

# How Soon Is Now? Writings on Digital Archiving in Canada from the 1980s to 2011

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## ABSTRACT

During the 1980s and 1990s, electronic records were a source of general concern and debate among Canadian archivists. There was a heightened interest in, and increasing numbers of articles about, electronic recordkeeping projects such as the University of British Columbia (UBC) Project and the National Archives of Canada's Information Management and Office Systems Advancement (IMOSA) Project, as well as non-Canadian projects like the Pittsburgh Project. Such projects often represented a turning away from approaches established and expertise gained during the machine readable archives (MRA) era. Nonetheless, digital archival work outside of these projects continued, much of it moving in trajectories set during the MRA era. This article suggests that MRA methods, ideas, and approaches have reemerged today as foundational to contemporary digital archives theory and practice.

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## KEY WORDS

Digital archives, Archival history

When you say it's gonna happen now  
 When exactly do you mean?  
 See I've already waited too long  
 And all my hope is gone.

—The Smiths, “How Soon Is Now?”<sup>1</sup>

**T**he *Future Now: Canada's Libraries, Archives, and Public Memory* is a 2014 status report on Canada's memory infrastructure by the Royal Society of Canada (RSC). Early in 2015, the Council of Canadian Academies (CCA) released a report focusing on Canada's digital memory infrastructure titled *Leading in the Digital World: Opportunities for Canada's Memory Institutions*. Concerns about the ability of Canadian memory institutions to capture, preserve, and make accessible Canada's digital heritage inspired the RSC and the CCA to undertake these reports. They came at a tumultuous time in the history of Canadian archives. Canada's Conservative government had cut Library and Archives Canada's (LAC's) budget by 10 percent in 2012; LAC responded to the cuts with a series of difficult choices including eliminating the National Archival Development Program (NADP), a matching-funds program that had supported the efforts of smaller Canadian archives, in addition to reducing front-line service staff, IT staff, private records archivists, and other staff in the organization.<sup>2</sup>

This was the immediate context of the RSC and CCA reports, but the reports focused on the longer term, while looking forward and backward. The CCA report does indeed describe opportunities for Canadian memory institutions to lead in the digital world—plenty of opportunities, as the CCA found that Canada presently lags. The title of the RSC report, *The Future Now*, evokes the urgency of the report's calls to establish digital memory infrastructure commensurate with Canadians' extensive use, for at least the last twenty years, of digital technologies in all aspects of their lives.<sup>3</sup>

It was not always thus. This article is the second in a two-part study of publications on digital archiving in Canada from the 1960s to 2011. “Media, and the Messengers: Writings on Digital Archiving in Canada from the 1960s to the 1980s,” available in *Archivaria* 82 (Fall 2016), explores, primarily through articles published in *Canadian Archivist* and *Archivaria*,<sup>4</sup> some of the earliest digital archives work in Canada, including computer-generated finding aid projects in the 1960s and the founding of a machine readable archives (MRA) unit at the Public Archives of Canada (precursor to Library and Archives Canada)<sup>5</sup> in the early 1970s. Such efforts placed Canadian archivists at the cutting edge of digital archival work. In retrospect, this might have been a golden age of Canadian digital archiving, with PAC serving as an incubator for new approaches to appraising, processing, preserving, and accessing digital records, standing firm

against the notion that digital heritage should be printed off and filed into paper recordkeeping systems.<sup>6</sup>

PAC's MRA Division was eliminated as a distinct unit in 1986. In part, this reflected changes in senior management at PAC (which became the National Archives of Canada in 1987), particularly the departure of Hugh Taylor, who left PAC in 1978 to become head of Nova Scotia's provincial archives. Taylor, inspired by Marshall McLuhan's works on media theory, was the manager of PAC's Archives Branch who had created separate media divisions, including the MRA Division. In doing so, Taylor inspired considerable controversy, with some arguing that these media divisions betrayed the fundamental archival principle of provenance, a prioritizing of content and form over context.<sup>7</sup> Terry Cook and Eldon Frost offered the best account of the elimination of the MRA Division, describing the theoretical and practical factors that led to the decision in December 1986 to combine the MRA Division with the Federal Archives Division to create the new Government Archives Division. This was intended to bring the management of federal digital records into better alignment with the principle of provenance. Cook and Frost believed that the spreading use of computers in the government, especially with the onset of routine desktop computing, meant that digital records should be addressed by portfolio archivists rather than by MRA specialists.<sup>8</sup>

This article picks up this story in the late 1980s and takes it through *Archivaria* 36 (1993), the journal's first special issue on electronic records, to *Archivaria* 72 (2011), the journal's second special issue on the topic.<sup>9</sup> I will argue that PAC's MRA unit developed essential principles and techniques of digital archiving that have been painstakingly rediscovered by today's digital archivists. Along the way, I will explore why the decision to turn away from media specialization resulted in two decades of wandering in the wilderness as Canadian archivists grappled with the tsunami of digital records that followed the mainstream adoption of desktop computing. Within the Canadian government, the shift to desktop computing compounded the effects of program review under the Liberal government of Jean Chretien, which decimated records management units throughout the Canadian government, even as the National Archives saw its own resources drastically reduced.<sup>10</sup>

This article represents my attempt, as a digital archivist at LAC during the 2000s, now as a professor of archival studies at the University of Manitoba, to make sense of the perplexing shift in Canadian digital archival thinking that coincided with the transformation of computer technologies from large, complex, and comparatively expensive mini- and mainframe computers to relatively cheap, user-friendly, and increasingly ubiquitous desktop machines. This shift saw the end of ongoing MRA-style digital archiving and the rise of a theoretical

approach to digital infrastructure that, it was claimed, would result in the creation of archivally sound digital records in the future.

My title owes multiple debts. The first is to a 1997 *Archivaria* article by Paul Marsden titled “When Is the Future?”<sup>11</sup> Marsden, an archivist at the National Archives of Canada throughout this period, was amused by those who wrote about digital archives as though time remained to prepare. The title of the 2014 RSC report, *The Future Now*, suggests that, eighteen years after Marsden’s article, Canadian memory institutions still need to stop building digital memory infrastructure for the future and start building it for the present and past. Finally, my title quotes a 1984 song by The Smiths. I have included a few lines from the song as my epigraph. Like Marsden in 1997, The Smiths’ lyricist, Morrissey, was tired of being told to wait. For his part, Marsden was exasperated by digital archiving sages of the 1990s telling working archivists that they “go about things the wrong way” without supplying any practical alternatives.<sup>12</sup>

### A Choice of Metaphors: Generations, the Wild Frontier, and the Enormous File

The story of Canadian writing about digital archives parallels the history of Canadian archivists having access to, and becoming comfortable with, computer technology.<sup>13</sup> Because archivists became desktop computer users along with other North American office workers in the early 1990s, this is also the story of the transformation of electronic records from a niche concern to a general concern. The writings of early boosters like Jay Atherton and Hugh Taylor, discussed in my earlier article, point to the importance of computers as a rhetorical signifier in the 1960s and 1970s—a marker of modernity and progress for some, a threat to human dignity for others.<sup>14</sup> During the late 1980s and 1990s, desktop computers became increasingly standard in Canadian archives, as in other office settings. This was the era when Canadian archivists, like millions of other North American office workers, literally “confronted the computer” every day when they walked into the office and turned it on.<sup>15</sup>

In many ways, this was a new beginning. While digital archives were once a media specialization, during the 1990s, electronic records started to swallow all other record types, starting with financial records, correspondence, and office documents and moving on to photographs, video, and so on. Previously, archivists could deal with records created, used, and managed as paper records, and they would deal with them with paper-based discovery tools: finding aids, file lists, card catalogs. Even as formerly paper or analog record types went digital, archival management techniques and tools also went digital, whether this meant that paper finding aids and file lists were now created using word-processing or spreadsheet software on a desktop computer and then printed, or

whether it meant that the finding aids were themselves electronic documents, spreadsheets, or databases, accessed in real time in the reading room or, as the 1990s progressed, over the World Wide Web.

As electronic records and digital archival methods became mainstream concerns, computers shifted from being rhetorical markers, whether of optimism or fear, to being a pressing concern. It is unfortunate that Canadian archivists did not therefore turn to the most experienced members of the profession, MRA archivists, for guidance in dealing with these records. Instead, they overlooked MRA experiences in formulating a response to widespread desktop computing. This is particularly obvious in Roy Shaeffer's introduction to *Archivaria* 36 (1993), the journal's first special issue on electronic records:

We are witnessing the emergence of specialists in the field of electronic records and even the appearance of that most esoteric of creatures, the "systems guru," in the archival world—individuals who write provocatively on the subject and can advise the community on broader issues and implications.<sup>16</sup>

Schaeffer breathlessly announced the *emergence* of specialists in digital archives and the *appearance* of "systems gurus," entirely overlooking already established, internationally recognized Canadian MRA experts such as Harold Naugler, John McDonald, and Sue Gavrel.

This slight must have been frustrating for MRA archivists, while the ahistorical take on computing technology must have been worrying. To the newly initiated computer user, the onset of widespread desktop computing, and the accompanying transformation of analog record types to digital, appeared to come out of nowhere. Those with more experience, like Naugler, who discussed many of these record types in his 1984 UNESCO RAMP report, knew that the replacement of analog formats with digital had been a longer process with a sudden quickening.<sup>17</sup> The roots of word processing go back decades, well before the development of word-processing software for microcomputers.<sup>18</sup> Widespread use of spreadsheets paralleled the rise of personal computing, starting in 1979 with the release of VisiCalc for the Apple II.<sup>19</sup> Hierarchical and networked database systems were drivers of mainframe usage in the 1960s, and relational database systems became increasingly common during the 1970s.<sup>20</sup> The windows-based, point-and-click graphical user interface integral to the Apple Macintosh, which Steve Jobs launched with such fanfare in 1984, had been first developed by Doug Engelbart in the 1960s—along with videoconferencing, interactive computing, and the use of networked computers as a collaborative work environment.<sup>21</sup>

Given that MRA archivists in Canada had been acquiring, managing, and providing access to digital records throughout the 1970s and 1980s,<sup>22</sup> and given the history of computer application development sketched above, it is puzzling that the 1993 special issue of *Archivaria* declared the recent emergence of digital

specialists.<sup>23</sup> One way to understand this situation is to examine contemporary metaphors used to characterize the spread of digital technologies into office environments and their impact on archival work. All too often, these metaphors subtly erased the contributions made by MRA archivists.

The spread of desktop computing among records creators, and among archivists, followed on the heels of the debate among Canadian archivists about the “historian-archivist.” Terry Cook correlated these two phenomena in his widely cited review article, “Easy to Byte, Harder to Chew: The Second Generation of Electronic Records Archivists,” which appeared in *Archivaria* 33 (1991).

Cook’s article usually is remembered for its central metaphor, namely the periodization of electronic records archivists into generations. These generations appear indebted to the grouping of computer technologies into generations in computer science. The four classic computer generations are defined by their circuitry: vacuum tubes, transistors, integrated circuits, and microprocessors.<sup>24</sup> Cook’s generations, however, are not distinguished by circuitry. The key difference between Cook’s generations lies in his perception of the complexity of the data structures that users created, rather than in circuitry or any other aspect of the underlying technology. First-generation digital archivists, according to Cook, processed software-independent flat files (outputs from relatively simple databases, resembling spreadsheets), while second-generation archivists processed relational databases and other complex, interdependent data sets and digital objects. Cook also tied his generations to the creation and enervation of MRA divisions at the Canadian and U.S. national archives, with the mid-1980s serving as a breaking point between the first and second generations.<sup>25</sup>

Though he may have been inspired by the generations described in computer science, Cook’s archival generations do not coincide with them: his first generation of digital archivists encompasses all four computer generations. This reinforces the point that while the computer generations represent changes in underlying technology—each new generation (from vacuum tubes to transistors, for example) representing a substantial improvement in terms of cost, processing power, speed, reliability, and durability—Cook based his generations on his perceptions of user experience of technology, itself affected by any number of technological, economic, social, and personal variables, including the familiarity of users with computers, how they accessed computers, and their access to institutional resources to support computing. Different user populations experienced these variables differently, and therefore they resist consistent periodization.

Despite this inconsistency, Cook’s generations became, for a time, the accepted periodization in the archival literature, with *Archivaria* and *American Archivist* contributors routinely making reference to first- or second-generation electronic records archivists, technologies, and archival practices, and Richard

Cox embedding the metaphor into the title of a book published in 1994.<sup>26</sup> Despite being widely adopted, Cook's periodization failed to reflect the range and complexity of computer usage and record types previously discussed in MRA literature such as Naugler's 1984 RAMP report or Donald Fisher Harrison's *Archivaria* 26 (1988) article on the U.S. National Archives and Records Service's (NARS's) acquisition and management of Vietnam War records.<sup>27</sup> It was an American MRA writer, Thomas Elton Brown, who directly addressed this point in *Archivaria* 41 (1996). Brown strongly objected to Cook's periodization and especially to his characterizations of the first generation of digital archivists, observing that agencies with routine, ongoing, and in-house access to mainframe computers and computer programmers had created complex, software-dependent data structures by the early 1970s and were transferring these electronic records to NARS by the mid-1970s.<sup>28</sup>

Cook's article suggests that the second generation of digital archivists was more or less starting with a clean slate. In many cases, this was literally true, since the MRA programs that Cook characterized as being the first generation were limited to the Canadian and American national archives, while new digital archival programs were being founded at the provincial and state levels, or in university or municipal archives.<sup>29</sup> Richard Cox, in *The First Generation of Electronic Records Archivists in the United States* (1994), unlike Cook, argued that the first generation of digital archives was a failure—that the history of the first generation was “largely an analysis of false starts, wrong approaches, experimentation, poor professional priorities, inadequate leadership, and other problems that have prevented American archivists from embarking on more meaningful research and application to preserve records with archival value in electronic form.”<sup>30</sup> Even in Cook's article, however, the first generation offers little deemed foundational to second-generation electronic records archival practice. Cook praised first-generation archivists as “pioneers” and “trail-blazers” who experienced the “exhilaration” of being first as well as “the pain of false starts and blind alleys.”<sup>31</sup> Finding no models for acquiring, managing, preserving, and providing access to digital records within the archival world, Cook suggested that they turned to the social sciences to develop the systems of valuation that underwrote their appraisal of digital records and to libraries for the processes used in describing, managing, and making available the records that were acquired.<sup>32</sup> Cook described how the spread of computer technologies resulted in “traditional” archivists (for Cook this meant historian-archivists) becoming more aware of and engaged with digital archives. Cook observed, “As more and more traditional archivists necessarily got deeply involved in electronic records . . . they also brought their ‘traditional’ archival principles to the world of computerized records.”<sup>33</sup> Viewed in this light, second-generation electronic records

archivists could be counted as the first generation of what Cook called “traditional archivists” to be dealing with electronic records.

Somewhat surprisingly, Cook portrayed the work of this second generation as *less* technical than that of the first generation. Cook criticized the first generation for producing an “increasingly uneasy union of the archivist and the computer technician [that] resulted in a world of arcane procedures, ‘high-tech’ jargon and almost impenetrable practice.”<sup>34</sup> He advocated a division of duties whereby “the archivist must decide what data to save,” while “the computer specialist determines how to implement these decisions made by the archivist.”<sup>35</sup> This is consistent with Cook’s earlier position on media archives, in which he suggested that archivists should make acquisition, management, and access decisions independent of media, while “storage and handling peculiarities could easily be handled by auxiliary technical staff.”<sup>36</sup> This vision is miles from some earlier Canadian writing on digital archives, including Hugh Taylor’s advice that archivists “learn the language of the computer like [their] native tongue”<sup>37</sup> or the dream of Michael Carroll, the first manager of PAC’s MRA Division, of hiring “a computer-archival expert.”<sup>38</sup> It also flies in the face of Marshall McLuhan’s observation, and the findings of archivists and conservators since, that media and message are not so easily compartmentalized.<sup>39</sup>

Cook’s perception of the declining importance of technical knowledge correlates with the rise of user-friendly consumer technologies, which started even earlier with the creation and marketing of the Apple II, launched in 1977, and the Macintosh in 1984. Previously, “homebrew” microcomputers like the Mark-8, the Altair 8800, or the Apple I were designed for the niche market of computer hobbyists who built their own systems and wrote their own software—much as mainframe computer and minicomputer operators of the same era often had to assemble systems out of heterogeneous hardware and either write or commission custom software.<sup>40</sup> Apple Computers, and particularly Steve Jobs, correctly realized that for microcomputers to move beyond the niche hobbyist market they would have to become much more user friendly, even at the cost of reducing their flexibility and functionality. Computers had to become instrumental: a thing that you use to do something else. Hobbyists and mainframe operators might enjoy the challenge of building their own systems and writing their own software, but most people were interested in a computer primarily as a means, an instrument, for doing something else.<sup>41</sup> Sales of the Apple II took flight only with the availability in 1979 of the first “killer app”—VisiCalc, a spreadsheet program written for the Apple II by two Harvard Business School students, Dan Bricklin and Bob Frankston, who had little connection to the then-tiny Apple Computer company. Steve Jobs took note. The much-hyped Apple Macintosh, released in 1984, was ready to use straight from its box, bundled not only



with an operating system, but with applications software for creating graphics (MacPaint) and word processing (MacWrite).<sup>42</sup>

By the late 1980s, as desktop computers became more common in workplaces and appeared in more and more homes, the experiences of these new users were very different from those of computer users of earlier eras. Popular desktop computer systems had small libraries of ready-to-install application software, much of it by third-party software developers, as well as operating systems, such as MS-DOS, that accepted relatively simple commands written in something that approached natural language, or that made use of point-and-click graphical user interfaces, as with MS Windows or the Macintosh. These relatively user-friendly computer technologies may have given new users the illusion that they were similarly technologically competent as had been the users of earlier technologies.

Cook's generations metaphor allowed Canadian archivists to acknowledge the work of MRA archivists while dismissing their accomplishments as needlessly technical and not truly archival. Cook reinforced the notion that medium is less relevant to communication than the reason for communicating (i.e., the function of the communication) or the content. Others would go further in both of these points—Richard Cox went much further, as we have seen, in negating the contributions of MRA archivists, while Catherine Bailey, in *Archivaria* 29 (1989), baldly declared that, in terms of archival theory, “There is no difference between paper and electronic records.”<sup>43</sup> As an established archival authority, Cook reinforced these ideas in mainstream archival thinking. He promoted the second generation of digital archivists as a fresh start, an opportunity “for an archivist without experience in the electronic records field to enter the race in its second lap without having to repeat the discovery work of the pioneers.” For Cook, the second generation was a new beginning, with “traditional archivists” entering the field and starting anew: “The second generation, too, will have its pioneers.”<sup>44</sup> The great benefit of this sentiment was that less digitally experienced archivists could imagine themselves into the role of digital archivists, opening up a rhetorical space for their contributions to the debate. This opening up of rhetorical space was typical of Cook's intellectual generosity, and he wove it into his principal arguments in the article.

Cook maintained that his “generational distinction concerns archival mindsets and programmes, not individual archivists.” He singled out a number of first-generation archivists who were able to remain “at the cutting edge of second-generation electronic records archival activity.”<sup>45</sup> Among their number was John McDonald who, four years later, crafted another widely adopted metaphor that similarly unintentionally obscured the approaches and history of the MRA era.

“Managing Records in the Modern Office: Taming the Wild Frontier,” by John McDonald, was published in *Archivaria* 39 (1995). Although McDonald did not cite Richard Kesner, this article can be read as updating arguments made by Kesner in “Automated Information Management” in *Archivaria* 19 (1984). Unlike Kesner’s piece, which provoked much controversy, McDonald’s article was embraced partly because he avoided Kesner’s inflammatory “death of the archivist” rhetoric, but also because it came ten years later, when archivists, like the rest of Canadian society, had more experience with computing technologies and were starting to see obvious social and professional effects of ready access to easy-to-use digital technologies.<sup>46</sup> Like Kesner, McDonald depicted the contemporary office as an unregulated zone where individual office workers create, destroy, and manage electronic records according to their own whims. Unlike Kesner, McDonald saw “archivists and records managers” as key to developing centralized controls and bringing “law and order” to “the wild frontier.”

McDonald presented the metaphor of the wild frontier in his title, abstract, and introduction and did not return to it thereafter. Indeed, it could be argued that the rest of McDonald’s article does little to substantiate the idea of a digital wild frontier, as it depicts government policy makers, IT professionals, and industry partners collaborating on recordkeeping solutions. Nonetheless, like Cook’s generations, McDonald’s wild frontier became (and remains) a touchstone reference in the literature.<sup>47</sup> In crafting this metaphor, McDonald invoked and participated in the colonialism inherent in the very notion of the wild frontier:

During the eighteenth and nineteenth centuries, land was settled in a variety of ways in different parts of North America. For some settlers the process was quite orderly. The government of the day developed rules and regulations, managed the movement of people, administered land grants, and established cities, towns and transportation networks. For new-comers in other areas, the experience was much more chaotic. The land was there for the taking and people simply moved in and staked their claims. In the absence of laws, people made up their own rules, but only when absolutely necessary and only for self-serving purposes. Individual freedom and autonomy reigned supreme.<sup>48</sup>

Whether describing the settling of North America or the management of information in the modern office, this narrative misrepresents key aspects of the situation. “The land was there for the taking,” McDonald wrote, “and people simply moved in.” Invoking the wild frontier depopulates the region it describes, denying the very existence of (in North American history) Indigenous peoples or (in the modern office) previous generations of technology and technology managers.<sup>49</sup> As Margaret Hedstrom, another of Cook’s exemplary “first-generation” MRA archivists, would note in the title of her reply to McDonald, “Archivists Are Not Alone on the Wild Frontier.”<sup>50</sup> Hedstrom characterized the modern office

as a meeting place for office workers, information technology personnel and managers, records managers, information managers, and digital archivists—a stark contrast to McDonald’s metaphor of the wild frontier, and to his depiction of modern organizations as providing “computers and software” in place of “horses and wagons” and “telling us to charge off into the great unexplored plains of cyberspace where supposedly we can work more effectively.”<sup>51</sup>

McDonald’s depiction of cowboy-archivists imposing “law and order” on behalf of the central state is compatible with those strands of archival thinking that emphasize legislated recordkeeping obligations, despite a long history of such legislation rarely being enforced. Many within the archival profession find the image of the archivist as an outgunned sheriff appealing, perhaps because it valorizes archival work while contributing to our self-image as outsiders fighting the good fight despite insufficient resources, confident in being on the side of the angels—a vision the semi-official use of “lone arranger” within the Society of American Archivists also reflects.<sup>52</sup> Hedstrom’s vision of a meeting of heterogeneous professions, accepting each other as partners, followed by open and equal collaboration, speaks to a completely different conceptualization of the various roles of office workers, IT professionals, and recordkeepers. In the decades since—despite periodic calls for ever-more granular recordkeeping legislation, or more authority for recordkeepers, or harsher penalties for disorderly black-hats—Hedstrom’s vision of collaboration and cooperation has proven essential.<sup>53</sup>

To be clear, I do not mean to suggest that Cook and McDonald consciously or specifically intended to efface or obscure the contributions of MRA archivists to digital archival thinking and practice. Instead, I am suggesting that there existed a broader tendency to view the widespread emergence of desktop computing in the 1980s and 1990s as unprecedented and entirely novel. Cook and McDonald, despite both being well aware of earlier MRA work, contributed to a discourse that downplayed the relevance of earlier MRA approaches in addressing the new social and technical challenges posed by widespread desktop computing. In crafting his “generations” metaphor, Cook appears to have intended to create a space for discussion of digital archives among all archivists, and not just digital archivists. McDonald’s “wild frontier” metaphor appears to have been simply an attempt to express the chaos of contemporary desktop computing rather than an endorsement of the archivist as a lone cowboy. Subsequent uses of Cook’s “generations” and McDonald’s “wild frontier” may not have been consistent with these specific intentions, but nonetheless can be said to be consistent with other explicit or implicit dimensions of the metaphors as deployed by Cook and McDonald.

In this way, Cook’s and McDonald’s metaphors contributed to a strange history of digital archives that boxed up the MRA era and set it aside, enabling

a fresh start in the present. Historians of technology like Michael Mahoney or Thomas Haigh characterized this kind of “fresh start” as false history, as every technology has a history and is part of the longer history of technology use by a particular population.<sup>54</sup> As I will argue, this setting-aside of MRA knowledge and experience had deleterious effects on the trajectory of digital archiving during the 1990s, even though archivists remained who continued practices consistent with those of the MRA era.<sup>55</sup>

Though their metaphors became important lenses through which to view desktop computing, Cook’s and McDonald’s articles were not the only resources available to Canadian archivists who sought to comprehend the impact of digital technologies on modern offices or on archival practices. Jay Atherton and Hugh Taylor had previously attempted to establish different historical and cultural models for understanding computing.<sup>56</sup> But perhaps the most intriguing of these is Graham Lowe’s characterization of the computer as simply the latest technology to add to “the enormous file.”<sup>57</sup> Lowe focused principally on office technologies of the late nineteenth through mid-twentieth centuries; he discussed typewriters and electromechanical tabulating machines more than computers. In his introduction, however, he argued that archivists should study the history of earlier office technologies to contextualize and interpret the use of mainframe and later computing technologies. In characterizing all of these technologies as contributing to “the enormous file,” Lowe stressed continuities in office work and management across the digital/analog divide and spanning the generations of computing technology. Lowe astutely identified the challenge facing archivists, arguing that digital records are a significant addition to the enormous file and must be preserved as such, whatever challenges they posed for archivists.

In hindsight, it seems unfortunate that Lowe was not as widely read and cited as Cook or McDonald and that we did not adopt his historically grounded metaphor of “the enormous file” as the conceptual basis for this era of digital archiving.

### A Fresh Start?

The ready reception and adoption of Cook’s generations and McDonald’s wild frontier suggest that these metaphors were consistent with their readers’ perceptions of the use of digital technologies in offices, and of the work of digital recordkeeping. As these metaphors were taken up and redeployed, often in ways that were not always consistent with how they were originally formulated, rhetorical space was cleared for a fresh start in digital archiving—Cook’s second-generation “pioneers” out on McDonald’s “great unexplored plains of

cyberspace”—uncompromised by the contributions of social scientists, computer specialists, and librarians.

For most archivists, this was the era of their “fresh start” in computing, their initiation, as in this era they began to encounter computers as standard office equipment for themselves and for records creators. And much unlike earlier computer technologies, technology of this era was designed for ease of use. Instead of assembling heterogeneous hardware and writing their own programs, users could select from a library of prewritten software and run it on straight-from-the-box hardware. This consumer computer culture promoted the illusion that the technology was merely instrumental or functional, just a way of completing a task. It allowed people to overlook the ways in which our expectations and our tasks are conditioned by the available tools—a concept memorably and succinctly expressed by Joan Schwartz with the phrase “we make our tools and our tools make us”<sup>58</sup>—and to overlook the true complexity of media effects (as described by Marshall McLuhan and Hugh Taylor, among others) even as they participated in them.

Nor was it only in Canada that archivists chose the early 1990s for their new beginning in digital archiving. Adrian Cunningham recalled in *Archivaria* 71 (2011) that the National Archives of Australia (NAA) in the 1990s

made the strategic decision to postpone addressing the digital preservation challenge in favour of first addressing the challenges of making and managing good digital records. The logic here was that there was no point in creating digital preservation programs if there were no good digital records to preserve.<sup>59</sup>

Putting digital archives on hold until records creators began to use sound recordkeeping technologies and until a fully developed digital preservation infrastructure and processing regime were in place was a new idea. Back in the 1970s, Carroll and Naugler described PAC’s MRA Division creating transfer and preservation processes on the fly, performing routine media and format migrations to compensate for a lack of long-term preservation media and standards, and accepting that, even so, it might not be possible to perfectly preserve 100 percent of the designated data. This older MRA approach is consistent with how archivists have approached, and continue to approach, other unstable media. Nitrate film, for example, or highly acidic paper, are also accepted for archiving, despite a lack of a means of permanent preservation and despite sure knowledge of ongoing and unstoppable degradation.

It was not only the Australians who believed it wise to put digital acquisitions on hold while “first addressing the challenges of making and managing good digital records.” In *Archivaria* 39 (1995), Luciana Duranti similarly advised, “Instead of concentrating on ensuring the integrity of unreliable records, we should be concerned with ensuring the creation of reliable records.”<sup>60</sup> Neither

NAA nor Duranti explained what records creators were to do with the (allegedly) unreliable records that had been created, and continued to be created, in the absence of archivally certified recordkeeping systems.<sup>61</sup> At least Duranti's statement, like the NAA policy, had the virtue of openly declaring this innovative archival prudence. Most archival institutions made no declaration of policy change, despite a de facto shift from the traditional preference for archiving records in the formats in which they were created, managed, and used to requiring that creators perform routine format and media migration, transforming various digital formats to paper-based formats by printing records before filing them. Recordkeepers may even have fooled themselves that such born-digital, made-analog records were more reliable and perhaps even more authentic. Many archivists at this time expressed concern for what they saw as the disturbing ephemerality of digital records—the ability for digital data to be added to, deleted, or changed without leaving an obvious trace. Printing records, whether a database report, a spreadsheet, or a word-processed document, would “fix” them, rendering them inert and stable.<sup>62</sup>

The logic is obviously problematic: if the challenge is the instability of digital records, solved by printing, then what would stop someone from simply changing (or re-creating) the digital original, reprinting it, and substituting the falsified record? Terry Cook aptly characterized this decidedly unarchival and undeclared but real preference for the paper copy in the title to his landmark 1994 *Archives and Manuscripts* article, “Electronic Records, Paper Minds.”<sup>63</sup> The problem went even deeper. MRA-era archivists and managers, like Atherton and Taylor, perceived the interactivity and mutability of the records as an important aspect of their digitality: a challenge for archivists, but an inherent and important characteristic of digital records and therefore necessary to preserve. Atherton recognized the limitations of paper-era thinking in managing electronic records, and so conceptualized the continuum. Taylor—like Naugler before him, but arguing more eloquently and with further consideration—perceived the fluidity of digital records as part of their essence. Atherton, Taylor, Naugler, and other MRA-era writers called for this fluidity to be comprehended and valued, not eliminated.<sup>64</sup>

Writings on electronic records from the 1990s often identified the fluidity of digital records as a problem to be solved. As mentioned above, the de facto solution—not often overtly recommended, but the most common response—was to “fix” the records by printing them.<sup>65</sup> Another proposed solution was to engineer an artificial environment in which office work would be conducted in a manner that would lead to an inert electronic record. This was a huge departure from past ideas about digital records and about archives in general. In “Media, and the Messengers,” I described how Richard Kesner, writing in the 1980s, challenged Canadian archivists to transform their processes and thinking, and their

professional education, to adapt to what he called the “electronic office.”<sup>66</sup> The new thinking called for the transformation of office technologies rather than the transformation of recordkeepers.

McDonald’s article is commonly remembered and cited for the metaphor of the wild frontier, but his point was to discuss a National Archives of Canada (NAC) initiative called Information Management and Office Systems Advancement (IMOSA).<sup>67</sup> IMOSA was the National Archives’ attempt to work with partners in government and industry to create a controlled digital environment in which office workers would perform their work in a way consistent with recordkeeping principles.

IMOSA was founded on a core precept from the MRA days: that electronic records require early intervention.<sup>68</sup> But, unlike MRA, IMOSA sought not to understand and document the digital technologies in use by a records creator; rather, IMOSA sought to create an artificial environment to *replace* the digital technologies in use by records creators. This change in approach took the basic MRA insight of early intervention and ongoing dialogue and made it focus not on the grubby, disorderly present, but on a gleaming future when systems like IMOSA would ensure that proper records—better records!—were created, managed, and transferred to the archives. Hying the future prospects of a technology has been an essential part of IT marketing since the earliest days of computing technologies.<sup>69</sup> Early boosters of computerization like Atherton and Taylor were not averse to making grand claims for the future. IMOSA, however, was an attempt to engineer the future.

The National Archives of Canada, through IMOSA, and the National Archives of Australia were not alone in their quixotic attempts to determine the future. In the Canadian archival literature, they are a footnote to the grand clash between two other attempts to reengineer the electronic office: the Pittsburgh Project (1993–1996), overseen by David Bearman but led by Richard Cox, and the University of British Columbia (UBC) Project (1994–1997), led by Luciana Duranti, precursor to the various iterations of InterPARES (International Research on Permanent Authentic Records in Electronic Systems, 1998–ongoing), also led by Duranti. The rivalry between the Pittsburgh and UBC Projects generated much heat and some light; it certainly became a focus for electronic records discussions in *Archivaria* and elsewhere.<sup>70</sup>

These projects reflect the malaise of their times. Inexpensive, user-friendly consumer technologies made computer users out of all of us, but the instrumental use of computers led to a digital culture in which we do not understand the technologies that we use. This lack of understanding can lead to helplessness, and perhaps even fear, when technologies do not work as we feel they should. MRA archivists had accepted that they personally would have to achieve a high level of technical competence to acquire and to manage their digital

archives. Rather than deepening their own technical knowledge, mainstream recordkeepers who became new computer users in the 1990s and encountered shortcomings in the technology appear to have believed that the solution to digital recordkeeping challenges lay in getting computer developers to better understand the importance and nature of recordkeeping requirements: that it was up to the computer scientists and systems designers to create products that would conform to recordkeeping requirements.

*Archivaria* 36 (1993), the journal's first special issue on electronic records, included Catherine Bailey's summary report of a digital archives survey conducted by the Association of Canadian Archivists (ACA). Bailey reported that in 1989 the Committee on Computing of the Canadian Historical Association (CHA) had approached ACA and proposed a joint ACA-CHA position on digital archiving. ACA demurred. "Without having considered these issues in any depth, the ACA could not hope to respond positively to the overture by the CHA." Instead, ACA established an ad hoc internal committee to survey ACA members on the state of digital archiving in Canada and develop an agenda that a successor committee might pursue.<sup>71</sup>

The survey revealed little digital archiving going on in Canada, despite finding that Canadian archivists were aware of digital records as a top-of-mind issue. It also found that archivists believed "first-generation" MRA-era approaches to digital records could not cope with the chaos of the present, but that they were unsure of what to do next: "The responses often revealed frustration and lack of direction regarding electronic records." Beyond the usual strictures of time and finances, Canadian archivists were reluctant "to accept electronic records that they cannot adequately preserve and make available."<sup>72</sup> Archivists apparently felt that electronic records were too important to acquire in the absence of adequate and proven archival standards, technology, and processes, and so were not acquiring them at all. One respondent plaintively asked: "How about a 'White Paper' of some sort?"<sup>73</sup>

White papers aplenty were on their way. Reports on current technologies and practices did still appear, written by MRA stalwarts like McDonald and Hedstrom, as well as from other voices,<sup>74</sup> but authors in *Archivaria* increasingly explored digital archiving not in the context of contemporary digital technologies, but in the context of hypothetical future technologies or as pure theory.<sup>75</sup>

Bearman and Duranti led in this, as in so much else. Bearman's first *Archivaria* article on the Pittsburgh Project took a deliberately theoretical approach in formulating functional requirements for recordkeeping systems, stating that "it is important to free ourselves from a physical model of record-keeping systems tied to a specific implementation." He criticized MRA approaches as too focused on outputs rather than working from conceptual models that would allow archivists to identify evidence located within the system itself. This was consistent



with Bearman's belief that to remove data from recordkeeping systems is to undermine the archival properties of the data and the system. He noted that "these functional requirements are not completely satisfied within existing paper-based information systems" and shrugged: "Decisions not to satisfy functional requirements are just that; they do not invalidate the requirement."<sup>76</sup> Similarly, Duranti and Heather MacNeil identified a strength of the UBC Project in that it was "purely theoretical," building up from foundational principles in archival theory and diplomatics.<sup>77</sup> Such articles were part of a shift of focus from how records were currently being created to how they might be better created. Looking back on this era late in the 1990s, Terry Cook characterized it as a shift from the physical record to the conceptual record.<sup>78</sup>

During the 1990s, Canadian archivists would have front-row seats as proponents of various approaches (NAA, Australian continuum, IMOSA, Pittsburgh, UBC, InterPARES, and others) debated key issues around the characteristics of electronic records (as opposed to electronic data or information) and recordkeeping systems, and how to identify and preserve their authenticity and reliability. These discussions, pitched as shaping the future development of recordkeeping systems, prompted Paul Marsden to inquire: "When is the future?"

"For most archivists," Marsden observed, "the need is not to attack the past nor to resist the future. They are largely disinterested in such theoretical debates and want merely to reconcile the present and the past with the future so that they can continue practising their profession." Marsden, a National Archives of Canada archivist who had recently contributed to the processing of a large, complex digital record set acquired from Canada's Trade Negotiations Office, wrote as a practitioner "appraising, acquiring and describing electronic records today."<sup>79</sup> Marsden echoed earlier complaints from Victoria Lemieux who described her experience archiving digital records in Edmonton's Office of the City Clerk and her dismay at finding little in the archival literature to guide her daily practice—despite the fact that "Volume 36 of *Archivaria* [on electronic records] was so large that it should have been issued with a warning on the packaging to lift only with the legs, not with the back!"<sup>80</sup>

It is tempting to view such complaints as a variation on the perennial debate over whether the archival literature should be oriented toward practice or theory.<sup>81</sup> Marsden and Lemieux, like many working in digital archives today, rejected as artificial and unhelpful any binary approach that would choose between theory and practice in the first place. The impatience of Marsden, Lemieux, and those who did not write articles in *Archivaria* but who talked over coffee and at conferences, was founded on the fact that these reengineering projects were pitched as though digital technologies lay off in some future era, and time still remained to prepare for their onset. The reality was that archives faced a daily deluge of electronic records. Most had been printed to

paper—migrated to analog, in terms of format and media—while others were being accessioned on portable media (magnetic tape, floppies, CDs, DVDs, etc.<sup>82</sup>) without adequate guidance on how to manage either the records or the media, or how to provide access to them. This situation did demand theoretical work. For example, it would have been useful to study the implications of archiving records in media and formats other than those in which they had been created, managed, and used, as was standard practice in any “print to file” recordkeeping system. The problem was that the theoretical work being done through IMOSA, Pittsburgh, and UBC involved speculations upon an alternate reality in which office workers followed clearly defined records-creating processes in sound recordkeeping environments, rather than examining the haphazard records creation occurring in contemporary offices.<sup>83</sup>

The frustrations expressed by Lemieux and Marsden are not evidence of the inability of working archivists to see the value of theoretical discussions. This is demonstrated by the facility with which Lemieux and Marsden dealt with theoretical issues in these very articles. Rather, frustration lay in the disjuncture between the lived reality of ongoing digital records acquisition (either migrated to paper or on portable media) and the speculative future depicted in these projects. Working digital archivists could see the value of figuring out how traditional archival theory could be applied to electronic records, but they could not see the value of doing so to the exclusion of addressing ongoing challenges. Terry Cook summed up the point in “What’s Past Is Prologue,” his hundred-year history of archival theory, published in *Archivaria* 43 (1997): “Archivists must not ignore present (if perhaps flawed) electronic records-creating realities or older legacy system records in order to pursue exclusively reengineering strategies for the future.”<sup>84</sup>

The Pittsburgh and UBC Projects, despite their determinedly theoretical orientation, did lay the groundwork for real-world solutions, though neither resulted in major changes in archival practice. The Pittsburgh Project accepted the MRA insight that archival value lay in preserving the interactivity, fluidity, and functionalities that archival records possessed in their systems of origin. But, whereas MRA archivists concluded from this that it was incumbent on them to re-create such native interactivity, fluidity, and functionalities within the archives, the Pittsburgh Project concluded that only radical postcustodialism could be sufficient.<sup>85</sup> Thus, Bearman argued that because the provenance and original order of electronic records were properly identified at the level of the recordkeeping system, to remove data from the system or the system from the organization would be to compromise the archival value of the records.<sup>86</sup> This point of view is consistent with NAA’s less extreme policy of leaving electronic records in creating institutions pending the development of sufficient infrastructure and policies, as well as behind NAC’s policy of postcustodialism

for electronic records, also articulated at this time and published in *Archives and Museum Informatics* in 1995.<sup>87</sup>

Archivists have been reluctant to embrace this kind of postcustodialism for reasons well articulated in 1984 by Terry Cook in “From Information to Knowledge.” Cook pointed out that archives serve as administratively distinct custodians of the evidence of governmental and organizational accountability: not only do they offer some necessary distance between the preserved record of accountability and those that we would hold accountable, Cook argued that moving records into archives protected them from the inevitable neglect that would come with ongoing administrative flux in records-creating agencies, whereby organizational units and functions are created and dissolved in the wake of shifting organizational mandates, priorities, and resources. Cook was skeptical that an organization without a specific mandate for managing and providing access to archival records would continue to devote resources to such an endeavor, particularly as new technologies rendered old ones obsolete.<sup>88</sup>

Bearman’s radical postcustodialism, while proposed as a practical solution, has not yet been put into practice in a workable fashion, but it did have some very real effects. While working as a digital archivist at Library and Archives Canada (LAC), I had a hard time understanding why the Government of Canada would mandate the purchase of an electronic document and records management system (EDRMS) that lacked the ability to export data out of the system as a core functionality, and why this was not raised as a concern, even by the committee that developed the government’s EDRMS application profile. Looking back, it is hard not to see in this the Pittsburgh-ish idea that recordkeeping systems are intended to be terminal systems.<sup>89</sup>

The development of EDRMS, however, is usually associated with the UBC Project, rather than the Pittsburgh Project, due to the association of the UBC Project with Department of Defense (DoD) 5015.02, the key compliance standard for EDRMS in North America. In 1994, staff from the U.S. Department of Defense reached out to the UBC Project. The resulting collaboration led to a series of entity models that would be foundational to DoD 5015.02.<sup>90</sup>

In EDRMS, recordkeepers finally had a working, artificially engineered environment in which the modern office worker would create, store, and access archivally sound records. While EDRMS have come to play a key role in some settings, they have met considerable resistance from users. Expensive to purchase, challenging to configure, difficult to use, and not well suited to collaborative work, these systems are hated by users, whose antipathy may well undermine the recordkeeping benefits that, theoretically, they are intended to deliver.<sup>91</sup> Increasingly, organizations are embracing content management systems, like Microsoft SharePoint, a tool that is comparatively cheap, integrates

with standard office software, and promotes collaborative work—but is not particularly effective as a recordkeeping system.<sup>92</sup>

The Pittsburgh and UBC Projects made significant contributions.<sup>93</sup> Pittsburgh's functional requirements represented a major step forward in thinking through archival principles, especially provenance, in electronic settings.<sup>94</sup> As noted above, Pittsburgh, without acknowledging previous MRA work, reinforced the MRA insight that the fluidity of digital data is to be valued and preserved, that it is what today would be called a significant property. The concept of literary warrant developed by Pittsburgh team member Wendy Duff offered a fresh and still relevant way of thinking about archival mandates.<sup>95</sup> The UBC Project, in addition to its immediate payoff in the development of DoD 5015.02, proved influential in demonstrating the relevance of archival theory and diplomatics to electronic records issues.<sup>96</sup> As well, the various InterPARES successor projects continue to develop the fundamental insights of the UBC Project and apply them to real-world recordkeeping environments.<sup>97</sup> In addition to any specific outputs of these projects, moreover, are the concepts and ideas that they inspired in many publications, discussions, and conference sessions. The theoretical focus of the Pittsburgh and UBC Projects gave license to any archivist, whether or not he or she had experience working with digital records, to address electronic records issues. If, as Catherine Bailey had claimed back in *Archivaria* 29 (1989), there is “no difference between paper and electronic records” in terms of archival theory, then any archivist could be a theorizer of digital archiving. This clearing of rhetorical space and reorienting of debate around electronic records had positive and negative effects. Perhaps its most positive effect was to broaden out the debate and to empower all archivists to take up the digital challenge. The electronic records survey that ACA conducted in the early 1990s demonstrated that Canadian archivists recognized the urgency and importance of digital archiving. Removing the need for experience with digital archives as a prerequisite to entering the debate meant that anyone could become a digital archivist: an empowering proposition. The negative effect, however, was to devalue and dilute the knowledge and experience that contemporary digital archivists, some veterans of MRA units, though others not, had gained through decades of professional work.

### The Through Line

In *Archivaria* 62 (2006), David Bearman returned to digital archives a decade after he had left the field with the end of the Pittsburgh Project. He found that while Pittsburgh could be argued to be conceptually foundational to digital recordkeeping thereafter, no obvious continuities extended from the project to specific technologies or practices. At the same time, he praised the Duranti-led

InterPARES projects for their internationally collaborative, participatory, and case-based approach, highlighting their influence on related projects like the European MoReq standard. Nonetheless, Bearman suggested, “Increasingly strands of activity from outside the archival community have seized the initiative from archivally led projects over the past decade.”<sup>98</sup>

Bearman had a point. The wider digital preservation community had not rallied to the basic orientation of the Pittsburgh and UBC Projects, focused as they were on archival theory, recordkeeping theory, and diplomatics. Instead, digital preservationists had turned to broad, collaborative initiatives like the Trusted Digital Repository (TDR) suite of reports and standards, led by OCLC-RLG, and the Reference Model for an Open Archival Information System (OAIS), led by the Consultative Committee for Space Data Systems.<sup>99</sup> Institutional repositories, often hosted by university libraries, became key pieces of digital infrastructure, hosting collaborative spaces, serving as data repositories, and hosting various other types of digital information and services.<sup>100</sup> Toward the end of the 1990s, nonrecordkeeping-orientated content management systems—Microsoft launched SharePoint in 2001—emerged as a solution to the challenges of workplace information management and collaboration.<sup>101</sup> During the 2000s, “cloud computing” became the latest trend, with organizations moving data off their own systems and onto the systems of cloud storage and service companies.

But Bearman was also mistaken, in two ways. Projects like TDR and OAIS were (or rather are, since they are ongoing) defined by collaboration, not by the (nonarchival) organizations that provide nominal leadership. And the reengineering projects of the 1990s had never been the sum of digital archival thinking and practice.

TDR and OAIS examined core aspects of contemporary digital preservation and proposed a way forward. In the case of TDR, cultural heritage institutions looked at contemporary initiatives for digital preservation and identified the issue of trust as key. Positioning themselves as the already trusted custodians of nondigital cultural heritage, the initial TDR report (2002) sought to extend that trust to digital heritage.<sup>102</sup> While TDR sought to calm anxieties about the mission to preserve cultural heritage in the digital age and about wider perceptions of the competence of the current custodians of cultural heritage, OAIS shifted the discussion to include the users of the archives. At the heart of OAIS is the concept of the designated community, the users of an archives, whom all activities are intended to benefit. What types of records to ingest into an OAIS and what amount and which kinds of contextual information are required to support access to these records are determined by looking at the needs and capacities of the designated community.<sup>103</sup>

TDR and OAIS, in addition to considering the role of digital archives in society and the role of users within archives, were also “big tent” projects. While led by the library and space data communities, respectively, they embraced participation from archivists, information and communications technology professionals, and others. These projects included American MRA archivists among their founding members and ongoing contributors: Margaret Hedstrom, for example, was a member of the committee that wrote the original TDR report in 2002, and Bruce Ambacher was cochair of the committee that produced *Trustworthy Repositories Audit and Certification* in 2007, copublished by OCLC and the National Archives and Records Administration.<sup>104</sup> Respectfully interdisciplinary, TDR and OAIS discussions, writing, and consultation processes were geared toward consensus building rather than confrontation. Famously, the “open” in OAIS does not refer to the nature of the technology or of the archives, but to the process by which the standard was written.

Such an approach is far from the cry of “there can be only one!” heard at any clash between the Pittsburgh and UBC Projects.<sup>105</sup> In *Archivaria* 42 (1996), Duranti and MacNeil argued that differences between the projects “are fundamental and, likely, irreconcilable,” suggesting that “implementation of the two models in a variety of organizational settings will demonstrate which approach offers the most effective means of achieving that purpose.”<sup>106</sup> As Margaret Hedstrom pointed out in *Archivaria* 44 (1997), this suggests “archivists should choose a single approach from the two possible options.” Hedstrom, consistently a champion of respectful collaboration, maintained that this was a mistake: the future of recordkeeping lay in ongoing discussion and fruitful collaboration, not in a decisive showdown with a single winner.<sup>107</sup>

At any rate, reviewing *Archivaria* from the 1990s and 2000s confirms a steady trickle of articles unaffiliated with Pittsburgh or UBC. This includes articles by digital archivists with roots in the MRA era, such as McDonald, Charles Dollar, and Hedstrom; articles on IMOSA and the Australian continuum, with its various metadata initiatives; as well as articles by critics of the big reengineering projects such as Lemieux and Marsden. Much of this literature, which appeared throughout the 1990s, has been discussed above. Other articles simply had little to do with the reengineering projects of the 1990s. In *Archivaria* 47 (1999), Lily Koltun offered a penetrating study of how the digitality of records changes everything from records creation to digital archiving. Her points of reference, rather than Pittsburgh or UBC, were postmodernism and popular culture.<sup>108</sup> In *Archivaria* 48 (1999), Bob Krawczyk demonstrated how digital technologies can change the ways we think about archival records, archival classification, and archival description. Krawczyk’s article reflected ongoing work at the Archives of Ontario inspired by the Australian series system.<sup>109</sup> In *Archivaria* 49 (2000), Elizabeth Yakel, in an article explicitly indebted to Hugh

Taylor's "Transformation in the Archives," considered how digital discovery, digital records, and digital communications were reshaping archival reference work.<sup>110</sup> *Archivaria* 51 (2001) includes Victoria Lemieux's use of postmodernist archival theory to create a more accurate understanding of digital banking records from Jamaica.<sup>111</sup> Jim Suderman's piece on the acquisition and management of electronic records series at the Archives of Ontario, in *Archivaria* 53 (2002), discussed issues core to the UBC and Pittsburgh Projects without making reference to either.<sup>112</sup> The longer story that emerged from the 1990s and 2000s was not the clash between Pittsburgh and UBC. It was a series of dawning realizations related to the shrinking and spreading of digital technologies and their integration into many aspects of work and personal life. Archives experienced this firsthand: archival processes, whether focused on digital or analog records, increasingly were mediated through digital technologies used by archives and by users. Records received by the archives in nondigital formats were in fact outputs from digital systems. The way people thought about information was changing, influenced by the availability and interactivity of digital information and the increasing abundance of digital devices. The Pittsburgh and UBC Projects, with their tight focus on the recordkeeping obligations and habits of office workers, and their shared goal of reengineering office technologies, were of limited relevance. MRA-era theory and practice—with its emphasis on technically adept archivists; preserving native functionalities of electronic records and data; a risk management approach to preservation; respectful collaboration with other professionals; and an interdisciplinary background for MRA staff—has reemerged as newly relevant.<sup>113</sup>

This reversion to MRA principles and practices is especially evident in *Archivaria* 72 (2011), the second special issue of the journal to address digital archives. In his opening statement, guest editor Mark Matienzo broadly signaled the connection between the special issue and the MRA era, largely ignoring the first special issue from 1993, and pointing to a 1972 *Canadian Archivist* article by Hugh Taylor as "one of the greatest influences on organizing this special issue." Matienzo quoted Taylor in his title ("New Contexts of Permanent Change"), expounded upon Taylor's thinking, and, for good measure, threw in a reference to Michael Carroll's 1974 *Canadian Archivist* article, which describes operations of the Machine Readable Archives Division of the Public Archives of Canada.<sup>114</sup>

The influence of MRA-era themes is not limited to Matienzo's editorial. Archival education was one of Hugh Taylor's abiding interests. As we have seen, Taylor, like Richard Kesner, was particularly interested in archival education that was technical—that would teach archivists to "speak the language of the computer"—and that built on a diversity of educational backgrounds. Matienzo honored Taylor's prioritizing of archival education by including articles on two distinct approaches to teaching digital archival skills. Patricia Galloway

described her hands-on approach at the University of Texas at Austin, in which her students take on real-world digital archival projects within the supportive environment of a teaching lab. Christopher Lee and Helen Tibbo described the transdisciplinary digital curation approach that they teach at the University of North Carolina at Chapel Hill.<sup>115</sup>

The lead article, titled, significantly, “Beyond the Magic to the Mechanism,” signals the importance of grounding digital archival work in a technical understanding of the specifics of how computers function. In it, Ciaran Trace described the sequence of operations that result in the creation and reading of digital records.<sup>116</sup> Other articles in the issue pick up this theme, including Laura Carroll, Erika Farr, Peter Hornsby, and Ben Ranker’s description of the processing of the Salman Rushdie records at Emory University and Charles Levi’s description of the Archives of Ontario’s approach to migrating legacy digital records from interfiled floppies.<sup>117</sup> Such articles connect specific archival practices to larger archival theories around provenance and original order, while insisting that it is impossible to understand such concepts in isolation of the technology by which the digital records are created, managed, and accessed. They focus on the materiality of digital records and digital technologies in a way that would have made sense to earlier digital archivists like Sue Gavrel and Richard Kesner.

The importance of having digital archivists understand the native functionalities of digital systems is brought home in the Carroll et al. article on the Salman Rushdie records and in Courtney C. Mumma, Glenn Dingwall, and Sue Bigelow’s exploration of the City of Vancouver’s acquisition of the records of the 2010 Olympic and Paralympic Winter Games. Carroll et al.’s article on the Rushdie records, titled “A Comprehensive Approach to Born-Digital Records,” describes an attempt to re-create, as fully as possible, the data structures, quirks, and functionalities of one of the computers that Rushdie used while living under fatwa following the publication of *The Satanic Verses*. The article implicitly recognizes the MRA principle (also recognized by the Pittsburgh Project) that native functionalities are central to the proper contextualization of digital records. As in the MRA era, Carroll et al. identified a working custodial strategy for managing digital records and functionalities in an archival environment. Similarly, the Mumma et al. article on the 2010 Winter Games records describes how the archives sought to document as fully as possible the Microsoft SharePoint environment used by the Vancouver Olympic Committee.<sup>118</sup> While the authors were not confident that their archives had the resources to re-create this environment, they evinced an MRA-esque respect for documenting the environment, as fully as possible, as the essential context for understanding the records.

The Mumma et al. article specifically addresses the acquisition and appraisal of the 2010 Winter Games records. The appraisal process described therein is reminiscent of the double-track appraisal strategy described in Naugler’s 1984



RAMP report. The authors started from the proposition that appraisal is the process by which large bodies of records are winnowed down to manageable portions, quoting Terry Cook's observation that "not all records having archival value can be kept." The authors helpfully disentangled the process of valuation—the traditional archival function of appraisal—from the pragmatic process by which the dividing line is drawn between those records that will be kept and those that will not. The authors maintained that inserting this line amid the gradations of value determined by archival appraisal is a process that takes account of the mandate and resources of a particular archives and the short- and long-term costs associated with acquiring and preserving the records.<sup>119</sup> This application of traditional archival methodologies with a digital twist strongly recalls the writings of MRA archivists like Harold Naugler and John McDonald, in addition to being in line with (and consciously indebted to) Terry Cook's work on the appraisal and acquisition of electronic records.<sup>120</sup>

The collaborative and interdisciplinary nature of digital archival work is evident throughout the special issue. *Archivaria* 72 is stuffed with collaborative work firmly rooted in digital archival practice and that seeks to present working solutions to contemporary digital archival challenges. The Royal Society of Canada's plea for *The Future Now* inevitably recalled Paul Marsden's "When Is the Future?" *Archivaria* 72, published three years before the RSC report, allows us to believe that the future really is now but, as William Gibson has observed, it is not evenly distributed.<sup>121</sup>

Smaller institutions are leading current digital archival work in Canada. I have elsewhere described the fall 2011 collapse of LAC's plan to build a Trusted Digital Repository (which happened, according to the timeline provided by Canada's auditor general in a 2014 report, even as *Archivaria* 72 was thinking onto archival doorsteps—eerie).<sup>122</sup> Work at the national archives continues, but is now trying to make up for time lost. Meanwhile, Vancouver's Artefactual Systems has made crucial contributions to the new digital archives ethic. Working within an open source framework, Artefactual has produced the Access to Memory (AtoM) archival description software as well as the Archivematica digital preservation system. In neither case are these products perfect, but they offer smaller archives access to purpose-built systems that can be adapted to local needs. Archives are still working to absorb the new logic and economic demands of using open source systems. Costs are not necessarily reduced, when compared to products that use proprietary code, but they are differently incurred, distributed, and managed. Initial setup costs are drastically reduced, but subsequent work is required to bring the system into line with local institutional and user needs. Development of the code base can be shared among institutions. Smaller institutions can leverage work done by larger institutions and consortia. Project funding can be used to develop systems in ways that will

have long-term payoffs for project sponsors and for others. This model is well suited to the archival sector. In the long run, open source systems could allow archives to collaboratively develop sector-specific systems that meet our particular needs, as archives make incremental improvements to the code base with every special project and new functionality.

For example, AtoM was used as the basis for a consortium of Mennonite archives to create a common digital infrastructure to manage their photographic collections, and to sell high-resolution copies of the images. The Mennonite Archival Image Database (MAID) was launched in 2015, with code development led by Winnipeg-based consultancy Peaceworks Technology Solutions. Similarly, Artefactual has placed OAIS-based digital preservation within the reach of virtually any archives through its open source digital preservation platform, Archivemata. Within this open source, do-it-yourself environment, smaller institutions such as City of Vancouver Archives, Simon Fraser University Archives, Queen's University Archives, and Faculty of Medicine Archives at the University of Manitoba have emerged as leaders in hands-on, practical digital preservation, often done in the context of structural collaboration through the use of open source software such as AtoM, Archivemata, BitCurator, and Fixity, and through interinstitutional collaborations like MAID. Digital preservation in Canada has not been, is not now, and never will be the story of any one project or institution.

## Conclusion

The history of digital archiving as told through *Canadian Archivist* and *Archivaria* reflects broader trends in computer usage and in thinking about digital archives. As we move forward today, what lessons can we learn from this history?

Throughout this article and “Media, and the Messengers,” I have argued that we should value and reclaim the early history of digital archiving as practiced during the machine readable archives era. I believe that the basic orientation of the field and core principles of that era remain essential today. This includes valuing and respecting the hands-on, technical knowledge gained by understanding computers as machines and electronic records as physical entities. Michael Mahoney argued, “Technology is not a literate enterprise, but a visual, tactile one,” quoting Henry Ford: “Machines are to a mechanic what books are to a writer. He gets ideas from them, and if he has any brains he will apply those ideas.”<sup>123</sup> MRA-era digital archivists understood the physicality of computers and computer records, even as they valued their fluidity and interactivity. Digital archiving required then, and requires now, the ability to control the machine at deeper levels than that of a common user. This requires

an ability to think in terms of the machine's component parts and to control the machine in its own language—taking us back to Hugh Taylor's dream of archivists who know "the language of the computer like [their] native tongue."<sup>124</sup>

Such technical knowledge is essential because, as part of this emphasis on the specifics of hardware and software, we now understand computer technology to be cultural and profoundly contingent to the time and place in which it was used. Although the "computer revolution" has been declared continuously for a good deal more than half a century, digital technologies and digital cultures have changed radically from the so-called giant brains of the 1950s to the handheld computers, wearable tech, and ubiquitous computing of today. What did computerization mean to a deputy minister or a CEO in the 1960s? What did the use of smartphones (including bring-your-own-device) mean in the early 2000s? Such questions can be understood and answered only in light of the specific functionalities of specific systems and the cultural dynamics of a specific workplace or other social environments. How did office workers and culture creators use these technologies? Again, answers that are not ahistorical will be socially, locationally, and technologically contingent. As I argued in "Media, and the Messengers," MRA archivists like Harold Naugler and John McDonald understood this when they wrote about the need to preserve digital originals and to document system functionalities as a means of understanding office cultures.

No person, however, can be expert in all of the languages and all of the architectures of all of the computers ever created. Patricia Galloway's meditation on the challenges posed by now-obscure, obsolete technologies like the Kaypro II, an early personal computer, describes how she restored the functionality of the system through collaboration with IT experts and retrocomputing enthusiasts, through access to online documentation, and through her own knowledge of the machine and that of others who had used it in the early 1980s.<sup>125</sup> The project team at Emory that created the emulation of Salman Rushdie's computer from the early 1990s included several archivists and several IT experts. These sorts of projects are too complex, and involve too many bodies of related but discrete knowledge, to be conducted by an individual archivist. As well, contemporary understandings of human-computer interaction mean that the physical-systems work involved in digital archiving, whether for transfer, migration, or emulation, cannot happen without the tight integration of archival or recordkeeping perspectives, while the archival work cannot proceed without a solid understanding of the computer and its functionalities. We can only move forward through interdisciplinary collaboration.

Respect for the machine; respect for the historical contingencies of system functionalities; respect for the disciplinary knowledge of other fields; and respectful collaboration on interdisciplinary teams: these are some of the

principal values promulgated through the digital archival literature of the 1970s and 1980s. What happened in the 1990s?

First, it should be noted that the achievements of the MRA era were not always as impressive as the thinking and writing of the best digital archivists of the day. We have seen that American MRA archivist Thomas Elton Brown objected to Terry Cook's characterization of the MRA era as only processing flat file data sets. Browsing through the 1984 research guide produced by the Machine Readable Archives Division of the Public Archives of Canada reveals plenty of flat file data sets and little evidence of the complex record types that Naugler described in his 1984 RAMP report or that Brown described in his response to Cook.<sup>126</sup> The same guide reveals a bare-bones approach to archival description that validates criticisms made by Terry Cook, Catherine Bailey, and others that MRA-era archival description evinced more of the content orientation of library cataloging than the context orientation of archival description.<sup>127</sup>

Moreover, the onset of widespread desktop computing changed the *meaning* of computers and their use. The continuous proclamation of the "computer revolution" since the 1950s obscures the fact that the meaning of computer usage changed dramatically from the days when a coterie of technicians and programmers administered mainframes and minicomputers, to the rollout of desktop computers throughout organizations, to the use of smartphones for work. The big reengineering projects of the 1990s, like Pittsburgh, UBC, and IMOSA or the National Archives of Australia's promulgation of the records continuum and various interrelated metadata standards, were grappling with this new and supersized cultural importance of computing. Although theorists like Catherine Bailey, MacNeil, and Duranti argued that no important differences exist between electronic and paper records in terms of archival theory, the very approaches that they championed demonstrated their grave concern for how the change from analog-by-default to digital-by-default had upended the record-keeping game. Archivists of the 1990s saw big social, cultural, and technological changes, and they sought digital archival solutions commensurate with these changes. Our challenge today is to marry the technologically specific, historically contingent granularity of digital archival work of the MRA era with the pulled back, bird's-eye view of the 1990s; to join the respectful interdisciplinarity of the MRA era with the nuanced specificity of archival theory and archival values promulgated during the 1990s.

Our history is a resource, and we should make use of it. Earlier, I quoted Henry Ford as stating, "Machines are to a mechanic what books are to a writer. He gets ideas from them, and if he has any brains he will apply those ideas." One could say that history is to the archivist as machines are to the mechanic. As we continue to grapple with the multiple challenges posed by digital archives, we would do well to look to our own history.

## NOTES

- <sup>1</sup> Morissey and Johnny Marr, "How Soon Is Now?," The Smiths, *William It Was Really Nothing / How Soon Is Now* (London, Rough Trade: 1984), 12-inch single.
- <sup>2</sup> Cecilia Muir, LAC's chief operating officer, reported to the Association of Canadian Archivists annual conference in 2012 that the Conservative government had cut LAC's funding by CAD\$9.6 million in the 2012 budget. She estimated this to be 10 percent of LAC's overall budget. Moreover, she explained that LAC was still struggling with an earlier reduction of CAD\$4.4 million. Muir maintained that "salary increases and inflationary pressures" had intensified the effects of these cuts, such that LAC's "spending power has been reduced by 30% over the past few years." Muir, "Library and Archives Canada's Reality in 2012" (speech delivered by Cecilia Muir in lieu of Daniel Caron, Whitehorse, Yukon, June 8, 2012), Library and Archives, Canada, <http://www.bac-lac.gc.ca/eng/news/speeches/Pages/8-june-whitehorse.aspx>. A change at the top of LAC, followed by the election of a new government in 2015, has brought a renewed sense of optimism to the Canadian archival community. Among the immediate changes was the creation of the Documentary Heritage Communities Program, a successor to the cancelled NADP. Despite such promising signs, the Canadian archival community continues to wait for Canada's new Liberal government to reverse the debilitating cuts imposed on LAC by the previous Conservative government.
- <sup>3</sup> The authors of these reports were aware of the complex, long-term factors behind the present challenges. In addition to identifying an urgent need for digital memory infrastructure in the underfunded present, these reports found that the digital heritage crisis in Canada is not the result of cuts imposed by a single government, or the policies of a single institution.
- <sup>4</sup> This research started as an article for *Archivaria's* 40th anniversary issue (*Archivaria* 80), intended to look back on the treatment of digital archives over forty years of archival writing in Canada. Inevitably, following specific authors, stories, and ideas led me from *Archivaria* to other publications, including *Archivaria's* precursor, *Canadian Archivist*, as well as *The American Archivist*, the Australian journal *Archives and Manuscripts*, and others. Nonetheless, these articles remain focused on the professional literature and especially work published in *Archivaria* and *Canadian Archivist*. I have not conducted archival research on the national archives *fonds* at Library and Archives Canada, or elsewhere, to go beyond what was published in the journals.
- <sup>5</sup> The Canadian national archives went through three name changes in the time span covered by this article. In 1986, it changed from the Public Archives of Canada (PAC) to the National Archives of Canada (NAC); in 2004, NAC was merged with the National Library of Canada to become Library and Archives Canada (LAC).
- <sup>6</sup> Perhaps the single best piece of research to come out of the MRA era at PAC/NAC was Harold Naugler's *The Archival Appraisal of Machine-Readable Records: A RAMP Study with Guidelines* (Paris: United Nations Educational, Scientific and Cultural Organization, 1984). This report can be read with profit today. Other significant works include Michael E. Carroll, "The Public Archives of Canada's Experience in Establishing a Machine Readable Archives," *The Canadian Archivist* 2, no. 5 (1974); Harold Naugler, "The Machine Readable Archives Division of the Public Archives of Canada," *Archivaria* 6 (1978); Jay Atherton, "From Life Cycle to Continuum: Some Thoughts on the Records Management-Archives Relationship," *Archivaria* 21 (1985): 43-51. Naugler's RAMP report explicitly rejects print-to-file as a solution to the challenges of digital archiving; see also Sue Gavrel, "Preserving Machine Readable Archival Records: A Reply to John Mallinson," *Archivaria* 22 (1986): 153-55.
- <sup>7</sup> See especially Terry Cook, "The Tyranny of the Medium: A Comment on Total Archives," *Archivaria* 9 (1979): 141-49; Andrew Birrell, "The Tyranny of Tradition," *Archivaria* 10 (1980): 249-52; Cook, "Media Myopia," *Archivaria* 12 (1981): 146-57; Dorothy M. Ahlgren and John McDonald, "The Archival Management of a Geographic Information System," *Archivaria* 13 (1981): 59-65.
- <sup>8</sup> Terry Cook and Eldon Frost, "The Electronic Records Archival Programme at the National Archives of Canada: Evolution and Critical Factors of Success," in *Electronic Records Management Program Strategies*, ed. Margaret Hedstrom, *Archives and Museum Informatics Technical Report* no. 18 (1993), 38-47.
- <sup>9</sup> Will there be a special issue on digital archives every thirty-six issues? Stay tuned for *Archivaria* 108 (2029)!

- <sup>10</sup> On the impact of program review in the 1990s, see Terry Cook, "Macroappraisal in Theory and Practice: Origins, Characteristics, and Implementation in Canada, 1950–2000," *Archival Science* 5, nos. 2–4 (2005): 101–61. During the 1990s, Cook was that rare manager in the public service who was willing to stand up and decry the disproportionate effects of government cuts on records management and archives. See Cook, "Indian Legacy, Aboriginal Future," *The Archivist* 112 (1996): 6. Throughout his career, Cook was an eloquent and passionate voice for the centrality of digital records in all archives, but especially government archives.
- <sup>11</sup> Paul Marsden, "When Is the Future? Comparative Notes on the Electronic Record-Keeping Projects of the University of Pittsburgh and the University of British Columbia," *Archivaria* 43 (1997): 158–73.
- <sup>12</sup> The quotation is from "How Soon Is Now?": "You shut your mouth / how can you say / I go about things the wrong way." Morrissey and Marr, "How Soon Is Now?" The Smiths released "How Soon Is Now" in 1984, the same year that UNESCO published Harold Naugler's RAMP report on digital appraisal. Today, interesting things are afoot at LAC once again, particularly in the areas of Web and social media archiving.
- <sup>13</sup> In 1973, the Canadian government published its *Survey of Public Attitudes Towards the Computer* (Ottawa: Department of Communications). Among its findings was the correlation between positive attitudes toward computers, realistic assessments of the possible uses of computers, and direct experience in the use of computers.
- <sup>14</sup> Atherton directly addressed the question of digital technologies and human dignity in his 1968 *Canadian Archivist* piece: "Automation and the Dignity of the Archivist," *The Canadian Archivist* 2, no. 1 (1970). On computers as signifiers of modernity, see (e.g.) Thomas Haigh, "The Chromium-Plated Tabulator: Institutionalizing an Electronic Revolution, 1954–1958," *IEEE Annals of the History of Computing* 23, no. 4 (2001): 75–104.
- <sup>15</sup> The phrase "confronting the computer" is drawn from Thomas Elton Brown, "The Society of American Archivists Confronts the Computer," *The American Archivist* 47, no. 4 (1984): 366–82; Betsey Baldwin also uses it in the title of her history of early efforts at automation at the Public Archives of Canada (precursor to Library and Archives Canada), "Confronting Computers: Debates about Computers at the Public Archives of Canada during the 1960s," *Archivaria* 62 (2007). My point in citing it here is that Brown and Baldwin both have placed the era of "confronting the computer" before desktop computing became common in the archival workplace and therefore before most archivists had personally encountered a computer.
- <sup>16</sup> Roy Schaeffer, "The Information Age Revisited," *Archivaria* 36 (1993): 14.
- <sup>17</sup> Harold Naugler, *The Archival Appraisal of Machine-Readable Records: A RAMP Study with Guidelines*. (Paris: United Nations Educational, Scientific and Cultural Organization, 1984).
- <sup>18</sup> Thomas Haigh, "Remembering the Office of the Future: The Origins of Word Processing and Office Automation," *IEEE Annals of the History of Computing* 28, no. 4 (2006): 6–31; Thomas J. Bergin, "The Origins of Word Processing Software for Personal Computers: 1976–1985," *IEEE Annals of the History of Computing* 28, no. 4 (2006): 32–47. Haigh explained that the term "word processing," coined in an era when "electronic data processing" was accepted as a core service, was intended to make people think of text as something that could be computer processed.
- <sup>19</sup> Martin Campbell-Kelly, "Number Crunching without Programming: The Evolution of Spreadsheet Usability," *IEEE Annals of the History of Computing* 29, no. 3 (2007): 6–19; Melissa Rodriguez Zynda, "The First Killer App: A History of Spreadsheets," *Interactions* 20, no. 5 (2013): 68–72.
- <sup>20</sup> Burton Grad, "Relational Database Management Systems: The Formative Years," *IEEE Annals of the History of Computing* 34, no. 4 (2012): 7–8. This article is an introduction to a special issue on the history of database systems; several of the articles are relevant.
- <sup>21</sup> Susan B. Barnes, "Douglas Carl Engelbart: Developing the Underlying Concepts for Contemporary Computing," *IEEE Annals of the History of Computing* 19, no. 3 (1997): 16–26. Engelbart demonstrated all of these technologies in 1968 in his astonishing "Mother of All Demos," available on YouTube from SRI International.
- <sup>22</sup> The history of Canadian MRA work is treated in my article "Media, and the Messengers: Writings on Digital Archiving in Canada from the 1960s through the 1980s," *Archivaria* 82 (2016). On American MRA work, see Bruce I. Ambacher, ed., *Thirty Years of Electronic Records* (Lanham, Md.: Scarecrow Press, 2003).

- <sup>23</sup> To add to the irony, *Archivaria* hosted a long-running debate over “the historian-archivist” throughout the early 1980s (see, for example, the special section on the debate in *Archivaria* 17 [1983]). Notable entries to the debate include Hugh Taylor, “Information Ecology and the Archives of the 1980s,” *Archivaria* 18 (1984); and Terry Cook, “From Information to Knowledge: An Intellectual Paradigm for Archives,” *Archivaria* 19 (1984). Throughout these debates, the issue of digital archives is rarely raised; when writers such as Taylor or Richard Kesner sought to address digital archives, they were apt to be dismissed as not of fundamental significance. I discuss this further in “Media, and the Messengers.”
- <sup>24</sup> Over the years, several proposals for a fifth generation have been made, but none has achieved consensus.
- <sup>25</sup> Terry Cook, “Easy to Byte, Harder to Chew: The Second Generation of Electronic Records Archives,” *Archivaria* 33 (1991). On the differences between the generations, see especially p. 205 and p. 214. Cook did not tie his generations to the rise of widespread desktop computing—which appears to be what actually distinguishes his first generation (predesktop) from his second generation. For a more detailed treatment of the elimination of the MRA unit, see Cook and Frost, “The Electronic Records Archival Programme at the National Archives of Canada.”
- <sup>26</sup> Richard J. Cox, *The First Generation of Electronic Records Archivists in the United States: A Study in Professionalization* (New York: Haworth, 1994). Searching *The American Archivist* and *Archivaria* on Google Scholar, limited to 1991 to 2001, with the keywords “first generation” or “second generation” yields some false positives as well as a fair number of articles that refer to Cook’s generations. The measure is imperfect, but sufficient to demonstrate significant uptake of Cook’s metaphor.
- <sup>27</sup> Donald Fisher Harrison, “Computers, Electronic Data, and the Vietnam War,” *Archivaria* 26 (1988).
- <sup>28</sup> Thomas Elton Brown, “Myth or Reality: Is There a Generation Gap among Electronic Records Archivists?,” *Archivaria* 41 (1996): 234–43. Brown cited the U.S. military, the Watergate Special Prosecution Force, and various regulatory agencies as examples of agencies that were creating complex data structures in the 1970s.
- <sup>29</sup> Cook made no reference to earlier data archives such as the Interuniversity Consortium for Political and Social Research (ICPSR) or the Roper Center that collected computer cards and other types of digital records. See Margaret O’Neill Adams, “Punch Card Records: Precursors of Electronic Records,” *The American Archivist* 58, no. 2 (1995): 182–201.
- <sup>30</sup> Cox, *First Generation*, 4.
- <sup>31</sup> Cook, “Easy to Byte,” 203.
- <sup>32</sup> Cook’s characterization of MRA appraisal as unarchival is hard to understand. Naugler’s RAMP report, while noting that library and social science experience with electronic records has been invaluable, specifically cites Schellenberg—then the standard authority on appraisal—in explaining how to evaluate the contents of electronic records. Naugler, *Archival Appraisal of Machine-Readable Records*.
- <sup>33</sup> Cook, “Easy to Byte,” 206.
- <sup>34</sup> Cook, “Easy to Byte,” 205.
- <sup>35</sup> Cook, “Easy to Byte,” 207.
- <sup>36</sup> Terry Cook, “The Tyranny of the Medium: A Comment on ‘Total Archives’,” *Archivaria* 9 (1979): 145.
- <sup>37</sup> Hugh A. Taylor, “Information Retrieval and the Training of the Archivist,” *The Canadian Archivist* 2, no. 3 (1972): 33.
- <sup>38</sup> Michael E. Carroll, “The Public Archives of Canada’s Experience in Establishing a Machine Readable Archives,” *The Canadian Archivist* 2, no. 5 (1974): 59.
- <sup>39</sup> Steve Bailey provides an excellent discussion of why the very idea of making appraisal and archival/records management decisions independent of media (“regardless of format”) is a nonstarter with regard to electronic records. See Bailey, “Taking the Road Less Travelled By: The Future of the Archive and Records Management Profession in the Digital Age,” *Journal of the Society of Archivists* 28, no. 2 (2007): 117–24. Bailey’s analysis was anticipated by Richard M. Kesner, “Whither Archivy? Some Personal Observations Addressed to those Who Would Fiddle While Rome Burns,” *Archivaria* 20 (1985). Ala Rekrut argued for understanding the unique features and affordances of all media in “Material Literacy: Reading Records as Material Culture,” *Archivaria* 60 (2003): 11–38.

- <sup>40</sup> Alan R. Kaplan, "An Informal History of the Hobby Computer Market," *Personal Computing* (January–February 1977): 36–39.
- <sup>41</sup> Steve Wozniak, *iWoz: Computer Geek to Cult Icon* (New York: W. W. Norton, 2007); Andy Hertzfeld, *Revolution in the Valley: The Insanely Great Story of How the Mac Was Made* (Sebastopol, Calif.: O'Reilly Media, 2004); Walter Isaacson, *Steve Jobs* (New York: Simon and Schuster, 2011).
- <sup>42</sup> Isaacson, *Steve Jobs*. Apple was not the only computer company to do this; by the mid-1980s, most microcomputers came with operating systems, and many came bundled with applications software that often included simple computer games.
- <sup>43</sup> Catherine A. Bailey, "Archival Theory and Electronic Records," *Archivaria* 29 (1989): 185.
- <sup>44</sup> Cook, "Easy to Byte," 208.
- <sup>45</sup> Cook, "Easy to Byte," 205.
- <sup>46</sup> This episode is discussed in detail in "Media, and the Messengers."
- <sup>47</sup> As an example of the persistence of the metaphor, see Costis Dallas, "Digital Curation beyond the 'Wild Frontier': A Pragmatic Approach," *Archival Science* 16 no. 4 (2016): 421–457.
- <sup>48</sup> John McDonald, "Managing Records in the Modern Office: Taming the Wild Frontier," *Archivaria* 39 (1995): 71.
- <sup>49</sup> There is a vast literature on the wild frontier as a myth of American nationalism, as well as a more recent literature on representations of wildness and wilderness as a distinctive feature of Canadian colonialism, often deployed in the dispossession of Indigenous peoples. On American representations of wilderness, see William Cronon, "The Trouble with Wilderness: or, Getting back to the Wrong Nature," *Environmental History* 1, no. 1 (1996): 7–28; on wildness in Canadian colonialism, see Jocelyn Thorpe, *Temagami's Tangled Wild: Race, Gender, and the Making of Canadian Nature* (Vancouver: UBC Press, 2012).
- <sup>50</sup> Margaret Hedstrom, "Building Record-keeping Systems: Archivists Are Not Alone on the Wild Frontier," *Archivaria* 44 (1997).
- <sup>51</sup> McDonald, "Wild Frontier," 71. It must be noted that in fashioning this image, McDonald contradicted everything else he had written in *Archivaria*, including a piece that specifically addresses "Archives and Cooperation in the Information Age," *Archivaria* 35 (1992), as well as his earlier pieces. I discussed this in "Media, and the Messengers." Indeed, even in "Managing Records in the Modern Office: Taming the Wild Frontier," he described the work of recordkeepers as collaborative and multidisciplinary, with a range of government, industry, and academic partners, and users who range from individuals at their individual desktop computers as well as project managers, operational managers, and records managers.
- <sup>52</sup> For example, "Lone Arrangers Roundtable," Society of American Archivists, <http://www.archivists.org/saagroups/lonearr>.
- <sup>53</sup> Hedstrom's emphasis on cooperation, collaboration, and mutual respect was typical of MRA approaches to digital archives. McDonald had previously advocated a similar approach in "Archives and Cooperation" and elsewhere, as described above.
- <sup>54</sup> Mahoney, "The Histories of Computing(s)." Applied examples include Haigh's work on how electromechanical data processing technologies shaped the reception of mainframe computing technologies (Haigh, "Chromium-Plated Tabulator"); Thomas Whalen's look at how typewriters and filing technologies shaped the evolution of bureaucratic practice ("Office Technology and Socio-Economic Change 1870–1955," *IEEE Technology and Society Magazine* 2, no. 2 (1983): 12–29); and Terry Cook's examination, in "Paper Trails," of how recordkeeping systems shaped (at the time) and provide windows into (when studied today) bureaucratic and ministerial decision making. Cook, "Paper Trails: A Study in Northern Records and Northern Administration, 1898–1958." In *For Purposes of Dominion: Essays in Honour of Morris Zaslow* (North York: Captus Press, 1989): 13–35.
- <sup>55</sup> As noted by Cook in "Easy to Byte," the MRA programs at the national archives of both Canada and the United States experienced significant financial and functional setbacks in the mid-1980s. As a counterfactual "what if" exercise, it is intriguing to look at the Danish government's digital archival program, where the digital archival unit created in the 1970s experienced increasing resources and responsibilities as computing spread in Danish government offices. The Danish digital archival program today represents what a Canadian or American archival program might have looked like if MRA approaches had continued to develop from the 1970s to today. See Danish



- National Archives, *Symposium about the Transfer, Preservation of and Access to Digital Records, Based on the Danish Experience* (Copenhagen: The Archives, 2008).
- <sup>56</sup> As discussed in “Media, and the Messengers.” Especially interesting in this regard is Hugh Taylor, “My Very Act and Deed: Some Reflections on the Role of Textual Records in the Conduct of Affairs,” *The American Archivist* 51, no. 4 (1988): 456–69.
- <sup>57</sup> Graham S. Lowe, “‘The Enormous File’: The Evolution of the Modern Office in Early Twentieth-Century Canada,” *Archivaria* 19 (1984).
- <sup>58</sup> Joan M. Schwartz, “‘We Make Our Tools and Our Tools Make Us’: Lessons from Photographs for the Practice, Politics, and Poetics of Diplomats,” *Archivaria* 40 (1995).
- <sup>59</sup> Adrian Cunningham, “Good Digital Records Don’t Just ‘Happen’: Embedding Digital Recordkeeping as an Organic Component of Business Processes and Systems,” *Archivaria* 71 (2011): 24.
- <sup>60</sup> Luciana Duranti, “Reliability and Authenticity: The Concepts and Their Implications,” *Archivaria* 39 (1995): 9.
- <sup>61</sup> Terry Cook levies this same critique against David Bearman’s Pittsburgh Project in “The Impact of David Bearman on Modern Archival Thinking: An Essay of Personal Reflection and Critique,” *Archives and Museum Informatics* 11 (1997): 31–32.
- <sup>62</sup> This perception may be rooted in an incomplete grasp of the various means, including those now identified as digital forensics, of revealing whether information objects have been altered or removed.
- <sup>63</sup> Terry Cook, “Electronic Records, Paper Minds: The Revolution in Information Management and Archives in the Post-custodial and Post-modernist Era,” *Archives and Manuscripts* 22, no. 2 (1994): 300–329.
- <sup>64</sup> Atherton, “From Life Cycle to Continuum; Naugler, *Archival Appraisal of Machine-Readable Records*; Hugh A. Taylor, “Transformation in the Archives: Technological Adjustment or Paradigm Shift?,” *Archivaria* 25 (1987). This point is discussed in greater detail in “Media, and the Messengers.”
- <sup>65</sup> This approach was explicitly recommended in John C. Mallinson, “Preserving Machine-Readable Archival Records for the Millennia,” *Archivaria* 22 (1986). Sue Gavrel provided an appropriate response in “Preserving Machine-Readable Archival Records: A Reply to John Mallinson,” *Archivaria* 22 (1986). Terry Cook described the deleterious effects of an official “print to file” policy at Ontario Hydro in the 1990s: “Despite management directives that all employees print out paper versions of electronic documents and place them on file, the volume of paper records arriving at the central storage office had dropped by 50 percent within six months of the network’s installation.” Cook, “It’s 10 O’Clock: Do You Know Where Your Data Are?,” *Technology Review* 98, no. 1 (1995): 48–53.
- <sup>66</sup> See Don Hurst and Richard M. Kesner, “Microcomputer Applications in Archives: A Study in Progress,” *Archivaria* 12 (1981); Richard M. Kesner, “Automated Information Management: Is There a Role for the Archivist in the Office of the Future?,” *Archivaria* 19 (1984); Kesner, “Whither Archivy?”
- <sup>67</sup> McDonald provided further details about IMOSA in “Managing Information in an Office Systems Environment: The IMOSA Project,” *The American Archivist* 58, no. 2 (1995): 142–53.
- <sup>68</sup> Discussed in “Media, and the Messengers.”
- <sup>69</sup> As discussed, for example, in Mahoney, “The Histories of Computing(s)”; Haigh, “Chromium Plated Tabulator”; or William Aspray and Donald Beaver, “Marketing the Monster: Advertising Computer Technology,” *IEEE Annals of the History of Computing* 8, no. 2 (1986): 127–43.
- <sup>70</sup> A good historical overview of these projects is provided in chapter 2 of Konrad Krahn, *Looking Under the Hood: Unraveling the Content, Structure, and Context of Functional Requirements for Electronic Recordkeeping Systems* (master’s thesis, University of Manitoba, 2012).
- <sup>71</sup> Catherine A. Bailey, “Canadian Archivists Speak Out: Results of the Surveys Conducted by the ACA Select Committee on Electronic Records,” *Archivaria* 36 (1993), quotation on p. 136.
- <sup>72</sup> It is worth noting that respondents did not raise the (allegedly) poor quality of the records as a reason for not taking in electronic records. This is in keeping with traditional archival thinking that records should be preserved in the forms in which they were created, managed, and used.
- <sup>73</sup> Bailey, “Canadian Archivists Speak Out,” quotations on p. 143 and p. 153.

- <sup>74</sup> For example, Michael B. Moir, "Finding Aids and Photographs: A Case Study in the Use of Analog Optical Disc Technology to Improve Access to Historical Images," *Archivaria* 36 (1993); Anne J. Gilliland-Swetland and Greg Kinney, "Uses of Electronic Communication to Document an Academic Community: A Research Report," *Archivaria* 38 (1994).
- <sup>75</sup> David Wallace, for example, described how emerging approaches to metadata "will enable whole systems, including the data and their defining metadata, to be migrated onto new system platforms" and observed that "traditional archival functions . . . will be altered by a metadata systems approach; the precise impact, however, remains unclear and too few archivists have either addressed or debated this issue." "Metadata and the Archival Management of Electronic Records: A Review," *Archivaria* 36 (1993), quotations on p. 99 and p. 101; emphasis added.
- <sup>76</sup> David A. Bearman, "Record-keeping Systems," *Archivaria* 36 (1993), quotations on p. 29 and p. 30.
- <sup>77</sup> Luciana Duranti and Heather MacNeil, "The Protection of the Integrity of Electronic Records: An Overview of the UBC-MAS Research Project," *Archivaria* 42 (1996): 46–67.
- <sup>78</sup> Cook, "Impact of David Bearman."
- <sup>79</sup> Marsden, "When Is the Future?" quotations on pp. 158–59; Marsden, "Acquiring Electronic Records of TNO: Archival Processing of Electronic Records," *Machine Readable Records Bulletin* 7, no. 2 (1991).
- <sup>80</sup> Victoria Lemieux, "An Archival Practitioner's Views on Archival Literature: Where We Have Been and Where We Are Going," *Archivaria* 40 (1995): 199.
- <sup>81</sup> Gordon Dodds reports that the debate was already well engaged in *Archivaria's* first decade. A decade later, ACA 1993 adopted theory and practice as the conference theme, as described in Heather MacNeil's keynote. See Dodds, "Canadian Archival Literature: A Bird's-Eye View," *Archivaria* 17 (1983): 37; and MacNeil, "Archival Theory and Practice: Between Two Paradigms," *Archivaria* 37 (1994): 6–20.
- <sup>82</sup> Digital originals on portable and backup media such as these form a largely unacknowledged digital reservoir in many Canadian archives. Contrary to the current wisdom that digital records cannot tolerate benign neglect, archives around the world have access to considerable quantities of digital records of various eras on interfiled portable digital media, magnetic tape, paper tape, and punch cards.
- <sup>83</sup> The recordkeeping chaos of Canadian bureaucracy in the 1990s was not simply an effect of the new desktop computing technologies. The Canadian government imposed an austerity regime (program review) at this time, which demanded a 10 percent cut to government spending across the board. Terry Cook has noted that this cut disproportionately affected departmental records management programs, even the new computing technologies transformed records creation, management, and use. See Cook, "Macroappraisal in Theory and Practice: Origins, Characteristics, and Implementation in Canada, 1950–2000," *Archival Science* 5, nos. 2–4 (2005): 101–61.
- <sup>84</sup> Terry Cook, "What Is Past Is Prologue: A History of Archival Ideas since 1898, and the Future Paradigm Shift," *Archivaria* 43 (1997): 42. Cook's assessment of Bearman's contributions, published in the same year, applied this criticism more specifically to the Pittsburgh Project. See Cook, "The Impact of David Bearman."
- <sup>85</sup> This is in keeping with Bearman's belief that archives could not be effective repositories in the digital age. Bearman, "An Indefensible Bastion: Archives as Repositories in the Electronic Age," *Archives and Museum Informatics Technical Report* 13 (1991).
- <sup>86</sup> Bearman, "Record-keeping Systems."
- <sup>87</sup> *Archives and Museum Informatics* was published by Bearman's consultancy, and he was the general editor. On the NAA policy, see Cunningham, "Good Records Don't Just Happen." On the NAC policy, see Terry Cook, "Leaving Archival Electronic Records in Institutions: Policy and Monitoring Arrangements at the National Archives of Canada," *Archives and Museum Informatics* 9, no. 2 (1995): 141–49. Bearman is one common link behind these similar policies. During the early 1990s, Bearman traveled frequently to Australia and Canada, and his articles appeared in *Archivaria* and *Archives and Manuscripts* as well as in *Archives and Museum Informatics*. The NAC policy represents a shift in Cook's thinking from his earlier writings, such as "Tyranny of the Medium," *Archivaria* 9 (1979) and "From Information to Knowledge," *Archivaria* 19 (1984), though he stressed in the text that introduced the policy, and in the policy itself, that the NAC policy was a short-term measure, complete with strict arrangements by which NAC staff would monitor the preservation and access regimes implemented for archival records held in creating

institutions. Cook envisioned a later review that would, based on the evidence and experience of postcustodialism, make a decision as to whether the creating agencies could remain the permanent custodians of the records. Unacknowledged by Bearman and Cook are the similarities between this postcustodial solution and ideas advanced by Hugh Taylor in "Information Ecology and the Archives of the 1980s," *Archivaria* 18 (1984) and Richard Kesner in "Automated Information Management."

- <sup>88</sup> Cook raised similar concerns in his piece on the NAC policy, but he conceded that the costs and complexities of digital records warrant a cautious trial of Bearman's postcustodial approach. Cook, "Leaving Archival Electronic Records in Institutions."
- <sup>89</sup> This situation caused major headaches for LAC's Trusted Digital Repository project resulting in considerable expenditures to create an electronic records transfer application (eRTA), which essentially reverse-engineered exportability into the government-sanctioned EDRMS. Johanna Smith and Pam Armstrong, "Preserving the Digital Memory of the Government of Canada: Influence and Collaboration with Records Creators," in *The Sixth International Conference on the Preservation of Digital Objects Proceedings, October 6–9, 2009, California Digital Library* (2009), <https://escholarship.org/uc/item/5xm3v98h>.
- <sup>90</sup> Luciana Duranti, Terry Eastwood, and Heather MacNeil, *Preservation of the Integrity of Electronic Records* (Dordrecht: Kluwer Academic Publishers, 2002), 6–8, 57.
- <sup>91</sup> This is because people who lack training and motivation to do proper recordkeeping often assign the wrong classification codes to resources when entering them into the EDRMS, or they avoid adding the records into the EDRMS in the first place. This is explored in more detail in Bak, "Continuous Classification: Capturing Dynamic Relationships among Information Resources," *Archival Science* 12, no. 3 (2012).
- <sup>92</sup> On the declining use of EDRMS and the rise in SharePoint, see the 2010 "Future Watch," special issue of *Records Management Journal*, and especially James Lappin, "What Will Be the Next Records Management Orthodoxy?," *Records Management Journal* 20, no. 3 (2010): 252–64; and Kate Cumming and Cassie Findlay, "Digital Recordkeeping: Are We at a Tipping Point?," *Records Management Journal* 20, no. 3 (2010): 265–78.
- <sup>93</sup> For an excellent and more sympathetic history of this era, see Krahn, *Looking Under the Hood*.
- <sup>94</sup> A point well made in Cook, "Impact of David Bearman."
- <sup>95</sup> Wendy M. Duff, "Ensuring the Preservation of Reliable Evidence: A Research Project Funded by the NHPRC," *Archivaria* 42 (1996).
- <sup>96</sup> Duranti's six-part primer on diplomatics, published in *Archivaria* 28–33, one article per issue, remains essential reading, while Duranti and MacNeil provided a textbook-clear application of diplomatics to electronic records in "Protection of the Integrity of Electronic Records."
- <sup>97</sup> *Archivaria*'s "Reflections on InterPARES" article series, which appeared in 64 (2007; three articles), 65 (2008; three articles), and 67 (2009; one article), documents some of the substantial contributions made through InterPARES.
- <sup>98</sup> David Bearman, "Moments of Risk: Identifying Threats to Electronic Records," *Archivaria* 62 (2007).
- <sup>99</sup> Consultative Committee for Space Data Systems, *Reference Model for an Open Archival Information System (OAIS)*, Magenta Book (June 2012); OCLC-RLG, *Trusted Digital Repositories: Attributes and Responsibilities* (Mountain View, Calif.: RLG, 2002); OCLC-RLG and National Archives and Records Administration, *Trustworthy Repositories Audit and Certification: Criteria and Checklist* (Chicago: Center for Research Libraries, 2007).
- <sup>100</sup> Greg Bak, "Digital Repository," in *Encyclopedia of Archival Science*, ed. Lucia Duranti and Patricia Franks (Lanham, Md.: Rowman and Littlefield, 2015); Mike Furlough, "What We Talk about When We Talk about Repositories," *Reference and User Services Quarterly* (2009): 18–32.
- <sup>101</sup> Lappin, "What Will Be the Next Records Management Orthodoxy?"
- <sup>102</sup> OCLC-RLG, *Trusted Digital Repositories*. An analysis of the model of trust in the TDR suite of standards is offered in Bak, "Trusted by Whom? TDRs, Standards Culture and the Nature of Trust," *Archival Science* 16 no. 4 (2016): 373–402.
- <sup>103</sup> Consultative Committee for Space Data Systems, *Reference Model for an Open Archival Information System (OAIS)*. For an analysis of the standard and an overview of its development, see Christopher

- A. Lee, "Open Archival Information System (OAIS) Reference Model," in *Encyclopedia of Library and Information Sciences*, 3rd ed., ed. Marcia J. Bates and Mary Niles Maack (2010): 4020–30.
- <sup>104</sup>OCLC-RLG, *Trusted Digital Repositories*; OCLC-RLG and NARA, *Trustworthy Repositories Audit and Certification*.
- <sup>105</sup>Apologies to fans of the movie *Highlander*, directed by Russell Mulcahy (London: Thorn EMI, 1986).
- <sup>106</sup>Duranti and MacNeil, "The Protection of the Integrity of Electronic Records," 64.
- <sup>107</sup>Hedstrom, "Building Record-keeping Systems."
- <sup>108</sup>Lilly Koltun, "The Promise and Threat of Digital Options in an Archival Age," *Archivaria* 47 (1999).
- <sup>109</sup>Bob Krawczyk, "Cross Reference Heaven: The Abandonment of the Fonds as the Primary Level of Arrangement for Ontario Government Records," *Archivaria* 48 (1999).
- <sup>110</sup>Elizabeth Yakel, "Thinking Inside and Outside the Boxes: Archival Reference Services at the Turn of the Century," *Archivaria* 49 (2000).
- <sup>111</sup>Victoria Lemieux, "Let the Ghosts Speak: An Empirical Exploration of the 'Nature' of the Record," *Archivaria* 51 (2001).
- <sup>112</sup>Jim Suderman, "Defining Electronic Series: A Study," *Archivaria* 53 (2002). In his conclusion, Suderman makes one brief reference to InterPARES.
- <sup>113</sup>These characteristics of MRA archiving are discussed in detail in "Media, and the Messengers."
- <sup>114</sup>Mark A. Matienzo, "'New Contexts of Permanent Change' in Digital Archivy," *Archivaria* 72 (2011). Carroll's article is discussed in more detail in "Media, and the Messengers."
- <sup>115</sup>Patricia Galloway, "Educating for Digital Archiving through Studio Pedagogy, Sequential Case Studies, and Reflective Practice," *Archivaria* 72 (2011); Christopher A. Lee and Helen Tibbo, "Where's the Archivist in Digital Curation? Exploring the Possibilities through a Matrix of Knowledge and Skills," *Archivaria* 72 (2011).
- <sup>116</sup>Ciaran B. Trace, "Beyond the Magic to the Mechanism: Computers, Materiality, and What It Means for Records to Be 'Born Digital'" *Archivaria* 72 (2011).
- <sup>117</sup>Laura Carroll, Erika Farr, Peter Hornsby, and Ben Ranker, "A Comprehensive Approach to Born-Digital Archives," *Archivaria* 72 (2011); Charles Levi, "Five Hundred 5.25-Inch Discs and One (Finicky) Machine: A Report on a Legacy E-Records Pilot Project at the Archives of Ontario," *Archivaria* 72 (2011).
- <sup>118</sup>Carroll et al., "Comprehensive Approach"; Courtney C. Mumma, Glenn Dingwall, and Sue Bigelow, "A First Look at the Acquisition and Appraisal of the 2010 Olympic and Paralympic Winter Games Fonds: or, SELECT FROM VANOC\_Records AS Archives WHERE Value="true"," *Archivaria* 72 (2011).
- <sup>119</sup>Mumma et al., "2010 Olympic and Paralympic Winter Game Fonds," quotation on p. 109.
- <sup>120</sup>The authors specifically cited Cook's piece on the appraisal of case files from *Archivaria* 32 (1991), but their discussion of the weighting of cost issues as a legitimate aspect of appraisal also is reminiscent of Cook, "Leaving Archival Electronic Records in Institutions."
- <sup>121</sup>The sentiment is clearly attributable to William Gibson but the exact wording varies. The genealogy of the quotation is discussed on Garson O'Toole's *Quote Investigator* blog. O'Toole, "The Future Has Arrived — It's Just Not Evenly Distributed Yet," *Quote Investigator* (January 24, 2012), <http://quoteinvestigator.com/2012/01/24/future-has-arrived/>.
- <sup>122</sup>Bak, "Trusted by Whom?"
- <sup>123</sup>Mahoney, "Histories of Computing(s)," 130.
- <sup>124</sup>Taylor, "Information Retrieval," 33.
- <sup>125</sup>Patricia Galloway, "Personal Computers, Microhistory, and Shared Authority: Documenting the Inventor-Early Adopter Dialectic," *IEEE Annals of the History of Computing* 33, no. 2 (2011): 60–74.
- <sup>126</sup>Katherine Gavrel and Walter Meyer zu Erpen, *Machine Readable Archives Division, General Guide Series* 1983 (Ottawa: Public Archives of Canada, 1984).
- <sup>127</sup>Cook, "Easy to Byte"; Catherine Bailey, "Electronic Records and Archival Description," *Archivaria* 34 (1992).

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