New Voices, New Topics

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The *Annals* has published an increasingly broad range of computer history scholarship over the past decade, but there are still many topics that remain unexplored, and some scholars conducting meaningful research in the field have yet to publish in this journal. These were the guiding thoughts as we had a phone conversation about a possible workshop to focus on new topics and new authors (to the *Annals*) that ultimately resulted in this issue. We developed a short list of individuals to invite—talented scholars conducting cutting-edge research on largely unstudied, but highly significant topics of computer history who had not previously published an article in the *Annals*.

In short, we wanted new voices that would push the understanding and boundaries of our field. We were delighted that all the invited individuals participated and we had a terrific two-day event in Austin, Texas, the first week of April 2010. We are grateful to the University of Texas-Austin, and particularly the UT School of Information, for sponsoring and hosting this event. Circulating the papers in advance combined with the generous and insightful engagement of the participants resulted in a highly productive and enjoyable workshop. Many of the ideas for revision extended from these collegial discussions, further improving the strong articles published in this issue.

Although the only requirement we placed on ourselves in extending invitations was ''new voices and new topics,'' nevertheless some broader themes emerged, and individual papers often complemented one another. Attention to the users and uses of computers were common to all the papers, and most addressed the theme of user-driven innovation. The manuscripts by Honghong Tinn and Patricia Galloway concentrated on tinkerers, an important kind of user and builder of early personal computing systems. Social groups, networks, and contexts figured prominently in all the articles. Explicit discussion of sources yielded numerous historiographical contributions, even though only one of the articles is framed as such (Galloway). Finally, the vastly understudied topic of embedded computing technology figures meaningfully in three of the articles (by Joseph November, Cristina Turdean, and Mara Mills) and George Royer's Think Piece on the videogame console industry.

Computers in Medicine

The computer is arguably the most important scientific instrument of the second half of the 20th century, yet historical scholarship on scientific computing has been sparse and uneven. The contributions of computing to the physical sciences have received more scholarly attention than its equally important contributions to the biological sciences and medicine. As Joseph November demonstrates in his article, computers have been prominent in many areas of medicine, but the potential for computer-aided diagnosis and therapeutic regimens have only recently gained widespread attention, and this change has developed alongside the relatively recent growth of evidence-based medicine (EBM).

Much of the literature on the history of medical computing has been narrow in scope and not added greatly to the rich writings in prominent medical journals by medical pioneers documenting their projects and ideas in the years after World War II. November takes a step back to analyze and contextualize the original ideas for computer applications for medical diagnostics in the 1950s and early 1960s, examining the work of Robert Ledley and Lee B. Lusted. November relates how Ledley, influenced heavily by his exposure to operations research (OR) in the US Army Medical Corps, together

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with Lusted, sought to bring OR methods, including statistical, probabilistic, and logical methods and simulations, to medical practice. The development of OR as well as its potential applications in medicine was enabled by the rapidly growth of digital computing technology.

From the networking of SAGE (Semi-Automatic Ground Environment) and later the Arpanet, to the supercomputing of Stretch, much of the scientific computing in the physical sciences resulted from heavy military R&D expenditures. November is the first scholar to do detailed historical research on the role of the National Institutes of Health (NIH) in funding early medical computing. Entrenched administrative and medical practices and philosophies often limited the possibilities of medical computing in practice, but NIH funding brought many digital computing systems into major hospitals and other medical settings, and these systems were used for many purposes other than diagnosis.

More specifically, November discusses the influence Ledley and Lusted had on physician Homer Warner, and Warner's subsequent experiment to apply OR methods using digital computing to medical diagnosis at the Latter Day Saints (LDS) Hospital in Salt Lake City, Utah. LDS Hospital has been the foremost testbed of medical diagnostic computing since Warner led a team there to develop the hospital's Health Evaluation through Logical Processing (HELP) computer system in the mid-1960s. As November relates, LDS hospital is now owned and operated by Intermountain Healthcare, an organization President Barack Obama has cited as an exemplar for using information technology to provide high-quality care at below-average costs.

Nevertheless, as November explains, medical computing, Intermountain, and EBM are not without prominent critics; healthcare applications of computing have been framed in broader debates concerning healthcare philosophies and understandings of the doctor-patient relationship.

The Forefront of Electronic Miniaturization

Similarly, Mara Mills offers an important, decades-spanning survey that demonstrates how neglected context—in this case concerning hearing aid technology—has led to distorted visions of digital computers being at the heart of the early history of electronics miniaturization. Mills argues that much of the literature in this area has inappropriately started with the development of the transistor in 1947 and is often framed in terms of Gordon Moore's seemingly prescient observation and prediction of the doubling of components on a chip in a given period of time. Mills explains how Moore's law is a self-fulfilling prophecy that Moore (as a founder of Intel) and the semiconductor industry (through its trade association's technological roadmaps) exerted considerable control over.

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While recognizing that certain military applications were important to the transistor's origins and early growth, Mills retells the story of electronics miniaturization, beginning long before the transistor. She argues how, both before and after the transistor, hearing aid applications drove electronics miniaturization. In the first half of the 20th century the hearing aid industry was essential to the development of subminiature vacuum tubes. During World War II military needs for light-weight equipment as well as hearing aid applications, contributed to miniaturization efforts—with the button battery and printed circuit—however, the military applications did not always necessitate the drastic size reduction demanded by users of hearing devices.

In the transistor era, the tens of millions of Americans with hearing loss or deafness, coupled with the relatively high prices charged for hearing aid devices, stimulated the development of transistor manufacturing and the origins of the semiconductor industry. Mills refers to the ''hearing aid approach'' discourse used by the developers of microelectronic components printed circuitry. She also notes how Raytheon not only pioneered subminiature vacuum tubes for hearing aid manufacturers, but also that the

company's pioneering role with transistors—starting a production line for point-contact transistors in 1948—enabled them to control much of the market for hearing aid amplifiers.

Mills concludes by briefly discussing the full circle of hearing aid technology, as microprocessors, or embedded digital computing technology, became increasingly common in the 1980, when real-time audio processing and microprocessor size and weight capabilities became appropriate for the application. This article demonstrates how the history of electronic miniaturization in noncomputing sectors of the economy can provide a fundamental corrective to computer history.

Casinos and Digital Technology

Over the past three decades, computing has found wide application in a vast range of technological devices, from automobiles and microwave ovens to exercise equipment and cell phones. November's presentation of Ledley's ''Metal Brain for Diagnosis'' and Mills' discussion of the microchips in most hearing aids since the 1980s are cases in point. Cristina Turdean provides another fascinating and important examination of embedded computing—digital slot machines. She demonstrates how mechanical slot machines, ''the so-called one-armed bandits,'' were marginal to both casino owners' revenue and profits, which was reflected by their peripheral positioning on casino floors. The machines were no more trusted by players than the casino owners trusted their players or employees with them. Instead, the table games, such as blackjack and poker, were the principal contributors to gambling establishments in the 1950s and 1960s.

Turdean recounts how the first electromechanical slot machine, Bally's Money Honey, introduced in 1964, revived slot machines through innovative features such as the electric-motor-driven hopper that facilitated higher automatic payouts, thus reducing the interruptions for employee-assisted payouts that often delayed or ended a player's gambling session. The Money Honey was in many respects a transitional technology to the fully digital slot machines and networked information systems of the 1970s and 1980s that transformed the slot machine and the face of gambling.

As Turdean explains, the growing efficiency, processing power, and cost of integrated circuits, and later microprocessors, led to new machines that enhanced security while improving flexibility, speed, and continuity of operation. Many of the advances in the machines and allied systems were pioneered by a research laboratory Bally established in Reno, Nevada, in 1974, led by Norwegian electronics engineer Inge Telnaes. New technology enabled remote mainframe computers in casino computer centers to monitor both players and employees.

Turdean notes that the role of users has only been explored in a few of the largest industries, such as Joanne Yates' examination of life insurance and computing in *Structuring the Information Age*. Turdean's creative and deeply researched study of digital slot machines, a previously unexplored area of computer history, contributes centrally to the role of users (casino management, players, and employees) and the social history of digital technology.

A Personal Microhistory

While Turdean's article is concerned primarily with digital technology's institutional users, Patricia Galloway focuses on an individual user, herself, to produce a personal microhistory of creating and refining a Kaypro II system in the early personal computer era.[1] Drawing on her training in archeology and archival studies, and adopting an autobiographical approach that is becoming increasingly common in humanities studies, she uses her narrative to provide a rich examination of the dialectic of early adopters and user innovation with personal computing.

Galloway's primary concern is not the microhistory itself (although this is a useful and intriguing look at the largely forgotten Kaypro II), but the methodology and documentation of this history. As such, her article is not just an engaging history, but more importantly a major documentation study and historiographical contribution. Citing Michael Mahoney's advocacy for ''retrieval of the dynamic artifact'' in computing and software, she develops a strong case for the importance of the material hardware and less tangible, though equally important, software to doing computer history. More broadly, she emphasizes that quality history requires published and unpublished documents, hardware, software, people, memories, and practices ''with an understanding of the information ecologies they constitute.'' Only through

such complex reconstruction and varied sources can we begin to move beyond the dominant studies on design and development to unearth individual interactions with technology and produce a deep understanding of work practices.

In seeking to capture and archive tacit knowledge of computer users, Galloway is interested in social networks and in uncovering or producing the documentation for largely overlooked social histories of computing and software. Acknowledging that large-scale documentation strategies, such as Helen Willa Samuels advocated for the history of science and technology in the mid-1980s, have come under attack by many archivists over the past couple decades as too labor intensive and impractical, Galloway defends such methods when practiced on a smaller scale. She distinguishes between the macro-strategies of big science and technology projects (Samuels' focus) and the micro-experience and innovations of individual users and small groups.

Few possess Galloway's range of professional experience in the humanities (both as an archivist and a historian) and as a sophisticated user and builder of computing systems—not to mention her thorough personal documentation habits. Given this, directly replicating her personal microhistory and documentation effort with other systems might prove challenging. Nevertheless, with multiple individuals working together (such as historians conducting oral histories with early users), many of the techniques Galloway used and described in this insightful article could yield important new documentation and social histories of computing.

A History and Sociology of Early Users

Honghong Tinn, in part, engages in just such the approach Galloway advocates—oral histories with early users and user innovators—to provide a valuable history of early tinkering with microcomputers in Taiwan. She defines *tinkering* as ''actors' modification of technological artifacts, informal production of technological artifacts, and the subsequent changing meanings of artifacts.'' Although they focus on very different geographies and contexts, Galloway and Tinn's articles complement one another. They both effectively use similar types of documentation, including trade publications and advertisements (source types also used by Mills).

Collectively the articles and Think Piece in this issue push the boundaries of computer history into new topical, thematic, and geographic domains.

Tinn's article takes us to Taiwan's Chung-Hua Arcade and Kuang-Hua Public Market, where her oral histories and other resources help her reconstruct the common story of users purchasing individual unlicensed components and software to build (or have built for them) Apple II compatible computers in the early 1980s. Although the first years of personal computing in the US (the mid-to-late 1970s) was also characterized by hobbyist builders of computing systems, this quickly gave way to dominant standard computer products such as the Apple II and IBM PC at the end of the 1970s and early 1980s. In Taiwan, however, user-built, or do-it-yourself (DIY), computer systems persisted far longer. She cites that DIY computers constituted more than a third of the computer market in Taiwan in the mid-1990s.

The second half of Tinn's article concentrates on the controversy and legal battle Apple Computer engaged in to prevent the production of what it regarded as illegal reproductions of its technology. Tinn presents the legal debate that ensued and the opinions expressed by Taiwan's Apple II compatible component firms as they appeared in trade journals and other venues. Many of these individuals argued that imitation is a necessary step for a developing country attempting to establish a new industry. Others emphasized that while it might be necessary at first, a simultaneous emphasis on internal research and development and the creation of original technologies is vital as well.

Overall, this article contributes not only to the history of Taiwanese computer history—a virtually unexplored topic in English language publications before this article—but also to the history and

sociology of users and user-driven innovation and to the history of technology in the developing world.

This issue's Think Piece is by George Royer, who refashioned a paper he presented at the workshop. Royer's "Familiar Concepts, Unfamiliar Territory" argues that although videogames have become increasingly common objects of study, the videogame console and videogames industries, and their associated technologies and business practices, have been neglected. He discusses the dynamics of the console and games industries, including the factors leading to their major downturn by 1983. Most importantly, Royer's Think Piece article provides a first attempt to show parallels and differences between the videogame and personal computer industries.

Collectively the articles and Think Piece in this issue, all by gifted first-time *Annals* authors, push the boundaries of computer history into new topical, thematic, and geographic domains. By concentrating on issues such as the roles of users/tinkerers and embedded computing technology, richly textured cultural and social histories of computing come to the fore and highlight new possibilities for our field.

Reference and Note

1. Galloway traces the methodological underpinnings of her use of autobiographical scholarship and microhistory to works such as B. Malinowski, *A Diary in the Strict Sense of the Term,* Stanford Univ. Press, 1989; L. Abu-Lughod, *Veiled Sentiments,* Univ. of California Press, 2000; F.R. Ankersmit, *Narrative Logic: A Semantic Analysis of the Historian's Langauge,* Groninger, 1981; G. Obrien, ed., *Pre-Removal Choctaw History: Exploring New Paths,* Univ. of Oklahoma Press, 2008; and H. White, *The Consent of Form: Narrative Discourse and Historical Representation,* Johns Hopkins Univ. Press 1987.

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