45th Anniversary
of the University of Michigan's Computing Center

and

Reception
Honoring its First Director
Robert C. F. Bartels

4-7 p.m., September 10, 2004
Alumni Center

Contents

- University Record Article, *First director kept computing on campus, available to faculty and students*

- Posters that were on display at the reception honoring Dr. Bartels

- A memory book, *Robert C. F. Bartels, 45 years of computing at the University of Michigan*, presented to Dr. Bartels at the reception

- A September 13, 2004 letter from Dr. Bartels thanking Bernie and Enid Galler for their work organizing the reception

- Dr. Bartels obituary in the University Record following his death on September 9, 2006.

- Notes

Updated 11:00 AM September 9, 2004

**Sept. 10 event to honor 45th anniversary of Computing Center**

Reception: 45th anniversary of the Computing Center and reception honoring its first director, Robert C.F. Bartels, 4-7 p.m., Alumni Center.

First director kept computing on campus, available to faculty and students

By Kevin Bergquist

There was a time when computing and its future at the University were in flux.

Shortly after the creation of the Computing Center in 1959, Vice President for Research Ralph Sawyer decided that the center's main computer should be released and its research and funding sent to U-M's struggling Willow Run Laboratory and Project Michigan—a University contract with the U.S. Army to conduct combat surveillance research.
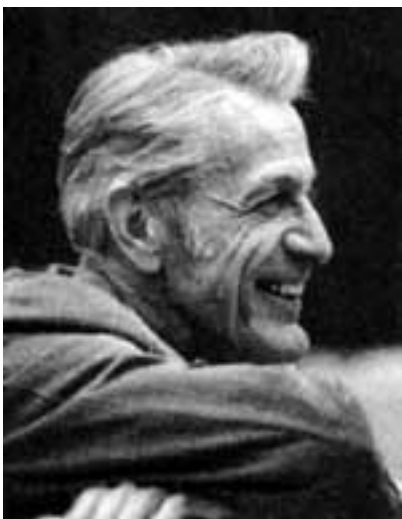
Bartels (ITD File Photo)

But it was then that mathematics professor and center director Robert C.F. Bartels secured the future of computing at U-M. Bartels and others who challenged the move noted that the charge given to the Computing Center by the regents was against moving its functions to a sponsored research facility.

"We spelled out what it meant to move everything out away from campus," Bartels recalls of a meeting in which he and others made the argument to keep the computer on-campus. "We wanted to keep it on campus because that was where the students were."

"The equipment is therefore not available for use on routine

problems pertaining to the administration of the University," Bartels wrote in a letter to Sawyer. "It is available to faculty and students of the University of Michigan without charge for unsponsored research and educational activities consistent with this policy."

Then-Vice President for Academic Affairs Roger Heyns then made the decision that the Computing Center would remain on campus.

Former colleagues and friends are invited to a public reception to honor Bartels—center director from 1959-78—and celebrate the 45th anniversary of the creation of the center 4-7 p.m. Sept. 10 in the Alumni Center. Bartels is a professor emeritus of mathematics and director emeritus of the Computing Center.

"All of a sudden, the idea of a smaller computer started to spread," Bartels says of the computing environment when he left U-M. "It was obvious they [desktop computers] were going to take over." It took some time for him to get used to the smaller machines, but Bartels says he uses a PC with Windows XP today.

The center's first home was in the North University Building. It moved to a new location in 1971 when a $1.5 million facility opened on North Campus (now the School of Information North building). Bartels served as the center's first director until 1978, when he retired.

"We had the opportunity to work on problems that weren't being solved anywhere else, and Dr. Bartels gave us the flexibility and freedom to just go ahead and do it," says Gary Pirkola, Information Technology Central Services (ITCS) technologist.

The Computing Center was created to provide computing services for faculty and students. It was housed with the Horace H. Rackham School of Graduate Studies. In 1985, it was absorbed into the Information Technology Division—now ITCS.

When Project Michigan was canceled in 1961, the Computing Center was a beneficiary. The IBM 709 that had been used at Willow Run was moved to the center. It was an upgrade over the center's IBM 704.

"The Computing Center envisions a computer system which can respond simultaneously to many users via terminal devices, and one which is capable of serving a wide range of the University's research and instructional needs for direct communication between the computer and man or instrument at rates consistent with human reaction times," Bartels wrote in a 1964-65 Computing Center report.

The center made its mark in the 1960s with the creation of the Michigan Algorithm Decoder (MAD) and Michigan Terminal System (MTS)—a timesharing operating system featuring a shared-access file system, message facility (i.e. e-mail), file editor and comprehensive set of language processors.

The MTS system capitalized on a state-of-the-art hardware/software feature called "virtual memory," which enabled efficient sharing of computer resources among multiple users. It became so popular that the work was divided between two mainframes—UM-University Maize (for sponsored research programs) and UB-University Blue (for student accounts).

The work of the Computer Center staff on "virtual memory," which now is found throughout the computing industry, was an important influence on IBM's decision to adopt it for all of their computers in the 1970s, says Bernard Galler, professor emeritus of electrical engineering and computer science.

MTS was phased out in June 1996, and ITD began to focus on network development and to orient users to a networked environment. According to ITCS—which manages telecommunications, e-mail, Web services and public workstation sites on campus—there will be 1,683 computers in use this fall at the University's computing sites.

Remember

SUPPLEMENT TO 1959-60 BUDGET FOR COMPUTING CENTER

This supplement contains a breakdown of the current expenses and rental and a summary of the anticipated sources of funds to meet the formalized 1959-60 budget for the Computing Center.

Nonsalary Items (current expenses and rental)
Rental: IBM 704, pheripheral, and auxiliary equipment
(12 months) $173,712
IBM 650 and auxiliary equipment (July,
August, and September)   7,174 $180,886
Supplies (net cost)   3,000
Telephone   1,100
Total of current and equipment rental $184,986
Rental per month on 704 System ≈ 14,476.00

Summary of Appropriations and Anticipated Income 1959-60
National Science Foundation grant $70,000
*University appropriation   58,234
Income from sale of supplies   8,000
Income from 704 time (12 months)   108,747
Income from 650 time (3 months)   7,000
Transfer of current account from Statistical Laboratory   27,000
                                           $278,981

*University appropriation to Statistical Research Laboratory
and the Computing Center for 1959-60:

Total salary budget $78,078
Nonacademic merit increases   871
Nonsalary items   10,894
Total appropriation to the two units $89,643

Less total Statistical Research Lab. budget 1959-60   31,409

University appropriation to Computing Center $58,234

The budget request has been approved by the administration. The University's appropriation is $58,234 as requested. This has been apportioned as follows:

Academic: $43,450
Non Acad: 14,784
           $58,234

The remaining $34,571 of the Non-Acad. salary is derived from other sources.

Bartels 8/20/59.

UNIVERSITY OF MICHIGAN

December 10, 1962

Memo to: R. C. F. Bartels

From: A. B. Hicks

Subject: IBM 7090 Recharge Rate

Based on your revised usage figures for October and November 1962, we recommend the following rate to be effective December 1, 1962:

Machine usage rate $410.00
Salaries and wages rate   50.00
                          $460.00 per hour

We would appreciate monthly reports of usage to determine whether any further changes are necessary before our review scheduled when the June 30, 1962, information is available.

If you have any questions please contact Mr. Harry Krater, extension 3455.

cc: H. A. Krater
    R. F. Rittenhouse
   Resident Army Auditor

---

THE UNIVERSITY OF MICHIGAN
BUDGET SHEET
1959-60

R. C. F. Bartels   Research
RECOMMENDED BY DEPARTMENT HEAD   SCHOOL, COLLEGE, OR OTHER BUDGET UNIT

                                            Computing Center
RECOMMENDED BY DEAN OR DIRECTOR   DEPARTMENT

SALARIES AND WAGES:	PAYROLL IN 1958-59				PROPOSED PAYROLL FOR 1959-60			
NAME (* INDICATES 12-MONTH APPOINTMENT)	TITLE	TEN-URE OR CL.	BASIC	1958-59 SALARY	TITLE	TEN-URE OR CL.	BASIC	1959-60 SALARY
Academic								
*Robert C. F. Bartels			(1)		Director		(1)	$11000
*2 Senior staff members					Research Assoc. (half time)			13500
*2 Junior staff members					Research Assoc. (half time)			10150
* Bruce W. Arden	Research Assoc.			$8000(2)	Research Assoc.			8800(2)
								43450
Total Academic Salaries								
Nonacademic								
*Robert M. Graham	Senior Programmer			6000(3)	Senior Programmer			6400
*Sarah L. Brando	Clerk	C-4		4200(3)	Clerk	C-4		4445
					8 Assistants (half time)			18610
					2 Machine Operators			8000
					1 Programmer			6000
					1 Key-puncher			3000
					1 Typist-Clerk	C-1		2900
								49355
Total Nonacademic salaries								
Total Salaries and Wages								92805
ACCOUNT NO.	NON SALARY ITEMS: CURRENT EXPENSE AND EQUIPMENT				Current expenses and rental of computing equipment			184986(3)
	TRAVEL				Travel			1000
Total Non-Salary Items								185986
Grand Total								278381(4)

IF ADDITIONAL COMPENSATION IS TO BE PAID FOR OTHER SERVICES (EXCLUSIVE OF SUMMER AND EXTENSION TEACHING), STATE OTHER UNIVERSITY DEPARTMENT AND AMOUNT TO BE PAID.

1958-59   1959-60

(1) Department of Mathematics (academic year) $9840.   (1) Two-thirds time academic year, full time summer. Also $4000 Mathematics one-third time academic year; total $15,000.

(2) Also $1000 from Tabulating Service; total $9000.   (2) Also $1000 from Tabulating Service; Total $9800.

(3) These salaries appeared on the 1958-59 budget of the Statistical & Computing Laboratory   (3) See attached supplement to budget sheet for itemization of current expenses and rental.

(4) See attached supplement to budget sheet for source of funds necessary to meet budget.

Form 7432 2-59 3500 X 50046
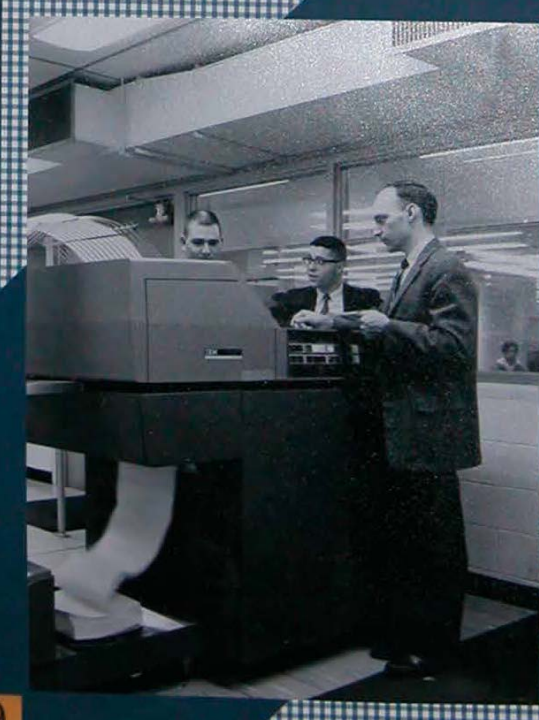
it happened in ... 1959

UNIVERSITY OF MICHIGAN'S COMPUTING CENTER
Edith Harvith Goodman

The University of Michigan's Computer Center has a new look--new headquarters, new computer, and some new goals made possible by a grant by the Ford Foundation for science and engineering.

The Computing Center has been organized as a separate entity under the jurisdiction of Vice-President for Research Ralph A. Sawyer. Previously it had been connected to the Statistical Research Laboratory.

The new look includes an enlargement from the 800 square feet which formerly housed the IBM 650 to the present 7000 square feet of offices and computer room space remodeled from the old Plant Building and renamed North University Building.

The Computer Center now contains an IBM 704, housed in 3000 square feet of computer room space for the main frame with 8000 words of core memory, magnetic drums (4 logical drums), and 6 tape units. There is an on-line printer, reader and punch. The on-line printer is used to print the program title, time and relevant diagnostic comments. A magnetic tape unit serves an off-line printer for printout of the solution of the actual problem being solved.

The 704 reads and writes at 12 microseconds a word in core storage or 96 microseconds for drum.

The Ford Foundation grant, of $900,000 makes possible a three year study on the impact and feasibility of using electronic computers for undergraduate engineering courses. This experiment will have sophmore engineering students taking a course in computer use. After this year it will be assumed that all third year engineering students know how to use the computer and thereafter problems will be assigned in their engineering classes which will take computer solution. This is to equip all graduate engineers, after this current year, with

at least a minimum acquaintance with electronic computer use, a skill highly useful to them when they are in industry as there is more and more demand for this knowledge.

The academic staff of the Computing Center consists of Bruce Arden, Dr. Bernard A. Galler, and R. C. F. Bartels who serves as its director. These members of the staff hold fractional appointments in The Department of Mathematics and are responsible for the teaching of undergraduate and graduate courses in computing and numerical analysis. The rest of the staff consists of one senior programmer, two clerical people, and one key puncher. There are 10 graduate assistants with half-time appointments who assist the students and computer users with their problems.

The staff is small because all outside programs are prepared by the individual wishing to use the computer. The machine is available without cost to undergraduates, graduate students for regular class problems and unsponsored graduate research, and to faculty with unsponsored research problems. About 75 per cent of the daily nine hour run is taken up with instructional work and non-sponsored research. Sponsored research uses 25 per cent of time on the machine. The daily programs usually number about 110 different problems.

The operation is entirely open shop. Anyone wanting machine time prepares his own program, has it key punched and drops his packet of cards into the hopper. From here the individual programs are taken in turn to the machine as time becomes available.

Every unit of the University is free to avail itself of the computer, and a day's scheduling printout includes such titles as:

Theoretical Interpretation of the Infra-Red Spectra of Ammonia
Crystal Structure Analysis of Boron Hydride Derivatives by X-Ray
Recoil Energies of Nuclelii Resulting from Neutron-Gamma
Research on a General Duality Method for the Linear Programming Method
Teacher Career Patterns
Grading Problems
Plasma Research
Speech Recognition

Application of Computer to Actuarial Teaching and Research
Religious Beliefs
Light Reflectance Properties of Rough Paint Surfaces
Feasibility Study of the use of Machines to Study the Classes of Engineering School
Study of Learning Processes in Humans and in Rats
Political Analyses of Counties
Effects of Organizations on Mental Health
Study of Affectivity and School Achievement in Elementary School Girls
Multi-Dimensional Neutron Diffusion Problem
Study in Psychology of Adolescence
Status Inconsistency and Mental Stress
Energy Relations for Structures Subjected to Earthquakes
Ray Paths and Traversal Times for Low Frequency Radio Waves in the Ionosphere

1959 debuts
The first copier the
Xerox 914, reproduces
documents at the
press of a button.

A professor was giving some visitors a tour of the Computing Center facilities one day and paused at the system console. Wanting to demonstrate some of the failsafe features that were designed into the system, he said. "Watch what happens when I try to destroy the Fortran compiler." Unfortunately, the system was not as failsafe as he anticipated, and the Fortran compiler was indeed destroyed. This impromptu lesson uncovered a bug that the MTS programmers were able to fix and thus avoid subsequent disasters.
--Bernard Galler

M T S

1966

May 1966—IBM 360 Model 50, located at the North University Building (NUBS), used for early MTS development work.

1966—Merit System launched.

1966—First Data Concentrators built (as part of the CONCOMP Project). First Merit links to panel sites provided the bulk of the access to MTS for timesharing users.

Dave Flower *courtesy Dave Mills*

DEC PDP 8 - Data Concentrator *courtesy Dave Mills*

1967–1968

January 1967—Computing Center obtains a new IBM 360 Model 67.

May 1967—MTS released to campus on the computing system IBM 360/67.

1967—First accounts and billing for CONCOMP and Merit MTS.

February 1968—First remote graphics terminal delivered to MTS.

August 1968—Computing Center obtains dual processor 360/67.

November 1968—University of British Columbia runs MTS.

Mike Alexander & IBM 360/67 *courtesy Dave Mills*

UM Computing
Timeline 45 Years

1969–1973

February 1969—University of Newcastle runs MTS.

October 1969—Construction commences on North Campus Computing Center Building.

September 1970—University of Alberta runs MTS.

January 1971—Wayne State University runs MTS.

April 1971—Computing Center moves to new building. NUBS remains as a remote batch station. MTS runs on an Amdahl 470V/6 computer (serial number 2).

Disk Farm *courtesy Dave Mills*
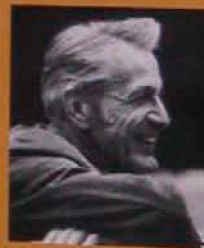
1985–1996

May 1985—CP terminal and computer accounts available to the campus community.

January 1986—The first U-M computer conference organized by students (Maxima) begins to spread to others using Confer on MTS.

June 1996—MTS retired at U-M. Still running at Wayne State University, Rensselaer Polytechnic University, and the University of British Columbia.

it happened in . . . 1996

Approximately 68 million people are using the Internet. 44% of U.S. households own a personal computer, and 14 million of them are online. E-mail extends surface mail and computer conferencing.

1974–1980

May 1974—First MTS workshop held at University of British Columbia.

1975—Confer software provides conferencing and e-mail service via MTS.

1976—"Which Host?" network protocol first appears.

July 1976—First Distributed Computing Sites (DCS) open.

October 1979—Campus-wide MTS used to support the foundation of the International Society for Technology Assessment.

1981–1984
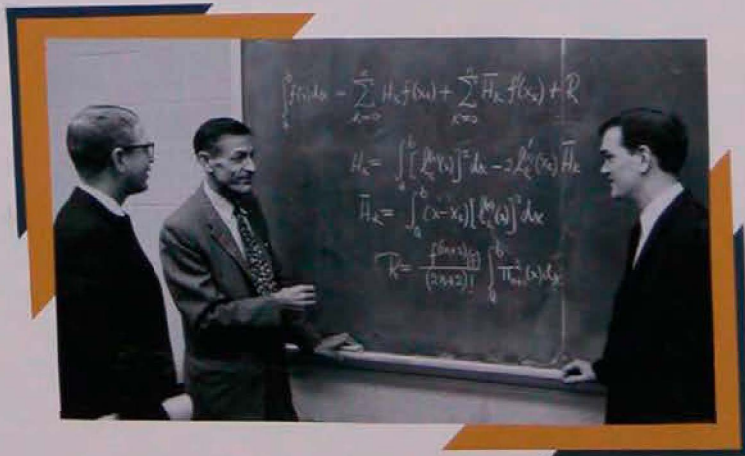
1981—Microcomputer access to MTS provided.

July 1981—$MESSAGE e-mail available on MTS.

September 1982—MTS able to send and receive e-mail to and from remote, non-MTS systems.

1983—First Secondary Communications Processor (SCP) deployed.

1984—Information Technology Division formed by combining Computing Center, Office of Administrative Systems, and U-M Office of Telecommunications.

$$\int f(x)\,dx = \sum_{k=0}^{n} H_k f(x_k) + \sum_{k=0}^{n} \overline{H}_k f'(x_k) + R$$

$$H_k = \int_a^b \left[\ell_k(x) \right]^2 dx - 2\ell_k'(x_k)\,\overline{H}_k$$

$$\overline{H}_k = \int_a^b (x - x_k)\left[\ell_k(x)\right]^2 dx$$

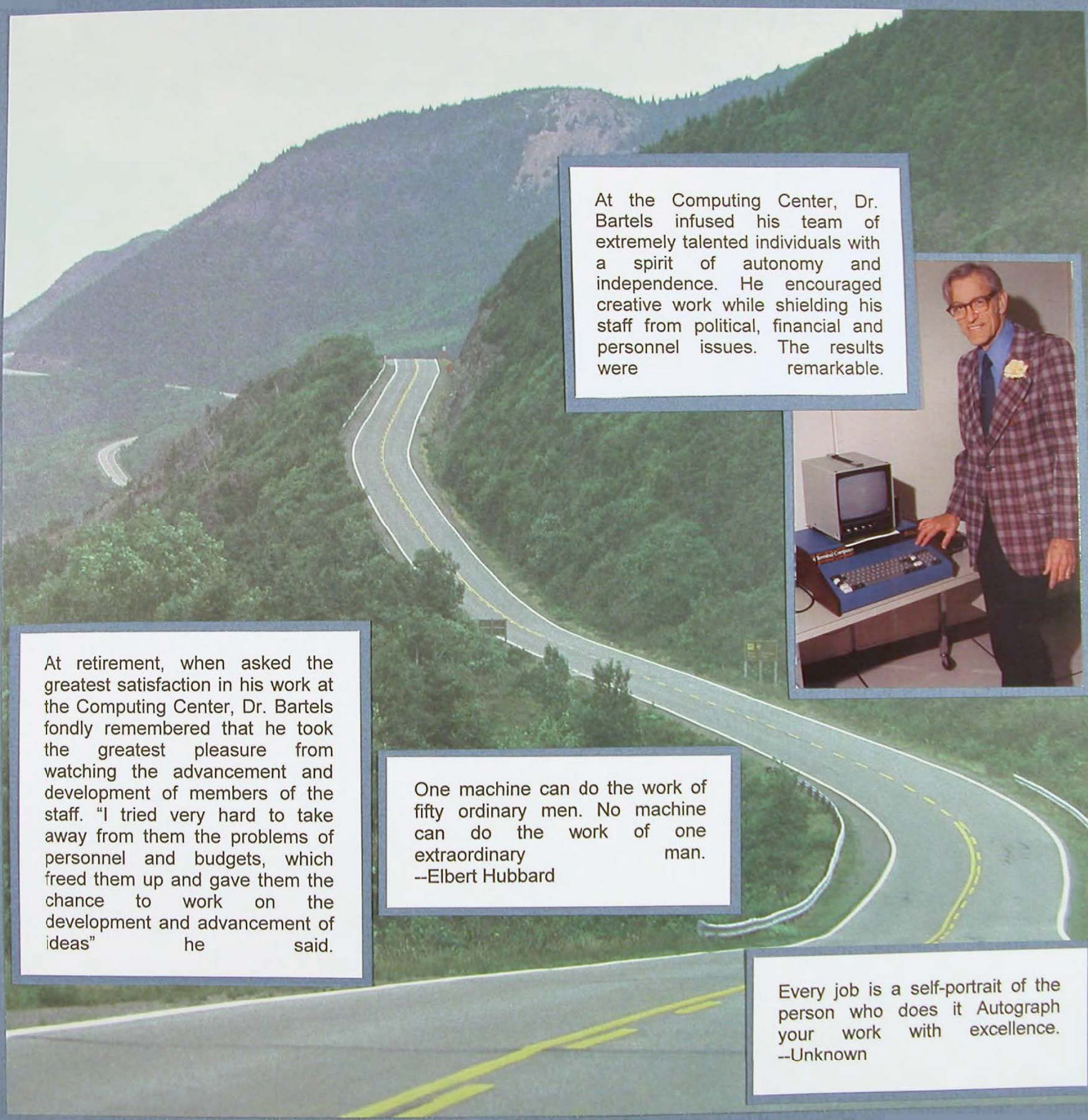$$R = \frac{(b-a)^{2n+2}}{(2n+2)!} \int_a^b \pi_n^2(x)\,dx$$

I came in one weekend to test something I'd been working on, and I brought my nine-month old son with me. I was busy typing at the console when I looked down to see Jamie pushing a large red button. MTS was stopped for about 30 seconds, with luckily no negative implications, just a brief pause on a Sunday afternoon.
— *Steve Burling*

Robert C. F. Bartels

45 years of computing at the University of Michigan

September 10, 2004

At the Computing Center, Dr. Bartels infused his team of extremely talented individuals with a spirit of autonomy and independence. He encouraged creative work while shielding his staff from political, financial and personnel issues. The results were remarkable.
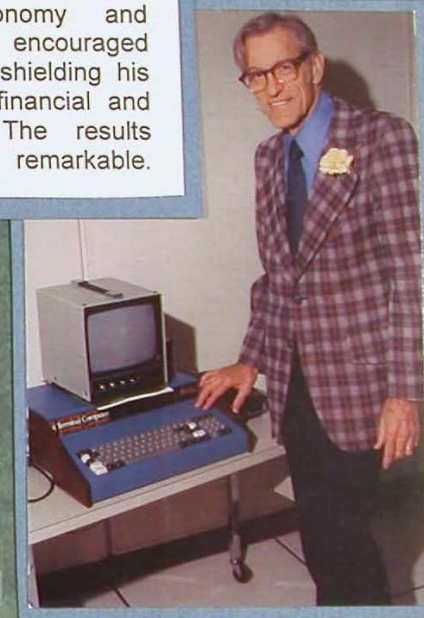
At retirement, when asked the greatest satisfaction in his work at the Computing Center, Dr. Bartels fondly remembered that he took the greatest pleasure from watching the advancement and development of members of the staff. "I tried very hard to take away from them the problems of personnel and budgets, which freed them up and gave them the chance to work on the development and advancement of ideas" he said.

One machine can do the work of fifty ordinary men. No machine can do the work of one extraordinary man.
--Elbert Hubbard

Every job is a self-portrait of the person who does it Autograph your work with excellence.
--Unknown

HISTORY

1924

New York's Computer Tabulating Recording Company is re-organized and now known as International Business Machines Corp. – IBM.

1930

Analog Computer debuts

1940s

Claude Shannon's "The Mathematical Theory of Communication" showed engineers how to code data so they could check for accuracy after transmission between computers. Shannon identified the bit as the fundamental unit of data and, coincidentally, the basic unit of computation.

1947

Transistors introduced.

Transistors – 1947

BITS

A bit is the smallest element of information used by a computer. A bit holds ONE of TWO possible values,

Value	Meaning
0	OFF
1	ON

A bit which is OFF is also considered to be FALSE or NOT SET; a bit which is ON is also considered to be TRUE or SET.

Because a single bit can only store two values, bits are combined together into large units in order to hold a greater range of values.

01

1948

John Backus completed speedcoding for IBM's 701 computer. Although speedcoding demanded more memory and compute time, it trimmed weeks off the programming schedule.

1953

Herbert Simon and Allen Newell unveiled Logic Theorist software that supplied rules of reasoning and proved symbolic logic theorems.

1957

FORTRAN, FORmula TRANslator language enabled a computer to perform repetitive tasks from a single set of instructions by using loops.

1958

NASA is founded. Aimed at putting a man in space within two years. Computers assist in this effort.

1959

COBOL, Common Business Oriented Language is developed for business use. It offered easy readability of computer programs.

1963

ASCII—American Standard Code for Information Exchange—permitted machines from different manufacturers to exchange data.

1963

BASIC programming language is created.

1965

Digital Equipment Corp. introduced PDP-8, the first commercially successful mini computer. It sold for $18,000.

1969

UNIX operating system was developed.

1972

Electronic mail is introduced.

1975

Laser printers debut.

1976

Apple computers debut.

Atari games introduced.

FACTS

Apple II - 1977

1977

Apple II becomes the first mass produced home computer.

1979

MS-DOS is released. Microsoft Disk Operating System, the basic new software with establishes a long partnership between IBM and Microsoft.

1981

IBM PC debuts.

1982

Microsoft introduces Word (originally called Multi-Tool Word) and Windows. Windows does not ship until 1985.

1984

Apple introduces the user - friendly Macintosh computer.

1985

C++ programming language emerged as an important object-oriented language.

1991

Gopher, the first user-friendly Internet interface is created at the University of Minnesota.

1995

Windows 95 debuts.

1998

Apple Computer unveils the iMac.

IBM PC - 1981

P **O** **W** **E** **R**

HORSE **TO**

MICHIGAN YESTERDAY   April, 1924   Horsepower in front of Buildings and Grounds
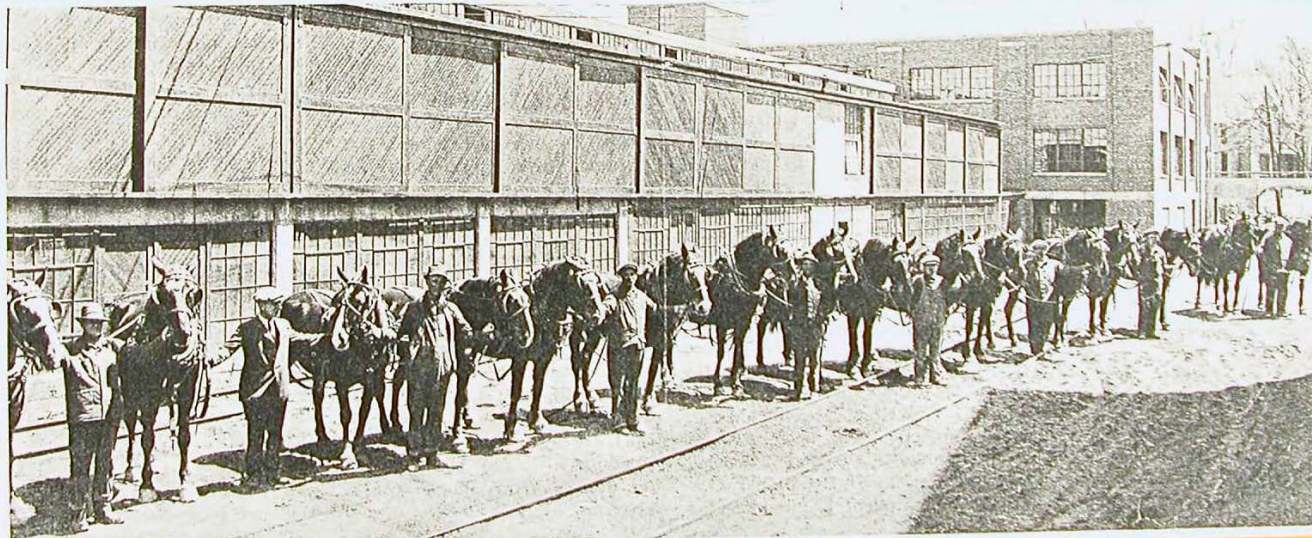
There is no substitute for hard work.
--Thomas Edison

POWER
CORDS

North University Building, Main Campus
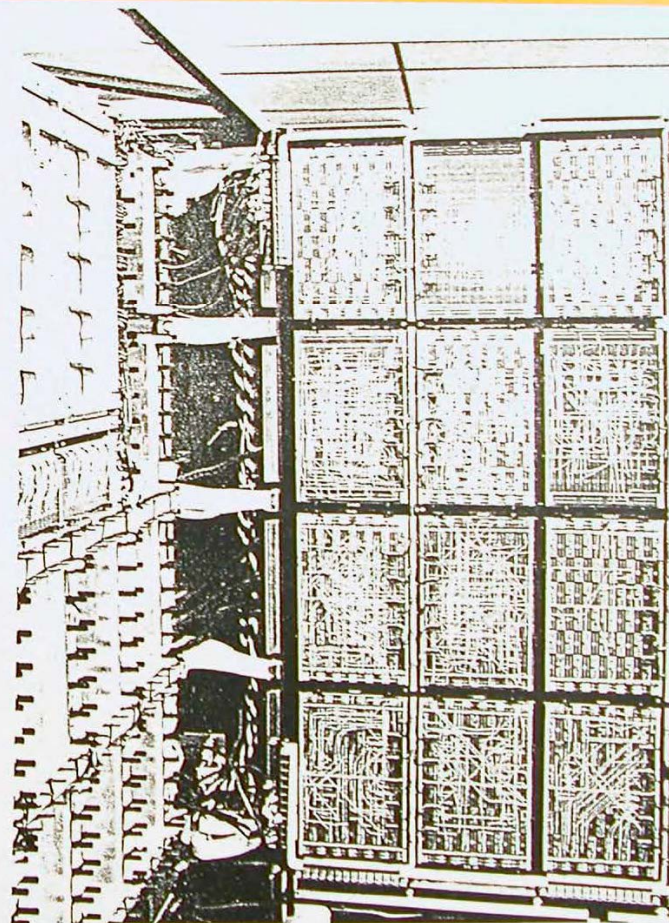
An inside look at a part of the University's newest central computer, the Amdahl 470V/6.

1966

1970

1977

Said Jeff Ogden, then an MTS programmer and associate director of the Computing Center, "MTS became a cooperative development effort of eight universities in three countries."

MTS *Timeline*
30 *years*

ITD file photo

Robert Bartels, first director of the U-M Computing Center, is credited with creating the type of environment that made development efforts such as MTS possible.

1966

May 1966—IBM 360 Model 50, located at the North University Building (NUBS), used for early MTS development work.

1966—Merit Network founded.

1966—First Data Concentrator built (as part of the ConComp Project). For more than 10 years, these provided the bulk of the access to MTS for timesharing users.

1967–1968

January 1967—Computing Center obtains a new IBM 360 Model 67.

May 1967—MTS released to campus as operating system for IBM 360/67.

1967—Batch-mode access and billing for CPU time added to MTS.

February 1968—First remote graphics station connected to MTS.

August 1968—Computing Center obtains dual-processor 360/67.

November 1968—University of British Columbia runs MTS.

1969–1973

February 1969—University of Newcastle runs MTS.

October 1969—Construction commences on North Campus Computing Center Building.

September 1970—University of Alberta runs MTS.

January 1971—Wayne State University runs MTS.

April 1971—Computing Center moves to new building; NUBS remains as a remote batch station. MTS runs on an Amdahl 470V/6 computer (serial number 2).

1974–1980

May 1974—First MTS workshop held at University of British Columbia.

1975—Confer software provides conferencing and e-mail services via MTS.

1976—"Which Host?" network prompt first appears.

July 1976—Rensselaer Polytechnic University runs MTS.

October 1976—Confer and MTS used in support of a conference of the International Society for Technology Assessment.

10

Information Technology Digest ▪ May 1996

"MTS was not just a system, it was a community," said Elizabeth Barraclough, director emeritus of Computing Services at Newcastle University. "Those of us who saw the benefits that the community brought to its members will never

Do not go where the path may lead, go instead where there is no path and leave a trail.

- Ralph Waldo Emerson

THANKS !

RETIRING COMPUTING CENTER DIRECTOR HONORED AT LUNCHEON

Dr. R. C. F. Bartels, who has retired as director of the Computing Center, was honored at luncheon held at the Computing Center on Friday, 30 September. Dr. Bartels has served as director of the Computing Center since its formation in July 1959. A professor of mathematics, he has been a member of the U of M faculty since 1938. His professional interests have been in the applications of mathematics to elasticity, hydrodynamics, and numerical analysis.

Dr. Allan R. Emery served as master of ceremonies for the luncheon, which saw many distinguished guests in attendance: notably, Mrs. Virginia Bartels; Dr. George Hay, professor of mathematics; Dr. Franklin H. Westervelt, former associate director and current director of the Wayne State University Computing Services Center; James F. Brinkerhoff, vice-president and chief financial officer; Dr. A. Geoffrey Norman, former vice-president for research; Prof. Arthur Burks, professor of Computer and Communication Sciences; Dr. Larry Flanigan, chairman of the Dept. of Computer and Communication Sciences; Dr. Richard Phillips, former associate director; Prof. Frederick Gehring, chairman of the Dept. of Mathematics; and Bud Enochs and Gordon Gagnon, Amdahl Corporation.

A highlight of the luncheon festivities was the presentation to Dr. Bartels of a Processor Technology SOL microprocessor. Purchase of the microprocessor was made possible by the many donations received from friends and Computing Center staff members. In addition, Dr. Bartels received a North Star mini-floppy disk from the Amdahl Corporation, a "customized" director's chair (initialized "Director—My Tiny System"), and a gift certificate. Dr. Bartels received numerous congratulatory notes and a lifetime "machine maintenance contract" from members of the Computing Center Electronics Shop.

Dr. Bartels will be missed by all who recall his years as an inspiring teacher, a distinguished mathematician and leader in the academic community, and director of the Computing Center. We wish him the best of luck in his future endeavors.

FAREWELL and GOOD LUCK
DR. BARTELS

U of M ...ng Center
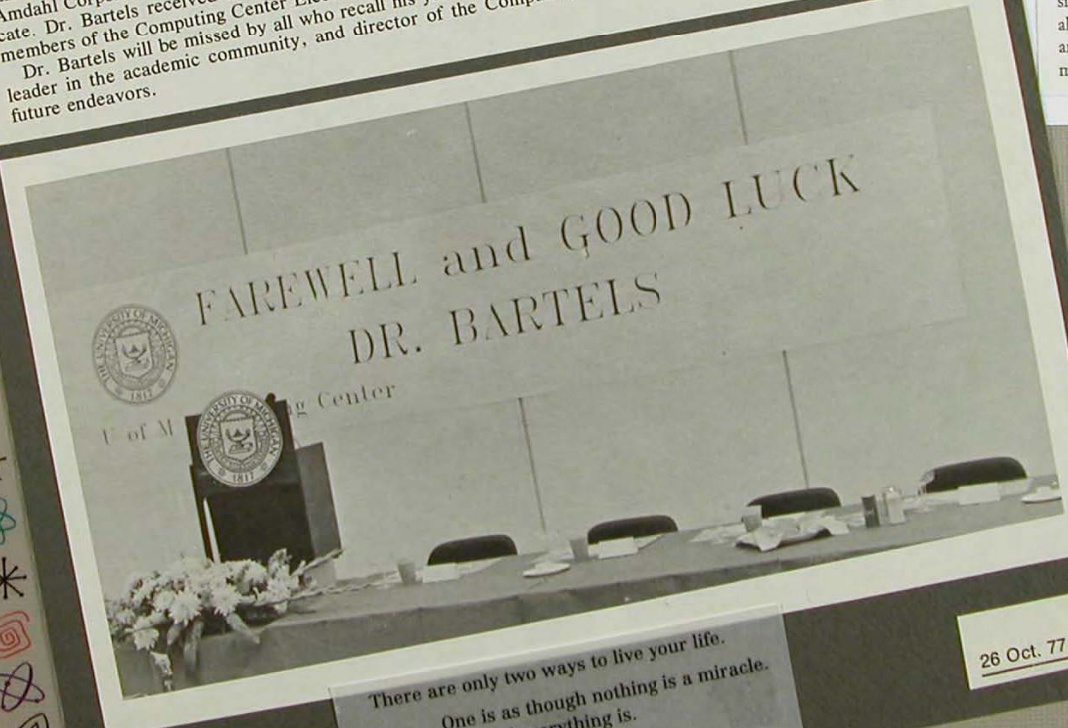
There are only two ways to live your life.
One is as though nothing is a miracle.
The other is as if everything is.

- Albert Einstein

26 Oct. 77

U-M Gets New Mainframe

In the mid-1960s, when IBM introduced its System/360 series of machines, the U-M Computing Center was doing some early experiments with a new type of system that could provide timesharing—an experimental technology at that time. However, the mainframe computers of that time were not capable of running this new type of system.

After a year of negotiations and design studies, IBM agreed to make a one-of-a-kind version of the IBM 360 mainframe to accommodate U-M's desire to move in this new direction, dubbed the Model 360/65M. The "M" stood for Michigan. But IBM initially decided not to supply software for the machine.
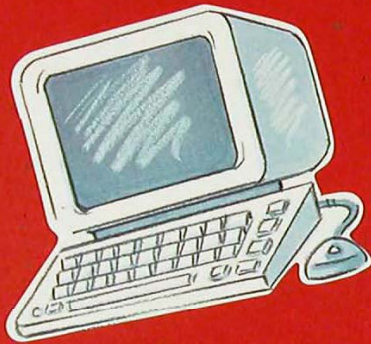
Meanwhile, a number of other institutions heard about the project, including General Motors, the Massachusetts Institute of Technology's (MIT) Lincoln Labs, Princeton University, and Carnegie Tech. They were also intrigued by the timesharing idea and expressed interest in ordering the modified IBM 360 series machines.
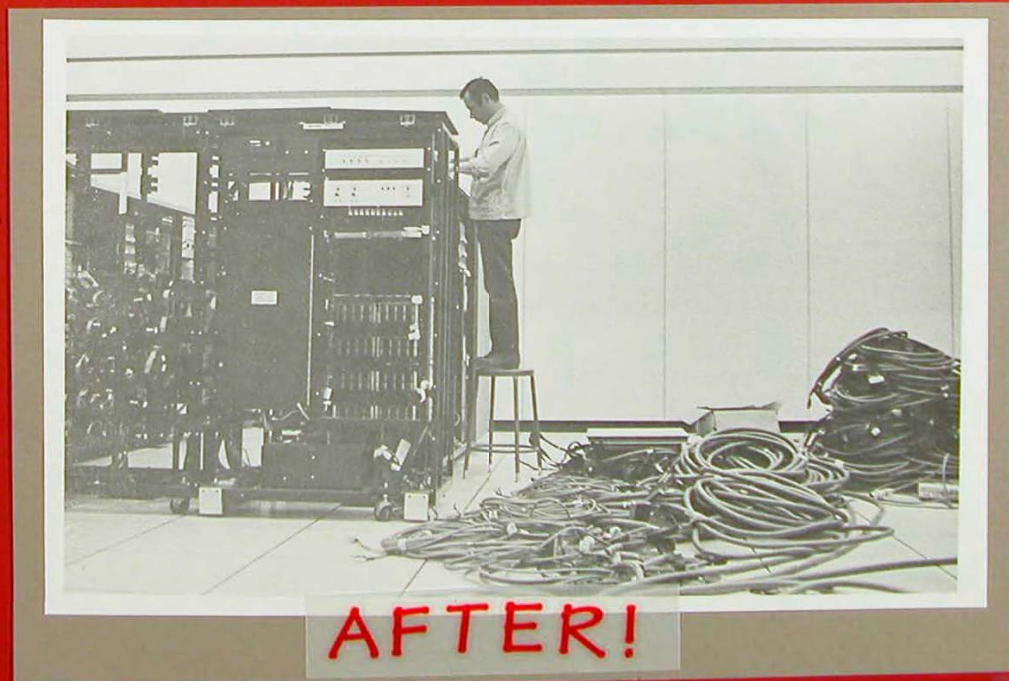
Thank You

at **WORK!**

BEFORE!

AFTER!

COMPUTING CENTER STAFF DIRECTORY

Name	Room	Phone
Alexander, Michael T.	3228-2	4-9595
Arden, Bruce W.	3212	4-9595
Bartels, R. C. F.	3210	4-9595
Baker, Jane A.	3226-13	4-9595
Blue, Jr., Robert D.	2206-5	4-2121
Bolas, Bruce J.	2206-6	4-2121
Boettner, Donald W.	3228-1	4-9595
Brando, Sarah L.	3204-1	4-2121
Brown, Wilma B.	3226-14	4-9595
Degroote, Sue	3202-13	4-2121
Dejong, Kenneth	2206-8	4-2121
Digiuseppe, Jack	2210-3	4-2121
Donnelly, Stephen M.	2216	4-2121
Dymond, Karen L.	3204-2	4-2121
Emery, Allan R.	3214	4-9595
Engle, Charles F.	3224-2	4-9595
Flower, David S.	2220	4-2121
Flanigan, Larry K.	2210-1	4-2121
Fronczak, Edward J.	2202-4	4-2121
Galler, Bernard A.	3216	4-9595
Gerstenberger, W. Scott	3228-3	4-9595
Goodrich, Suzanne D.	2202-3	4-2121
Gray, Sheldon C.	3224-1	4-9595
Harding, Jr., Leonard J.	2202-1	4-2121
Hieber, Ross H.	2206-7	4-2121
Hogan, John	2210-2	4-2121
Jones, Nancy L.	1212	4-2121
Knoblock, Daryl	2208-3	4-2121
Lavoie, Phyllis A.	3202-12	4-2121
Lubbers, Clark	2210-4	4-2121
Marvin, Lynn R.	3208-2	4-2121
Mitchell, Leroy G.	2216	4-2121
Mills, David L.	2208-4	4-2121
Payne, John D.	3230	4-2121
Pirkola, Gary C.	3224-3	4-9595
Preston, Grace B.	3202-1	4-2121
Rogers, Ron	2210-2	4-2121
Rowe, Fredrick D.	2220	4-2121
Srodawa, Ronald J.	2208-1	4-2121
Salisbury, Richard	2202-2	4-2121
Schaefer, John T.	2216	4-2121
Scott, Beverly	3202-4	4-2121
Smith, Douglas B.	2208-2	4-2121
Smith, Phyllis J.	3226-5	4-9595
Stewart, Brenda	3226-1	4-9595
Tiffany, Lyle B.	2202-5	4-2121
Wentland, Carole S.	3226-2	4-9595
Wilkes, Mary Ann	3208-1	4-2121
Counseling Office	1206	4-2121
Job Status		3-3360
24-Hour Answering Service		3-0420

NEW!

THE NEW COMPUTING CENTER

The keypunches shown here are located at NUBS. Public keypunches are also available at the Computing Center. At least one keypunch at each location is reserved for express use.

The system console is the operator interface to the amdahl470V/6. It contains an independent minicomputer and has access to approximately 16,000 latches within the system, which can be displayed on the CRT. This static readout capability is an important innovation in system diagnostics and maintenance.

The console consists of a console processor minicomputer, a communication modem, a disk storage device, a magnetic tape cassette drive, an operator control panel, a CRT display unit, and a keyboard. It has direct computer-to-console interface to permit static readout of system latches and setting of certain control and data registers. In addition, it has a channel interface to allow it to function as an operator console device.

Three distinct modes of console operation are possible:
- Device support mode
- Hardware command mode
- Maintenance mode

In device support mode, the console emulates an IBM 3066 CRT console device or an IBM 3215 printer/keyboard using CRT output instead of printing. Device support mode uses only the channel interface to the amdahl470V/6, communicating through a selector or a multiplexer channel. The amdahl console functioning in this mode in no way affects other devices that may be used as consoles or alternate consoles.

Hardware command mode governs a variety of functions within the amdahl 470V/6 System hardware. Included are such functions as IPL, reset operations, displaying and altering data in registers and main store, and setting operating conditions for the system. These functions

A lot of people have gone farther than they thought they could because someone else thought they could.
--Zig Ziglar
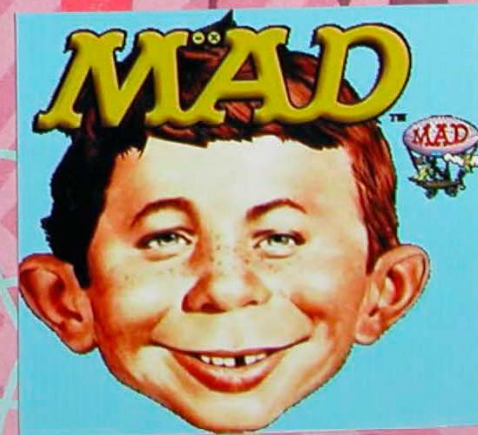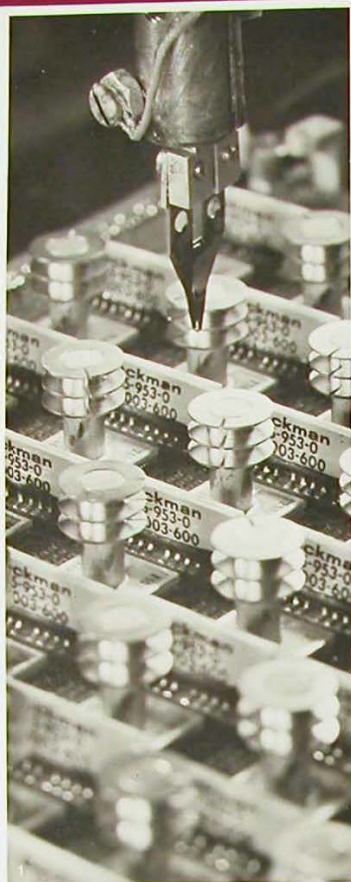
MTS was a democratic system in that all users were treated equally and had equal access to services. Ogden added, "The system didn't really know or care if you were a student or a faculty member."
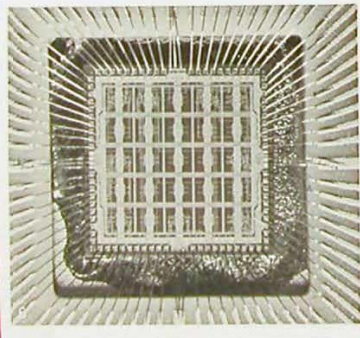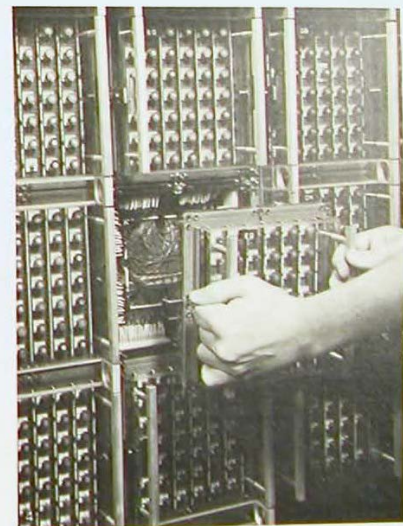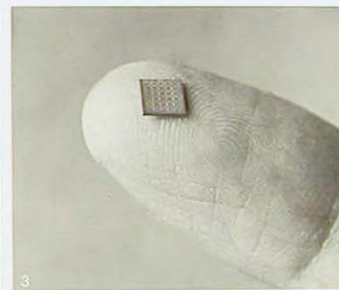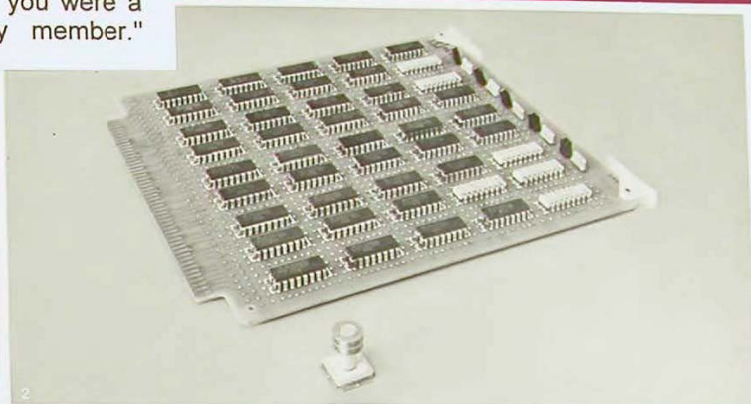
1. Above left is a photo of an LSI chip carrier being mounted in an MCC. Backwiring provides interconnections between chips on the MCC. At each edge of the MCC are two 100-pin connectors, for a total of 800 pins. The MCC is the field-replaceable unit of the amdahl 470V/6 System. The chips on a single MCC contain approximately 3000 circuits. There are 51 MCCs in the amdahl 470V/6 System, comprising approximately 150,000 circuits.

2. At top above is a study in contrast. The large board is third-generation technology. In contrast, the fourth-generation equivalent is the LSI chip, shown mounted in a chip carrier, with cooling stud and fins attached. Each contains 75 to 100 separate electronic circuits.

3. Photo above shows an amdahl LSI chip. It measures 154 thousandths of an inch square and is 10 mils thick. Each chip can contain up to 100 circuits, a typical chip may contain about 75.

4. In the photo at the right, MCCs are shown being mounted in the main frame of the amdahl 470V/6. A similar array of MCCs is mounted back-to-back with these, on the other side of the machine. The bus plate between the arrays contains about 12,000 coaxial wires that provide interconnections among the MCCs.

5. An LSI chip is pictured at the right; the chip carrier is mounted on a small PC board for testing. Air flow around the cooling stud and fins eliminates the need for liquid cooling in the amdahl 470V/6 System.

6. Shown at the left is an enlarged photo of an LSI chip, mounted in a chip carrier. Minute wire connections are made to supply power and signal paths between the LSI chip and the chip carrier.
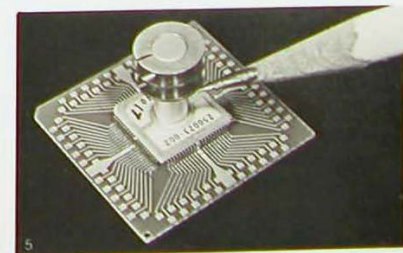
The storage control unit (S-Unit) accepts addresses from the instruction unit (I-Unit) or channel unit (C-Unit) and returns data to the I-Unit, C-Unit or the execution unit (E-Unit). A real address request is made through the effective address register (EAR) which then starts the high-speed buffer access and loads the appropriate port (instruction fetch, operand fetch, C-Unit, pre-fetch, or an internal priority port). A unique tag is generated in the buffer for the associated real main storage address. A tag is similarly generated for the requested location and, if it matches either the primary or alternate buffer tag, the appropriate data is returned as requested. If the data is not present in the buffer, a main storage request is generated and the data request must wait for a main storage cycle.

A virtual address request is also presented to the S-Unit through the EAR. An attempt is then made to translate the virtual address to a real address by using the translation lookaside buffer (TLB). The TLB contains real address equivalents previously obtained from virtual address translations. If the TLB search fails to find a match, a full translation is performed using the segment and page tables in main storage, and the results are subsequently entered into the TLB. If a match is found, an ID that is associated with the current segment table origin (STO) is compared with the ID stored with the matching TLB entry. If the IDs are not the same, the TLB entry is not currently valid and cannot be used. A STO stack retains previous STO values so that, if control registers are reloaded with previous values, TLB entries with the appropriate ID again become valid. The STO stack also controls selective purging of the TLB when an ID must be associated with different STO values.

> Ordinary people believe only in the possible. Extraordinary people visualize not what is possible or probable, but rather what is impossible. And by visualizing the impossible, they begin to see it as possible.
> --Cherie Carter-Scott
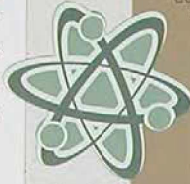
1. The modern functional design of the amdahl 470V/6 console is pictured at left. Housed within the console are an independent mini-computer, disk storage, cassette tape reader and a modem. The CRT, keyboard and system control panel complete the components of the console.

2. The system control panel provides the standard indicator lights, switches and controls required to operate the amdahl 470V/6 System, as illustrated in the photo below.

3. The amdahl 470V/6 console operates in three modes. At right, the CRT is shown operating as a 3066 emulator, in use as a console for an MVT system. In this mode, data is transferred between the main-frame and

the console using a channel and a standard interface.

4. The second mode, as pictured at right, is hardware command mode. In this mode, the operator can display and modify registers and main storage. Also, operating state registers can be displayed and modified.

5. Scan-out mode is shown in the photo at the right. In this mode, approximately 16,000 latches within the main frame can be displayed. This innovative diagnostic capability does not depend upon the operation of the main CPU or channels; the console processor has an independent access to the main frame for static readout. An internal modem allows remote use of this diagnostic tool for a new dimension in maintainability.

are initiated by the operator through the keyboard and results are displayed on the CRT.

Maintenance mode allows the Amdahl maintenance personnel to perform diagnostic tests of the main computer utilizing the console processor. It should be noted that Amdahl system diagnostic programs can be run utilizing the console processor and the computer-to-console interface without depending on the operating condition of the CPU, the channels or any other component in the main system. The result is a very high level of system maintainability and availability. The modem allows the on-site Amdahl representative to be assisted by the headquarters experts, who can remotely control and diagnose the system, increasing maintainability even further.

SYSTEM CONTROL PANEL

The design of the amdahl system console simplifies operation in two ways:
- Most console input functions are performed using the console keyboard instead of console toggle or rotary switches.
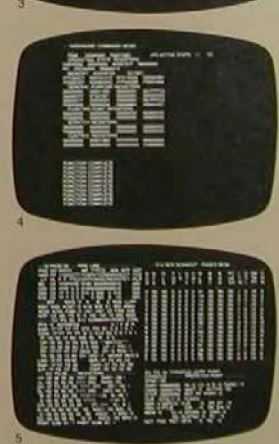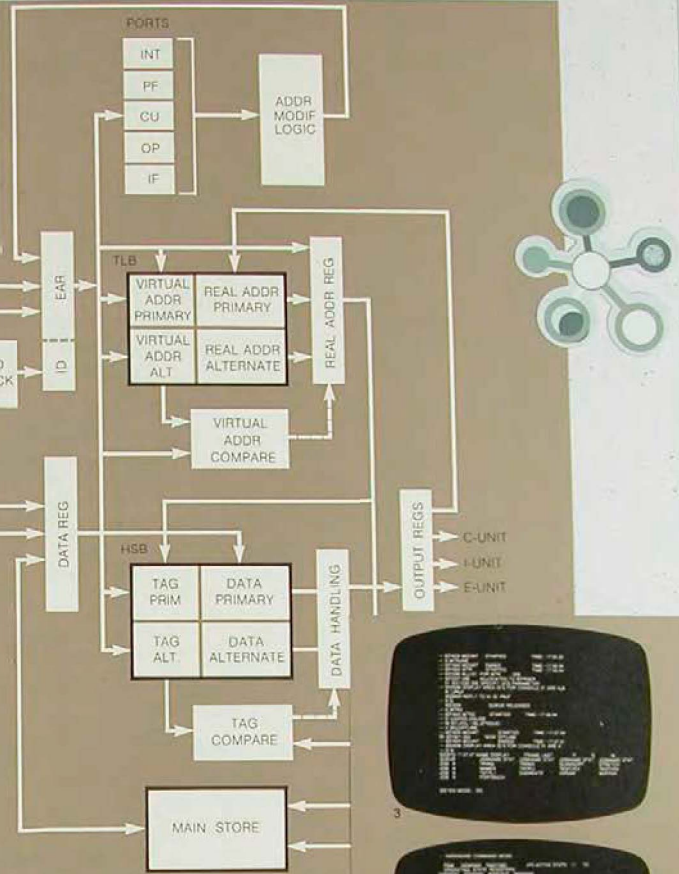
- Most console output functions appear as formatted displays on the CRT, not as panel lights.

The system control panel contains the standard controls necessary for power-on, initial program loading and time-of-day clock setting and has the standard SYSTEM, MANUAL, WAIT, TEST and LOAD lights.

As a reliability and availability feature, the system console can perform initial program loading with only the console computer and the magnetic tape cassette drive in operation.

BUS MARGIN
BUS 3

NORMAL

US
PS5   PS6   PSC

LT   LR

BUS 5

NORMAL

technology

The amdahl 470V/6 computing system uses large-scale integration (LSI) semiconductor technology to obtain high reliability and speeds measured in trillionths of seconds. An LSI version of bipolar emitter-coupled logic (ECL) is used throughout the central processing unit (CPU); metal oxide semiconductor (MOS) LSI circuits are used in main memory; and ultra high-speed bipolar components are used for the buffer cache memory. The CPU circuits are Amdahl-custom-designed, using emitter-coupled logic with speeds on the LSI chip on the order of 600 picoseconds (trillionths of a second). CPU cycle time is in the 30 nanosecond range. Standard integrated circuits are used in the I/O interface to communicate with control units and peripherals.

Some of the advantages that advanced LSI technology offers to the amdahl System user are:

- A substantial increase in internal operating speeds. The amdahl 470V/6 is two to three times the speed of comparably-priced systems, yielding a significant improvement in large system price performance.
- A dramatic improvement in system reliability. LSI technology reduces the number of interconnections and components by an order of magnitude. This reduction is accompanied by a considerable reduction in system failure rate. The amdahl 470V/6 System CPU and channel consist of only 51 multichip carriers (MCCs) containing approximately 150,000 circuits.
- Sixteen inboard channels are standard. Innovative use of LSI in channel design allows 16 inboard channels as a standard feature. Each channel can be configured as a byte or a block multiplexer or a selector channel.
- Greatly-simplified field maintenance and repair procedures. Additional circuitry is incorporated into the design of each LSI chip, which allows some 16,000 latches to be examined and diagnostic analysis to be performed using the system console.
- Physically smaller and significantly reduced cooling requirements. The amdahl 470V/6 System is totally air-cooled, not liquid-cooled as are many other large computers. It occupies approximately one-third the floor space of comparable systems.

The technology of the amdahl 470V/6 System has presented a design challenge from the outset. Circuits of tremendous complexity had to be fitted on silicon chips measuring 154 thousandths of an inch square and 10 mils thick. Furthermore, to be economically feasible, the circuitry had to be designed at a reasonable cost and in a reasonable time. The solution was to design a master diffusion mask that is capable of generating hundreds of different final parts by making different interconnections in the final processing stages with the aid of a computer.

Logic designs were tested on a working model of the amdahl 470V/6, using third-generation technology. When the logic was correct, it was reduced to LSI using Amdahl-proprietary design automation techniques.

The minute size and high speed of these LSI circuits have also required specially-designed testing and fabrication equipment. In 1970 no equipment existed on the market that could test chip response within the necessary 15 picoseconds. This required Amdahl to design and build sophisticated test equipment to meet this standard.

Wiring the MCCs also called for new methods. Interconnections between mounted chips are routed automatically. Lead wires are connected by a computer-controlled, Amdahl-designed wire bonding machine.
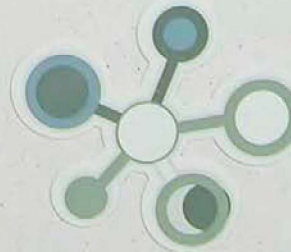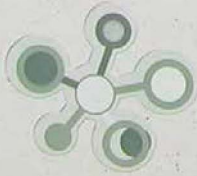
MARY SUE COLEMAN
PRESIDENT

THE UNIVERSITY OF MICHIGAN

2074 FLEMING ADMINISTRATION BUILDING
ANN ARBOR, MICHIGAN 48109-1340
734 764 6270   FAX: 734 936-3529
marysuec@umich.edu

August 25, 2004

Professor Robert C. Bartels
Director Emeritus of the Computing Center
401 Oakbrook Drive West, #307
Ann Arbor, Michigan 48103

Dear Professor Bartels:

I am sure that I represent the faculty, staff, and students of the University of Michigan, especially those who were here during your Directorship of the Computing Center, in congratulating you on the celebration of your successful career.

I had heard in great detail about the leadership of the University of Michigan Computing Center in the early days of electronic computers, and especially the innovation and creativity you and your staff showed in becoming the flagship university Computing Center in the 1950's, 1960's, and 1970's.

I have learned that you established the Computing Center at a time when most universities had clear separation between the academic departments and the computing facilities, and that our Computing Center was dedicated to the principle of bringing these communities together, and to providing such excellent service that no one would want to go elsewhere for their computation.

We are proud of you and your staff, many of who have gone to lead other great centers of computation. We are deeply appreciative of the exceptional legacy that you created, and we wish you continued success in your retirement.

Sincerely,

Mary Sue

Mary Sue Coleman
President

MSC/pjf

UNIVERSITY

JULY MEETING, 1978

The Regents met at 1:30 P.M.

Present were the President and Regents Baker, Brown, Dunn, Laro, Nederlander, Power, Roach, and Waters. Chancellors Goodall and Moran and Vice-Presidents Shapiro, Brinkerhoff, Radock, Overberger, Johnson and Vice-President and Secretary Kennedy also were present.

VI. RETIREMENT MEMOIRS

Secretary Kennedy reported the retirement of eleven faculty members. The following memoirs were adopted.

Professor ROBERT C. F. BARTELS, Director of the Computing Center and Professor of Mathematics, retired from active faculty status as of June 30, 1978, after a productive career as a teacher, researcher, and administrator.

R. C. F. Bartels Retirement

Professor Bartels was born in Brooklyn, New York, and took his undergraduate and graduate degrees at the University of Wisconsin, receiving his Ph.D. in 1938. He came to The University of Michigan in 1938 as an Instructor, was promoted to Assistant Professor in 1945, to Associate Professor in 1950, and to Professor in 1957.

Professor Bartels was one of a few farsighted people who, during the 1950's, applied numerical techniques to solve new problems in mathematics and introduced numerical analysis as a field of study in the university curriculum. He was appointed Director of the newly established University of Michigan Computing Center in 1959, a position which he held until his retirement. As Director he did a remarkable job of fostering an environment in which the Center could grow to its present prominence as one of the best in the academic world. That he did so in spite of severe budgetary restrictions and many conflicting demands for computing services attests to his great skill as an administrator.

In 1972 Professor Bartels received a Distinguished Faculty Achievement Award in recognition of excellence in teaching, research, and public service.

The Regents now salute this distinguished educator for his dedicated service by naming him Professor Emeritus of Mathematics and Director Emeritus of the Computing Center.

OF MICHIGAN

University Of Michigan

MTS

VOLUME II

second edition
December 1, 1967

FMS and Batch Processing

MIT and the University of Michigan were both 7094 owners, and the computation center people were colleagues who traded code back and forth. When I was a freshman in 1961, we used FORTRAN in the elementary course (FORTRAN II was brand new then), but by the time I was a sophomore, MIT had installed Michigan's **MAD** language, written by Graham, Arden, and Galler, and was using that in most places that a compiler language was needed, especially computer courses. MAD was descended from ALGOL 58: it had block structure and a fast compiler, and if your compilation failed, the compiler used to print out a line printer portrait of Alfred E. Neumann. (MIT took that out to save paper.) Mike Alexander says, "MAD was first developed about 1959 or 1960 on a 704, a machine which makes the 7094 look very powerful indeed." MAD ran under UMES, the University of Michigan Executive System, derived from a 1959 GM Research Center executive for the IBM 701 that was one of the first operating systems7uuuuu9u.

Part of the Michigan/MAD code was a replacement for the standard FORTRAN output formatter routine, (IOH). (Programs written in **FAP** (FORTRAN Assembly Program, the 7094 assembler) could use special characters, such as parentheses, in external names. I/O library routines were often given names that FORTRAN and MAD programs could not generate, to avoid name conflicts.) The MIT/Michigan version of (IOH) supported additional format codes used by the MAD language, and had other internal improvements over the IBM version. One change was to use the extra index registers that the 7094 had and the 7090 didn't. And buried deep in the code, there was an instruction to save the contents of X5, with the comment, SOMEBODY HAS TO SAVE IT, SAYS BOB CRABTREE. Noel Morris and I created the **Bob Crabtree Society**, open to people who knew where that comment was and what it did.

The IBM 7094 and CTSS (from http://www.multicians.org/thvv/7094.html?1)

Tom Van Vleck
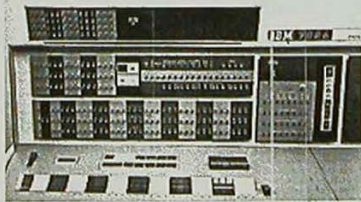
The 7094

In the mid-1960s, the 7094 was one of the biggest, fastest machines available, able to add floating numbers at a speed of about 0.35 MIPS. A standard 7094 had 32K 36-bit words of memory. Its data channels could access memory and run simple channel programs to do I/O once started by the CPU, and the channels could cause a CPU interrupt when the I/O finished. They cost about $3.5 million. Paul Pierce's collection includes a real 709 and 7094.

Coming together is a beginning, staying together is progress, and working together is success. --Henry Ford

"MTS didn't require you to be very technical in order to use it; the user interface shielded us from the techno-wizardry behind the system," said Anderson. "This is one of the reasons it grew to have so many users."

ROBERT C. BARTELS

Gentleman, scholar, educator, leader, mentor, visionary, facilitator, pioneer, administrator (in the best sense of the word), …

These words (and more) all characterize Bob Bartels. I had the great privilege of both working for, and later, with him. Under his Directorship, the University of Michigan Computing Center provided researchers here with peerless computing facilities. He had assembled a staff of the caliber of B.A. Galler, F. Westerfeld, and many others.

Bob fully understood the vital role of statistics in modern scientific method. During his directorship he actively supported both statistical consulting for researchers and the development of interactive statistical computing software – in particular, the writing of MIDAS (**M**ichigan **I**nteractive **D**ata **A**nalysis **S**ystem) by Daniel J. Fox. This software was, in its time, "state of the art".

As these proceedings attest, the University of Michigan and its many older researchers, teachers, and students are all deeply grateful for the many contributions of Bob Bartels.

William A. Ericson
Professor of Statistics (1970 - 1995)
Director, Statistical Research Laboratory (1971-1984)

Alexander said, "I always thought it was a sign of success that some computer scientists hated MTS."

Date: Fri, 13 Aug 2004 14:19:48 +0000
To: marysue@umich.edu
From: "e.d.barraclough@ncl.ac.uk" <nedb@popin.ncl.ac.uk>
Subject: Re: Bartels Receptiion
Cc:
Bcc:
X-Attachments:

Mary Sue,

Thankyou so much for the invitation to the reception in honour of Professor Bartels. I would love to be there but the Atlantic and pressing commitments here make it impossible.

I know that we in Newcastle owe a huge debt to the University of Michigan and the Computer Centre under Professor Bartels leadership. I believe that our liaison with you and the use of the Michigan Terminal System made Newcastle the most forward looking and effective computer centre in the UK at that time. The foundation it gave us has enabled us to continue to be one of the leading Universities for Computing Science and provider of a good service to the whole of the University.

The quality of the people in the Michigan centre was fantastic. I remember when we held the MTS workshop in Newcastle and trouble occurred in Michigan. The Michigan students were learning about the integrity of systems and were encouraged to try and break into the MTS system. They managed to find the weak spot which the systems people were awre of but were not content with just locating it so proceeded to cause problems for all the MTS users. All the system architects were in Newcastle so (in 1974) they connected through to Michigan and repaired the system blocking the hole the students had found. I was most impressed!

I do hope you get a good turn out on the day, please give my best wishes and thanks to all the MTS team.

Elizabeth

Elizabeth Barraclough
Windrush, Rogerfield, Keswick.CA12 4BN

Tel +44 1768 772771 Mobile 07786347002

Director Emeritus, Computing Service, Newcastle University
Newcastle Upon Tyne, England.
Liberal Democrat Councillor

Alexander added, "It was one of the first 'networked' development efforts, and it was coordinated across international sites before the advent of the Internet." visits to other MTS sites.

Mike Alexander, one of the MTS architects, said of Bartels, "He, more than any other single person, was responsible for creating the kind of environment that let MTS happen." Over and over, when asked what MTS meant to those who used and developed it, the response was "a sense of community."
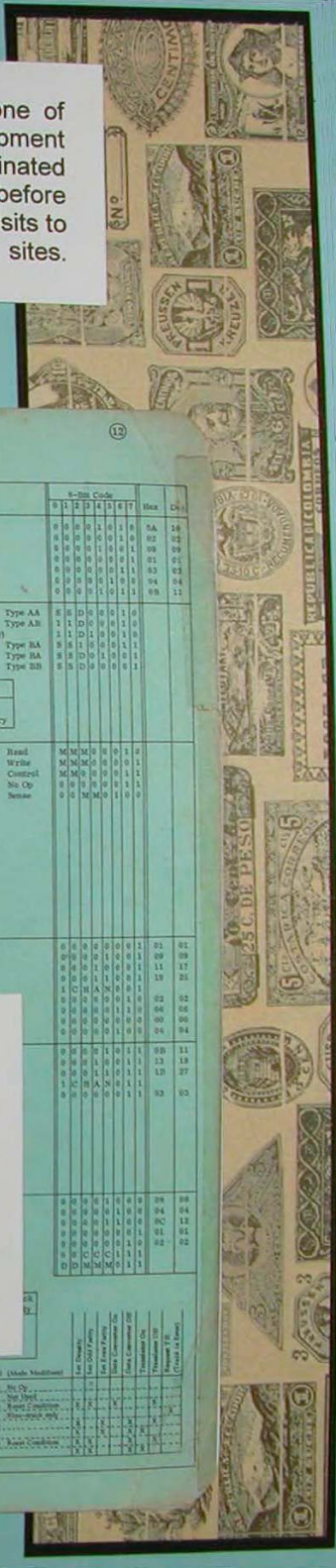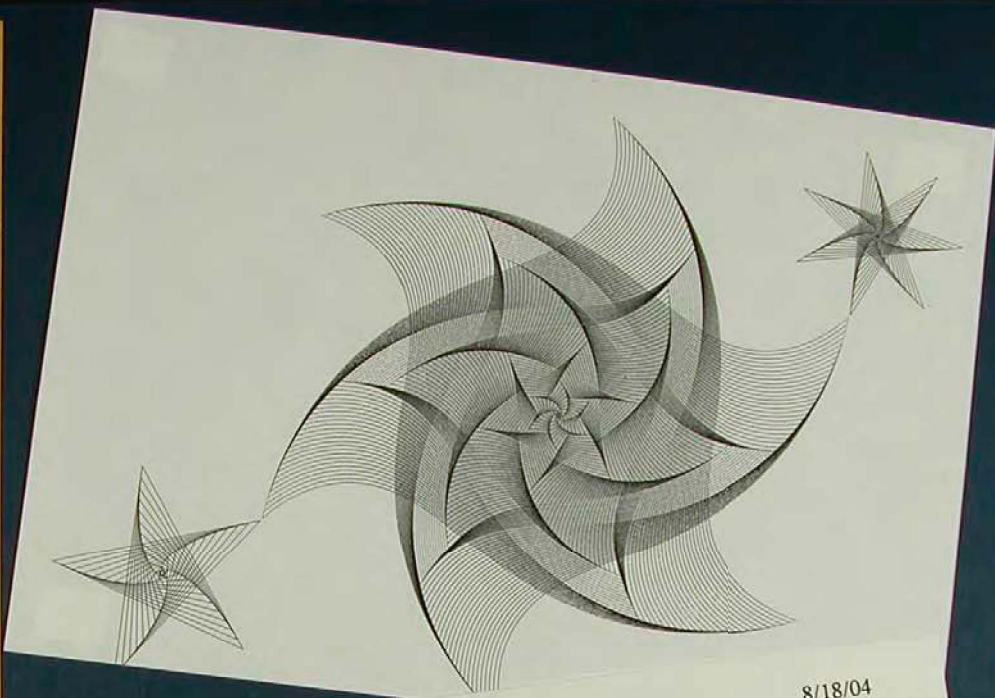
8/18/04

Dear Dr. Bartels,

I was very glad to learn that you are being honored for your leadership role at the Computing Center. It gives me the opportunity to thank you for being the best boss I ever had. For me those were the golden years, when you were in charge and I was building the Taxir system. You deserve all the honors that are being bestowed upon you.

I still live in Ann Arbor and since my retirement I've written some graphics programs and have become an algorithmic artist. This card, which was my holiday greeting card last year, is an example of my art.

And, oh yes, I gave up my Zenith Z100 long ago, probably about the same time as you gave up yours.

Bob Brill

Bob Brill

M GO BLUE

George Mason University

Alan G. Merten
President
Fairfax, Virginia 22030-4444

Office: (703) 993-8700
Fax: (703) 993-8880
E-mail: amerten@gmu.edu

July 26, 2004

Dr. Robert Bartels

Dear Bob,

It is a privilege to mark the 45th anniversary of the Computer Center and to honor you. I am sorry that I will not be able to join you for the celebration as I will be on a yearly trek to the floor of the Grand Canyon. It is a good place for a university president to hide!

My fondest memories of you are the perspective and balance that you brought to computing at Michigan in those important formative years. You had the ability to focus simultaneously on the needs of the user community and on the needs of the evolving Computing Center. I was fortunate to observe you and learn from you first when I was an assistant professor in Engineering and then when I was in the Business School.

Relatively early in my Business School career you made possible what was probably one of the first distributed computing environments in a university. I received an offer from a major software supplier to install a mainframe and their software in the Business School. Following discussions with you on the pros and cons of this solution, you convinced me that the best alternative was for the Computing Center to establish a workstation lab in the Business School. My major contribution to this solution was to take your advice!

Thank you for all that you have done for me and for many others.

Sincerely,

Alan G. Merten

AGM/mm

UNIVERSITY OF MICHIGAN BUSINESS SCHOOL

DICK A. LEABO
Fred M. Taylor Endowed Distinguished Professor of Statistics, Emeritus
701 Tappan Street • Ann Arbor, Michigan 48109-1234

9 August 2004

Dear Bob:

President Coleman's letter reminding me of the 45th anniversary of the establishment of the U-M Computing Center brought back many fond memories. All of your colleagues thank you and congratulate you on your leadership in the development of the Center to a position of international excellence. I am proud to have known you during this period and to recognize the impact your efforts had on my own career.

Enclosed is an IBM punch card that might give you a good laugh. It is a reminder as to how far the computer has come, and the impact it has made on research, education, business and government. Our lives are touched daily and I marvel at the technical accomplishments over 4.5 decades. In my own area of study, the computer and the development of many software programs dramatically changed what we could do in research and teaching. Some statistical techniques that took hours of calculations now can be solved in microseconds, and with better reliability. I cannot tell you how much of an impact that the availability of a resource like the center had on my own career and development. For that, I am most grateful to you and your colleagues' dedicated work over the developmental years at the U-M. Thanks, seems inadequate, but it is the best way I know for expressing my gratitude.

Yesterday, I recalled the exciting winter trip we made to the Flint campus to discuss with the faculty and administration their computing needs for the future. US #23 was icy and slippery but your little car held the course diligently. Apparently, your sound advice was well taken as the Flint Campus has thrived!

I have enjoyed 20 years of retirement, and I assume that you have enjoyed your own retirement, as you reflect on the many memories you must have. My wife and I wish you the best in the years ahead and may time be as good to you as you were to the University of Michigan.

I wish you continued success and good luck. May you and your many friends enjoy the much-deserved reception in your honor on September 10. Some times these "non-taxable" benefits provide the best memories. Enjoy.

Sincerely,

Dick.

Dick A. Leabo
5065 Vivienda Way
Sarasota, FL 34235-1840

Professor Robert C. F. Bartels
University of Michigan
Ann Arbor, Michigan 48109

Ann Arbor 734-973-7197   Internet dleabo@AOL.com   Sarasota, FL 941-371-6643

Bob:

Do you recall how we punched our data cards and hand delivered them to the Center? One comma omitted and the 24-hour turn around produced no meaningful output!

My nephew, who has a Ph.D. in artificial Intel- I genial and works in Silicon Valley in California, was amused by my birthday writer written on this "thing" he had never seen!

Dick Leabo 8/9/04

Bernard A. Galler
1056 Ferdon Road
Ann Arbor, MI 48104
734-668-8152
galler@umich.edu
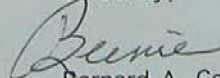
September 10, 2004

Dear Bob,

Enid and I want to thank you for the wonderful leadership you gave all of us at the Computing Center for so many years. As with so many others, my personal career was made possible, and enhanced, by the mentoring you provided, and by the opportunity you gave me and the others to do our best work.

The Computing Center was a perfect laboratory in which to try new ideas, provided, of course, that we created the best possible environment for users of the campus academic computer. You led us, but you didn't get in the way. In the process, you transformed your own career from research mathematician to the greatest manager and administrator we could have hoped for.

I am honored to recall the day we were together on the grounds of the University of Wisconsin in Madison. We had gone there for some kind of short course, probably on Numerical Analysis. It must have been in the summer of 1959, since you had just been asked to take on the leadership of the new Computing Center that was planned for August, 1959. You were agonizing over the effect it would have on your own career, and on the many questions that remained as to the organization of such a center. In the end, you decided to take it on, and I treasure the memory of our candid conversation that day. If I recall correctly, we heard Segovia play his guitar that night, a fitting celebration.

Our friendship with you and Virginia has lasted all these years, and we feel very close to both of you. It is a pleasure to have had a hand in this celebration honoring you. Our very best wishes.

Sincerely,

Bernard A. Galler

Opportunity is missed by most people because it comes dressed in overalls and looks like work.
--Thomas Edison

GO BLUE

Professor Bartels,

In 1960, few people used or understood computers. Not only did you understand computers, you had a vision to help others develop a working knowledge, understanding, and acceptance of computers. Your vision was to establish a facility where students, faculty, and researchers could have easy access to a computer system and learn about computers and how to use them. With your direction, this vision became a reality in the University of Michigan Computing Center.

I am one of the students that learned about computers in 1960. In fact, the learning was much easier in 1960 than today since there were only two courses—Math 73 which was an introduction to computers and Math 173 which covered everything else from circuit design to compliers.

Even though I studied Mechanical Engineering at Michigan and later at Stanford, I have spent most of my adult life working with computers in one way or another. On the one hand, I am now retired and using a PC to help write this note; on the other, I served as the principle investigator for the feasibility of porting the software that supports the US en route air traffic process from an aging computer system to new computer system.

I have always been grateful for the opportunity to learn about computers at the University of Michigan and to benefit from your vision. Many thanks and best wishes for many new adventures.

Alfred B. Cocanower, PhD

From: Bill McKeachie <billmck@umich.edu>
Date: August 4, 2004 11:29:19 AM EDT
To: bartels.reception@umich.edu
Subject: Congratulations

Dear Bob,

    I am delighted that you are being honored and sorry that I cannot attend. I have a meeting in Washington on the 10th.

    You were a fine colleague and very helpful as I first began to get acquainted with computers. I well remember punching cards and putting them into the computer in the Rackham basement. I'm glad that those days are gone, but I miss you and other friends I made during those years.

Best wishes!

Bill McKeachie

From: Carol Finerman <culcat@umich.edu>
Date: August 21, 2004 10:18:37 AM EDT
To: bartels.reception@umich.edu
Subject: Tribute to Bob Bartels

Dear Bob:
A tribute in recognition of your leadership and guidance of the Computing
Center is long overdue. One of the reasons that Aaron wanted to come to
Michigan to become director, is that he said it was the finest Computing Center
in the United States. He greatly admired the work you had done and said it
would be a challenge to make the facility even better.

You and Virginia welcomed us here and made the transition to Michigan easy
for both of us. I look forward to seeing you on September 10, to convey my
good wishes on this occasion to you both personally.

Sincerely,

Carol Finerman

From: "Martin Raim" <martinaraim@hotmail.com>
Date: August 18, 2004 5:29:43 PM EDT
To: bartels.reception@umich.edu
Subject: Memory book contribution

Dear Dr Bartels

Martin Raim, here.

I was a Counselor, Teaching Assistant and Staff Programmer 1966-1969
during the transition from UMES/7090 to MTS/360. I was one of those who
benefited from the magic environment at the U of M Computing Center that
allowed industrious, dedicated programmers to participate in the great
transition from batch processing to time-sharing.

I never quite understood how so loosely managed a project as MTS could bear
fruit and serve thousands of satisfied users. A lot of it was due to Mike
Alexander's genius and to the extraordinary work environment created by you
and your senior team.

My major contribution at the time was SDS, the interactive debugger. I also
maintained such monumental dinosaurs as WATFOR (the Waterloo Fortran
compiler) and ASMG (the Waterloo G Assembler).

I'm sure this letter is but one of many from myriad friends and colleagues who
thrived during your tenure at the Computing Center and am happy to make this
contribution to your book of memories.

With warmest regards,

Marty Raim
Paris, France

John A. Sonquist
Professor of Sociology, Emeritus
Department of Sociology
University of California
Santa Barbara CA 93106
Voice: 805-967-3059 Fax: 805-967-8705 Email: sonquist@west.net

I knew as soon as I arrived in Ann Arbor in May of 1959, to become the director of the little group of programmers, punch card machine operators, and keypunchers at the Institute for Social Research that I had become a part of one of the most exciting computing environments in the U.S.

We used the UM Computer Center's IBM 650 in the basement of Rackham, and sometimes we went to Willow Run to use the 650 out there. We adopted the philosophy of searching for, and importing computer programs that would meet the needs of our wide variety of researchers at ISR, choosing to fill in the gaps by writing additional programs (either in SOAP or eventually in FORTRAN). We learned a lot about quality control from testing these early statistical programs that we received from others. They didn't always produce right answers!

MTS was a system for everyone, not just those who were traditionally thought to need computing. Alexander stated it more simply: "MTS let ordinary people do routine things easily."

Once during these early days, returning from Willow Run, I went to the Rackham basement to see how things were going there. We had a lot of work to do and there were still piles of IBM cards (remember those!) to be run through the modified reproducer that served as a data input unit. Suddenly the temperature in the room started to climb rapidly! Not only could we feel it in our bodies, but the thermometer on the wall confirmed it. We simply had to shut down the computer and leave.

Soon afterwards we found that a tornado had followed me (lagging me by only 10 minutes) all the way up Washtenaw Avenue! It did some damage to a house near where Prof. George Katona lived, and knocked some bricks off the UM Field house's fence. Among other things, it also knocked out the power to the air conditioner in the Rackham computer room. The computer's power was apparently underground and was left untouched. Wow, we said, "That was a close one!"

Under Dr. Bartels the UM Computer Center undertook to make major inroads on the problem of making computer resources easier to use by both faculty and students. These efforts eventually included the M.A.D compiler (What, Me Worry?), and the Michigan Terminal System (MTS). As I recall, the picture of Alfred E. Neuman printed in the front of the diagnostics from one's erroneously written source program had to be removed because of the excessive amounts of paper required. I still have my old MAD Manual (see the attached photo).

Making users able to manage their own lives also took the form of support for research units having their own smaller scale equipment. ISR had keypunches and a "Tab Room" when I arrived in 1959, but we eventually added first an IBM 1401 (4k!), then a 16k 4-tape 1401 system and, in 1965, a small IBM 360. The idea was to do our own data management and small statistical runs, and depend on the UM Computer Center for our heavy-duty statistical computations. Our collection of programs eventually became the OSIRIS statistical system, which was used worldwide.

For programmers developing routines for researchers to use UM was an ideal place to work. Resources were accessible, and technical backup was available when one really needed it.
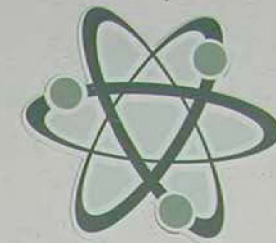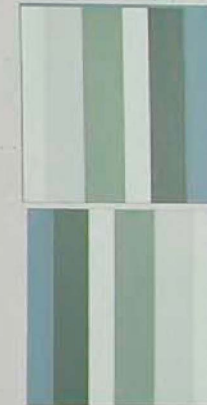
John A. Sonquist
Professor of Sociology, Emeritus
Department of Sociology
University of California
Santa Barbara CA 93106
Voice: 805-967-3059 Fax: 805-967-8705 Email: sonquist@west.net

The computing culture at Michigan was one of the best in the country all through the 1960's. Dr. Bartels' management skills were no small part of that. When I left in the spring of 1970 to take a faculty position here at UC Santa Barbara, I had received over ten years of the best computer training and experience anyone could ever want.

Dr. Robert Bartels, my hat's off to you -- and thank you for the role you and your fine organization played in the development of my own career in computing, as a programmer, software designer, administrator, and teacher.

John A. Sonquist
Professor of Sociology, Emeritus.
University of California, Santa Barbara

Attachments:
MAD Cover
John A. Sonquist recent picture.

John A. Sonquist
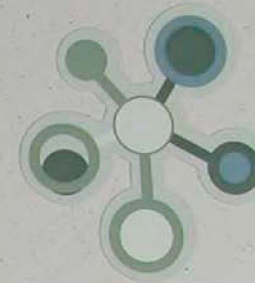
According to Barraclough, "MTS allowed those of us providing a computing service to protect our users from the horrors of raw computers and manufacturers' operating systems."
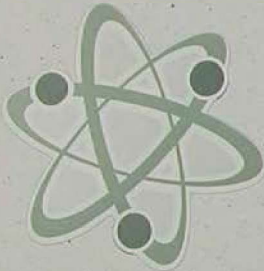
They can because they think they can. - Vergil (BC)

Dr. Bartels,

You were my mentor, teacher and friend. Your teachings of numerical analysis led me to meet the mathematical challenges in electron gun simulations at the University's Electron Physics Lab. Beyond that, as the leader of the Computing Center you nurtured my professional development. I had many diverse projects such as cross assemblers, network file transfer, compilers, computer graphics (The Plotting System), speech synthesis (Voice Response System) and others.

You were sensitive and supportive during a period when others were not. You believed in me and gave me a chance to prove myself. I did that and more. The Bartels years at the Center were the best years of my computing life. There were many technical challenges ... we all worked hard and met them, enjoying the process. Life in Information Technology is quite different now. Thank you for those wonderful years.

Ed Fronczak
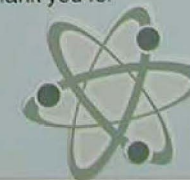
CORNELL UNIVERSITY

FRANK H. T. RHODES
PRESIDENT EMERITUS

6.17.04

Dear Bob,

Warmest congratulations on celebration which is being held in your honor. I wish I could be with you for that significant anniversary.

Your contribution to the Computing Center, the University of Michigan the wider world of computing leave all of us in your debt.

With warmest greetings, sincere congratulations and good wishes

Sincerely yours,

Frank

3104 SNEE HALL   ITHACA, NEW YORK 14853-1504   TEL (607) 255-6233   FAX (607) 254-4780   Email: MJW11@cornell.edu

An Introduction to
ALGORITHMIC METHODS
Using the
MAD Language

Normal mode is integer

Start

i = 1

i > 3

i = i+1

j = 1

j > 3

j = j+1

i = j

k = 6-i-j

Print i, j, k

System

Alan B. Marcovitz and Earl J. Schweppe

Said Pirkola, "His managerial and administrative style of letting his technical people just do their jobs was in large part responsible for not only attracting, but also retaining many of the people who made MTS the success that it was.

Some [people] succeed by what they know; some by what they do; and a few by what they are.
--Elbert Hubbard

Dear Bob -

It doesn't seem like it's been nearly forty years since we first met. As you well know, I had recently arrived at the new UM-Dearborn Campus. Having been introduced to computing while I was employed at the Mobil Oil Company Research Labs in New Jersey, I recognized the importance of gaining access to the Computing Center facilities in the old North University Building.

My purposes were to introduce the use of computers into my Physical Chemistry courses and to provide a means by which all students and faculty members at UM-D could make use of the Computing Center. The earliest users were mainly in the Engineering and Business Administration programs.

Our "pony express system" involved the physical transport of IBM punched card decks from Dearborn to Ann Arbor late each afternoon and, through your generous help, those job were given a priority such that (in almost every case) the jobs were run overnight so the output could be transported to Dearborn the next morning. Overnight turnaround was extremely helpful to the UM-D students and staff!

A few years later you were again most generous to me by taking me on as a Computing Center staff member to work on a variety of projects including the early establishment of "remote batch stations". The first of these to operate under the MTS system was the IBM 2780 terminal at UM-D. These developments did away with the "pony express system" in a very short time.

Finally, in the late 1960s I transferred all of my attention to the planning and development of the Center. Working with you and the other staff members on projects such as the North Campus Computing Center Building and the acquisition of the early Amdahl systems couldn't have been more fun!

Even after your retirement we've maintained close contact over the last twenty-five years and I want to say that it's been great. It will be fun to see many of the "old timers" on September 10.

Al Emery

A1

September 10th, 2004

Dear Dr. Bartels,

As the Academic Computing Center celebrates it's 45th anniversary, I would like to take this special opportunity to thank you personally for the technical opportunities that you afforded me during the my early professional career.

I still recall as if it were yesterday, meeting with you for first time in the summer of 1966 as I was about to began my graduate student studies in Department of Mathematics, and inquiring of you about part time employment.

You put me in touch with Bernie Galler who had a textbook project in need of a proofreader for the remainder of the summer, and then you offered me a computer counseling position beginning in the fall semester.

Not surprisingly, my interest in mathematics quickly gave way to a new found interest in computing, specifically the type of computing that was becoming possible with time-sharing operating systems like the Michigan Terminal System that was being developed at the Computing Center.

The quality of the staff that you assembled in those early years, and the supportive intellectual environment for leading edge software development that you fostered, were in large part the reason that I and many others chose to spend most of our professional careers right here at the University of Michigan.

Thank you again for giving me the opportunity to participate in the development of the computing environment at the University of Michigan over the years. It's been a "very good fit" for me both professionally and personally, and it would not have happened if someone else had been frequenting the Director's Office in the Academic Computing Center at the University of Michigan in the summer of 1966.

Sincerely

Gary Pirkola
9858 S. Maple Rd.
Saline, Michigan 48176
734-429-7684
gpirkola@umich.edu

MICHIGAN

Dr. Bertram Herzog
16 Haverhill Court
Ann Arbor, MI 48105
734/747-7445

2 September 2004

Professor R. C. F. Bartels
Director R. C. F. Bartels
Bob Bartels
The University of Michigan
Ann Arbor, MI 48109

Dear Prof. Bartels:
Dear Director Bartels:
Dear Bob:

Having known you for a period of just under 50 years forces me to address you in this triplicate manner. It is a pleasure to be able to express my respect and affection for you and your manifold contributions to the University and to me.

First, and you may not remember this in particular, I saw you in action as Professor. Being a graduate student in Engineering Mechanics meant taking several applied math courses in the halls of West Engineering where, in summers, you had to yell your lectures over the noise of lawn mowers. I vividly remember your lucid lectures matched only with your equally clear writing on the blackboard. In the span of 55 years of teaching, I have not ever achieved that goal. Thanks for being a superb mentor.

Second, you and the Computing Center supported my introduction and subsequent professional involvement in digital computing. My doctoral dissertation was supported through the user number E13N. My two and half years of struggling first with FORTRAN (and never succeeding) and eventually with MAD (and succeeding) resulted in a small table in a 54-page dissertation – one just did not allow bragging about computing in those days. Your support and the interaction with your staff - Bruce, Bernie, Frank, Bob and Sally - were important.

Third, I had the privilege and pleasure of working with you both via the research activities of the CONCOMP Project sponsored by DARPA and my subsequent appointment as Director of the Merit Computer Network Project. The latter, especially, put us into sometimes conflicting roles by the nature of the relationships of the three universities and the challenges of networking. Your professional example served as an excellent model for my professional conduct. I remember with great joy being taught and reaching a collegial relationship with you.

I am pleased to be a participant in the community's expression of respect and affection for you.

Sincerely,

Bertram Herzog

Some questions for Bob:

1) Does he still think it was a good idea to put Bill Joy to work on benchmarking the Line Editor? (Maybe this was Gary Pirkola's idea.)

2) Did he realize that putting me to work on compiler support would lead to a lifetime of unremunerative work on the margins of the GNU Fortran compiler?

Best wishes to Bob on the occasion of recognizing his contribution to early computing at the U of M!
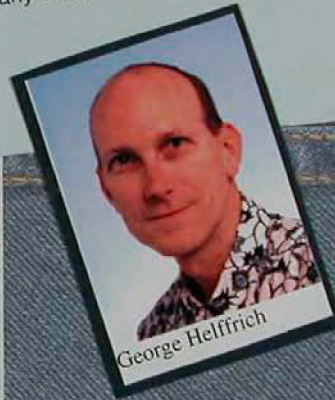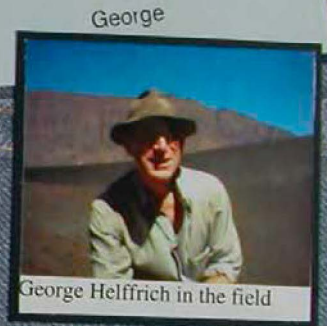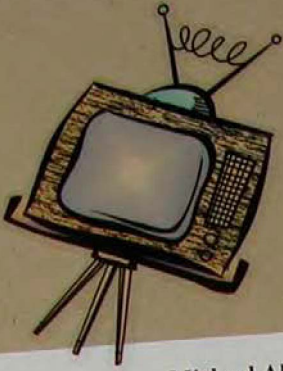
George

George Helffrich

George Helffrich in the field

Let us realize that the privilege to work is a gift, that power to work is a blessing, that love of work is success.
–David O. McKay

Michael Alexander
1309 Gardner
Ann Arbor, MI 48104
734-663-1759

3 September 2004

Dr. R. C. F. Bartels
The University of Michigan
Ann Arbor, MI 48109

Dear Dr. Bartels:

I came to the University of Michigan in 1964 as a graduate student with no intention of working for the Computing Center. However, by the end of the first semester I was bored silly and the Computing Center looked like it might be an interesting place to work. I started working in January 1965 at a temporary job and didn't leave for over 30 years. I was very fortunate to stumble, almost by accident, into such a wonderful place to work.

I quickly discovered that the environment that you had created at the Computing Center was special. You had brought together a group of very bright people and created an atmosphere where they could concentrate on their work with a minimum of distraction. You were a master at finding good people and then getting out of their way so the could do interesting things. Although you kept a low profile, you always knew what was going on in all parts of the Computing Center, and if we got off course, you would gently nudge us back in the right direction while leaving us alone most of the time.

The late 60s and 70s were a very interesting time to be in the computing business and the Computing Center was as good as any place in the world to be at that time. Many of the technologies that people take for granted today, such as the Internet, virtual memory, interactive computing, etc., were being invented then and the Computing Center was very much involved in this. I feel very fortunate to have been able to participate in this revolution. I used to say that I liked my work so much that I would do it for free, but fortunately you never knew that.

Sincerely,

Michael Alexander

Jeffrey C. Ogden
1310 Fountain
Ann Arbor, Michigan 48103

September 1, 2004

Dear Dr. Bartels,

I want to thank you for creating such a wonderful environment at the Computing Center. I started out at the CC in 1973 as a temporary hourly counselor working at NUBS and the CC answering people's questions about MTS. It was a fun and challenging job and through it I met a wonderful set of colleagues and in some cases life long friends.

I remember the first time you and I talked in something other than a group setting. The new Graduate Employees Organization was about to call its first strike and I came upstairs to tell you that, while I wasn't a member of GEO, if some of the graduate student counselors asked me not to cross a picket line that I would be missing some work. I didn't know you and was a bit nervous about how you would react. I shouldn't have worried. You thanked me for letting you know, said that you didn't know how the University would deal with the strike, but if you learned more, you would let me and other counselors know, so we could make decisions about what we wanted to do fully informed about the possible consequences. We then went on to have a ten or fifteen minute conversation about what it was like to work at the Computing Center and a bit about your philosophy for managing such a talented set of folks. For a young man who was still trying to figure out what he wanted to do when he grew up it was a wonderful introduction to what it could be like to work for a good manager.

Many years later in 1986 after you had retired as CC Director and I was leaving to take a job working for Jim Sterken and Dave Rodgers at ArborText, you wrote in a memory book for me "I will still consider you one of my boys." I was then and am still very proud and honored to have been one or your boys.

Sincerely,

-Jeff

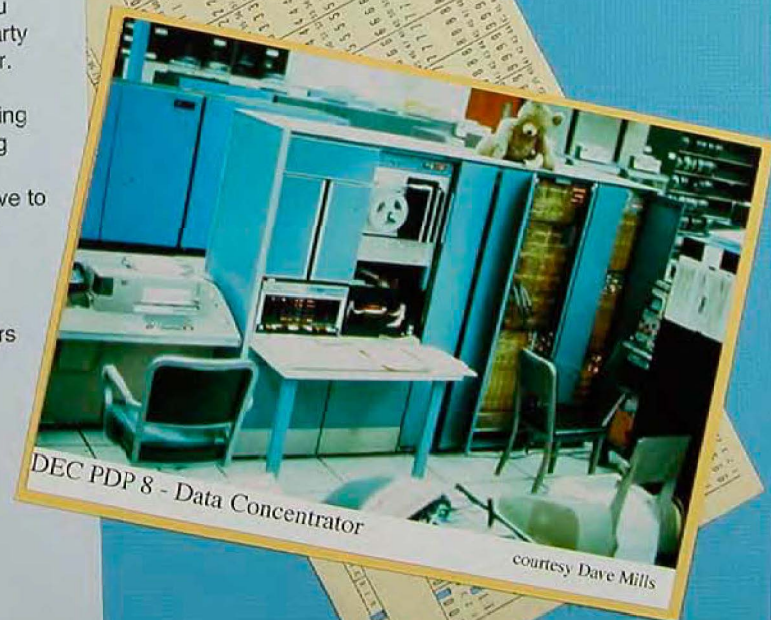Mike Alexander & IBM 360/67

courtesy Dave Mills

Prof. Robert Bartels

Since the establishment of the Computing Center in 1959 until my departure in 1973, I had the pleasure of working under the direction of Prof. Robert Bartels as he worked to incorporate the still-new technology of electronic, digital computing into the research and instructional activities of The University. It was an exciting time and probably everyone involved had their own vision of the future of this technology, no doubt all were underestimates. Bob Bartels' views were based not only on the potential of digital computing in his own field of numerical analysis but also on his conviction about the broader applicability to education in general. He was a prescient, enthusiastic leader.

As I think back I cannot recall any single event or anecdote that would be representative of Bob's tenure at the Computing Center. Michigan became a leader in academic computing largely because Bob understood and supported the goals and needs of his young, sometimes fractious staff in their efforts to create complex, novel systems for interactive computing. To accommodate the multitude of new programs always under development by students and research personnel, a system for the remote sharing of a mainframe computer was essential. Such a large, complex undertaking had the risk of failure. After a significant financial investment by the University it might not work. Of course Bob was the interface to the University at large on the matters of costs, goals and progress. His knowledgeable persuasion was reassuring for all concerned.

On a more personal level Bob was a wise, patient and good humored colleague with an open door for questions and concerns of all kinds. I am much indebted to him, as are many others, for his support and counsel during stressful times in the Center's formative years.

Bruce Arden

From: "Norman R. Scott" <norms@eecs.umich.edu>
Date: September 7, 2004 9:27:28 PM EDT
To: bartels.reception@umich.edu
Subject: Letter for Bob Bartels

Dear Bob,

My hearty congratulations to you on this celebration of the 45th anniversary of the establishment of our U. of M. Computing Center under your direction.

I wish I could be there in person to see you again and to recall with you some of those early days, but I'm deeply sorry that somehow this great party falls on the only weekend this year on which I will be away from Ann Arbor.

I have many wonderful memories of your leadership in getting computing established at the University, of the succession of IBM machines, of sitting around a big conference table with Cuthbert Hurd and the IBM people to discusss the acquisition of one of the early machines, and then of the move to the new Computing Center building where you presided quietly over that wonderful establishment. Your guidance helped make The University of Michigan one of the leaders in computing.

We all owe deep thanks to you, Bob, for your part in making computers available to the entire Unversity community.

Warmly yours - -

Norm

Norman R. Scott
Professor Emeritus
Elec. Engrg & Comp. Sci.

DEC PDP 8 - Data Concentrator

courtesy Dave Mills

I first became associated with computing at Michigan in 1967 when, as a graduate student, I was hired to work on the Concomp Project and then subsequently on the development of the MTS system for the then new IBM System/360 model 67. Over the next few years, I worked with many people at the Computing Center, many of whom I still know and admire, as we continued to develop and operate the fledgling MTS system.

My recollection of those early computing times is largely one of excitement and hard work with little thought (at least by me) to whether the fairly monumental task we had undertaken was realistic or rational. Somehow the physical and intellectual environment and computing resources had been put in place and so it was a natural for us to just get on with it and not think much about where it was all heading.

Now, in hindsight, I can see very clearly that the environment in which we flourished was mainly the creation of Bob Bartels, the soft-spoken, gently guiding hand who not only found the financial resources, convinced the administration that what we were doing made at least a little sense, but also managed to find, hire, and manage several dozen staff programmers, many of whom were not the least bit shy in asserting their views. Yet, to a person, we all knew that "Dr. Bartels" was the Computing Center, the person to whom we were all indebted, the leader that made it all work somehow.

I am personally indebted to Bob for giving me a chance, serving as a model, making me ask myself over the years, what would Dr. Bartels have done in this situation, and just being there as a image for how to run an organization with integrity and humility. Thank you, Bob.

Scott Gerstenberger

Disk Farm
courtesy Dave Mills
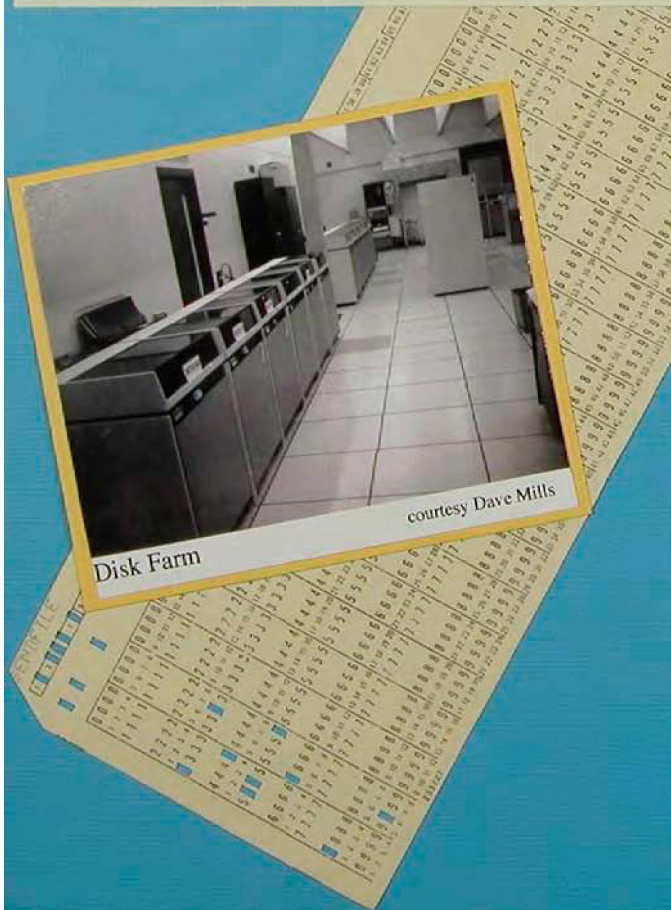
Rolf A Deininger
3063 Overridge Drive
Ann Arbor, MI 48104
734-973-0547
rad@umich.edu

September 10, 2004

Dear Bob,

A long time has passed since I served with you on the Executive Committee of the Computing Center …too many years ago.
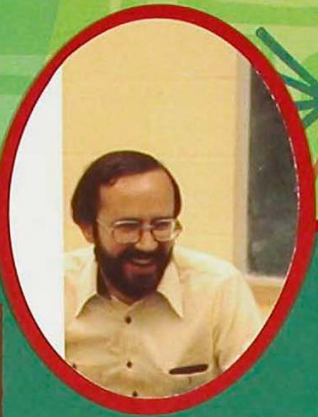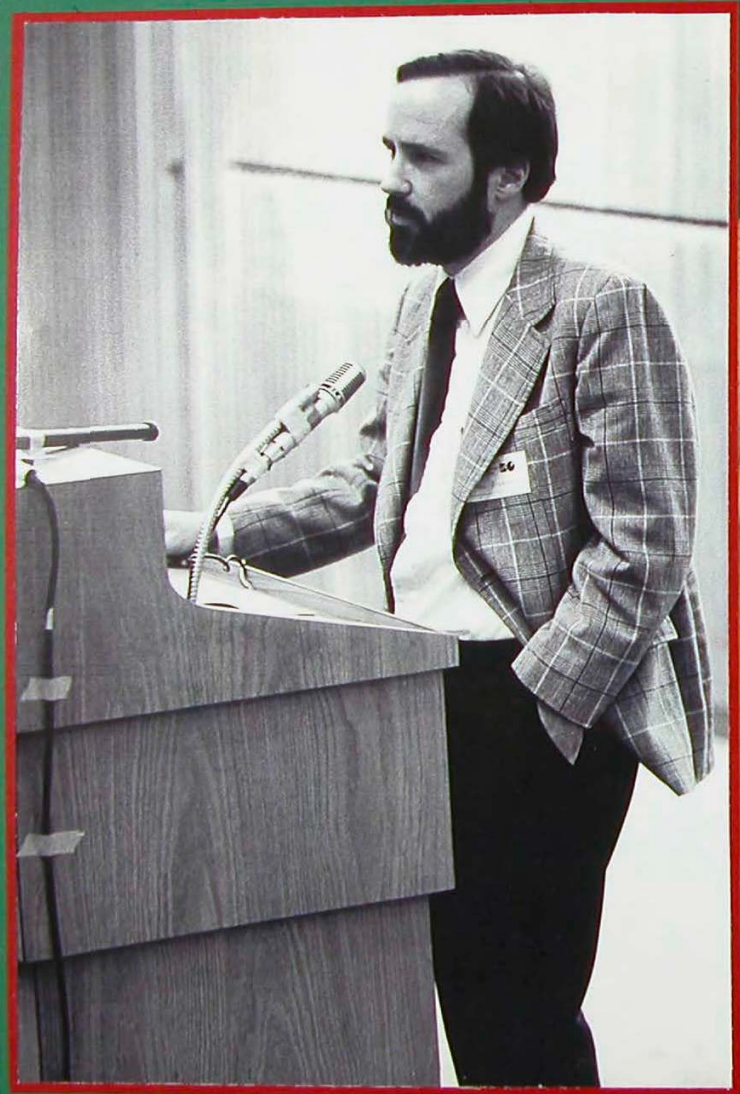
But I remember that trip to the Burroughs executive office where they showed us their unfinished product, like with many configurations. Our vote as many times "thank you", but no taking. It would have been a round egg in a matrix of squares.

Or the time you came over to our place and saw the on-line display of a "linear programming" module that you admired. You would duplicate it with minimal time. It took resources, but you prevailed and our connection to Dartmouth vanished.

There were many such searches – but YOU prevailed. I am most grateful to you and your leadership and for all you did for us. This has taken us many years and I am happy for you. Congratulations and all my very best wishes to you and your family.

Sincerely yours,

Rolf A. Deininger

ASCII CODE

Character	Code	Character	Code
A	301		241
B	302		242
C	303		243
D	304		244
E	305		245
F	306		246
G	307		247
H	310		250
I	311		251
J	312		252
K	313		253
L	314		254
M	315		255
N	316		256
O	317		257
P	320		272
Q	321		273
R	322		274
S	323		275
T	324		276
U	325		277
V	326		300
W	327		333
X	330		334
Y	331		335
Z	332		336
0	260	EOT	337
1	261	W RU	204
2	262	RU	205
3	263	BELL	206
4	264	Line Feed	207
5	265	Return	212
6	266	Space	215
7	267	ALT MODE	240
8	270	Rub Out	375
9	271		377

PDP-8

INSTRUCTION LIST

Y-86
8/67

Mnemonic	Code	Operation	Cycles
		BASIC INSTRUCTIONS	
AND	0000	logical AND	
TAD	1000	2's complement add	
ISZ	2000	increment and skip if zero	
DCA	3000	deposit and clear AC	
JMS	4000	jump to subroutine	
JMP	5000	jump	
IOT	6000	input output transfer	
OPR	7000	operate	

		GROUP 1 OPERATE MICROINSTRUCTIONS (1 CYCLE)	
NOP	7000	no operation	Event Time
CLA	7200	clear AC	
CLL	7100	clear link	
CMA	7040	complement AC	
CML	7020	complement link	
RAR	7010	rotate AC and link right one	
RAL	7004	rotate AC and link left one	
RTR	7012	rotate AC and link right two	
RTL	7006	rotate AC and link left two	
IAC	7001	increment AC	

|		**GROUP 2 OPERATE MICROINSTRUCTIONS (1 CYCLE)**	
SMA	7500	skip on minus AC	Event Time
SZA	7440	skip on zero AC	
SPA	7510	skip on plus AC	
SNA	7450	skip on non zero AC	
SNL	7420	skip on non zero link	
SZL	7430	skip on zero link	
SKP	7410	skip unconditionally	
OSR	7404	inclusive OR, switch register with AC	
HLT	7402	halts the program	
CLA	7600	clear AC	

The Golden Age of MTS

It's hard now to realize what a revolutionary innovation MTS was less than twenty-five years ago. It began as a way to let the Computing Center use its brand-new IBM System/360 mainframe as quickly as possible.

T he System/360 was as big a break-through in its day as the PC was in the 1980's – eight times more powerful than previous mainframes. But the machine was so advanced, and IBM so eager to get it on the market, that the mainframe arrived in Ann Arbor without an operating system. Instead of waiting for IBM's software designers to catch uip, U-M computer experts triumphantly introduced their own operating system, MTS.

Before MTS, only technicians had direct access to U-M's computers. The handful of professors who used the Computing Center at all had to prepare their programs in advance, hand them over to the technicians to run, and return later to pick up the results. MTS upended that. It was designed to allow thousands of users to access the computer simultaneously, tapping directly into its power from remote terminals.

IBM eventually produced its own operating system for the System/360, but the Computing Center elected to stay with MTS.

-- from "ITD at the Crossroads," by Ami Walsh, The Ann Arbor Observer, November 1992
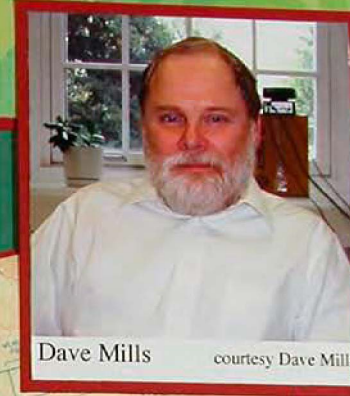
Dave Mills   courtesy Dave Mills
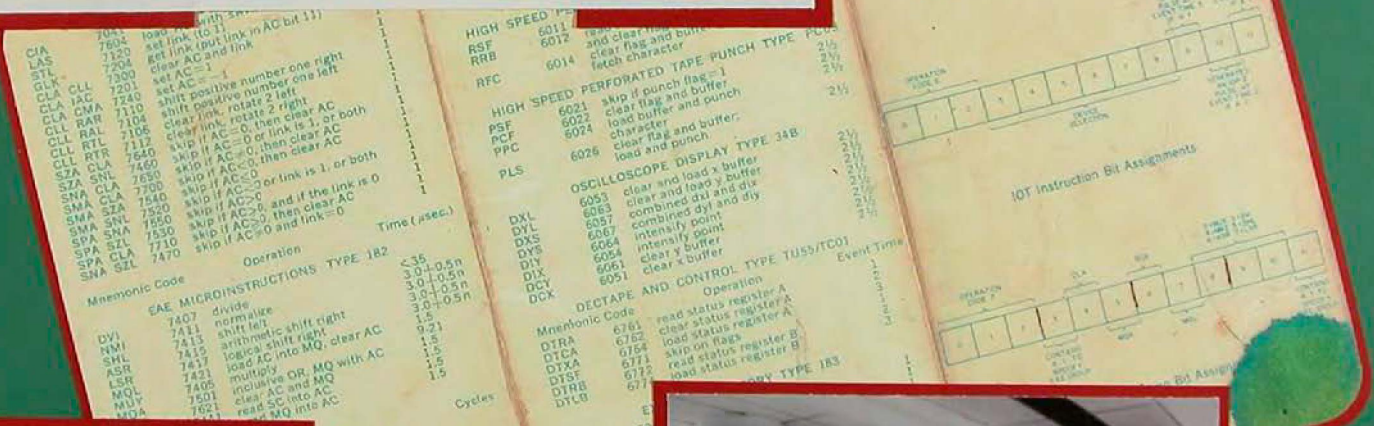
Dave Flower   courtesy Dave Mills

The University of Michigan

East Hall, 525 East University • Ann Arbor, MI 48109-1109
Phone: 734-764-0335 • Fax: 734-763-0937
http://www.math.lsa.umich.edu/

Department of Mathematics

September 2, 2004

Professor Robert C.F. Bartels
University of Michigan
Computing Center 2112
1075 Beal

Dear Bob,

I am pleased that the University is taking the occasion of the 45th anniversary of the founding of the University of Michigan Computing Center to honor your leadership in founding the Center and making one of the very best academic computing centers.

I remember way back in the early 70's when Sir Peter Swinnerton-Dyer of Cambridge University, England was visiting and I took him over to see the Center. Peter had been crucially involved in establishing a Computing Center at Cambridge and when traveling would attempt to see what others were doing. His comments to me were that the Michigan was far ahead of others in equipment and in a commitment to service – that the Center was exceptional.

I learned a great deal when serving with you on the Department's Executive Committee. I saw the need for a commitment to quality in both research and teaching and I came to a better understanding of the importance of applied mathematics. I was very sorry when your responsibilities at the Computing Center took you away from the Department for I felt your leadership was crucial to the maintenance of a forward looking applied program.

Many thanks for the opportunity to know you.

Sincerely,

D.J. Lewis

DJL/dh

I-UNIT PIPELINE INSTRUCTION SEQUENCE

FUNCTION	PHASE	FACILITY
INSTRUCTION ADDRESS	I FETCH	I
BUFFER START		B1
BUFFER READ		B2
DECODE INSTRUCTION	A	D
READ GPR		R
OPERAND ADDRESS	B	A
BUFFER START		B1
BUFFER READ	C	B2
EXECUTE (ONE)		E1
EXECUTE (TWO)	D	E2
CHECK RESULTS	E	C
WRITE RESULTS	F	W

Above is a graphic illustration of a typical sequence of RX-type instructions. The numbers 1–8 each represent an instruction as it moves down the I-Unit pipeline.

The I-fetch phase begins with the I-Unit requesting data from the buffer. The instruction becomes available at the B2 cycle. Phase A decodes the instruction and reads index and base registers for use in operand address generation. Phase B computes the operand address and requests the operand from the buffer. Phase C completes assembly of the components of the instruction and starts E-Unit execution. The E-Unit sets early condition codes

at the E-1 cycle be[...]
cution. This allow[...]
correct path follo[...]
pipeline will be [...]
proper branch p[...]
is complete. In [...]
from the E-Unit [...]
Phase E and a[...]

There ca[...]
pipeline, as [...]
illustration.

Robert C. F. Bartels

1621 Harbal Drive
Ann Arbor, Michigan 48105
September 9, 2004

Dear Bob,

What a remarkable piece of history, your leadership at the University of Michigan Computing Center, and just think of all the good people and events that were a part of it. It has been wonderful to think back about all that was accomplished.

You had a remarkable ability to bring together and nurture an exceptional group of people. There's simply no denying their enormous talent and boundless energy. Certainly there were lots of intense arguments about what was the right thing to do, but you provided the calming influence and sense of guidance so that these people could do outstanding work, year after year after year.

The result was an enormous amount of creative and innovative output, balancing the development of new computing technologies with day-to-day service delivery. That was a balancing act! I look back with fond memories about the quality of computing we were able to experience at Michigan, and I give you great credit for establishing and leading the organization that delivered with such excellence.

I was a consumer of the results, first as a student (starting with the vacuum-tube 7090!) and then at the Institute for Social Research. Throughout there was a terrific amount of discussion all across campus about the nature of the changes in computing, an engagement on the part of the users with shaping and understanding what was provided that is quite unlike what we see today. Then as MTS emerged and spread to other campuses, we saw this transferred to an even broader community. Groups initiated many developmental projects across campus, including mine at ISR, building on the excellent foundation provided by the Computing Center. People at many other universities thought of the combinations of these applications and MTS as the most advanced available.

Memories of the policy-level discussions with you in the University Committee on Computer Policy and Utilization are treasures for me. You were quite influential, both in guiding resources toward very worthwhile projects, and in rejecting proposals such as for alternate major computing systems that would have diluted the focus at Michigan. I clearly recall discussions such as the decision to go with Amdahl, and your plea for support for development on the PDP-11 for network communications.

I just wish I'd been there when you decided "What Me Worry?" and Alfred E. Newman could no longer print as the UMESS tailsheet.

With warmest regards,

Gregory A. Marks

MEMORIES

To Bob Bartels —
On behalf of the entire numerical analysis community, thank you for the Engineering Summer Conferences. They have had a profound effect on our discipline.

— Cleve Moler
Ann Arbor
Sept. 10, 2004.

Life is what happens to you while you're working for your future.
-Unknown

September 10, 2004

Dear Dr. Bartels,

It is an honor for Jean and me to participate in this celebration. I want you to know that I cherish my time at the Computing Center under your leadership. I remember it as a time when I was working with top-notch people who wanted to do excellent work, and they were given every opportunity to do just that. I was constantly being challenged to keep up with all of the exciting things that were going on around me. I think it made me want to do challenging things from then on. I know that it was you, and the people you surrounded yourself with, that created that environment.

I want to thank you for making it possible for me to be a part of the Computing Center experience. It enriched my life in so many ways both professionally and personally, including the friends I still have from the Center, Electronics Shop and Merit. Thanks also for the support and encouragement you gave me when I was working on my Ph.D.; I'm not sure I would have ever finished if it hadn't been for that.

So, Jean and I are here today to honor and thank you, and offer our best wishes to you and Virginia.

P.S. After all these years, I am once again doing a project with Dr. David Mills.

Sincerely yours,

Jack

Jack L. DiGiuseppe, Ph.D.

Dr. Bartels —

Jurate and I were a husband/wife counselling team under Jim Henriksen in the early 1970s and I did a dissertation under Bruce Arden and Bernie Galler based on ~~the th~~ a queueing model of the MERIT network.

It was great to see you again and to help celebrate your career. We wish you many happy years to come and look forward to the lecture series to be inaugurated in your name.

With warmest regards,
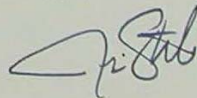
Carl + Jurate Landwehr

Sept 10, 2004

Dr. Bartels,

Congratulations again. I enjoyed seeing you tonight. I was one of many you influenced, but I want you to know that by giving me an opportunity to work at the Computing Center, & by challenging us all to do great things, you'll always be someone I remember who had a very positive influence on my life.

Thank You!

Jim Sterken
UMCC 1976-1982

---

central
processing unit

EIGENVALUES

THE UNIVERSITY OF MICHIGAN

DEPARTMENT OF CHEMICAL ENGINEERING

COLLEGE OF ENGINEERING
3074 H. H. DOW BUILDING
2300 HAYWARD
ANN ARBOR, MICHIGAN 48109-2136
313/764-2383   FAX: 313/763-0459

10 September 2004
Internet: wilkes@umich.edu

Prof. R.C.F. Bartels
401 West Oakbrook Drive
Ann Arbor, MI 48103
Phone: 734–662–7420

Dear Bob:

As we mark the 45th anniversary of the founding of the University of Michigan Computing Center in 1959, I congratulate and thank you for all the work that you did to make it so successful during your tenure as its first director. You should be proud of your record in creating a climate that allowed many individuals to develop their talents—and hence the U–M computing system—to the fullest, and for making sure (within budget constraints—you costed everything down to the last penny) that we always had the latest equipment. I recall in 1956 the IBM 650 (before the Computing Center officially started), and then there was a whole host of IBM machines—the IBM 704, 709 and its transistorized successor the 7090, and then the 360/67 with its two central processors. There were more of course—Amdahls I believe for the rest of your tenure as director.

Paul Jaroszki

Brice Carnahan and Robert Bartels, 7 Oct. 2000.

Do you remember the time when Brice Carnahan and I were teaching our freshman engineering digital-computing course, in the late 1970s. We were discussing file commands such as $CREATE, $EMPTY, and $DESTROY, and how MTS would reply DONE after each. We had also emphasized to our students how fool-proof MTS was. But then one of our students tried his luck with $DESTROY *FORTRAN, and was astounded when MTS also returned

1

$DONE—and indeed the FORTRAN compiler was inoperable for many hours thereafter. I think you were pretty horrified at the time—we soon got a telephone call from you, but I am sure that you will now recall the episode with good humor!

Mary Ann and I returned permanently from England in 1960, and it was in the fall of that year and winter 1961 that I took your two numerical analysis courses. Not only were you a superb teacher, but the material you presented stimulated my interest in the field and in fact helped to guide me into much of my research on finite-difference and finite-element solutions of partial differential equations. I recall that you assigned a class project in which you gave each student a different paper to critique. Mine was on Rutishauser's "left-right" method for finding the eigenvalues and eigenvector of a matrix, and I think you were somewhat surprised when I actually programmed the thing and it worked.

Anyway, we appreciate all that you have done for the U–M and for me and Mary Ann, who joins me in wishing you and Virginia a continued happy retirement.
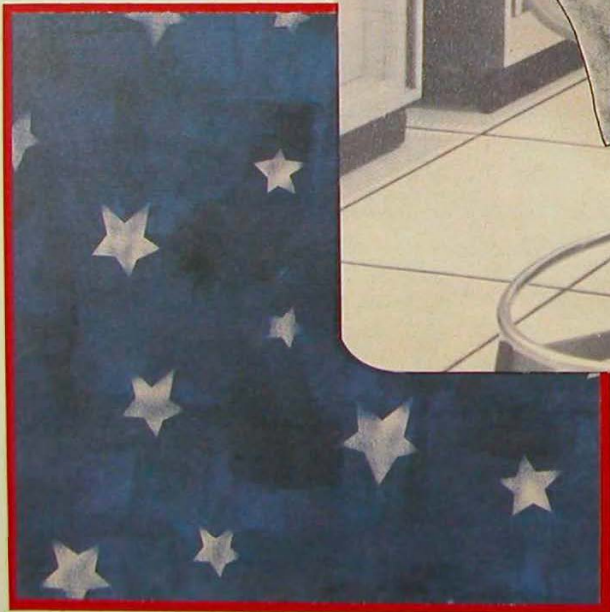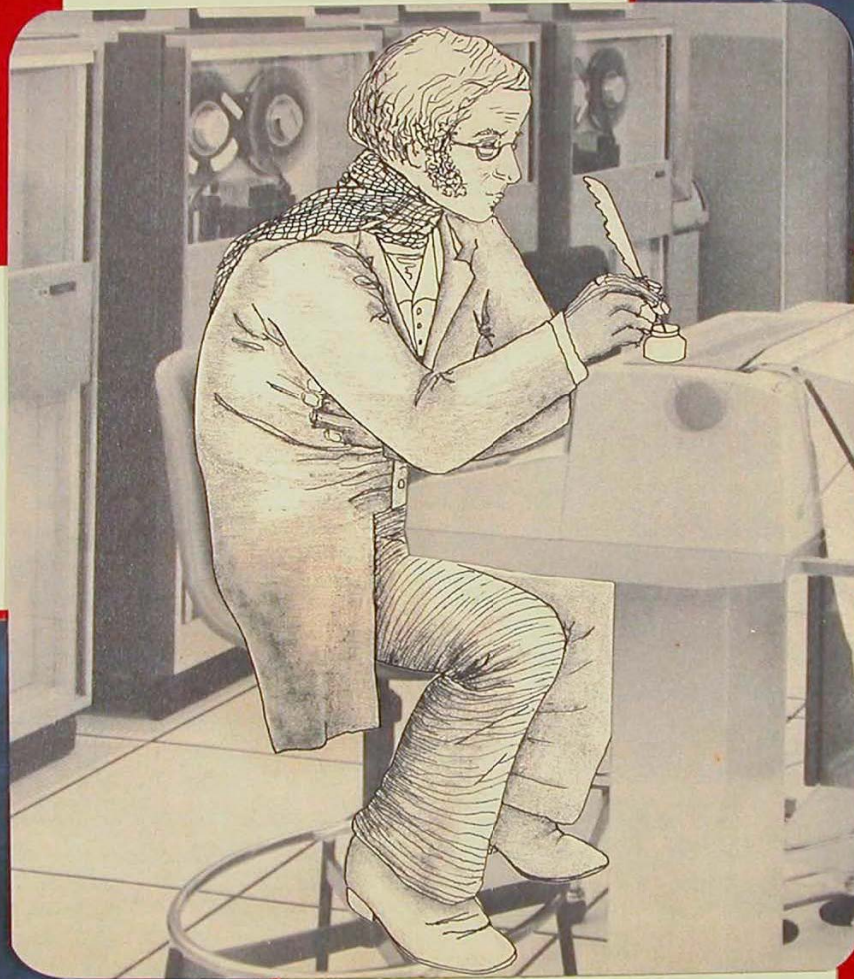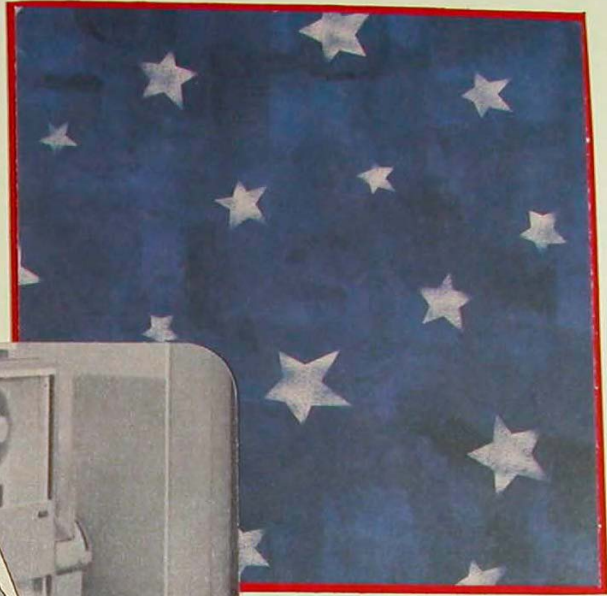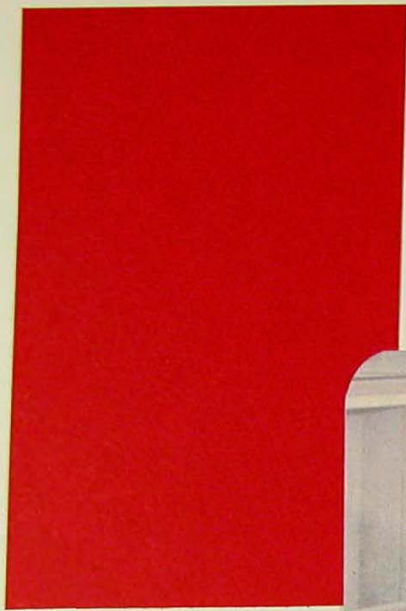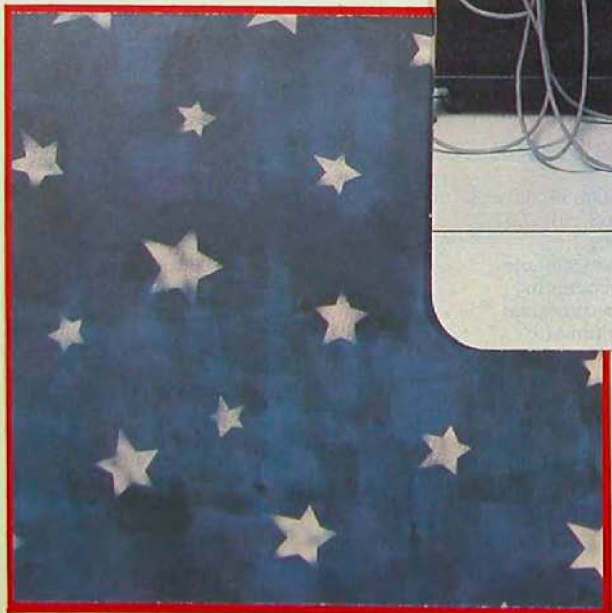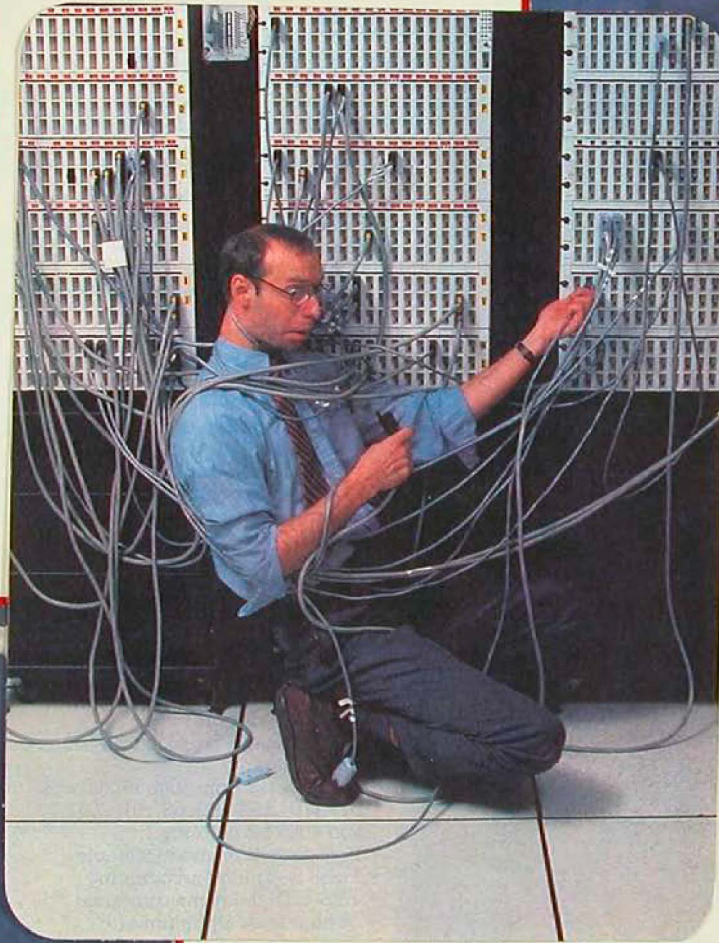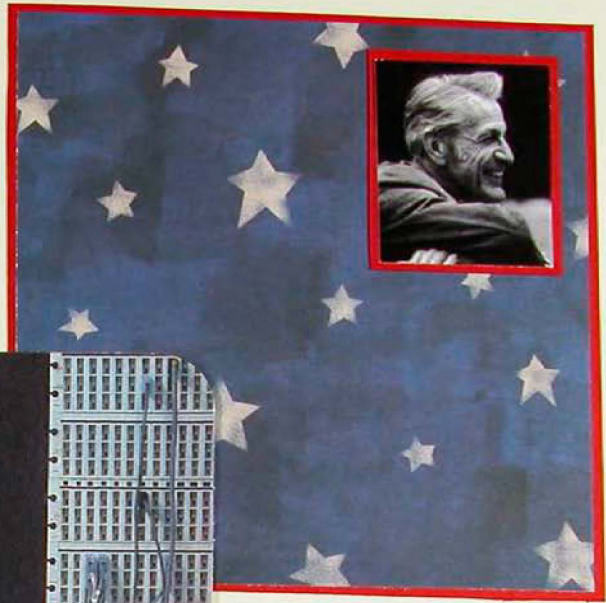
Very sincerely,

Jim

James O. Wilkes

Many of life's circumstances are created by three basic choices: the disciplines you choose to keep, the people you choose to be with; and, the laws you choose to obey.
--Charles Millhuff

EIGENVECTOR

How did we get from there to here?
We have to look back to make it more clear.
The wise planned a party to honor a man
Just cake and cookies was the original plan.

Invites were sent, the responses gave hope
As letters emerged from each envelope.
A picture developed explaining a road
A journey long needing to be retold.

Great things can happen when all is in place
First came the need, add a leader with grace,
The crew that joined in left no space for defeat.
This combination might never repeat.

A daring purchase was a mainframe they say
With no system arriving day after day
When waiting became an unbearable bore,
The willing arrived, and the rest is now lore.

The system they built blew inertia away
Groundbreaking creators is now what they say.
But it was the 60's, so who really knew?
Of course the work they produced has given a clue.

Taking great risks and believing you can
They were directed by a unique, gentle man.
He supported brilliance by managing the load
Obstacles were removed that could damage a road.

The names in this book contributed their time
The people he drew put careers on the line.
They've helped focus why the traveling went well.
It was the driving force of Dr. Bartels.

The Road
Written for Dr. Bartels
By Carol Pirkola
9-10-04

September 13, 2004

Bernard A. Galler
1056 Ferdon Road
Ann Arbor, MI 48104

Dear Bernie and Enid:

I am really impressed by the work that you both have shared in the preparation and management of the informational meeting for the commemoration of the 45th anniversary of the Computing Center. I thank you for honors which have been credited to me and the staff of the Center for the services to the University and the outstanding recognition it had received among the universities in our country and abroad.

My thanks extends to the contributions made by your committee. Please inform them of my thanks. I will make a special effort to thank Gary and Carol Pirkola for their contributions in making it a memorable part of my academic career and for their attention to my welfare during the meeting.

I reviewed again the book containing the many letters from faculty and colleagues wishing me a happy and healthful retirement. The names of Bernard and Enid Galler again appear as the instigators and managers of that memorable occasion.

Thank you again for the many thoughtful plans to honor me personally.

To very dear friends and colleagues,

Bob

Bob Bartels

UNIVERSITY OF MICHIGAN · NEWS SERVICE

THE UNIVERSITY **RECORD** *ONLINE*
For Faculty and Staff of the University of Michigan

Updated 10:00 AM November 13, 2006

Obituary

Robert Bartels

Robert Bartels, a professor emeritus of mathematics at the University and retired director of the U-M Computing Center, died Sept. 9 in his sleep at the Swan Creek Retirement Village in Toledo, Ohio.

Born the second of three sons to German immigrant parents in New York, he grew up in Brooklyn and rural New York. His mother's desire that her children should be educated led to the three brothers each earning a bachelor's degree; his was in engineering.

Courtesy Department of Mathematics

Bartels' training enabled him to find a position as a junior technician with Bell Telephone Laboratories in New Jersey, a prize of some consequence during the Depression. When Bell instituted a program of educational support that offered people of his rank the opportunity to return to college and earn a postgraduate degree, he entered the graduate program in electrical engineering at the University of Wisconsin in Madison.

Colleagues say that unfortunately for Bell, Bartels dropped into a mathematics lecture one day on the advice of a friend, became interested in what he saw and changed his major. In 1938 he earned a doctoral degree in mathematics, married Virginia Terwilliger and accepted his first academic position at U-M.

From that year until the summer of 2006, with a timeout in World War II to work on research with the Navy in Washington, D.C., he was a resident of Ann Arbor and a professor of mathematics with the University.

In late 1958, when U-M planned to move its small computer operation off campus and discontinue general computer access to students and faculty, Bartels embarked on a successful campaign to reverse this decision and to establish a viable central computing facility to support teaching, research and administration. He became the Computing Center's first director in 1959 and remained at its helm until retiring in 1978.

During that time he actively promoted the University's development of computer science education and research. Colleagues say important advances in programming languages and operating systems were nurtured in the computing environment he established.

Bartels also was responsible for organizing a series of short courses and lectures during a 15-year period with the U-M Engineering Summer Conferences in the late 1950s and early '60s that encouraged some important early developments in the theory and software for computer mathematics.

Upon retirement, he and his wife took up an interest in American art glass. Friends say during the course of the next 20 years they established an impressive private glass collection, guided by the considerable historical knowledge of American art glass they acquired.

Bartels is survived by his wife and sons Richard (Renate) Bartels and Albert (Jacqueline) Bartels; grandchildren, Robert, Adrienne and Ainslee; great-grandchildren, Ziggy, Ansel and Isabel; and by numerous nieces and nephews.
—*Submitted by Suzanne Rogers, Department of Mathematics*

Notes

Page 7 photo at lower right: Bruce Arden standing in front of a line printer at the North University Building (NUB).

Page 8 photo at lower left: Professor Bernie Galler (r) standing in front of the IBM 704 computer in the North University Building talking to several unidentified individuals.

Page 9 photo at upper left: Dave Flower on the 2nd floor of the Computing Center Building on North Campus leaning on a teletype next to a DEC PDP-8.

Page 9 photo at upper right: Mike Alexander sitting in front of the console for the IBM 360/67 computer at the North University Building.

Page 9 photo center left: DEC PDP-8 on the 2nd floor of the Computing Center Building on North Campus.

Page 9 photo at lower left: IBM disk drives on the 2nd floor of the Computing Center Building on North Campus. Photo is reversed.

Page 9 photo at lower right: Dr. R. C. F. Bartels, Director of the Computing Center.

Page 12 photo at middle right: Dr. Bartels standing in front of a SOL microprocessor computer that was given to him as a gift by his friends and the staff of the Computing Center when he retired in 1977.

Page 15 photo: A view looking south shows horses in front of the old University Plant Building to which the university stables were attached. This building became the North University Building and home to the Computing Center.

Page 16 photo at left: A view looking north showing the steps leading down to the Computing Center at the North University Building.

Page 16 photo at right: A stock photo of the inside of an Amdahl 470v/6 computer. The University's 470v/6 (serial number 2) was installed on the 3rd floor of the Computing Center on North Campus.

Page 19 upper photo: Machine room at the North University Building (NUB) with raised floor tiles removed showing computing cables during the Computing Center's move from the NUB on Main Campus to the new Computing Center Building on North Campus. The space in the North University Building became a remote batch station and terminal room named NUBS (North University Building Station).

Page 21 photo: Stock photo of the system console for an Amdahl 470v/6. The actual computer, main storage, and I/O channels are not shown.

Page 31: Bob Brill was a programmer on the staff of the Computing Center responsible for *TAXIR, a taxonomic database management system.

Page 35: Bill McKeachie was a Professor of Psychology at UM.

Page 36: Carol Finerman was the wife of Aaron Finerman, the second Director of the Computing Center.

Page 39: Frank Rhodes was a UM professor and Dean of the UM's College of Literature Science and the Arts before he left Michigan o become president of Cornell University.

Page 40: MAD was the acronym for the Michigan Algorithm Decoder, a programming language and compiler developed at UM for use on the IBM 704 and 7090 computers.

Page 41: Al Emery was the long time Deputy Director of the Computing Center.

Page 42: Gary Pirkola was a senior member of the Computing Center's programming staff and eventually an Associate Director.

Page 43: George Helffrich was a programmer at the Computing Center until he left to become a Professor of Geology at the University of Bristol, England. Bill Joy was a student employee at the Computing Center until he left to study computer science at the University of California Burkley, develop BSD UNIX and co-found Sun Microsystems. It was Gary Pirkola who put Bill to work on benchmarking projects.

Page 44: Mike Alexander was the senior programmer at the Computing Center and chief designer together with Don Boettner of MTS. Jeff Ogden was a programmer and eventually Associate Director at the Computing Center and "one of Dr. Bartels' boys".

Page 45: Norm Scott was Professor of Electrical Engineering and Computer Science at UM. Bruce Arden was one of the first staff members at the Computing Center and eventually an Associate Director. Bruce was involved in the design and development of the MAD language and compiler, virtual memory architecture, and the early design and development of MTS. The photo of the DEC PDP-8 and the Teddy Bear is at the Computing Center on North Campus.

Page 46: Scott Gerstenberger was a senior programmer and eventually Associate Director at the Computing Center. Rolf Deininger was Professor of Environmental Health Sciences at the UM School of Public Health. The photo at the lower left is of disk drives on the 2nd floor of the Computing Center on North Campus (photo reversed).

Page 47 photos left to right: Mike Alexander with a jacket and tie, Mike again, without the jacket and tie, and Don Boettner.

Page 48: Dave Mills was chief architect of the PDP-8 Data Concentrator ,a channel attached front end processor for connecting terminals to MTS. Dave Flower was manager

of the electronics shop at the Computing Center for many years. The picture of Dave leaning on a teletype was taken on the 2nd floor of the Computing Center Building on North Campus. The photo in the lower right is Professor Bernie Galler standing in front of the IBM 704 at the North University Building.

Page 49: D. J. Lewis was a professor and chair of the Department of Mathematics at UM.

Page 50: Greg Marks was a computing manager at the Institute for Social Research (ISR) and eventually Special Assistant for Computing to the Vice-President for Academic Affairs and Deputy Vice-Provost for Information Technology.

Page 51: Cleve Moler was a professor of Mathematics at UM and later founder, chairman, and chief scientist at The MathWorks.. Jack DiGiuseppe was an engineer involved with data communication and network hardware and software at the Computing Center.

Page 53: Jim Sterken was a programmer at the Computing Center who went on to co-found the Ann Arbor based Arbortext software development company.

Page 53: Jim Wilks was Professor of Chemical Engineering and author (with Professor Brice Carnahan) of the textbook, *Digital computing, FORTRAN IV, WATFIV, and MTS (with *FTN and *WATFIV)*.

Page 55: The drawing is from the cover of a *A Faster Cratchit: The History of Computing at Michigan*, 1976, in the UM Research News

Page 56: The center photo is a stock photo of someone that never worked at the University of Michigan. The photo in the upper right is Dr. Bartels.

Page 57: *The Road* was written for Dr. Bartels by Carol Pirkola, Gary Pirkola's wife and a member of the committee that organized the reception honoring Dr. Bartels. Carol was heavily involved in the creation of the memory book.