The Making of the MCM/70 Microcomputer

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MCM/70, manufactured by Micro Computer Machines (MCM), was a small desktop microcomputer designed to provide the APL programming language environment for business, scientific, and educational use. MCM was among the first companies to fully recognize and act upon microprocessor technology's immense potential for developing a new generation of cost-effective computing systems. This article discusses the pioneering work on personal microcomputers conducted at MCM in the early 1970s and, in particular, the making of the MCM/70 microcomputer.

Personal computing might have started as early as the 1940s, when Edmund Berkeley, a great enthusiast of computing and computer education, conceived his first small computing device and named it Simon. Simon was a relay-based device, and Berkeley published its design between 1950 and 1951 in a series of articles in *Radio Electronics*. Alternatively, one might consider personal computing's time line to have begun with the Digital Equipment PDP-8 computer, the machine that brought about the era of minicomputers and provided users with an interactive and cost-effective alternative to expensive and centralized mainframe computer systems. For still others, the Micro Instrumentation and Telemetry Systems (MITS) Altair 8800 started it all. In December 1974, the readers of *Popular Electronics* received the magazine's January 1975 issue and, with it, a promise of their own personal computer powered by the Intel 8080 processor and priced under $400 for a do-it-yourself kit. It was the Altair 8800 that became the icon of the computer hobbyist movement of the second half of the 1970s.

Despite the many ways one might render the term *personal computer*, the present-day personal computing reality is the consequence of the microprocessor's invention coupled with the demand for public access to interactive computing rapidly growing since the beginning of the 1970s. For some historians, the dawn of personal microcomputing is just that—the convergence of the force that powered the technological advancement in the semiconductor industry with an intellectual force to redefine the social status of computing. As historian Paul Ceruzzi wrote: "When these forces met in the middle, they would bring about a revolution in personal computing."[1]

Much has already been written about the timing of this convergence and about the people and events that were the catalysts for it. One interpretation that has long ago filtered into the folklore of the modern history of computing and into popular culture depicts the two forces rushing past each other in the period between the introduction of the first 8-bit microprocessor and the announcement of the Altair 8800. Without the involvement of the electronics hobbyists, Ceruzzi noted, "The two forces in personal computing might have crossed without converging. Hobbyists, at the moment, were willing to do the work needed to make microprocessor-based systems practical."[2]

The design work on microcomputers (that is, on general-purpose computers built around a microprocessor) for the commercial market—conducted in 1972 and 1973 by, for example, Réalisations et Études Électroniques (R2E) in France and Micro Computer Machines (MCM) in Canada—paints a more complex picture of the personal microcomputer's emergence. The announcements of R2E's Micral microcomputer in February 1973 and, soon after, of MCM's MCM/70 personal computer make it evident that the forces that were to spawn the era of microcomputing were already entangling when the first 8-bit microprocessor (the Intel 8008) was introduced in early 1972. It was already the objective of that first wave of microcomputer development activities—which predated and ran independently of the hobbyist movement—to make microprocessor-based systems practical and widely accessible. By the time the

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Altair 8800 kit was offered to hobbyists with its 256 bytes of RAM and no high-level programming capability, MCM and R2E were manufacturing complete microcomputer systems for commercial, scientific, and educational applications. The systems were running A Programming Language (APL), Basic, and were even equipped with virtual memory.

In this article, I discuss the pioneering work on personal microcomputer systems conducted at MCM, particularly involving the MCM/70 microcomputer, in the early 1970s. The MCM/70 was a small desktop personal computer designed and manufactured to provide the APL environment for business, scientific, and educational use. The computer was to eliminate the services of expensive time-sharing systems in applications that did not require the computing power of a mainframe. The technical sophistication of the MCM/70 microcomputer (designed before *personal computer* had even become an academic term) and the consistent absence of MCM from the history of computing call for a careful examination of the seminal work on personal microcomputing at MCM.

Prologue

Intel announced its first 8-bit microprocessor—the 8008 chip—in April 1972. In just a few months, the prototypes of the first general-purpose computers powered by the 8008 chip were already working on site at R2E and at MCM. By the time Intel announced its new microcomputer development systems—the Intellec 4 and Intellec 8—in June 1973, some 30 companies were involved in "designing, programming, and packaging microcomputers with the MOS LSI [metal oxide semiconductor large-scale integration] chip sets that Intel Corp. introduced in 1971 and 1972."[3] Other companies were joining Intel in the microprocessor club by successfully depositing central processing unit circuitry onto wafers of silicon: Fairchild developed the PPS-25 (a two-chip CPU); National Semiconductor developed a 4-bit general-purpose controller/processor to power its IMP-16 series of single-board computers; Rockwell offered its Parallel Processor System PPS-4; and Texas Instruments developed a 4-bit TMS-1000.[4]

Already at the end of 1971, one company was determined to bet its future on the pace of innovation in the semiconductor industry, aiming at profoundly altering the way an individual perceives, employs, and interacts with a computer. This company was MCM, and the product that it wanted to launch in an effort to open up the personal computing market was a small, microprocessor-based desktop computer that would run a dialect of APL compatible with the popular APL/360 developed by IBM in 1966.

Merslau (Mers) Kutt, a Canadian entrepreneur and inventor, was no stranger to the Canadian computer scene of the early 1970s. After receiving his degree in mathematics and physics from the University of Toronto in 1956, Kutt held successful jobs at Philips, IBM, and Honeywell before deciding to go his own way. In 1965, Kutt's career took an unexpected turn—he joined Queen's University in Kingston, Canada, as a professor of mathematics. Queen's—one of Canada's oldest and best-known universities—was far behind other Canadian universities in the area of academic computing, and Kutt was hired to change that. While at Queen's, he teamed up with Donald Pamenter to form his first company—Consolidated Computer Inc. (CCI)—to develop and manufacture a novel data entry system that they named the Key-Edit 100.

The Key-Edit allowed the direct entry of information from a keyboard to a computer memory, eliminating the need for punch cards—among the oldest, historically most prevalent, and for many years, the only computer input media. Multiple data entry terminals of the Key-Edit system (key stations) were connected to a shared PDP-8 minicomputer that allowed one, among other functions, to enter, screen edit, verify, combine, and store data on a magnetic drum. Almost overnight, CCI become one of the most innovative and internationally recognized Canadian high-tech companies of the period.

In November 1970, Kutt met Robert Noyce—an Intel cofounder and its first CEO—during the Fall Joint Computer Conference in Houston, Texas. In a clichéd cocktail-bar scene during a conference recess, Noyce and Kutt were passionately sharing ideas, drawing on cocktail napkins the specifications of a new gadget—an 8-bit microprocessor—that Intel was about to develop for Computer Terminal Corporation (CTC) and that Kutt wanted for every key station of his Key-Edit to improve the system's general performance.

Intel's microprocessor—eventually named the 8008—was to be employed in CTC's Datapoint 2200 intelligent computer terminal. But 1970 was a time of economic recession; the demand for memory chips had not increased as rapidly as Intel had predicted, and the company was shedding jobs. Intel's management was indecisive in promoting the microcomputer technology and uncertain whether money could be made from Intel's new technology. The work on the 8-bit microprocessor at Intel had stalled, and CTC was slowly losing its interest in the microprocessor project—the recession had reduced prices of TTL chips to the level that allowed CTC to develop its Datapoint 2200 terminal economically without a microprocessor. During the meeting with Noyce, Kutt proposed a possible cofinancing of the 8-bit microprocessor project, but by the time he obtained the go-ahead from CCI's board of directors, Intel's board, reversing its former position, approved the company's new business venture of building microprocessors.[5,6]

That, however, was at the end of 1970. A year later, things were entirely different. In spite of CCI's gaining international reputation for its Key-Edit system, Kutt was fighting battles to hold control over his own company—the battles that he eventually lost under rather murky circumstances in late 1971.[7]

Micro Computer Machines

Squeezed out of CCI, Kutt was hungry for a new and even bigger venture. The introduction of the 8008 microprocessor seemed imminent, and the time appeared right to go ahead with the plan he had been mulling over while still at Queen's. He was disappointed in Queen's ineffective and frustrating batch-mode utilization of computer resources. Kutt recalls students and faculty at Queen's lining up at the computer center to have their jobs converted into punched cards and handed over to the designated operator to be batched with scores of other programs and eventually fed to a computer. It was at that point that he started contemplating an idea for an interactive desktop computing environment built around APL. But "you have to look at the practical side of the development," said Kutt. "You cannot build something just because it is neat."[6] His new idea for a small desktop computer had to wait for the technological trigger, and the 8008 chip was exactly what he was waiting for: "I was looking down the road, I knew that this [was] going to be a computer of the future and one per person. And on the way there, APL—such a powerful language."[6]

The crowd of followers of Kenneth E. Iverson's APL had been growing steadily since the publication of his APL bestseller—*A Programming Language*—in 1962.[8] In Canada, the APL movement was taking on cult status. Kutt, like many others around him, fully recognized and appreciated APL's power and simplicity. There could be only one result of all of that: a microprocessor-based desktop computer running APL.

To move any further, Kutt needed a team that could force the 8008 processor to understand APL. Soon he sought out Gordon Ramer, the head of the Computing Center at St. Lawrence College in Kingston, Canada. Ramer, an APL enthusiast, had already to his credit the York APL programming language, a dialect of APL/360 that he developed in his spare time while working at York University in North York, Canada. "First time we met," Kutt recollected, "he thought that I was from another world ... putting APL into that [the 8008]? No way!"[6] Eventually Kutt's enthusiasm prevailed and both partners set out to design, build, and market a small APL computer, which came to be the MCM/70 (see Figure 1). Consequently, Kutt Systems Inc. was incorporated in Toronto on 28 December 1971 to "make, buy, sell, lease and otherwise deal in computer hardware and related products."[9]

"In designing the MCM/70 we totally bet on the emerging microprocessor technology," explained Ramer. "We just proceeded, even before the first [8-bit] microprocessor was built…."[10] Ramer agreed to handle the software side of the enterprise that involved writing the APL interpreter and application packages for the 8008 microprocessor. "That took a very big leap of faith in those days because that was an 8-bit machine which chugged away at some incredibly low speed," Ramer recollected.[10] And, in 1972, the writing of a high-level programming language interpreter for a microprocessor was mostly uncharted territory.

Soon, other APLers involved with York APL were rounded up: Don Genner and Morgan Smyth joined Kutt Systems in early 1972, as did other core members of the company: André Arpin and José Laraya. Arpin noted:

> He [Ramer] talked to me and showed me the chip. And I remember bringing that thing up home. That thing had a tiny little document, right? There was nothing to it, a few pages, I don't know, maybe 30–40 pages ... it was small. And I set down and I read the description, and I just marveled at that piece of hardware. I could not believe that such a chip could exist.[11]

The design and development group was small but enthusiastic. In a collaborative effort, the group shaped and formed what would become the first personal desktop microcomputer: Laraya developed the hardware; Ramer, Genner, and Arpin developed the software; Smyth was responsible for documenting the system, application packages, and quality assurance; and Reg Rea oversaw engineering and, later, manufacturing. Kutt, meantime, was overlooking and coordinating the project, hunting for potential investors with a cardboard mock-up of the computer of the future. By the end of 1972, when the company changed its name to Micro Computer Machines Inc. (with Kutt as president), the rack-mounted prototype of the MCM/70 computer, designed by Laraya, was working on site in MCM's Kingston manufacturing facility. Ramer and Genner could now port their APL interpreter into MCM's first computer.

In May 1973, MCM demonstrated a portable prototype of the MCM/70 to the APL community during the Fifth International APL Users' Conference in Toronto. The demonstration was well attended, but reaction varied. Some were clearly more impressed with IBM, which had selected the conference venue to announce its long-awaited successor to the APL/360 language—APL.SV—than with MCM and its desktop APL machine demonstration. But many were astonished, like Ted Edwards, Jim Litchfield, and Glen Seeds who left Control Data Corporation to join MCM soon after the conference. Kutt also vividly remembers the reaction of one participant following the presentation: "Who are you, where did you come from?"[6] According to Kutt, the astounded APLer was involved in the development of a personal desktop APL computer at IBM, most likely as a member of the Special Computer, APL Machine Portable (Scamp) project. Scamp was proposed to the IBM management by Paul J. Friedl—an engineer in the IBM Scientific Center in Palo Alto, California—in January 1973. The project was approved later that year with the stringent time frame of six months for the completion of the fully functional prototype. Scamp wasn't a microcomputer; its CPU—the IBM's Put All Logic in Microcode (PALM) microcontroller—was not a microprocessor. "The short time available for development meant that the system had to be built from existing hardware and software components as much as possible," recollected Friedl.[12] Scamp was never converted into a production model. Before the Scamp concept would reemerge as the IBM 5100 computer late in 1975, two of the first dozen MCM/70 units manufactured by MCM in the early 1974 would be shipped to IBM's General Systems Division in Atlanta, Georgia, for the purpose of "research and analysis."[13]

Also in 1973, Kutt took the MCM/70 prototype to Intel's headquarters in Santa Clara, California, and demonstrated it to Robert Noyce and Gordon Moore. The APL interpreter for the 8008 processor generated a lot of excitement. "They didn't believe that this little chip

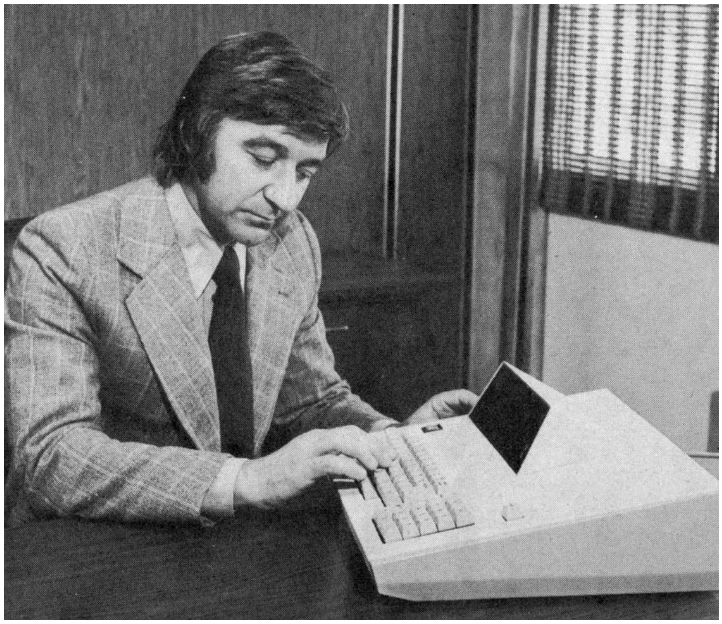


Figure 1. Mers Kutt demonstrates a prototype of the MCM/70. (Source: *Electronics and Communications,* November 1973, p. 7.)

they were producing could do that much."[5]

The computer industry at large was generally unaware of the MCM developments. The company maintained secrecy, rarely releasing information to the press. It was not until March 1973 when a short note in *Canadian Datasystems* informed the readers about the coming of a "small computer" from a new Canadian company:

> After keeping a low profile for 18 months, Kutt has acquired space in suburban Toronto and formed Micro Computer Machines Ltd. ... The company, he [Kutt] says, is looking at the very small computer market, using advanced LSI technology. ... Kutt described the project as "pretty exciting," but said it would be inappropriate to release information, until full specifics are available. ... To date, no products have been released but Kutt says a couple of major announcements will be made within two months.[14]

Five months passed and still there was no official announcement, no press conference—only hints that made the mystery of the esoteric new hardware even more alluring:

> Mers Kutt Is Back With Minicomputers
>
> New technology is behind a range of minicomputers to be announced, probably next month, by Micro Computer Machines Ltd., Toronto. ... Kutt is tight-lipped on specifics, but told CD

Figure 2. The announcement of the MCM/70. From left: Mers Kutt, Gordon Ramer, Ted Edwards, and Reg Rea. (Source: *Canadian Datasystems,* October 1973, p. 49.)

> [*Canadian Datasystems*] the computers are extremely small and will have a "dramatic impact" on the market. High-density chips and circuits are said to make them unlike anything now available.[15]

At the time when the readers of *Canadian Datasystems* puzzled over the phrase "'dramatic impact' on the market," the prototype of the MCM/70 was on its European tour that began with the APL Congress in Copenhagen, Denmark, on 22–24 August 1973. During the congress, Ted Edwards demonstrated a briefcase version of the MCM/70. The machine was mounted in an attaché case and was powered by batteries—the adaptation done by the MCM team just in time for the congress. On 25 August, the Copenhagen newspaper *Politiken* reported enthusiastically about the presentation in the front-page article, "Computer i en kuffert," giving a detailed description of the 'revolutionary computer'.

It was the *Politiken* article that Kutt used skillfully to give the computer wide European exposure through press conferences, interviews, and trade presentations in France, Germany, Holland, Italy, Switzerland, and the UK, including the unveiling of the MCM/70 at the Canadian High Commission in London on 10 September 1973. But it was not until the end of the European tour that the veil of secrecy about the MCM line of microcomputers was finally lifted, in North America. The MCM/70 was officially announced in Toronto on 25 September 1973 at a press conference at the Royal York Hotel (see Figure 2) and, subsequently, on 27 September in New York, and on the 28th in Boston. Extensive press coverage followed.[16]

MCM would make portable desktop microcomputers to

> bridge the gap between the sophisticated calculators that offer simplicity of operation but fail to provide the information processing capabilities of the computer ... and the large and complex mainframe computers that require such high degrees of training and experience as to place them beyond the operational capabilities of most people who want to use them.[17]

At a time when the meaning of *personal computer* wasn't yet fixed, MCM planned to offer microcomputers "of a size, price and ease-of-use as to bring personal computer ownership to business, education and scientific users previously unserved by the computer industry."[18]

The first personal microcomputer

The MCM/70 was a small all-in-one computer the size of a typical typewriter of the time, weighing approximately 20 lbs. (see Figure 3). Its well-designed case had a built-in 51-key keyboard (its layout modeled after the keyboard of the IBM 2741 terminal), up to two optional digital cassette drives, and a small red plasma display panel (Burroughs Self-Scan). The panel could display 32 characters in a single line; the moving-window feature allowed up to 85 characters to be entered and viewed in a single line. The cassette drives provided both external storage (more than 100 Kbytes per drive) as well as virtual memory to compensate for a small amount of memory that the 8008 chip could address (up to 16 Kbytes).

The computer's hardware architecture was almost exclusively the work of one engineer—José Laraya. Born in the Philippines, he studied mechanical engineering at the University of the Philippines and, between 1962 and 1967, electronics engineering at Tokyo University. In 1967, he moved to Canada to work as a computer hardware engineer at Queen's University, at the very time when Kutt directed Queen's computing center. Laraya didn't work for CCI, but in 1971 when Kutt and Ramer were putting together the nucleus of MCM, Laraya decided to leave Queen's for MCM, lured by Kutt's idea of building an APL computer around the Intel 8008 chip. "I was very impressed with what Intel had done with the chip," admitted Laraya, "and I wanted to be one of the first to put together a processor with it."[19] And indeed he would become one of the first engineers to build a general-purpose computer powered by a microprocessor.

Laraya started his work on the prototype by experimenting with Intel's SIM8-01 prototyping system in the basement of his Kingston house. "Mers brought it in and said 'here, see what it does.' It was really computing, it really did things—one little chip."[19] But the computer that the MCM team had envisioned could never be designed around Intel's prototyping system, and Laraya was ready to build his own computer: "OK, this [SIM8-01] is fine, great, interesting, works with teletype ... but now, let's build something serious," recalled Laraya.[19] In just a few months, he designed and built the rack prototype of the MCM/70. It had the 8008-based CPU and the display interface on one card, and a number of RAM and Eprom chips on another. Laraya built and interfaced an APL keyboard with the computer and included a small Burroughs plasma display. Soon after, Ramer and Genner ported a subset of APL into the prototype's Eproms. Laraya recollected:

> The first time we did a calculation [on the MCM/70 prototype], you did 1 + 1, and it took forever (a few seconds) to crunch out the number. You could see long computations happening on the work space too, because, at one point, we were using the display area as a temporary workspace since we were so tight on RAM. You could see the numbers rolling up and down on the screen. And you could see, oh, that's about finished, because you could read the bits ..., you could see that there was a counter decrementing and when you saw that the counter dropped to zero, it would flash the answer. So, it was fascinating to look at that small screen."[19]

Inside the production model of the MCM/70, Laraya and his hardware team planted the Intel 8008 microprocessor, 2 Kbytes of RAM (expandable to 8 Kbytes) and 14 Kbytes of ROM (2 Kbytes of mask-programmable ROM chips from Electronic Arrays). Because the total memory installed was more than the 8008 could address, the MCM/70's ROM memory was divided into a core portion plus a number of banks. Bank switching was used to access the memory necessary for the current operations. ROM contained the APL language interpreter, and the operating system consisted of EASY (External Allocation System) and AVS (A Virtual System) software. The EASY cassette operating system let the user store, retrieve, and delete data and user-defined functions from a tape. AVS provided virtual memory by swapping programs and data between RAM and a digital cassette mounted in one of the computer's tape drives—a technique that allowed the execution of programs that otherwise would require more RAM than the MCM/70 could offer. Virtual memory on the MCM's computer was a matter of necessity:

Figure 3. An early production model of the MCM/70. (Source: MCM photo, 1974.)

> While having to do APL with this much memory [i.e., a little], when APL needs this much memory [i.e., much more], OK, you design it so that stuff is going in and out. And that is what I had to do with the York APL.[10]

What Arpin and Laraya came up with was the implementation of virtual memory using a specially designed digital cassette drive operated by the AVS software that Arpin wrote. Arpin recalled:

> Now, doing that on a digital tape, on a cassette tape, seemed like insanity, but it was actually not that bad, it actually worked. People used [AVS] for doing some pretty serious programming and quite successfully.[11]

The user had an option of operating the MCM/70 computer in either the virtual or nonvirtual mode. When AVS was activated (virtual mode), both the computer's RAM and the unused space on the cassette tape became the user's workspace. With virtual memory implemented, the MCM/70 offered in excess of 100 Kbytes of memory, an astonishing amount for such a small system. Without the virtual memory, there would be no APL inside the MCM/70: Program storage would consume most of the computer's memory, with little (if any) left for program execution. Glen Seeds, an MCM engineer, recollected (private communication, 2001):

> The one thing that seemed obvious to us that no one else thought of … was not having an off switch, but powering down with an OS command, to ensure protection of your data. … Even today, the use of automatic UPS-supported shutdown, with resume on restart, is uncommon.

Table 1. General technical data for MCM computers.

Model	MCM/70	MCM/700	MCM/800	MCM/900	Power
Year	1973	1975	1976	1978	1980
CPU	Intel 8008	Intel 8008	AMD 2900 bit-slice	AMD 2901 bit-slice	AMD 2901 bit-slice
RAM	2–8 Kbytes	2–8 Kbytes	4–16 Kbytes	8–24 Kbytes	8–24 Kbytes
ROM	14 Kbytes	32 Kbytes	40 Kbytes	40 Kbytes	40 Kbytes
Virtual memory	102 Kbytes cassette	102 Kbytes cassette, 256 Kbytes diskette	102 Kbytes cassette, 256 Kbytes diskette	≥ 256 Kbytes diskette	≥ 256 Kbytes diskette
Built-in display	One line of 32 characters, plasma	One line of 32 characters, plasma	One line of 32 characters, plasma	21 lines by 96 characters, CRT	21 lines by 96 characters, CRT
Keyboard	Built in, IBM 2741 layout	Built in, as in MCM/70	Built in, as in MCM/700 plus keypad	Built in, as in MCM/800	Detached, as in MCM/900
Operating system	AVS/EASY	AVS/EASY	AVS/EASY	AVS/EASY	AVS/EASY
Language	MCM/APL	MCM/APL	MCM/APL	MCM/APL	MCM/APL
Price (in dollars)	$3,500–$9,800	$4,700–$9,800	$9,400–$19,800	$9,300–$22,000	not available

Indeed, an on/off switch was nowhere to be found on the MCM/70. To start it, the user had only to press the start key and the computer responded with "MCM/APL" on the screen to indicate that it was ready for use. To switch the computer off, one typed □ OFF and pressed the return key. However, before the computer would be deactivated, the entire contents of the workspace and the workspace status were preserved in the current state on the cassette. The MCM/70 user's guide explains:

> This is to insure that nothing is accidentally destroyed. In order to have the system restore them [i.e. the workspace and the workspace status] back in the computer at some later date, the cassette must be mounted in the tape drive before the start key is pressed. If this is done the computer will automatically reconstruct the saved items in memory to appear as though the □ OFF function had never been executed.[20]

A unique feature of the computer's power supply was a power failure protection system, designed by Edwards. It allowed continuous operation under battery power in the event of power failure; for extended power loss, the computer initiated an orderly shutdown: it automatically provided system backup by copying the RAM content to a cassette before it shut the computer down. The system was automatically reinstated when the power was restored and batteries were recharged.

The MCM/70 could drive a printer (such as the printer/plotter MCP-132 that MCM offered). Later, with the introduction of the improved, /700 model in 1975 (see Table 1), MCM offered a range of other peripherals: external displays (the VDU-2480 and VDU-9620), floppy-disk-drive systems (the SDS-250 and DDS-500), a card reader (the PMR-400), and a modem (for models equipped with the SCI-1200 communications subsystem). The MCM/700 could have as much as 32 Kbytes of ROM (containing EASY, AVS, and an improved MCM/APL interpreter) and could use one of the disk drive systems for virtual memory due to some clever design decisions made by Arpin when he was still working on the original cassette version of AVS.

To appreciate what MCM hoped to accomplish when it embarked on a mission to build the MCM/70 requires a sense of the economic context of the early 1970s. The economic slowdown during 1969–1971 caused many businesses to regard minicomputers as a cost-effective alternative to expensive mainframe computer systems that time-shared their resources among many users. In the early 1970s, the total cost of a modest minicomputer system was approximately $30,000 or $1,000 per month in rental and maintenance fees. Consequently, many small- and medium-scale companies that previously relied on time-sharing services and could not afford an in-house system could now acquire their own computing resources.

However inexpensive, minicomputer hardware alone could not deliver the promise of a viable, cost-effective small system for business, research, or education without addressing the problem of software availability and cost. Limited memory of the early minis made the direct use of high-level programming languages, such as APL, rather venturesome. Instead, application software developed in-house was done chiefly in assembly language. That, of course, required programmers to have an intimate knowledge of the specific hardware the program was intended for, and, consequently, it meant that minicomputers were to be programmed and operated by an expert group of individuals. Unfortunately, that also left the growing crowd of APL users, including the business community segment attracted to APL's suitability for applications like accounting, economic planning and forecasting, or decision support systems with only one option: to buy time on one of the time-sharing mainframe computers running APL, such as the IBM System/360 or System/370 computers.[21]

The MCM/70 wasn't a minicomputer; it didn't operate with speeds or word lengths of its minicomputer contemporaries. But it also didn't have the size, the desk-crashing weight, or the flat look of high-tech measurement equipment, either. Instead of a front panel loaded with rows of switches and lights that an operator would laboriously use to initiate and operate a minicomputer (as was the case with Digital Equipment's best-selling line of PDP-8 minis), the MCM/70 had a full-featured keyboard, a built-in alphanumeric display, and the APL interpreter waiting for the user's input as soon as the computer was switched on. And all of that for the price of $3,500 to $9,800 (in 1974), depending on the configuration. Some MCM/70 features were found only on mainframes: the MCM/APL language compatible with the IBM APL/360, and the virtual memory as in the IBM System/370 Models 158 and 168, introduced in 1972. The System/370 computers were among the first mainframes to operate with virtual memory.

But first and foremost, the MCM/70 was a dedicated personal computer system—novel, portable, and easy to operate. For commercial and scientific use, it offered a low-cost APL programming environment. As one of the MCM/70 users recollects (Glenn Schneider, private communication, 2001):

> … having a portable APL machine was such a novelty back then it was a godsend. … Lugging the MCM home on the subway in New York helped build up my muscles, as it was hardly a lightweight, but it gave me great hope (and inspiration) for the future which would yet erupt.

For education, it was a promise of the "MCM/70 Classroom" to

> provide each student in a computer equipped classroom with his own individualized interactive computer [and to bring] to the world of education a technological solution to the problem of introducing economical interactive computer systems.[22]

In 1973, Kutt prophesied that "in the coming years the computer field is going to be made of millions of small computers and a limited number of large computers,"[23] and with this trend developing, "the MCM/70 could revolutionize the world of computing in the same way that the handheld calculator changed the calculator field."[24] But oracles are devious. By the end of the 20th century, the microcomputers would indeed have pervaded all aspects of our lives; however, it would not be the MCM/70 or, for that matter, any of its MCM successors, that brought about this profound change in our culture. The computers from MCM should have entered commerce, research centers, and educational institutions on a massive scale; they should have established MCM as the world's leader in interactive microcomputer technology. But they did not.

From prototype to production

The MCM/70 hype continued through 1973, with the MCM exhibit at the Canadian Computer Show in Toronto (16–18 October) and with even more intensive press coverage. The company engaged much of its resources in converting the prototype to the production model, and it seemed for a while that the computer's mass manufacture would commence on the dawn of 1974. Although some in-house manufactured units were shipped to distributors in early 1974, and the pilot run and shipments continued through the year, the launch of a full-scale production was disrupted by a sudden turn of events that culminated in October 1974, with Kutt being forced out of the company.

The MCM/70 system was an ambitious project loaded with industry-first features. Timely implementation of these features was critical; by the end of December 1973 the company's deficit rose to CAD$574,000 and the company was strapped for cash. But a cluster of novel features such as those encapsulated in the MCM computer was bound to cause delays, especially when their rigorous implementation was frequently disrupted by new hardware and software proposals that, if realized, would make the computer an even more sophisticated gadget. They were good ideas, such as the switching power supply, admitted Kutt. But they could never be finished for commercial use on time, and "we had to keep fighting fires for survival when we depended on [such] work to be included in a new product."[6]

The year 1974 was a time for entrepreneurial discipline at MCM, for the convergence of motivations among the company's core members and for the rigorously organized effort to bring the MCM/70 to the market. As Arpin described it later, it was a time

> to have a very clear and well defined target and stop on these targets. Don't make them move. Freeze them and say: This is all we're going to do and until this is done we are not going to do anything else. If we cannot sell this product at that point—we fail. Adding bells and whistles to it, if nobody is interested, it doesn't get you anywhere.[11]

But Kutt's attempt to streamline the company's production efforts and to constrain the engineering team's perfectionist mentality was sharply checked. His attempt to get rid of some key people whose performance, in his opinion, continuously threatened his enterprise with disintegration, failed. Not being much of a corporate politician and unable to properly sense the maneuvering around him and to build the necessary alliances, Kutt found himself isolated not only on the board of directors but, sadly, among MCM's core members as well. He failed to keep firm control over his company and to bring together the creativity, individual values, and priorities of some of the key members of MCM. Ultimately, Kutt was the one to go:

> Few dispute Kutt's brilliance at product conception and salesmanship … Kutt is able to spread enthusiasm about his new ventures, raise enough capital to launch companies and hire top-notch people to run them. Still, he is the classical story of the entrepreneur who runs out of capital and loses control of his ventures to outside investors.[7]

In 2001, Kutt spoke about his entrepreneurial experience with a sense of gratification and reconciliation (private communication, 2001):

> I always was more attracted to things that they said could not be done, I always needed to do more digging earlier and keep the doors open on decisions until there was no other choice, all in an almost desperate effort to optimize the odds of succeeding, and definitely not to frustrate my friends. … The most satisfying result for me … was seeing so many bright young technical people take the chance and then perform way beyond what they thought they could. And they did it in Canada.

The ramifications of Kutt's departure for MCM were difficult to predict. After all, the MCM/70 production model was ready, and the development of the much-improved model /700 was well under way. Between 1974 and 1977, MCM manufactured and sold the MCM/70 and /700 systems to American and European customers. The company, however, found itself competing for the same clientele with a number of well-established manufacturers that offered their own desktop computers and programmable calculators. IBM introduced its 5100 desktop computer in 1975, Wang Laboratories released the first of its 2200 family of all-in-one desktops in 1973, and Hewlett-Packard had offered the HP 9830 calculator, programmable in a dialect of Basic called Basic Plus, since the end of 1972. Although programmable electronic calculators were not designed to process payroll or customer data of a medium-scale company, their successful utilization as an efficient problem-solving tool in business, education, and engineering had continued since the introduction of Olivetti's Programma 101 desktop calculator in the mid-1960s. Even on the Canadian scene, MCM was no longer the sole manufacturer of microcomputer systems. In October 1976, Dynalogic Ltd., a small company founded in Ottawa by Murray Bell—a former employee of Kutt's CCI—debuted its general-purpose microcomputer system DMS-8 that featured the Motorola 6800 microprocessor and Dynamo, a Unix-like operating system.[25]

From 1976 on, MCM was downshifting its mode of operations from trailblazing to survival gear. What transpired was a company no longer able to anticipate market and technological trends. MCM's momentum was failing due to a convergence of factors that, besides the external conditions, included a slow response to the technological changes and trends in the marketplace and inadequate marketing.

The inability to develop a new competitive product to replace the aging and slow MCM/700 was one factor. The MCM/800 computer, introduced in the fall of 1976 (see Figure 4), was a remake of the MCM/700. Financially strained and hard pressed to keep up with processing speeds of other microcomputers on the market, MCM was seeking ways to build new hardware by reusing as much of the /700 technology as possible. As Laraya noted:

> We had a pile of ROMs from Electronic Arrays that would execute the 8008 code. Now, how do you develop a computer that would make use of these read only memory chips, that would make

use of the binary code that Gord [Ramer] and Don [Genner] had put together? After all, it was a big system that took a long time to debug.[19]

In the end, MCM decided not to adopt the new generation of Intel processors, such as the 8080 or 8085, but to emulate the instruction set of the already-obsolete Intel 8008 processor using the AMD 2900 bit-slice chipset. All the other components of the model /800 were the same as in the /700. The MCM/800 gamble ended in a fiasco; the /800 system was expensive $19,800 apiece) and by the end of 1978 only a handful were installed, resulting in the company's earnings plummeting from CAD$1.25 million in 1977 to CAD$866,000 in 1978. At the same time, the company's debt almost tripled. MCM was also losing key people, including Laraya. The technological advancement in the semiconductor industry that once propelled MCM to the front line of pioneering work on personal computing was now bypassing the company: "We were there sitting with the bit-slice machine; we weren't going to do the 8080 or 8086, we were getting left behind. … I felt that there was nothing more to contribute," explained Laraya.[19]

Desperate for a new system, MCM announced the MCM/900 (see Figure 5) in October 1978. The MCM/900, whose primary architect was André Arpin, was designed and prototyped in double-quick time. In spite of its dull-looking packaging, the computer was moderately successful; it was reliable and had a well-developed software library. Its beefed-up and cosmetically improved version—the Power system—was offered in 1980. In 1981, a smaller system—the Micropower—competed against computers from Apple and Radio Shack.

Figure 4. The MCM/800. (Courtesy of Ned Chapin. Photograph by Zbigniew Stachniak.)

Figure 5. The front cover of the MCM/900 promotional brochure. (Source: MCM, 1979.)

An APL machine to the end

Regrettably, none of the MCM computers could break through the barrier of APL's shrinking world to gain the general acceptance that other small systems, such as the Apple II, Commodore CBM, or TRS-80 Model II, were beginning to enjoy since the late 1970s. "One of the things that hurt MCM was APL. I think that's a marvelous language. … But it is not the language for the mass. It is really esoteric…" said Arpin.[11] APL was a powerful programming language and, due to its spreadsheet-like features, a darling of the insurance and actuarial industries in the 1970s—the main focus of MCM marketing. Developing an APL interpreter for a rudimentary 8008 microprocessor was a challenging task that required a great deal of expertise. The MCM/APL interpreter was designed and implemented by Ramer with Genner's assistance and help from Arpin, who wrote the floating-point arithmetic. The inter-

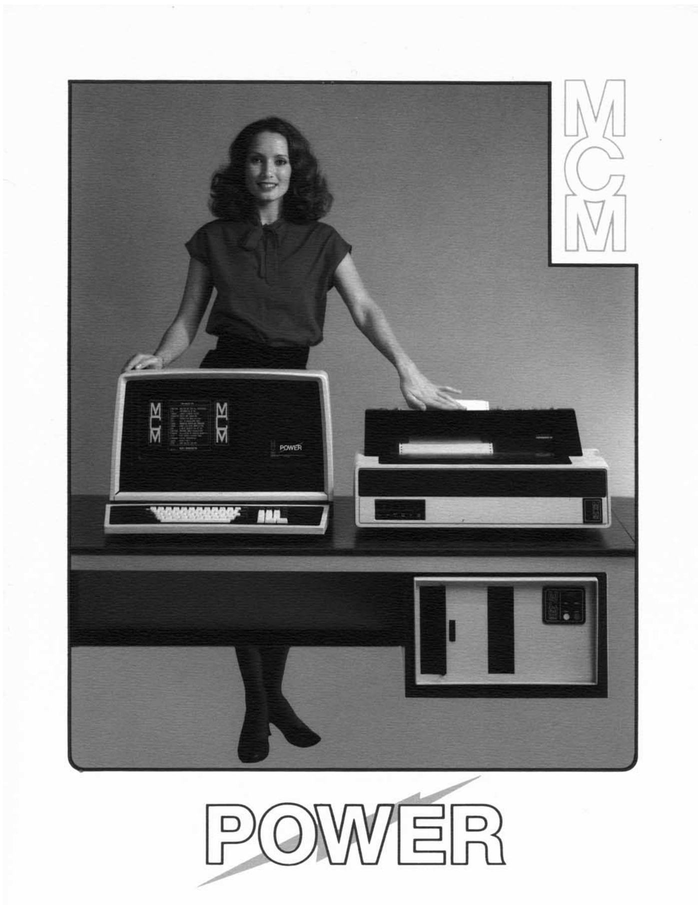


Figure 6. The front cover of the MCM Power system promotional brochure. (Source: MCM, 1980.)

preter was slow (a consequence of the 8008's instruction set, speed, and memory addressing limitations), but APL's efficient syntax made the language a suitable choice for small computers such as the MCM/70 or /700. Ramer noted:

> We had full 64-bit floating point on this thing. Now, you're running on a chip that has an 8-bit instruction set, so that was not an easy thing to do. By the time it was done, if you were doing full floating-point divides, you could do three [such operations] a second, that's how slow it was. But it worked and all the numbers came out right.[10]

In time, however, the sole reliance on APL became a drag and a major obstacle to capturing enough of the small systems market for the company to grow. In the 1970s, the Basic programming language, developed by John Kemeny and Thomas Kurtz at Dartmouth College in the early 1960s, became one of the software standards accepted by both the small systems industry and individual users. Although some dismissed Basic as an inconsequential programming toy, and others considered it harmful, it was unquestionably one of the most widely used programming languages in the first decade of microcomputing. Basic was easy to learn, easy to use, and could run on machines equipped with little memory. The Wang 2200 series computers were running Basic, as were the HP 9830 calculator and the IBM 5100, which, in fact, supported both Basic and APL.

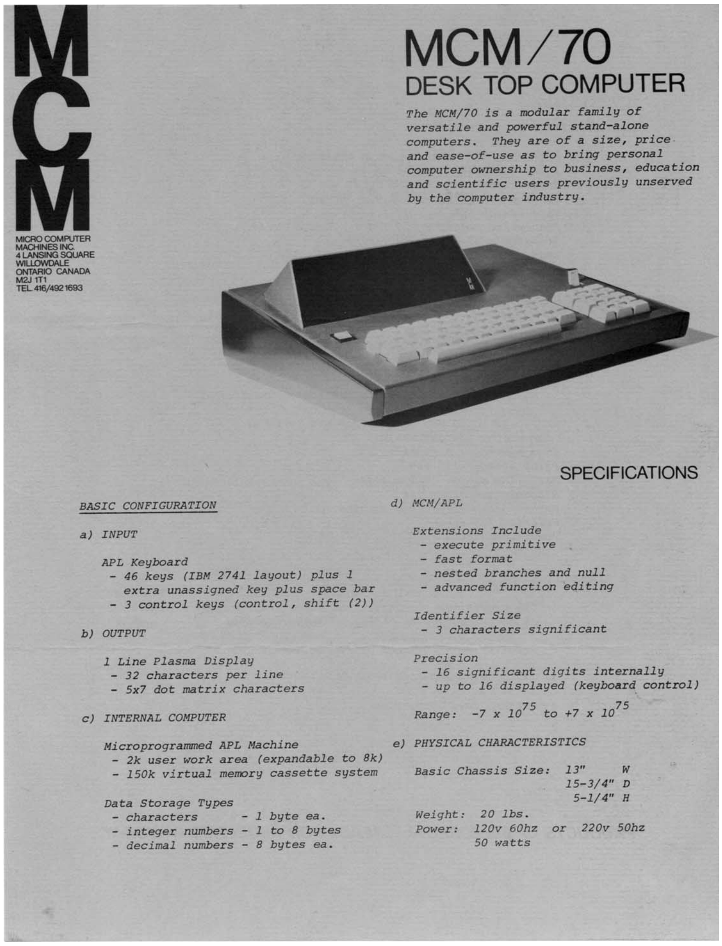
There was some talk at MCM to supply the MCM/800 with a Basic interpreter at a time when machine sales almost stalled. "And one decision was," said Ramer, to "put Basic on it and a word processor." But, in the end, nothing was done, and soon the company found itself cut off from the emerging microcomputer software industry and its growing clientele—MCM was unable to benefit from the market forces powered by the growing acceptance of Basic. Instead, the APL priesthood within MCM was devoted to winning the hearts and souls of the APL community, which they perceived as the ultimate judge of MCM's endeavor. Unfortunately, the APL community was reluctant to view the MCM machines as more than just slow, curious-looking systems that happened to run a dialect of APL. "But the APL community was not the right judge," explained Arpin. "They were not the ones that were going to buy it, because they were all working on IP Sharp. They wanted that big, big system. They were not the customer."[11]

MCM sold enough of its MCM/900 units to extend its existence into the 1980s. Unfortunately, it all ended in 1982 when the company was placed in receivership, worn down by financial problems, unable to redefine itself: to recapture the vision and enthusiasm of the early days when the engineering talent of a small team was sculpting the features of the personal computer.

Marketing

In 1973, the MCM/70's prospects were good. Following the successful tour of Europe and the US in August and September, the marketing strategy MCM adopted was to select and appoint marketing organizations as distributors that, it was hoped, would ride the wave of publicity to the target audience. The first contracts were already signed in early 1974, with Office Equipment of Canada and Unicomp Canada, to capture the Canadian market, and with ILC Data Device Corporation as an exclusive distributor of MCM products to scientific and technical markets in the US. In time, the distribution network would extend to Europe. Such an extensive marketing structure required thorough training of distributors' sales and programming personnel, demonstration software, extensive national and international advertising and promotion, participation in trade shows, production and distribution of promotional literature, all kinds of brochures (see Figures 5, 6, and 7), data sheets, and manuals. All these efforts required marketing and financial resources that MCM could never secure. "It's a case of being there first and not realizing how expensive it is to tell people what you're doing. Because that was our biggest problem." explained Ramer.[10]

It was especially difficult to envision the marketing tools needed to effectively communicate the full benefits of microprocessor technology, virtual memory, APL language, and still claim that the system was not a utopian electronic gadget but a useful personal tool "as easy to use as a handheld calculator." Ramer explained: "Every sale was really a hard thing because you are going in with something totally new, something never seen before."[10] There were some strong distribution outposts, such as Sysmo S.A. of Paris, France, which by 1976 was installing around 10 MCM/700 systems per month. But in the end, no distributor was able to strike a megasale that could make MCM a feared contender in the small systems class. And, on its own front, from the end of 1974, MCM failed to attract business media to any satisfactory level; advertising in the trade and technical press was nonexistent, and the MCM computers were never exhibited at any of the National Computer Conferences, which, in the 1970s, were North America's premier computer trade shows.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MCM/70
DESK TOP COMPUTER

The MCM/70 is a modular family of versatile and powerful stand-alone computers. They are of a size, price and ease-of-use as to bring personal computer ownership to business, education and scientific users previously unserved by the computer industry.

SPECIFICATIONS

BASIC CONFIGURATION

a) INPUT

APL Keyboard
- 46 keys (IBM 2741 layout) plus 1 extra unassigned key plus space bar
- 3 control keys (control, shift (2))

b) OUTPUT

1 Line Plasma Display
- 32 characters per line
- 5x7 dot matrix characters

c) INTERNAL COMPUTER

Microprogrammed APL Machine
- 2k user work area (expandable to 8k)
- 150k virtual memory cassette system

Data Storage Types
- characters - 1 byte ea.
- integer numbers - 1 to 8 bytes
- decimal numbers - 8 bytes ea.

d) MCM/APL

Extensions Include
- execute primitive
- fast format
- nested branches and null
- advanced function editing

Identifier Size
- 3 characters significant

Precision
- 16 significant digits internally
- up to 16 displayed (keyboard control)

Range: -7×10^{75} to $+7 \times 10^{75}$

e) PHYSICAL CHARACTERISTICS

Basic Chassis Size: 13" W, 15-3/4" D, 5-1/4" H
Weight: 20 lbs.
Power: 120v 60hz or 220v 50hz, 50 watts

Figure 7. The first MCM/70 promotional brochure depicting a prototype of the computer. (Source: MCM, 1973.)

Epilogue

The MCM/70 was not an isolated event, a mere footnote in the earliest chapter of the history of microcomputing; there were other electronics companies engaged in similar microcomputer ventures as soon as the 8008 chip became available. Indeed, when the European tour brought the MCM/70 prototype to France in September 1973, a small French electronics company—R2E—was exhibiting its own microcomputer during the SICOB expo in Paris.

R2E, founded in 1971 by a Viet Nam–born engineer (André) Thi T. Truong, was contracted in 1972 by the Institute Nationale de la Recherche Agronomique, the French National Agricultural Research Institute, to develop an inexpensive, transportable, and programmable control system that could reliably handle a large number of peripherals. The result was the Micral—arguably the first commercially available general-purpose microcomputer.

The Micral, designed by R2E engineer François Gernelle, was announced in Paris in February 1973. The R2E's micro was not intended as a personal computer; instead, the Micral was to replace minicomputers in real-time applications, mostly process control and scientific instrumentation, in which high performance was not critical. The computer was originally offered with just 256 bytes of RAM, and it could be programmed only in machine language by laboriously setting the toggle switches located on the computer's front panel. Every byte of information required setting of eight switches—one switch per bit. By the end of 1973, R2E sold 500 Micrals; by the time MCM shipped the first MCM/70 units, R2E presented a much-improved version of its computer—the Intel 8080-based Micral S—during the National Computer Conference in Chicago in May 1974.

Figure 8. MCM team at York University, October 2001: (top) Mers Kutt; (bottom, from left) Morgan Smyth, Don Genner, André Arpin, and Gordon Ramer. (Photographs by Zbigniew Stachniak.)

The corporate histories of MCM and R2E have many parallels. Both companies were 1971 startups, brought to life by gifted entrepreneurs. They both aimed at the same target audience, blazing a unique trail between the hobby microcomputer movement and the minicomputer mainstream. They were determined to escape the aura of radicalism, vulgarity, and inferiority that surrounded the microcomputer hobbyist movement of the 1970s, but unable to gain the general acceptance of small- and medium-scale business, then firmly in the hands of the minicomputer manufacturers.

Before the hobbyists' full impact on the microcomputer hardware and software industries, on the consumer electronics market, and on popular culture would be evident, and eventually, acknowledged, the business community utterly dismissed the movement for its openly antiestablishment position, for rejecting about everything that the stilted corporate culture had to offer. The hobbyists were stereotyped as those scruffy and unshaven types in T-shirts and jeans, suspended between hacking and dropping out of university, with close ties to free-speech and pacifist movements of the late 1960s and early 1970s, high on countercultural sentiments and social radicalism.

Mers Kutt and André Truong were not hippies; they were not idealistic hackers focused on throwing the corporate culture and its impact on the society off balance. Computers manufactured by their companies were supposed to represent a new, socially accepted computing paradigm rather than the technology of social and cultural liberation.

But keeping a safe distance from the microcomputer hobbyists didn't buy MCM or R2E the entry into the minicomputer mainstream. The first 8-bit microprocessors were slow, and their utilization as the backbone of modern computer architectures was uncertain at best. The arrival of electronic handheld calculators was greeted with enthusiasm by the consumer electronics market. Neither the speed nor functionality was sacrificed during the process of miniaturization. In fact, both were improved. In contrast, the performance of the first 8-bit microcomputers was destined to be spiritless, and that could not be easily compensated with a batch of new features such as cost efficiency or portability. In 1975, Daniel Pimienta was managing the Nice branch of Sysmo—the French distributor of MCM computers. He still remembers a mixed reaction of potential MCM customers who were generally impressed with an idea of a portable APL environment but were rather dissatisfied with a leisurely performance of the MCM/700.[26] And the showing of Micral S during the 1974 National Computer Conference did not attract significant attention in spite of a favorable price differential between the French computer (under $2,000 for basic configuration) and a typical mini.

In the end, MCM and R2E were confined to their own limited market space, paying the price for "being there first" but unable to break the barrier of inferiority, uncertainty, and aloofness. Both companies predated and outlived the hobbyist movement, they both fell prey to the emerging PC clone market. But it must be remembered that they were the first companies to fully recognize, articulate, and act upon the immense potential of microprocessor technology for the development of a new generation of cost effective computing systems. It was the MCM/70 microcomputer, conceived and built by a group of Canadian engineers and entrepreneurs at MCM (see Figure 8), to lift the curtain of emerging technologies for a glimpse of new personal computing reality that was soon to come. These facts alone merit a historical reinterpretation of the dawn of microcomputing.

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