By FREDERICK WAY III
Professor of Computer Engineering and Science

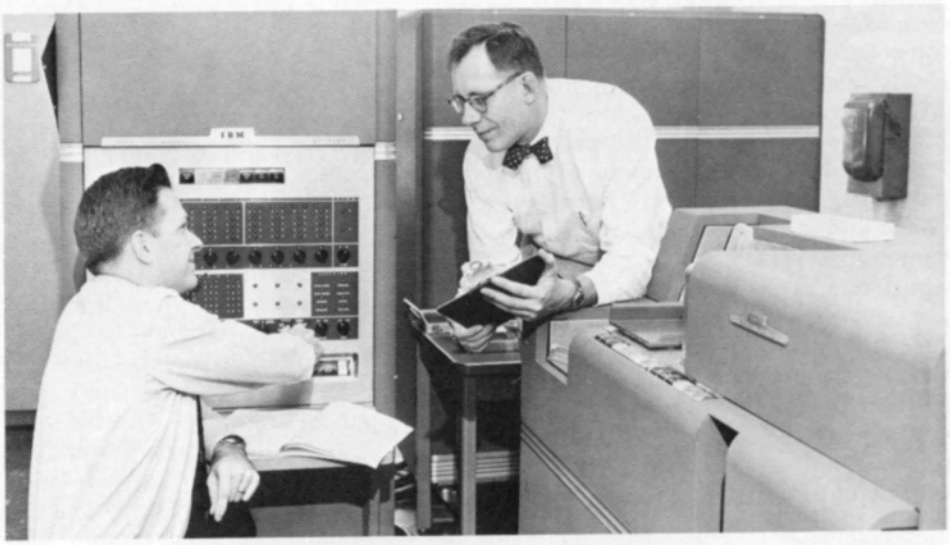
Computing at Case Institute

COMPUTING at Case Institute of Technology as presently known had its beginnings in 1945 when a Mathematics Laboratory was established under the direction of Dr. Orley E. Brown, professor of mathematics. The initial equipment consisted of a Henrici Harmonic Analyzer and a Fourier Synthesizer (built by Dr. Dayton C. Miller, chairman, Department of Physics). The laboratory was located in a small room on the fourth floor of the Case Main Building.

Two years later (1947), a Marchant Calculator and a slide projector were added to the equipment. Dr. Fred C. Leone joined the faculty as an instructor in mathematics in 1949 with the directive to "develop undergraduate and graduate work in statistics and a laboratory in which problems in this field may be brought by other Departments of the Institute," according to the Department of Mathematics Annual Report.

By 1950, the laboratory facilities were being used to their limits. In 1953, an IBM 602A (International Business Machines) Calculating Punch was rented and installed in the Laboratory. This machine was (by hindsight) a most difficult little thing to deal with and required an extraordinary amount of effort to do even simple calculations. About the same time (1953), some other IBM equipment (a sorter, tabulator, reproducer and keypunch) was also rented.

In January of 1956, I was hired as instructor in mathematics and assistant director of the Computing Center. Dr. Raymond J. Nelson came aboard at about the same time as an associate professor of mathematics. A search was started for a director of the Computing Center and after sev-



FIRST OF THE computers installed at Case Tech was the IBM 650 (top, background). Frederick Way III (center, left) was the first assistant director and Dr. Raymond J. Nelson, the first director of the Computing Center. Next were the Burroughs 220 (right) with Albert E. Misek'53 shown with a reel of tape.

ager of the Dow U.S.A. Styrene Plastics Department in 1972. He became a corporate product director in 1976.

Moves to Washington, D.C.

Formerly vice president, Finance and North American Operations, Motors Trading Corp., a subsidiary of the General Motors Corp., Detroit, Mich., PHILIP W. ROWBERG JR.'70 has become vice president, Countertrade, Sears World Trade Inc., Washington, D.C. The company is a division of Sears, Roebuck and Co. At Sears World Trade, Rowberg is responsible for all of the firm's countertrade and offset obligations. He previously held positions with the General Motors Corp. in New York, N.Y., and Detroit.

Heads Siebe-Norton Co.

Making a career out of protecting and helping workers in all types of hazardous activities is JOHN W. PROHASKA'51. He is president, Siebe-Norton Co., Charleston, S.C., a new organization formed from the sale of the Norton Co.'s Safety Products Division to Siebe Gorman Holdings, an English manufacturer of industrial safety products. The company markets sophisticated protective gloves, helmets, sound proofing devices, lotions, breathing gear and some of the most advanced types of eye shields ever introduced. Prohaska joined the Charleston Rubber Co. in 1953 and moved to the Norton Co. when it absorbed Charleston Rubber 22 years later. Siebe-Norton has the company headquarters and plant and its second plant in Charleston and other plants in North Carolina, Rhode Island, Massachusetts, Illinois and California, plus international plants in Canada and Haiti.

Alumni Head Chi Corp.

Chi Corp., Cleveland, Ohio, the leading manufacturer of compatible communications products for Sperry UNIVAC Computer Systems, has been acquired from Ecotran Corp., Beachwood, Ohio, by WILLIAM E. PRITTS II'61, newly appointed Chairman and Chief Executive Officer of Chi, and Dr. MARVIN S. SCHWARTZ'68, President and Chief Operating Officer.

Pritts was most recently a Director and Group Vice President of Erico Products, Inc., Solon, Ohio, responsible for the coordination of U.S., Canadian and Far East Operations. Prior to this he was the partner responsible for management consulting services with Ernst & Whinney's Cleveland Office. Pritts was president of the Case Alumni Association in 1981-82 and is a representative of the organization to the Board of Overseers of Case Western Reserve University. He is also a member of the Advisory Board of Case Institute and is a past president of the Case Club of Cleveland.

Schwartz, who has been with Chi since its founding in 1968, developed many Sperry UNIVAC-based, high performance data base and data communications systems world-wide. □

Council Honors Volunteer

NATIONAL recognition for his many services to Case Western Reserve University, Case Institute of Technology and the Case Alumni Association was accorded Dr. Elmer L. Lindseth'25 by the Council for Advancement and Support of Education at ceremonies in October in Washington, D.C. The Council is a nonprofit organization for the advancement of education and it annually bestows national awards for excellence in its field. Lindseth was one of 10 people nationwide to be honored.

Lindseth began his devoted service to his alma mater in 1928 when he became a member of the Case Alumni Council, governing board of the Case Alumni Association. He also was a columnist for the Case Alumnus magazine, writing "Adiabatic." He was president of the Case Alumni Association in 1940-41 and was elected an Association-designated member of the Case Board of Trustees in 1942. He became a Trustee-elected member in 1949. Lindseth was named chairman of the Case Board of Trustees and elected a life member in 1964. He continued as chairman to 1967, the year of Federation of Case Tech and Western Reserve University. Then he became a member of the University's Board of Trustees and is now an honorary member.

Lindseth was presented with the Case Alumni Association's Meritorious Service Award in 1937 and 50 Years Service Plaque in 1978. He made a gift to Case Tech in 1945 to establish the Fred Hale Vose Prize in honor of one of his most respected teachers. An office in the William E. Wickenden Building is named for Lindseth's father, Andrew.

Case Institute conferred an honorary doctor of engineering degree upon Lindseth in 1946; Miami University of Ohio gave him an honorary doctor of science degree in 1951 and Cleveland State University presented him with an honorary doctor of engineering degree in 1952. The Freedoms Foundation Honor Medal was given to Lindseth in 1960.

In 1965-68, Lindseth was chairman of Case Tech's $17,000,000 Capital Campaign that exceeded its goal in less than three years. At the Tenth Anniversary Celebration of the Federation of Case Institute and Western Reserve University, he was presented with CWRU's University Medal, its highest honor. More recently (1976-81), Lindseth was a member of the Major Gifts Division of the CWRU $215,000,000 Resources Program.

In honor of Lindseth's 80th birthday a million dollars was raised in 72 days to endow a professorship in his name in the Department of Biomedical Engineering at Case Institute of Technology. First public announcement and notification to Lindseth of the endowed chair was made at a surprise reception in his honor Feb. 12, 1982 in the lobby of Frederick C. Crawford Hall. □

IN THIS PHOTO (left), Albert E. Misek'53 is at the Burroughs 220. The UNIVAC 1107 (center photo) replaced UNIVAC I. Pictured are Edmund A. Harbert (left) and Thomas W. Petrie G'66. The UNIVAC 1108 (lower photo) was purchased by the newly formed Chi Corp. and sold time to Case Tech.

eral months, it was clear that the best candidate in the world was Ray Nelson. His background included industrial experience with IBM (where he obtained several patents and designed some of the internal logic of the IBM 650), as well as an extensive publication record in symbolic logic.

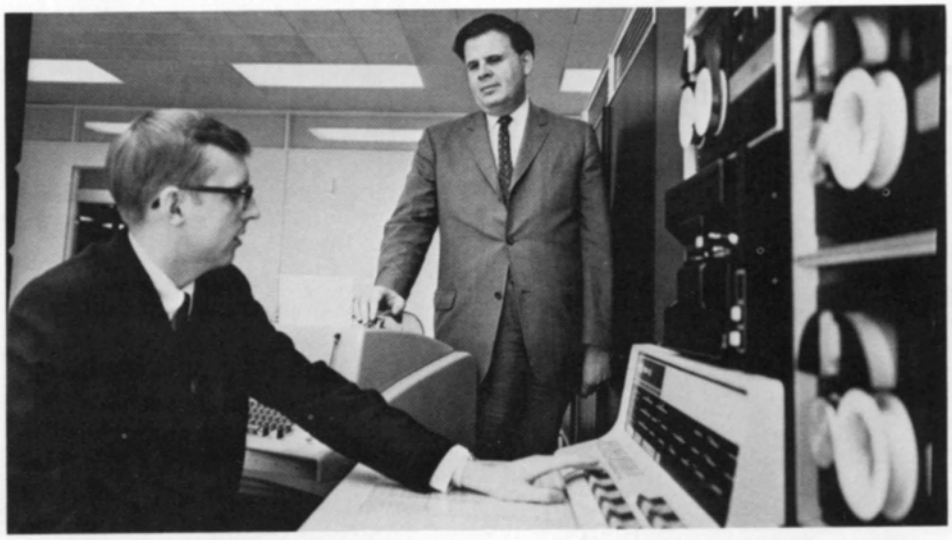
In the spring of 1956, acting on a suggestion of mine, George E. Haynam'51 and George W. Petznick Jr.'59 managed to beat the IBM 602A into submission so that one could easily do some rather sophisticated computations. We managed to use the machine in a Short Course for High School Teachers that summer.

The summer of 1956 saw the move of the IBM equipment from the fourth floor of the Main Building to the first floor of the Old Chemistry Building (then behind Case Main). In the process of moving, it was necessary to lower a two-ton accounting machine down through the Case Main spiral stairway. A student stood on the ground floor (four floors under the machine) to take a picture — the moving crew was less than enthusiastic with him!

Also during the summer of 1956, the IBM 602A was returned to IBM and a new IBM 650 Magnetic Drum Data Processing Machine (also known as the IBM 650 Computer) was rented.

In March 1957, the Board of Trustees approved a proposal for augmenting the existing facilities with a UNIVAC I computer. The proposal was mainly concerned with the financial details and was (reasonably enough) silent about the campus location. One of the possibilities examined was the basement of the Charles J. Strosacker'06 Auditorium. There were several meetings with Joseph D. Pigott (director of Physical Planning), Department of Physics and Department of Mathematics representatives, Nelson, myself and others about floor space, utilities, air conditioning, etc. In the end it was clear that it was not reasonable to use the basement and the decision for the computing facilities was made to put everything on the ground floor of the Frank Adgate Quail Building. This location then became the first place on the campus which actually had a sign on it that said "Computing Center".

The UNIVAC I was a gift from the Remington-Rand Division, Sperry-Rand Corp. and arranged between



AT THE PDP-10 in the Computing Center are Dr. Charles W. Rose G'70 (left) and Prof. Edward L. Glaser. Pictured with the DEC Systems 2020 and 2060 Main Frames is Center Director H. Wendell Klingensmith.

Dr. T. Keith Glennan, president of Case Institute of Technology, and Lt. Gen. Leslie R. Groves (USA Ret.), vice president, Sperry-Rand. The offer of the gift was made at a luncheon meeting at the Yale Club in New York, N.Y. at which time Keith responded to the offer with "O.K., that sounds fine. Put it in writing and send it to me in Cleveland." With that, we left the meeting! Later, Keith Glennan also managed to modify the offer by adding some fellowships, sponsorship of a colloquium series, some funds for operations and a revision of the maintenance provisions. The gift was valued at $1,500,000.

A formal dedication of the UNIVAC I on April 12, 1958 was attended by President Glennan, Marcell N. Rand, Remington-Rand, Mr. and Mrs. Cyrus S. Eaton (then chairman of the board, Chesapeake and Ohio Railway Co.), various other C&O dignitaries and academic and community leaders.

A brave decision was made to maintain the UNIVAC I ourselves and Albert E. Misek'53 was hired as chief engineer. He and his crew, not only maintained the machine with an absolutely remarkable up-time record, but also substantially modified the hardware. Modifications included the addition of the UNIVAC II instruction set, adding the high-speed printer as an on-line output device, doubling the speed of the printer, installation of tape cleaners and others. None of the changes had any undesirable effects on the existing programs.

The UNIVAC I used magnetic tapes that were made of phosphor bronze with an alnico plating for the recording surfaces. It was always amusing to watch a novice try to pick up several tapes at once since they weighed about six pounds each. (There is a reel of this tape on display in the Wallace R. Persons'03/Case Alumni Association Lounge and Memorabilia Room). Another of the modifications made to the computer allowed the use of both the metallic tape and the more familiar plastic tape. (I believe that our UNIVAC I was the only one that worked with both types.)

Early on, in the acquisition process, Dr. Grace M. Hopper, director of programming, UNIVAC, kindly invited four of us to spend a week in Philadelphia, Pa., at which time she and her staff gave us all of the internal details of their programs. (She is now a captain in the U.S. Navy and at the age of 76 years, the oldest officer on duty in the services.) We obtained quite a large amount of software including a business oriented compiler language (a direct forerunner of COBOL) and an algebraic compiler (much like FORTRAN). The remarkable thing about all of this software was that it was written in machine language. There were (as far as I can recall) only two symbolic assembler programs ever produced for the UNIVAC I. One was produced at UNIVAC by Anatol W. Holt and Turanski and the other was written at Case Tech by Melvin E. Conway'55.

The UNIVAC I was used for student records (Registrar's Office), parking records, a few courses, various research projects and quite a bit of time was sold to the C&O Railway. The machine was not heavily used in course work because it was possible to damage it through maloperation of the console switches. By today's standards, it is amazing that anything at all could be done with the machine since it had a main memory capacity of only 12,000 characters — almost none of the current microcomputers have that small a memory.

Concurrently with all of the foregoing activity on the UNIVAC I, we were busily using the IBM 650 for classes, research and miscellaneous business data processing. The first algebraic compiler (FORTRAN like computer language) for the 650 was written at Carnegie Institute of Technology by Dr. Alan J. Perlis and his staff. He very kindly sent me a complete symbolic listing of the "IT" lan-

pathetically poor!

guage. I clearly remember handing the listing to William C. Lynch'59 and Donald E. Knuth'60 saying something to the effect that Haynam, Conway, Petznick and I were going to be out of town for a week (to see Hopper at UNIVAC) and would they kindly draw a flow chart for the compiler! They not only drew the flow chart, but they also found several errors and insisted that they could produce a better compiler — all of this in one week! They proceeded to create the first in a series of compilers. The generic name for all of them was "RUNCIBLE". The name came about as a result of my two sons asking me what a "runcible-spoon" was. I didn't know and neither did anybody in the Computing Center so the word became something of a curiosity! We sent over 300 decks of cards for RUNCIBLE to various universities, laboratories and IBM offices all over the world.

When Knuth wrote volume I of "The Art of Computer Programming" (1968), he dedicated it to the IBM 650 Computer at Case Institute of Technology.

The IBM 650 was substantially upgraded to increase its utility but the demands of the Case community grew even faster and it was replaced in 1960 by a Burroughs 220. Since we had so much success with maintaining our UNIVAC I, we decided to play the same game with the Burroughs 220. Naturally (at least it then seemed natural), we soon saw that some very worthwhile improvements could be made in the B-220 hardware, one of which doubled the speed of the machine at a parts cost of $20. The B-220 arrived without any symbolic assembler, so Conway and Gilbert P. Steil'62 created the SAVE assembler for it. This one introduced the notion of a "program point" and contained the first implementation of a co-routine. Conway and Steil also got the first two passes of a COBOL compiler running but dropped the project when Burroughs decided to give the project to Stanford University, Stanford, Calif. I believe it was in the development of the COBOL compiler that Conway invented the idea of a "transition diagram". The transition diagram and the co-routine are now standard ideas used in computer science. As I remember it, the co-routine came about because of a major difference of opinion between Conway and Steil — neither liked the way that the other did programming. The former took a straight forward approach using no "tricks" while Steil would never write a second line of code if he could modify an existing one to do the job. Since neither wanted to read the other's code, and each had to call the other's part of the program, the co-routine came about. (Steil also distinguished himself by his habit of separating card decks with chocolate covered graham crackers.)

It was on the B-220 that Knuth created two tic-tac-toe programs — a "smart" one and a "dumb" one. He let them play each other for a while and the "dumb" one soon "learned" how to play the game effectively. Knuth was also the manager of the Case Tech basketball team and invented a computerized method of ranking the players. Coach Philip K. (Nip) Heim used Knuth's data to revise the lineup and the team began winning some games. (After Knuth graduated, I remember Heim's successor, Coach William C. Sudek, coming in and asking where the program was and how to use it. Sad to say, but nobody knew.)

UNIVAC I used magnetic tapes that were made of phosphor bronze with an alnico plating for the recording surfaces.

By 1962, we were once again out of computing capacity, C&O was not using the UNIVAC I, and it was once again time for a change. The UNIVAC I was actually ripped apart by the Western Salvage Co., Cleveland, Ohio. We had tried to interest the Smithsonian Institution, Washington, D.C., and the Museum of Science and Industry, Chicago, Ill., in it, but they already had similar exhibits and would not take it.

We purchased a UNIVAC 1107 and installed it in the floor space in the Quail Building vacated by the UNIVAC I. The 1107 was the first machine we had that ran so fast that a paper-tape log of use was out of the question. It was delivered with essentially no software at all. Haynam and Gilbert Hanson wrote an algebraic compiler for it that was compatible with the one running on the B-220. The compiler ran on the day that the 1107 passed its acceptance test. We obtained a copy of the Computer Sciences Corp.'s "EXEC II" Operating System and hired Joseph P. Speroni'60 to maintain and modify it. This project caused him a lot of sleepless nights since there were quite a few bugs and it was necessary to make some substantial enhancements for our type of use.

Later, Alan K. Olson'64 wrote "EXEC III" for his master's thesis project. (Let me hasten to say that this is hardly a typical thing to do for a master's degree since it represented several man-years of effort.)

Not content with leaving well enough alone (as usual) we decided to go ahead with writing a compiler for ALGOL-60, an international standard language for communicating algorithms. This language was very popular in Europe but never seemed to catch on in the U.S. despite the fact that it was vastly superior to anything else. Haynam was in charge of the project and was helped by a large number of undergraduate students. ALGOL became the principal language used at Case, being used for quite a few years and on two computers.

Some of the researchers at Case Tech had contracts that specified FORTRAN as the language to be used. A lot of them actually did all of the work in ALGOL then converted to FORTRAN at the end of the project. The reason: ALGOL was designed to be "user friendly" with readable error messages, subscript checking and other enhancements to make the user's life easier. We were once asked to make a translation of a FORTRAN program used in nuclear reactor design — i.e. translate it to ALGOL — in order to see what the running speed difference between the two languages would be on that application. To someone's chagrin it turned out that we could not actually run the test data since there was a subscript out of range in the original FORTRAN program. It is certain that the program designed something — but no-one knows what.

Several flaws in the design of the 1107 were corrected by Misek and UNIVAC subsequently upgraded all

of the 1107s with his changes. He also attached a UNIVAC 1004 card-reader/printer unit to the 1107 as the main input/output device. This development essentially put UNIVAC out of the business of making separate readers and printers. Misek and the crew then figured out how to use a 1004 remotely through a telephone line to access the 1107. This worked out so well that the Lord Manufacturing Co., Erie, Pa. became our first remote user, followed by Baldwin-Wallace College, Berea, Ohio, and Highland View Hospital, Cleveland, Ohio. As far as I know these were the first instances of anyone using an 1107 via phone lines.

Case has always run all of the computers in what was called the "open-shop" mode which simply means that the users came in and ran the computers themselves instead of going through a fog of operating personnel with the attendant delays and frustrations. It was this type of operation which allowed us to get the enormous amount of work done before we eventually ran out of capacity. We specialized in what was known as a "fast turnaround batch" operation.

In recognition of a major bequest from Mrs. Martha Holden Jennings in 1963, the facility became the "Andrew R. Jennings Computing Center" in memory of her husband who had been European manager for IBM. Arthur S. Holden Jr.'35, in his role of executor of the estate, became (and still is) very interested in the Center.

After Nelson, Computing Center directors were Dr. Robert R. Archer (1965), Jack D. Alanen'60 (1966), Prof. Edward L. Glaser (1967-1975), Provost Joseph E. Rowe (acting, 1976-1978), Prof. Frederick Way III (acting, 1979) and H. Wendell Klingensmith (1980 and at the present time).

By 1967, we were again out of capacity due to the large number of users. To make matters more interesting this was at the time that Case Institute and Western Reserve University were federated — thus increasing the demand for computing facilities.

The solution this time was to form a separate company, the "Chi Corporation" which was wholly owned by the University. Provost John A. Hrones was the chairman of the board of directors and Jack L. Stones was the vice president of the corporation. All of the people in the Jennings Computing Center (with the exception of those who had academic appointments) moved across the street to 11000 Cedar Ave. and opened the doors for business. Chi bought a UNIVAC 1108 and Case Tech sold its 1107 to the General Motors Corp. The University (and Case Tech) bought computing services from Chi — operating remotely via private telephone lines and UNIVAC 1004s.

During the initial planning for the formation of Chi, there were quite a few confidential memos circulated which referred to Corporation "X". Then one fine day, a delegation was on its way to Columbus, Ohio, to go through the legal process of forming the corporation. It was then that they realized that here was actually no name for it. Francis E. Ilcin'61 had the bright idea to call it Chi since the Greek letter "chi" looks like an "X".

The shifting of the University user load to the Chi Corp.'s UNIVAC 1108 looked like a potential disaster since most of the users had all of their programs and data on magnetic tape and the tape units on the 1107 and the 1108 were not compatible. By a

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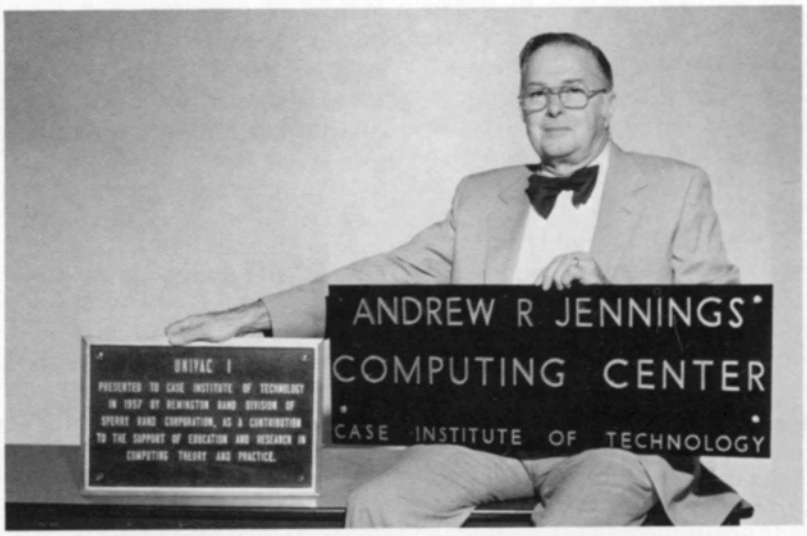
About the Author



PROF. FREDERICK WAY III displays historic plaques.

PROFESSOR of Computer Engineering in the Department of Computer Engineering and Science at Case Institute of Technology, Frederick Way III joined the faculty as an instructor in mathematics in 1956. He was also appointed the assistant director of the new Computing Center at that time. He became the associate director in 1959 and the name of the facility was changed to the Andrew R. Jennings Computing Center in 1963. On June 30 this year, Way relinquished his position with the Center but continues on the faculty in his professorship capacity. Way graduated from the University of Pittsburgh, Pa., in 1950. He continued his graduate studies there while working as a physicist at the Babcock and Wilcox Co., Beaver Falls, Pa. In 1955, he became an analytical engineer engaged in computers at the firm's Alliance, Ohio, Research Laboratory. Way is the senior faculty member at Case Tech in computers. He has also served one computing center longer than anyone else in the field. □

Global Currents

LECTURES examining the broad currents of change, conflict and innovation that may shape tomorrow's headlines will be held Nov. 1, 8, 15, 22, 29, and Dec. 6 at the Charles J. Strosacker'06 Auditorium, 4 to 5:30 pm. Admission is free. For details, please telephone (216) 368-4492. □

Directions

(Continued from Page 13)

Digital is the world's leading vendor of academic timesharing systems. Over 80 percent of the colleges and universities in North America have installed Digital systems. And Digital is one of the nation's top five industrial contributors to higher education.

The company sponsors joint research programs at colleges and universities throughout the country. The joint research agreement with Case Institute includes support for research into academic support applications of personal computers and for a separate graduate research program into machine intelligence.

Digital also supports institutions with cash research and study grants to faculty and students and with special equipment grant programs.

Technical seminar series and college and university seminar series provide forums for the exchange of Digital and college and university speakers on emerging technologies and technology-related issues.

Digital has long known that it is on college and university campuses that use will first be made of the best, most innovative and most forward-looking new technologies. Digital is committed to providing practical applications of those technologies through coherent, manageable and accessible networks of information resources for higher education. □

Computing Center

(Continued from Page 8)

remarkable stroke of luck, Alvin Goldsmith, TRW Inc., Cleveland, Ohio, called and offered me two RW530 computers free. We really did not want the computers but accepted them to get the high speed card readers and printers that came with them. The lucky part was that the tape units on the RW530 were compatible with those on the UNIVAC 1108. Misek then attached one of the RW530s to the 1107 as an output device and every night we would read tape on the 1107 tape units and write the information on the RW530 tapes.

The Chi Corp. crew continued in the Case Tech tradition by making some engineering changes in the UNIVAC 1108 to fix some design oversights. They also realized the need for a new executive system to take advantage of the 1108 capabilities. Olson wrote "EXEC IV" and employed John W. Langner'68 as "sorcerer's apprentice". David L. Abt'76 took on the ALGOL maintenance and Frank J. Olynyk'64 was in charge of FORTRAN maintenance. Later on, a major decision was made to write a new executive system and Langner and company wrote "CHI O/S". This was a real breakthrough since it was written in an implementation language (CHILI) designed by Abt. Lynch and I were consultants to Chi and Lynch was the chief idea generator for most of the new software.

The Jennings Computing Center was moved from the Quail Building to the Frederick C. Crawford Hall in 1970 where it currently occupies the third and fourth floors. H. Wendell Klingensmith is currently director of the Computing Center.

In 1977, the Case Jennings Computing Center was changed to a University Computing Center (i.e. it no longer was operated by Case Tech). At the same time, the Center acquired the staff and equipment associated with a Campus Network Project. Two of the Harris-slash-six Computers involved with the network project were installed in the William E. Wickenden Building for general campus access.

By 1980, it was again time to augment capacity since the two machines in the Wickenden Building and the UNIVAC 1108 were not able to carry the load. A committee was formed with Dr. Charles W. Rose G'70 as chairman to make a recommendation to the President's Office then in transition from Louis A. Toepfer to Dr. David V. Ragone. The end result was that the Jennings Computing Center installed a DEC20 (Digital Equipment Corp.) in August 1980. The DEC20 was up and running for classes that same month. The Center now (August 1983) has three DEC20s and a VAX.

In the spring of 1983, Dr. Donald E. Schuele G'63 (then vice dean of Case Institute) negotiated the purchase of 75 DEC Professional 350 Personal Computers for Case Tech. Fifty of the machines are in the Albert W. Smith'87 Building and will be used for Case Tech courses. This represents one of the best things that has happened for the students in quite a while since they will now have guaranteed access to computing, no fear of running up large bills and a very pleasant working environment. Ms. Linda Karaffa was hired as manager of the Case Institute Professional Computer Laboratory and following the usual Case tradition has everything running smoothly in spite of some rather "interesting" problems that were solved. □

TECMAR Inc.

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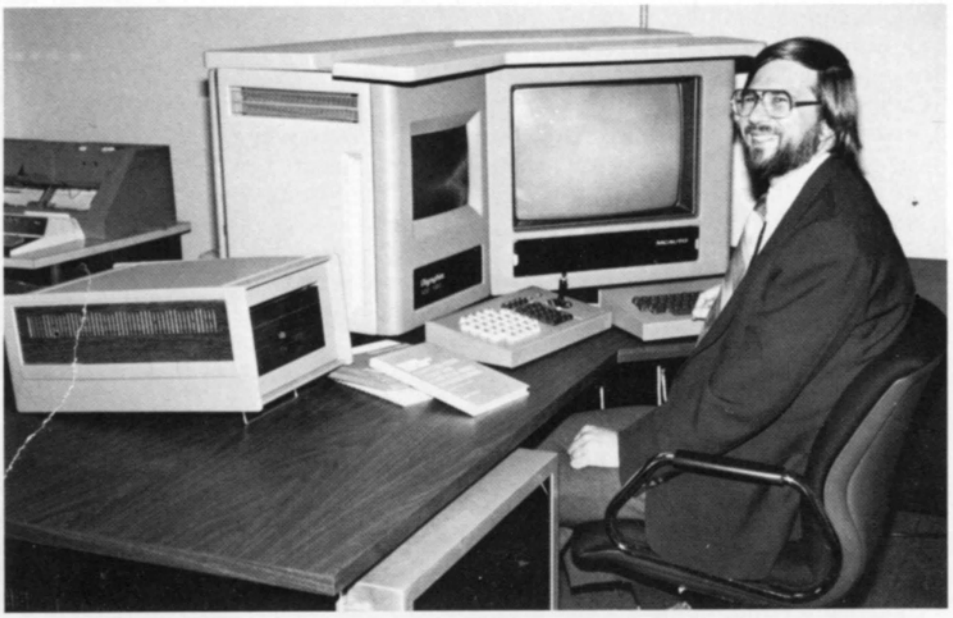
systems and supporting software, the S-100 analog to digital converter, timer/counter board, the Apple analog to digital converter and digital to analog converter boards, PC-mate, 1st mate, 2nd mate and ELAN extended local area network. There are over 100 products in TECMAR's line with many more to be announced shortly. Alpert estimates that TECMAR has over 30 percent of the IBM-PC compatible market share.

TECMAR has reacted rapidly to the changing hi-tech market and the future looks bright for Marty and Carolyn Alpert, who only seven years ago paid an attorney $360 to incorporate because they needed a letterhead to order parts! □

CAD/CAM User Guide Is Published



AUTHOR JOHN J. KROUSE'69 is seated at a computer terminal.

ANTICIPATING the need for a book on Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) by the top engineers and managers in the field, John J. Krouse'69 has written one for this audience. It is "The CAD/CAM Revolution."

The author is a staff editor, Machine Design magazine, published by Penton/IPC Inc., Cleveland, Ohio.

By 1985, 90 percent of all mechanical drafting is expected to be by CAD and 30 percent of all manufacturing will use some form of CAM, Krouse said in the preface of his book.

"CAD/DAM will magnify man's mental power just as the machines of the industrial revolution expanded the strengths of his muscles. This wave of change, however, will depend on the limitless creativity of the human mind. And we are now seeing the beginning of this new approach to engineering," he wrote.

Into one volume, Krouse has provided a guide to important activity in CAD/CAM. The book pinpoints and defines the major areas, shows how they fit together, describes the major CAD/CAM users and outlines the cooperative efforts to develop unified systems. The book is meant to serve as a solid base on which the novice and professional may build further knowledge about CAD/CAM and may provide a revealing perspective for those involved in the new technology.

Seated at a computer graphics terminal, an engineer can create a design of a mechanical part on the screen with pushbuttons, a lightpen, joystick, or other graphical input device. As he works, he can zoom in on the design for a closer look at intricate details, rotate the model to view it at another angle, take cross-sections to see internal details. He has many automatic features that let him, at the push of a button, reproduce repeated details, create mirror images, scale part sizes up or down, or recall standard symbols. All these features let the engineer create mechanical designs many times faster than with traditional manual drawing methods. In most cases, the increase is three or four-fold. However, some companies report increases in productivity as high as 60:1 for some applications.

After the design is created and the computer model is stored in the memory, CAD/CAM systems also allow the user to perform sophisticated analysis such as finite-element analysis to determine stress, strain, or

By 1985, 90 percent of all mechanical drafting and 30 percent of all manufacturing is expected to be by CAD/CAM.

deformation of the part under load. Or simpler analysis on the geometry can compute (again, at the push of a button) material properties like density, center of gravity, moment of inertia, volume, etc.

Another feature of CAD/CAM systems called kinematics lets the user see moving parts animated on the screen of the cathode ray tube (CRT). Thus, the operator can see if, for example, a landing gear will have enough clearance to go up and down. Or a wheel of an automobile may be animated to see if it will turn properly. This saves the time and expense of building a physical prototype. Basically, the work is done on the computer instead of on the shop floor.

After the design is created and analyzed and refined to the engineer's satisfaction, automated drafting capabilities in the system produce finished drawings on a high-speed plotter.

Many systems also have the capability to create instructions for making the part on automated numerically controlled (NC) machine tools. The instructions, usually created either automatically or semi-automatically on the system, are stored on paper or magnetic tape and fed into the machine tool which

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