculando q̃tæ rigæ tu uole & tanto die essere lo spatio di fuori quãto e la colona scripta che de ragione tanto die essere lo biancho quãto il nigro. q. est propositum.

CONSIDERATIO. XVII.

El se puo rigare in piu modi. Ma quello del pertene e piu utile & piu spatiatiuo. Togli medio piombo & medio stagno & gietalo in una carta de bambagio in locho piano. Gietata questa piastra battela che la sia æquale & grossa quanto sia una costa di coltello. Et poi fare piu petini in questa piastra. Fa-

Figs. 6a and b: Roma, Biblioteca Casanatense, Rari 783, f. 4r–v. With permission of the Biblioteca Casanatense

As we shall presently see, the difference between the four texts does not depend solely on their respective lengths or the quantity of instructions they provide, nor on the arrangement of the pages that the prescriptions serve to guide the realisation of, but instead has to do with the selection of the basic steps involved in page construction and their hierarchical order of priority. That being said, the four recipes do, however, share some important basic characteristics.

First of all, with the sole exception of the instructions set out by Sigismondo Fanti, the precepts are all by unknown authors and have come down to us (by happy chance) inserted in other works dealing with various technical issues (such as in the case of the Munich recipe), when they are not 'randomly' inserted in blank spaces that were not originally intended to accommodate content[29]

29 Regarding the definition of 'random microtexts' as 'entirely unrelated written evidence, which accompanies a given text purely in the physical sense, and is the product of altogether random choices', see Petrucci 1999, 983. The recipes presently under examination can be placed in the second and third of the four categories of 'textual additions' identified by Petrucci (i.e. 'simple graphical additions'; 'corrective additions'; 'mnemonic additions', and 'drafting additions').

(at some point in time subsequent to the original creation of the 'host' codex). In the latter case, the adjuncts do not aspire to be of universal value, nor are they directly correlated to the layout of the volumes in which they appear, but instead seem to be inspired by secondary motivations. The aim of providing a minutely detailed account of a particularly complex *mise en page*, such as in the case of the Byzantine source mentioned above, is another way in which a recipe has come down to us.

Concerning the organisation of the four texts, all of them appear to be based—in accordance with the principle of 'universality' mentioned above[30]—on the definition (either full or partial) of the simple relationships existing between the basic parameters of the page, namely the book's total dimensions, the size of the written area and the breadths of the four margins, to which we can add (apart from in the case of the Munich recipe) the breadth of the intercolumnar space. Differing in each case—as we shall see—is the basic parameter chosen to serve as the 'foundation' of the geometric construction: the codex's height (in the case of Saint-Remi recipe); its width (in the 'Vatican' recipe and that of Fanti); or just the relationship existing between the margins, as in the case of the Bavarian text, which is the most 'reticent' among the four.

As will be demonstrated, irrespective of any uncertainties and differences which can open the way to various interpretations of the individual recipes, it is fairly clear that their application resulted in the creation of profoundly different pages, both with respect to the quantitative relationship between the written and non-written areas and the positioning of the latter—i.e. the margins—around the written area. Despite this, all the known recipes share one basic criterion, namely the allocation of more space to the two outer and lower margins than to the inner and upper ones, hence the written area always gives the impression of being visually 'decentralised' towards the upper, inner corner of the page, as if the artisan wished to protect its integrity (in the case of a parchment codex, this might be threatened by natural irregularities in the periphery of the skin), or to spare it from contact with the reader's fingers, thereby providing him or her with as much blank space as possible to grasp the book by.[31]

Finally, all the recipes include instructions which to a greater or lesser extent are shrouded in obscurity and therefore present the 'interpreter' with a

30 See above.

31 Montecchi 2005, 202 attributes the 'decentralised' positioning of the written area to the desire that 'the text, due to the different angle from which it is perceived by the eye, does not appear "squashed" on to the page but instead "emerges" from it, purely on account of an optical illusion, and in this way seems to assume a third dimension, namely depth'.

rather perplexing set of problems and occasionally a range of alternative solutions, among which it is not always easy to settle on the most convincing.

Now that these introductory points have been adequately addressed, it is time to embark on a comparative reading of the recipes, with a view to fulfilling the following two objectives: (a) a critical examination of the interpretations that have been suggested by the authors who have studied them, and (b) verification of the applicability—and, wherever possible, of the actual application—of the various norms to the *mise en page* of medieval manuscripts. With respect to the second goal, work already completed a number of years ago on the 'Saint-Remi' and 'Munich'[32] recipes will be looked at afresh and integrated into the present study. Furthermore, the investigation will be extended to cover the other two recipes, the actual use of which has never, up to the present, been reliably confirmed.

In addition to the corpora of Greek and Latin codices that have already been examined in the past,[33] the verification process can also take advantage of the rich and valuable store of data generated by the cataloguing of dated Italian manuscripts. The vast majority of them date to the Late Middle Ages and were produced within the confines of the Italian Peninsula; for this reason they are particularly well-suited for the study of the representativeness and dissemination of the two recipes written in vernacular Italian.[34]

With respect to the 'Saint-Remi' and 'Munich' recipes, here I shall confine myself to briefly summarising the results obtained in the past—and for the most part confirmed in the Latin context—by extending the verification process to the new corpus of dated codices. Similarly, in the present study I shall not dwell on the theoretical problems raised by the alterations undergone by codices as a result of trimming—a theme that has already been discussed elsewhere—which,

32 Maniaci 1995, a work inspired by a previous contribution by Muzerelle 1989.

33 See Maniaci 1995, 29–30; Maniaci 2012, 480–483 [in this volume, 465–508].

34 The relevant data derive from an electronic survey of the first 20 volumes of *Manoscritti datati d'Italia* (the complete list of those which have been added to date can be viewed at http://www.manoscrittidatati.it/mdi/i-volumi.php?id=16; last access 07/09/2021). The survey was carried out and kindly made available to me by Leda Ruggiero. With respect to the size of margins, the survey is supplemented by a close scrutiny of the 'in progress' database present on the site, which contains a wide and well-chosen selection of information from catalogue descriptions ([editor's note: not yet available on the new website]; see also Palma 2010, 259–267). The individual codices taken into consideration number approximately two thousand (a figure that varies a little due to usability issues related to the *mise en page*), and they are chronologically distributed as follows: 9th century = 3; 10th century = 3; 11th century = 19; 12th century = 12; 13th century = 46; 14th century = 243; 15th century = 1,679.

when combined with the inexactitudes of medieval manufacturing processes and inaccurate measurements, make it difficult to verify discrepancies between the relationships prescribed in the ancient recipes and the actual relationships seen in the manuscripts today (a problem that calls for the judicious application of sufficient 'margins of tolerance').[35]

Now we can take a look at the recipes, starting with the oldest:

> Taliter debet fieri quaternionis forma, quinta parte longitudinis, quarta latitudinis. Quintam partem da inferiori vel anteriori margini, et ipsam quintam partem divide in III et dabis II superiori, subtracta I. Rursus ipsas II partes divide in tres, dabisque duas posteriori margini, subtrahendo unam. Huic compar erit si media interfuerit. Lineas vero iuxta rationem scripturae divides, quia maior scriptura latioribus, minor autem strictioribus lineis indiget.

The recipe adopts the constructional principle which prevails in the small group of surviving sources, namely the definition of a *pars* (termed *puncto* or *parte* in the Vatican recipe, and *parte* in Fanti's[36] later recipe); in other words, a module whose repetition gives rise to all the constructional dimensions of the page (i.e. height, width, margins, and sometimes an intercolumnium), independent of its total dimensions.

In comparison, the Munich recipe seems a lot more concise; indeed, it is in fact the briefest among the surviving texts:

> Ad faciendum spacia in libris. Nota quod spacia superiora et circa ligaturam sunt equalia. Spacium inferius sit in duplo lacius sicut unum de prioribus. Item spacium extremum habeat tres partes sic, quod sit minus quam inferius in una quarta.

The recipe is limited to describing—as usual in terms of relationships rather than of absolute values—the dimensions of the margins, leaving the reader at liberty to define as he or she pleases the relationship between the height and width of the page. This, however, is only an ostensible liberty, if one considers the clear tendency for the late medieval codex to assume an 'invariant' proportion of $1/\sqrt{2}$ (approximately 7/10 or 0.707)—a ratio which, not by chance, was adopted early on by Italian papermakers for the standardisation of the moulds they used on a daily basis.[37]

---

35 The same procedure was applied in Maniaci 1995, see below, 448 and footnote 69.

36 See above, 422 and footnote 21.

37 As is widely known, the 'invariant' (i.e. Carnot's) proportion is repeated in all the subdivisions in two made along the short edge of an initially rectangular form. Not by chance, the same proportion is still employed today in ISO 216 format sheets, or the DIN A sequence (which starts out from an integral A0 sheet, whose surface area is 1 m^2).

In addition, the Munich recipe can rightly be considered as having been conceived for the *mise en page* of paper codices—which prevailed overwhelmingly in the German domain—of highly standardised dimensions and proportions.

Therefore, the 'Saint-Remi' and 'Munich' pages (the latter considered of invariant proportion) present major differences in their respective layouts. The former is rather square-looking (with a ratio of 4/5, or 0.800), and is characterised by the similarity of its two widest margins (i.e. the external and lower ones),[38] whilst the Munich page is (hypothetically) 'slimmer' in appearance, with the opposite pair of margins (i.e. the inner and upper ones) being of the same dimensions, as the external and lower margins in the 'Saint-Remi' page.

Despite being visually dissimilar, both of the layouts automatically imply respect for an 'unwritten rule'—a rule which is almost constant in the manufacture of the medieval book, namely the creation of a written area whose 'slimness' is more pronounced than that of the page which accommodates it. In the more ancient of the two recipes, the proportional ratio is 0.750/0.800, whilst in the later one the value is 0.655/0.707—assuming that the height of the written area and the width of the volume are equal.[39] Both values are essentially in line with the trend observed in Italian dated manuscripts throughout the Middle Ages.[40]

38 The reader will probably recall that Denis Muzerelle proposed a modification of the value stipulated in the recipe, setting the internal margin at half, rather than two thirds of the width of the upper margin. The correction, whilst necessary, is difficult to justify palaeographically–even when one allows for the fact that in the original text the relationship was expressed in words rather than in numbers–and therefore could be regarded as being superfluous, especially if we allow that the recipe tacitly adds the space necessary for the binding to the internal margin (which, in essence, is analogous to the 'small space' prescribed by Fanti, concerning which see below, 440 and footnote 60).

39 On the 'remarkable similarity' between the height of the written area and the width of the sheet, see below, 451 onwards.

40 One consistently encounters the same tendency in Greek codices; see Maniaci 2002, 157–165; Maniaci 2012, 501 [in this volume, 465–508].

Comparison of the written area's proportion and that of the page (l/h vs L/H) in Italian dated manuscripts (MDI) (tab. 1)

Century	L/H	l/h	No. mss
9th	0.758	0.745	3
10th	0.731	0.691	3
11th	0.717	0.654	19
12th	0.684	0.586	12
13th	0.691	0.632	44
14th	0.714	0.674	235
15th	0.699	0.637	1666
Total	0.701	0.641	1982

Tab. 1: Comparison of the written area's proportion and that of the page (l/h vs L/H) in Italian dated manuscripts (MDI)

In the Saint-Remi recipe the degree of page filling—which is to say the ratio between a page's written area and its total surface area, often referred to as the 'black'[41]—amounts to almost 42%, a figure that is entirely in conformity with that attested to in the Early Middle Ages. With respect to the recipe transmitted through the Munich codex, its application to a leaf of the same dimensions as those used in coeval paper manuscripts (i.e. with a written area whose height is equal to the leaf's width) results in a page filling value of 43.8%—one that tallies perfectly with the page filling value typical of the period, above all in the manufacture of paper volumes, on average lower than their parchment counterparts (see below, Tab. 5).[42] Despite its highly condensed and theoretically 'incomplete' nature, the Munich recipe therefore indirectly provides—thanks to two plausible additions—all the necessary information for the realisation of an 'acceptable' *mise en page*, with respect to coeval standards.

In the Latin context the artisan abandoned, from the Early Middle Ages onwards, a predilection for the manufacture of 'square-shaped' manuscripts typical of book production in late antiquity (apart from occasionally returning to it

41 See Bozzolo et al. 1984.

42 The total average value for 'black' (i.e. page filling) in the sample of 15th-century Italian dated manuscripts used for this research project is 41.8% for parchment volumes and 44.3% for paper ones. For additional information on the distribution of the values, see below, Tab. 18.

in the Carolingian Age),[43] whereas Greek parchment codex continued, until the Late Middle Ages, to exhibit distinctly broader pages, albeit somewhat less 'square-shaped' than those of the earliest volumes.[44] This conservative tendency justifies the 'success' enjoyed by the Saint-Remi set of rules in Greek manuscript production,[45] in contrast to its almost non-existent application in the Latin world.[46] On the other hand, the Munich recipe—rather predictably—appears frequently to be applied in the manufacture of Latin codices of the Late Middle Ages, a production which was progressively dominated by the use of paper, as can be deduced from the high percentage rate of the recipe's application recorded in a corpus of approximately 1,100 manuscripts originating from different periods and production centres, and confirmed, as we shall see, by tests carried out on the sample group of dated codices.[47]

In the light of these results, curiosity naturally compels one to extend the investigation to the recipes written in vernacular Italian between the 15th and 16th centuries. First of all, however, we must examine the instructions found in the two texts, whose past interpretation is not entirely convincing, and which have been summarised in a not altogether clear way in some recently published textbooks.

In chronological order, we can start with a re-reading of the text transmitted through Vat. lat. 4825, which was recently 'rediscovered' and brought to the attention of scholars by Paolo Cherubini:

> A sapere spaciare ogni libro, o vuole picolo o vuole grande. / Comincia di sopra e fane 15 puncti cioè 15 pa(r)ti; poi di/cti puncti pigliane 2. E tanto spacio dà da lato dentro alla / lunga, poi da lato di fuora dàne 4, poi da lato di sopra dàne / 3. E se tu volissi scriv(er)e di sopra de la rega dagline alchuna cosa / men de 3. E da lato di .ssotto dàne 6. E se tu volissi fare a co/lone, un puncto solo vuole essere la colona. E vidi che suso / questo lato te l'ò designato.

43 The 'archaicising' suggestions referred to in order to explain the 'revival' of the 'square' proportion in the Carolingian Age (see Palma 1998) quite plausibly accounts for its success in a few learned circles, albeit limited to certain textual typologies (e.g. sumptuous editions of the classics), but does not explain the spread of the 'square' format to other texts and contexts. Secondary motivations may emerge in the future that will shed light on the methods adopted for processing animal skins–methods aimed at maximising their exploitation, through the application of subdividing techniques similar to those identified in some Greek codex production centres (see Maniaci 1999 and Maniaci 1999a [in this volume, 309–321]).

44 Maniaci 1995; Maniaci 2002, cap. III. *La proporzione dei fogli*, 127–148; Maniaci 2012, 492–494 [in this volume, 465–508].

45 Provided that the width of the page is adjusted, reducing it from 4/5 to 3/4. See Maniaci 1995, 31.

46 Thus explaining Denis Muzerelle's strong criticism (Muzerelle 1989, 131), which speaks of 'une recherche proportionnelle purement speculative'.

47 See the charts/graphs presented in Maniaci 1995, 33, 34 and 36, and below, 443 ff.

> Questo libro no(n) fu ben spaciato come bisognarìa, ma vole(n)do tu i(m)parare de squadrare ogni forma de carta di capretto, p(er)ch(é) / le forme di la carta di capreto no(n) possono venire formate, come / fàno li fogli di la carta di bambaso, p(er)ò piega la carta come indi / ho facto questo lato, e fa che la lungheza alla traversa sia tanto / qua(n)to la lungheza de suso i(n) ziuso, poi spacia come t'ò detto di sopra.

The recipe, which broadly speaking is formulated in a clear enough way (despite a few inconsistences in the use of technical terms), adopts as its fundamental unit of measurement a *puncto* or *parte*, which equates to one fifteenth of the total width of the page. This unit is used to define the width of the four margins by establishing a ratio of 1:2 between the two opposite pairs. Respectively, the internal and external margins measure 2 and 4 *puncti*, whilst the upper and lower ones measure 3 and 6 *puncti*.[48] The intercolumnium, when present, is allotted a single *puncto*, that is half of the space allocated for the fold margin.[49] To compensate for the lack of instructions relating to the leaf's height (a lack which in theory renders the recipe 'incomplete'), in the second paragraph the unknown writer provides directions for the shaping of parchment sheets, albeit without supplying standardised measurements (unlike in the case of paper). The squaring of the parchment bifolia is achieved by equalising their horizontal fold line with the height of a paper sheet, which is to say with the height of its most widespread size type, known as '*reçute*' or 'common', which also predominates in the Vatican codex).[50] If, as we can take for granted, the implicit reference in the Vatican text is the reality of the Italian paper codex of (normally) 'invariant' proportion,[51] it should, in

48 The phrase 'e se tu volissi scriv(er)e di sopra de la rega dagline alchuna cosa / men de 3', which clearly alludes to the alternative possibilities of writing 'above' or 'below the top line', appears to create confusion between a 'geometric' vision of the written area, which is to say a rectangle defined beforehand during the *mise en page* planning stage, and a 'graphical' vision, which depends on the way in which the copyist utilises the spaces that are created by ruling.

49 With respect to this feature, for a comparison of the data supplied with the other recipes, see below, 443 n. 66. It is interesting to observe that in the Vatican source the *puncti* are physically marked out (and, indeed, are still visible) in the upper margin of the same page upon which the recipe appears, so much so, in fact, that the copyist refers to them in the final sentence of the recipe ('E vidi che suso / questo lato te l'ò designato'), which confirms its impromptu nature (see Cherubini 2004, 245).

50 The folding varies between 'royal quarto' and '*reçute*' only in the initial quires (including within one and the same quire).

51 The folding in two of a '*reçute*' sheet (which according to the 'Bologna Stone' measures approximately 440 mm × 310 mm and is of invariable proportion) automatically generates pages which are in turn of invariable proportion. Folding a 'royal' format sheet (measuring 608 mm × 440 mm) in four produces a value close to the invariable proportion (0.691). When a 'royal' sheet is folded in two it produces a large folio sheet with a broader appearance (0.723). Seen from this

theory, be correct to set the missing height value at approximately 21 *puncti*,[52] as Cherubini suggests. The addition of the missing value also makes it possible to set the height of the written area at 12 *puncti*.

Fully defined and completed in this way, the page set-up 'produces results that do not tally—not even when adjustments envisaged by practically all scholars are made—with any of the recipes known up to now'.[53] Furthermore, the page set-up produces results which in theory are not very compatible with the two 'rules' that were most commonly applied in the *mise en page* of medieval manuscripts, namely the relationship between the external proportion of the book and that (consistently narrower) of the written area, and the degree of page filling (i.e. 'black'), which is almost never less than one third of the total capacity of the page. In fact, the application of the Vatican recipe results in a written area which is noticeably more square-shaped than the page that hosts it (0.75, as opposed to 0.71), and a page filling value of around 34%, which is certainly somewhat lower than the standard value seen throughout the 15th century (see below, Tab. 5).[54]

The application of the Vatican text to a '*reçute*' page results in margins (measurements are expressed in centimetres) that are interesting to compare with the ones seen in the codex which bears the text (Tab. 2).

perspective, the results of the survey carried out by Cherubini 2004, 248–249 on a small group of 28 documents that are of nearly the same period as the Vatican text (1429–1442) and are all (apart from two) in '*reçute*' format, appear to be entirely predictable. The documents were all drawn from Briquet's inventory. The proportions, expressed in an unusual way by Cherubini as height/width ratios, range between two extremes of 1.30 and 1.51, or 0.768 and 0.659, but the average value is 0.39, or 0.717. As regards the measurements inscribed on the so-called 'Bologna Stone', which vary slightly depending of the scholar concerned and measuring criteria applied, see the detailed observations of Gumbert 1993, I, 240, footnote 27.

52 This results in a page proportion of 0,714. When the invariable proportion is respected a height of 21.2 *parti* results, which is equal to the page's width.

53 Cherubini 2004, 252.

54 Despite these clear contradictions, the set-up of the margins as stipulated in the recipe also achieves (somewhat surprisingly)–as we shall see (see below, 448 ff.)–a certain amount of recognition in late medieval book production.

Comparison of the margins prescribed by the recipe with those actually observed in Vat. lat. 4825 (tab. 2)

Margins	Recipe	Vat. lat. 4825
Mint	28	25
Msup	42	43
Mest	56	47
Minf	84	47

Tab. 2: Comparison of the margins prescribed by the recipe with those actually observed in Vat. lat. 4825

The harsh opinion expressed by the recipe's unknown writer in relation to a 'book not [...] as well laid out as it should be' can undoubtedly be accounted for by the very generous amount of space that the recipe allocates to the lower margin, which is far larger than that seen in the actual codex, and is noticeably greater than the space allocated by the other recipes.[55] The codex's outer margin is also narrower than what is prescribed by the recipe, but the difference in this case is far less apparent. Conversely, the inner and upper margins of the codex appear to be entirely compatible with those stipulated by the recipe.

These observations do not explain the formulation of an abstract and rather problematical set of alternative norms that are different from those seen in the actual layout of the Vatican manuscript, all the more so given that the said manuscript is fully in line with the characteristics of coeval production of the same level, both in relation to its total dimensions (today 295 mm × 210 mm) and those of its written area (205 mm × 138 mm). The Vatican manuscript is also in line with the percentage of page filling (46%, which is adequate for a volume of technical content), and the proportion of its written area (0.673), which is lower, as usual, than that of the slightly higher proportional ratio of the invariant page (0.712).

Furthermore, the proportionally abnormal width prescribed for the lower margin by the Vatican text is very seldom seen in other manuscripts dating from the same period: indeed, in the 15th century, in only 5.7% of Italian dated manu-

55 In the Vatican recipe the lower margin is equal to 28.6% of the total height of the sheet, in comparison to 20% in the Saint-Remi recipe, 19.5% in the Munich recipe, and 22.2% in Fanti's text.

scripts (97/1679) does the lower margin occupy more than 28% of the total height of the page, and 40% of them are parchment volumes.

In conclusion, it should be admitted that the analysis does not fully solve in an entirely satisfactory way the mystery lying behind a source which is not lacking in peculiarities. In any event, in the absence of direct and convincing evidence, Cherubini's suggestion of a connection with accounting schools, where the recipe was supposedly used for educational purposes to train pupils in the manufacture as well as the compilation of accounting books, remains rather feeble, and purely hypothetical.

A critical examination of the last (in chronological terms) of the four recipes shows it to be of a similarly problematical nature, and perhaps even more so than the Vatican text. The recipe was written down by the imaginative mathematician Sigismondo Fanti in the first book of the felicitous short treatise of 1514 on the geometric design of letters. The conclusions reached in a contribution by Giorgio Montecchi were recently revisited (and occasionally misunderstood) by Maria Luisa Agati in her textbook, and in the previously mentioned essay by Cherubini.[56]

> Togli la mensura de la latitudine come tu desideri largo lo volume. El volume vole essere una volta e meza, quanto è largo tanto da esser longo, cioè che la longitudine et la latitudine vol esser in proportione sesquialtera come iii a ii.
> Facta la tua forma tu die sequitare et squadrare. Facto questo togli quello traverso in tre parte et la tertia parte sie lo spacio di sotto.
> Va più inanti a fare lo spacio di fuori tu die partire quello che avanza del quadro in giù, et quello mezo è lo spacio di fuori.
> Va più inanti a fare lo spacio dentro de la ligatura et di sopra. Tu die partire questo di fuora per mitade et dare alchuno picolino avantagio a quello de la ligatura dentro. Et questo è lo spacio di sopra.
> Va più inanti quanto die essere larga la colonna scripta. Tanto die essere larga la colona che se scrive quanto è lo spacio di fuori.
> Et sequitando questo ordine il spacio picolino in tramedio le colonae vene factae per ragione come per te medesimo approbando vederai. Et se questa arte te piace di questi spacii ricordate de non fallire cum lo sexto, peroché uno puncto che tu falli inporta grande distantia. Et ul-

56 Caterina Tristano's observations in Tristano 2010 (82 onwards) are more generalised, and not all admissible; for example, in clear contrast to the results of the codicological analysis is the affirmation which states that 'the codex produced in the 14th century and at least up until the middle of the 15th maintains a dimensional ratio, which one can term "traditional" [...], summarised by the stipulations of the Saint Rémi Rule [*sic*]' (85), 'a rule' that the author arbitrarily applies to bifolia and not to single leaves, as is clearly anticipated by the recipe which has come down to us in the French manuscript. A number of inaccuracies can be found in the analysis of examples presented on pp. 87–88.

> tra questa regula cum discretione poi accrescera le tuae colonnellae quanto importa una gamba de la littera non astringendo lo spatio dentro de la ligatura. Ma se quello picolino che è intramedio lae columnae et se quella riga che te da la ragione te piace la poi usare. Et inquanto che non te piacesse divide lae tuae colonnellae cum lo sexto calculando quantae rigae tu vole. Et tanto die essere lo spatio di fuori quanto è la colona scripta che de ragione tanto die essere lo biancho quanto il nigro. Quod est propositum.

Fanti's rather long-winded description, in the form of seven directives, contains more than one ambiguous passage, and not all of the theoretically feasible solutions to resolve problems raised by the text produce results that are compatible with the facies of coeval codices.

The directions start out, as in the oldest of the surviving recipes, by defining the relationship between the external dimensions of a sheet, which are set 'in a sesquialteral ratio of three to two'. In other words, Fanti favours a 2/3 (0.67) proportional ratio, which is poorly represented in books produced prior to and immediately following the advent of printing.[57]

The setting up of the margins starts out from the 'space underneath', which corresponds to—as in the 'complete' prescription found in the Munich recipe—a third of the volume's width. The third stipulation, concerning the external margin, which is defined as 'that which extends downwards from the square', is less immediately comprehensible. Giorgio Montecchi is correct in interpreting this rather tortuous phrase as meaning the difference between the width and height of the page, a measurement which is equal to one unit.[58] The external margin is therefore equal to 1/2, and hence is equivalent to 1/6 of the page height, and also, as in the Munich recipe, to 3/4 of the lower margin. The alternative possibility proposed by Maria Luisa Agati, and seconded by Paolo Cherubini, allocates a space for the outer margin which is equal to half the lower margin's width (based on Agati's interpretation of the phrase 'that which extends downwards from the square'). This is a hypothesis that gives rise, as we shall see, to impracticable parameters

57 See above, Tab. 2. In the sample of dated Italian manuscripts, only 12% of the codices present a proportional ratio of less than 0.670. It should be recalled that the cataloguing rules published in De Robertis et al. 2007, conventionally sets the lower chronological limit for the census at 31.12.1500. A quantitative investigation of the dimensional and layout characteristics of incunabula and books of the 16th century, for which there is a lack of relevant data, would be a desirable goal to fulfil.

58 The unquestionably convoluted character of the expression 'quello che avanza dal quadro in giù' ('that which extends downwards from the square') could be explained by a desire to maintain an implicit link to the width of the codex, which the geometric construction stems from, thereby avoiding express involvement of the volume's height.

for the proportion of the written area (larger than that of the page) and for the page filling percentage (which is abnormally high).[59]

Proceeding, then, on the basis of Montecchi's interpretation, Fanti makes the inner and upper margins equal to half of the breadth of the outer margin, adding an imprecise amount ('a little extra advantage') to the inner margin (and not to the upper one, as Maria Luisa Agati bafflingly suggests), so as to compensate for the space 'filched' by the binding.[60]

Montecchi's reading of the next point is far less convincing. In it, Fanti shifts attention from the definition of the margins to that of the written area. According to the first interpreter of the recipe (and all subsequent exegetes who have clung to it), this point notes a deviation 'from geometric strictness to an affirmation of general principles and practical compromises', no longer in relation to the individual dimensions of the page, but instead to the overall relationship between 'white' and 'black' areas. The stipulation *tanto die essere larga la colonna che se scrive quanto è lo spacio di fuori* ('the written column has to be as wide as the space outside' apparently refers to the latter (i.e. the 'black'), and is reiterated in the conclusion with the recommendation that *tanto die essere lo spatio di fuori quanto è la colona scripta* ('the outer space has to be as wide as the written column'), which establishes an equivalence between the written area and the area occupied by the margins. It does not escape Montecchi's attention that the said equivalence is not supported by his own hypothesis concerning the distribution of the margins, from which automatically stem the dimensions and surface of the written area, which represents 43% of the overall surface area of the page, in perfect agreement—as has already been mentioned—with the most widely adopted rules used in the artisanal production of

59 In Maniaci 2012, 505 and footnote 70 [in this volume, 465–508], the responsibility for an interpretation made exclusively by Agati 2009, 228 and footnote 3, is incorrectly attributed to Montecchi, thereby endorsing Cherubini's misinterpretation. (Agati specifically states that her interpretation is a 'correction' of Montecchi's reading.)

60 Agati 2009, 228. Montecchi 1995 (1997), 98, had already shown an inexplicable reluctance to interpret this passage ('it is not entirely clear whether or not this small amount should be added to the upper margin'), a passage which, in my view, is without ambiguity. In any event, it can be ruled out that the 'small space', which was clearly aimed at compensating for the reduction in the width of the inner margin caused by the intrusion of the binding, should be 'calculated as just a millimetre', a clearly trifling amount, especially when compared to the inevitably rough and ready nature of measurements made using the rudimentary instruments available to medieval craftsmen. A more plausible estimate can be found in the variation, which amounts to 3 mm, between the internal margin of the codex in which the Vatican recipe is transcribed and the theoretical one anticipated by the same recipe. See above, Tab. 2.

manuscripts during the 15th century.[61] In order to remedy what—in his view—appears to be an inconsistency, Montecchi proposes an ingenious interpretation, albeit one which is not supported by the text, when he hypothesises the addition of the space occupied by the written area to the area taken up by the inner margin lying adjacent to it. In this way, when a volume is open, the two writing areas and their two flanking internal margins generate a total surface area of 52%.[62]

A more persuasive solution, and one which is closer to the recipe's prescription, is achieved by interpreting the recommendation *tanto die essere lo spatio di fuori quanto è la colona scripta* in linear terms rather than in relation to the page area (which is never taken into consideration in the recipe), and by recognising the 'technical' value, which is anything but generic, of Fanti's directions. This requires one to believe that it was primarily his intention to specify the *mise en page* of a two-column book by prescribing the equivalence between the width of the outer margin and that of a column, already implied in the Saint-Remi[63] recipe, and reaffirmed centuries later in the Vatican recipe, and still verifiable—albeit not very widely—in the Latin codices of the 15th century, as evidenced in the sample of dated volumes (Tab. 3):[64]

61 The reconstruction suggested by Agati 2009, 230, is compromised by endowing the upper margin with an 'advantage' of a disproportionate size (even greater, indeed, than that of the margin to which it is applied!).

62 If we suppose that the width of the codex is 2 and its height 3, the dimensions of the written area will be 1.25 × 2.08, and those of the double written area plus the space occupied by the two inner margins 3 × 2.08; the ratio of 52% between the area of the internal rectangle and that of the double page area has to be increased a little in order to factor in the 'small advantage'.

63 Provided that the width of the volume equals four *partes*, the outer margin one *pars*, the inner margin 0.5 and the intercolumnium likewise (if present), two *partes* will remain to be divided equally between the two columns.

64 In the headings of this and the following tables, the margins are abbreviated as *msup* (upper margin), *minf* (lower margin), *mint* (inner margin), and *mest* (outer margin), according to the Italian acronyms.

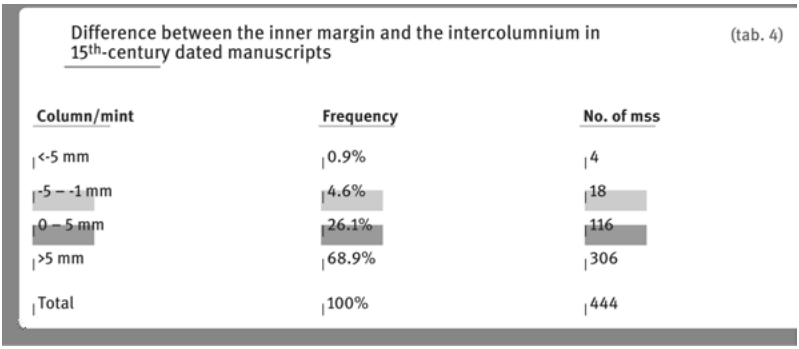
Difference between the written column and the outer margin in 15th-century dated manuscripts (tab. 3)

Column/mest	Frequency	No. of mss
<-5 mm	4.1%	18
-5 – 0 mm	6.3%	28
0 – 5 mm	7.9%	35
5 – 10 mm	16.0%	71
>10 mm	65.8%	292
Total	100%	444

Tab. 3: Difference between the written column and the outer margin in 15th-century dated manuscripts

According to this interpretation, the equivalence in size of the two columns and the outer margin automatically gives rise to the definition (*per ragione*, i.e. 'in consequence'?) of the width of the intercolumnium, which is described in the next directive. The intercolumnium turns out to be narrower than the inner margin (and therefore narrower than the upper margin too), with the obvious purpose of compensating for the 'small advantage' conferred on the fold. The prescription calls to mind the similarity between the intercolumnium and the inner margin set forth centuries prior in the Saint-Remi[65] recipe and, above all, turns out to be compatible with the working methods that were widely employed in the production of two-column codices in the Late Middle Ages (Tab. 4).

65 See above, 431, *huic* [= *posteriori margini*] *compar erit si media interfuerit*. In the Vatican recipe, the intercolumnium, which is very narrow, is equal to half the width of the inner margin (see above, 434–435).



Difference between the inner margin and the intercolumnium in 15th-century dated manuscripts (tab. 4)

Column/mint	Frequency	No. of mss
<-5 mm	0.9%	4
-5 – -1 mm	4.6%	18
0 – 5 mm	26.1%	116
>5 mm	68.9%	306
Total	100%	444

Tab. 4: Difference between the inner margin and the intercolumnium in 15th-century dated manuscripts

Fanti's concluding directions briefly address, in a rather obscure way, matters in relation to the exploitation of the spaces defined above, recommending that the artisan/copyist pay the utmost attention when using the compass (*sexto*),[66] and allowing him a certain amount of discretion both in defining the width of the columns and the number and spacing of lines.

4 Examination of the recipes' actual application

Now that we have concluded an overview of the currently known recipes, here, in a summarised table (Tab. 5; see also Figs. 7a/b and 8a/b), we present their main features (with the exception of the Greek text, which, as has already been pointed out, has characteristics that are not compatible with those of the others, on account of its structure and the environment in which it was applied):[67]

66 See above, 420, and footnote 17. Concerning the interpretation of this term, see Agati 2009, 228 and footnote 4.

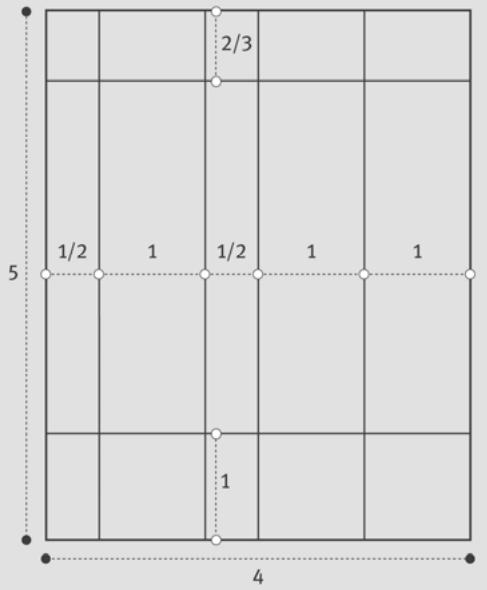
67 For Fanti's recipe some of the following tables also list the values anticipated by Agati 2009. The figures are shown in order to demonstrate that they are unsatisfactory.

Comparison of the layout configurations prescribed by the recipes (tab. 5)

	Saint-Remi	Munich	Vatican	Fanti Montecchi	Fanti Agati
Mint/msup	0.758	1	0.667	>1	<1
Mint/mest	0.500	0.667	0.500	>0.500	0.500
Mint/minf	0.500	0.500	0.333	>0.375	0.250
Msup/mest	0.667	0.667	0.750	0.500	>0.500
Msup/minf	0.667	0.500	0.500	0.375	>0.250
Mest/minf	1	0.750	0.667	0.750	0.500
Prop. codex	0.800	nd [0.707]	(0.707)	0.667	0.667
Prop. written area	0.750	nd [0.633]	0.750	0.600	0.692
'Black'	41.7%	nd [43.8%]	34.2%	43%	54.2%

Tab. 5: Comparison of the layout configurations prescribed by the recipes

The 'Saint-Remi' recipe (with correction by Denis Muzerelle) (fig. 7a)



Complete recipe

Base of the construction = height of the codex

mest = minf
mint = intercol
1 col = mest

mint/msup = 0.750
mint/mest = 0.500
mint/minf = 0.500
msup/mest = 0.667
mest/minf = 1

Prop. of the codex = 0.800 (4/5)
Prop. of the written area = 0.750 (3/4)
'black' = 41.7%

Fig. 7a: The Saint-Remi recipe (with correction by Denis Muzerelle)

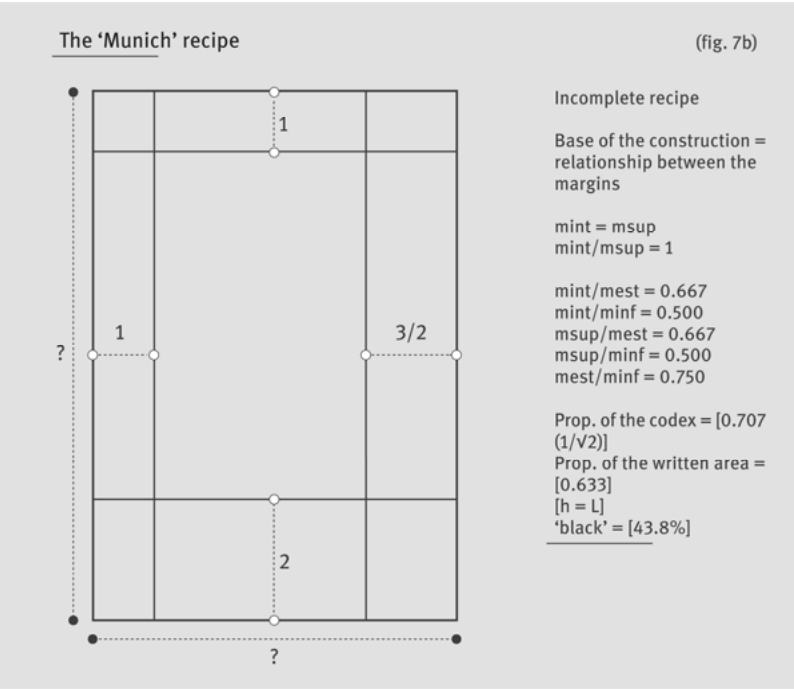


Fig. 7b: The 'Munich' recipe

A comparison of the layouts generated by the four recipes prompts a number of general remarks.

In the first place, it is well known that the *mise en page* of medieval manuscripts, Greek and Latin ones at least, presents—as has already been pointed out—two consistent features and a very widespread trend:

- both the outer and lower margins are broader than the inner and upper ones;
- the proportion of the written area is generally smaller than that of the codex;
- the proportion of the codex is concentrated on values which, in the Byzantine world, equate to approximately 3/4, whilst in the Western world the values incline towards the invariant value of 0.707.

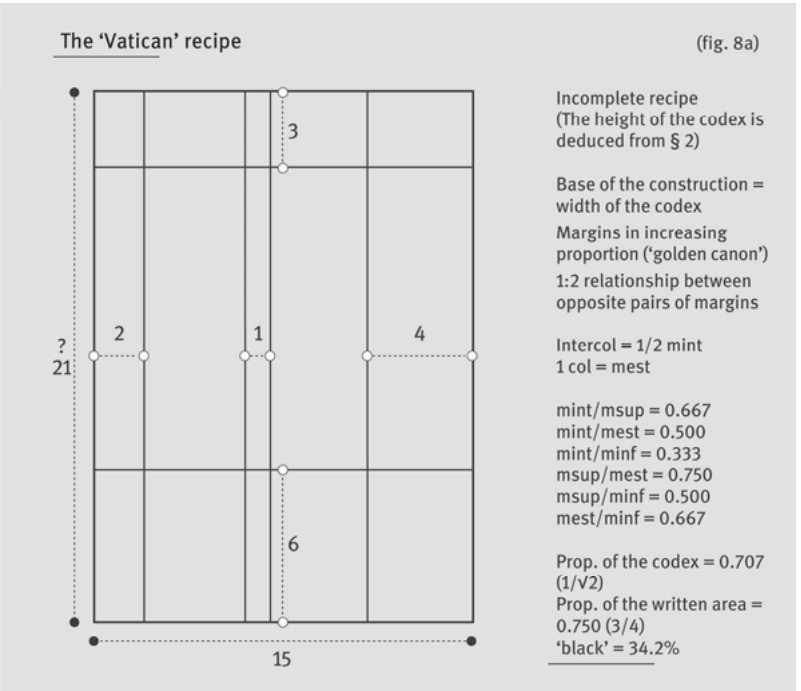


Fig. 8a: The 'Vatican' recipe

Logic dictates that the recipes should conform to these conditions. If they do not, the possible reasons are, in theory, several: (a) there is a 'gap' between the recipe and general practice, which perhaps reflects limited and local application; (b) the recipe introduces a new procedure; (c) the instructions set out in the recipe, in the form that it has come down to us, are incorrect; and (d) the instructions are correct, but they were incorrectly interpreted.

Given that all the recipes share in common the definition of the proportional relationships between margins, the following compatibility tests are limited to examining these alone.

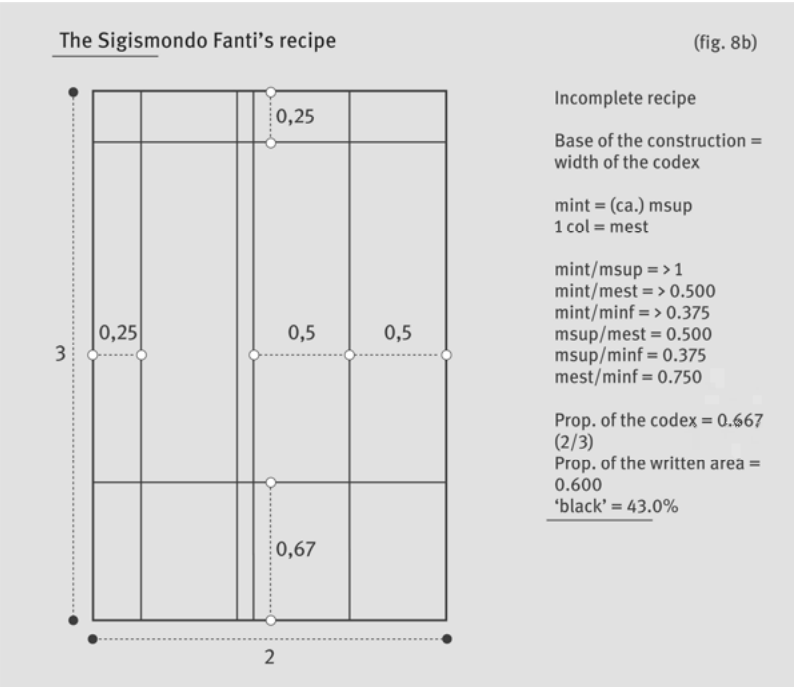


Fig. 8b: The Sigismondo Fanti's recipe

Therefore, declaring that one of the recipes was applied is equivalent to affirming that only the instructions in relation to the margins were followed, irrespective of the leaf's proportions and the proportional relationships between the margins and the two sides of the page (clearly defined in all the recipes—with the exception of the Munich text—inasmuch as the *pars* can be calculated by subdividing a page's height or width).[68] Thus one is dealing with—and it is important to bear this in

68 Strictly speaking, even if it is true that all the recipes are based on the definition of the proportional relationships between the margins, these are arrived at by applying different algorithms that make it possible for the relationships to derive from one another in an established order. It therefore follows that not all the relationships have the same 'weight' or level of accuracy: a few of them are, as it were, 'primordial', and should therefore be more accurately reflected in the manuscripts; others, instead, are either directly or indirectly drawn from antecedents, and are therefore impacted by approximations that tend to mount up upon each other. Besides, it is sufficient to know three of the four relationships between the margins, because the fourth is automatically determined by them. Therefore, verification of all four is a redundant step, even if it can be justified by the difficulty in

mind—a very rough interpretation of the term 'compatibility'. A sounder verification would have been impossible to achieve, given the large number of factors at play and the approximations that have to be taken into account for each of them. The verifications were carried out by calculating the space occupied (as a percentage) by each of the margins with respect to the total area and then comparing this figure to the values predicted by the recipes. In cases where the sum of the deviations as an absolute value with respect to a recipe turned out to be under 8%, the setting up of the margins was adjudged to be compatible with it.[69] For simplicity's sake, the validation procedure was limited to 15th-century codices, the category which prevailed (with almost 1,400 usable units) in the corpus assembled from the survey of Italian dated manuscripts (MDI).[70]

Number of manuscripts compatible with each of the recipes (tab. 6)

Total standard deviation	Saint-Remi	Munich	Vatican	Fanti Montecchi
0 – 2 %	0.1% (1)	0.2% (3)	0.1% (2)	1.0% (14)
2 – 4 %	0.9% (12)	3.5% (48)	1.7% (24)	4.2% (58)
4 – 6 %	2.0% (27)	5.7% (78)	3.5% (48)	7.1% (98)
6 – 8%	3.7% (51)	10.3% (142)	6.0% (83)	9.1% (126)
% total compatibility	6.6%	19.7%	11.4%	21.5%

Tab. 6: Number of manuscripts compatible with each of the recipes

The percentage of codices whose margins are compatible with one of the four recipes is not negligible. They reach, and exceed, respectively, 20% in the Munich and Fanti's prescriptions. However, more than half of the volumes (to be precise, 53.3%, or 734 units) turn out to be incompatible with any known recipe. Additionally, it should be borne in mind that the arrangement of margins often proves to be simultaneously compatible with more than one recipe. This can be seen to occur in 651 cases, distributed as follows (Tab. 7):

establishing, beforehand, the 'primordial' relationships. Needless to say, the problems presented by the verification of the width of margins alone are complex and, perhaps, not fully resolvable.

69 This procedure had previously been applied by Maniaci 2012, 505–506 506 [in this volume, 465–508]. Alternatively, in Maniaci 1995, a two-way 'range of tolerance', equating to +/- 15% of the margins' respective widths, was applied in an attempt to take into account the various sources of approximation.

70 See above, 431, footnote 36.

Distribution of manuscripts that exhibit 'dual compatibility' (tab. 7)

	Saint-Remi	Munich	Vatican	Fanti Montecchi
Saint-Remi	–	8.6%	2.3%	6.8%
Munich	8.6%	–	24.4%	39.2%
Vatican	2.3%	24.4%	–	25.7%
Fanti Montecchi	6.8%	39.2%	25.7%	–

Tab. 7: Distribution of manuscripts that exhibit 'dual compatibility'

Needless to say, the elevated number of cases of 'dual compatibility' involves the group of recipes of later origin, and in particular those of Munich and Fanti, which show the most striking similarities.

Conversely, there are 490 cases, which is to say more than a third of the total (35.6%, to be precise), in which the affinity between the arrangement of margins in an individual codex and that stipulated in a given recipe is sufficiently precise so as to exclude dual compatibility (Tab. 8):

Cases where there is compatibility with only one recipe (tab. 8)

	Number of mss	Percentage
Saint-Remi	78	5.7%
Munich	135	9.8%
Vatican	103	7.5%
Fanti Montecchi	174	12.6%
Total	490	35.6%

Tab. 8: Cases where there is compatibility with only one recipe

In this instance, too, the Saint-Remi recipe appears to stand out the most amongst the others, which confirms its low degree of compatibility with the prevailing tendency seen at the end of the medieval period. On the other hand, the application of an exclusive compatibility condition draws attention to the tendency for Italian 15th-century codices to favour the spatial organisation prescribed by Sigismondo Fanti: indeed, it cannot be ruled out that the Renaissance theorist may have wished to incorporate his innovative preference for the

3:2 ratio within the already popular margin arrangement seen in the late medieval codex.

The fact that a given distribution of blank marginal spaces is compatible with a recipe does not mean *per se* that its compatibility automatically extends to other aspects of its prescription. One can therefore pose the question as to whether, and to what extent, the preference for one or another recipe is linked to the relatively wide or narrow proportion of the sheet.

The analysis of the compatibility of recipes with the full range of proportional values yielded the following results (Tab. 9):

Compatibility with the recipes expressed as a percentage in relation to the value of L/H (tab. 9)

Proportion L/H	Manuscripts	Saint-Remi	Munich	Vatican	Fanti Montecchi	None
<0.67	274	4.4%	21.2%	13.1%	25.6%	48.5%
0.67 – 0.72	687	5.7%	22.1%	12.8%	24.3%	50.1%
0.72 – 0.77	232	9.0%	15.2%	8.1%	14.6%	61.0%
>0.77	95	11.6%	12.6%	7.4%	12.6%	63.2%

Tab. 9: Compatibility with the recipes expressed as a percentage in relation to the value of L/H

It is not surprising that the application of the Saint-Remi recipe turns out to be more widely distributed within, but not outside, the proportional range of 3/4 (0.750), which is typical—as has already been pointed out—of mid-Byzantine book production. On the other hand, it is remarkable to discover that all the other recipes turn out to be more representative when the proportional ratio is less than 0.720, in line with the practice established in book manufacture during the Late Middle Ages. The latter observation should be considered in relative terms: even when associated with the wide proportion criteria preferred by the Saint-Remi recipe, the proportional relationships prescribed by the Munich and Fanti's recipes still maintain their quantitative predominance in the 15th century.

More generally speaking, irrespective of the strict application of one or another of the recipes, the sampling of dated codices confirmed the increasing spread, in the Late Middle Ages, of a trend which sees the upper and inner margins becoming equal in width (a criterion prescribed, not by chance, in the Munich and Fanti's recipes). This trend runs parallel with a progressive abandonment of parity between the opposite pair of margins (i.e. the outer and lower): in fact, in the 15th century these tend to assume a proportion of 2:3 or 3:4, with a

definite skewing in favour of the lower margin, which in Western manuscript production is always markedly wider than the outer one (Tab. 10):

Distribution of the relationship between the outer and lower margins (tab. 10)

Mest/minf	Frequency
<0.4	2.3%
0.4 – 05	3.8%
0.5 – 0.6	10.7%
0.6 – 07	24.5%
0.7 – 0.8	24.3%
0.8 – 0.9	16.9%
0.9 – 1	8.1%
1 – 1.1	4.5%
1.1 – 1.2	1.8%
>1.2	3.2%
Total	100%

Tab. 10: Distribution of the relationship between the outer and lower margins

5 Three 'noteworthy equivalences'

At this point our analysis of the instructions that are clearly codified in the recipes (within the limits imposed by the application of an after-the-fact verification) can be brought to a conclusion. Scholars of the *mise en page* have, however, repeatedly recognised and hypothesised the conscious application, on the part of medieval artisans, of three 'equivalences' or 'remarkable relationships' which are not explicitly codified in the sources:[71]

– the width of the codex is equal to the height of the written area (h = L);
– the width of the writing area is equal to half the height of the codex (l = H/2);

71 This issue, which was only hinted at (and solely in relation to the first two 'noteworthy equivalences') in Maniaci 1995, 37–40, will be re-examined more closely in the pages that follow.

– when the volume is open, the total of the widths of the two written areas plus the two inner margins (adjacent to the binding) is equal to the height of the page (2l + 2mint = H).

Accordingly, it is worthwhile check the possible compatibility of each of the three properties against the instructions contained in the surviving recipes, as well as their diffusion throughout the corpus of investigated manuscripts. The following table (Tab. 11) reports, for the four recipes, the relationship between the two elements that compose each of the three equivalences, as deduced from the values of the basic parameters (needless to say, a score of 1 corresponds to perfect compatibility).[72]

Relationship between the remarkable equivalences and the instructions provided in the recipes (tab. 11)

	Saint-Remi	Munich	Vatican	Fanti Montecchi	Fanti Agati
h / L	0.833	1	0.880	1.040	1.063
l / (H/2)	1	0.926	0.860	0.833	1
(2l+2mint) / H	1.20	1.121	1.05	1	1.111

Tab. 11: Relationship between the remarkable equivalences and the instructions provided in the recipes

Of the three 'unwritten rules' the most widely known,[73] which is to say h = L, is only compatible with pages of narrow proportions. Indeed, it is not purely by chance that it is encountered, albeit in an approximate way, in the Sigismondo Fanti's and Munich recipes, in the form of relationship values of 0.80 and 1.040, respectively.[74]

72 As the reader will recall, in the case of the Munich recipe, conformity to the h = L formula is hypothesised at the outset in order to presuppose the spacing measurements, which cannot be directly inferred from the text.

73 The rule is also clearly stipulated in the Gothic canon of Tschichold 1948 (1975, 2003), 45 of the Italian version.

74 The insufficient compatibility seen in the case of the Vatican recipe adds another layer of complexity to its interpretation.

It should be noted, however, that the percentage of codices in which this property is respected (within an asymmetrical tolerance range of -5 and 10 mm)[75] is high overall, irrespective of the recipes concerned (Tab. 12). This is not surprising, given that the equivalence is not explicitly stipulated by any of the recipes, nor does it constitute in any of the cases an implicit result of their application: in fact, it is also encountered in codices whose margins turn out to be incompatible with all of the recipes.

Distribution of the equivalence h = L in relation to the application of the recipes (tab. 12)

h-l (mm)	All	Saint-Remi	Munich	Vatican	Fanti Montecchi
-5 – 0	13.2%	16.5%	12.9%	10.8%	15.9%
0 – 5	8.9%	7.7%	7.8%	8.3%	8.8%
5 – 10	7.9%	8.8%	7.0%	6.4%	6.4%
Total	30.0%	33.0%	27.7%	25.5%	31.1%

Tab. 12: Distribution of the equivalence h = L in relation to the application of the recipes

On the other hand, the following table (Tab. 13) confirms that, irrespective of compatibility with the recipes, the h = L relationship criterion is satisfied above all in volumes of narrow proportion:

75 Whilst in the preceding calculations the margin of error is implicit in the tolerance permitted in the respective percentages of the margins, in the case of the equivalence h = L, it was necessary to set an 'asymmetrical' threshold: in fact, while the height of the written area (h), being contained by the page, is 'immune' from significant distortions, the width of the page (L) can be affected, to a not insignificant extent, by page trimming or errors made in measurements (due, for example, to the difficulty in reaching all the way to the leaf fold with the measuring instrument. For this reason, the tolerance latitude is set at 5 mm when h < L, and 10 mm if the opposite is true.

Distribution of the difference h–L in relation to the leaf's proportion (tab. 13)

L/H	Difference H/L			Total
	<-5	-5 – 10	>10	
<0.57	0	16.7%	83.3%	100%
0.57 – 0.62	20.0%	30.0%	50.0%	100%
0.62 – 0.67	26.4%	48.8%	24.8%	100%
0.67 – 0.72	52.6%	33.0%	14.3%	100%
0.72 – 0.77	67.2%	25.5%	7.4%	100%
>0.77	83.2%	12.6%	4.2%	100%
Total	52.8%	32.7%	14.5%	100%

Tab. 13: Distribution of the difference h-L in relation to the leaf's proportion

The height of the written area gradually decreases as the width of the leaf becomes relatively greater (thus its proportion becomes wider), and vice versa. This phenomenon is an automatic result of the positive correlation between the proportion of the leaf and that of the written area. The cases in which the relationship h = L is respected are most frequently observed when the leaf's proportion ranges from between 0.62 and 0.67, although parity is still well documented in the band that corresponds to a distinctly wider proportion.

The second rule—l = H/2—is naturally associated with the layout of wide-proportioned pages (Tab. 14), which make it possible to provide sufficient space for the horizontal margins. It is therefore not surprising that the rule is even implicit in the correct prescription of the Carolingian[76] recipe, nor that it appears less frequently in the Latin Late Middle Ages.

76 By allocating one *pars* to the outer margin and half of one to the inner one, the width of the written area equates to 2.5 *partes*, that is to say half of the 5 *partes* allocated to the page's height.

Distribution of the l = H/2 difference in relation to the leaf's proportion (tab. 14)

L/H	<-5	-5 – 10	>10	Total
<0.69	92.4%	6.6%	0.9%	100%
0.69 – 0.72	77.5%	19.2%	3.2%	100%
>0.72	51.9%	32.8%	15.3%	100%
Total	75.5%	18.5%	6.0%	100%

Tab. 14: Distribution of the l = H/2 difference in relation to the leaf's proportion[77]

In any event, the relationship is respected, in the 15th century, by 18.5% of Italian dated manuscripts (Tab. 15):[78]

Distribution of the l – H/2 difference in relation to the recipes (tab. 15)

l – H/2 (mm)	All	Saint-Remi	Munich	Vatican	Fanti Montecchi	None
<-5	75.5%	82.4%	89.3%	74.5%	90.9%	67.0%
-5 – 10	18.5%	13.2%	9.6%	20.4%	7.8%	24.0%
>10	6.0%	4.4%	1.1%	5.1%	1.3%	9.0%

Tab. 15: Distribution of the l - H/2 difference in relation to the recipes

Despite the connection that links it to wider pages, the parity is inexplicably most commonly seen in volumes with generally invariant proportion, such as those posited by the Vatican manuscript.

77 Also in this case, the margin of tolerance is identical to that which applies in the preceding equivalence.

78 The fact that in Tab. 14 and 15 the bulk of the occurrences are located in the first of the three bands (< -5 mm) is not a result of (as one might imagine) the adoption of an asymmetrical margin of tolerance, but instead is a consequence of the intrinsic properties of the recipes. If the distortion were in fact due to the asymmetry of the margin of tolerance, the > 10 category should register a much higher number of occurrences, given that the value of H, when subjected to trimming, would undergo a reduction which is too great in relation to the value of l.

The question still has to be posed as to whether or not the two equivalences appear simultaneously and, if so, how frequently? A simultaneous presence is, in fact, far from widely encountered in Italian manuscripts of the 15th century; indeed, within the limits of the defined tolerance range, it is observed in less than 7% of cases (Tab. 16).

Frequency of the possible different combinations of the two equivalences h = L and l = H/2 (tab. 16)

h – L (mm)	l – H/2 (mm)		
	<-5	-5 – 10	>10
<-5	43.0%	7.2%	2.5%
-5 – 10	24.5%	6.8%	1.4%
>10	8.0%	4.4%	2.1%
Total	75.5%	18.5%	6.0%

Tab. 16: Frequency of the possible different combinations of the two equivalences h = L and l = H/2

In the small sub-group composed of 94 manuscripts in which one observes the simultaneous presence of the two 'remarkable relationships', the Saint-Remi recipe is clearly underrepresented. In absolute terms, the manuscripts that are incompatible with all the known recipes predominate (Tab. 17).[79]

How, then, can we explain the poor success rate achieved by the combination of the two equivalences?

79 In this and the tables that follow the fact that the sum of the percentages sometimes turn out to exceed 100 is explained by the possibility that one and the same set of margins might be compatible with multiple recipes.

Distribution of cases of concomitance between h = L and l = H/2 in relation to the recipes (tab. 17)

Recipes	Frequency h = L + l = H/2
All mss	6.8%
Saint-Remi	4.3%
Munich	9.6%
Vatican	9.6%
Fanti	11.7%
None	71.3%

Tab. 17: Distribution of cases of concomitance between h = L and l = H/2 in relation to the recipes

If they were to be applied simultaneously, the written area would necessarily occupy half of the total page area, whereas the ideal level of 'black' (i.e. page filling) in late medieval manuscript production is in actual fact much lower than 50% of the total page area (this is also true of paper manuscripts, which are generally of a lower quality than parchment ones). Only 12% of 15th-century dated manuscripts exhibit a filling level which is greater than half of the page's total area (Tab. 18):

On the other hand, if the two equivalences were simultaneously applied to a codex of invariant proportion, the written area would automatically assume the same proportion as the leaf, although in practice it regularly proves to be narrower.[80] It therefore seems that the artisans' instinct for practicality took precedence over elegance and/or the ease of implementation predicted by the theory.

The mathematical expression of the third and less well-known 'remarkable relationship'—2l + 2 mint = H—is owed to Giorgio Montecchi, who submits it as a corollary to Fanti's recipe: 'in an open book positioned in front of the reader the base of the double written area, formed by the sum of the two bases of the writing areas (2b) plus the two inner margins (2c), is equal to the height of the page'.[81] This third rule also turns out to be compatible, overall, in the 15th century, with all the recipes (Tab. 19).

80 Montecchi 1995 (1997), 105.

81 In this instance, the margin of tolerance applied is +/- 10 mm, because the height of the codex may have been underestimated at both the top and the bottom of the volume as a result of trimming.

Distribution of the degree of page filling ('black') in full-page manuscripts, 15th-century Italian dated manuscripts (MDI) (tab. 18)

'Black'	Frequency
<0.30	5.7%
0.30 – 0.35	19.4%
0.35 – 0.40	29.7%
0.40 – 0.45	20.7%
0.45 – 0.50	14.1%
0.50 – 0.55	7.3%
0.55 – 0.60	2.8%
>0.60	1.9%
Total	100%

Tab. 18: Distribution of the degree of page filling ('black') in full-page manuscripts, 15th-century Italian dated manuscripts (MDI)

Frequency of the relationship 2l + 2mint = H in relation to the recipes (tab. 19)

Recipes	Frequency h = L + l = H/2
All mss	19.7%
Saint-Remi	20.9%
Munich	25.8%
Vatican	26.1%
Fanti	24.3%
None	15.1%

Tab. 19: Frequency of the relationship 2l + 2mint = H in relation to the recipes

However, it comes as no surprise to discover that the relationship is more frequently observed in full-page volumes (whose written area, generally speaking, is narrower), but far less frequently in two-column volumes. It is not quite as easy to explain the more frequent occurrence of the relationship in parchment volumes, although this might be related to their (largely speaking) superior quality of execution (Tab. 20).

Frequency of the relationship 2l + 2mint = H in full-page volumes and two-column volumes, on both parchment and paper (tab. 20)

Full-page	2 columns	Parchment	Paper
22.8%	13.3%	22.4%	18.0%

Tab. 20: Frequency of the relationship 2l + 2mint = H in full-page volumes and two-column volumes, on both parchment and paper

As regards the connection between the other two 'remarkable relationships', simultaneousness with l = H/2 can be ruled out mathematically[82]. On the other hand, a simultaneous presence with h = L can be confirmed in 87 cases (6.3%), chiefly associated with the Munich and Fanti's recipes (Tab. 21).

Distribution of cases of concomitance of 2l + 2mint = L in relation to the recipes (tab. 21)

Recipes	Frequency
All mss	6.3%
Saint-Remi	6.9%
Munich	24.1%
Vatican	14.9%
Fanti	27.6%
None	71.2%

Tab. 21: Distribution of cases of concomitance of 2l + 2mint = L in relation to the recipes

***

Overall, the comparative study of the small number of recipes which—quite fortuitously—have come to light so far, confirms, notwithstanding various reservations as regards their interpretation, the existence of some basic trends with respect to the page's structure and the subdivision of written and blank spaces on its surface. The recipes provide a partial and (unfortunately) not always very clear reflection of the

82 In the case of l = H/2, H is obviously equal to 2l.

layout trends witnessed by medieval manuscripts, especially when they are seen purely as guidance on matters concerning taste, rather than as prescriptions to be followed to the letter. Seen in this perspective, the directions regarding the set-up of margins can be addressed separately from those that deal with the proportion of the page, which are more stringent. The tendencies documented by the recipes describe an evolutionary path that coincides with changes in the appearance of the written page that occurred between the Early and Late Middle Ages. Differences between manuscripts and printed books can also be observed. Numerous specific choices were made along this evolutionary path, which are borne witness to by the surviving recipes (only one of which dates prior to the Late Middle Ages). In any event, the extant recipes constitute the tip of an iceberg, beneath which it is quite reasonable to hypothesise the existence of additional fully developed sets of rules, or perhaps isolated examples of guiding principles for the artisans to observe when they made their choices. However, the large number and complexity of the various factors in play make it exceedingly difficult, if not impossible, to identify such recipes today.

References

Abbady, Hossam (2005), *Las artes del libro en el-Andalus y el Magreb* (*siglos IV H/X d. C. -VIII H/XV d. C.)*, Madrid: Ediciones El Viso.

Agati, Maria Luisa (2009), *Il libro manoscritto. Da Oriente a Occidente. Per una codicologia comparata*, Roma: L'Erma di Bretschneider (Studia archeologica, 166).

Batlle, J. (n. d.), in *'Shaping the page'. Propuesta de métodos de construcción y medidas de las cajas escriptóricas en manuscritos góticos* at <http://www.arteilluminandi.com/extres/shape.pdf>

Bianconi, Daniele (2010), 'Sources écrites et stratégies de mise en page à Byzance. À propos d'une recette pour l'Organon d'Aristote', in Jacob, Christian (ed.), *Lieux de savoir*, II. *Les mains de l'intellect*, Paris: Albin Michel, 401–425.

Bischoff, Bernhard (1984), 'Zur Schreib- und Buchtechnik des Spätmittelalters, II. Regeln für die Seiteneinteilung (Fünfzehntes Jahrhundert)', in Bischoff, Bernhard (ed.), *Anecdota novissima. Texte des vierten bis sechzehnten Jahrhunderts*, Stuttgart: Hiersemann (Quellen und Untersuchungen zur lateinischen Philologie des Mittelalters, 7).

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1990), 'L'artisan médiéval et la page: peut-on déceler des procédés géométriques de mise en page?', in Barral y Altet, Xavier (ed.), *Artistes, artisans et production artistique au Moyen âge,* III. *Fabrication et consommation de l'œuvre.* Colloque international, Centre National de la Recherche Scien-

tifique, Université de Rennes II - Haute-Bretagne, 2-6 mai 1983, Paris, 295–305 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 447–456).

Casamassima, Emanuele (1996), *Trattati di scrittura del Cinquecento italiano*, Milano: il Polifilo.

Catalogus 1873 (1968*) Catalogus codicum manu scriptorum Bibliothecae Regiae Monacensis, III.3. Codices Latinos (Clm) 5251-8100 complectens*, Monachii 1873 (rist. Wiesbaden 1968).

Cherubini, Paolo (2004), 'Una nuova ricetta in volgare per rigare la pagina (secolo XV)', in *Miscellanea Bibliothecae Apostolicae Vaticanae*, 11, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 423), 241–258.

De Robertis, Teresa / Giovè Marchioli, Nicoletta / Miriello, Rosanna / Palma, Marco / Zamponi, Stefano (eds), *Norme per i collaboratori dei Manoscritti datati d'Italia*, seconda edizione rivista ed ampliata, Padova: CLEUP.

Déroche, François et al. (2000), *Manuel de codicologie des manuscrits en écriture arabe*, Paris: Bibliothèque nationale de France (Études et recherches).

Devreesse, Robert (1950), *Bybliothecae Apostolicae Vaticanae codices manu scripti recensiti iussu Pii XI Pontifici Maximi [...]. Codices Vaticani Graeci*. Tomus III. *Codices 330–603 recensuit Robertus Devreesse*, in Bibliotheca Vaticana.

Ernst, Giovanna (1994), 'Sigismondo Fanti', in *Dizionario Biografico degli Italiani*, 44, Roma: Istituto della Enciclopedia Italiana, coll. 638–642.

Gilissen, Léon (1977), *Prolégomènes à la codicologie*, *Recherches sur la construction des cahiers et la mise en page des manuscrits médiévaux*, Gand: Éditions scientifiques Story-Scientia.

Gumbert, Johan Peter (1993), 'Sizes and Formats', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I-II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 227–273.

Gumbert, Johan Peter (n.d.), *Les outils du copiste*, http://www.palaeographia.org/outils/outils.htm

Kronblicher, Walter (1968), *Die Summa de arte prosandi des Konrad von Mure* Zürich: Peter Lang (Zürcher Beiträge zur Geschichtswissenschaft / Arbeiten aus dem Historischen Seminar der Universität Zürich).

Maniaci, Marilena (1995), 'Ricette di costruzione della pagina nei manoscritti greci e latini', in *Scriptorium*, 69: 16–41.

Maniaci, Marilena (1999), 'Suddivisione delle pelli e allestimento dei fascicoli nel manoscritto bizantino', in *Quinio. International Journal on the History and Conservation of the Book*, 1: 83–122.

*Maniaci, Marilena (1999a), 'L'art de ne pas couper les peaux en quatre', in *Gazette du livre médiéval*, 34: 1–12.

Maniaci, Marilena (2002), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Maniaci, Marilena (2006), 'Problemi di *mise en page* dei manoscritti con commento "a cornice". L'esempio di alcuni testimoni dell'Iliade', in *Segno e testo*, 4: 211–298.

*Maniaci, Marilena (2012), 'Costruzione e gestione dello spazio scritto fra Oriente e Occidente: principi generali e soluzioni specifiche', in *Scrivere e leggere nell'alto medioevo*, Spoleto: Fondazione Centro italiano di studi sull'alto medioevo (Settimane di studio del Centro italiano di studi sull'alto medioevo, 59), 473–514.

McLean, Ruari (1997), *Jan Tschichold: A Life in Typography*, Princeton: Princeton Architectural Press.

Mercati, Giovanni (1931), *Notizie di Procoro e Demetrio Cidone, Manuele Caleca e Teodoro Meliteniota ed altri appunti per la storia della teologia e della letteratura bizantina del secolo XIV,* Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 56).

Montecchi, Giorgio (1994), 'Le dimensioni del libro secondo la *Theorica et practica* di Sigismondo Fanti', in Guerrini, Mauro (ed.), *Il linguaggio della biblioteca. Scritti in onore di Diego Maltese*, Firenze 1994 [in fact 1995] (Toscana Beni librari; 4. Biblioteche e archivi), II, 505–518.

Montecchi, Giorgio (1997 [1994]), 'Le dimensioni del libro secondo la *Theorica et practica* di Sigismondo Fanti', in Montecchi, Giorgio (ed.), *Il libro nel Rinascimento*, Roma: Viella (I libri di Viella, 11), 93–107 (1st edition, Milano: La storia, 1994).

Montecchi, Giorgio (2005), 'La disposizione del testo nel libro antico', in Santoro, Marco / Tavoni, Maria G. (eds), *I dintorni del testo. Approcci alle periferie del libro.* Atti del Convegno internazionale, Roma, 15-17 novembre 2004, Bologna, 1819 novembre 2004, Roma: Edizioni dell'Ateneo (Biblioteca di Paratesto, 1), 191-205.

Muzerelle, Denis (1989), 'Normes et recettes de mise en page dans le codex pré-carolingien', in Blanchard, Alain (ed.), *Les débuts du codex*. Actes de la journée d'études organisée à Paris les 3 et 4 juillet 1985, Turnhout: Brepols (Bibliologia, 9), 125–156.

Muzerelle, Denis (1991), 'Évolution et tendances actuelles de la recherche codicologique', in *Historia, instituciones, documentos*, 18: 347–374.

Ornato, Ezio (1997), 'L'histoire du livre et les méthodes quantitatives: bilan de vingt ans de recherche', in [Ornato, Ezio et al.], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues*, Roma: Viella (I libri di Viella, 10), 607–679.

Palma, Marco (1998), 'Classico, piccolo e quadrato. Dati per un'indagine su una tipologia libraria nell'Europa carolingia', in Ferrari, Anna (ed.), *Filologia classica e filologia romanza: esperienze ecdotiche a confronto*. Atti del convegno (Roma, 25–27 maggio 1995), Spoleto: Centro italiano di studi sull'alto Medioevo (Incontri di studio, II), 399–408.

Palma, Marco (2010), 'Un archivio di libri medievali datati', in *Miscellanea Bibliothecae Apostolicae Vaticanae*, 17, Città del Vaticano (Studi e Testi, 462), 259–267.

Petrucci, Armando (1999), 'Spazi di scrittura e scritte avventizie nel libro altomedievale', in *Ideologie e pratiche del reimpiego nell'alto medioevo* (Spoleto, 16–21 aprile 1998), Spoleto: Centro italiano di Studi sull'alto medioevo (Settimane di studio del Centro italiano di studi sull'alto medioevo, 46), 981–1010.

Polosin, Val (1999), 'All is Numbers? An Unknown Numerical Component in the Design of Medieval Arabic Manuscripts', in *Manuscripta Orientalia*, 5/1: 7–11.

Polosin, Val (2001), 'Unknown Numerical Aesthetics in the Design of Turkish Manuscripts', in *Manuscripta Orientalia*, 7/4: 30–36.

Porter, Yves (2004), 'La réglure (mastar): de la "formule d'atelier" aux jeux de l'esprit', in *Studia islamica*, 96: 55–71.

Rosenfeld, Randall (2002), 'Tools for Producing Books and Documents in Roman Antiquity and the Middle Ages: a Summary List of Classes', in *Scriptorium*, 56/1: 156–176.

Sagaria Rossi, Valentina / Déroche, François (2012), *I manoscritti in caratteri arabi*, Roma: Viella (Scritture e libri del medioevo, 9).

Sauvan, Yvette (1989), 'Un traité à l'usage des scribes à l'époque nasride', in Déroche, François (ed.), *Les manuscrits du Moyen-Orient. Essais de codicologie et de paléographie*. Actes du

Colloque d'Istanbul (Istanbul, 26–29 mai 1986), Istanbul – Paris: ADET Bibliothèque nationale de France (Varia Turcica, 8), 49–50.

Tristano, Caterina (1991), 'Caratteristiche tecnico-formali dei codici dell'Italia meridionale tra IX e X secolo', in Vitolo, Giovanni / Mottola, Francesco (eds), *Scrittura e produzione documentaria nel Mezzogiorno longobardo*, [Cava dei Tirreni]: Badia (Acta Cavensia, 1), 55–89.

Tristano, Caterina (2010), 'Costruire la scrittura, costruire la pagina. Dai trattati di scrittura a Luca Pacioli', in Merisalo, Outi / Tristano, Caterina (eds), *Dal libro manoscritto al libro stampato*. Proceedings of the International Study Conference, (Rome, 10–12 December, 2009), Spoleto: Centro italiano di Studi sull'alto medioevo, 67–89.

Tschichold, Jan (1975), *Ausgewählte Aufsätze über Fragen der Gestalt des Buches und der Typographie*, Basel, Stuttgart: Birkhäuser.

Wattenbach, Wilhelm (1896), *Das Schriftwesen im Mittelalter*, dritte vermehrte Auflage, Leipzig: Hirzel.

Witkam, Jan Just (2002), 'Twenty-Nine Rules for Qur'an Copying: a Set of Rules for the Lay-Out of a Nineteenth-Century Ottoman Qur'an Manuscript', in *Journal of Turkish Studies*, 26/2: 339–348.

Marilena Maniaci

Divergences between the East and the West in the Construction and Management of the Written Space: General Principles and Specific Solutions

It is the margin that makes the page
Jean-Luc Godard

The graphic design of books—both ancient and modern—generally represents the result of an intertwining of utilitarian, ideological and aesthetic factors that shape and steer the reception of a volume's content. Such is the frequency with which this proposition is cited and discussed—in the fields of codicology, bibliography, semiotics and sociology—that it requires no further affirmation.[1]

Technically speaking, the final layout of a page is accomplished through the 'construction' and 'management' of the written area, allied operations that contribute to the realisation of a project which is initially defined by its overall framework—in other words, the organisation of space destined to receive script. This is achieved through the following steps: the volume's ultimate dimensions are decided on; a grid is created on pages that determines the internal balance between 'full' and 'empty' spaces; the positioning of the text is settled on; and finally, the

Translated from the Italian into English by Mark Livesey. Original published as Maniaci, Marilena (2012), 'Costruzione e gestione dello spazio scritto fra Oriente e Occidente: principi generali e soluzioni specifiche', in *Scrivere e leggere nell'alto medioevo*, Spoleto, Fondazione Centro italiano di studi sull'alto medioevo (Settimana di studio, LIX), 473–514.

1 The bibliography for the *mise en page* and *mise en texte* of the medieval and modern book (the words *impaginazione* [in Italian] and *layout* [in English] both have rather narrower meanings) is, needless to say, vast, and therefore not readily summarised (even in a highly selective way) in a single footnote. However, if we confine ourselves to the manuscript, an initial list of suggested reading should include the references collected in Maniaci 2002 (2005[2]), 228–233, and Agati 2009, 240, to be supplemented–especially with respect to the relationship between the appearance of text and ways of reading it–with titles suggested by Frank 1993, 79–81. For a richly illustrated volume of examples, see Martin / Vezin 1990. Research of a quantitative nature (the written page represents the 'home ground' of this kind of approach) will be amply exemplified during the course of the present contribution. A useful synthesis of prerequisites, results and future prospects is offered in Ornato 1997, 648–660 (*La page écrite; construction, présentation, exploitation*), and 660–677 (*Autour de l'écriture*).

https://doi.org/10.1515/9783110743838-013

spacing—more or less commodious—of ruling is established. This phase is followed by the insertion into the predefined space of sufficiently well-organised and visually structured content. In turn, both phases can be broken down into sequences of tasks which are only occasionally documented in specific written sources, and whose after-the-fact reconstruction therefore has mainly to be entrusted to a direct consultation of surviving volumes.

From time to time, medieval artisans and copyists were charged with the task of making decisions aimed at fulfilling objectives which were—at least in part—contradictory: on the one hand it was necessary to guarantee the legibility of a text and the durability of the volume entrusted with its transmission to future generations, whilst on the other there was also the need to satisfactorily express the iconic implications of the book, in line with its ideological, sacred or purely functional orientation. When viewed in this way, the page can seem like a permanent 'field of tensions', but it can also be seen as an ideal 'laboratory' in which to carry out analyses, both synchronic and diachronic, of the connections and contradictions that influence transmission processes and the reading of texts.

If the making of a manuscript—and of the codex in particular—obeys, in the Mediterranean setting, a 'universal grammar' that codifies in a generally uniform way some of its fundamental characteristics, the various other book cultures have arrived at their own interpretations of the craft's basic rules, giving rise to more or less conspicuously discordant outcomes. The differences—which affect, though not exclusively, the appearance of the page—are not the result of sporadic individual choices dictated by taste, but instead represent an indirect reflection of historical, geographical, economic, social, cultural and even psychological factors. Herein, then, lies the interest of a comparative approach to the study of manuscript books—an approach which today is more often theorised about than actually applied in practice, although in the specific area of the *mise en page*, Eric Turner's investigation of the earliest history of Greek, Latin and Coptic[2] codex manufacture represents a happy, but unfortunately isolated, exception.

As might be expected, any observations arising from a comparative study of different manuscript cultures can be placed alongside those made when an internal point of view is adopted within each distinct setting. Indeed, within the individual manuscript traditions the overall appearance and form of volumes underwent gradual transformations that more or less radically modified their appearance, their capacity, and their usability. Such transformations reflected changes in users and the designated function of volumes. In addition, significant differences point to synchronic local variations within each distinct manuscript culture.

2 Turner 1977.

In an artisanal production context that lacked the strict application of uniformly defined and reproducible standards, a study of the chrono-geographical evolution of the *mise en page* not only calls for an archaeological examination of individual copies or an assessment of the overall appearance of specific types of volume,[3] but also requires—in order to draw attention to and analyse general trends—a simultaneous analysis of a large complex of testimonial evidence. When the problem is viewed from this perspective, the application of statistical techniques becomes inevitable.

However, despite being well established and enjoying widespread application, statistical analysis is a methodological approach that continues to divide the opinion of scholars. Nevertheless, it is an approach which, in the analysis of the dimensional aspects of books and the written page, finds some of its more persuasive and fruitful applications. Only an evaluation centred on general trends allows one to identify, within the continuum of numerical data, the appearance of phenomena which are neither sporadic nor the product of pure chance—on condition, that is, that the limits set by the adopted approach, the nature of surviving documentation, and the quantity and quality of the data upon which the analysis is carried out (taking care to avoid making undue generalisations and drawing dubious conclusions) are accepted. Such an approach is far from being, in any sense, an ill-founded attempt at achieving 'objectiveness'.

Above and beyond the practical issues faced by the individual researcher working to build a well-populated database, the organisation and general parameters of a 'serial' investigation of the *mise en page* are inescapably affected by a variety of factors, chief among which is the difficulty of gathering and surveying in a systematic way the data necessary for conducting a close study of the page. Given the practical impossibility of directly examining many hundreds of manuscripts, one has to accept the necessity of substituting the task with a census of data collected from previously published descriptions. It has been noted, however, that even the most recent and carefully prepared catalogues neglect, or at least only partially survey, size parameters, and almost always fail to provide specific details on the distribution of margins. Not infrequently, the dimensions of

3 Even if it is impossible to provide a complete list of individual contributors, it seems indespensable to at least mention, for their exemplary value, the works of Jean Irigoin on Greek poetical manuscripts: Irigoin 1984; Irigoin 1985. A substantial bibliography concerning the *mise en page* of both Latin and Greek glossed manuscripts (see the selection of works cited in footnote 1) has accumulated over the last few years, whilst for codices written in vernacular, certainly worthy of mention is Careri et al. (eds) 2001.

the written area, or even the overall arrangement of the text are also overlooked.[4] In addition, the reliability of information inferred from already existing descriptions is subject to uncertainties of various kinds (e.g. doubts in relation to the degree of trimming, the measuring criteria employed, and frequent variations that occur in the *mise en page* within a single codex), all of which make it necessary to limit the analysis to a more macroscopic level.[5] Problems of a different (but no less awkward) nature affect reliability and accuracy when establishing dates and geographic origins, especially when these are drawn from old and/or heterogeneous descriptions. Then there is the difficulty of grouping together the content (often varied) of codices into appropriate categories,[6] and the challenge presented by the scarcity of suitable indicators for the definition of subsets useful for performing analyses (according to graphic or textual typologies, qualitative hierarchies, destination contexts, reader categories, etc.). Finally, an unavoidable limitation lies in the highly heterogeneous chronological distribution of surviving evidence, which affects the late antique period more conspicuously than it does the Early Middle Ages (and the latter era is more noticeably affected in comparison to later centuries), a disparity which is only partially compensated for by the predilection of scholars for the earliest epochs, which are better known and documented.

The obstacles described above have not hampered, over the last few decades, the realisation of a number of wide-ranging research projects dedicated primarily

4 As regards photographic reproductions, where these are present they are often affected by cropping–sometimes drastic–of the blank areas that surround the text, the significance of which is unjustly ignored.

5 The external dimensions, which are normally mentioned even in the baldest of descriptions, are also altered to an extent that is difficult to quantify, although a tendency, either intentional or spontaneous, to round figures up due to insufficient or excessive measurements, is apparent. Appraisal of the effect of trimming (not on individual volumes, but instead on collections of surviving manuscripts) is a recurrent theme in codicological literature and has yielded different results: these range from the 'a few millimetres' postulated (on the basis of statistical observations) by Bozzolo / Ornato 1980 (1983[2]), 243–251: 244, to almost 2–5 cm (to be precise, 4 cm for the upper margin, 4–5 cm for the lower margin, and 2 cm for the external margin) hypothesised by Tristano 1991, 76, in support of a questionable theoretical reconstruction of the procedure that a craftsman would have followed when squaring up sheets.

6 To the particular uncertainties presented by each category, one should add the 'multi-textual' character of many medieval codices: such volumes represent complex 'containers' of texts which are sometimes assignable to specific categories that differ greatly among themselves. The available descriptions of these types of books are often summary or partial, and do not distinguish their compositional unity. On the problems inherent to the so-called 'miscellaneous' codex, the reader should find it sufficient to refer to Crisci / Pecere (eds) 2004, and to Andrist / Canart / Maniaci 2013 (with an extensive discussion of the antecedent bibliography).

to the *mise en page* of the Latin codex, and more recently to the Greek. As a result of such research, significant divergences in the volumes' general characteristics have emerged—despite the fundamental similarity of manufacturing methods—which are not limited, needless to say, to the *mise en page*, but also affect the 'underlying structures' of the two book traditions. Such differences appear independently from geographical and temporal subdivisions, content typologies and qualitative characteristics. Based on an examination (or re-examination) of corpora of old and new materials, I will seek to systemise and examine in detail (through a comparative study) the differences between the East and the West. I shall also build on—in an unavoidably schematic way—some of the cues provided by previous studies focused on the layout of Greek and Latin pages, and I shall enhance these with some additional facts suggested by a synchronic and diachronic examination of the two traditions.

The need to identify an area of investigation that corresponds to the theme being explored at Spoleto's *Settimana* has led me to apply the following limitations to my research:

a) As regards chronological reach: the period placed under examination stretches from the height of the 4th century—the first parchment codices of dimensions and number of leaves that are reasonably close to the original ones date from this period—up until the end of the 7th century, during which manuscript volumes independently underwent, both in the East and in the West, considerable changes that had a marked effect on their structure and appearance. At a meeting whose focus is the Early Middle Ages, an extension of the retrospective reach to the late antique period can be justified by the desire to draw attention to the circumstances in which—beginning in the late 6th century—the Greek and Latin traditions diverge and become increasing distant from their shared late antique foundations.[7] As for the 'low' limit, this has a purely conventional value, even if it is supported by a technical datum, namely the progressive assertion of paper over parchment codices in both cultural contexts, a phenomenon that had considerable consequences for the composition of quires and for the criteria applied to the utilisation of pages.[8]

7 Starting in the 7th century, the bilingual nature of late-antique culture–the product of shared bureaucratic and cultural interests–was affected by a divergence of the relationships (causing them to be channelled in different directions) between Latin and Greek writings, books and documents. See also the survey by Cherubini / Pratesi 2010, 159 onwards, with an extensive bibliography.

8 Even if the first affirmations of the use of paper date back to the 11th century in the Spanish domain, and to the beginning of the 9th century in the Greek domain (albeit sporadically), its presence increases significantly in both areas only during the 13th century (Agati 2009, 86–87). The dearth of specific investigations into the speed at which the new support became established–and also into its greater perishability–makes it difficult, as far as the earliest phases are

b) As regards writing materials and book typologies, I shall focus my attention on the parchment codex. I will exclude from the discussion both the bookroll (which, despite not entirely disappearing from use, plays an altogether marginal role in the Middle Ages) and the papyrus codex, which was employed for only a limited time from late antiquity to the dawn of the Middle Ages.[9] For equivalent and specular reasons, I shall avoid any mention of the paper codex, which was even less frequently employed during the period in question.

c) Finally, concerning the objectives of my analysis, on account of time constraints and the incomplete nature of the documentation I have been able to gather, it will not be possible to examine all the implications raised by the study of the *mise en page*. Therefore, upstream in the codex manufacturing process the more technical aspects of page construction will be excluded (i.e. pricking and ruling, particularly in relation to the numerous types observed), whilst downstream, aspects inherent to the 'typography of the written page'[10] will not be taken into consideration, such as its segmentation into lines and the division of words, the use of 'editorial devices' aimed at enhancing the legibility of text (e.g. titles, initials, filling elements, running titles, *incipit* and *explicit* highlighted in various ways),[11] and the selection and use of abbreviations. Thus, the subject of the investigation will be a circumscribed (but nonetheless relevant) 'package' of purely spatial parameters: above all, total dimensions, the distribution of the text, the number of lines and, wherever possible,[12] the dimensions of the written area and of the four margins—parameters which are indispensable in order to be able to investigate the governing principles lying behind the *mise en page*, of which only occasional traces remain in the few surviving layout 'recipes'.[13]

---

concerned, to arrive at a more accurate evaluation of the speed at which the material was adopted (information about which therefore has to be entrusted to occasional accounts in written sources, and a few sporadic quotes in individual manuscripts).

9 Findings that remain of fundamental significance in relation to the external dimensions of the papyrus codex can be found in Turner 1977, 13–25. More recent, and persuasive, is the in-depth study by Crisci 2003, which critically re-examines and re-evaluates the presence of papyrus in Eastern book production up until the beginning of the 8th century. As regards bookrolls, which lie outside the bounds of this contribution, I will confine myself to mentioning Johnson 2004.

10 The expression was coined by Gumbert 1992.

11 Despite being somewhat concise in nature, the general observations on the expedients used to structure text and enhance the legibility of medieval books are made admirably clear in Gumbert 1989.

12 'Même des caractéristiques aussi élémentaires que les dimensions reflètent de près [...] les mutations intervenues au cours des siècles dans l'aspect matériel du livre' (Bozzolo / Ornato, 1980, 252).

13 For the said 'recipes', see the text corresponding to footnotes 70–75 below. As regards details of the problems they raised, manuscripts presenting with unusual *mise en pages* were not taken

For reasons already stated above, the corpora that provide the investigation's 'backbone' are, unavoidably, disparate in nature, being partly derived from a direct examination of several hundred manuscripts (mostly Greek), and partly from a perusal of manuscript catalogues and the findings obtained during previous research projects which have been made freely available by their authors.[14] In order to document—albeit in a partial and rather disjointed way—the entire historical time span examined, the following materials were utilised:

(a) For the Latin context

1) For the centuries leading up to the 8th (but also including some material dating from subsequent decades),[15], a thorough first-hand examination of the original *Codices Latini Antiquiores*[16] series, albeit limited to manuscripts whose dimensions are equivalent to, or at least significantly close to, those of the originals, and therefore excluding not only rolls, fragments and palimpsests, but also codices expressly marked as having been heavily trimmed.[17] A total of 1,015 suitable

into account (e.g. those with textual content supplemented with comments, regardless of their arrangement).

14 Limitations in relation to the qualitative and quantitative heterogeneousness of the information used will be provided from time to time during the presentation of individual results emerging from the investigation. In any event, for all the values presented in tables and discussed in the text, the basis of the calculation, which will vary according to the available data, will be shown in brackets, thereby enabling the reader to identify values that cannot be regarded as reliable due to statistically insignificant numbers.

15 It is common knowledge that the selection criteria applied by Lowe, partly of his own volition, permit the inclusion of manuscripts in the group that without doubt date from after the end of the 8th century (with deviations which can, in some cases, extend to several decades).

16 I have not included in the census the supplementary material collected in Bischoff / Brown 1985 and Bischoff / Brown / John 1992.

17 In the case of palimpsest manuscripts, which were frequently used in the manufacture of codices of mediocre quality, the dimensions and *mise en page* of the original codices run the risk of being skewed by those of the overwritten ones. On the other hand, it should be pointed out that the surveying approach adopted by Lowe suffers from inaccuracies that are rather difficult to quantify: e.g. the rounding of figures, approximations prefixed with the word 'circa', and uncertainties as regards the treatment of the narrow columns positioned alongside the written area (on this last issue, see Muzerelle 1989, 131). The distortions result from the random distribution within the sample, and as such do not appear to cast doubt on the validity of the overall trends that emerged during the analysis.

volumes were examined, representing a little over half of the 1,865[18] surveyed by Elias Avery Lowe in his monumental work, generally considered 'the supporting column of any research on book production in late antiquity'.[19]

2) For the 9th to 12th centuries, a rather 'mixed bag' composed of a little more than 1,650 items, produced variously in the north and south of Europe. This group represents the fruit of various surveys and perusals.[20]

(b) For the Greek context

1) For the centuries leading up to the 9th, a small corpus, including a survey of Greek majuscule codices (carried out by Pasquale Orsini). Unfortunately, in the case of the Greek *codices antiquiores*, the difficulty in establishing essential measurements created an obstacle that could only be partially worked around, hence markedly limiting the number of volumes whose total dimensions could be determined (245), and limiting to an even greater extent the number of volumes for which it was possible to ascertain—either directly or indirectly—the size of the written area and width of the margins (48 and 27, respectively). Furthermore, a sample composed in this way cannot be truly representative, given that, in addition

18 According to the calculations of John 1990, 96. Despite the various topics implied by the title, John's article only presents the results of a few basic observations, which largely speaking regard–above and beyond the chrono-geographical distribution of the codices catalogued by Lowe–pricking positioning and method of execution and ruling (systems and types, albeit limited to the distribution of columns). The only information on the *mise en page* regards the positioning of text in one or more columns and the diffusion of a square, or somewhat square, written area.

19 Cavallo 1984, 417.

20 One is in fact dealing with a randomly selected sample (composed of exactly 1,665 codices) which, over time, has had data from various other surveys added to it. The majority of such data is ascribable to the following researchers and authors: Carla Bozzolo and Ezio Ornato (Bozzolo / Ornato 1980); Birger Munk Olsen (Munk Olsen 1982–1989); Peter Gumbert (Gumbert 1984); the team responsible for research on the material structure of 11th-century Italian manuscripts (Bianchi et al. 1993); and the authors of various catalogues of dated codices, used for an experiment in electronic conversion (about which see Maniaci / Ornato 2002). The codices examined are chronologically distributed as follows: 9th century = 163 items; 10th century = 126 items; 11th century = 630 items; 12th century = 733 items. The entire Latin sample (including the volumes extracted from the *CLA*) is composed of 2,680 items, arranged (approximately) into centuries as follows: 4th century = 10 items; 5th century = 46 items; 6th century = 90 items; 7th century = 85 items; 8th century = 794 items; 9th century = 166 items; 10th century = 126 items; 11th century = 630 items; 12th century = 733 items.

to uncertainties as regards the dating of volumes, it is also affected by typological distortions (for example, a superabundance of codices written in biblical majuscule)[21] that can only be partially rectified by using two 'control groups', which in turn are unbalanced in their own way. The two 'control groups' were sourced, respectively, from a list published in the appendix of Eric Turner's monograph,[22] and from the bibliography of New Testament codices compiled by Kurt Aland.[23] Observations on the *mise en page* of Greek codices in majuscule script will therefore be limited to a small amount of data that can be considered reliable (until more detailed information becomes available in the future).

2) For the period stretching from the 9th to the 12th century, a total of 681 Byzantine parchment manuscripts, all of which have been examined in person by the present author during other research projects.[24]

The sundry composition of the samples and heterogeneity of the available data within the various subdivisions called for a circumspective evaluation of the results, which was therefore limited to analysing a few general characteristics which emerged with greater clarity. In particular, it did not seem prudent to explore in a systematic way—apart from making a few occasional remarks—the relationship between the *mise en page* and the content of volumes, which would have required data acquisition and analysis of a more precise and detailed kind. The same applies to the relationship between page layout and the different graphic typologies used in the East and in the West. For the same reason, it would have been imprudent to stretch beyond a certain point the interpretation of a few divergent trends which can be distinguished among the various regions of Medieval Europe. As will become clear in due course, despite the considerable

21 Described in Orsini 2005; I thank Pasquale Orsini for having generously allowed me to make use of the material gathered by him.

22 Turner 1977, dealing with a total of 130 parchment volumes of known or at least reconstructible dimensions, previously examined in Maniaci 2002.

23 Aland 1994 (or. 1963). The list can now (albeit not very easily) be consulted online at http://intf.uni-muenster.de/vmr/NTVMR/ ListeHandschriften.php (last access 07/09/2021).

24 In particular, Maniaci 2002, in which the characteristics and method employed for assembling the sample are explained (49–54). Due to a dearth of recorded measurements (data is limited to the height and width of pages), the database, resulting from a perusal of Sautel's list of 4,000 codicological items) proved to be unsuitable for the purposes of the present investigation (Sautel 1995, about which see Maniaci 2002, 25–49). The Greek codices examined (a total of 964) are chronologically distributed as follows: 4th century = 3 items; 5th century = 8 items; 6th century = 16 items; 7th century = items ; 8th century = 18 items; 9th century = 111 items; 10th century = 316 items; 11th century = 305 items; 12th century = 176 items.

chronological and geographical breadth that the investigation covers, a number of basic trends emerge in a meaningful and coherent way, irrespective of contexts, content and manuscript typologies.

1 Overall dimensions (size)

An examination of overall dimensions made it possible to draw some initial comparisons.

Between late antiquity and the end of the 12th century, the average dimensions of Latin codices remained very stable.[25] The 11th century was an exception, though, since this was a period in which the examined sample shows a significant increase in dimensions, accompanied by much greater dimensional variety, followed, once again, by a reduction in size.[26] It is noticeable that the average 'size' (i.e. the sum of the height and width of a volume) lies, in both the East and the West, exactly on the boundary that divides the two classes of volumes (small-medium, and medium-large,[27] as defined by Carla Bozzolo and Ezio Ornato, based on the nomenclature used in medieval Latin inventories).[28]

25 The unification of the 4th–7th centuries in the tables is aimed simply at making it easier to draw a direct comparison between Greek and Latin codices, taking into account the low number of examples of the latter contained in the sample. Given that, for the Western book, the transition from the 6th to the 7th century brought with it considerable and significant changes in production contexts and methods (including the spread of lay artisans and their taking the place of craftsmen in ecclesiastical scriptoria), where it seems appropriate–and, indeed, possible–figures in relation to each of the four earliest centuries will be addressed separately in a note. As regards sizes, means do not vary greatly, and therefore do not merit consideration. The materials, graphical appearance and content of 5th-century Latin volumes are addressed in a recent contribution by Giovè Marchioli 2010.

26 The variance (an index of dispersion obtained by calculating the average of the squared differences of data values from their mean) almost doubles, increasing from 11,299.84 (the cumulative value for the 8th–10th centuries) to 20,858.34 for the 11th century (and to 18,188.15 for the 12th century).

27 This is the most common indicator employed in codicological literature, although not without some reservations: see Gumbert 2001, and Muzerelle 2007.

28 Bozzolo / Ornato 1980, 218: small volumes < 320 mm; small to medium volumes 321–490 mm; medium to large volumes 491–670 mm; large volumes > 670 mm. As a curiosity, it should be noted that the sizes documented in the Latin sample range from a minimum of 128 mm to a maximum of 1,015 mm.

Average size of Latin and Greek codices (4th–12th centuries) (tab. 1)

Century	Latin codices	Greek codices
4th–7th	482 (231)	518 (38)
8th	469 (794)	447 (20)
9th	488 (166)	476 (112)
10th	490 (126)	500 (316)
11th	530 (630)	508 (305)
12th	488 (733)	470 (176)
Total	492 (2680)	495 (967)

Tab. 1: Average size of Latin and Greek codices (4th–12th centuries)

It should be noted that the calculations made by Bozzolo and Ornato for Northern France—relating to a sample of 6,200 volumes of biblical, patristic, theological and hagiographic content—differ slightly in the 9th, 10th and 11th centuries (respectively 500 mm for the 9th-10th, and 524 mm for the 11th), and a little more in the 12th, which does not see a reduction (527 mm).[29] Therefore, the size reduction seems mostly to affect the southern regions of Europe (where measurements descend from 563 to 468 mm).

The average dimensions of Greek codices largely follow a similar trend,[30] since these, too, between the 11th and 12th centuries, and for all types of content, undergo a considerable reduction in size, even when one takes into account the period of crisis that preceded the fall of Constantinople into the hands of the Crusaders.[31] As regards the exceptionally high value recorded for volumes dating to the earliest centuries, this is very likely attributable to a distortion caused by a

29 Bozzolo / Ornato 1980, 265.

30 The codices examined ranged from 164 to 764 mm in size.

31 For a more detailed analysis of this issue, see Maniaci 2002, 114–121. The values in the table are fully confirmed by the means calculated for the largest samples (*ibid.*, 111). The chronological evolution observed between the 9th and 12th centuries includes (albeit in varying degrees) the entire range of textual typologies (*ibid.*, 114), although it is marked by a quantitative reduction in codices of larger dimensions (homilaries and patristic collections), which hints at a general decline in the quality of book production, a scenario which is further reinforced by an overall impoverishment of qualitative parameters, as the absence of gilding and defects in parchment etc. (*ibid.*, 114–121).

superabundance in the sample of premium quality volumes of biblical content.[32] Conversely, the mean recorded for 131 codices gleaned from Eric Turner's lists is a lot lower, at just 340 mm,[33] which is also decidedly inferior to the value recorded for coeval Latin volumes. The mean for the 4th to 7th-century gospels and lectionaries drawn from Kurt Aland's inventory registered at 380 mm. Unfortunately, the available data are not sufficient to make it possible to investigate the root cause of such differences—indeed, a study of the overall dimensions of Greek codices in majuscule script would certainly call for an in-depth investigation based on a far wider-reaching and more precisely targeted survey.

Needless to say, by only considering average values, a very approximate and rather 'flat' version of a complex picture emerges, but one which in any event makes it possible to cast doubt on the legitimacy of the rather drastic and oversimplified comparison of the ancient codex's essential elegance and ease of handling with the rather 'rigid' monumentality of volumes of the Early Middle Ages, which were considered objects of veneration rather than books to be read and employed as study aids.[34] An analysis of the way in which the recorded sizes are distributed throughout the various historical periods makes it possible to clarify matters, since it exposes—lying behind the seemingly uniform average values—some differences that merit our attention (Chart 1).

Up until the 8th century, the distribution of sizes with respect to the Latin codices is characterised by a clear convergence towards a common peak, roughly corresponding in size to a sheet of today's A4 paper (210 mm × 297 mm), although one occasionally encounters volumes that measure more than 700 mm in size.[35] Truly large Latin codices—which is say those of monumental proportions measuring up to 1,000 mm—start to appear more frequently in the 9th century, and occur above all in the 11th.[36]

32 Two of the three 4th-century codices examined are the famous Vatican (540 mm) and Sinaitic (720 mm) Bibles. 80% of the volumes dating from the three successive centuries are in biblical majuscule (28 of 35).

33 The mean is affected by the significant presence of volumes of considerably reduced size; see Maniaci 2002, 82, Table 2.

34 See, for example, the rather peremptory judgement formulated in the opening of the well-known essay by Petrucci 1972.

35 For the 4th to 8th centuries, above the 700 mm threshold one finds only 16 volumes out of a total of 1,025, which equates to about 1.05%, and only 8 of them exceed a value of 800 mm.

36 For the 10th and 11th centuries a total of 80 manuscripts measuring more than 700 mm in size was counted among the 756 included in the census, representing about 11%; half of these exceeded 800 mm, and 11 of them measured from 900 to more than 1,000 mm.

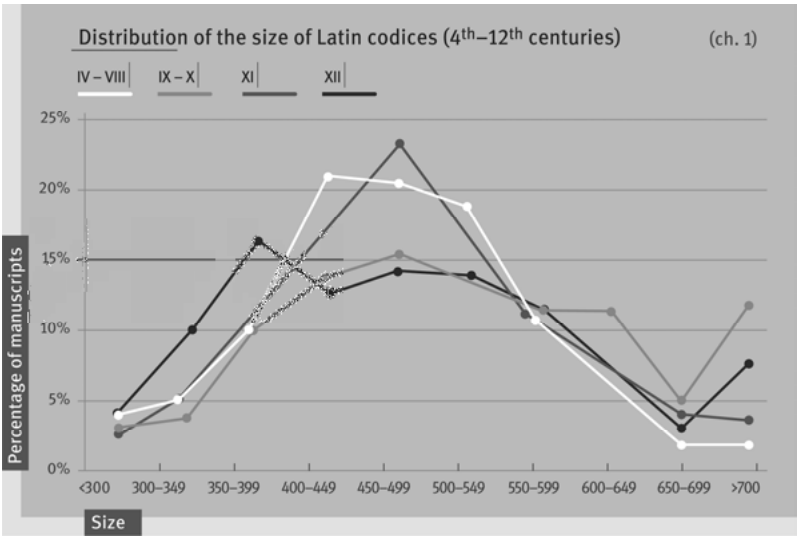


Chart 1: Distribution of the size of Latin codices (4th–12th centuries)

In the 11th and 12th centuries, the range of sizes seen in the Latin context exhibits, overall, a much greater degree of variation, with about 80% of volumes ranging from 380 mm to 665 mm in the 11th century, and from 350 mm to 580 mm in the 12th, thus the two distribution patterns (from this viewpoint) are virtually identical, albeit somewhat 'out of phase'. It is interesting to note that the curves representing the 11th and 12th centuries differ from those presented by Carla Bozzolo and Ezio Ornato for the French codices, which are distinguished (above all in the 12th century) by a clustering around two peaks. These peaks were associated by the two scholars with skins of similar or identical sizes being folded in two different ways, respectively in-4 (the outcome of two successive folds) and in-8 (the outcome of three successive folds), resulting in larger manuscripts (of more or less similar size) and smaller manuscripts (again, of more or less similar size), respectively.[37]

37 Bozzolo / Ornato 1980 (1983²), 257 and Table I, and 338–339 (graphs E and F). The two peaks correspond to the following succession of sizes: 420–494 mm and 552–607 mm (11th century), and 395–444 mm and 545–594 mm (12th century). In the 12th century, a much less pronounced third peak appears that corresponds to larger size values (745–794 mm). With respect to paper codices, where standardisation reaches a maximum, the peaks are much more conspicuous.

The same tendency is also seen in the French component of the sample presently under examination, but not in codices originating from other regions (in the north and south of Europe), which reinforces doubts about the widespread use of a symmetrical fold in the creation of quires. Even if a variation in working habits could account for the application of different ways of subdividing skins, this possibility is yet to be confirmed through a direct analysis of the characteristics of parchment used in the manufacture of individual codices.[38]

With respect to the East (and also the West), affirmation of the minuscule script in book production was immediately accompanied by a significant widening of the codex's size range. This trend persisted throughout the centuries subsequent to the 9th, when a wholly episodic presence of large format volumes of Greek manufacture is seen.[39] The only noteworthy development that occurs is a significant increase in small volumes in the 12th century. This trend is symmetrical, as it were, with the higher frequency of large volumes that appeared in the 11th century, and is correlated to an overall decline in quality, representing a clear reflection of this crisis-gripped period (Chart 2).

38 According to Gumbert 2000, 86, 'at least until the ninth century skins were normally not divided into bifolia by folding, but by cutting out sections of the desired size in any way they would fit'. An investigation carried out a few years ago on a small collection of Greek codices which was based on an examination of the axillae (see Maniaci 1999 [in this volume, 309–321]) confirms the opinion of the Dutch scholar, but analogous research on the Latin context is lacking. Some surveys carried out by the present author on individual pre-12th-century codices have revealed a variable position of the axillae on leaves within one and the same volume and have made it possible to distinguish, for the Early Middle Ages, a situation in which a desire to exploit skins to the maximum (through a methodical folding of sheets in half) seems to take precedence over an optimisation of the working method. The perfunctory application of the folding method (without taking into account visible evidence on skins) represents the basis of a study by Nelson / Bona 1991. The two authors propose, albeit somewhat dubiously, the reconstruction of size relations within a small group of late Byzantine illuminated codices, with the aim of evaluating respective costs. Additionally, they hypothesise (somewhat optimistically) a possible computerised automation of the comparison procedure.

39 In the sample examined here, a total of 10 codices can be counted for the period stretching from the 9th to the 12th century, all of which measure well under 800 mm in size (the mean is 725 mm).

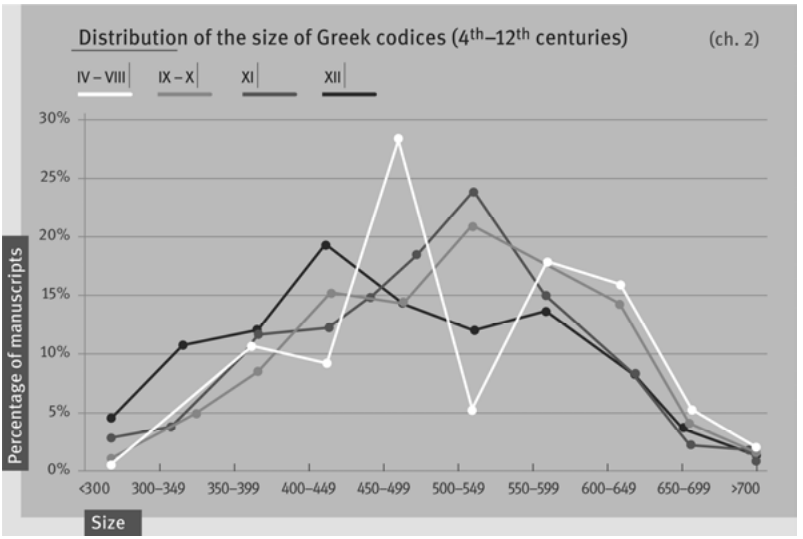


Chart 2: Distribution of the size of Greek codices (4th–12th centuries)

Concerning the average size of leaves and their development over time, taken as a whole, the Greek and Latin codices on parchment generally exhibit similar[40] characteristics, with the exception of the largest volumes (i.e. those measuring more than 750 mm in size), which are entirely unknown—as has already been stated—in the Greek context.

Given that the systematic use of animals of significantly different sizes in Eastern and Western[41] book production seems improbable, the absence of very large Greek codices could be explained by the use of particular techniques (on the part of artisans) for the subdivision of skins, aimed at achieving a better use of the potential surface area offered by a single skin (e.g. the division of larger

40 If, in the earliest centuries, the size distribution of Greek majuscule codices matches almost exactly that of Latin volumes in capital and uncial script, the deviation with respect to the sample of parchment volumes gleaned from Turner's lists, which–as has already been stated–are always distinctly smaller, seems to be clear (and at present without explanation).

41 It is true that in Northern Europe Western Latin production saw the use (though not exclusively) of larger calfskin parchments, but these–as has been noted–are very rare south of the Alps. Some of the largest 11th-century Latin volumes were certainly made using parchment derived from sheepskin (in particular, complete volumes known as 'Atlantic' Bibles, which can measure more than 1,000 mm in height: see Maniaci 2000 [in this volume 35–63]).

skins using two perpendicular cuts in 'T' form, so as to produce three bifolia of medium size instead of two larger ones, or alternatively four smaller ones).[42]

All things considered, in both production areas one observes a phenomenon of progressive size differentiation. Using a broader sample and a better targeted survey, a possible correlation between greater heterogeneousness of textual typologies and the manner of their use ought to be investigated.

In contrast to overall dimensions, which were subject to considerable variations (both synchronically and diachronically), 'proportion'—conventionally expressed as the relationship between width and height[43]—evolved over the course of time, but proves to be relatively stable throughout the various historical eras, independent of the script type or textual content of the codices.

The means calculated for the Latin corpus tally perfectly with those previously arrived at by Bozzolo and Ornato[44] in their calculations (Tab. 2). The figures effectively confirm, for the rest of medieval Europe, what has already been noted for the north of France, namely a gradual and widespread shift, above the 45th parallel, towards a so-called 'invariant' value (0.707), which is not affected by successive folds of a single sheet along its short axis, and as such was subsequently approved as a norm by medieval papermakers. (Not by chance, the same proportion is used for the most widely used format in today's paper industry.)[45] As in the case of dimensions, the overall tendency towards a levelling out of proportions, which is also borne witness to by the reduction in the variance,[46] is accounted for by scholars as being the result of a desire to standardise the external appearance of large and small books made by effecting one or more successive symmetrical subdivisions of skins which had first been trimmed so as to reduce their natural breadth.

42 In relation to so-called in-sexto subdivision, see Maniaci 1999.

43 The use of the inverse relationship H/W–preferred (for example) by Irigoin 1990, 123, or more recently by Cherubini 2004, 247–249–apart from making less immediately apparent a page's 'slender' or 'squared off' appearance, does not facilitate comparisons.

44 The value provided by Bozzolo and Ornato relates to the 9th to 10th centuries.

45 The relevant format standard is ISO 216, which was previously codified at the beginning of the 20th century by the Deutsche Institut für Normung (DIN). The A3 format is of almost exactly the same dimensions as the *reçute* format inscribed on the famous 13th-century 'Bologna stone'. The *reçute* format became firmly established in the world of European papermaking as the 'common sheet'.

46 See Bozzolo / Ornato 1980, 287.

Average proportion of Latin and Greek codices (4th–12th centuries) (tab. 2)

Century	Latin codices	Bozzolo / Ornato	Greek codices
4th–7th	0.767 (231)	–	0.791 (38)
8th	0.701 (794)	0.696	0.710 (18)
9th	0.739 (166)	0.740	0.737 (111)
10th	0.734 (126)	0.740[44]	0.748 (316)
11th	0.695 (630)	0.709	0.769 (305)
12th	0.685 (733)	0.690	0.748 (176)
Total	0.705 (2680)	0.715	0.754 (964)

Tab. 2: Average proportion of Latin and Greek codices (4th–12th centuries)

The progressive trend towards stable proportions, which was already evident in the 8th century, was temporarily interrupted in the 9th to 10th centuries, during which, across the board, there was further growth in a preference for relatively wide volumes. In the north-west of France, this phenomenon was related to the 'revival' and transcription of late antique models: a revival that was well represented, according to Marco Palma's findings, by a type of 'antique-style' academic volume of a 'small, classic and 'square' appearance, whose text was laid out in two columns surrounded by spacious margins.[47] However, this typology—of which Palma identified about fifteen witnesses of non-specific provenance—only held a minority position following the widespread appearance of small and predominantly narrow codices.

The 'revival' of wide proportions is plain to see in the whole of Northern Europe (i.e. Northern France, Germany and the Low Countries) and is not limited to volumes containing classical texts, but instead encompasses, albeit to varying degrees, almost all textual typologies (Tab. 3). As regards France, the 'Pythagorean' ratio (i.e. proportions equal to 4/5), or even squarer-looking standard forms (roughly 4/5 proportioning), were employed above all at Reims and Tours, but are much less evident in other scriptoria.[48] In other areas of Europe, in the

47 Palma 1998.

48 See Bozzolo / Ornato 1980 (1983[2]), 297. A fragment of a 9th-century codex (Paris, Bibliothèque nationale de France, Par. lat. 11884, ff. 2–4), originating from (and probably produced in) the Abbey of Saint-Remi at Reims, has come down to us bearing the oldest known layout 'recipe'

absence of adequate survey data, the reduced numbers constrain one to be cautious in the interpretation of means, which in the case of Southern Italy, at any rate, seem to differ from those established for the countries lying north of the Alps (Tab. 3).[49]

Average proportion of Latin codices in Northern and Southern Europe (tab. 3)

Century	D, F, NL	I, E	Total
4th–7th	0.766 (41)	0.767 (142)	0.767 (183)
8th	0.688 (516)	0.718 (114)	0.693 (630)
9th	0.744 (91)	0.690 (9)	0.739 (100)
10th	0.750 (70)	0.712 (9)	0.746 (79)
11th	0.716 (231)	0.684 (297)	0.698 (528)
12th	0.684 (349)	0.677 (127)	0.684 (376)
Total	0.702 (1298)	0.710 (589)	0.704 (1896)

Tab. 3: Average proportion of Latin codices in Northern and Southern Europe

jotted down (in a slightly later hand) in the lower margin of f. 2v. The 'recipe' implies the adoption of 4/5 page proportioning (see the text corresponding to footnotes 70–75 below).

49 As a result of his study of a small group of volumes (a little over thirty), Tristano 1991, 81, claims she is able to infer, by observing a higher level of dispersion of the proportion, 'a certain sluggishness in Southern Italy to adapt to the models and techniques followed by the rest of Europe'. Given that explicit information on the number of Southern Italian codices 'of the 8th century in uncial, and of the 9th and 10th centuries in minuscule' taken into consideration is not provided, and also that in the sample I have examined Southern Italy is not adequately represented for the centuries prior to the 11th, it is impossible for me to appraise the soundness of the scholar's hypothesis. However, I can state that the 574 codices of generic Italian origin examined by me exhibit, for the 8th to 10th centuries (118 volumes), an average proportion of 0.705, which decreases to 0.683 in the 11th century (293 volumes). I also note that the adherence to ancient practices–which did not change significantly between late antiquity and the Early Middle Ages–on the part of Irish artisans is perhaps not entirely a product of chance (the phenomenon is plain to see in the 8th century; the relative meagreness of the sample makes it impossible to chart any changes which occurred in successive centuries). More generally speaking, these and other differences suggested by the figures for the various areas of Europe should be subjected to a more precise analysis.

The preference for a 'square' page layout is seen most clearly in late antique Greek codices, whose proportions remain unchanged at about 0.80 (4/5) throughout the 6th century, with even higher values seen in the most ancient volumes. However, a century-by-century calculation of means reveals a gradual shift, although not always without a margin of doubt—taking place between the 4th and 8th centuries—towards 'slimmer' standards, a trend also observed simultaneously in the Latin corpus[50] (Tab. 4).

Average proportion of ancient Greek and Latin codices (4th–8th centuries) (tab. 4)

Century	Latin codices	Turner	Greek codices
4th	0.891 (3)	0.793 (30)	0.810 (10)
5th	0.826 (8)	0.788 (28)	0.783 (46)
6th	0.790 (16)	0.798 (26)	0.772 (90)
7th	0.740 (11)	0.705 (4)	0.747 (85)
8th	0.710 (18)	0.735 (1)	0.701 (794)
Total	0.792 (56)	0.764 (89)	0.763 (325)

Tab. 4: Average proportion of ancient Greek and Latin codices (4th–8th centuries)

In practice, the 0.80 (4/5) value coincides with the original proportions of an animal skin,[51] or more precisely with those of its 'usable rectangle', which for anatomical reasons is naturally quite wide. It seems reasonable, therefore, to hypothesise that there was a passive tendency on the part of the artisans to work with a skin's natural proportions, and that they limited themselves to obtaining two, or

50 Since proportion is a more stable parameter and largely speaking not related to content, the risk of statistical distortions arising due to low numbers in the sample is reduced in this instance.
51 See Ansalone et al. 1993. For the 108 modern skins examined, whose measurements are reported on pp. 187–190, the average proportion of the usable rectangle is equal to 0.803, with a maximum of 0.885 for large calf skins and a minimum of 0.654 for small lambskins. Goat and sheepskins register means of 0.815 and 0.779 respectively. The sizes of animals in medieval times can be considered comparable to those of today, as demonstrated by Bischoff / Maniaci 1995.

at the most three, bifolia (also naturally wide)[52] from each skin. Such bifolia were suitable for the manufacture of volumes of small to medium, or medium size.

In the centuries following the 6th, the Greek codex maintains, albeit to a lesser extent, a tendency towards wideness (a legacy of late antiquity), hence between the 9th and 12th centuries (and also during the 13th) proportions closer to 3/4 (0.75) than 4/5 (0.80) are seen.[53] The 11th century stands out as an exception in this context, since it is distinguished by (on average) larger size and a return to proportions closer to those of a square.[54]

In essence, in the Latin context there was (in the northern regions of Europe, at least) a clear evolutionary process oriented towards a rational solution which, in theory, made it possible to manufacture books of the same proportions regardless of their size, that is as long as skins were divided in the same way. However, this trend, which was already apparent in the 12th century, was hampered in the Carolingian period by the fresh success of wider proportioned tomes, a success that was perhaps owed to an ideological and material influx of antigraphs dating from late antiquity on the preparation of new copies in minuscule. On the other hand, in the Greek context the trend is once again towards stability. One cannot explain the reasons lying behind this, apart from citing aesthetic concerns and an enduring respect for tradition, to which it would seem that the manufacturing procedures used for making quires (i.e. the subdivision of wide skins into two or three bifolia, which result in 'naturally' wide volumes), were subordinated.

52 It has been noted that a wide rectangle, if folded along its short axis, yields a succession of narrow surfaces (when a sheet of parchment is folded in-folio or in-8), or wide ones (when folded in-4). When a skin is cut into three pieces in 'T' form (in-6), the resulting three rectangles will naturally be wide (Maniaci 1999, 106).

53 In the absence of specific research on the material and structural characteristics of the Greek parchment codex in the Palaeologan Age, one can point to the proportions of late Byzantine volumes included in Sautel 1995, which lists the following values: 13th century = 0.747 (294 volumes); 14th century = 0.729 (80 volumes); 15th century = 0.734 (21 volumes).

54 See Maniaci 2002, 138–139, in which Tab. 3 shows that the maximum width of 11th-century codices is the same for both single and double column pages.

2 Layout of the text

Apart from a few isolated cases of *mise en page* in three or four columns, in general the criteria applied when choosing between single column and double column pages confirm the more conservative character of Greek in comparison to Latin volumes (Tab. 5).

Text layout in Latin and Greek codices (4th–12th centuries) (tab. 5)

Century	Latin codices		Greek codices	
	Full page	Two columns	Full page	Two columns
4th–7th	72.37% (165)	27.63% (63)	50.00% (17)	50.00% (17)
8th	74.90% (588)	25.10% (197)	41.18% (7)	58.82% (10)
9th	80.25% (130)	19.75% (32)	34.55% (38)	65.45% (72)
10th	69.11% (85)	30.89% (38)	39.94% (125)	60.06% (188)
11th	55.50% (348)	44.50% (279)	40.33% (182)	59.67% (305)
12th	60.54% (425)	30.46% (277)	67.05% (58)	32.95% (176)
Total	66.27% (1741)	33.73% (886)	44.82% (428)	55.18% (527)

Tab. 5: Text layout in Latin and Greek codices (4th–12th centuries)

As has already been pointed out by Lowe,[55] in Latin *codices antiquiores* the rate at which pages are laid out in two columns is almost 50% in the most ancient examples, but undergoes a virtual collapse after the end of the 5th century, when it decreases to only about a quarter of the total. The single column layout continues to predominate in the centuries subsequent to the 8th, even if it appears a lot less frequently from the 11th century onwards.

In the Greek context the relationship between the two types of layout is entirely different: with the advent of minuscule script, the balance seen in the earliest centuries is replaced by a progressive affirmation of the two-column layout, a trend which culminates in the 11th century. However, the following century is marked by a reversal of this trend, with the single column layout gaining the

55 Lowe 1925 (1970), 207; Lowe 1928 (1970), 59; John 1990, 100.

upper hand.[56] Codices in majuscule script dating from the mid-Byzantine period, which are mostly liturgical in nature, are almost all laid out in two columns.[57]

Carla Bozzolo and Ezio Ornato have drawn attention to the relationship that links the choice of one or another of the layout options to a volume's size, as well as—but only in an obvious way from the 8th century onwards—to the degree of page utilisation.

The relationship between the layout and dimensional characteristics of manuscripts can readily be verified by looking at a criterion which is most immediately and directly related to all the others, namely size (Tab. 6). The connection between the width of a book and the layout of its text is very clear even in the smallest of volumes, notwithstanding the greater success enjoyed by the two-column layout in the Greek context. In both book manufacturing traditions, the single column layout was almost always adopted for the creation of small volumes, whereas the two-column layout predominates in larger codices, even if it never fully prevails. It should be noted, however, that large volumes with single column layouts are more common than smaller volumes with two-column layouts. This shows that in the case of large format codices the shift to a two-column layout (in the Early Middle Ages) was not perceived as an absolute necessity, which conversely would be the case in Latin production (though not in Greek) in the 13th to 14th centuries.[58]

The correlation between dimensions and layout is apparent from the very outset of the Greek and Latin codices' histories. As regards the latter, it is particularly evident in the subclass of codices written in uncial script, where the contrast between small single column and large two-column volumes is at its most conspicuous.

56 Connected, as will be explained shortly, to the reduction in size. See (below) the text corresponding to footnote 59.

57 For the 9th to 12th centuries the ratio between the two layouts is 83% to 17% (186 against 37 of the 223 items evaluated).

58 In all periods one meets with exceptions to the prevailing trend which do not invalidate this view. The examples cited by Tristano 1991, 78–79, fully conform to the norm observed in Southern Italy.

Relationship between size and text layout in Latin and Greek codices (4th–12th centuries) (tab. 6)

Century	Latin codices		Greek codices	
	Full page	Two columns	Full page	Two columns
<300	97.85% (91)	2.15% (2)	10.00% (10)	0% (0)
300–349	93.83% (152)	6.17% (10)	93.33% (42)	6.67% (3)
350–399	94.15% (306)	5.85% (19)	75.95% (60)	24.05% (19)
400–449	89.27% (391)	10.73% (47)	73.79% (76)	26.21% (27)
450–499	82.67% (396)	17.33% (83)	69.31% (70)	30.69% (31)
500–549	59.95% (250)	40.05% (167)	49.21% (62)	50.79% (64)
550–599	35.29% (102)	64.71% (187)	24.00% (30)	76.00% (95)
600–649	21.00% (42)	79.00% (158)	22.22% (20)	77.78% (70)
650–699	8.54% (7)	91.46% (75)	11.11% (3)	88.89% (24)
>700	2.82% (4)	97.18% (138)	11.11% (1)	88.89% (8)
Total	66.27% (1741)	33.73% (886)	52.84% (382)	47.16% (341)

Tab. 6: Relationship between size and text layout in Latin and Greek codices (4th–12th centuries)

In essence, with the first appearance of parchment manuscripts, both the Greek and the Latin artisans showed themselves to be perfectly aware of the possibility of breaking up excessively long lines of script so as to make them easier to read. Conversely, the two-column layout was not yet used to achieve another goal, namely a more intensive utilisation of the page. This would happen later on, in the Late Middle Ages, when the value of the 'ruling unit' (calculated by dividing the height of the written area by the number of lines it contains, minus one) could be very low. When this was the case, the large number of lines on the page, together with the large number of characters contained in lines of considerable length, made it necessary to 'split' the width of the written area. For this reason, starting in the 8th century, it often happened that the 'ruling units' of two-column layouts were distinctly smaller than those of single column layouts in volumes of the same size.

In order to confirm the (again) very weak link that existed between page utilisation and layout in the Early Middle Ages, one has only to compare, in volumes of equal size, the means of ruling units in single column and two-column

manuscripts.[59] In the Latin context, the distance between lines is consistently shorter in two-column volumes, but the degree of variance is always quite small (ranging from a minimum of 0.48 mm in the 8th century, to a maximum of 0.97 mm in the 12th). In addition, the highest value (though only by a millimetre or so) is generally lower than the values that would be reached in the succeeding centuries.[60] In the case of the Byzantine codex, the adoption of a two-column layout did not confer any benefit vis-à-vis the utilisation of space, given that in volumes of equal size the average ruling unit remained almost identical in the two different types of layout (with a maximum variance of 0.23 mm in the 10th century). The greater occurrence of the two-column layout in medium-sized volumes, which does not necessarily imply a more intense utilisation of the page, instead seems to be attributable to the passive and uninspired way in which working methods dating back to late antiquity were applied.

Having ascertained that, prior to the Late Middle Ages, the purpose of a two-column layout was not to increase the capacity of a page by compressing lines of text, we need to take into account the fact that the presence of an intercolumnar 'corridor' probably caused a loss of space that an artisan may (or may not) have felt the need to compensate for. In other words, the intercolumnar space could simply be 'cut through' a written area of exactly the same width as that of a single column manuscript, with a resulting loss of writable space. Alternatively, the gap could be created by 'stretching' the base of the rectangle allotted for the text, thereby reducing the width of either one or both of a page's lateral margins. An analysis of the relationship between the width of the written area and that of the page (Tab. 7) makes it possible to identify the solution employed: should the ratio be higher in two-column volumes, we shall deduce that the written area was deliberately 'widened', thereby sacrificing the internal and external margins (or only one of these), with the aim of recuperating all or part of the surface area lost through the introduction of the intercolumnar space.[61]

59 The variances are calculated by grouping volumes into 40 mm incremental classes, limited to centuries represented by more than five items for each layout type. Notwithstanding lacunae (in centuries preceding the 8th above all), the variation between the two contexts is consistently higher, and can therefore be considered statistically significant.

60 A variation of 1 mm in a manuscript ruled in 30 lines makes it possible to gain 30 mm in a single column, which equates to approximately four lines of script. In the 8th century, in volumes of identical size, the diminution of the 'ruling unit' would make it possible for a page to contain 40, or perhaps even 50, lines of text.

61 The almost total absence of data relating to the size of the intercolumnar space makes it impossible to carry out a more precise analysis.

Ratio between the proportion of the written area and the proportion of the page according to text layout in Latin and Greek codices (4th–12th centuries) (tab. 7)

Century	Latin codices		Greek codices	
	Full page	Two columns	Full page	Two columns
4th–7th	0.75 (165)	0.77 (63)	0.73 (4)	0.73 (7)
8th	0.77 (588)	0.79 (197)	0.70 (4)	0.82 (1)
9th	0.71 (129)	0.72 (32)	0.62 (20)	0.66 (13)
10th	0.67 (85)	0.75 (37)	0.63 (115)	0.66 (105)
11th	0.65 (341)	0.71 (278)	0.63 (112)	0.66 (161)
12th	0.67 (403)	0.71 (272)	0.63 (117)	0.68 (54)
Total	0.71 (1711)	0.73 (879)	0.63 (382)	0.66 (341)

Tab. 7: Ratio between the proportion of the written area and the proportion of the page according to text layout in Latin and Greek codices (4th–12th centuries)

In actual fact, up until the 10th century, in both the East and the West, page layout did not exert a significant influence on the width of the written area, which in two-column volumes shows only a slight increase. By contrast, in the centuries that followed, in the Latin context a new level of awareness on the part of the artisans led to their taking different approaches to the way in which the written area was established in relation to the overall layout. This consisted in increasing the width (and later on also the height) of the written area in two-column volumes, with the aim of avoiding, or at least mitigating, the reduction in the writable surface.[62] Continuing to prefer working methods that originated from the earliest times, the Greeks applied compensating mechanisms in a more limited way, and at a later point.[63]

62 Up until the 8th century, the written area of Latin codices expanded in a symmetrical way at the 'cost' of both the internal and the external margins (whose relationship is not influenced by the layout), whereas in the centuries that followed the 'cost' of the expansion was borne mostly by the internal margin. It would seem that the Greek codex evolved in the opposite way, namely towards a more equal distribution of the variation (which was in any event very slight), when the two types of layout are compared.

63 Maniaci 2002, 165, Table 8.

3 Criteria for the distribution of 'black' and 'white' areas on the surface of the page

The positioning of text is just one of various aspects which combine to define the layout of a page and is determined by the amount of space allotted to the written area, by its form (either slender or more or less square), and by its placing within the available surface area (in other words, by the 'spatial configuration' of the four margins which combine to form its frame).

Overall, in all historical periods the pages of the Greek codex are distinctly less filled with script than those of Latin ones, as one can deduce from an analysis of the relationship between the written area and the total surface area of a page (a parameter conventionally referred to as 'page filling' [Tab. 8]).[64]

The gap, which is initially quite low, starts to increase at the beginning of the 8th century (the period in which in both the East and the West page filling is high), only to decline again towards the end of the period under examination, when pages of the Latin manuscript start to become less text-laden, a phenomenon that represents the beginning of a tendency that would continue in the following centuries.

This trend is in total contrast to the stability of the Greek codex, in which the average page filling value remains substantially unchanged until the 12th century.[65]

64 The classic reference is to Bozzolo et al. 1984.

65 The analysis of the 'black' should be expanded by taking into account the manuscripts' content. For information limited to the mid-Byzantine codex, see Maniaci 2002, 263–265, in which lower levels of page filling are observed in the production of manuscripts of biblical, liturgical and homiletic content.

Average of page filling of Latin and Greek codices (4th–12th centuries) (tab. 8)

Century	Latin codices			Greek codices		
	Full page	Two columns	Total	Full page	Two columns	Total
4th–7th	0.575 (165)	0.574 (63)	0.572 (228)	0.545 (4)	0.538 (7)	0.540 (11)
8th	0.624 (588)	0.637 (197)	0.627 (785)	0.528 (4)	0.719 (1)	0.566 (5)
9th	0.532 (129)	0.558 (32)	0.538 (161)	0.431 (20)	0.487 (13)	0.453 (33)
10th	0.503 (85)	0.580 (37)	0.526 (122)	0.448 (115)	0.466 (105)	0.457 (220)
11th	0.492 (341)	0.544 (278)	0.515 (619)	0.444 (122)	0.467 (161)	0.457 (283)
12th	0.506 (403)	0.534 (272)	0.517 (675)	0.447 (117)	0.485 (54)	0.459 (171)
Total	0.552 (1711)	0.566 (879)	0.557 (2590)	0.447 (382)	0.472 (341)	0.459 (723)

Tab. 8: Average of page filling of Latin and Greek codices (4th–12th centuries)

As far as the proportion of the written area is concerned, this is necessarily correlated to the page's proportion so as to preclude the possibility of a displeasing aesthetic effect caused by the written area being much narrower or much wider than the page it is placed on.

The ideal situation would call for parity between the two proportions; however, this only occurs in both Latin and Greek codices in late antiquity, a period in which the written area is characterised, like the page, by a particularly large set-up.[66] Starting in the Early Middle Ages, the proportion of the written area tended to become narrower, and stabilised at values that were always lower than those of the book, with the difference remaining almost constant in the East and the West until the end of the 12th century (Tab. 9).

66 Lowe 1925 (1970), 207 (202 of the reprinted version) had already listed the square proportioning of the written area among the various 'symptoms' of antiquity; he then extends the criterion more generically to include 'nearly square' proportions (Lowe 1928 [1970], 59 [270 of the reprinted version]).

Difference between the proportion of the written area and the page in Latin and Greek codices (4th–12th centuries) (tab. 9)

Century	Latin codices	Greek codices
4th–7th	-0.011	nd
8th	0.022	0.013
9th	0.033	0.073
10th	0.059	0.071
11th	0.065	0.059
12th	0.056	0.057
Total	0.041	0.062

Tab. 9: Difference between the proportion of the written area and the page in Latin and Greek codices (4th–12th centuries)

If the correlation between the proportion of the written surface and that of an individual codex is roughly the same in both manuscript traditions, by contrast the positioning of the written area on the page—determined by the 'hierarchy' of the four margins—answers to a different set of construction principles, as demonstrated by an examination of the distribution of the margins and, in particular, a comparison—which is simple to perform—of the overall breadth of the two opposite pairs, composed of, respectively, the external margin coupled with the lower margin, and the internal margin coupled with the upper margin (Tab. 10).[67]

67 The usable sample is limited to a little over 400 items for the Latin context, while the Greek one, predominantly composed of codices whose page sizes were all directly measured, numbers approximately 700. Since the *CLA* do not register the dimensions of margins and the data available on the Greek codices is too limited, it is not possible to analyse the positioning of the written area in the earliest times.

Ratio between the two opposite pairs of margins (mest + minf / msup + mint) in Latin and Greek codices (4th–12th centuries) (tab. 10)

Century	Latin codices			Greek codices		
	Full page	Two columns	Total	Full page	Two columns	Total
4th–7th	nd	nd	–	1.28 (1)	1.16	1.22 (2)
8th	1.87 (19)	1.86 (6)	1.87 (25)	1.05 (2)	1.40 (1)	1.17 (3)
9th	1.92 (40)	2.06 (7)	1.94 (47)	1.62 (19)	1.75 (12)	1.67 (31)
10th	1.70 (14)	1.61 (6)	1.67 (20)	1.53 (115)	1.57 (101)	1.55 (216)
11th	1.96 (47)	2.22 (21)	2.04 (68)	1.60 (122)	1.58 (161)	1.59 (283)
12th	2.20 (154)	2.19 (93)	2.20 (247)	1.60 (117)	1.62 (54)	1.61 (171)
Total	2.07 (274)	2.15 (133)	2.09 (407)	1.58 (376)	1.59 (330)	1.58 (706)

Tab. 10: Ratio between the two opposite pairs of margins (mest + minf / msup + mint) in Latin and Greek codices (4th–12th centuries)

While in the Greek codex the relationship between the two pairs remains essentially unchanged over time, registering a value of 3 to 2 (1.5) in favour of the most 'exposed' margins (i.e. the external and lower ones), in the Latin context the space that these occupy, which was already greater starting from the 8th century, increases further over the course of time, and ultimately reaches a total size that is more than double than that of the other pair of margins.

Associated with this change, in the 11th century only the Latin codices exhibit a clear reduction in the width of the upper margin in relation to the total height of the page. In other words, the written area tends to become progressively more distant from the most exposed margin areas, and in particular from the lower margin (the so-called 'footer').[68] This phenomenon is not seen in the Greek sample which, once again, is distinctly more stable in this regard (Tab. 11).

68 Conversely, the relationship between the internal margin and the width of the page remained essentially unchanged over time, probably on account of a dearth of available space.

Ratio between top margin and page height (msup/H) in Latin and Greek codices (4th–12th centuries) (tab. 11)

Century	Latin codices			Greek codices		
	Full page	Two columns	Total	Full page	Two columns	Total
4th–7th	nd	nd	–	15.00 (1)	14.84 (1)	14.92 (2)
8th	9.73 (20)	8.95 (6)	9.55 (26)	13.28 (2)	3.75 (1)	1.10 (3)
9th	9.52 (40)	10.12 (7)	9.61 (47)	11.99 (19)	10.89 (12)	11.56 (31)
10th	10.18 (14)	9.29 (6)	9.91 (20)	12.06 (115)	11.88 (101)	11.97 (216)
11th	8.67 (47)	7.11 (21)	8.18 (68)	12.44 (122)	12.32 (161)	12.37 (283)
12th	8.19 (154)	7.94 (93)	8.10 (247)	12.42 (117)	11.77 (54)	12.21 (171)
Total	8.68 (274)	8.03 (133)	8.47 (407)	12.31 (376)	12.02 (330)	12.17 (706)

Tab. 11: Ratio between top margin and page height (msup/H) in Latin and Greek codices (4th–12th centuries)

The idea that the tendency to decentralise the written area in relation to the overall page surface—a very widespread phenomenon which persists even today and can be seen in the best contemporary typesetting[69]—can be explained by the desire to protect the text as much as possible from the negative impact of *lisières* is though-provoking, but would only be applicable in cases where the bifolia were obtained by folding skins symmetrically, either in in-4 or in-8. This possibility would not be incompatible with a previous and perhaps more convincing (but likewise impossible to prove) hypothesis that the greater width of the external and lower margins could have served to make it easier to hold an open book in a way that limited, or even eliminated the possibility of the written surface coming into contact with the user's fingers.

However one chooses to interpret the two hypotheses, the positioning of the written area on the page represents the governing principle behind the (few) sets of instructions or 'recipes' which have come down to us—two in Latin, two in vernacular, and one in Greek (which is, in fact, a detailed 'mock-up' or 'framework' intended for the preparation of an individual volume containing Aristotelian

69 See, for example, the templates suggested by Fioravanti 2002, 186–189.

material with an added commentary). With a sole exception, almost all the surviving sources refer to late or post-medieval book production.[70]

In a different setting, I intend to carry out a comparative study of the stipulations set out in the 'recipes'—prescriptions that have previously been separately addressed in individual studies, but which have never been afforded an overall evaluation—by analysing the basic principles underlying the compilation of each of them, and by ascertaining the true extent of their diffusion, as I have previously done with two Latin texts. Accordingly, here I shall limit myself to focusing on two stipulations regarding the width of margins, which in the Western 'recipe' are distributed differently. (For reasons that I will explain elsewhere, to my mind the Sigismondo Fanti's text is open to an interpretation different to that proposed by Giorgio Montecchi.)[71] (Tab. 12).

70 Here, I shall confine myself to summarising the surviving sources that contain the relevant 'recipes', their approximate dates and the main contributions dealing with them (to which I refer for further details on the texts): (1) the 'Saint-Remi' recipe, Paris, Bibliothèque Nationale, Par. lat. 11884, 10th century, in Latin (Muzerelle 1989; Maniaci 1995); (2) the 'Munich' recipe, München, Bayerische Staatsbibliothek, Clm 7775, 15th century, in Latin (Bischoff 1984; Maniaci 1995); (3) the 'Vatican' recipe, Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. lat. 4825, 15th century, in vernacular (Cherubini 2004); (4) the 'Sigismondo Fanti's recipe, 16th century (*c.*1514), in vernacular (Montecchi 1997 [1994]); (5) the 'Greek' recipe, Città del Vaticano, Biblioteca Apostolica Vaticana, Vat. gr. 604, ff. 183r–187r, 14th century (Bianconi 2010). The Arabic 'recipe' that survives in a very likely corrupted form lies outside our area of interest: see the Paris codex, Bibliothèque nationale, Par. ar. 6844, 13th century (Déroche et al. 2000, 179). The so-called diagram drawn by the 13th-century Piccardian architect Villard de Honnencourt, which is preserved in a 'notebook', Paris, Bibliothèque nationale, Par. lat. 19093, is not in fact a 'recipe', but rather a graphic representation of a system for the subdivision of any segment into equal parts, starting out from a rectangle (see Tschichold 1965, and Tschichold 1975). Only when this contribution had already been prepared for publication did I come across Tristano 2010: in the essay, dedicated to the stipulations of 15th-century calligraphy, Fanti's directions for the *mise en page* (81–88) are also taken into consideration (based on the interpretation by Montecchi).

71 The reconstruction proposed by Montecchi–taken up by Agati 2009, 229–232, and by Cherubini 2004, 250–252, produces–'results which do not tally [...] with any of the 'recipes' that have been noted up to the present' (*ibid.*, 252). My alternative hypothesis rests on a different interpretation of the instructions issued for the setting-up of the external margin: *tu die partire quello che avanza del quadro in giù et quello mezo è lo spacio di fuori*, which I am inclined to believe refers not to the width of the lower margin (identified in a very muddled way), but rather to the difference between the height of the page and the square constructed based on the width of the written area.

Amplitude in % of the four margins according to the preserved layout 'recipes' in Greek and Latin codices (4th–12th centuries) (tab. 12)

'Recipe'	Mint	Msup	Most	Minf	Total
Saint-Remi	16%	21%	32%	32%	100%
Munich	18%	18%	27%	36%	100%
Cherubini	13%	20%	27%	40%	100%
Fanti Montecchi	14%	12%	25%	49%	100%
Fanti Maniaci	16%	15%	30%	39%	100%

Tab. 12: Amplitude in % of the four margins according to the preserved layout 'recipes' in Greek and Latin codices (4th–12th centuries)

The surviving 'recipes' document the use of various page construction principles. The two most ancient ones both require that one pair of margins be equal in breadth (in the Remigian 'recipe' the external and lower margins; in the Munich 'recipe' the internal and upper margins). The first of the vernacular texts stipulates that the margins be arranged in an ascending progression, whilst the governing principle behind Fanti's recommendations seems rather less clear, no matter how one 'deciphers' his instructions. In any event, the actual degree of application of the various relationship series can be confirmed, in a preliminary analysis, by applying a simple test based on an estimate of the width of each margin, expressed as a percentage in relation to the margins' overall width. By calculating the four percentages for all the codices and comparing each of the values obtained with those prescribed in the 'recipes', one can calculate the sum of the distances, thus making it possible to identify (with an acceptable degree of accuracy), the likely application of a given 'recipe', when the sum does not exceed 7%. For each century, the percentage of volumes which satisfy this condition represents the 'good fortune' (or otherwise) enjoyed by the various 'recipes' (Tab. 13).[72]

72 The absence (in the Latin codices) and the scarcity (in the Greek) of information on the widths of margins precludes the possibility of extending the verification procedure to the previous centuries.

Percentages of adaptation of Latin and Greek codices to layout 'recipes' (tab. 13)

Century	Saint-Remi	Munich	Cherubini	Fanti Montecchi	Fanti Maniaci
Latin codices					
4th–7th	nd	nd	nd	nd	nd
8th	0%	0%	0%	0%	0%
9th	4.26%	0%	0%	0%	0%
10th	15.79%	0%	0%	0%	5.26%
11th	7.46%	2.99%	0%	0%	13.43%
12th	6.07%	5.67%	0%	0.40%	14.17%
Greek codices					
4th–7th	nd	nd	nd	nd	nd
8th	0%	0%	0%	0%	0%
9th	3.23%	3.23%	0%	0%	3.23%
10th	15.28%	4.63%	0.93%	0%	0.46%
11th	19.79%	4.59%	1.06%	0%	0.71%
12th	23.98%	4.09%	1.17%	0%	1.17%

Tab. 13: Percentages of adaptation of Latin and Greek codices to layout 'recipes'

As I have already demonstrated elsewhere,[73] the Greek manuscripts unexpectedly provide proof of a close kinship with the Saint-Remi recipe[74], which on the other hand is not well suited for application in Latin book production. With regard to the three later prescriptions, predictably enough these turn out to be completely alien to the manufacture of the Medieval parchment manuscript, with the sole (partial) exception of Sigismondo Fanti's 17th-century recipe, if one is prepared to accept my

73 Maniaci 1995, 31–32.

74 Bearing in mind the numerous uncertainties which hamper verification (about which see *ibid*., 22–23), the value of 24% recorded for the 12th century should be considered particularly high. Conversely, the low percentage recorded for the 9th century is probably influenced by the relatively small number of items included in the sample. Giovanna Menci's attempt (Menci 1997) to detect in the layout of Greek papyrus rolls traces of an antecedent taste which subsequently 'flowed into' the Saint-Remi 'canon' is not convincing.

re-reading of it. The quest for other canonical rules, of which there seems to be no trace in the surviving documentation, has so far been in vain.[75]

4 Exploitation of the written area

Just as in the case of the geometric criteria applied when setting-up a page, its capacity was determined by the amount of text inserted within the area allotted to accommodate it. As is well known, a copyist had various strategies at his disposal to 'calibrate' the density of text, and these could be combined when necessary. He could adjust the interlinear space, the module and the horizontal compression/expansion of script, and the frequency and severity of any abbreviations employed. In the absence of the relevant data necessary to carry out an in-depth investigation, a rough calculation of the number of characters per line (carried out on originals or facsimiles, or gleaned from surveys already carried out by others) can in any event provide some indications useful for assessing the degree to which the space allotted to host the script is exploited. Indeed, the product of the total number of characters counted in a single line divided by the total number of lines provides an estimate of the amount of text accommodated by a single page (Tab. 14).[76]

75 In particular, with regard to the texts created by hypothesising the application (starting from the internal margin) of relationships in progressions of 10-20-30-40 and 12-12-38-38, the research has yielded practically nothing of significance. For the Latin codices alone, the percentages obtained by applying the sequence 15-15-35-35 are a little higher, but are in any event still lower than 10%.

76 The count, which had previously been carried out on the original Greek codices, was performed from scratch on the reproductions contained in the *CLA*, which (in a forward-looking way) almost invariably reproduce the entire breadth of the written area. The calculation, which is per force very approximate, consistently includes all notation of any kind placed on lines (excluding spaces). It was not possible to extend the evaluation to the size of the script–the width of characters in particular–which would have called for an *ad hoc* surveying campaign. It is worthwhile to point out that the means reported in Table 13 are influenced by the size distribution of volumes in the various historical periods, but that the observed chronological evolution is also confirmed within the individual size ranks.

Evolution of the average page capacity in Latin and Greek manuscripts (4th–12th centuries) (tab. 14)

Century	Latin codices			Greek codices		
	Characters per page	Characters per line	Ruled lines	Characters per page	Characters per line	Ruled lines
4th–7th	909 (229)	33.44 (230)	26.42 (231)	691 (8)	24.38 (8)	23.83 (33)
8th	1188 (785)	41.96 (785)	27.02 (794)	1138 (7)	29.57 (7)	34.81 (17)
9th	1252 (64)	45.52 (78)	28.38 (165)	1005 (42)	34.57 (43)	27.47 (110)
10th	1414 (37)	46.97 (59)	28.75 (126)	1153 (227)	37.09 (231)	29.69 (313)
11th	1423 (167)	44.76 (191)	31.86 (629)	1106 (281)	37.41 (283)	28.25 (305)
12th	1782 (251)	50.79 (317)	33.04 (725)	1096 (170)	39.49 (172)	27.67 (176)
Total	1277 (1533)	43.73 (1660)	29.91 (2670)	1108 (735)	36.72 (744)	28.48 (954)

Tab. 14: Evolution of the average page capacity in Latin and Greek manuscripts (4th–12th centuries)

Roughly speaking, when evaluated in this way, the overall exploitation of the page in Latin codices shows a clear tendency to increase over time. This increase is determined by a concomitant increase in the number of characters aligned on a single line and of the number of lines ruled on to a single page.

The reason for the growth that occurred after the 7th century (which was in fact heralded by developments during the course of the 6th) can largely be attributed to the abandoning of capitals, and therefore of uncial script, in favour of a fully and definitively formed minuscule script. In fact, in contrast to that of the majuscule, the morphology of minuscule script allowed for a gain of about 30%, mostly due to the increase in capacity of single lines, and somewhat less so to the increase in the number of lines on a page, which only becomes apparent in manuscripts of larger dimensions (i.e. measuring more than 500 mm) written in minuscule. Additionally, in minuscule book production the capacity of individual pages increases by about 35% between the early centuries of the Middle Ages and the 12th century. Overall, if one considers on the one hand the volumes in uncial script of the 4th to 8th centuries, and on the other volumes produced in the 12th century, a general tendency for the script's spatial performance to increase appears in volumes of the same dimensions, and in some cases it can even improve by some 75% (i.e. in codices ranging in size from 400 to 600 mm) (Tab. 15).

Average capacity of Latin codices depending on the graphic type and size (tab. 15)

Century	Capital or Uncial			Minuscule		
	Characters per page	Characters per line	Ruled lines	Characters per page	Characters per line	Ruled lines
<300	433 (14)	24.36 (14)	17.29 (14)	773 (53)	33.65 (57)	22.34 (61)
300–399	643 (40)	28.45 (40)	22.06 (40)	1002 (213)	39.51 (232)	24.94 (271)
400–499	959 (140)	34.55 (140)	26.42 (140)	1196 (434)	42.70 (459)	27.58 (526)
500–599	955 (122)	34.88 (122)	26.82 (122)	1628 (303)	50.11 (349)	31.57 (402)
600–699	1169 (30)	37.83 (30)	29.63 (30)	2122 (99)	56.57 (110)	35.87 (158)
>700	1789 (6)	48.67 (6)	35.58 (6)	2437 (46)	54.93 (54)	44.04 (101)
Total	933 (352)	34.09 (352)	26.13 (352)	1384 (1148)	45.31 (1261)	29.91 (1519)

Tab. 15: Average capacity of Latin codices depending on the graphic type and size

In the Greek context, the situation, once again, is different (Tab. 16).

Average capacity of Greek codices depending on the graphic type and size (tab. 16)

Century	Capital or Uncial			Minuscule		
	Characters per page	Characters per line	Ruled lines	Characters per page	Characters per line	Ruled lines
<300	627 (2)	25.00 (2)	24.50 (5)	685.76 (18)	30.44 (18)	21.17 (18)
300–399	576 (9)	23.89 (9)	23.89 (34)	894.59 (117)	33.00 (120)	25.38 (120)
400–499	693 (17)	27.00 (17)	24.67 (95)	1084.33 (192)	37.23 (195)	27.79 (195)
500–599	715 (29)	27.17 (29)	27.17 (111)	1231.11 (230)	39.28 (231)	30.35 (231)
600–699	1469 (7)	39.86 (7)	29.19 (33)	1344.53 (105)	40.14 (107)	32.04 (107)
>700	1485 (2)	38.50 (2)	48.00 (3)	1953.05 (10)	47.17 (10)	36.70 (10)
Total	791 (66)	28.30 (66)	25.71 (281)	1144.44 (672)	37.60 (681)	28.86 (681)

Tab. 16: Average capacity of Greek codices depending on the graphic type and size

Despite the numerical sparseness of the sample, above all the figures clearly demonstrate that the overall spatial performance of the Greek manuscripts in majuscule is inferior to that of those produced in uncial script. As a result, the shift from majuscule to minuscule script proved highly advantageous in the Byzantine codex. That being said, the constant increase in the capacity of the page that occurred between the Carolingian era and the 12th century is counter-posed in the Byzantine context, with the establishment of the minuscule script, by a marked stability (commencing in the 9th century) of average levels of text density, which are in any event lower than those seen in the Western codex. Subsequently, the variation between the two traditions tends to increase substantially in the successive centuries.[77]

***

What conclusions, then, can be drawn from the general trends identified up to this point? As regards the logic that governs the *mise en page* of Eastern and Western codices, much work certainly remains to be done in the form of research focused on specific historical eras, manufacturing contexts, circulation and use, and text and script typologies. From this perspective, the results of the present study are limited to sketching out, at a macroscopic level, the main changes that occurred in the Greek and Latin manuscript production contexts between late antiquity and the Early Middle Ages, and 'signposting' some promising directions which ought to be further investigated. In the case of the Latin West, the geographical differences in production criteria used for the planning and realisation of the written page, and the 'trickling down' of innovations from the north towards the south, still have to be more clearly defined. Further investigation of the distinctive features of some areas (Insular manuscripts in particular) and the positive effect of the use of minuscule script—Carolingian minuscule above all—on the exploitation of the page is also required. Meanwhile, the Greek context is still lacking, among other things, adequate characterisation of the layout of codices in majuscule script and associated variations, which depend on a given manuscript's writing and content.

77 Considerable differences have come to light which divide the sample according to the specific content of works. Among the most conspicuous of the divergences observed is the consistently less efficient utilisation of space in volumes containing biblical and liturgical texts, as opposed to the greater text density associated with patristic, theological and secular manuscripts. More detailed information will only be obtained once more specific investigations of individual eras and contexts have been carried out.

When compared, the similarities and, above all, 'structural' differences that emerge at around the beginning of the 7th century in Latin and Greek codices, in both the construction and the management of the page, become more apparent and significant. If the size of volumes, which is dependent on the characteristics of the raw materials used in their creation, shows similar arithmetic means and steadily evolves, in both production contexts, from an 'automatic' preference for a medium-sized format towards a greater variety of sizes, it is also clear that the Greek codex does not include monumentality among its communication strategies.

Far more striking are: variations in the proportion of volumes (a parameter that has no direct relationship with the practical representational function of a book, but one which is in any event indicative of the artisans' level of technical know-how); choices vis-à-vis the single or two-column layout; standards of page-filling; and the exploitation of the written area. In all cases, it seems to be possible to confirm a sharp contrast between the Latin artisans, who gradually become ever more 'evolved' and open to experimentation, and the Greek, who are decidedly more 'static' and remain firmly attached to techniques originating from the distant past—techniques that are well represented by the wide diffusion of canonical models of, in all likelihood, late antique ancestry, handed down over time through the 'recipe of Saint-Remi'.

As has already been noted, the differences seen over the long term in the *mise en page* are confirmed by various other material and structural characteristics, namely the Greek codex's protracted adherence to blind ruling, as opposed to the innovative introduction of colour in the Latin context; the almost exclusive persistence of the quaternion, as opposed to a much greater degree of variation seen in the late medieval Latin context; and the opening of quires, always starting with the flesh side in the Greek context, but in the Latin context alternating over the centuries. To these examples of different strategic choices, which demonstrate the more conservative nature of the Greek book, we can add others of less obvious significance, such as the speed—apparently different—at which the shift from the 'old style' to the 'new style' of blind ruling occurred, and the much wider variety of Greek ruling types employed in comparison to Latin ones. All things considered, the *mise en page* of the Greek book in the mid-Byzantine period—in common with other features of its manufacture—reflects an overall consistency in production and stability of form over the centuries, and little inclination to experiment in order to simplify the production of books and optimise their script capacity, at the same time as preserving their functionality. This is a picture which is entirely consistent with a 'world of scattered writers/scribes and writing places',[78] characterised by the

78 Cavallo 1995, 76.

presence of actors and organisational approaches that were largely speaking different from the dominant monastic and episcopal scriptoria that constituted the norm in the Early Latin Middle Ages.

***

5 Discussion of Maniaci's intervention

Kujawinski: First and foremost, thank you for providing us with such a highly informative account of the 'management' of the manuscript page. The question I would like to ask regards an issue that you have previously addressed in other settings, namely the relationship between the bifolia found in manuscripts today, and the original sheets of parchment from which they were sourced. The particular issue that interests me is the position of the dorsal axis in bifolia sourced from the central part of a skin and which were then folded in two. I would like to ask whether, based on your most recent surveys, the decision to fold a bifolia perpendicular to, or parallel with, the dorsal column was automatically influenced by the dimensions of the bifolia, in accordance with the specific procedure used for the subdivision of skins (either symmetrically or in-6), as is commonly stated in various studies carried out up till now, or alternatively whether other factors might have influenced this choice.

Maniaci: As regards volumes of the dimensions studied by you, the folding of the skin in-folio (confirmed by the position of the dorsal line), not only is the simplest solution, but is also the only one possible (folding—or subdivision—in-4 would require the availability of skins of far greater size than those of the kids or lambs that were normally used for the manufacture of parchment in the Late Middle Ages). In earlier times, the mixing of subdivided skins using various methods (not necessarily based on folding) even within the same codex (and also in very large format volumes, such as Atlantic Bibles) is an entirely unexceptional fact, and one which should be investigated in a more systematic way.

Ferrari: Thank you for your interesting and well-researched presentation. I would like you to clarify something for me. The dimensions of the codices included in your analysis are those of today: in other words, those which resulted from the trimming of margins during rebinding operations. My question is: do you think the greater width observed in the margins of the Greek manuscripts could be the result of a possible tendency in the Greek world to subject codices to less frequent

rebinding operations than their Latin counterparts have been subjected to? Or is it possible that the Greek rebinding methods resulted in manuscripts being less drastically trimmed than was the case with the Latin methods?

Maniaci: Regarding the attitudes of the Greek binders vis-à-vis trimming, I am not able to provide you with any information, and I do not think any specific sources of information exist. In any event, the variation that distinguishes the Greek from the Latin codices, in terms of the percentage of 'black' or 'page filling', is too great and consistent over time to allow it to be attributed exclusively to a different frequency, and hence to different degrees of impact resulting from trimming operations. I am therefore inclined not to overestimate the significance of this factor.

References

Agati, Maria Luisa (2009), *Il libro manoscritto. Da Oriente a Occidente. Per una codicologia comparata*, Roma: L'Erma di Bretschneider (Studia archeologica, 166).

Aland, Kurt et al. (1994 [1963]), *Kurzgefasste Liste der griechischen Handschriften des Neues Testaments*, Berlin, New York: De Gruyter (Arbeiten zur neutestamentlichen Textforschung, 1) (originally published in 1963).

Andrist, Patrick / Canart, Paul / Maniaci, Marilena (2013), *La syntaxe du codex. Essai de codicologie structurale.* Turnhout: Brepols (Bibliologia, 34).

Ansalone, Mario et al. (1993), *Caractérisation matérielle du parchemin moderne*, in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 185–225.

Bianchi, Francesco et al. (1993), 'La structure matérielle du codex dans les principales aires culturelles de l'Italie du XI^{e} siècle', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), II, 363–456.

Bianconi, Daniele (2010), 'Sources écrites et stratégies de mise en page à Byzance. À propos d'une recette pour l'Organon d'Aristote', in Jacob, Christian (ed.), *Lieux de savoir*, II. *Les mains de l'intellect*, Paris: Albin Michel, 401–425.

Bischoff, Bernhard (1984), 'Zur Schreib- und Buchtechnik des Spätmittelalters, II. Regeln für die Seiteneinteilung (Fünfzehntes Jahrhundert)', in Bischoff, Bernhard (ed.), *Anecdota novissima. Texte des vierten bis sechzehnten Jahrhunderts*, Stuttgart: Hiersemann (Quellen und Untersuchungen zur lateinischen Philologie des Mittelalters, 7).

Bischoff, Bernhard / Brown, Virgina (1985), 'Addenda to Codices Latini Antiquiores', in *Medieval Studies,* 57: 317–366.

Bischoff, Bernhard / Brown, Virgina / John, James J. (1992), 'Addenda to Codices Latini Antiquiores (II)', in *Medieval Studies*, 54: 286–307.

Bischoff, Frank M. / Maniaci, Marilena (1996), 'Pergamentgröße, Handschriftenformate, Lagenkonstruktion. Anmerkungen zur kodikologischen Forschung am Beispiel südeuropäischer Pergamente und Handschriften', in *Scrittura e civiltà*, 19: 277–319.

Bozzolo, Carla / Coq, Dominique/ Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIV^{e} et XV^{e} siècles. Textes et études, 2).

Careri, Maria et al. (eds) (2001), *Album de manuscripts français du XIII^{e} siècle. Mise en page et mise en texte*, Roma: Viella.

Cavallo, Guglielmo (1984), 'Frammenti di un discorso grafico-testuale', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo.* Atti del convegno internazionale (Urbino, 20–23 settembre 1982), Urbino: QuattroVenti, 415–429.

Cavallo, Guglielmo (1995), 'La cultura scritta a Bisanzio. Inventario di problemi per una riflessione', in Hamesse, Jacqueline (ed.), *Bilan et perspectives des études médiévales en Europe*. Actes du premier Congrès européen d'études médiévales (Spoleto, 27–29 mai 1993), Louvain-La-Neuve: Institut d'études médiévales (Fédération internationale des études médiévales. Textes et études du Moyen Âge, 3), 65–80.

Cherubini, Paolo (2004), 'Una nuova ricetta in volgare per rigare la pagina (secolo XV)', in *Miscellanea Bibliothecae Apostolicae Vaticanae*, 11, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 423), 241–258.

Cherubini, Paolo / Pratesi, Alessandro (2010), *Paleografia latina. L'avventura grafica del mondo occidentale*, Città del Vaticano: Scuola Vaticana di Paleografia, Diplomatica e Archivistica (Littera antiqua, 16).

Crisci, Edoardo (2003), 'Papiro e pergamena nella produzione libraria in Oriente dal IV all'VIII secolo', in *Segno e testo*, 1: 79–127.

Crisci, Edoardo / Pecere, Oronzo (eds) (2004), *Il codice miscellaneo, Tipologie e funzioni*. Atti del convegno internazionale (Cassino, May 14–17, 2003), Cassino: Università degli studi di Cassino (= *Segno e testo*, 2).

Déroche, François et al. (2000), *Manuel de codicologie des manuscrits en écriture arabe*, Paris: Bibliothèque nationale de France (Études et recherches).

Fioravanti, Giorgio (2002), *Il nuovo manuale del grafico. Guida alla progettazione grafica del prodotto editoriale: libro, rivista, giornale* CD-Rom e sito web, new edition edited by F. A. Chilli, Bologna: Zanichelli.

Frank, Barbara (1993), 'Zur Entwicklung der graphischen Präsentation mittelalterlicher Texte', in Erfurt, Jürgen / Gessinger, Joachim (eds), *Schriftkultur und sprachlicher Wandel*, Osnabrück: Gilles & Francke Verlag (Osnabrücker Beiträge zur Sprachtheorie, 47), 60–81.

Giovè Marchioli, Nicoletta (2010), 'Caratteri e trasformazioni della cultura scritta nel V secolo', in Delogu, Paolo / Gasparri, Stefano (eds), *Le trasformazioni del V secolo. L'Italia, i Barbari e l'Occidente romano*. Atti del seminario di Poggibonsi, 18–20 ottobre 2007, Turnhout: Brepols, 679–703.

Gumbert, Johan Peter (1984), *IIMM. Illustrated Inventory of Medieval Manuscripts in the Netherlands*, *Utrecht Museum Catharijneconvent*, I, Leiden: Verloren.

Gumbert, Johan Peter (1989), 'La page intelligibile: quelques remarques', in Weijers, Olga (ed.), *Vocabulaire du livre et de l'écriture au Moyen Âge*. Actes de la Table ronde, Paris, 24–26 septembre 1987, Turnhout: Brepols (Civicima. Études sur le vocabulaire intellectuel du Moyen Âge, 2), 111–119.

Gumbert, Johan Peter (1992), 'Zur "Typographie" der geschriebenen Seite', in Keller, Hagen / Grubmüller, Klaus / Staubach, Nikolaus (eds), *Pragmatische Schriftlichkeit im Mittelalter. Erscheinungsformen und Entwicklungsstufen*. Akten des internationalen Kolloquiums 17–19. Mai 1989, München: Wilhelm Fink Verlag (Münstersche Mittelalter Schriften, 65), 283–292.

Gumbert, Johan Peter (2000), 'Skins, Sheets and Quires', in Pearsall, Derek (ed.), *New Directions in Later Medieval Manuscript Studies*. Essays from the 1998 Harvard Conference, York: Boydell & Brewer, York Medieval Press, 81–90.

Gumbert, Johan Peter (2001), 'Livre grand, livre petit: un problème de taille', in *Gazette du livre médiéval*, 38: 55–58.

Irigoin, Jean (1984), 'Livre et texte dans les manuscrits byzantins de poètes; continuité et innovations', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, 20–23 settembre 1982), Urbino: QuattroVenti, 87–102.

Irigoin, Jean (1985), 'La mise en page des œuvres poétiques de l'antiquité à la fin du XI^{e} siècle', in Lemaire, Jacques / Van Balberghe, Émile (eds), *Calames et cahiers. Mélanges de codicologie et de paléographie offerts à Léon Gilissen*, Bruxelles: Centre d'Étude des Manuscrits (Les publications de Scriptorium, 9), 79–87.

Irigoin, Jean (1990), 'Grégoire de Nazianze', in Martin, Henri Jean / Vézin, Jean (eds), *Mise en page et mise en texte du livre manuscrit*, Paris: Editions du Cercle de La Librairie, 123–128.

John, James J. (1990), 'The Format of Manuscripts in *Codices Latini Antiquiores*: A Statistical Report', in Díaz y Díaz, Manuel Cecilio (ed.), *Actas del VIII Coloquio del Comité Internacional de Paleografia latina*, Madrid, Toledo 29 setiembre–1 octubre 1987, Madrid: Joyas Bibliográficas (Estudios y ensayos, 6), 95–105.

Johnson, William A. (2004), *Bookrolls and Scribes in Oxyrhynchus*, Toronto, Buffalo, London: University of Toronto Press (Studies in Book and Print Culture).

Lowe, Elias Avery (1925 [1970]), 'Some Facts about our Oldest Latin Manuscripts', in *The Classical Quarterly*, 19/ 3–4: 197–208 (repr. in Lowe, Elias Avery [1970], *Palaeographical Papers 1907–1965*, I, edited by Bieler, Ludwig, Oxford: At the Clarendon Press, 187–202).

Lowe, Elias Avery (1928 [1970]), 'More Facts about our Oldest Latin Manuscripts', in *The Classical Quarterly*, 22/1: 43–62 (repr. in Lowe, Elias Avery [1970], *Palaeographical Papers*, I, edited by Bieler, Ludwig, Oxford: At the Clarendon Press, 251–274).

Maniaci, Marilena (1995), 'Ricette di costruzione della pagina nei manoscritti greci e latini', in *Scriptorium*, 49: 16–41.

*Maniaci, Marilena (1999), 'L'art de ne pas couper les peaux en quatre', in *Gazette du livre médiéval*, 34: 1–12.

*Maniaci, Marilena (2000), 'La pergamena nel manoscritto bizantino dei secoli XI e XII: caratteristiche e modalità d'uso', in *Quinio. International Journal on the History and Conservation of the Book*, 2: 63–92.

Maniaci, Marilena (1999), 'Suddivisione delle pelli e allestimento dei fascicoli nel manoscritto bizantino', in *Quinio. International Journal on the History and Conservation of the Book*, 1: 83–122.

*Maniaci, Marilena (2000), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino, Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, Milano: Centro Tibaldi, 47–60.

Maniaci, Marilena (2002), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Maniaci, Marilena (2002 [2005²]), *Archeologia del manuscritto. Metodi, problemi, bibliografia recente*, con contributi di Carlo Federici e di Ezio Ornato, Roma: Viella (I libri di Viella, 34).

Maniaci, Marilena / Ornato, Ezio (2002), 'I cataloghi di manoscritti datati: una torre di babele codicologica?', in *Gazette du livre médiéval*, 61: 1–11.

Martin, Henri Jean / Vézin, Jean (eds) (1990), *Mise en page et mise en texte du livre manuscrit*, Paris: Éditions du Cercle de la Librairie – Promodis.

Menci, Giovanna (1997), 'L'impaginazione nel rotolo e nel codice: alcune note', in Kramer, Bärbel / Luppe, Wolfgang / Maehler, Herwig / Poethke, Günther (eds), *Akten des 21. Internationalen Papyrologen-Kongresses (Berlin, 13.–18.8.1995)*, Leipzig: Teubner, II, 682–690.

Montecchi, Giorgio (1997 [1994]), 'Le dimensioni del libro secondo la *Theorica et practica* di Sigismondo Fanti', in Montecchi, Giorgio (ed.), *Il libro nel Rinascimento*, Roma: Viella (I libri di Viella, 11), 93–107 (1st edition, Milano: La storia, 1994).

Munk Olsen, Birger (1982–1989), *L'étude des auteurs classiques latins au XIe et XIIe siècles*, I–IV, Paris: CNRS.

Muzerelle, Denis (1989), 'Normes et recettes de mise en page dans le codex pré-carolingien', in Blanchard, Alain (ed.), *Les débuts du codex*. Actes de la journée d'études organisée à Paris les 3 et 4 juillet 1985, Turnhout: Brepols (Bibliologia, 9), 125–156.

Muzerelle, Denis (2007), 'Pour revenir sur et à la "taille" des manuscrits', in *Gazette du livre médiéval*, 50: 55–63.

Nelson, Robert S. / Bona, Jerry L. (1991), 'Relative Size and Comparative Value in Byzantine Illuminated Manuscripts: Some Quantitative Perspectives', in Harlfinger, Dieter / Prato, Giancarlo (eds), *Paleografia e codicologia greca*. Atti del II colloquio internazionale (Berlin-Wolfenbüttel, 17–21 October, 1983), with the collaboration of D'Agostino, Marco / Doda, Alberto, Alessandria: Edizioni dell'Orso (Biblioteca di Scrittura e civiltà, 3), I, 339–353.

Ornato, Ezio (1997), 'L'histoire du livre et les méthodes quantitatives: bilan de vingt ans de recherche', in [Ornato, Ezio et al.], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella (I libri di Viella, 10), 607–679.

[Ornato, Ezio et al.] (1997), *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella (I libri di Viella, 10)

Orsini, Pasquale (2005), *Manoscritti in maiuscola biblica. Materiali per un aggiornamento*, Cassino: Università di Cassino (Collana scientifica, Studi Archeologici, Artistici, Filologici, Letterari e Storici, 7).

Palma, Marco (1998), 'Classico, piccolo e quadrato. Dati per un'indagine su una tipologia libraria nell'Europa carolingia', in Ferrari, Anna (ed.), *Filologia classica e filologia romanza: esperienze ecdotiche a confronto*. Atti del convegno (Roma, 25–27 maggio 1995), Spoleto: Centro italiano di studi sull'alto Medioevo (Incontri di studio, II), 399–408.

Petrucci, Armando (1972), 'Libro, scrittura e scuola', in *La scuola nell'Occidente latino dell'alto medioevo* (Settimana di studi sull'alto medioevo, 19) Spoleto: Centro italiano di studi sull' Alto Medioevo, 313–337 (repr. and transl. in Petrucci, Armando / Radding, Charles M. [eds], *Writers and Readers in Medieval Italy. Studies in the History of Written Culture*, New Haven: Yale University Press =

Petrucci, Armando [2007], *Scrivere e leggere nell'Italia medioevale*, Milano: Sylvestre Bonnard, 81–97).

Sautel, Jacques-Hubert (1995), *Répertoire de réglures dans les manuscrits grecs su parchemin. Base de données établie par Jacques-Hubert Sautel à l'aide du fichier Leroy et des catalogues récentes*, Turnhout: Brepols (Bibliologia, 13).

Tristano, Caterina (1991), 'Caratteristiche tecnico-formali dei codici dell'Italia meridionale tra IX e X secolo', in Vitolo, Giovanni / Mottola, Francesco (eds), *Scrittura e produzione documentaria nel Mezzogiorno longobardo*, [Cava dei Tirreni]: Badia (Acta Cavensia, 1), 55–89.

Tristano, Caterina (2010), 'Costruire la scrittura, costruire la pagina. Dai trattati di scrittura a Luca Pacioli', in Merisalo, Outi / Tristano, Caterina (eds), *Dal libro manoscritto al libro stampato.* Atti del Convegno di studio (Roma, 10-12 dicembre 2009), Spoleto: Centro italiano di Studi sull'alto medioevo, 67–89.

Tschichold, Jan (1965), 'Non-arbitrary Proportion of Page and Type Area', in Osley, Arthur Sidney (ed.), *Calligraphy and Palaeography. Essays presented to Alfred Fairbank on his 70th Birthday*, London: Faber & Faber, 179–191.

Tschichold, Jan (1975), *Ausgewählte Aufsätze über Fragen der Gestalt des Buches und der Typographie*, Basel, Stuttgart: Birkhäuser (Italian translation Tschichold, Jan [2003], *La forma del libro*, Milano: Sylvestre Bonnard).

Turner, Eric Gardner (1977), *The Typology of the Early Codex*, Philadelphia: University of Pennsylvania Press (Hanley Foundation Series, 18).

Luciana Devoti

A Medieval Puzzle. The 'Architecture' of the Page in Manuscripts and Incunabula of the *Codex Justinianus*

The image most often associated with a medieval law manuscript is that of a teacher sitting at a raised desk in a university classroom as he reads and comments on a normative text to a group of students who attentively follow their master's disquisition, all the while making notes on what is being said in the margins of their manuscripts.

This association is fully justified by the fact that juridical codices are, in many respects, products of 12th to 14th century university culture. Indeed, such volumes reflect the scientific principles and criteria used to organise the new legal doctrine; in addition, they provide evidence of the reproduction and dissemination mechanisms that were fostered and overseen by the major *Studia* in the cities where the universities were situated.

Viewed in this way, all medieval law books used for professional and educational purposes constitute, either directly or indirectly, important and valuable testimony of the academic world's scientific activity. Specific planning and execution methods mean that such codices represent a very well-defined book typology with peculiar characteristics, thus making them an interesting and thought-provoking object of study.

The above preamble is necessary in order to introduce the particular 'terrain' that the present research aims to cover and the objectives it seeks to fulfil. Our goal is to analyse the structure of the page in a juridical codex by examining the criteria that dictated the organisation and structuring of all its components—both written

---

Translated from the Italian into English by Mark Livesey. Original published as Devoti, Luciana (1999), 'Un rompicapo medievale. L'architettura della pagina nei manoscritti e negli incunaboli del *Codex* di Giustiniano', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 143–206.

This work is the outcome of a specialisation thesis undertaken at the University of Cassino in 1995. I would like to thank Marco Palma and Ezio Ornato for consistently following my progress, and for making helpful suggestions concerning the study of the medieval book from an alternative and innovative standpoint.

https://doi.org/10.1515/9783110743838-014

and non-written—and the ways in which the space allocated to accommodate the text was exploited and utilised.

Interest in the 'architecture' of the page and the arrangement of the elements that determine its design is inspired by the striking homogeneity and uniformity which characterise, when seen from this perspective, a juridical book. Text and commentary are arranged according to schemes that were almost identical in all centres of production during the period stretching from the 8th to 15th centuries, an observation which is true of both manuscripts and printed books. This makes it both feasible and justifiable to carry out an investigation on the strategies employed by the various artisans concerned when they shaped and organised a predetermined quantity of text in relation to the page space available to them. With this goal in mind, the question has been posed as to whether or not the uniformity which is so typical of the pages of legal codices is the result of specific strategies and choices. Stated more precisely, our aim has been to discover whether, in order to synchronise the text associated with the commentary, solutions of a functional kind prevailed that were aimed at ensuring that related passages remained in proximity to each other; or if, conversely, greater stress was placed on aesthetic considerations, with the objective of creating a visually homogeneous effect. Finally, we have investigated how, and to what extent, within the bounds of certain mechanisms, written and non-written areas of the page were worked on.

The present investigation takes advantage of quantitative analysis methodologies which have already been widely experimented with in various fields of historical research, not least that of the book.[1] However, even if such an 'experimental' approach is not exactly ground-breaking with respect to codicology, it does appear to be so as far as law books are concerned, at least from the standpoint of the issues that will be addressed in the present contribution. The association of a book typology with the specific context in which it was planned and realised, and within which it found its intended application and ultimate purpose, has long been the source of inspiration behind these studies.[2] Likewise, the mechanisms involved in the con-

1 The complexity of the motives and aims which lie at the root of this methodology have been amply addressed by Bozzolo / Ornato 1982; Bozzolo / Ornato 1986; Ornato 1991.

2 A similar premise is the basis of numerous contributions aimed at the analysis of this book typology. Such contributions are ultimately inspired by the direction taken by Jean Destrez in his seminal work *La pecia* (Destrez 1935). In his book, the author focuses attention on a series of issues and new aspects (previously disregarded) vis-à-vis the university manuscript in the four main centres of Paris, Bologna, Oxford and Naples (paying particular attention to the first two centres). In addition, he addresses themes relating to tradition and textual criticism. Destrez also shows an interest in the elements that characterise the architecture and construction of the page and the techniques that were predominantly used in the manufacture of manuscripts, albeit always from the standpoint of

struction of the page and the relationship that exists between its component parts do not constitute a novelty and, indeed, are often referred to in manuals and the numerous contributions dedicated to the multifarious aspects of manuscript and printed books. All the same, an in-depth examination of such issues within this particular book typology has not been attempted before now.[3]

In order to be able to provide answers to the questions posed above, in the first place it was necessary to establish the boundaries of the research, both from the qualitative and quantitative standpoint. Indeed, the goal set was that of building a suitable and sufficiently representative corpus of witnesses so as to be able to furnish all the information necessary to carry out the investigation. With this object in mind, attention was focused on a sample of manuscripts dating from the 13th to 14th centuries and incunabula dating from last quarter of the 15th century, all containing the *Codex Justinianus* with the 'ordinary gloss' (*Glossa ordinaria*).

---

drawing a comparison between the different editorial policies practiced by the various universities, in relation to an institution 'qui correspond à cet état des choses nouveau, créé par l'évolution sociale, institution qui arriva à sa pleine perfection dès le milieu du XIII[e] siècle, e qui durera jusqu'à la mise en circulation des premiers livres imprimés: c'est la *pecia*'. Destrez's treatise represented an important starting point for subsequent research, most of which focused (above all) on themes relating to the production and marketing of the university codex. New discoveries of a documentary nature, together with a deepening, and in some cases critical revision of the sources already known by Destrez, have contributed to enriching and widening the breadth of such research. An important moment for taking stock of the state of affairs regarding these studies occurred almost fifty years after the publication of *La pecia* at a symposium titled *La production du livre universitaire*, held in 1983 at the Collegio di San Bonaventura at Grottaferrata (Bataillon et al. [eds] 1988). In this instance, too, the attention paid to university books of (not solely) legal content was essentially inspired by the always complicated question vis-à-vis reproduction mechanisms and the possibility of reconstructing operational criteria based on the available evidence. A great deal of interest has also developed around production issues in relation to the juridical incunabulum; the most recent contributions on this topic are Coq / Ornato 1988, in which production of legal incunabula in the principal Italian, French and German markets is analysed, based on 1,200 editions dating from 1460 to 1500 and belonging to three categories, namely Roman law, canon law and judicial practice manuals; and Thilo 1984, in which an investigation of the history of law book printing is carried out with respect to the Germanic area (a list of texts from the *Corpus Iuris Civilis* published between 1400 and 1800 is also provided).

3 Certain themes in relation to the structure of law books have been addressed, albeit only in part and in a predominantly descriptive way, in two contributions by Jacqueline Rambaud, in which the author considers some important pieces of evidence from the *Decretum Gratiani* (Rambaud 1990) and the *Decretales* (Rambaud 1990a). She also illustrates the arrangement of the text and its glosses with particular regard to the use of decoration within the various subdivisions of the works. For an overview of the ways in which glosses and commentary developed within various literary genres, see Holtz 1995. Concerning the codification of various systems for the layout of pages with annotations, see Powitz 1979 (in particular, 84–85, where framework No. 6, which corresponds to the one in our sample, is described).

1 Text and apparatus

The term 'law book' is rather vague and is used to refer to a literary genre that encompasses a vast range of works. In the Middle Ages, the two great categories of law—canon and civil—included cornerstone regulatory texts along with a series of treatises of various kinds designed to complement them: *lecturae*, *summae*, *quaestiones*, *repetitiones*, etc. For the purposes of the present investigation, it was considered best to focus our attention on just one of the two great categories, namely civil law, and in turn on one of its basic sub-divisions, namely the *Codex*. The *Codex Justinianus* represents a section of the *Corpus Iuris Civilis*[4] and was widely disseminated and particularly well known within universities and beyond their precincts. It was therefore a heavily used text both for teaching purposes and in the course of legal practice. A series of documents relating to the book trade in Bologna between the second half of the 13th century and first three decades of the 14th (preserved in the *Ufficio dei Memoriali* fund of the State Archives of Bologna)[5] furnishes much evidence regarding the production and circulation of the *Codex*. Roughly 57% of sale and purchase contracts and writings relating to works in the

4 According to tradition, Justinian's *Corpus Iuris Civilis* was divided into five volumes. The first three comprised the books of the *Digesta*, traditionally divided into the *Digestum Vetus* (books 1-24.2), the *Digestum Infortiatum*, or simply *Infortiatum* (books 24.3-38.17), and the *Digestum Novum* (books 39.1-50.17). In turn, the *Infortiatum* was divided into two sections; the second (35.2-38.17) was indicated by the words *Tres Partes*, and began with Law 82 of book 35.2. The fourth book was composed of the first nine books of the *Codex*. The fifth contained all the remaining texts and was known as the *Volumen*; these comprised the *Institutiones, the Novellae* according to the version in the *Authenticum* collection (called for this reason the *Authenticae* or *Authenticum*) divided into nine *collationes*, the *Tres libri*, or the last three books of the *Codex*, and the *Libri Feudorum* and a few imperial laws added at a later date as a tenth *collatio*. Justinan's legislation, which spread across Italy in 554 with the *Pragmatica Sanctio*, dissipated in the Early Middle Ages, to the extent that many collections were broken up, and some disappeared entirely. It was during the 11th century, in all likelihood on the initiative of some jurists, that Justinian's law was rediscovered. The first texts to reappear were the *Institutiones* and the books of the *Codex*. The task of recuperating and organising the other texts based on the original arrangements then fell to Irnerio and his milieu, and it would be Irnerio himself, according the testimony of Odofredus, who began to teach and write glosses to better illustrate Roman laws. On the disappearance and rediscovery of the Justinian's texts during the Middle Ages, see Astuti 1968a, 57-73, 297–338; Calasso 1954, and, more generally, Bellomo 1988, 7–33.

5 Published in *Chartularium* 1909–1988 and in Orlandelli 1959.

Corpus Iuris Civilis concern the text of the *Codex*, which also addresses other types of transaction, such as pledge, loan, and transportation contracts.[6]

The planning of curricula in law schools varied according to the universities and faculties concerned. In any event, the teaching of the *Codex* was considered to be of fundamental importance and was imparted by the masters (*doctores*) during the courses called *ordinarii*, which generally took place in the morning.[7] A collection of norms relating to the university statutes of Bologna of 1252 (the oldest that have come down to us) illustrate the teaching system which was based on the *puncta*, that is to say the times and ways in which the juridical texts were to be read. In the case of the *Codex*, two lesson cycles were envisaged. The first was divided into seven parts with each part lasting fourteen days; the second cycle was divided into nine parts which each lasted for twelve days. The entire programme added up to a grand total of 206 days, during which all nine of the volumes would be read.[8]

The *lectura* represents the original and enduring form of university teaching. Essentially, it is born from an awareness that it is only on the basis of authoritative readings of texts that the student's mind can arrive at the truth. *Legere* becomes a synonym for 'to teach' and 'to study', and it is only a work, or an accredited interpretation—and therefore one which is officially recognised and guaranteed—which is valid and can be considered an indisputable point of departure. Reading 'devient ainsi une pratique que l'on peut organiser, determiner à l'avance; elle se donnne pour but la preparation culturelle et l'activité didactique et scientifique du nouvel intellectuel professionel, qu'il soit laïc ou religieux: professeur, juriste, médecin, théologien, notaire'.[9] A method of this kind, which is very widely used in all fields of knowledge, becomes all the more important in the legal context, where the rediscovery of the Justinian texts and the need to endow the law with certainty does not arise purely from an intellectual interest, but instead represents an indispensable premise for a society which is in the process of organising itself into new political and institutional entities that differ from those of the past.

---

6 For the last mentioned, in addition to the *Chartularium* and Orlandelli's study, see, in particular, Stelling Michaud 1963. For sales, purchase and writing contracts, see also Devoti 1994, and Devoti / Tristano 1998.

7 In addition to the *Codex*, the *Digestum Vitus* was included in the *ordinarii* courses. The other texts in the *Corpus Iuris Civilis* were instead read during the post meridiem lessons (the *extraordinariae*), held by the Bachelors of Law.

8 Maffei 1975, 94–96.

9 Petrucci 1984, 610; see also Saenger 1982, 391–393.

From the earliest days of university teaching, the reading of Justinian works envisaged both the analysis and the elucidation of individual laws and their glosses. For the most part, this consisted in quoting the norms relating to the subject addressed by the passage being examined. The majority of cases concerned analogous or contrary laws (*loci similes et contrarii*), all of which could be found within the same Justinian compilation. Quotations from these laws were translated into brief notes and observations which were then inscribed in the margins of the manuscripts. These preliminary glosses constituted a starting point and provided a network of references to parallel texts to be expanded upon and examined in more depth. Thus, once 'the fragment to extrapolate from had been identified it was copied out and appended as a gloss to the text to be elucidated, like a new interpretative tool which served to clarify the text's meaning and develop its content'.[10] However, with the passage of time, analysis of the law became more complex, hence from a simple reutilisation of the material extracted (or to be extracted) from the *Corpus Iuris*, a shift was made to a more detailed exegesis, which at first consisted in the illustration of the *casus* (i.e. the legal case), and subsequently in the explication of a full series of problematical aspects relating to the various interpretations.

Thus, the book became an indispensable tool for the production of scientific elaborations and for 'fixing' the same for future reference: 'on lit pour écrire... on lit et on écrit tout ensemble quand on commente et quand on annote; on écrit en lisant quand on compose, car tout texte est—nécessairement—fondé sur l'auctoritas' des prédécesseurs et sur l'usage permanent de la citation'.[11]

The glosses were associated to the main text by means of a reference symbol. In the earliest times a number of different symbols were employed, the paragraph sign (§) being particularly widespread (it was also used to indicate the addition of an individual gloss). Later on, various letters of the alphabet were used. In civil law manuscripts the reference symbol was followed by the incipit of the passage concerned.

Gero Dolezalek has shown that glossed juridical codices[12] existed from the beginning of the 12th century. However, such material was not yet fully developed—i.e. it consisted of 'in progress' annotations'—even if it was not of a sporadic and merely occasional nature. In fact, it was the product and testimony of exegeses carried out in the *scholae* of the jurists.[13] These early glossed manuscripts proba-

10 Bellomo 1988, 67.
11 Petrucci 1984, 610.
12 Dolezalek 1989, 205.
13 Dolezalek 1994.

bly constituted the *Libri magistrorum*[14]—that is to say the volumes which belonged to school principals—to which the masters added their glosses or those of other jurists, which they then used during the lectures they delivered. With the passage of time, new evidence of the progress made during the scientific study of legal matters was added to or replaced earlier annotations. For this reason, manuscripts of the 12th century, which can be traced back to one and the same 'archetype', or to one and the same school, often exhibit glosses that are similar but not identical. Thus, in order to lay claim to authorship and differentiate their glosses from earlier ones, the jurists began to add their initials (e.g. y[*merius*], b[*ulgarus*], m[*artinus*], r[*ogerius*] etc.),[15] although these were frequently insufficient to maintain and ensure independent circulation. In fact, many manuscripts were erased in order to make way for new *additiones*. Others were transcribed, but during this process many initials were either intentionally or accidently rubbed out, perhaps because they were hidden between the original glosses and those which were added at a later date.[16] Consequently, it is difficult to identify and recognise in the oldest manuscripts consistent sets of glosses, even if it is precisely at this moment in time that the notion of a 'layer' begins to assume relevance, understood to 'refer to the shared unitary tradition of a living text [...] identifiable by its actual circulation'.[17]

The decisive phase that immediately followed consisted in the merging of such agglomerations of glosses into a single, crystallised structure, which equates to the critical apparatus. In this structure the glosses were arranged and unified into a fixed order, thereby becoming identifiable and reproducible as the personal and autonomous work of the jurist who selected them.[18] It is here that 'the historiographic notion of a "layer", as a group of glosses characterised in an agreed upon way, can converge with the historiographic notion of an "apparatus"; [...] in the historiographic "layer" a group of glosses, which can also have historical substance as an "apparatus", is evaluated for its structure. One must therefore say that each apparatus is also a layer, but that each layer is not necessarily an appa-

14 Dolezalek 1985, 42.

15 Sella 1932 and Sella 1935; Speciale 1994, Appendix C.

16 Dolezalek 1994, 248–241.

17 Caprioli 1981, 417; on the analysis of indications of the use of the glossed manuscripts contained in the *Codex*, see Speciale 1994.

18 On the one hand the spread of ordinary apparatuses indicated the high scientific level achieved by the Bolognese law schools, whilst on the other it represented, for university teaching, a remarkable combination of economic and ideological interests, thanks to the care and control exerted over the production and dissemination of texts destined to be used for educational purposes.

ratus [...]. It can be said that henceforth the original structure of the group of glosses remained "uncontaminated", but not the way in which it circulated, since it no longer represented an "open" text, but instead a "closed" one'.[19]

With respect to civil legal texts, the authors of the first standardised gloss apparatuses were Ugolinus and Azzo, even if the entire process of gathering, selecting and re-ordering the annotations that had accumulated from the time of Irnerius was only completed by Accursius in the first half of the 13th century.[20] The Accursian apparatus is at one and the same time a work of exegesis and compilation; in fact, the author did not limit himself to simply assembling the pre-existing material;[21] he also subjected it to revision and elaboration—in both form and substance—in the light of the principles, definitions and classifications which by this time had become part of the scientific patrimony of the Bolognese schools of law. However, identification of pre-Accursian material within the *Magna Glossa* remains highly problematical, since the contributions of previous jurists who kept their initials intact are very few, whereas as a rule all the glosses present as having been realised by Accursius and frequently bear his initials (*ac.* or *acc.*), even when they are in fact the work of other authors.[22]

The term *apparatus* first began to be applied in the 12th century and, despite being used to mean slightly different things, for a long time largely kept its generic meaning as 'a group of glosses intended for educational use'.[23] Starting in the 13th century, such groups of glosses came to be regarded as complete works of a compilatory nature that were produced with an instructional objective in mind, and whose nature essentially lies in the fact that they are strictly linked to the interpreted material, since the individual glosses normally refer to a specific lemma in the text. A wider and more generic definition saw the apparatus regarded as a group of glosses distributed in a certain way along the margins of the manu-

19 Caprioli 1981, 418–419.

20 Astuti's essays in Astuti 1968 are of fundamental importance, as are those of Soetermeer in Soetermeer 1989.

21 It has been calculated that the glosses produced by Accursius number amount to 96,940, of which 17,814 are for the *Codex*. See Kantorowicz 1929, 43.

22 Accursius developed the *Magna Glossa* during the first forty years of the 13th century. However, the question concerning the genesis and chronological succession of the apparatus remains unanswered. Based on an investigation carried out on a few manuscripts from the *libri ordinarii*, the *Codex* and the *Digestum Vetus* (containing various critiques of the *glossa accursiana*), Soetermeer suggests the decade spanning 1220–1230 for the publication of the apparatus for the *Digesto Vecchio*, and the period stretching between 1227 and 1234 for the *Codex's* apparatus (Soetermeer 1989, 2879 and 2892).

23 Colli 1990, 232–233.

scripts so as to form a sort of continuous 'scaffolding', obtained by modelling the commentary in the form of a frame around the text.[24]

This characteristic—more physical than interpretive—reinstates to the term 'gloss' the exegetical function which traditionally was the preserve of jurists. Indeed, according to the jurists' lexicon, a gloss is a work of any kind which serves to provide an interpretation of the text, irrespective of its position on the page.[25] The distinction between interlinear and marginal texts is therefore purely material[26] and depends on the size of the support and the length of the commentary. Only when the latter has become sufficiently long so as to make it necessary to position it on the page according to certain rules and graphic devices can one speak of an apparatus or gloss apparatus.

2 The law book

The law book represents a rather peculiar and well-defined product, both from a structural perspective and in relation to its use, and the purpose it was intended to fulfil.

An indispensable work and study tool, the law book was shaped according to the needs of a culturally homogeneous and erudite readership composed of professionals, teachers and students, representing a category of technical intellectuals[27] who were the leading actors in the rebirth of legal studies which emerged between the 12th and 13th centuries.

Such books have a distinctive appearance which is related to the educational criteria of the time: they were books to be placed on book rests ('libri da banco'),[28] generally of large format, with the text arranged in two columns positioned towards the centre of the page so as leave space for ample margins to accommodate commentary written in a small hand, in accordance with a functional hierarchy which 'permet de différencier l'essentiel de l'accessoire, le général du particulier'.[29] A structured system of references and pointers made it easy to link passages in the main text to the annota-

24 In this connection, the 'hypertextual' aspect of the Accursian apparatus has been highlighted—an *ante litteram* hypertext which is 'characterised by its fragmentary and non-linear nature, and for the inseparable connection, including on the physical level, between *glossae* and the legal text' (Speciale 1994, 36–37).

25 Colli 1990, 233.

26 Fransen 1982, 134.

27 This is Petrucci's definition, Petrucci 1983, 499.

28 Petrucci 1969, 298.

29 Ornato 1994, 10.

tions, and both were positioned in such a way so as to be able to readily identify individual parts of the discourse thanks to the use of upper-case characters, pen-flourished initials in red and blue ink, sectioning of the text, and the paragraph sign (§), devices which also facilitated rapid consultation and memorisation. The impression of uniformity created by the Gothic script (typical of scholastic works), the use of a precise vocabulary and the adoption of a rather extensive system of abbreviations, which made it possible for an expert reader to complete the text 'in his head', all favoured the reading process.[30]

The uniformity of the product is also reflected in the ways in which it was executed and the manufacturing techniques employed; these were based on the *pecia* mechanism, a system upon which the new university publishing output was founded. The official models of the texts destined for teaching purposes—the *exemplaria*—were deposited at the workshops of the *stationarii liborum* and *peciarum* and were rented out as loose quires—the *peciae*, that is—at fixed rates, so as to permit rapid and simultaneous reproduction of the individual works.[31] The copying process represented just one of various operations necessary for the manufacture of a book, albeit the most time consuming and costly one.[32] In fact, the new techniques resulted in a clear division of the various work phases, based on the specific skills required of the workers, such as papermakers, *pergamenarii* (parchment makers), illuminators and rubicators, who, despite working in separate places, had a common connection with the book producing entrepreneur: the stationer, that is.

This model of the codex, which emerged in the university context between the 12th and 13th centuries, endured in the same environment for the entire 15th century and was also reproduced in incunabula, which imitated their structure, format, layout, text arrangement, system of references, script,[33] and the hierarchy decorative devices.

---

30 The structure of the reasoning had to be reflected in the structure of the book, based on the 'architecture' of the page, which corresponded not only to practical criteria, but was also a reflection of the new principles according to which human knowledge was defined and analysed itself, since 'the opportunity for further developments in the presentation of texts came as a result of the drive to reorganise inherited material in a new, systematic way, to make *auctoritates* not only accessible, but accessible in terms of new ways of thinking' (Parkes 1976, 117).

31 On the production mechanisms of the university book, only roughly outlined here, there exists an ample and detailed body of literature. The interested reader can refer to several fundamental works, including: Destrez 1935; Fink-Errera 1983; Pollard 1978; Bataillon et al. (eds) 1988; Soetermeer 1990 (now available in an Italian version, revised and expanded by the author, Soetermeer 1997); and Weeijers 1987.

32 Devoti 1994.

33 In fact, the use of Gothic characters turns out to be a distinguishing feature of the legal incunabulum (see Bozzolo et al. 1984, 212).

The aforesaid continuity, as part of a radical transformation of book production techniques, is a commonly accepted precept: at first glance there exists, in effect, a great deal of affinity between the pages of a 15th-century law incunabulum and those of a manuscript volume containing precisely the same text. However, one has to ask oneself whether, and how, the inevitable and actual changes which resulted from the shift from a manuscript production system to printing had an impact on certain mechanisms used to adjust the text to the glosses; and whether the way in which the two text masses were arranged, with respect to the links that unite them, answers to the same functional and aesthetic needs, and if, as a result, the criteria applied for the exploitation and utilisation of the written area changed. Finally, with respect to proportions and regularity, one has to pose the following question: to which basic principles did all the written and non-written elements of a manuscript page and those of a printed volume conform?[34]

More than once in the past, the book production system based on the *pecia* mechanism has been defined as industrial[35]—albeit in a primitive way. The *exemplaria* of the text and gloss circulated separately and as loose quires. This ensured the simultaneous reproduction of multiple copies of one and the same text, since a scribe would rent one *pecia* at a time, thereby making it possible for the other scribes to work from the remaining 'pieces'. Whether the writing of the text and apparatus were executed simultaneously, or alternatively carried out at different times, the serial reproduction process, articulated by the 'rhythms' created by the *pecia*, should not, in theory, have altered the manual copying operation, which generally conformed to the natural sequence of the writing and the reading. However, a few exceptions were possible, when, for example, gaps in the rental or transcription of the quires occurred with respect to their position in the *exemplar*, a circumstance which would have constrained the scribe to align the 'composition' of the text according to the material unit upon which he was working, which did not necessary coincide with that of the circulating model.[36]

34 The dynamic of the relationship between the manuscript volume and the printed book, and between continuity and innovation, has been thoroughly addressed by Ornato 1985, and Ornato 1994, 18–31; see also Bozzolo et al. 1987, 121–133, concerning the *mise en page* of manuscripts and incunabula in Latin and French produced in France in the 15th century.

35 One is not entirely in agreement with the use of this term, since it envisages a series of factors, such as the relationship between capital investment and productivity levels, which in reality are characteristic only of the printed book.

36 A *pecia* is in fact equivalent to half a *quaternus*, whilst in Italy, for example, the prevailing quire configuration in law books was the quinion (see Busonero 1999, 74–75 [in this volume, 205–307]).

An eventuality that could sometimes occur in a manuscript—the non-sequential execution of pages—becomes the rule in the printed book, at least from about 1473 onwards, when the introduction of the double-page press made it possible to print two or more pages adjacent to each other on one sheet.[37] This procedure, if on the one hand favoured printing productivity, on the other made typographic composition more difficult, thanks to an increase in problems arising with respect to the calibration of the text mass within the quires.[38] The mechanisms used for the segmentation and arrangement of a written message naturally require the calculation of other factors, such as the size of the volume, the amount of the support to be utilised, and the division of the latter into constituent parts for the realisation of the work. The surface of the support must then be made ready to accommodate the text by delimiting spaces which are then subdivided into a certain number of lines, based on the number, size and type of characters and graphic devices to be employed.

The clear definition and management of all the aforementioned procedures represent essential steps, both in the preparation of manuscripts and of printed books, even if the rules that govern their combination and execution can differ.

It will therefore be interesting to investigate whether and how the choices and solutions adopted in the two different production contexts diverge or coincide in relation to the phenomena that we aim to address, and for which, as far as possible, we shall also try to provide an interpretation.

3 The corpus of manuscripts and incunabula

Given that one of the goals of this research was to analyse the text/gloss relationship based on the different ways employed to adapt one to the other on the page, the main criterion employed for selecting manuscript and printed books was the presence of an uninterrupted apparatus of glosses: in other words, an 'oeuvre littérairement achevée due à un auteur, connu o non, et qui forme un tout [...], un ensemble voulu et conçu comme tel, qui est recopié pour lui-même'.[39] In fact, many manuscripts, despite being constructed in comformity with the classical canon—which is to say with the legal text positioned in the centre of the page and surrounded by generous margins intended to accommodate the commentary—contain occasional

37 Febvre / Martin 1985, 71; Coq / Ornato 1987, 92.

38 Concerning the numerous issues relating to the introduction of this new technique and the working practices adopted by 15th-century printers, see Ornato 1994, 20–21 and 28–29; and Coq / Ornato 1987, 90–93.

39 Fransen 1982, 137.

or sporadic glosses, distributed around the external frame or in between lines. In such cases, it is clear that the annotations are not systematic in nature and can easily be positioned in any area close to the passage to be interpreted, without any great effort being made to coordinate the two pieces of text, since the space available on the page was larger than it needed to be.

The first phase of the research therefore consisted in conducting a census of the manuscripts containing the annotated *Codex Justinianus* with gloss. A subsequent step consisted in selecting the codices in which the gloss apparatus matched the characteristics mentioned above—in other words, those in which it was stable and continuous. With this objective in mind, Gero Dolezalek's[40] catalogue was utilised—a resource that represents an invaluable tool, as it includes all the manuscripts of the works of Roman law that have come down to us starting from the earliest times up until 1600. Dolezalek, in describing the surviving witnesses, flagged up the presence or absence of glosses, apparatuses and *additiones* (i.e. the glosses of new jurists added to an ordinary apparatus), specifying the author or authors by name or by means of their initials. The information reported by Dolezalek derives only in part from an autoptic investigation, whilst in the majority of cases it is the fruit of perusals of library catalogues and of an ample bibliography relating to the subject.

This approach entailed a twofold selection of material useful for the investigation, since from the original, theoretical, sample, constructed on the basis of the information furnished by Dolezalek, it was necessary to eliminate a certain number of manuscripts whose characteristics did not correspond to the indications given in the catalogue, and therefore were devoid of some of the parameters necessary for the investigation.

The manuscripts of the *Codex* of Justinian listed by Dolezalek total 302. Based on a preliminary count, 190 turned out to be suitable for the investigation, whilst 86 had to be eliminated, since they lacked an apparatus or were equipped with only marginal glosses. Moreover, 26 appeared to be doubtful. Of the 68 manuscripts theoretically present in the libraries of the centres included in the investigation—Vatican City, Rome, Paris, Florence and Bologna[41]—it was necessary to eliminate 27, because they lacked an uninterrupted apparatus. Hence, a total of 41 manuscripts

40 Dolezalek 1972.

41 Manuscript 286 of the Biblioteca del Collegio di Spagna in Bologna was replaced with manuscript E.I.2 of Turin's Biblioteca Nazionale, since I was not granted permission to access the Bolognese library.

was arrived at, equating to 25.15% of the suitable candidates, which at this point had dwindled to 163.[42] In all cases, the gloss was that of Accursius.[43]

The selection of incunabula proved to be less problematical. In order to carry out a preliminary analysis of the phenomena under investigation, with the objective of comparing manuscript volumes with printed books, it was considered sufficient to work with a limited number of witnesses. Therefore, a total of five incunabula were examined. The sources used to locate these were vol. VII of the *Gesamtkatalog* and vol. VIII of the *Indice generale degli incunaboli delle biblioteche dl'Italia*. Given that no specific preconditions were required—other than that a continuous apparatus must be present, and that the volume should not be a reprint of an earlier edition[44]—volumes were selected based on their greater degree of availability.[45]

42 This percentage is probably too low, given that one cannot be certain that the 122 codices, which are theoretically suitable, but which have not been scrutinised, are endowed with all the characteristics considered necessary for carrying out this kind of research.

43 The following codices were used: Città del Vaticano, Biblioteca Apostolica Vaticana, Barb. lat. 1462, Borg. lat. 224, Borg. lat. 372, Pal. lat. 757, Pal. lat. 758, Pal. lat. 759, Pal. lat. 760, Pal. lat. 762, Reg. lat. 1120, Ross. lat. 582, Urb. lat. 165, Vat. lat. 1428, Vat. lat. 1429, Vat. lat. 1430, Vat. lat. 11598; Florence, Biblioteca Medicea Laurenziana, Edili 68, Santa Croce Plut. 6 sin. 4, Santa Croce Plut. 6 sin. 5; Paris, Bibliothèque de l'Arsenal, 689; Bibliothèque nationale de France, Par. lat. 4521 A, Par. lat. 4521 B, Par. lat. 4521 C, Par. lat. 4522, Par. lat. 4523, Par. lat. 4524, Par. lat. 4526, Par. lat. 4527, Par. lat. 4530, Par. lat. 4531, Par. lat. 4532, Par. lat. 4535, Par. lat. 8940, Par. lat. 8941, Par. lat. 14342, Par. lat. 16912, Par. lat. 16913, Par. lat. 16914; Rome, Archivio di Stato, S.S. Salvatore 999; Biblioteca Casanatense 230; Biblioteca Vallicelliana, A 12; Turin, Biblioteca Nazionale, E.I.2. For further information, in addition to the already cited study by Dolezalek, see also Avril / Gousset 1984; Dolezalek 1985; Dolezalek 1972; Rota 1935; Soetermeer 1990, and Soetermeer 1997; Speciale 1994.

44 Here, the term 'reprint' means the identical re-publication, typographically speaking, of a work. The recomposition of a text in this way entails maintaining the original *mise en page*, which ensures that the original arrangement does not end up being lost from the model text.

45 The following incunabula were used: Venezia 4, VIII 1482, Andrea Torresano (Città del Vaticano, Biblioteca Apostolica Vaticana, Prop. II, 209); Norimberga, 30 I 1488, Anton Koberger (Roma, Biblioteca Casanatense, 912; Venezia 8, XII 1488, Battista de Tortis (Roma, Biblioteca Nazionale Centrale Vittorio Emanuele II, 70.3.G.2.V); Venezia, 3 X 1489, Andrea Torresano (Roma, Biblioteca Corsiniana 50.G.12); Venezia, 10 I 1493/94, Battista de Tortis (Città del Vaticano, Biblioteca Apostolica Vaticana, Prop. II, 213). In the last thirty years of the 15th century, Venice represented the most important European location for the production of law books: indeed, in the period spanning 1481 to 1490, the city generated 44% of juridical texts dating from before 1400 (especially Roman law), and in the following decade the percentage reaches 63% (see Coq / Ornato 1988, 314–319). On the first legal incunabula produced in Venice, see Lowry 1991, 137–172 (the chapter titled *The Lawyers and the Friars*). As regards the *Codex Justinianus* in the 29 incunabula present in Volume VII of the *Gesamtkatalog*, 17 were printed in Venice. None of the incunabula relative to the cornerstone works in the *Codex Iuris Civilis* and listed in the *Gesamtkatalog* was produced in Bologna, which suggests that the city was still a rather small marketplace for the printed book, a hypothesis which is reinforced by Curt Bühler's view that there was robust activity in the

The overall chronological distribution of the manuscripts sample and the chronological division within the two most represented centuries is summarised in pie Charts 1–3. Table 1 contains information on the format,[46] size[47] and proportions[48] of all the volumes.

Average size and proportion of codices and incunabula tab. 1

	Codices	Incunabula
H (mm)	428.44	426.11
W (mm)	262.91	263.81
W + H (mm)	691.35	689.22
W/H	0.615	0.620

Tab. 1: Average size and proportion of codices and incunabula

15th century for the commercial production of manuscripts connected with the university. See Bühler 1958, 18–19, 27, and also Sorbelli 1929, 1–75, and Balsamo 1988).

46 In this case, the term 'format' is used to mean the '*dimensions du volume in hauteur et en largeur*', Muzerelle 1985 (also in the revised and expanded Italian version, Maniaci 1996 [1998²], 127). Concerning the different definitions of the term, see Lemaire 1989, 34–36.

47 Here, the term 'size' is used to mean the sum of the height and width (H+L = H+W) of a volume, which corresponds to the semi-perimeter, see Bozzolo / Ornato 1980, 217. On the subject of manuscript dimensions, in medieval catalogues reference is made to the *forma parva* (ranging from 235 mm × 173 mm to 190 mm to 135 mm), *mediocris* (ranging from 380mm x 250mm to 245mm to 165mm) and *magna* (ranging from 600 mm × 390 mm to 435 mm to 305 mm), Pizzo 1973, 47–48. These measurements roughly correspond to the divisions used by Carla Bozzolo and Ezio Ornato in their study of the dimensions of sheets in French medieval manuscripts, where manuscripts measuring under 320mm are defined as *petits*, those ranging from 321 mm to 490 mm in size are termed *petit-moyens*, and those measuring more than 670 mm *moyen-grands*; (Bozzolo / Ornato 1980). The relationship between the dimensions of a manuscript and the writing material has recently been addressed by Gumbert 1993, 227–263.

48 The proportion of a volume is expressed through the relationship between its width and height (L/H = W/H). One speaks of an invariable proportion when the 'proportion d'un rectangle dont le rapport du petit côté est égal à $1/\sqrt{2}$, et qui a pour propriète de donner deux moités conservant cette même proportion lorsqu'on divise en deux le grand côté', Muzerelle 1985, 101 (Maniaci 1996 [1998²], 144). In practice, the proportion $1/\sqrt{2}$ (i.e. 0.707) is the only one which has the characteristic of remaining the same when successive symmetrical folds of a sheet are made. Accordingly, one defines as 'étroite une proportion inférieure à la proportion invariante; large une proportion supérieure à la proportion invariante', (Bozzolo / Ornato 1980, 219).

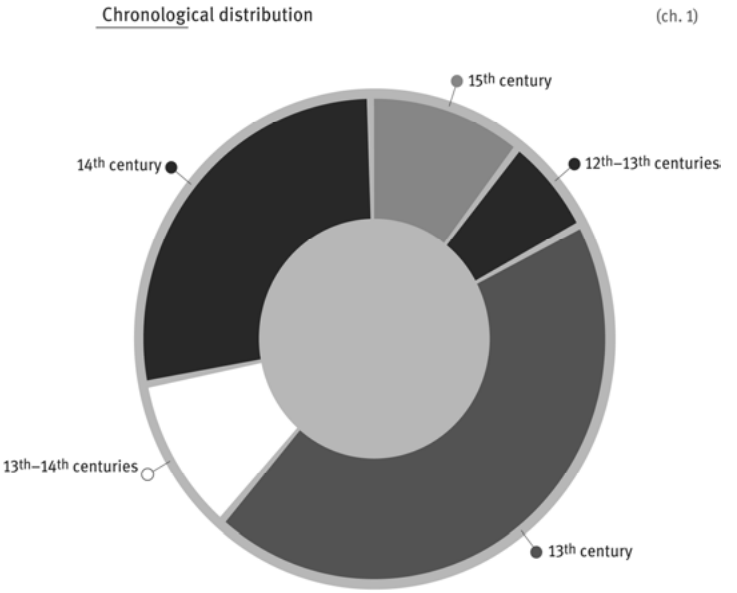


Chart 1: Chronological distribution

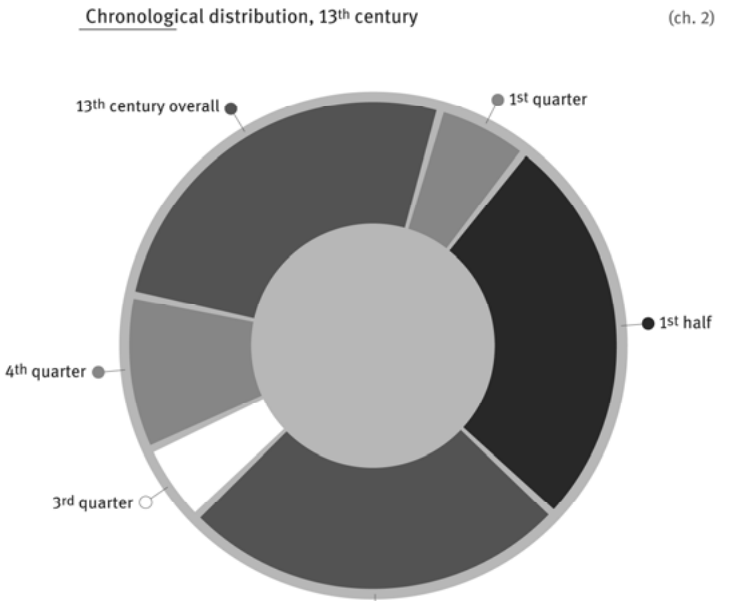


Chart 2: Chronological distribution, 13th century

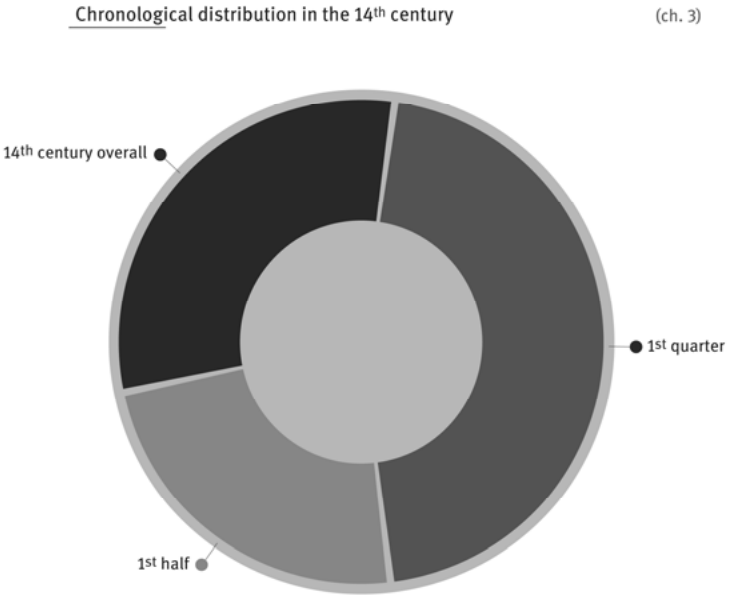


Chart 3: Chronological distribution in the 14th century

4 The *mise en page*

The study of the *mise en page*, which is to say the 'disposition générale des différents éléments figurants sur une page',[49] was carried out by identifying 17 sectors on the surface of the page which correspond to the areas occupied by the text, gloss and unfilled space. The said areas are represented by the two columns of text (Fig. 1); the six branches of the apparatus (Fig. 2); the four margins (upper, lower, inner and outer, Fig. 3); the intercolumnar space (Fig 4); and the four sides of the 'moat', which is to say the internal 'corridor' that separates the two columns of text from the branches containing the glosses (Fig. 5).

49 Muzerelle 1985, 109 (Maniaci 1996 [1998^2], 159).

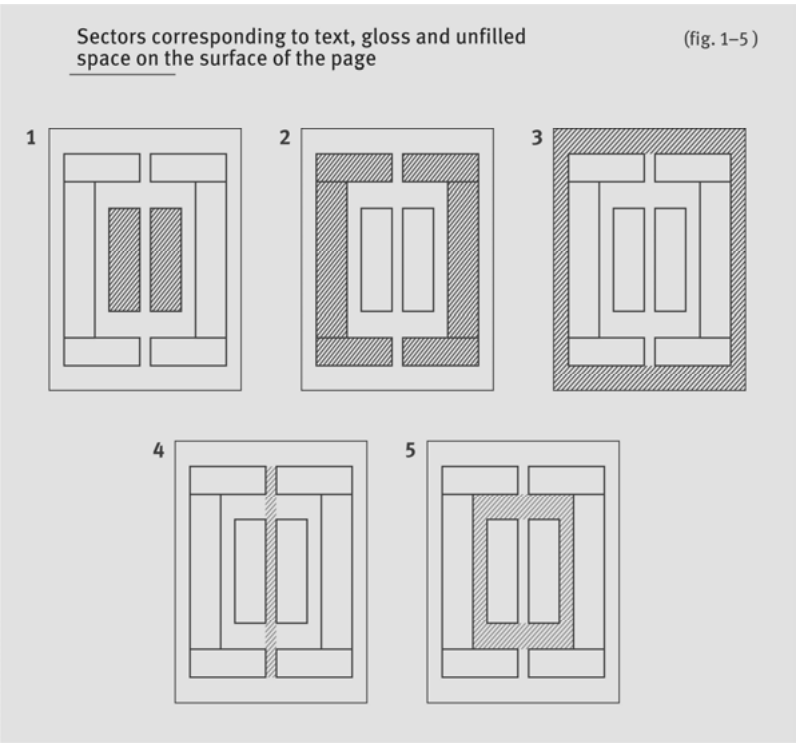


Fig. 1–5: Sectors corresponding to text, gloss and unfilled space on the surface of the page

The sizes of these spaces are arrived at by combining 16 linear, 9 horizontal and 7 vertical measurements, taken as shown in the schema on page 528.

The horizontal measurements were carried out by starting consistently at the outer margin and working from left to right on the *verso* of leaves, and from right to left on the *recto*. Conversely, the vertical measurements were obtained by working from the top towards the bottom, and therefore from the upper margin towards the lower margin of each leaf.

The nine horizontal measurements, indicated by a cardinal number, correspond to the following segments:

Verso of leaves

1 = The distance between the boundary of the outside margin and branch B/column *a* of the gloss.
2 = The width of branch B/column *a* of the gloss.

3 = The distance between branch B/column *a* of the gloss and column *a* of the text.
4 = The width of column *a* of the text.
5 = The distance between column *a* and column *b* of the text.
6 = The width of column *b* of the text.
7 = The distance between column *b* of the text and branch B/column *b* of the gloss.
8 = The width of branch B/column *b* of the gloss.
9 = The distance between branch B/column *b* of the gloss and the boundary of the inner margin.

Recto of leaves

1 = The distance between the boundary of the outside margin and branch B/column *b* of the gloss.
2 = The width of branch B/column *b* of the gloss.
3 = The distance between branch B/column *b* of the gloss and column *b* of the text.
4 = The width of column *b* of the text.
5 = The distance between column *b* and column *a* of the text.
6 = The width of column *a* of the text.
7 = The distance between column *a* of the text and branch B/column *a* of the gloss.
8 = The width of branch B/column *b* of the gloss.
9 = The distance between branch B/column *a* of the gloss and the boundary of the inner margin.

The measurement of the vertical axis of the page was carried out only once on either column *a* or column *b*, which for branches A and C of the gloss exhibited a greater number of lines, and therefore a larger measurement. The seven vertical measurements, indicated by a Roman numeral, correspond to the following segments:

I = The distance between the boundary of the upper margin and branch A of the gloss.
II = The height of branch A of the gloss.
III = The distance between branch A of the gloss and the column of text.
IV = The height of the column of text.
V = The distance between the column of text and branch C of the gloss.
VI = The height of branch C of the gloss.
VII = The distance between branch C of the gloss and the boundary of the lower margin.

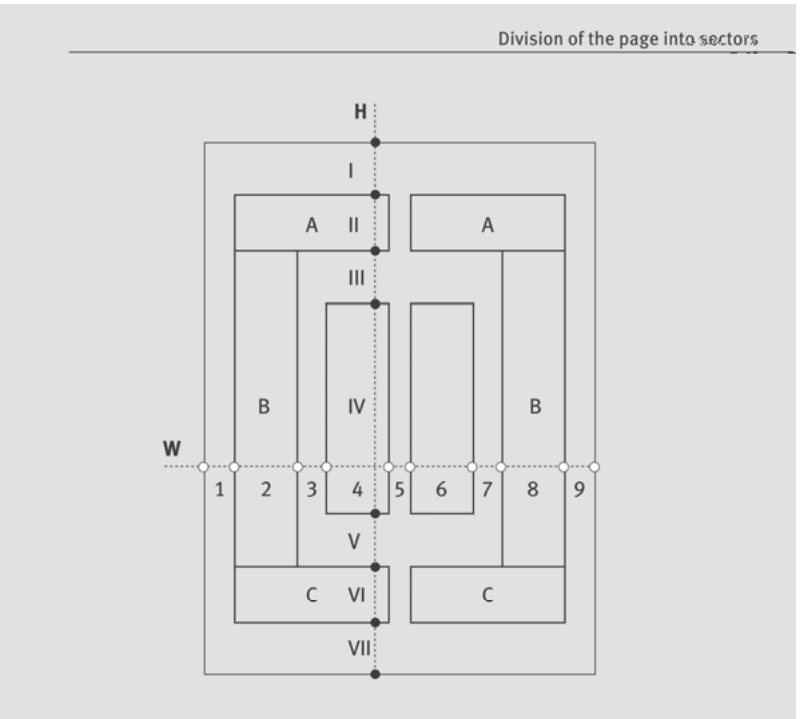


Fig. 1–5B: Division of the page into sectors

5 The hierarchy of dimensions and their interconnection

The investigation of the 'architecture' of the page based on the arrangement and structuring of the elements described above necessitated an important preliminary operation that consisted in the standardisation of data.

To 'standardise' means to render the values of the individual segments which make up a page—whether they be horizontal or vertical—independent from the (variable) dimensions of volumes. Books, in fact, follow a proportionality criterion based upon which all the constituent components of the written page are—largely

speaking[50]—positively correlated to the dimensions of the volume. Essentially, this governing principle caters to aesthetic needs, the goal being to balance exigencies with respect to the transmission of a message with the potential—and limits—of the material support destined to accommodate it.

To fulfil this goal, the average and standard deviation[51] of each horizontal and vertical segment in each manuscript and incunabulum were calculated. Next, the average was subtracted from the value of each segment and the result divided by the standard deviation. In this way, the individual values can be centred with respect to the average and reduced with respect to the standard deviation.

In Charts 4 and 5, which present the standardised values of the horizontal and vertical volumes (i.e fields) of the page, the values turn out to be positive and negative in relation to the average, which corresponds to a value of 0, and are therefore an expression of the greater or lesser reach of each individual segment with respect to the average.

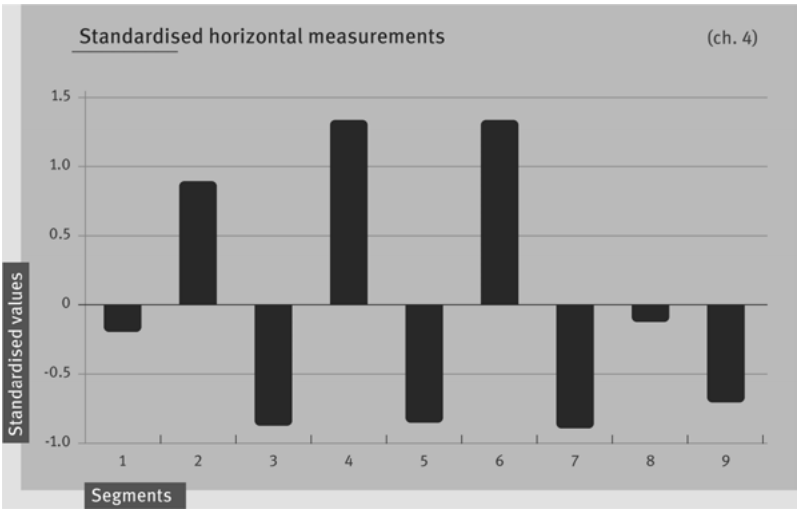


Chart 4: Standardised horizontal measurements

50 One cannot exclude some exceptions to this rule, since 'l'artisan pouvait prendre un certain nombre de libertés par rapport à ce principe, pourvu qu'elles demeurent noyées dans l'aspect d'ensemble de la page écrite' (Ornato 1994, 10, No. 11).

51 The standard deviation (σ) represents, within a distribution, the square root of the arithmetic mean of the square distances between each value and the mean value; in other words, the square root of the variance; see also footnote 54.

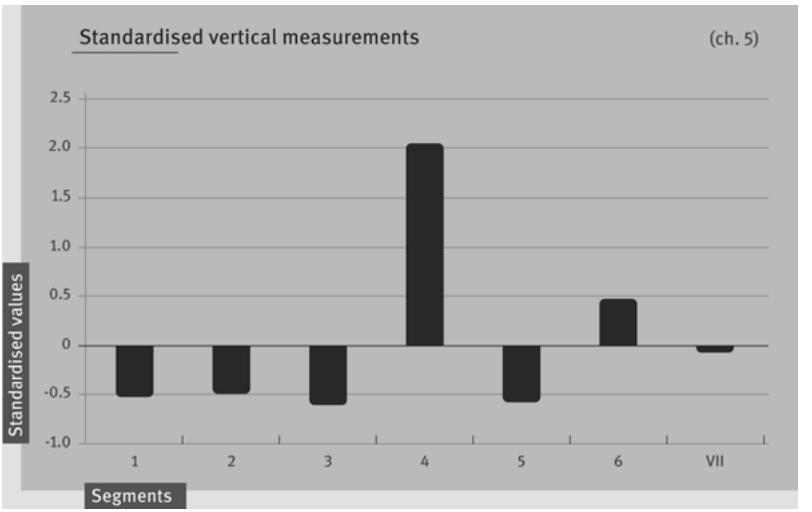


Chart 5: Standardised vertical measurements

As regards the horizontal area of the page, segments 3/5/7, which correspond to the intercolumnar space and the 'moat' that separates the text zone from the gloss zone, appear to be very similar in size. Segments 4/6, which correspond to the two columns of text are equal in size, and, proportionally, the largest. Segments 2/6 are dissimilar; these correspond to the two lateral branches of the annotated area, that is to say zone B of the gloss–segment 2 tends to be decidedly larger than its mirrored counterpart, segment 8. The values for segments 1/9, which correspond to the margins, are negative, with the inner margin showing a lower value.

Now we come to the standardised vertical measurements: the upper margin and the first branch of the gloss, which is to say segments I/II, are equal, as is also the case with segments III/V, which correspond to the 'moat'. The most expansive area is, once again, that which corresponds to the column of text, segment IV, whereas the relatively large difference between segments VI/VII should be noted, along with the even greater disparity between segments II/VI, which correspond to the upper and lower branches of the gloss.

These preliminary data already reveal, with considerable clarity, a characteristic uniformity, both vertically and horizontally, with respect to the central area of the page, framed by the branches of the apparatus and incorporating the 'moat', the two columns of text and the intercolumnar space.

The two lateral margin areas prove to be rather less uniform, and therefore further comparison of the standardised averages of the individual segments is called for. If one adds up the values of segments 1/2/3 and those of segments 7/8/9, an average value of -0.16 to -1.68 is obtained. Given that, as we have already seen, segments 3/7 are broadly speaking equal (the difference between the two is just 0.019), the discordance in their reach is caused in the first place by the two lateral branches of the gloss, and secondly by the corresponding margin. Indeed, segment 2 always proves to be larger than segment 8 (difference segm. 2 - segm. 8 = 1), and likewise, but to a lesser degree, segment 1 turns out to be larger than segment 9 (difference segm. 1 - segm. 9 = 0.49).

The two lateral vertical margin areas exhibit similar discordances. If one adds up the standardised values of segments I/II/III and those of segments V/VI/VII, an average value of -1.71 to -0.31 is obtained, and since segments III/V are almost equal (difference segm. III - segm. V = 0.017), the differences between the volumes have to be sought in segments I/II and VI/VII. Segment VI always turns out to be larger than segment II (difference segm. VI - segm. II = 0.94), and similarly, segment VII is larger than segment I (difference segm. VII - segm. I = 0.44).

At this point in the investigation it is interesting to note the type of correlation[52] that exists between the horizontal and vertical segments of the page (see Tab. 2 and 3).

If one examines Table 2, which presents the standardised horizontal measurements of the page, a clear correlation between segments 4/6, the two text columns, segments 3/5/7, the lateral branches of the 'moat' and the intercolumnar space, segments 2/8, the lateral branches of the gloss, segments 1/9, and the inner and outer margins of the page becomes quite obvious.

Conversely, a negative correlation can be identified between segments 2/8 and 4/6, the two lateral branches of the gloss and the text columns, which demonstrates that as the size of the text increases, the corresponding lateral gloss decreases in size, leaving the dimensions of the 'moat' unchanged.

52 A statistical correlation function makes it possible to express the link between two variables, which is to say whether when one increases the other decreases, or vice versa, or if they increase or decrease in tandem. If the result is 0, there is no correlation, whereas a value that approaches +1 or -1 indicates the presence of a positive or negative correlation.

Correlation between the horizontal segments of the page (tab. 2)

	1	2	3	4	5	6	7	8	9
1	1.000								
2	-0.588	1.000							
3	-0.541	-0.041	1.000						
4	0.229	-0.846	0.224	1.000					
5	-0.604	0.046	0.871	0.141	1.000				
6	0.242	-0.858	0.249	0.974	0.154	1.000			
7	-0.483	-0.120	0.971	0.277	0.853	0.297	1.000		
8	-0.359	0.652	-0.395	-0.642	-0.305	-0.701	-0.453	1.000	
9	-0.620	-0.687	-0.261	0.382	-0.281	0.446	-0.171	-0.690	1.000

Correlation between the vertical segments of the page (tab. 3)

	I	II	III	IV	V	VI	VII
I	1.000						
II	-0.005	1.000					
III	-0.0 58	0.358	1.000				
IV	0.326	0.573	0.578	1.000			
V	-0.120	0.325	0.905	0.578	1.000		
VI	-0.377	-0.433	-0.271	-0.880	-0.277	1.000	
VII	0.094	-0.265	-0.539	0.072	-0.501	-0.500	1.000

Tab. 2–3: Correlation between the horizontal / vertical segments of the page

Concerning the vertical volumes, the degree of correlation between the individual segments appears to be less systematic (Tab. 3). There is a positive relationship between segments III/V and the upper and lower branches of the 'moat', which provides further evidence of the geometric uniformity reserved for this area of the page. The relationship between these two branches of the 'moat', the two text columns, and segments III/IV/V is on average positive, whereas there is a negative correlation between the last three vertical columns of the page, which correspond to segments V/VI/VII, in contrast to the upper area, represented by segments I/II/III, between which there is no correlation.

Based on these preliminary observations, some fundamental trends can be observed vis-à-vis the 'construction' of the page.

Within a space that is generally oblong in form, the width measurements, which are lower than the height measurements, tend to 'discipline' the volumes in a lateral direction. Conversely, the volumes have more opportunity to grow in a vertical direction.

The most uniform zone, namely that where the size of the volumes and the relationships between them is clearly more stable, extends from segment 3 to segment 7, and from segment III to segment V, and therefore includes the 'moat', the intercolumnar space and the two text columns. Additionally, the same area proves to be somewhat shifted towards the inner margin, and rather more obviously shifted towards the upper margin of the page.

In the outer zone of the page, in a horizontal direction, we find the two lateral branches of the gloss and the inner and outer margins, which despite being decidedly more variable and generally non-uniform (segments 1+2+3 > segments 7+8+9), always maintain a close relationship both between themselves and with the inner horizontal volumes. The horizontal exploitation of the page therefore exhibits an established and systematic trend, and the 'architecture' of the internal volumes of the same space follows a 'rhythm' which gradually becomes more regular and constant as one progresses towards the inner portion of the page.

Conversely, the construction of the page in the vertical direction reflects a different strategy. The stable central nucleus is bounded by two areas (upper and lower) which the rectangular form renders more easy to exploit in terms of space, and which as a consequence are articulated in a looser and less systematic way. This pattern can be observed particularly in the lower portion of the page, because for technical and aesthetic reasons intrinsic to the manufacture of the medieval codex, the upper margin does not extend beyond a certain limit and is in any event generally narrower than the lower margin.[53]

As we have seen, no correlation exists between segments I/II, nor between them and the corresponding lower volumes, segments VI/VII, whereas there is a correlation, albeit negative, between segments V/VII. In addition, the sum of segments I/II is always lower than that of segments V/II. There is no significant degree of correlation between these vertical marginal and outer segments and the inner volumes, with the exception of the negative relationship that exists between seg-

53 The possible geometric procedures used in constructing the *mise en page* in the context of the medieval manuscript and printed book have been addressed by various authors, among whom should be mentioned: Bühler 1946; Tschichold 1965; Tristano 1991; Montecchi 1994; Maniaci 1995.

ments III/V and segment VII (and this is due to the fact that whilst the 'moat' is largely speaking stable, the lower margin, as we shall see more clearly later on, exhibits a high degree of variability), and the consistently negative relationship between segments IV/VI.

The geometric strategy adopted for the page in a vertical direction is therefore much more elaborate in comparison to the horizontal one: indeed, the relationship between the individual volumes is a lot less systematic owing to a rather low interdependence. Significant exceptions are seen in the positive correlation between the central segments, II/IV/V, and the inversely proportional mechanism which governs the relationship between the size of the final branch of the gloss and that of the lower margin, segments VI/VII, and the relationship between the same segments with the text column, segment IV: it is here, in fact, that the interplay between the various volumes becomes most apparent.

5.1 Variability

Even if it has been possible to express the observed phenomenon through the average standardised measurements, based on the premise that within the internal area of the page the different volumes register values that are almost constant in the various cases considered, it was also necessary to further process the data in order to obtain indicators that represent the different quantitative modalities taken on by all the segments, and hence their variability, both within one and the same manuscript or incunabulum and across the overall corpus of manuscripts and incunabula.

In the first case, an index of relative variability was applied (known as the coefficient of variation),[54] by means of which the variability of the vertical and horizontal segments within each unit can be expressed, and therefore the strat-

54 The coefficient of variation (CV) is expressed by the formula σ/average*100, where σ represents the standard deviation, which is an index of absolute variability; in other words, it is an index expressed in the same unit of measurement as the terms of a distribution. Given that σ is frequently correlated to the average (in fact, it is normal that within one and the same reference point—such as the page of a manuscript—the largest spaces are affected by more noticable variations), in order to express the variability of each segment of a page within each manuscript and incunabulum and to eliminate the dimensional effect, an index of relative variability is applied, namely CV. The use of variable relativity indices becomes necessary when distribution patterns are expressed in different units of measurement, or when such patterns are expressed in the same unit of measurement, but the average intensities (that is to say the range of the values examined) are different (as in our case), or when the distributions compared are composed of relationships.

egy adopted in each instance—one could even say leaf-by-leaf—for each volume in one and the same manuscript or incunabulum. Accordingly, from hereon in we shall be referring to *intra codicem* variability.

On the other hand, in the second case, in order to express the variability of each segment within all the manuscripts and incunabula, the standard deviation (which represents an absolute index of variability)[55] of the standardised average measurements was calculated (s). This makes it possible to observe the phenomenon in a transverse direction, so as to focus attention on how the choices made by the different artisans varied. Accordingly, from hereon in we shall be referring to *inter codices* variability.

If one studies Chart 6, which relates to the total horizontal *intra codicem* variability measurements, one can see that the inconstancy turns out to be at its maximum along the outer margins, and then gradually decreases, although not with equal intensity, between the inner and outer zones, as one progresses towards the centre.

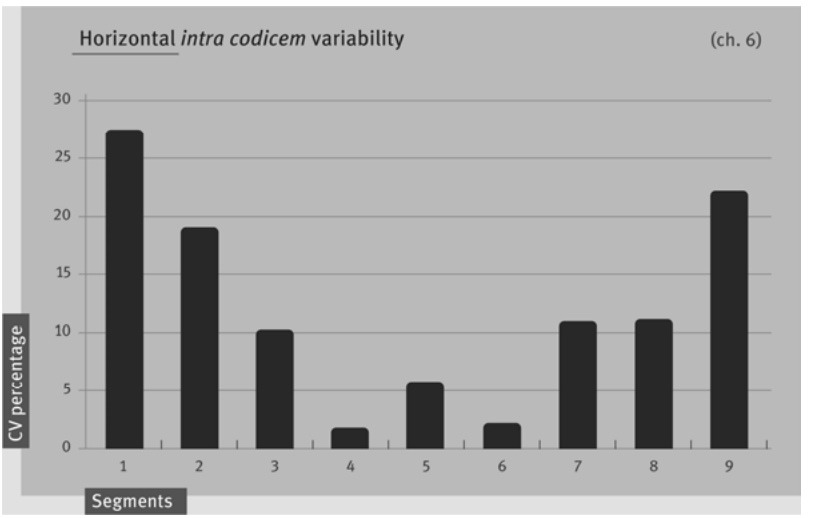


Chart 6: Horizontal *intra codicem* variability

55 In the standardised data, the average is 0. In such cases, there is no correlation between the variation and the average. Furthermore, division by 0, which is necessary to obtain the CV, is impossible.

Concerning the two lateral branches of the gloss—segments 2/8—once again it is the outer one which is most variable, whilst the central nucleus, composed of segments 3/4/5/6/7, remains essentially uniform and exhibits a decidedly low variability index, especially with respect to the two text columns.

As regards the vertical *intra codicem* variability total (Chart 7), this shows values that are clearly much higher than those seen in the horizontal segments, as can readily be gleaned from the much higher levels marked on the scale. Plain to see is the irregularity of the lower margin, segment VII, in comparison to the upper part of the page, composed of segments I/II/III. Likewise, the text column proves to be rather variable.

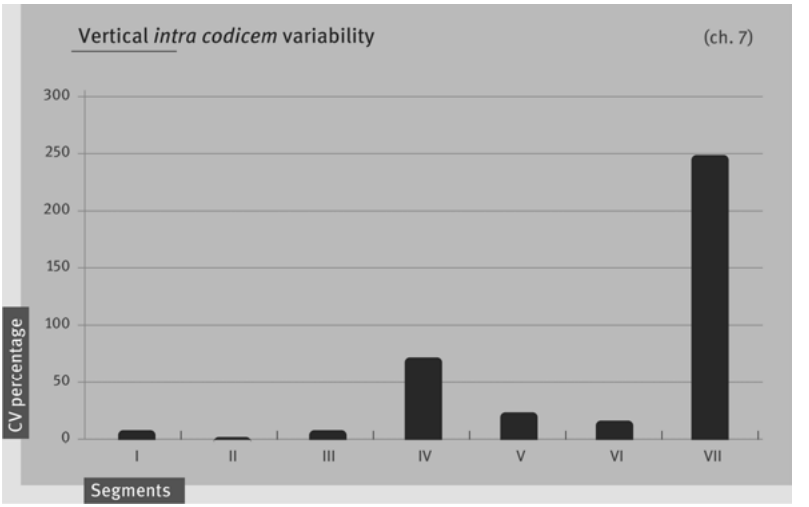


Chart 7: Vertical *intra codicem* variability

Within the overall corpus, for the horizontal zones (see Chart 8, which relates to total *inter codices* variability) a strategy aimed at better structuring the area that frames the central nucleus, composed of segments 1/2/8/9, manifests itself. This is especially apparent in segments 1/2, and slightly less so in the text column, represented by segment 4.

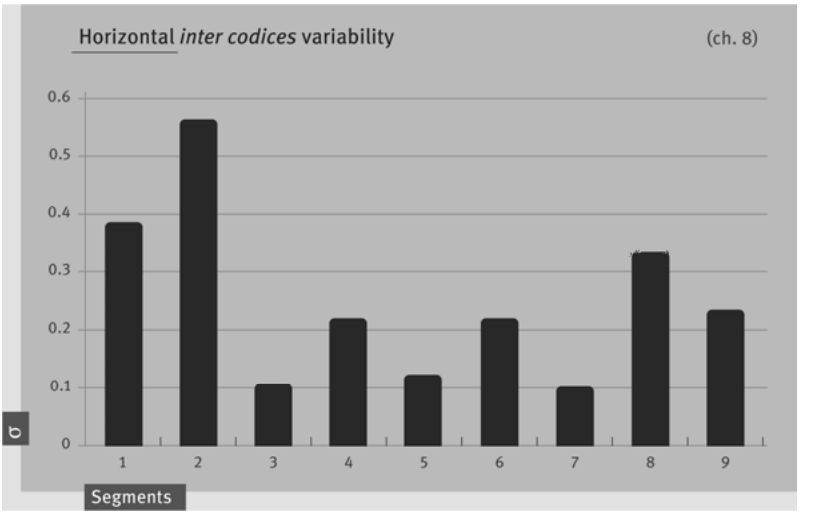


Chart 8: Horizontal *inter codices* variability

As for the vertical *inter codices* variability total (see Chart 9), the final branch of the gloss and the lower margin represent the volumes (segments IV/VII) that differ the most, the disparity being the result of a steady and continuous adjustment of one volume in relation to the other.

If one distinguishes between the manuscripts and the incunabula, the different strategies employed in the construction of the page become even more significant.

Chart 10, which relates to the horizontal *intra codicem* variability total, shows that the levels of variability in the incunabula are clearly lower than those of the manuscripts.

In any event, alongside a very uniformly structured central nucleus in the incunabula, and only slightly less so in the manuscripts, the two outer and marginal areas differentiate themselves in both book typologies owing to their far more articulated structures, even if they present some differences. The two lateral glosses of the incunabulum, segments 2/8, which are almost identical, remain unchanged in comparison to the two blank 'corridors' they frame, segments 1/3 and 7/9, which present more obvious variations. Conversely, in the manuscript, one can once again make out the variability in the lateral zone, particularly in the outer area.

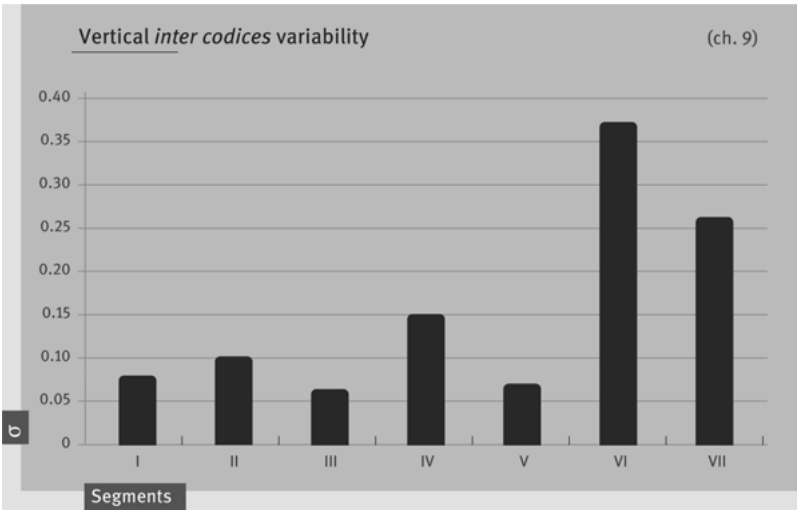


Chart 9: Vertical *inter codices* variability

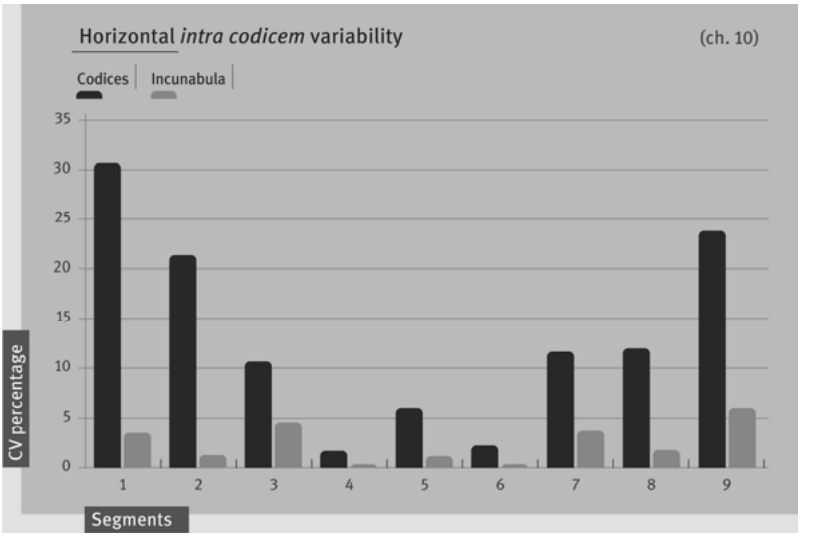


Chart 10: Horizontal *intra codicem* variability

As for the vertical volumes (see Chart 11, which relates to vertical *intra codicem* variability), in the incunabulum, the text column, segment IV, exhibits the maximum degree of variability, whereas in the manuscript the greatest degree of irregularity is seen in the lower margin.

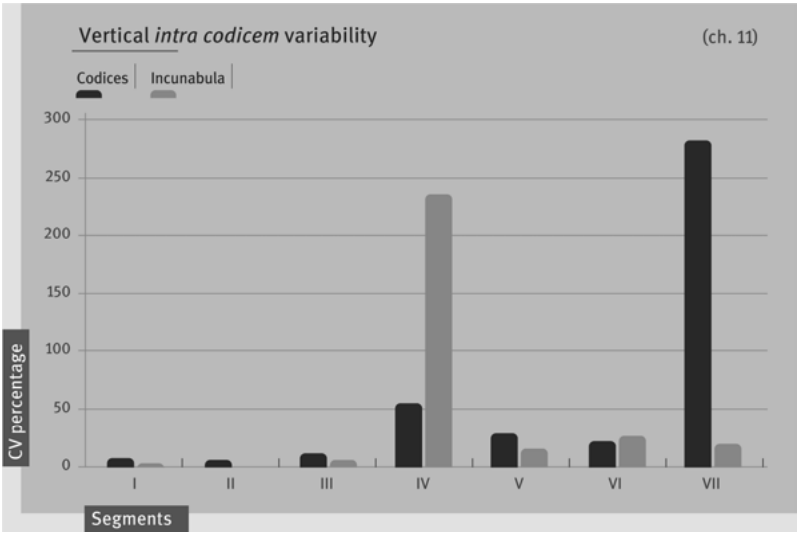


Chart 11: Vertical *intra codicem* variability

Moving on to the horizontal and vertical *inter codices* variability (Charts 12 and 13), in the first case, next to a uniform central nucleus, albeit one which is slightly more variable in the incunabula, we once again observe an outer marginal zone which is decidedly more articulated in appearance. In the case of the vertical measurements, maximum irregularity is seen in the lower volumes, represented by segments VI/VII.

A page construction strategy aimed at assuring maximum rigor in the central nucleus and more flexibility in the outer and marginal areas was adopted for the manuscript. Corresponding to an inner stability, one observes an outer irregularity which manifests itself in different ways and to varying degrees. Segments 1/2/VI/VII, which correspond to the outer and lower margins and the outer and lower branch of the apparatus, represent the volumes that were subject to the most adjustments—spaces which could be reshaped with greater liberty, and therefore linked, as we have seen, to an inversely proportional relationship. A lower degree of flexibility was reserved for the treatment of the mirroring volumes, segments I/II/8/9, which are generally of smaller size and tend to vary less.

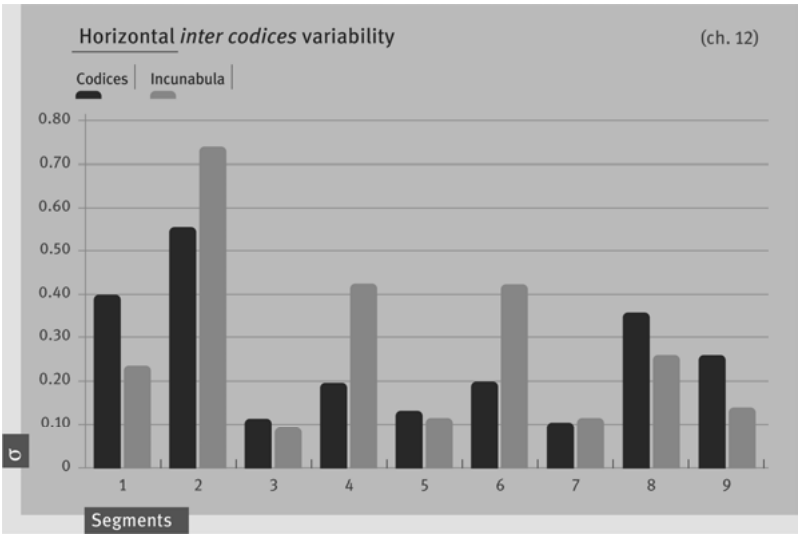


Chart 12: Horizontal *inter codices* variability

In the incunabulum, the phenomenon, despite registering values that are clearly lower than those seen in the manuscript, manifests itself in different ways. The dimensional relationships between the volumes of the page are comparable to those seen in the manuscript: the lower and outer margins are larger than the inner and upper ones, and the outer and upper branches of the gloss larger than the lower and outer ones. On the other hand, a more variable central nucleus corresponds to a regular outer frame, which is probably due to the printing technique employed. In fact, within one and same incunabulum the marginal zone did not vary,[56] and therefore it was the internal zone that from time to time underwent the adjustments necessary for the continual adaptation of the two text masses to one another.

56 This is probably due to the fact that any modification of the marginal zone would have called for a change in the size of the shape, which would have involved additional work.

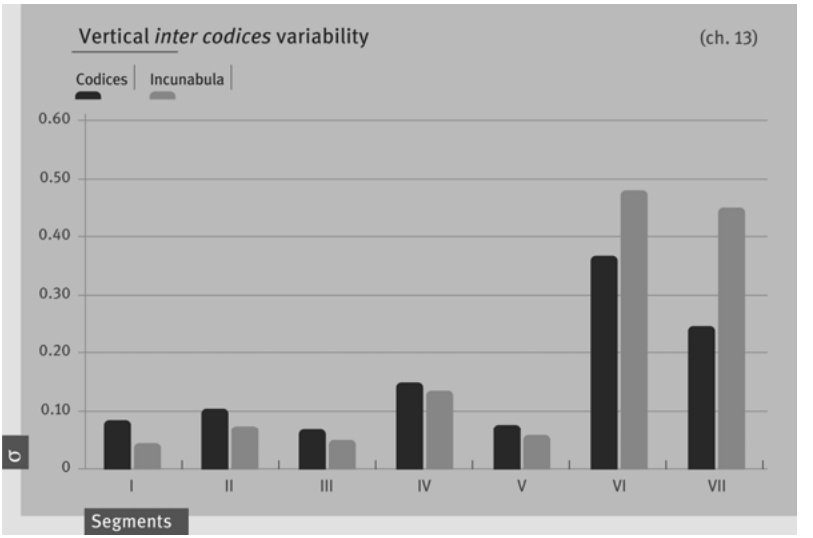


Chart 13: Vertical *inter codices* variability

One of the more significant characteristics of the shifts that occur in the volumes within the incunabulum is, without doubt, the extreme vertical irregularity of the text column, segment IV. This characteristic represents a manifestation of the progressive configuration on the page of the normative text in relation to the apparatus. In other words, the text could be lengthened or shortened as it was continually adjusted to the gloss, whose lower volumes also waxed and waned, somewhat like the pieces of an interlocking puzzle. In the incunabula, the organisation of the two text masses on the page depended, needless to say, on printing techniques, since these made it necessary to plan the arrangement of the text and gloss on the page throughout the entire volume. However, the presence of a vertical text column that was systematically variable in relation to the gloss is also met with in Bolognese manuscripts.[57] If one scrutinises Charts 14 and 15, which illustrate the vertical *intra codicem* variability of Bolognese manuscripts and all those of different provenance, it becomes clear that in the former the variability tends to shift towards the centre of the page and reaches its maximum in segment IV, the

57 The manuscripts are: Borg. lat. 372, E.I.2, Pal. lat. 759, Par. lat. 4521 A, Par. lat. 4523, Par. lat. 4527, Par. lat. 4530, Par. lat. 4531, Par. lat. 4532, Par. lat. 4535, Par. lat. 8941, Par. lat. 16913, Laur. S. Croce plut. 6 sin 4, Urb. lat. 165, Vat. lat. 1430. This group of manuscripts constitutes the only sufficiently compact and significant geographical partition which can be identified in the sample and whose behaviour has been studied in various fields of research.

text column, whereas in the latter the greatest degree of irregularity is concentrated in the lower margin, segment VII.

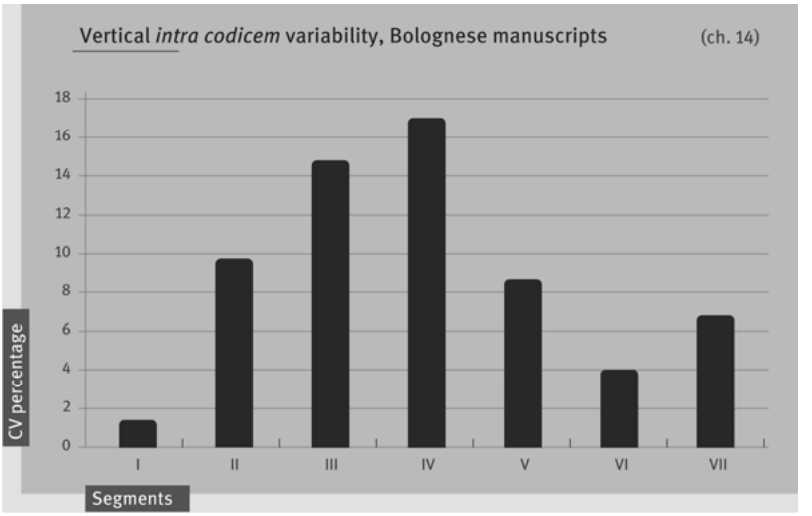


Chart 14: Vertical *intra codicem* variability, Bolognese manuscripts

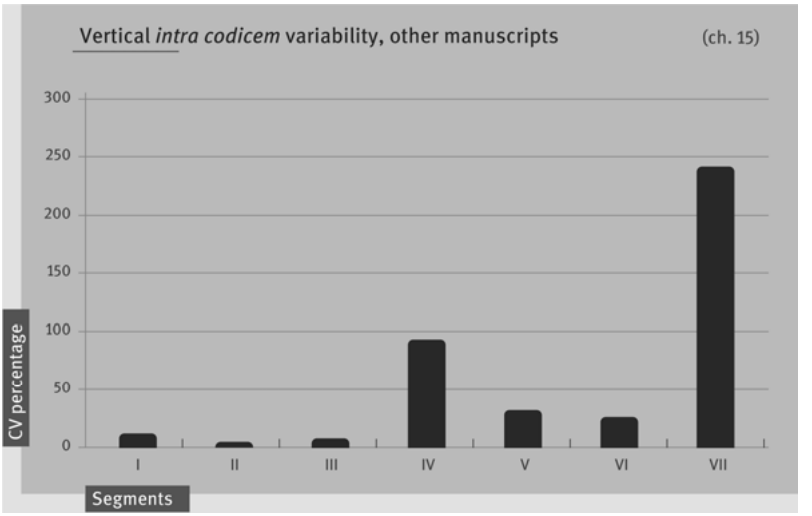


Chart 15: Vertical *intra codicem* variability, other manuscripts

This means that whilst in the non-Bolognese manuscripts a strategy aimed at maintaining the stability of the text column and rendering the lower portion of the sheet more adaptable prevails, in the codices originating from Bologna all the volumes on the page participate in a mechanism which is clearly more complex. If, in a manuscript, the text column varies in a consistent way in parallel with the gloss, this points towards assiduous planning and a purposeful scheme which had to be implemented page after page in order to synchronise the two text masses with each other. In such instances, an essential prerequisite is that the writing of the text and of the gloss take place in parallel, even if such an expedient does not necessarily involve a planned diversified arrangement of the volumes on the page. In the Bolognese manuscripts, the adjustment of the volumes therefore tends to be carried out in accordance with specific procedures, which were the product of a particularly attentive page construction technique.

The technical reasons lying at the root of a page configuration aimed at maintaining a stable outer framework, in contrast to a more variable central nucleus, have already been addressed. However, could it be that aesthetic issues also played a role in the choices made? It is difficult to express an opinion on this matter, given that to the eyes of a present-day scholar a juridical incunabulum can be likened to a book equipped with a rich apparatus of footnotes whose sizes vary from page to page, with the text expanding or shrinking according to need, which in any event is contained within an unchanging framework. This illustration seems pertinent when one considers that in the printed editions of the *Codex* the text columns and the lower branches of the gloss are linked by an inversely proportional relationship and turn out to be the most variable sectors, whereas in the manuscripts the same kind of relationship is established between the final branch of the gloss and the lower margin and, albeit to lesser extent, between the outer margin and the central column of the apparatus, thereby violating an aesthetic principle, namely that of uniformity and the proportionality of margins—a principle which is not solely applicable to the printed book.[58] The different shifts in size

58 Ezio Ornato has formulated various hypotheses regarding the endurance over the centuries of the principle that governs the hierarchy and proportionality of margins. If in fact it is not to be ruled out that material restraints could have exerted an influence on this aspect of the book's structure, one should also not discount the effect of aesthetic considerations and those of taste, given that 'tous les phénomènes qui relèvent du goût—notamment dans le domaine des proportions—comportent une large part d'arbitraire au depart, et d'habitude par la suite: ce que nous sommes habitués à voir, devient normal, et ce qui est normal peut

seen in the lower portions of the manuscript and incunabulum along the vertical axis of the page actually find some common ground in the group of codices originating from Bologna, in which the variability tends to move towards the centre of the page and reaches its apex precisely at the level of the text columns. This, as has already been said, could be indicative of continuous planning and adaptation of the two text masses carried out on a page-by-page basis, in accordance with a principle reminiscent of that used in typographical composition.

One could therefore say that where there is more planning vis-à-vis the relationships between the written areas and the non-written areas on the page—thanks to a more painstaking manual construction technique, as in the case of the Bolognese manuscripts, and a mechanical method, as in the case of the incunabula—the tendency is for greater articulation of the text with gloss (the graphical element), thereby respecting as much as possible the principle that governs the hierarchy of the margins.

To conclude, then, variability, even if it involves the entire page, manifests itself in a relatively contained way along the horizontal axis of the page, and in a clearer and more articulated manner in the vertical direction. Coinciding with greater stability, there is a higher degree of correlation in the horizontal volumes. This contrasts with the vertical volumes, for which, as we have seen, a high degree of freedom was exercised with respect to choices made and solutions employed.

In Chart 16,[59] the overall distribution of the variability measurements along the vertical and horizontal axes of the page within the entire sample is presented. It becomes immediately clear that in the majority of volumes the lowest level of variability is concentrated in the horizontal zones of the page, whilst the highest percentage occurs within the vertical ones.

---

se transformer rapidement en règle qu'il est nécessaire de suivre sous peine de choquer' (Ornato 1994, 16).

59 The graph takes a different form with respect to the previous ones, in that the number of volumes is shown on the *y* axis, whilst the CV values are arranged along the *x* axis.

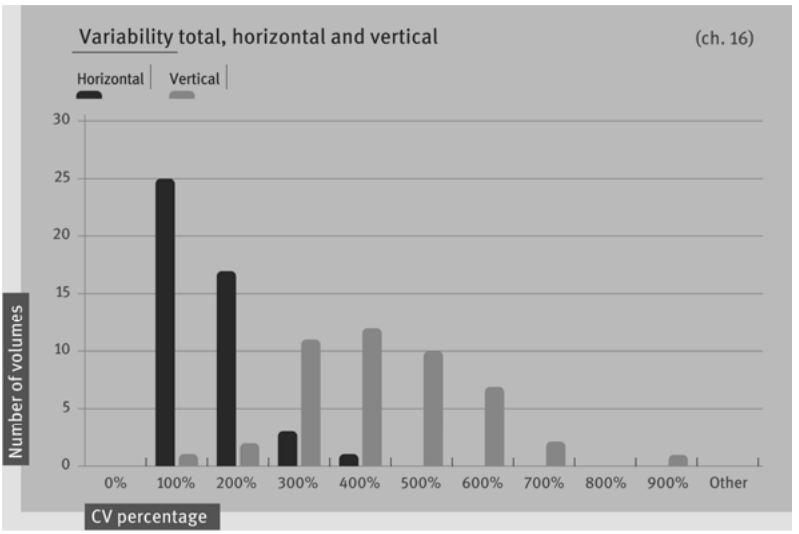


Chart 16: Variability total, horizontal and vertical

6 Facing and overlying pages

Having examined the relationships that exist between the individual volumes that constitute the page layout—in terms of dimensional hierarchy, correlation and variability—at this point in the investigation we should broaden our horizon and extend the analysis from single pages to neighbouring ones.

The objective, then, is to discover whether, and to what extent, the treatment of facing (*verso-recto*) and overlying (*recto-verso*) pages in a manuscript or incunabulum was the same as that adopted for individual pages, whether an aesthetic-formal choice that favours geometric and visual uniformity prevails, and finally if it is possible that such a strategy could have conflicted with the text/gloss adjustment mechanism, and hence with legibility requirements.

Therefore, the question being posed is whether or not the variability of the text/gloss composition is independent from the arrangement of pages (facing-overlying), and whether the aesthetic aspect (i.e. the uniformity of the composition) takes precedence over practical considerations (i.e. text/gloss adaptation).

When opened, a juridical codex generally presents an impression of great uniformity, with the *recto*/*verso* leaves appearing as mirrored 'reflections' of each other throughout the entire book.

As we have seen, in reality such apparent regularity is to an extent only superficial, since some areas of the page are particularly variable in the way they present, and therefore tendentially not very uniform within one and the same codex. At this point, then, our aim is to verify how such regularity, inherent to the pages of a juridical codex, albeit in different ways, is managed in spaces which are significantly close to each other—such as facing and overlying pages—and whether the dynamic that links the non-written and written areas of a page is repeated in the same segments of the adjacent zones.

As part of this set of problems, we can also include the question concerning the treatment of the text/gloss relationship—whether, that is, a strategy aimed at geometric uniformity corresponds to a good level of adjustment in terms of the distance between a passage of text and its relevant gloss.

For each manuscript and incunabulum, the difference between the dimensions of each segment of the written area was calculated for facing and overlying pages, which is to say the difference between segment 1 on the *verso*/*recto* and *recto*/*verso* pages, and the difference between segment 2 on the *verso*/*recto* and *recto*/*verso* pages, etc. This was done for both the horizontal and the vertical measurements. Next, the average value for the differences between all the individual segments on facing and overlying pages within all the manuscripts and incunabula was calculated, and finally the average value for the differences observed among all the manuscripts and incunabula.

If one examines Charts 17 and 19, which present the differences between the horizontal measurements on facing and overlying pages, the zones that tend to be afforded greater flexibility are the lateral ones, segments 1/2 and 8/9, which correspond to the margins and the two central branches of the gloss. Once again, the outer zone turns out to be the most non-uniform; on the other hand, the central nucleus maintains great uniformity in all its segments, with the lowest level of variation seen in the intercolumnar zone. It should be noted that the phenomenon manifests itself in a similar way when it comes to facing and overlying pages, even if higher values are seen in the latter.

As for the vertical measurements (see Charts 18 and 20), the greatest irregularities are found in the lower portion of the page, segments VI and VII, which correspond to the final branch of the gloss and the lower margin, followed by the text column, segment VI, and the area corresponding to the upper margin and the first branch of the gloss. The 'moat' is largely speaking uniform, and registers the lowest values. In this case, too, the phenomenon manifests itself in a more pronounced way in the overlying pages.

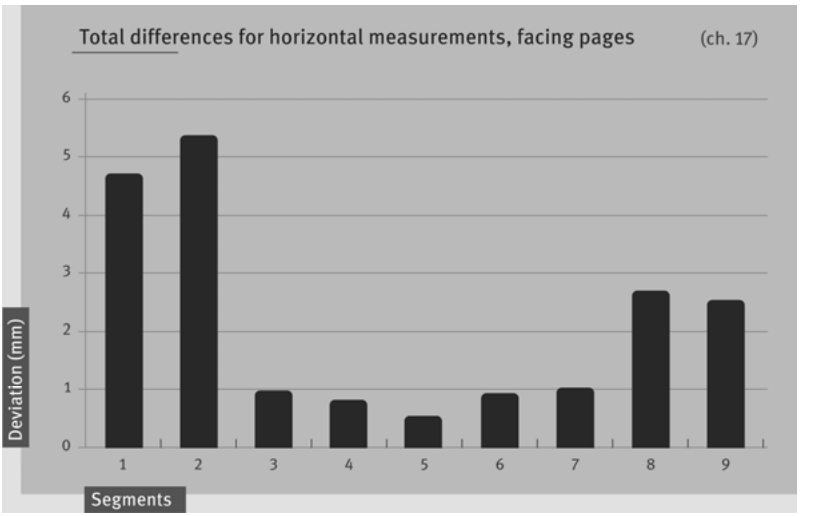


Chart 17: Total differences for horizontal measurements, facing pages

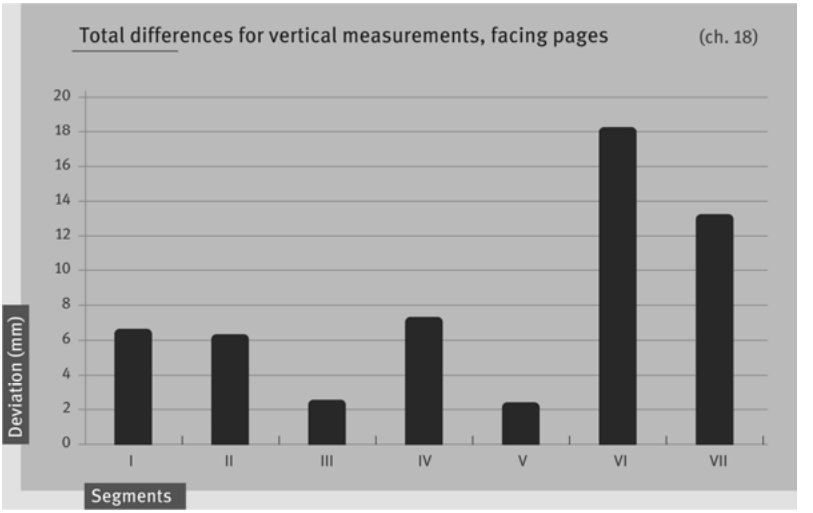


Chart 18: Total differences for vertical measurements, facing pages

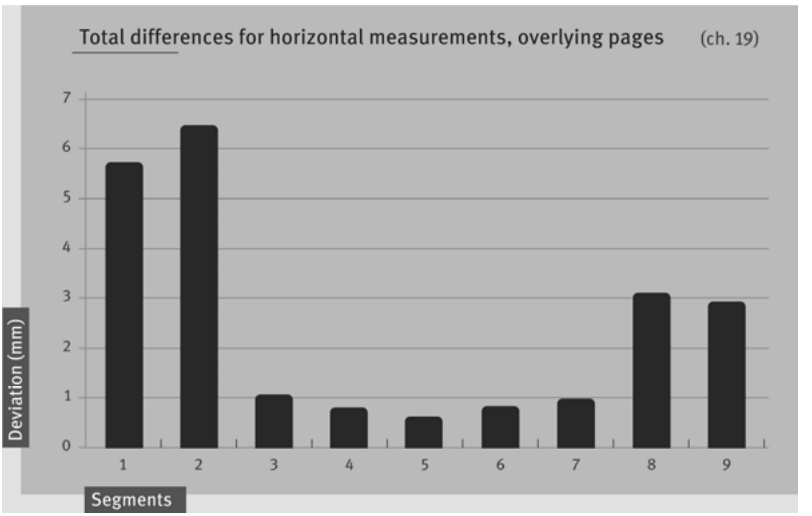


Chart 19: Total differences for horizontal measurements, overlying pages

Generally speaking, then, whether it be for the horizontal or the vertical volumes, the biggest differences are met with along the outer margin, in contrast to a more uniform central nucleus.

The treatment of the overlying pages follows a trend which is identical to that of the facing pages, even if they show higher values. In any event, on balance the highest levels of irregularity are seen along the vertical axis of the page.

At this point it is interesting to see how the phenomenon manifests itself when we distinguish between manuscripts and incunabula (see Charts 21 and 22).

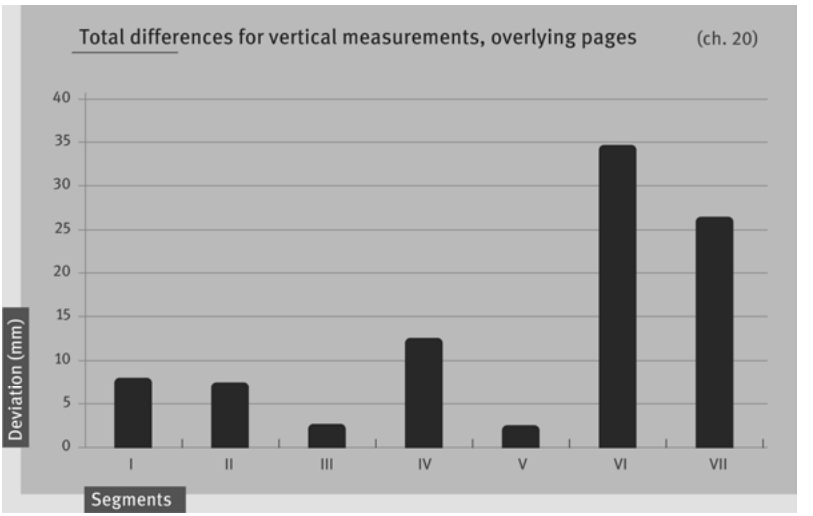


Chart 20: Total differences for vertical measurements, overlying pages

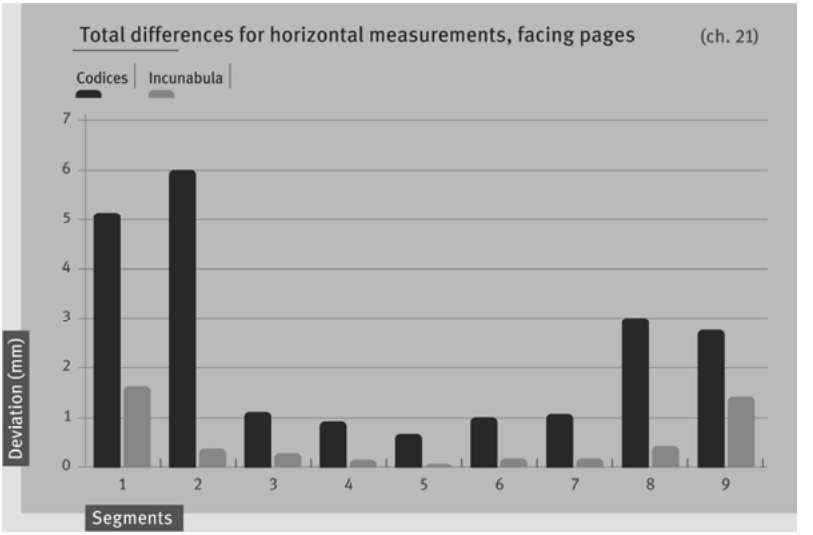


Chart 21: Total differences for horizontal measurements, facing pages

In general, within each manuscript, the facing and overlying pages exhibit a similar trend in their horizontal parts. This represents an indicator of the fact that the lower or higher levels of irregularity in the layout of the text and appa-

ratus on the page are consistent for the facing and overlying pages in one and the same manuscript. Therefore, the strategy employed for the arrangement of the two text masses on facing pages was evidently the same as that adopted for the overlying pages.

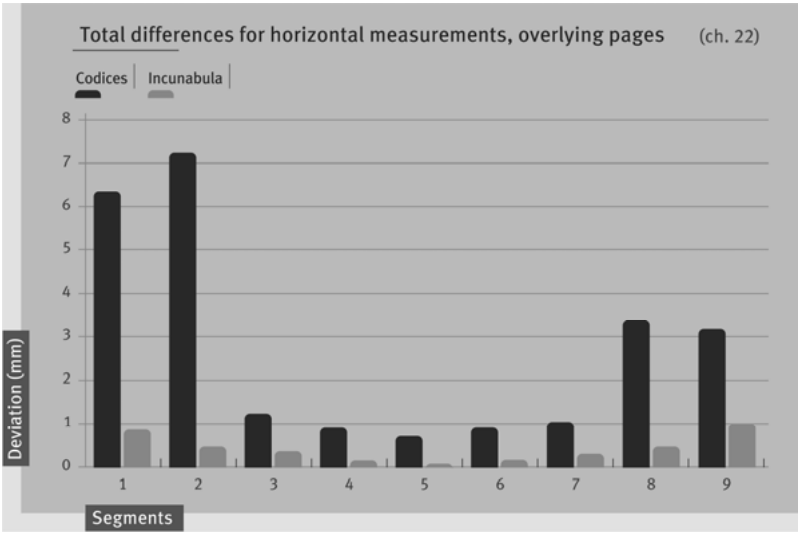


Chart 22: Total differences for horizontal measurements, overlying pages

In the incunabula, this trend proves to be similarly evident: the relationship between volumes, which manifests itself in a less articulated form in comparison to the manuscript, is practically identical in facing and overlying pages.

Conversely, the most important differences can once again be seen along the vertical axis of the page (see Charts 23 and 24). In the manuscripts, the maximum degree of disparity affects the last two volumes, segments VI/VII, which correspond to the final branch of the gloss and the lower margin. This phenomenon, which is very apparent in facing pages, is much more pronounced in overlying ones. In practice, the tendency to exploit and utilise with greater liberty the lower part of the page (by systematically varying the boundary between the gloss and the margin) is applied in a consistent way for the facing pages, and even more so in the overlying ones.

In the incunabulum, on the other hand, since, as we have already seen, the lower margin remains unchanged, the 'game' shifts to segments IV/VI (i.e. the text column and the final branch of the gloss) in almost identical ways for both the facing and the overlying pages.

The central nucleus of the Bolognese manuscripts mostly conforms to the overall strategies applied in the manuscript, although since the text column, segment IV (see Chart 14), shows greater variability in the overlying pages in the vertical areas, the adjustment mechanism involves not only volumes VI/VII, the final branch of the gloss and the lower margin, but the text column as well.

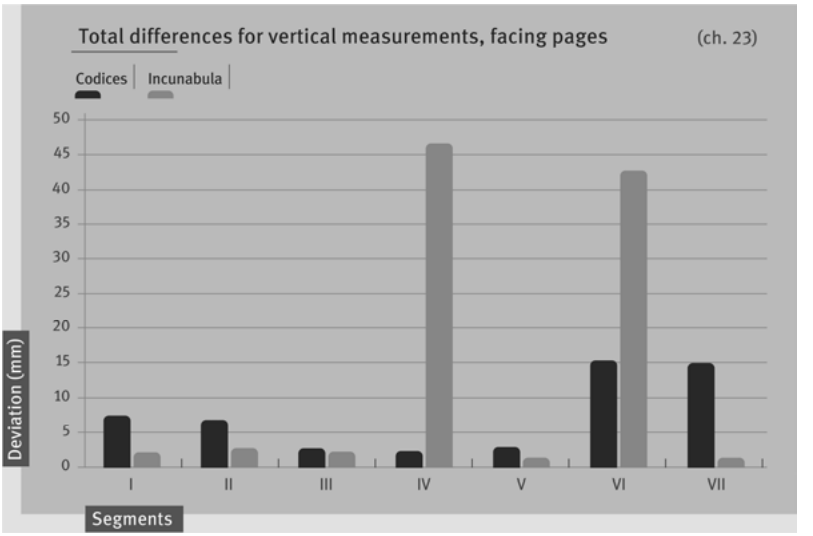


Chart 23: Total differences for vertical measurements, facing pages

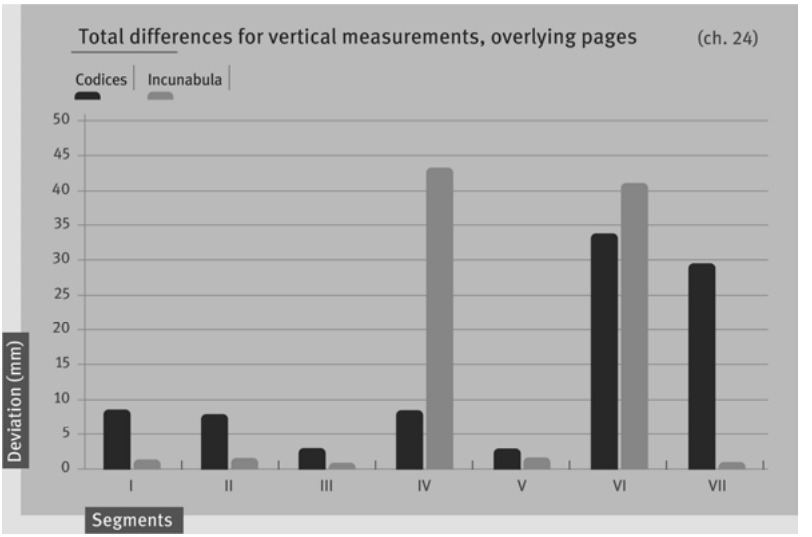


Chart 24: Total differences for vertical measurements, overlying pages

Tab. 4 shows the sum of the differences between the absolute values of all the segments, both horizontal and vertical, of the facing and overlying pages, and indicates the degree of irregularity seen among the various pages.

Sum of the differences between the absolute values of all the horizontal and vertical segments — tab. 4

	All	Codices	Incunabula
Total nr. of facing pages	103.66	104.57	96.17
Total nr. of overlying pages	116.86	119.43	95.78
Sum total	220.51	224.00	191.94
Total nr. of horizontal segments/facing pages	19.70	21.53	4.65
Total nr. of vertical segments/facing pages	57.15	52.04	99.10
Total nr. of horizontal segments/overlying pages	22.37	24.65	3.70
Total nr. of vertical segments/overlying pages	94.49	94.78	92.08
Total nr. of horizontal segments	79.52	76.68	102.80
Total nr. of vertical segments	151.64	146.82	191.17

Tab. 4: Sum of the differences between the absolute values of all the horizontal and vertical segments

6.1 The inner and outer sectors and the text/gloss adjustment in facing and overlying pages

As a result of this analysis—aimed at examining the framework of the *mise en page* with respect to the strategies employed for the positioning of each individual segment on facing and overlying pages—a clear tendency has once again emerged to set out a horizontally, and to a slightly lesser extent vertically stable central nucleus, in contrast to more flexible outer and marginal zones.

We shall now focus our attention on these two zones, and therefore shift from a more analytical examination of the individual segments, to an examination of the inner and outer sectors of the page, with a view to identifying the relationship between them. Just as before, the investigation will be carried out on facing and overlying pages.

Given that the inner area, corresponding to segments 3-7 and III-V, contains the text, while the outer one, corresponding to segments 1/2/8/9 and I/II/VI/VII, is occupied by the gloss, the relationships that exist between the two areas can be associated with the measurements relating to the adjustment of the legal text to the apparatus, which therefore makes it possible to establish the ways in which geometric uniformity strategies and legibility requirements correlate.

If one adds up the values of the differences measured in the segments of the central and outer areas for the facing and overlying pages, it becomes apparent that for both the manuscripts and the incunabula the most striking variations lie within the outer zone of the page, with a greater accentuation in the case of the overlying pages. The inner zone remains stable and follows a trend which is almost identical in both page typologies. This trend, which is more pronounced in the manuscripts, is considerably more limited in the incunabula, where, for example, in facing pages there is almost no difference at all between the central zones (0.84), although an almost imperceptibly higher value is seen in the overlying pages (see Tab. 5).

Sum of the differences between facing and overlying segments in the horizontal segments of the central and outer areas tab. 5

	All	Codices	[illegible]
Sum of the diff. between 34,567 facing segments	4.32	4.75	0.84
Sum of the diff. between 34,567 overlying segments	4.27	4.67	1.00
Sum of the diff. between 1,289 facing segments	15.38	16.79	3.81
Sum of the diff. between 1,289 overlying segments	18.10	19.98	2.70
Sum of the diff. between 34,567 segments, total	8.59	9.42	1.84
Sum of the diff. between 1,289 segments, total	33.48	33.76	6.51

Tab. 5: Sum of the differences between facing and overlying segments in the horizontal segments of the central and outer areas

The result of the correlation between all the figures relating to the differences between the central and peripheral areas is 0.145, which indicates the absence of a correlation. This means that where there is uniformity in the central part of the page, it is not necessarily the case that there is a corresponding uniformity in the outer area, and vice versa.

When the correlation function is applied to the values obtained for the differences between the central nucleus in facing and overlying pages (34,567 facing; 34,567 overlying) and to the values obtained for the differences between the outer area in the facing and overlying pages (1,289 facing; 1,289 overlying), figures of 0.919 and 0.799 are generated. The two results, which are significantly positive, confirm what has already been ascertained for individual segments on leaves, which means that for the two horizontal areas the same treatment was applied to both facing and overlying pages.

If we now move on to the vertical axis and add up the measurements obtained for the differences between the segments in the central and outer areas of facing and overlying pages, the situation appears to be rather more complex (Tab. 6).

Sum of the differences between facing and overlying segments in the vertical segments of the central and outer areas tab. 6

	All	Codices	Incunabula
Sum of the diff. between facing segments III/IV/V	12.36	7.79	49.78
Sum of the diff. between overlying segments III/IV/V	17.96	14.48	46.50
Sum of the diff. between facing segments I/II/VI/VII	44.80	44.25	49.31
Sum of the diff. between overlying segments I/II/VI/VII	76.52	80.30	45.58
Sum of the diff. between segments, total III/IV/V	30.32	22.27	96.28
Sum of the diff. between segments, total I/II/VI/VII	121.32	124.55	94.89

Tab. 6: Sum of the differences between facing and overlying segments in the vertical segments of the central and outer areas

In the incunabulum, the phenomenon follows a regular trend in the central and outer zones in both page typologies: in fact, the values range from a minimum of 45.58 to a maximum of 49.78. This is due to the fact that in the incunabulum the two most variable segments, as we have seen, are the text column and the final branch of the gloss, represented by segments IV/VI. The former belongs to the central nucleus, the latter to the outer zone, and in effect it is precisely these two volumes that generate an overall irregular trend in the pages. In fact, if one calculates the sum of the differences between segments III/V for the facing and overlying pages, and likewise for segments I/II/VII, also for the facing and overlying pages, one obtains values of 6.37, 4.13, 3.16 and 2.90, figures which are significantly low and demonstrate, once again, how in the incunabulum the greatest effort to synchronise the text and the gloss was made in the vertical axis in segments IV/VI.

Tab. 6 therefore makes it plain that in the incunabulum there is a calculated and uniform irregularity in the arrangement of the volumes forming the central and outer areas, for both facing and overlying pages.

Conversely, in the manuscripts a generally stable central nucleus on the facing pages, and one which is slightly less so on the overlying pages, is framed by a more 'fluid' outer marginal zone, particularly in the overlying pages, which further demonstrates the role played by segments VI/VII in this respect.

When all the values in relation to the differences between the central and peripheral areas are correlated, the result obtained is -0.125, which, as for the horizontal direction, demonstrates the absence of a correlation between the two zones of the page.

When the correlation function is applied along the vertical axis to the values obtained for the differences between the facing and overlying pages in the central nucleus (III/IV/V facing; III/IV/V overlying), and to the values obtained for the differences between the facing and overlying pages in the outer area (I/II/IV/VII facing; I/II/IV/VII overlying), results of 0.484 and 0.479 are obtained. These are positive values, but their significance is not equal to that of those obtained for the horizontal zone of the page. The sector-by-sector analysis also confirms the existence of a greater degree of coordination of volumes along the horizontal axis in comparison to the vertical one.

If the correlation coefficient is no longer applied between the central nucleus and outer zone of the facing and overlying pages, but instead the two areas are cross-correlated, which is to say 3,567 facing with 1,289 facing, 34,567 overlying with 1,289 overlying, III/IV/V facing with I/II/VI/VII facing, III/IV/V overlying with I/II/VI/VII, respectively the values of 0.306, 0.284, 0.223 and 0.170 are obtained.

By inserting into a table all the values of the coefficients of correlation obtained by comparing the central and outer zones of facing and overlying pages (Tab. 7), it becomes clear that in practice the techniques employed to achieve uniformity are applied consistently in consecutive leaves, regardless of whether or not they are facing or overlying, and that among consecutive leaves the correlation reaches its maximum when the same areas of pages are evaluated.

Coefficients of correlation obtained by comparing the central and outer zones of facing and overlying pages — tab. 7

	Coefficient of correlation
Matching horizontal facing segments	0.919
Matching horizontal overlying segments	0.799
Matching vertical facing segments	0.484
Matching vertical overlying segments	0.479
Inner/outer horizontal facing segments	0.306
Inner/outer horizontal overlying segments	0.284
Inner/outer vertical facing segments	0.223
Inner/outer vertical overlying segments	-0.170

Tab. 7: Coefficients of correlation obtained by comparing the central and outer zones of facing and overlying pages

Returning to the vertical axis, we have seen how the volumes belonging to the central nucleus and outer areas of the page are somewhat different. By comparing the variability of the inner (III/IV/V) and outer (I/II/VI/VII) vertical segments, it has been possible to identify a series of techniques or strategies aimed at regulating the degree of geometric uniformity/diversity in the arrangement of the two written units. In order to calculate the distribution of the strategies employed in the sample corpus, the absolute values of all the variations in all the vertical segments were added up, for both the facing and the overlying pages. Next, for each type of page, the values obtained for the inner and outer zones were compared. If the values arrived at for the facing and overlying pages are below 40-50, this equates to a *u* (uniformity) strategy, which is to say consistency between facing and overlying pages. If, on the other hand, the value for the facing pages is below this figure and that of the overlying ones exceeds it, one can speak of an *r* (regularity) strategy, which is to say regularity in the composition of the former and irregularity in the latter. If, however, both exceed a value of 40/50, an *i* (irregularity) strategy can be spoken of, which is to say irregularity in both facing and overlying pages.

The distribution of the strategies within the sample is shown in Tab. 8 and 9.

Strategies of uniformity/diversity adopted for facing and overlying pages in codices and incunabula — tab. 8

	Codices	Incunabula
r(inner)r(outer)	7	
u(inner)r(outer)	14	
i(inner)i(outer)	1	5
u(inner)i(outer)	14	
u(inner)u(outer)	5	

Tab. 8: Strategies of uniformity/diversity adopted for facing and overlying pages in codices and incunabula

Strategies of uniformity/diversity adopted for facing and overlying pages (inner and outer zones) tab. 9

	Codices		Incunabula	
	Inner	Outer	Inner	Outer
u	80.48%	12.19%		
r	17.07%	51.21%		
i	2.43%	36.58%	100%	100%

Tab. 9: Strategies of uniformity/diversity adopted for facing and overlying pages (inner and outer zones)

By assigning numerical values to the different couplings of strategies identified in the sample, namely 1 = *u* (inner) *u* (outer), 2 = *u* (inner) *r* (outer), 3 = *r* (inner) *r* (outer), 4 = *u* (inner) *i* (outer), 5 = *i* (inner) *i* (outer), it becomes possible to compare these data with those relating to the adjustment of the text/gloss.

For this part of the investigation the survey was carried out within a specific quire containing a specific passage from the *Codex*. The passage concerned is composed of approximately 500 words,[60] and is drawn from *liber* III, *titulus* I (*de iudiciis*), *lex* 30, *paragraphi* 1-2.[61] To adjust one passage of the gloss to the corresponding lemma in the text a numeric value, based on certain modalities, is assigned to the distance between the two parameters. These values depend on the area of the page where the text and apparatus are positioned. Fig. 6 and 7 represent two pages of an open codex; to the left we see the *verso* leaf, to the right the *recto*.

60 The count was carried out on a printed edition of the *Corpus Iuris Civilis*.

61 The selection of this passage from Justinian's *Codex* was not purely random, given that the objective was to be able to have at one's disposable a sufficiently long piece of text, and one which comprised the beginning of a book and all its most important hierarchical subdivisions, including the title, the law and the clause.

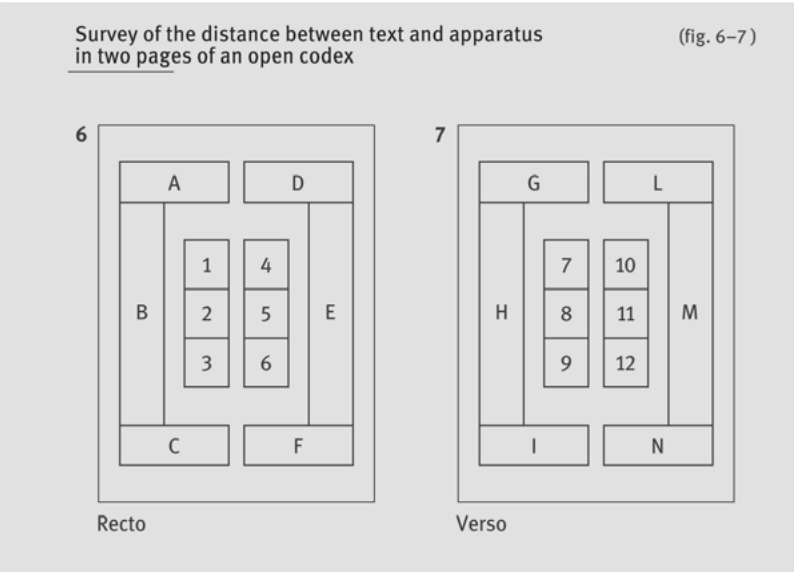


Fig. 6–7: Survey of the distance between text and apparatus in two pages of an open codex

The columns containing the text have been divided into three sections. Likewise, the gloss has been divided into the usual three branches. If the first glossed lemma of the pre-selected text is located in section 1 and the corresponding gloss in sector A, the numerical value assigned is 0; if the gloss is positioned in B, the value is 1; if the gloss is in C, the value is 2; if the gloss is in D, the value is 4, and so on. If, on the other hand, the text commences in section 2, the mechanism is identical, but the 'slippage' (i.e. asynchrony) of a block is factored into the evaluation. Thus, if the text is located in section 2 and the gloss in sector A, the numerical value assigned is 1; if the gloss is in B, the value is 0; if the gloss is in C, the value is 1; if the gloss is in D, the value is 2, and so on. With the transition from a *verso* leaf to a *recto* leaf a penalty of 3 points is envisaged, hence if the text commences in sector 1 and the gloss is found in G, the score is 9. Conversely, the transition from the *recto* to the *verso* of a leaf results in a penalty of 6 points, hence if the text (once again) commences in sector 1 but the corresponding text is located in sector A on the *verso* of the successive leaf, the score is 20.[62]

62 Tab. 9a shows the results of all the possible combinations contained within two pages (*recto*/*verso*).

The results of all possible combinations contained within two pages (recto/verso)

	A	B	C	D	E	F	G	H	I	L	M	N
1	0	1	2	3	4	5	9	10	11	12	13	14
2	1	0	1	2	3	4	8	9	10	11	12	13
3	2	1	0	1	2	3	7	8	9	10	11	12
4	3	2	1	0	1	2	6	7	8	9	10	11
5	4	3	2	1	0	1	5	6	7	8	9	10
6	5	4	3	2	1	0	4	5	6	7	8	9
7	9	8	7	6	5	4	0	1	2	3	4	5
8	10	9	8	7	6	5	1	0	1	2	3	4
9	11	10	9	8	7	6	2	1	0	1	2	3
10	12	11	10	9	8	7	3	2	1	0	1	2
11	13	12	11	10	9	8	4	3	2	1	0	1
12	14	13	12	11	10	9	5	4	3	2	1	0

Tab. 9a: The results of all possible combinations contained within two pages (*recto*/*verso*)

In the manuscripts the average is 2.23, whereas in the incunabula it is 0.77: this means that in the manuscripts the distance covers roughly two sectors of the page, whilst in the incunabula the distance covered is less than one sector. Legibility, promoted by a better synchronisation of the text to the relevant gloss, therefore proves to be far superior in the incunabulum in comparison to the manuscript.

If one compares the values of the uniformity strategies with those of the text/gloss adjustment, a negative situation emerges for both book typologies. In the manuscript the correlation result is -0.480, which suggests a conflict between the need for geometric regularity in the distribution of volumes on the page and the legibility requirement.

In the incunabulum the conflict is even greater; this can immediately be apprehended from the average values by means of which the two phenomena

manifest themselves.[63] In practice, in the incunabulum we find ourselves looking at two extreme solutions represented by the values 0.77 for the displacement of the text/gloss and 5 for the uniformity strategies. The former requires greater attention being paid to legibility, whilst the latter corresponds, as the reader will recall, to the *ii* strategy, which is to say a situation characterised by maximum irregularity.

Therefore, even if the two phenomena are generally seen in opposition in the manuscript and incunabulum, it is in the latter that the contrast is more pronounced.

The overall picture is summarised in Tab. 10, where the average values with respect to 'slippage' in relation to hierarchical type are presented.

Average value of 'slippage' in relation to hierarchical type — tab. 10

Hierarchical type	'Average slippage'
1 (uu)	5.16
2 (ur)	2.89
3 (rr)	1.67
4 (ui)	1.33
5 (ii)	0.79

Tab. 10: Average value of 'slippage' in relation to hierarchical type

The inversely proportional relationship that links the tendency towards regularity with superior legibility is plain to see. Those who favoured consistent uniformity between the inner and outer parts of facing pages paid the price for this when it came to the degree of text/gloss adjustment, and vice versa. The intermediate and qualitatively better solution is represented by a page facing technique that succeeds in balancing the two phenomena.

We have already seen how the Bolognese codices occupy, in some respects, an intermediate position among the incunabula and the other manuscripts. It

63 In fact, from a mathematical perspective, in the incunabulum it is not possible to calculate the coefficient of correlation between the uniformity strategy and the need for legibility, since the first of the two phenomena always has a value of 5, and hence a variability of 0.

will be interesting to see whether it is also true that in the text/gloss adjustment phenomenon they also reflect this tendency.

For the Bolognese manuscripts, the average value for text/gloss 'slippage' is 1.09, whereas in all the other manuscripts the average is 2.80. This means that if in the former the distance covers almost one sector of the written page, in the latter it extends across three sectors. Since, on the other hand, the 'slippage' value in relation to the hierarchy type is 2.93 for the Bolognese manuscripts and 2.74 for all the others, in practice the Bolognese manuscripts, despite maintaining a hierarchy equal to that of the other manuscripts—corresponding for the most part with Type 2 (*ur*)—present a good level of adjustment between the text and gloss.

7 Text/gloss adjustment within the inner zone of the page

The investigation carried out so far on the distribution of the volumes that make up the text, gloss and blank spaces on the page has made use of measurements taken of the written area which, as the reader will recall, were obtained by means of a specific methodological strategy.

Measurement of the vertical axis of the page was carried out once only, on either column a or column b, which for branches A and C of the gloss presented with a greater number of lines, and was therefore of larger size.

The data obtained in this way made it possible to analyse the construction techniques employed in the layout of the page in all the segments of the written area in relation to size, variability and correlation within each book typology, and among all the manuscripts and incunabula. The focus was then shifted to the strategies adopted for the same segments in facing and overlying pages, and it was observed how the different solutions employed to foster a greater or lesser degree of regularity of the two text masses on the page relate to the different text/gloss adjustment procedures.

However, the measurements taken of the written area did not make it possible to examine the relationship between the two sectors—left and right—on one and the same page. This is due a lack of values with respect to columns *a* and *b*, relating to the lower and upper branches of the gloss.

This setback was overcome by making use of data relating to the number of lines in the apparatus on the page. The relevant data was obtained for each of the text columns and the three branches of the gloss, distinguishing between column *a* and column *b*.

In any event, the analysis that follows will only refer to sectors A and C of columns a and b, given that the size of branch B, despite varying in the number of lines it contains, is always furnished by the sum of the measurements of segments III/IV/V, whereas the number of lines within the two columns of text is always the same on any page.

Tab. 11 presents the average values of the differences in the number of lines in branches A and C of the gloss within the two columns.[64]

In the incunabulum, the difference is minimal in all cases; indeed, it effectively equates to less than one line.

Differences in the number of lines in branches A and C of the gloss (columns *a* and *b*) tab. 11

	All	Codices	Incunabula
Diff. zone A col. *a/b*	0.87	0.97	0.01
Diff. zone C col. *a/b*	1.44	1.52	0.78
Diff. zone A+C col. *a/b*	2.30	2.49	0.79

Tab. 11: Differences in the number of lines in branches A and C of the gloss (columns *a* and *b*)

In the manuscript, a larger, even if not very great, difference between the two branches is seen. As usual, this is noticeable above all in the most variable lower zone of the page: the difference, in fact, is of one and a half lines.

Tab. 12 presents the figures obtained from the calculation of the average difference in the number of lines between the two branches of the gloss in the facing and overlying pages.

64 The difference in the number of lines contained in the two branches of the gloss was calculated as an absolute value.

Difference in the number of lines between the two branches of the gloss in facing and overlying pages tab. 12

Diff. in number of lines	All	Codices	Incunabula
Facing zone A col. *a/b*	1.68	1.89	0.00
Overlying zone A col. *a/b*	1.54	1.72	0.01
Facing zone C col. *a/b*	2.75	2.86	1.78
Overlying zone C col. *a/b*	2.74	2.88	1.57

Tab. 12: Difference in the number of lines between the two branches of the gloss in facing and overlying pages

The first thing to note is the rather marked difference between the two branches, A and C, of the gloss. In the manuscript, in the upper part of the page there is a difference of almost two lines, whereas in the incunabulum there is no difference at all. As regards the lower area, the variation is roughly three lines and one and a half lines, respectively. This trend is at any rate consistent in both the facing and the underlying pages.

These data provide further confirmation of, and partly explain what has already been said about the shifting of volumes on the surface of a page. Even if the lower area of the page proves to be the most variable, the differing degrees of variability are not always found in the same sectors of the page, but rather in different ones, which, as the reader will recall, correspond to segments VI/VII in the manuscript and segments IV/VI in the incunabulum.

Now we shall try to compare the variability of the number of lines with the various other strategies used to regularise the volumes, identified by the initials *u*, *i* and *r* (see above), in the inner and outer zones on the vertical axis of a page. As we have already seen, the most qualitatively significant strategy was represented by type *rr*, an approach that resulted in perfect uniformity in the outer and inner areas of facing pages, and which achieved a good degree of text/gloss synchrony.

The comparison we plan to make requires that we calculate the average difference in the number of lines contained in branches A and C of the gloss in relation to the various strategies employed. With this goal in mind, four strategy classes have been identified. The first strategy includes the manuscripts in which at least one page facing option was employed, *ur* and *rr*; the second and third strategies include the manuscripts in which a complete facing op-

tion was employed, *rr*, or a partial one, *ur*; finally, the fourth class includes all the strategies where no facing technique was employed, i.e. *ui*, *ii*, *uu*.

By studying the results presented in Table 13, one can see that when facing is complete, the difference in the number of lines is lower. In any event, even a partial facing option always results in a certain degree of uniformity. On the other hand, the greatest variation is found in all the strategies that represent alternatives to the facing option. Finally, it should be noted that, as a rule, the values for zone A are always proportionately lower than those of zone C.

Difference in the number of lines contained in branches A and C of the gloss in relation to the strategies employed — tab. 13

Strategy	Zone A	Zone C
ur+rr	0.58	1.10
rr	0.13	0.82
ur	0.81	1.25
ii+ui+uu	1.37	1.95

Tab. 13: Difference in the number of lines contained in branches A and C of the gloss in relation to the strategies employed

The treatment reserved for facing and overlying pages is almost identical. The greater or lesser degree of uniformity adopted for the two external branches of the gloss in relation to the various strategies manifests itself in a consistent way on consecutive pages and shows, as usual, higher values in area C of the gloss (Tab. 14).

The differences in facing between the two branches of the gloss indicate the extent of the variability of two written areas—separate from the main text—which are markedly flexible within the boundaries of the page.

Difference in the number of lines contained in branches A and C of the gloss according to the different strategies, in facing and overlying pages

tab. 14

	ur+rr	rr	ur	ii+ui+uu
Diff. between facing pages, zone A col. *a/b*	1.0	0.15	1.42	2.78
Diff. between overlying pages, zone A col. *a/b*	1.04	0.24	1.44	2.42
Diff. between facing pages, zone C col. *a/b*	2.05	1.75	2.20	3.67
Diff. between overlying pages, zone C col. *a/b*	2.03	1.64	2.23	3.74

Tab. 14: Difference in the number of lines contained in branches A and C of the gloss according to the different strategies, in facing and overlying pages

This phenomenon can be helpful when carrying out a more specific and detailed analysis of the relationship between the technique used to achieve uniformity and the need for legibility, since it allows one to correlate the text/apparatus displacement values with a gloss mobility index that refers to one and the same page.

The procedure consists in calculating the coefficient of correlation between the variations in the number of lines in the two branches of the gloss and the text/gloss displacement values: for the incunabulum, the result produced is 0.697, whereas for the manuscript it is -0.096.

In the first case, we are confronted by a contradictory situation, since, as the reader will no doubt recall, in the incunabula there exists a clear conflict between uniformity and the need for legibility—a conflict which is plain to see between the type of strategy with the highest value, 5 (*ii*), and the lowest value for the text/gloss adjustment, 0.77. However, based on the result of the correlation, the page appears to be in a state of positive equilibrium, because the uniformity in the outer volumes of the gloss corresponds to the attention paid to the legibility factor. What, then, does this discordance between the central part of an incunabulum and a page of the same book depend on?

The conflict can in fact readily be resolved if one views the problem from a practical viewpoint, focusing attention on how, in material terms, a law book equipped with an apparatus was fabricated. Needless to say, different techniques, such as printing in the case of the incunabulum and copying by hand in the case of the manuscript, have to be taken into consideration.

Thanks to important technical innovations, starting in around 1473[65] the printing of surfaces corresponding to entire sheets began. The composition of the two text masses was carried out on concordant and non-concordant pages, according to the natural sequence of the text. This necessitated a prior simultaneous arrangement of the text and gloss. Consequently, the adjustment on the page of the main juridical text to the apparatus was planned in advance. This represented what we can define as the 'adjustment unit' or 'adjustment index'.[66]

In practice, the calibration of the text was carried out in such a way so as to vary its length in relation to the size of the gloss. Because a predetermined amount of apparatus had to be inserted, in the incunabulum the geometry of the glossed area was given precedence. In fact, asymmetry in the branches of the gloss is, as we have seen, minimal, despite the adjustment being kept at an optimal level (usually, in less than one block). Hence, a check was kept on any displacement by occasionally calibrating the columns of text to the gloss volumes located in the lower part of the leaf (segments IV and VI). In the incunabulum, then, the adjustment index was embodied by the surface of the page.

By contrast, in the case of a manuscript a different situation is observed. If, within a codex, a conflict between uniformity strategies and the need for legibility has emerged—the coefficient of correlation is in fact -0.480—the same coefficient for a page is, as we have seen, -0.096, which indicates the absence of a correlation.

The fundamental difference with respect to the incunabulum lies in the fact that in the manuscript the transcription of the juridical text and gloss was carried out in accordance with the natural sequence of the text. Additionally, the adaptation of the gloss, within a specific amount of text, was dependent upon both the number of lemmata to gloss and the length of the commentary corresponding to each individual passage.

When a scribe was preparing to copy a juridical work equipped with an apparatus, we can surmise that he found himself confronted by two possibilities: (a) the manuscript already contained the text, or (b) he would have to realise both the text and the gloss.[67] In both cases, it is quite likely that from the outset he endeavoured to pay attention to the text/gloss adjustment and therefore tried to calibrate the two text masses as closely as possible.

---

65 See footnote 37.

66 Here, the term 'unit of adjustment' is intended to mean the amount of space represented by text or material space on the writing support in which the scribe sought to remedy any displacement (i.e. 'slippage') he encountered.

67 In effect, this characteristic is common to all the manuscripts within the corpus, both those in which the writing of the text and of the apparatus were carried out contemporaneously, and those in which the two operations were carried out at different times.

If, for various reasons, during the writing process displacement phenomena were encountered, several corrective measures could be employed to compensate for the variance. Given that this process followed the sequential succession of the text, such measures could only be predetermined up to a certain point. In addition, an unplanned adjustment could never be performed completely 'off the cuff', as it were.

It becomes clear, then, that the correction mechanism that favoured a superior adaptation of the text and gloss could be deployed at any point in the manuscript where the situation rendered it necessary.

The fact that no correlation exists (-0.096) between the displacement and uniformity of the outer volumes of a page, whereas the same correlation is negative (-0.489) in the inner part of the manuscript, indicates that even if in the codex, taken overall, symmetry and legibility strategies conflict, the material adjustment unit upon which this mechanism is based in the manuscript is not the page.[68]

Current research does not permit further investigation of this issue, since the text/gloss measurements carried out on a single passage of Justinian's *Codex*, despite being adequate for the incunabulum, proved to be insufficient in the case of the manuscript.

In the manuscript, the adjustment of the juridical text to the apparatus was carried out according to particularly complex 'rhythms' and schemes, and therefore specific surveying procedures are necessary for the collection of data.

To achieve this end, a number of factors should be borne in mind. Several different recensions of Accursius's ordinary gloss can be linked to the nine text units which correlate to the division into nine books of the *Codex*. Therefore, a preliminary selection should be made on the basis of the apparatus, the objective being to assemble groups of manuscripts equipped with almost identically developed glosses. Next, the reproduction mechanisms used in the production of the *Corpus Iuris Civilis* cannot be disregarded, since these were based on models—the *exemplaria*—that were composed of loose quires, which in turn were subdivided internally into *peciae*. In addition, the *exemplaria* of the text and glosses circulated separately, which undoubtedly made it more difficult to link them on a page.[69] A preliminary analysis of the text/gloss displacement (i.e. 'slippage') could start out

68 A different method is employed for surveying the text/gloss displacement in the manuscript. Instead of being limited to just one passage of text, the survey is carried out at different points, though not at selected at random, throughout the entire codex.

69 Above all in the Bolognese manuscripts, where at the time of manufacture a good synchronisation of the text and gloss was achieved (see above).

from manuscripts bearing *pecia* marks; then a specific passage to survey could be selected from within a length of text contained between two *pecia* marks.

This procedure should be carried out on multiple segments of manuscript, distributed, if possible, within individual volumes. The passages selected would then constitute the benchmark models to refer to when surveying manuscripts lacking *pecia* marks.

Some other procedures based on material rather than textual criteria could be combined with those outlined above. These would consist in gathering a random series of data from within a specific number of whole or half quires in the manuscript.

The two methods combined could provide valuable clues on the strategies employed by the copyists to synchronise the gloss with the text. In addition, this approach may on occasion make it possible to identify the key space on the page or the juncture when this operation, which we have termed the unit of adjustment, was carried out.

From this initial investigation of various manuscript and printed volumes containing Justinian's *Codex* with glosses, some important information on the techniques and strategies adopted in the two book types for the shaping and organisation of a fixed amount of text in relation to the available space has emerged. In our view, the first important observation to make is that it is impossible to draw a clear distinction between the manuscript and the incunabulum, since the solutions employed by artisans in the 13th to 14th centuries, and by printers in the 15th, despite resulting in differences in, for example, the management of the various sectors of the page, or the composition of the text with gloss, cannot be seen as being entirely at odds with each other. An underlying distinctiveness exists in the concept and type of product that was made, but clearly not in the means and forms that were very closely bound to the two different production contexts. The reason for this continuity that accompanied the shift from a manual fabrication technique to a mechanical one essentially lies in the strength and prestige of a book—the law tome—which was still regarded as being functional in the system and structure that a centuries-old tradition had established. To these, other factors that cannot be disregarded, and which likewise became consolidated over time, must be added, namely the manuscript's aesthetic bearing and trends in taste that only with difficulty the printed book could have countered. In general, then, the image for the juridical book that the world of the manuscript proposed was largely inherited by that of the printed book, even if not in a purely and simply imitative form. In fact, a page in an incunabulum containing Justinian's *Codex* does not constitute a 'photographic' reproduction of a manuscript page bearing the same passage of text. Nevertheless, both were planned in the same

way, and within them all the written and non-written sectors follow the same design. In what way, then, do they differ? The difference essentially lies in the relationship which is set up between these elements in terms of hierarchy and proportionality, and therefore the mechanisms that regulate and govern the composition of the two textual units—i.e. the main text and the gloss—in an effort to strike a difficult balance between the functional need for legibility and an aesthetic principle, namely visual uniformity and homogeneity. More than once during the course of this investigation reference has been made to the decisive role played by different production methods in determining a certain kind of strategy, and therefore to how a manual production process (contingent on the pace of the copying of the *exemplar* into quires) and a mechanical one inevitably exert an influence on the structure of the book and the ways in which the graphical component was placed in the space it was destined for. It is rather obvious, and perhaps unnecessary, to remind ourselves that the advent of printing represented a drastic material and economic departure from the age of the manuscript; on the other hand, it is also true that this revolution 'tout en améliorant d'une manière décisive le bilan énergétique global du système de production, ne peut-elle que déséquilibrer la repartition des coûts et engendrer ainsi de nouvelles contradictions'.[70] Notwithstanding the specificity of the two production contexts and the unquestionable advantages that accompanied the advent of printing, what we have been able to confirm here, by examining the various phenomena, is the extent to which the standards applied in manuscript production, with respect to specific aesthetic and functional demands, coincide with those used for the incunabulum, and the degree to which tradition and innovation coexist.

References

Astuti, Guido (1968), '*La "glossa accursiana"*', In Rossi, Guido (ed.), *Atti del convegno internazionale di studi accursiani*. Bologna 21–26 octobre 1963, Milano: Giuffrè, 289–379.

Astuti, Guido (1968a), *Lezione di storia del diritto italiano. Le fonti. Età romano-barbarica*, Padova: CEDAM.

Avril, François / Gousset, Marie-Thérèse (1984), *Manuscrits enluminés d'origine italienne,* II. *XIII^e^ siècle*, Paris: Centre de recherche sur les manuscrits enluminés, Bibliothèque nationale (Manuscrits enluminés de la Bibliothèque nationale de France).

Balsamo, Luigi (1988), 'Editoria a Bologna nei secoli XV–XVIII', in *Alma mater studiorum. Nove secoli di editoria bolognese per l'Università*, Bologna: CLUEB, 74–76.

70 Ornato 1994, 18–19.

Bataillon et al. (1988), 'La production du livre universitaire au moyen âge : Exemplar et pecia'. Actes du symposium tenu au Collegio San Bonaventura de Grottaferrata en mai 1983, Paris: C.N.R.S.

Bellomo, Manlio (1988), *Saggio sull'università nell'età del diritto comune*, Catania: Giannotta.

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIV[e] et XV[e] siècles. Textes et études, 2).

Bozzolo, Carla / Ornato, Ezio (1982), 'Pour une codicologie "expérimentale"', in *Scrittura e civiltà*, 6: 263–302 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma; Viella [I libri di Viella, 10], 3–31).

Bozzolo, Carla / Ornato, Ezio (1986), 'L'étude quantitative du manuscrit médiéval : aspects méthodologiques et perspectives de recherche', in Härtel, Helmar (ed.), *Probleme der Bearbeitung mittelalterlicher Handschriften*, Wiesbaden: Harrassowitz (Wolfenbütteler Forschungen 30), 233–239.

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino: QuattroVenti, 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 473–508).

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1987), 'Page savante, page vulgaire : étude comparative de la mise en page des livres en latin et en français écrits ou imprimés en France au XV[e] siècle' , in Baumgartner, Emmanuèle / Boulestreau, Nicole (eds), *La présentation du livre*. Actes du Colloque, Paris X-Nanterre (4, 5, 6 décembre 1985), Paris: Centre de recherches du Département de français de Paris X-Nanterre (Littérales, 2), 121–133 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 509–517).

Bühler, Curt Ferdinand (1946), 'The Margins in Mediaeval Books', in *The Papers of the Bibliographical Society of America*, 40: 32–42.

Bühler, Curt Ferdinand (1958), *The University and the Press in fifteenth-Century Bologna*, Notre Dame, Ind.: Mediaeval Institute (Texts and Studies in the History of Medieval Education).

*Busonero, Paola (1999), 'La fascicolazione del manoscritto nel basso medioevo', in Busonero, Paola / Casagrande Mazzoli, Maria Antonietta / Devoti, Luciana / Ornato, Ezio, *La fabbrica del codice. Materiali per la storia del libro nel tardo medioevo*, Roma: Viella (I libri di Viella, 14), 31–139.

Calasso, Francesco (1954), *Medio Evo del diritto,* I, *Le fonti*, Milano: Giuffrè.

Caprioli, Severino (1981), 'Convenzione su strato e apparato', in *Studi senesi*, 30: 417–424.

Chartularium Studii Bononiensis. Documenti per la storia dell'Università di Bologna dalle origini fino al secolo XV, 16 vols, Bologna: Commissione per la storia dell'Università di Bologna, 1909–1988.

Colli, Vincenzo (1990), 'Termini del diritto civile', in Weijers, Olga (ed.), *Méthodes et instruments du travail intellectuel au Moyen Âge*, Turnout: Brepols (Études sur le vocabulaire intellectuel du Moyen Âge, 3), 231–242.

Coq, Dominique / Ornato, Ezio (1987), 'Les séquences de composition du texte dans la typographie du XV[e] siècle. Une méthode quantitative d'identification', in *Historie et mésure*, 2/1: 87–136.

Coq, Dominique / Ornato, Ezio (1988), 'La production et le marché des incunables. Le cas des livres juridiques', in Aquilon, Pierre / Martin, Henri-Jean (eds), *Le livre dans l'Europe de la Renaissance*. Actes du XXVIII[e] colloque international d'Études humanistes de Tours, Paris: Promodis, 305–322 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 227–243).

Destrez, Jean (1935), *La pecia dans les manuscrits universitaires du XIII[e] et du XIV[e] siècle*, Paris: Éditions Jacques Vautrain.

Devoti, Luciana (1994), 'Aspetti della produzione del libro a Bologna: il prezzo di copia del manoscritto giuridico tra XIII e XIV secolo', in *Scrittura e Civiltà*, 18: 77–142.

Devoti, Luciana / Tristano, Caterina (1998), '*Completus in textu et in glosis*. Il libro giuridico a Bologna tra XIII e XIV secolo: il mercato dell'usato', in *Nuovi Annali della Scuola Speciale per Archivisti e Bibliotecari*, 12: 63–116.

Dolezalek, Gero Rudolf (1972), *Verzeichnis der Handschiften zum römischen Recht bis 1600*, Frankfurt am Main: Max-Planck-Institut für Europäische Rechtsgeschichte.

Dolezalek, Gero Rudolf (1985), *Repertorium manuscriptorum veterum Codicis Iustiniani*, I–II, Frankfurt a. M.: Klostermann (Ius Commune Sonderhefte, 23).

Dolezalek, Gero Rudolf (1989), 'La pecia e la preparazione dei libri giuridici nei secoli XII–XIII', in *Luoghi e metodi di insegnamento nell'Italia medioevale (secoli XII – XIV)*, Atti del convegno internazionale di studi, Lecce – Otranto 6–8 ottobre 1986, Lecce: Congedo editore, 201–217.

Dolezalek, Gero Rudolf (1994), 'Les gloses des manuscrits de droit: reflet des méthodes d'enseignement', in Hamesse, Jacqueline (ed.), *Manuels, programmes de cours et techniques d'enseignement*. Actes du Colloque international de Louvain-la-Neuve (9–11 septembre 1993), Louvain-la-Neuve: Institut d'études médiévales (Textes, études, congrès, 16), 235–255.

Febvre, Lucien / Martin, Henri-Jean (1985), *La nascita del libro*, Roma-Bari: Laterza (Universale Laterza, 154).

Fink-Errera, Guy (1983), 'La produzione dei libri di testo nelle Università medievali', in Cavallo, Guglielmo (ed.), *Libri e lettori nel medioevo. Guida storica e critica*, Roma-Bari: Laterza (Universale Laterza, 419), 133–165.

Fransen, Gérard (1982), 'Les gloses des canonistes et des civilistes', in Bultot, Robert (ed.), *Les genres littéraires dans les sources théologiques et philosophiques médiévales. Définition, critique et exploitation*. Actes du colloque international de Louvain-la-Neuve, 25–27 mai 1981. Louvain-la-Neuve: Institut d'études médiévales (Textes, études, congrès, 5), 133–149.

Gumbert, Johan Peter (1993), 'Sizes and Formats', in Maniaci, Marilena / Munafò, Paola F. (eds), *Ancient and Medieval Book Materials and Techniques* (Erice, 18–25 September 1992), I–II, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 357–358), I, 227–273.

Holtz, Louis (1995), 'Glosse e commenti', in Cavallo, Guglielmo / Leonardi, Claudio / Menestò, Ernesto (eds), *Lo spazio letterario del Medioevo*, 1. *Il Medioevo latino*, III. *La ricezione del testo*, Roma: Salerno, 59–111.

Kantorowicz, Hermann (1929), 'Accursio e la sua biblioteca', in *Rivista di storia del diritto italiano*, 2: 35–62.

Lemaire, Jacques (1989), *Introduction à la codicologie,* Louvain-la-Neuve: Institut d'études médiévales (Textes, études, congrès, 9).

Lowry, Martin (1991), *Nicholas Jenson and the Rise of Venetian Publishing in Renaissance Europe*, Oxford: Blackwell.

Maffei, Domenico (1975), 'Un trattato di Bonaccorso degli Elisei e i piu antichi statuti dello Studio di Bologna nel manoscritto 22 della Robbins Collection', in *Bulletin of Medieval Canon Law*, 5: 73–101.

Maniaci, Marilena (1996 [1998²]), *Terminologia del libro manoscritto*, Milano, Roma: Istituto centrale per la patologia del libro.

Maniaci, Marilena (1995), 'Ricette di costruzione della pagina nei manoscritti greci e latini', in *Scriptorium*, 49: 16–41.

Montecchi, Giorgio (1997 [1994]), 'Le dimensioni del libro secondo la *Theorica et practica* di Sigismondo Fanti', in Montecchi, Giorgio (ed.), *Il libro nel Rinascimento*, Roma: Viella (I libri di Viella, 11), 93–107 (1st edition, Milano: La storia, 1994).

Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*, Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).

Orlandelli, Gianfranco (1959), *Il libro a Bologna dal 1300 al 1330 (documenti) con uno studio sul contratto di scrittura nella dottrina notarile bolognese*, Bologna: Zanichelli.

Ornato, Ezio (1985), 'Les conditions de production et de diffusion du livre médiéval (XIIIe–XVe siècles): quelques considérations générales', in *Culture et idéologie dans la genèse de l'état moderne*. Actes de la table ronde organisée par le Centre National de la Recherche Scientifique et l'Ecole Française de Rome, 15 – 17 octobre 1984, Rome: L'Ecole (Collection de l'École Française de Rome, 82), 57–84 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 97–116).

Ornato, Ezio (1991), 'La codicologie quantitative. outil privilégié de l'histoire du livre médiéval', in *Historia, instituciones, documentos*, 18, 375–402 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 41–65).

Ornato, Ezio (1994), 'Exigences fonctionnelles, contraintes matérielles et pratiques traditionnelles dans le livre médiéval : quelques réflexions', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit*. Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel (12–14 November 1990), Marburg: Institut für Historische Hilfswissenschaften, 7–31 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 117–159).

Parkes, Malcom (1976), 'The Influence of the Concepts of Ordinatio and Compilatio on the Development of the Book', in Alexander, Jonathan J. G. / Gibson, Margareth T. (eds), *Medieval Learning and Literature: Essays Presented to Richard William Hunt*, Oxford: Oxford University Press, 115–141.

Petrucci, Armando (1969), 'Alle origini del libro moderno. Libri da banco, libri da bisaccia, libretti da mano', in *Italia medioevale e umanistica*, 12: 295–313.

Petrucci, Armando (1983), 'Il libro manoscritto', in Asor Rosa, Alberto (ed.), *Letteratura italiana*, II, *Produzione e consumo*, Torino: Einaudi, 497–524.

Petrucci, Armando (1984), 'Lire au Moyen Âge', in *Mélanges de l'Ecole française de Rome* (Moyen Âge, temps modernes, 96), 603–616.

Pollard, Henry Graham (1978), 'The Pecia System in the Medieval Universities', in Parkes, Malcom / Watson, Andrew (eds), *Medieval Scribes, Manuscripts and Libraries: Essays Presented to N. R. Ker*, London: Scholar Press, 145–161.

Powitz, Gerhardt (1979), 'Textus cum commento', in *Codices manuscripti*, 5, 80–89 (repr. in Powitz, Gerhardt [ed.] [2005], *Handschriften und frühe Drucke: ausgewählte Aufsätze zur mittelalterlichen Buch- und Bibliotheksgeschichte*, Frankfurt a. M.: Klostermann [Frankfurter Bibliotheksschriften, 12], 57–81).

Rambaud-Buhot, Jacqueline (1990), 'Le Décret de Gratien, in Martin, Henri-Jean / Vézin, Jean (eds), *Mise en page et mise en texte du livre manuscrit,* Paris: Éditions du Cercle de la Librairie - Promodis, 201–204.

Rambaud-Buhot, Jacqueline (1990a), 'Les Decretales', in Martin, Henri-Jean / Vézin, Jean (eds), *Mise en page et mise en texte du livre manuscrit*, Paris: Éditions du Cercle de la Librairie - Promodis, 205–210.

Rizzo, Silvia (1973), *Il lessico filologico degli umanisti*, Roma: Edizioni di Storia e Letteratura (Sussidi eruditi, 26).

Rota, Andrea (1935), 'Un fondo giuridico ignorato dell'Archivio di Stato di Roma. I codici dell'Arcispedale del S.S. Salvatore ad Sancta Sanctorum', in *Archivi*, 2, 2: 155–177.

Saenger, Paul Henry (1982), *Space Between Words: The Origins of Silent Reading*, Stanford: Stanford University Press (Figurae. Reading Medieval Cultures).

Sella, Pietro (1932), *Sigle di giuristi medievali, in inspecie dello Studio bolognese, tratte dai Codici vaticani*, Bologna: Zanichelli (Biblioteca de l'Archiginnasio, 2/44).

Sella, Pietro (1935), *Nuove sigle di giuristi medievali*, Imola (Studi e Memorie per la Storia dell'Università di Bologna, 1).

Soetermeer, Frank (1989), 'L'ordre chronologique des apparatus d'Accurse sur les libri ordinarii', in Peláez, Manuel J. (ed.), *Historia del derecho privado. Trabajos en homenaje a Ferran Valls i Taberner*, X, Barcelona: Promociones publicaciones universitarias (Serie bibliografica de derecho historico e historia de las instituciones), 2867–2892.

Soetermeer, Frank (1990), *De pecia in juridische Handschriften*, Utrecht: Elinkwijk.

Soetermeer, Frank (1997), *Utrumque ius in peciis: aspetti della produzione libraria a Bologna fra Due e Trecento*, Milano: Giuffrè (Orbis Academicus, 7).

Sorbelli, Albano (1929), *Storia della stampa in Bologna,* Bologna: Zanichelli.

Speciale, Giuseppe (1994), *La memoria del diritto comune. Sulle tracce d'uso del Codex di Giustiniano (secoli XII–XV)*, Roma: Il Cigno Galileo Galilei Edizioni di Arte e Scienza.

Stelling Michaud, Sven (1963), 'Le transport international des manuscrits juridiques bolonais entre 1265 et 1320', in *Mélanges d'histoire économique et sociale en hommage au professeur Antony Babel*, I, Genève: Imprimerie de la Tribune de Genève, 95–128.

Thilo, Ralf Michael (1984), 'Drucke des Corpus Iuris Civilis im deutschen Sprachraum', in Koppitz, Hans-Joachim (ed.), *Gutenberg Jahrbuch*, 59, Mainz: Selbstverlag der Gutenberg-Gesellschaft, Internationale Vereinigung für Geschichte und Gegenwart der Druckkunst e. V., 52–66.

Tristano, Caterina (1991), 'Caratteristiche tecnico-formali dei codici dell'Italia meridionale tra IX e X secolo', in Vitolo, Giovanni / Mottola, Francesco (eds), *Scrittura e produzione documentaria nel Mezzogiorno longobardo*, [Cava dei Tirreni]: Badia (Acta Cavensia, 1), 55–89.

Tschichold, Jan (1965), 'Non-arbitrary Proportions of Page and Type Area', in Osley, Arthur Sidney (ed.), *Calligraphy and Palaeography. Essays presented to Alfred Fairbank on his 70th Birthday*, London: Faber & Faber, 179–191.

Weijers, Olga (1987), *Terminologie des universités au XIIIe siècle*, Roma: Edizioni Dell'Ateneo (Lessico intellettuale europeo, 39).

Marilena Maniaci

Words within Words: Layout Strategies in Some Glossed Manuscripts of the *Iliad*

After centuries of printed books, we moderns have become used to printed pages where the visual organization of space clearly subordinates notes to text by using a smaller type size and confining them to the lower part of the textblock. We might find it strange at first that medieval scribes never discovered the convenience of footnotes.[1] In manuscripts the various possible forms of what we could term 'accessory texts' do not occupy a single standard position: occasional annotations, sporadic glosses, or systematic commentaries are situated in different parts of the page according to a plurality of arrangements.

The popularity of specific solutions varied according to the period, the context, and the content of the works; the same solutions can be found in chronologically or spatially distant texts, as well as different solutions in different versions of the same text.[2]

Among the various types of association between text and commentary, glossing, or notes, the simplest case is that of continuous commentaries written on a roll or in a codex separate from the reference text; in all other cases text and commentary are found in the same book, resulting in a number of different layouts. Here is a summary list of the most widespread combinations:

– codices with commentaries entirely written after the main text (reproducing or not reproducing its layout)

First published as Maniaci, Marilena (2006), 'Words within Words: Layout Strategies in some Glossed Manuscripts of the *Iliad*', in *Manuscripta*, 50, 2: 241–268.

This paper reproduces, with slight variations and revisions, the text of a talk given at the Thirty-Second Annual Saint Louis Conference on Manuscript Studies (14–15 October 2005) at Saint Louis University in a session on codicology sponsored by The Bibliographical Society of America. I am very grateful to Gregory Pass, the organizer of this session, for having invited me to participate and for offering the opportunity to publish my contribution in this journal.

1 See Grafton 1997.

2 For an updated bibliography on the layout of commentaries in manuscript books, see Maniaci 2006. The references given in the following footnotes will therefore be limited to a bare minimum.

https://doi.org/10.1515/9783110743838-015

- codices with more or less extensive portions of text and commentary alternating within the written area (laid out full page or in two columns)
- codices with text and commentary closely interwoven within the written area in juxtaposing blocks of various size and form, creating a sort of 'check pattern'
- codices with commentary written in between the lines of the main text
- codices with commentary written in columns positioned to the right or (less commonly) the left or on both sides of the main text, in which case the commentary can be either within the boundaries of the written area or in the margins
- codices with full page or two-column layouts where the commentary forms an open or closed frame (or alternatively two half-frames), taking up part or all of the margins.

The reality of manuscripts is, as always, much more varied and unpredictable. It is further complicated by the stratification through time of annotations belonging to different hands, periods, contexts, and purposes that had to be fitted within whatever space was left on the page. In fact, recent research has suggested the limited use of a purely formal study of manuscript layout[3]and highlighted the greater interest of an in-depth analysis of the various ways in which scribes synchronized texts and glosses and were able to address the difficulties encountered in their work.

In this regard, it is evident that some methods of linking text and commentary were more problematic for scribes than others and are, therefore, of greater interest to codicologists. Two formats stand out at first glance for their complexity: the 'check' layout and the 'frame' layout. The difference between the two layouts is not solely visual; in fact, they entail two quite different working methods. The 'open' form of the check layout sets (almost) no limit to the extent of text and commentary to be copied on a single page, but requires the scribe meticulously to copy both of them together—page by page and block by block. The check layout, however, makes it easy for the scribe to supplement the commentary with additional material by extending at will the number and length of the glosses contained on each page. Alternatively, the frame layout is a 'closed' form; it isolates the commentary from the text, limiting it to marginal spaces that, while varying to some extent in size from one codex to the other, remain in any case predetermined and cannot be adapted to the needs of the moment. The 'exegetic capacity' of the frame layout is therefore limited to the capacity of the margins.

3 As proposed by Powitz 2005.

On the positive side, however, the frame layout allows scribes the freedom of deciding whether to transcribe the commentary along with the main text or in a separate stage. In short, both forms have specific advantages and disadvantages, the results of which can be shown only through an in-depth analysis of individual pages.

1 Commented Homeric codices

In Byzantine book production we have evidence of the (probably widespread) use of frame layout for majuscule codices from late Antiquity.[4] Frame layout was also widely adopted in minuscule codices from the 9th to the 12th century, after which it virtually disappeared, giving way to simpler layouts. The reason for the decline of the frame layout lies probably in the decreasing size of codices from the end of the Comnenian age, which 244 made the smaller margins unsuited to large quantities of text.[5] The frame layout was particularly used in the so-called catena (chain) of scriptural texts, a specific form of exegesis based on the linking of excerpts from the Fathers and early ecclesiastical writers.[6] However, it was already common early on in the commentaries of profane texts, both in prose and poetry. The annotations in the margins of classical Greek texts, however, are usually too few and discontinuous to be considered a running commentary, or they appear only in the first pages of the codex.[7] In most cases, the tradition of such commentaries does not demonstrate sufficient stability and is often attested by a single witness.

Commentaries on Homer, especially the *Iliad*, represent a significant exception, both for the quantity of surviving witnesses and for the relative stability of the commentary (for extent and content). Especially rich is the tradition of the so-called *scholia vetera* of the *Iliad*, consisting of 25 manuscripts (to which must be added the fragments attested in papyri), which has been documented in a

4 Basic updated bibliography on the relation of text and commentary in Greek papyri and late Antique codices can be found in Messeri / Pintaudi 2002.

5 On the dimensions and layout of Byzantine parchment codices, see Maniaci 2002a.

6 Despite intensive research, the history of the catena does not seem to be fully explained, both from the textual and codicological point of view. Dorival 1986, makes an interesting effort to take both aspects in account, but his conclusions require careful evaluation.

7 As it happens in Arethas's copy of Aristotle: Vatican City, Biblioteca Apostolica Vaticana, Cod. Urb. gr. 35; see Follieri 1969, pl. 18.

monumental and extremely accurate edition by Hartmut Erbse.[8] Though this is not the appropriate context to discuss the complex details of the composition of Homeric scholia, a glance at the stemma (Fig. 1) is enough to observe that four of the five oldest codices, all written between the middle of the 11th and the beginning of the 12th century,[9] are part of a same family (bT).

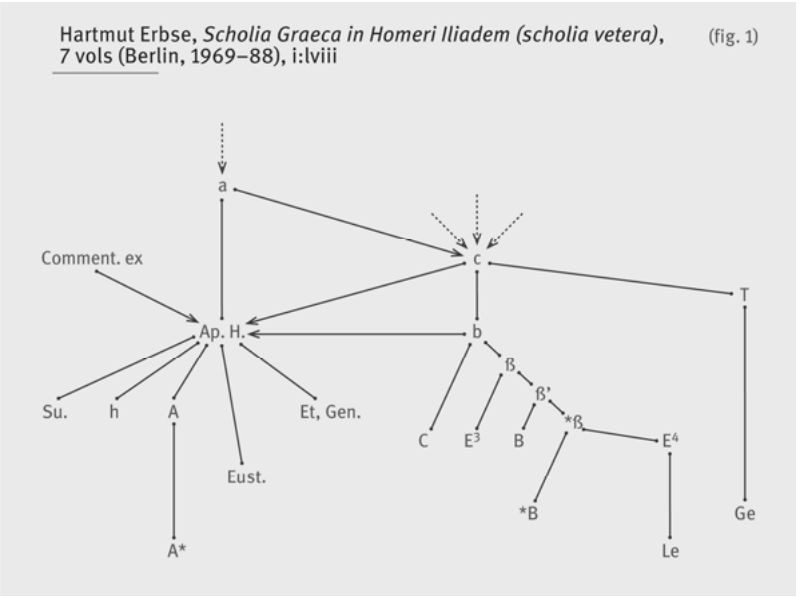


Fig. 1: Hartmut Erbse, *Scholia Graeca in Homeri Iliadem* (*scholia vetera*), 7 vols (Berlin, 1969–88), i:lviii

These manuscripts are: Venice, Biblioteca Marciana, Cod. Marc. gr. 453 (B) (Fig. 2); El Escorial, Real Monasterio de San Lorenzo, Cod. U.I.1 (E^3) (Fig. 3); London, British Library, Burney 86 (T) (Fig. 4); and Florence, Biblioteca Medicea Laurenziana, Cod. Plut. 32.3 (C) (Fig. 5). A fifth and older Venetian codex, Marc. gr. 454 (A) (Fig. 6), ascribable on a palaeographical basis to the middle of the 10th century, is the unique direct Byzantine witness of a different branch of the

8 Erbse 1969–88.

9 London, British Library, Burney 86 is the only manuscript of the group to be more precisely datable according to a partially illegible colophon on fol. 281V referring to 1014 or (rather) 1059.

tradition of the *scholia vetera*.[10] All five codices are characterized by a frame layout (with the commentary distributed on three or four margins) and are all, predictably, of medium large or very large size, a format never again attested in the tradition of Homeric commentaries (Tab. 1). Each of these five manuscripts is by a different scribe, responsible for both the main text and the bulk of the commentary, to which must be added, of course, the stratifications of later annotations. The two mid-11th-century witnesses in the Venice and El Escorial manuscripts (B and E^3) are so similar from both the physical and textual point of view that they can be referred to as 'twins'.[11]

All scribes clearly strived for legibility, doing their best to adhere to the basic criterion of keeping all glosses within the boundaries of the page to which they refer without straying onto the next. While they all share this main criterion and the choice of page-layout, the five scribes—including the 'twins'—differ both in terms of certain general formatting choices and of certain expedients adopted to address specific problems in the 'management of the page'. Some differences are already evident when we visually compare the codices, while others require a more indepth analysis. Because of all these features, commented codices of the *Iliad* represent an ideal example for illustrating the potential of a systematic approach to the study of the frame layout.

Dimensions of the five oldest *Iliad* codices with frame layout (in mm) (tab. 1)

Incunabula	Sigla	Century	H	L	H+L	Folios	Lines of text
Venice, Marc. gr. 454 (822)	A	10th	393	278	671	327	25
Venice, Marc. gr. 453 (821)	B	11th	405	315	720	338	12, 20–27 (20–24)
El Escorial, gr. 291 (Y.I.i)	E^3	11th	360	284	644	328	20–27 (20–24)
London, Burney 86	T	11th (prob. 1059)	305	240	545	281	27–29
Florence, Laur. Plut. 32.3	C	11th/12th	297	244	541	424	15, 20, 25

Tab. 1: Dimensions of the five oldest *Iliad* codices with frame layout (in mm)

10 See the complete facsimile with an introduction by Comparetti 1901.

11 For a detailed description, pointing out the similarities between the two codices, see Maniaci 2006.

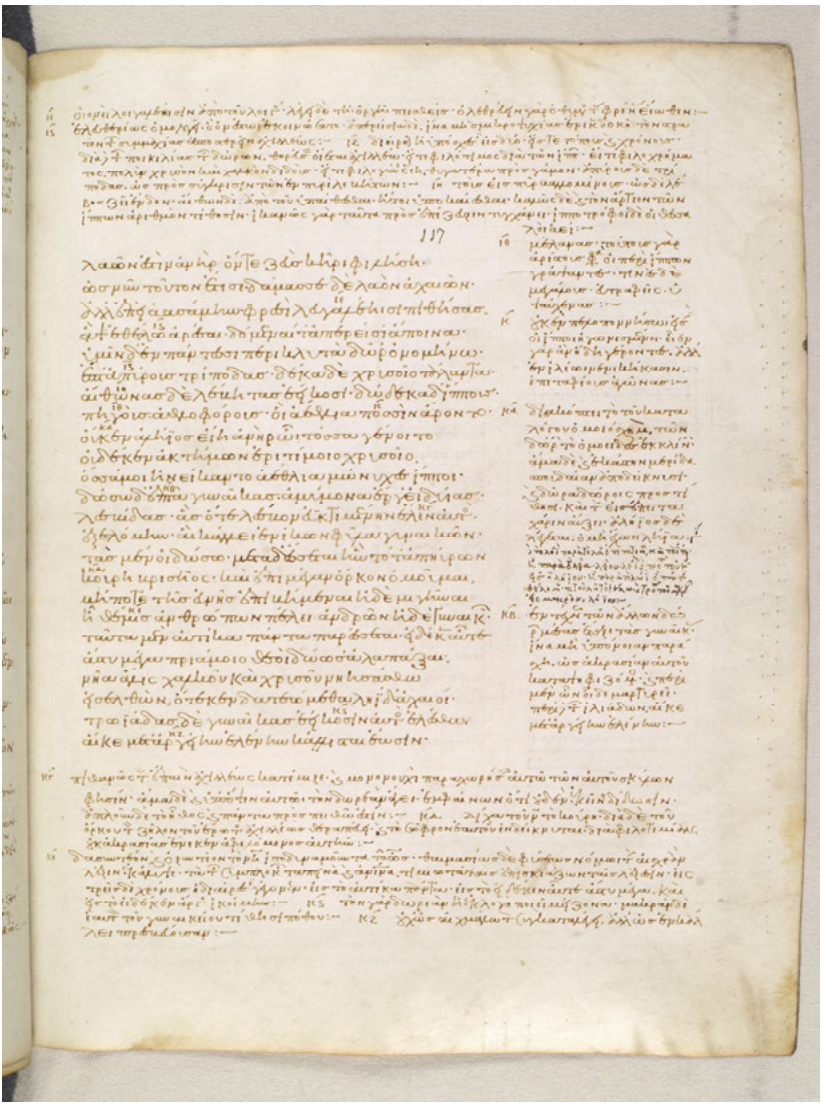


Fig. 2: Venice, Biblioteca Marciana, Cod. Marc. gr. 453 (B), f. 117r. With permission of the Biblioteca Marciana

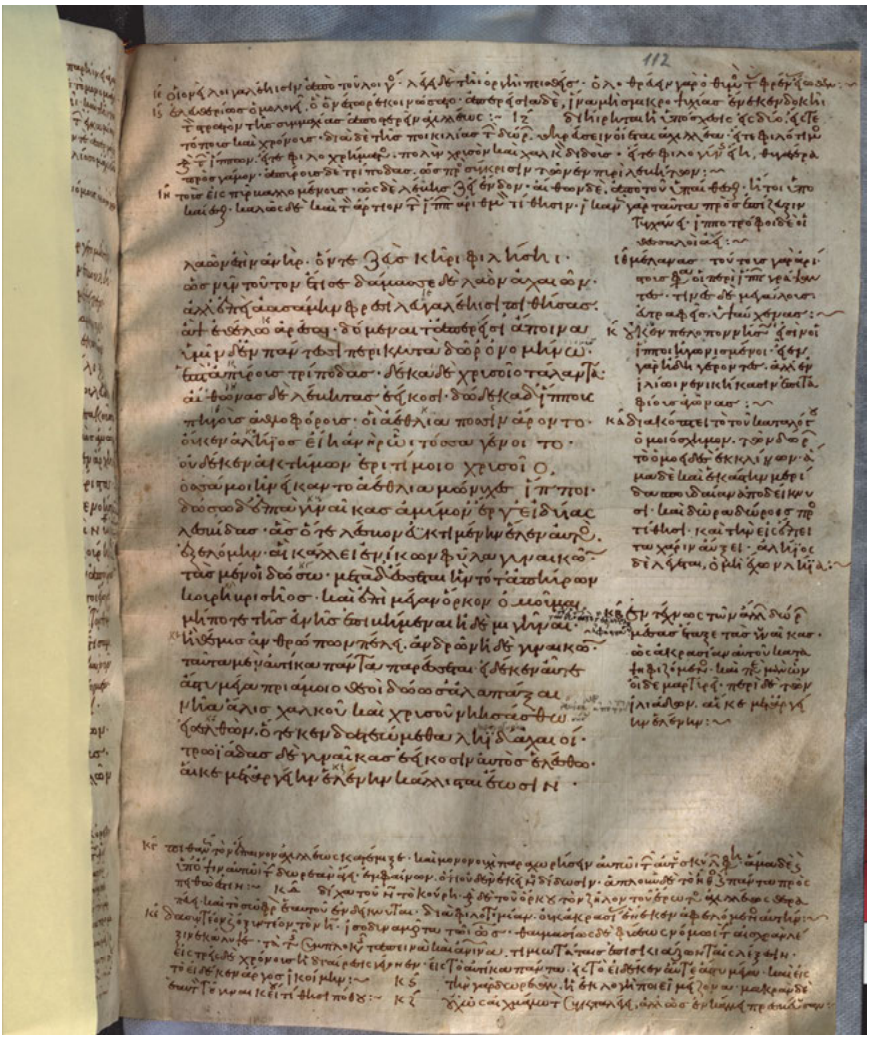


Fig. 3: El Escorial, Biblioteca del Real Monasterio di San Lorenzo, Cod. u.I.1 (E^3), f. 112r. With permission of the Biblioteca del Real Monasterio di San Lorenzo

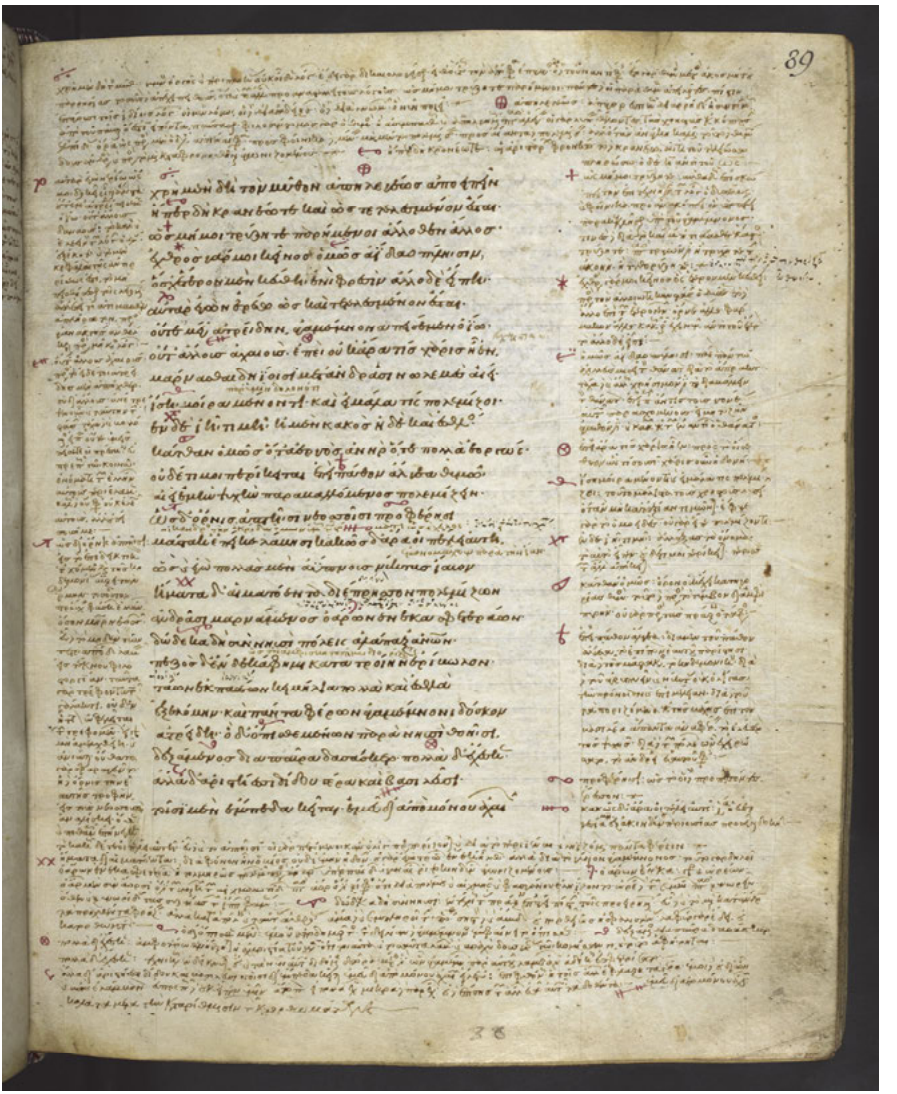


Fig. 4: London, British Library, Burney 86 (T), f. 89r. © The British Library Board

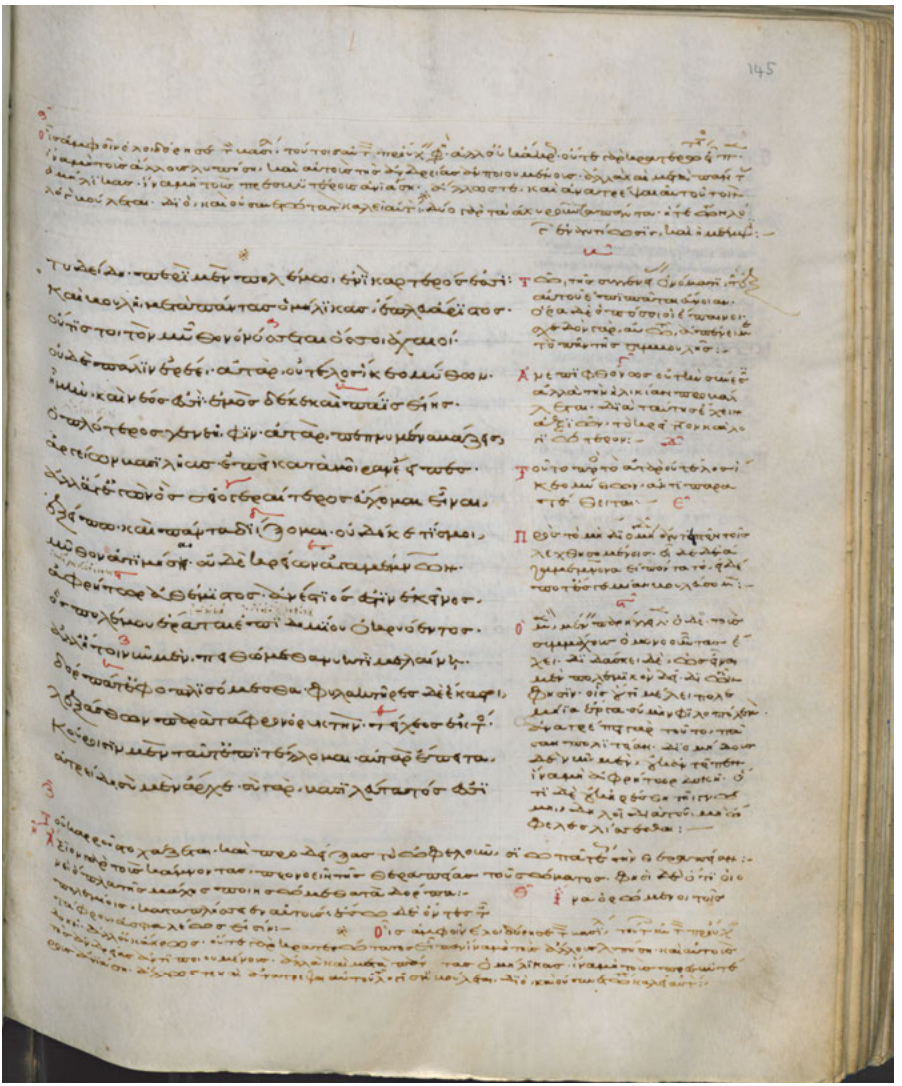


Fig. 5: Florence, Biblioteca Medicea Laurenziana, Cod. Plut. 32, 3 (C), f. 145r. With permission of the Ministero della Cultura (MiC)

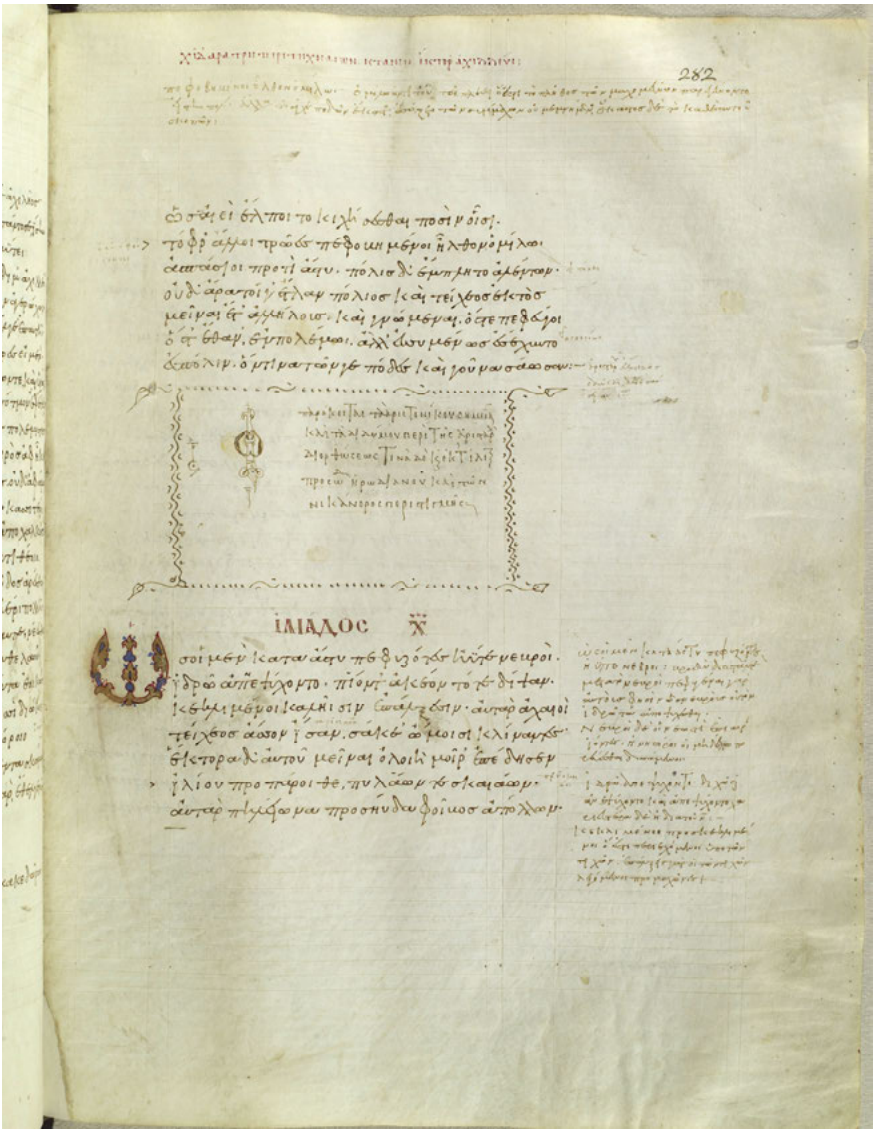


Fig. 6: Venice, Biblioteca Marciana, Cod. Marc gr. 454 (A), f. 282r. With permission of the Biblioteca Marciana

2 Methodological considerations

As I have already argued elsewhere,[12] when copying commented manuscripts, scribes must address two basic requirements:

– synchronizing text and commentary on each page (or on two facing pages) without, if possible, straying onto the next (especially in the case of *recto* and *verso*) and without inserting scholia too far away from the passages to which they refer, thus hindering legibility
– adequately linking each scholium to relevant passages, helping the eye go from one to the other

With regard to the first requirement, obviously the difficulty of synchronization is to some extent proportional to the ratio between the length of the main text and the length of the commentary: as the size of the commentary increases, so does the risk of difficulty in linking it to the main text. However, since the space occupied by a given sequence of words can be decreased by resorting to abbreviations or letter superpositioning, the actual size of the commentary will not be directly determined by the number of words or the characters to which they would normally correspond, but by the number of characters actually positioned on the written line. In any case, the total size of the commentary is not the only variable that may pose problems to the scribe. Total size being equal, a commentary consisting of many brief scholia will pose different problems from a commentary consisting of a few long ones: when the two typologies coexist in the same commentary (as often happens), it is the way in which they alternate that determines the level of difficulty (in unfortunately unpredictable ways). In general, the greatest factor in determining the difficulty of the scribe's work is the relation between the length of individual scholia and their frequency. A series of brief scholia referring to lines of the main text sufficiently distant from one another will not pose a problem. But the longer the scholia and the closer the lines to which they refer, the more the scribe's ability will be put to the test, the greatest difficulty occurring when a number of long scholia refer to the same line. To evaluate these difficulties it is necessary to consider: a) the position of each scholium on the page and b) the position of commented passages/lines.

In regard to the second requirement (that is, the association between text and commentary), the scribe must choose, in the first place, the way in which

12 Maniaci 2002b.

text and commentary will be 'linked.' In modern printed texts, linkage is achieved through numbers positioned in the spaces between the lines of the main text and at the beginning of each note, in a rigidly ordered sequence that can either continue throughout the entire text or resume its cyclical pattern after each chapter, section, single page, or pair of facing pages. This device is, indeed, also found in medieval manuscripts (Fig. 7), but along with it there are many other linking systems, such as what I would term a 'symbolic system' consisting of small, more-or-less elaborate drawings (Fig. 8), or a 'verbal system' based on the repetition of the first words of the commented text at the beginning of the note (Fig. 9). Furthermore, different systems could be used together in the same book (Fig. 10). It is not irrelevant, as will be shown, that all these modalities of linkage are attested in Homeric commentaries.

Independently of the linking system adopted, the reading of a commented text is influenced by the relative position of text and glosses, more specifically by the position of glosses in margin A, B, and C (and possibly D) and by the distance between each gloss and the lines of text to which it refers. In this case, too, the choices, the uncertainties, or the mistakes made by the scribe can have a considerable impact on legibility, though it remains difficult to gauge precisely.

For the evaluation of the above aspects (synchronization and linking) to be as accurate as possible, it is necessary to perform for each page a quantitative analysis based on a fairly complex series of measurements, whose detailed description and interpretation I have discussed elsewhere.[13] In this present article, I will limit myself to presenting a few examples of how quantitative analysis can be used to gauge the difficulties faced by the scribes, to demonstrate their choices, and to evaluate the reasons for and effectiveness of those choices.

13 See Maniaci 2006.

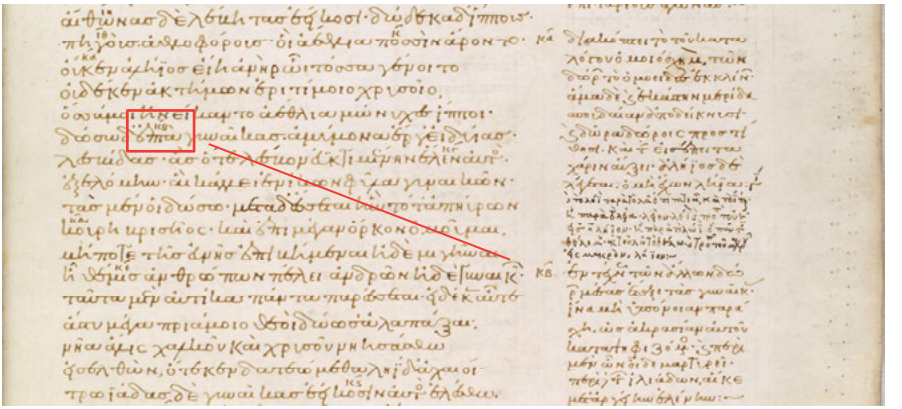


Fig. 7: Linkage of text and scholia by 'numerical system'. Venice, Biblioteca Marciana, Cod. Marc. gr. 453 (B), f. 117r. With permission of the Biblioteca Marciana

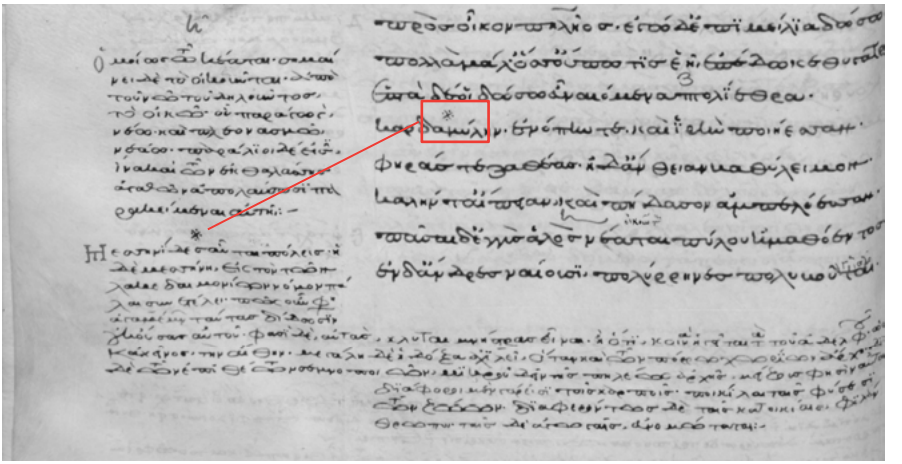


Fig. 8: Linkage of text and scholia by 'symbolic system'. Florence, Biblioteca Medicea Laurenziana, Cod. Plut. 32, 3 (C). With permission of the Ministero della Cultura (MiC)

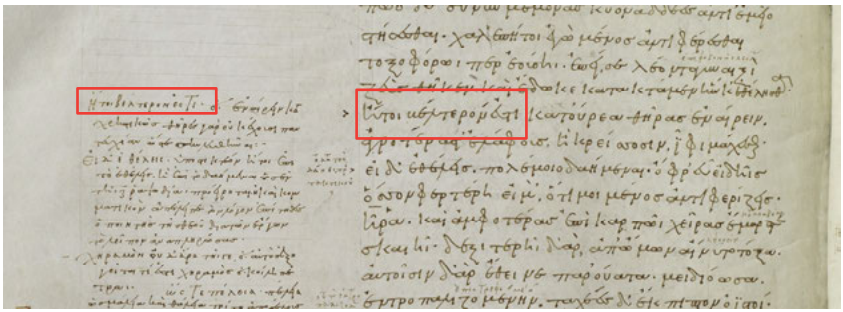


Fig. 9: Linkage of text and scholia by 'verbal system' (through lemmas or headwords). Venice, Biblioteca Marciana, Cod. Marc. gr. 454 (A), f. 279v. With permission of the Biblioteca Marciana

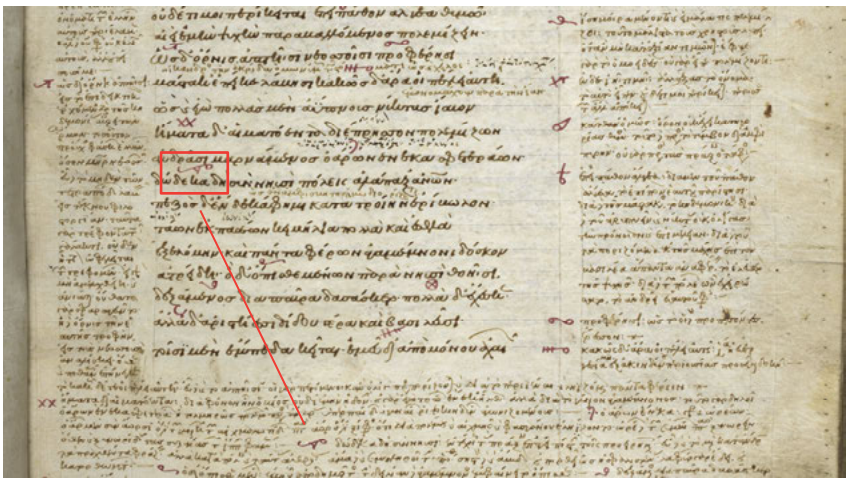


Fig. 10: Linkage cumulating two different systems (lemma + symbol.). London, British Library, Burney 86 (T), f. 89r, detail © The British Library Board

3 Codices B, E³, c, and T: general features

In all four codices we are dealing with (B, E³, C, and T, as well as Venetus A, for that matter), scholia are found in three of the four margins (upper, outer, and lower); only in Londinensis T are annotations also present at times in the inner

margin and between the lines.[14] While the four codices belong to the same exegetic tradition, the total quantity of commentary varies significantly: it is greatest in Londinensis T and least in Laurentianus C, which contains slightly over half the amount of commentary found in T.

Notwithstanding these differences, the quantitative distribution of the commentary throughout the poem follows similar patterns in the four manuscripts. In all four there is considerable variation from one book of the *Iliad* to the next, as is shown by the detailed calculations based on B and E^3 (Tab. 2). The 'density' of the commentary decreases from the beginning to the end of the poem,[15] a feature common also in other texts, especially when targeted at a school audience. The four codices also present a second and more unusual peculiarity: a sudden leap in density of commentary, followed by a period of decline, and then a sharp increase between books M and N, exactly half-way through the work. This peculiarity is accompanied in all four codices by a codicological caesura[16] at the end of book M, evidently meant to indicate the possibility of subdividing the work into two volumes. It was common, in fact, to comment more (and therefore to read more) upon the first books of both volumes and upon the first volume more than the second.

What then are the principles that govern the arrangement of exegetic scholia in the margins? A quick comparison of the size of the four codices allows us to grasp immediately the different working conditions of the respective scribes (Tab. 1). The two 'twin' codices are decidedly large for the Byzantine tradition and almost always have a fixed number of 24 lines per page. The other two witnesses are much smaller and marked by contrasting choices in regard to the number of lines: codex T has a high average of about 27–28 lines per page, while C opts for a much less cramped average of 17–18 lines per page.

14 All the remarks concerning London, British Library, Burney 86 (not considered in Maniaci 2006 depend on a recent analysis based on the microfilm and will be further developed and refined through direct study of the manuscript.

15 Book 1 (A) has been left out of consideration because its text is acephalous in E^3.

16 What I have elsewhere called a 'snodo'; see Maniaci 2000, 54.

Quantitative distribution of the commentary throughout the *Iliad* (B and E[3]) (tab. 2)

Book	Pages	Lines of scholia		Number of scholia		Average length (signs)	
		1st half	2nd half	1st half	2nd half	1st half	2nd half
Β	42	494	287	274	172	40.81	33.75
Γ	20	199	180	112	113	18.25	17.79
Δ	22	250	208	147	119	18.83	19.20
Ε	31	281	232	160	140	27.63	24.70
Ζ	21	196	193	116	118	17.02	16.56
Η	20	203	135	110	83	18.54	17.26
Θ	24	266	156	129	84	23.48	20.23
Ι	29	341	306	155	153	31.52	28.05
Κ	24	209	179	98	112	38.76	19.77
Λ	33	275	259	144	136	30.54	30.74
Μ	19	135	116	76	76	15.65	13.90
Ν	35	304	268	175	160	29.80	28.76
Ξ	22	233	191	134	100	19.65	21.81
Ο	31	278	246	162	125	26.47	30.51
Π	32	354	183	172	111	32.59	25.99
Ρ	31	220	183	109	91	30.84	32.61
Σ	21	161	200	78	117	20.20	17.75
Τ	17	155	127	94	66	13.04	14.68
Υ	20	176	134	85	72	21.03	19.10
Φ	25	225	182	117	127	23.57	17.11
Χ	21	210	160	124	102	16.76	15.36
Ψ	37	229	215	170	158	24.25	24.73
Ω	27	217	125	154	99	17.38	16.61
Total		5611	4465	3095	2634	556.61	506.97

Tab. 2: Quantitative distribution of the commentary throughout the *Iliad* (B and E[3])

To this we might add that all four scribes tend, though with some flexibility, toward what I have elsewhere defined as a 'fixed balance' page layout: that is, the number of text lines per page remains more or less the same and only the number of lines of commentary in the three (or four) margins vary. The 'fixed balance' offers some

advantages: it simplifies the preparation of the page and makes it easy to copy text and commentary separately if needed (because the amount of text to be copied on each page is fixed independently of the size of the commentary). However, as we shall see, the 'fixed balance' layout can also lead the scribe into trouble when the commentary is too dense or distributed in an excessively irregular fashion. A more sophisticated alternative (not adopted for the copying of Homeric scholia) is that of varying the number of lines of text per page according to the size of the commentary. This system avoids the pitfalls above, but requires very careful planning of the layout and ad hoc page ruling.

4 Page layout

In order to produce a more detailed analysis of the page layout of B, E^3, C, and T, I have focused on book IX (I) where the mass of commentary is at its highest, severely testing the ability of the scribes. As shown in the graph (Chart 1), in all four codices (B and E^3 are in fact identical) the size of the commentary gradually decreases throughout the entire book following a similar pattern. Particularly noteworthy is the complete absence of commentary on lines 263–299.

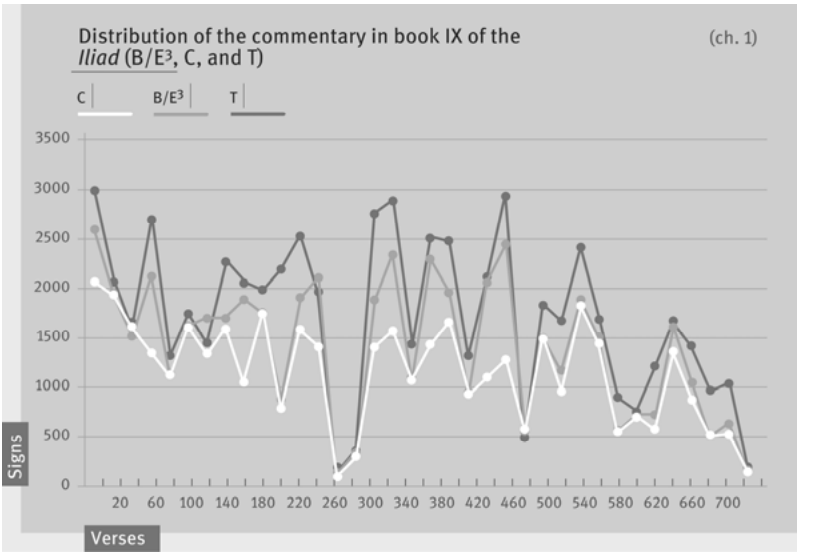


Chart 1: Distribution of the commentary in book IX of the *Iliad* (B/E^3, C, and T)

This anomaly, which is common to the entire tradition, probably dates back at least to subarchetype 'b' and could be the result of the loss of a leaf containing lines 263–299 (18 per page), which led to the missing lines being reinserted without commentary from another source.

If we consider (using the Erbse edition) the number of scholia in each codex, we note that T contains 91% of the total known corpus of exegetic scholia, twins B and E^3 contain 66%, and C contains 62%. The gap between the codices further increases when, instead of the sheer number of scholia, we consider their actual size, that is the number of graphic signs in the commentary: T holds 95% of the total, B and E^3 72%, and C 58% (Tab. 4). This is due to the fact that many scholia common to all four codices are found in a more extended version in T, whereas they are often mutilated in C. Furthermore, the scribe of C omits, as we shall see, a number of scholia, significantly chosen among the longer ones. Thus, in terms of the sheer mass of graphic signs the commentary in T is 25% more than that of B/E^3 and about 40% more than C.

Distribution of the commentary in book IX of the *Iliad* (B/E^3, C, and T) (tab. 3.1)

Verses	Codex T	Codices B/E^3	Codex C
1–20	2969	2590	2064
21–40	2062	1946	1946
41–60	1619	1504	1612
61–80	2695	2113	1346
81–100	1314	1127	1127
101–120	1734	1601	1601
121–140	1442	1690	1333
141–160	2264	1700	1577
161–180	2046	1882	1044
181–200	1980	1720	1742
201–220	2185	875	793
221–240	2520	1900	1581
241–260	1958	2092	1407
261–280	127	106	106
281–300	342	310	310
301–320	2475	1877	1407
321–340	2874	2336	1571
341–360	1434	1070	1070

→

Distribution of the commentary in book IX of the *Iliad* (B/E³, C, and T) (tab. 3.2)

Verses	Codex T	Codices B/E³	Codex C
361–380	2498	2289	1443
381–400	2473	1957	1654
401–420	1313	935	935
421–440	2113	2042	1099
441–460	2933	2438	1272
461–480	491	576	576
481–500	1824	1482	1482
501–520	1662	1163	960
521–540	2406	1859	1791
541–560	1684	1491	1451
561–580	896	559	559
581–600	754	699	699
601–620	1212	716	579
621–640	1625	1585	1316
641–660	1417	1041	877
661–680	964	518	518
681–700	1022	630	534
701–720	195	155	155
Total	61792	50574	41537

Tab. 3.1 and 3.2: Distribution of the commentary in book IX of the *Iliad* (B/E³, C, and T)

Percentage of the corpus of exegetic scholia transmitted by codices B/E³, C, and T (tab. 4)

	T	B/E³	C
Number of scholia	91%	66%	62%
Number of graphic signs	92%	72%	58%

Tab. 4: Percentage of the corpus of exegetic scholia transmitted by codices B/E³, C and T

This is not the place to discuss the stemmatic relations of the bT family of codices. I shall limit myself to noting that T certainly descends from a 'b' witness, from which also the progenitor of the B-C-E^3 ('c') group derives. The surplus commentary in T is a result of various factors: a) the addition of a number of 'non exegetic' scholia, taken also from Venetus A, b) the presence of scholia not found in the other three witnesses, and c) the presence of more extensive versions of scholia found also in the other three witnesses. Codex T appears thus as the direct or indirect result of 'selective assembling' of the commentary found in two or more codices. It is probably because of this that the scribe of T (like the one of Venetus A) adopts a reference system based on lemmas instead of numbers, which allows him greater freedom in the order in which glosses are transcribed (because it avoids the problem of having to organize the glosses on each page according to an ordered sequence of numbers). This system is integrated at a slightly later stage (that is, before the transcription of the interlinear glosses)[17] with a supplementary system based on symbols. The other witnesses, which follow a homogeneous tradition, adopt instead a numbering system based on two facing pages. I hope to give more details on this aspect in a further contribution. I shall rather focus here on the opposite way in which the scribes of T and C addressed the problem of having to transcribe a rather extensive commentary on much smaller pages than the ones used in the twins B and E^3. For reasons that I cannot deal with in detail[18] (but basically consisting in the adoption of excessively spaced lines and a system of 'dual function' guiding lines[19] used for both text and scholia), the scribe of C runs into trouble as soon as the mass of the commentary exceeds 1,100 or 1,200 signs in the Erbse edition. Having underestimated the required space in planning the layout, the scribe finds no solution other than cutting or omitting what he deems the more superfluous parts of the commentary (mostly in long scholia). In fact, there is a clear tendency in the scribe of C to overestimate the danger of saturating the page and therefore to cut excessively as shown by the fact that in all pages where cuts were performed, empty spaces remained at the end, which led the scribe to reinsert some of the previously excised commentary in the remaining space (Fig. 11). It is also interesting to note that most of the shortened or suppressed scholia refer to the lower third of the page, whereas the majority of the reintegrated ones refer to the top third. Evidently, cuts and omissions were not the result of careful planning but rather of improvised solutions based on rough estimates made when already half-way into the copying of the page.

17 The glosses 'jump over' the symbols in the interlinear space.

18 See Maniaci 2006, 233–234 and 257–266.

19 'Two-speed ruling', according to the English terminology developed by J. Peter Gumbert in his unpublished codicological vocabulary (*Word for Codices*).

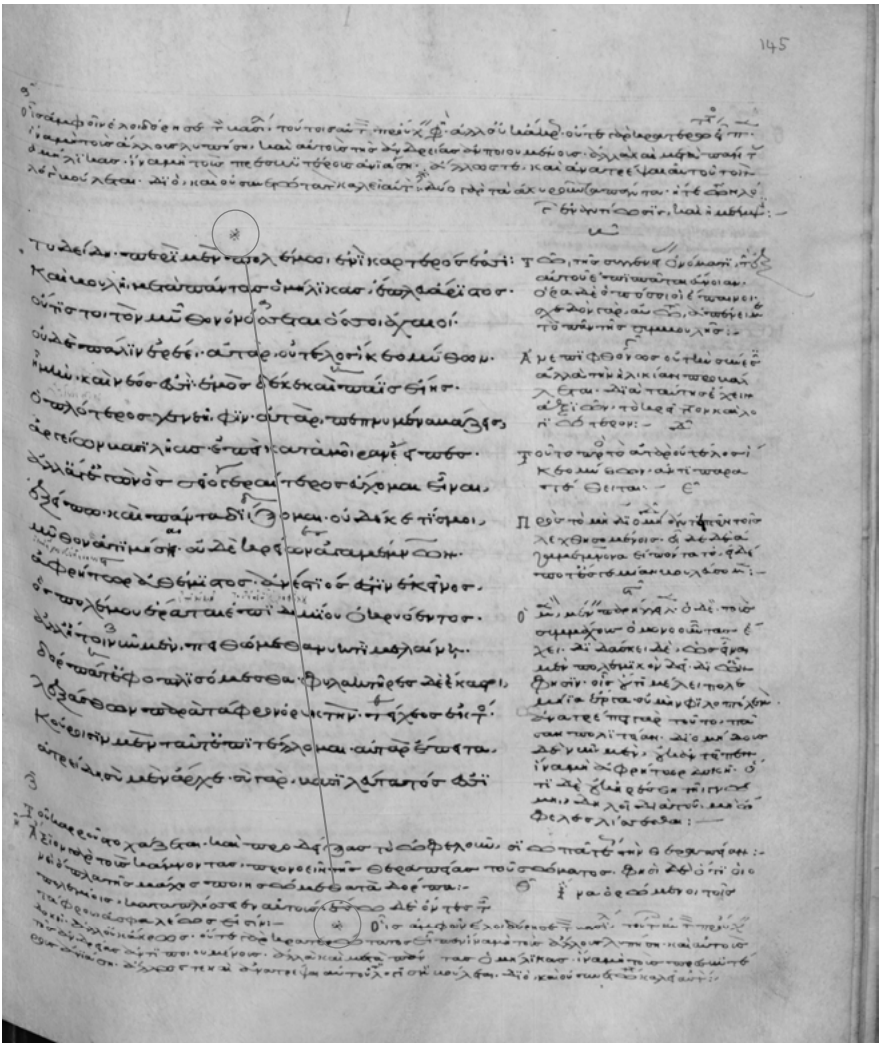


Fig. 11: Florence, Biblioteca Medicea Laurenziana, Cod. Plut. 32, 3 (C), f. 145r. Suppressed and later reintegrated scholia. With permission of the Ministero della Cultura (MiC)

The choices made by the scribe of Londinensis T are very different and marked by much greater foresight. Calculations based on the Erbse edition show that T can carry up to 4,500 graphic signs per page,[20] an exceptional value considering that in the much bigger codices B and E^3 the maximum number of signs is 3,300. Codex T, then, contains 25% more signs in a much smaller space. How did the scribe of T achieve this exceptional result? First of all, unlike other witnesses, codex T inserts scholia in the inner margin and interlinear spaces. I have been unable, for the moment, to identify any particular principle governing the distribution of scholia in these two areas other than the obvious fact that interlinear scholia must necessarily be short. In any case, these areas were clearly used as a sort of 'emergency lane', proof of which is the fact that the inner margin contains only 11% of the scholia against 46% of the external margin, while interlinear spaces contain about 8% of the total. About 20% of the commentary in T is therefore found in these additional areas. However, even without considering these areas, the average capacity of a page in T remains about the same of a page in the much larger codex B. This is due to the adoption of a proportionally smaller ruling unit and script, once again showing how in framed manuscripts good planning of page layout is essential for an effective arrangement of text and commentary. The negative results in codex C are reverse proof of the same.

But the evaluation of the codicological quality of the witnesses of scholia bT cannot be limited to their capacity. It is also necessary to judge the extent to which the particular arrangement of text and commentary facilitates the reading of both. One way to evaluate this statistically consists in notionally dividing the page into three horizontal sections and calculating the times a scholium positioned (or beginning) in the upper margin refers to a line of the first section and so on. Codices T and B/E^3 are generally able to maintain a correct alignment of commentary and text while C progressively falters and loses ground (Tab. 5).

20 Details will be given in a forthcoming publication [note of the editor: Maniaci 2006].

Alignment of commentary and text in codices B/E^3, C, and T (tab. 5)

Codex	Alignment between commentary and main text			Total
	First third	Second third	Last third	
T	78.26%	48.66%	91.89%	218.81%
B/E^3	81.93%	55.86%	80%	217.79%
C	81.36%	43.27%	76.09%	200.72%

Tab. 5: Alignment of commentary and text in codices B/E^3, C, and T

The T scribe, while facing greater difficulties than his colleagues of the 'twins' B and E^3, seems quite capable of containing the commentary within the page and organizing it effectively as far as the 'to and fro' of comment and text is concerned. The skill with which the copyist of T did his job is confirmed by the absence of any mechanism of compression or expansion of text and handwriting according to the circumstances: unlike other codices, in T there are no variations in the rate of abbreviations from one area of the page to the other, nor in the lateral compression of the handwriting.

5 Conclusions

The systematic analysis of the material features of the manuscript allows us, in a way, to look over the shoulder of the scribe intent on copying the text. In so doing, we realize how, behind the correctness of the text and the regularity of the layout, there lies an invisible and accurate organization of the textual flow over the page and within the individual line, a matter that becomes particularly delicate when the scribe must negotiate at once the flow of the text and the flow of the commentary. From this perspective, the direct analysis of codices is particularly important because it allows us to discover 'between the lines' the hidden rules that regulated a profession much more difficult than commonly believed.

The preservation of the scholia of the *Iliad* is due for the most part to the ability of the scribes: if Laurentianus C had been the only ungainly survivor, 40% of the exegetic scholia would have been lost, and little does it matter whether its commentary is globally better or worse than that of the other codices. Textual analysis based on abstract and purposely mechanical comparison of lectiones and *loci corrupti* is certainly capable of providing us with a plausible framework, a 'skeleton' to which, however, it is still necessary to add the 'body' of the textual

tradition. If we entrust ourselves blindly to the verdict of a *stemma codicum* we risk being led to wrong conclusions, losing our way in laborious and unconvincing arguments. In these cases, the detailed analysis of the written page offers an indispensable touchstone capable of definitely settling controversies between hypotheses that, in theory, may be equally possible in the light of what is materially possible and what is not.

References

Comparetti, Domenico (1901), *Homeri Ilias cum scholiis: Codex Venetus A, Marcianus 454 phototypice editus*, Leiden, Lugduni Batavorum: A. W. Sijthoff (Codices graeci et latini photographice depicti, 6).

Dorival, Gilles (1986–95), *Les Chaînes exégetiques sur les Psaumes: Contribution à l'étude d'une forme littéraire*, 4 vols, Leuven: Peeters (Spicilegium sacrum Lovaniense, 43–46).

Erbse, Hartmut (ed.) (1969–88), *Scholia Graeca in Homeri Iliadem* (*scholia vetera*), 7 vols, Berlin: de Gruyter.

Follieri, Enrica (ed.) (1969), *Codices graeci Bibliothecae Vaticanae selecti temporum locorumque ordine digesti commentariis et transcriptionibus instructi*, Città del Vaticano: apud Bibliothecam Vaticanam (Exempla scripturarum, 4).

Grafton, Anthony (1997), *The Footnote: A Curious History*, Cambridge, Mass.: Harvard University Press.

*Maniaci, Marilena (2000), 'La struttura delle Bibbie atlantiche', in Maniaci, Marilena / Orofino Giulia (eds), *Le Bibbie atlantiche. Il Libro delle Scritture tra monumentalità e rappresentazione*. Catalogo della mostra, [Milano]: Centro Tibaldi, 47–60.

Maniaci, Marilena (2002a), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Maniaci, Marilena (2002b), '"La serva padrona": Interazioni fra testo e glossa sulla pagina del manoscritto', in Fera, Vincenzo / Ferraù, Giacomo / Rizzo, Silvia (eds), *Talking to the Text: Marginalia from Papyri to Print*. Proceedings of a Conference held at Erice, 26 September–3 October 1998 as the 12th Course of International School for the Study of Written Records, I–II, Messina: Centro Interdipartimentale di Studi Umanistici, I (Percorsi dei classici, 4–5), 3–35.

Maniaci, Marilena (2006), 'Problemi di mise en page dei manoscritti con commento "a cornice". L'esempio di alcuni testimoni del'Iliade', in *Segno e testo*, 4: 211–298.

Messeri, Gabriella / Pintaudi, Rosario (2002), 'I lettori dei papiri: dal commento autonomo agli scoli', in Fera, Vincenzo / Ferraù, Giacomo / Rizzo, Silvia (eds), *Talking to the Text: Marginalia from Papyri to Print*. Proceedings of a Conference held at Erice, 26 September–3 October 1998 as the 12th Course of International School for the Study of Written Records, I–II, Messina: Centro Interdipartimentale di Studi Umanistici, I (Percorsi dei classici, 4–5), 37–57.

Powitz, Gerhardt (1979), 'Textus cum commento', in *Codices manuscripti*, 5, 80–89 (repr. in Powitz, Gerhardt [ed.] [2005], *Handschriften und frühe Drucke: ausgewählte Aufsätze zur mittelalterlichen Buch- und Bibliotheksgeschichte*, Frankfurt a. M.: Klostermann [Frankfurter Bibliotheksschriften, 12], 57–81).

Marilena Maniaci

At the End of the Line: Text Continuity and the Division of Words in Byzantine Manuscripts

From the earliest stages of their development, all horizontally arranged alphabetical writing systems have consistently divided texts into lines of equal length (as far as possible) and set them down in a regular way from left to right or from right to left, with one line placed on top of another until a pre-determined space has been partially or fully occupied.[1] Arrangement of the text in this way constrained

---

Translated from the Italian into English by Mark Livesey. Original published as Maniaci, Marilena (1997), 'Alla fine della riga. Divisione delle parole e continuità del testo nel manoscritto bizantino', in *Scriptorium*, 51: 189–233.

This contribution makes use, in part, of the data, ideas and results presented in a doctoral thesis in Greek and Latin palaeography produced between 1995 and 1998 (*Il libro manoscritto bizantino (secoli XI e XII): supporto, impaginazione, gestione del testo*), which is currently undergoing an in-depth review prior to its publication [note of the editor: published as Maniaci 2002]. I would like to thank Guglielmo Cavallo for his unwavering willingness to follow and to encourage the clear definition of my research interests, and for consistently inspiring me to publish my findings. I would also like to thank Marco Palma, who read a first draft of the text and improved it with his exacting and pertinent observations. My gratitude is also due to Ezio Ornato, who took a lively interest in following the progress of my work and participated in a generous fashion, thereby contributing in a decisive way to the simplification of various problematic issues, but at the same time adding new layers of complexity to others which had previously seemed rather more straightforward to me.

---

1 It is well known that in order to economise on time and energy, many ancient Greek inscriptions (above all those dating prior to the 5th century) were written in a boustrophedonic manner (i.e. 'in the direction of a ploughing ox'), which entails changing the direction of the script at the beginning of each new line, and sometimes also the direction of individual characters, or even—albeit more rarely, and in order to achieve particular aesthetic effects—in a stoichedic style, that is to say one which aligns the letters both horizontally and vertically, as in the boxes of a crossword (see Guarducci 1987, 28–30). It is not unlikely that the abandonment of this peculiar typology of text arrangement influenced the progressive refinement of layout requirements for inscriptions: in fact, boustrophedonic writing necessitated an alternate checking of each of the vertical extremities of the epigraphical rectangle, which entailed a doubling of the effort required on the part of the lapicide or *ordinator*. Conversely, stoichedic writing offered the aesthetic advantage of producing a perfect vertical alignment of the sequence of characters

https://doi.org/10.1515/9783110743838-016

the medieval scribe to exert a continuous effort in order to conform to a more or less rigid standard of uniformity that respects the grid laid out by himself or others when the page was initially 'constructed'.[2] On the other hand, the adoption of a unidirectional writing strategy—which requires a not negligible periodic shifting of the eye—is countered by the uninterrupted flow of the text, and consequently hampers the linear nature of the reading process.

The conflict that arises between the continuity of text flow and the discontinuity of the graphic 'chain'—and, as a result, between segmented writing and uninterrupted reading—manifests itself in a number of ways. The subdivision of the text into unidirectional lines impedes, *ipso facto*, an uninterrupted uptake of the transmitted message. Indeed, every change of line forces the reader's brain to make an effort to temporarily memorise the spatial coordinates and content of the previous line, at the same time as pinpointing the coordinates of the successive one and verifying the essential coherence of the written message. In the present contribution, this combinational procedure is referred to by the conventional term 're-assemblage'.

The success of the 're-assemblage' process—or at least of its comfortable application—is inevitably impeded by a number of factors. Some of these factors are directly linked to the visual perception of the written page: for example, the geometrically uniform succession of complete lines that are seemingly devoid of any individual character, but whose monotony is sometimes mitigated by distinct aesthetic and stylistic choices (typical of certain graphical systems and medieval ornamental devices). Another example is the succession, either intentional or by chance, of alliterations or anaphoras which tend to result in the overlapping of homeoarctons and homeoteleutons, a phenomenon which increases the possibility of faulty 're-assemblage' occurring.[3]

---

at the end of each line, albeit at the cost of a random subdivision of words (i.e. without respecting syllabic division) which happened to fall in this position.

2 This expression hints at a procedure that consisted in establishing, in advance, the spaces on the surface of the page destined to be occupied by the main text and those to be left blank. This was achieved through the application of criteria and procedures whose after-the-fact reconstruction has proved both difficult and controversial, given the almost total absence of explicit testimonial evidence. See Maniaci 1995; Maniaci / Ornato 1995.

3 Highly complex—and beyond the scope of my knowledge—is the array of research initiatives aimed at developing interpretative models of the interrelationships existing between the visual structures of writing and the ways in which they are perceived and interpreted through reading. Concerning these matters, which can be regarded as almost entirely modern disciplines, whose methods and approaches, despite being occasionally raised in palaeographical studies, remain largely unknown to manuscript historians as methods and data acquisition approach-

Other factors are dependent on the segmentation of the text into lines, a procedure that interacts in a complex way with the grammatical and syntactical division of the manuscript's contents. In whatever tangible way this 'interference' manifests itself, it exerts an influence—almost always a negative one—on the rapid and accurate reading of a text: if the distribution of the written lines coincides with the natural pauses in the discourse, memorising the content of a line will be made easier, but 're-assemblage' with the successive line cannot be entrusted—in the absence of other indications—to an intuitive reconstruction of the overall logic of the contents. In the opposite scenario, 're-assemblage' will be facilitated by the structure of the phrase, but memorising a truncated message will inevitably create difficulties.[4]

In addition to artificially superimposing itself on the syntactical structure of the discourse, the segmentation of a written text into a series of lines placed one on top of another brings with it the need to repeatedly interrupt the semantic continuity of the message, inasmuch as, assuming one keeps the length of each segment the same or roughly the same (a situation regularly made evident, in manuscripts, by the existence of a 'border line' set down in hardpoint or in colour), the interruption at the end of a line will not always coincide with the end of a

es, I will confine myself to directing the interested reader to the thought-provoking review by Mastruzzo 1995, 413–424.

4 It should be noted, in this regard, how common sense, following the logic of verbal language, dictates the rules of typographical aesthetics without too much concern for the functionality of the reading process. Indeed, it is the case that the pauses in verbal discourse have to coincide with syntactical structure: needless to say, the said rules also impose themselves on the reader's 'interior discourse', and punctuation techniques succeed in respecting them perfectly well. However, the segmentation of the text laid out on the page exerts an effect on the reading process at another level, which conforms to a different logic: in this context, the most effective line shift is the one whereby the final word in the previous line most influences the reader's pursuit of the next line. Thus, in the sentence 'Solo l'universo medesimo apparisce immune dallo scadere e languire: perocché se nell'autunno e nel verno si dimostra quasi infermo e vecchio, nondimeno sempre alla stagione nuova ringiovanisce' [G. Leopardi, *Operette morali*, *Cantico del gallo silvestre*], the seemingly most logical line change occurs after the infinitive 'languire', but instead the most effective one actually falls after the preposition 'dallo', inasmuch as a faulty 're-assemblage' with any lexeme other than a substantive (or substantive infinitive)—and only a substantive beginning with an impure 's' or with a 'z'—would raise an 'alarm'. It should be noted that the change after '"l" or "nell"'—which is also quite effective (since it necessarily connects with a substantive or infinitive beginning with a vowel), inasmuch as it is more open than the previous one—is forbidden by traditional orthographic rules (even if it is in fact increasingly tolerated). Also greatly frowned upon in the world of typography is a change of line between a reference sign and the reference itself: 'see p./348' upsets the most sensitive reader, even if it provides an effective reconnection with the successive line.

word.[5] The division of words at the end of a line (from hereon in referred to by the term 'splitting'[6] for the sake of simplicity) therefore constitutes a practically inevitable phenomenon which is intrinsic to the process of transcribing texts—and not only in the Greek context, which constitutes, as we shall soon see, the chief subject of the present research.[7]

Precisely on account of its widespread diffusion, in addition to the repetitiveness with which it occurs—and consequently the ease with which it can be observed—the phenomenon of word splitting offers a highly propitious area of study when conducting research into the legibility of the medieval book.[8] On the other

5 Needless to say, it is always possible to conclude all the lines of a text with a whole word, on condition that one is prepared to forgo the regularity of the two side margins, which appears to have represented, for texts in prose, an ideal that was already very widespread in the practice of manual text transcription. Curiously, in modern times this ideal had to be temporarily renounced when, with the advent of the typewriter, the inflexibility of the machine's mechanism made it too difficult to calculate the spaces that had to be left between one word and another in order to achieve perfect justification of a line. Not by chance, the automatic justification of lines was one of the greatest advantages vaunted by word processing systems when they were first launched on to the market.

6 The not altogether felicitous expression is used here in the absence of a better one (and also to avoid resorting to even more bold neologisms, albeit possibly more accurate, such as 'lexitomy' (Italian = 'lessitomia'), which is equivalent to the French 'coupure des mots' and the German 'Worttrennung'). The lack of an unambiguous, specific and established term to define, in its various aspects, the phenomenon under discussion provides an indication of the scant attention which has been paid to it up until now (not only in the field of palaeography, but also in the fields of orthography and the psychology of reading), a neglect which justifies the introduction of neologisms, with the aim of avoiding the need to continually resort to cumbersome circumlocutions.

7 The same can confidently be affirmed with respect to Latin and the principal modern languages of Indo-European derivation. It can also safely be presumed that other linguistic systems had to address similar concerns.

8 The specific problem of determining, after-the-fact, the legibility of medieval manuscripts has seldom been addressed—and then only at a theoretical level—in the palaeographical bibliography. In order to obtain a general impression of the set of problems concerned, one should consult, in particular, Bergeron / Ornato 1990, as well as some of the results obtained from an investigation of a sample of Latin and French codices dating from the 15th century presented in Bozzolo et al. 1987, 130–133. As regards the Latin context, the relationship between the changes seen in textual presentation—i.e. the separation of words, punctuation, and other aids to the reader—and the evolution of reading methods is elucidated above all in works by Paul Saenger, Malcolm Parkes and Richard and Mary Rouse (to which essential references can be found in the bibliographical review cited at the end of this footnote; additional titles are listed in successive footnotes). The dialectical debate on the copying process and the reading process during different eras of the Latin medieval period, along with reflections on the presentation of texts are addressed in Petrucci 1984. The interested reader can also consult the anthology edited by

hand, the analysis of strategies employed by copyists to optimise the segmentation of texts represents just one aspect of a much larger set of problems—a set of problems that we can identify with the blanket expression 'line management', namely the combination of principles that guided the copyist and the stratagems that he put to practical use so as to create pages that were at one and the same time both legible and aesthetically harmonious.[9]

In order to justify the choice of a phenomenon which, on the face of it, appears to be somewhat marginal as a topic for research, as a first step it is necessary to frame it within the wider context of a 'history of legibility' (yet to be written in its entirety) and a 'history of copying by hand', whose mechanisms have only been partially understood and outlined.[10] With this objective in mind, one can draw a parallel between the written page and a 'mine field' that conceals potential 'reading slip-ups' which occur quite frequently, and are fairly serious in nature—slip-ups whose frequency and gravity prove, in all cases, to be considerably increased when the reader is also the copyist, and therefore reads with the immediate aim of transcribing. This is because (a) any errors made in the copyist's work might be perpetuated in successive copies, and (b) because the 're-assemblage' process is far more tiring—and therefore riskier—for an amanuensis who is obliged to perform visual 'gymnastics' by constantly shifting his gaze between his copy and the model he is working from, than it is for an ordinary reader. In other words, the process of transcription involves something above and beyond simply reproducing a text in a new volume without losing any information, whilst at the same time respecting a set of fundamental aesthetic rules that more or less resemble those seen in the model. Indeed, the work of transcription entails tackling a series of tangible problems whose resolution depends not only on the objective difficulty of applying specific rules,[11] but also—to a large extent—on the ability of

---

Cavallo / Chartier (eds) 1995, with a detailed and well-thought-out bibliography on pp. 441-461. Unfortunately, only when the writing of this article had already been completed did I become aware of the contribution by Supino Martini 1996. On p. 40, with respect to the Latin world, the essay also touches on the set of problems that concerns us here, although somewhat oddly no mention is made of the previous methodological reflections of Bergeron / Ornato 1990, which pay particular attention to this issue.

9 Needless to say, both of these criteria are subjective, and therefore susceptible to variations in time and space: indeed, a text can be adjudged to be more or less legible, based on the competences of the person reading it—or on those of the audience/person destined to read it—or more or less aesthetically pleasing in relation to codified customs and individual tastes.

10 A chapter on the 'copyist at work'—providing essentially the same information—can be found in all the principal textbooks on palaeography, codicology and textual criticism.

11 Needless to say, the problem increases in relation to the number and inflexibility of the constrictions that the copyist—by his own volition or that of others—has to tackle. It is obvious,

the individual scribe. Therefore, if the scribe performs his task in an intelligent way, transcription also means assisting the reader (with stratagems that will vary in relation to his familiarity with the written material) by foreseeing and seeking to resolve in advance any ambiguous situations. However, the act of foreseeing necessitates work which, depending on the circumstances—i.e. the ways and extent to which stylistic traditions, functional needs and technological rigidness exert their influence—can prove to be quite demanding. For this reason, it is likely that the solutions of the said technical problems will take multifarious forms and will vary according to the different geographical, cultural and historical contexts concerned.

But in what way, in more concrete terms, can the division of words at the end of lines compromise the smooth progress of the reading process?[12] It is obvious that the presence of split words will never totally prejudice the correct interpretation of a text: indeed, the phenomenon can be compared to the formation of small whirlpools in a homogeneous body of water which impede its flow to a certain extent, but at any rate only temporarily. If we consider the simplest case—one which, moreover, is well-represented in the transcription of medieval texts—where a part of a word is 'forwarded' to the successive line without the use of a hyphen, it is already easy to see how merely the theoretical possibilities alone that this event raises might represent a source of continual ambiguity for the reader who, once he has reached the end of a line, will always find himself in one of the following two situations, briefly summarised as follows:

– (a) The final lexeme of the line (Z) cannot be considered semantically independent (in other words, it does not make sense in the language of the text).
– (b) The final lexeme appears to be semantically independent.

In case 'a' it is probable that the Z is the first part of a split word, but on the other hand it is not entirely out of the question that one is dealing with an error

on the other hand, that the material 'translation' of a text into a new form will prove to be far more demanding as the difference in presentation (i.e. size, text arrangement, script, decorative elements, abbreviations, etc.) between the model and the copy to be made increases.

12 Here, the expression 'reading process' is intended to mean the personal way in which a text is absorbed. Abstracting from this case—in many ways a rather particular one—the reading process contributes to the copying process. However, it should be noted in this connection (where the possibility of comparing an antigraph with one or more of its direct apographs exists) how textual criticism can serve as a very useful tool for the in-depth study of the 'history of legibility'.

made by the copyist (or a typographical error), or alternatively an uncommon word that the reader is not familiar with.

On the other hand, in case 'b' it is probable that the Z is in fact a whole word, but one might also be dealing with the first half of a split word which, owing to the freakishness of the case, has been afforded semantic independence.

In both cases, an examination of the first lexeme of the successive line (A) has to be carried out and its semantic value duly assessed. This necessitates determining not only the semantic value of Z and A considered separately (Z+A), but also that of Z and A conjoined (ZA). However, the recomposition of a semantically valid sequence is not sufficient: it is also necessary to confirm whether or not it proves to be compatible with the context of the discourse. With this objective in mind, the penultimate word of the line (Y) is examined, together with the second word of the successive line (B), in order to verify the respective pertinence of the groups Y+Z+A+B and Y+ZA+B. Even in cases where the reader is well versed in this type of exercise, the necessity to carry out all the verifications can only slow down his reading speed and hamper the 're-assemblage' process. In addition (obviously) to the personal attitude of the reader, the relative ease and speed of mental verification depend on the context, which is to say the degree of likelihood that the splitting of a word at the end of a line might create a misunderstanding, and the degree of plausibility of the misunderstanding generated.[13]

Regarding these general observations on the division of words at the end of lines, one could raise the objection that such examples of potential ambiguity are seldom encountered in the real world. In fact, the reality is precisely the opposite, even if, naturally, extreme[14] cases (H) are quite rare. For example, one has only to

13 Thus, for example, *non potest parvo res ma | gna constare* would not create any difficulty; *in ea coniu | ratione apprehendistis*... all things considered, would be less confusing than *illi | furi | bundo*...—where the first part of the split word, which has a full meaning, agrees with *illi*—in that the semantic value of *coniu* attenuates, in advance, the effects of the misunderstanding raised by the *ratione apprehendistis* in the following line; *mea est par | vitas illis*...—in which the three initial lexemes follow a logical course and do not immediately appear to be incompatible with the grammatical flow—would probably create greater confusion, but would seem less ambiguous than *mea est par | vis pauperibus*..., in which only the irrelevance of the context would represent a source of concern. Fortunately, phrases such as *sine virtute vir tute non vivit*... do not crop up very often in Latin.

14 In actual fact, a statistical analysis carried out on an incunabulum of good quality in the Italian language (Sallustio, *Opera*, Venezia, 1470, Windelino da Spira) demonstrated that more than 40% of cases in which the first or second fragment of the split word at the end of a line are endowed with semantic independence, and that 7% of both cases, considered separately, have a meaning in the language that the text is written in (which does not necessarily mean, obviously, that their succession is grammatically and syntactically coherent). (The relevant data

remind oneself of the fact that in inflected languages the division of words all too easily results in grammatical ambiguities (e.g. *matri-bus*; *amavi-mus*; λύω-μεν; whilst the abundance of prefixes frequently represents the source of modifications, or even semantic inversions such as *au-fero* | *af-fero*; ἀνα-βαίνω | ἐκ-βαίνω.[15]

A second objection, on the other hand, would not cast doubt on the ways in which the phenomenon appears, but instead would question the extent of their objective effects and their subjective impact. In other words, the reading difficulties caused by the division of words could be judged to be broadly speaking insignificant—or at least, not sufficiently serious so as to raise much concern on the part of medieval copyists and readers—above all in contexts where the division of words is not yet fully apparent and established in the graphic chain.[16]

This kind of objection can be countered by two striking facts: first of all, there is the use in some manuscripts, be they in verse or in prose—and of various content—of so-called subscripted letters (Italian = 'codini', that is 'little tails'). This involves the final letters of the final word on a page being transcribed into the

were kindly supplied by Ezio Ornato, who I duly thank.) Even in the absence of analogous statistics, one can assume that the Greek language is less susceptible to ambiguities of this kind, if one bears in mind its systematic accenting notation and the phonetic phenomena arising from the meeting of suffixes and desinences, and from apophony, all of which can modify the presentation of the theme and the position of the accent during the inflection.

15 It should be noted that in such cases the division of words respects the lemmatical and etymological structure of the word involved. Such a circumstance—which on first glance would seem to assist the reader in comprehending the text—turns out in reality to be detrimental to a smooth and correct reading.

16 Here, it should be recalled that in the Byzantine minuscule the coincidence between graphic unity and semantic unity took place gradually over a number of centuries and was never fully accomplished. Up until a time which has not yet been clearly identified through specific studies (but at any rate, after the 12th century), the distribution of blank spaces responded—broadly speaking—to a logic imposed by the capacity of individual letters to 'hook up' (towards the right) with the succeeding letter. The rules governing such a logic should be studied from diachronic and synchronic standpoints (some general observations—and corresponding research perspectives—on the tracing of the Byzantine minuscule can be read in Canart 1990. Additional bibliographical references are provided ivi, footnote 2). As regards the Latin world, Paul Saenger placed the widespread adoption of the 'canonically separate' script at the peak of a process that took place between the 11th and 12th centuries; this was the product of a demand for expository clarity by the medieval schoolmen and was closely related to the shift from reading aloud to silent reading (see, among the numerous contributions dedicated by the author to this subject, Saenger 1982; Saenger 1990; Saenger 1995). Starting at the beginning of the 12th century, the first to abandon *scriptio continua* in the transcription of Latin, thereby forcing themselves to isolate one word from another with the help of new punctuation marks, were the Irish scribes (see Parker 1987; Parker 1992, 20-29; Parker 1995).

lower margin located below the final line, so as to avoid having to transfer the entire word to the following page.[17] From the stylistic point of view, 'codini' are always segments of split words, inasmuch as the word concerned is divided into two fragments. However, the second fragment, instead of being inserted into the textual flow of the successive line, is transcribed under the preceding one, and therefore retains a specific and unambiguous connection with it. A solution of this kind has the advantage of eliminating any ambiguity in relation to the value of the final lexeme of the line, but at the same time it has the disadvantage of spoiling the uniform appearance of the page's presentation. It is therefore understandable that this solution is only occasionally encountered—and is limited to particular situations—in medieval manuscripts.[18]

The case with respect to hyphens[19] is different, since these were destined to be widely used both in handwriting and in modern typography. If one considers the simplicity and immediacy of the use of this sign, it is quite surprising to note how it only succeeded in establishing itself rather gradually, and even then, not fully, during the course of the Middle Ages.[20] This is true not only in the sense that hy-

17 The term 'codino' is derived, by analogy, from the typographical lexicon, in which it is used to refer to one or more lines that, during the composition of a text, exceed the length of the writing area, but which cannot be transferred to the following page. Such fragments are therefore placed in the lower margin, a small distance away from the text, in order to be 're-absorbed' (see Fioravanti 1993, 132, and Maniaci 1996 [1998^2], 167). Less frequently, in Byzantine manuscripts one also encounters 'codini' formed not from a few letters, but instead from the final words of a sentence (see, for example, the codex Vat. gr. 268, 11th century, in which about half a line often appears in the lower margin). Scant precise knowledge is available on the spread of the phenomenon and the circumstances that govern the presence of such fragments of text; however, one notes, for example, that in Greek two-column manuscripts 'codini' generally appear only under the second column, and very seldom—understandably—under the first column, although the text can easily extend from under one column to under the next, remaining on the same page. On the other hand, 'codini' that coincide with lines other than the last, similar to those encountered in Hebrew manuscripts (although these serve a different purpose), are entirely unknown (see below, footnote 40).

18 As will become clearer in due course, the use of 'codini' does not follow any entirely regular and coherent pattern. See below, footnote 119.

19 Maniaci 1996 (1998^2), 205.

20 The situation appears to be less clear in the case of the printed book, inasmuch as in manual typesetting, thanks to the total inflexibility of the writing area, the systematic division of words, marked by the presence of the hyphen, necessarily requires additional work. There is a lack of precise data on the precise moment in time when the hyphen appeared and spread in Byzantine manuscripts, but in any event its use remains altogether exceptional throughout the entire 12th century. Even if the phenomenon has not yet been the subject of any systematic survey, I can at least state that in our corpus one meets with very few instances: see, for exam-

phens do not appear in all codices, but also in that within one and the same codex—and even, quite often, on the same page—they can either be present or absent, proving at worst to be more troublesome than helpful. It is not, in fact, difficult to understand that if the presence of a sign is positively associated with a phenomenon, its absence will be regarded negatively, for which reason the sporadic application of a rule inevitably results in a false sense of certainty, and is therefore ultimately more detrimental than if there were no rule at all. Here, one is dealing, as in many other instances, with an example of the remarkable degree of sloppiness that characterises medieval manuscript production—a sloppiness which, to our eyes, appears to be present even when one cannot cite, as a partial justification, the rudimentary nature of preindustrial tools. It is a behaviour that is perhaps more ostensible than real, but in any event the 'key' to understanding it continues to evade us.

Whatever the case may be, the existence of subscripted letters and hyphens demonstrate that the problems raised by the division of words were very real, and as such were certainly experienced by medieval readers. It is also clear that whatever his technical ability may have been, the scribe was never entirely unconcerned about line change; indeed, the rule that insists on respecting the syllabic structure of words when they are divided established itself very early on, in the Greek and Latin worlds, at least. The existence of such a rule—which even in the absence of precise statistics can be considered to have been widely applied[21]—obliged the scribe to be capable of foreseeing the need to divide a word, as well as being able to decide on the precise point at which to make the division.

---

ple, the manuscripts Vat. Barb. gr. 525 [10th–11th centuries]; Vat. Barb. gr. 521 [11th–12th centuries]; and Vat. Pal. gr. 203 [11th century]). Only at a very advanced stage of the preparation of this essay did I become aware of Ruffini 1996, which I was not able to consult directly. Today, the development of ever more powerful and sophisticated word-processing programs that are able to minutely adjust spacing between letters and words (i.e. microjustification) so as to achieve the highest possible degree of line filling, has once again led to the redundancy of word splitting at the end of lines, and also, as a result, of the use of hyphens. In Latin manuscripts in Caroline minuscule of Italian origin the hyphen seems to disappear starting from the third/forth decade of the 11th century, according to indications in Petrucci 1968. According to Saenger 1990a, 453, the 'invention' of the hyphen is owed to scribes working in Benedictine monasteries in southern England in the first half of the 8th century, who later on introduced its use to scriptoria of continental Europe.

21 The rule had already been codified by grammarians in the Early Middle Ages: Petitmengin 1985, 107–108 and footnote 113, cites the case of Bishop Victor of Capua, who between 546 and 547 revised the orthography of the 'Codex Fuldensis' (Fulda, Landesbibliothek, Bonif. 1, CLA 1196) and corrected the division of words falling at the end of lines, based on rules inspired by Greek grammarians.

1 The necessity to split words: a simulation experiment

Subscripted letters and hyphens overcome the more serious problems arising from the division of words, but not the actual phenomenon itself: whichever remedy is applied, it is obvious that an intact word will always be more legible than one which is divided in two. Remedies demonstrate a clear desire to reduce the awkwardness resulting from the division of words, but not a concern to eliminate them, as far as possible, at their root. Theoretically, the two attitudes are not incompatible, but neither are they equivalent. One cannot, in fact, exclude the possibility that the total absence of split words was seen as the ideal goal in some instances, and that the remedies were used in situations where the ideal was simply not achievable.

How, then, can one 'measure' the existence of a working method aimed at preventing the appearance of the phenomenon one wishes to study—in other words, the absence of a phenomenon? Merely counting the number of lines in which the integrity of the final word is preserved is not sufficient, since whilst the presence of a split word always has a negative connotation—i.e. chance dictated that the final word on a line was too long to be included in its entirety—the significance of its absence is somewhat ambiguous: either fate had it that the length of the final word was not excessive, or the writer[22] ensured that the length of the final word coincided with that of the final segment in the available line.

A better and more scrupulous investigative approach—and one which can be accomplished in a reasonable space of time—consists in counting the number of lines that terminate with a divided word and then comparing the result of the count (carried out on a sufficiently large number of lines) with that obtained from a transcription selected entirely at random. In other words, a random probability model is employed which serves as a basis for drawing comparisons with observed reality.

Reducing the problem to its bare essentials, let us picture an alphabet whose letters are of invariable width, on a page whose lines, which likewise are of invariable length, are circumscribed by a strictly delineated border and contain N characters. Such a scenario, despite being simplified to the maximum, can be observed in a real situation (even if this is one which is now

22 Here, the term refers as much to the copyist (scribe) as to the typographical compositor.

rapidly approaching extinction), namely that of the typewriter.[23] In the case of a typewriter, a line is totally without flexibility; indeed, the transcription process moves inexorably from the beginning to the end of each line, and the writer cannot resort to the use of any expedient that will afford him the least amount of leeway to operate.[24]

Now, let us imagine an ideal 'raffle box' containing all the words making up the language being used, *weighted according to the frequency with which they occur*[25], together with a mechanism that successively extracts a certain number of them and compares, upon each extraction, the number of characters *C* already positioned on the line with the amount of space *S* remaining, which is to say with the number of characters that the line can still accommodate. The process is repeated until the value of *C* is lower than the value of *S*. If, after the final extraction, it is found that $C = S$, the mechanism will register a 'success' and go on to fill the next line; if, on the other hand, the result is $C>V$, a 'failure' is registered, meaning that the final word has to be split.[26]

What then, in theory, is the probability, respectively, of each outcome occurring? In order to be able to calculate this in a precise way, one would have to know the distribution of the word lengths—expressed through the number of characters they contain—in the language of the text undergoing analysis. The probability of word splitting will in fact be greater as the average word length increases, and in particular as the frequency of long words increases.[27]

---

23 The adoption of a proportional alphabet, which constituted the norm in manual and mechanical working practice in medieval times, complicates matters, as we shall see later on. This does not, however, greatly change the overall nature of the problem.

24 Such flexibility corresponds, in essence, to the degree of tolerance that one can afford oneself with respect to the pre-established number of characters per line in order to avoid splitting the final word.

25 This means that the imaginary 'raffle box' would include a higher number of the most common words, and a proportionately lower number of the rarest.

26 If we ignore the rather cumbersome presence of an opponent who conceals his cards, our imaginary mechanism can be likened to a baccarat player, or a player of the more popular card game 'Seven and a Half', who has to get as close as possible to attaining the maximum score, and ideally to achieve it. At the same time, though, he must not exceed the maximum, otherwise he will be disqualified. In any event, the player, even if he completely discounts the value of the successive card, enjoys a certain advantage, since he knows in advance the composition of the pack, and is therefore able to calculate, if he takes into account the sum total of the points already scored, the chances of his 'going bust'.

27 In the case of a proportional alphabet—where the words *filii* and *mamma*, which are both composed of five letters, but which are not remotely of the same length in terms of the amount of space they occupy on a line—it would be necessary to know the length of individual words in millimetres (or typographical points). In other words, the length expressed as the number of

However, even if the distribution of long words were consistent, for practical reasons such a calculation would still be impossible to carry out.[28]

In such circumstances one inevitably has to resort to a solution which, despite being far more simplified than the real-life situation, permits the analysist to create a good approximation of the theoretical model. This consists in simulating, with the aid of a computer, the conditions encountered during a real-life text transcription, by using a typewriter whose 'terminal margin' (i.e. tab stop)[29] has been blocked. For this purpose, two passages are inserted into a spreadsheet[30] (at the rate of one word per rectangular field, without considering punctuation),[31] one in Latin, one in Greek, with each text composed of 550 words.[32] Next, for each pas-

characters has to 'weighted' with respect to the width of each of the characters. In this way, the simulation would inevitably become more complicated, but the fundamental problem would remain the same. On the length of words in Latin and Greek, see footnote 35 below.

28 If one considers, for example, a line whose length is fixed at 50 characters (like the one that will be adopted later on in our simulation), the difficulty consists not so much in determining the splitting probability for each n <50 value hypothesised from the length of the text (this will be provided, obviously, by the frequency of all the words whose length is greater than 50 n), but rather in establishing the probability of each n <50 value, in relation to which the need to carry out a word split division is assessed. In fact, as soon as the value of n becomes quite large, the number of possibilities to achieve it through a given sequence of words becomes astronomical (n = 6 can already theoretically equate to: 6 words of 1 letter in length; 1 word of 1 and 1 of 5 letters; 1 of 2 and 1 of 4 letters; 2 of 3 letters; 3 of 2 letters; and 1 of 3, one of 2 and 1 of 1 letter, and so on, in 17 possible permutations, each with different probabilities. Combinational analysis (which forms part of the general theory of probabilities) does not provide a mathematical formula to solve such a problem.

29 This neologism is preferable to the term 'right margin', which, needless to say, is valid for writing systems that progress from the right to the left.

30 A spreadsheet is a form of software that permits the management of data inserted into lines and columns (which intersect each other to form a network of rectangular fields) that makes it possible—through the application of appropriate formulae—to perform calculations (including complex ones), apply statistical tests, create tables and generate two- and three-dimensional graphs of various kinds, all a lot more easily and rapidly than by using manual procedures.

31 Naturally, given that one is dealing with transcriptions of modern printed editions, the samples do not envisage the presence of abbreviations and acronyms. Clearly, this does not mean (as we shall see) that an assessment of the latter has no relevance within the framework of the set of problems being addressed. See below, 635 ff.

32 The pre-selected Latin text is the opening of the Life of Romulus (*de Romulo primo Romanorum rege*) from *De viris illustribus di Francesco Petrarca* (Martellotti [ed.] 1964, 6-8); the Greek text is drawn from Plutarch, *Caesar*, 63-64 (Ziegler [ed.] 1968, 327-330). It is only natural that both the textual typologies and the datings of the texts are not without consequence with respect to the distribution and the length of the words they contain. To reduce potential distortions as much as possible, two texts of similar content were selected.

sage a page composed of fifty 'pseudo-lines' is created, with each line containing eleven words, and all of them (obviously) containing a variable number of characters. Within each 'pseudo-line' formed in this way, a 'real line', limited to fifty characters, is created—ideally by advancing the carriage of the typewriter—which, depending on the length of the words it accommodates, either entails or does not entail a final word division.[33]

The test was performed under conditions of increasing 'tolerance'. To begin with, the number of 0 tolerance splits was calculated: this situation implies that the scribe was neither able to stop writing before he reached the margin nor to exceed it. In order to avoid starting a fresh line by splitting the final word, it was therefore necessary for the fiftieth letter to coincide *exactly* with the end of the word. Successive tests were carried out with tolerances of ±1, ±2, ±3 and ±4 characters.

Needless to say, the results obtained by applying such a test are inevitably subject to random variations, the extent of which it is worthwhile to verify by subjecting a sufficiently large number of text samples to the same procedure. Given that the inclusion on the calculation sheet of several dozen passages would have significantly hampered the practical side of the operation, the variability of the samples was also simulated by randomly 'shuffling' the words and lines.[34]

---

33 In theory, for the Latin sample, to the fifty characters envisaged per line, ten characters equating to the spaces between words should have been added. It is easy to see how the introduction of such blank spaces, being constant in number, would have pointlessly complicated the experiment, and furthermore would not have exerted an effect on the outcome. For the Greek writing, in which the distribution of the blank spaces never coincides exactly (in the centuries concerned) with the distinction between words (see above, footnote 16), the problem is only *seemingly* more complex: in the splitting of words, the scribe in any event referred to semantic unity, and did not allow himself to be swayed by their physical segmentation on the page. However, this does not mean to say that this particular distribution of blank spaces will not have repercussions for the problem we are presently addressing, inasmuch as even the blank spaces within individual words could be used by scribes to adapt the text to the length of the line.

34 Concerning the simulation carried out on the different passages, the approach settled on raises two problems, namely the population of words is always the same, but on the other hand, the sequence obtained is no longer a 'text', if by this term we mean a succession of words that form a logically coherent whole, rather than merely a series of words existing separately from each other in the language concerned. However, provided that the distribution of the length of words in the preselected sample reflects in a sufficiently faithful way that of the population of origin, the shuffling will result in a massive number of possible combinations, which guarantees sufficient variability. As regards the coherence of the text, this aspect does not appear to exert a negative effect on variability: indeed, it is easy to grasp how the probability of a word division occurring depends in the first place on the length of the final word that can be accommodated by the line, and in the second by the length of the sum of the preceding words. The latter parameter is not dependent on the order in which the words appear. On the contrary, one might say that the variability of the samples could be

The samples composed in this way more than anything make it possible to identify the parallels between Greek and Latin with respect to the length of words. Such parallels are not immediately obvious in advance, since the two languages—both of which are inflected—differ, owing to the presence in Greek of an article, which in theory should reduce the average length of words. In reality, the overall average word length is practically the same in both languages (5.49 for Greek, and 5.80 for Latin),[35] which reveals, when viewed from this perspective, a large degree of structural similarity, even if distribution trends in each language do not coincide perfectly (Chart 1).[36] The similarity observed with respect to the length of words is reflected in the theoretical distribution of word splitting, which remains almost the same in both languages, regardless of variations in the tolerance level (Tab. 1).

---

even greater in an incoherent discourse, inasmuch as a succession of very long or very short words is perfectly compatible with the rules of the particular case, but this is more unlikely to happen in reality.

35 The Greek sample effectively contains a manifestly higher number of words composed of 1, 2 and 3 letters (the bulk of them being prepositions and articles—the latter not existing in Latin), but Latin is richer in words in the next band up, composed of 4, 5 and 6 letters, which to a certain extent compensates for the variation between the two language systems. The greater presence of short words in the Greek language is also reflected in the wider scattering of the distribution (the coefficient of variation—which is to say the relationship between the quadratic deviation and the mean—equates to 53.3% for Greek and 46% for Latin. One can offer as an example the count carried out on two samples composed of 550 words, with respect to the frequency of words in relation to the number of syllables. If the words are arranged in order based on an increasing number of component syllables (from 1 to 7), the words included in each group turn out to be, respectively, 137, 200, 128, 96, 1, 1 for Latin, and 191, 144, 130, 57, 22, 5, 1 for Greek. One notes that, as expected, Greek contains more words composed of one syllable (mostly articles), whereas Latin is richer in disyllabic words. This difference notwithstanding, the sum of words which contain from one to three syllables is identical in both languages. It should also be noted that the two means with respect to the length of words used in the text represent only an approximation vis-à-vis the medieval transcription process employed for Greek and Latin texts, owing to the effect exerted by the different rates of abbreviation employed in the two separate linguistic contexts (which are difficult to compare in the absence of systematic studies for the various periods concerned), and by the width of the omitted letters (for example, it is well known that the letter most frequently eliminated in Latin is M, though it is also the widest letter, whilst Greek minuscule script does not include abbreviations for π, which together with ω, is usually the widest letter in that language).

36 It is interesting to observe that a sample composed of just 550 words is sufficient to produce curves that are well defined and clearly convergent, in contrast to what happens with other phenomena related to the grammatical and syntactical characteristics of texts (i.e. the frequency of determinant words or constructions), which result in much wider variations (e.g. discrimination in the case of lexical analysis and textual criticism, for attribution and stylistic characterisation purposes).

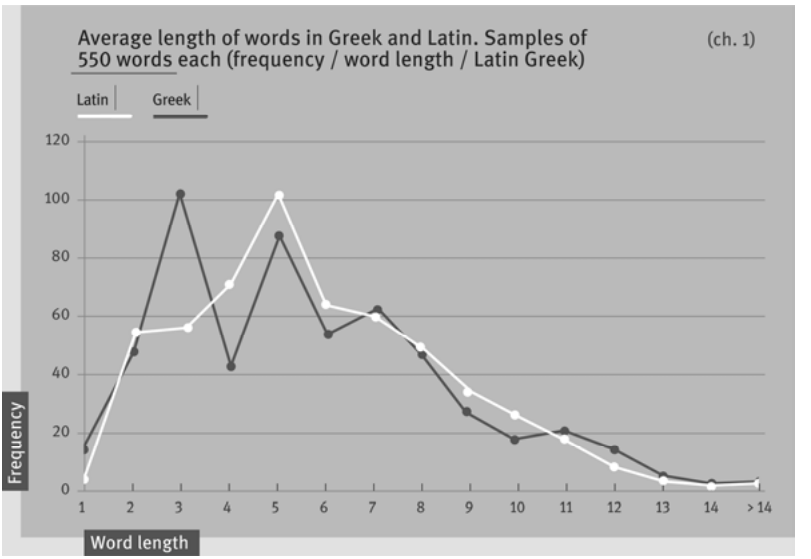


Chart 1: Average length of words in Greek and Latin. Samples of 550 words each (frequency / word length / Latin Greek

Theoretical distribution of word splits in a Greek and a Latin sample of 550 words — tab. 1

'Elasticity'	Greek text	Latin text
0	73.2	69.0
± 1	41.4	43.2
± 2	22.2	22.8
± 3	9.6	10.4
± 4	2.6	3.3

Tab. 1: Theoretical distribution of word splits in a Greek and a Latin sample of 550 words

As should be plain, the frequency with which word division is resorted to rapidly diminishes with the increase in tolerance, until it touches on zero. The explanation for this phenomenon is clear enough: the computer works in a rather 'dimwitted' way, albeit with utter efficiency. This means that, if the margin of toler-

ance is ±4, all the words of fewer than nine[37] letters in length escape being divided. It does not mean, however, that all the words of more than nine letters in length will necessarily be split, inasmuch as this depends on the sum of the lengths of the preceding words; indeed, the probability of word splitting is positively correlated to this parameter.[38]

In the case of a line entirely lacking any degree of tolerance, the average frequency of word splitting is about 70%. Can we permit ourselves to use this result as an aleatory 'yardstick' with which to conduct an investigation of the working practices employed by medieval copyists, then? The answer is in the negative: the copyist, even if he wanted stubbornly to forego the possibility of exercising any control over the issue which concerns us here, could not have worked within a margin of error of zero, because the rule that demands respect for the syllabic structure of a word cannot be applied if one does not allow oneself a certain degree of approximation in either one direction or the other. Unfortunately, we do not have at our disposal any statistics on the distribution of the lengths of syllables in various languages, but we can quite reasonably assume that long syllables are in a clear minority both in Greek and in Latin.[39] Working within a margin of error of ± 1—in other words, being prepared to accept that the last word of a line can terminate with a character lying either before or after the page justification—therefore makes it possible to respect the rule in the great majority of cases. Under such conditions, the average frequency of word division descends to under 42%; this is the value that will be adopted for the present investigation as a basis for comparison.

To minimise the need to split words at the end of a line therefore necessitates endowing it with a certain degree of 'elasticity'. Here, the term 'elasticity' is intended to mean the capacity to ensure that the end of a line coincides with the end of a whole word. The easiest way to achieve this aim—which is the same, ideally, as that used in our experiment—consists in simply ignoring, up to a point, the

37 Here and elsewhere, the spaces between words have not been taken into account. The presence or absence of the same, as has already been stated (see above, footnote 33), does not have any effect on the theoretical modelling of the process.

38 Taking up again the previously expressed formula, and continuing on the basis of the ±4 hypothesis, if C n-1 = 45 (where C stands for the number of characters per page and n-1 the penultimate 'draw'), only words composed of more than 9 letters will be split. However, if C n-1 = 40, only words composed of more than 14 letters will be divided.

39 In the two samples consisting of 550 words, the number of syllables ranging from 1 to 5 letters is, respectively, 104 (1), 761 (2), 445 (3), 52 (4), 1 (5) for Latin, and 119 (1), 546 (2), 530 (3), 75 (4), 3 (5) for Greek. Syllables composed of 1–3 letters prevail in both languages, even if Latin has more syllables composed of two letters, and Greek more syllables composed of three.

'terminal margin', and instead concentrating on either a lower tolerance (i.e. 'containment') or a higher one (i.e. 'overrun'). In such circumstances the margin will act as a simple 'signal', whose function can be compared to that of the margin bell on an old mechanical typewriter. This solution can be applied immediately and does not require any special attention to be paid on the part of the writer. On the other hand, it also breaches to a greater extent the regularity of the writing area's boundary.[40] For this reason—apart from in cases of low-grade transcriptions, and especially those intended for personal use—the copyist never has enough freedom to drastically reduce, and without too much trouble, his need to resort to word division. Nevertheless, in most cases it will be possible for him to eschew, up to a point, respect for the margin line, and to resort—albeit without going too far—to the two antipodal possibilities, namely overrunning the margin or starting a fresh line before reaching it, with the dual aim of respecting syllabic rules at the same time as avoiding breaks in the shortest words.[41]

In all instances where the copyist either cannot or does not want to 'abuse' the elasticity of the line—by adapting its length to a given sequence of whole words—he will, on the contrary, be forced to adapt the word sequence to the length of the line. In theory, this goal can be accomplished by making one or more of the following elements more 'elastic':

1. The tracing of letters. The writer can either compress or expand the script in a horizontal direction, based on the available space—albeit at the cost of sacrificing the regularity of the graphic chain, and therefore the appearance of the page.[42]

40 The arrangement of the text 'flush right' or 'flush left' conflicts with the existence of a visibly traced delineated writing area on the page, and therefore violates the 'regularity principle' which represents the guiding principle behind many aspects (as far as possible) in the making of the medieval book. See Ornato 1994, 9. In Eastern cursive scripts in the Arabic and Hebrew world, a concern for respecting the outer margin is made evident in the use of slanting script—positioned slightly below the line—in the final word, in order to avoid an overrun. See Beit-Arié 1992, 38 and Fig. 9.

41 For prototypographical editions, on the other hand, the border formed by the terminal margin is no longer merely a psychological limit, but instead forms a real barrier that necessarily has to be reached but not exceeded. Viewed from one standpoint, the copyist's task was more demanding, but viewed from another it should be noted that he enjoyed the 'luxury' of working on a line of 'virtual' text which could be 'dissolved' or incorporated—in theory, at least—at will, up until the moment the work was printed.

42 In reality, the aesthetic disadvantages resulting from excessive spacing out or compression of script can be reduced by using briefer allographs at the end of lines (although this is only possible with a few letters), or alternatively by superimposing letters. Conversely, a typographer is totally unable to intervene on the width of individual characters but, in addition to

2. The text. The writer can vary the length of the 'actual'[43] text according to the space available by introducing any necessary abbreviations to adapt the length of a word to the space in which it has to be accommodated, or, vice versa, by foregoing (with the same goal in mind) the most common abbreviations.
3. The 'non-text', meaning the spaces between words, the size of which can vary according to specific needs. This expedient, which in theory can also be applied in handwriting, is the one best suited to typographical applications, for which it is today universally employed.[44]

To verify whether or not, and to what degree (and with what objectives in mind) one or the other expedient was employed in the production of a medieval book would call for a minute examination, line-by-line, of a vast number of pages in a sufficiently large sample of volumes. Whatever his interest may be at the outset, it would be unwise for a researcher to undertake such a laborious investigation without first confirming the validity of his initial postulate, namely whether or not the copyists of a given period and work environment were to some extent aware of the problems that we earlier on attributed to word divisions, and whether or not they actively sought to apply remedies whenever possible. This is precisely the

employing allographs, he can, if necessary, expand the space between one character and another (which is to say the unprinted space, known as 'spacing' in typographical jargon). The optimal distance between one letter and another is known as 'kerning'. In manual typesetting this space can be expanded as required, whilst its reduction is limited by the inflexible nature of lead type. Conversely, in photocomposition, kerning—also known as 'compression'—can be reduced even up to the point of superimposing letters. See Fioravanti 1993, 436–437 and 5.

43 Here, the word 'actual' is intended to mean the number of characters present in the text as it was transcribed, in contrast to the 'virtual' text, which contains all the characters that are theoretically necessary for the transcription of the same text in a specific alphabet, without resorting to abbreviations. Needless to say, the same 'virtual' text can correspond to a very high number of different 'actual' texts.

44 Due to shifting attitudes and continual technological development, the application of the regularity principle to the graphic presentation of the book gradually became more exacting; thus, in order to adapt the text to the length of a line, today's typographer is no longer able to use the full range of solutions that his medieval predecessor had at his disposal. Nevertheless, the regularity of the page layout—thanks to a carefully calculated and uniform distribution of spacing on lines—is today assured by the speed and efficiency of the automation offered by electronic typesetting techniques. However, manual typesetting (linotype) already made it possible to distribute blank spaces equally—without having to resort to complex calculations or great artisanal skill—through the use of a system of metal wedges which, when inserted into the blank spaces, 'stretch out' a composed line so that it reaches the two outer limits of the justification (Fioravanti 1993, 283).

hypothesis that, through the research that follows, we shall attempt to verify by focusing our attention, for now, on the Byzantine manuscript.

2 Recourse to word division in a corpus of Byzantine manuscripts

The following results were obtained from a sample of 700 Byzantine parchment manuscripts whose dates range from the 9th to the 14th centuries.[45] In addition to some other characteristics that will be introduced in due course, the word divisions observed on 15 lines of three non-consecutive pages situated at the beginning, middle and end of each volume respectively, for a total of 45 lines, were counted.[46]

The average percentage of word splits observed across the entire corpus is slightly under 40% (i.e. 37.6%), which is a little lower than that observed in a simulation carried out on 550 words of Greek sample text (41.4%).[47] Therefore, the question has be asked whether this apparently slight variation is purely the prod-

45 More precisely, the manuscripts are divided according to each of the centuries considered: the 9th century 23; the 10th century 192; the 11th century 280; the 12th century 167; the 13th and 14th centuries 38. Naturally, the observations put forward in the text are valid for the three most representative centuries. Furthermore, it should be made clear that the fact that the sample does not include paper codices does not appear (at first glance, at least) to be relevant to the issue under examination. The choice simply depends on the fact that the manuscripts were gathered and examined in the context of a wider research initiative which was dedicated more generally to the construction and utilisation of pages in Byzantine manuscripts on parchment. For making it possible for me to carry out, in a relatively short time, the examination of a large number of volumes, I gratefully acknowledge the generosity of the Prefect of the Vatican Apostolic Library, Father Leonard E. Boyle, and of the Vice Prefect Monsignor Paul Canart. I also gratefully acknowledge the help offered by the personnel working in the library's Manuscripts Department. For the assistance provided in assembling a suitable sample, I must thank Monsignor Canart in particular for making available, with characteristic generosity, his personal catalogue.

46 Obviously, one is dealing with a highly simplified surveying protocol, given the rather large size of the sample involved and the desire to contain within reasonable time limits this preliminary survey. A far more detailed (and consequently far more arduous) survey to gather the necessary data in order to carry out a more in-depth examination of the phenomenon has been suggested by Bergeron / Ornato 1990, 182–188.

47 See above 611–613 and footnote 32. This is the percentage obtained if one allows for a 'reasonable' degree of elasticity, equal to ± 1 character.

uct of chance, or instead if it represents a consistent and sufficiently significant difference so as to justify extending the analysis.

A statistical approach makes it possible to resolve the two opposing hypotheses by comparing the data harvested from the corpus with those we can theoretically expect to obtain—according to the calculus of probability—from a 'binominal distribution' (Tab. 2).[48]

Real and simulated number of word splits (based on their theoretical frequency) in the Byzantine corpus tab. 2

Number of split words per 45 lines	Actual number	Theoretical number
0	1	0
6 (13%)	11	0
12 (27%)	92	17
18 (40%)	296	301
24 (53%)	258	349
30 (67%)	19	32
36 (80%)	18	0
45 (100%)	0	0

Tab. 2: Real and simulated number of word splits (based on their theoretical frequency) in the Byzantine corpus

In fact, the examination of 45 lines of writing in a manuscript can be equated to an *N* series of 'repeated trials'[49] in which the number of instances—in our case split words—taken into consideration is counted. Such instances are commonly known as 'successes'. If *P* indicates the probability of a suc-

48 Concerning the 'binominal distribution' or 'Bernoulli's distribution', see Blalock 1984, 191 onwards, and Giusti 1990, 448 onwards. In order for the function to be applicable, it is necessary that the probability of obtaining a success be the same for each test, and that each test be independent from all the others, and also that each experiment be repeated a predetermined number of times. Our sample, which consisted of 45 × 700 identical observations in individual volumes (different codices and, in the vast majority of cases, ones transcribed by different copyists), fulfilled all the necessary prerequisites.

49 The classic example employed in textbooks is that of coin tossing (i.e. the probability of getting a certain number of 'heads' and a certain number of 'tails' when a coin is tossed *n* times). See Blalock 1984, 152 onwards.

cess, in virtue of the function known a 'binominal distribution' one can calculate the probability *P* of attaining, in an *N* series of trials 0, 1, 2, ... *n* successes; in other words, in our case, the probability of attaining 0, 1, 2, ... *n* word splits in a sample composed of 45 lines, if we suppose $P = 0.41$, which corresponds to the average number of splits met with in an random experiment.[50] Once 700 observations have been made, the product of p x 700 will provide the theoretical frequency of the 0, 1, 2, ... *n* splits within our corpus, a figure which can then be compared to the instances actually observed.[51]

With respect to the theoretical distribution, the manuscripts included in our sample are more heavily concentrated than expected in the band that corresponds to the lowest percentage of split words (under 27%), which reveals, overall, the existence of a desire to avoid word divisions at the end of lines as much as possible. It remains to be shown whether or not such an ideal was uniformly distributed—in other words, whether or not the majority of copyists tended, in general, to avoid splits (albeit without making an inordinate effort to do so), or alternatively whether the problem was noticed by only a certain number of them who subsequently paid more attention to it.

To provide an answer to this question we can once again apply the test carried out above, although its basic parameters have to be changed, because the basis for comparison in this instance takes the form of a random binominal distribution where the frequency of word splits does not coincide with the theoretical one, but instead with that actually observed in the corpus (Tab. 3).

50 In fact, the mathematical law known as the 'Law of Large Numbers' (or LLN) shows that the average value observed in a sample, or in a series of samples, constitutes the best undistorted approximation of the probability value *P*, and that the more samples considered, the closer to the expected value it becomes. See Giusti 1990, 415.

51 In cases where the differences between the theoretical frequencies and the empirically observed ones appear to be of little relevance, the χ^2 test permits one to verify their statistical significance. (The χ^2 test makes it possible to compare an empirically observed distribution with a theoretical one, or to compare two empirically observed distributions. The higher the value is, the lower the probability will be that the difference is attributable purely to chance. Results can vary according to a distribution calculated by statisticians. Benchmark values are presented in specially produced tables, depending on the margin of error—or probability—that one is prepared to accept, which in current practice is fixed at 5%. It should be noted that the χ^2 value is very sensitive to the size of the sample involved; for small samples, it is difficult to obtain meaningful results. See Blalock 1984, 349 onwards).

Real and simulated number of word splits (based on the observed frequency) in the Byzantine corpus tab. 3

Number of split words per 45 lines	Actual number	Theoretical number/ actual average (38.11%)
0	1	0
6 (13%)	11	0
12 (27%)	92	52
18 (40%)	296	413
24 (53%)	258	226
30 (67%)	19	9
36 (80%)	18	0
42 (93%)	0	0

Tab. 3: Real and simulated number of word splits (based on the observed frequency) in the Byzantine corpus

Once again, a comparison with the theoretical distribution shows that the volumes containing only a few split words are more numerous than one might expect. However, a similar phenomenon can be observed at the far end of the distribution, namely in codices that exhibit a large number of split words (which are more numerous in the actual corpus than they ought to be in theory), whilst on the other hand, for the manuscripts that fall within the confidence interval (between 27% and 40% of split words in all the lines), the value for the actual corpus is somewhat lower than it is in the theoretical one. If the data is presented on a graph, the actual occurrence of word splits in the volumes examined would appear to be more 'compressed' than in the theoretical one, or in other words, it is less concentrated around the mid values. The dispersion observed at the two extremities of the actual distribution range probably reflects the 'mixed' composition of the corpus, i.e. the merging of two distinct groups of volumes that correspond to different attitudes on the part of the scribes with respect to the splitting of words at the end of lines. In one group, it would seem that the copyists placed a great emphasis on limiting the number of divided words, maintaining them under an overall average of 37.6%,[52] whilst in the other it would seem that the copyists

52 Needless to say, this purely indicative value does not imply that scribes specifically counted the maximum number of word divisions they were prepared to accept on each page of text. In fact, it

were entirely unconcerned by this contingency and tolerated a rate of word splitting which is very close to that of the theoretical average revealed in the simulation experiment (41.2%).[53]

3 Factors that influence recourse to word division: an initial hypothesis

In order to confirm the validity of the hypothesis formulated above, it is necessary to establish whether or not the cause of word splitting can be attributed to one or more characteristics in the codices being examined. This necessitates carrying out a systematic survey of the entire sample in order to identify some basic variables. However, an investigation aimed at discovering the reason (or reasons) lying behind the phenomenon requires that a few precautions be taken.

First of all, it is not enough to point to a systematic connection between the number of split words and another parameter of any kind, because the latter might automatically be assumed to explain the phenomenon. Indeed, many of the codices' characteristics are interdependent upon each other, and therefore it is essential to ascertain that the effect exerted by one of them, even if it is a very real one, is not merely a concomitant factor, or simply the product of another more fundamental characteristic.[54] For example, possible variations seemingly linked to the number of lines per page will probably reflect the influence exerted by a volume's size (i.e. the sum of its width and height)—upon which to a large extent this

should not be forgotten that the average numbers of splits calculated by us in 45 lines of each manuscript conceal fairly significant differences among the three samples composed of 15 lines.

53 The hypothesis concerning the simultaneous presence of two distinct populations seems to be contradicted by the finding that the distribution of actual volumes is characterised by a 'peak' (mode) between 40% and 53% of word splits (see Tab. 3). This 'peak'—which, furthermore, is more pronounced than that seen in the theoretical distribution—can be explained by the fact that it very likely combines the maximum values of one of the two populations and the minimum values of the other. One runs the risk of this illusory effect arising each time the averages of the two populations are quite similar to each other and the spread attributed to the classes is too wide to permit an accurate analysis of the distribution trend.

54 In borderline cases, a seemingly significant effect can turn out to be entirely illusory when subjected to a more detailed analysis. As is well known, the results of pre-election polls can be used in a misleading way if one does not take into account the sociological composition of the sample to which they relate, a step which is indispensable in order to obtain an accurate and correct interpretation of the collected data. The eliminable 'structural effects'—although not always easy to recognise and draw attention to—represent the main foe of any statistical investigation.

parameter depends—and will disappear as soon as the corpus is further subdivided according to the dimensions of the volumes it contains.[55]

Second, it is obvious that any phenomenon is easier to study as a general trend if one focuses one's attention on its most conspicuous manifestations—in other words, if the analysis is limited to the two extreme ends of the distribution, leaving out the central portion. This is particularly true for phenomena seen in manuscript volumes, where each and every example represents the fruit of an artisanal activity in which the craftsman's level of freedom—no matter how his task was organised and regulated—is always quite wide. For this reason, based on the rate of word division, the corpus under examination has been divided into three classes, namely volumes which exhibit a rate of less than 30% (under the average); volumes which exhibit a rate of 30%-42%; and finally those which show a rate of above 42% (above the average rate). By temporarily setting aside the central group, which is of more heterogeneous composition, it becomes possible to examine in greater detail two far more clearly differentiated groups of practically the same numerosity. One group is composed of 152 volumes in which the number of split words is too low not to be the result of a deliberate effort to limit its occurrence, whilst the other, contrarily, is composed of 166 volumes in which the word splitting occurrences are sufficiently numerous to enable us to rule out the existence of any serious effort made to limit them.

A relatively simple method to confirm the existence of a link between the phenomenon in question and any other variable consists in the subdivision of the latter into two 'opposite' classes in relation to an average value,[56] and then to

55 Strictly speaking, the effective validity of all bipartitions that appear to produce meaningful results should be verified by crossing the value that seemingly determines it with the highest possible number of other variables. In our case, in order to simplify the procedure, the variables that can be assumed to lack any connection with the phenomenon in question (for example, ruling systems or leaf signatures) can be excluded. Owing to the inevitable subjectivity of such value judgements, this procedure carries the risk of overlooking a certain number of relevant crossings.

56 It is important to remember that the variables which can be subjected to statistical analysis are of three types, as follows: qualitative variables that can be organised in nominal groups, and which cannot be placed in anything other than an arbitrary order, and therefore can only be judged on the basis of their similarity or dissimilarity (e.g. the position of quire signatures, either on the writing area or in the margin); qualitative variables that can be organised in a graduated order, that is arranged in an ascending or descending series, but which cannot undergo arithmetic processing (i.e. 'bad', 'mediocre', 'good' or 'outstanding' parchment quality); and qualitative variables that can be organised in a graduated order, and which can all be subject to arithmetic calculations (see Giusti 1990, 49–51). Whilst for qualitative variables the most obvious approach (indeed, the one adopted for this research) consists in taking the 'average value' to be the arithme-

cross reference them with the two extreme ends of the split word distribution. In this way, one can build a 'contingency table'[57] composed of four boxes (as shown in the example of Tab. 4). It can be said that the cross reference is significant or 'effective' if it is able to alter the subdivision of the two original groups of word splits (Tab. 4a)—which we have already seen to be almost equal[58]—and 'ineffective' if the opposite is true (Tab. 4b). It need hardly be said that in the real world one never encounters a situation that corresponds to one of the two possible scenarios described; rather, one typically encounters an intermediate situation, where the tendency towards one or the other extreme has to be evaluated on a case by case basis by applying the χ^2 statistical test.

Contingency table: model of distribution of word splits according to another variable tab. 4

	a			b	
	split words –	split words +		split words –	split words +
Variable –	80	80	Variable –	160	0
Variable +	80	80	Variable +	0	160

Tab. 4: Contingency table: model of distribution of word splits according to another variable

In order to identify the factor—or factors—which held the potential to influence the attitude of Byzantine scribes vis-à-vis the division of words at the end of lines, three types of characteristics were examined. In the first place, aspects attributable, broadly speaking, to the general concept of the 'quality of the codex' have to be taken into consideration. It is obvious that such a concept, which is difficult to define in objective terms, is not expressible in a satisfactory way by means of an indicator which is at one and the same time concise and devoid of any ambiguity.

tic mean of the distribution (even if in the case of very unbalanced distributions it is a good idea to utilise a different intermediate value so as to obtain two acceptable classes), in the case of ordinal qualitative variables all the gradations are reduced to just two classes that incorporate several sub-groups. In both cases, the classes obtained will be identified in the present text using the name of the variable followed by a + or – sign.

57 The 'contingency table' provides the simplest graphic representation of the interdependence of the two variables, with one inserted in lines and the other in columns. See Giusti 1990, 122.

58 47.8% as opposed to 52.2%. In Tab. 4, in order to simplify matters, it was hypothetically supposed that the sample is cleanly divided into two groups, each being composed of 160 manuscripts.

Therefore, one must settle for considering a few concrete characteristics—which are unquestionably linked to the cost of raw materials and the manufacturing and transcription time—that combine to determine, in more ways than one, the quality of a codex. These characteristics include the quality of the parchment,[59] the presence or absence of gilding, the complexity of ruling,[60] the exploitation of available space[61], and the regularity of the script.[62]

Another entirely plausible *a priori* hypothesis is that the mechanism which determines the splitting of words depends to a certain extent on the graphic typology of a given manuscript and, within each typology, on the greater or lesser degree of speed with which the script was executed[63]. The inherent difficulties associated with the classification of Byzantine scripts—and, more generally speaking, the 'reduction to pure numbers' of the characteristics of any handwritten script[64]—prevent us from being able to subject this particular facet of the prob-

59 Subdivided into four categories, and grouped progressively as follows: 'poor', 'mediocre', 'good', and 'outstanding'.

60 Expressed by the total number of surplus marginal lines, subtracting all those which are indispensable for the delineation of the writing area (including the lines that define the columns of manuscripts with 'double justification', which it was deemed unnecessary to consider separately, on account of their uniform distribution throughout the sample).

61 This is quantified by two parameters: the so-called 'black'—i.e. the relationship between the written area and the total area of the page, which serves as a page filling gauge (Bozzolo et al. 1984, 195–221, and 203)—and the average area of parchment occupied by an individual character (expressed in mm2), a concise indicator which is dependent on the size of characters, the height of the line and the overall dimensions of the page.

62 Expressed by the sum of the coefficient of variation of the width and height of the letter 'o'. Even if this parameter can reflect the influence of systematic variability factors—voluntary and involuntary modifications, either recurrent or non-recurrent, of the script module (Bischoff 1996)—it depends, to a large extent, on the transcription's level of accuracy.

63 If the existence of an interaction between writing speed and the frequency of word divisions at the end of lines appears, at first glance, to be very likely, it is rather less easy to establish whether or not this translates in concrete terms into an increase in, or containment of, the number of split words. On the one hand, the greater level of self-assuredness that typifies a swift hand might seem rather incompatible with the need to anticipate the length of final words in order to be able to avoid having to divide them; on the other hand, a fluid and agile ductus might lead to inadvertently exceeding the bounds of the justification, and therefore make it possible to avoid the need to split the final word on a line.

64 The potential—and limitations—of the use of a statistical approach in palaeographic studies, as well as the problems associated with establishing suitable parameters for the morphological measurement of writing speed and fluidity, certainly merit investigation, not only in theoretical terms but also on the basis of results gained from actual research. An example of the information that can be obtained by carrying out a series of basic measurements can be

lem to a detailed verification process. Nevertheless, it was still considered worthwhile to carry out a rudimentary survey[65], based on an examination of various purely dimensional aspects of the script (i.e. the relationship between the width and height of the nucleus[66] of a character; the relationship between the height of the nucleus and the total reach of the ascending stem; the difference between the total maximum height of the letters that can be written within a quadrilinear system and the ruled line; and finally the relationship between the height of the 'nucleus' of a character and the ruled line).[67]

Third, it was considered necessary to determine whether or not a link exists between the quantity of split words and several variables that define the relationship between the script and a line. On the one hand, this has to do with the average width of a character (*larcar*)—which equates to the product of the length of the line divided by the average number of characters it accommodates—and the relationship between that value and the length of the line, expressed by the average number of characters accommodated by a full line of script (*medcar*)[68]. On the other hand, it also has to do with the attitude adopted by the copyists with respect to the 'terminal margin', which appears on the page as the right justification (this

found in Bischoff 1996, which utilises the 'temporal series' method to furnish an accurate analysis of an 11th-century Latin scribe's 'writing rhythm'.

65 For this purpose, data relating to some basic variables were used. The said data were obtained during previous research projects—or ones that are currently underway—that examine the construction and utilisation of the page in Byzantine manuscripts.

66 This is the modular relationship in the narrowest sense (calculated by using the letter omicron as a basis). For the present study, this was considered preferable to the modular relationship applied in the so-called 'Lobbes Lectionary' (Bruxelles, Bibliothèque royale 18018) by Gilissen 1973, 20–32. As is well known, in this parameter—which represents an abstraction obtained by relating the average width of letters to the average height of their nuclei—factors beyond the control and capabilities of the scribe converge, such as the frequency with which individual letters occur or, more indirectly, the number and nature of abbreviations (see Ornato 1975, and Bischoff 1996, already mentioned above).

67 Despite the lack of clear morphological characteristics, it is reasonable to suppose that by associating these parameters it should become possible to distinguish among different graphic styles, albeit in an approximate way, but in any event well enough to make it possible to carry out a preliminary statistical analysis.

68 Clearly, for two-column manuscripts, instead of the length of the two adjacent columns without textual continuity, set out using only one guideline, or alternatively two neighbouring guidelines (i.e. 'physical line'), the length of a single column (i.e. 'logical line') along which the textual sequence unfolds, was considered. As regards the counting of the number of characters per page, this was carried out on ten lines of text (i.e. twenty 'logical lines', in the case of two-column volumes), without taking into account blank spaces.

is an attitude that can be evaluated, and measured, by means of the previously mentioned 'overrun' phenomenon).

The first two variables are related to the space that the script occupies horizontally. In what way, then, can this exert an impact on the number of split words occurring? It is a widely held belief that the splitting of a word at the end of a line becomes harder to avoid when the space available on a line is restricted (space being expressed by the number of characters that a line can accommodate). In reality, this belief holds true only in a situation where vertical justification at the open end of the line takes place by intervening, either mechanically or manually, on the width of the spaces between words which have already been composed.[69] In all the other cases the necessity for, and probability of, word division depend purely on the length of the final word—or alternatively on the final sequence of consecutive letters, in the case of scripts where words are not strictly separated.

However, both the average number of characters on a line and the average width of the script could have exerted a psychological effect on the copyist in two different ways: if a line accommodates only a few characters, the probability of having to resort to splitting a word is already greatly increased even when the 'terminal margin' is still quite a long way off, and therefore a copyist who wished to avoid splitting a word had to be alert to the problem earlier on and act with greater assiduity. If the script module is large—and therefore harder to 'compress' without creating a displeasing visual effect—the copyist might then fear that the space available to him will turn out not to be large enough to accommodate the final word, and therefore he would opt for word splitting even in cases where he could have avoided doing so.[70]

With respect to 'overrunning'—which is measured by the number of lines where the script exceeds, even if only by a small amount, the right-hand justifica-

69 In such circumstances, the 'elasticity' of the line is proportionate with the number of blank spaces—and therefore with the number of words—that it contains. If the space that has to be added in order to achieve a perfectly aligned justification and the number of words in the line is limited, the words would seem excessively spaced out, and therefore it would be necessary to resort to word division so as to avoid creating a displeasing effect.

70 It should be noted that the two parameters 'average number of characters per line' (*medcar*) and 'average character width' (*larcar*) are correlated, but not equivalent. The attitude adopted by a copyist might have been different if he had had to arrange characters of equal breadth on a short line, which would contain fewer characters, or on a longer line, which would contain a greater number. Needless to say, in the former case the impact of the two contributing factors will of course be cumulative.

tion[71]—in theory this is a phenomenon which is inversely correlated to the number of split words, and can either represent a convenient way of intentionally limiting divisions, or instead it can betray rather careless behaviour (on the part of the copyist) which was not expressly intended to fulfil this aim.

It will not escape the reader's attention that the set of characteristics which can be associated, *a priori*, with the splitting phenomenon is still missing an important component, namely the frequency of abbreviations. Indeed, it is easy to understand the importance of these in relation to the 'management of lines' for the scribe who sought to avoid resorting to word division at the end of lines, while at the same time trying to limit the number of 'overruns' beyond the right-hand justification. Unfortunately, the abbreviation count—which relates to a sample composed of 60 words—was carried out on only the first part of the corpus and was reduced to its simplest expression, namely the overall number of abbreviations present in a given number of words.[72] It need hardly be said that in such circumstances the variable cannot be exploited in a systematic way, nor with the degree of complexity that the problem demands.[73]

71 In the case of manuscripts with 'double justification'—which represent almost half of our corpus (with respect to the frequency of their occurrence in the Byzantine context, see Maniaci / Ornato 1995, 180–182)—'overrun' was measured twice, using as a reference point the innermost vertical or that which is most distant from the narrow column. In fact, it should be obvious that the latter case, despite being rarer than the former, is a lot more significant. In hindsight, the criteria adopted for counting the occurrence of 'overruns' proved to be too rigid; indeed, it would have been better to consider only cases where the justification boundary was exceeded not by merely one stroke—a very frequent occurrence—but instead by at least an entire character.

72 The counting of abbreviations only involved the 386 manuscripts dating from the 11th and 12th centuries which were the subject of the doctoral thesis cited above, footnote on page 599. For the remainder of the sample, it was necessary to forego carrying out similar counts, owing to the large amount of time that would have been necessary to accomplish the task. The conflict arising from scientific demands and the amount of time necessary to gather sufficient data—which represents an inevitable problem when it comes to research based on very large collections of material—can only be resolved if multiple researchers collaborate on the same project. For obvious reasons, such collaborations are not always easy to organise or to accomplish.

73 For example, it is obvious that the abbreviations observed in the first and last words on lines should be placed in and counted in two separate categories. In this way, any systematic and consistent imbalance in favour of the abbreviations occurring at the end of lines will provide proof that the copyist employed them as devices to limit the need to resort to splitting words.

4 Word splitting and text layout

All the spatial partitions in relation to the quality of the codex proved to have no effect on the distribution of the number of split words. This 'non-result' does not have the same value as a simple negative finding. Rather, it demonstrates that in the world of the Byzantine book—at least during the centuries covered by the present investigation—limitation of the number of split words was not explicitly included among the criteria which had to be fulfilled in order to manufacture a codex of good quality.

The same lack of a correlation characterises the partitioning linked to the way in which writing was laid down, which would seem to imply—contrary to one's expectations—that attention to word splitting neither depended on graphic typology nor on the faster or slower speed with which the writing was executed. In other words, limiting split words was not included among the characteristics associated with a given script or writing level.

Equally, the absence of any connection between the frequency with which splits occur and the number of occasions that 'overrunning' is resorted to is quite surprising. In fact, one would normally expect word splitting to occur significantly less frequently[74] in manuscripts where 'overrunning' is seen very often. However, this is not in fact the case—not even in manuscripts with double justification where the script tends to exceed even the boundary set by the outermost vertical ruling line.[75]

---

74 It should be noted, however, that there is a negative correlation between the number of split words and the variation in the average number of characters per line (CV*medcar*) measured using the coefficients of variation (= variation in relation to the mean) of the average number of characters in a line. However, the correlation becomes noticeable only in codices in which the average number of characters per line is for the most part variable (CV*medcar* higher than 12%), which is only the case in about twenty volumes. In other words, CV*medcar* is an indirect measurement of 'overrunning', since it indirectly quantifies the degree of irregularity (i.e. 'indentedness') of the right-hand justification—or, in other words, the amount of 'elasticity' permitted by the scribe vis-à-vis the length of a line. Naturally, this is a rather approximate indicator, and one which should be substituted by a direct count of instances of 'overrun' and containment observed in a given number of lines, so as to avoid distortions generated by the random distribution of narrow or wide letters of the alphabet on the lines considered. The incidence of this last-mentioned factor obviously increases in relation to the proportionality of the alphabet—or in other words, in relation to the differences in the width of narrow and wide letters. Thus, in a strictly non-proportional alphabet, the CV*medcar* value should not be subject to any distortion.

75 As has already been suggested, this extended form of 'overrun' is a lot more pronounced than 'simple' overrunning, inasmuch as when the layout was created the narrow 'double justi-

Two intersections that exert a significant influence on the frequency of word splitting are those involving the average number of characters per line (*medcar*) and the average width of the individual characters (*larcar*) (Tab. 5).[76]

Distribution of word splits according to the average number of characters per line and the average width of the characters — tab. 5

	Split words < 30%	Split words > 42%	Total
medcar			
Up to 28 characters	48	113	161
More than 28 characters	105	52	157
Total	153	165	318
larcar			
Up to 3 mm	62	32	94
More than 3 mm	91	131	222
Total	153	165	316

Tab. 5: Distribution of word splits according to the average number of characters per line and the average width of the characters

When a line contains a small number of characters (fewer than 28), the manuscripts that contain the highest number of split words are a lot more common than chance would dictate, whereas the situation is almost exactly the opposite when lines are occupied by a greater number of characters. At first glance, such an effect seems to

fication' columns constituted part of the margins, rather than part of the writing area. The behaviour of the scribes provides an idea of the ambiguous role played by these narrow columns, which ideally were conceived as empty or almost empty spaces (if intended for the placement of initials), but in practice were considered a 'transition zone' between the two opposite areas, 'black' and 'white'. A closer examination (and interpretation) of 'overrunning' and the rules that governed it would have necessitated the application of a more detailed surveying protocol that would entail making a note of the presence or absence of instances of word division in each 'overrun' line.

76 In all three cases, the χ^2 value calculated with respect to the theoretical value is very telling: 16.5 for *larcar* (probability of 0.5%); 19.3 for *abbr* (probability of less than 1/105), and as much as 43.7 for *medcar* (probability of less than 1/107). It should be remembered that the probability threshold at 5% is 3.84.

agree with the hypothesis which states that lines that are too short increase the need to split final words. A positive correlation, albeit to a lesser degree, between the number of split words and the width of characters also emerges.

It would be an oversimplification to attribute the effect of *medcar* and *larcar* solely to the influence of a psychological factor. It should not be forgotten, in fact, that both the variables are not independent from other characteristics of the page or codex. Above all, we know that the size of characters depends to a certain extent on ruling, and therefore, indirectly, on the size of the volume in question. As regards the average number of characters per line, this is linked not only to the size of characters, but also to the length of the line, and therefore, once again, to the size of the codex. Hence it is not purely a matter of chance that when the distribution of the number of split words is cross-referenced with the size of the volume and its ruling, the value of χ^2 is always significant.[77] Finally, it should be remembered that all the parameters mentioned so far are strictly correlated to the density of the characters laid out on the page—in other words, the extent to which its surface is exploited.

Because of the interdependence between the different characteristics of the codex and the complex nature of each volume taken individually, it is not easy to ascertain whether or not a variable exists that is more directly linked to word division than *medcar* and *larcar*, and if so what such a variable might be.[78] However, we know that in addition to the size of a codex and the parameters that are contingent on the same, a non-numerical variable exists which has a much more direct impact on the length of lines, and therefore on the average number of characters accommodated by them, namely the arrangement of the text either as a full page or alternatively one laid out in two adjacent columns. The correlation between the layout of the text and the length of lines traversing it is particularly strong in Byzantine manuscripts, where a two-column arrangement was not motivated, as was the case in Western late medieval book production in the Late Middle Ages, by the desire to achieve a better exploitation of the page.[79] For this rea-

77 Respectively, 8.6 (probability of 0.3%) and 4.6 (probability of 3.2%).

78 The positivity of the χ^2 test which—as can be seen—provides the best result for *medcar* (see above, footnote 76), does not offer any indication in this regard, since it is limited to measuring the degree of interdependence between two variables placed in relationship to one another. This means that it is not possible to infer the type of relationship between the two variables, nor its exact nature: therefore, it is impossible to exclude the existence of a third variable which might prove to be more closely connected to the phenomenon one wishes to study.

79 Concerning this issue, see Maniaci / Ornato 1995, 186–190. On the construction and utilisation of the page in Byzantine manuscripts, the author is currently working on a more wide-reaching contribution.

son, when the size of a volume is the same, a line of text in a full-page layout will on average contain at least twice the number of characters as those contained in a line of text in a two-column layout.[80] Therefore, if the average number of characters is so closely linked to the type of layout, it becomes necessary to verify whether or not this factor can really explain the either greater or lesser degree to which word splitting was resorted to by Byzantine scribes.

The intersection between the layout of the text and the two extreme opposites of word splitting distribution confirms this hypothesis (Tab. 6), because it reveals a very clear divergence between codices with full-page layouts—the majority of which exhibit a lower number of split words—and two- column codices—the majority of which exhibit numerous split words.[81]

Distribution of word splits according to text layout tab. 6

Layout type	Split words < 30%	Split words > 42%
Full page	119	65
Two-column	35	102
Total	154	167

Tab. 6: Distribution of word splits according to text layout

That this new variable, among those which have been examined up to this point, is the only one to exert a real influence on the distribution of split words is

80 In actual fact, when the dimensions of volumes are the same, the relationship proves to be even closer, inasmuch as the sum of the width of the two columns is almost always lower than the length of a full-page line. This is ascribable to the fact that, in Byzantine codices, the construction of a two-column page, created by 'cutting' a vertical corridor through the justification frame, without recovering the sacrificed space—if not partially—by narrowing the two lateral margins, predominates (see Maniaci / Ornato 1995, 189). On the other hand, if one considers the corpus—which includes volumes of very different sizes—in its totality, the average relationship will be less than 2/1 in favour of full-page manuscripts. In fact, generally speaking, two-column codices are of larger dimensions.

81 The χ^2 test in this case yields a result of 48.2, which represents the highest result achieved so far.

demonstrated by the fact that the effect seemingly exerted by *medcar*[82] is cancelled out when the sample under examination is divided into two sub-groups, based on page layout (Tab. 7).[83]

A similar phenomenon is produced by all the other variables, which, following an initial analysis, appeared to be directly correlated to the division of words at the end of lines (i.e. the average width of characters, volume size and ruling).

Distribution of word splits according to the average number of characters per line in full page and two-column manuscripts tab. 7

	Split words < 30%	Split words > 42%
***medcar* full page**		
Up to 32 characters	29	17
More than 32 characters	90	46
Total	119	63
***medcar* two-column**		
Up to 20 characters	19	67
More than 20 characters	15	35
Total	34	102

Tab. 7: Distribution of word splits according to the average number of characters per line in full page and two-column manuscripts

82 The reader will recall that, in the case of two-column codices, the *medcar* value considered is the one that corresponds to the 'logical line', or in other words to only *one* column of text (at the end of which the scribe would have started a fresh one), and not the value that relates to the 'physical line', formed by the two flanking columns.

83 The χ^2 value is 0.2 for full-page volumes and 1.1 for two-column volumes. Both values are a long way from the minimum statistical significance threshold. The discriminating properties of the '28 characters per line' value—above which one notes a reduction of the number of split words—stem from the fact that in the vast majority of two-column texts the *medcar* is lower than the quoted value. In addition, as has already been stated, below this value full-page manuscripts exhibit a quantity of split words which is consistently lower that that seen in the corresponding two-column volumes. This would not be the case if the number of characters represented a decisive factor.

Conversely, all the variables that appeared to be unrelated to the phenomenon in question become operative once the full-page volumes are separated from the two-column ones. The layout of the text is therefore the key factor which, without exception, accounts for all the variables identified by the crossings carried out up till now, as the tests performed very clearly show.

When confronted with such a clear-cut—from a statistical perspective[84]— situation, the explanation for the relationship between the layout of the text and the number of split words is not correspondingly clear; indeed, one cannot easily imagine the tangible ways in which the scribes' conscious choices and/or spontaneous responses vis-à-vis the splitting of words might have been influenced. In other words, it is not clear whether the layout of the text should be regarded, with respect to the distribution of the split words, as a factor (of an 'automatic' or psychological nature) that has a *decisive* influence on the distribution of divided words, or alternatively simply as a *concomitant* factor, behind which is veiled the effect of one or more additional variables associated with one or the other type of text arrangement.

What then, on the material level, does the fact that a page is laid out in two columns rather than as a single block of text imply? Apart from being composed of shorter lines—which consequently contain fewer characters—a two-column arrangement entails the lines of script in the first column being delimited at their furthest point by an intercolumnar space, which is generally narrower than the outer margin that sets a boundary for the lines of script arranged in the second column. Contrary to what one might expect, neither of these two characteristics provides an explanation for the relationship that links the layout of the text to the number of split words. The hypothesis that the shortness of individual lines of script in two-column volumes automatically increases the tendency to split words at the end of lines cannot be considered valid, inasmuch as full-page manuscripts with lines of equal length—or containing an equal number of characters—present fewer split words in comparison to two-column ones. On the other hand, the hypothesis that 'overrunning' of the script into the intercolumnar space was outlawed on account of it being aesthetically displeasing—and that the 'ban' was extended, for the same reason, to the second column on the page[85]—would only

84 This seldom happens when statistical analysis is applied in the field of historical studies, in which the phenomena—owing to the great variety of ways in which they manifest themselves, even as part of the same trend—show poorly defined profiles in the majority of cases.

85 A survey carried out on approximately forty volumes showed that the number of split words is on average the same for each of the two columns on the page.

be confirmed if the number of 'overruns' were higher in full-page manuscripts, but the survey results furnish evidence to the contrary.[86]

What we have seen up till now permits us to exclude the possibility that the type of text layout exerted a direct influence on the attitude of copyists with respect to the problem raised by the division of words at the end of lines. On the other hand, if the text arrangement were the only factor correlated—even in a non-decisive way—to the number of split words, the separation of full-page manuscripts from two-column ones should reveal two very distinct sub-populations which are symmetrically and randomly distributed around the respective means.[87] The reality, however, is very different: a comparison with the random distributions shows that the adjustment is satisfactory—even if it is not perfect—only for the two-column volumes, which therefore appear to constitute a fairly homogeneous population in which a concern about splitting words at the end of lines as little as possible is practically non-existent.[88] In the case of full-page volumes, the situation appears to be different, because the actual distribution[89] highlights—with respect to the manuscripts exhibiting the greatest number of split words—a clear surplus of split words in relation to the theoretical distribution. Based on all the evidence we have at our disposal in this case, which involves two partially mixed populations, some of the full-page manuscripts follow the 'indifferent' trend already ascertained for two-column manuscripts, whilst in the remainder there is clear evidence of concern with respect to containing the number of split words.

5 Other factors that produce variations in word splitting

The situation described thus far allows us to suppose that, apart from text arrangement, various other elements can exert an influence on the distribution of

86 Additionally, this hypothesis would imply a negative correlation between the number of split words and the extent of 'overrunning', which does not correspond to the reality observed in our sample (see above, 627–628).

87 In agreement with the corresponding mean binominal distributions. The scattering around the averages in this case is due to the slightly different choices made on the part of the scribes and the inherent fluctuations within the sample (the survey was limited to 45 lines of text).

88 The average for the two-column codices is, in fact, 41.8%, and therefore very close to the random value (42.1%).

89 On average, 35.1%.

split words. Since we have already excluded the impact of qualitative and graphic variables, it only remains for us to consider data—albeit only partial, but in any event numerically sufficient—relating to abbreviations.

In effect, abbreviations prove to be negatively correlated to the number of split words, inasmuch as the scribes who copied manuscripts that exhibit many abbreviations did not split words at the end of lines very often (Tab. 8).[90]

Distribution of word splits according to the abbreviation rate tab. 8

Abbreviations (386 mss)	Split words < 30%	Split words > 42%
Up to 7 abbreviations (2.3%)	42	73
More than abbreviations (2.3%)	44	19
Total	86	92

Tab. 8: Distribution of word splits according to the abbreviation rate

It will be useful, then, to expand our knowledge of the phenomenon. This can be accomplished by confirming the possible existence of a direct link between the layout of the text and the abbreviation rate, and by attempting to clarify, should one exist, whether such a link—as we have seen before with the other variables—is entirely responsible for the correlation between the abbreviation rate and the number of split words. By crossing data relating to the text arrangement and the abbreviation rate it can be seen that the distribution of the two variables is not independent: the codices that present with an abbreviation rate above 2.3% [91] exhibit, in fact, full-page layouts in a significant majority[92] (Tab. 9).

90 In the table, the χ^2 value for the abbreviations should not be related to the figure previously cited for the average number of characters per line (see Tab. 7), because the value for this variable is a lot lower and limited to only two of the centuries considered. What counts more than anything is the probability value, which, even in the case of abbreviations, ensures that we are not dealing with random variations.

91 This figure, chosen on an experimental basis as a dividing line, corresponds to the number of abbreviations occurring in 60 words of text, equivalent to approximately 300 characters. The absolute value is 7 abbreviations (see Tab. 8–10).

92 The χ^2 value is 13.9 (probability = 0.02%). Tab. 9 also reveals the fact that, in the 11th and 12th centuries, abbreviation-rich Byzantine manuscripts are clearly in the minority.

Abbreviation rate according to page layout tab. 9

Percentage of abbreviations	Full page	Two-column	Total
< 2.3%	117	148	265
> 2.3%	78	43	121
Total	195	191	386

Tab. 9: Abbreviation rate according to page layout

Therefore, it can be stated that there exists in the Byzantine manuscript—at least in the 11th and 12th centuries—an association between the full-page layout and an abundance of abbreviations.[93] However, this association is not sufficiently strong to ascribe the impact of the rate of abbreviations on the number of split words to a simple 'structural effect'.[94] If one analyses the behaviour of codices exhibiting 'slight' and 'considerable' rates of abbreviation in relation to text arrangement (Tab. 10), the following facts emerge:

1. The abbreviations exert an effect on the degree of word splitting irrespective of the type of text arrangement: the group composed of 'two-column codices containing many abbreviations' is, in fact, accompanied by a reduction in the number of abbreviations, whilst the opposite group composed of 'full-page codices containing few abbreviations' registers a slight increase in relation to the overall average for full-page volumes.
2. The effect of the data partitions, whose two components act in the same way, is increased: the two groups composed of 'full-page codices containing many abbreviations' and 'two-column codices containing few abbreviations' produce percentages of split words which are lower and higher, respectively.
3. The effect of the type of text arrangement is in any event more relevant than that of the rate of abbreviations. Indeed, it can readily be seen that the re-

93 This is an association which, needless to say, should be viewed as an overall trend. This does not discount the fact that 36% of the volumes with an abbreviation rate exceeding 2.3% have two-column layouts.

94 The 'structural effect' should be regarded as an only seemingly significant result—and difficult to 'mask' as such—generated by the sample's characteristics, which mean that the link between two variables, which outwardly appears to be direct, in reality does not exist, or alternatively is induced by a third variable not identified as being responsible. See Maniaci / Ornato 1993, 22.

sult obtained when one cross-references 'few abbreviations/full-page' (divergent trends) is lower than the overall average of split words seen across the entire corpus. The same observation is true—*mutatis mutandis*—when one cross-references 'many abbreviations/two-columns',[95] whose average value is higher than the overall one.

Distribution of word splits according to layout and abbreviation rate tab. 10

Percentage of abbreviations	Full page	Two-column	Total
< 2.3%	35.6%	42.3%	39.4%
> 2.3%	31.7%	38.4%	34.1%
Total	34.1%	41.5%	37.7%

Tab. 10: Distribution of word splits according to layout and abbreviation rate

The fact that a cause and effect relationship does not exist—in either sense—between text arrangement and abbreviations, supports the hypothesis that their interaction with the phenomenon of word splitting at the end of lines can be ascribed to the concomitant action of the three parameters that characterise Byzantine book production: the scribes who exercised deliberate control over the division of words favoured the simplest type of page layout and their reading skills—and/or those of their commissioning clients—were compatible with a certain number of abbreviations. It is only natural to suppose, then, that one or more factors unrelated to the codex's material aspect had something to do with this preference, namely historical period, cultural context and readership. Unfortunately, our level of knowledge concerning the dissemination of written culture in the Byzantine world—and in particular knowledge with respect to localisation—prevents us

95 A detailed examination of the distribution of split words—carried out with help of a diagram not reproduced in the present contribution—makes it possible to gain a very clear understanding of the relationship that links this phenomenon to abbreviations. In full-page layouts, in fact, one observes that the bulk of codices in which the percentage of split words is lower than 30% simultaneously present a higher number of abbreviations. Conversely, in two-column layouts one notes that the manuscripts exhibiting a rate of abbreviations in excess of 2.3% belong to two sub-groups which can be distinguished without ambiguity based on the number of split words they contain, depending on the care taken or indifference shown towards controlling this particular aspect of line management.

from being able to divide the samples into sub-groups which are at one and the same time well defined and sufficiently large so as to make it possible to subject the hypothesis to a statistical verification. In practice, the only data fields that can to a certain extent be made use of are those which relate to the manuscripts' century of manufacture and their textual typology.[96]

The distribution of split words in relation to the most representative textual typologies within the corpus shows that the content of volumes effectively constitutes a discriminating factor (Tab. 11).

Distribution of word splits according to text type — tab. 11

Text types	% Split words	Split words < 30%	Split words > 30%
Bible	33.1%	21	9
Biblical	38.3%	17	22
Hagiography	42.9%	4	16
Homiletical	41.5%	18	39
Liturgical	37.7%	31	31
Patristic	37.2%	19	19
Secular	33.3%	29	15
Total	37.8%	139	151

Tab. 11: Distribution of word splits according to text type

Two text typologies—Bibles and secular codices—stand out from all the others on account of the scarcity of split words they exhibit, whereas hagiographies and homilaries stand out for the opposite reason. It is therefore logical, at this point, to pose the question as to whether or not, and how content might interact with the

96 Concerning the systematic classification of the codices based on their content, the recent work by Sautel 1995 was referred to, in particular pages 12 to 13, where various sub-groups are consolidated so as to obtain groups of sufficient size (for the complete list of the classes adopted, see Tab. 11). Despite the fact that the inventory edited by Sautel presents the shortcomings of any database that covers a large span of time and is enhanced with information of heterogeneous origins, it still represents a valuable source of information relating to almost 4,000 Greek manuscripts, many of which have not yet been scientifically catalogued. In this regard, see the reflections formulated in Maniaci 1996, the response by Sautel 1996, and the observations made by Muzerelle / Ornato 1997, 26–36.

two parameters—text layout and abbreviations—that we already know are linked to the number of split words.

The cross between content, text arrangement and the number of abbreviations (Tab. 12) produces similar results to those obtained for the interaction between layout and abbreviation rate: the effect of the textual type on the number of split words does not decrease simply due to its more or less large representation, within one or another type, of a given text arrangement or a particular abbreviation rate.

In fact, within each sub-group, the Bibles and secular texts exhibit, on average, fewer split words in comparison to codices of other textual content, whereas hagiographies and homilaries contain a greater number.

Distribution of word splits according to text type, layout and abbreviation rate — tab. 12

Text types	Full page	Two-column	< 2.3% abbr.	> 2.3% abbr.
Bible	28.3	44.9	33.7	31.5
Biblical	34.7	41.6	39.9	36.2
Hagiography	40.6	43.5	43.4	42.2
Homiletical	38.0	42.9	42.6	36,8
Liturgical	33.6	40.4	37.9	37.4
Patristic	37.4	36.6	40.7	32.6
Secular	32.1	37.8	36.4	32.0
Total	34.1	41.5	39.3	35.2

Tab. 12: Distribution of word splits according to text type, layout and abbreviation rate

However, within each textual typology—if one excludes hagiographic codices, which appear to totally ignore the problem of word splitting[97]—the text layout and abbreviation rate maintain, albeit in varying degrees, their influence.

97 In order to understand the reasons at the root of this anomaly it would be necessary to carry out a closer analysis of the group in question, behind whose apparent unity of content—a product of the necessity to adopt, in order to carry out a preliminary examination of the phenomenon in question, very broad classes identified by highly generic 'labels'—are concealed, in all likelihood, profound typological differences.

The sub-division of the manuscripts according to the century of their production (Tab. 13) also exposes some differences vis-à-vis the frequency of word splitting phenomenon.

Distribution of word splits according to centuries tab. 13

Century	Split words < 30%	Split words > 42%
9th	10	3
10th	26	53
11th	45	78
12th	54	28
13th	13	5
14th	5	0
Total	153	167

Tab. 13: Distribution of word splits according to centuries

In particular, codices of the 9th century on the one hand, and those of the 12th to 14th centuries on the other, exhibit fewer split words compared with the intervening centuries. In this case, too, by crossing the chronological factor with previously[98] considered factors (Tab. 14), the differences between centuries do not disap-

98 Given that certain centuries (the 9th, 13th and 14th) are rather sparsely represented in the corpus, the comparison was carried out by grouping together the centuries into just two classes, based on behaviour already identified during the comparison of split words. The same procedure was adopted with respect to textual typologies (Bibles and secular texts on the one hand; hagiographies and homilaries on the other). It goes without saying that the said combinations were devised purely for the sake of convenience, and that they neither point towards nor influence an explanation for the phenomenon that interests us here. In this connection, it should be noted that a fundamental difference exists between the sub-divisions created on the basis of page layout and abbreviation rate, and the groupings that concern the dating and content of the codices. In the first case one is dealing with 'natural' populations endowed with their own significance and created on the basis of defined characteristics which can prove to be more or less correlated to the phenomenon—in our case, word splitting—one is seeking to explain. By contrast, in the second case one is dealing with 'artificial' and, as it were, 'tautological' agglomerations, inasmuch as they are created using as a starting point the very phenomenon that the analysis is focused on.

pear, even if, at the same time, the tendencies already identified with respect to text arrangement, content and abbreviation rate remain the same.

Distribution of word splits according to centuries, layout, abbreviation rate and text type — tab. 14

Century	Full page	Two-column	< 2.3% abbr.	> 2.3% abbr.	Bib + Sec	Hag + Hom
10th–11th	36.84	41.82	40.48	36.76	35.24	41.37
9th; 13th–14th	31.86	38.40	36.79	31.33	31.61	37.97

Tab. 14: Distribution of word splits according to centuries, layout, abbreviation rate and text type

If one considers simultaneously all the variables that minimise or maximise, respectively, the number of split words, it will be found that they are often concurrently present in the one and the same manuscript.[99] Conversely, an association between two or more characteristics which act in the same way has the capacity to 'enhance'—either positively or negatively—the effect exerted by each characteristic individually.[100] Thus, the coexistence of any three of the four sub-groups that minimise word splitting (full-page codices/codices containing many abbreviations/codices containing biblical or secular texts/codices dating from the 9th, 12th and 13th to 14th centuries) results in a reduction of the average percentage of split words to around 29% (and the coexistence of all four criteria lowers it even further to 25%).[101]

99 Some examples: our corpus contains 52 volumes that share the following characteristics: (a) all were transcribed in either the 10th or 11th centuries; (b) all have hagiographic or homilary content; (c) all have two-column layouts; and (d) all have an abbreviation rate lower than 2,3%. On the other hand, the volumes that—leaving aside three of the characteristics listed above—have an abbreviation rate of above 2.3% number only 7, and those produced in any one of the other four centuries number 5, as do those of biblical and secular content. Finally, 11 have full-page layouts.

100 For example, the group of codices with full-page layouts, with an abbreviation rate above 2.3%, and which were transcribed in the 9th, 12th, 13th and 14th centuries (a total of 45 volumes), is composed entirely of manuscripts whose scribes clearly took trouble to limit the division of words.

101 It is true, however, that in this case the number of volumes descends to just 12. The synergy produced by the association of multiple factors is considerably less evident in the sub-groups that generated the higher frequency of split words, inasmuch as there is an upper limit that corresponds to an absolute lack of concern regarding the problem on the part of the scribes.

6 A few interpretations worth considering

The close interaction between the parameters considered up till now makes it difficult to access on an individual basis the effect that each of them exerted on the management of word splitting. In fact, it is not easy to isolate the effect exerted by an individual factor, inasmuch it will normally present in association with others which act in the same way or in the opposite way, thereby contributing, in varying degrees, to the intensification or diminution of the particular effect. Indeed, among full-page volumes, many can exhibit an abbreviation rate of more than 2.3%; a certain number of such volumes will also be of biblical or secular content, and so on.

In order to determine the importance of the individual factors, two different procedures can be applied, each of which has advantages and disadvantages.[102] Fortunately, the application of one or the other of the two procedures produces the same result: the element that has the greatest influence on word splitting turns out to be page layout,[103] followed by textual content, whereas the dating and number of abbreviations appear to be less important, despite being partly independent from the other two factors. The dating and abbreviation rate exert their respective effects above all on full-page volumes. This finding is hardly surprising if one considers that two-column manuscripts constitute—as we have seen—a more homogeneous sub-group and one which tends to show indifference to limiting the division of words.[104]

102 The first criterion—which makes it possible to isolate the effect of a given parameter—consists in limiting the calculation of the percentage of split words solely to the volumes in which all the other parameters act in a contrary way (for example, codices with full-page layouts, but which contain hagiographic material or present an abbreviation rate of less than 2.3%, and which were transcribed in the 10th or 11th centuries). The second method consists in counterposing two at a time the variables that act in the opposite way (full-page/few abbreviations, two-column/biblical or secular content, etc.), and observing whether the average percentage of split words in relation to the overall average of the corpus increases or decreases. The most active variable will obviously be the one which most frequently deviates the result of the comparison in the direction that complies with its autonomous tendency. The second method does not enable one to isolate on a case-by-case basis the effect of an individual variable, whose impact therefore has to be evaluated based of the outcome of all the comparisons.

103 This is true for all the comparisons, with the exception of one—full-page manuscripts and hagiographic/homilary content—in which the latter factor is dominant (with a very small variation: 37.85% as opposed to 37.58%).

104 Whilst the desire to limit word splitting can manifest itself in varying degrees and can even extend to eliminating them entirely (or almost entirely), the lack of any concern for the

Even if the variables examined up to this point do not contribute to the definition of a sufficiently characterised and homogeneous 'codex type'—based on structure, content and quality of craftsmanship—their convergent trends make it possible to hypothesise that the need to limit the division of words at the end of lines was closely linked to the existence of specific commissioning and consumption environments.

In particular, it is only natural to suppose that a concern to limit the number of split words was felt mostly by readers who paid closer attention to the correctness and legibility of the text, rather than to the sumptuousness of its presentation. This attitude undoubtedly characterised books created for study purposes or for personal reading by and/or for a cultivated readership. The predominance of secular texts, the preference for a simpler layout (i.e. full-page), the tendency towards an intensive use of abbreviations, a preference for cursive or tendentially cursive ('*corsiveggiante*') scripts and/or less standardised ones, rather than for so-called 'Perlschrift' and 'traditional' scripts,[105] are all characteristics that appear to support this hypothesis. In other words, the manuscripts produced for private consumption by a readership of a higher cultural calibre exhibit less concern for their appearance—i.e. the quality of the writing support and the aesthetic principles used for the page's layout and its decoration—and a greater concern with respect to their substance, which is to say the integrity and legibility of the text. This could explain the almost total absence of a correlation between the number of split words and the richness of decoration: in fact, limiting the number of di-

phenomenon cannot be progressive and produces, *ipso facto*, a concentration of values around the level that corresponds to the phenomenon's random modes. Concerning the effect of the different variables, the page's proportion should be added to the list: values lower than 0.75 correspond to a lower number of split words (36.2%), whereas values above 0.75 register a higher rate (38.5%). Clearly, the gap is too small to make it worthwhile to attempt an explanation. In any event, this is a systematic effect which proves to be independent of other factors, and in particular from the layout of the text, whose influence on the proportion of the page is in any case smaller than in the Latin context (see Maniaci / Ornato 1995), and from the dating of the codices (although the proportion tends to become narrower over time: see Maniaci 1995, 31 footnote 35). It should be pointed out that the effect—which for now remains inexplicable—apparently exerted by page proportion only manifests itself in the group that registers a low percentage of split words.

105 The term, coined by Herbert Hunger in the mid-1950s (Hunger 1954), is adopted here, in a very broad sense, to indicate the ideal calligraphic model which prevailed from the middle of the 10th century until roughly the middle of the 12th. Old-fashioned scribes resisted this script, especially for reasons of provincialism and/or lack of skill, in a show of loyalty/deference to earlier epochs; see Canart / Perria 1991, 83–87.

vided words became the chief priority on the list of requirements demanded by readers more concerned about content than the appearance of their books.

However, there is a specific case that seems to contradict this interpretation. One of the textual typologies whose layout (largely speaking) is highly meticulous and richly decorated—the Bible, mostly represented in the corpus by the New Testament—contains the lowest number of split words (33.6%). The similarity between biblical texts and secular texts—both of which testify to a rather marked tendency towards limiting word division—is not matched by other features of their manufacture; indeed, the two groups, far from constituting a homogeneous whole, tend on the contrary to run counter to each other with respect to their palaeographic and codicological characteristics (Tab. 15).[106]

Amongst other things, the manuscripts of biblical content are superior in the quality of their writing support and their pages are less exploited. They are also more uniform and contain far fewer abbreviations. With respect to certain parameters (i.e. parchment quality, ruling complexity and spacing, and percentage of 'blackness'), they exhibit the best values bar none among all the other groups. Finally, one notes that the behaviour of the Bibles in relation to split words is anomalous in comparison to that of the other textual typologies, in the sense that it remains almost constant in all witnesses of all periods, whether they be slightly or greatly abbreviated (Tab. 16).[107]

106 A few of the variables entered in the table require some clarification as regards the values they have conventionally been measured by. The 'quality of the parchment' is evaluated on the basis of a hierarchical scale as follows: 2 = excellent; 1 = good; -1 = mediocre; -2 = poor. The 'ruling complexity' index equates to the sum of all the supplementary lines (i.e. those which are not indispensable to the delimitation of the writing area), with the exception of the narrow columns used for double justification. The 'exploitation of the parchment' indicates the mm^2 ideally available for each character; these are calculated by dividing the total surface area of the page (and not only that of the writing area) by the average number of characters it contains. The 'normalised ruling unit' expresses the relationship between the ruling and a volume's size (multiplied by 10,000). The 'irregularity of the script' is afforded a rough evaluation by calculating the sum of the coefficients of variation of the height and width of the Greek letter *omicron*. The degree of 'overrun' was considered for only 228 codices endowed with two-column layouts, taking into account only the percentage of cases where the script exceeds the outermost vertical of the framing column. Finally, the 'rate of abbreviation' parameter—relating, as the reader will recall, to only 386 manuscripts—is calculated, as previously stated, based on a sample composed of 60 words.

107 Two-column volumes represent an exception, however, since they are largely in the minority (5 in 63, or 8%).

Differencies between the Bible and secular texts with respect to palaeographic and codicological characteristics tab. 15

Text types	Bible	Secular texts	Entire corpus
Parchment quality	0.42	-0.09	0.03
Ruling complexity	3.59	2.16	2.68
Percentage of 'blackness'	29.0	31.0	30.1
Parchment utilisation	56.62	46.6	61.74
Normalised RU	16.11	14.21	14.59
Writing irregularity	19.67	23.66	20.86
Abbreviations	5.53	18.53	7.93
Overrun	9.86	5.78	8.32

Tab. 15: Differencies between the Bible and secular texts with respect to palaeographic and codicological characteristics

Distribution of word splits in bibles and other text types according to layout, abbreviation rate and centuries tab. 16

	Bible	Other texts
Full page / two-column	30.3	42.9
< 2,3% – > 2,3% abbr.	31.1	33.8
Centuries 10^{th} – 11^{th} / 9^{th} ...12^{th}	34.1	32.6

Tab. 16: Distribution of word splits in bibles and other text types according to layout, abbreviation rate and centuries

The apparent anomaly that the manuscripts with biblical content show in the management of word division could be explained by the particularly high quality of their preparation; indeed, in a context where every last detail of the volume's manufacture had the utmost attention paid to it, even a relatively secondary concern such as word division would have been carefully considered.

7 Treatment of divided words in unusual situations: at the end of pages and at the end of quires

If we accept that the attitude of copyists towards the splitting of words springs not from two different situations—i.e. an awareness or ignorance of the role it plays in legibility—represented to a greater or lesser extent in the volumes examined, but instead from a complex interrelationship between the different requirements that contribute to the 'planning' of each individual manuscript, one also has to consider that in one and the same codex the word splitting phenomenon can manifest itself in different ways, depending on the particular circumstances involved.

The problems that result from the steady application of a 're-assemblage' procedure for the reading of a text arranged in a series of lines positioned one on top of the other have already been touched on in the introductory remarks. Needless to say, the longer and/or more irregular the visual pathway that the eye has to follow is, the more troublesome the procedure becomes. This is certainly the case with the final line on a page which, representing a particularly sensitive juncture in the reading flow, and therefore one which can be a source of potential errors, naturally calls for greater attention to be paid to it with respect to word splitting. Furthermore, because final lines are far less numerous than all the other lines which form a complete text, without doubt less time and effort has to be expended on them.

If one calculates separately the percentage of split words located at the end of pages, one finds that in actual fact their distribution is rather different from the distribution of those located at the end of lines, in that it is weighted towards considerably lower values (Chart 2). The same observation is valid not only for all the manuscripts taken as a whole, but also if one calculates, for each individual codex, the difference between the two parameters.[108] This means that manuscripts in which the scribe shows himself to have been unconcerned about split words at the end of pages, but on the other hand sought to avoid those at the end of lines, do not exist. Moreover, the scribe also shows that he was alert to the phenomenon in general and tended to pay more attention to the special situation represented by the end of a page (Tab. 17).

108 In only 80 cases out of a total of 700, or 11.4%, was a larger number of split words at the end of pages than at the end of lines recorded. However, in these cases, too, the difference never exceeds 20%, and proves compatible with the random variation. In addition, the manuscripts in question share no characteristics in common, which would explain their concordance in the handling of word division.

Distribution of word splits at the end of the page according to their distribution at the end of lines — tab. 17

% split words, end of line	% split words, end of page				
	< 20%	20%–30%	30%–42%	> 42%	Total
< 20%	37	8	0	0	45
20%–42%	159	111	66	26	362
> 42%	69	101	81	42	293
Total	265	220	147	68	700

Tab. 17: Distribution of word splits at the end of the page according to their distribution at the end of lines

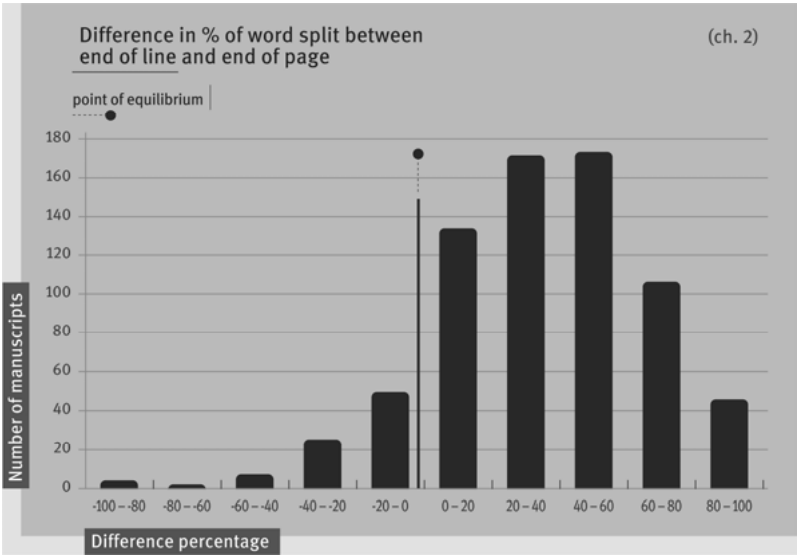


Chart 2: Difference in % of word split between end of line and end of page

While almost half of the scribes (293, or 42%) were totally unconcerned about the number of split words occurring at the end of lines, only about a tenth of them

(9.7%)[109] adopted the same attitude towards split words occurring at the end of pages. Needless to say, the scribes who were careful to avoid splitting words at the end of lines were even more careful to avoid doing so at the end of pages. However, also among those who did not hesitate to split words at the end of lines there was a clear reluctance to do likewise at the end of pages.[110] Hence there existed a significant number of scribes who were concerned about limiting split words only when it came to transcribing the final line of a page.[111]

These observations highlight the fact that in Byzantine books transcribed in minuscule script, already starting in the 9th century split words were perceived as an occurrence that could interfere in a negative way with the legibility of the text; and that the attitude of the scribes with respect to remedying the problem was commensurate with, at one and the same time, the degree of potential detriment to the text and the 'expenditure of energy' required to carry out the remedy. Indeed, more than 90% of the scribes paid a certain amount of attention to the phenomenon, but a little under 60% of them did it at each line's end,[112] albeit a lot less keenly. In other words, a codified norm existed that proscribed the splitting of words at the end of a page (it should be noted that only 42 scribes, equating to 6%, completely neglected to observe this rule) which extended, as far as possible, to the limitation of split words at the end of lines, at the discretion of the scribe.[113]

109 Or, more correctly stated, 293 codices. The equivalence is, however, legitimate, because during the surveying phase for each codex an effort was made to carry out all the calculations on sheets or quires that were in all likelihood executed by the same hand.

110 Strictly speaking, one has to deduce that only 6% of the scribes (42 in a total of 700) appear to be entirely resistant to maintaining any voluntary check whatsoever over split words. The reality is, however, somewhat gradated, inasmuch as the result of the survey (carried out, we should recall, on 45 lines in the case of split words at the end of lines and on three quaternions for those located at the end of pages) is influenced to a certain extent by random fluctuations, and by the fact that the threshold set at around 42% cannot have an absolute value. However, since the fluctuations occur in both directions, the percentage of 'unconcerned' scribes will not be all that far off the value indicated.

111 It is interesting to observe that this concern was acutely felt, given that in 58% of the manuscripts where the split words reach random values the number of split words at the end of pages falls to under 30%, and in 24% of cases to under 20%.

112 A more in-depth investigation—based on a closer examination of the individual codices in which an effort to limit split words proves to be obvious—could make it possible to identify fluctuations in the amount of attention paid by the scribes to the issue, and possibly to link such variations to 'cyclical' factors (first quire/other quires; first leaf of a quire/successive leaves; first side of a leaf/second leaf; first lines of a page/last lines, etc.).

113 The analysis of the distribution of split words at the end of pages in relation to the other external and internal characteristics of the codex reveals that the attention paid by the scribes is not uniform in all the sub-groups, but instead is distributed proportionately in relation to the

The grouping together of the scribes who did not apply—and who were probably not aware of—any rule aimed at regulating the division of words is not the product of pure chance. Indeed, within this sub-group can be found almost all the oppositional factors linked to the characteristics of the codex that have already been shown to exert an effect on the number of split words. However, one of these elements seems to be particularly pronounced, namely the rate of abbreviations, which is much lower in the manuscripts that exhibit a total lack of concern on the part of the scribes vis-à-vis the splitting of words.[114] In addition, the scribes who showed no concern whatsoever towards splitting words also employed parchment of lower quality and showed a clear preference for two-column layouts. All these elements, even if they cannot be arranged into an unambiguous whole, do not identify a specific type of codex, but rather a level of production which is noticeably sloppy, and one which is certainly a far cry from cultivated attitudes and concerns.[115]

Up to this point, the divided words located at the end of pages have been analysed as if they were all the same. In reality, this is not the case, since the alternation of *recto* and *verso* sides in a manuscript results in two different situations arising. In one situation both the scribe and the reader are obliged to turn the page in order to continue, respectively, either the transcription or the reading of the text. In the other setting, whereas the reader's eyes can shift naturally and without interruption to the neighbouring page, the scribe—if we take for granted that the transcription unfolds in a natural sequence on pre-cut bifolia[116]—has to move from one bifolium to the

total percentage of split words occurring at the end of lines, according to the pattern already outlined.

114 Only 6.9% of the codices displaying a 'total lack of concern' (in fact, only three items) have a rate of abbreviation higher than 2.3%, as opposed to 31.3% across the entire corpus.

115 As has already been observed, among the manuscripts containing secular material, those with full-page layouts and many abbreviations predominate. Not by chance, this typology—which is associated with a learned readership—is heavily underrepresented in the group of volumes which exhibit a lack of concern towards the splitting of words.

116 For now, we need not pose the question as to whether or not the transcription was carried out on separate bifolia, or instead on an already folded and assembled quire. We can exclude, at the outset, the possibility that the copying took place in a natural sequence, but was instead carried out by means of a procedure known as 'imposition', because this—also in the case of the manuscripts in Latin script which provide the only examples—represents a late and minority practice that was pointed out for the first time in 1928 by Charles Samaran (see Samaran 1928), upon which a vast bibliography has accumulated, consisting, in most cases, of reports of new examples which have come to light purely by chance. The main references are listed in Ruiz Garcia 1988, 171, and Lemaire 1989, 214, to which we can add important contributions by Gilissen 1977, 114–122 (with a bibliography on the subject on pp. 117–118), and by Bozzolo / Ornato 1980, 154–175. No indisputable cases of 'imposed' Greek manuscripts are known to exist; for an analysis

next. The second possibility becomes even more apparent when a change of bifolium coincides with a change of quire.

In this scenario it is reasonable to suppose that the occurrence of a split word at the end of a page will result in more serious consequences if it is accompanied by a transition from the *recto* to the *verso* of the same leaf. Indeed, in this case the reader is constrained to memorise, at the moment he or/she turns the page, the first fragment of the split word, with the risk that the 're-assemblage' procedure will be disrupted. In the opposite case, where the reader has instead before his/her eyes both halves of the split word, the 're-assemblage' procedure, despite being less easy because it occurs on the same page, will in any event result in less disruption.

If the hypothesis coincides with reality, one should expect to observe an imbalance between the number of *recto*/*verso* word splits and *verso*/*recto* ones, in favour of the latter. Verification of this postulate is very simple to carry out at a global level: it is sufficient to make separate counts of the number of split words that occur in either one or the other position.[117] The result obtained, with a significant variation of 17.4% in favour of *verso*/*recto* caesurae (4,414, as opposed to 3,761), fully supports the hypothesis.[118]

By contrast, it is impossible to verify the validity of the same hypothesis for every manuscript, since the number of split words occurring at the end of pages—as has already been ascertained—is, as a rule, insufficient to render it viable to subject it to a statistical analysis. However, one can attempt to establish—as in the case of split words at the end of lines and at the end of pages—whether or not the phenomenon presents in variable ways in relation to the characteristics of the codices. The outcome, in this instance, is contrary to what one might expect: indeed, while the quantitative imbalance between *recto*/*verso* and *verso*/*recto* split words persists—thereby confirming the generalised dissemination of the phenomenon—its extent, between one group and the other, does not present variations worthy of comment (in contrast to what emerged vis-à-vis other aspects of the distribution of split words). Furthermore, its extent is independent from the total average number of split words. Therefore, the doubt arises that this particular phenomenon does not in fact derive from the more or less widespread application of a rule intended to aid reading, but rather from a reaction on the part of the copyist, who would intentionally tend to limit errors which could potentially be fostered by the fact that, when

(with a negative conclusion) of two questionable cases of small paper codices dating from different periods (the 12th and 15th centuries), see the short piece by Irigoin 1992.

117 The survey was carried out on three quires (all quaternions) of each codex, located at the beginning, middle and end of the gatherings.

118 The χ^2 test yields a result of 52, which is a very high value.

turning a page, visual control on the previous line is lost. It has already been stated that such a reaction is intentional rather than unwitting, since one observes that subscripted letters are also—in the codices where they are present—consistently more numerous between the *recto* and *verso* than in the opposite situation.[119] Given that the practice of subscribing the final letters of a word ('codino') represents an 'extreme' solution deployed in order to avoid word splitting—when it is impossible to do otherwise—it is clear that its quantitatively differentiated use on the *recto* and *verso* and *verso* and *recto* of sheets reveals the existence of an outright rule, aimed perhaps—upon first consideration, at least—at avoiding transcription errors rather than promoting legibility.

One could object that, from the scribe's point of view, there should be no great difference between the two types of page change, since the transition from a *verso* to the following *recto* is also determined by a continuity solution, owing to the shift from one bifolium to another. However, this objection does not hold up if one supposes that the scribe wrote not on loose and separate bifolia, but instead on an already folded and assembled quire, even if it was not necessarily already sewn.[120]

Finally, the succession of *verso*/*recto* alternations can be upset by another continuity solution: that which involves juxtaposing the last *verso* of a quire with the first *recto* of the successive one. If one looks closely, in contrast to the normal transition from *verso* to *recto*, the word split that happens to fall in this position constitutes a rather special event, and one which is laden with ambiguity from the outset. On the one hand, one can imagine that the scribe regarded the opening[121] between the end of one quire and the beginning of the next in just the same way that he regarded those occurring within one and the same quire, and therefore entirely like a normal instance of word splitting. On the other hand, one can also suppose that, on the contrary, the end of a quire was perceived as a strong break, and that each quire

119 The overall average (calculated from three quires) is, respectively, 4.62 for *recto*/*verso* 'codini' and 3.08 for *verso*/*recto* ones. The χ^2 test on the overall averages again yields a result of 52, which is highly significant. This phenomenon is also present in all the categories into which the corpus was sub-divided.

120 The hypothesis could be further supported if the number of split words at the end of lines that coincide with the inner side of the central bifolium turned out to be the same as that seen in all the other cases. In order to verify this, it would be necessary to make a separate count of the split words that fall in this position.

121 The term 'opening' corresponds to the French 'double page', according to the definition provided by Muzerelle 1985, 92; see Maniaci 1996 (1998[2]), 126.

constituted, in some respects, an independent unit, even when it did not contain a distinct section of a text.[122]

The second option is the one that was settled on. A count of all the instances of split words falling at the end of quires reveals that they are proportionately less numerous not only than the remaining *verso*/*recto* splits, but also the *recto*/*verso* ones.[123] That said, the phenomenon's trend is different from the one observed vis-

122 The scribes of the Latin Evangeliaries that were produced between the 7th and 11th centuries show themselves to have been abundantly aware of the need to match the material structure of the codex with the canonic partitions located between one Gospel and another, and between the Gospels and the material that normally accompanies them (i.e. Prologues, Eusebian Canons, summaries, *capitula* or Breviary, *Capitulare Evangeliorum*). This demonstrates the very widespread habit of starting the transcription of each individual textual unit—and, in particular, of each of the four Gospels—on a fresh quire, and concluding, if necessary, the previous text (possibly including the *capitula* of the successive Gospel) on a quire whose thickness is different from normal): Bischoff 1994. I have identified an adherence to the same practice in the various Greek Evangeliaries dating from the 9th to 12th centuries. Here, I cite, purely as examples, Vat. Pal. gr. 220, 9th–10th centuries; Vat. gr. 1159, 10th century; Ott. gr. 297, 10th–11th centuries; Pal. gr. 227, 12th century, and Roma, Biblioteca Vallicelliana, B 133, 12th century (in these codices the portraits of the evangelists, when present, are painted as miniatures on the *verso* of the last page of the quire where a Gospel ends, or on the *verso* of an independent bifolium that holds the *capitula*, or alternatively on the *verso* of a loose leaf with a stub. In contrast, the more recent Vat. gr. 1160 (13th–14th century) does not present a continuity solution between one Gospel and another (the portraits of the evangelists are also executed on the *verso* of a page—not necessarily the final one—forming part of a quire of text). We shall not concern ourselves here with establishing whether the perception of a quire as a complete and independent unit corresponded solely to textual subdivisions passed down from ancient times, or if it was instead a reflection of specific individual copying rhythms, or perhaps a consequence of the need to distribute labour among a number of scribes and illuminators, as was apparently the case with Latin Evangeliaries, according to Bischoff. In any event, the similarity of the treatment reserved for the evangelical text in the Latin and Greek contexts is striking and merits further investigation. More generally speaking, the Bible, owing its sacred nature—and status as a Book/book *par excellence*—was shared by multiple cultures, even if it was regarded differently in each of them, and therefore represents particularly fertile terrain for comparative codicological research. See Maniaci et al. 1996.

123 In fact, in the entire corpus, a total of 435 split words at the end of quires were counted, as opposed to 4,414 at the end of pages in the *verso*/*recto* situation (included among which the last pages of quires) and 3,761 in the *recto*/*verso* situation. Since we are dealing with quaternions, there is a 1:16 chance of finding a split word at the end of a quire compared to that of finding a split word at the end of a page, and a 1:8 chance if one considers the *recto*/*verso*, *verso*/*recto* transitions separately. A comparison with two theoretical values (552 and 470 respectively)—obtained, in both cases, by dividing the frequencies surveyed in the corpus by eight—yields χ^2 values of 51.5 (very high) and 5.2, respectively. The second value, even if it is much lower than the first, is significant, with a probability of <5%.

à-vis the imbalance between the *recto*/*verso* and *verso*/*recto* instances, since it is in line with the general tendencies. In other words, the number of split words occurring at the end of quires varies in relation to the same characteristics of the codex that exerted an influence on the distribution of split words at the end of lines and pages, and it swells with the increase in split words situated in these positions. Whatever the underlying reason may have been, in this case, too, we are dealing with a widely disseminated rule, and one which was respected all the more so when the scribe, largely speaking, was particularly concerned with limiting the occurrence of split words.[124]

8 Conclusions

What overall consequences can be seen to result from the various phenomena brought to light up to this point, then? Above all, with the production of Byzantine minuscule manuscripts, starting from the earliest times, a widespread concern emerges—even if on the whole not a very pronounced one—with respect to the problems arising from the division of words located at the end of lines (i.e. 'word splitting'). It is not unlikely that this fact constitutes evidence, albeit not of the most glaring kind, of a more general and multi-faceted intention vis-à-vis 'line management', which is to say a combination of strategies consciously aimed at fulfilling a dual objective, namely to maintain a number of fundamental aesthetic standards—such as the regularity of the layout and writing area—and at the same time to enhance the visual impact of the graphic ensemble and ensure recognition of its individual elements, with the ultimate goal of facilitating a more accurate and effortless scanning of the text by the reader.

Following a closer analysis, the management of word splitting has been shown to adhere not merely to one rule—applied more or less systematically and with greater or lesser degrees of care when the need arose—but rather to a series of prescriptions shaped by the potential detriment that the splitting of a word might cause to the smoothness of the textual flow. Hence, the splitting of words at

124 Stated more precisely, the rule that stipulates the limitation of split words at the end of quires is closely linked to that which was aimed at avoiding them as much as possible at the end of pages. In other words, in contrast to what is seen in the relationship between split words at the end of lines and of pages—the former could be overlooked in volumes in which the latter were kept under control—the link between split words at the end of pages and quires is much closer, in the sense that scribes who were unconcerned about splits occurring at the end of pages, but who were careful to limit those situated at the end of quires, did not exist.

the end of lines was avoided wherever possible, but was not categorically proscribed. The splitting of words at the end of pages was firmly discouraged—above all when the word concerned fell between the *recto* and *verso* of a page—whilst the occurrence of a split word between one quire and the next was to be avoided as much as possible.

The attention paid to limiting the occurrence of split words at various places on pages was not equally distributed across the entire spectrum of manuscript production. In fact, it varied both in relation to a volume's material, technical and graphic characteristics, and according to its content, date and the particular circumstances of its commissioning and production. All these characteristics often prove to be associated, and not attributable—on the contrary, they are for the most part unrelated—to a fundamental opposition between high quality and more run-of-the-mill production.

Far from being the prerogative of a distinct group of scribes who had an increased awareness of the problem, as opposed to others who were entirely ignorant of it, knowledge of the rules aimed at limiting the division of words at the end of lines was widely distributed and freely available to all. On the other hand, the application of such rules was normally a matter of choice, in the sense that it was possible to respect, within certain limitations, one rule but not another, and that the use of one or all of them could largely speaking be systematically applied. Therefore, the attitude of scribes varied according to the degree of importance attributed to a problem whose solution required an undeniable expenditure of effort in relation to other issues that called for a similar amount of time and effort. This explains why the limitation of split words was more common in certain types of texts and codices—such as secular or heavily abbreviated ones—which were clearly produced by, or in relation to, a more erudite readership, or in a particularly high quality and standardised production type—like the majority of Tetra-Gospels—in which all quality and functionality requirements had to be satisfied to the maximum extent possible.

The overall picture thus described, even if it is fairly clear in terms of general trends, is perforce incomplete. The lack of a greater and more detailed knowledge of the ways in which the actors in Byzantine manuscript production operated prevents us from gaining a closer understanding of the scribes' working practices, and from being able to grasp all the factors and the rationale lying behind the choices they made. In particular, still unclear to us are the specific reasons which determined, in the management of word splitting, the contradistinctions between groups of manuscripts of different content, date and layout etc., which give rise to

statistically significant differences, albeit ones that are not equally interpretable, and about which it was decided not to furnish a more detailed report.[125]

Finally, it only remains to put forward the proposal that a comparison be made with the solutions developed to solve precisely the same problem in other cultural contexts—above all in the Latin setting—for which the surveys conducted up till now have already revealed the existence of a similar awareness of the problem, but the adoption of somewhat divergent attitudes and the application of different criteria for its resolution.

References

Beit-Arié, Malachi (1992), *Hebrew Manuscripts of East and West. Toward a Comparative Codicology*, London: The British Library (The Panizzi Lectures).

Bergeron, Réjean / Ornato, Ezio (1990), 'La lisibilité dans les manuscrits et les imprimés à la fin du Moyen Âge', in *Scrittura e civiltà*, 14: 151-198.

Bischoff, Frank M. (1994), 'Systematische Lagenbrüche: Kodikologische Untersuchungen zur Herstellung und zum Aufbau mittelalterlicher Evangeliare', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel, 12th–14th November, 1990, Marburg: Institut für Historische Hilfswissenschaften (Elementa diplomatica, 2), 83–110.

*Bischoff, Frank M. (1996), 'Le rythme du scribe. Analyse sérielle de la densité d'écriture dans les évangiles d'Henri le Lion', in *Histoire et mésure*, 11, 1–2: 53–91.

Blalock, Hubert M. (1984[2]), *Statistica per la ricerca sociale*, Bologna: Il Mulino.

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1984), 'Noir et blanc. Premiers résultats d'une enquête sur la mise en page dans le livre médiéval', in Questa, Cesare / Raffaelli, Renato (eds), *Il libro e il testo*. Atti del convegno internazionale (Urbino, settembre 1982), Urbino 195–221 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma; Viella [I libri di Viella, 10], 473–508).

Bozzolo, Carla / Coq, Dominique / Muzerelle, Denis / Ornato, Ezio (1987), 'Page savante, page vulgaire : étude comparative de la mise en page des livres en latin et en français écrits ou imprimés en France au XVe siècle' , in Baumgartner, Emmanuèle / Boulestreau, Nicole (eds), *La présentation du livre*. Actes du Colloque, Paris X-Nanterre (4, 5, 6 décembre 1985), Paris: Centre de recherches du Département de français de Paris X-Nanterre (Littérales, 2), 121–133 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 509–517).

125 For example, the lack of any clue regarding the provenance of the manuscripts, which is notoriously difficult to ascertain in the absence of explicit references or sufficiently indicative external evidence, should be noted.

Bozzolo, Carla / Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIV^e^ et XV^e^ siècles. Textes et études, 2).

Canart, Paul (1990), 'La minuscule grecque et son ductus du IX^e^ au XVI^e^ siècle', in Irigoin, Jean / Poulle, Emmanuel / Sirat, Colette (eds), *L'écriture: le cerveau, l'œil, la main*. Actes du colloque international du Centre National de la Recherche Scientifique, Paris, Collège de France, le 2, 3 et 4 mai 1988, Turnhout: Brepols (Bibliologia, 10), 307–320.

Canart, Paul / Perria, Lydia (1991), 'Les écritures livresques des XI^e^ et XII^e^ siècles', in Harlfinger, Dieter / Prato, Giancarlo (eds), *Paleografia e codicologia greca.* Atti del II colloquio internazionale (Berlin-Wolfenbüttel, 17–21 October, 1983), with the collaboration of D'Agostino, Marco / Doda, Alberto, Alessandria: Edizioni dell'Orso (Biblioteca di Scrittura e civiltà, 3), 67–118.

Cavallo, Guglielmo / Chartier, Roger (eds) (1995), *Storia della lettura nel mondo occidentale*, Roma-Bari: Laterza.

Fioravanti, Giorgio (1993), *Il dizionario del grafico*, Bologna: Zanichelli.

Gilissen, Léon (1973), *L'expertise des écritures médiévales. Recherche d'une méthode avec application à un manuscrit du XI^e^ siècle : le lectionnaire de Lobbes, codex Bruxellensis 18018*, Gand: Ėditions Story-Scientia.

Gilissen, Léon (1977), *Prolégomènes à la codicologie*, *Recherches sur la construction des cahiers et la mise en page des manuscrits médiévaux*, Gand: Éditions scientifiques Story-Scientia.

Giusti, Franco (1990), *Introduzione alla statistica*, Torino: Loescher.

Guarducci, Margherita (1987), *L'epigrafia greca dalle origini al tardo impero*, Roma: Istituto poligrafico e Zecca dello Stato.

Hunger, Herbert (1954), 'Die Perlschrift, eine Stilrichtung der griechischen Buchschrift des 11. Jahrhunderts', in Hunger, Herbert (ed.), *Studien zur griechischen Paläographie,* Wien: Hollinek (Biblosschriften, 5), 22–32 (repr. in Hunger, Herbert [1973], *Byzantinische Grundlagenforschung,* London: Variorum Reprints).

Irigoin, Jean (1992), 'Manuscrit imposé ou copie sur carnets?', in *Scriptorium*, 46: 88–90.

Lemaire, Jacques (1989), *Introduction à la codicologie,* Louvain-la-Neuve: Institut d'études médiévales (Textes, études, congrès, 9).

Maniaci, Marilena (1995), 'Ricette di costruzione della pagina nei manoscritti greci e latini', in *Scriptorium*, 69: 16–41.

Maniaci, Marilena (1996), 'Un repertorio da leggere fra le righe?', in *Gazette du livre médiéval*, 28: 13–22.

Maniaci, Marilena (1996 [1998^2^]), *Terminologia del libro manoscritto,* Milano, Roma: Istituto centrale per la patologia del libro.

Maniaci, Marilena (2002), *Costruzione e gestione della pagina nel manoscritto bizantino*, Cassino: Università degli studi di Cassino.

Maniaci, Marilena / Muzerelle, Denis / Ornato, Ezio (1999), 'Une bible ... mais encore? Le portrait des manuscrits bibliques dans la catalographie moderne', in Schlusemann, Rita / Hermans, Jos / Hoogvliet, Margriet (eds), *Sources for the History of Medieval Books and Libraries*, Groningen: E. Forsten, 291–309.

Maniaci, Marilena / Ornato, Ezio (1993), 'Che fare del proprio corpus? I. Costituzione e descrizione di una popolazione di libri a fini statistici', in *Gazette du livre médiéval*, 22: 27–37 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: Viella [I libri di Viella, 10], 67–75).

Maniaci, Marilena / Ornato, Ezio (1995), 'Intorno al testo : il ruolo dei margini nell'impaginazione dei manoscritti greci e latini', in *Nuovi Annali della Scuola speciale per archivisti e bibliotecari*, 9: 175–194.

Martellotti, Guido (ed.) (1964), F. Petrarca, *De viris illustribus,* I, Firenze: Sansoni.

Mastruzzo, Antonio (1995), 'Ductus, corsività, storia della scrittura: alcune considerazioni', in *Scrittura e civiltà*, 19: 403–464.

Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*, Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).

Muzerelle, Denis / Ornato, Ezio (1997), 'Une affaire bien mal réglée ... contribution au débat sur le codage des schémas de réglure des manuscrits grecs', in *Gazette du livre médiéval*, 30: 26–36.

Ornato, Ezio (1975), 'Statistique et paléographie: peut-on utiliser le rapport modulaire dans l'expertise des écritures médiévales?', in *Scriptorium*, 29: 143–156.

Ornato, Ezio (1994), 'Exigences fonctionnelles, contraintes matérielles et pratiques traditionnelles dans le livre médiéval : quelques réflexions', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel (12–14 November 1990), Marburg: Institut für Historische Hilfswissenschaften, 7–31 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma: [I libri di Viella, 10], 117–159).

Parker, Malcolm B. (1987), 'The Contribution of Insular Scribes of the Seventh and Eighth Centuries to the "Grammar of Legibility"', in Maierù, Alfonso, *Grafia e interpunzione del latino nel medioevo*. Atti del Seminario internazionale (Roma, 27–29 settembre 1984), Roma: Edizioni dell'Ateneo, 1987 (Lessico intellettuale europeo, 41), 15–29 (repr. in Parkes, Malcom B. [1991], *Scribes, Scripts and Readers. Studies in the Presentation and Dissemination of Medieval Texts*, London: Hambledon Press 1991, 1–18).

Parker, Malcolm B. (1992), *Pause and Effect: An Introduction to the History of Punctuation in the West*, Aldershot: Scolar Press.

Parker, Malcolm B. (1995), 'Leggere, scrivere, interpretare il testo: pratiche monastiche nell'alto medioevo', in Cavallo, Guglielmo / Chartier, Roger (eds) (1995), *Storia della lettura nel mondo occidentale*, Roma-Bari: Laterza, 71–90.

Petitmengin, Pierre (1985), 'Les plus anciens manuscrits de la Bible latine', in Fontaine, Jacques / Pietri, Charles (eds), *Le monde latin antique et la Bible*, Paris: Beauchesne (Bibles de tous les temps, 2), 89–123.

Petrucci, Armando (1968), 'Censimento dei codici dei secoli IX–XII, Istruzioni per la datazione', in *Studi medievali* Ser. 3a, 9, 1115–1126.

Petrucci, Armando (1984), 'Lire au Moyen Âge', in *Mélanges de l'Ecole française de Rome*. Moyen Âge, temps modernes, 96:, 603–616.

Ruffini, S. (1996), 'Tipologia e funzioni del segno di a capo nella minuscola libraria greca dell'età media, a graduate thesis' in *Manuscript Conservation at the Scuola Speciale per Archivisti e Bibliotecari at Rome's "Sapienza" University*, supervised by Lidia Perria, and later summarised in *Nuovi Annali della Scuola Speciale per Archivisti e Bibliotecari*, 10, 1996, 304.

Ruiz Garcia, Elisa (1988), *Manual de codicologia*, Salamanca – Madrid: Fundaciôn German Sanchez Ruipérez - Pirâmide (Biblioteca del Libro. Series Maior).

Saenger, Paul (1982), 'Silent Reading: Its Impact on Late Medieval Script and Society', in *Viator. Medieval and Renaissance Studies*, 13: 367–414.

Saenger, Paul (1990), 'The Separation of Words and the Order of Words: the Genesis of Medieval Reading', in *Scrittura e civiltà*, 14: 49–74.

Saenger, Paul (1990a), 'Coupure et séparation des mots sur le continent au Moyen Âge', in Martin, Henri-Jean / Vézin, Jean (eds), *Mise en page et mise en texte du livre manuscrit*, Paris: Éditions du Cercle de la Librairie - Promodis, 451–455.

Saenger, Paul (1995), *Leggere nel tardo medioevo*, in Cavallo, Guglielmo / Chartier, Roger (eds) (1995), *Storia della lettura nel mondo occidentale*, Roma-Bari: Laterza, 117–154.

Samaran, C. (1928), an untitled paper published in the *Bulletin de la Société nationale des Antiquaires de France*, 202.

Sautel, Jacques-Hubert (1995), *Répertoire de réglures dans les manuscrits grecs su parchemin. Base de données établie par Jacques-Hubert Sautel à l'aide du fichier Leroy et des catalogues récentes*, Turnhout: Brepols (Bibliologia, 13).

Sautel, Jacques-Hubert (1996), 'Défense et illustration de la codification Leroy', in *Gazette du livre médiéval*, 19: 24–36.

Supino Martini, Paola (1996), 'Scrittura e leggibilità in Italia nel secolo IX', in Scalon, Cesare (ed.), *Libri e documenti d' Italia: dai Longobardi alla rinascita delle città.* Atti del Convegno nazionale dell'Associazone Italiana Paleografi e Diplomatisti, Cividale, 5–7 ottobre 1994, Udine: Arti Grafiche Friulane (Libri e biblioteche, 4), 35–60.

Ziegler, Konrat (ed.) (1968), Plutarchus, *Caesar*, II, 2, Leipzig: Teubner.

Scripts and scribes

Frank M. Bischoff

The Rhythm of the Scribe

A Serial Analysis of the Density of Writing in the Gospels of Henry the Lion

Abstract: In all medieval manuscripts, the width of a line is subject to continuous variation. This is true even of the most sumptuous volumes, entrusted only to the finest of scribes. The Gospel of Henry the Lion, produced by the monk Herimann in the second half of the 12th century, is one such case. In order to determine whether these variations were involuntary or intentional it is necessary to measure them and, in particular, to apply methods developed for the analysis of time series. In this way, cyclical fluctuations can be identified, along with other fluctuations, non-cyclical but systematic, which prove that such oscillations in the writing are not merely evidence of a faltering hand, but rather an expression of consummate artistry and skill.

Henry the Lion's Gospels were probably written in around 1175 at the monastery of Helmarshausen, in Saxony, by a Benedictine monk named Herimann (Fig. 1–2)[1].

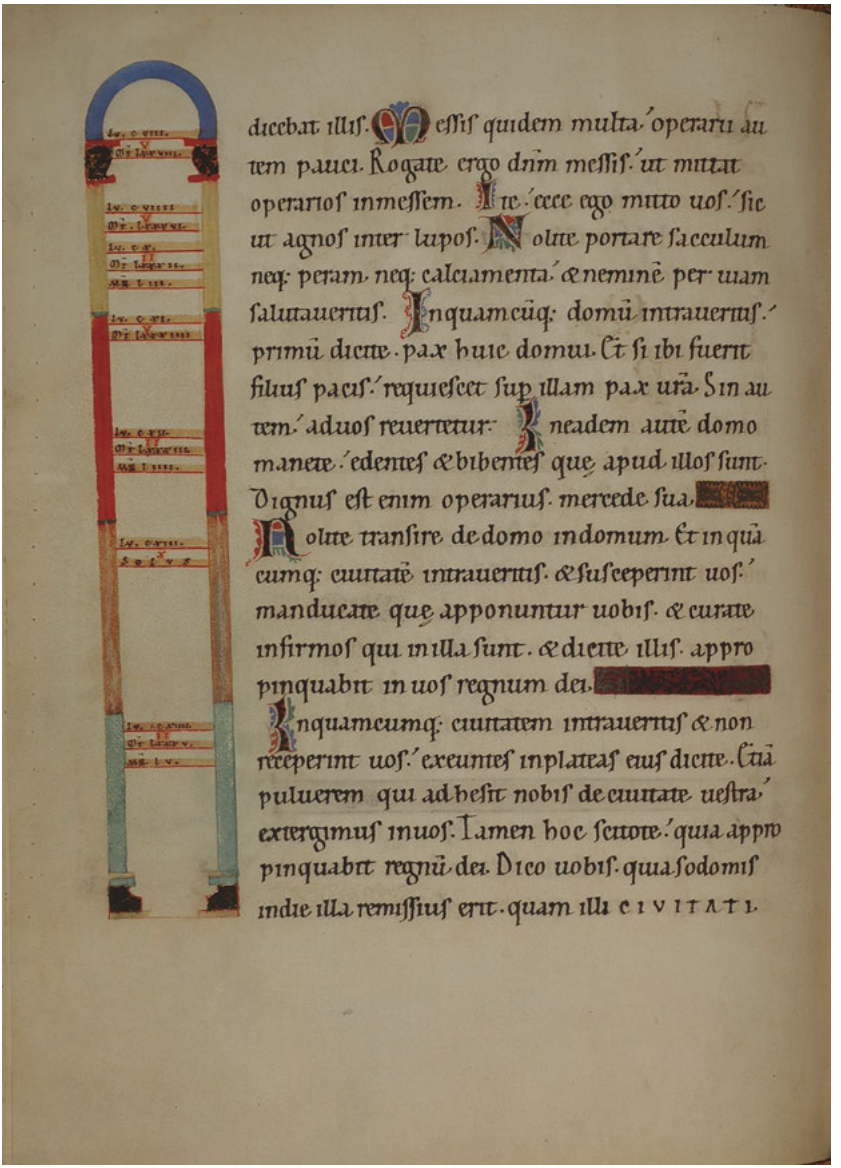
Translated from the French into English by Mark Livesey. Original published as Bischoff, Frank M. (1996), 'Le rythme du scribe. Analyse sérielle de la densité d'écriture dans les évangiles d'Henri le Lion', in *Histoire et mesure*, 11, 1/2: 53–91. The German version of this article was published as Bischoff, Frank M. (1999), Zyklischer Schreibrhythmus. Zeitreihenanalytische Untersuchungen zur Schreibdichte im Evangeliar Heinrichs des Löwen, in Rück, Peter (ed.), Methoden der Schriftbeschreibung, Stuttgart: Jan Thorbecke, 119–140.

I would like to extend my gratitude to Marilena Maniaci and Ezio Ornato, thanks to whom this article came to be translated into French, not without a few linguistic conundrums. I also extend my gratitude to Alain Guerreau, who was willing to proofread and correct the final draft. [Note of the editor: a full digital reproduction of the codex is now available on the library's website (http://diglib.hab.de/?db=mss&list=ms&id=105-noviss-2f)].

---

1 For a considerable time, the manuscript was dated to 1175; see Jansen 1933, and Kruger 1972. This dating was contested by Reiner Haussherr, 1980, 3–15, and the codex was subsequently post-dated to around 1188 on the basis of a consecrational inscription on the Altar of Our Lady at Brunswick in Lower Saxony. Even though art historians (as well as an increasing number of historians) adhere to the dating proposed by Haussherr, the older dating has once again begun to find favour, thanks to some new details discovered in the dedication of a second altar to Our Lady located in the crypt of the cathedral of Brunswick, and some new arguments of a palaeographical nature. In actual fact, this question cannot be answered in a definitive way. The most recent and wide-reaching approach

https://doi.org/10.1515/9783110743838-017



dicebat illis. Messis quidem multa. operarii autem pauci. Rogate ergo dñm messis. ut mittat operarios in messem. Ite. ecce ego mitto uos. sicut agnos inter lupos. Nolite portare saculum neq; peram. neq; calciamenta. & neminē per uiam salutaueritis. In quamcūq; domū intrauerit. primū dicite. pax huic domui. Et si ibi fuerit filius pacis. requiescet sup illam pax ura. Sin autem. aduos reuertetur. Ineadem aut̄ domo manete. edentes & bibentes que apud illos sunt. Dignus est enim operarius. mercede sua. Nolite transire de domo in domum. Et in quā cumq; ciuitatē intraueritis. & susceperint uos. manducate que apponuntur uobis. & curate infirmos qui in illa sunt. & dicite illis. appropinquabit in uos regnum dei. In quamcumq; ciuitatem intraueritis & non receperint uos. exeuntes in plateas eius dicite. Etiā pulueren qui adhesit nobis de ciuitate uestra. extergimus in uos. Tamen hoc scitote. quia appropinquabit regnū dei. Dico uobis. quia sodomis in die illa remissius erit. quam illi CIVITATI.

Fig. 1: The Gospel of Henry the Lion, produced by the monk Herimann in the second half of the 12th century, f. 136v © Herzog August Bibliothek Wolfenbüttel

to Herimann's work (which includes a complete bibliography) can be found in Kötzsche 1989. See also Möhle 1991, 1–24.

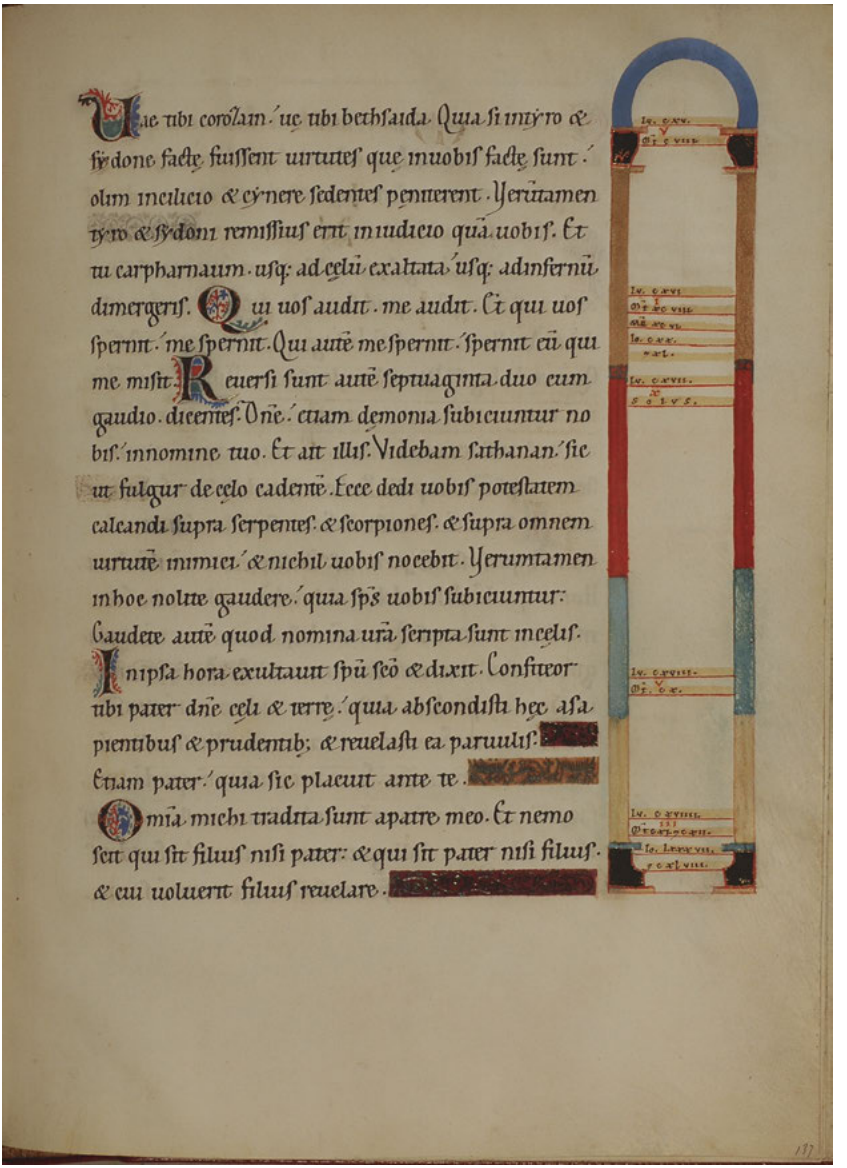


Fig. 2: The Gospel of Henry the Lion, produced by the monk Herimann in the second half of the 12th century, f. 137r © Herzog August Bibliothek Wolfenbüttel

In his analysis of the sumptuously executed manuscript, Peter Rück has shown that the monk was very attentive to the smallest details and that he adopted a highly varied repertoire of scripts in order to achieve the desired objective: for the main text body he employed the Carolingian minuscule, whilst he used a 'spaced out script' for the *capitula* and the *Comes*, as well as for the dedication in chrysography, where he identified himself alongside his illustrious commissioning patron. Similarly, in the display scripts, Herimann introduced a number of variants that are different in size, colour and form. As Peter Rück confirms[2], Herimann was an expert who was able to create in the Guelf Duke's Gospels a veritable *Museum graphicum* of the Romanesque era.

It is therefore undeniable that the monk of Helmarshausen was in all ways a master of his art. For this reason, it is all the more surprising to observe fluctuations in the script that repeatedly manifest themselves throughout the Gospels. Thus, one immediately notices that at the beginning of quire 19, in the Gospel according to St. Luke, Herimanns's script is far more compressed than on the preceding page—indeed, whilst in the manuscript one counts an average of 38 characters per full line (excluding, that is, lines which contain decorated initials, title lines, and sequences of spaced out script), f. 136v holds two lines less than the average and f. 137r two and a half more. The difference is similarly large between quires 21 and 22: on f. 160v Herimann puts down 723 characters of normal script, as opposed to 803 on the following page (f. 161r). The difference is only a question of four characters per line, so one can reasonably suppose that such a disparity is of no significance in the overall concept envisaged for the book. In actual fact, this is not so. The approximate size of these fluctuations can be gauged when one considers the transcription in Carolingian minuscule of the Gospel according to St. Luke which occupies ff. 114v to 166v[3], for a total of 105 pages composed of 22 lines.[4] If the scribe had written the text with the space-consuming minuscule seen on f. 136v, his transcription would have occupied 111 pages, whereas had he used the 'economical' script seen on f. 137r, 97 pages would have sufficed. The difference is almost equivalent to the length of a quire composed of four bifolia. Extended to the entire volume—here, by including blank pages or illustrated pages, one attains a total of 226 leaves assembled into 31 quires—we reach a total of

2 Rück 1989, 122–154.

3 One encounters a change of quire on ff. 113, 121, 129, 137, 145, 153 and 161.

4 F. 121 contains 21 lines, whilst f. 166 contains 18.

about 50 pages, equating to three quires.[5] The spacing out or compression of the script therefore becomes highly significant, given that, at the very least, this will have an impact on the thickness of the volume and the amount of parchment used to manufacture it.

Herimann—who completed the text of the Gospels and the *Capitulare Evangeliorum*[6] prior to the first part of the manuscript up to the Canon Tables or the purple-tinted page of the Gospel according to St. Matthew[7]—was clearly obliged to modify the density of his writing. In the examples cited, modification of the script was carried out at the meeting point between two quires, and this phenomenon can only be explained if the copyist decided in advance to contain one part or the other of the text within a pre-established number of pages. Now, were it indeed the case that a calculation was made in advance, the scribe would necessarily have had to ensure from time to time that he was not straying too far from the fixed norm, and he would have done so by regulating the density of his writing accordingly. Therefore, the change observed on ff. 136v–137r is simply the visible result of this periodic and ongoing checking and adjustment procedure.

It would be interesting to follow Herimann's writing line-by-line in order to identify the variation in the rhythms it contains. Unfortunately, simple visual observation will not provide us with reliable results, since the eye can only discern the most conspicuous oscillations. The smallest fluctuations tend to escape our notice, all the more so when an assessment is subject to distraction by other elements of the tracing and the *mise en page*, namely the use of spaced out script (so as to make the *nomina sacra* stand out, in association with display capitals or a space filler inserted at the end of a section), and the decoration of text, either by means of ornamental bands placed at the beginning of a *breve* or a weekday pericope, or by ornamental initials and line endings used in the transcription of a Eusebian section[8], or—in the case of initials—to function as verse identifiers.[9]

---

5 Most of the quires in the manuscript are quaternions. The dimensions of the leaves (34.2 × 25.6 cm) lead one to suppose that the realisation of each quaternion required the skins of two calves. See Bischoff 1991, 87.144, above all 113ff.

6 This is a calendar (also known as the *Comes*) that sets out the order of Mass readings throughout the liturgical year.

7 This practice is entirely typical in the realisation of the Gospels. See Bischoff 1994.

8 The *breves* and Eusebian sections are subdivisions in the Gospels. In the Gospels of Henry the Lion, the Gospel according to St. Luke is divided by 21 *breves* and 343 Eusebian sections.

9 From this point on, we shall employ the terms 'highlighted line' or 'ornamental band' for all lines written in gold ink on a coloured background placed at the beginning of the *breves*. The line endings which in general close a Eusebian section consist of coloured and gilded bands

1 Measurement of writing density

Writing density can be measured by means of a counting operation. To achieve this aim, it will suffice to count the words[10] or characters contained within a sufficiently extended space. At first glance, this operation does not raise any significant problems; however, in reality it is not as simple as it seems. In fact, the shorter the text, the greater the influence of variation factors: words might be relatively long, and the random presence of very long or very short words may distort results. The counting of characters—which unquestionably constitutes a less inaccurate evaluation method—also presents some problematic issues: characters are not all of the same width; so much so, in fact, that a particularly high frequency of wide letters—such as *m* or *u*—necessarily reduces the number of characters per space unit on account of the script being more spaced out. The difficulty arises owing to the irregular distribution of word length or of letter width: if one were to select portions of text of sufficient length so as to render the variations in these parameters effectively negligible, the results would be practically free of errors and the two methods would be equivalent.

We must now ask what length of text must be analysed in Latin Gospels if one wishes to obtain an error-free result. By considering the case of a printed text—where disparities can only be due to variations in the frequency of letters—one can affirm that a passage of text is sufficiently long when a completely different passage containing the same number of characters occupies the same space. One can therefore allow that in all the passages analysed the frequency of the appearance of letters will be more or less the same. In practice, however, this definition of 'sufficient length' is rather problematical, as a test carried out on some printed passages of script reveals. In a recent edition of Petrarch's *De viris illustribus*, Ezio Ornato,[11] after having measured twenty samples numbering one thousand characters in length, obtained a coefficient of variation of 1.45%. This is a low but not null value, and in any case, even if one is prepared to accept the margin of error, the area covered by one thousand characters in Henry the Lion's

intended to fill spaces devoid of script. For the relevant terminology (in French), see Muzerelle 1985.

10 A word count was performed by Frenz 1976, 347–375, on some pontifical documents dating from the Late Middle Ages. The count was carried out by tallying up all the words contained in three lines of text. As we shall see, this method is adequate for the purpose of conducting a rough survey of writing density based on average values, but is not sufficient to support research into a scribe's writing rhythm.

11 Ornato 1975, 198–234.

Gospels corresponds to 1.2 pages.[12] We are therefore very far from being able to track Herimann's writing line-by-line.

Another solution could be envisaged, namely that of taking into account the typology of letters, so as to know not only the number of letters per line, but also the frequency of each letter. By weighting the latter according to the average width of the corresponding letter, one can tell, line-by-line, whether the copyist's writing is compressed or spaced out. In order to apply this method, one would certainly require more time than Herimann needed to carry out his transcription. The method might be rigorous, but is totally impractical in terms of the number of researcher-hours that would be necessary for its practical application.

On the other hand, it does not take very long to compare the margin of error in the first two methods—word count and character count—with the results of the third method on a small portion of text. To this end, from a selection of five pages of the volume (33v, 91r, 136v, 137r, 179v), a sample of 23 lines was put together. If one takes the ligatures *nt* and *et* into account, as well as the spaces between words, one can amass almost a thousand measurements. The use of a photographic enlargement made it possible to measure not only the spaces between words, but also the spaces between the individual letters within words. An example, line 15 of f. 137r, provides a helpful illustration of the measuring method employed (Fig. 3).

Fig. 3: Spaces between the individual letters within words, f. 137r, line 15.

This method is far from perfect. Indeed, a certain number of symbols, such as punctuation marks, were not accounted for, and capital letters (not represented in Chart 1) were grouped together, without worrying about their nature or their form. In

12 Clearly, the method applied by Ezio Ornato is not well suited to manuscript writing, owing to the fact that the width of each printed character is consistent by definition, hence the method cannot take into account the variations of density in the writing. If, in any of the 41 consecutive pages of the Gospel according to St. Luke, the relationship between the number of characters and the length of the line always remains the same at approximately +/- 1 % of the mean (on average 34,255 letters distributed over 127m of lines, according to the results obtained—which are presented in the Appendix—by dividing the page into five sections), one can deduce that all the letter widths have a similar frequency, but one cannot establish the respective share of the writing density and of the typology of the characters in determining their width, and likewise one cannot ascertain the rate of occurrence of each character.

addition, variations in the way in which letters were drawn in relation to the density of the writing (the problem as regards the proportion of letters will not be addressed in the next part of the study) were not taken into account, nor were variations owing to the position of the initial or final letter in a word.[13] The boundary between two adjacent letters was determined by guesswork because, in certain cases, the termination of a letter can overlap on to the letter that follows. Finally, it proved difficult to measure the space between two words, and sometimes it is not easy to confirm that the copyist really intended to separate them. These limitations notwithstanding, the results obtained can nevertheless represent an acceptable approximation of the width of minuscule characters.

To trace an *m*, Herimann required, on average, almost three times more space than he needed to trace an *i* (2.9:1). All the other letters of the alphabet fall within the two extremes, including the ligatures *et* and *nt*, as well as the blank spaces between words. If one arranges the letters in ascending order based on width, one observes a very clear gap between the *e* and the *a*, which separate the letters with only one descender from those which include multiple descenders and those with bowls. This gap is particularly interesting, since the average width of characters—weighted according to their respective frequency—falls exactly between the *e* and the *a*.[14] The relationship between the two letters, shown in Chart 1, represents the averages, whose standard deviations reflect the variations in the density of Herimann's script. It should be noted that some fluctuations also affect the relationships themselves: thus, the relationship between the letters *n* and *b* with the other letters is relatively stable, whereas the differences are more significant in the case of rare letters such as *x*, or of letters of relatively simple form, such as *l* or *s*.

13 Without dwelling too much on this aspect, it should nonetheless be pointed out that the notion of a letter's 'typical' width is a rather slippery one. Letters exhibit different 'behaviours' depending on the situation/environment in which they are found. This is the case with the letter *s*, which slants towards the right when the succeeding letter is lacking ascenders but is held back from a letter that includes a bowl situated on the left (i.e. *d, g* and *q*; see, likewise, in Chart 1, the difference between these letters and the aforementioned characteristics when the bowl is situated on the right, i.e. *b* and *p*). These differences cannot be taken into account in a simple calculation of the width of each letter. However, it is equally true that some constants exist that are independent of the environment in which the letter is found: a minuscule *m* will *always* be broader than an *a*, and an *a* will *always* be broader than an *i*, regardless of the situation with respect to these letters. These conditions having been specified, the results presented in Chart 1 should be considered an 'estimate' of the theoretical determination of the width of each letter.

14 Regarding the frequency of each letter, see Tab. 2. The value of 1.47 takes into account the blank spaces between words, capitals and abbreviations such as *us* and *que,* for which the corresponding symbols are found on the line of writing. If one dismisses all these elements, the value increases to 1.53 (compared with 1.50, a value obtained for the printed text of Plutarch).

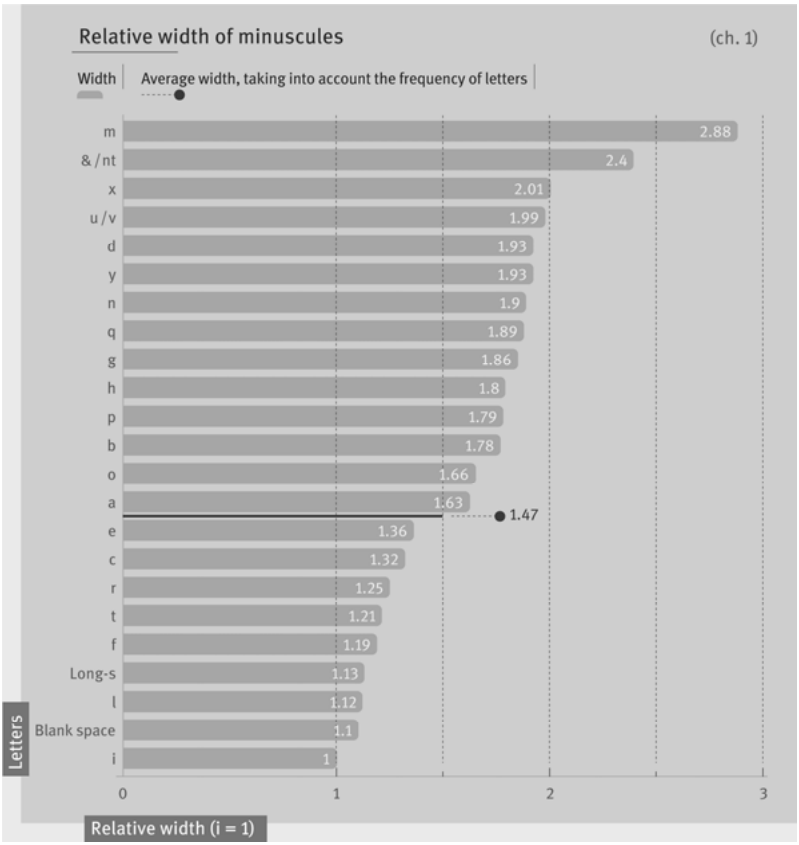


Chart 1: Relative width of minuscules

Calculation of the average width of each letter is necessary so as to be able to determine the influence (i.e. weight) it has on the calculation of the overall width of the writing. Accordingly, all the letters[15] were counted line-by-line in a length of text extending for four pages (ff. 136r–137v), and the size of each was multiplied by its weight. Essentially, since all the widths are expressed in terms of their relationship with the letter *i*, the operation consisted in calculating, for each line, the number of 'average' *i*'s that each contained. Since the lines are not always completely occupied by script, this number was related to the length of the written portion and

15 This calculation takes into account the blank spaces between words and ligatures, as well as the abbreviations *us* and *que*, but does not include ornamental initials.

expressed in the form of a percentage.[16] The resulting value hereinafter in our study will be referred to as the *standardised letter width*; if its value is under 100, this signifies that the line contains a greater number of *i*'s than a line containing an 'average number of *i*'s', and therefore that the script is narrower than the average observed in the book taken as a whole.

A second series of measurements was carried out, this time consisting in a simple character count. This furnished the *average letter width*[17] and, based on the same principle, the *average word width* forms a third series.[18] A few examples suffice to illustrate the difference between the standardised width and the average width of the letters: in the case of line 18 of f. 136v, the first parameter has a value of 102.7 (the script here is a little more compressed than it is on the rest of the page; see Tab. 1), whilst the second parameter has a value of 93.4. The difference is due to the unusually high frequency of narrow letters, namely nine *e*'s, six *i*'s, five *t*'s, and four *s*'s. Line 20 of f. 137 exhibits the opposite phenomenon (95.8 as opposed to 102.7), this time thanks to numerous appearances of the letter *m*.

Average writing density per page depending on the various measuring methods employed (tab. 1)

Page	Width of the standardised letter		Width of the average letter		Width of the average word	
136r	106.1	(2.5)	106.0	(6.7)	106.1	(23.7)
136v	105.4	(2.7)	105.0	(6.7)	110.2	(18.6)
137r	93.9	(3.8)	92.9	(5.0)	91.7	(13.1)
137v	95.0	(4.3)	96.3	(7.1)	92.2	(14.2)

Standard deviation shown in brackets

Tab. 1: Average writing density per page depending on the various measuring methods employed

16 In the calculation to establish the density of the script ϑ in a line composed of a group α of letters (where α represents all the letters of the alphabet, including the special forms mentioned in the previous footnote), the following formula is applied:

$$\vartheta = l/\Sigma\,(\alpha \times weight_{\alpha}),$$

where l = the length of a line, and *weight* = the relative width of the letter in accordance with Chart 1.

17 This calculation does not consider blank spaces, nor the abbreviations *us* and *que*.

18 In the calculation, we assigned a value of 0.5 to words split at the end of a line.

Compared with the two other methods, measurement of the standardised width of letters reduces the fluctuations in script density: the averages and the deviations demonstrate that this procedure tends to 'flatten out' fluctuations caused by variations in the frequency of letters and eliminates the frequently abnormal imbalances which result from calculating the average length of words. However, the standardised width is very sensitive to abrupt variations in script density occurring between one line and another, as seen in the example of f. 137r—whilst almost everywhere else the writing density is under 100, on line 19 Herimann suddenly spaced out his writing, a manoeuvre which has an immediate impact on the standardised width value (105.9).

The evaluation of the error probability inherent to the three methods presupposes that one of them produces optimal results, or at least results that are better than those obtained using the other two. For this reason, from now on we shall allow that the standardised width of the letters better reflects the real situation. In addition, we shall allow that, in the passage analysed for this test (87 lines,[19] corresponding to more than 600 words or about 3,300 letters) the three methods in question produce identical results, which amounts to saying that, in a sample of 87 lines of a Latin Gospel book, all the letters and all the word lengths crop up with the same frequency. In the strictest sense, this postulate is probably false; however, the deviation compared to what is observed in reality is quite small, as borne witness to by Petrarch's *De viris illustribus*,[20] in which the average frequency of letters—despite its being a completely different text—is nearly the same as in the 87 lines of the Gospel book analysed here (see Tab. 2). Thus, at least where the standardised width and the average width of letters are concerned, we can confirm that the samples composed of 87 lines produce similar results.[21]

Based on these two hypotheses, we can now calculate experimentally the maximum and average deviations of each of the two approximations (calculated by grouping the lines in successive order; i.e. 1, 2, 3... 87) in relation to the standardised width of letters. This was considered the best method to employ. The results are presented in Chart 2.

19 The decorated band on f. 136r does not affect the calculation.

20 Ornato 1975, 224.

21 The averages shown in Table 1 are all orientated equally in this direction.

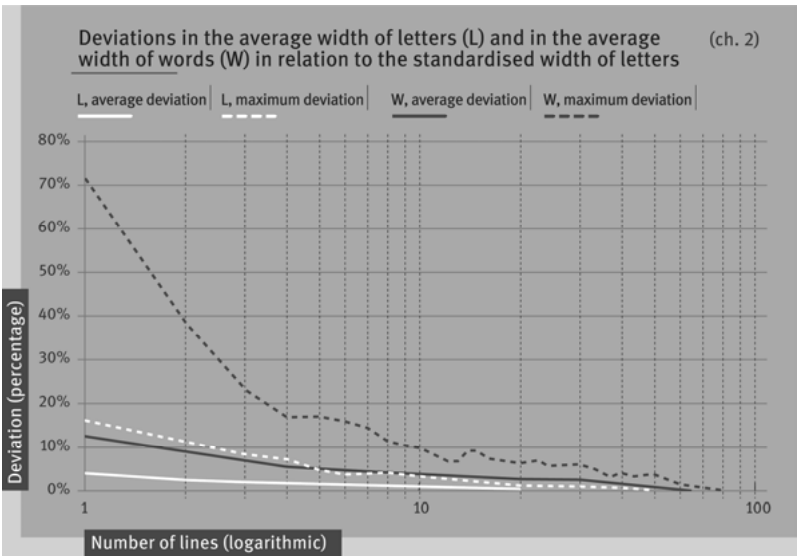


Chart 2: Deviations in the average width of letters (L) and in the average width of words (W) in relation to the standardised width of letters

Not surprisingly, the method that adopts the average width of words is the one which produces the least satisfactory results. If one considers a deviation of 10% as the maximum acceptable, one would need to work with samples made up of ten lines in order to be sure of never exceeding that value. Regarding the average deviation, it is roughly 4%.[22] By using the average width of letters, samples composed of two and a half lines, which is to say roughly one hundred letters, would be sufficient, with an average deviation of a little more than 2%. For samples composed of four lines, the average deviation obtained by applying this method is 1.8% and the maximum deviation does not exceed 7%. Consequently, in accordance with the degree of accuracy deemed acceptable, measurement of writing density in a manuscript would not call for more than 100–200 letters.

22 This means that in 78 samples made up of ten lines of consecutive text, one encounters at least one case where the average width of letters deviates at least 10% from the standardised width. In these samples, the average difference between the two values is roughly 4%.

Frequency of letters, ff. 136r–137v (tab. 2)

Letters	Total number of occurences	Ff. 136–137, as an percentage	Frequency in Petrarch, in percentage
a	232	7.8	7.51
b	41	1.25	1.67
c	118	360	3.74
d	124	3.79	2.69
e	375	11.45	11.18
f	20	0.61	0.85
g	24	0.73	1.27
h	29	0.89	0.59
i	449	13.71	11.95
l	116	3.54	3.32
m	138	4.21	5.83
n	199	6.08	6.04
0	155	4.73	5.28
p	88	2.69	2.78
q	54	1.65	1.60
r	160	4.89	6.88
s	259	7.91	7.81
t	292	8.92	8.32
u/v	329	10.05	10.16
x	24	0.73	
y	5	0.15	
z	1	0.03	
&/nt	43	1.31	
Others			0.54
Total	3275	100	100.00
In addition, on ff. 136r-–137v, the following appear:			
Abbreviations (b; and q;)			10
Capital letters (without decorated initials)			60
Blank spaces			586

Tab. 2: Frequency of letters, ff. 136r–137v

2 Writing density in the Gospel according to St. Luke

Taking these results into account, the measurement of writing density was carried out based on the average width of letters. Each page of the Gospel according to St. Luke (ff. 114v–166r)[23] was subdivided into five sections: three composed of four lines (sections 1, 4 and 5), and two composed of five lines (sections 2 and 3), so that the deviation in relation to the standardised width of the letters never exceeds 7% and remains on average under 2%. For each of the sections identified thus, all the letters were counted prior to measuring the overall amount of space that they take up on the line.[24]

The average width of the constituent letters, calculated on the basis of approximately 86,800 characters, representing a total length of almost 320 m, measures 3.7 mm. This global figure is quite imprecise when one considers Herimann's writing density, which shows considerable fluctuations across the 520 sections of text surveyed. The disparity between the two extremes is roughly 30%, and these extremes can occur between adjacent folios, pages or single sections of text. Within 'very dense' passages of text one might well encounter a 'very spaced out' section, whilst elsewhere one might find alternating passages of spaced out and densely packed script which, when plotted on a graph, translate into a series of peaks and troughs. If one excludes some partially identifiable trends, Herimann's script seems to be the product of pure whimsy.

23 ff. 107r–110r contain the *Capitula* and the Prefaces to the Gospel according to St. Luke; ff. 110v–113r are dedicated to the iconographic scheme; f. 113v is the page that carries the text's initial; f. 114r is a chrysographed page set out on a coloured background; f. 166v constitutes the last page, three quarters of which is blank. From now on, all these pages will be excluded from the calculations.

24 The blank spaces between words and the ';' that shortens the endings *us* and *que* were not included in the calculation; the capitals and ligatures *nt* and *st* were made compatible by representing them by means of a unique symbol; the illuminated lines, decorated bands, ornamental letters and passages of spaced out script were also subtracted from the length of the line. The average line length calculated in this way is therefore shorter (14 cm) than that put down during the *mise en page* (15 cm). It can be seen that Herimann utilised 7% of the page for decorative elements and graphic devices aimed at drawing attention to certain parts of the text. The role played by decorative elements is even more important in the Gospel according to St. Matthew (see Rück 1989, 127).

2.1 Methods employed in serial analysis

By applying the methods used in time series analysis, we are now going to see if we can confirm that, contrary to one's initial impression, Herimann's writing does in fact contain some cyclical trends. Such analytical methods, developed by experts in econometrics, are aimed at disclosing the existence of regular rhythms in a non-lacunar series of data organised chronologically and at regular intervals. This makes it possible to account for such rhythms and enables one to make some projections.[25]

In a time series, economic statistics distinguishes three basic elements: the trend, which describes long-term behaviour; cyclical components, which act on a series at regular intervals; and 'white noise', which does not present any regularity and cannot be accounted for by systematic factors, given that it depends on random occurrences. These different elements can be linked to one another by addition or multiplication, or exponentially, although one normally begins by presuming the existence of an additive link. Thus, according to the simplified model, each value measured at moment *t* is the result of the sum of the trend (g), the cyclical components (c) and white noise:

$$\vartheta y_t = g_t + \Sigma\,(cl_{t\ldots}\, cn_t) + \Sigma_t$$

25 Over the last twenty years, time series analysis has attracted considerable interest. The new methods—autoregressive and spectral analysis procedures in particular—were developed and applied in historical studies, above all in the reconstruction of economic conditions and the history of prices. Concerning these matters, see the special issue of *Histoire et Mesure* dedicated to time series (6, 1–2 [1991]), or the contributions of Stier (14,1 [1989]), Spree (Supplement 4 [1991]), Metz / Stier (17, 3 [1992]) and Thome (17, 3 [1992]) in the latest issues of *Historische Sozialforschung (Quantum)*. During the course of this investigation, we will not be employing the more complex methods which have recently been the subject of a good amount of discussion. Rather, we shall employ the more straightforward and descriptive methods used in classical time series analysis; these are well known to historians who practice statistical analysis and are adequately explained in widely available manuals on statistical economics. Given that this article addresses an area where the application of such methods is not commonplace, we shall mark out the boundaries in order to briefly outline the fundamentals of classical time series analysis. Details of the calculation procedures will not be furnished here; the interested reader will be able to find directions to such information in the footnotes. To this, one can usefully add the very clear introduction to classical time series analysis presented in Esenwein-Rothe 1976, (principally vol. 2), and Leiner 1982.

The validity of this formula implies that at any moment it should be possible to isolate and quantify the various factors contributing to the influence.

The extrapolation of postulates from the time series analysis of a medieval scribe's writing rhythm presents some problems and can only be contemplated when a certain number of precautions are taken. For this reason, in the Gospels copied by Herimann, we can say nothing about the time factor, which is of critical importance in statistical economics—indeed, we have no idea how much time would have been required for the scribe to perform his task, nor the speed at which he would have worked. Instead of a series of chronologically ordered moments in time, we have a series of sections of adjacent text, and we can only measure the density of the transcription in the latter. In addition, it is impossible for us to know whether text density was influenced by time-related factors: for example, whether the scribe's writing pace changed between the beginning and end of the day, after many hours of painstaking labour.

Also doubtful is the way in which the various components of the series are linked to one another. The choice of an additive model in the presentation that follows is motivated by the fact that a reduction in writing density does not lead to strong fluctuations in the series and that, furthermore, elimination of the cyclical component by means of the multiplicative model does not reduce its variance by much.[26]

Finally, the analysis of a medieval scribe's working method presents some problems that the classic set of tools offered by time series analysis are of little help in tackling. Indeed, time series analysis can only identify regular cyclical variations: non-periodic fluctuations, which also depend on arrhythmic factors, cannot be disclosed by using the simple method, and likewise it is impossible to separate two non-periodic superimposed movements.

At first blush, the notion that Herimann may have adjusted the rhythm of his writing for some reason other than that of simply meeting incidental needs and instead *a fortiori* according to a mathematical model can only seem mistaken (as indeed it is, if one interprets the term 'model' in its strictest sense), and the idea that the spacing out of a line of script was the result of a trend, a cyclical and a random component might seem absurd. It is not, though, when one construes measurements in hundredths of a millimetre as an expression of the tendency of the scribe to space out or compress his writing in specific places. The scribe's hand does not obey a model; the model only serves to expose some underlying tendencies.

26 The comparison recommended by Thome 1992, 75ff. between the script density averages and the standard deviation (for this test, all the values were calculated on the basis of half quires and page-by-page) also supports an additive model, because the standard deviation values do not change in accordance with the writing density averages (which, indeed, are plotted parallel to the abscissa axis).

3 The trend

Calculation of the trend is generally based on the application of two methodologies: moving averages and polynomial fitting. The moving averages can be well adapted to the data, but they necessarily entail some losses at the beginning and end of the series (which can, however, be restored by means of an estimate). Given that, in the case at hand, the data loss would have been too noticeable[27], it was deemed preferable to use two polynomial functions capable of estimating the values of *y* (writing density) based on the values on the *x* axis, which is to say those of the 520 sections of measured text. In these functions, the sum of the deviations between the estimated values and the real values is nil and that of quadratic deviations minimal.

In a time series, the accuracy of the estimation depends on the degree of the polynomial, progressing from the regression line (first degree equation) to the quadratic polynomial (second degree equation), to the cubic polynomial (third degree equation), and so on. Given that the cycles which lasted up to the length of a quire (= 8 leaves = 16 pages = 80 sections) should not be eliminated by the quadratic equation, each polynomial that would have created a peak and a trough within a single quire had to be disqualified.

Some other considerations are critical when choosing the degree of the polynomial. In theory, in a series of data, one should select the polynomial whose variation is very clearly lower than that of the preceding one, but on the other hand only little higher than the polynomial of the succeeding degree. It is important, moreover, that the polynomial should closely fit the raw data on the visual level. For ff. 114v–136v, these two criteria are fulfilled by a polynomial equation of fourth degree;[28] for ff. 137r–166r, they are fulfilled by the polynomial of the fifth degree.[29]

---

27 The estimate for data lost at the two extremes is subject to error, and in my opinion the parameters are difficult to determine. For this reason, priority has been given to functions, all the more so because the extrapolation of a function above and beyond the available data would be pointless. In the spheres of econometry and economic history, weighted moving averages are often employed to smooth out time series.

28 The function, rounded to twelve decimal points, is as follows: g^t = 3,522329049613 + 0,006301805498 t - 0,000145832749 t^2 + 0,000001198808 t^3 - 0,000000002897 t^4, for a t interval of 1–225. The variance that results after subtracting the trend, which is to say the value of the polynomial for each ascending degree of the same, is equivalent to 68,2 % (regression line), 61 % (second degree), 59,2 % (third degree), 55,6 % (forth degree), 55,5 % (fifth degree), 53,8 % (sixth degree), 51,4% (seventh degree), 49,8% (eighth degree), 49,4% (ninth degree)... 46,6 % (thirteenth degree).

29 Trend function: g^t = 373445558919 + 0,017692166694t - 0,000351741975t^2 + 0,000002978540 t^3 - 0,000000010997t^4 + 0,000000000015t^5. The residual variance decreases in the following way: 93.0% (regression line), 91.8% (second degree), 91.1% (third degree), 91.0% (forth degree),

However, excessive initial and final values represent a major disadvantage of all polynomial fittings; this can be observed above all in the second part of the series (see Chart 3).

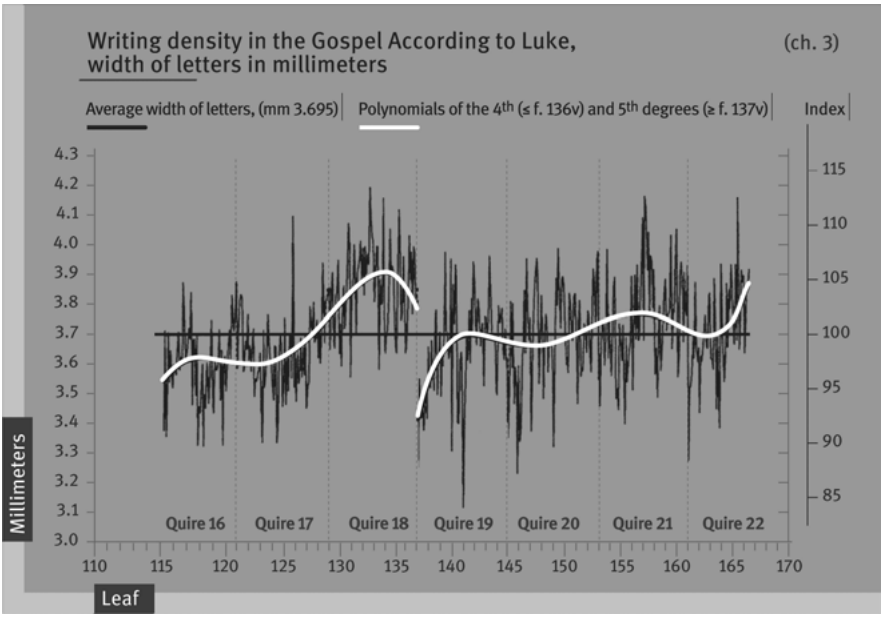


Chart 3: Writing density in the Gospel According to Luke, width of letters in millimeters

Splitting a time series for trend determination is uncommon and introduces risks of error, especially when subsequent analyses are performed using the recombined series. This pitfall notwithstanding, it is undeniable that in this case such an approach is not lacking a sound basis. To be sure, apart from a few fluctuations in the upper parts of quire 17, Herimann's writing seems gradually to become more spaced out; we would scarcely have needed a mathematical equation to create a well-fitted curve to reflect this phenomenon. However, this trend terminates rather abruptly at the end of f. 136v. Starting from the next page, Herimann increases the density of his writing considerably, and then gradually reduces it again, but it never becomes as spaced out as that seen in quire 18.

86.2% (fifth degree), 86.1% (sixth degree), 85% (seventh degree), 84.6% (eighth degree), 83.1% (ninth degree)… 80.9 % (thirteenth degree).

The decision to divide the series in two was not suggested solely by the sudden variation in writing density, which can also be observed between quires 21 and 22, but above all on account of the fact that, between quires 19 and 22, Herimann managed his writing in a different way. The variation cycles are not as long: Herimann adjusts the density of his writing much more frequently, which gives the impression of a veritable to-ing and fro-ing between compressed and spaced out script. This explains why, contrary to what happens in quires 16 to 18, in the succeeding quires the polynomial modification is not much more effective in representing the appearance of the series than the simple calculation of the average.

The visual impression can be reinforced by some figures. Thus, in the first part of the series, an average width of 3.70 mm corresponds to a standard deviation of 0.183; in the second, an average of 3.69 mm corresponds to a standard deviation of 0.177, which is very close to the previous one. However, when the trend is subtracted the deviation decreases to 0.136 in the first case, whereas in the second it barely changes (0.165), although as an absolute value it clearly remains higher than in the previous quires.[30] Respectively, the reductions in the standard deviation are 26% (quires 16 to 18) and 7% (quires 19 to 22). The portion located between quires 16 to 18 is also influenced by a very long-lasting trend which is not seen in the successive portion.

All this takes place, then, as if the copyist, having completed quire 18, noticed that the density of his writing was too low and decided to check his work more often. This is not the case in a short passage in quire 21, where once again we see a script which is just as spaced out as in quire 18. It is possible that Herimann wanted to make certain parts of the text coincide with the end of a quire. In fact, quire 10 terminates with the last verse of the Gospel according to St. Matthew; the end of quire 15 contains the first pages of the iconographic programme of the Gospel according to St. Luke, which commences at the beginning of the following quire with a portrait of the evangelist. In this perspective, it is obvious that if Herimann wanted to avoid blank pages just as much as 'widows and orphans', he would have had to have undertaken a very closely managed regulation of the space occupied by his transcription by adjusting the density of his writing. To be sure, he could have adopted other tactics as well, such as abbreviations, which in any event play a role in the Gospel according to St. Luke, even if their frequency does not exceed 2.5%.[31]

Furthermore, some other factors can exert an influence on script density. Consequently, one can see that quire 18—where the writing is at its widest—is relatively

30 Even the polynomials tested up to the thirteenth degree show little variation. See the data in the previous footnote concerning the residual variance.

31 To calculate the abbreviation rate, the number of letters counted on ff. 113v–166v were placed in relation to the corresponding number of letters contained in the Vulgate (90/910). See Berger 1893.

poor in ornamental elements (see Chart 4). This tendency for there to be a negative correlation between writing width and an abundance of ornamentation manifests itself in quires 16 to 18, where it looks as though Herimann compressed his writing so as to create space, in the text, for a considerable number of decorative elements. The hypothesis that an abundance of ornamentation might be linked to an increase in writing density should, however, be qualified; when a scribe ends a line at the end of a Eusebian section, the writing may well be expansive. In quire 20, where Herimann was very sparing with decorative elements, one does not see any spacing out of his writing, whereas he wrote effusively when it came to drawing Christ's family tree. In doing so, he started each line with a small initial, in accordance with a graphic scheme that entailed placing three generations on each line, leaving the last part of the line blank. Finally, f. 136, which hosts very spaced out writing, is far from lacking in decorative elements.

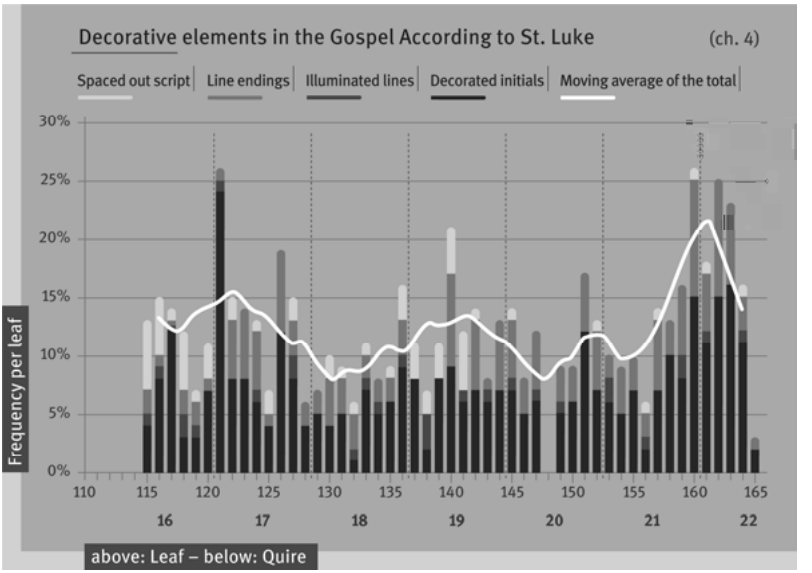


Chart 4: Decorative elements in the Gospel According to St. Luke

With respect to the insertion of decorative elements, Herimann did not have much choice in the matter. His scheme obliged him to terminate Eusebian sections at the end of a line and to start them with an ornamented letter, and to place a decorated line at the beginning of each *breve*. If Herimann checked the density of his writing less frequently in quire 18, this was perhaps because the number of Eusebian

sections, the ornamentation linked to them and their insertion into arcades—the cause of continual interruptions in the text—was very low and did not demand his close attention. Quire 18 therefore represents a portion of text that Herimann was able to transcribe quite quickly.

4 Cyclical components

The theory behind time series analysis presupposes that the series from which one has extracted a trend contains only random fluctuations and potential cyclical components. To confirm the presence of the latter, a simple method consisting in autocorrelation can be employed: each *y* value is placed in correlation with the previous values (i.e. time lag 1, time lag 2, etc.), up to the beginning of the series. The coefficients of correlation obtained in this way can reveal, if need be, any manifestations of a cyclical kind.

In the case which concerns us here, autocorrelation did not furnish very high values, but it did make it possible to outline a sufficiently unequivocal model. Herimann's writing rhythm is marked by a 'five phase' cycle: the coefficients decrease to time lag 4, rise again to time lag 5, descend once again to time lag 9, then rise to time lag 10, and so on (Chart 5 shows the entire correlogram, both for the raw data and those reduced by the trend). Since each page was divided exactly into five sections, this model revealed a cycle within the written page (an 'intra-page' cycle): at the beginning of the page the writing density is relatively high; towards its end, it tends to decrease. In comparison to the average width (3.70 mm), the fluctuation is only ±2.5% (ranging from -0.09 to +0.09 mm). This is a seemingly small amount, but it is quite large if one compares the fluctuation with the extremes in the script variation observed in the overall volume (±15%). Expressed as a quantity of letters, these percentages signify that the first four lines of the page each contain an extra letter, and the last four lines one letter less.

Could it be that at the beginning of each page Herimann sought to strike a balance with the excessive width of the script at the end of the previous page, as he did at the beginning of quire 19? This may be so, but the cycle brought to light could equally be the product of the scribe's concern to gain a head start at the beginning of the page so as to be able to cope with the limitations imposed by the prior planning of the text.[32]

32 The 'intra-page' cycle identified in Herimann's work is far from what one might expect. Normally, the presence of large and empty pages instead encourages the creation of wider interline spaces and wider spaces between words, whereas in smaller pages or very full ones the writing density tends to increase. Concerning the correlation between the size of writing and the dimensions of the page, see Wiegand 1953/54, 230–266, and 601–606.

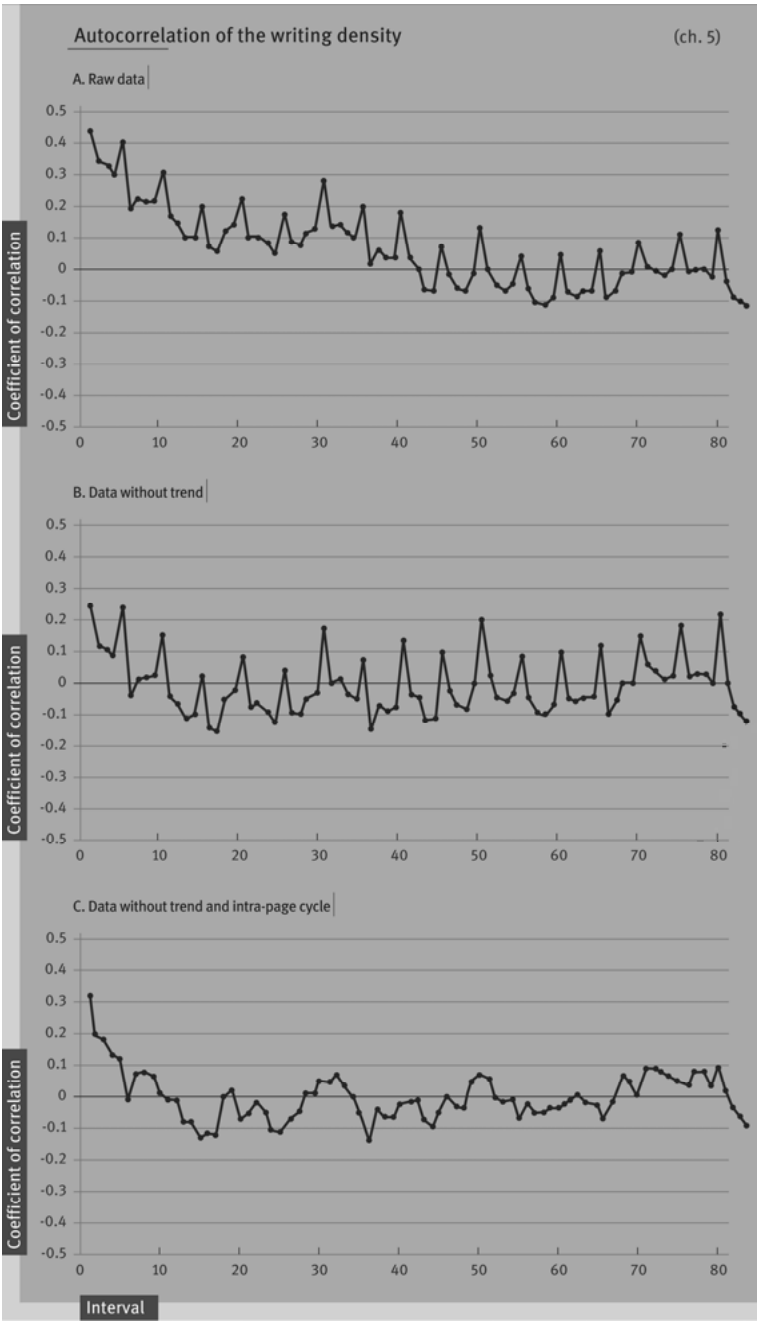


Chart 5: Autocorrelation of the writing density

Up to this point, we have only considered the regular cycles that consistently appear throughout the Gospel according to St. Luke. We shall continue to do likewise, since we must forswear a minute subdivision of the analysed material so as to avoid allocating an excessive weight to the extreme random values. In any case, one should not forget that Herimann's writing rhythm underwent some variations during the transcription of the Gospel according to St. Luke; hence, the 'intra-page' cycle is always present in all the quires[33], but it is a lot more pronounced in the last four (see Tab. 3). As for the variations that characterise the passage located between quires 18 and 19, they were addressed when we discussed the trend.

The correlograms provide some further clues, albeit less distinct, on the existence of some other rhythms. An examination of the positive correlations (see Chart 5b) reveals some additional important values for time lags 20, 30, and 50. Beyond time lag 50 the correlations become weaker, but they increase without discontinuity (in increments of 5) up to time lag 80. However, the positive correlations disappear if one eliminates the 'intra-page' cycle.

Extent of the intra-page cycle within quires 16–18 and 19–22 (tab. 3)

Lines	Quires 16–18	Quires 19–22
1–4	-0.073 mm	-0.102 mm
5–9	-0.020 mm	-0.028 mm
10–14	0.002 mm	0.005 mm
15–18	0.030 mm	0.016 mm
19–22	0.060 mm	0.110 mm

Tab. 3: Extent of the intra-page cycle within quires 16–18 and 19–22

Some more or less regular intervals also appear in accordance with the strongest negative correlations (time lags 6, 15, 25, 36, 44, 55 and 66). Given that this interval between ten measurements coincides with the sweep of two pages, one can reasonably suppose that there is a negative correlation between *recto* and *verso* pages (an 'inter-page' cycle). Even so, the correlogram shows that this is a weak

33 The weakest cycle is found in quire 17, with extremes ranging from -0.041 to 0.058.

relationship and is not statistically significant:[34] the average difference between the *rectos* where the writing is most dense and the *versos* where it is most spaced out is only ±0.014 mm, that is to say ±0.4%. In addition, one notices that the 'intra-page' and 'inter-page' cycles overlap, so the writing density is clearly greater in the first section of the *rectos*, and a lot less so in the last section of the *versos*.

None of the methods employed made it possible to identify any other writing rhythms with certainty, a state of affairs which is not unrelated to the deficiency of the cycles that we shall now discuss. In the case of another cycle, which corresponds to the hair and flesh sides of the skin ('hair/flesh' cycle), this failure could be due to irregularities in the assemblage of the bifolia. In fact, in the Gospel according to St. Luke, Herimann twice breaks Gregory's Rule (in quires 19 and 21), so much so that the cycle of four pages that characterises the 'hair/flesh' alternation is interrupted.[35] In any case, the data analysis revealed that Herimann's script is slightly more dense on the flesh side than on the hair side. The average width differs by ±0.027 mm, that is to say by about ±0.7%. In this situation, too, superimposition with the 'intra-page' cycle results in a relatively denser script in the first section of a flesh side page, and a relatively more spaced out one in the final section of hair side page. Given that we noticed the same type of emphasis in the 'inter-page' cycle, the three cycles can be superimposed upon each other.[36] This phenomenon is illustrated in Chart 6: the difference between the two extremes ranges from -0.13 mm to +0.11 mm.

The 'hair/flesh' cycle in the volume transcribed by Herimann is indistinct and does not allow us to draw any sweeping conclusions. The differences in density

34 Once the trend and the 'intra-page' cycle had been eliminated, a separate test carried out on quires 19–22 produced some slightly clearer results. The gaps are located at time lag 15 (r = 0.19), time lag 25 (r = 0.10) and time lag 36 (r = 0.18), as well as at time lags 30–32 (r = 0.11–0.12), time lags 50-51 (r = -0.04–0.07) and time lags 79-80 (r = 0.11–0.12). In comparison to quires 16–18, here the autocorrelation model is easier to interpret, despite the values being lower.

35 Gregory's so-called 'rule', which holds that in manuscripts of Late Antiquity and the Early Middle Ages quires should commence with the hair side and that opposing pages should always present the same side of the skin, is twice broken in the Gospel according to St. Luke: the first time in the two inner bifolia of quire 19, the second in the two outer bifolia of quire 21. In quire 19, when the *rectos* of pages are considered, the hair (H) and flesh (F) sequence is as follows: HFFH/FHHF, and in quire 21: FHHF/HFFH.

36 The cycles were not analysed on a page-by-page basis, but rather section-by-section, whilst the averages cited for the 'inter-page' and 'hair/flesh' cycles always relate to the entire page.

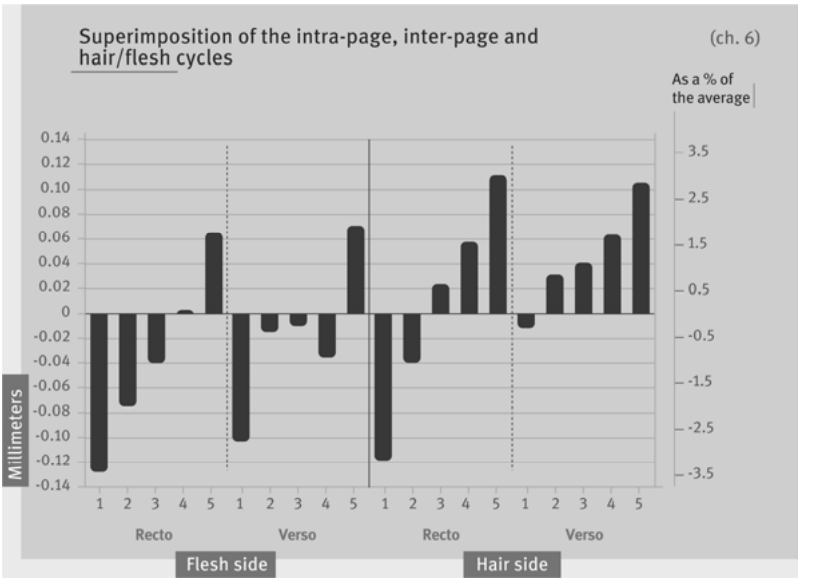


Chart 6: Superimposition of the intra-page, inter-page and hair/flesh cycles

between the two sides of the skin could be due to technical considerations. Having examined twenty Greek manuscripts, Stig Y. Rudberg[37] had already remarked in 1958 that the writing on the flesh side is denser than that on the hair side. According to the said author, the difference between the two sides is far more conspicuous in volumes where the hair side has a particularly rough surface, and is therefore not very well finished. The manuscripts examined by Rudberg were without doubt written on parchment made from goat or sheepskin. Such skins exhibit plain-to-see traces of the hair follicles typical of the animals concerned. Manuscripts whose parchment is smooth, and therefore better finished on the hair side than on the flesh side, only exhibit small differences in writing density. Now, in the Gospels of Henry the Lion, one only finds parchment sourced from calves, where both sides show scarcely any difference in surface quality. Because the hair side of sheets was very well finished, the difference in writing density is minimal.

In examining the raw data, a glimpse of the existence of yet another cycle was caught: if we exclude quire 17, one observes that the writing is denser in the first

37 Rudberg 1960, 528–539. J. P. Gumbert of the University of Leyden kindly provided me with this pointer.

leaves of a constituent quire than in the last. However, the cycle is not without interruption: on the first five leaves the writing density steadily decreases; the writing contracts again on the sixth leaf and then becomes even more spaced out on the last (quires 16, 18, 20, 21). The density changes from -0.025 mm on the first leaf to +0.027 mm on the fifth, then from -0.046 mm on the sixth to +0.052 mm at the end of the quire. It could be this rhythm that accounts for the fact that the autocorrelation measurements are higher at time lag 30 (cycle of three leaves), time lag 50 (cycle of five leaves), and time lag 80 (full quire cycle).

The differences are more significant if one excludes quire 17 (see Chart 7),[38] which differs from the norm in more ways than one[39]. In the second part of the Gospel according to St. Luke, in particular, the beginning of the quire represents a caesura, after which Herimann resumes his work using a more compressed script. A new correction of the writing density seems to coincide with the quire's central bifolia (see Chart 3). It is possible that this correction marks the transition to a new work phase. The end of the quire very likely coincided with an interruption in the copying process—as well as, perhaps, with the passage from the central bifolium to the sixth leaf. Nevertheless, this observation does not allow us to go any further; we can only say that Herimann often compressed his script at the beginning of a quire and did likewise once the halfway point had been passed.

---

38 The averages for all the sections, after the elimination of the trend and the 'inter-page', 'intra-page' and 'hair/flesh' cycles, are shown in Chart 7. Quire 17 is excluded from the graphic representation (see the successive note). This is why the highest figures quoted differ from those shown in Chart 7. To boost the visual impact of the graph, we used the moving averages of period 10 (corresponding to the number of sections involved in an 'inter-page' cycle). Regarding the periodisation of the moving averages, see Thome 1992, 77ff.

39 Quire 17, which commences with the genealogical sequence, each line being embellished with an illuminated initial (see Chart 4), does not provide any unmistakable glimpses of the cycles that we have observed elsewhere. There is only one clearly discernible phenomenon: the writing is more compressed at the top of the page than at the bottom (see, however, note 33). Nevertheless, this result must not be overestimated, because the section in f. 125v, with an average density of 4.11 mm, clearly diverges from the norm (see Chart 3). This difference is not due to the fact that Herimann adopted in this instance a much more spaced out hand than that used in the neighbouring lines, but rather to the fact that the four lines concerned contain a considerable number of wide letters (including 15 *m*'s), and we know that the impact of this factor can be particularly sensitive in small samples. It should also be said that, in contrast to what happens elsewhere, quires 17 and 19 are characterised by the use of very thin parchment. The choice of such a writing support could have exerted an influence on the writing density, but this hypothesis would have to be confirmed across a much larger sample. Given that the behaviour observed in quire 17 is abnormal, its inclusion in the calculations tends to diminish the cycles observed in the other quires. These are above all the 'intra-page' and 'hair/flesh' cycles which, in the latter case, are more pronounced than they appear to be in Chart 6.

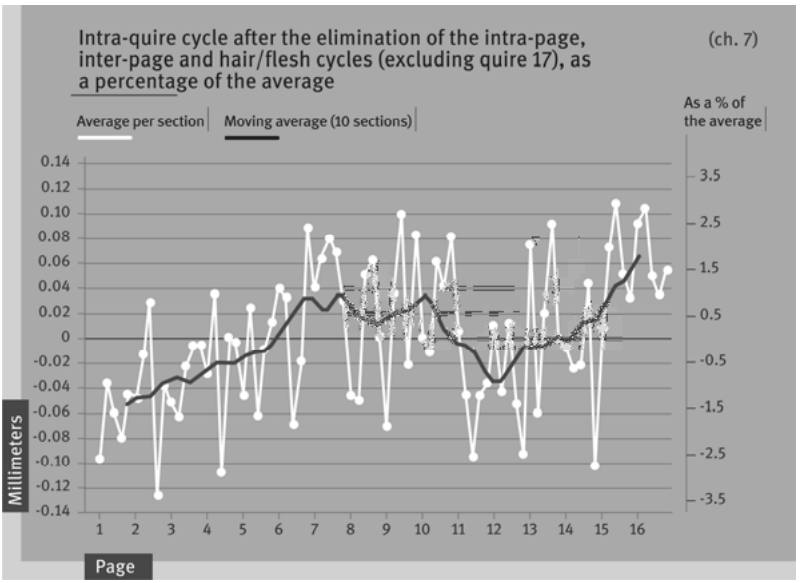


Chart 7: Intra-page cycle after the elimination of the intra-page, inter page and hair/flesh cycles (excluding quire 17), as a percentage of the average

The superimposition of all the cycles generates differences of ±0.16 mm. Close to 30% of the variations in writing density in Herimann's work should only be attributable to the trend and the cyclical components (inasmuch as one also interprets statistically insignificant recurrences as cycles). The 'intra-page' rhythm exerts an influence on all the other cycles. When one successively eliminates all the cycles, their respective weights in the standard deviation summary becomes clear (see Tab. 4).[40]

40 The elimination of each of the cycles is rather problematical, hence the procedure adopted in this study is not the one typically used in classical time series analyses. In fact, the benchmark procedure used for all operations was the moving averages method, which is often employed when making seasonal adjustments. This makes it possible to calculate averages free of cyclical influences for each juncture in a particular phase of a series (this process is described in all specialised manuals; see, in particular, Esenwein-Rothe 1976, Leiner 1982 or Thome 1992). However, in the present study, this method can only be partially applied. Accordingly, the 'hair/flesh' cycle, owing to the exceptions observed in quires 19 and 21, loses its regularity. Moreover, strict application of this method to the quire cycle for all the sections of each page would have resulted in the disappearance of unique values whose analysis was impossible: Chart 7 shows that, if the moving averages taken overall constitute a valid explanatory model, the values for the different sections undergo some strong fluctuations. Taking these problems into account, two methods for the elimination of the

Reduction of the standard deviation once the trend and cyclical components have been eliminated (tab. 4)

Eliminated component	Standard deviation	Raw data (%)
Raw data	0.179	100
Data without trend	0.153	85.5
After the elimination of the intra-page cycle	0.142	79.3
After the elimination of the inter-page cycle	0.140	77.9
After the elimination of the hair/flesh cycle	0.136	75.6
After the elimination of the intra-quire cycle	0.133	73.9

Tab.4: Reduction of the standard deviation once the trend and cyclical components have been eliminated

cycles were tried out simultaneously, namely the 'deviation between the phase averages' method and the 'averages' method, the latter of which consists in simply subtracting from the value of each section the overall average of all the sections that have the same properties (position on the page, *recto*/*verso*, hair/flesh side). The test was carried out on the two most conspicuous and least disrupted cycles, namely the 'intra-page' and 'inter-page' cycles. As one might expect, the results obtained are largely speaking identical (the differences at the third decimal point could be attributable to rounding errors or to the loss of extreme data that affects the 'deviation between the phase averages' method). In accordance with the test protocol, we proceeded in the following way: for each of the sections represented in Chart 6, by applying the 'averages' method, the 'intra-page' and 'inter-page' cycles were successively subtracted from the data reduced by the trend. Next, the quire cycle was eliminated leaf-by-leaf according to the averages cited in the text, including, therefore, quire 17. This means that, contrary to what takes place when the 'deviations between the phase averages' method is applied, the same value was subtracted from the all of the ten sections on the same leaf. In addition, when it comes to dealing with data which have had the trend subtracted, they will be processed using the method described above. Furthermore, to measure the reduction in the standard deviation (Tab. 4), the data which have had the trend subtracted were reduced by the averages of the four cycles (i.e. 'intra-page', 'inter-page', 'hair/flesh', and 'inter-quire'). Finally, it should be pointed out that, according to the results of the Durbin-Watson tests, the data minus the trend and the cycles, that is to say the 'white noise', which in theory should be free from any form of regularity, in any event do not satisfy the autocorrelation criterion. In the test, a score of 0 indicates a positive autocorrelation, while a score of 4 indicates a negative autocorrelation, and a score of 2 a complete absence of any correlation. Now, the result is 1.48, which is below the threshold values (1.81-2.19), and therefore the null hypothesis (calculated according to the Theil-Nagar method with a probability threshold of 1%) is not acceptable. Concerning the test procedures, see Ostrom 1978.

4.1 Non-cyclical trends in the writing density

The cyclical nature of a series can be demonstrated through the application of various methods. One of these consists in fitting the evolution model underlying the data to a series of sine/cosine curves. If the weighting of a cycle is sufficiently strong, the corresponding sine/cosine curves exhibit a marked range. Given that all the ranges are not necessarily expressions of a cyclical phenomenon, various tests exist which are designed to determine whether any phenomenon whose appearance seems to be periodic can indeed be considered a cycle. As regards the writing density, the probability that the range of the 'intra-page' cycle might be attributable purely to chance is less than 0.1%.[41] At the 0.1 and 1.0 percent level, however, this cycle is also the only statistically significant period (see Chart 8a).[42]

In this situation, the weaker cycles only become interesting when they evolve in parallel with the cycles of other characteristics, in particular the number of decorated initials, line endings and Eusebian sections. In order to avoid bias which, on account of the method adopted for the survey, could have affected some of the units examined due to the presence of initials and Eusebian sections, in Charts 8b and 8c the frequencies corresponding to passages 2 and 3 have been systematically reduced to 4/5. This operation does not have any effect on the cycles that will be discussed hereinafter, but it does attenuate the effects of the 'intra-page' cycle that were accentuated by the presence of the aforementioned elements.[43]

---

41 We applied the Walker test. For information on the calculation of frequency and the test's methodology, see Billeter / Vlach 1981, 59 onwards. An analogous method is proposed by Schlittgen / Streitberg 1984, 42, whose results, despite being different, are in any event largely speaking similar.

42 With respect to the writing density, it should be borne in mind that, as we have already mentioned more than once, quires 19 and 21 do not respect Gregory's Rule, and that quire 17 does not exhibit any cycles. A periodogram, performed without taking into account these 'abnormal' quires, revealed that if one excludes the 'intra-page' cycle, the 25, 10, 36-41 and 20 cycles clearly distinguish themselves from the others (even if one eliminates the last).

43 Since sections 2 and 3 contain five lines as opposed to the four in sections 1, 4 and 5, the decorative elements and the chapter openings are more numerous. In certain cases, the 20% reduction in frequencies generates incongruous results (e.g. the presence of 0.8 Eusebian sections or ornamental initials), but this was necessary in order to prevent the appearance of visible cycles linked solely to the difference in length among the units examined.

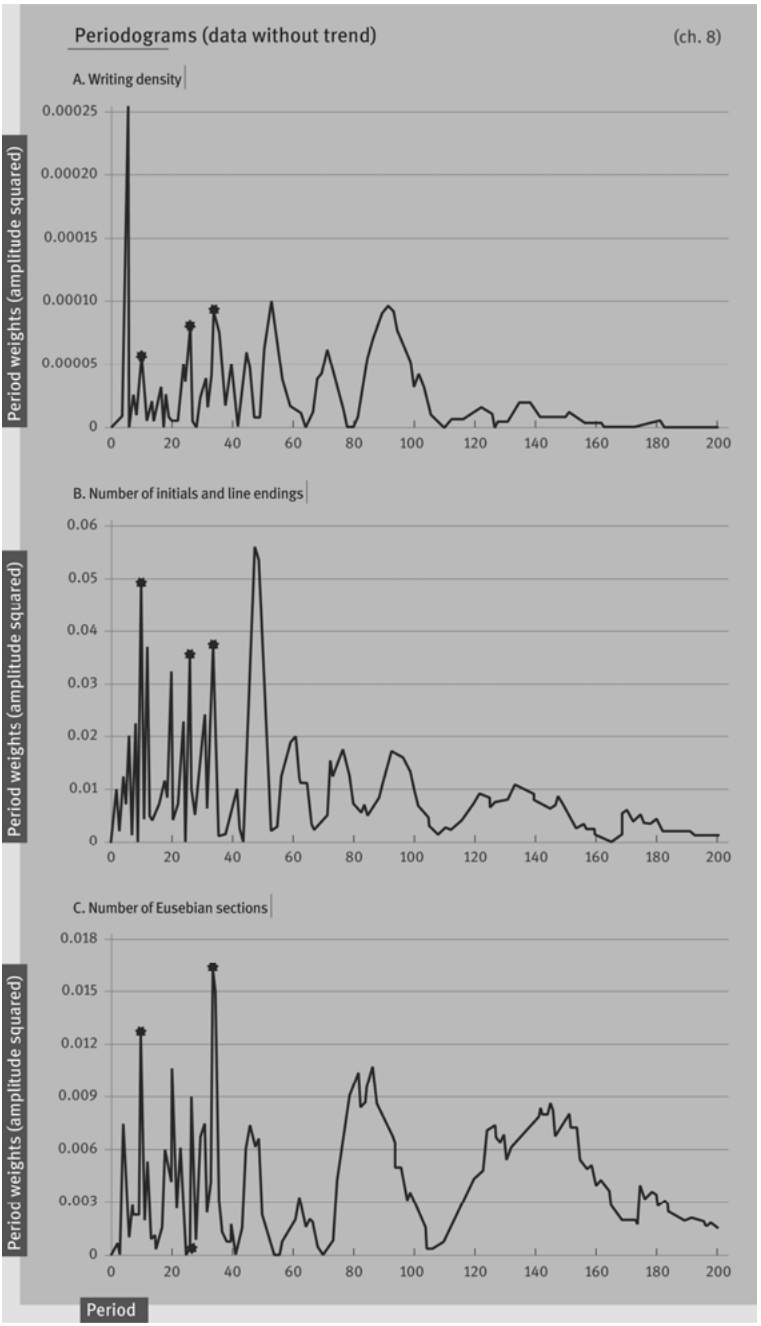


Chart 8: Periodograms (data without trend)

Leaving aside the differences in detail, it becomes clear that certain cycles have the same appearance in terms of writing density, ornamental elements and Eusebian sections. This is particularly true of cycles 10, 26[44] and 34, marked by an asterisk in Chart 8, but there is no point in analysing them here. We have already stated that these cycles are not statistically significant; on the other hand, all hypotheses on the cyclical nature of the Eusebian sections prove to be without basis if one considers the fact that they are textual elements whose frequency does not depend on the choices made by the scribe. Concerning the only element which might be open to interpretation—cycle 10 (the 'inter-pages' cycle)—this turns out to be a structural effect linked to the distribution of ornamental initials and Eusebian sections:[45] the frequency of these two characteristics is greater on the *rectos* than on the *versos* (among 556 ornamental initials, 314 are found on the *recto* and 158 on the *verso*). Therefore, one is not dealing with a true writing cycle, but rather the product of pure chance during the division of the text.

Nevertheless, the periodograms furnish information on the concordance of a certain number of characteristics that we have already discussed in relation to the trend. These concordances are rather difficult to pin down, because Herimann did not always modify his writing in the same way: thus, even if he often compressed his script immediately before or immediately after the ornamental band that preceded a *breve* (for example on ff. 127v, 132r, 143v), this did not always happen, so the average is scarcely 2% lower than the overall average.

A similar phenomenon shows up in the Eusebian sections: most of the time the passages that do not start with a Eusebian section tend to have writing which is more spaced out, whereas in those in which one finds several sections the writing is denser. Given that the tendency persists even after the elimination of the trend and the cyclical component (see Tab. 5), this phenomenon clearly does not depend on the distribution of the text between the *rectos* and *versos* of sheets.[46]

---

44 Conversely, in the Eusebian sections, cycle 27 is quite pronounced, with a root-mean-square amplitude of 0.009. However, it is cycle 26 which, in Chart 8c, is marked by an asterisk.

45 Section 1 of f. 118v and section 343 of f. 166v were not taken into consideration.

46 In theory, the correlation between the Eusebian sections and writing density could stem from the fact that, as already mentioned, the start of these sections is most often found on the *recto* rather than the *verso* of a sheet. In this case, the decisive factor in the correlation can only be the scribe's habit of employing a denser script on the upper side of a sheet. Since the data presented in Table 5 have already been reduced by the trend and the cycle components have been subtracted, the 'intra-page' cycle has already been eliminated. Given that 30% of the passages that start with one or more Eusebian section are executed in a very dense script, one can only conclude that there is a correlation between dense writing and Eusebian sections, which, in our opinion, is equally likely at a concrete level.

Writing density in relation to the frequency of Eusebian sections (trend and cycles-adjusted data for writing density: percentage deviation of the mean) (tab. 5)

Frequency of Eusebian sections per page section	Denser		<- Writing density ->		Wider	
	<-3%	- 1 to - 3%	- 1 to 1%	1 to 3%	> 3%	Total
Without Eusebian section	43	47	56	51	64	261
	(16.5)	(18.0)	(21.5)	(19.5)	(24.5)	
One Eusebian section	40	35	45	33	33	186
	(21.5)	(18.8)	(24.2)	(17.7)	(17.7)	
Two to four Eusebian section	22	14	14	13	10	73
	(30.1)	(19.2)	(19.2)	(17.8)	(13.7)	
Total	105	96	115	97	107	520

Frequency with percentage of lines in brackets

Tab. 5: Writing density in relation to the frequency of Eusebian sections (trend and cycle-adjusted data for writing density: percentage deviation of the mean)

One should interpret this behaviour in relation to the way in which Herimann conceived the presentation of the page. In most cases, he endeavoured to start a Eusebian section on a new line. In addition, since the design of the *mise en page* constitutes a kind of block, he tried equally hard to avoid leaving a blank space on the preceding line or, failing that, to reduce the space to a minimum by filling it with a line ending in the form of a decorated bar. Such line endings are not very long, and without doubt they follow a plan; in fact, in the Gospel according to St. Luke, the endings only rarely attain the length of half a line, and one no longer encounters the complicated filling elements which, by contrast, characterise the Gospel according to St. Matthew. For this reason, Herimann worked using the available space and regulated the density of his writing so as to ensure its justification on the right. Now, he often succeeded in accomplishing this feat, but not always: a series of Eusebian sections concludes, indeed, before the middle of the line is reached. In this situation, in order to completely avoid committing an aesthetic blunder, Herimann evidently relinquished his conceptualisation of the

page, because he avoided spacing out his text or inserting line endings, and instead preferred to start the following section with its initial on the same line.

In light of these considerations, a certain number of incongruities can be explained. Herimann used writing density to orchestrate the linkage between the text and the page, hence his writing strategy depended on the accuracy of his projections. Indeed, in certain cases, in proximity to some Eusebian sections we can observe a compression of the writing; in other instances, no modification can be observed; in still others, one observes a tendency to enlarge the width of the writing.

Table 5 has been constructed on the basis of Eusebian sections, since the concordance between writing density and the presence of ornamental initials is a lot less clear. The weakness of the relationship may be linked to the fact that the initials, which occur particularly often at the beginning of the Gospel according to St. Luke, appear equally often in places that do not involve a change of line or which, as in the genealogical tree of Christ, are not linked to a particular distribution of the surrounding script.

The fluctuations in the writing density that remain following the elimination of the trend and the cyclical component are certainly greatly diminished, but they are far from being negligible because, in the most extreme cases, they can attain a value of ± 0.5 mm. Some of them, as we have already seen, are closely linked to the Eusebian sections and the beginning of the *breves*. In fact, if one only considers the most compressed passages, where the width of the writing is more than 0.2 mm below the average, still 14 out of a total of 35 contain the beginning of a *breve* or several Eusebian sections. As for the 28 sections in which the mean width is exceeded by more than 0.2 mm, there is only one text passage with the beginning of a *breve* and another one with two Eusebian sections. Therefore, one must conclude that the organisation of the ornamental programme around the beginning of a *breve* or a Eusebian section would have led the scribe to pause for a moment in order to calculate how much space would be necessary to accommodate the decorative elements, and to compress his writing accordingly.

By applying further methods and by working on a larger volume of material, one could doubtless discover some other factors that exerted a direct influence on the scribe's writing rhythm. But there will always be text passages in which the writer has adapted his writing density to needs that can be traced in detail but not summarized in a system. Seen from this standpoint, we can safely say that Herimann also worked on a line-by-line basis.

Furthermore, the analysis of residual fluctuations would not filter out the measurement errors that are inherent to the way in which the data are collected. We have already pointed out the drawbacks which result from the choice of the

average width of letters as an indicator of writing density, given that this parameter does not take into account the effective width of each letter of the alphabet, nor the variations in its frequency in the text. The comparison with what we have termed the 'standardised width' of letters revealed that, even if one divides the text into groups of four or five lines, the error rate is not reduced to nil. Should one wish to be convinced, it would suffice to examine the extreme values: among the passages where the width (once the trend and the cyclical component have been eliminated) is below -0.2 mm in relation to the average, one finds 31 where the frequency of *m* is weak (2-6 in groups composed of four lines, 2-7 in those composed of five lines). Only four sections contain more than 6 or 7 *m*'s. In contrast, in the 28 passages located symmetrically above +0.2 mm, the frequency of this letter is manifestly greater, since one observes 24 cases where it appears 7-15 times (in groups composed of 4 lines), or 8-15 times (in passages composed of 5 lines). The number of *m*'s is lower than these values in only four sections.

Clearly, this bias raises some doubts about the output of our research: can the impact of errors have a noticeable effect on the results obtained? The answer to this question would be affirmative only if it turned out that the frequency of wide or compressed letters also varies in relation to the cycles identified in the writing—for example, when wide letters are less common at the beginning than at the end of a page, or rarer on the *recto* than on the *verso* of a leaf, or less common in proximity to the *breves* or at the beginning of Eusebian sections than in the main body of the text. We can see that the danger is not great, because the errors in measurements, even if they can explain certain deviations with respect to the data series, exert no influence on the rules that govern Herimann's writing density. In fact, the scribe's writing develops in a far less capricious way than a superficial inspection might lead one to believe, instead following rhythms which repeat themselves page after page. Further research would certainly be necessary in order to be able to establish whether or not the rhythms we have identified are indeed a unique feature of this scribe, or instead reflect a *modus operandi* shared by copyists working in other scriptoria.

Annex

Number of letters per seftion and length of section (H = Hair, F = Flesh) 1 of 7

Quire	Leaf	H/F	Section	Letters	Length (mm)
16	114 v	h	1	150	504
			2	128	475
			3	225	751
			4	172	593
			5	159	589
	115 r	h	1	170	600
			2	206	750
			3	186	660
			4	171	600
			5	167	600
	115 v	f	1	88	314
			2	195	694
			3	197	718
			4	153	568
			5	168	600
	116 r	f	1	157	569
			2	202	726
			3	180	698
			4	153	578
			5	161	582
	116 v	h		158	574
			2	115	420
			3	200	744
			4	159	586
			5	152	584
	117 r	h	1	167	576
			2	195	718
			3	195	719
			4	162	564
			5	157	581
	117 v	f	1	124	410
			2	205	707
			3	214	732
			4	169	595
			5	167	600
	118 r	f	1	175	578
			2	210	732
			3	206	708
			4	92	331
			5	162	578
	118 v	h	1	108	373
			2	207	738
			3	197	738
			4	164	574
			5	176	602
	119 r	h	1	162	584
			2	210	750
			3	210	750
			4	165	594
			5	126	468
	119 v	f	1	168	582
			2	192	700
			3	166	550
			4	159	571
			5	164	594
	120 r	f	1	167	584
			2	209	750
			3	202	739
			4	160	594
			5	154	557
	120 v	h	1	143	548
			2	188	707
			3	187	694
			4	134	504
			5	134	522
17	121 r	h	1	146	522
			2	176	649
			3	170	648
			4	133	510
			5	102	390
	121 v	f	1	117	418
			2	215	768
			3	209	768
			4	170	619
			5	154	581
	122 r	f	1	164	592

(H = Hair, F = Flesh)

Quire	Leaf	H/F	Section	Letters	Length (mm)
			2	207	757
			3	212	756
			4	106	389
			5	141	524
	122 v	h	1	166	577
			2	213	755
			3	196	692
			4	161	575
			5	172	614
	123r	h	1	149	541
			2	218	750
			3	190	630
			4	160	594
			5	136	478
	123 v	f	1	167	590
			2	209	758
			3	190	715
			4	159	588
			5	157	568
	124 r	f	1	164	592
			2	162	570
			3	155	538
			4	160	586
			5	167	611
	124 v	h	1	181	600
			2	221	751
			3	192	696
			4	158	584
			5	157	575
	125 r	h	1	172	593
			2	214	757
			3	205	769
			4	167	576
			5	163	593
	125 v	f	1	151	528
			2	205	757
			3	203	751
			4	163	577
			5	139	571
	126 r	f	1	159	558
			2	203	740
			3	178	617
			4	162	590
			5	146	515
	126 v	h	1	160	568
			2	180	664
			3	206	731
			4	166	616
			5	165	587
	127 r	h	1	155	572
			2	207	712
			3	205	721
			4	111	391
			5	129	490
	127 v	f	1	126	470
			2	203	751
			3	149	568
			4	159	583
			5	163	600
	128 r	f	1	158	593
			2	206	744
			3	188	702
			4	167	600
			5	164	607
	128 v	h	1	145	572
			2	195	742
			3	209	767
			4	160	610
			5	150	574
18	129 r	h	1	141	541
			2	184	710
			3	184	671
			4	154	593
			5	146	571
	129 v	f	1	164	602
			2	206	751

(H = Hair, F = Flesh) 3 of 7

Quire	Leaf	H/F	Section	Letters	Length (mm)
			3	194	743
			4	156	600
			5	151	598
	130 r	f	1	163	592
			2	179	668
			3	201	720
			4	132	503
			5	154	595
	130 v	h	1	165	613
			2	190	719
			3	173	677
			4	147	600
			5	152	608
	131 r	h	1	136	482
			2	170	650
			3	189	731
			4	143	574
			5	151	594
	131 v	f	1	166	613
			2	195	762
			3	190	748
			4	151	600
			5	150	604
	132 r	f	1	154	598
			2	190	760
			3	187	716
			4	116	464
			5	111	433
	132 v	h	1	149	593
			2	189	744
			3	183	770
			4	148	608
			5	150	606
	133 r	h	1	150	602
			2	196	746
			3	141	546
			4	146	584
			5	148	593
	133 v	f	1	121	432
			2	193	750
			3	192	730
			4	154	586
			5	147	613
	134 r	f	1	164	600
			2	206	748
			3	207	766
			4	145	539
			5	147	563
	134 v	h	1	145	589
			2	1 84	720
			3	148	582
			4	151	592
			5	164	614
	135 r	h	1	167	611
			2	198	719
			3	189	745
			4	147	607
			5	146	577
	135 v	f	1	162	606
			2	196	739
			3	172	683
			4	139	524
			5	169	613
	136 r	f	1	165	607
			2	192	731
			3	153	618
			4	119	462
			5	107	426
	136 v	h	1	147	553
			2	181	725
			3	176	701
			4	139	533
			5	145	553
19	137 r	h	1	177	568
			2	201	712
			3	214	728

(H = Hair, F = Flesh)

Quire	Leaf	H/F	Section	Letters	Length (mm)
			4	163	554
			5	137	473
	137 v	f	1	165	554
			2	210	730
			3	206	728
			4	176	599
			5	166	606
	138 r	f	1	166	586
			2	125	438
			3	202	743
			4	159	564
			5	123	431
	138 v	h	1	158	593
			2	193	730
			3	212	738
			4	157	565
			5	158	586
	139 r	f	1	141	491
			2	191	692
			3	208	745
			4	160	601
			5	145	577
	139 v	h	1	163	605
			2	176	652
			3	203	732
			4	164	596
			5	138	546
	140r	h	1	141	463
			2	188	727
			3	203	757
			4	139	547
			5	110	427
	140 v	f	1	146	494
			2	200	677
			3	169	610
			4	158	575
			5	126	451
	141 r	f	1	138	426
			2	209	707
			3	212	749
			4	162	598
			5	166	599
	141 v	h	1	120	454
			2	181	650
			3	191	730
			4	161	594
			5	151	596
	142 r	h	1	154	598
			2	199	734
			3	203	743
			4	158	604
			5	156	589
	142 v	f	1	132	482
			2	167	620
			3	181	677
			4	166	583
			5	147	552
	143 r	h	1	154	577
			2	195	716
			3	196	734
			4	149	592
			5	156	600
	143 v	f	1	161	598
			2	200	736
			3	194	718
			4	113	416
			5	172	601
	144r	f	1	169	588
			2	193	732
			3	201	750
			4	159	598
			5	134	508
	144 v	h	1	164	598
			2	186	671
			3	164	610
			4	142	509

(H = Hair, F = Flesh) 5 of 7

Quire	Leaf	H/F	Section	Letters	Length (mm)
			5	155	560
20	145 r	h	1	167	558
			2	207	725
			3	150	571
			4	162	580
			5	135	514
	145 v	f	1	174	600
			2	157	563
			3	208	732
			4	63	203
			5	168	602
	146 r	f	1	155	515
			2	215	725
			3	188	682
			4	163	593
			5	156	600
	146 v	h	1	166	602
			2	187	740
			3	191	725
			4	162	595
			5	160	600
	147 r	h	1	139	467
			2	150	535
			3	196	727
			4	155	595
			5	152	594
	147 v	f	1	145	575
			2	168	656
			3	220	774
			4	169	617
			5	157	601
	148 r	f	1	160	589
			2	214	743
			3	201	744
			4	160	602
			5	163	602
	148 v	h	1	168	599
			2	206	755
			3	207	760
			4	162	594
			5	169	600
	149 r	h	1	181	598
			2	205	739
			3	172	670
			4	149	565
			5	127	508
	149 v	f	1	107	410
			2	203	755
			3	194	755
			4	152	593
			5	159	614
	150 r	f	1	162	602
			2	190	682
			3	185	670
			4	156	556
			5	152	583
	150 v	h	1	157	596
			2	204	752
			3	206	756
			4	158	605
			5	151	580
	151 r	h	1	148	545
			2	203	701
			3	181	677
			4	153	583
			5	158	560
	151 v	f	1	156	558
			2	202	720
			3	201	750
			4	161	599
			5	164	595
	152 r	f	1	159	600
			2	201	756
			3	176	637
			4	166	592
			5	144	546

(H = Hair, F = Flesh)

Quire	Leaf	H/F	Section	Letters	Length (mm)
	152 v	h	1	153	600
			2	169	654
			3	205	762
			4	129	510
			5	121	482
21	153 r	f	1	120	421
			2	213	733
			3	205	751
			4	159	595
			5	103	386
	153 v	h	1	166	595
			2	207	762
			3	191	762
			4	153	552
			5	154	580
	154 r	h	1	164	598
			2	212	752
			3	202	750
			4	156	602
			5	130	506
	154 v	f	1	167	580
			2	211	739
			3	210	720
			4	152	568
			5	163	599
	155 r	h	1	155	558
			2	194	724
			3	194	691
			4	177	599
			5	158	582
	155 v	f	1	168	593
			2	209	750
			3	205	744
			4	168	617
			5	155	605
	156r	f	1	169	592
			2	205	757
			3	139	542
			4	117	431
			5	155	611
	156 v	h	1	161	592
			2	195	718
			3	196	752
			4	153	607
			5	148	607
	157 r	h	1	164	602
			2	171	714
			3	176	728
			4	131	514
			5	120	486
	157 v	f	1	160	602
			2	184	731
			3	186	734
			4	162	613
			5	123	482
	158 r	f	1	152	540
			2	200	730
			3	208	722
			4	141	530
			5	149	565
	158 v	h	1	161	575
			2	177	644
			3	204	766
			4	154	590
			5	158	614
	159 r	f	1	156	578
			2	99	372
			3	180	678
			4	159	601
			5	148	599
	159 v	h	1	167	608
			2	178	673
			3	185	697
			4	145	574
			5	131	533
	160 r	h	1	118	419

(H = Hair, F = Flesh)

Quire	Leaf	H/F	Section	Letters	Length (mm)
			2	178	644
			3	185	721
			4	128	505
			5	121	470
	160 v	f	1	132	485
			2	176	689
			3	161	608
			4	131	492
			5	132	520
22	161 r	h	1	178	580
			2	119	418
			3	202	709
			4	149	530
			5	155	572
	161 v	f	1	153	552
			2	168	652
			3	202	736
			4	164	590
			5	164	599
	162 r	f	1	165	564
			2	157	569
			3	199	716
			4	140	511
			5	165	612
	162 v	h	1	162	610
			2	162	592
			3	193	703
			4	149	570
			5	135	518
	163 r	h	1	150	541
			2	162	584
			3	197	703
			4	133	517
			5	156	587
	163 v	f	1	172	590
			2	177	653
			3	206	710
			4	176	593
			5	145	571
	164 r	f	1	158	594
			2	197	708
			3	198	698
			4	164	592
			5	139	539
	164 v	h	1	136	497
			2	188	724
			3	191	722
			4	154	606
			5	86	330
	165 r	h	1	154	569
			2	178	652
			3	187	737
			4	161	592
			5	141	588
	165 v	f	1	166	605
			2	206	763
			3	192	752
			4	157	608
			5	156	608
	166 r	f	1	163	592
			2	167	626
			3	194	748
			4	125	481
			5	137	538

References

Berger, Samuel (1893), *Histoire de la Vulgate pendant les premiers siècles du Moyen Âge*, Paris: Librairie Hachette.

Billeter, Ernst P. / Vlach, Vladimir (1981), *Zeitreihen-Analyse. Einführung in die praktische Anwendung*, Würzburg/Wien: Springer (Schriften des Instituts für Gesellschafts- und Wirtschaftswissenschaften der Universität Bonn).

Bischoff, Frank M. (1991), 'Pergamentdicke und Lagenordnung. Beobachtungen zur Herstellungstechnik Helmarshausener Evangeliare des 11. und 12. Jahrhunderts', in Rück, Peter (ed.), *Pergament: Geschichte, Struktur, Restaurierung, Herstellung*, Sigmaringen: Jan Torbecke, 97–144.

Bischoff, Frank M. (1994), 'Systematische Lagenbrüche: Kodikologische Untersuchungen zur Herstellung und zum Aufbau mittelalterlicher Evangeliare', in Rück, Peter / Boghardt, Martin (eds), *Rationalisierung der Buchherstellung im Mittelalter und in der frühen Neuzeit.* Ergebnisse eines buchgeschichtlichen Seminars der Herzog August Bibliothek Wolfenbüttel, 12th–14th November, 1990, Marburg: Institut für Historische Hilfswissenschaften (*Elementa diplomatica*, 2), 83–110.

Esenwein-Rothe, Ingeborg (1976), *Die Methoden der Wirtschaftsstatistik*, 2 vols, Göttingen: UTB.

Frenz, Thomas (1986), 'Zur äußeren Form der Papsturkunden 1230–1530', in *Archiv fur Diplomatik*, 22: 347–375.

Haussherr, Rainer (1980), 'Zur Datierung des Helmarshausener Evangeliars Heinrichs des Löwen', in *Zeitschrift des Deutschen Vereins fur Kulturwissenschaft*, 34, 3–15.

Jansen, Frank (1933), *Die Helmarshausener Buchmalerei zur Zeit Heinrichs des Löwen*, Hildesheim/Leipzig: Verlag August Lax.

Kötzsche, Dietrich (ed.), *Das Evangeliar Heinrichs des Löwen. Kommentar zum Faksimile*, Frankfurt: Insel-Verlag 1989.

Krüger, Ekkehard (1972), *Die Schreib- und Malwerkstatt der Abtei Helmarshausen bis in die Zeit Heinrichs des Löwen*, 3 vols, Darmstadt/Marburg: Selbstverlag der Hessischen Historischen Kommission Darmstadt u. der Historischen Kommission für Hessen (Quellen und Forschungen zur hessischen Geschichte, 21).

Leiner, Bernd (1982), *Einführung in die Zeitreihenanalyse*, München/Wien: Oldenbourg.

Möhle, Martin (1991), 'Die Krypta als Herrscherkapelle. Die Krypta des Braunschweiger Doms, ihr Patrozinium und das Evangeliar Heinrichs des Löwen', in *Archiv für Kulturgeschichte*, 73: 1–24.

Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*, Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).

Ornato, Ezio (1975), 'Statistique et paléographie : peut-on utiliser le rapport modulaire dans l'expertise des écritures médiévales ?', in *Scriptorium*, 29: 198–234 (repr. in [Ornato, Ezio et al.] [1997], *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci*, Roma [I libri di Viella, 10], 567–605).

Ostrom, Charles W. (1978), *Time Series Analysis: Regression Techniques*, Beverly Hills/London: Sage Publications (Quantitative Applications in the Social Sciences, Ser. 7/9).

Rück, Peter (1989), 'Die Schriften', in Kötzsche, Dietrich (ed.), *Das Evangeliar Heinrichs des Löwen. Kommentar zum Faksimile*, Frankfurt: Insel-Verlag, 122–154.

Rudberg, Stig Y. (1960), 'Eine Eigentümlichkeit der Schrift griechischer Pergament-Kodizes', in Dölger, Franz / Beck, Hans-Georg (1960), *Akten des XI. Internationalen Byzantinistenkongresses*, München 1958, München: Beck, 528–539.

Schlittgen, Rainer / Steitberg, Bernd (1984), *Zeitreihenanalyse*, München: Oldenbourg (Lehr- und Handbücher der Statistik).

Thome, Helmut (1992), 'Beschreibende Zeitreihenanalyse : Komponentenzerlegung mit Hilfe gleitender Mittelwerte', in *Historische Sozialforschung*, 17/3: 123–129.

Wiegand, Richard (1953–1954), 'Erlebte (wahrgenommene) Zeitdauer in quantitativer Abhängigkeit von optischen Bedingungen (Papierformat)', in *Psychologische Forschung*, 24: 230–266.

Wiegand, Richard (1953–1954b), 'Der Zeilengitterwechsel (Größenwechsel der Schrift bei Größenwechsel des Papierformats)', in *Psychologische Forschung*, 24: 601–606.

Denis Muzerelle

The Scribe's Gesture and its 'Shadow'

An Essay on the 'Modular Ratio' of Scripts

Since it was first introduced by Léon Gilissen in his classic work *L'expertise des écritures médiévales*,[1] the notion of a 'modular ratio' in scripts will have become familiar to most palaeographers—or at least, it should have done. The modular ratio is, as we know, the proportion that characterises an individual letter in a given script, or more broadly speaking, the entire set of characters composing that script: it is the relationship between the width and height of letters, or vice versa. To the Belgian scholar's way of thinking, this parameter ought to represent a 'distinguishing feature' which makes it possible to identify a particular hand among a group composed of several others executing scripts of the same type—in the present case, the various scribes involved in transcribing a lectionary at Lobbes in the 11th century, a task which involved the contributions of no fewer than nineteen individuals. Gilissen's calculation was carried out in a simple enough way: in order to immediately ascertain the average width of the letters forming a given alphabet, he proposed to divide the width of the line by the number of characters written on it.

From the moment of its publication, Gilissen's approach has been the subject of fierce criticism on the part of Ezio Ornato.[2] In essence, Ornato's objections can be condensed into two main points:

– On the one hand, the way of calculating the average width of the characters generates a certain amount of 'noise', owing to the presence of spaces on the lines, punctuation marks, and/or abbreviations to be kept count of in a more or less meticulous way. This 'noise' would be regarded as a negligible epiphenomenon if it did not result in divesting the differences—which are always quite small—of statistical significance.
– On the other hand, it appears that the modular ratio is to a great extent conditioned by the module itself (i.e. the average 'eye' height of the letters), since small scripts tend to be consistently wider than large ones. Ezio Ornato observed a ratio

Translated from the French into English by Mark Livesey. Original published as Muzerelle, Denis (1999), 'Le geste et son ombre: essai sur le "rapport modulaire" des écritures', in *Gazette du livre médiéval*, 35: 32–45.

1 Gilissen 1973.

2 Ornato 1975 [1997].

https://doi.org/10.1515/9783110743838-018

> of 0.727 between these two variables, which suggests a very clear correlation. Now, in order to be able to consider a parameter (whatever it may be) as being specific to a particular writer, it should not depend on any other circumstantial factor, and this in fact is not the case.

One must, however, be careful to avoid throwing out the baby with the bathwater, as it were. All things considered, the arguments we have just set out only call into question the rather clumsy application of a concept which is otherwise valid, and whose relevance becomes apparent as soon as one sets about the task of analysing the complex set of problems that has to be confronted when managing the space on a page. The modular ratio has therefore continued to be observed in different contexts by means of the application of a variety of procedures, all within the general framework of research which, in the wake of Ezio Ornato, has been dedicated to addressing these issues for the last twenty years or so.[3] On the whole, based on the accumulated observations, it would appear that the correlation identified in the case of the *Lobbes Lectionary* is not entirely unique to this context.

We can begin to get an idea of this by studying Graph 1, which shows the distribution of 712 manuscripts described in the French *Catalogue des manuscrits datés* covering the period that stretches from the beginning of the 11th century to the middle of the 13th, with respect to the module and the modular ratio of the script. The graph represents 'raw' data which has not undergone any selection process, and which encompass a very diverse range of book types and writing styles jumbled up in such a way so as to render them indistinguishable from one another (which accounts for the somewhat amorphous appearance of the points cloud). This, however, only lends more weight to the trend which is plain to see: the cloud is far from assuming the globular form that would be generated by pure chance or by factors independent from those which were taken into account. Indeed, it clearly assumes a stretched-out form marked by a gentle and consistent 'dipping' trend. It is therefore incontrovertible that, tendentially, the smaller scripts are, the higher their modular ratio is—in other words, the greater their increase in width.

In addition, it can be stated that this is a phenomenon that affects the writing itself, and not merely the result of various dimensional constraints which exert an effect within the confines of the page. For example, one observes that no correlation of this kind exists between the ruling unit and the modular ratio—even if there is a clear and statistically observable link between the line spacing value and the height of the writing that occupies it (that relationship being, all things considered, relatively complex and still rather under-investigated).

---

3 In large part the results of this research can be found collected in [Ornato et al.] 1997.

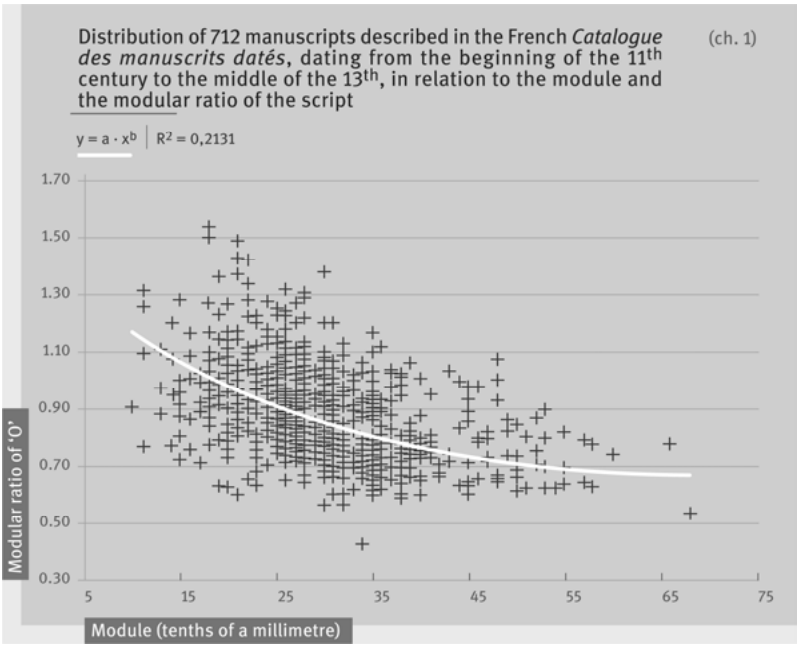


Chart 1: Distribution of 712 manuscripts described in the French *Catalogue des manuscrits datés*, dating from the beginning of the 11th century to the middle of the 13th, in relation to the module and the modular ratio of the script

Up till now, we have had to content ourselves with merely registering this trend, without being able to demonstrate its mechanism. To account for it, we have resorted to rather vague notions, such as a preoccupation with preserving legibility by means of a hypothetical horizontal 'compensation effect' produced by the reduction in script height. These notions should probably not be cast aside, but in any event they would certainly require close analysis.

More recently, the 'Lobbes Syndrome' has taken on particular significance, on the heels of some observations made by Antonella Tomiello during a research project dedicated to juridical manuscripts bearing glosses that frame the main text.[4] Our colleague undertook a comparative study of the palaeographic characteristics of a text (in large script) and its glosses (in small script) written by one and the same hand. With respect to the topic that concerns us here, the results of Tomiello's detailed analysis can be broadly summarised in the following way: the scripts employed for the main text and for the glosses are morphologically identical; they differ in only two ways, namely the frequency with which abbreviations are employed (considerably more often in the glosses), and the proportions of the characters, which are systematically wider in the smaller script.

Therefore, the phenomenon does not simply correspond to a generalised trend: it manifests itself at the level of each individual writer, irrespective of his writing style or personality. All this appears to happen as if the reduction in the height of letters automatically leads to their increased width … and vice versa. In order to simplify our exposition, we have only considered the facts with respect to the former direction. But whether there be reduction or growth, the comparison of the smaller with the larger leads to the same conclusion, regardless of the direction in which the scale is changed. The inversion is therefore immediate.

***

Let us now examine a rather simple case—indeed, a grossly simplified one, it could even be said. The case is that of a circle resembling, more or less, the letter **o**, and our aim is to see what happens when one reduces the height of a character (Fig. 1–2, 1).

4 Tomiello 2000.

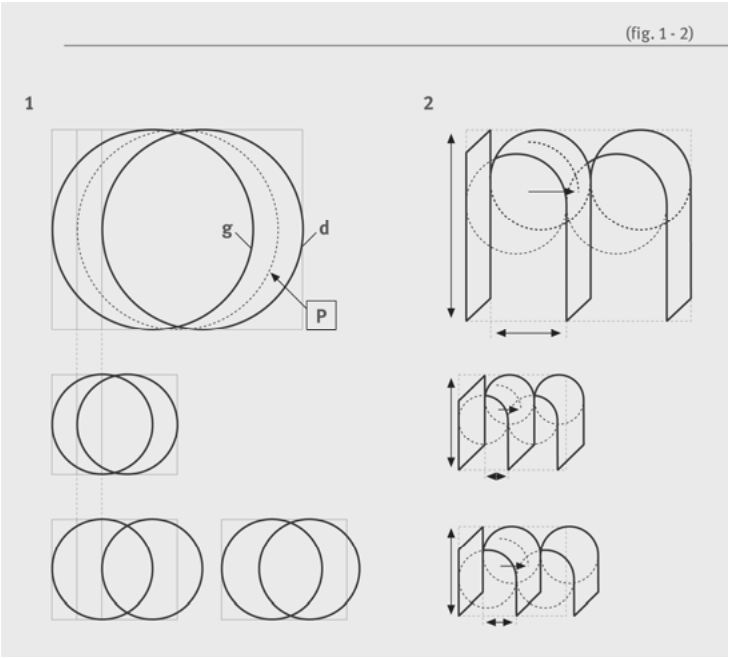


Fig. 1–2: Tracing of letters 'o' and 'm'

Right from the outset, we must make an important observation—it may seem like a trivial one, but its consequences will soon become apparent to us. To simulate our **o**, we must draw two circles (Fig. 1a; g, d), each of which coincides with the path traced by the two extremities of the edge of the pen's nib. Each of the two extremities perfectly reproduces the circular gesture made by the scribe's hand. Strictly speaking, if we wanted to illustrate this, we would have to draw a third circle of equal size positioned precisely midway between the first two circles and corresponding to the axis of the pen's pathway (P). However, we can simplify the representation if we consider that one of the two circles corresponds to the gesture described by the scribe's pen, and the other to the 'shadow' cast by the pen's nib, with a displacement that depends on its breadth. (The displacement depends equally upon the angle formed between the pen and the vertical, but for the sake of clarity we shall ignore for now the impact of this parameter by hypothesising a zero angle.)

The scribe has thereby formed a character of 1:1 proportion; but when the palaeographer (or codicologist) measures the inscribed form, he/she is in fact measuring the sum of the gesture and its 'shadow', and will therefore note a

distinctly wider proportion. Hence it follows that one should think in terms of a 'gestural ratio', as distinct from a 'modular ratio'.

Now that these introductory remarks have been made, we can embark on our investigation by reducing the **o** by half in a way which is very familiar to us: we are all accustomed to using mechanical, optical and electronic means to carry out such reductions (Fig. 1b). In geometric terms, this represents a perfect homothety, which is to say all the dimensions of the original figure have been reduced by half in the resulting figure (given that our rate of reduction in this case is two). The width of the pen's nib—which can be determined by measuring the 'track' it produces—clearly contributes to these dimensions. In other words, to obtain the same result using a real pen, it would be necessary for the width of the pen's nib also to be reduced by half. If the scribe continues to use the same pen and reduces the size of his script by half, he will produce a 'track' whose proportions are noticeably wider than those of the original figure (Fig. 1c).

Naturally, the scribes were not so stupid as to have failed to notice, or at least to have felt the effects of this phenomenon; indeed, it is well known that the smaller writings were generally achieved using more fine-nibbed pens. But the scribe could not be expected to adjust the size of his pen with each change of script size, and even less to carefully adjust each new script's proportions accordingly. It can also be supposed that in order to maintain a certain degree of writing comfort, there was a tendency for the scribe to keep the size of his pen as close as possible to that which best 'fit his hand'. Generally speaking, then, this very imperfect adjustment only partially compensated for the phenomenon, without entirely curbing it. Fig. 1d shows the same **o** reduced by half; it was made using a pen whose breadth was only reduced to three quarters the size of that used to draw the original figure.

The phenomenon we have examined above in the 'simplest case' is purely geometric and does not involve any intervention by an actual implementer. Things change when instead of a figure drawn using a single gesture, one is dealing with a letter formed from multiple elements joined together. There is no better example than the letter **m** (Fig. 1–2, 2), composed of three downstrokes which 'lean' on each other successively, one after the other.

Fig. 2b illustrates what happens when one simply reduces the character's size by half while still using the same sized pen. The modular ratio is affected in the same proportion as before, but the 'track' produced is hardly satisfactory. In fact, if one simply reduces the size of one's pen strokes by half throughout the drawing of the character, a far greater reduction in the gap that separates two successive downstrokes results; and despite the fact that, overall, the letter may have increased in width, it looks as though it has contracted. Clearly, this gap plays a

key role in the reader's perception of the letter and contributes to its 'identity'. The scribe would have had a natural inclination to react against this distortion, so he would have widened the movement of his pen in such as way so as to mitigate the reduction of the space between the legs of the **m** (its 'crotch', so to speak), thereby making it proportionate with the letter's height (Fig. 2c). Ultimately, the increase in the modular ratio that we observed in the case of a simple form (**o**) is seen here multiplied (roughly speaking) by the number of downstrokes.

In order to proceed with our analysis, we must now consider the effect of the 'pen's angle', which up until now we have chosen to ignore. First of all, we should clarify its definition: it is the angle formed between the edge of the pen's nib and the horizontal—or the angle formed between the barrel of the pen and the vertical, if one supposes the pen's nib is cut square. (Most of the time this is probably not the case; however, it is palaeographically and geometrically impossible to determine whether the pen is slanted towards the left or towards the right, and to what extent. One can only work with an 'apparent angle', as if the pen were cut at 90°, without knowing the 'real' angle; but this makes no difference to our demonstration.)

Now let us observe its effect (Fig. 3). In order that the nib of the pen should exert an effect on the horizontal dimension alone (as was the case in the previous examples), it is necessary and sufficient for the edge of the nib to coincide with the horizontal—in other words, that the pen's angle be zero. As soon as the pen shifts from that position to form an angle with the vertical, which we shall call **ζ**, the effect of the pen's width will be divided between the two dimensions, according to a trigonometric function of that angle: the vertical 'gain' is proportional to SIN **ζ**; the horizontal 'gain' to COS **ζ**. As long as **ζ** remains lower than a certain critical value (Fig. 3a), the proportional increase in the width remains higher than the proportional increase in height. Taking into account these factors, we remain in the province of the phenomenon that we have just studied. On the other hand, beyond this limit the height proportionally increases more than the width (Fig. 3c), causing the opposite effect, so the modular ratio decreases in comparison the gestural ratio. When a balance is achieved between these two tendencies (Fig. 3b), the modular ratio remains precisely the same as the gestural ratio, regardless of the width of the pen's nib: this is what we call the 'homothetic angle' of the track (i.e. the mark left by the nib of the pen).

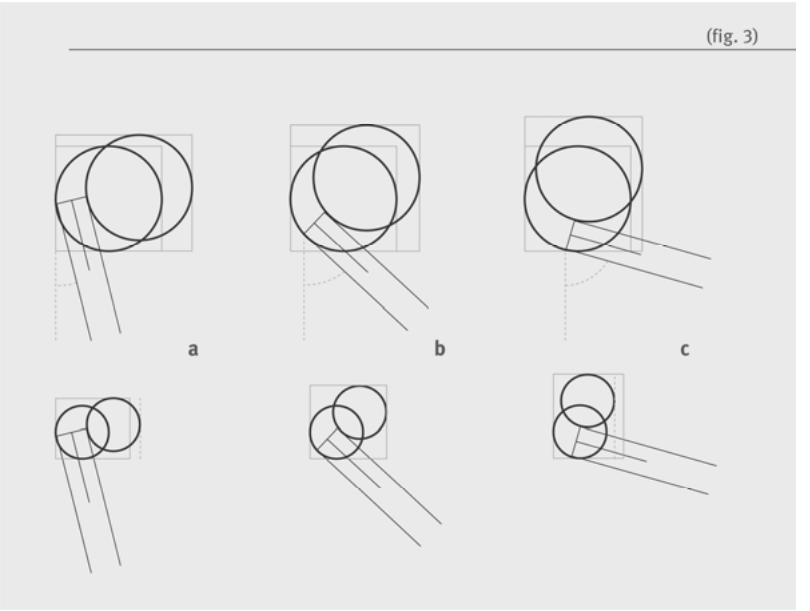


Fig. 3: Effect of the pen's angle on the tracing of letter 'o'

To confirm the hypothesis according to which the increase in the modular ratio is induced by the horizontal impact of the nib's width, we must determine the aforementioned critical value and verify that it is normally the first case which applies, rather than the second. Now, the said value is not fixed; indeed, it depends on the letter concerned—the gesture or actual written letter, since both are of the same proportions—and corresponds to the position in which the edge of the pen is orientated with the diagonal of the rectangle where the letter is inscribed. If one names the height of this rectangle **h** (hauteur), and its width **l** (largeur), the homothetic angle can be calculated through $\boldsymbol{\zeta} = \mathrm{tg}^{-1}(\mathbf{h}/\mathbf{l})$. Tab. 1 and Fig. 4 present some values of $\boldsymbol{\zeta}$ (purely as examples).

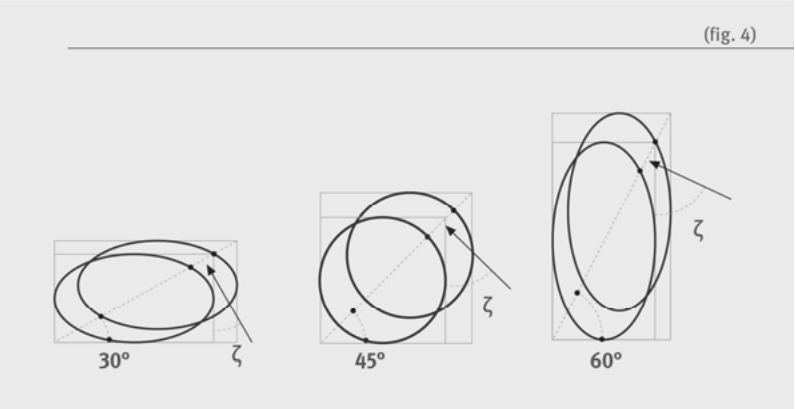


Fig. 4: Values of ζ according to different modular ratios for letter 'o'

Values of ζ according to different modular ratios for letter 'o' tab. 1

Modular ratio	Zeta (ζ)
0.75	53.130°
1.0	45.000°
1.25	38,660°
1.50	33.690°
1,75	29.745°
2.0	26.565°

Tab. 1: Values of ζ according to different modular ratios for letter 'o'

The values calculated for **ζ** appear to be much higher compared with those seen in practice. The angles measured in the *Lobbes Lectionary* fall between 12° and 30° (with one exception, which we shall return to in due course), the average being 21°. Various surveys carried out here and there (which I do not purport to have any statistical value) allow us to suggest that, by and large, the pen angle adopted by scribes did not exceed about thirty degrees. There is one famous exception, namely the Roman majuscule—still called 'rustic capital'—which, as we know, was written with an almost 'reversed' pen angle in comparison to later practices, with the edge of the nib tending towards a vertical orientation. Seen from another perspective, the width of certain cursive scripts of the Late Middle Ages grew to

such an extent—equivalent to a very high modular ratio—that the homothetic angle can easily be ascertained.

Keeping in mind the above caveats, one can conclude by stating that in the vast majority of cases we find ourselves within the zone where the pen's angle exerts a *positive* effect on the modular ratio.

***

Up to this point, we have focused on strictly theoretical issues and geometrical demonstrations of the relevant phenomena. We have done this out of necessity, rather than on a mere whim. The phenomena that we have examined are not of the kind that immediately strike one's eye; indeed, they manifest themselves on a very small scale, and one should also bear in mind the fact that they can be further 'blurred' by the contribution of other factors. We can therefore only hope to observe them 'in the wild', so to speak, if they have been predicted beforehand by the theory.

To measure the effects *in rebus*, we shall now return to the *Lobbes Lectionary* and examine three aspects of the writing: the gestural ratio, the pen's angle, and the modular ratio.

Fig. 5 illustrates the characteristics of the hands of five scribes chosen for their 'exemplary' behaviour (it should be noted that the five artisans are anonymous, with the exception of Goderan; the rest are identified by means of the name of the saint whose biography they wrote). This is an experimental approach: the geometrical figures shown do not represent specimens of the letter **o** of the kind that the scribes would have written; rather, they are ellipses or circles drawn (to scale) in accordance with the dimensional characteristics associated with each of the scribes' writing styles.

The handwriting styles encountered in *Alexis* and *Cyril* straight away present some interesting characteristics. The writer of the first appears to calculate his gesture so that the resulting script is of rigorously square proportions; the writer of the second seems adamantly to adopt square proportions for his writing gesture, leaving the other two parameters to operate freely. The remarkably 'geometric' character of these two styles points towards two different models. However, the actual distribution observed makes it impossible to justify such a conclusion, since the writing of other scribes is distributed in a fairly uniform way, without any tendency to cluster around potential 'poles of attraction'.

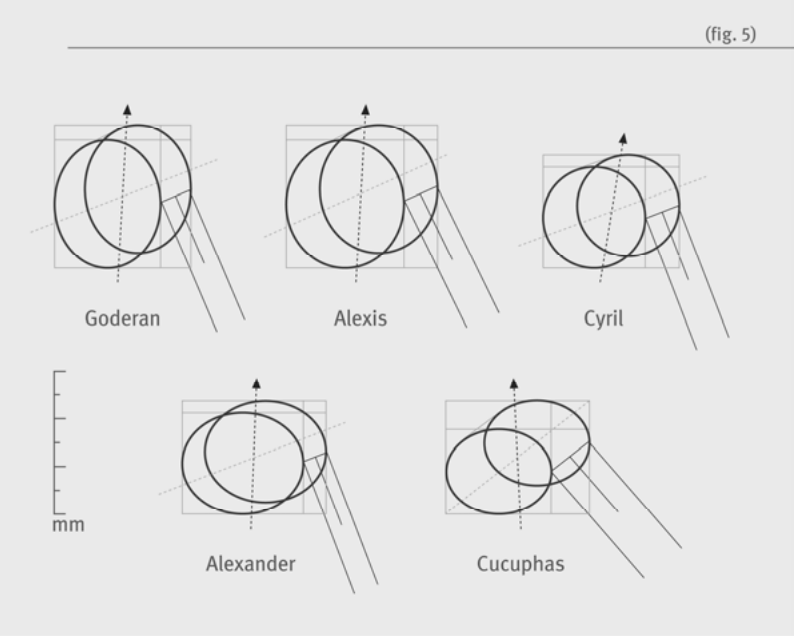


Fig. 5: Letter 'o' as written by five 'exemplary' scribes of the Lobbes Lectionary

The behaviour personified here by *Alexander's* script is the same as that of the aforementioned scribes and of many of his colleagues, all of whose writings exhibit various signs of amateurishness (*George, Martial, Thierry III*): the gesture is already distinctly wider than the 1:1 proportion and gives rise to an even wider pen stroke. Upon closer inspection, one can see that the gestural ratio adopted by the scribes corresponds (roughly) to the modular ratio that would have resulted from a gesture with a ratio of 1:1. It is tempting to view this as fresh evidence of their inexperience—not having mastered the necessary deftness of hand and the angle at which to hold the pen, the scribes naively worked hard to reproduce what they saw, without making the all-important adjustment to the width of the pen's nib.

Goderan's method is quite the opposite: it is, on the contrary, the trace delineated by the writing that has the proportions best suited to the movement of the scribe's hand to produce a ratio of 1:1. We can suppose that this represents a sort of 'hypercorrection'—in fact, all the evidence would point to Goderan being the most experimental scribe. According to Gilissen's analysis, he appears to be the 'master of the atelier', whose writing serves as a benchmark and a model for his collaborators to follow. In this respect, then, it has to be said that Goderan's

example is not very well followed by his team, because his writing performance is completely different from that of the others.

Only the peculiar case of *Cucuphas* remains, whose writing stands radically apart from that of the other scribes. Executed with an exceedingly broad-nibbed pen held at a very 'open' angle, it has an unsettling appearance; indeed, one must agree with Gilissen, who considered it rather inelegant and coarse. And it is not altogether surprising to find that the angle of *Cucuphas*' pen corresponds exactly to that of the 'homothetic angle', which seems almost impossible to imagine meeting with in reality. The combination of such an unusual writing angle, a non-standard pen size and a gestural ratio that compensates for the disadvantages of the first two handicaps can hardly be considered a coincidence. Is it the width of the pen that *Cucuphas* favours which forces him to adopt such an angle? Or is it the angle of the pen which is natural to him that allows him to take advantage of the wider nib? This question is a bit like asking: which came first, the chicken or the egg? At all events, his example seems to confirm that the finer points in the relationship between the three parameters were picked up on and mastered by the scribes—among the most skilled of them, at any rate.

***

On the basis of the above, it emerges that the modular ratio—the simple outcome of a combination of factors—is not very significant from a palaeographic perspective. Even so, an examination of the correlation that links it to the module gives rise to some interesting observations.

In order to get a sense of the historical environment, we shall now transport ourselves to the other end of the Middle Ages—to the scriptorium at Cesena which, from 1450 to 1465 (or thereabouts), worked to create a library for Malatesta Novello, the local feudal lord. The fruit of this labour (roughly one hundred and twenty-five volumes) constitutes one of the most homogenous collections of books ever produced in the humanistic arena. Conserved *in situ* in its original context, it has been the subject of numerous studies, the most recent of which can be found gathered together in an important collection published some time ago.[5]

The most strictly palaeographical aspects—particularly the identification of scribes—have been studied more than once, most recently by Emanuele

5 *Libraria domini* 1995.

Casamassima and Cristina Guasti,[6] and by Albinia De la Mare.[7] Broadly speaking, the conclusions reached by these experts coincide; however, as an added precaution, the rare cases where their opinions differ have been excluded from this point forward.

The analysis is based on data gathered in the early 1980s, along with numerous other codicological parameters, during a systematic book restoration campaign. For reasons specific to this enquiry, the average dimensions of the letter **m** served as a control.

A quick glance at the images gathered in Chart 2 will suffice to show what one can expect from this kind of study. The graphs created for the groups of different writing hands (Charts 2a and 2b) present a totally anarchic scenario, whereas those which relate to one and the same scribe reveal a very close correlation (Charts 2c and 2e, and in the circumstances that we shall presently see, 2f). One can therefore take it for granted that the absence or presence of such a correlation constitutes a homogeneity criterion.

Chart 2d appears to contradict this law: it relates to manuscripts attributed to Johannes von Mainz (Iohannes Moguntinus). The term 'attributed' has to be emphasised here: in actual fact, these are volumes which lack scribal signatures. Casamassima and Guasti, after much deliberation, finally decided to see in them the work of the same hand (which remains anonymous, but for practical reasons was nicknamed 'l'Amico', 'the friend'), albeit with some serious reservations. Albinia de la Mare has the distinction of having identified this scribe with Johannes von Mainz, of whom, besides, we possess some signed specimens, although she, too, emphasises the great uncertainty that surrounds his signature. The correlation analysis neither corroborates nor disproves this identification, but it clearly illustrates the lack of homogeneity in the group in question and fully justifies the bepuzzlement of palaeographers.

Without doubt, though, it is Jean d'Épinal (Iohannes Antonii de Spinalo) who provides us with the most interesting case. We can consider this figure as the 'pivot' of the scriptorium at Cesena, where he exercised his skills from its inception (*c.*1450) and probably up until his death (in 1467). To him we owe about forty volumes of which three quarters bear his signature; unfortunately, only four of them bear dates.

6 Casamassima / Guasti 1992.

7 De la Mare 1995.

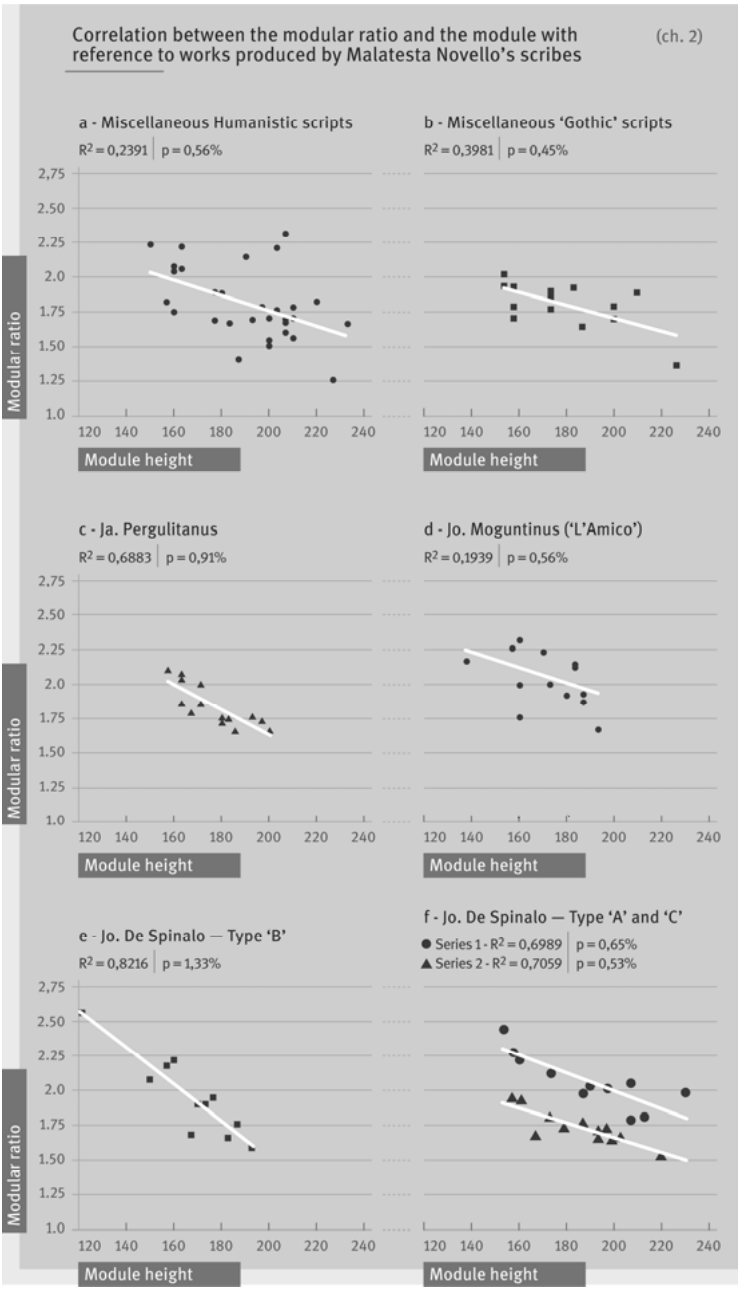


Chart 2: Correlation between the modular ratio and the module with reference to works produced by Malatesta Novello's scribes

The 'rough' graph that can be drawn to represent this group is totally chaotic (hence it would serve no useful purpose to present it here). However, the heterogeneous nature of the scribes' output does not represent a revelation. Already in 1959, in the monograph dedicated to him, Antonio Domeniconi[8] identified three different aspects of his writing. The first ('type A'), which seemed to Domeniconi to have been the most natural, is the humanistic semi-cursive, agile and rapidly written, which is employed in more than two cases out of three. The second ('type B') is a much more 'classical' antiqua, which is somewhat rigid and formal in appearance. In addition, Domeniconi identified a 'type C', represented by just one witness. This third type is positioned more or less midway between the first two types. However, this distinction seems superfluous to Albinia de la Mare, who sees it as merely a variant of the first type. Shortly, we shall see that our analysis is in sympathy with her point of view.

If we resume the analysis whilst taking this distinction into account, things immediately fall back 'into order' with respect to 'type B' (Chart 2e). The result is scarcely different from that which one obtains for Jacopo della Pergola (Chart 2c), who employed a very similar hand.

'Type A', on the other hand, continues to demonstrate its heterogeneity by consistently generating a rather diffuse cloud. However, this nebulousness is only superficial: a closer examination makes it possible to ascertain that the cloud is in fact composed of two series of aligned points scattered along the two parallel axes, with only one or two objects 'floating' in the intermediate space.

To the naked eye, and even under a magnifying glass, one cannot identify in the writings of one or the other series any fundamental difference which can justify this dichotomy. We must therefore discard the hypothesis of the existence of a 'type C', which we have merged with 'type A', having assessed it as being incompatible with former ('type B')—the volumes in that class can be placed in the two series, with no particular preference. The hypothesis that there is a possible chronological effect must also be rejected, since the four dated witnesses are distributed equally on both sides.

It is therefore in the codicological realm that the cause resides. In this context, a piece of evidence catches one's eye: almost all the volumes written in a full-page layout (with the exception of one, which is to say six out of seven) aggregate in the first series. The explanation for this is immediately at hand: Jean d'Épinal cramps his writing when he feels hemmed in by the line; conversely, he loosens it up when his pen can range over a long stretch before coming up against the righthand justification. But the origin of the phenomenon is certainly far more

8 Domeniconi 1959.

psychological than palaeographical or codicological—in fact, it only manifests itself in the context of his spontaneous writings, and no duality of this kind appears when the same scribe employs formal antiqua (in five cases on long lines, and in another six in two-column layouts).

The instances of five manuscripts with two-column layouts in which Jean d'Épinal employs his expansive writing (Biblioteca Malatestiana D.III.4, D.VII.3, D.IX.2 et 3, et D.XXI.6) still have to be explained. From a statistical standpoint, these have no parameters that differ from those of the other volumes with two-column layouts.

The interest of this analysis extends beyond that which it provides for a study of a particular scribe's 'graphological' behaviour. In the first place, this is because—methodologically speaking—it reveals a duality which is almost impossible to bring out by other means. The separate study of the writing's size and its proportions does not suffice: one can see that the spattering of points that compose the data cloud are in fact mixed up, just as much on the vertical axis as on the horizontal. The same is true with respect to the palaeographical level in its connection with codicology. The studies carried out over the last decades on the management of space within the confines of a page have led us to suspect that there should exist, between the size of the page and that of the writing, an interaction which is subtler than the mere adaptation of the module to the ruled unit. However, for the reasons mentioned above, this subtle interaction has previously been rather difficult to expose, but we can see it quite clearly now.

References

Casamassima, Emanuele / Guasti, Cristina (1992), 'La Biblioteca Malatestiana: le scritture e i copisti', in *Scrittura e Civiltà*, 16: 229–264.

De la Mare, Albinia (1995), 'Lo scriptorium di Malatesta Novello', in Lollini, Fabrizio / Lucchi, Piero (eds), '*Libraria Domini*'. *I manoscritti della Biblioteca Malatestiana: testi e decorazioni*. Bologna: Grafis, 35–93.

Domeniconi, Antonio (1959), 'Ser Giovanni da Épinal, copista di Malatesta Novello', in *Studi Romagnoli*, 10: 261–282.

Gilissen, Léon (1973), *L'expertise des écritures médiévales. Recherche d'une méthode avec application à un manuscrit du XI^e siècle: le lectionnaire de Lobbes, codex Bruxellensis 18018*. Gand: Editions scientifiques E. Story–Scientia (Les publications de Scriptorium, 6).

Lollini, Fabrizio / Lucchi, Piero (eds) (1995), *'Libraria Domini'. I manoscritti della Biblioteca Malatestiana: testi e decorazioni*. Bologna: Grafis.

[Ornato, Ezio et al.] (1997), *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues. Avec une préface d'Armando Petrucci* Roma: Viella (I libri di Viella, 10).

Ornato, Ezio (1975), 'Statistique et paléographie : peut-on utiliser le rapport modulaire dans l'expertise des écritures médiévales?', in *Scriptorium*, 29: 198–234 (repr. in [Ornato, Ezio et al.] (1997), *La face cachée du livre médiéval. L'histoire du livre vue par Ezio Ornato, ses amis et ses collègues*, Roma: Viella [I libri di Viella, 10], 567–605).

Tomiello, Antonella (2000), 'Scrittura di testo e scrittura di glossa nella cosiddetta *Littera Bononienis*', in Goulet-Cazé, Marie-Odile avec la collaboration de Dorandi, Tiziano/ Goulet, Richard / Hugonnard-Roche, Henri / Le Boulluec, Alain / Ornato, Ezio (eds), *Le commentaire entre tradition et innovation*. Actes du colloque international de l'Institut des traditions textuelles, Paris et Villejuif, 22–25 septembre 1999, Paris: Vrin, 147–154.

Lucien Reynhout

Quantitative Codicology and Scientific Paradigms. A Typology of Latin Formulae in the Colophons of Western Manuscripts

In a note published some ten years ago in the 'Gazette du livre médiéval'[1], I announced a research project set within the framework of my doctoral thesis *Étude sur le formulaire latin des colophons de manuscrits occidentaux (III^e^–XVI^e^ siècle)*. The publication of this work is currently in progress [Note of the editor: completed in 2006]. Accordingly, it seems timely to present, in the following pages, a preliminary methodological assessment of my investigations.

I will consider, successively, the most important results of my research, its specific methodology, and its methodological repercussions—namely the new codicological criteria that a clear understanding of the way in which colophon formulae 'functioned' can afford us. Finally, based on my experience while conducting the research, I shall make some remarks of a more epistemological nature.

1 Results of the research

Initially undertaken in order to portray the 'mindset' of copyists through their colophons—in other words, to see what anecdotal information might be drawn from them—my work quite soon became orientated towards a more typologically-based study. The notion that in colophons the copyists gave free rein to their natural expressiveness as a sort of protest against the arduousness of their work cannot be reconciled with the propensity towards formality in medieval men, nor with the hypothetical historical development of verbal formulae present in colophons. And yet, many scholars have accepted and perpetuated the preconceived idea of the anecdotal nature of colophon formulae and the notion of the scribes' spontaneity. An important part of the reason behind their use could

Translated from the French into English by Mark Livesey. Original published as Reynhout, Lucien (2001), 'Codicologie quantitative et paradigmes scientifiques: une typologie des formules latines de colophons de manuscrits occidentaux', in *Gazette du livre médiéval*, 39, 1–11.

1 Reynhout 1988.

https://doi.org/10.1515/9783110743838-019

instead have to do with the need to adhere to stereotypes. In carrying out a systematic perusal of Bénédictins du Bouveret's *Colophons de manuscrits occidentaux*, it became apparent to me that the formulae were used to fulfil specific functions, since they include relatively precise datings and localisations. Furthermore, the aforesaid specific uses appeared to correspond very closely to the major periods of cultural history in the Latin West, from the end of the classical age up until the Renaissance. In some cases, very close parallels can also be established with major historical milestones in the history of Latin writing. So much, then, for intuition: it was still necessary to develop a reliable method to prove my thesis! For the time being, and without presuming that my text will be published in its entirety, to begin with I would like to identify the main junctures in the history of the system of colophon formulae employed in Western manuscripts.

The history begins with the most ancient witnesses that have come down to us from Imperial Rome's book trade. The word *feliciter* employed in the colophons of manuscripts bearing Latin classics betrays the influence of the lexicon used in Roman religion. At least four variants exist: *Explicit … feliciter*, *Lege feliciter*, (verb) + *feliciter* and *utere feliciter*. The last-mentioned formula is found particularly in the epigraphical part of the *instrumentum*, which is to say the group of inscriptions placed on handcrafted items, where it serves a propitiatory function. It is striking to observe that, in some of the rarest and relatively late examples, one encounters phrases such as *Explicit feliciter in Christo*, which testify to a form of cultural adaptation of the classic slogan of pagan inspiration, which was used in Christian circles—a phenomenon that can be likened to the adaptation of a classical scholarship culture in a Christian context. However, before long specifically Christian formulae began to appear. In particular, there is the case of *Orate pro scriptore si(c) Deum habeatis protectorem*, where it pleased Michel Huglo to discern an epigraphical origin.[2] Contrarily, in my view it is in liturgical language and that of the Church Fathers where one can find the source of inspiration for these formulae. Two interesting points should be noted. The most ancient witness (Firenze, Biblioteca Medicea Laurenziana 65, 1, f. 144v) is inscribed by a certain Viliaric, who qualifies himself as *antiquarius … in statione*, and was beyond doubt active at Ravenna in the 6th century. Now, as everyone knows, members of the Ostrogoth elite adapted themselves to what remained of ancient society by progressively developing towards the inception of the Middle Ages. The same formula was still frequently employed in the Carolingian age and, indeed, up until around the 10th century. Subsequently, the formula disappears. The sole exception is on the Iberian Peninsula, where it en-

2 Huglo 1961.

dured until the 12th century! The Principalities of Catalonia and Spain effectively found themselves under the suzerainty of the Frankish kings, whose hallmarks they bear, especially in the formulae of diplomatic acts, up until, indeed, the 12th century. But later on, being conscious of these signs, the principalities rid themselves of the last vestiges of this dependence.[3] Without doubt, our formula met with the same fate, which explains its total disappearance after the dawn of the 13th century.

The Carolingian Age saw the appearance of rather more 'technical' terms to describe the act of transcriptions, such as *transcriptus*, *expletus*, etc. In general, the use of these terms was certainly not limited to the 8th, 9th and 10th centuries. In particular, one encounters them in the lexicons of the Latin Fathers. In colophons, however, they are not seen before the 8th–9th centuries. Nevertheless, a reconciliation was achieved: learned Carolingians sought ancient models, both intellectual and stylistic, in just the same way that the Humanists would some six centuries later.

With the dawn of the 12th century and the revival of scholastic culture,[4] a new family of formulae appeared that Denis Muzerelle has termed *ritournelles* (i.e. refrains).[5] If some of the formulae seem somewhat Italianate (such as *Finito libro sit laus et gloria Christo*) or Germanic (such as *Finis adest operis, mercedem posco laboris*), others are clearly informed by a French influence, such as *Explicit, expliceat, ludere scriptor eat; Explicit iste liber, sit scriptor crimine liber* or *Detur pro penna scriptori pulchra puella*. Notwithstanding the very wide distribution of these formulae in the 13th to 14th centuries and the fact that their largely anonymous use makes them impossible to localise, one can discern, through the content of the associated texts, the very clear influence of the milieus of both the cathedral school and the University of Paris. It should be noted that elsewhere alternating 'pious' and 'satirical' variants can be seen which are fully in the spirit of the Goliards.

On the other hand, the Late Middle Ages would see an increase in specific formulae in more circumscribed geographical areas. 'National', as it were, cultures began to assert themselves. Thus, the formulae *Finito libro referatur gratia Christo* and *Qui scripsit scribat, semper cum Domino uiuat* are certainly of 13th to 14th century Italian origin. Regarding the latter formula, its use in Provence, Languedoc, Aquitaine and the north of the Iberian Peninsula (i.e. Catalonia) should be seen in parallel with the area of dispersion of *scriptura gothica rotunda*, and with the influence of the early Italian Renaissance on the other contemporary

3 Zimmermann 1981.

4 See, in particular, Paré / Brunet / Tremblay 1933.

5 Muzerelle 1985, 137, No. 435.11.

southern cultures of the Avignon Papacy: Dante, for example, served as a model for the father of Catalonian poetry, Auzias March, one of whose manuscripts represents part of our sample. Additionally, one finds elsewhere *...cuius animae propitietur Deus*, which seems to be confined to the English area, and *Nomen scriptoris... plenus amoris*, in the Anglo-Norman domain. The area of diffusion of the formulae *Finitus et completus...* and *Oretis pro scriptore propter Deum* is limited to the old Low Countries and North-West Germany. In the latter case, the link between that geographical area and the Carthusian Order is clear. This is also the area of dispersion of the seats of the *Devotio moderna* (i.e. Brethren of the Common Life, Windesheim Congregation). One is conscious of the importance of book transcription to this spiritual movement, an appetite which was largely inspired by the Carthusian Order.[6] Therefore, we can readily imagine the impact that spiritual and cultural trends had on the use of colophon formulae.

Finally, the Renaissance saw the emergence of a three-fold phenomenon: the resurgence of certain ancient formulae with renewed vigour, the adoption of formulae of Carolingian origin which had fallen into disuse, and the creation of formulae specific to humanist milieus. Thus, *Feliciter*, which was chiefly associated with classical content throughout almost the entire duration of the Middle Ages, exhibits a very significant rate of association (more than 20%) with the texts of contemporary authors (i.e. humanists), starting at the end of the 14th century and extending into the 15th, thereby providing clear evidence of an appropriation of this usage. *Transcriptus*, a formula which had disappeared between the 11th and 14th centuries, reappeared in a very visible way in the 15th century, and likewise was employed particularly in humanist milieus.

As can be seen, the functional division of formulae through space and time is clearly identifiable. Links to the main cultural trends sometimes make themselves apparent in a striking way. Therefore, this placing in perspective of colophon formulae by means of a qualitative methodological approach definitively precludes their supposedly anecdotal nature.

2 Methodology

The methodology adopted bears the stamp of 'quantitative codicology'. This approach aims at selecting the indicators associated with a particular phenomenon, at describing their values in a uniform way across a representative population, and at

6 Lourdaux 1963a; Lourdaux 1963b.

measuring their manifestations. However, the statistical approach is not entirely adequate to the task. Indeed, it is still necessary to explain the phenomenon in relation to the cultural context concerned. In the sphere of codicology, this methodology has been applied in the observation of material facts that are readily quantifiable (i.e. ruling, justification, the number of lines per page, etc.). In our case, one is working with elements of a textual nature. The only area in which a similar methodology has been introduced is that of 'quantitative' lexicography, where the units one is working with are literary texts. In the case of colophons, one is likewise dealing with a text, although of a very marked documentary nature. Accordingly, we find ourselves in the realm of the stereotype and the replication of frameworks (in other words, in contrast to the lexicon of literary texts, in the case of colophons one will encounter only a few different terms whose usage rates are very significant). Furthermore, the lexical unit is not represented by the word or the form, but rather by the formula, which is to say a characteristic verbal sequence. The problem arises because neither the thematic unity nor the identity of terms alone is sufficient to identify a formula. It is usually a characteristic 'family appearance' that determines the typology.

Once the formulae have been identified, one must still establish their attestation grouping trends. In order to achieve this, it is necessary to isolate some indicators that represent such trends, namely the copyist's place of origin, along with that of the manuscript, the dating of both the text and of the transcription as stated in the colophon (these two dates may be different if the copyist reproduced the colophon from his model, as unfortunately was often the case), the textual content and other historical constituents of the manuscript, all of which are 'contextualisation' elements that shed light on the use of colophon formulae. The next step is to calculate the frequency with which a given factor appears, or the correlation of several factors combined.

Largely speaking, the methodology is widely known. All the same, it should be pointed out that it has never been applied to such a large sample (consisting of 6,000 to 7,000 colophon attestations). At the same time, contextualisation is not always a simple matter, nor is it entirely unequivocal. But all things considered, the most important goal is to identify some trends and functional distinctions. Finally, the ultimate step to carry out in the survey is without doubt the most sensitive one, namely the interpretation of the results. In order to gain an understanding of the system's governing logic, one must explain why the groupings are as they are through the application of an interpretative grid.

3 Methodological repercussions

The broad historical canvas set out above is not the only product of the present research. The study of colophon formulae also exerts an influence on the methodological plan, and therefore requires the establishment of new expertise criteria for manuscript dating and localisation, the identification of the role played by factors of a cultural nature on codicological phenomena, and a recognition of the notion that for a given codicological phenomenon there exist external determining factors (e.g. historical or economic), as well as endogenous mechanisms which can explain development. Finally, it becomes possible to build bridges between the various disciplines concerned with the history of writing, such as epigraphy and diplomacy, where we know that characteristic formulae were also employed.

New expertise criteria. The relative datings and localisation of colophon formulae will in fact make it possible to attain implicit datings and localisations for manuscripts whose colophons do not furnish precise information. Additionally, the systematic validation of the dating and localisation of colophon formulae holds the promise of creating some new codicological criteria, which up until now have not been exploited. However, one should not imagine that such new criteria will make it possible to replace the already established criteria; rather, they will play a complementary role. That being said, in some cases they could shed some additional light on matters, albeit of a secondary kind.

Cultural factors. The thinking behind the use of colophon formulae is also worth reflecting on. Economic or technical factors were not the only ones to exert an influence on the shaping of the material characteristics of the manuscript book. Indeed, the field is wide open, not only to the spontaneity of the artisans but also to the application of cultural patterns. In the choice of these, stylistic factors doubtless played a role that was no less important than material constraints. In the case of colophons, the copyists sought not so much what was unequivocal and consistent information on the transcription of the manuscript, but rather the best response possible to prevailing cultural models. Hence, in different periods and at different locales, one can observe formulae and variants cast from the same mould. This can be explained by the influence of cultural phenomena which have parallels in the development of writing types or the decoration of manuscripts, or even in architectural forms or major trends in contemporary intellectual history. Needless to say, this concerns the history of mindsets as much as that of techniques.

Endogenous mechanisms. Alongside the influence of cultural factors, one should be careful not to overlook the influence of endogenous mechanisms. In the birth, development, decline and ultimate demise of formulae there are some very real mechanisms at play—some highly distinctive functional frameworks. This is true, for example, of the division into variants of one and the same formula: the birth of several concurrent variants, with one eventually winning out over the others; the alternation of variants over time, with the decline of one appearing to usher in the rise of another; and the geographical division into cultural subdomains, with one or another amassing more attestations of a given type of variant (this, in turn, representing a more precise localisation index than the formula). If one were bold enough to venture an epistemological parallel, one could almost compare the mechanisms that govern the 'lives' of the formulae to manifestations of a biological nature!

Multidisciplinary potential. Finally, it should be emphasised that from a methodological standpoint, the study of colophon formulae can contribute to building bridges between the different areas of study concerned with the history of writing. We have seen how the use of certain formulae is just as well established in the work of book scribes as it is in that of chancellery clerks or lapicides. In the colophons themselves, certain formulae are shared by different cultural domains and civilisations, such as the formula *Sicut nauigantibus portus, sic scriptori nouissimus uersus*, whose equivalent is found in Greek, Southern Slavic, Syrian, and Arab Christian domains. The direction of their shift from one domain to another and the chronology of their 'migrations' would certainly contribute to helping us to better understand the reciprocal influences of the above-mentioned cultures. More broadly speaking, this study aims to reach beyond epistemological limits in at least three ways: namely disciplinary boundaries, boundaries between cultures, and finally temporal limits.

4 Epistemological remarks

To conclude, I shall now outline some considerations of a more epistemological nature. For the benefit of scholars, with respect to colophon formulae dating from the 11th century onwards, we can identify two distinct approaches and three stages in the development of a scientific theory. One of these approaches is of a historical nature and takes into account only the explicit information on colophons derived from research which is not based on the colophons themselves. This can be clearly understood by reading the proceedings of the Erice conference on scribes and

colophons:[7] from colophons one can extract information on the world of copyists, their status, and potentially their mindset. There are other examples which make it possible to write a history of manuscript manufacture and techniques, or of the production of books in certain milieus. At the same time, though, one must regard colophons as a *sui generis* phenomenon and place an emphasis on the study of their internal structure, terminology, and the ways in which they were employed. It is worth noting that the oldest contribution to this approach was made by Otto Jahn[8], who in the mid-19th century was already pondering the role played by the prosopography of ancient colophons in critical philology.

However, the first scholar to take a close look at the formulae employed in colophons was Wilhelm Wattenbach in a chapter of his *Schriftwesen im Mittelalter*.[9] In this work one senses his intuition for the dating and localisation of colophons. In fact, one encounters phases such as 'vorzüglich in späterer Zeit', 'Später ist sehr gewöhnlich', and 'Schon dem Alterthum gehört'. Unfortunately, his comments are replete with value judgements: 'Besser, wenn auch noch incorrect…', 'Hübsch…', '…der sinnlose Scherz…', 'In etwas eidlicheren Versen…', 'Zu den harmlosen Scherzen gehört…', etc. Essentially, Wattenbach failed to bring historical coherence to his approach. An anecdotal perception of formulae in colophons ensued which, by means of a curious mechanism, was perpetuated in the work of various scholars following in Wattenbach's footsteps up until just before the dawn of the 20th century, a little as if a *koiné* had been established that was never called into question. Be it in the work of Alphonse De Poorter, Lynn Thorndike, Antoine Dondaine, Louis Laurand, Arthur Långfors or André Boutemy,[10] one gets the feeling that this rather spontaneous theory of formulae had been installed for good. Nothing more than an idea was being repeated, with attempts made to support it by using other examples, the more of which there were, the more persuasive the theory. Only Gérard Garitte[11] in the Greek domain, and Michel Huglo[12] in the Latin, called this theory into question. The two scholars were driven by a hunch that, it should be noted, was not based on a quantity of witnesses much greater than that used by their predecessors. A systematic approach applied to a large number of sources would be necessary in order to be able to identify some clear trends to support the notion that the use of colophons was anything but anecdotal.

7 Condello / De Gregorio 1995.

8 Jahn 1851.

9 Wattenbach 1896.

10 De Poorter 1935; Thorndike 1937; Thorndike 1956; Dondaine 1978; Laurand 1933, 108, 115, 116; Långfors 1936; Boutemy 1934–1935.

11 Garitte 1962.

12 Huglo 1954.

What is rather surprising is that if one applies an interpretative grid to the history of our theme one essentially observes the same pattern as that seen in the so-called 'exact' sciences. In fact, according to Thomas Kuhn,[13] the development of science progresses in a series of steps in which theories are devised, only to be followed by periods of stagnation while a new theory forms into a paradigm, and finally, on the heels of new experimental evidence that calls into question the basis of the previous paradigm, the birth of a new theory. This is known as a 'theoretical revolution'. The phenomenon we observe in our study of colophons is analogous. The 'historical' theory (i.e. that colophons contain explicit pieces of information) and the theory that views colophons as being anecdotal in nature (i.e. that they naturally express the personalities and mindset of the copyists) seemingly coexist without being connected. The latter view becomes a paradigm and is repeated *ad infinitum*, without being supported by scientific investigation and evidence. One day a new hunch may emerge that is also lacking any scientific basis. To conclude, only the processing of valid sources on a large scale makes it possible to support a new theory—one which will be supplementary to the 'historical' theory, but in total contradiction of the previous supposition. Thus, any advances made by us in our various fields of study will not be built on progressive accumulation, but instead on the perennial necessity to examine *reality* and to call into question ideas which have all too readily been accepted as gospel.

References

Boutemy, André (1934–1935), 'Un grand abbé du XI^e siècle: Olbert de Gembloux', in *Annales de la Société archéologique de Namur*, 41: 43–85.

Condello, Emma / De Gregorio, Giuseppe (eds) (1995), *Scribi e colofoni: le sottoscrizioni di copisti dalle origini all'avvento della stampa*. Atti del seminario di Erice, X Colloquio del Comité international de paléographie latine (23–28 ottobre 1993), Spoleto: Centro Italiano di studi sull'alto medioevo.

De Poorter, Alphonse (1935), 'Quelques formules à l'usage des scribes et annotations diverses tirées des manuscrits de Bruges', in *Revue belge de philologie et d'histoire*, 14: 872–879.

Dondaine, Antoine (1978), 'Post-scriptum', in *Scriptorium*, 32: 54–55.

Garitte, Gérard (1962), 'Sur une formule des colophons grecs: ἡ μὲν χεὶρ ἡ γράψασα', *Collectanea Vaticana in honorem Anselmi M. Card. Albareda a Bibliotheca Apostolica edita*, Città del Vaticano: Biblioteca Apostolica Vaticana (Studi e Testi, 219): 359–390.

Huglo, Michel (1954), 'Christe fave votis', in *Scriptorium*, 8: 108–111.

13 Kuhn 1983.

Huglo, Michel (1961), 'Origine épigraphique d'une note de copiste', in *Hispania sacra: Revista de historia ecclesiástica*, 14: 444–451.
Kuhn, Thomas S. (1983), *La structure des révolutions scientifiques*. (Trad, de l'américain par L. Meyer), Paris: Flammarion (Champs, 115).
Jahn, Otto (1851), 'Über die Subscriptionen in den Handschriften römischer Classiker', in *Berichte über die Verhandlungen der Königlich Sächsischen Gesellschaft der Wissenschaften zu Leipzig, Philol.-hist. Cl.*, 3: 327–372.
Långfors, Arthur (1936), 'À propos des explicits des manuscrits de la Bibliothèque de Bruges', in *Neuphilologische Mitteilungen*, 37: 1–15.
Laurand, Louis (1933), 'Les manuscrits de Cicéron', in *Revue des études latines*, 11: 92–128.
Lourdaux, Willem (1963a), 'Enkele beschouwingen over de betrekkingen tussen Kartuizers en Moderne Devoten', in *Handelingen van het XXV^e Vlaams Filologencongres* (Antwerpen 17–19 april 1963), Leuven: Drukkerij M. & L. Symons, 416–422.
Lourdaux, Willem (1963b), 'Kartuizers - Moderne Devoten: een probleem van afhankelijkheid', in *Ons Geestelijk Erf*, 37: 402–418.
Muzerelle, Denis (1985), *Vocabulaire codicologique. Répertoire méthodique des termes français relatifs aux manuscrits*. Paris: CEMI (Rubricae. Histoire du livre et des textes, 1).
Paré, Gérard / Brunet, Adrien Marie / Tremblay, Pierre (1933), *La renaissance du XII^e siècle: les écoles et l'enseignement*. Refonte complète de l'ouvrage de Gaston Robert. Paris: Vrin (Publications de l'Institut d'études médiévales d'Ottawa, 3).
Reynhout, Lucien (1988), 'Pour une typologie des colophons de manuscrits occidentaux', in *Gazette du livre médiéval*, 13: 1–5.
Thorndike, Lynn (1937), 'Copyists' Final Jingles in Mediaeval Manuscripts', in *Speculum*, 12: 268.
Thorndike, Lynn (1956), 'More Copyists' Final Jingles', in *Speculum*, 31: 321–328.
Wattenbach, Wilhelm (1896), *Das Schriftwesen im Mittelalter*. 4th edition, Graz: Akademische Druck u. Verlagsanstalt [reprint. 3rd edition, Leipzig 1896.]
Zimmermann, Michel (1981), 'La datation des documents catalans du IX^e au XII^e siècle: un itinéraire politique', in *Les Annales du Midi*, 93: 345–375.

Denis Muzerelle

Concerning the (Re)discovery of French Scriptoria

The Contribution of the 'Catalogue of Dated Manuscripts'

Abstract: By paying special attention to the manuscripts' places of origin, the French *Catalogues of Dated Manuscripts* have engendered substantial changes in what was previously known about the 'palaeographic geography' of France, as surveyed in Émile Lesne's authoritative work (published in 1938). These advances are exemplified with the help of several maps. Historical reasons are posited for the massive imbalance between Northern and Southern France. The conclusion is drawn that there were active scriptoria not only in the principal monastic centres, but in practically all the minor institutions as well.

The honour that falls to me to open the proceedings of a meeting dedicated to French scriptoria carries with it a great scientific responsibility, given that the said theme occupies a central position in the world of palaeographers and codicologists. Instead of embarking on a theoretical preamble, which would only constitute a needless reiteration of the conference's call for papers (and would therefore not be of much benefit to anyone), I would prefer to introduce the topic in relation to an experience that dealt me a stinging blow in my 'palaeographic infancy', and which is the reason why I have been intensely preoccupied by the subject of the scriptorium for many years since. It seems to me that the anecdote in question rather effectively illustrates the nub of the problem.

The said episode took place at the beginning of the 1970s, when I had been freshly recruited as a collaborator on the *Catalogue des manuscrits datés*. While examining the collection of the *Nouvelles acquisitions latines* at the Bibliothèque nationale de France (BnF), I happened upon a small manuscript of rather poor

Translated from the French into English by Mark Livesey. Original published as Muzerelle, Denis (2015), 'À la (re)découverte des scriptoria : l'exemple du *Catalogue des manuscrits datés* français', in Nievergelt, Andreas / Gamper, Rudolf [et al.] (eds), *Scriptorium: Wesen – Funktion – Eigenheiten*. Comité international de paléographie latine, XVIII. Kolloquium, St. Gallen 11.–14. September 2013, München: Bayerische Akademie der Wissenschaften, in Komm. beim Verlag C.H. Beck (Veröffentlichungen der Kommission für die Herausgabe der mittelalterlichen Bibliothekskataloge Deutschlands und der Schweiz), 25–50.

https://doi.org/10.1515/9783110743838-020

quality containing a collation of different texts. An initial perusal of its content led me to conclude that the book could only have been copied in a certain second rank monastery located in Normandy, which at the time of the work's transcription was perhaps only a priory.[1] Being quite proud of my discovery, I submitted the description I had drafted to my superiors and was rather surprised to see it rejected. This was not because my reasoning was judged to be unsound; the chief objection was that I could not demonstrate that the establishment concerned was equipped with a scriptorium. Well, I was convinced that proof of the historical existence of a scriptorium at that institution was in my hands!

So, what exactly was—or is—a scriptorium? How can one determine the historical existence of scriptoria? Is it possible to compile a list of them, and to evaluate them?

1 French scriptoria according to Émile Lesne (1938)

At the time that the 'Comité de Paléographie' launched its programme, the concept of a scriptorium was still rather fresh and somewhat vague. It was only after the Second World War that the concept and the word started to be substituted with expressions such as 'école calligraphique' (employed by Léopold Delisle),[2] or 'Schreibschule' (used up until quite recently by Bernhard Bischoff),[3] terms which testify to an approach that tends towards the qualitative dimension, not to say the essentially artistic aspect.

The concept that was commonly agreed on in France, and which I adopted when I was a student at the École Nationale des Chartes, stems directly from Émile Lesne's *magnum opus*, published in 1938.[4] The work constitutes volume IV of the monumental work *Histoire de la propriété ecclésiastique en France*, and bears the title *Les livres: scriptoria et bibliothèques*. It should be noted that the author was the first in France to include the word scriptorium in the frontispiece of his work.

1 If memory serves, this may have been the Benedictine monastery of Saint-Victor-en-Caux (in the diocese of Bayeux), the presumed origin concerning just one of the elements of a random miscellany. Unfortunately, the archival material relating to the associated cataloguing campaign was not retained, and the summary catalogue that only describes the fund in a very superficial way did not enable me to track down the manuscript concerned.

2 For example, Delisle 1875, if we confine ourselves to the titles of the publications.

3 On the same basis, we must above all cite Bischoff 1940. Volume II, published at a much later date (Bischoff 1980) obviously retains the same title.

4 Lesne 1938: the work constitutes volume IV of the monumental work *Histoire de la propriété ecclésiastique en France*.

In doing so, he had only been pipped to the post his fellow scholar, Albert Bruckner,[5] by three years.

A fellow scholar, rather than a colleague *per se*, since Émile Lesne cannot rightly be described as a palaeographer:[6] as the title of his work rather clearly conveys, just as well his bibliography, he was fundamentally a historian of the ecclesiastical institutions of the Late Middle Ages; but he was also a very learned multidisciplinary scholar, highly methodical in his approach and impeccable in his documentation.

By the same token, he was equally far from being limited to playing the role of a mere compiler; indeed, his introduction presents a robust critical analysis of the subject and the way in which it had been approached by his predecessors. For example, he reproaches Lowe for the laxity of his criteria for determining the origin of manuscripts, adjudging that the mere presence of a volume in an establishment's library from time immemorial does not provide a sufficiently solid argument. Similarly, he puts forward a rather novel idea when he suggests that the imperatives of ecclesiastical life would have called for the operation of scriptoria in many places about which we know little or nothing—thereby opposing a widely held view in the preceding century, according to which the production of manuscript books was concentrated in the elite circle of religious institutions. He would go on to put this idea into practice elsewhere in his work by meticulously citing a large number of institutions—episcopal, in particular—which lead one to believe that they played a certain role in religious, political, administrative or intellectual matters, although no testimonial evidence of these has survived.

However, Lesne had no choice but to depend entirely on previous works. Now, the interests of 19th-century authors and those of the early 20th century were for the most part centred on intellectual history, the history of art, and the history of libraries—or at least, the development and spread of a script style, as it were. Back then we were still a long way from establishing a specific field of study that addresses the history of the production and distribution of books, in the sense that we understand it today.[7] It therefore follows that there frequently exists a significant difference (positive or negative) between the importance assigned in his work to each centre

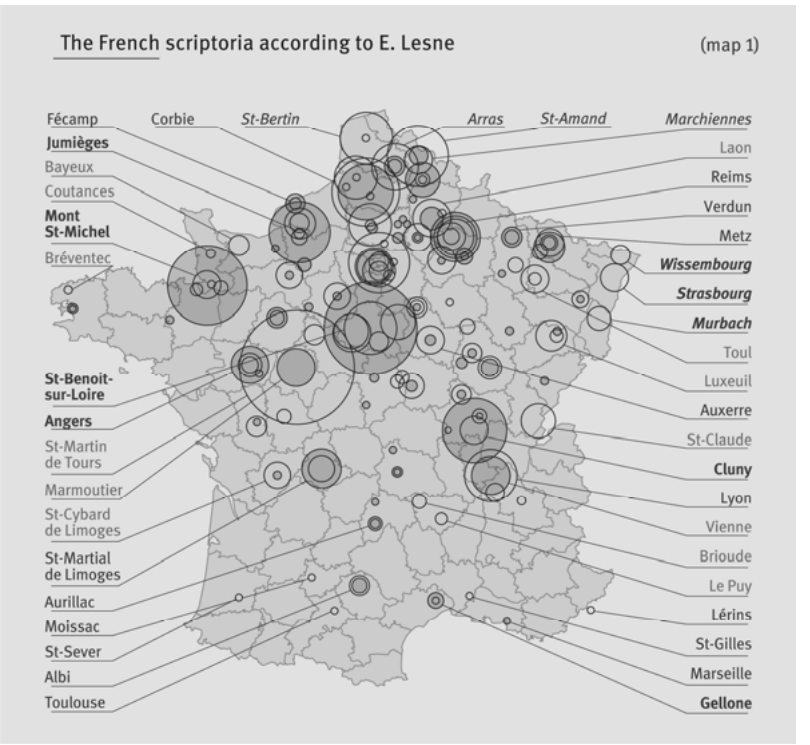
5 Bruckner 1935–1974.

6 Émile Lesne, Chancellor of the Catholic Faculty of Lille, produced a thesis titled *La hiérarchie épiscopale, provinces, métropolitains, primats, en Gaule et Germanie, depuis la réforme de saint Boniface jusqu'à la morte d'Hincmar, 742–882* (Lesne 1905).

7 The emergence of codicology, especially with respect to the quantitative approach, needless to say has played a major role in this transformation. The overall concept of evolution in production was introduced by Bozzolo / Ornato 1980.

and the quantitative testimony that the number of manuscripts attributable to each of them provides, according to the *CMD*'s survey.

Map 1 sets out to present the 'codicological picture' of France which emerges from Lesne's work. The black circles are proportionate[8] to the number of lines dedicated to each centre by the author;[9] the grey shadow surrounding each circle represents the number of manuscripts which beyond doubt originated from the centre concerned.



Map 1: The French scriptoria according to É. Lesne

8 Nevertheless, a logarithmic adjustment had to be applied in order to obtain a satisfactory representation.

9 This, of course, is a very approximate evaluation method. But a close study of the footnotes in which the author lists the manuscripts—with numerous duplications and splits owing to the fact that he considered texts rather than volumes—proved to be out of proportion with the aims of the present research.

One is immediately struck by the conspicuous 'swelling' of certain centres.[10] This is clearly because the author did not confine himself to a quantitative level, nor to a strict palaeographical one, and also because his presentation frequently dwells on the cultural role played by each institution, its history, and the illustrious figures associated with it. But more than anything, his representation is to a great extent fed by attributions which had been made by his predecessors on a very shaky basis, or even on a purely hypothetical one. The most outrageous case of overestimation is that of Tours, to which Lesne dedicates no fewer than fifty pages. It is quite obvious that he was very well informed—and heavily influenced—by the magisterial work that Edward Kennard Rand had just published.[11] But the difference can also be explained in part by the huge losses that the collection held at the municipal library suffered at the beginning of the 19th century.[12] Similar losses, owing to various circumstances, are met with in many other instances, and it is precisely here that one comes up against a fundamental methodological aporia: it is impossible to reconstruct the activity of a scriptorium without ensuring that the volumes ascribed to it were actually produced there; and one can only do this if the volumes still exist.

Corbie—to which only twelve pages are dedicated—is treated in a more realistic way. That being said, one is immediately struck by the minimisation of Saint-Benoît-sur-Loire, which is afforded only half that number of pages. However, this represents a sort of optical illusion, since the bias is largely offset by the neighbouring centres, with which the abbey had close ties (chiefly Orléans, Ferrières and Micy).[13]

The other instances of obvious underestimation cannot be explained in the same way. This is true of Cluny and the other two great players in Norman production: Mont-Saint-Michel and Jumièges. There is only one possible explanation for this, namely the boom in production that took place at these centres in the 11th century. Now, even if this period is, in principle, covered by his study, Lesne remains above all a specialist of the Carolingian age and therefore tends to skim over the succeeding periods.

The considerable overestimate of the number of scriptoria in Alsace-Lorraine is only partly spurious. In fact, following the conquest of this region by Prussian

10 These tally, in the diagram, with the labels positioned on the shaded area. The negative labels (white on black) represent the opposite case (i.e. underestimation).

11 Rand 1929–1934.

12 See *CMD*-F, VII, XXIX–XXXII.

13 It proved impossible for me to label the latter two localities on the map, if a minimum of legibility was to be preserved.

forces (in 1870), a good number of manuscripts that were held there were transferred to Germany. This explains why one can no longer find any trace of them in the funds held by French libraries—which are the only ones considered in our comparison.[14] This is particularly true of the manuscripts originating from Weissenburg Abbey, the majority of which are kept in the Wolfenbüttel library. However, it certainly would not suffice to include these witnesses in the tally in order to wholly reduce the overestimate. This appears in large part to be due to the particular context of the period in which Lesne conducted his study—in fact, the scholar carried out his work in the days immediately following the end of the First World War, while the dogged diplomatic negotiations vis-à-vis war reparations and the return of looted treasures were in full swing. Here, one suspects the influence of a certain vengeful patriotism, characterised by the elation of the people of the provinces newly recovered from the former foe.

In any event, it was this map that was more or less embedded in the minds of palaeographers when the cataloguing of dated manuscripts got off the ground.

2 The exploration of funds through the *Catalogue of Dated Manuscripts* (*CMD*)

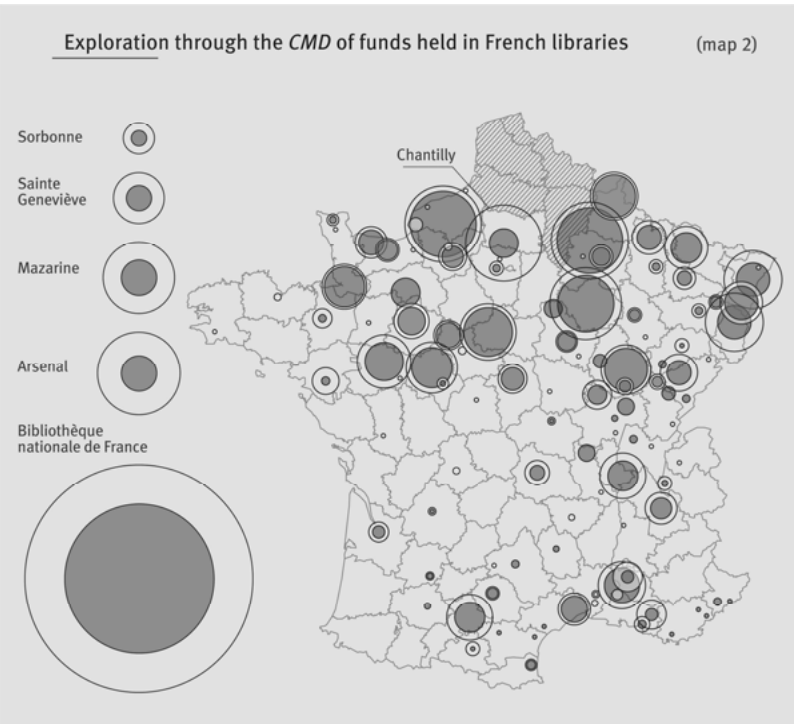
One of the concerns of the 'founding fathers' was to compare the palaeographers' reconstructions with the reality of the surviving witnesses, with the aim of systematically verifying, on the basis of concrete clues, the validity of attributions. For quite some time now it has been suspected that the natural tendency to pay attention only to the most precious works might have resulted in some very evident distortions.

The intention was also—indeed, perhaps primarily—to extend the reach of the investigation up until the end of the Middle Ages, so as to discover new horizons, which up until that point had been entirely overlooked. And it immediately became clear that the taking into account of the copious output of the monasteries in the 11th, 12th and 13th centuries[15] would inevitably change the shape of the inquiry in many ways, in particular with respect to scriptoria.

14 This biased result is rather regrettable. Unfortunately, at the present time statistics on the manuscripts of French origin held in foreign collections remain a wish to be fulfilled.

15 This is not to speak of the Late Middle Ages, on which palaeographic works were still quite rare at the time.

In this connection, it should be emphasised that, among the various national series of catalogues of dated manuscripts, the French series is the one that accords the most attention to the origin of manuscripts—to the extent of having adopted a special disposition towards those whose origin alone is known. With respect to the official title of the series, we would necessarily have to speak of 'dated and localised manuscripts', rather than just 'dated manuscripts'.



Map 2: Exploration through the *CMD* of funds held in French libraries

The results of the survey carried out over a period spanning half a century on funds held in French libraries are presented in Map 2. Each of the funds examined is represented by two concentric circles:[16] the outer circle is proportionate to the number of manuscripts which are the subject of an entry in the catalogue, whilst

16 As is customary, it is the surface area of the circles that should be considered, rather than their diameter.

the inner circle (shaded in grey) is proportionate to the number of manuscripts whose origin could be established. Two important points merit our attention; on the one hand, the data represented in this way cover the entire duration of the Middle Ages: the vast bulk of the output produced after the 'golden age of the scriptoria'[17] is as a result very noticeable, which renders a direct comparison with the previous map a rather tricky proposition.[18] On the other hand, these statistics only cover the original series of the catalogue and therefore do not include the far north of France (the Picardy and Nord-Pas-de-Calais regions).[19] This caveat is relatively formal with respect to the phenomena that I intend to draw attention to, since we already know what is held in the libraries of these regions, namely particularly rich and homogenous funds that bear witness to the existence of very active scriptoria whose ample production is well preserved.

Overall, what emerges from this map is that the potential of designating an origin to a manuscript is very much lower than that of determining its date, but that this 'rule' is applied in a rather different way depending on the nature of the funds and the way in which they are composed. As regards provincial libraries, the proportion of 'localised' manuscripts among the manuscripts surveyed by the *CMD* amounts to 58% overall, rising to more than 80% in the case of particularly homogenous funds (Alençon: 94%; Charleville-Mézières: 86%; Avranches: 84%; Dijon: 83%). Conversely, some libraries clearly stand out from the ensemble, reflecting very low values (Nantes [Musée Dobrée]: 17%; Carpentras: 18%; Aix-en-Provence: 25%). Now, it turns out that the funds of the latter places mostly originate from collections assembled in the modern era. The same explanation applies when we consider the group of funds held in the Parisian libraries (excluding the BnF), which attain a value of 21%. Surprisingly, with a value of 48%, the Bibliothèque nationale de France represents an average situation.[20]

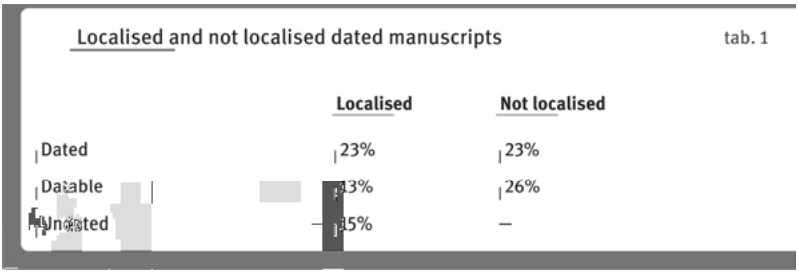
17 This can be fully appreciated by studying Chart 1 (below).

18 It should be added that here one is speaking of places of conservation, and not places of origin, as before.

19 The two volumes published in the new series (Cambrai and Laon) will in any event be taken into account in the graphs that follow.

20 Nevertheless, one can detect a considerable difference between 'old funds', represented by the old royal collections (36.8%), and 'new funds', composed in large part by items seized during the French Revolution (53.4%).

This reality can be neatly conveyed through the following synoptic table of values (Tab. 1).



Tab. 1: Localised and not localised dated manuscripts

In the ensemble of manuscripts identified by the *CMD*, the localised manuscripts only achieve a value of 51%, as opposed to 85% for the dated or datable ones.

The 15% of manuscripts which are only localised, without any indication of dating, demonstrate the clear benefit of including the origin of works among the catalogue's admissibility criteria.

Even so, we must reiterate the word of caution expressed earlier on: the figures presented here correspond to the entire period covered by the Middle Ages. If we confine ourselves to what might be termed 'the golden age of scriptoria', which is to say to the period that stretches from the 11th century to the 13th, a drastic change can be seen in the proportions: as Chart 1 clearly shows, the proportion of dated or datable manuscripts, but ones which are not localised, is considerably greater in later periods.[21] This paradigm change is quite abrupt and occurs very distinctly in the middle of the 13th century.

21 In the graph, the phenomenon is partly obscured by the logarithmic scale that the exponential growth of surveyed manuscripts made it necessary to adopt.

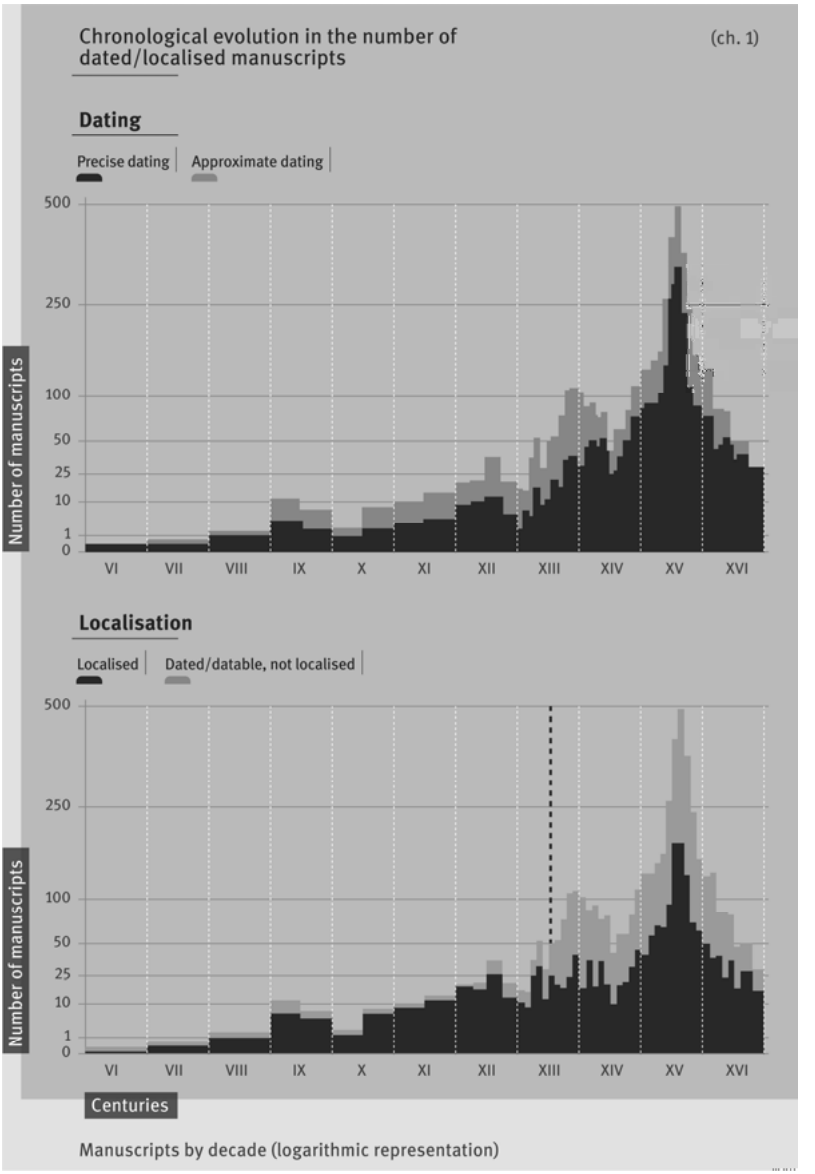


Chart 1: Chronological evolution in the number of dated/localised manuscripts

3 The French scriptoria according to the *CMD*

Map 3 plots the number of manuscripts that pre-date the middle of the 13th century deemed to be 'localised' by the *CMD*, correlated to their place of origin. One can take it that this map shows all the French scriptoria known today.[22] The increase in circles that did not appear on Map 1 is striking and provides a good indication of the gain made, but at the same time renders the overall ensemble rather difficult to decipher.[23] Unfortunately, this represents an insurmountable problem, given that in order to be workable and meaningful, this form of representation must be exhaustive, and we cannot content ourselves by merely indicating the 'most important' phenomena. The rough and ready results that we see here can therefore seem rather chaotic and difficult to interpret, above all to those who have a limited knowledge of France's geography.

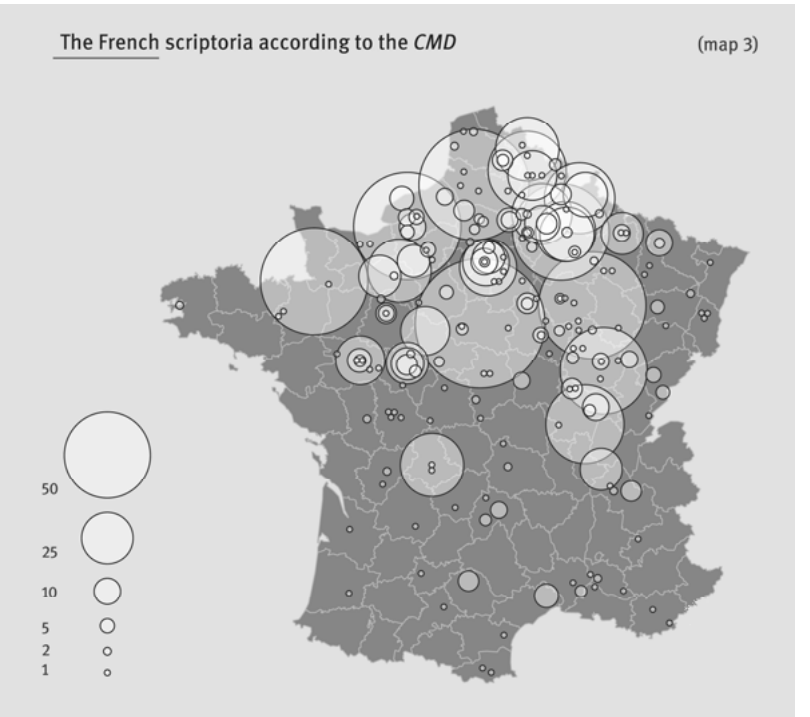
The first thing that leaps off the page is that the production of manuscripts—at least to the extent we are able to apprehend through the surviving funds—is very heavily concentrated in the north of the country, and in the north-east quadrant in particular. However, even if this portion of the territory is thoroughly and generously covered, it is in a way that is very different from the other regions. In the east-central area (corresponding to the Lower Champagne and Burgundy regions) and the north-west (that is to say Normandy), one finds oneself looking at an effectively rather limited number of production centres of outstanding calibre, in whose orbit 'flutter' a multitude of less important centres.

In the north-eastern region—corresponding very roughly to the ecclesiastic province of Reims in the Middle Ages[24]—we instead see a large number of circles of average diameter. The Parisian region follows more or less the same pattern.

22 Albeit with the proviso already stated above with respect to the north of the country.

23 It proved impossible to provide each circle with an identification label.

24 The Cambrai province only became detached from this area in 1559.



Map 3: The French scriptoria according to the *CMD*

Interpreting this situation is no easy task. It would seem that, through a sort of gravitational effect, the large clusters which represent the most important centres created a void around themselves, 'phagocytising', as it were, the productive potential of the neighbouring areas. With respect to Clairvaux and Cîteaux, easily found on the map, such a scenario would fit rather neatly with a widely held notion in relation to Cistercian manuscripts—namely that of production being heavily concentrated in the principal mother houses of the order. Now, the fact that one observes a similar distribution pattern in Normandy, where an affiliation network of the same kind did not develop, makes it necessary to pose questions about the soundness of the basis for such a vision. On the other hand, and most importantly, the campaigns carried out within the framework of *CMD* brought to light a certain number of cases which do not tally too well with this point of view: this is particularly true with respect to the abbeys of Vauclair and Signy—I will take a further look at the latter in due course—both located in the

north-eastern part of the map,[25] and which, despite their modest size, generated a substantial output. Therefore, it would appear to be necessary to undertake some new research in order to determine the extent to which this theory remains valid.

More than anything, though, we should remain conscious of the fact that what is illustrated here does not represent what was actually produced, but instead what has come down to us, or rather what, among surviving volumes, can be attributed with sufficient certitude. Nevertheless, for the period that particularly interests us here, the incidence of factors that determine the existence of date or origin indications do not appear to tally with loss factors. In any event, this is simply the price to pay for a long and rather tricky interpolation task that makes it possible—in the best of cases—to infer one from the other.[26] It therefore follows that the view we can obtain of the facts is largely speaking conditioned—if not to say entirely distorted—by the fates of the libraries of the institutions concerned. Unfortunately, this thoroughly distorted view is all that we have available to us today.

In this perspective, the case of the abbey of Mores, located not far from Clairvaux,[27] provides an excellent example. Founded by Saint Bernard in 1153, the abbey had a lively history throughout the Middle Ages.[28] When, in 1732, the

25 These are located, respectively, in the departments of Aisne and Ardennes.

26 The problem with respect to the representativeness of dated manuscripts has been the subject of discussion for a considerable time. See, in particular, the various interventions in *Les manuscrits datés: premier bilan et perspectives* / *Die datierten Handschriften: erste Bilanz und Perspektiven* 1985. In any event, this is essentially a question of the relationship (qualitative and quantitative) between dated manuscripts and any other manuscripts that have been considered up till now, rather than one of the relationship between the mass of material produced and what survives today. Without a doubt, this has less to do with a deficiency than with a methodological aporia, given that classical statistics do not offer the means of tackling the problem directly. In fact, the laws of probability are such that, regardless of the contents of an 'urn' (i.e. the total number of manuscripts produced) and the number of random drawings made from the said 'urn' (i.e. the surviving manuscripts), it is impossible to infer the number of manuscripts in the 'urn' based on the result of the drawings. In a sphere where matters are considerably less complex, the incunabulists ran up against the same 'wall of the unknown' when they tried to extrapolate the number of editions of which not one witness survives by starting out from the surviving copies held (see, for example, Neddermeyer 1977). It nevertheless remains true that a systematic study of cases where old collections have come down to us (in which, therefore, the contents of the 'urn' are known) would help to shed some light on this issue.

27 Municipality of Celles-sur-Ource, near Bar-sur-Seine, Aube (about 30 km from Clairvaux).

28 It was ruined for the first time in around 1216–1222, during the war of succession for the rule of Champagne (pitting Blanche de Navarre, regent in the name of her son Thibaut IV of Cham-

abbey ceded its library to Clairvaux, it contained just fourteen volumes dating from the 12th century. Half of these appear to have been copied at Clairvaux, and represent an initial gift from the mother abbey to its affiliate; the remainder are of unknown origin. Indeed, a hypothesis has been put forward which suggests that the Saint Bernard abbey never possessed its own scriptorium.[29] Nonetheless, the extensive chartulary it left[30] makes it clear that along with the various catastrophes it suffered, the institution enjoyed some periods of prosperity. It is astonishing, then, that during these periods of prosperity there is no sign of copying activity to be seen.

We can also revisit the case of Saint-Benoît-sur-Loire, which puzzled us on the previous map. The jealous care that the monks took of their library led them to cram their volumes, at the time they were copied, with conspicuous *ex libris,* often in the most unexpected places (margins, intercolumnar spaces, etc.).[31] Consequently, the collection of witnesses is particularly abundant.

4 The 'codicological desert' in France's Midi

By contrast, the southern part of the country[32] is marked by a singular paucity of manuscripts; indeed, in certain areas one can speak of a veritable 'codicological desert'. This dearth has been known of for a long time. But the opinion that prevailed at the time work was started on the catalogue was that numerous southern manuscripts were dispersed amongst various libraries (particularly those which hold the funds of the great collectors of the past) and were often not recognised. A thorough and painstaking search would (it was believed) rectify this situation and re-establish a degree of balance. Well, unfortunately that hope has been cruelly dashed, as southern manuscripts remain woefully rare.

pagne, against Érard of Brienne, husband of Philippa of Champagne), and a second time during the wars between Louis XI and Charles the Bold (1440–1447).

29 See *CMD*-F, V, XXXVIII.

30 Published by Lalore 1873.

31 See *CMD*-F, VII, XXXVII–XXXIX.

32 See, as an annex to Map 4, the confines assigned here to the southern and northern areas of France. These conform to the old ecclesiastical divisions, with the exception of the province of Bourges, whose metropolitan diocese has been incorporated into the northern area.

In the introduction to the volume that covers the whole of southern France,[33] the pillaging of abbeys that occurred during the religious wars is more than once cited to explain the disappearance of some funds presumed to be important. However, it would be a mistake to generalise and see in this phenomenon the sole cause of the overall shortfall,[34] because such abuse is far from being uniquely characteristic of this region and historical period. In the same era, the north-eastern provinces, from which many manuscripts have come down to us, were also brutally ravaged by the Huguenots. And that is not to speak of the military campaigns, which have been fought one after the other, practically without interruption, from the earliest times in our national history up until scarcely fifty years ago.

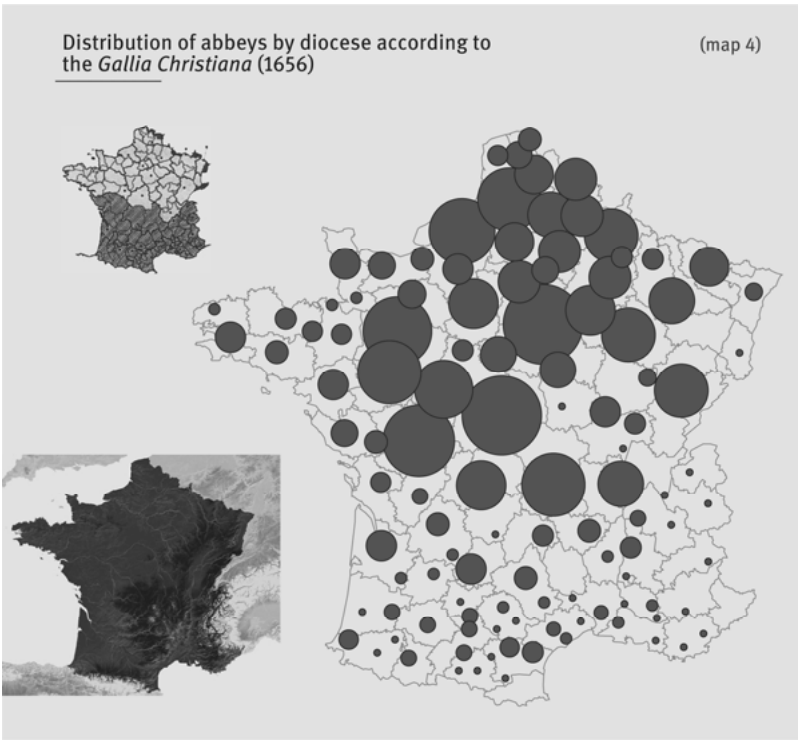
In order to try to better understand this state of affairs, the first thing to do consists in comparing what has come down to us with the geographical distribution of production centres—or at least of abbeys, to which they are assumed to correspond. However, this task is not as simple as one might imagine. In fact, even if many meticulous works have been dedicated to the history of monasticism, and despite the fact that abbeys' inventories have been the subject of monumental catalogues,[35] there scarcely exist any tools which make it possible to have at one's disposal a table showing their distribution. Irrespective of its imperfections, one can nevertheless utilise to this end the map titled *La France divisée en archeveschés, eveschés, abbaïes… pour servir au livre de Gallia christiana*, published around 1656 by the Sisters of Saint Martha.[36]

33 *CMD*-F, VI. The shortfall is such that Burgundy had to be attached to this group to compensate for the deficiency.

34 *CMD*-F, XXVI, onwards. One must bear in mind that the sources which report the pillages are generally works of propaganda and do not fail to exaggerate the enemy's atrocities. See, for an analogous case, the clarification required with respect to the sack of the library of the College of Navarre in 1418 (CMD-F2, t. I, XV, footnote 44).

35 In particular, concerning France, the massive work by Baunier / Besse 1905–1920.

36 This is the first edition, in four volumes, of the said repertoire. The work was revisited and expanded (starting in 1712) by Denis of Saint-Marthe (it is the 'new' edition that is commonly used today). Despite being of superior quality from a cartographic standpoint, the map published by Bernard-Jean-Hyacinthe-Jaillot in 1736 (*La France ecclésiastique divisée par archevêchez et évêchez, dans lesquels se trouvent toutes les abbayes d'hommes et de filles à la nomination du roy*), 'on which one can locate all the monasteries and convents warranted by the King', is not very helpful to our cause for reasons that can readily be deduced from its title.



Map 4: Distribution of abbeys by diocese according to the *Gallia Christiana* (1656)

Map 4 shows the number of abbeys identified in a census of each diocese in that primitive version of *Gallia christiana*. Its similarity to the previous maps immediately strikes the eye. But just as evident is the relationship of this distribution with the map of France's physical geography. It is clear that some geographical features explain, to a large extent, the difference seen in the codicological map: the most mountainous areas are concentrated in the southern part of the country, where the climatic conditions are often arid. Such conditions are not very favourable for the establishment of monastic settlements. To be sure, it is possible to mention a certain number of highly prestigious monastic centres located in these regions: we can start with Gellone, Aniane and Lérins, to cite only the most ancient among them. Even so, we are still a far cry from the level of proliferation of institutions that one observes in some of the northern regions.

The mid-Atlantic seafront is clearly less inhospitable, particularly with respect to Poitou and its neighbouring provinces. It is here that the shortfall is at

its most paradoxical; it is here, too, that the explanation offered appears to be most admissible.[37]

But there can be no doubt that some additional factors of another kind combine with the purely geographical causes. Well before the wars between the Catholics and Protestants, another religious cataclysm—as we well know—rattled the south of France, namely the Cathar Heresy and the crusade that followed in its wake, with the subsequent retaking of the ecclesiastical structures by the mendicant orders (the Dominicans, in particular), whose attitude vis-à-vis the book was very different from that of the traditional monastic orders.[38]

More than anything, the very structure of the ecclesiastical institutions radically polarised northern and southern France—indeed, this had been the case since time immemorial. The most ancient regions, under the yoke of Rome's dominion (the ecclesiastic provinces of Aix, Arles and Narbonne) were highly fragmented into a multitude of microscopic dioceses.[39] Now, the scantiness of the diocesan territory can be considered a sort of 'brake' on the development of monastic institutions, inasmuch as the necessary human and economic potential was monopolised by the secular ecclesiastical structures.

In this perspective, Aquitaine and the Toulouse region, which had eluded the parcelling up of land inherited from ancient times, were ruthlessly returned to the same model in the age of the Avignon papacy—an episode that strongly contributed to disrupting the local ecclesiastical fabric. The territorial reform imposed by Pope John XXII between 1317 and 1318 led to their being broken up into a multitude of small dioceses endowed with barely sufficient resources and placed under great pressure from pontifical taxation.[40]

If, informed by these considerations, we return to the map that provided their pretext, we will still have to take into account the fact that it only reflects the state of affairs which prevailed four or five centuries after the period that interests us. In the absence of a better one (or of being unable to dedicate a large amount of time to compiling one), we can try to gain a better understanding of the situation by examining the evidence provided by a similar source, but one for which production and conservation factors are markedly

37 It is precisely in this geographical area that the professed pillages were attested to.

38 See, as regards Italy, Bartoli Langeli 1994; Paolazzi 2004; Pellegrini 1999; and as regards France, Vernet (ed.) 1989, 125–146.

39 See Mirot 1948–1950, II, 314–345. By way of an example, one can cite the diocese of Agde, which, at the end of the 18th century, consisted of a grand total of eighteen parishes.

40 The most spectacular case is that of the diocese of Toulouse, where the dismemberment spawned no fewer than seven new bishoprics.

different. Here, we are speaking of chartularies, almost all of which are kept in archival depositories, for which reason they escaped the attention of the *CMD*.[41]

With respect to this source, it is appropriate to think not in terms of the number of volumes conserved, but rather in terms of the number of institutions which conserve at least one, given that the range of archival uses is highly varied. Whilst some abbeys endeavoured to assemble the entire sweep of their titles in one volume, by contrast others preferred to divide their documentation among several specific books, based on a several criteria (geographic, administrative, etc.).[42]

By carrying out a rapid, though exhaustive, overview of the corpus of French chartularies,[43] one can generate the statistics presented in Chart 2.[44] Expressed as percentages, the results of the counts remain independent of the fact that the number of abbeys concerned are very unequal in each of the two parts of the land. The differences observed between the two areas are not massive, but they are clearly significant from a statistical perspective, and all the more so given that they coincide perfectly.

Among the abbeys indicated on the map in the *Gallia christiana*, the proportion of those which hold at least one cartulary is 65% in the northern area, in contrast with only 55% in the southern area. This difference can be read as an indication of a greater loss of funds occurring in the south.

41 The few that are still held in libraries were even deliberately excluded from the investigation (in the early series), on the pretext that they are 'diplomatic' documents, and not sufficiently 'book-like'. I have previously criticised (in *CMD*-F2, I, IV) the negative effect of this exclusion.

42 The Abbey of Saint-Denis provides the most satisfactory example: it holds no less than 18 chartularies, of which a good number particularly concern one of the abbey's numerous domains, or the beneficiary office of certain kinds of revenue (i.e. chantry, chaplaincy, pittancery, and so on).

43 This is the catalogue that revises and completes the one by Stein 1907, put online by the Institut de recherche et d'histoire des textes (http://www.cn-telma.fr/cartulR/; last access 07/09/2021). I should clarify that these statistics take into account the entire contents of this catalogue, without drawing a distinction between the various types of document included in the census (i.e. chartularies, rental agreements, etc.).

44 In order to avoid a surfeit of images, in the present contribution I am choosing not to reproduce the corresponding map. As one might expect, it closely resembles the previous ones.

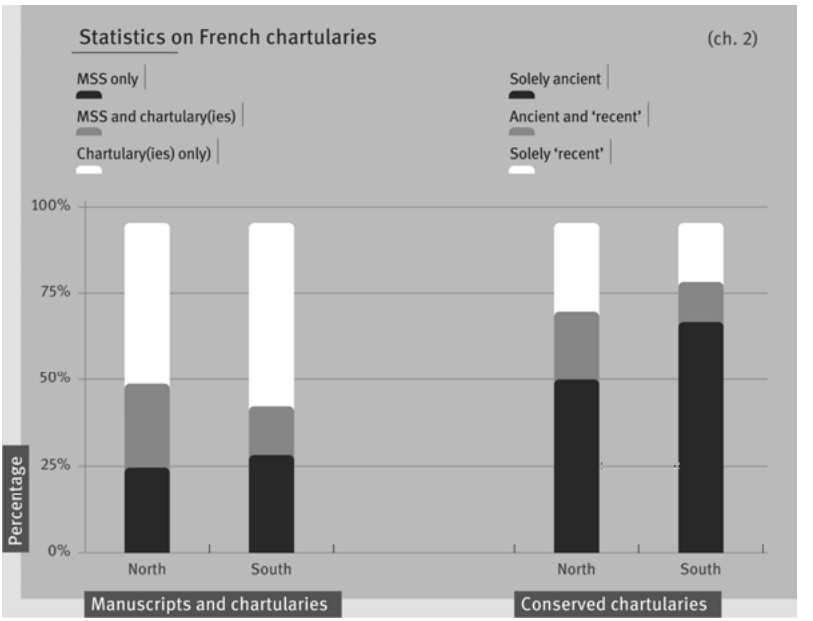


Chart 2: Statistics on French chartularies

On the other hand, the proportion of abbeys that simultaneously hold a certain number of manuscripts and at least one cartulary increases to 26% in the north, in contrast to 15% in the south. This time the difference can be explained by a greater number of documents having been dispersed than have survived.

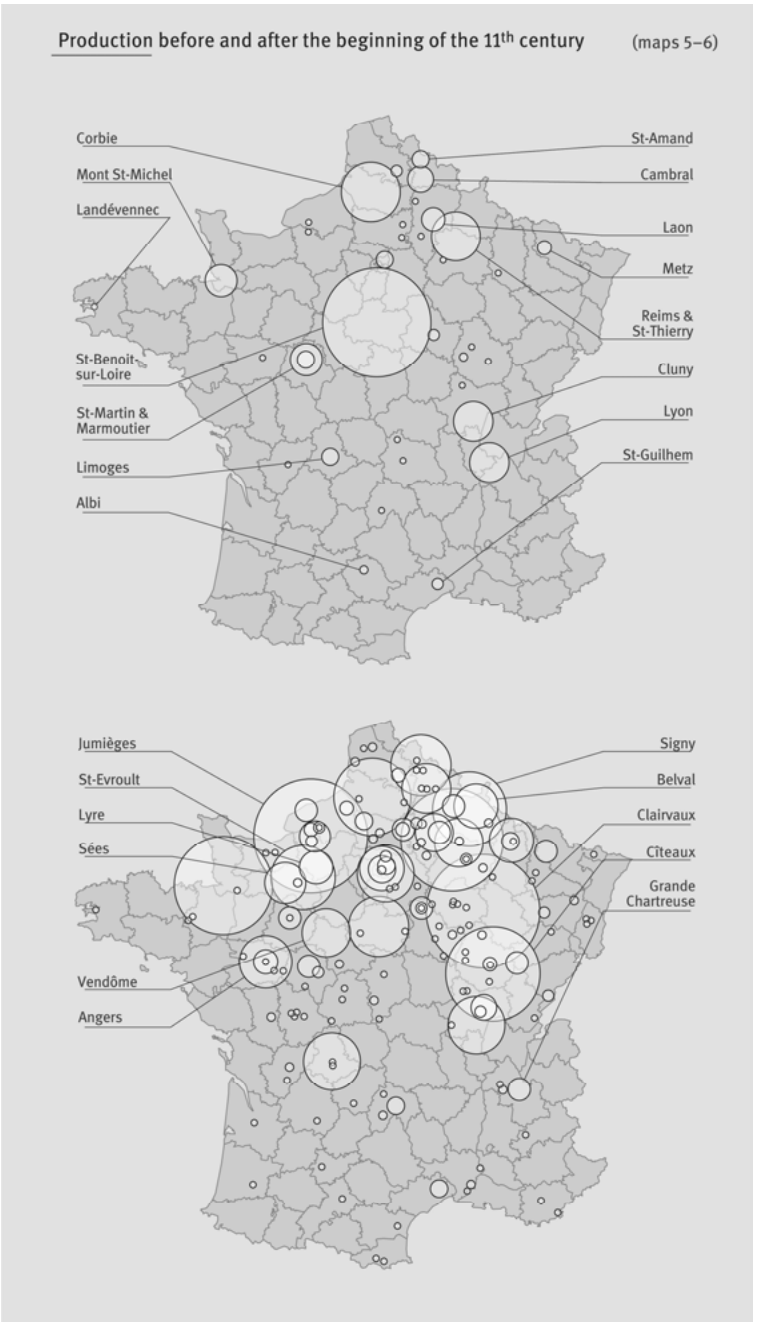
The analysis can be further refined by distinguishing between 'old' cartularies, datable from the origins to the 13th century, and 'recent' ones, belonging to 14th and 15th centuries. Once again, the situation is marked by a strong contrast: in the northern half of the country 31% of the abbeys which have conserved some documents provide us with 'recent' witnesses, as opposed to only 15% in the southern half.[45] Now, the need to compile a new cartulary serves as an indicator of the vitality and prosperity of an institution: those which scrape by on their past achievements have to settle for their ancient archives. One must therefore conclude that, overall, the southern abbeys underwent a degree of decline in the Late Middle Ages.

45 One will notice that it is in relation to this parameter that the difference is at its most conspicuous.

Clearly, these rather general considerations ought to be expanded on through some more detailed analyses, although they would lead us to stray quite far from our initial objective. In their current state, the considerations at least allow us to make a rough assessment, which broadly speaking factors in the dearth of manuscripts observed in the south. This assessment combines natural geographic causes, the structuring of ecclesiastic institutions (which is very different from that which held sway in the north), a less dense network of monasteries, and a succession of historical and economic events which led to the progressive deterioration of monasteries (and likewise bishoprics), starting in the 13th century.

5 The impact of the monastic boom in the 11th–12th centuries

Having completed this necessary *excursus*, we can now return to the interpretation of Map 3, from which we started out. Maps 5 and 6 present precisely the same content but differentiate between two chronological periods, which helps to bring a little clarity. Above all, though, this division aims at rectifying the problems raised by the chronological framework chosen by Lesne: by covering uniformly the period that stretches from the earliest times to the 11th century, we place on an equal footing production originating from significantly different systems. On the one hand, episcopal scriptoria and those of urban monasteries dating to the earliest times; on the other, the scriptoria of abbeys identified through their ruins, or ones which were newly founded, beginning in the 11th century. The overall picture is somewhat muddled and does not enable us to distinguish this new stratum, which underwent extraordinary growth in the following century.



Maps 5–6: Production before and after the beginning of the 11th century

At the same time, when we place these two maps side-by-side we get an idea of all the advantages that could be gained by creating a century-by-century series of maps, or series based on other criteria, such as production centre type, manuscript typology, etc. Thanks to the digital technologies available to us today, it is not difficult to imagine being able to produce a 'palaeographic atlas', in the title of which the word 'atlas' would find its full sense.[46] Here, I would like to take the opportunity to underscore how regrettable it is that such little importance is placed on the spatial distribution of historical phenomena. Palaeography and codicology are far from being the only disciplines where one encounters this deficiency, and it is paradoxical that history and geography, even if they are closely associated in secondary school curricula, are entirely 'divorced' from each other as soon as one reaches higher education and research programmes.

To return to our discussion, if the changes brought to light by comparing the maps are undoubtedly due to the boom in the establishment of monasteries in the 11th to 12th centuries, it would be erroneous and naïve to imagine that by crossing the boundary between the 10th and the 11th century, one passes from a world where production is exclusively the realm of episcopal scriptoria to another where it is monopolised by monastic scriptoria. The quantitative relationship between the two modes of production (secular and regular, in accordance with the standard terminology) is more complex and can be illustrated with the aid of Chart 3.[47]

46 This is a suggestion that I have been putting forward for a long time; see Muzerelle 1993.

47 These figures are not open to immediate interpretation. Indeed, owing to the vertiginous growth in production, it is necessary to use a logarithmic scale to read the main graph: in fact, between the 8th and 12th centuries this increased one hundred-fold. The supplementary charts (3B and C) should assist the reader in understanding the size of the numbers involved.

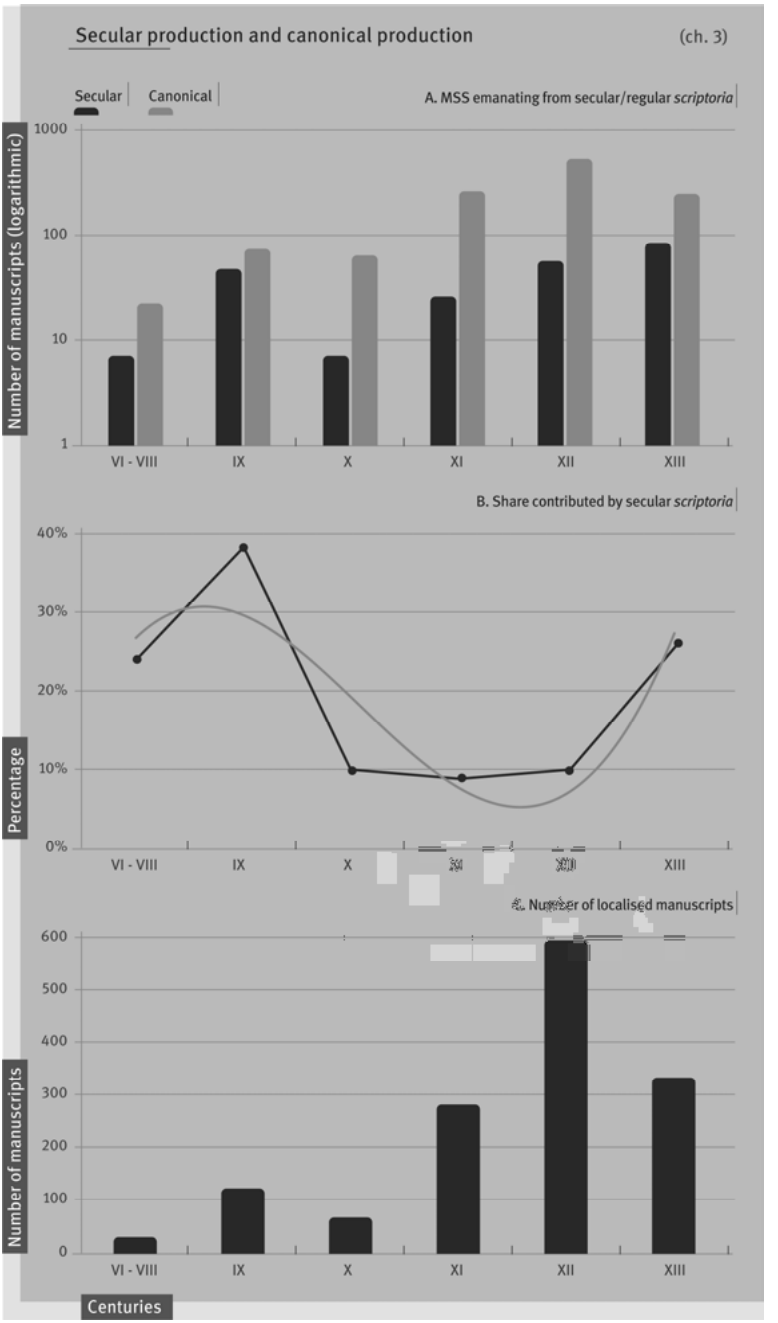


Chart 3: Secular production and canonical production

One can see that throughout the era the two production modes coexist, and that monastic production consistently remains higher than secular production. It is only in the 9th century that the latter succeeds in approaching the level of productivity achieved by its competitor, with a ratio of 40% versus 60%. After collapsing in the 10th century, output only began to recover a degree of significance in the 13th century, in the period that we can term 'pre-academic'.[48]

This analysis, which stems directly from information furnished by the *CMD*, would of course merit being re-visited and studied in greater depth. In fact, experience shows us that—for a succession of reasons which I cannot go into here—it is easier to ascertain a monastic origin than a secular one. The proportions would without doubt change; but the historical development of the phenomenon would certainly remain the same.

5.1 Examples of some major discoveries

Up to this point, the contribution of the *CMD* has only been considered from a quantitative standpoint. Without doubt, it would be advantageous to shift to an assessment mode more in keeping with the working methods normally employed in our field of study. However, because the quantity of material is so vast, a synopsis would be practically impossible. Indeed, one would have to review the cases of Saint-Vanne and Saint-Airy de Verdun, Saint-Thierry-au-Mont-d'Or, Saint-Serge and Saint-Aubin d'Angers, Saint-Pierre-de-la-Couture du Mans, the Trinity Abbey of Vendôme, the Mont-Saint-Michel, Notre-Dame de Lyre..., to cite just a few of the most important funds held in the most favoured regions. Given that I cannot undertake a full exploration of such a seemingly endless litany,[49] here I shall make do by presenting three cases that I consider to be particularly enlightening.

5.2 Scriptoria of the Ardennes: Belval and Signy

In the realm of discoveries, beyond a shadow of doubt the first prize has to be awarded to the library of Charleville (today Charleville-Mézières), in the Ar-

48 The astonishing diminution in production that appears to occur during the 13th century (which can be seen in Chart 3B above), is due to the fact that only the first half of that century is taken into account (but this has no bearing on the overall reasoning).

49 For those who would like a complete picture of the situation, I can only recommend a systematic reading of the introductions to the various volumes which have been published.

dennes. Holding around 350 medieval volumes, this library constitutes a rather noteworthy collection. But it has never attracted the attention of experts, and the Ardennes—generally considered a rather peripheral and culturally disadvantaged region—have not exactly gained a reputation as a 'hotspot' of medieval monasticism, and even less so of palaeography. Charleville, a town of relatively recent founding,[50] has never been an episcopal seat and no monastic centre of any importance has ever developed within its administrative domain. Paradoxically, there can be no doubt that the cultural privation of this region worked to its advantage by obscuring it in the shadows when the voracious appetite of amateur manuscript collectors led to the dispersion of so many other funds.

The Charleville collections are essentially composed of two monastic funds that originate from quite modest establishments, but which have been conserved in a truly exceptional way—indeed, one could almost say that they have been 'fossilised'.

The first of these abbeys is that of Beval, of the Premonstratensian Order. Of the approximately 120 manuscripts included in the inventory of 1732, 110 are still in place, 60 of which date to the 12th century. Most of them are so similar in appearance, writing and decoration that they are clearly the output of one and the same scriptorium, and the references to origin borne by 26 of the volumes serve as unequivocal proof that they were indeed produced at Beval. In addition, 11 are dated, thereby allowing us to ascertain that it was between 1148 and 1170 that the scriptorium enjoyed its most active period.

The volumes are not remotely sumptuous in their appearance and are therefore well in keeping with the characteristic modesty of the institution. In essence, they are study books of rather small format, and predominantly the products of multiple hands. They were copied on to a support of very poor quality, and it is plain to see that every effort was made to make the most it. The artisans did not hesitate to use defective skins—indeed, even mere scraps of parchment were utilised. However, the layout, writing and decoration bear witness to a very characteristic style.

The second abbey is that of Signy, of the Cistercian Order. This comes as less of a surprise when one is aware of the amount of importance that the order placed on books. The fund was also reported during the *Ancien Régime*, and in 1727, the abbot Bignon, Secretary of the King's Library, considered acquiring it. Fortunately—one could say—the project was never realised. Of the 150 manu-

50 The town was founded by Charles Gonzaga (1580–1637), Duke of Nevers and Rethel, in 1606, as the capital of his sovereign Principality of Arches.

scripts mentioned in this era, 146 are still in place. As at Beval, more than half of them (86, to be precise) date to the 12th century.

Even so, the degree of homogeneity is less marked than in the previous case, and where it does manifests itself, it seems less convincing. Just like all the affiliate branches of Clairvaux, Signy received books originating from kindred institutions, and in the volumes that bear its earliest *ex libris* the Cistercian 'look' more often than not dominates among the regional characteristics. In addition, in line with the general trend of the order, references to dates or copyists are exceedingly rare. Any proposed attributions should therefore be viewed with much caution. Twenty-eight volumes that bear clear indications with respect to their origins have nevertheless been taken into consideration, to which we can add another 30 or so that bear all the hallmarks of a local style, very similar to that of Beval.

In this way, then, an 'Ardennes School' has been discovered, which until now was unknown to palaeographers and art historians alike. The investigations carried out at the library of Laon,[51] which also conserves, in equally good condition, the fund of another small Cistercian abbey, that of Vauclair, have demonstrated that this style prevailed across a slightly wider region, where Picardy, Champagne and Lorraine meet.

6 The scriptorium at Jumièges

The case of the Abbey of Jumièges, in Normandy, is very different. This is a 'big name' in the history of monasticism and the history of Normandy.[52] The importance of the number of manuscripts originating from this abbey has already been highlighted (in 1966) in Geneviève Nortiers's work on the libraries of Normandy.[53] Its artistic (and palaeographic) qualities were showcased during an exhibition staged at Rouen in 1975, curated by François Avril.[54] But in both cases, the manuscripts of Mont-Saint-Michel are the ones that steal the limelight. It is without doubt the unsurpassable glory of the Mont—as much for its touristic appeal as for its architectural and palaeographic interest—that eclipses the fund

51 See *CMD*-F2, II, 48–52 and 63–70. A very similar style also emerges at the Abbey of Cuissy, of the Premonstratensian Order, whose fund is also held in the library at Laon (see *ibid*., 55–54).

52 See Loth 1882–1885.

53 Nortier 1966 (1971[2]).

54 Avril 1975.

at Jumièges and discourages scholars from taking an interest in it. Indeed, up to the present no specific research has been dedicated to the Jumièges fund.[55]

In this context, then, it is less the existence and excellence of the scriptorium than the chronology of its development that constitutes the importance of the discovery made through the *CMD*. In fact, a systematic examination of manuscripts has led to what historians have previously speculated about the intellectual history of the institution being challenged. According to them, the abbey experienced two phases during which it flourished: the first occurred immediately following its foundation, in the first half of the 11th century; the second, after a period of stagnation, towards the end of the 12th, thanks to the celebrated teaching of Master Alexandre. Now, for these two periods the listings in the *CMD* are essentially insignificant. Conversely, the abbacy of Gontard (1078-1095), which despite its rather pious reputation scarcely left a trace in the annals, has provided us with a very homogenous group of 26 volumes of certain date or origin, to which a further 14 can be linked, so it is very obviously this date that marks the apogee of the scriptorium*'s* activity. This difference therefore leads one to challenge the equivalence—which is often thought to exist—between the intellectual blossoming and the period of book production. Unfortunately, it often is impossible to avail oneself of sources which include both of these aspects. The instances where it is possible to study the temporal and intellectual development of an institution in parallel are also few in number and little exploited.

***

Naturally, the *CMD* in its current form was not the sole player in the renewal that took place between the mid-1950s and the end of the 1980s. There are many other publications dedicated to individual scriptoria which sometimes prepared the ground, as it were, or in other instances took immediate advantage of the fruit harvested from them.[56] Here, I shall limit myself to citing, rapidly and in no particular order, the works of Jean Vézin on the scriptoria of Angers,[57] of Jean Dufour on Moissac,[58] of Françoise Gasparri on Corbie[59] and Saint-Victor of Paris,[60]

55 This lacuna will soon be filled, thanks to the recent work of Gurrado 2015.

56 It is impossible to report all the publications stemming from this movement in the present contribution. For further details, the interested reader can consult (in addition to the usual research materials): Muzerelle 1991; Muzerelle 1992.

57 Vézin 1974.

58 Dufour 1972.

59 In particular, Gasparri 1966; Gasparri 1991.

of Marie-Pierre Laffitte on Saint-Thierry,[61] of Simone Collin-Rozet on Belval,[62] of Monique-Cécile Garand on Cluny,[63] and Nogent-sous-Coucy,[64] and of Denis Escudier on Saint-Evroult d'Ouche,[65] and this list is far from exhaustive. Publication dates are occasionally misleading, sometimes being earlier, or later, than the publication date of the corresponding catalogue. However, it can safely be said that everything that was achieved in the field of palaeography in France during this period was accomplished within the ambit of the programme initiated by Charles Samaran.

Largely speaking, Cistercian monasteries escaped this, so to speak, 'gravitational' attraction. However, the studies relating to them developed with a similar degree of vigour throughout the period, although they were focused on the abbeys' libraries rather than on their scriptoria—and this represents a clearly different standpoint, since the exact origin of volumes is only considered a secondary concern. In fact, the studies benefited from another impetus: that of the reconstitution of the library at Clairvaux and the library heritage of the order, instigated by André Vernet.[66] Even so, it is obvious that this parallel undertaking greatly profited from the investigation of dated manuscripts.[67]

At the (albeit still provisional) conclusion of this undertaking, the 'palaeographic landscape' of France finds itself profoundly reshaped—even if only on account of the influx of new witnesses. Some lofty places have been cut down to more reasonable proportions; a few new summits have been drawn; and what previously appeared as scattered islets occasionally find themselves at the centre of an archipelago, or sometimes even form a small continent. But above all, the perception we formerly had of production conditions has substantially changed.

The major palaeographic studies (which focused chiefly on the most ancient manuscripts) carried out up until the outbreak of the Second World War created the impression that a rich and thriving intellectual life was concentrated in a few centres, in each of which an effort was made to develop a unique artistic and graphic style. The investigation has revealed that in reality writing was produced everywhere, and that the output of establishments that we can legiti-

60 In particular, Gasparri / Stirnemann 1991.
61 Laffitte 1979.
62 Collin-Roset 1974.
63 In particular, Garand 1977; Garand 1978.
64 Garand 1995.
65 Escudier 1999.
66 On this subject see, especially, the introduction in Vernet 1979.
67 See, in particular, Bondelle-Souchier 2006.

mately call minor was (unwittingly) conserved. Such output, if not particularly impressive, was at least significant, although quality, homogeneity and originality were not always present.

Can we therefore say that the scriptorium concept has been clarified? The answer to this question can only be partially affirmative. The large number of small institutions which are represented by only a few scattered and rather modest witnesses in any event demands that questions be raised about the position occupied by the copying of books. If the intellectual needs of such institutions were probably limited to the indispensable, it is clear that the communities found it necessary to at least produce their own liturgical material, and above all to maintain it and keep it up to date. At a minimum, one person would have sufficed, and the work would not have consumed all his time. Now, he who is able to transcribe a Mass can also copy a missal; indeed, if necessary, he can also transcribe an Augustinian treatise or, come to that, one by Virgil or Ovid, should the need arise. Can one, in this scenario, really speak of a scriptorium? It is here, indeed, that one finds the meaning assigned to the word, at the end of the 11th century, in the ancient customs of Chartreux:[68] a table, some parchment, and the necessary tools and materials for ruling sheets and writing on them—nothing more. Thus, the scriptorium is reduced to no more than a mere corner in a monk's cell. To be sure, some scholars have remarked on this source and limited the compass of the term scriptorium, specifying that in this instance it was interpreted in a particular way. But, on the contrary, would it not be more reasonable to define the scriptorium as a centre of operations that produced a large quantity of consistent, aesthetically pleasing and original material that has come down to us through the ages, and which provides a worthy subject for a scientific publication?

Lying somewhere between the two extremes, it should to be possible to settle on a suitable term—a sort of halfway house—which is compatible with what the major investigation of dated manuscripts and the new approach to medieval written output has taught us over the last fifty years or so. However, there is no question that it is still not possible to propose a concise and prescriptive definition which is at one and the same time both limiting and all-encompassing. I think we can wager, then, that the papers presented within the framework of this meeting will help to guide us towards some important answers to this question.

---

68 Guigues 1st, Prior of Chartreuse, (1083–1137), *Consuetudines Ordinis Cartusiensis*, chapter 28, § 2, *Acta Santorum*, Jun. 2, p. 495; PL, 153, col. 631–757; etc. The passage has been commented on many times.

References

Avril, François (1975), *Manuscrits normands, XI^e–XII^e siècles* (exhibition, Rouen, Musée des Beaux-Arts, 1975), Rouen: Musée des Beaux-Arts.

Bartoli Langeli, Attilio (1994), 'I libri dei frati. La cultura scritta dell'Ordine dei Minori', in *Francesco d'Assisi e il primo secolo di storia francescana*, Torino: Einaudi, 285–305.

Beaunier, Charles / Besse, Jean-Martial (1905–1920), *Abbayes et prieurés de l'ancienne France*, I-IX, Paris: Poussielgue.

Bischoff, Bernhard (1940), *Die südostdeutschen Schreibschulen und Bibliotheken in der Karolingerzeit*, I. *Die bayrischen Diözesen*, Leipzig: Harrassowitz (reprinted several times).

Bischoff, Bernhard (1980), *Die vorwiegend österreichischen Diözesen*, Wiesbaden: Harrassowitz.

Bondelle-Souchier, Anne (2006), *Bibliothèques cisterciennes dans la France médiévale. Répertoire des abbayes d'hommes*, Paris: CNRS.

Bozzolo, Carla/ Ornato, Ezio (1980), *Pour une histoire du livre manuscrit au Moyen Âge. Trois essais de codicologie quantitative*, Paris: CNRS (Publications de l'équipe de recherche sur l'humanisme français des XIV^e et XV^e siècles. Textes et études, 2).

Bruckner, Albert Emil (1935–1974), *Scriptoria Medii Aevi Helvetica*, published in 12 volumes from 1935 up until 1974, Genève: Roto-Sadag.

Collin-Roset, Simone (1974), 'Une importante bibliothèque de Prémontrés: les manuscrits de Beval à la bibliothèque de Charleville-Mézières', in *Actes du 95^e Congrès national des sociétés savants (Reims, 1970)*, Modern History section, vol. I, Paris : Bibliothèque nationale, 419–458; reprinted in *Lotharingia*, 3: 141–172.

Delisle, Léopold (1875), *Mémoire sur l'école calligraphique de Tours au IX^e siècle*, Paris: Mémoires de l'Institut national de France.

Dufour, Jean (1972), *La bibliothèque et le scriptorium de Moissac*, Gèneve, Paris: Droz.

Escudier, Denis (1999), 'Orderic Vidal et le *scriptorium* de Saint-Évroult', in Boutet, Pierre / Dosdat, Monique (eds), *Manuscrits et enluminures dans le monde normand, X^e–XV^e siècle,* Caen: Presses universitaires de Caen, 17–28.

Garand, Monique-Cécile (1977), 'Le scriptorium de Cluny, carrefour d'influences au XI^e siècle', in *Journal des savants*, 4: 257–283.

Garand, Monique-Cécile (1978), 'Copistes de Cluny au temps de saint Maieul (948–994)', in *Bibliothèque de l'École des chartes*, 136: 5–36.

Garand, Monique-Cécile (1995), *Guibert de Nogent et ses secrétaires*, Turnhout: Brepols (Autografa Medii Aevi, 2).

Gasparri, Françoise (1966), 'Le scriptorium de Corbie à la fin du XIII^e siècle et le problème de l'écriture a–b', in *Scriptorium*, 20: 265–272.

Gasparri, Françoise (1991), 'Le scriptorium de Corbie', in *Scrittura e civiltà*, 15: 189–305.

Gasparri, Françoise / Stirnemann, Patricia Danz (1991), 'Scriptorium et bureau d'écriture de l'abbaye Saint–Victor de Paris', in Longère, Jean (ed.), *L'abbaye parisienne de Saint-Victor au Moyen Âge* (XIII^e Colloque d'humanisme médiéval de Paris, 1986–1988), Turnhout: Brepols, 119–141.

Gurrado, Maria (2015), 'L'évolution de l'écriture au XI^e siècle en France: le cas des scriptoria de Cluny, d'Angers et de Jumièges', in Nievergelt, Andreas / Gamper, Rudolf et al. (eds), *Scriptorium. Wesen - Funktion - Eigenheiten.* Comité international de paléographie latine, XVIII. Kolloquium. St. Gallen 11.–14. September 2013, München: Bayerische Akademie der

Wissenschaften, in Komm. beim Verlag C.H. Beck, 2015 (Veröffentlichungen der Kommission für die Herausgabe der mittelalterlichen Bibliothekskataloge Deutschlands und der Schweiz), 231–246.

Histoire des bibliothèques françaises (1989), vol. I: *Les bibliothèques médiévales, du VI^e siècle à 1530*, under the supervision of André Vernet (Les bibliothèques des ordres mendicants), Paris: Éditions du Cercle de la Librairie - Promodis.

Laffitte, Marie-Pierre (1979), 'Esquisse d'une bibliothèque médiévale: les fonds de manuscrits de l'abbaye de Saint-Thierry', in *Saint-Thierry: une abbaye du VI^e aux XX^e siècle* (Colloque international d'histoire monastique, 1976), Saint Thierry: Association des Amis de l'Abbaye de Saint-Thierry, 73–100.

Lalore, Charles (1873), *Chartes de l'abbaye de Mores (Aube)*, Troyes: Dufour-Bouquot.

Les manuscrits datés: premier bilan et perspectives / Die datierten Handschriften: erste Bilanz und Perspektiven (1985) (colloquium, Neuchâtel/Neuenburg, 1983) Paris: CEMI, (Rubricae, 2).

Lesne, Émile (1905), *La hiérarchie épiscopale, provinces, métropolitains, primats, en Gaule et Germanie, depuis la réforme de saint Boniface jusqu'à la morte d'Hincmar*, 742–882, Lille 1905 (thesis).

Lesne, Émile (1938), *Les livres: scriptoria et bibliothèques du commencement du VIII^e à la fin du XI^e siècle*, Lille: Facultés Catholique.

Loth, Julien (1882–1885), *Histoire de l'abbaye royale de Saint-Pierre de Jumièges,* 3 vols, Rouen: Ch. Métérie.

Mirot, Léon (1948–1950), *Manual de la géographie historique de la France*, Paris: Picard.

Muzerelle, Denis (1991), 'Paléographie et codicologie', in *L'histoire médiévale en France, Bilan et perspectives.* Actes du XX^e Congrès de la Société des historiens médiévistes de L'Enseignement supérieur, Paris, 1989, Paris: Seuil, 478–483.

Muzerelle, Denis (1992), 'Paléographie et codicologie', in Balard, Michel (ed.), *Bibliographie de l'histoire médiévale en France*, 1965–1990*,* Paris: Publications de la Sorbonne, 421–427.

Muzerelle, Denis (1993), 'Les atlas paléographiques sont dans l'air du temps', in *Gazette du livre médiéval*, 22: 40–42.

Neddermeyer, Uwe (1997), 'Why were there no Riots of the Scribes? First Results of a Quantitative Analysis of the Book Production in the Century of Gutenberg', in *Gazette du livre médiéval*, 31: 1–13.

Nortier, Genevieve (1966 [1971[2]]), *Les bibliothèques médiévales des abbayes bénédictines de Normandie*, Caen: Caron (repr. in Paris: Lethielleux, 1971).

Paolazzi, Carlo (2004), 'I Frati Minori e I libri. Per l'esegesi di "Ad implendum eorum Officium" (RNB, III, 7) e "Nescientes litteras" (RNB, III, 9; X, 7)', in *Archivum Franciscanum Historicum*, 97: 3–60.

Pellegrini, Letizia (1999), *I manoscritti dei Predicatori*, Roma: Istituto storico domenicano.

Rand, Edward Kennard (1929–1934), *Studies in the Script of Tours*, I–II, Cambridge, Massachusetts: The Mediaeval Academy of America.

Stein, Henri (1907), *Bibliographie générale des cartulaires français ou relatifs à l'histoire de France*, Paris: Alphonse Picard.

Vernet, André (ed.) (1979), *La bibliothèque de l'abbaye de Clairvaux du XII^e au XVIII^e siècle*. I. *Catalogues et repertoires,* Paris: CNRS.

Vézin, Jean (1974), *Les scriptoria d'Angers au XI^e siècle*, Paris: H. Champion.

Index of Written Sources

https://doi.org/10.1515/9783110743838-021