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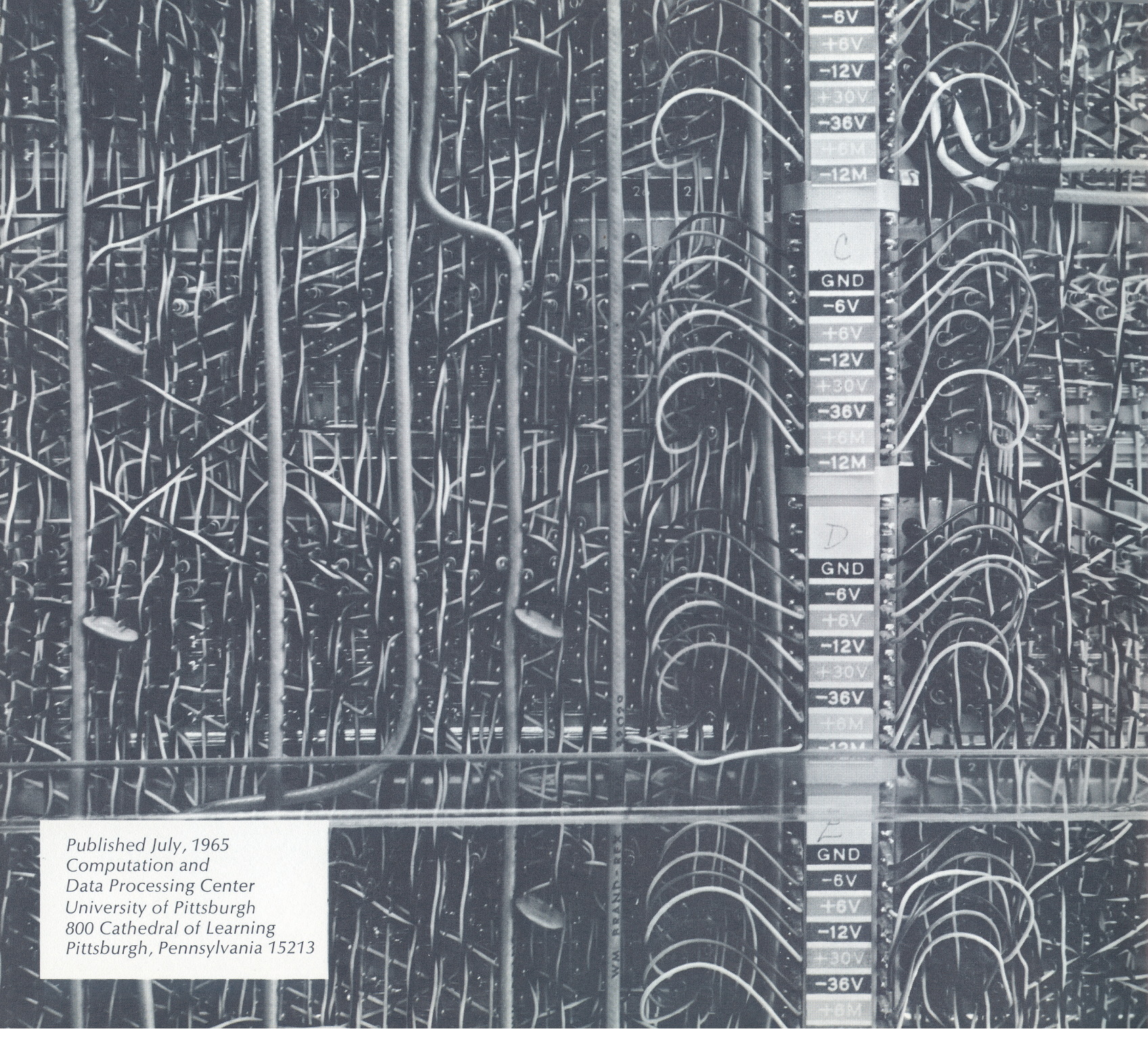
COMPUTATION & DATA
PROCESSING CENTER
OPERATIONS



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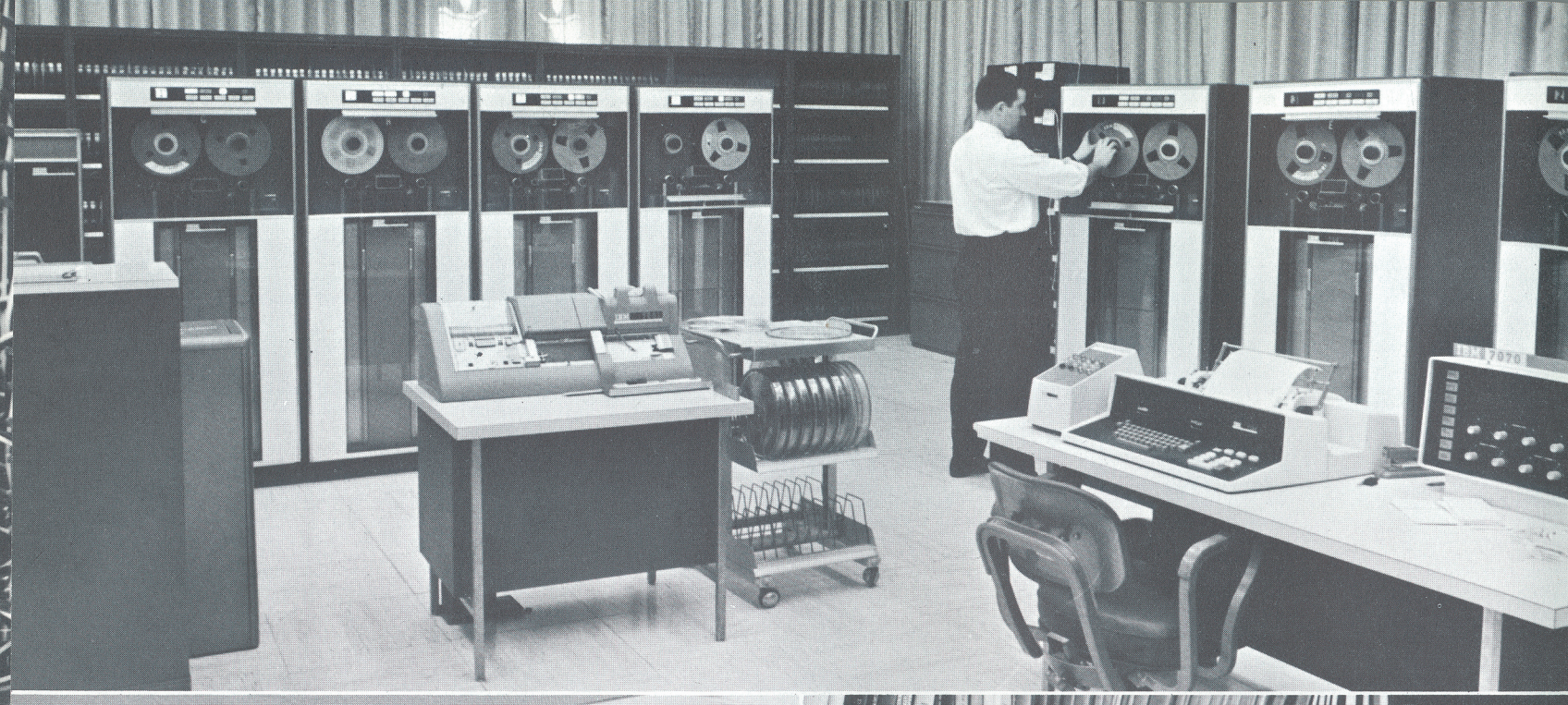
Computation and
Data Processing Center
University of Pittsburgh
800 Cathedral of Learning
Pittsburgh, Pennsylvania 15213

UNIVERSITY OF PITTSBURGH

COMPUTATION AND DATA PROCESSING CENTER

The Computation and Data Processing Center at the University of Pittsburgh was established in 1956 as a center for research and education in the use of computers. It has three major functions:

- *Computational facility—to select and maintain appropriate computer equipment and programming systems for research and educational use by University students and faculty.*
- *Educational—to support the academic program of the University's Council on Computer Science.*
- *Research—to develop new concepts in computer systems and technology; to explore new uses of computers.*



THE FACILITY

Heart of the Center's current computing facility is the IBM 7090 and 7070 complex. The 7090 has 12 tape drives, 32,768 words of core storage and a disc drive with a capacity of 56 million characters. The 7070 computing system has 10 tape drives and 10,000 words of storage. Each of these general purpose computers, purchased partly through grants from the National Science Foundation, has its own satellite IBM 1401 for input and output.

In addition, the Center has a Digital Equipment Corporation PDP-4 with cathode ray display and light pen. This machine, acquired under a Department of Defense contract, is used on line with the 7090 principally for editing text and information retrieval.

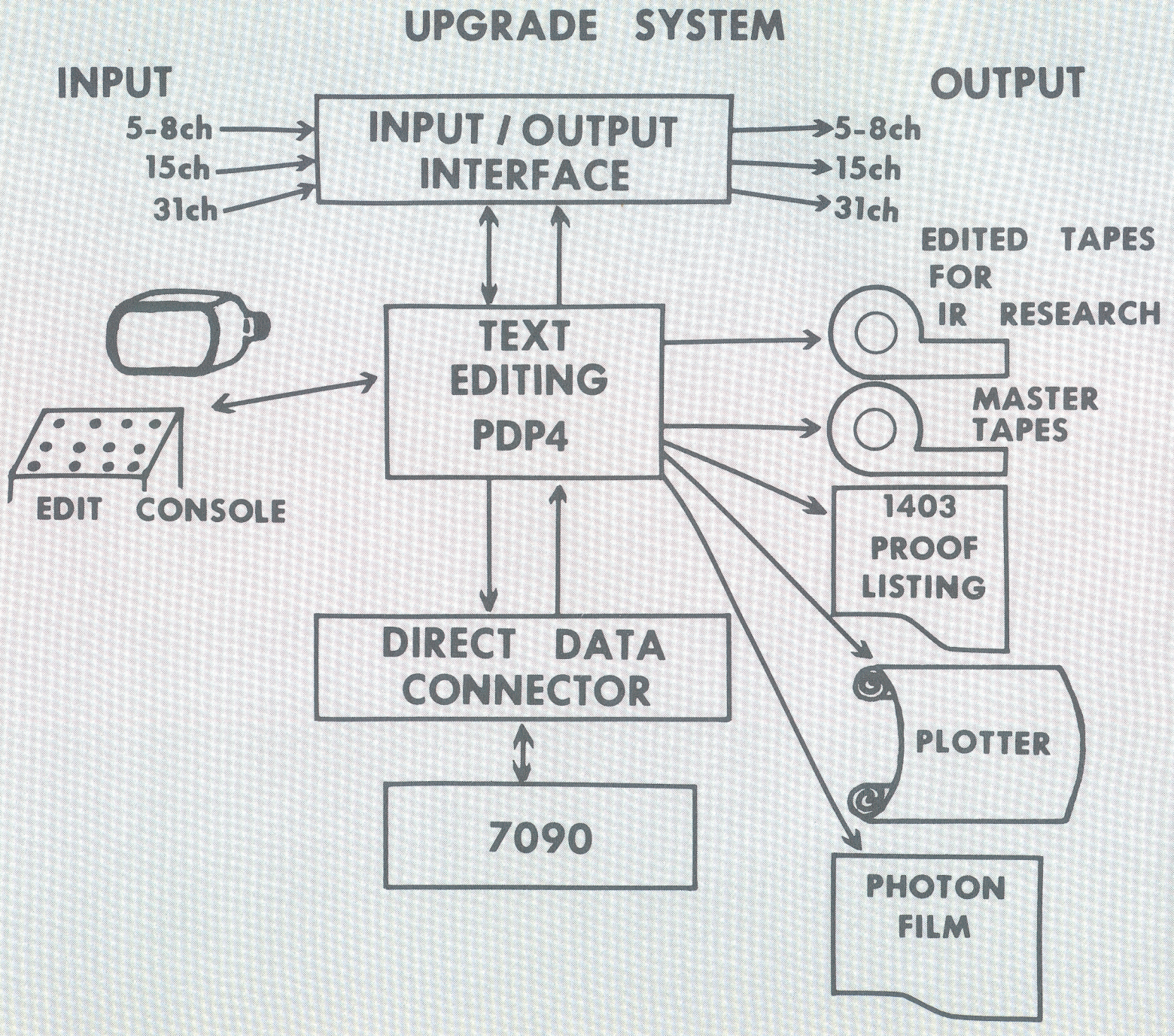
Through a grant from the National Institutes of Health in 1964, the Center obtained a Photon S-560 photo-composing unit for computer-controlled typesetting. The University plans to add a Model 50-IBM System/360 in January, 1966. Directly connected to the IBM 7090 system, this will be used to process data, via telephone lines, from locations relatively distant from the Center, such as the University's Medical School and the Graduate School of Public Health. Current plans call for replacement of the entire complex of IBM computers with an IBM System/360 Model 67 by January, 1967. This would provide centralized service and at the same time permit access to the computer, through use of remote consoles, from any location on campus.

The facility also includes a Calcomp plotter (model 564), a Friden calculator, keypunches, Flexowriters and tabulating machines.

Located on the eighth floor of the University's Cathedral of Learning, the Center houses the computer area, staff offices, study and work rooms, a keypunch and tabulating equipment area, an input-output room, where programs are submitted and results returned, and a library. Books, journals and periodicals published in computing and related fields are available in the Center's library.

The library also provides current issues of GUIDE and SHARE catalogues (users have access to programs listed), and copies of the PEST (Pitt Executive System for Tapes) and the Michigan System manuals, which describe in detail the conventions and rules under which the University's computers are operated.

Faculty and students from all departments of the University and scientists and engineers from industrial firms in the area utilize the Center's resources. Computers are operated on a 24-hour, 5-days-a-week schedule, and programs may be submitted from 8:00 A.M. to 10:00 P.M., Monday through Friday. As many as 1,200 programs are processed in a single day.


UPGRADE SYSTEM
INPUT
OUTPUT
5-8ch
15ch
31ch
INPUT / OUTPUT INTERFACE
5-8ch
15ch
31ch
EDITED TAPES FOR IR RESEARCH
TEXT EDITING PDP4
MASTER TAPES
EDIT CONSOLE
1403 PROOF LISTING
DIRECT DATA CONNECTOR
PLOTTER
7090
PHOTON FILM

STAFF RESEARCH

PROJECT UPGRADE

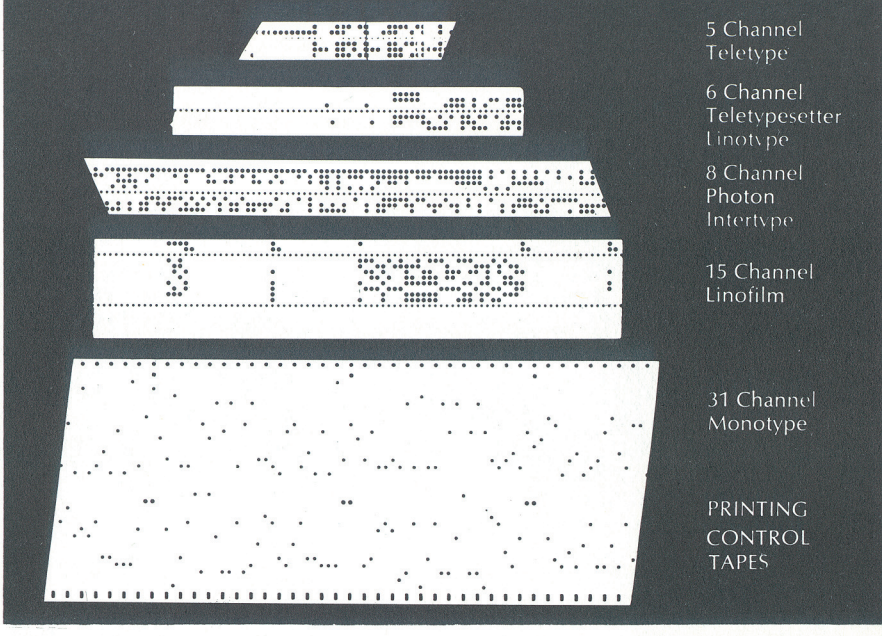
The University of Pittsburgh Generalized Recording and Dissemination Experiment (Project UPGRADE), is, as its name implies, limited to no single phase but covers the entire field of text processing.

Research deals with:

- The problems of primary input—collecting and storing, in computer form, text of original manuscripts and publications.
- Development of computer hardware and programming languages to manipulate input for various uses—indexing, editing, content analysis.
- Experiments in graphic display and printing technology, including automatic typesetting.

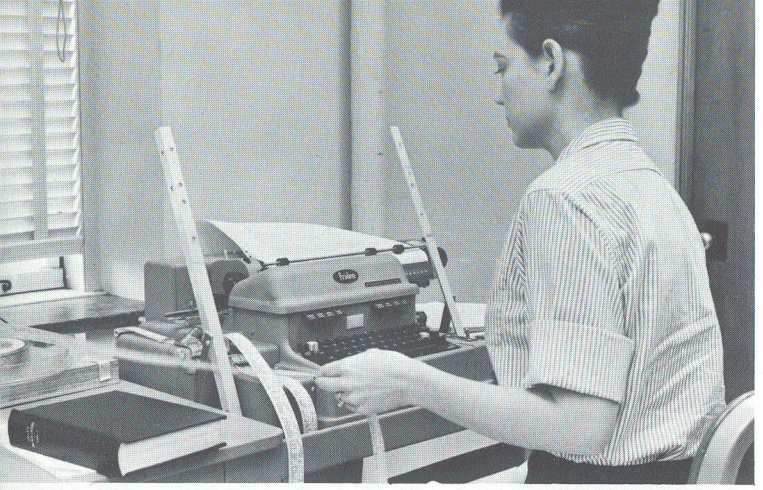
To obtain input—the first stage in the total system—the Center has developed methods of collecting and organizing, in computer-usable form, technical text still in the process of publication.

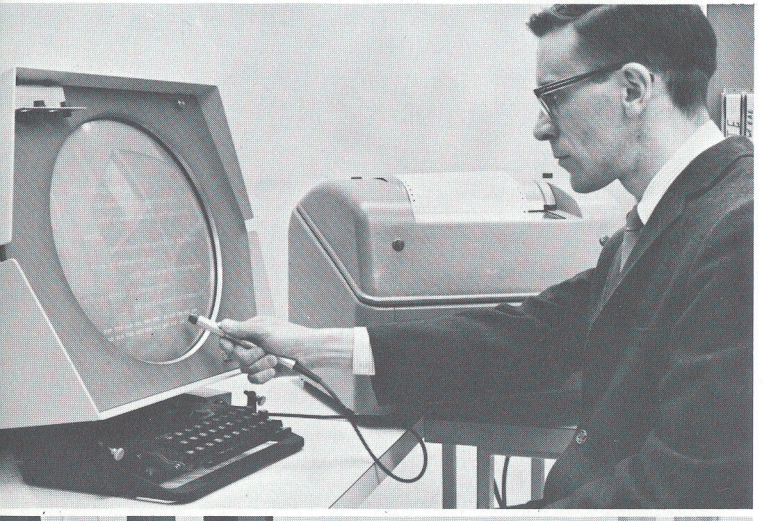
The project, supported by a grant from the Advanced Research Projects Agency, Department of Defense, uses, as one source of text, the paper tapes punched during the printing process for linotype, monotype and some of the newer photo-typesetting methods. Total information, including text, size of type, font and page layout, is recorded. The system, which eliminates the costly process of manual keypunching, has made available on magnetic tape, for example, the entire text of the McGraw-Hill Encyclopedia of Science and Technology.

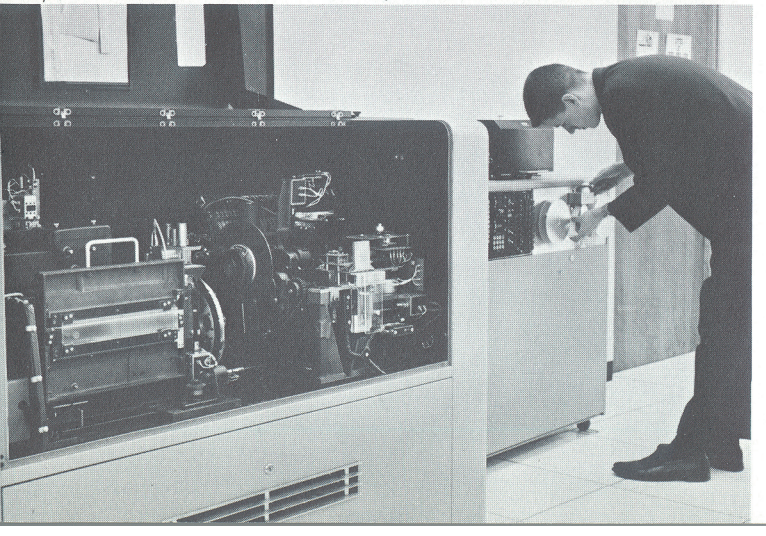


In developing the system, Center researchers collected and analyzed a variety of punched paper tapes typical of those used in the printing industry and built the equipment necessary to read them into the computer. The Center is now equipped to read information from: Five channel teletype tape; six channel teletypesetter tape used on Linotype; eight channel tape which is used on the Photon and the Intertype machines; fifteen channel tape for the Linofilm; and thirty-one channel tape which is used on the Monotype and Monophoto machines.

Equipment currently used in the UPGRADE project includes the IBM 7070 and 7090 systems with two 1401's; paper tape readers and punches capable of accepting 5, 6, 7, 8 and fifteen channel tapes, plus the only 31 channel computerized Monotype reader in the country; a Calcomp plotter; and a cathode ray display tube and editing console with a PDP-4 on-line to the 7090.







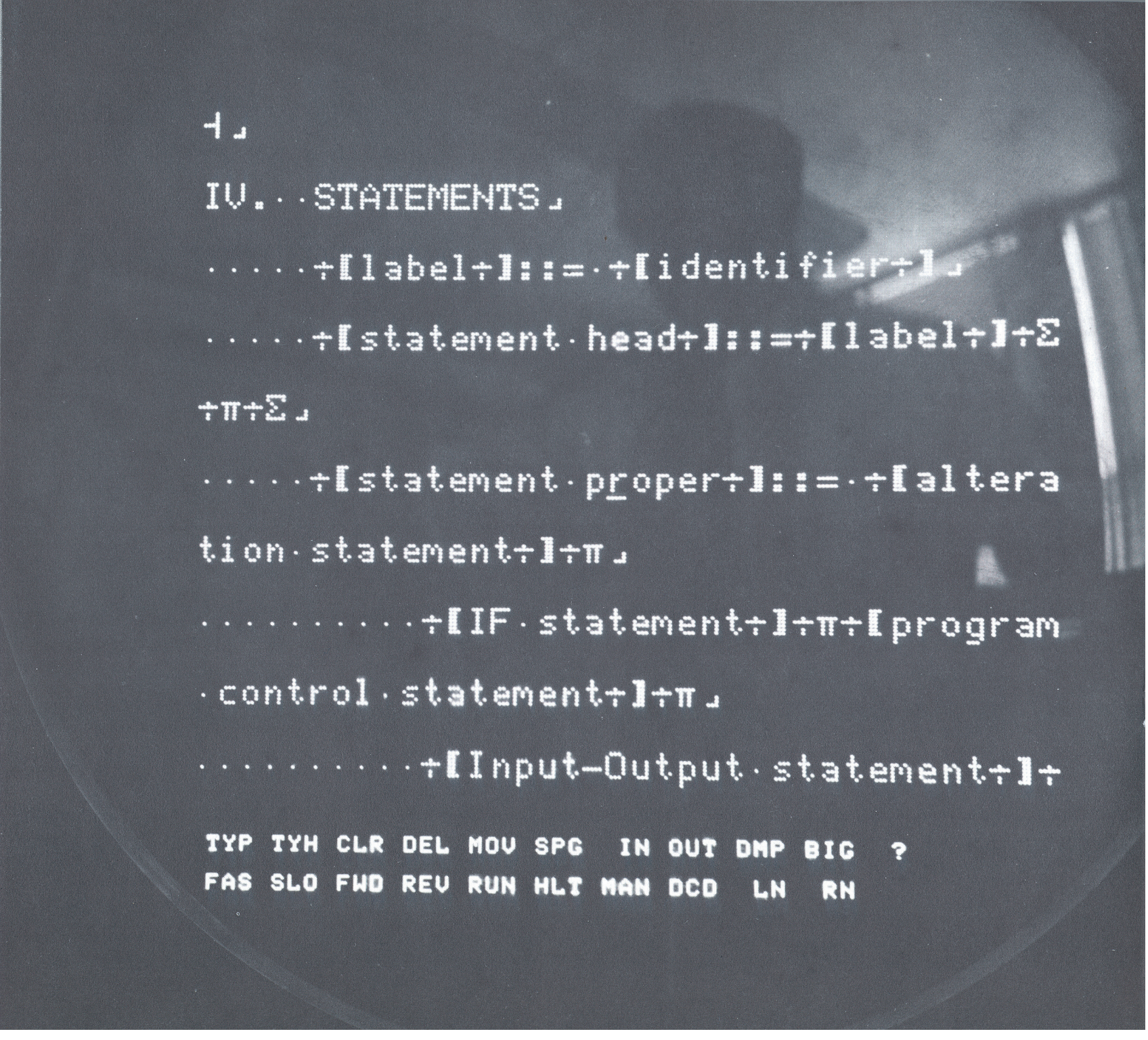
COMPUTERIZED TYPESETTING

The Center's computerized typesetting system, designed primarily for book and journal printing, is currently capable of setting straight text or tabular material from unjustified tape. Control codes used on input specify type font, line length, type size, leading between lines and similar composing room instructions. The system can accept input from eight channel paper tape, punched cards or magnetic tape and produce justified tape for the Photon-560.

An on-line display screen with a light pen and a typewriter are used for editing, page arrangement and corrections. Material being edited is displayed on the screen as desired. Alteration instructions, such as additions, deletions and transpositions, are transmitted to the computer in part by simply directing the light beam at appropriate points on the display screen. Effect of the alteration becomes immediately visible on the screen. For example, a deleted word will vanish and the space it occupied will be closed up with the readjusted text.

Current research goals include:

- A high quality hyphenation routine.
- Ability to automatically set complicated mathematical formulas.
- Modification of typesetting routines to simplify the preparation of text.
- Generalization of the output to allow the system to be used with all hot metal and other phototypesetting machines.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TYP TYH CLR DEL MOV SPG IN OUT DMP BIG ?
FAS SLO FWD REV RUN HLT MAN DCD LN RN

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                $ ENGLISH TO A DIALECT OF PIG-LATIN TRANSLATION $
$ PROGRAM ASSUMES EVERY WORD HAS A VOWEL AND PUTS ALL CONSONANTS
  PRECEDING FIRST VOWEL AT END OF WORD AND SUFFIXES AY $

            ALPHAMERIC  DICTIONARY  IS  VOWELS = A, E, I, O, U.
            ALPHAMERIC  VARIABLE  IS  ENGLISH(X,Y,Z).
            INTEGER  VARIABLES  ARE  SENT, WORD.
START       READ  ENGLISH  FROM  CARDREADER,    START.
            PRINT  ENGLISH  ON  PRINTER.
            FOR  SENT = 1,2,...,LENGTH OF ENGLISH  EXECUTE SENT-TRANS.
            SKIP TO NEXT PAGE.
            PRINT  ENGLISH  ON  PRINTER,        END.
SENT-TRANS  FOR WORD=1,2,...,LENGTH OF ENGLISH(SENT) EXECUTE WORD-TRANS, RETURN.
WORD-TRANS  IF  ENGLISH(SENT,WORD,1)  IN  VOWELS,   GOT-VOWEL.
            MOVE ENGLISH(SENT,WORD,1) AFTER ENGLISH(SENT,WORD,LAST), WORD-TRANS.
GOT-VOWEL   SET ENGLISH(SENT,WORD) = ENGLISH(SENT,WORD) .+. -AY-,   RETURN.
            PROGRAM  BEGINS  AT  START.
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PENELOPE

To develop new uses for the computer, the Center emphasizes research in the design and specification of computer languages, both graphic and procedural. Among recent projects was development of the computer language PENELOPE (Pitt Natural Language Processor) which, unlike most computer languages, is designed primarily to handle text rather than numeric computation. It is particularly useful to people who have limited training in computer programming and whose work involves, not numbers, but natural language.

PENELOPE is designed with twofold purpose: To be easy to learn and use; to handle alphabetic text naturally and efficiently. The main units in PENELOPE are statements which externally resemble English statements to the extent that they are intelligible but not ill-structured. The user may operate on structured elements referred to as "sentences," "words" and "characters."

Typical applications of PENELOPE are: Studies of student themes by psychologists; word frequency listings of first grade readers compiled by educators; content analysis and information studies on the New English Bible by Center staff members; concordances prepared by English professors; compilation of business files by business administration professors; compilation of medical records by medical personnel.


TEST
MR1
MR

MONITOR SYSTEM PEST

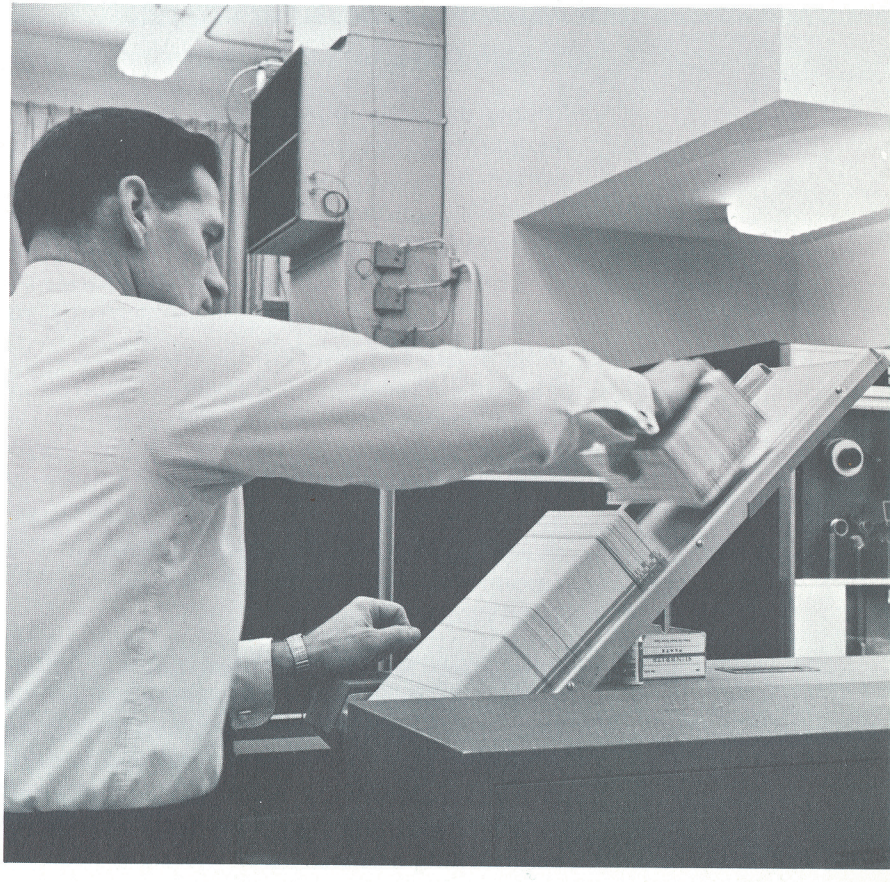
The monitor system PEST (Pitt Executive System for Tapes) was developed at the Center for two main purposes:

- To process efficiently the large number of computer runs on research projects conducted by students and faculty at the University.
- To enable users, including beginning students, to cope with the complexity of a tape-oriented 7070 using the 1401 as an input-output device.

The user's program, keypunched on cards, is transferred to magnetic tape and stored sequentially by the 1401 computer. On-line with the 7070, this taped store of programs assures efficient, continuous 7070 operation with a minimum of operator intervention and eliminates the need for hour-by-hour scheduling of computer time. The 1401 also prints out the results obtained by the 7070.

PEST is responsible for sequencing jobs, system control card interpretation, accounting functions and general supervision of the computer operations within a given program and between programs.

A feature of the system is FORT PITT, an extremely fast FORTRAN compiler, which is particularly helpful for the short runs commonly submitted by students.



OTHER RESEARCH PROJECTS OF THE CENTER

- Theory of numbers: An inquiry into new representations for cyclotomic numbers supported by a grant from the National Science Foundation. Applications of cyclotomic numbers—numbers of solutions of certain congruences—are also considered.

- Pattern recognition: Design and development of hardware and software for optical scanning and pattern recognition. Particular application of this project is analysis and matching of human chromosomes to determine those which are mutant. Another study, closely related, involves construction of a "whole-body counter" that will be used to measure the amount of radiation to which a person has been exposed.

- Simulation models: Construction of mathematical and simulation models representing the economies of Turkey and other developing countries. This work, conducted jointly with the Graduate School of Public and International Affairs, will have applications in decision-making and economic planning.

EDUCATION

COUNCIL ON COMPUTER SCIENCE

The University of Pittsburgh's Council on Computer Science, established in September, 1964, is responsible for the academic program related to computing in all departments. Currently, the Council is developing M.S. and Ph.D. programs in Computer Science. Although an undergraduate major in computer work is not being considered at this time, the departments of Industrial Engineering and Mathematics are developing undergraduate options in this field.

Council chairman is William B. Kehl, Professor of Computer Science and Director, Computation and Data Processing Center. Other members of the interdepartmental Council are:

Mario Benedicty ..... Chairman, Department of Mathematics
Sidney Goldring ..... Chairman, Division of Neurological Surgery
Nicholas Rescher ..... Professor of Philosophy
T. W. Sze ..... Professor of Electrical Engineering
Donovan Thompson ..... Professor of Biometry
Carl Beck ..... Associate Professor of Political Science

The Council advises students in planning a basic course of study which will serve as preparation for subsequent specialization and research work. Each Council member can provide specific information on computer-related courses currently offered in his area.

For the academic year 1965-1966, while the Council is completing the development of the curricula for graduate degree programs, students are advised to continue their studies in a related discipline. After the formal curriculum leading to a degree in Computer Science has been established, students may transfer credits already earned in Computer Science courses.

Detailed information concerning the programs of study and research in various branches of Computer Science may be obtained by writing to Professor William B. Kehl, Chairman of the Council on Computer Science, Computation and Data Processing Center, University of Pittsburgh.

COURSES IN COMPUTER SCIENCE

During the academic year 1965-1966, the University of Pittsburgh is offering an expanded list of courses in Computer Science. In the following course listing, the academic department which administers each course is indicated in parentheses. The potential computer scientist may also select courses, in accordance with his interests, from the large number of courses in related fields offered by various departments, such as Electrical Engineering, Industrial Engineering and Mathematics. For information on these, see the bulletins of Natural Sciences, Liberal Arts and Engineering and Mines.

Computer Science 1—Introduction to Algorithmic Processes (Math.) 3 cr.

A prerequisite for all courses sponsored by the Council on Computer Science, this course, also listed as Industrial Engineering 12, will be offered every trimester in both day and night sections. This is an introductory course which enables the student to become familiar with the elementary aspects of computers and their application. Emphasis is on problem definition and problem solving. Topics: Concept and properties of an algorithm; language and notation for describing algorithms; analysis of computational problems and development of algorithms for their solution; application of a special, procedure-oriented language to solve simple numerical and non-numerical problems using a computer. Prerequisite: Two years of high school algebra.

Computer Science 13—Computer Organization and Programming (Math.) 3 cr.

Logical basis of computer structure; machine representation of numbers and characters; flow of control; instruction codes; arithmetic and logical operations; indexing and indirect addressing; input-output; subroutine linkages; macros; interpretive and assembly systems; pushdown stacks and recent advances in computer organization. Prerequisite: Computer Science 1.

Computer Science 44—Numerical Calculus (Math.) 2 cr.

An introduction to numerical methods. Includes elementary discussion of errors, polynomial interpolation, numerical integration and solution of nonlinear equations. The algorithmic approach and the efficient use of the computer will be emphasized. This course parallels the course of study in the elementary analysis sequence with computational experience. Prerequisite: Computer Science 1. Co-requisite: Mathematics 24.

Computer Science 111—Introduction to Logical Design (Electrical Eng.) 3 cr.

Basic concepts of Boolean algebra; a survey of logical components; combinatorial and sequential system analysis and synthesis procedure; logical design of arithmetic, control, input-output and memory subsystems in the digital computer. (Listed in the Fall, 1965, Time Schedule of Classes as Electrical Engineering 111.) Prerequisite: Knowledge of an assembly language (such as UMAP or AUTOCODER). Beginning in 1966, Computer Science 13 will be the prerequisite for this course.

Computer Science 113—Information Structures (Math.) 3 cr.

An introduction to the techniques used in the processing of structured data. Both numeric and non-numeric data structures will be considered, but interest will be centered on the latter. Machine constraints on the organization of information structures will be considered together with the problems of referencing and searching structured data. Prerequisite: Knowledge of an assembly language (such as UMAP or AUTOCODER). Beginning in 1966, Computer Science 13 will be the prerequisite for this course.

Computer Science 121—Algorithmic Languages (Math.) 3 cr.

Concepts and design of processors; macros; Boolean algebra; ALGOL 60; interpretive languages; information processing languages; threaded lists; theory of sorting; generator programs. Prerequisite: Knowledge of an assembly language (such as UMAP or AUTOCODER). Beginning in 1967, Computer Science 13 will be the prerequisite for this course.

Computer Science 131—Numerical Algebra (Math.) 3 cr.

Computer methods in matrix algebra—solution of linear systems of equations by direct and iterative methods, matrix inversion, eigenvalues and eigenvectors of matrices. (Listed in the Fall, 1965, Time Schedule of Classes as Mathematics 131.) Prerequisites: Computer Science 1, Mathematics 24, Mathematics 123.

Computer Science 132—Numerical Analysis (Math.) 3 cr.

A thorough treatment of solutions of equations, interpolation and approximation, numerical differentiation and integration, orthogonal polynomials and functional approximation, and initial value problems in the solution of ordinary differential equations. Selected algorithms will be programmed for solution on computers. Prerequisites: Computer Science 1 (or equivalent) and Mathematics 110 or 153 or 155.

Computer Science 251—Simulation of Dynamic Systems (Industrial Engineering) 3 cr.

An introduction to the use of computer simulation for the analysis of dynamic systems. Includes formulating a simulation model, programming the model for the computer and using the computer to test the performance of the modeled system. The SIMSCRIPT simulation programming language will be used. Prior to completion of the course, each student will be expected to describe a dynamic system he wishes to examine, write a SIMSCRIPT program which simulates the system and utilize the program to test the response of the system. Prerequisite: Computer Science 1.

Industrial Engineering 122—Computer Operating Systems (Industrial Engineering) 3 cr.

Concepts of processors; the software environment within which processors operate; general considerations in computer systems design. Prerequisite: Computer Science 1. Beginning in 1966, Computer Science 13 will be the prerequisite for this course.

Industrial Engineering 255—Structure of Assemblers, Interpreters and Compilers (Industrial Eng.) 3 cr.

Construction of assemblers; design and construction of compilers; construction of interpreters; problems of real-time on-line processing; problems of multiprogramming computer systems; selected problems in multiprocessing computer systems; scheduling algorithms for input-output and processing. Prerequisite: Industrial Engineering 122.

STAFF

The Center's staff includes systems analysts, programmers, scientists and mathematicians. Staff members conduct research in general computer systems, including time sharing, multi-processing and multi-programming, and develop new operating systems to effectively utilize the current facility. Most recent example involves the conversion to a disc-tape system from a tape-oriented system for the 7090. Staff members also develop and integrate programs and systems that are frequently used such as SIMSCRIPT, LP/90 and the BIMD statistical routines.

Researchers, faculty members and students who wish to utilize the Center's equipment may call on members of the Center's staff for consultation and help. In addition, the Center employs program advisors to assist in preparing problems for the computers. Those who use the facility also have access to programs and relevant data available in the Center's library.

The Center offers a limited number of appointments as research associates and visiting scientists to scholars with advanced degrees. This practice provides an opportunity for an interchange of scholars from other institutions. Inquiries concerning the appointments should be addressed to the Director of the Center.

COMPUTATION AND DATA PROCESSING CENTER EQUIPMENT

IBM 7090 COMPUTING SYSTEM
32,768 words of core storage
3 input/output channels
IBM 1301 Model 2 Disk Storage
12 model 729II Tape drives,
4 shared with the 1401 system
On-line printer (716) and card reader
Core storage clock and Interval trap features

IBM 7070 COMPUTING SYSTEM
10,000 words of core storage
Floating decimal hardware
2 tape channels
10 model 729II Tape drives,
4 shared with the 1401 system
Interval timer feature

TWO IBM 1401 SYSTEMS
Each has:
4,000 characters of storage
4 model 729II Tape drives,
1403 Printer with 132 print positions
1402 Reader/punch

PDP-4 SYSTEM
Paper tape reader/punch
Printer-keyboard
CRT Display and light pen
Interface for communication with 7090 system

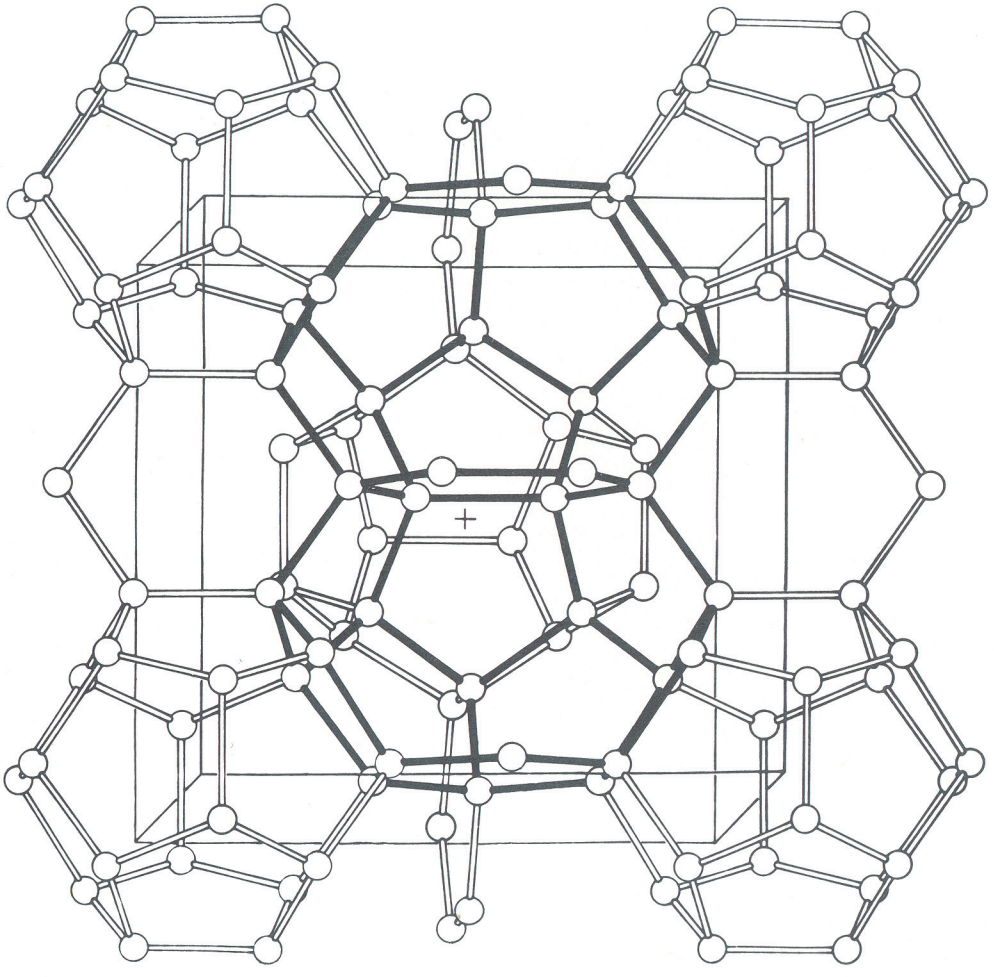
CALCOMP PLOTTER, MODEL 564
0.005 inch incremental motion in X and Y axes
1.5 to 2.1 inches per second
Program controlled by one 1401

PHOTON COMPUTER TYPESETTER
Multiple font
1600 characters
Paper tape readers for 5, 6, 7, 8, 15, and 31 channel tape

TABULATING EQUIPMENT
19 IBM Keypunches, model 026
2 IBM Reproducing punches, model 514 and 519
2 IBM Sorters, model 082 and 083
1 IBM Accounting machine, model 407
1 IBM Collator, model 085
2 Friden flexowriters

FRIDEN CALCULATOR

The Computation and Data Processing Center has been used for research in the natural sciences, public health, law, pharmacy, medicine and the social sciences.



Crystallographers at the University use the Center's equipment to help analyze crystal structures, such as that of ethylene oxide pictured above.