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This article describes Bernard A. Galler's involvement in early systems programming and machine languages research, his work with the ACM, and—of especial interest to the readers of this journal—his contributions to the development of the history of computing, and his role as the first editor in chief of the *Annals of the History of Computing*.

Let me begin this article on a personal note. I met Bernard Galler on a crisp winter day in Ann Arbor, Michigan, having been commissioned by the Association for Computing Machinery (ACM) to conduct a series of oral histories of the society's past presidents. I had previously done some historical research on Dr. Galler's career for a book project, which was not yet in print. I was somewhat apprehensive about speaking to a living subject, being more accustomed to the silence of archival texts. But even before the visit, Dr. Galler made it immediately clear that such apprehensions were unwarranted. Not only did he enthusiastically embrace the idea of the interview, but before I had hung up the phone, he made sure that the place I was staying, the Lamppost Inn, was a warm and reputable place in the middle of Michigan's cold winters. He welcomed me into his home and spoke pleasantly of his memories and his plans for retired life with his gracious wife, Enid. It was with shock, and sadness, that I heard just eight months later of his passing. I open this article with my deep condolences for his family.

Many *Annals* readers, along with the *Annals* editorial board, will remember Bernard A. Galler as its founding editor (see Figure 1). Through his involvement with the American Federation of Information Processing Societies, Bernie Galler, as most people knew him, took the lead role in ensuring that a new journal was created that chronicled the disappearing memories of the founding figures in computing, while also nurturing and accelerating serious scholarship in the history of computing. In fact, his vision for the *Annals* called for a unique and productive dialogue between the two different groups who pursued these two then divergent aims, something which I hope my own work has been able to manifest. Yet although I will include here an account of Galler's early contributions to the *Annals*, we are fortunate in that the ACM had the foresight to call for a broad life history of its past presidents. What follows, therefore, is a life history of Bernie Galler, one that combines the ACM interview[1] with an extensive and wide-ranging interview conducted by his wife in 1991,[2] and my prior historical research on the University of Michigan's Computing Center.[3]

Early life and career

Bernard A. Galler was born in Chicago, Illinois, in October 1928 to well-educated Jewish parents, Morris and Polia Galler, who had emigrated from Ukraine in 1921. There, Galler's father was pursuing his studies in agricultural engineering, his mother in medicine, when anti-Semitic rioting forced their departure to the US. His father, therefore, began his working career as a peddler, his mother as a garment worker, until the family saved enough to open their own general store in Chicago. Galler attended Chicago public schools and went to Marshall High School. Committed to the idea of a sound education, Galler's father tutored Bernard and his older sister throughout their school years.

At that time, the University of Chicago, long known for its work on education, had just launched a new program called the College Plan. The plan permitted the city's most aspiring youth to begin taking college-level courses during their junior year in high school, earning a general bachelor's degree in the liberal arts after four years of study. Galler had failed to pass the entrance exam in the first round, but passed it in the second, and proceeded to earn both a BS in liberal arts and a BS in mathematics in 1947. Galler also

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met his future wife, Enid Harris, while attending the University of Chicago.

Galler decided to pursue his master's degree in mathematics at the University of California at Los Angeles in 1949, before returning to Chicago to receive his PhD there in 1955. During that time, Chicago benefited from two powerful chairmen, Paul Halmos and Marshall Stone. Under Halmos' influence, Galler developed an interest in mathematical logic, in which he received a PhD. Yet although Galler completed highly credible work in this field, mathematics in the US had become intensely competitive after World War II. Galler chose, therefore, to pursue a teaching appointment, and wound up with an instructorship at the University of Michigan.

By 1955, IBM had released its first digital computers, including the IBM 701; the IBM 704 was on the way. However, in focusing on the more abstract problems in mathematics, Galler had neither seen nor made use of computers. His one exposure to digital computers prior to arriving at Michigan was an early article written by Arthur Burks, which had led him, in turn, to *High-Speed Computing Devices* (1950), produced by Engineering Research Associates. His work in mathematical logic, and general familiarity with Boolean algebras, made this a fascinating text and he had read it with great interest.

Still, it was only upon arriving at Michigan that Galler began avidly following computing developments. At the time Michigan had a digital computer and computer development program on campus centered on the Michigan Digital Automatic Computer (MIDAC). The machine had been modeled after the National Bureau of Standards' Standards Eastern Automatic Computer (SEAC), which was based in turn on the original draft report of the EDVAC design compiled by John von Neumann. MIDAC was built to support a guided missile development program being carried out at Willow Run Laboratories, Michigan's off-site contract research unit. This work had brought John Carr, an early expert on computer programming who had gotten his start with Project Whirlwind at the Massachusetts Institute of Technology, to Michigan. By 1955, Carr had transferred to Michigan's Mathematics Department, and was teaching a highly popular course, MATH-173: Methods of High-Speed Computation.

Out of curiosity, Galler had decided to sit in on Carr's course during his first semester at Michigan. By the second semester, he found himself teaching the course. Carr had apparently decided to encourage Galler's interest in computers. As Galler himself put it, "When John Carr saw that I was interested in computing, he said, 'The only way to learn it is to write programs.' He said, 'I'll introduce you to Paul Dwyer.' I guess he already knew somehow that Dwyer needed someone to write programs in linear programming."[4] Dwyer, a statistician, was in fact an early pioneer in linear programming. Dwyer was working on a special class of linear programming problems called the "transportation problem," via a US Air Force contract. Galler cut his teeth on more advanced problems and programming methods by volunteering his time to this project.

Figure 1. Bernard A. Galler, c. 1970s. (Courtesy of Charles Babbage Institute)

Linear programming, a problem that involved a large number of arrays, required intense computing power. Thus, as Dwyer's project advanced from its early proof of concept to more realistic experiments and demonstrations, the work migrated to more powerful computers.[5] The work was first moved over to the IBM 650 (a magnetic-drum-based computer) installed in Michigan's Statistical Research Laboratory in 1956, and then to the IBM 701 installed at General Motors. This latter, collaborative arrangement with GM was not uncommon during the early years of computing, nor was it unfamiliar to Michigan, which had always retained strong ties to the region's automobile industry. Because he volunteered his time, Galler was also given considerable freedom to extend his knowledge about computers in ways not necessarily tied to Dwyer's project.

During this period, Galler found himself letting go of his aspirations to become a research mathematician. As he recalled, "I did a nice PhD, but it was not great research." He never developed a sense of himself as someone who could become one of the "great research mathematicians." Moreover, in comparison to the intellectually isolating work of most research mathematicians, the early work on computers and systems programming took place in a dynamic environment that required regular, extensive conversations with colleagues from very different disciplines. Given that he held a PhD in mathematics, he immediately earned considerable respect from those who worked on computers both at GM and Michigan. There was also the excitement intrinsic to the work: "[I]f you're a computer person, the excitement of seeing something work and the potential of applying it down the road to societal problems, which at that time we hardly knew, but someday we thought, 'These are important ways to use a machine.'… that was exciting."[6]

By 1957, IBM was also in conversation with Michigan due to a desire to create the second, large-scale regional academic computing center, second only to the MIT Computation Center announced a year earlier. Although conversations were stalled for a while because of Michigan's concerns about its role and obligations as a state institution, by late 1958 the arrangements were completed to bring an IBM 704 mainframe computer to campus through a 60 percent academic discount. With the machine now scheduled to come online within a year, those planning this center called on Galler to help them develop a suitable operating system. They also offered him a tenure-line position, which was set up as a joint appointment between the new computing center and the Mathematics Department.

Programming research at Michigan

Michigan opened the doors to its computing center in August 1959. Its first director was Robert C.F. Bartels, an applied mathematician and senior mathematics faculty member. Bruce Arden and Robert Graham, both of whom got their start as machine operators for Michigan's general tabulating service and the MIDAC, respectively, were brought over from the Statistical Research Lab's IBM 650 to serve as the senior programming staff. Galler benefited, in part, from the choice of Bartels as director, for Carr had left Michigan after being passed over as computing center director. Carr's departure left the second and only other joint appointment open to Galler.

At the same time, his appointment was based as much on the immediate needs of the center. Although Galler felt that GM had a "very good [operating] system on the IBM 701," the requirements of an academic computing center were quite different from that of a corporate computing facility. As used primarily for teaching, Michigan's IBM 704 would handle many minor programs written by novice programmers when compared to the routine computing load of a major engineering computing facility. This characteristic load, and the fact that Michigan had to charge for academic computing services, made it necessary to develop highly efficient procedures for automatic operation and automated billing services that involved a minimum of computational overhead. As Galler himself recalled,

> Our goal was to run short student problems very rapidly. … [I] needed to modify the system so that the transition between jobs was very efficient. For [GM], this didn't make that much difference. If a job ran an hour, and then it took a minute to get to the next job, who cared? I needed to get the transition down to a couple of seconds to end one job and get the next one going.

GM had allowed Galler to make free use of the source code for its operating system (following a tradition of open exchange cultivated by the SHARE user group), but he later recalled that he had had to rewrite perhaps 90 percent of the code in creating the Michigan Executive System (MES).[7]

Throughout this period, Galler remained a faculty member. Indeed, his position was defined as a joint appointment specifically because Bartels and others wished to see the programming work within the center move in the direction of academic research, even as they recognized the clear obligation the center had to provide a reliable service. The first opportunity to take their work in such a direction occurred when the University of Michigan Computing Center opened its doors, only to find itself immediately flooded with programs submitted by students in MATH-173. Arden and Graham had decided to install a standard Fortran compiler, given that Fortran was already emerging as the standard programming language for scientific and engineering applications. However, in being designed for technical computing, all Fortran compilers were optimized for computing time, as opposed to the time required to perform the compilation. Such an arrangement was again ill-suited to an academic computing facility's operating environment, or at least one where most of the jobs submitted were for coursework. With CPU usage exceeding 30 percent from MATH-173 alone (with several thousand other students scheduled to arrive from the other courses), Arden, Graham, and Galler immediately set out to solve the problem at hand.

The particular product of this crisis was the Michigan Algorithm Decoder (MAD) compiler, a compiler that combined some of the features of Fortran and an early implementation of Algol. Before Carr had left Michigan, he had become involved with early conversations about Algol, and had enlisted Arden and Graham into working on Michigan's own implementation of Algol-58. It was apparently Graham who first discovered, while combing through the Fortran source code, that the problem lay with the frequent references the standard Fortran compiler made to translation tables stored on the slower, secondary magnetic drum storage. Arden and Graham were already familiar with optimizing programs to run on the IBM 650, which relied on such a memory system. Working with Galler, they devised a new approach that developed the translation tables in core memory, and transferred portions of the table to the magnetic drum storage only when the tables exceeded the space available in the core. They also employed an abstraction in implementing their solution so that a separate module within the compiler always maintained the most commonly used portions of the tables in the machine's core memory, and automatically swapped in the sections stored on the magnetic drum as needed. Although Galler and his colleagues made the somewhat brash and inaccurate declaration at the 1960 SHARE general meeting that all current work on Fortran was unnecessary, they had made the successful demonstration that there were different objectives toward which compilers could be optimized.

Time-sharing and virtual memory

Both the local and professional recognition that Galler and the programming staff at Michigan's Computing Center received for their work allowed them to aspire toward doing computer science research, specifically within the confines of an academic computing center.

The group shifted their attention to computer time-sharing systems in 1964, driven again by academic computing loads and requirements. This interest was based directly on earlier developments and discoveries at MIT. Back in 1960, MIT had launched a long-range study on academic computing requirements, which led to a large-scale research initiative in computer time-sharing. This work was based on ideas advanced by John McCarthy and Jack Dennis, both faculty members associated with MIT's interdisciplinary Research Laboratory for Electronics. By 1963, another RLE faculty member, Robert Fano, had created Project MAC, a lavishly funded project supported by the Advanced Research Projects Agency that set out to realize the vision of "man-computer symbiosis" laid out by Joseph Licklider, the first director of ARPA's Information Processing Techniques Office. Eager to make fundamental advances in the field, Fano alienated the MIT Computation Center's major benefactor, IBM, when he decided to work with GE rather than IBM.

Fano's decision created an opportunity for Michigan. Michigan had carried out its own requirements study in 1963, which had produced similar conclusions about the benefits of a large, central computer time-sharing facility. By the time Galler, Arden, and an electrical engineering faculty member, Frank Westervelt, began approaching computer manufacturers with their own ideas about machine requirements, they found a willing partner in IBM. At this point IBM agreed to build a specially modified machine in its yet-to-be-announced IBM System/360 series, built around specifications provided by Michigan. Promising conversations were also initiated with the National Science Foundation (NSF) in support of a research initiative competitive with that of MIT.

Arden, who had assumed the initiative in this work, was reasonably confident about their ideas, which by his own admission were derivative of those initially developed at MIT. Nevertheless, eager to have a strong sounding board for their ideas, the group at Michigan reached out to other colleagues whom they felt might be interested in a time-sharing system built by IBM. Arden approached Alan Perlis at Purdue University, whom he knew quite well though his work on MAD (and an earlier compiler at Michigan, the General Algorithm Translator,[8] which was more specifically a variant of the Internal Translator [IT] developed by Perlis). Galler spoke to the staff at GM. IBM then proceeded to invite other prospective clients, including the Carnegie Institute of Technology, the Systems Development Corporation, and Lincoln Laboratories at MIT.[9]

Unfortunately from Michigan's standpoint, these conversations demonstrated to IBM the avid interest in time-sharing among academic and other research institutions. IBM announced that it would make the IBM System 360/67 a standard item in its product line. With this also came the decision that they had to pull all system development work in house including systems programming to ensure that they were offering a reliable product. IBM's action killed NSF's interest in Michigan. Galler, speaking later, recalled that he and his colleagues all felt that they had been "left in the lurch."[10]

The difficulties that every research group encountered upon trying to develop the first large-scale computer time-sharing systems are well known in the history of computing literature. What is less well known are the contributions that those at Michigan, including Galler, made to this technology.

It was in August 1966 that IBM informally advised Michigan of the problems it was having with its time-sharing system and that it was unlikely it would deliver the machine before December. Worse yet, the necessary Time Sharing System (TSS) software would not appear until April, and this with no guarantees as to performance. Michigan's Computing Center had already announced that it would begin offering computer time-sharing service that fall.

From the outset, the research on computer time-sharing at Michigan was launched, in large measure, as an attempt to stem the rising tide of decentralized computing services. Accordingly, new news of delay weighed heavily on the minds of those at Michigan. In recalling these events, Galler suggested that IBM failed because it tried to satisfy too many different users having different requirements. Given time-sharing's technical challenges, it made little sense to attempt from the beginning to build a system that included everything except the kitchen sink. Operating in a crisis mode, Michigan's Computing Center assembled a technical staff to examine its situation. Westervelt, who had been working on responsive online interfaces for the system, examined the hardware design and the performance simulations carried out by IBM. His evaluation gave Arden and Galler the confidence to conclude that the IBM 360/67 hardware, which conformed to their own early specifications, had no inherent flaws, but that the problem lay entirely with the software and with the simulations.

What emerged then was a crash program to develop more efficient and reliable time-sharing software. NSF stepped in to provide the necessary funds for this research. Initially, two other staff members within the computing center obtained the source code for the MIT Lincoln Laboratory's Lincoln Terminal System (LTS) and loaded it on the university's existing IBM 7090 so that they could offer some semblance of a time-sharing service. This system was modified into a rudimentary version of the Michigan Terminal System (MTS), which was up and running on the IBM System 360/67 by May 1967. By November, this system attained reasonably reliable service, and could support a volume of users comparable to the Compatible Time Sharing System (CTSS) at MIT. By the following August, Arden, Galler, and the rest of their staff worked on a more robust and extensively modified version of MTS that made full use of the IBM 360/67 hardware modifications. In late 1968, MTS was the only large-scale time-sharing system to be in regular, reliable operation in the US.

There was a technical foundation to Michigan's success. As many came to recognize afterward, one of the main challenges for early time-sharing systems was the limited size of core memory. But Arden and Galler had already encountered a similar problem while working on the MAD compiler. Specifically, they had developed a software utility that automatically loaded sections of the MAD compiler tables into core memory. By extending this idea from a single application to the operating system, it was possible to create the illusion that the machine had a very large core memory. Most important, this illusion was available to systems programmers, as well as to any other user, so that the abstraction had simplified the task of developing time-sharing software at Michigan.

The efficient implementation of this scheme required special hardware modifications—precisely the ones Arden, Galler, and their colleagues had requested from IBM. The underlying ideas, on the other hand, were not original to Michigan. It was Jack Dennis at MIT who originally developed the idea of "segmentation" while dealing with a very small computer, the Digital Equipment Corporation PDP-1, which had even more severe memory constraints. Arden openly admitted that Dennis's paper led to obvious questions about implementation. Although Arden and others at Michigan may have independently come up with their own ideas about how to rapidly relocate different sections of core memory, similar concepts were already circulating inside IBM, GE, and MIT's Project MAC.

Still, only the Michigan group possessed both the requisite hardware and the pressing institutional demand to implement a large-scale computer time-sharing system. Other institutions, including MIT, either defined their work exclusively as research or as a timely computing service and therefore did not possess both the incentive and the technical means to rapidly implement a reliable time-sharing service. Galler and his cohort had found themselves on the productive middle road that allowed them to contribute not only to the development of time-sharing systems, but to virtual memory.

In the end, this did not save the University of Michigan Computing Center's foray into computer science and systems programming research. Academic computing demand and usage continued its exponential ascent during the late 1960s; consequently, the computing center's main computer was always overloaded. Shifting such a system to a time-sharing service was a recipe for disaster. At Michigan, and no doubt elsewhere, users complained either that they had no use for such a service, or else about the service's poor performance. The university created a Committee on Computer Policy that quickly determined that it was necessary to disintegrate research and service. They argued that it was wrong to require computer users to subsidize systems programming research within the computing center.

Work in computer science did of course continue at Michigan. However, the initiative shifted to other units on campus, most notably to the Department of Computer and Communication Sciences, a department created in 1965.

Involvement with ACM

Before proceeding to the rest of Galler's career at Michigan, I'll briefly shift to discussing his involvement with the ACM. The systems programming work at Michigan quickly placed Galler in touch with others at ACM, the principal society at the time for those with a broad interest in computing and computer programming. Galler became a member in 1958, and came to assume greater duties in 1960 as the first "university editor" for the newly established *Communications of the ACM*.

The *Communications* was the product of some growing pains within the ACM. Although the society was originally established under a broad charter that included the study of computing machinery (hence its name), by the 1950s ACM came to be dominated by those with a theoretical orientation toward programming languages, applied mathematics, and systems programming. But as the number of computer installations exploded during the latter half of the 1950s, many programmers gravitated to the ACM as the only society generally available to them for membership. This inflow created an unacknowledged two-tier structure within the ACM, where many industrially employed programmers felt, quite rightly, that their contributions to the art of programming had no opportunity for circulation within an academically dominated society. The academics within ACM, for their part, feared for a compromise in academic standards, both at the annual meetings and in the *Journal of the ACM*. As Galler himself recalled, "Yes, at the time, [the ACM] was very academically oriented … if you were known in academic circles, you were known."[11]

The compromise that emerged was to create a new publication, the *Communications*, which would offer a venue for shorter articles that described what was in fact a practical and fast-moving art. It also created a way for ACM's officers to reach out to its expanding membership. Alan Perlis was made its first editor in chief. Given his connections with Michigan, and the fact that academic computing centers had become an important site for innovations in systems programming, Perlis enlisted Galler into serving as "university editor." Though not an official title, this helped expand Galler's connections with other academic computing centers.

Galler quickly became more visible within the ACM organization, first as the chair of the Detroit chapter and as the Great Lakes regional representative to the ACM Council. Galler also participated in the national lectureships program organized by ACM, which set out to strengthen awareness about, and interest in, the profession. Based on his work at Michigan, Galler came to write a broadly used text on programming languages, *The Language of Computers* (McGraw Hill, 1962).[12] This in turn brought Galler into the fold of the ACM Programming Languages Committee in 1964. In 1966, Galler stepped up to become ACM

Vice President, and followed on to serve from 1968–1970 as ACM President.

It was really under Galler and his immediate predecessor, Anthony Oettinger (of Harvard), that ACM moved to fully embrace the growing body of computer programmers that had come to represent the computing profession. Each decade brought with it significant changes in the nature of computing, and during the 1960s, this included an explosion in business data processing. The trend accelerated, especially following the release of the IBM System/360 series computers. Both Oettinger and Galler supported special-interest groups, and especially the growing SIG on business data processing (SIG-BDP). They continued to promote the national lectureships, which appealed to the wider membership. There was also an effort during Galler's tenure to substitute the *ACM Computing Surveys* for the *Journal* as the standard publication sent to all members. *Computing Surveys* was a newer publication created specifically to introduce less-experienced programmers to more-advanced programming techniques by offering broad surveys of the state of the art. Here, Galler orchestrated a compromise whereby each member was offered a credit so they could choose which publication they wished to receive.

Galler concurred with a recent observation that it was Oettinger who launched most of the reforms; he in turn was left to oversee their implementation. This included substantial changes in fiscal policies and administrative reorganization that were needed to deal with what was becoming a large society. (During Galler's tenure as president, there were more than 25,000 members.) The size of the staff and the services offered out of the national office were substantially augmented during this period, with corresponding increases in the annual dues. There continued to be individuals within the ACM with a more academic orientation (and whose membership fees were not always covered by their institution) who were less pleased about the ACM's new direction. However, the general sentiment was that the ACM should remain the principal society for computer programmers. Given this directive, Galler and his predecessor helped to remake the ACM from an academic organization into a professional society.

Academic career at Michigan

The fact that Galler became more involved with ACM did not mean he was any less involved in the affairs at Michigan. Galler had stepped up to become the associate director of the computing center in 1966, and retained an affiliation with the center until 1991. But following all the problems associated with the university's computer time-sharing service, Galler shifted his focus to his departmental activities, which had itself undergone change.

Back in the late 1950s, Arthur Burks, one of Galler's colleagues at Michigan (and a veteran of the ENIAC project) established a new research initiative in natural language and cognitive modeling in collaboration with other faculty. By the early 1960s, this initiative had evolved into an interdisciplinary graduate program with PhD-granting privileges. John Holland, known for his work on "genetic algorithms," received his PhD through this program. When the first computer science departments began to appear across US universities during the mid-1960s, this initiative became the basis for the first computer science–oriented department at Michigan. This push to create a computer science department began with the administration at Michigan; Burks and his colleagues used the opportunity to argue that this should not be a standard computer science department.[13] In respecting their wishes, a decision was made, in 1966, to create instead a Department of Computer and Communication Sciences. (It was originally named simply the Department of Communication Sciences until it was discovered that a department with a similar name already existed at Michigan State based on a journalism tradition.) The new department was placed within Michigan's College of Literature, Sciences, and the Arts (LS&A). Galler transferred his academic affiliation to this department at the time of its founding to become one of its charter members.

Although Burks had some influence on the overall character of this department, in practice it remained an interdisciplinary home for a diverse array of faculty whose interests lay with computers and computing. Initially, Galler was able to continue his work on machine languages and time-sharing.[14] Over time, his interests shifted to more applied areas, such as the work he did on intelligent vehicles and transportation. Galler also continued his work in the more formal area of extensible languages.[15]

The 1960s was, of course, also a tumultuous time. Galler remembered vividly the 1968 Democratic National Convention in Chicago, the riots that ensued, and the changes in campus culture which, as he saw it, followed from this event. Galler felt that he was fully sympathetic toward the Vietnam era protesters. His parents were committed to Socialism and the unions. They had worked hard as individuals, had come from Europe, and had made their way in the inner-city environs of Chicago. Galler recalled the many May Day parades that he had participated in as a child. But he also recalled, "I became more 'center' later."[16]

Indeed, as the protest movement on campus grew more vigorous, Galler found himself shifting to a more centrist position. Once, when a group of students prevented General Electric from recruiting on campus, Galler organized a campaign to collect money from other faculty to place a full-page ad in the campus paper protesting the student activists' coercive practices. He also recalled a time when students from the Black Action Movement organized a BAM strike, where they disrupted his class of 200 students by chanting in the back of the room. In response, Galler had written something on the chalkboard, which made the activists quite angry. "I wrote 'Hitler 1933' on the board, and they became very angry. That was an interesting time."[17]

The Department of Computer and Communication Sciences continued to prosper at Michigan for some time, both at the undergraduate and graduate level. The continued popularity of computers fueled the growth of undergraduate coursework in computer programming and architecture. Some related work took place in the College of Engineering's Electrical and Computer Engineering Department, but the work there centered on hardware rather than software. At the graduate level, CCS produced a number of notable PhDs, including Ted Codd in relational databases, and John Holland (and his own students) in the field of genetic algorithms.

Arden, who had completed his PhD in electrical engineering while working for the computing center, became CCS Department chair in 1971. When Arden left for Princeton in 1973, Galler stepped in to fill this role.

Two years later, Galler was asked to become the associate dean for long range planning within the LS&A, a position he held between 1975 and 1979. Influenced by state budgetary crises brought on by the first oil crisis, this was a period of retrenchment at Michigan and Galler had to oversee the consolidation and restructuring of the departments within the college. But this work also gave Galler an opportunity to learn about his university. A he put it:

> [F]or me, the personal benefit of being an associate dean was to move up above the department level and suddenly meet people and learn about the functions of all the other departments and the museums and the gardens and so on. It broadened my perspective of the University greatly."[18]

In 1984, CCS merged with the Electrical and Computer Engineering Department to create a new Department of Electrical Engineering and Computer Science housed entirely within the College of Engineering. This too was a move necessitated by fiscal circumstance. But many of the former CCS faculty, including Galler, came to regret this decision. At least as far as they experienced it, the culture of engineering was dramatically different from the culture of science promoted within the LS&A. There was, as Galler put it, "much more pressure to bring in outside grants as opposed to doing research."[19] Moreover, as the accreditation pressures from the Accreditation Board for Engineering and Technology (ABET) grew, the new EECS Department found itself having to adapt its curricula to the standards set for the engineering profession. Given the curricular crowding in engineering, this meant that much of the interdisciplinary coursework, which had been a signature aspect of the CCS curricula, had to be let go. This had repercussions for faculty research as well, since hiring decisions had to be based in part on the instructional needs of the curriculum.

Galler retired from the University of Michigan in 1994, at the age of 65. Shortly before doing so, he became interested in the issue of software patents. The entire domain of intellectual property was being transformed by the spread of digital technologies. Congress approved a major change in the US copyright laws in 1980, and a Supreme Court decision followed in 1981 that suggested that one could patent software, provided that the software was part of an otherwise patentable process. The US Patent and Trademark Office, however, was quite slow in adapting its bureaucratic apparatus; its examiners, for the most part, were more familiar with machines than software.

When Galler discovered this fact during the early 1990s, he spearheaded an initiative to create the Software Patent Institute, a nonprofit organization set up to educate the public and to provide technical assistance to the USPTO and the legal profession through educational and training programs. It was not always that he felt this way. During the 1960s, while working directly for the computing center, Galler had written a letter to the editors of the *Communications* chastising university people for trying to charge for software. At the time, he belonged to the culture that regarded it as important for "software to be free." However, by the 1980s, Galler had altered his views in recognizing the important role that industry, and university-industry collaboration, could play in the development of new software. Galler successfully approached IBM, Apple, Sun Microsystems, and others for initial operating funds, and served as the first chairperson and president of the Software Patent Institute.

The immediate members of Galler's family, who were called upon at times to contribute to the effort, recall the energy with which their father set out to inform the public and the legal profession about US copyright and patent law as applied to software. Galler made the courtroom his classroom, pulling together the posters and slides that he could use to "'teach' the jury a couple of college courses' worth of information in just a few hours."[20] There are in fact many lawyers who called upon the services of the Software Patent Institute who valued Galler's expertise, and his ability to focus legal conversations onto the most pertinent issues.[21]

History of computing and the *Annals*

Finally, I return in this article to address Galler's contributions to the history of computing. Both his work on programming languages and his official position within the ACM had brought Galler to a prominent position within the American Federation of Information Processing Societies, an umbrella organization created to represent organizations like the ACM. (The ACM President automatically had a seat on AFIPS.) When AFIPS began talking about creating a history committee during the early 1970s, Galler became involved with that as well, not in the least because this new committee came to be chaired by Jean Sammet who was known for her interest in the history of programming languages.

Galler stated that he was always interested in history. "I guess I've always been interested in history. Partly it must have come from my parents, their experiences and so on."[22] His immigrant parents and the family's Jewish background indeed made ignorance of history impossible. But by the 1970s, it was also becoming clear that the developments in computing were having profound effects on society, and that it deserved to be documented as much as, if not more than, developments in physics and the other sciences.

The sentiment was sufficiently great that there emerged a parallel and more private effort by Erwin and Adele Tomash to create a new international society on the history of computing.[23] As will no doubt be familiar to many *Annals* readers, these two initiatives for a while operated jointly. The Tomashes founded the International Charles Babbage Society in 1977, and in 1979 AFIPS stepped forward to become one of the society's principal sponsors. The organization was renamed the Charles Babbage Institute, and both Sammet and Galler became members of the Institute's board of directors. A year later, the University of Minnesota agreed to both house and fiscally contribute to the operation of the CBI. Soon a separate nonprofit organization, the Charles Babbage Foundation, was formed to create proper separation between the two organizations (one being a sponsor of the other). This arrangement also freed the foundation to pursue general fundraising and to begin exploring other activities.

There were some differences of vision in how best to promote this nascent field, especially during its earliest stages. Sammet preferred an emphasis on archives to preserve the disappearing historical record; Erwin Tomash and others wished to delve more quickly into historical research. Unfortunately, this tension produced a temporary split among the principal benefactors. Sammet resigned from the Babbage Foundation. Galler also resigned, out of loyalty if not sentiment. (The members of the Foundation's nominating committee, in recognizing Galler's well-meaning way, in fact asked Galler to rejoin the board a year later as a scientific representative, which he accepted. He went on to serve as the Secretary of the Foundation late in his life.) This may seem paradoxical, given the emphasis that the CBI came to place on its archival collections and oral histories; AFIPS, for its part, came to support scholarship via its support for the *Annals of the History of Computing*. However, the CBI did in fact produce a substantial body of research, especially as carried out by its early directors and staff. The Adele and Erwin Tomash Fellowship in the History of Information Processing has also produced a formidable generation of academic historians committed to the history of computing.[24] For its part, the unique blend of materials in the *Annals* demonstrates a real commitment to preserving the historical record as well as promoting historical scholarship; this can be traced back to the early dialogue I've described.

Galler also insisted that the *Annals*, at least in its immediate origins, had as much to do with his involvement with the AFIPS Publications Board as with the AFIPS History of Computing Committee. This position gave him the means to argue for the importance of a historical journal in the field. The *Annals* was launched in 1979, and Galler served as its first editor in chief. Galler worried at first whether there would be enough material to publish in the first several issues. However, there was a latent supply of good material that could not find a suitable venue for publication, and many ideas quickly came forward for special issues devoted to specific aspects of the history of computing. Galler served as chief editor through the ninth volume of the *Annals*, and the record of his contributions are preserved in the archived copies of the journal itself. As he recalls,

> We had a very good editor, Myrtle Kellington, who came over from ACM originally, and later, Mondy Dana. My role was to solicit papers, to solicit reviewers, to set the tone with the Board. We had all kinds of decisions to make. The appearance of the journal, the audience, the price, the level, the amount of editing to be done. Some authors appreciate some editing to improve their style, and others absolutely don't … We had to learn how to do this.[25]

The *Annals* was transferred to the IEEE in 1992, where it remains a vibrant journal today.

Coda

Throughout the interview I conducted with him, Galler demonstrated a dual exuberance, both for the work he did to push new ideas and technologies with little concern for his own professional or disciplinary interests, and for his work as educator. Concerning the latter, he expressed special pride at the 20 PhD students he supervised, and the fact that most of them had chosen to stay in close touch after receiving their degree.

Bernie Galler died on 4 September 2006, at the age of 77. There are many people in the history of computing and in computer science, as well as all his friends and colleagues in Ann Arbor, who miss him sorely.

References and notes

1. I wish to thank Bruce Galler, Arthur Norberg, and William Aspray for their very helpful comments and suggestions regarding this article. Otherwise, this article is based primarily on the three sources in Refs. 1, 2, and 3, from which the article's direct quotes come. ''Dr. Bernard Galler,'' oral history by Atsushi Akera, 18–19 January 2006; http://portal.acm.org/citation.cfm?id=1141880&jmp=cit&coll=GUIDE&dl=GUIDE&CFID=34491662&CFTOKEN=49539886#CIT.
2. ''An Interview with Bernard A. Galler,'' conducted by E.H. Galler, 8, 10–11, and 16 Aug. 1991, OH 236, Charles Babbage Institute (CBI), Center for the History of Information Processing, Univ. of Minnesota, Minneapolis; http://www.cbi.umn.edu/oh/pdf.phtml?id=126.
3. A. Akera, *Calculating a Natural World: Scientists, Engineers, and Computers during the Rise of U.S. Cold War Research*, MIT Press, 2006, chapters 8 and 9.
4. ''Dr. Bernard Galler,'' oral history, part I, p. 6.
5. For a publication stemming from this work, see P.S. Dwyer and B.A. Galler, ''The Method of Reduced Matrices for a General Transportation Problem,'' *J. ACM*, vol. 4, no. 3, 1957, pp. 308-313.
6. ''Dr. Bernard Galler,'' oral history, part I, pp. 7-8.
7. Ibid., part I, pp. 9, 11.
8. B.W. Arden, B.A. Galler and R.M. Graham, ''An Algorithm for Translating Boolean Expressions,'' *J. ACM*, vol. 9, no. 2, 1962, pp. 222-239.
9. Galler and his colleagues' early efforts in this field is described in B.W. Arden et al., ''Programming and Addressing Structure in a Time-Sharing Environment,'' *J. ACM*, vol. 13, no. 1, 1966, pp. 1-16.

Key Publications

Some of Bernard Galler's key publications are as follows:

B. Galler, *Language of Computers*, McGraw-Hill, 1962.

B.A. Galler and A.J. Perlis, *A View of Programming Languages*, Univ. of Michigan, 1970.

B.A. Galler, *Software and Intellectual Property Protection: Copyright and Patent Issues for Computer and Legal Professionals*, Quorum Books, 1995.

P.S. Dwyer and B.A. Galler, ''The Method of Reduced Matrices for a General Transportation Problem,'' *J. ACM*, vol. 4, no. 3, 1957, pp. 308-313.

B.W. Arden, B.A. Galler, and R.M. Graham, ''An Algorithm for Translating Boolean Expressions,'' *J. ACM*, vol. 9, no. 2, 1962, pp. 222-239.

B.W. Arden et al., ''Program and Addressing Structure in a Time-Sharing Environment,'' *J. ACM*, vol. 13, no. 1, 1966, pp. 1-16.

B.A. Galler and A.J. Perlis, ''A Proposal for Definitions of ALGOL,'' *CACM*, vol. 10, no. 4, 1967, pp. 204-219.

B.W. Arden, B.A. Galler, and R.M. Graham, ''The MAD Definitional Facility,'' *CACM*, vol. 12, no. 8, 1969, pp. 432-438.

10. Akera, *Calculating a Natural World*, p. 328.
11. ''Dr. Bernard Galler,'' part II, p. 4.
12. B. Galler, *The Language of Computers*, McGraw-Hill, 1962.
13. Ibid., part III, p. 2.
14. For example, B.A. Galler and A.J. Perlis, ''A Proposal for Definitions of ALGOL,'' *CACM*, vol. 10, no. 4, 1967, pp. 204-219. Galler also published a book-length monograph with Perlis, *A View of Programming Languages*, Univ. of Michigan, 1970.
15. B.W. Arden, B.A. Galler and R.M. Graham, ''The MAD Definitional Facility,'' *CACM*, vol. 12, no. 8, 1969, pp. 432-438.
16. ''Dr. Bernard Galler,'' oral history, part II, p. 12.
17. Ibid., part II, p. 13.
18. Ibid., part III, p. 9.
19. Ibid., part II, p. 5.
20. Clearly a hyperbole, this nevertheless provides a sense of the enthusiasm with which he approached this work. (David Galler to Atsushi Akera, letter, 26 Sept. 2007.)
21. For the product of this work, see B.A. Galler, *Software and Intellectual Property Protection: Copyright and Patent Issues for Computer and Legal Professionals*, Quorum Books, 1995.
22. ''Dr. Bernard Galler,'' oral history, part III, p. 13.
23. For a much more extensive account of this history, see the special issue of the *Annals* honoring Adele and Erwin Tomash, *IEEE Annals of the History of Computing*, vol. 23, no. 4, 2001. See especially A.L. Norberg, ''A Perspective on the History of the Charles Babbage Institute and the Charles Babbage Foundation,'' pp. 12-23.
24. A list of the past recipients of the Tomash Fellowships may be found at the Babbage Institute Web site, http://www.cbi.umn.edu/research/recipients.html.
25. ''Dr. Bernard Galler,'' oral history, part III, p. 15.

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