Introduction

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Training eyes and training hands in the digital research with manuscripts

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We could say that the relevance of the contributions in this special volume dedicated to paleography and manuscript culture in today’s digital environment is borne out by Cornelis van Lit’s (2020) recent emphatic assessment: “I would argue that paleography is perhaps the most digital field of all of manuscript studies, even though the perception within the field is at times to the contrary.” On the other hand, the growing specialized bibliography, and also the emergence of aspects that interrelate paleography and computers in high-level scientific journals, fuels a state of affairs centered on a revival of research using original manuscript sources, particularly from a general dimension endorsed by the digital humanities (Stutzmann, 2017), (Albritton, Henley, Treharne, eds., 2020) or more specifically by the digital philology (Bamford and Francomano, 2018).

The majority of the texts included herein originate in the presentations made at the University Carlos III of Madrid (UC3M) seminar entitled “Analogic and Digital: looks on digital paleography and manuscript culture nowadays,” held on October 24-25, 2019 and supported by its Vice Rectorate of Scientific Policy. In the sessions, a group of paleographers, archivists, calligraphers, materials engineers, historians of written culture, graphic designers, linguists and philologists and experts on image and photographic reproduction, came together to try to integrate our respective fields in a review of a markedly practical and creative nature of our respective work with old manuscripts. Our dialog fostered, for example, the communication between paleographers and computer scientists that is essential for designing the functional requirements of the computerized paleographic systems, the role played by contemporary calligraphic creativity in the study of medieval and early modern handwriting typologies, or the search for the necessary international standards in the capture phases of multi- and hyperspectral photographs of an original manuscript text. We finished up with a discussion about the need to integrate paleography and advanced study of historical witnesses in a proposal of a manufactural nature and from the standpoint of stroke mastery for interpreting manuscript cultural heritage and applying techniques for document digital Image Processing (Doermann and Tombre, 2014) and Handwritten Text Recognition. These are shown in the leading projects developed by the Pattern Recognition and Human Language Technology (PRHLT) research center (Universitat Politècnica de València) or the Pattern Recognition and Document Analysis Group (DAG) of the Computer Vision Center (CVC) (Universitat Autònoma de Barcelona). Movement (whether through the rhythm, velocity or direction of the motion of the writing instrument), materiality and evolution are the vectors that define the approach taken in these pages, a clearly Darwinian approach compared to the Linnaean or classificatory/taxonomic one used in paleography (Stansbury, 2009). This is an approach or way of understanding paleography (analogical and digital) in which a key organizing element is the deep review of the grapheme and individualization of the graphic elements that define it (Ruiz, 1992) to facilitate segmentation (Fernández, Lladós, Fornés, 2014), decomposition of the constituent elements of the alphabetic sign and, particularly, calligraphic reinterpretation of the ductus in order to transfer it to the digital environment (Köhler, 2008), (Cloppet, 2011).

The fact that the seminar was organized by the Library and Information Sciences Department (UC3M), an accredited international Information School, is not insignificant. The multidisciplinary interest of information, library and archive professionals indeed encounters an appropriate workspace centered on paleography and archival documents that

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inescapably requires assistance from other related, complementary and essential fields. This volume is approached from an integrative perspective that is paleographic as well as technical and conservation-oriented (Ricciardi, 2019). This perspective obliges us to see the manuscript and its scriptural morphologies as a multidimensional and coordinated meeting place in which its “materialities” (Athanassoglou-Kallmyer, 2019) as cultural artifacts, take on renewed protagonism in line with concepts such as the “Material Philology” endorsed by Stephen Nichols (1997), (Jolly, 2013) or those reviewed recently by the special issue devoted to new research paradigms for Iberian Manuscripts as Material Objects of the Journal of Medieval Iberian Studies.

The skills and competencies that are integrated in this UC3M iSchool include capture processes, analysis, description and dissemination of the document (in the broad and omni-comprehensive sense of the term). Tasks like creating ontologies in knowledge management processes, applying markup languages, the search for an Interoperability Framework derived from the application of TEI and specially LOD, designing information recovery and dissemination strategies, design of standardized descriptions, running big data applications, managing documents and archives electronically, the historical approach of the study of (hand)writing culture, etc., involve competencies that define this (often) extensive and versatile area of expertise. The historical document is therefore also an essential object that falls under its purview, and it shouldn’t be underestimated the deep frames of creation and chronological development of documentary forms and their necessary contextual knowledge and meaning, something that defines the very spirit of the humanistic sciences. The concern about the present and future of paleographic competencies in a context of vindication of the digital humanities in the training plans for future archive and library managers, as well as the need to endow digital paleography with content and substance, gives rise to other research questions that form the basis of this volume.

In fact, in a thought-provoking reflection proposed in 2015 on the role of paleography within the digital humanities, Peter A. Stokes asked himself the following question: “Can paleographers learn from typographers and vice versa?” (Stokes, 2015). The answer would have to be mainly affirmative but, at the same time and as a natural complement, we pose another question that structures part of the special volume that we present here: Can paleographers, regardless of whether they work in an analogical or digital environment, learn from calligraphers and vice versa? Is it absolutely necessary to develop calligraphic skills in order to comprehend the fundamentals of reading manuscript texts with old scripts? Nor is the question a new one, as this proactive link between calligraphy and paleography was brought to light in reference works such as those of Osley, Fairbank, Reynolds, etc. (Osley, 1965). Before answering these questions, the misgivings that called for prudence in this matter, originating in the teachings of M. B. Parkes (2008), rumble discreetly. Thus, this interaction between calligraphy and paleography is probably not essential, but it is recommendable and useful for acquiring higher paleographic competency that goes beyond the classical paleography of reading. That generates significant implications in the processing of digital images by means of updating millennial Roman “Stilus” transformed into versatile optical pens that slide their sets of points over today’s wax tablets, metamorphosed into powerful devices such as graphic tablets with applications like Procreate, Photoshop or Illustrator, which offer innumerable combinations of calligraphic brushes used to reconstruct handwritten strokes that are illegible on screen (Rafiyenko, 2017). Therefore, to what extent do the multiple vectors that define calligraphic competency help in paleographic analysis? To what extent is the training of a mixed profile that combines the paleographer and the calligrapher in a library and information sciences department a good idea academically for improving competencies in the analysis of the manuscript over the centuries? Experiences like those of Cheryl Jacobsen at the University of Iowa, or our own, in bringing calligraphy into the paleography classroom or into the massive open online courses that we offer in edX, seem methodologically suggestive (Jacobsen, 2013).

In any case, if we accept this necessary interrelation for educational purposes, one of the greatest didactic challenges related to experimentally introducing the pen, parchment and ink well into the classroom would have to be confronted. That challenge lies in the proper design of a study program that adequately evaluates not only the integration of calligraphic skills into the paleography classroom but also reliable evaluation criteria for something as complicated to objectively measure as the degree of calligraphic perfection. In this respect, we are working on the viability of applying neurological sensors that measure parameters such as the pressure, movements, distances, etc., of a hand while it performs calligraphic exercises in line with certain advances in handwriting biometrics proposed by Axel Brink (2011), Schomaker and Flamondon (1990). This stream of data derived from the very conception of writing as a dynamic process and not one that is solely static or involving study of an image (kinematics) (Sampath, 2017) would generate significant quantities of information that could be processed using big data tools, something we consider
one of the immediate challenges. From this perspective, theories like those of Vinodh Rajan Sampath address the shift from subjective to objective paleographic analysis through the use of quantitative techniques, but keeping in mind that paleography is not an exact science and that the assistance of the paleography expert will be absolutely necessary (unless progressive advances in artificial intelligence demonstrate the contrary). We could say the same, then, of “calligraphy objectively evaluated” by a machine, an intrinsically complex undertaking due to the inevitable subjective component in the creative act of writing that suggests that this is an oxymoron, and that the assistance of a calligrapher capable of evaluating the performance of students with their pen strokes would inevitably be required. Nevertheless, and talking about AI, a big and challenging question remains in front of us after reading the key influence of algorithms in the computerized artistic creativity processes proposed for example by philosophers or mathematicians as Marcus du Sautoy. In his cutting edge essay *The creativity code*, the possibilities of deep machine learning are the basis for new paintings or new music scores created completely by computer. These AI increasing improvements define also the machine reading skills and automated paleographic transcriptions as achieved in the *Transkribus* project or the *Transkriptorium* spin-off created in the Universitat Politècnica de València. However, one of the most exciting fields of research and experimentation for us as paleographers and calligraphers deals with the central role played by this human/computer interacted creativity. This is, needless to say, about to modify the scope, methods and approaches of manuscript culture to define new perspectives. For instance and by exploring generative adversarial networks, the near moment in which machines will not only learn to read from original documents their historical scripts, cursives and not cursives, as they are doing now, but also to generate directly, *ex novo* and correctly from a calligraphic assessment those same historical handwritings and not only excellent facsimile or typographic inspired new fonts.

1 Digital paleography: definitions, tasks and approaches

We define digital paleography as the result of using information technology to transform the methods of comprehensive analysis of the manuscript and to support comprehension of the text as image and as meaning. On the other hand, digital paleography can be considered as a logical and transformative extension of traditional paleography methods, as indicated by Peter A. Stokes (2009) by “taking statistical measures of handwriting and then using these measures to make inferences and quantify similarities and differences between hands.” When they hear talk of digital paleography, people often think of an automatic transcription tool for manuscript texts derived from the application of artificial intelligence and artificial paleography, as displayed for instance in projects like *q2b: From quill to bytes* (Uppsala University), the *Himanis European project* (Historical MANuscript indexing for user-controlled search), the *Scripta project* at Université Paris Sciences et Lettres or the above mentioned *Transkribus* project at the University of Innsbruck, a flagship project focused on Recognition and Enrichment of Archival Documents. Nonetheless, to reach this end, a great deal of research remains to be done in which promising results are emerging progressively in projects like those promoted by the Institut de recherche et d’histoire des textes (France), the IRIS program Scripta-PSL History and practices of writing (Université Paris) or the Centre for the Study of Manuscript Cultures of the University of Hamburg (Germany). Even more: an upper grade of difficulty working with special manuscripts emerges from the attempts of automatic (or better said semi-automatic) tools to transcribe encrypted historical texts as those developed in the DECRYPT project (Megyesi et al., 2020).

The definition proposed by Dominique Stutzmann continues to be valid and very complete: “Digital Palaeography addresses the notions of text through image, layout and shape, through their materiality, their history, origin and provenance of the witnesses, through their cultural significance. Digital Palaeography means: how to use computers to help the humanities identifying the relevant historical phenomena, to identify interscript, interscribal, intra-script and intra-scribal variations as well as cultural and textual relevant features.” (Stutzmann, 2014). Computer-assisted analysis of manuscripts, computerized paleography, etc., are terms that define a semantic field assembled around digital paleography. Under this more computational or computerized conception, other authors have defined it as follows: “Computerized paleography: digital tools that furnish the analysis of a human paleographer with large-scale capabilities and assist with evidence-based inference.” (Wolf, et al., 2011).
2 Teaching in digital paleography

The appearance of this volume coincides with the inclusion of the course “Digital Paleography” in the new bachelor’s degree in Management of Information and Digital Contents coordinated by the Library and Information Sciences Department (iSchool). This classroom-based course joins the now-consolidated Virtual Learning Environments, (Zozaya, 2014) led by the same department, such as the MOOC on paleography and calligraphy through the edX platform. Stokes warned of the difficulties of teaching paleography and codicology in virtual learning environments and identified the “materiality of the book” as a great limitation. We have likewise identified that limitation of the materiality of handwriting on screen. Materiality and even “plasticity” should also be determining factors: “in the Middle Ages, the physical feel of a manuscript is almost as important as its appearance — that touch was close in significance to sight — [...]” (Stokes, 2011). This sense of the materiality of the manuscript is important, but why has paleography only barely penetrated the multiple sensory, material and even emotional dimensions of calligraphic construction itself directly, in real time and using the original objects and practices? Beyond workshops to complement or embellish seminars or courses, massive incorporation of actual writing practices in the hands of paleographers, of whom we not only demand reading of the letters but also the experience of reproducing them calligraphically, needs to be explored if we want to achieve excellence and virtuosity in their competency. Cheryl Jacobsen posed a pertinent question that I myself had asked on many occasions without receiving a solid or halfway satisfactory answer: “Why aren’t more paleographers trained as scribes? There may be a fear of the process, or a sense that it is really not that helpful at all. Even if convinced of the usefulness, there are other disincentives [...] becoming proficient at lettering is a hugely time-consuming process, with true mastery of the craft requiring something like ten thousand hours of experience. This may not be feasible for all scholars.” (Jacobsen, 2013).

Anyone who is capable of taking a pen in hand to reproduce the strokes of any writing system can understand, in all of their meaning and depth, many of the indicators that are studied in their results (the manuscript text) and, especially, in the phases of practical and real scribal development. In this sense, professional capacities such as an extensive knowledge of the historical context in which the manuscript texts were produced, an authoritative investigation of written culture in its multiple dimensions, and robust paleographic competency are considered necessary but not sufficient to illuminate that new expert profile. Two key elements are missing: calligraphic competency and the capacity to address the numerous challenges arising from the technology applied in the multiple fields of the digital humanities in general and of digital paleography in particular. Without a doubt, this integration of knowledge, sensibilities, practices and ways of addressing the reality of writing by hand from a theoretical standpoint is not easy to find in a single profile. Nonetheless, names such as Ewan Clayton (monk, calligrapher, designer, writing historian) or Claude Mediavilla (calligrapher, writing historian and expert on paleographic conventions) constitute examples to be followed in this other practical and factual dimension of written culture that is hardly mentioned or considered.

The chapters of this volume draw, likewise, on the many assumptions from the history of written culture. The contributions of the International Committee for Latin Palaeography are not exactly minor if we want to understand modes of learning writing in the past (Robinson, 2010), (Castillo, 2016), (Galende, Cabezas, Ávila, 2016). In any case, having gotten past paradigms related to the consideration of paleography as a mere auxiliary science of history or solely linked to medieval history studies, a second reconsideration of the so-called New Paleography — one more centered on practices, results and representations of writing in history and led by authors such as Armando Petrucci, Antonio Castillo or Roger Chartier among others — is gradually making way for a vision of integrative knowledge, expertise and the gaps left by earlier reformulations in which the digital environment is not a mere change of scenario for presenting images of documents for doing the same as always but onscreen. As Ciula (2017) stated in a decisive work for the study of digital paleography, it will be transformative or it will not be. This is what illuminates the so-called “transversal or global paleography” defined by Peter A. Stokes (2015). In sum, in this volume we continue to explore those potentials and limits of information science applied to paleography to which Hassner, Rehbein, Stokes and Wolfe referred in a reference work for these studies which proposed a valid status of the question with approaches centered on digital paleography that went from forensic document analysis to quantitative methods, ontologies construction (Stutzmann, 2018) or advanced OCR applied to automated transcription systems (Hassner et al., 2012). Conceptual models that define new paradigms for the study of handwriting propose quantitative and qualitative approaches to the manuscript text as meaning and as form (Stokes, 2012). All of these shape that present and, particularly, that future that affects the application of computer science and technology to paleography (Stokes, 2009).
3 Back to handmade materiality

As reported by Nina Athanassoglou-Kallmyer (2019) editor in chief of the prestigious The Art Bulletin, “Materiality is the sign of the Times”. Transversal and multidisciplinary approaches focus on the deep impact of sensory and physical aspects of cultural artifacts. One of the keys for articulating a renewed meeting point in studies on manuscript culture, both analogical and digital, lies indeed in the field of materiality and of work on the supports and utensils, not only theoretical but also experimental and direct, attuned to the writing techniques, tools and methods of the past as tracology and experimental archeology have issued for instance with the reconstruction of antique brushes (Martin et al., 2016), (González Fernández, 2017).

That combined immersion in the pure act of writing as a proposal for improving paleographic capacities is what we advocate in these pages, and it finds interesting echoes in the concept of “writing performance” studied by Francesco Ascoli (2003; 2020) or in the papers published in the volume edited by Jonathan Wilcox. In it, several initial questions shook the hearts and minds of paleographers, calligraphers, archivists and codicologists: “How can responsible scholars overcome the disadvantages of digital reproductions and more fully engage with the physicality of the book? How can we better understand and convey the craft that went into the handmaking of books? How can we enter into the world of scriptorium practice that brought us the manuscripts that we study?” (Wilcox, 2013).

If we assume that the trace left by handwriting over the centuries is a compound of meaning but also of form in a necessary combination of image and text, we cannot leave aside the aesthetic dimension, despite the fact that Bischoff already predicted that “paleography was on the way from being an art of seeing and aesthetic empathy to becoming an art of measurement” (Bischoff, 2004). That study of the appearance of the forms defines the variations in the morphologies of writing that unravel paleographers, and, there, the assistance of people who apply all their manual skill, literally, to creating beautiful writing styles according to the canons of the past, that is, calligraphers, is relevant. The classical paleography of reading as a teaching method must be transcended by means of active incorporation of not only a paleography of writing but also, and powerfully, one of applying information technology to numerous elements that help us to understand aspects that have traditionally been separate from numeric quantification of a manuscript. Calligraphically, that interaction between form and meaning has an immediate consequence, as it defines the classic dialectic between legibility and expression, between recognizable forms of meaning and formal graphic elements, that is difficult to interpret but which has maximal formal visual impact and defines current calligraphic tendencies such as gestural writing (Mediavilla, 1996).

The paleographic method is based essentially on images, both those from direct visual examination of the original manuscript and reproductions ranging from old photographs and their insufferable photocopies to magnificent, high-quality photographic replicas and digital surrogates that reformulate the concepts of availability, usability and accessibility as Bamford and Francomano (2018) have argued.

The application of technology to the original manuscript again offers a reality limited to two perspectives: photographic capture and the processing of those digitized images (Stansbury, 2009). In fact, even if we use extraordinary digital reproduction of the originals with a deep commitment to international standards, as pointed out by Jesús Robledano in his chapter, we neither can nor should lose direct contact with the original. This poses significant challenges and complex situations in the forms of direct access to the original manuscripts, a matter that was addressed in the first round table of the seminar regarding the levels of permissibility in the direct use of photographic cameras by the archive scholar.

Paleographers, as Cheryl Jacobsen points out, “have for a long time studied the letters as given objects to be identified and classified and to assist in transcription and in translation, but for some reason how it was done got overlooked or even (dare I say?) snubb[ed] [...] Even these basic principles of looking at the actual act of writing are surprisingly absent from the discourse of palaeographers” (Jacobsen, 2013). In short, methodological work has been done on an object that in the best case was the original manuscript itself. But this work has barely crossed the frontier of the process of the manufactural dynamics of its fabrication as a cultural artifact, as the research project leaded by professor Enrique Villalba (UC3M) has developed (From manuscript to the screens: memory, artifacts and cultural practices: 15th century to present. HAR2016-76550P. Spain. Ministry of Economy, Industry and Competitiveness, 2016-2020)

Hence, work is being done on the posterior result but not on the very act or intrinsic dynamics of writing in each historical epoch. That dynamic of the hand in action that inspired Richard Sennett (2008), in tune with an even artisanal and rhythmic conception of the “work of the stroke” is what we defend here: “medieval manuscripts exemplify a model
of craft production enacted by artisans, and this artisanal model may take on new resonance in a post-industrial world. The moment is ripe, then, for new understandings of medieval manuscripts as objects of study and as artifacts of desire” (Wilcox, 2013).

What we propose with this manufactual approach is that those talents of observation and paleographic expertise be exercised not only in eye training but also in hand training in a paradigm of seamless integration of reading and writing (Ciula, 2005). In other words: approaching and integrating the reading of old texts (paleography of reading) through the writing of their strokes (paleography of writing). Therefore, it involves an in-depth conception of paleography, with profound implications in the form of learning and forms of innovation in teaching and researching. We thus partake of that paradigm that feels comfortable with quantitative techniques but, as indicated by Altmann and Fengxiang, “traditionally, analysis and study of paleography have also been done manually,” so it is a question of synergistically harmonizing traditional paleographic and calligraphic capacities and orienting the result towards digital paleography projects (Altmann and Fengxiang, 2008).

Nonetheless, let’s be honest, as the idea of moving calligraphy into the paleographic classroom in a practical way has interesting antecedents in authors like Lloyd Reynolds. In a brilliant work of 1965, he referred to the physical and tactual characteristics of calligraphic creation, reinforcing an argument that we will reflect on a bit later: the tactual-kinetic aspect of writing, based on the definition of another great calligrapher and font designer, Alfred Fairbank, for whom “writing is a system of movements involving touch” (Reynolds, 1965).

4 Ductus revisited

It is nothing new to assert the value of ductus considering that since the classic 1952 work by Mallon, it has been a key element coupled, on the other hand, with what calligraphers and practitioners continually reproduce, bringing in indicators that define handwriting: height, width, proportion, morphology, ductus, separation, etc., indicators that have also been reformulated and analyzed critically by Stokes (2009) and Aussems and Brink (2009). Dominique Stutzmann rightly returns to that when he highlights an essential factor in the manufactual conception of the act of writing, which is direction and movement: “Palaeographers have specified the features to be analyzed, but some of these remain ambiguous. One key feature in the analysis of script is ductus: the fact that the very essence of handwriting itself is a movement before being a trace must be stressed. Analysis of ductus could suggest a means of overcoming some of the difficulties in script classification, but this very important aspect of script remains largely unexplored and scarcely within the reach of Computer Vision” (Stutzmann, 2016). For this reason, the active incorporation of calligraphers in the exercise of studying each ductus becomes fundamental in that they appreciate a practical and real dimension of the execution of multiple ductus that define their competence and expertise in faithful reproduction of historical script types. Sampath, for his part, revives interest in ductus in reflections like the following: “Also the ductus feature, which can be defined as the direction and order of strokes to produce a character, has not been given high priority (nor has it been the basis of analysis) in most of the systems discussed” (Sampath, 2017). His profound work reinforces the value of ductus as the central element from which to begin. Not in vain, he integrates not only the static forms of a letter as a digitized image but also the dynamics and its movements, the path, the velocity, the acceleration and all that defines the “kinematics of handwriting” in the tracing and execution process, first calligraphic and later digital, in a transformation process that typographers and designers of written communication use habitually. The choice of the stroke as the minimum unit of meaning and study in the approach we propose has been advocated in works such as those of Stokes (2017). M. B. Parkes (2008) has also insisted on the decomposition of the result of writing into these minimum units, and the thought-provoking research of Axel Brink in the area of handwriting biometrics furnish other units, such as “fraglets: fragments of handwriting, consisting of complete and partial characters” (Brink, 2011). The participation of the calligrapher and the paleographer in a human-oriented approach, thus, becomes fundamental in numerous phases of a process of transformation of the handwritten letter into digital representation. Furthermore, we propose the application of sensors to the calligrapher’s hand itself to online generate numerous quantitative and qualitative indicators of velocity, pressure, rhythm, ascent, descent, etc., in the act of reproducing or generating old scripts to determine the degree of competence, word spotting, graph edit distance and coincidence/variations with the document and original manuscript (Riba, et al., 2020).
5 Artefactum and manufactum

Writing is physical, emotional and mental experimentation in its origin, that is, when the pure act of writing is born. Getting away from this physical and manufactual dimension is, in our opinion and as calligraphers and paleographers, an error. As pointed out continually by Manny Ling and Ewan Clayton, from the Design Centre of the University of Sunderland, the body is also the response to the act of writing, and we should understand the multiple dimensions that its mobilization and the harmonious connection between body parts contribute in writing: now and in the past. For this reason, a fundamental part for comprehending the origin, both neurological and physical, of the act of writing lies in multidisciplinary research that defines writing as a human capacity over time. But, as a graphic form, writing is not devoid of an aesthetic, graphic and formal dimension, and even one of creativity and personal liberty through graphism. Thus, graphic designers and historians of written forms should also participate in the interdisciplinary reflection proposed here. Additionally, this commitment to the materiality of instruments, tools and supports in combination with processes, phases and coordinated fields of knowledge leads us, as a logical and natural consequence, to contact colleagues from other departments, such as that of continuum mechanics and theory of structures, experts on additive manufacturing technology to create that “manufactum” concept a reality applied to the manufacture of letters in 3D based on handwritten models in educational innovation project.

The circumstance of manufacture of the manuscript is of capital importance for reclaiming the characteristics that define the diverse materialities and sensorialities the manuscript provokes. If, as Wilcox asserts, “medieval manuscripts are a powerful way of touching the past,” an “artifact of desire” or even a “corporeal experienced based on the concept of empathy with inanimate forms” proposed by Bischoff and remarked on by Stansbury,” calligraphic reproduction following the principles and methods of writing from the past is, in our opinion, a magnificent key for activating our five senses and paleographic capacities around the manuscript (Stansbury, 2009). The loss of materiality or even of the physical characteristics of the manuscript onscreen is recovered to a great extent thanks to the postulates established decades ago by the material bibliography with Ronald B. Mckerrow, A. W. Pollard and W. W. Greg at the forefront. Recovering them, from the perspective of the active dimension of makers of strokes, which is ours as paleography and calligraphy professors, is one of the objectives of this volume.

Its pages open with the text by Ewan Clayton in which his long personal and professional experience crystallizes in “The virtual and the real: Culture and the body in the study of (hand)writing.” This paper looks at how paleography, the digital and the body-based disciplines of document making might interact with each other. The influences all run both ways, the paleographical can affect the digital as much as the digital can bring new ways of seeing to the paleographical. The same is true for the worlds of calligraphy and design.

Multispectral, hyperspectral and X-ray fluorescent photography for years has been one of the most visible interactions between technology and manuscripts. Experts like Ken Boydston and Roger Easton have become internationally prominent for their techniques for rescuing and analyzing obscured manuscripts with multispectral capture, chemical analysis of inks and supports, digital representation with maximum colorimetric accuracy, etc. In Spain, their application to manuscripts of incalculable historic importance, such as the sole codex of Cantar de Mio Cid (Montaner, 2008) or to discover Grecolatin palimpsests has generated an essential line of research (Escobar, 2006). In these pages, the paper by Sebastian Bosch and Andreas Janke provides a thought-provoking case study. In it, a Scientific Analysis of Manuscript Illumination through XRF, Visible Reflectance Spectroscopy and Infrared Reflectography is carried out on one of the most important Italian song collections of the late Middle Ages: the so-called Squarcialupi Codex, which was created around 1410 in Florence. Nonetheless, standardization of quality criteria applied to photographic capture in digital paleography projects continues to be essential. For this reason, the paper by Jesús Robledano entitled “Quality control of digital representations of manuscript texts: proposal of a standards-based method” provides a valuable guide for researchers in digital paleography. In fact, his study based on more than 275 representations of manuscript pages dating to the 12th to 17th centuries proposes a quality control method for digitized versions of manuscript documents consisting of a systematic review of papers related to automated analysis of the physical characteristics of handwritings as well as of the numerous standards that have been emerging in the field of image engineering for quality assessment in digital image recordings.

The broad conceptualization of the manuscript as a cultural artifact promoted in this volume obliges us to address specimens that are increasingly being situated at the center of an assertion of short texts or secularly forgotten fragments. Digital fragmentology finds an extremely interesting field of application, not only in the recovery of
manuscript fragments but also in educational innovation, in the *Textus Invisibilis* project in which Alessandra Molinari is participating from the University of Urbino. Her contribution shows the development and main results of the engagement of students in this project that was initiated in 2011 to valorize the parchment fragments preserved at the Urbino section of the Pesaro State Archive. The original plan was to digitally restore the single pieces, virtually re-unite the *membra disiecta* into their original codex layout, and set up a database that would follow the cataloging principles of the international archival standards. However, students participating in the project during paleography training and internship programs in subsequent years have raised issues that had not been considered in the original project vision. In fact, working with fragments has affected the students’ perceptions of themselves and of the functions of literacy in their personal existence so as to increase their awareness of the interplay between their handwritten imprinting and their born-digital mindset.

Classic works like that of the typographer and designer Gerrit Nordzij (2005) continue to represent valid bridges for the study of ductus for paleographers, calligraphers and typographers alike, united by the multidimensional study of handwriting, illuminating doctoral theses with enormous impact for typographic written culture like that defended by F. E. Blokland (2016). For this reason, it was necessary to round out the multiplicity of manufactual visions of the manuscript with the intervention of an expert calligrapher who is also a graphic designer such as professor Manny Ling. As with his colleague Ewan Clayton at the International Research Centre for Calligraphy (IRCC, University of Sunderland, UK), his academic profile perfectly combines these dimensions which are so necessary for penetrating the influence that historical scripts have had and continue to have in typographic communication processes. In fact, as indicated by the author himself, “When looking at a manuscript, calligraphers tend to study the general aesthetics, the letter forms and the use of materials, tools and processes rather than the literary content (assuming the calligrapher cannot read the language of the manuscript).” This paper discusses how some historical scripts are adapted and translated into contemporary calligraphy and typefaces, also reevaluating the role of the calligrapher in a globalized and technologically advanced world, where the handmade scripts need to adapt and evolve to reflect the multicultural world that we live in.

One of the limitations that can arise when promoting technology-based paleographic micro-studies is that their results or applications can be diluted or not fully comprehended in a wider social history of written culture or one with a broader chronological spectrum. Nonetheless, it is precisely comparative studies of letter morphology in a historic period that can open the way to interesting perspectives of renewal in the history of the introduction of one writing model or another. This is the case of the work proposed by Eduardo Juárez when confronting a succulent historical graphic intersection: the possibility that the early Roman-influenced movable types of the printing press brought by Juan Parix to the Castilian city of Segovia might have had an influence in the greater cleanness, care and delineation of the so-called court calligraphy of the late 15th century.

### 6 Epilogue

The multiple perspectives and approaches that are revitalizing paleographic competencies in the digital environment oblige us to go a bit further than what is expressed above and, for its extensiveness, than what is being proposed in the rich contributions in this special issue. One example: the impact that digital paleography is having or is going to have in the immediate future on the consideration of the manuscript as an object of archival attention (although not exclusively) (Schenk, 2018) and in archival and counterarchival practices still remains to be quantified if, as indicated by Markus Friedrich (2018), the “history of archiving should be seen as a crucial history of writing.” The necessary consideration of the manuscript from a perspective that is not static but rather subject to movement and graphic evolutions derived from the pure act of writing in each historic epoch opens the door to interesting educational and research challenges for archive and library professionals. Ensuring that the use of computers and digital cameras solely as capture and display devices is not merely a change of supports for doing the same tasks as before is the responsibility of all the players involved. Ideas, possibilities, projects and interdisciplinary collaborations are not lacking, and this volume you are about to begin is good and sincere evidence of that.
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