

IBM 650 RAMAC TAPES

International Business Machines Type 650
Magnetic Drum Data Processing Machine

International Business Machines Corporation



Picture by International Business Machines (Basic)

APPLICATIONS

Manufacturer /
Commercial, scientific and engineering data processing.

Government Sample

Ames Aeronautical Laboratory, NACA
Wind tunnel and flight data reduction and scientific calculations.

Signal Corps Engineering Laboratory
Scientific and engineering computations.

U. S. Naval Avionics Facility
Research.

U. S. Naval Ordnance Laboratory, White Oak
Scientific computation.

Industrial Sample

American Telephone and Telegraph Company
AT & T has 15 IBM 650 systems operating, including Bell Laboratories. Typical applications of these systems, completed, in progress and planned, include

Property and Cost - Material Distribution - including retirements, pricing, loading and summarizing.
Property and Cost - Perpetual Inventory and Average Prices.

Payroll (all weekly) - traffic reported by trick codes.

Depreciation Calculations.

Business Office Work Volume Report.

Customer Attitude Survey

Payroll - (a) All departments up to District Level
(b) All departments District Level and above.

Salary Advances

Savings Bonds

Quarterly Wage and Tax Computations (941A & W-2)

Quarterly Anniversary Listing

Blanket Payroll Change for General Increases

Pricing and Loading Overhead for Engineering Sources

Payroll Data Used in Developing Predetermined Average

Hourly Rates

Labor, Motor Vehicle, Special Tool, and Overhead Distribution



Picture by International Business Machines Corporation (Tapes)

Voucher Distribution
 Specific Estimates
 Material Distribution
 Management Survey
 Wage Survey
 Commercial Measurements
 General Trunk Studies
 Quarterly Outside Plant Construction Results Plan
 Annual Continuing Property Record
 Development of Capital Tool and Material Disbursed
 Prices
 Wages of Employees Residing in Indiana for State
 Income Tax Purposes
 Labor, Motor Vehicle, Special Tool, and Overhead
 Distribution
 Annual Census
 House Service Distribution
 Million Conductor Feet Report
 Telephone Set Movement Report
 Prorate of Transportation Charges Reported on
 Western Electric Bills
 Flash Report of Expenses and Current Month Maintenance
 Report
 Sampling Inventory of Station Apparatus for Simplified
 Station Accounting
 Revenue Accounting - Billing - Toll ticket billing
 work, message register billing, local service charge
 and miscellaneous billing, customer payments and
 coin telephone collecting and accounting.
 Community Chest Contributions

Preliminary studies of seasonal variation analysis
 (as a training problem), Toll Service Observing,
 Message Mile Minute and Exchange Plant Trouble
 Analysis.
 Punching Airline Mileages into Message Sample Cards
 Aeronutronic Systems, Incorporated
 General purpose.
 Batelle Memorial Institute
 Commercial, scientific and engineering.
 Bell Telephone Laboratories
 Two IBM 650's on research, 1 on network calculations.
 Chrysler Corporation, Chrysler Engineering
 Engineering applications in Computer Laboratory
 Chrysler Corporation Missile Operations
 Ballistic missile trajectory analysis and other
 engineering computation.
 Chrysler Corporation, Plymouth Division
 Material requirements determination, sales statistics,
 production reports, payroll.
 Chrysler Corporation, West Coast Division
 Material requirements calculations, production
 reports, payroll.
 Cook Research Laboratories
 Engineering and scientific.
 Cornell Aeronautical Laboratory, Incorporated
 Scientific computing, engineering, accounting.
 Indiana University
 Used for research and instruction by members of the
 faculty and staff of Indiana University. This equip-
 ment is not used for routine administrative
 calculations.



Picture by International Business Machines Corporation (RAMAC)

Prudential Insurance Company of America
 Statistical and other mathematical applications.
 Republic Aviation Corporation
 Aircraft engineering, research and development.
 Stanford Computation Center
 Scientific computing and education.
 University of California Radiation Laboratory
 Scientific calculation.
 University of Rochester Computing Center
 Physical research, statistics, educational tool.
 Westinghouse Bettis Atomic Power Division
 Scientific calculations.

NUMERICAL SYSTEM

Manufacturer	
Internal number system	Decimal
Decimal digits per word	10 plus sign
Instructions per word	One
Instructions decoded	89
Arithmetic system	Floating and fixed point available
Instruction type	Two address
Number range	$-10^{10} < n < 10^{10}$

Government Sample
 Ames Aeronautical Laboratory, NACA
 Modified one-address (one address and location of next address), 37 instructions used.
 Signal Corps Engineering Laboratory
 Floating point through interpretive system, modified

one address with three address interpretive system.
 Industrial Sample
 Bell Telephone Laboratories
 "Interpret" most work to make it look like floating point. Eight digits plus two digit exponent.
 Interpretive systems use 3-address order structure.

ARITHMETIC UNIT

Manufacturer	Microsec
Add (exclud. stor. access)	672-768
Mult (exclud. stor. access)	2,210-19,600
Div (exclud. stor. access)	6,000-23,400
Construction	Vacuum tubes and diodes
Rapid access word registers	3
Basic pulse repetition rate	125 Kc
Arithmetic mode	Serial by decimal digit, parallel by bits
Timing	Synchronous
Operation	Sequential and partially concurrent

Government Sample
 Ames Aeronautical Laboratory, NACA
 Assuming optimum programming, the add time is 288, multiply time 10,000, and divide time 12,000 microseconds.

Signal Corps Engineering Laboratory
 Access time ranges from 0 to 4,800 microseconds, yielding the following, including and excluding median access time respectively, add time 3,360, 960; multiply time 13,344, 10,944; divide time



Picture by University of California Radiation Laboratory

17,184, 14,784 microseconds.

Industrial Sample

Aeronutronic Systems, Incorporated
 Respectively 700, 12,000, and 14,000 microseconds
 with optimum programming, excluding storage access.

Cornell Aeronautical Laboratory, Incorporated
 For including and excluding storage access time,
 respectively, add 10,176 (worst case), 672; multiply
 29,186 (worst case), 2,400; divide 33,024 (worst
 case), 6,240. Higher figures represent worst possi-
 ble programming whereas lower figures indicate better
 programming.

Republic Aviation Corporation
 Vacuum tubes used in arithmetic unit are 6350, 6211,
 5965, 6AL5, 6AY7, OC3.

University of California Radiation Laboratory
 Including and excluding storage access, respectively,
 add 5,472 (average), 288; multiply 15,360 (average),
 10,560 (average); divide 15,648 (average), 14,400
 (average); microseconds.

STORAGE

Manufacturer	Medium	Words	Microsec Access
Magnetic drum		1,000 or 2,000	96 min 4,800 max
Magnetic core		60	96
Magnetic tape		500,000 per unit	
Disc (RAMAC)		600,000	800,000 max/60 words

Maximum of six tapes possible. Time to accelerate
 tape to read or write status (75 inches per second)
 from standstill is 10 millisecc of which 9.7 millisecc
 are available for further computation. Magnetic tape
 is compatible with EDPS IBM 701, 702, 704 and 705.
 Magnetic tape unit can rewind 2,400 feet of tape in
 1.2 minutes. The RAMAC stores 600,000 words (6,000,
 000 dec. dig.) on magnetic discs. Up to four units
 may be used on one system. Access time is 800,000
 microseconds maximum, for 60 words; 300,000 micro-
 seconds maximum track to track access, same disc
 and 180,000 microseconds track to track adjacent
 disc. Average write access is 125,000 microseconds;
 average read is 100,000 microseconds.

INPUT

Manufacturer	Media	Speed
Punched Card Reader		200 cards/min
Magnetic Tape		15,000 char/sec

150 cards/min may be read from read feed of type 407
 Accounting Machine when attached. A 10-word input
 buffer is provided which allows computation to
 proceed for 272 millisecc of the 300 millisecc
 necessary to read a card. A 60-word magnetic core
 buffer is available between magnetic tape and the
 magnetic drum. Each of these words of core is
 addressable between the magnetic tape and the magne-
 tic drum. Each of these words of core is addressable
 and can be used for rapid access storage when not

reading or writing magnetic tape (96 microsec per word access). Tape from IBM 702, 704 or 705 System can be read by this tape unit. Rewind time for 2,400 feet of tape is 1.2 minutes. The IBM 650 (RAMAC) (355) and the IBM 650 (Tapes) utilize a .537 Read-Punch Unit operating at 155 cards/minute.

Industrial Sample

Cornell Aeronautical Laboratory, Incorporated
At the maximum input rate of 200 cards/minute up to 257 milliseconds are available for computing. This is approximately 2,700 word times or 54 drum revolutions. If more time is required between read instructions, the input rate is necessarily decreased.

OUTPUT

Manufacturer	Medium	Speed
	Punched Card Recorder	100 cards/min
	Magnetic Tape	15,000 char/sec
	Line Printer (wheel type)	150 lines/min 120 char/line
	Line Printer (wire matrix)	1,000 lines/min 60 char/line

A 10-word output buffer is provided which allows computation to proceed for 565 milliseconds of the 600 milliseconds necessary to punch a card. A 60-word magnetic core buffer is available between the magnetic tape and the magnetic drum. Each of these words is addressable and can be used for rapid access storage when not reading or writing magnetic tape (96 microseconds per word access). Printer connected directly to main frame of computer through a 10-word print buffer. Printer connected to magnetic tape frame, independent of computer. The IBM 650 RAMAC and IBM 650 Tapes Systems utilize a 537 Read Punch Unit with a speed of 155 cards/minute.

Industrial Sample

Cornell Aeronautical Laboratory, Incorporated
At the maximum card punching rate of 100 cards/minute up to 544 milliseconds are available for computing. This is approximately 5,600 word times, or 110 drum revolutions. If more time is required between punch instructions, the maximum rate is necessarily decreased.

University of Houston Computing Center
Machine is equipped with alphabetic and special character devices.

CIRCUIT ELEMENTS ENTIRE SYSTEM

Manufacturer	Quantity
Tubes	2,000
Tube types	7
Crystal diodes	4,000-5,280
Tube types are	5965, 6350, 5687, 6211, 12AY7, 2D21, and 6AL5. 1,000-word drum has 119 heads; 2,000-word drum has 219 heads.

CHECKING FEATURES

Manufacturer
Validity character check. This check is placed on data and instructions in arithmetic and logical units every 96 microseconds. (Every word time). The check accomplishes the following:
Dropped and picked up bits are immediately detected. Only 10 admissible combinations out 128 possible combinations.
The register in question is indicated on console. Non-existent addresses and order codes are detected as errors. Clocking checking circuits are provided

for magnetic drum. Card feed errors are indicated. A double punch or a blank column in any column which has received a punch instruction for the output cards causes an error indication light to switch on and the operation will stop. Overflow of accumulator.
Divide check Dividend divisor.
Horizontal and vertical parity checks on magnetic tape.
Magnetic tape to card check.

Government Sample

Ames Aeronautical Laboratory, NACA
Address stop and half-cycle switches.
Signal Corps Engineering Laboratory
Biquinary validity checks, timing checks and overflows are fixed checks. Double-punch, blank column are optional checks.
Industrial Sample
Aeronutronic Systems, Incorporated
Check on proper biquinary representation of decimal digit, check on proper range of addresses.
Battelle Memorial Institute
Validity checks on both data and instructions. Non-existent addresses are detected as errors. Non-existent orders are detected as errors. Clocking checking circuits are provided for magnetic drum. Card feed errors and blank or double punch column detection.
Chrysler Corporation, West Coast Division
Biquinary and double-punch, blank-column detection.
Cook Research Laboratories
Validity checks, read checks, punch checks, control checks.

Cornell Aeronautical Laboratory, Incorporated
Validity checks, 3 checking stations at strategic points in computer to check transmission of numbers internally; also read check and punch checks are incorporated at input and output. Control checks, which detect the following: Illegal addresses, illegal operation codes, timing circuitry discrepancies, and accumulator overflows not anticipated by the programmer.

Republic Aviation Corporation
Fixed checks are bit check, timing check, invalid address check, overflow check, card feed check. Optional checks are double punched, blank column detection.

University of California Radiation Laboratory
Validity character check, clocking circuits, card feed errors.

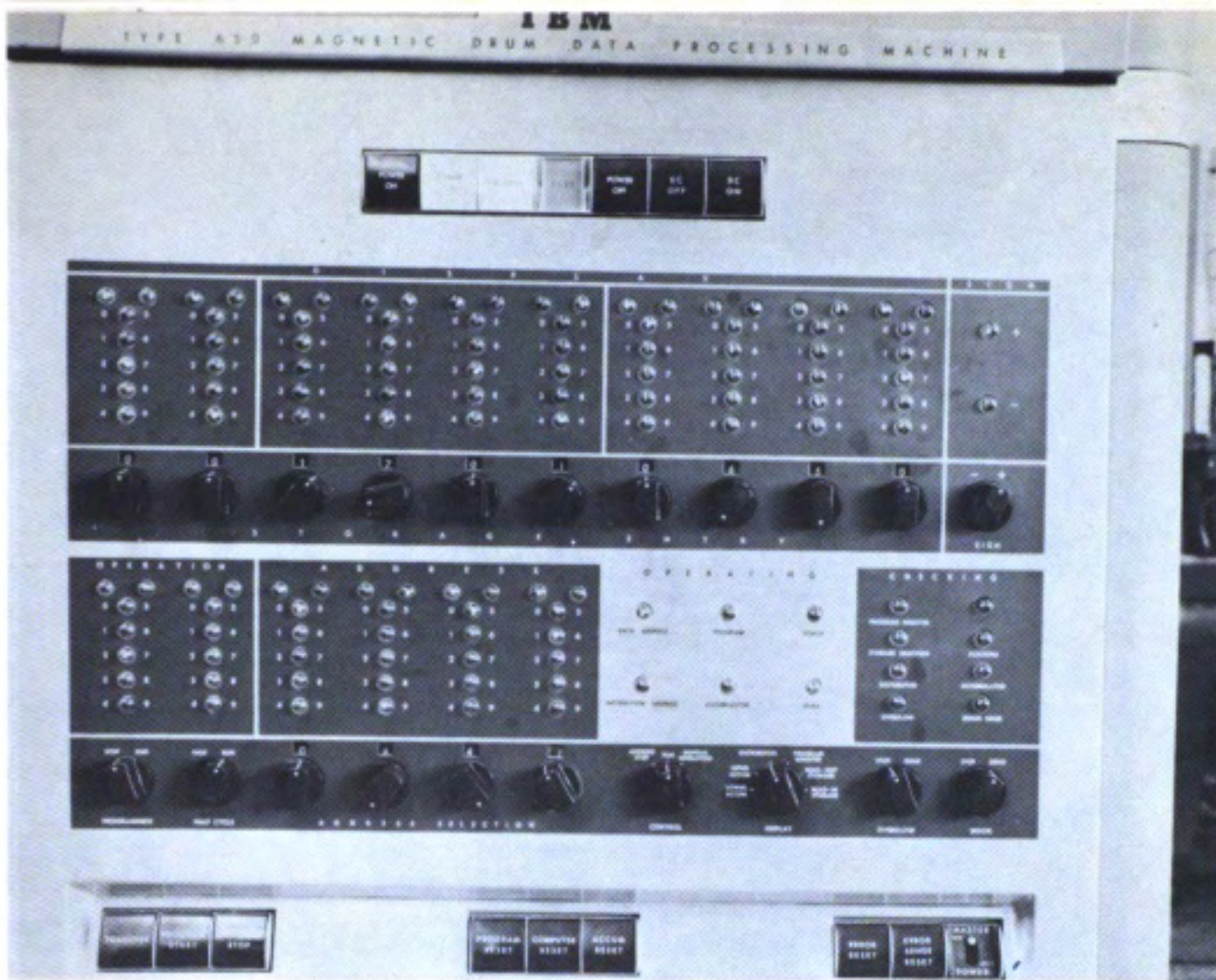
Westinghouse Bettis Atomic Power Division
Redundancy and validity are fixed, double punch blank column on output only is optional.

POWER, SPACE AND WEIGHT

Manufacturer	Power	Space	Weight
	Power, computer	17.7 KVA	
	Space, computer	270 cu. ft.	45 sq. ft.
	Weight, computer	5,656 lbs.	
	IBM 650 RAMAC requires	35.5 KVA, 9,000 cu. ft., 1,000 sq. ft., weighs 14,000 lbs. and requires 8 Tons of refrigeration.	
	IBM 650 Tapes requires	42 KVA, 9,000 cu. ft., 1,000 sq. ft., weighs 15,000 lbs. and requires 9 Tons of refrigeration.	

Government Sample

Signal Corps Engineering Laboratory
Installation requires 25 KW, 200 cu. ft., 36.6 sq. ft., weighs 6,060 lbs. and utilizes 5 Tons of refrigeration.



Picture by U. S. Naval Air Missile Test Center, Point Mugu, California

Industrial Sample

Aeronutronics Systems, Incorporated
 Installation requires 19 KW, at 0.87 power factor,
 225 sq. ft.

Battelle Memorial Institute
 Installation requires 17 KW, 55,000 BTU, 225 sq. ft.,
 weighs 5,500 lbs.

Chrysler Corporation, Plymouth Division
 Installation 22.5 KW, 225 sq. ft., 30 Ton air
 conditioner.

Chrysler Corporation, West Coast Division
 Installation requires 208-230 volts, 100 amps., 500
 sq. ft., 4,500 lbs.

Cook Research Laboratories
 Installation 17.7 KVA, 199 cu. ft., 40 sq. ft.,
 5,360 lbs., 7.5 Tons.

Cornell Aeronautical Laboratory, Incorporated
 Installation requires 17.62 KVA, 84.7 amps at 208
 volts single phase, 60 cycle. 5,360 lbs. Power
 space and weight of computer are for the basic 650
 system, i.e. type 655 power unit, type 650 console
 unit and type 533 Read-Punch Unit. The read punch
 dimensions are 59-7/16 in. x 25-3/8 in. x 49-1/8 in.
 Power unit dimensions 62-1/8 in. x 30-5/16 in. x 71
 in. Console Unit is 76-1/2 in. x 30-5/16 in. x 71
 in. Air conditioning requirements must be such that
 the following conditions are met, (1) Temperature
 50° F to 90° F and (2) Relative humidity 0% to 80%.

Republic Aviation Corporation
 Installation requires 14 KW, 16.6 KVA, 0.86 PF,

2,875 sq. ft., 5,360 lbs.; 10 Tons of refrigeration.

University of Houston Computing Center
 Air conditioning 6-1/2 Tons (5 Tons freon refrigeration
 and 1-1/2 Tons chilled water) operating in the
 room containing the IBM 650, 407 and 082. However,
 the amount of air conditioning is not adequate.

Westinghouse Bettis Atomic Power Division
 Installation requires 16 KW, 21 KVA, 0.76 PF, 600 sq.
 ft. (machine space only).

PRODUCTION RECORD

Manufacturer	
Produced	524
Operating	507
Delivery time	Special



Picture by University of California Radiation Laboratory

COST, PRICE AND RENTAL RATE

Manufacturer

Rental rates of basic system \$3,250/month and up.
 ~\$975/month for RAMAC Disc Unit only.

Government Sample

Ames Aeronautical Laboratory, NACA
 Basic system rental rate \$3,750/month.
 Signal Corps Engineering Laboratory
 Basic system rental rate \$4,000/month, additional
 equipment \$900/month.

U. S. Naval Avionics Facility
 Basic system \$3,800/month.

Industrial Sample

Aeronutronic Systems, Incorporated
 Basic system \$3,725/month, additional equipment
 \$1,700/month.

Battelle Memorial Institute

Basic computer \$3,750/month includes maintenance
 and parts, additional equipment \$1,300/month.

Chrysler Corporation, Chrysler Engineering
 Respectively, \$3,200/month, \$800/month.

Chrysler Corporation, Missile Operation
 Basic system \$3,600/month.

Chrysler Corporation, Plymouth Division
 Basic system \$3,700/month.

Chrysler Corporation, West Coast Division
 Respectively \$3,750/month, \$450/month.

Cook Research Laboratories

Approximate price \$205,900, \$3,750/month.

Cornell Aeronautical Laboratory, Incorporated
 Approximate price of basic system (Purchase Price)
 is \$205,900. Rental rate, basic system \$3,750/month.
 Immediate access (core) storage with Floating
 Decimal Arithmetic and Indexing Accumulators rental
 rate is \$2,350/month.

Indiana University

This equipment is rented with a 60% Educational
 Contribution from IBM.

Republic Aviation Corporation

Basic system \$3,750/month, alphabetic device is
 \$325/month.

Stanford Computation Center

Standard IBM charges with educational contribution.

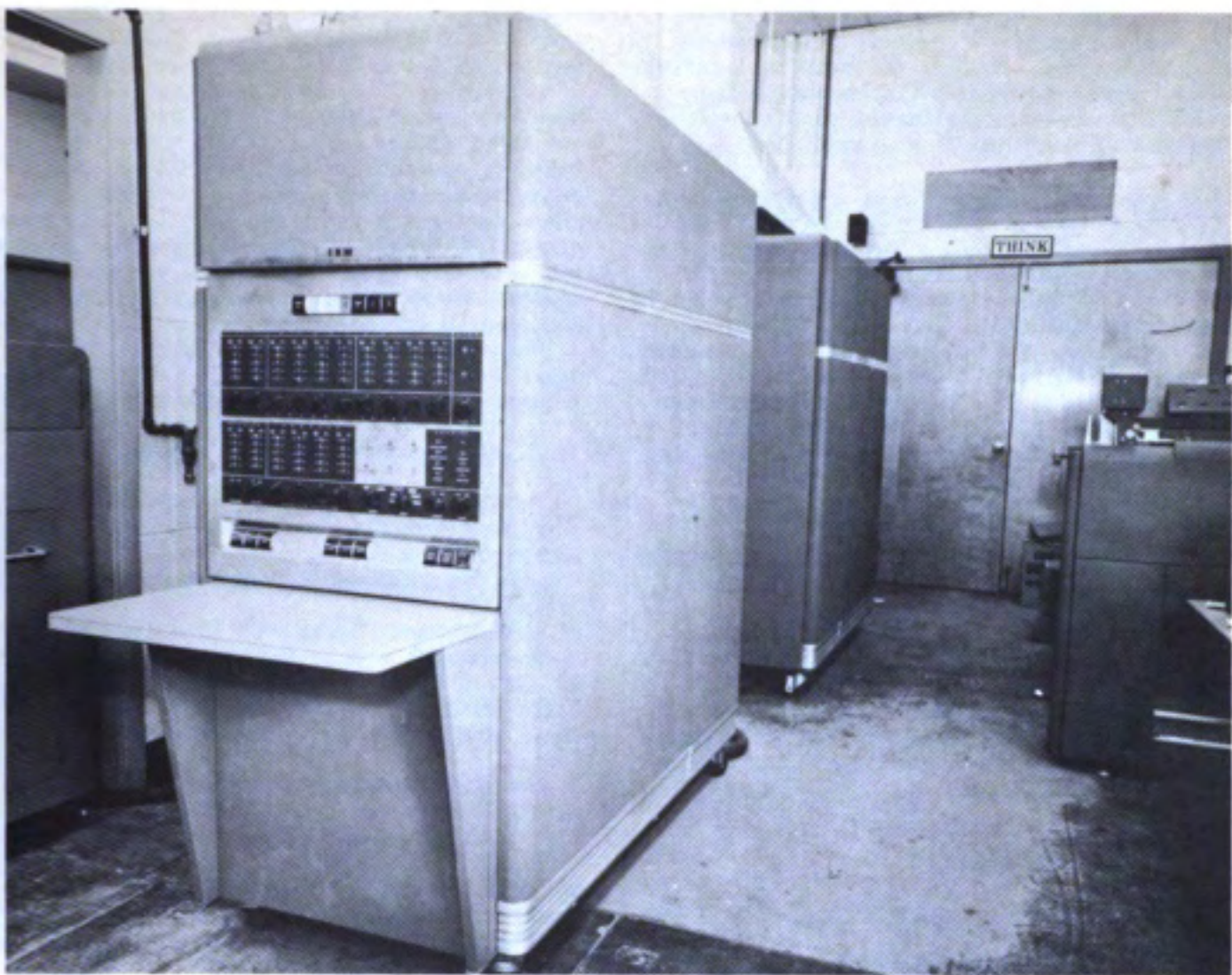
University of California Radiation Laboratory
 Basic system \$3,650/month for 1st shift, \$400/month
 for 402 printer.

PERSONNEL REQUIREMENTS

Manufacturer	Engineers	Math	Tech and Operators
Daily Operation			
1-8 Hour shift	IBM	3	2
2-8 Hour shifts	IBM	6	4
3-8 Hour shifts	IBM	9	6

Government Sample

Ames Aeronautical Laboratory, NACA
 Two 8-hour shifts require 1 engineer, 2 tech or
 operators, programmers do some operating.



Picture by U. S. Naval Air Missile Test Center, Point Mugu, California

Signal Corps Engineering Laboratories

Nine mathematicians utilized with system.

U. S. Naval Avionics Facility

4 engineers and 4 technicians or operators utilized.

U. S. Naval Ordnance Laboratory

The Applied Mathematics Division consists of 23 technical people. Other "open shop" personnel also use and operate the machines. The maintenance is done by IBM.

Industrial Sample

Aeronutronic Systems, Incorporated

One 8-hour shift requires 0.5 engineer and 1 tech or operator.

Battelle Memorial Institute

One 8-hour shift requires 4 mathematicians and 2 technical operators.

Bell Telephone Laboratories

One operator is capable of operating two machines per shift. The "open shop" system is utilized. Staff to program and code for one machine for one 8-hour shift is 3 engineers and 12 assistants.

Chrysler Corporation, Engineering Computing Laboratory

One 8-hour shift 3 technicians or operators. Understaffed by 3 at present. (All operators are programmers).

Chrysler Corporation, Missile Operation

One 8-hour shift 5 coders, 2 technicians or operators.

Chrysler Corporation, Plymouth Division

Three 8-hour shifts require 3 programmers plus 3

console operators.

Chrysler Corporation, West Coast Division
One 8-hour shift 1 operator and 2 programmers; one additional operator per additional shift.

Cook Research Laboratories
One 8-hour shift 3 engineers, 2 technicians (engineers are programmers).

General Dynamics Convair Division
Operated 7 AM to 1 AM by programmers.

Cornell Aeronautical Laboratory, Incorporated
Two 8-hour shifts require 2 engineers and 4 operators.

Indiana University
An "open shop" installation in which faculty and students do their own programming. There is one permanent chief programmer and a small temporary staff consisting largely of graduate students who do key-punching and program special problems. IBM services the equipment.

Minneapolis-Honeywell Regulator Company, Aeronautical Division
Staff consists of 7 engineers, 6 technicians, "open shop" arrangement.

Republic Aviation Corporation
Two 8-hour shifts require 3 operators, maintained by IBM. This does not include programming.

Stanford Computation Center
One 8-hour shift 3 to 10 operators, "open shop".

University of California Radiation Laboratory
Two 8-hour shifts 0.5 engineer; service on two machines.

University of Rochester Computing Center
One 8-hour shift requires 4 operators, including a Burroughs E101 System. Usually operated on "open shop" basis. Most programming and operating is done by the user who is not attached to the Computing Center.

RELIABILITY AND OPERATING EXPERIENCE

Government Sample

Ames Aeronautical Laboratory, NACA
Average error-free running period 36 hours.
Good time 211.3 hours
Attempted to run time 234.9 hours
Operating ratio 0.900
Above figures based 29 November 1956 to 28 December 1956. System passed acceptance test 11 September 1955. About 3.6% of the "attempted to run" time is scheduled maintenance. This time is not entered under "good time".

Signal Corps Engineering Laboratory
Accepted February 1956. Except for May 1956, machine has been very reliable and practically error free.

U. S. Naval Avionics Facility
Average error-free running period is 85% of available running time, based on period 1 June 1955 to 1 December 1956. Accepted 1 June 1955.

U. S. Naval Ordnance Laboratory
Respectively as under Ames Aeronautical Laboratory above, 4 hours, 40.5 hours per machine week, 42.7 hours per machine week, 0.95, May 1956 to June 1956, May-June 1955.

Industrial Sample

Bell Telephone Laboratories
Operating ratio 0.95.
Chrysler Corporation Engineering Computing Laboratory
Respectively 32 hours, 1,900 hours, 2,400 hours, 0.80, July 1956 to October 1956.

Chrysler Corporation, Missile Operations
Respectively, average error-free running period 60 hours, operating ratio 0.90, period 1 May 1956 to 1 November 1956, acceptance 1 May 1956.

Chrysler Corporation, Plymouth Division
Average error-free running period two weeks, good time 500 hours, attempted to run 504 hours, based on 1 month period.

Cook Research Laboratories
Respectively 40 hours, 6,020 hours, 6,622 hours, 0.90, 1 June 1956 to 1 January 1957, 28 May 1956.

General Dynamics Convair Division
Average error-free running period 24 hours, operating ratio over 0.99.

Cornell Aeronautical Laboratory, Incorporated
Respectively 49.7 hours, 298.6 hours, 336 hours, 0.888, March 1956 to August 1956. The figures are for the New York Central RR, Buffalo, N. Y., IBM 650 System for indicated 6 months period.

Indiana University
The equipment was installed in July 1956 and apart from the first month of operation there has been very little unscheduled down time. Repairs have been made relatively promptly and far less trouble has occurred with the 650 than with a CPC in a previous year.

Minneapolis-Honeywell Regulator Company, Aeronautical Division
Unscheduled down time not over 5% of scheduled hours. Monthly schedule at least 200 hours/month.

Republic Aviation Corporation
Respectively 424 hours, 443 hours, 0.95, 1 October 1956 to 30 October 1956, January 1956.

University of California Radiation Laboratory
Respectively 12 hours, 3,597.4 hours, 3,744.9 hours,

0.96, October 1955 to September 1956 (12 months), Machine A accepted April 1955, Machine B accepted October 1955. Data is from 2 machines.

University of Houston Computing Center
Based on period 16 August 1956 to 31 October 1956, one tube failure occurred, causing a delay of about 4 hours. No noticed machine errors. Jams in the punch feed mechanism occur approximately twice a month during the first two months. This frequency appears to be diminishing as operators improve card handling technique. Four hours per month preventive maintenance has been the average thus far. System accepted 16 August 1956.

University of Rochester Computing Center
Operating ratio 0.95, period 10 July 1956 to 1 November 1956, accepted 10 July 1956.

FUTURE PLANS

Government Sample

Signal Corps Engineering Laboratory
Additional IBM 650 on order, including indexing accumulators, alphabetic device, automatic floating decimal.

Industrial Sample

American Telephone and Telegraph Company
AT & T has 23 IBM 650 Basic, 7 IBM 650 Tapes, and 4 IBM 650 RAMAC systems on order for applications shown above. One RAMAC is now undergoing IBM field test.

Battelle Memorial Institute
Alphabetic Device, Floating Point, and Index Registers will be available January 1957.

Bell Telephone Laboratories
The IBM 650's will soon be inadequate for the total load and a larger machine is on order.

Chrysler Corporation, Engineering Computing Laboratory
Built in electronic floating decimal has been ordered. At present, the floating decimal is attained by programming. Additional storage capacity may be acquired in the RAMAC attachment.

Chrysler Corporation, Missile Operations
Addition of IBM 653, containing automatic floating decimal unit, indexing accumulators, and also addition of an on-line 407 Tabulator.

Chrysler Corporation, Plymouth Division
Propose to install IBM 650 with 407 input and output, also propose to install 650 RAMAC, with additional tape storage.

Continental Oil Company ✓
A second 650 on order with tapes and RAMAC.

Cook Research Laboratories
Second shift operation to be started 21 January 1957.

Indiana University
Addition of auxiliary equipment to basic 650 during 1957, including an electronic floating point, a small core storage unit, three B-registers, magnetic tapes and direct connection to an IBM 407 Tabulator.

Republic Aviation Corporation
A second 650 is on order, with a type 653 auxiliary unit to incorporate 60 words of magnetic core storage, 3 four-digit index accumulators and floating point arithmetic.

Aeronutronic Systems, Incorporated
Intend to rent an IBM 704 or a Remington Rand 1103A in about one and half years.

University of California Radiation Laboratory
Floating point instructions and index registers will be added when available.

University of Rochester Computing Center
A symbolic three address assembly-interpretive floating point system is in process of development for basic 650.

Westinghouse Bettis Atomic Power Division
May add magnetic tape, depending upon results of an
economics study.

INSTALLATIONS

Government Sample

Ames Aeronautical Laboratory, NACA, Moffett Field,
California

Bonneville Power Administration, Portland 8,
Oregon

Department of Public Works, State of California,
Sacramento, California

Lewis Flight Propulsion Laboratory, NACA,
Cleveland, Ohio

Signal Corps Engineering Laboratory, Fort Mon-
mouth, New Jersey

U. S. Naval Avionics Facility, Indianapolis,
Indiana

U. S. Naval Ordnance Laboratory, White Oak,
Maryland

Industrial Sample

Aeronutronic Systems, Incorporated, Glendale,
California

American Telephone and Telegraph Company, New
York 7, New York

Armour Research Foundation, Chicago, Illinois

Battelle Memorial Institute, Columbus 1, Ohio

Bell Aircraft Corporation, North Tonawanda,
New York

Bell Telephone Laboratories, Murray Hill, New
Jersey

Chrysler Corporation, Chrysler Engineering,
Computing Laboratory

Chrysler Corporation, Missile Operations, Detroit
31, Michigan

Chrysler Corporation, Plymouth Division, Detroit,
Michigan

Chrysler Corporation, West Coast Division, Los
Angeles 54, California

Clark Brothers, Incorporated, Olean, New York

Continental Oil Company, Ponca City, Oklahoma

Cook Research Laboratories, Skokie, Illinois

Cornell Aeronautical Laboratory, Incorporated,
Buffalo 21, New York

Dow Chemical Company, Midland, Michigan

El Paso Natural Gas Company, El Paso, Texas

Equitable Life Insurance Company, New York, New
York

General Dynamics Convair Division, San Diego,
California

General Electric Atomic Research Laboratory,
San Jose, California

Harrison Radiator Company, Lockport, New York

Indiana University, Bloomington, Indiana

Lockheed Aircraft Corporation, Sunnyvale,
California

Minneapolis-Honeywell Aeronautical Division,
Minneapolis, Minnesota

New York Central Railroad, Buffalo, New York

Ohio State University Research Center, Columbus
10, Ohio

Olin Mathieson Chemical Company, Niagara Falls,
New York

Allstate Insurance Company, Skokie, Illinois

The Atlantic Refining Company, Philadelphia, Pa. ✓

The Atlantic Refining Company, Dallas Texas ✓
Chesapeake and Potomac Telephone Company,
Baltimore 12, Maryland

Iowa State College, Ames, Iowa

New York University, College of Engineering,
New York 53, New York

Northwestern University, Aerial Measurements
Laboratory, Evanston, Illinois

Pittsburgh Steel Company, Pittsburgh, Pennsylvania
Prudential Insurance Company of America, Newark,
New Jersey

Republic Aviation Corporation, Farmingdale, New
York

Stanford University Computation Center, Stanford,
California

State College of Washington, Pullman, Washington

University of California Radiation Laboratory,
Livermore, California

University of Houston Computing Center, Houston
4, Texas

University of Rochester Computing Center,
Rochester 20, New York

Washington University, Saint Louis, Missouri

Westinghouse Atomic Power Division, Pittsburgh
50, Pennsylvania

And many others.

ADDITIONAL FEATURES AND REMARKS

Manufacturer

A program is available which will automatically
optimum program any existing program. Magnetic tape
is compatible with 701, 702, 704, and 705. Index
Registers: 3 four-digit plus sign registers are
available. Each register is uniquely addressable
from the logical element. Floating point hardware is
available. The system is based on 8 significant
digits of data and a 2 digit exponent.

Government Sample

U. S. Naval Ordnance Laboratory
The NOL has developed two very efficient speed
coding systems, one is a fixed decimal system and the
other a floating decimal system. In addition, a
system of automatic programming called ADES has been
constructed and is now in process of final checkout.

Industrial Sample

Battelle Memorial Institute
Automatic program available for coding problems.

Bell Telephone Laboratories
A fairly elaborate interpretive system is used for
ease of coding.

Chrysler Corporation, Plymouth Division
Greater system advantages due to increased speed and
storage capacity.

Cornell Aeronautical Laboratory
Basic system is supplemented by addition of 3 four-
position indexing accumulators, 60 words of magnetic
core storage, automatic floating decimal unit and an
on-line printer.

Indiana University
Most coding has been done in one of two ways - short
programs requiring not very much storage and rapid
programming have been constructed using Bell Labs
system described in IBM Tech Newsletter No. 11.
Longer programs have been constructed using IBM
Symbolic Assembly Routines, SOAP and SIR.

Republic Aviation Corporation
Unusual reliability.

Stanford Computation Center
Standard 650 with alpha unit and additional selectors
and 1/2-time emitter.

The following miscellaneous information arrived too
late to be included in the above outline:

Army Ballistic Missile Agency
Model 2 to be delivered in May 1957.

United States Department of Agriculture, Commodity
Stabilization Service
Applications

Preparation of precomputed invoices covering ware-
housing charges due to Grain elevators - approximate-
ly 4,000 invoices are prepared monthly.

Preparation of settlement statements for warehousemen covering quantity and quality difference on grain delivered as opposed to ordered for delivery, also covers final settlement for warehousing charges - approximately 2,000 settlements are prepared per month.

Applications Planned

We are now making an office-wide survey preparatory to commencing feasibility studies to determine the practicability of placing a number of the other voluminous activities on this data processing equipment. Some of these activities are: Inventory accounting and management operations, transit tonnage operations, loan accounting, other type general accounting, etc.

Bonneville Power Administration, Portland 8, Oregon

Air conditioner is common with tabulating room. A duct system is installed to convey generated heat from the IBM 650 system to the outside.

Reliability and operating experience:

Good time 930 - 44 = 886 hours
Attempted to run time 930 hours
Operating ratio (Good/Attempted to run) 0.95
Figures based on period July 1956 to December 1956.
Acceptance test 18 April 1956.

Very little down time for emergency outages. The above down time figure of 44 hours includes field installations and emergency repair, but does not include scheduled maintenance.

An alphabetic feature has been requested.

Allstate Insurance Company

One IBM 650 Tape and one IBM 650 RAMAC are on order.

Atlantic Refining Company, Philadelphia

Utilized for accounting purposes.

Atlantic Refining Company, Dallas

Utilized for payrolls, package stock accounting, crude oil accounting, gas accounting and research problems.

The Chesapeake and Potomac Telephone Company

System is rented for \$4,175 per month.

System is utilized for:

Computations related to property and cost accounting (Labor and material cost distributions to accounts, overhead loadings, engineering cost distribution to accounts, material price calculations and perpetual inventory records) have been adapted to 650 operation recently.

Payroll computations (interpretation of time-of-day assignment codes, rating, calculation of State and Federal tax, accounting for allotments and tax withholdings) are expected to be adapted to 650 operation in February 1957.

The development of life tables in connection with depreciation studies, is being adapted for current work.

Accounting for plant projects (accumulations of charges and comparison with authorization for each class of plant with related administrative reports) is expected to be programmed and adopted later in 1957.

Further adaptations of clerical work and records will be considered later.

E.I. du Pont de Nemours and Company

Basic system used for payroll. RAMAC used for product inventory control.

General Electric Company

As a general comment, system reliability is very high.

New York University, College of Engineering

System accepted 10 January 1957.

Southwestern Computing Service

System is utilized for contract computing service.

State College of Washington, Computing Center

System is to be installed in July 1957, with built-in floating-point and index accumulator.

Syracuse University, Computing Center

System is to be received 1 February 1957, including a 2,000 word drum storage unit, and alphabetic and special character devices. The system is to be rented under the IBM Educational Program, therefore the system will be used at least half time for teaching. The rest of the time will be devoted to scientific and data processing problems for members of the faculty and research students with a small amount of time being sold to local industry.

Government Sample

Army Ballistic Missile Agency, Computation Laboratory, Huntsville, Alabama

New York Naval Shipyard, Brooklyn 1, New York

United States Department of Agriculture, Commodity Stabilization Service

Industrial Sample

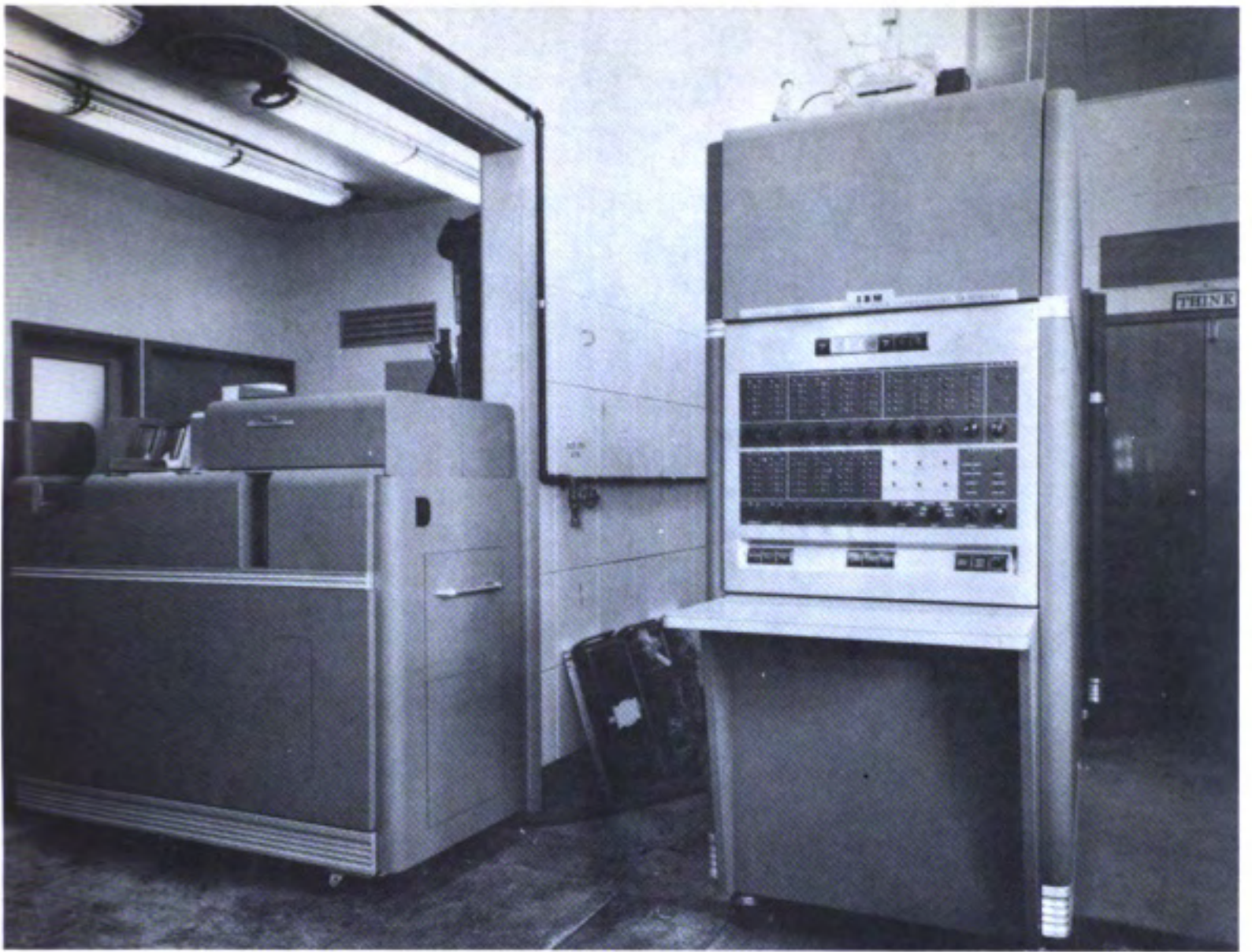
Southwestern Computing Service, Tulsa, Oklahoma

Syracuse University, Computing Center, Syracuse 10, New York

Wayne State University, Detroit, Michigan

Armour Research Foundation of Illinois Institute of Technology

Digital computation for the Foundation is performed with the IBM 650 (20,000 digit storage), supplemented with an extensive array of ancillary equipment. IBM 650 library of routines is continually being increased. Development and maintenance of this library frequently makes it possible to avoid delay and expense in programming and coding specific problems.



Picture by U. S. Naval Air Missile Test Center, Point Mugu, California