Michael Sean Mahoney (1939–2008)

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From 1988, when he published his first paper in the history of computing, until his death in 2008, Michael Sean Mahoney was one of the leading international figures in the history of computing. This biography focuses on Mahoney's contributions to computing history and how he came to study this topic. His research in other areas of the history of science and technology is covered here only to the extent that it helps to explain the context for his work in computer history.

Research in the History of Computing

Mahoney published approximately 15 papers in this field, primarily covering three aspects of the history of computing: historiography, software engineering, and theoretical computer science.[1] His work in historiography will probably be the most lasting contribution, and in fact his first publication in this area, "The History of Computing in the History of Technology,"[2] has been his most influential. In this paper, he challenged the scholars in the field—mostly computer practitioners and a few historians—to learn from and integrate the study of computer history with the more mature field of technology history. He identified seminal questions and influential studies by leading technology historians such as Thomas Hughes, Merritt Roe Smith, David Hounshell, Walter MacDougall, David Noble, Eugene Ferguson, Brooke Hindle, Reese Jenkins, Edward Constant, and Nathan Rosenberg that could profitably guide study in the history of computing. Many scholars listened closely and followed this lead. One of his last papers, "The Histories of Computing(s)," published in 2005, looked back on the scholarship in this field over the previous 20 years and questioned the common, machine-centered organization of historical writing and in particular the argument that the ENIAC is the watershed event between many independent strands of early calculation and modern computing.

Mahoney quite reasonably placed his main interest in software rather than hardware, given his principal interest in the use of technology. His three most important contributions in software area were each of a different type. Upon the invitation from a friend, Mahoney was given access to Bell Labs, where he recorded a series of oral histories documenting the invention of the influential operating system Unix.[3] In 1993, ACM's special interest group SIGPLAN held its second of three conferences on the history of programming languages, inviting the principal developers to tell the creation stories of major languages such as Ada, C, Pascal, Prolog, and Smalltalk. Mahoney worked tirelessly with these practitioners to create accounts of enduring historical value. His third and perhaps most vivid result in the software area was his analysis of the misappropriation by software engineers of the metaphor of the Fordist production line in software production.[4]

The most enigmatic, yet perhaps the most passionate of Mahoney's work in computer history concerned theoretical computer science. Over the last 16 years of his life, he published seven papers on this topic.[5] Throughout this period, he continued to work on a book with the title *The Structures of Computation: Mathematics and Theoretical Computer Science, 1950–1970,* which remained in a highly incomplete state at the time of his death. The book sought to provide an intellectual history of the creation of theoretical computer science out of mathematics and logic. Protagonists in his account included, among others, Alonzo Church, John McCarthy, Dana Scott, Christopher Strachey, and John von Neumann. I regard this work as enigmatic because Mahoney had a limited audience for this

Background of Michael Sean Mahoney

Born: 30 June 1939, New York City

Died: 23 July 2008, Princeton, New Jersey

Education: BS (magna cum laude, history and science) Harvard University, 1960; PhD (history and history of science) Princeton University, 1967.

Professional Experience: Melpar Electronics, computer programmer, 1960; Princeton University, assistant professor, 1967–1972; associate professor, 1972–1980; full professor, 1980–2008; director, Program in History and Philosophy of Science (1972–1976); director, Program in History of Science (1982–1983); director, Program in Science in Human Affairs (1982–1983, 1987–1990).

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work, yet it was the one he most passionately pursued; historians were turned off by the technical detail, while many mainstream computer scientists were uninterested in the theoretical topics he covered. Even while devoting most of his attention to the filiation of these theoretical ideas, his was as much an example of social history as of intellectual history because he recognized the social nature of knowledge creation and dissemination and spoke about this subject on many occasions in terms of competing communities, each with its own agenda.

Mahoney would often address two or three of his main computing history areas in a single paper. There are parallels between his interests in the history of mathematics and the history of computing. He paid particularly attention to periods in which the concepts and basic scientific principles were first worked out—that is, when the fields changed from being driven by problems and technologies to being codified by an underlying science—mathematics in the 17th century, computing after World War II. He himself stated this point:

> Across the 17th century, … one can see the creation of a new field—algebraic analysis—that reshaped mathematics. I'm interested in how that comes about. How do you create a new scientific discipline? That, broadly speaking, is my interest in computer science. Where does computer science come from, and in particular, where does theoretical computer science come from? In 1955 there was no such subject; by 1970, there were textbooks and college courses about "theoretical computer science" and "the theory of computation." A new scientific discipline had come into being. I've been writing a book about how that happened—who was involved, where it happened, what were the obstacles, where the math came from, and so on.[6]

For further information on Mahoney's contributions in the history of computing, see Thomas Haigh's excellent account in the introduction to Mahoney's collected papers on computing.[7] The rest of this biography will instead trace Mahoney's career, with particular attention to the path that led him to study the history of computing, which was a principal intellectual pursuit during the second half of his life.

Early Life

Mahoney was born in 1939 in New York City. Growing up in Flushing, New York, the eldest of four boys, he excelled at both his academic and athletic pursuits. He had planned on attending the academically renowned Bronx High School of Science, but the commute was long and his family decided to send him instead to one of the nation's premiere private boarding schools, Phillips Academy in Andover, Massachusetts. At Andover, he graduated first in his class and won the mathematics prize and the highest scholar-athlete award. He attended Harvard University, where he majored in history and science, the undergraduate degree program offered by the history of science department. His advisor was John Murdoch, a historian of science of antiquity and the Middle Ages. Mahoney wrote a senior honors thesis in the history of mathematics and graduated magna cum laude in 1960. He described his choice of majors in an interview:

> When I arrived at Harvard as a freshman I was planning to go to medical school, so I was looking for a major that combined the sciences and the humanities. At the time, 1957, Harvard had just introduced a major, History and Science, that fit the bill. I soon realized that I didn't want to be a doctor, but I was fascinated by the history of science…. I have always been very interested in math. In fact there was a time when I thought I might become a mathematician, until in college I encountered people who could really do math. I would struggle with problem sets that these guys could knock off in minutes. Creative mathematics was not my calling.[6]

In his final year at Harvard, he worked part time as a computer programmer for Melpar Electronics, a small electronics firm down the road in Cambridge, and throughout his career, he was interested in computers, being one of the early adopters of personal computers on the Princeton campus and having one of the first campus email accounts. Although Harvard had been offering computer courses since 1947, Mahoney did not take any of these courses while he was there.

> Mike tended to be self-deprecatory about his own very early engagement with computer programming, and he enjoyed joking about how irritating the machines could be. At a 2004 lecture at the Center for Computing in the Humanities, at King's College, London, he told the crowd: "During my final year at Harvard in 1959–60, I had a job as a computer programmer for a small electronics firm in Boston. It involved writing code for a Datatron 204 [computer], soon to become through

> acquisition the Burroughs 204, a decimally addressed, magnetic drum machine. Programming it meant understanding how it worked, since it was just you and the computer: no operating system, no programming support. Six or seven months of that persuaded me that computers were not very interesting, nor did they seem to me to have much of a future. So I abandoned my thoughts of going into applied mathematics and became a historian instead. With foresight like that, it was probably a good choice."[8]

From 1960 to 1962 Mahoney was a foreign exchange student, with fellowship support from the Deutschen Akademischen Austauschdiensts, at the University of Munich, to which he returned on many occasions throughout his career. Fluent in German, Mahoney was able to take courses at the University of Munich. He took advantage of this opportunity and studied Arabic, Byzantine history, natural philosophy, Archimedean physics, the philosophy of mathematics, and the philosophy of language. At his own initiative, he also spent time in Munich compiling an index of the mathematical manuscripts at the Handschriften Abteilung of the Staatsbibliothek, which held an impressive but disorganized collection of medieval manuscripts relating to mathematics.

Perhaps the most important aspect of Mahoney's education in Munich was his networking with the active set of scholars in Germany interested in the history of mathematics and in ancient and medieval science. His most important contact was Kurt Vogel, the doyen of the history of ancient and early modern mathematics.[9] Vogel had retired from his university post in 1954 but continued to be an active force in the history of mathematics and science in Germany until the 1980s. During Mahoney's fellowship in Munich, Vogel was in the process of establishing the Institute for the History of Science and Mathematics at the University of Munich (which opened in 1963 with Vogel as the first chair). Vogel and Mahoney shared an interest in 15th century mathematics, and during those years, Mahoney translated into English Vogel's book, *Vorgriechische Mathematik* (although it was never published in English translation).

The other important senior scholar in Mahoney's life at this time was Helmuth Gericke, who held a faculty position in the history of mathematics at the University of Freiburg from 1952 to 1963, at which point he assumed the chair in history of science at the University of Munich and the directorship of the Research Institute for History of Science and Technology housed in Munich at the Deutsches Museum.[10] Gericke was a visiting professor at the University of Munich during Mahoney's fellowship years, and Mahoney enrolled in his seminar. Gericke had been writing on the history of mathematics since the 1930s, and he shared with Mahoney an interest in the history of 16th century mathematics and engineering, in particular the work of Simon Stevin.[11]

In 1962 Mahoney returned from Germany to enter the doctoral program in history and philosophy of science at Princeton University. He chose Princeton because his undergraduate advisor, John Murdoch, had joined the faculty there. However, a year later Murdoch decided to return to Harvard, and with guidance from Charles Gillespie, the director of the Princeton program, Mahoney changed his emphasis from the medieval period to the 17th century. He wrote a dissertation in the history of mathematics titled "The Royal Road: The Development of Algebraic Analysis from 1550–1650, with Special Reference to the Work of Pierre de Fermat," under the direction of the historian of physics Thomas Kuhn.

Mahoney was a star pupil and joined the history of science program as a junior faculty member in 1967, the year he completed his doctorate. He remained a Princeton faculty member throughout his career, promoted to associate professor in 1972 and full professor in 1980. He served terms as the director of the Program in History and Philosophy of Science (1972–1976), Program in History of Science (1982–1983), and Program in Science in Human Affairs (1982–1983, 1987–1990).

A Bump in the Road

It is easy to imagine Mahoney devoting his entire career to the history of mathematics. Although the history of mathematics was actively studied in Germany and some other European countries, at the time there were only a few historians of mathematics in the United States and Canada.[12] However, an unfortunate event early in his career appears to have contributed to a redirection in his focus. A revision of his dissertation was published in 1973 by Princeton University Press, under the title *The Mathematical Career of Pierre de Fermat.* The historians of mathematics and science were well satisfied with this book, and it became part of the standard English-language canon on the history of mathematics.[13] It was an important element

of Mahoney's successful dossier for tenure and promotion to associate professor. However, soon after the tenure decision, a highly negative review appeared from an influential mathematician.

Fermat is an important figure in the history of mathematics. He is especially well known for his "last theorem," where he conjectured in 1637 that there are no positive integers a, b, c for which $a^n + b^n = c^n$ for $n > 2$. This conjecture engaged many of the greatest mathematical minds of the next 350 years and stimulated the development of the field of algebraic number theory. It was not resolved until 1995, when the Princeton University mathematician Andrew Wiles proved that it is true.[14]

One of those mathematicians whose attention was drawn to Fermat's conjecture was Andre Weil (1906–1998)—not to be confused with Andrew Wiles, who solved the conjecture. Weil was a member of the faculty at the Institute for Advanced Study, not a part of the university but also located in Princeton. He held an international reputation for his contributions to algebraic geometry and number theory and for being one of the founders of the important French mathematics research collective known as Bourbaki. Although many mathematicians welcomed the attention given to mathematics by historians, there were others who believed that historians had no business studying this history because they did not have a deep enough understanding of mathematics. Weil's research in number theory attracted him to the work of Fermat, and when Mahoney published a book out of his dissertation, Weil used this publication as his opportunity to make known his general concerns about historians studying mathematics.

Weil savaged Mahoney's book in a 12-page review in one of the leading mathematical journals, the *Bulletin of the American Mathematical Society*. The review begins: "Nothing could be more welcome than a book on Fermat. This has been a desideratum for many years, and one wishes one could congratulate the author and the Princeton University Press on the publication of this volume." The review goes on to (incorrectly) critique the book on the grounds of inaccuracy, inability to express simple ideas in plain English, imperfect knowledge of French and Latin, poor historical sense, lack of familiarity with Fermat's contemporary mathematicians and successors, and clumsy organization. Weil concludes his review with these words:

Mahoney's book *The Mathematical Career of Pierre de Fermat* was well researched, historically sensitive, and beautifully written.

> Has this book no redeeming feature at all? As we have noticed, it does contain a lively account … of Fermat's scientific career, of his position among his contemporaries as a scientist and of the human aspects of his controversies with Descartes and Wallis. That section can be read with profit by any one who is not already conversant with the scientific personalities of that period. Apart from that, a student of XVIIth century mathematics will find little in that volume that could be useful to him, and much that can only confuse and mislead him.[15]

In fact, the book was well researched, historically sensitive, and beautifully written. It was this historical sensitivity to which Weil was probably objecting because the mathematicians were more interested in measuring past accomplishment in terms of modern concepts, while Mahoney was trying to recapture the mental world of Fermat. But a mean-spirited review can be devastating, especially when it comes from a leading member of the international mathematics community, and arguably, it did affect Mahoney's research direction and output.[16,17]

For many years, Mahoney largely set aside his own scholarship on the history of mathematics. During these years, he supervised several students who wanted to work in the history of mathematics, and later, he did some research in the history of mathematics and revised his Fermat book. However, never again was he to be first and foremost an historian of mathematics. Much of his work after the Weil review dealt with mathematical applications and the formation of a mathematical base to other scientific or engineering disciplines in the 16th and 17th centuries. Examples include his work on Simon Stevin and engineering, Christian Huygens and navigation, Isaac Barrow as a transitional figure between ancient

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and modern mathematical science, Rene Descartes on light, and various papers on visualizing scientific and engineering problems.[18]

The Move to Computer History

Mahoney was not one of the first historians to publish in the history of computing. The *Annals of the History of Computing* was founded nine years before Mahoney's first paper in computing history, and professionally trained historians already publishing in this field included I. Bernard Cohen, Martin Campbell-Kelly, Paul Ceruzzi, Nancy Stern, and me. It was about a decade after the Weil review appeared before he turned his attention seriously to computing history. Part of Mahoney's interest in computing history arose from his teaching. Although Princeton University is a leading research institution, it takes the quality of its undergraduate education very seriously. Mahoney had a strong interest in public and university education, and he worked hard at it. He served as president of the local public school board, ran summer schools for high school teachers, and invested many hours in his undergraduate teaching. Faculty colleague Tony Grafton said of Mahoney, "most teachers are not so good at pushing students to work their hearts out to do the very best work they can. Mike—who regularly worked with Princeton's swimmers and athletes outside the university—had a coach's passion for making everyone do better and a coach's belief that drive and effort matter."[19]

Research universities often promote the ideal of the teacher-scholar who can impart cutting-edge research knowledge in the classroom. In this case, however, it was the teaching that seemed to inform the research. In 1979 Mahoney began to develop an undergraduate course in the history of technology, which included a section on the history of computing.[20]

> I set out to design a course on the history of technology, a topic I thought we needed to teach about (this course would become History 398, Technologies and Their Societies). In the process I discovered some aspects of the recent history of computing that really interested me. I decided to look more closely at the history of computing, and in order to do that, I needed to learn something about computing as it then existed.[6]

Mahoney decided to expand his technical knowledge in order to inform his research, teaching, and general interest. Despite his experience with the Datatron, he decided he needed a deeper and more systematic knowledge of computing, and between 1982 and 1985, he enrolled in the core sequence of undergraduate courses for majors in computer science at Princeton. His later historical work on computing was characterized by a solid understanding of the science of computing and an abiding interest in the intellectual filiation of ideas, especially mathematical ideas, in computer science.[21]

Mahoney continued to develop his teaching in the general history of technology as well as in history of computing during the 1980s. Between 1984 and 1991, together with three faculty members from the Princeton engineering school, he used funding from the Alfred P. Sloan Foundation to create a curriculum for the humanistic study of technology, intended for engineering students.

> Working on this project over several years led Mike to solidify his own ideas in the fields of machines and mathematics. In addition to computers, Mike had always been interested in the development of the automobile, and the Ford assembly line was a favorite topic of his. One of the other members of the team, Robert Mark, was an expert on gothic cathedrals. This fit right in with Mike's interests too, as his [Mike's] Irish grandfather had come to this country at the turn of the century to work as a stone cutter at the Cathedral of St. John the Divine in NY. Mike gained a lot of insight from the book, *The Education of Henry Adams*,… which gave an accurate picture of what people knew 100 years ago. During the Sloan years, he was able to develop several of his topics in history of technology. He wrote "Reading a Machine," and another a very popular paper, … [no evidence of its having been published],

called "The Virgin, the Dynamo and the Chip," taking the cue from the Adams biography chapter, "The Dynamo and the Virgin."[22]

It is often difficult to know the specific genesis of an idea, but it seems that two important lines of thought in Mahoney's research came out of his undergraduate teaching. He often assigned his students to read Tracy Kidder's Pulitzer Prize-winning book, *The Soul of a New Machine*. What fascinated Mahoney was the claim reported in the book by one of the Data General engineers that the organization and culture of Digital Equipment Corporation could be observed in the design of one of its completed VAX minicomputers. Mahoney often came back in his research to the notion of the close reading of a technological artifact to understand scientific, political, and organizational agendas of its creators.[23] One of the major topics that he taught in his undergraduate history of technology courses was Fordism and the system of mass production. This led him to reflect on and write several papers about how, in their work, software engineers misappropriated the mass production concept as it was employed in the production of automobiles.

As mentioned earlier, Mahoney's first publication in the history of computing was a historiographic article that appeared in 1988. In it he tried to make sense, for himself and others, of the history of computing as a scholarly field of study. His first major research project in computer history commenced at about the same time and involved the oral history project on the Unix timesharing operating system that we have already mentioned. Charles Stenard, a friend of Mahoney from their undergraduate days together at Harvard, was a mathematician at Bell Labs. He introduced Mahoney to Bell Labs in 1982 because of Mahoney's interest in the software productivity crisis of the preceding decades,[24] and about five years later, he invited Mahoney to become a consultant at Bell Labs:

> Later, around 1987–88, I was directing AT&T's bid to develop a nationwide weather analysis and forecast network that would combine all data streams for presentation and analysis by meteorologists at workstations. The project included a complex of interacting requirements, including high speed pan and zoom of satellite and radar imagery, data fusion, a programming environment to try various experimental routines, and the transport some 10 million lines of legacy code written by various meteorologists for their local use. Because the requirements, architecture, and design of the system were likely to be a quagmire, I hired Mike as a consultant to evaluate tools for requirements analysis and generating system specifications. During this period, I introduced him to the researchers who invented the Bell Labs constellation of software. Mike and I saw the same need to understand the best of software technology – I for current application, Mike from his earlier work on software productivity. He acquired the understanding of how we could best capitalize on Bell Labs software for my project, but also conceived of his "Oral History" project, having first-hand interviews with the inventors.[25]

The 20 years from the time of Mahoney's first publication in the history of computing in 1988, until his death in 2008, was the most productive time in his career. He wrote not only on the history of computing and early modern science and technology, but he also returned to the history of mathematics. He was a well-known and highly regarded figure in the history of science and technology communities. This may explain why he published most of his work as chapters in edited books (21 times during these 20 years) rather than as articles in peer-reviewed journals (only four articles). Known as an excellent lecturer, he was in demand as a speaker and gave 54 invited lectures and talks during this period.

While Mahoney was a well-established senior member of the history of science and technology, in the 1990s he also became actively involved in the historical activities of the computing professional community—more so probably than any other professionally trained historian. He served from 2001 until the time of his death on the editorial board of the *IEEE Annals for the History of Computing,* the main professional journal in this field. He also served on the Historical Advisory Committee of the IT History Society, from its founding in 2007 by the IT History Foundation, a nonprofit created by pioneers from the computer industry.

However, Mahoney's most extensive engagement with the technical computing community was his work with the ACM. There, he served from 1987 to 1995 as the editor of the History Series published by ACM Press. He advised on three major history conferences organized by technical special-interest groups of the ACM: Milestones: The History of Computer Graphics (SIGGRAPH, 1988—1989); the Second Conference on

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History of Programming Languages (SIGPLAN, 1990–191993); and the Third ACM SIGPLAN History of Programming Languages Conference (2004). He served from 2002 until his death as the historical consultant on ACM SIGSOFT Project Impact, a project organized by the software engineers to understand the impact of software engineering research on software engineering practice. For the last several years of his life, he also served on the ACM History Committee, advising the professional society on how to collect and preserve its organizational records and develop a professional oral history program.

Conclusion

Mahoney died in 2008, following a heart attack suffered while exercising in the Princeton University swimming pool. The community was stunned at this loss, not only because it is always hard to lose a leading figure but also because it was so sudden and unexpected. Although he was 68 years old, he had the vitality of someone many years younger. Many of his friends and colleagues had seen him only days earlier at pace with his usual, active life replete with university activities, research, family, and exercise. As spotty news of his death circulated online, there was disbelief about the accuracy of these reports for several days, until finally an official notice appeared on the Princeton University webpages.

How do we understand Mahoney's contributions? He was arguably the most influential figure in the history of computing over the past quarter century, as the field became populated by professionally trained historians and as major institutions such as the Charles Babbage Institute and the Computer History Museum became established. Some of the traditional markers of academic influence do not fully capture Mahoney's influence. As a faculty member in one of the most important graduate programs in history of science, Mahoney produced in 30 years only four doctoral students working primarily in the history of computing or closely related areas such as computing applications or the materials and devices from which computers were built.[26] He published fewer than 20 papers in the history of computing, representing less than one publication per year during those years in which he was actively involved with this subject. He mentioned on several occasions his frustration with his lack of progress on his book manuscript on theoretical computer science, which remains incomplete.[27]

Mahoney's influence is more clearly seen in other ways. He set high standards for his own scholarship and those of others he touched—students, colleagues, and members of the technical community—requiring research to be both historically and technically grounded. He challenged his colleagues to learn from and build on the work of established historians of technology.

Through his influential historiographical talks and papers, he helped to set a research agenda for the history of computing that was sound historically and yet addressed the interests of computer scientists. He entered the field at a critical time, when the history of computing had not yet matured in terms of its research topics and methods. No other paper has had more importance to the historians of computing, or had a wider readership, than his 1988 paper, "The History of Computing in the History of Technology." Many of his other papers concerning software engineering and theoretical computer science, as well as historiography, are also groundbreaking and will inspire new generations of scholars to continue where he left off.

Mahoney reached out to the professional computing community to teach them about what history is and how it can be important to them. He was well received in the technical community because he had a technical education, was patient in teaching them about history, and was respectful of the interests and contributions the technical community had made. No other professionally trained historian of computing has come close to having the impact on the technical community that he did.

Mahoney was generous with his time in the activities that helped to professionalize the field. Examples include active

participation in the computing special interest group of the Society for the History of Technology (SHOT), membership on the editorial board of *IEEE Annals*, extensive reviewing of new books even after he was a senior member of the community, and various encyclopedia and survey articles he took time to write.

Because of where he was situated, Mahoney helped to legitimate the study of the history of computing. As a senior faculty member at a leading university, his interest in the history of computing gave it gravitas. He was also well positioned to connect the history of computing community with the much better established history of science, history of technology, and history of mathematics communities.

Not least, the community remembers the many acts of generosity and personal kindness Mahoney offered to people interested in the history of computing, especially to young scholars. The copies he returned to us of our draft papers extensively marked up in his beautiful cursive writing (that belied the incisive critiques) was a sign of his care, even if some of us as young scholars did not know what to make of it the first time it happened. It is entirely fitting that the SHOT fund supporting the scholarship of doctoral students and young scholars in the history of computing has been named in his honor.

References and Notes

1. There is considerable overlap in content in some of the papers, as well as multiple versions, so it is difficult to count precisely the number of Mahoney's computer history publications.
2. M.S. Mahoney "The History of Computing in the History of Technology," *Annals of the History of Computing*, vol. 10 no. 2, 1988, pp. 113–125.
3. Prints in box 53, Michael S. Mahoney Papers, CBI 213, Charles Babbage Inst., Univ. of Minnesota.
4. See, for example, M.S. Mahoney, "Issues in the History of Computing," *History of Programming Languages*, T. Bergin and R. Gibson, eds., vol. 2, ACM Press, pp. 772–781.
5. Perhaps the most complete of these papers is M.S. Mahoney, "Computer Science: The Search for a Mathematical Theory," *Science in the 20th Century*, J. Krige and D. Pestre, eds., Harwood, 1997, chap. 31.
6. Excerpt from the Michael S. Mahoney Princeton Univ. interview available at www.princeton.edu/history/people/display_person.xml?netid=mike&interview=yes.
7. T. Haigh, ed., *Histories of Computing*, Harvard Univ. Press, 2011.
8. J.Z. Buchwald and D.G. Burnett, "Michael S. Mahoney, 1939–2008," *Isis*, vol. 100, no. 3, 2009, pp. 623–626.
9. See M.S. Mahoney and I. Schneider, "Eloge: Kurt Vogel, 30 September 1888–27 October 1985," *Isis*, vol. 77, no. 4, 1986, pp. 667–669.
10. M. Folkerts and K. Reich, "In Memorium: Melmuth Gericke," *Historia Mathematica*, vol. 35, no. 3, Aug. 2008, pp. 170–172.
11. In later years, Mahoney formed long-standing friendships with other Munich scholars with similar interests who were closer to his own age, including Menso Folkerts, a professor of history of science specializing in history of medieval mathematics at the Ludwig Maximilians University in Munich, and Ivo Schneider, another historian of mathematics who taught at the University of Munich and the Universitat der Bundeswehr in Munich.
12. An incomplete list of historians of mathematics active in North America in the 1960s and 1970s includes Kenneth May and C.J. Scriba at the University of Toronto, Thomas Hawkins at Boston University, and the historians of mathematics in antiquity at Brown University (Otto Neugebauer, Gerald Toomer, and others).
13. See, for example, the review by the well-known American historian of mathematics Carl B. Boyer in *Science* magazine (vol. 181, no. 4095, 1973, pp. 152–153) and by the British historian Alan Gabbey in *The British Journal for the History of Science* (vol. 8, no. 1, 1975, pp. 81–84).
14. Wiles's proof led to a new interest in Mahoney's book.
15. A. Weil, "Book Review: The Mathematical Career of Pierre de Fermat," *Bull. Am. Mathematical Soc.*, vol. 79, no. 6, 1973, pp. 1138–1149.
16. Mahoney's widow, Jean, and his long-time friend, the mathematician Charles Stenard, strongly dispute the claim that the Andre Weil's book review of *The Mathematical Career of Pierre de Fermat* affected Mahoney's career. Mahoney himself also took a public stance that suggested that this episode was not of great importance: "Mathematicians are also jealous of their history in ways that scientists are not. Some mathematicians have even argued that only people who are themselves creative mathematicians should write the history of math. Once I was attacked in print by someone who thought I wasn't worthy to study Fermat. I don't pay much attention to that. I'm a historian, not a Platonist. As a historian, I believe that an account of a 17th-century mathematician has to be restricted to what that person knew. Practicing mathematicians and scientists sometimes have a tendency to look at a

figure like Fermat and say, "Oh, he's just doing *X*," where *X* is some more modern technique. As a historian, you can't use mathematics that came after Fermat to explain what Fermat was doing. Fermat was working with the mathematics of his time. How *X* grew out of Fermat's work is itself part of the history." Excerpt from the Michael S. Mahoney Princeton Univ. interview available at www.princeton.edu/history/people/display_person.xml?netid=mike&interview=yes.

17. Why in the face of these claims should we believe that this episode may well have been a shaping influence on Mahoney's career? There are two reasons. One is based on two conversations that I had with Mahoney. The first occurred when I was a graduate student studying the history of mathematics under Mahoney's supervision during the 1975–1976 academic year. I had asked him why he was supervising so few doctoral students, and he indicated that several students had wanted to study history of mathematics with him at Princeton but that he had shied away from accepting them or doing more research in the history of mathematics because of the reactions of some of the mathematicians; it was easier for him to pursue one of the other historical topics of interest. Many years later, in the 1990s, when I was a friend and colleague rather than a student, we revisited this topic and he confirmed the impact of Weil's review on his research. The second reason for this belief is based on an analysis of Mahoney's publication output between 1967 and 1979. During these 13 years, he published a translation of a fragment of Gottlob Frege's famous philosophical work, *Grundlagen der Arithmetik*; a translation of Rene Descartes' *Le Monde*; an encyclopedia article about mathematics in the Middle Ages; two articles on mathematical thinking in ancient Greece and Babylonia; an article on Copernicanism in the 16th and 17th centuries; 14 book reviews (many on the history of mathematics); and only two research articles on the history of mathematics. This record constitutes low scholarly output for a faculty member at a top research university in his area of specialty, even for someone who is as careful a scholar as Mahoney was.
18. One might argue that these publications do represent research in the history of mathematics, especially given that mathematical developments often arise from scientific and engineering problems. The point, however, is that there is a kind of internal intellectual history of mathematical concepts, which was for many years the standard way in which historians studied the history of mathematics and is still the way in which most mathematicians study the history of their field. Mahoney's doctoral dissertation and his Fermat book fall into that research genre, while his later work focuses not on the production of mathematical concepts and theories but instead on the introduction of mathematical concepts and methods into various scientific and engineering disciplines. This later work is less likely to incur the attention or opprobrium of mathematicians interested in the history of their discipline, especially in the United States where mathematics has a long history of being "pure" rather than "applied."
19. A. Grafton, "Remembering Mike," *The Daily Princetonian*, 15 Sept. 2008; www.dailyprincetonian.com/2008/09/15/21361/.
20. Joseph November, the last student to complete a doctoral dissertation in the history of computing under Mahoney's guidance, remembers this course (J. November to W. Aspray, email, 9 Apr. 2010): "I TAed this course twice. The undergrads were enthralled. Mike was spectacular at getting Princeton students to move past just trying to receive high grades. History of technology was usually something entirely new to them, so they really learned a great deal. The course's 'Reading the Artifact' exercise was a particularly effective teaching tool Mike developed. Students would select an object and then, without doing research, attempt to elicit from its structure the knowledge systems and technological systems that had to be in place for a society to make and use that object. Something as simple as a piece of paper reveals a great deal about the society that built it."
21. Only a small number of the historians of computing have a knowledge of computer science equivalent to or greater than that taught in a rigorous undergraduate computer science degree program. Although Mahoney's degrees were both in the history of science, he was unusually well versed in broader historical matters. Holding both of these credentials, Mahoney was a rare commodity. When he was a young faculty member, he often taught preceptor sections of the general courses on British history, European history, and medieval history—something beyond the comfort level of many historians of computing.
22. The source of this quotation is an unpublished document: J.A. Mahoney, "Thoughts on the Life and Career of Michael Sean Mahoney," Mar. 2010. It was emailed to William Aspray and Thomas Haigh on 9 March 2010. This document has been a very helpful source in correcting errors and filling in detail in an early draft of this paper.
23. See, for example, "Reading a Machine," updated and enhanced, 21 June 2003; www.princeton.edu/~hos/Mahoney/.

24. I have no evidence of Mahoney's interest in the software crisis, or in the history of software more generally, as early as 1982 other than this email from Stenard. Mahoney's curriculum vita does not show any publications on software history until 1990. However, during the 1980s, he did begin to make public presentations on computing, especially in relation to the curriculum. For example, he presented a talk on "Computers and the Classics: The Parameters of a New Functional Literacy" at a conference at Bard College Conference in 1982 and "Reading a Machine: The Products of Technology as Texts for Humanistic Study" in a lecture at the University of Wisconsin in Madison in 1983. His first public lecture on the origins of the software crisis was made in 1986 to the New York Academy of Science.
25. C. Stenard to J. Mahoney, private email comm., 22 Feb. 2010.
26. The four students were Joseph November, Ross Bassett, Frederik Nebeker, and Lawrence Owens. According to the History of Science at Princeton, Alumni of the Program (www.princeton.edu/hos/graduate/alumni/), Mahoney supervised or cosupervised 18 doctoral students in all: Philip Kitcher (1974, history and philosophy of science), John Schuster (1977, early modern science), JoAnn Morse (1981, ancient mathematics), Geoffrey Sutton (1982, 18th century science), Peter Dear (1984, early modern science), Larry Owens (1986, technology and computing), Chikara Sasaki (1988, mathematics), Erik Sageng (1988, mathematics), Frederik Nebeker (1989, computing and meteorology), Ken Arnold (1991, early modern museums), Richard Sorenson (1993, 18th century experimental science), Ross Bassett (1997, semiconductors), Mingjie Hu (1998, 19th century mathematics), Ann Johnson (2000, 20th century technology), Matthew Wisnioski (2005, 20th century technology), Joseph November (2006, computing and biology), Jane Murphy (2006, 18th century science), and James Byrne (2007, 15th century astronomy). He also served as an outside reader on a few dissertations on the history of computing, including Brent Jesiek at Virginia Tech and David Mindell at MIT.
27. The incomplete manuscript is in the Charles Babbage Institute archives at the University of Minnesota. In an email to W. Aspray, dated 19 Aug. 2009, Jean Mahoney provided the list of the book's chapter titles: 1. Patterns of Mathematization, 2. Finding the Form to Fit the Problem, 3. Mathematical Machines, 4. The Syntax of Programs: Automata and Languages, 5. Computability and Computational Complexity, 6. The Semantics of Procedures and Data Functions and Machines, 7. A Discipline Takes Shape, and 8. Mathematics and Engineering in Software.

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