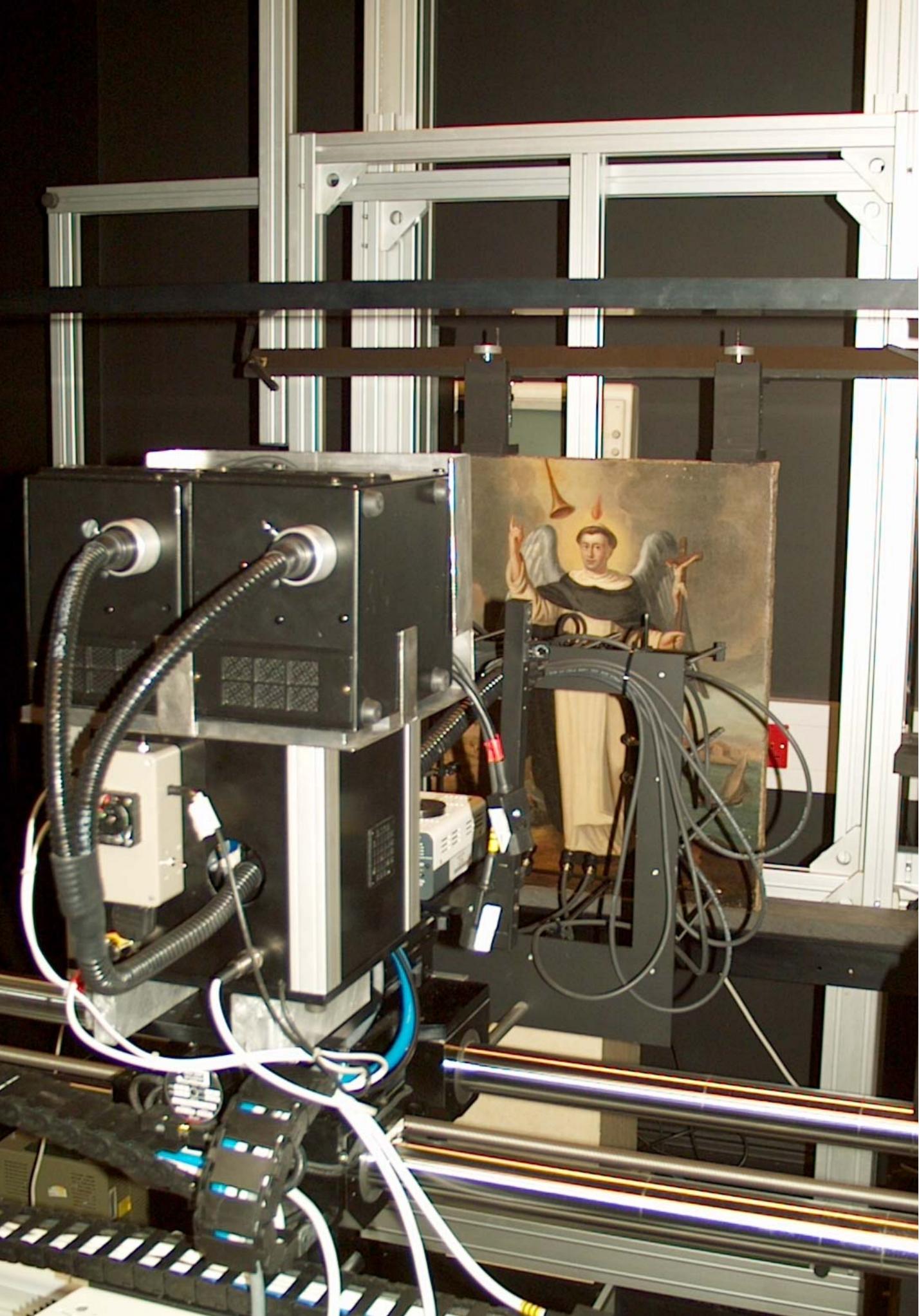# What is Digital
# Art History?

# Forgotten Genealogies: Brief Reflections on the History of Digital Art History

Benjamin Zweig

**Abstract:** The past five years have witnessed a growing interest amongst art historians in the potential of digital projects to impact, if not transform, the discipline. A steep rise in conferences and institutes dedicated to digital art history, along with funding opportunities and institutional support, has accelerated the rate at which art historians are now engaging with digital techniques. With this new visibility, art historians have criticized themselves for lagging behind other disciplines such as history and archaeology. This article questions the assumption that art historians have been slow to embrace digital tools and methods through a brief historical examination of projects undertaken by institutions and scholars during the infancy of art history computing: the early 1980s through the early 1990s. Using Johanna Drucker's distinction of the "digitized" and "digital" iterations of art history, this essay traces the genealogies of both categories, arguing that scholars have been more active in theorizing, practicing and creating digital methods than is often seen to be the case. Ultimately, this essay is an attempt to help define from a historical perspective what "digital art history" is and how it has been practiced.

**Keywords:** historiography, databases, art history, methodology, museum, digital, digitized

# Introduction[1]

In her 2012 report for the Kress Foundation *Transitioning to a Digital World: Art History, Its Research Centers, and Digital Scholarship*, Diane Zorich summarizes both the consternation that art historians have been left behind by the digital turn in the humanities and the skepticism that it is going to change the practices of the

discipline in any meaningful way.[2] In her estimation, "There is a pervasive sense that the discipline is too cautious, moves too slowly, and has to "catch up" in the digital arena."[3] This perception is not a new one. In his 1992 article "Computer Applications in the History of Art," Anthony Hamber argues how "information

Figure 1: The VASARI Scanner. Date unknown.
(Photo: Kirk Martinez. Reproduced with permission)

technology within the world of the history of art has, until recently, lagged somewhat behind [other disciplines]."[4] Such attitudes have continued to circulate throughout art history. In the 2004 book *A Companion to Digital Humanities*, Michael Greenhalgh, a longtime supporter of art history computing, laments how it is "the human element [rather than the technological] that restricts obvious developments in the discipline."[5] The announcement for a conference on "Digital Art History" held at the Institute of Fine Arts, New York University, at the end of 2012 proclaims, "In the context of art history the integration of digital tools and processes has lagged, in varying degrees, in comparison to other disciplines like archaeology and literary studies."[6] And in a paper delivered at the conference "The Digital World of Art History 2013: From Theory to Practice" at the Index of Christian Art, Zorich argues that art history has been "slow at adopting the computational methodologies and analytic techniques that are enabled by new technologies," singling out as examples visualization, network analysis, and topic modeling.[7]

Rather than embracing the methodological innovations or challenges presented by computational practices, the argument goes, art historians have simply lapsed into using technology as ever-expanding slide libraries. Johanna Drucker makes this point in a 2013 article in the journal *Visual Resources*, in which she distinguishes between art historians who practice *digitized art history* and those who practice *digital art history*. According to Drucker, "[a] clear distinction has to be made between the use of online repositories and images, which is *digit-*

*ized* [emphasis in original] art history, and the use of analytic techniques enabled by computational technology that is the proper domain of *digital* [emphasis in original] art history."[8] In Drucker's view, the "digitized" iteration of art history propels traditional practices, exemplified by the online publication of image collections and born-digital periodicals such as *Nineteenth-Century Art Worldwide*. This iteration gives scholars quicker access to more materials without challenging the practices under which they work.[9] In contrast, the "digital" is "the use of analytic techniques enabled by computational technology," including structured metadata, network analysis, discourse analysis, virtual modeling, simulation, and the aggregation of materials from disparate geographic locations.[10]

With the steep rise of scholarly interest in using, theorizing, and funding the creation of digital tools and methodologies, it seems as though art historians are indeed playing catch-up. But art historians' engagement with both the *digitized* and the *digital* versions of art historical practice, as per Drucker, is more historically complex than current debates suggest. For instance, as early as 1981 the Getty Art History Information Program (AHIP), an antecedent of the Getty Research Institute, set out to facilitate the creation of sets of linked "data banks" by the Getty and a group of international partner institutions that included the National Gallery of Art, Washington, and the Witt Library.[11] In 1985, the group Computers and the History of Art (CHArt) was founded in London in order to bring together academics, museum professionals, and information technology specialists who were interested in

pursuing computational practices, such as database creation and quantitative analysis, as well as developing new software and hardware with which to examine works of art.[12] CHArt began publishing a newsletter in 1986, a book in 1989, and an eponymous journal in 1990. [13] Indeed, 1990 also witnessed the first "Electronic Visualization and the Arts" (EVA) conference at the Imperial College, London. In 1997, Hubertus Kohle published the volume *Kunstgeschichte digital: eine Einführung für Praktiker und Studierende*, a collection of 15 essays exploring a diverse array of projects and theoretical positions on the relationship between art history and computers. [14] That same year, two unrelated articles were published exploring the intersection of art history and emerging technologies: "Digital Art History: A New Field for Collaboration" by Sally Promey and Miriam Stewart in *American Art*, and "Digital Culture and the Practices of Art and Art History" by Kathleen Cohen *et al* in *The Art Bulletin.*[15] And in 2005, CHArt published the volume *Digital Art History: A Subject in Transition.*[16]

In this short essay, I want to question the assumption that art history has lagged behind other humanities disciplines in its engagement with digital tools and techniques.[17] I approach the ontology of "digital art history" from a historical perspective rather than a technical or methodological one.[18] I want to sketch out the genealogies of "digital art history" itself to better understand how the practices and debates subsumed under this concept have taken shape. I do not attempt to tell the complete story. Indeed, I limit my chronological scope from roughly the early 1980s through the

mid 1990s, and have selected just a few examples from a rich body of material. Ultimately, this essay is an attempt to help define from a historical perspective what "digital art history" is and how it has been practiced.

## A Genealogy of "Digitized" Art History

Drucker's distinction between *digitized* and *digital* art history, while imperfect categories, affords us with a good point of entry from which to understand the history of doing art history digitally. Let us begin with the *digitized*, the creation of electronic databases and the digitization of works of art and image collections.

The earliest projects integrating computers with art history primarily emerged from museums and libraries in the late 1970s and the early 1980s.[19] As computers enabled cultural organizations to organize better large and sometimes poorly documented collections, museums and libraries from the United States and Europe saw the potential for collaboration and the cross-referencing of their collections. But there were complications. While computers allowed for the unprecedented exchange of information, disparate standards of cataloging practices made communication difficult. Several ambitious initiatives and groups sought to tackle this problem. For instance, in 1983 the international Architectural

Drawings Advisory Group (ADAG) first convened at the Center for Advanced Study in the Visual Arts (CASVA) in Washington in order to systematize cataloging standards that would ensure for scholars "a consistent set of research information across repositories, perhaps eventually, *through an electronic network* [emphasis added]."[20]

In 1986, a sub-group of four ADAG repositories and the Getty Trust, the Foundation for Documents of Architecture (FDA), was created for the purpose of addressing disparate cataloging practices for closely related drawings. In 1988-1989, and housed at the National Gallery in Washington, the FDA project staff was tasked with experimenting on a new cataloging system devised by AHIP that "would allow scholars to manipulate catalogue information in ways that would yield *new views of the material itself* [emphasis added]."[21] The ideal goal was not simply to reconcile cataloging practices through computers, but to use them as a means to find new research questions. They sought "to define what an electronic research environment might be."[22] While the FDA eventually concluded that the development of a computer network was beyond its reach, the ambition to develop such a project, and the foresight regarding its possibilities, was at the cutting edge of conceptualizing the intersection of art history with information technology.

Smaller institutions began independently testing the ideas floated by the ADAG and AHIP from an early date. In 1989, Janet Barnes, Keeper of the Ruskin Gallery, Sheffield, England, considered implementing a database that would function as both the first accurate catalog of the gallery's collection *and* as a multi-faceted image retrieval system for users rather than a standard commercial inventory system.[23] The logic behind creating such a system was to follow the intentions of the art critic John Ruskin, who compiled the museum's collection, so that visitors could easily make connections between ostensibly unrelated artworks – effectively an early user-oriented and visually-constructed relational database. The ultimate fate of the project is sadly unclear.

1989 also witnessed the initiation of the ambitious and well-documented image-oriented database VASARI project, both a reference to Giorgio Vasari and an acronym for Visual Arts System for Archiving and Retrieval of Images.[24] VASARI was an international collaborative, bringing together scientific departments from the National Gallery, London, the Doerner Institute of the Bavarian State Galleries, Telecom Paris, the Louvre, and the Department of the History of Art, Birkbeck College, University of London, which handled much of the art historical and computer science aspects of the project.[25] The goal of VASARI was to create digital images of sufficiently high resolution that could replace photographs as the preferred recording system for artworks. VASARI did not rely on scanning existing images or transparencies into a database. Rather, it sought to create new colorimetric images taken directly from paintings, which involved the creation of a new type of scanner that recorded paintings frame by frame (or pixel by pixel) through seven simultaneous color filters, and then "mosaiced" them together using custom software (Fig. 1).[26] These

images were to be far more accurate in terms of their color reproduction and color monitoring than analog photography.[27] Most interestingly, the VASARI project was envisioned as "machine independent," able to be transported from computer to computer and, ideally, over a network, rather than tied to a single workstation.[28] In this way, VASARI was conceived as a web-based project before the "web" was in the public consciousness – indeed, conceived of at the same moment as Tim Berners-Lee's revolutionary work at CERN.

In 1994, AHIP published *Humanities and Arts on the Information Highways*, one of the earliest "state of the field" reports for what would become better known as the "digital humanities."[29] The report extolled the possibilities presented by the exchange of information electronically, while also highlighting its many challenges, such as technological barriers, political apathy, and the undercapitalization of projects. The report lists many art history projects in their survey of important computer-based projects in the humanities and the arts (a number of which still function), including the MIT Museum Architecture Project, the Bibliography of the History of Art, the Save Outdoor Sculpture Project, the Witt Computer Index of Print Works, and the Census of Antique Art and Architecture Known to the Renaissance.[30]

The above projects are electronic databases or iterations of mostly pre-electronic initiatives. But the report goes deeper than summarizing then-current electronic projects. It enumerates a series of recommendations for the practice of creating and maintaining digital projects,

such as enabling the "highest fidelity of representation of originals" and preserving object integrity through "technical methods such as color matching and compensation."[31] Moreover, the report encourages the development of new tools for humanities and arts computing, including building authoring tools that "exploit networked resources," "capture text, image, and sound in its editing and mark-up while capturing the history of different versions," "annotate videoclips, images, oral interviews, music, dance, and other cultural heritage information," and "support annotation systems that allow not only for personal commentary, but also for additions to the cumulative scholarly record."[32] AHIP was highly conscious of the impact that the digitization of source material could have on scholarly exchange while being equally aware of how electronic formats presented a host of particular challenges and possibilities.

There are many other notable examples of art historical projects that began testing the limits of technology's impact on image databasing in the 1980s and 1990s, such as the Visual Arts Network for the Exchange of Cultural Knowledge (VAN EYCK) project, a European international collaborative that sought to exchange text and image information between different art historical databases that could be searched simultaneously from remote terminals – a precursor of aggregator sites like Europeana or the Getty Research Portal.[33] The point to be taken from the above survey is that art historians have not simply been interested in creating a better slide library. For many years scholars have recognized the potential that the *digitized* iteration of art

history held for organizing and working with both the objects of study and for scholarly collaboration; something that is becoming increasingly important with the move towards linked open data and the semantic web.

# A Genealogy of "Digital" Art History

What, then, about the *digital* iteration of art historical practice that art historians are criticized for not practicing? Can this charge hold up to a scrutiny of the historical record?

Let us begin answering this question by examining one the earliest projects that sought to use computational techniques for art historical research: the pioneering MORELLI project, named after the physician and connoisseur Giovanni Morelli and initiated in the mid 1980s by William Vaughan, Professor of Art History at Birkbeck College. In short, MORELLI was a pattern recognition tool that automatically classified and analyzed the formal qualities of pictures.[34] Vaughan conceptualized the project as "a simple matching process...the visual equivalent of the 'word search' [feature]..."[35] But MORELLI did not rely on metadata as its organizing principle, as would be the case with a traditional database. Instead, features such as compositional configuration and tonality were to be derived directly from the process of digitization, which would then be com-

pared across a base data set of 10,000 images.[36] Moreover, it used a monochrome low-resolution digital image of 64KB rather than large files, and was able to recognize within "reasonable limits" different copies of the same picture and differentiate formally similar pictures without confusion.[37]

According to Vaughan, the ultimate ambition of the project was to enable a *new* methodology in order "to make such visual sorting and selecting.... something that could genuinely be the basis of structured pictorial analysis."[38] Because the system relied on visual matching and sorting, in a fully implemented system the user could sift through an enormous visual archive, one beyond the capacity of human memorization, to find patterns and anomalies in the historical record; that is, to find if a particular type of composition is unique to one artist or one period, and, most importantly, to "link images together that cannot be found by means of textual reference."[39] MORELLI was thus envisioned as enabling a "visual syntax of forms" from which complex visual arguments could be made, and stands as an unheralded antecedent to contemporary projects like Image Plot.[40]

Vaughan's MORELLI project had a cognate in IBM Almaden's Query by Image and Video Content System (QBIC).[41] Like MORELLI, QBIC retrieved data from images not based on subject matter, as art historians might understand "content" to mean, but on the visual qualities of the image – line, color, patterns, textures, and shapes.[42] In theory, the system allowed a user to conduct queries such as "Find images with a red, round object,"

"Find images that have approximately 30-percent red and 15-percent blue colors," or "Find images that have 30 percent red and contain a blue textured object."[43] In 1993, the Department of Art and Art History at the University of California, Davis, put these ideas into practice and launched a pilot database using QBIC as a means of enabling better searching through the department's collection of 200,000 slides.[44] After the completion of initial testing using a data set of 2,000 images, the department concluded that QBIC's chief strength resided in its ability to *sort* artworks by aesthetic values rather than search for them. The value of applying the QBIC system to an image collection was to allow a user to sift quickly through large datasets to find hidden trends, relationships, or themes; the visual equivalent to computational methodologies such as text mining and topic modeling.

During the late 1980s and early 1990s, a number of art historians were also working on smaller-scale digital projects. For instance, around 1988, Marilyn Lavin began planning an interactive three-dimensional recreation of Piero della Francesca's *Legend of the True Cross* at Arezzo.[45] As she saw it, formats such as slides gave uniform scale to all images, unintentionally eliminating important aesthetic and experiential differences. The aim of the Piero project was to "present an electronic surrogate for the configuration of the fresco paintings as they appear to a visitor in the church," which would incorporate natural color, relative scale, and physical environment.[46] Lavin's project sought to use the digital environment to re-create one of the most persistent concerns of the history of art –

understanding a work of art in its physical and historical context. The central problem tackled by Lavin's project was by no means a radical one; in fact, it was a rather conservative one. But the virtual modeling approach allowed for an "analytic flexibility" that still photography could not equal.[47]

One of the more interesting early digital projects (c. 1990) was Gilbert Herbert and Ita Heinze-Greenberg's statistical analysis of the profession of the architect in Palestine during the British Mandate of the 1920s and 1930s.[48] In contrast to the biographical approach (understandably) favored by most scholars, Herbert and Heinze-Greenberg organized a databank of 595 persons who had lived and worked in Palestine as architects between 1918 and 1948, of which 470 contained enough information to use in their study. The authors organized their data by the years of immigration of architects into Palestine, the countries from which they emigrated, the country of education of architects born in Palestine, and the country of education of architects who qualified for the profession after immigration. Some of the conclusions they reached by quantitative analysis included the large number of German-born and German-educated architects, many who studied at the Bauhaus; that while the number of British-born architects was small, a large group of Russian and Polish-born architects trained in the United Kingdom; and that during the first decade of the mandate, 85% of immigrant architects had been in the country less than ten years.[49]

The value of such quantitative studies as Herbert and Heinze-Greenberg's for

art history is that they can problematize the weighty claims put forth by scholars based upon very small data sets. By displacing the centrality of exceptional works of art or individual biographies into larger networks, this approach can function as a research method that raises new questions about historical events and as a potential mode of historiographic critique. As the foundation for methods such as topic modeling and data mining, the quantitative analysis of art historical data can be both a challenge and a *complement* to the case-study model of practice.

## Conclusion

This brief enumerative trip into the historical record shows how art historians have been engaged in theorizing and using computational technologies and techniques since the 1980s. As noted earlier, the projects outlined here merely scratch the surface of a much richer history. While working digitally has been a small subset of disciplinary practice, it has by no means been absent. Many of the challenges these early forays in the digital world faced and that sadly could not be addressed here – funding, sustainability, archiving, copyright, technological obsolescence, documentation, tenure consideration, peer evaluation – will remain issues that art historians must tackle as the field moves forward. By gazing at the recent past, the field can recognize these pioneering contributions and learn from their ambitions. Technology has reached a point where it is now easier (but by no means easy) to experiment with digital tools and methods, from using content management systems,

to analyzing collection metadata released by museums, to employing open-source programs such as the visualization tool Gephi and the mapping program QGIS. But as digital art history continues to grow, as the problems it addresses become more sophisticated, as we work to define the tenets under which it functions, as it occupies a more central place in the discipline, and as scholars become more active in the creation of digital tools, we should be careful not to forget that the digital itself has formed part of the larger history of art history.

## Notes

[1] For their most valuable input and support, I would like to thank Deans Elizabeth Cropper, Peter Lukehart, and Therese O'Malley at the Center For Advanced Study in the Visual Arts, Paul Jaskot, Susan Siegfried, Kirk Martinez, the journal's editors, and the two anonymous reviewers.

[2] Diane Zorich, *Transitioning to a Digital World: Art History, Its Research Centers, and Digital Scholarship* (New York: Samuel H. Kress Foundation, 2012), esp. 6, 14, 20. Available at: http://www.kressfoundation.org/uploadedFiles/Sponsored_Research/Research/Zorich_TransitioningDigitalWorld.pdf

[3] Ibid, 20.

[4] Anthony Hamber, "Computer Applications in the History of Art: A perspective from Birkbeck College, University of London," *Extrait de la Revue Informatique et Statistique dans les Sciences humaines*, Vol. 28, No. 1 (1992), 79-91.

[5] Michael Greenhalgh, "Art History," *A Companion to Digital Humanities* (Oxford: Blackwell, 2004), 41. Book available at: http://www.digitalhumanities.org/companion/

[6] http://www.nyu.edu/gsas/dept/fineart/research/me llon/mellon-digital.htm

[7] Diane Zorich, "The "Art" of Digital Art History," presented at the Index of Christian Art, Princeton University, June 26, 2013. Available at: http://ica.princeton.edu/digitalbooks/digitalworldofarthistory2013/7.D.Zorich.pdf

[8] Johanna Drucker, "Is There a "Digital" Art History?" *Visual Resources: An International Journal of Documentation*, Vol. 29, No. 1-2 (2013), 7.

[9] Ibid.

[10] Ibid.

[11] A brief overview available at: http://socialarchive.iath.virginia.edu/xtf/view?docId=getty-art-his tory-information-program-cr.xml

[12] For a brief discussion of the founding of CHArt, see Jean Miles, "Introduction," *Computers and the History of Art*, Vol. 1, No. 1 (1990), 1-2; also Hamber, "Computer Applications," 81.

[13] A full list of CHArt programs and publications available at: www.chart.ac.uk

[14] *Kunstgeschichte digital: eine Einführung für Praktiker und Studierende*, ed. Hubertus Kohle (Berlin: Dietrich Reimer Verlag, 1997).

[15] Sally M. Promey and Miriam Stewart, "Digital Art History: A New Field for Collaboration," *American Art*, Vol. 11, No. 2 (1997), 36-41; Kathleen Cohen, James Elkins, Marilyn Aronberg Lavin, Nancy Macko, Gary Schwartz, Susan L. Siegfried and Barbara Maria Stafford, "Digital Culture and the Practices of Art and Art History," *The Art Bulletin*, Vol. 79, No. 2 (1997), 187-216.

[16] *Digital Art History: A Subject in Transition*, ed. Anna Bentkowska-Kafel, Trish Cashen, and Hazel Gardiner (Bristol: Intellect Books, 2005).

[17] Elizabeth Cropper, Dean of the Center for Advanced Study in the Visual Arts (CASVA), made a similar point in her introductory remarks to the conference "New Projects in Digital Art History," held at the National Gallery of Art, Washington D.C., November 21, 2014.

[18] Indeed, the history of the digital humanities has received little attention. See Julianne Nyhan, Andrew Flinn, and Anne Welsh, "Oral History and the Hidden Histories project: towards histories of computing in the humanities," *Digital Scholarship in the Humanities*, Vol. 30, No. 1 (2015), 71-85. Thanks to Paul Jaskot for alerting me to this essay. Available at: http://dsh.oxfordjournals.org/content/30/1/71

[19] The history of museums and technology deserves a much fuller investigation than can be done here.

[20] Vicki Porter and Robin Thomas, *A Guide to the Description of Architectural Drawings* (New York: G.K. Hall & Co., 1994), xvii.

[21] Ibid, xix.

[22] Ibid.

[23] Janet Barnes and Alan Griffiths, "Creating an image database for the Collection of the Guild of St. George Ruskin Gallery, Sheffield, UK," *Computers and the History of Art*, Vol. 3, No. 1 (1992), 17-24.

[24] Anthony Hamber, "The VASARI Project," *Computers and the History of Art*, Vol. 1, No. 2 (1990), 3-19.

[25] For the entire list of partners, see Ibid, 3-4.

[26] Ibid.

[27] Ibid, 4-5.

[28] Ibid, 5.

[29] *Humanities and Arts on the Information Highways: A Profile. Final Report.* (Santa Monica: Getty Art History Information Program, 1994). Available at: http://www.cni.org/resources/historical-resources/humanities-and-art-on-the-information-high ways

[30] Ibid, 43-44.

[31] Ibid, 31.

[32] Ibid, 32.

[33] Colum Hourihane and John Sunderland, "The Van Eyck Project, Information Exchange in Art Libraries," *Computers and the History of Art,* Vol. 5, No. 1 (1992), 25-40.

[34] William Vaughan, "The Automated Connoisseur: Image Analysis and Art History," *History and Computing*, ed. Peter Denley and Deian Hopkin (Manchester: Manchester University Press, 1987), 215-221; *idem*, "Automated Picture Referencing: A Further look at 'Morelli'," *Computers and the History of Art*, Vol. 2, No. 2 (1992), 7-18; *idem*, "Computergestützte Bildrecherche und Bildanalyse," *Kunstgeschichte digital*, 97-105.

[35] Vaughan, "Automated Picture Referencing," 9.

[36] Ibid, 15.

[37] Hamber, "Computer Applications," 82.

[38] Vaughan, "Automated Picture Referencing," 8-9.

[39] Ibid, 17.

[40] Image Plot: http://lab.softwarestudies.com/p/imageplot.html

[41] It is unclear to me when exactly IBM began developing QBIC. It was well underway by 1992-1993. See note 42.

[42] Myron Flickner, Harpeet Sawhney, Wayne Niblack, Jonathan Ashley, Qian Huang, Byron Dom, Monika Gorkani, Jim Hafner, Denis Lee, Dragutin Petkovic, David Steele, and Peter Yanker, "Query by Image and Video Content: The QBIC System," *IEEE Computer*, Vol. 28, No. 9 (1995), 23-32.

[43] Ibid. 25.

[44] Bonnie Holt, Ken Weiss, Wayne Niblack, Myron

Flickner, and Dragutin Petkovic, "The QBIC Project in the Department of Art and Art History at UC Davis," *Proceedings of the Annual ASIS Meeting*, Vol. 34 (1997), 189-195.

[45] Marilyn Aronberg Lavin, "Researching Visual Images with Computer Graphics," *Computers and the History of Art*, Vol. 2, No. 2 (1992), 1-5. The project, albeit in a very different form than the original, is available at: http://projects.ias.edu/pierotruecross/

[46] Ibid, 2.

[47] Drucker makes a good point of highlighting the "analytical flexibility" of virtual reconstructions. Drucker, "Is There a "Digital" Art History?" 11.

[48] Gilbert Herbert and Ita Heinze-Greenberg, "The Anatomy of a Profession: Architects in Palestine during the British Mandate," *Computers and the History of Art*, Vol. 4, No. 1 (1993), 75-85.

[49] Ibid, 80-84.

# Bibliography

Barnes, Janet and Alan Griffiths. "Creating an image database for the Collection of the Guild of St. George Ruskin Gallery, Sheffield, UK." *Computers and the History of Art* 3, No. 1 (1992): 17-24.

Bentkowska-Kafel, Anna, Trish Cashen, and Hazel Gardiner, ed. *Digital Art History: A Subject in Transition*. Bristol: Intellect Books, 2005.

Cohen, Kathleen, James Elkins, Marilyn Aronberg Lavin, Nancy Macko, Gary Schwartz, Susan L. Siegfried and Barbara Maria Stafford. "Digital Culture and the Practices of Art and Art History." *The Art Bulletin* 79, No. 2 (1997): 187-216.

Drucker, Johanna. "Is there a Digital Art History?" *Visual Resources: An International Journal of Documentation* 29, No. 1 (2013): 5-13.

Flickner, Myron, Harpeet Sawhney, Wayne Niblack, Jonathan Ashley, Qian Huang, Byron Dom, Monika Gorkani, Jim Hafner, Denis Lee, Dragutin Petkovic, David Steele, and Peter Yanker. "Query by Image and Video Content: The QBIC System." *IEEE Computer* 28, No. 9 (1995): 23-32.

Greenhalgh, Michael. "Art History." In *A Companion to Digital Humanities*, edited by Susan Schreibman, Ray Siemens, and John Unsworth, 31-45. Oxford: Blackwell Publishing, 2004.

Hamber, Anthony. "The VASARI Project." *Computers and the History of Art* 1, No. 2 (1990): 3-19.

--- "Computer Applications in the History of Art: A perspective from Birkbeck College, University of London." *Extrait de la Revue Informatique et Statistique dans les Sciences humaines* 28, No. 1 (1992): 79-91.

Herbert, Gilbert and Ita Heinze-Greenberg. "The Anatomy of a Profession: Architects in Palestine during the British Mandate." *Computers and the History of Art* 4, No. 1 (1993): 75-85.

Holt, Bonnie, Ken Weiss, Wayne Niblack, Myron Flickner, and Dragutin Petkovic. "The QBIC Project in the Department of Art and Art History at UC Davis." *Proceedings of the Annual ASIS Meeting* 34 (1997): 189-195.

Hourihane, Colum, and John Sunderland. "The Van Eyck Project, Information Exchange in Art Libraries." *Computers and the History of Art* 5, No. 1 (1992): 25-40.

*Humanities and Arts on the Information Highways: A Profile. Final Report.* Santa Monica: Getty Art History Information Program, 1994.

Kohle, Hubertus, ed. *Kunstgeschichte digital: eine Einführung für Praktiker und Studierende*. Berlin: Dietrich Reimer Verlag, 1997.

Lavin, Marilyn Aronberg. "Researching Visual Images with Computer Graphics." *Computers and the History of Art* 2, No. 2 (1992): 1-5.

Miles, Jean. "Introduction." *Computers and the History of Art* 1, No. 1 (1990): 1-2.

Nyhan, Julianne, Andrew Flinn, and Anne Welsh. "Oral History and the Hidden Histories project: towards histories of computing in the humanities." *Digital Scholarship in the Humanities* 30, No. 1 (2015): 71-85.

Porter, Vicki and Robin Thomas. *A Guide to the Description of Architectural Drawings*. New York: G.K. Hall & Co., 1994.

Promey, Sally M. and Miriam Stewart. "Digital Art History: A New Field for Collaboration." *American Art* 11, No. 2 (1997): 36-41.

Vaughan, William. "The Automated Connoisseur: Image Analysis and Art History." In *History and Computing*, edited by Peter Denley and Deian Hopkin, 215-221. Manchester: Manchester University Press, 1987.

--- "Automated Picture Referencing: A Further look at 'Morelli'." *Computers and the History of Art* 2, No. 2 (1992): 7-18.

--- "Computergestützte Bildrecherche und Bildanalyse." In *Kunstgeschichte digital: eine Einführung für Praktiker und Studierende*, edited by Hubertus Kohle, 97-105. Berlin: Dietrich Reimer Verlag, 1997.

Zorich, Diane. *Transitioning to a Digital World: Art History, Its Research Centers, and Digital Scholarship*. New York: Samuel H. Kress Foundation, 2012.

--- "The "Art" of Digital Art History." Paper presented at the Index of Christian Art, Princeton University, June 26, 2013.

**Benjamin Zweig**, Ph.D., is the Robert H. Smith Postdoctoral Research Associate for Digital Art History at the Center for Advanced Study in the Visual Arts (CASVA) National Gallery of Art, Washington DC. He received his Ph.D. in Art History from Boston University. He is a medievalist by training, with a particular interest in digital mapping and developing/writing tools useful for art historical research.

Correspondence e-mail: b-zweig@nga.gov