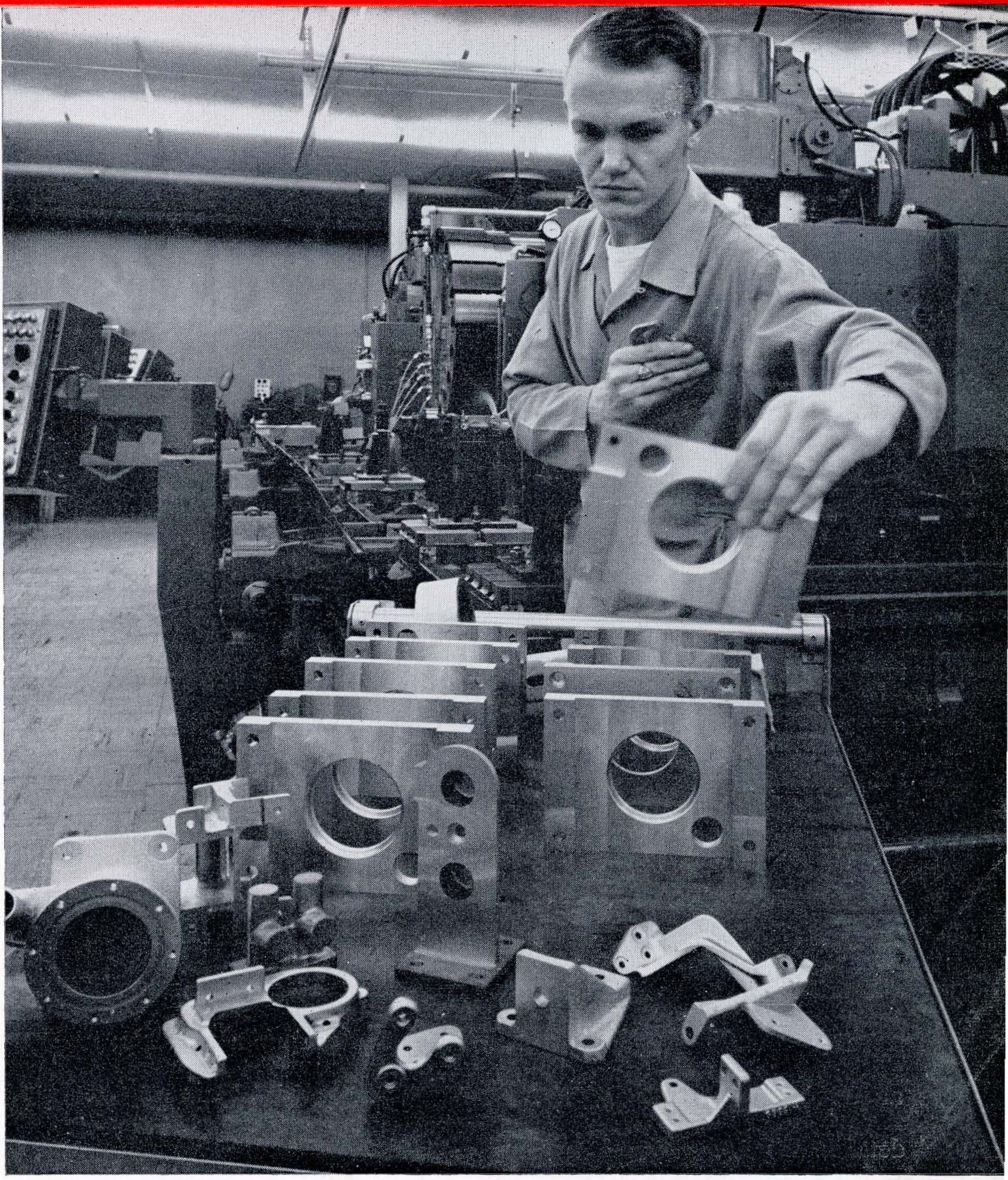
COMPUTERS
and AUTOMATION

DATA PROCESSING • CYBERNETICS • ROBOTS



SEPTEMBER
1958
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Volume 7
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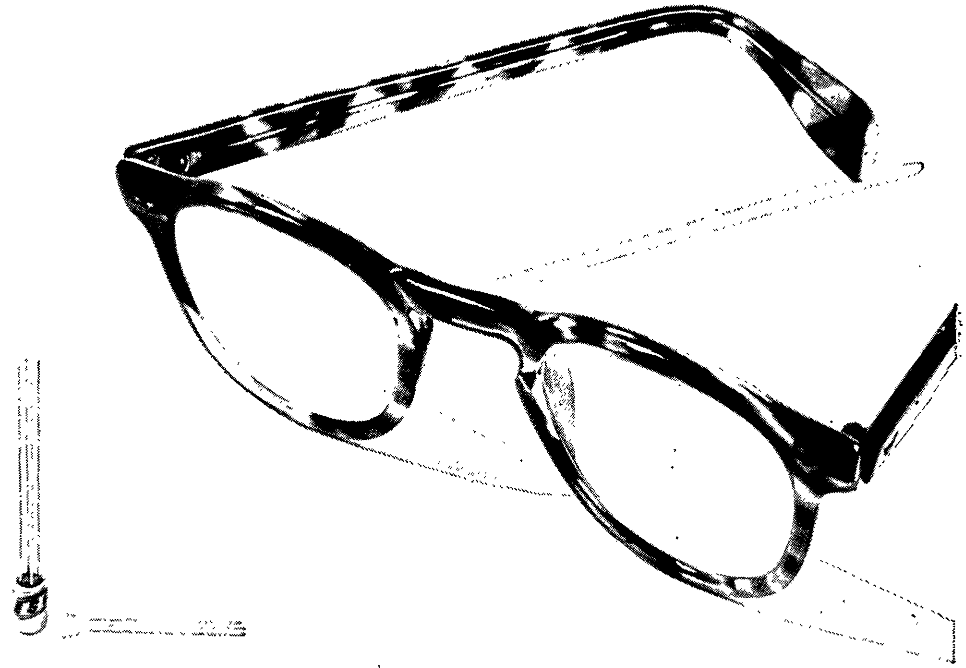

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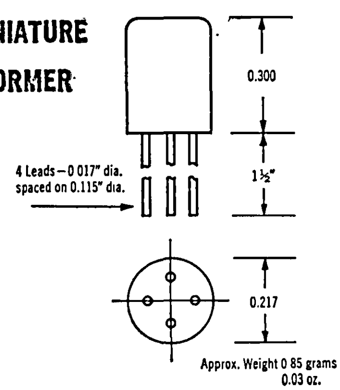

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Readers' and Editor's Forum

FRONT COVER: MACHINE TOOL DIGITAL CONTROL SYSTEM

THE FRONT COVER shows an integrated set of machine tools (milling, drilling and boring machines) and a group of machined parts produced simultaneously and automatically from punched tape instructions. The machine tools were made by Kearny and Trecker, Milwaukee, Wisc.; the controls — a special purpose digital computer called an Industrial Digital Control System — were made by Hughes Aircraft Co., Culver City, Calif. The punched tapes express blueprints. The machined parts shown are for a Hughes Aircraft Co. armament control system designed for U.S. Air Force Interceptor Airplanes.

49 COMPUTER PEOPLE ON SR OF COMPUTER SCIENTISTS

THE EXPRESSION OF different opinions by different people, vigorously pointing out different aspects of a subject, vigorously contradicting each other, is a fascinating part of free debate. The clash of views is an indispensable part of the discussion that eventually leads to progress.

In the continuing ballot by **Computers and Automation** "Should we discuss and argue the social responsibility of computer scientists?", the score is currently about 250 yeses and 140 noes. The comments of 49 people, who have kindly taken the trouble to tell us what they think, are here published, gathered into three groups, the affirmative, the middle ground, and the negative.

I.

Ernest M. Sunega, Niantic, Conn.: "All scientists have a social responsibility to their community and their profession."

Charles Concordia, Schenectady, N.Y.: "We should discuss social responsibilities, whenever it is done in an interesting way, and we can learn something from the discussion."

Robert Frohman, Gardena, Calif.: "I believe we should start to discuss and argue the social responsibility of computer scientists. We have hardly been in a position to do so previously."

William A. Gross, San Jose, Calif.: "I believe every individual is responsible for his actions and their effects on others. This obviously includes computer people. There should be considerable more concern because more people may be involved."

Eleanor D. Wilson, Houston, Texas: "Scientific journals in general have been much too slow in discussing controversial topics. Your editorial on poison gas was welcome!"

Robert E. Kesterson, Wichita, Kansas: "No group can truly escape the social implications of its efforts. If we do not discuss this responsibility, others will."

Eric Korngold, Cambridge, Mass.: "Let us discuss, by all means, but let us not pressure."

John T. Nowell, Swansea, Mass.: "It is of critical importance that all scientists or rather all intelligent people assume social responsibility for their actions."

Kevin J. Cahill, Grosse Pointe, Mich.: "We should discuss, etc., to the extent of establishing a practical code of ethics in promoting applications."

B. Pat Moore, San Leandro, Calif.: "Occasional articles and editorials on social responsibility are always welcome."

Irwin Wunderman, Mt. View, Calif.: "I think articles like March 1958's 'Destruction of Civilized Existence by Automatic Computing Controls' are excellent."

Walter B. Merton, Jr., Anaheim, Calif.: "I believe you should wage a very determined struggle to have computer people accept social responsibility."

Mark E. Goldwater, Baltimore, Md. (voted "Yes"): "Progress depends upon a broad concept of our work. Specialization would narrow our vision and defeat chances of improvement."

Henri H. Jacobi, Bronx 67, N.Y. (voted "Yes"): "Who will be affected more than computer scientists?"

George W. Kays, Glen Ridge, N.J.: "Computer scientists have a social responsibility to do their best in all fields."

Lionel U. Mailloux, Jr., Woonsocket, R.I.: "Computer scientists should realize their social responsibility and dependence on others."

A. C. Hendrickson, Washington, D.C.: "Everyone has a social responsibility; computer scientists are no exception. I urge you get competent people for any discussion."

William O. Nicholson, Pasadena, Calif.: "I suggest a computer model of our economy — an immediate 'on stream' application."

Douglas C. Wendell, Jr., Paoli, Pa.: "I commend the stand taken in the editorial about the poison gas diffusion problem."

Richard A. Miner, Phila., Pa.: "Have more of those articles on social responsibility, etc., and less on technical subjects."

Robert C. Brackett, Itasca, Ill. (voted "Yes"): "One of the reasons I enjoy your publication is that it does not stick strictly to technical subjects but occasionally takes off into the field of fantasy."

Harold W. Richmond, Venice, Calif.: "Seldom is a scientist able to control the use of his science, but he should do all in his power to point up the social impact resulting from various uses, and can indeed lend some pressure in the direction he feels his science should go."

Herman S. Englander, La Mesa, Calif.: "I believe that discussion and argument in any subject is healthy."

II.

David Macklin, Yonkers, N.Y.: "However, I don't believe computers are worse than matches."

Ned Chapin, Menlo Park, Calif.: "Material on this topic should be clearly labeled."

[Please turn to page 26]

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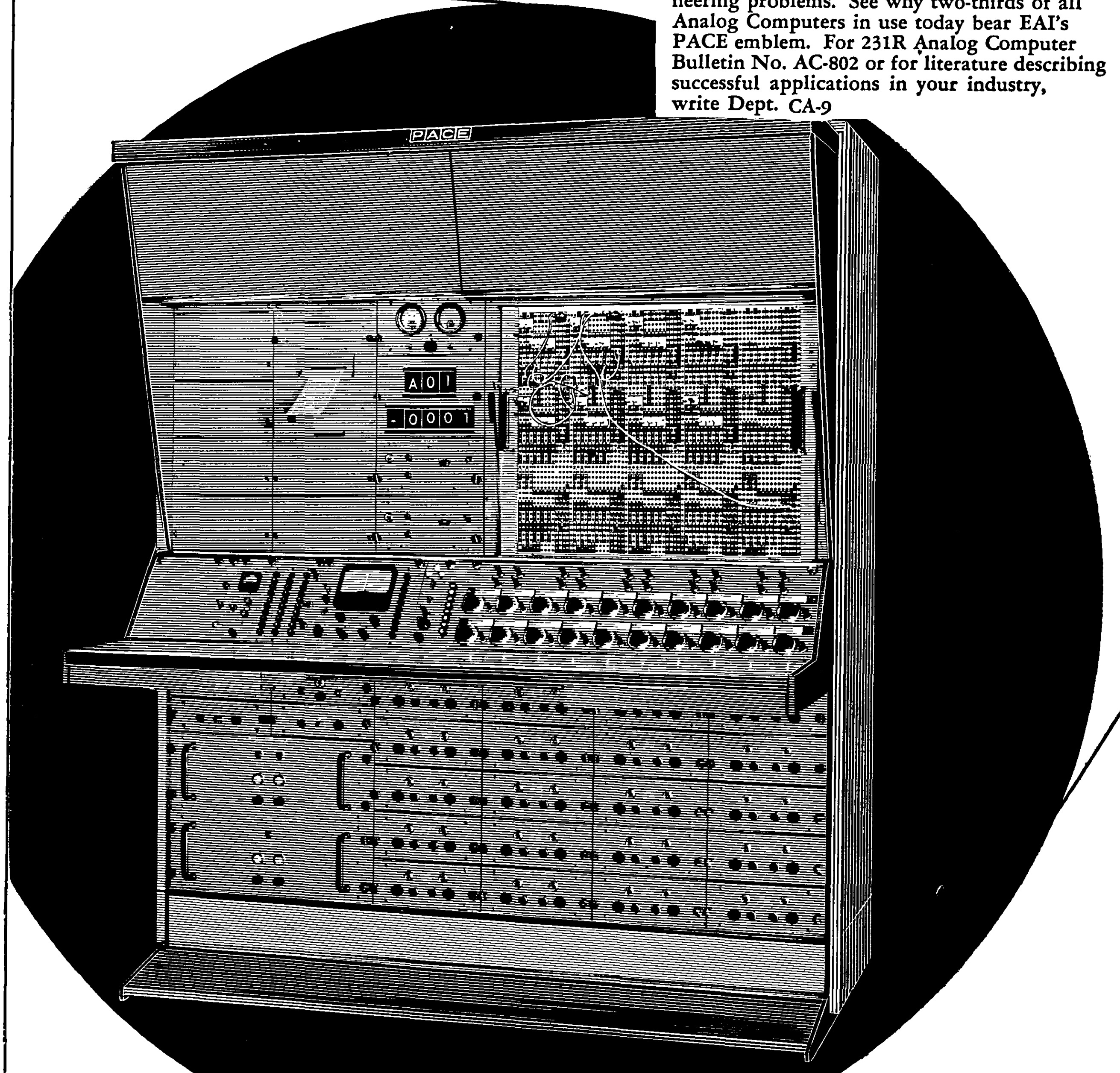

Survey of Special Purpose Computers and Data Processors

Neil Macdonald
Assistant Editor
COMPUTERS and AUTOMATION

I. Introduction

AT THE END of June we mailed out to 56 organizations which we believe manufactured or probably manufactured special purpose computers and data processors a letter saying that we planned to publish a Survey of Special Purpose Computers and Data Processors and asking for information. We said:

"This time we are seeking to exclude general purpose computers and data processors and the programming of general purpose machines to fulfill special purposes. Examples of special purpose computers and data processors are:

- Travel reservations machines
- Simulators
- Automatic training devices
- Spectroscopic analysis equipment
- Process industry plant flow analyzers
- Geophysical seismic readers and profile plotters
- Digital differential analyzers
- Automatic bookkeeping machines
- Information retrieval systems
- Power company network analyzers
- Airborne digital computers
- Flight control computers
- Machine tool control systems
- Automatic elevator control systems
- Remote control telemetering systems
- Telemetered data reduction systems
- Automatic graph readers
- Air traffic control computers
- Early warning analysis and response systems
- Fire control computers
- Automobile traffic light controllers
- Automatic railway traffic controllers
- Automatic data sampling systems
- File-searching machines
- Inventory machines
- Automatic navigating systems
- Character reading and recognizing systems
- Telephone message accounting systems
- Test scoring machines
- Programmable electric typewriters

We asked each organization for announcements, brochures, and literature given to their prospects who might obtain special purpose computers and data processors from them, and also for the completion of the following reply sheet, and for any other information which they felt we should know in making our survey.

COMPUTERS and AUTOMATION'S
SURVEY OF SPECIAL PURPOSE COMPUTERS and DATA PROCESSORS — REPLY SHEET

1. Brief description of the types of special purpose computers and data processors that you currently market?

Type	Purpose	Price Range
....	....	....
....	....	....
....	....	....
....	....	....

(attach more paper if needed)

2. In your opinion which types of these machines will become the most important, will represent the largest growth areas, for our industry in the next few years?
....
....

3. a) Do you also supply general purpose computers and data processors? ....
   b) If so, what would be your estimate of the approximate percent of your special purpose machines produced to all your data-handling machines produced? ....%.

4. Any remarks? ....
....
....

5. Number of employees? ....

6. Year established? ....

Filled in by.......... Title..........
Date ....
Organization ....
Address ....

When this is completed, please send it with your literature to:

Neil Macdonald, Assistant Editor
Computers and Automation
815 Washington St., Newtonville 60, Mass.

Thirty-two organizations kindly replied to us (counting two which said they had no products in this classification and so have been omitted); a summary of the reply of each included organization is given in this report (see II below).

The editors will be glad to receive additional entries, or corrections or revisions of these published entries, by November 10, so that the "Survey of Special Purpose

Computers and Data Processors" may be made more complete and brought up to date in the December issue of **Computers and Automation.**

II. Report

AERONUTRONIC SYSTEMS, INC., a subsidiary of Ford Motor Co., 2701 Halliday St., Santa Ana, Calif. / SPEC PUR: 100%: FLIDEN, a Flight Data Entry Device, to organize and enter messages to an air traffic control computer; its applications include: remote data entry, inventory control, air traffic control, customer account maintenance, scheduling, communications message screening, electronic file inquiry. Digital System Simulator (about $18,500) for direct simulation of digital systems, direct check of reduction of logical equations, study of systems operation prior to construction, aid for studying alternate logical designs / LARGEST GROWTH AREA: FLIDEN Data Entry Device / GEN PUR: 0 / Ms(200) Se(1956)

ALLEGHANY INSTRUMENT CO., INC., 1091 Wills Mountain, Cumberland, Md. / SPEC PUR: 100% K-7 Error Computer (simulator) for computing errors in wire strain gage transducer systems ($4,000); K-1, K-2, K-4 Ballistic Computers, employed to study nonrecurrent phenomena; integrates electronically, records peak values, records action time, records delay time, presentation is digital / Ms(100) Se(1952)

ARMOUR RESEARCH FOUNDATION, Electrical Engrg Research Dept., Computer Systems Section, Illinois Inst. of Technology, Technology Center, Chicago 16, Ill. / RESEARCH AND DEVELOPMENT IN: an electronic calculator using cold cathode tubes; a complete order system computer using magnetic cards; a data storage and computing system to inventory a tank farm; arithmetic units for billing and accounting systems; a hybrid data processor which (1) takes in statistical information on trips by individuals in a metropolitan area, recorded serially on magnetic tape, and (2) puts out integrated pictorial maps, using photographs of a precision cathode ray tube, showing traffic density for various selections of the input data / Ls(1250) Me(1937)

THE AUSTIN CO., Special Devices Division, 76 9th Ave., New York 11, N.Y. / SPEC PUR: Custom engineered automatic control systems; sonar simulator for submarine attack trainer; data processing system that senses input information from an automatic profile milling machine, computes chip loads, and automatically varies the angular velocity of the work spindles to produce a uniform chip load; computer and control center for machine tool control; color scanner for automatic production of color separation negatives; Weather Information Telemeter System (WITS), to sense and record weather information and automatically transmit local conditions by teletype or microwave / GEN PUR: none / Ms(Division 150, company 25,000) Me(division 1943; company, 1878)

BECKMAN INSTRUMENTS INC., Systems Div., 325 N. Muller Ave., Anaheim, Calif. / SPEC PUR: 90%: Type 123 Data Logger, recording and giving alarms for process variables, 100 points ($40,000 to $50,000); Type 112 Data Processing Computer, recording, computing, alarming, process variables, 50 to 1000 points ($100,000 to $300,000); Type 210 Data Processor (Hi-Speed) processing data prior to computer ($50,000 to $300,000); Low Speed Data Processors for process industry instrumentation and control ($80,000 to $200,000); Telemetered Data Reduction System, recording telemetered data on aircraft and missile flight on magnetic tape or cards ($50,000 to $200,000); Missile Checkout Systems, Hi-Speed scanning and alarming of missile electronics ($10,000 to $100,000); Tachometer Systems, recording and monitoring engine speeds, etc., ($10,000 to $100,000) / LARGEST GROWTH AREA: missile checkout systems, high speed data processors, standard data loggers (Type 123) / GEN PUR: 10% Ms(300) Se(1955 as a division)

BENDIX AVIATION CORP., Fisher Bldg., Detroit, Mich. / SPEC PUR: 60%: Flight system simulators (three-axis flight tables) for simulation of missiles, aircraft, etc, ($200,000 to $600,000). Digital differential analyzers for engineering computation ($13,700, attachment to G 15 computer). Flight control computers for missiles and aircraft. Machine tool control systems using continuous path control as in milling ($65,000, complete 3-axis system). Automatic navigating systems for aircraft. Air data computers to process raw sensor data to compute Mach No., etc. Reactor simulators for use in design / GEN PUR: 40% / Ls(48,000) Me(1929)

BENDIX AVIATION CORPORATION, Bendix Computer Division, 5630 Arbor Vitae St., Los Angeles 45, Calif. / Digital differential analyzer (DA-1), for simple programming of numerical solution of ordinary differential equations, linear and non-linear, also solutions for roots of transcendental equations, and the simulation of real systems ($13,700). 3 Dimensional Flight Simulator, providing testing of missiles, aircraft navigational systems, and associated components under test flight conditions. (Area of $600,000) / Ms(400) Me(1952)

BENDIX AVIATION CORP., Industrial Controls Section, 21820 Wyoming, Detroit 37, Mich. / SPEC PUR: Machine tool numerical control unit, to provide interpolation and continuous path control to machine tools ($50,000 to $85,000). G-15 D general purpose computer rendered special purpose with AN-2 unit, to automatically prepare machine control tape from blue print information ($60,000 to $70,000) / LARGEST GROWTH AREA: numerical control unit / Ms(51, this division) Se(1957, this div.)

BENSON-LEHNER CORP., 11930 West Olympic Blvd., Los Angeles 64, Calif. / SPEC PUR: 25%: Data Reduction Devices for film and oscillograph analysis ($10,000-$25,000); Terrain Data Translators, automatic processing of information from stereographic photographs ($7,000 to $10,000); Data Retrieval Machine, automatic look-up of microfilm records ($30,000 to $150,000); spectroscopic analysis equipment; geophysical seismic readers and profile plotters; automatic graph readers; file-searching machines; inventory machines; programmable electric typewriters / LARGEST GROWTH AREA: Data storage and retrieval equipment / GEN PUR: 75% / Ms(250) Me(1950)

COMPUTER CONTROL COMPANY, INC., 92 Broad St., Wellesley 57, Mass. / SPEC PUR: 100%: only custom designed and manufactured: information storage and retrieval systems, error detecting and counting systems, machine tool control systems / GEN PUR: 0 / Ms(110) Se(1953)

CONTROL DATA CORPORATION, 501 Park Ave., Minneapolis 4, Minn. / Production data recorder, which reads punch cards, accepts automatic recording of time and keyboard manual input, and produces punched paper tape or punch cards, with automatic sequence control, for control of in process inventory and factory scheduling ($5500) / Ms(225) Se(1957)

CURTISS WRIGHT CORP., Electronics Div., Carlstadt, N.J. / SPEC PUR: 100%: Analog AC and DC and Digital Flight Simulators ($80,000 to $1,200,000) / Ls(1600) Me(1947)

DONNER SCIENTIFIC CO., 888 Galindo St., Concord, Calif. / SPEC PUR: 60%: nuclear reactor simulator ($25,000); flight control computer for automatic hovering of helicopter ($5500); fire control computer using logarithmic computation ($5000) / LARGEST GROWTH AREA: flight control devices, simulator devices / GEN PUR: 40% / Ms(150) Se(1953)

EPSCO, INC., 588 Commonwealth Ave., Boston 15, Mass. / Data Transmission System (DT-800), providing transmission of highly accurate analog data between remote locations with the ability to use Class C or D telephone lines; Structure Analysis Data Reduction System, used to gather and prepare for computer analysis data from structure tests on large sections of military missiles or air frames; Telemetry Data Reduction System, for automatically preparing telemetry data for analysis in a digital computer; Addaverter Computer Linkage System for linking an analog computer and a digital computer into one integrated computational system for large-scale simulation studies of a complete ballistic missile system; Petro-Chemical Data Acquisition System, for gathering data for computer statistical analysis of functions of various processing plants / LARGEST GROWTH AREA: automatic control systems which in addition to receiving, recording, and acting upon data, also serve as control loops to operate process machinery / Ms(400) Se(1954)

FERRANTI ELECTRIC LTD., Electronics Div., Industry St., Mt. Dennis, Toronto 15, Canada, and elsewhere / SPEC PUR: 90%: (1) Travel reservations and inventory system for airline inventory with "Transactor" for data input/output medium; (2) Post office mail sorting system; (3) Early warning analysis and response system; (4) Simulators for nuclear reactor start-up and control; (5) Nuclear reactor control systems; (6) "JANET" data communication system (point to point, V.H.F., using forward scattering of radio waves from meteor trails); (7) Ground Support system for airborne digital computers; (8) Numerical control of machine tools via (a) continuous tool-path for tape controlled milling, or (b) discrete positioning for tape controlled drilling, boring and milling / LARGEST GROWTH AREAS: Reservations and inventory control, numerical control of machine tools, data communication / GEN PUR: 10%: / Ms(150, Electronics Div.; 600, all divisions) Me(1949)

FISCHER AND PORTER CO., Hatboro, Pa. / Analog computer for calculating 11 operating guides in a petroleum refinery ($50,000 to $100,000). Series 1200 Data Recording and Alarm Scanning System, for process industries ($30,000 to $150,000). Multiple Pressure Read-out System, for simultaneous measurement of many pressure readings in testing aircraft gas turbines ($50,000 to $200,000). High Speed Digital Recording System, using analog to digital converters, for high speed sequential recording on magnetic tape ($25,000 to $100,000) / LARGEST GROWTH AREA: data logging and alarm scanning systems, with digital recording systems, for general process industry applications / Ls(1100) Me(1937)

FORD INSTRUMENT CO., Division of Sperry Rand Corp., 3110 Thomson Ave., Long Island City 1, N.Y. / airborne digital computers, flight control computers, fire control computers, file-searching machines, inventory machines, automatic navigation systems, employee time control systems, cost control systems, order control systems, rocket launching computers, missile launching computers, harbor plotting systems, missile control order computers, ballistic cams (serving as precision memories for ballistic data), land-based combat vehicle navigation systems, plotting systems, etc. / Ls(4000) Le(1915)

THE FRANKLIN INSTITUTE LABORATORIES FOR RESEARCH AND DEVELOPMENT, Benj. Franklin Pkwy at 20 St., Philadelphia 3, Pa. / RESEARCH AND DEVELOPMENT IN: a radar computer and data analysis system used in studying the statistical characteristics of the fluctuations of radar signals; data processing equipment used in studying radio wave propagation phenomena; a flight control simulator for the determination of "describing functions" for the human pilot; a "Reactivity Computer" for nuclear reactor instrumentation systems; "The Sampled-Data Simulator and Computer" (SADSAC), a new type of analog computer for the solution of partial differential equations / Ms(350) Me(1946)

HUGHES AIRCRAFT COMPANY, Culver City, Calif. / SPEC PUR: 100%: Digitair, Airborne Digital Computer, for automatically controlling the routine functions of flight, programmed fuel consumption, navigation, search, and attack. Industrial Digital Control System, for automatic control of industrial operations using machine tools operated from punched tapes and controlled by transistorized digital computers / Ls(30,000) Me(1948)

INDUSTRIAL NUCLEONICS CORP., 1205 Chesapeake Ave., Columbus 12, Ohio / SPEC PUR: 100%: Ratio Computers for computing continuous ratio of actual production quantities vs. production goal at any instant of time ($5,000-$20,000); Quality Control Center, for automatically and sequentially scanning the analog output of up to 30 AccuRay Cigarette Gauge-Controllers and computing and recording production variances; each variance figure is compared with a variance limit for the particular cigarette maker and suitable alarms initiated when the limit is exceeded ($35,000-$55,000); Process Control Center, for automatically accumulating and recording production quantities and down time for each of up to 30 cigarette-making machines ($60,000-$80,000); Portable Process Analyzer, used to compute production variances from the analog output of continuous process measuring transducers ($18,000-$30,000) / LARGEST GROWTH AREA: Those computers which will be used directly on the process, to accumulate data and effect control over the variables / Ms(360) Me(1950)

LABORATORY FOR ELECTRONICS, Computer Products Division, 141 Malden St., Boston 18, Mass. / SPEC PUR: RASTAC, random access storage unit containing 1 to 33 magnetic file drums each storing about 1.7 million alphanumeric characters, able to be connected to any large or medium size existing commercial digital computer; ($200,000 and up); RASTAD, random access storage and display ($300,000 and up); SM-1 and SM-2 data display systems ($16,000 and up) / LARGEST GROWTH AREA: random access storage and data display systems / Le(1000 plus) Me(1945)

LEEDS & NORTHRUP CO., 4907 Stenton Ave., Philadelphia 44, Pa. / SPEC PUR: 100%: Nuclear Reactor Simulator for training in reactor kinetics and in reactor operation ($15,200); Digital Data Handling Systems for acquisition and digital display of measured physical quantities, to scan, log, and compute process variables in engineering tests and in process plant operation; Incremental Cost Analog Computers for generation of electric power for the lowest delivered cost ($50,000 to $150,000) / Ls(3,000) Le(1899)

LIBRASCOPE, INC., 808 Western Ave., Glendale 1, Calif. / SPEC PUR: 80%: process control computers, the Libratrol 500 ($40,000 up), Libratrol 1000 ($75,000 up); simulators, spectroscopic analysis equipment, digital differential analyzers, power company network analyzers, airborne digital computers, flight control computers, flow computers, variable incremental computers, machine tool control systems, air traffic control computers, fire control computers, automatic data sampling systems, automatic navigating systems / LARGEST GROWTH AREA: special purpose digital computers for industrial control, information, and instrumentation / GEN PUR: 20%: the LGP-30 / Ls(1500) Me(1937)

MID-CENTURY INSTRUMATIC CORP., 611 Broadway, New York 12, N.Y. / SPEC PUR: 25%: Simulators — Submarine, for simulating response of a submarine to its controls and environment for crew training ($50,000 to $500,000); Simulators — Nuclear Reactor, for simulating power reactors for design studies and operator training ($10,000 to $200,000); Radar Tracking Computers, used for tracking, surveying, and ground control of aircraft, missiles, and anti-missile devices ($10,000 to $30,000); Process Analyzers for analysis of chemical process units for improved operation ($50,000 to $500,000); Computers for guided missile simulation, flight simulation, automobile suspension simulation / LARGEST GROWTH AREA: "Military applications to dominate analog computer field to 1965. Thereafter, the process industry market. Expect analog computer market to double in the next two years and double again by 1963" / GEN PUR: 75% / Ms(55) Me(1950)

MINNEAPOLIS-HONEYWELL REGULATOR CO., Industrial Products Group, Wayne and Windrim Aves., Philadelphia 44, Pa. / SPEC PUR: 100%: simulator for nuclear reactor; power company network analyzers for load and frequency control; Remote Control Telemetering Systems for remote measurement of variables in process industries, utilities, and pipelines; Telemetered Data Reduction Systems for recording and transcribing 100 channels of analog data with conversion to digital form for data processing; Automatic Data Sampling Systems for logging information from processes, utilities, and research / Ls(4000, Industrial Products Group; 30,000 in Minneapolis-Honeywell) Le(1885)

GEORGE A. PHILBRICK RESEARCHES, INC., 285 Columbus Ave., Boston 16, Mass. / SPEC PUR: General purpose electronic analog computers components put together by customers to make special purpose computers: correlation computers; simulators for missiles, jet planes, submarines, and other vehicles of all types; in-line process control equipment; simulators for nuclear power plants; Fourier analyzers; power measuring and control equipment; frost penetration computers; target simulators; computing instrumentation; / LARGEST GROWTH AREA: Computing instrumentation and control, analog linear programming, training simulators / GEN PUR: Yes / Ss(60) Me(1946)

PHILCO CORPORATION, Government and Industrial Division, 4700 Wissahickon Ave., Philadelphia 44, Pa. / SPEC PUR: 30%: TRANSAC C-1100, Flight Control Computers (about $200,000), Airborne Digital Computers (about $200,000); TRANSAC S-2000, Fire Control Computers (about $1,600,000), Air Traffic Control Computers (about $1,600,000), Automatic Data Sampling Systems (price varies), Process Control Systems (price varies) / LARGEST GROWTH AREA: application of special purpose computers and data processors in fields lending themselves to automation / GEN PUR: 70% / Ls(19,000) Le(1891)

J. B. REA CO., INC., 1723 Cloverfield Blvd., Santa Monica, Calif. / SPEC PUR: 50%: Readix Digital Computer in scientific data logging systems ($130,000). Reacon Analog-Digital Converter, used as component in scientific data logging system ($11,000) / Ms(230) Se(1951)

REMINGTON RAND UNIVAC DIV., Sperry Rand Corp., 1902 West Minnehaha Ave., St. Paul, Minn. / Mobile, high-speed, special purpose electronic digital computer, with a display output consisting of a projected and numerical presentation, for controlling electronic warfare devices, mounted on two 35 foot semitrailers. The system is fixed program, internal binary, serial, machine programmed to identify, filter, and process incoming target data / Ls(1000) Me(1946)

ROYAL McBEE CORP., Westchester Ave., Port Chester, N.Y. / LGP-30 digital computer applied by customers for travel reservations, simulators, statistical analysis, process industry plant flow analyzers, machine tool control system for cutting irregularly shaped gears / Ls(12,000) Me(1946, computer division)

COMMUNICATIONS FOR PRIVATE WIRE DATA PROCESSING

George O. Vincent
Manager, Administration, Facsimile and Private Wire Services
Western Union Telegraph Co.
New York, N.Y.

(Based on a talk before the National Machine Accountants Association, Boston, Mass., March, 1958)

GROWING EIGHT-FOLD in ten years, the leasing of private wire systems by Western Union to business, industry, and government totaled $37,000,000 in revenue in 1957. The growth in recent years has been sparked by the increasing use of such systems for integrated data processing (IDP) and management control purposes. Systems in service keep on expanding each year, while many new ones are added. The service is identified in Western Union as "Facsimile & Private Wire Services."

Circuits or channels on a lease basis are provided for 60-, 65-, 75-, and 100-word per minute teleprinter operation. A circuit may be a single — that is with one station at each end sending and receiving on an alternate basis; or it may be a duplex with simultaneous sending and receiving at each end. Either type of circuit may also be a "way"; that is, with three or more stations sharing the use of the channel.

There are available tape teleprinters, page teleprinters, Type 19 sets, automatic transmitters, typing reperforators, non-typing reperforators, manual perforators, and for central installations torn-tape switching equipment, push-button switching equipment, or fully automatic switching equipment. Many hundreds of associated items are available. With the flexibility which these auxiliary devices provide it is truly possible to custom-tailor a system to meet any customer's requirements.

Teleprinters may be supplied with features providing for creation of multilith or other types of masters for reproduction of copies, multiple interleaved carbon sets of forms, horizontal tabulation, vertical tabulation or form feed, sprocket or pin feed, automatic positive vertical forms alignment and automatic station selection.

The Type 19 set provides for preparation and transmission of 5-channel code perforated tape in addition to the teleprinter. The tape is pre-punched before it is transmitted to the line, thus conserving valuable circuit time. Pre-punching of the tape also permits editing, and deletion of manual errors. The transmitter associated with the set may be arranged with a special selector, a device that permits the transmitter to start itself without operator attention whenever the circuit is available. This arrangement is a real facility on "way" circuits, eliminating the waiting for an opportunity to send.

Switching Equipment

A wide variety of switching equipment is available, the most important ones of which will be described briefly in the following.

Plan 111 Switching System

The Plan 111 Switching System, sometimes referred to as "semi-automatic," is an extremely versatile and flexible torn-tape arrangement designed for small and medium-size communications and data networks. Messages from outlying stations are received at the center in printed-perforated tape in the receiving console, each one of which will accommodate three circuits. Each sending console will accommodate six circuits. Switching is accomplished by simply tearing the tape at the receiving console and inserting it in the transmitter associated with the appropriate outgoing circuit.

Selection of appropriate stations on "way" circuits is by push button; "master sending" of messages or data is made available by a small applique unit placed on top of the sending console. Outgoing messages are automatically numbered by the equipment. A center can be expanded on a simple building-block basis as may be required for additional circuits.

Plan 51 Switching System

Plan 51 will accommodate a system up to 60 circuits with a greater message and data volume. Communications are also received in perforated tape but the tape passes directly into a line transmitter. This is often referred to as "continuous tape switching" as opposed to "torn-tape" switching. The destination is read from the tape, a push-button is depressed by the attendant, and the message is on its way. The transmitter stops automatically and signals the attendant at the end of each transmission so that the next destination can be selected. Automatic numbering, and automatic "logging" of transmissions are provided. "Master sending" can also be provided.

Plan 54 Switching System

Larger yet is the Plan 54 Switching System in that it's capacity is 125 circuits. In operation it is similar to Plan 51, but with improvements. The separate automatic numbering machine cabinets used in Plan 51 are eliminated by placing the numbering machines in the receiving and sending consoles, thus conserving expensive floor space. "Master sending" is also available as well as multi-channel selection.

Plan 55 Automatic Switching System

Plan 55 is a new, high-speed electronic private wire system designed for the United States Air Force for use in the United States as well as overseas. In addition to automatically switching information from one circuit to another, push-button fall-back operation is provided. In other words, it can be operated as a push-button switching center similar to Plan 54 and Plan 51 at will, or for switching any tapes with mutilated directing codes. Each center can accommodate 200 destinations and 400 cross-office circuits. All terminals in the consoles are equipped with Cannon plug connectors, making installation on the customer's premises a quick and simple matter. It is designed for 100 word per minute tributary operation with 200 word per minute "cross office switching" and automatic parity checking and priority message features.

The Washington center has been installed. The system will be completed by the end of the year and in the United States will utilize more than two hundred thousand miles of circuits and serve over 200 Air Force locations. Its volume will exceed 2½ billion words a year — more than 3 times the capacity of the service right after World War II. It formerly required 1300 operators to handle 1/3 the volume. Now 480 operators with Plan 55, will handle three times the volume thus freeing 1,700,000 man-hours a year for other military requirements!

Plan 56 Switching System

Plan 56 was designed for, but not necessarily limited to, brokerage systems. Circuits and equipment all operate at 75 words per minute speed. It is fully automatic, requiring no switching attendants. It has a "priority" feature which permits more important messages, such as those involving buying and selling at market, to reach the exchange in seconds, getting ahead of other communications of a routine or less urgent nature. It's capacity is 20 circuits. A new system for 10 circuits has just been designed and is designated Plan 56.1.

Plan 57 Switching System

This will be the "commercial" version of the Air Forces' Plan 55 system: fully automatic, with high-speed electronic features and all of the other desirable features developed by experience in recent years in other systems. The laboratory model has already been built and a prototype is expected to be installed by the end of this year, with other installations already on order, immediately following.

The system makes use of transistors and like Plan 55 accommodates 100 word per minute tributary circuits and 200 word per minute cross-office circuits. The cross-office circuits will parity-check each character insuring not only local circuit continuity but also protecting for such conditions as tape outage, tape jams, and equipment troubles.

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While the foregoing systems are generally thought of as communications systems to connect widespread operations, they are used by many of our present customers in addition for automation of "data". They are used to collect and distribute information of all kinds.

Data Transferring Systems

Now we will get into the systems designed primarily for data. They are used for "communications" too if you think of messages, but the emphasis is on "Data". Except for assigning the 200 series to designate them we haven't yet agreed on a name; so you may hear them called data "switching", "control", "processing" or "communications" systems.

Data Communications System 201

In 1954 Western Union designed and built for U.S. Steel's American Steel and Wire Division, the first specially engineered communications system for integrated data processing. It comprehended service between a major headquarters sales office, and two distantly located mills. While the system required only the normal speed teleprinter circuits, a considerable array of equipment was involved at the terminals, consisting of various arrangements of page teleprinters, automatic perforated tape transmitters, printer-perforators, and three new designs of control cabinets with push-button controls and indicator lights.

All of the equipments were assembled and wired in one room at Western Union's New York headquarters and arranged to operate in the same manner as when installed in the customer's offices. It was used for training and practice purposes, and because of the then awakening interest by business in general in "IDP", several hundred other people visited the room for "live" demonstrations.

Before this installation was designed and installed, the information on a customer's purchase order was typed and retyped in every department — Sales, Purchasing, Engineering, Installation, Stores, and others — because the information was not in usable form for a specific department's requirements.

The paper work involved in the handling of such orders was studied in each department and redesigned so that, with the use of the 201 system, once the order was typed to produce the product desired, no more typing of the same information was necessary in any of the other departments.

At the sales office, pre-punched master tapes containing product descriptions are kept on file; for certain customers, name, shipping instructions, and the most frequently ordered items are kept in the pre-punched tapes. These tapes also contain the controlling codes for the various editing operations. The operator at the sales office uses these tapes, entering, as an initial operation, the variable information. From then on, all of the necessary copies even including shipping labels, and a multilith master for mill copies, are produced in the operation with a minimum of effort. Printer-perforators operating in response to codes in the perforated tape produce selected parts of the transmissions in accumulated form for tape-to-card converters for statistics for sales, accounts receivable, and production control.

Since the original installation, the process has been simplified and some of the off-line or local equipment has been eliminated. However, the basic IDP system is still proving its worth and is still being utilized.

Data Communications System 202

This system was designed to meet the requirements of our private wire service customers who desire to use tape from a card-to-tape converter for transmission over a private wire system to supplement a standard teleprinter termination. It was specifically designed for United Air Lines for use with the I.B.M. 063 card-to-tape converter, which can be arranged to provide a standard message termination signal; such as "carriage return, carriage return, letters" (teleprinter machine functional characters) at the end of each card at the option of the operator. This system provides for automatic numbering of each transmission when required. There are two basic parts to the system:

1) A transmitter table which is arranged to "nest" with the I.B.M. 063 machine to accept its perforated tape and to transmit it.
2) A numbering machine cabinet built of variable basic units and containing the required control equipment to send automatic numbers, and timer control.

The timer control is used on "way circuits" (more than two stations on the same circuit) to prevent the tape from being transmitted into a busy circuit.

Data Communications System 203

The most publicized and therefore probably the best known of our specially designed systems is this one installed for Sylvania Electric Products in a building at Camillus, N.Y., near Syracuse, which Sylvania constructed for housing the system and a UNIVAC computer for centralizing data handling for their decentralized organization reaching across the United States and to various places in Canada. The nationwide communications system utilizes our standard teleprinters, Type 19 automatic sending and receiving sets, and three Plan 111 Private Wire Switching Centers. The system handles administrative messages, as well as data for such functions as payroll, invoicing, order and production scheduling and so forth. Messages and data may be transmitted from any station on the system in a random manner; that is, one transmission may be a message, the next data for payroll, the next a message, etc. The 203 equipment at Camillus was adapted from automatic equipment, used for many years in our commercial telegraph system for handling public messages, for sorting incoming data into the various required classifications and accumulating and storing it in perforated tape reels, for processing by Remington Rand's UNIVAC.

The 203 system is composed of five basic cabinet units:

1. Reperforator receiving positions
2. Automatic Switching
3. Transmitter Finders
4. Automatic control unit
5. Data Storage Positions

Each receiving cabinet is double-decked; equipped to terminate two circuits, one in the upper and one in the lower position. The receiving reperforators operate at a speed of 75 words per minute, and intra-office circuits operate at 150 words per minute. It contains an automatic error-checking feature for the first section of each transmission.

While this paper does not undertake to describe the system in detail, it has admirably filled Sylvania's requirements established by their office automation program. It facilitates feed-back communications control, fulfills the specific demands on communications equipment imposed by requirements of the input-output sections of the data processing system, and fulfills the administrative traffic needs of Sylvania, from both a divisional and corporate viewpoint, providing rapid exchange of message traffic and reports between all of the company's many locations throughout the country.

Data Communications System 204

The equipment used in this system was originally designed for the Liberty Mutual Insurance Company and is used to transmit accounting information from tributary or branch offices to a central accounting center. The information is received at the main office in perforated tape form, stored on reels, and subsequently processed by a computer. The central accounting department has complete control of communication at all times by means of a monitor equipment cabinet and its complement of printer-perforator consoles, and sending and receiving teleprinters. Tributary communications circuits may be either single or "way" operated. Perforated tape for transmission from branches of the customer is prepared on Friden's Flexowriters.

Data Communications System 205

This system was designed and installation made at many locations in the United States for General Electric Company. The main system consists of an "originating station" composed of an automatic tape transmitter, a control panel and cabinet, and a sending-receiving teleprinter. The operator has a pre-punched tape file which contains constant information, such as a product description. Also contained in this master tape are codes which cause the transmitter to stop and the teleprinter keyboard to be activated, permitting the operator to add variable information to the order form, such as quantity. By the operator coding the control panel, a matter of simply pressing buttons, the order form is transmitted by wire to a warehouse, and information, as a by-product of the wire transmission, is categorically distributed to printer-perforators on the system.

Data Communications System 206

This is rather a simple system permitting the transmission of messages or data to "unattended" stations equipped with sprocket or pin-feed multi-copy forms. The equipment provides assurance to the sending station, that, at the receiving station which may be a thousand miles away, the forms are properly lined up for the information. It is popular with trucking companies for sending waybills to stations during night hours when no operator is available to cover the receiving end. It can be used to advantage in other applications.

Data Communications System 207

This is a data processing system designed for the railroad industry to meet the requirements for accomplishing six different processing functions relating to "train consists" in perforated tape form. In addition to a page teleprinter, printer-perforator, and an automatic tape transmitter, the equipment contains a control cabinet for the processing functions. This has since been redesigned to use a program board, like a plugboard, so that instead of using characters for the various "tricks" the position of the forms govern; it is then called Data Communications System 209. (208 is for a reservation and computer network for airlines and other usage).

7-Channel Code System

A communications system has been designed for the government for an agency engaged in standardizing and uniformly identifying over 3,000,000 inventory items with three objectives: (1) to reflect new procurements, (2) to reflect changing identification data on existing inventory items, and (3) to withdraw items no longer in military usage. One of the requirements for the communications system which would link stations to a central data processing center is for 7-channel codes without conversion and for error detection in transmission of data prior to electronic computer processing.

The "central station" equipment consists of a paper tape reader or automatic transmitter, and punch or perforator, a control unit, and a Type 28 teleprinter equipped with a "stunt box". The "outstation" or remote station equipment is basically the same except for the design of the control unit. Friden's Commercial Controls' readers and punches are used. One of the features of the system is its ability to work on "way" circuits; this is valuable when remote stations do not have the volume to keep a circuit busy for nearly eight hours daily.

When an error in transmission is detected by the receiving equipment, the sending equipment is automatically stopped. Tapes are manually reset to send that section of data over again.

I.B.M. Card Transceivers

Western Union provides circuits operating at 60, 75, and 100 words per minute speeds for I.B.M. Card Transceiver operation, with or without alternate teleprinter connections for regular traffic or conversions. A new type of communications channel has just been developed that will permit the maximum speed of 11 fully-punched 80 column cards per minute on a telegraph channel, or at a speed of approximately 210 bits per second.

Teledata

The Friden Teledata equipment combined with a communications channel provides a means for automatic 5-, 6-, 7-, or 8-channel tape transmission and reception. Error detection is incorporated and transmission is automatically stopped when an error is detected in either transmitting or receiving. Installations usually provide for alternate teleprinter operation by means of switches so that both perforated tapes and messages can be exchanged.

EDIT

A system has been developed that will provide error detection and correction for data, both alphabetic and numeric characters. It has been dubbed "EDIT" from its literal meaning of "error deletion by iterative transmission". A technique of totalling the marking pulses in a line of data on a weighted, binary basis, is employed. Equipments at the sending and receiving ends of a circuit provide error detection and correction while transmission is taking place. The transmitting equipment can send tapes already having checking information or can automatically insert checking information after each line. In either case, that transmitter will stop after sending the checking information for each line of data to await instructions from the receiving station. The receiving equipment checks each line of data with its associated checking characters. If the check indicates no error, the transmitter is signaled to send the next line. If an error is indicated, the reperforator deletes the incorrect line from the tape and signals the transmitter to repeat the line of data.

The EDIT transmitter is arranged for handling 5-, 6-, 7-, and 8-channel tapes. It can step and read the tape either forward or backward!

Electronic distributors are associated with the reperforator and transmitter and may be operated at regular telegraph channel speeds of 65, 75, and 100 words per minute, or at higher speeds up to 200 words per minute.

Public Message Data Service

While the systems presented have been for use by private wire services, there is no reason to confine the handling of data to such systems. Western Union's nationwide public message network can be utilized for the automatic transmission of perforated tapes. Such transmissions are necessarily confined to the 5-channel code since the entire multi-million dollar high-speed plant is based on this code arrangement. Satisfactory tests have been made for customers who hand us perforated tapes in one city, and we deliver an exact copy to their office in another city for business machine or computer processing.

Western Union itself is utilizing this system for a nation-wide integrated data processing system for our own huge payroll, equipment inventories, and other statistical and management control information. More than half a million words and groups of figures weekly, giving detailed information about telegraph operations in every major city coast-to-coast, is quickly assembled at special centers for processing by business machines and calculators. This factual data flashed by wire to supervisors in the field and to management officials at New York, makes possible more efficient handling of payrolls, more up-to-date decision-making, and more efficient control of inventory and operating costs.

This system links 18 control cities. These cities transmit assembled information to one of five integrated data processing centers in New York, Atlanta, Chicago, Dallas, and San Francisco. These centers consolidate the information. Ten other control cities will be added as the work progresses. A "nonsense" total, automatically produced by equipment at the control cities, Friden Add-Punches, is included in each line of figures transmitted. At the center a calculating machine automatically adds each line of figures received to obtain a similar "nonsense" total, thus insuring accuracy. The machine releases the data for final processing only if the two totals agree. The "nonsense" total idea for accuracy checking purposes of transmission over 5-channel code tape transmission systems has proved to be surprisingly good.

Incidentally one of the important contributions to accuracy in transmission is provided by Western Union's having early recognized and adopted as our standard the FM, frequency modulation, carrier equipment instead of AM, amplitude modulation, equipment.

Expansion of microwave radio beam systems is playing an increasingly important role in the growth and expansion of record communications. This is particularly important as we grow into the facsimile method of transmission for certain types of material, and data.

We have just completed the extension of microwave radio beam facilities into Cincinnati and Chicago, and tower sites have been selected for additional routes reaching from Indianapolis to Kansas City by way of St. Louis, and from Cleveland to Chicago by way of Toledo and Detroit. Our ultimate planning is for a nationwide network of microwave facilities linking all important cities and defense areas.

Costs

Now for some comments on costs.

Until 1939 a page teleprinter, for example, on a leased basis cost $50 monthly for service eight hours a day, six days a week. If it were used seven days a week, twenty-four hours a day, it cost $65. In 1939 the rate was made $25 monthly, regardless of the hours or days of usage and there was no rate differential for 60-, 65-, or 75-words per minute operation. In 1953 the rate of $25 was increased 20% to $30 monthly, with still no differential on hours of usage or speeds to 75.

In 1953, circuit rental rates were lowered, for example from a fraction over 77 cents per airline mile monthly for service 9:00 a.m.-5:00 p.m., Mondays through Fridays, to 72 cents for a singly-operated 65 word per minute circuit. Compare this rate with $2.20 per mile up to 1943! There is a 10% differential on circuits for 75 word per minute operation. 100 word speed is 25% more. Circuits for pricing purposes are measured on a point-to-point airline mileage basis. Many more actual miles of circuits are often used to set up systems than are charged for.

Discounts of 10% to 40% are allowed on circuits of from 250 miles to over 1500 miles. It takes only a little arithmetic to prove that on a per character or per word basis, the higher speeds are a better buy, provided of course that the volume of information or data is there to utilize the higher speeds, or there is definitely a need for higher speed service from other standpoints such as computer usage for say reservations applications.

We all recognize that more and more business machines and electronic computers will need to communicate directly with each other at higher and higher speeds. Considerable work is being done on this.

Communicating With Computers

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(Reprinted from *Battelle Technical Review,* April, 1958)

IN RECENT YEARS, much has been written about analog and digital computers or "electronic brains" as they are sometimes called. The growth of the industry producing these machines has been spectacular. They have attracted much attention among American scientists and businessmen and have aroused also the interest of the general public. However, an equally amazing series of related developments has gone almost unrecognized. These have resulted in the numerous electronic, mechanical, and electromechanical devices that have become necessary to obtain and process the information which is used by computers. Some of these devices take data from all manner of sources and convert them into language the computer can understand and accept. Others take the output of the computer and convert it into language that people can understand and use.

The tremendous growth in the number and types of available auxiliary equipment deserves notice, particularly because of its importance in the computer picture. As will be seen, the computer itself is only the beginning of a computing system. To carry on desired operations each system requires auxiliary equipment of varying types. And to round out the picture, the importance (and problems) of housing and manning such a system must also be considered.

Everyone is familiar with the age-old expression "necessity is the mother of invention," and it would be very difficult to imagine any field where this is more evident than in the evolution of today's auxiliary devices for computers. It would be an oversimplification to say that development of these devices has been the outgrowth of computer developments alone. The fact is, new developments of either computers or their auxiliary devices often create the necessity for further developments (or inventions) in the other field. Because of the emphasis upon speed of processing of information, each technological advance in one area calls for corresponding advances in the other in order to make possible the utilization of the ever-increasing capacity.

Development of Auxiliary Devices

It is difficult to realize that the bulk of this equipment has been developed since about 1940, much of it being more or less direct results of electronic discoveries during World War II. Never before has such a vast industry developed so quickly, and of course the end is by no means in sight. The far-reaching effects of pioneering research into the electronic unknown has contributed strongly to these developments.

This entire auxiliary-equipment industry is built on the foundation of civilized man's need to communicate. Ultimately the degree of success of a person, a company, an industry, or even an entire nation is determined largely by the effectiveness of its communications, both internal and external. A company that installs an efficient information-processing system gains an advantage over its competitors. To keep pace, others in the industry must install corresponding improvements in their information systems. And so it goes: each improvement calls for further improvements, with the present boom in developments being the natural outgrowth of this condition.

Utilization of Developments

Many a company has discovered, much to its ultimate financial regret, that a newly acquired computer seemingly did not understand the language used by the organization. Although it may seem ridiculous to speak of a machine "not understanding," this is exactly what happens occasionally. Components of an information-processing system must be carefully selected to provide adequate compatibility of the computer, procedures, information, people, and physical plant facilities. Otherwise, there is a very good chance that the system will not be successful in fulfilling its intended purpose.

For the purpose of illustration, consider the situation in which a company apparently has a need for a technical specialist. Let us assume that the only source of competent men in this field is a small group of Greek mathematicians speaking various dialects. The first question the company must ask is: Do we need such a mathematician? Because many of this company's competitors have already hired specialists and found them useful, responsible executives decide such a mathematician is urgently needed. Other questions must then be answered. Which one should be employed? Which speaks the dialect that best fits the information to be dealt with? Who is going to be the interpreter? In other words, exactly what alterations are necessary to integrate this highly desirable specialist into the company's operations?

The Greek mathematician may be compared with an electronic computer that a company acquires to meet a specific need. The computer, like the mathematician, will require "auxiliary equipment" to fit it into the organization so that the greatest possible benefit will be derived from its use.

In digital-computer-system design

How to save $100,000 worth of computer time

Look for the biggest gain where you normally lose the most. Applying this bit of external logic to the digital computer, you will find a big advantage for yourself (and your customers) in a tape handler that runs for months with only routine care. This pre-production Ampex FR-300, stripped down to its underwear, was photographed undergoing an accelerated endurance test. It proved out the basic design features that have made this possible.

AMPEX MEETS THE CHALLENGE OF THE MOVING PART

Within the computer's own circuitry, nothing moves but electrical currents. But the tape handler must keep pace with mechanical movements of incredible speed. A tape can't be moved by electrons alone!

On the Ampex FR-300 Tape Handler, the magnetic tape goes from zero to 150 inches per second in just 1.5 milliseconds — an acceleration of 260g. A flip-flop pinch-roller mechanism makes contact between tape and driving capstan. It has an inertia brake that stops the tape with equal deceleration. This mechanism is the single most critical part in the tape handler. Ampex engineers tested prototype designs through as many as 50,000,000 start-stop cycles. This equals one year of extra-heavy-duty service for the most critically stressed part in the entire tape handler. Replacement at recommended intervals virtually eliminates unpredicted shutdowns from this cause of failure.

Yearly Value of Reduced Maintenance Shutdown

	Hourly computer rental (or amortization)		
Hours saved per week	$ 100	$ 200	$ 300
1	$ 5,200	$ 10,400	$ 15,600
2	$ 10,400	$ 20,800	$ 31,200
5	$26,000	$ 52,000	$ 78,000
10	$52,000	$104,000	$156,000

On other parts of the Ampex tape handler, we alternate between the philosophies of the instrument maker and the tractor builder. Anything that accelerates with the tape is incredibly light. For instance, tape tensioning is done by columns of air. On the other hand, the motors, bearings and frame are as rugged as a bulldozer.

DEPENDABILITY, OF COURSE, BUT SPEED IS MOST IMPORTANT OF ALL

Ampex's non-stop dependability would be meaningless if it were achieved at any sacrifice in input/output transfer rate. It isn't. The FR-300 offers the fastest digital-transfer rates available today — 30,000 to 90,000 six-bit characters per second. It has the shortest inter-record distances — ½ inch with ample safety factor. And it compacts the most data per file with its 300 bit-per-inch packing density.

We suggest you take the earliest opportunity to watch an Ampex Digital Tape System in operation. We are sure it will win your confidence — just as it has sold itself to a number of major computer manufacturers. In the meantime may we send you literature? Write Dept. Z-18

AMPEX INSTRUMENTATION DIVISION • 860 CHARTER STREET • REDWOOD CITY, CALIFORNIA

Phone your Ampex digital tape specialist for personal attention to your needs. District offices serve the U. S. A. and Canada. Foreign representatives cover the free world.

Data-Collection Devices

The collection of information is a prime function in any computing system. In fact, the computer exists only as a tool for rapid processing of information which has already been obtained. The information must be detected, converted into machine language, recorded, processed, translated, and since it is normally collected at a source remote from the computer, it must be transported or transmitted. Also, on some occasions, data such as random numbers must be generated to fill a computing need. The following paragraphs will describe the various existing types of data-collecting devices and show how they contribute to the smoothness of the flow of information in the system. The fact that overlaps and apparent misfits occur is acknowledged, and the reader may feel free to consider that a particular device might better be classified otherwise.

DATA CONVERTERS accept information destined for the computer (such as quantities, measurements, time recordings, identifications, etc.) and translate it into electrical impulses, holes in paper tape or cards, or other forms required for the particular computer. Examples: *analog-to-digital converters, digital-to-analog converters, paper-tape punches,* and *card punches.*

RECORDERS, as the term implies, record measurements, occurrence of events, time, etc., directly in computer language, or in a form readily convertible to computer language. They provide temporary or permanent storage of information which is available to the computer when required. Examples: *time recorders (special clocks), data curve plotters, tapes (magnetic, punched, printed, etc.),* and *counters.*

DATA PROCESSORS accept recorded raw data and prepare it for use by the computer. This might involve sorting, summing, collating, verifying, tabulating, converting, etc., depending upon the type of computer and the application. The machines required for this processing are indispensable and must be carefully selected in order to assure efficient computer systems operation. Examples: *sorters, collators, tabulators,* and *reproducers.*

TRANSLATORS take recorded data in a form which is not directly suitable for the processing equipment or the computer and translate or convert them into a desired form. This might occur, for example, when processing data are recorded as curves. In this case, a curve reader would be employed in order to produce data on punched tape or cards. This type of device would also be required in processing the same information on two different types of computers where the output from one computer would have to be translated before it could be used in the other. Examples: *curve-reading devices* and *decimal-to-binary-number translators (and vice versa).*

TRANSMITTERS may be said to be merely additional types of processing devices, and this is probably true. Nevertheless, it is felt that they should be listed separately since data-transmission systems generally are optional rather than essential. At any rate, data transmitters serve the purpose of projecting data to another location, either within or between plants. Such devices make it possible to collect data from many places and process them at a central location for efficiency. Examples: *punched tape, punched card, magnetic tape (which may be transmitted by telephone, telegraph, or radio),* and *television monitors.*

DATA GENERATORS are sometimes necessary to generate special data, such as mathematical functions or random numbers. This need has called for another category of special equipment and, as usual, the equipment manufacturers have brought forth a series of devices. Examples: *random-number devices, time-function generators,* and *noise generators.*

Data-Distribution Devices

After the computer has completed its task of processing the collected information, it becomes necessary to distribute the results to those places where they are needed. There are many methods for distribution. The most common one is the printed report or tabulated sheet. Other methods depend upon the kind of information involved, how much of it there is, and by whom it will be used or what type of equipment will be used. The types of devices include printers, visual displays, recorders, and storage devices, and are described in the following paragraphs.

PRINTERS, as output devices for computers, are of a more obvious utility than other data-distribution devices, and there is little need to point out their importance. They are the usual means by which the computer communicates directly and immediately with its operator. However, as the speed of computers has increased, the variety and speed of printers has also increased. There are many types from which to choose and, again, the choice is very important to the system in order to assure compatability. Examples: *electro-mechanical (type-bar, type-wheel, etc.),* wire matrix, and *electrographic.*

VISUAL DISPLAYS provide visual access to intermediate data for the purpose of monitoring the computer process. These are the fascinating blinking lights one sees on computer consoles which indicate a flurry of activity within. However, in addition to the displays at the console, and particularly in the case of machines which do not provide such a display, other outlets for this information are sometimes desirable. For example, the stock exchanges, if utilizing a computer system, could automatically display transactions simultaneously at several remote locations. For such special cases, read-out devices are available. A few visual displays are: *lighted numerals, light matrixes, radar-type maps, mechanical registers,* and *beam-writing (T.V. type) tubes.*

RECORDERS, previously mentioned as data-collection devices, may also be used as distribution media. Many times the same recorder, or at least the same type of recorder, can be used both in the input and output areas of the system if the proper coordination of equipment allows. Typical data-distribution recorders are: *data-curve plotters, tape (magnetic, punched, printed, etc.),* and *card punches.*

STORAGE DEVICES for distribution purposes refer to those into which information from a computer may be rapidly deposited for future printing or punching. Such devices are used so that the computer need not be stopped or appreciably slowed down during this data-distribution operation. Other storage devices have been developed to replace card files (such as inventory cards) in order to maintain a more accessible and readily updated system. Examples: *magnetic drums and discs, tapes (magnetic, punched, printed,, etc.), magnetic cores,* and *television-type storage tubes.*

It is evident from the preceding paragraphs that the number of devices eventually falling into these classifications is considerable. There are certainly several hundreds of varieties; perhaps even thousands, and the task of reaching a decision as to which particular piece of equipment is best suited to a given function is, at best, very difficult. Actually, this situation promises to become more difficult with the passage of time, as the addition of new pieces of equipment seems to be limited only by the imaginations of systems designers in finding new areas where auxiliary equipment can satisfy a systems requirement.

Additional Auxiliary Requirements

Continuing the discussion of the auxiliary requirements of the computing system "as a whole," two additional factors must be considered. Both adequate physical facilities and properly trained personnel are important factors in the efficient operation of a computing system.

Physical Facilities

It is necessary to plan the computing system completely. One of the most important considerations, sometimes unanticipated, is that of the physical facilities required. The importance of this factor is emphasized by the fact that many manufacturers will not deliver their computers until the proper environment for it has been prepared. The equipment required for communicating with the computer must be either located in, or excluded from the computer area as the case may be, and space requirements will depend upon this decision. Thus, physical facilities, to be adequate, must properly house the entire system, with enough room to permit a reasonable amount of expansion.

The facilities required will vary considerably with the kinds of computer involved. Physical arrangements may call for air-conditioning, humidity control, dust control, regulated electrical power, false floor paneling and, of course, considerable space. The cost of designing and installing all these alterations runs up to a sizeable percentage of the cost of the complete computer installation. Such costs are definitely too large to ignore.

People

Perhaps it is indelicate to consider people as auxiliary equipment, but in a computing system they are just that. A computer is like a thoroughbred horse; they both require special handling by carefully trained people if they are to be more than impressive showpieces.

Normally, organizations have two primary sources of supply of people who may operate computers. The employees who are already part of the organization and familiar with the company's present operations comprise the first source. These people may be trained in operation of the computer (and the auxiliary devices). The second group is made up of people who have training and experience in the use of the new computing system. They must be found and hired. In many instances, these people will be the ones who instruct the first group, and therefore they must be highly qualified. As with the physical-facility factors, this problem of training and hiring is a very important consideration in the success or failure of the complete system.

Some Unusual Auxiliary Equipment

Some idea of the variety of uses to which computers may be put, when proper auxiliary equipment is available, may be gained from examplts of such uses. As is so often the case, much of the more advanced work in the development of new areas for use has been stimulated by the Armed Forces. One of the most interesting applications of the computer as developed by the military is described below.

Perhaps one of the most important present-day uses of computers is in "real-time operation." The term "real time" means that the computer operates so quickly that present information is processed continuously to give continuous and instantaneous solutions to the problem involved.

A current example which illustrates this principle of operation is the inertial guidance system of a missile. The guidance of a missile in flight requires constant checking and correction. Inertial guidance is the most effective system now available. To make this possible, the builders have created a "stable platform" which remains fixed with respect to its position at the time of firing. The platform, which was created by attaching a small frame to gyroscopes, holds its original position regardless of the rotation or angle of elevation of the missile.

Between the gyroscopes and the frame of the missile are sensing devices which produce electrical signals corresponding to the difference in position between the stable platform and the missile frame. The electrical signals from these sensing devices are that part of the information which is entered into the missile's computer to tell when it is off its course. The information as to what the course should be at a particular time, is entered directly into the computer from a preset program determined by the flight path desired.

The term "real-time computing" in this instance means that the missile's computer instructs the missile guidance system to deviate a certain amount from the position of the "stable platform." Then, it checks to see that this position is reached. If the proper position has not been reached, the different signals from the gyroscope sensing devices tell the computer what corrections to make. Being electronic, these instructions are almost instantaneous and are constantly controlling the missile's flight path.

An interesting nonmilitary application uses a computing system to control automatic mixing or weighing machines. In this case, the computer is instructed to allocate certain amounts of each of several materials to make up a batch of a certain substance. The computer controls (in "real time") the operation of the selection devices and is informed from the auxiliary equipment when the proper amount of each material has been apportioned. In this case, the auxiliary equipment would be weighing mechanisms, color sensing devices, counters, thermometers, etc., as required to provide the computer with information about the mixing process.

Another nonmilitary application, and one which is familiar to many people, is the traffic-light control system. In a system of this type, there is a relatively simple computer which controls the traffic at an intersection. The length of time that lights permit traffic to move in a given lane is determined by the information from the traffic counting devices in that lane. In this instance, the counting devices constitute the auxiliary data collection equipment. If the intersection is made up of more than four streets, or if an unusually large number of cars turn left, the computer becomes more complex, and requires more information from the traffic counters.

There are, of course, many more very interesting systems with computers providing the logic, and the auxiliary equipment providing the communication link.

Conclusions

As suggested by the preceding paragraphs, auxiliary data collection and distribution devices satisfy a long list of special functional requirements. Some of these devices

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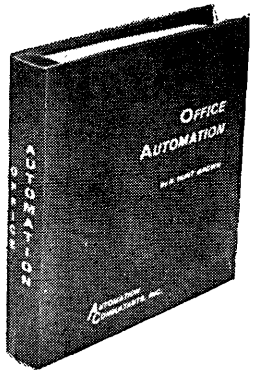

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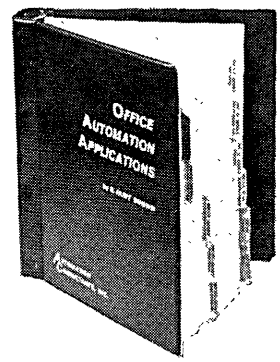

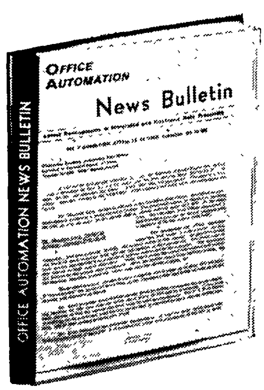

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are indispensable. Others have somewhat diminishing degrees of necessity. In fact, in some systems, certain of these devices are quite unnecessary and their use can cause the cost of the system to become prohibitive. On the other hand, there are times when a bottleneck in the information flow of a system can be opened quite effectively by installing a special device in the key spot. People experienced in computer operation know that computers and auxiliary equipment must be understood and selected according to a realistic and objective plan. Each device — and the system collectively — must speak the same language as the computer to provide smooth communication.

Developments to date in this field of auxiliary devices for computers have brought astounding progress. Yet the very progress itself has led to considerable confusion in the process of selecting the best piece of equipment for a given function in a particular system. This confusion is not limited to users. Even manufacturers have difficulty deciding which pieces of equipment to include in their line of products. The consequences, as one might expect, lead to considerable differences of opinion as to what systems should be recommended to perform a given function. Recommendations of components may need to be based upon a complete knowledge of all existing equipment available rather than upon a knowledge of a particular manufacturer's equipment.

Because of the uncertainties as well as the costs involved, companies would do well to canvass the situation before proceeding with such a costly installation. An objective study should include these important points: (1) a careful evaluation of the tasks which the computing system may be expected to carry out; (2) a study of the types and forms of information to be handled; (3) selection of equipment that will most effectively handle the information and perform the desired tasks; (4) determination of the cost of the installation and operation of the equipment; and (5) last, but not least, compare this cost with the costs of other possible methods of doing the same job. Such an evaluation may be performed by either a specially organized group within the company or by some outside organization which is informed on developments and able to give objective recommendations.

IMPLICATIONS OF ELECTRONIC DATA PROCESSING FOR BUSINESS EDUCATION IN HIGH SCHOOL

Enoch J. Haga
Sacramento State College
Sacramento, Calif.

AS ELECTRONIC DATA processing causes changes in business methods and procedures, it should also cause changes in the curriculum for vocational business education in the high school. The business use of data processing equipment is continuing to expand, and equipment suited to and within the economic means of even small business enterprises will increasingly come into prominence.

Electronic data processing is only the latest advance in the attempt to solve a very old business problem — the problem of what to do with a great mass of business paperwork.

Electronic machines of great speed and versatility have been developed to speed up and simplify the handling of business paperwork, and their increasing acceptance by the business world proves their utility. The first machines were large scale and very expensive, but medium scale and small scale systems have been developed for use by smaller businesses with more limited financial resources, and this trend may be expected to continue, so that electronic systems will come to be used more widely by the business world.

The increasing use of electronic data processing equipment will cause some displacement of personnel, but the overall effect should be beneficial. Business, with new up-to-date operating information at its fingertips, will find itself better prepared to expand with growing markets and increasing competition. New jobs have been created — for people to build the electronic equipment, for people to operate and use the equipment, and for people to repair and maintain the equipment and to develop improved models.

Many of the high level positions such as *programmer, systems analyst,* and *coder* will go to college trained and highly experienced personnel, but there will be many lower level or starting positions open to qualified high school graduates. These positions will be mostly in the clerical and operating areas. Experience and aptitude seem to be far more important than the school grade level completed, and exceptional personnel will be able to qualify for some of the higher level positions.

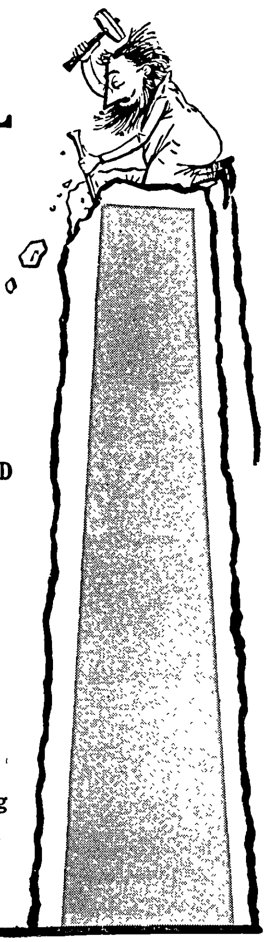
Business educators think that electronic data processing is going to have some effect on high school vocational business education. They also believe that some revision of the curriculum is going to be necessary. For one thing, the number of clerical workers may possibly decline sharply in the coming years. Bookkeeping duties have been reduced to clerical tasks in many large offices, and bookkeeping probably will not survive in its present form; principles will largely take precedence over practice in bookkeeping classrooms. Typists will be upgraded, and they will assume the duties of stenographers; shorthand will decline as a vocational use subject. Typists will be producing original documents for machine use, and they will type from information that has been dictated to a transcription machine. Key-punch fingering may be taught in the typing classroom on electric typewriters. All business courses will be affected by electronic data processing to some extent, and both teachers and students should probably familiarize themselves with the principles that are basic to electronic data processing.

Electronic data processing personnel are usually chosen from within the organization whenever possible. The manufacturer and individual business enterprise are going to continue their responsibility for training computer personnel. Schools will increasingly assume the responsibility for this training as the use of electronic machines becomes more widespread in business. Cooperative work experience programs are going to become important if realistic education is to be provided.

Training in fundamentals, business educators think, is going to be the best kind of training for the workers in the mechanized office. Students are going to have to be more responsible, able to think for themselves, and have a more solid foundation in logic and mathematics. There may always be a wide enough range of jobs in computer installations to fit a corresponding range of intelligence and ability, but it is certain that the higher positions will require higher quality students just as they always have. Certainly business educators, teachers, and students, are all going to have to learn more about electronic data processing.

Conclusions

1. Bookkeeping in large offices is becoming largely a clerical task requiring little or no bookkeeping training.
2. Bookkeeping is not going to be as important in the business education curriculum as it has been.



3. Bookkeepers and accountants are going to have to learn to deal with new media such as punched cards and tapes that will take the place of more conventional methods of recording business transactions.

4. Typing will become the most important business subject.

5. Some auxiliary equipment operators, such as keypunchers, may be trained in the typing classroom on electric typewriters.

6. Typists will largely replace stenographers; they will type from information dictated to transcription machines.

7. Shorthand will decrease in importance as a vocational subject.

8. A new data processing curriculum may have to be set up under the charge of the business education department.

9. While the manufacturers of the equipment have been largely responsible for the training of computer personnel, and this type of training has been combined with on-the-job education and experience, it is probable that schools will be called upon to provide training for data processing personnel as the use of electronic devices becomes more widespread.

10. As the present electronic data processing equipment is very costly, cooperative work experience is going to become essential if the classroom is going to keep pace with office practice.

11. Business students are going to need more background in fundamentals.

12. Business students are going to need higher intelligence and ability for the more responsible tasks they will face in the mechanized office.

13. Business teachers and educators should strive to become more familiar with electronic data processing.

Recommendations for Further Research

1. There is a need for the development of some comprehensive and annotated bibliographies in the field of business data processing.

2. A comprehensive catalog of audio-visual aids in the field of electronic data processing needs to be compiled.

3. Each subject in the high school vocational business education curriculum should be studied in relation to the impact of electronic data processing.

4. Some tentative courses of study for revised business subjects should be drawn-up — perhaps even an entire tentative data processing curriculum should be formulated.

5. Some attempts should be made to clearly define the responsibility of the high schools in the training of electronic data processing personnel.

6. Opportunities for cooperative work experience programs should be thoroughly explored.

7. The problem of how the high school is going to get the use of electronic data processing equipment should be investigated (cooperative work experience programs, rental, use of cheap models and mock-ups in place of the actual equipment, should all be considered).

Readers' and Editor's Forum

[Continued from page 6]

H. C. Bertuccelli, West Newton, Mass.: "Discussion might be enlightening. Unless, however, it struck a vital chord within me, I very much doubt that I would care to take an active part in such a discussion."

Lewis A. Ondis II, Pittsburgh, Pa.: "However, this should be only a small part of C & A. Technical information should dominate."

George B. Sutton, West Los Angeles, Calif.: "What is meant by the 'social responsibility of computer scientists'?"

Raymond J. Twery, Chicago, Ill.: "You might develop views of what some social responsibilities might be, but I do not consider this a major problem area."

John Funaro, Sacramento, Calif.: "It is time that scientists and computer manufacturers learn that the hardware they produce is useless in an unpeopled world. Let us heavily de-emphasize the mechanics and let us accentuate the human elements."

Frank S. Preston, Tarrytown, N.Y.: "In moderation."

Andrew Rauchwerk, Norristown, Pa.: "I have not yet recognized the problem. Some articles and letters would lead me into recognition, would be helpful."

Lewis P. Tabor, Narberth, Pa.: "I belive that those who wish to discuss this should be permitted to do so, even if nothing worth while comes out of it."

John G. MacKinney, Alexandria, Va.: "I am not clear as to what social responsibility we have that is not in common with other citizens."

Dr. Mario L. Juncosa, Pacific Palisades, Calif.: (voted "Yes"): ". . . but we should not commit ourselves to a resolution of the majority binding on the minority.

"In particular, our educational responsibility should be covered. Items on what we can do to influence elementary and secondary school curricula would be of great social value."

Kendall Preston, Jr., Summit, N.J.: "Why not discuss this subject. I don't feel that it is a burning issue, but if there has been comment on it, what better place to see this in print than 'Computers and Automation'?"

Donald O. Larson, Bethesda, Md.: "Occasional articles apart from technical articles add flavor to a publication if the highest percent of material in the magazine is still technical."

George E. Reynolds, Wrentham, Mass.: "The effect of automation on employment is the only major social issue presently of importance."

III.

James W. Woody, Jr., Oak Ridge, Tenn.: "I believe social responsibility is an individual's concern. Therefore, stick to technical subjects."

Robert B. Grant, Bartlesville, Okla.: "I believe we should carry our social responsibility but do not believe C & A is the proper forum."

Ben Kessel, Natick, Mass.: "I don't like to see a mixture of technical and non-technical subjects in one publication."

Mrs. W. Hochstrasser, Lawrence, Kansas (voted "Yes"): "But not in a technical journal."

Dr. H. N. Laden, Cleveland, Ohio (voted "No"): "I believe in discussing it but not in your discussing it. I will discuss this with those whom I choose, when I choose, where I choose. I am frankly disinterested in you and your point of view."

Dennis D. Willard, San Jose, Calif.: "I think computer men are neither more nor less responsible than other scientists; why use space in a magazine for a "narrow

[Please turn to page 28]

NEW PATENTS

RAYMOND R. SKOLNICK
Reg. Patent Agent
Ford Inst. Co., Div. of Sperry Rand Corp.
Long Island City 1, New York

THE following is a compilation of patents pertaining to computers and associated equipment from the "Official Gazette of the United States Patent Office," dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention. Printed copies of patents may be obtained from the U.S. Commissioner of Patents, Washington 25, D.C., at a cost of 25 cents each.

February 4, 1958: 2,822,130 / George V. Nolde, Berkeley, and Harold T. Avery, Oakland, Calif. / Marchant Calculators, Inc., Calif. / A readout and radix conversion from a mechanical register to a capacitive storage.

2,822,131 / Pierre Raoul Roger Aigrain, Paris, Fr. / International Standard Electric Co., New York, N.Y. / An impulse multiplying arrangement for electric computing machines.

2,822,467 / Frederick Leander Washburn, Jr., Schenectady, N.Y. / National Union Electric Corp., Del. / An electronic signal storage and reading system.

2,822,471 / Howard L. Foote, Fairport, N.Y. / General Dynamics Corp., Del. / A binary counting system.

2,822,474 / Alexander Boecker, East Norwich, N.Y. / U.S.A. as represented by the Sec. of the Army / A circuit for deriving the absolute magnitude of input voltage signals having positive or negative polarity with respect to ground.

2,822,480 / Carl L. Isborn, Hawthorne, Calif. / The National Cash Register Co., Maryland / A bistable state circuit.

2,822,506 / Edward J. Rabenda, Poughkeepsie, N.Y. / International Business Machines Corp., New York, N.Y. / A decimal and binary self-complimenting gas tube counter.

2,822,511 / William B. McLean and Jack A. Crawford, China Lake, Calif. / U.S.A. as represented by the Sec. of the Navy / A magnetic integrator.

2,822,532 / Lyle G. Thomson, Broomall, Pa. / Burroughs Corp., Detroit, Mich. / A magnetic memory storage circuit and apparatus.

2,822,533 / Simon Duinker, Derk Kleis, and William K. Westmijze, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N.Y. / A device for reading magnetically recorded memory elements.

February 11, 1958: 2,822,977 / John W. Gray, Chappaqua, N.Y. / General Precision Lab., Inc., New York / A computer for dividing a first electrical quantity having a range including posi-

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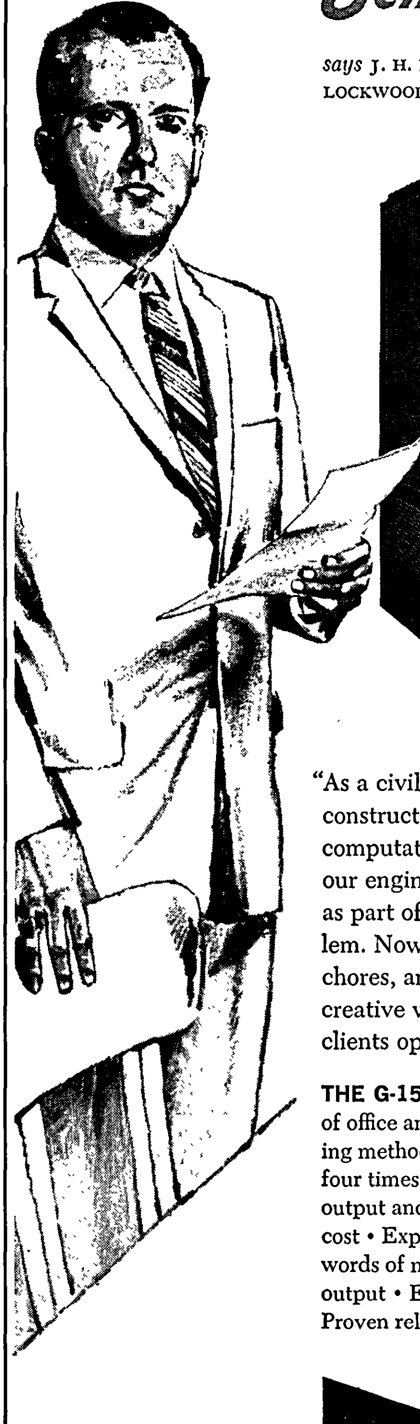
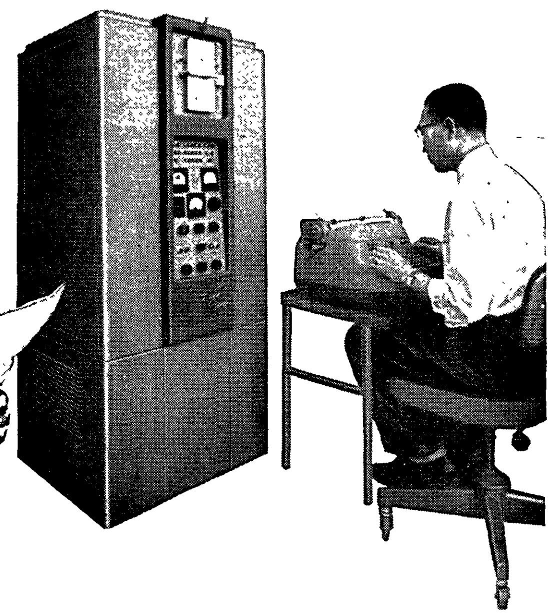




Readers' and Editor's Forum

[Continued from page 26]

field" to discuss a general, though important problem?"

Robert H. Goerss, Franklin Park, N.J.: "Why the responsibility of computer scientists rather than all scientists?"

Bernard Schein, Phila., Pa.: "Computer scientists have no distinctly different social responsibilities from other people, or other scientists."

Donald C. Holmes, Rye, N.Y.: "The social responsibilities of computer scientists are identically the same as those of other technologists; why discuss separately?"

Arnold G. Rawling, College Park, Md.: "Nontechnical forums and periodicals exist for those who wish to make asses of themselves. Please stick to the subjects which are pertinent to computers, their applications, and allied fields."

Ronald W. Colman, Brooklyn, N.Y.: "While an important subject, I do not think it is of interest to many of your readers."

IV.

It is clearly desirable for **Computers and Automation** to provide a forum for at least some discussion of the social responsibility of computer scientists for the social effects of their science.

In the words of the 1959 Western Joint Computer Conference announcement published in the July issue (p. 6), the "social implications of the widespread application of computer techniques" is a subject for invited articles, papers, and letters, of a "type to invite serious discussion."

Meeting of Association for Computing Machinery—

Urbana, Ill., June 11 to 13, 1958—Program, Titles and Abstracts

Part 3

(Continued from the August issue)

64. TEST ROUTINES BASED ON SYMBOLIC LOGICAL STATEMENTS

RICHARD D. ELDRED

Datamatic Corporation, Newton Highlands, Massachusetts

In order for the successful operation of a test routine to guarantee that a computing system has no faulty components, the test conditions imposed by the routine must be devised at the level of the components, rather than at the level of programmed orders.

Therefore, the proper approach to writing test or maintenance routines is by way of the logical diagrams of the systems, and not the list of machine orders. This is the only way in which all conditions of operation of each logical function can be completely and uniquely defined. Orders can then be programmed to present all conditions, and further orders can be programmed to detect improper performance of the logical functions, thereby producing a minimum program which tests and detects failure in each logical component in the system.

66. FUNCTION GENERATION IN FLIGHT SIMULATION

CAPTAIN DAVID D. YOUNG

USAF, Edwards Air Force Base, California

The functions which describe the coefficients in the nonlinear equations of aircraft performance are generated by two-variable analog function generators. The analog computer uses these coefficients in the solution of the flight equations used to "fly" a simulator. The flight simulator is used for ground training of flight crews in airborne flying techniques.

The existing methods for generation of arbitrary functions of two or more variables in analog computers are extremely inflexible and severely limited in realtime operating capabilities. These limitations affect the operating capabilities of the entire closed-loop flight simulator. All eight present-day function generators described in this paper use unique circuitry and servomechanisms to provide a function of two independent variables. The performance of the most elaborate of these designs is limited by the relatively slow maximum speeds possible in systems containing moving mechanical parts.

A faster, more versatile function generator must be developed if the flight simulator is going to be used to simulate flight of future high-performance aircraft, missiles, and space vehicles. Almost all of the six described theoretical methods of all-electronic two-variable function generation have the potential capability of being developed into a "universal" function generator that can replace the servo-driven systems. The new methods of electronic two-variable function generation now under development exhibit no serious problems or limitations in flexibility and frequency response.

67. COMPUTER SIMULATION OF A MACHINE JOB SHOP

IVAN REZUCHA

IBM, New York, New York

The task of evaluating all possible combinations of movements of work through a large machine job shop is possibly beyond the power of present day computers. The alternative of simulating a machine shop and observing the expected efficiency of scheduling and dispatch rules was followed in this project.

Scheduling is the establishing of a planned workflow through the shop, dispatching the implementation of the plan in view of unpredictable stochastic events.

The input to the computer is first a sequence of job orders received from customers, then shop parameters, such as number and kind of machine tools, number of men, work hours, cost rates, and various statistical performance distributions. The particular scheduling and dispatch rules to be studied must also be supplied.

Since the simulator is not intended for real life scheduling and on-line dispatching of a shop, the output are statistical reports about the behavior of the simulated shop. Anticipating a variety of objective functions, the com-

[Please turn to page 30]

New Patents

[Continued from page 27]

tive and negative senses and representative of first input data by a second electrical quantity having a range including positive and negative senses and representative of second input data to form output data.

2,822,979 / Carl D. Southard, Endicott, N.Y. / International Business Machines Corp., New York, N.Y. / A value counting circuit for dividing all digit values based on a predetermined modulus and storing the remainder after such division.

2,823,344 / Earl A. Ragland, Van Nuys, Calif. / Bendix Aviation Corp., North Hollywood, Calif. / A direction-sensing code matching system for binary codes.

2,823,345 / Earl A. Ragland, Van Nuys, and Harry B. Schulthris, Jr., Reseda, Calif. / Bendix Aviation Corp., North Hollywood, Calif. / A direction-sensitive binary code position control system.

2,823,368 / Robert A. Avery, Vestal, N.Y. / International Business Machines Corp., New York, N.Y. / A data storage device.

2,823,369 / Roy L. Haug, San Jose, Calif. and Charles W. Allen, Endicott, N.Y. / International Business Machines Corp., New York, N.Y. / A condenser storage regeneration system.

2,823,370 / John J. Oestreicher, Roselle Park, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A system for the electromagnetic storage of data respectively relating to orders in an information program.

February 18, 1958: 2,823,586 / Byron L. Havens and John J. Lentz, Cambridge, Mass. / U.S.A. as represented by the Sec. of War / A bomb release point computing system.

2,823,855 / Eldred C. Nelson, Los Angeles, Calif. / Hughes Aircraft Co., Del. / A serial arithmetic unit for binary-coded decimal computers.

2,823,857 / Antonio L. Heitor, Lisbon, Portugal / George D. Dunlop, Annapolis, Md. / A mechanical dead reckoning and time-distance navigational computer.

2,824,222 / William M. Furlow, Jr., Arlington, Va. / U.S.A. as represented by the Sec. of the Navy / A digit storage circuit.

2,824,242 / Rene J. Hardy, Le Chesnay, and Yves L. Le Port, Triel, France / Drivomatic (Societe a Responsabilite Limitee), Paris, France / A control circuit for positioning an object.

February 25, 1958: 2,824,452 / Robert A. Colby, Marion, Iowa / Collins Radio Co., Cedar Rapids, Iowa / A shaft positioning mechanism.

2,824,453 / Lloyd E. Winter, Cedar Rapids, Iowa / Collins Radio Co., Cedar Rapids, Iowa / A differential mechanism.

[Please turn to page 31]

[Continued from page 28]

puter reports cover load analysis, machine and manpower utilization, work in process inventory carrying cost, length of waiting lines and time spent by orders waiting at work-stations, and finally a record of met delivery dates.

68. SOME NUMERICAL INVESTIGATIONS OF PROBLEMS INVOLVING PHASE CHANGES

M. E. Rose
Brookhaven National Laboratory, Upton, New York

This paper proposes a method for obtaining the numerical solutions of a class of nonlinear problems which arise in discussions of physical processes involving a moving interface separating regions through which a change in phase occurs. A feature of the method is that the formulation proceeds without prior knowledge of the existence of the interface, in which respect it is suggestive of the Von Neumann-Richtmyer and, more particularly, the Lax treatment of shocks in hydrodynamics. Some theoretical arguments together with the results of certain trial calculations are given with the view of adding support to our belief in the validity and generality of this method.

69. THE SOLUTION OF TALL DISTRIBUTION PROBLEMS

B. A. Galler and P. S. Dwyer
University of Michigan, Ann Arbor, Michigan

This paper describes an IBM 704 program for the solution of the two-dimensional distribution (transportation) problem in the case where the cost matrix is either *tall* or *flat,* i.e., where there are relatively few columns as compared with the number of rows, or few rows as compared with the number of columns. Such problems may arise, for example, in industrial situations, where there may be very few manufacturing plants but a large number of warehouses or customers to whom shipments are to be made, or where there may be many suppliers to a few manufacturing locations. The program is based on the detailed method of optimal regions and in some ways is similar to the method of reduced matrices.

70. A METHOD FOR THE SEPARATION OF EXPONENTIALS

J. C. Gardner
University of Pittsburgh, Pittsburgh, Pennsylvania;
D. G. Gardner
Westinghouse Electric Corporation, East Pittsburgh, Penn.;
G. Laush
University of Pittsburgh, Pittsburgh, Pennsylvania

A constantly recurring problem in many branches of science involves the resolution of experimental data into a sum of exponentials. Given a function of the following form $f(t) = N_1e^{-\lambda_1 t} + N_2e^{-\lambda_2 t} + \ldots + N_ne^{-\lambda_n t}$ where $f(t)$ is defined at a finite number of points, our aim is to determine n (the number of components), the λ_i's and N_i's where $N_i \neq 0$, $\lambda_i > 0$ and $\lambda_r \neq \lambda_s$ when $r \neq s$. The above equation may be expressed in integral form as $f(t) = \int_0^\infty g(\lambda)\, e^{-\lambda t}\, d\lambda$. This Laplace Integral Equation is solved numerically by a method of Fourier transforms on the IBM 650 and the result is a frequency spectrum in λ and $g(\lambda)$. This method appears to have several distinct advantages over previous methods: (1) an automatic determination of the number of components, (2) replacement of human judgment by mathematical analysis, (3) full use of the accuracy inherent in the data, and (4) an error estimation. Studies were made of the effect of cut-off error, different integration methods, and errors in the initial data on the accuracy of the final results.

71. AN INTERPOLATION PROCEDURE FOR CLOSED CURVES

T. I. Arnette
Oak Ridge National Laboratory, Oak Ridge, Tennessee

A simple procedure has been devised for supplying closely spaced points on an analytic closed curve by interpolation between data points. The interpolated curve has continuous value, slope, and curvature, and is free of spurious fluctuation. Conventional methods appear always to have either spurious fluctuation, or discontinuities of slope and curvature. If n is a variable which takes on integral values at the given (x,y) values, x (and y) is fitted by a cubic polynomial in n, between each two integral values, which joins with continuous slope and curvature to the preceding and following polynomials. The coefficients are determined by a simple recursion relation, and a consistency condition must be satisfied to make the end of the curve join smoothly to the beginning. The procedure has been embodied in a general oscilloscope plotting routine, which can be used to save the work of plotting machine results by hand in an artistic form.

72. THE DESIGN OF FIXED-POINT ITERATIONS

Arthur C. Downing
Oak Ridge National Laboratory, Oak Ridge, Tennessee

The recursion relations for solving nonlinear equations by successive substitution can be written in the form $\xi_{\nu+1} = \xi_\nu + \rho(\xi_\nu)\gamma(\xi_\nu)$, where the residual $\rho(\xi_\nu)$ tends to zero as ν increases without limit. The ultimate accuracy of ξ depends upon the rounding errors made in computing the final correction $\rho(\xi_\nu)\gamma(\xi_\nu)$. These rounding errors may be minimized for those problems in which $2^\kappa\rho(\xi_\nu)$ can be accurately computed whenever one knows a priori (from the previous iteration) that $|\rho(\xi_\nu)| < 2^{-\kappa}$. This is possible, for example, when $\rho(\xi)$ is a sum of terms which are at most quadratic in ξ and in the parameters of the equation, since all fixed-point computers yield exact sums modulo 1 or modulo 2.

Detailed applications are made to the problem of computing planar rotations, to the computation of cube roots, and to the problem of improving characteristic values and vectors of a symmetric matrix using perturbation techniques.

73. REPORT OF PITTSBURGH CHAPTER COMPUTING COURSE FOR HIGH SCHOOL STUDENTS

Frank Engel, Jr.
Westinghouse Electric Corporation, Pittsburgh, Penn.

Since October 1957 some 48 selected Pittsburgh high school students have been meeting on Saturday mornings for three hours on the Carnegie Institute of Technology campus for lectures and laboratory sessions on the IBM Computer Type 650. Members of the Pittsburgh ACM chapter act as lecturers and counselors for the group. The experiences will be reviewed.

REPORT OF SECONDARY EDUCATION COMMITTEE

G. E. Forsythe, Chairman of the Committee
Stanford University, Stanford, California

Current trends in secondary education in mathematics and sciences will be reviewed, including a summary of

[Please turn to page 32]

New Patents

[Continued from page 29]

2,824,690 / Francois H. Raymond, Saint-Germain-en-Laye, France / Societe d'Electronique et d'Automatisme, Courbevoie, France / An algebraic polynomial generator for computing the real and imaginary portions of a polynomial.

2,824,693 / Hubert M. James, Belmont, Mass. / U.S.A. as represented by the Sec. of the Navy / A computer for stabilization systems whereby the simultaneous solution of equations are performed.

2,824,697 / George F. Pittman, Jr., and Richard O. Decker, Pittsburgh, and Richard L. Bright, Adamsberg, Pa. / Westinghouse Electric Corp., East Pittsburgh, Pa. / A control apparatus.

2,824,698 / Robert I. Van Nice, Shaler Township, Allegheny County, and Richard C. Lyman, Castle Shannon, Pa. / Westinghouse Electric Corp., East Pittsburgh, Pa. / A recycling pulse counter.

2,824,710 / Albert C. Hall, Bloomfield Township, Oakland County, Mich. / U.S.A. as represented by the Sec. of the Air Force / A control system for guided missiles.

2,824,961 / John O. Paivinen, Berwyn, Pa. / Burroughs Corp., Detroit, Mich. / A decade counter for producing an output at the count of nine.

March 4, 1958: 2,825,502 / Knut A. Knutsen, Paris, Fr. / Compagnie des Machines Bull (Societe Anonyme), Paris, Fr. / An electronic calculator.

2,825,805 / Garrett F. Ziffer, Cambridge, Mass. / Tracerlab Inc., Boston, Mass. / An electronic big speed counter circuit.

2,825,859 / Edward A. Quade, San Jose, Calif. / International Business Machines Corp., New York, N.Y. / A positioning mechanism of the servo type.

2,825,861 / Mark Weinstein, Bronx, N.Y. / Emerson Radio and Phonograph Corp., Jersey City, N.J. / An integrating servo mechanism.

2,825,873 / Cyril Gordon Treadwell, London, Eng. / International Standard Electric Corp., New York, N.Y. / An electric pulse coding arrangement.

2,825,890 / Desmond S. Ridler and Robert Grimmond, London, Eng. / International Standard Electric Corp., New York, N.Y. / An electrical information storage circuit.

2,825,891 / Simon Duinker, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N.Y. / A magnetic memory device.

2,825,892 / Simon Duinker, Eindhoven, Netherlands / North American Philips Co., Inc., New York, N.Y. / A magnetic memory device.

March 11, 1958: 2,826,252 / Harold D. Dickstein, San Diego, Calif. / — / An automatic shaft position data encoder.

2,826,357 / John J. Lentz, Chappaqua, N.Y. / International Business Machines Corp., New York, N.Y. / A high speed read-out arrangement for data storage devices.

Association for Computing Machinery

[Continued from page 30]

agencies now active in this area. The activities of the ACM secondary education committee (E. C. Berkeley, W. E. Ferguson, Wallace Givens, A. S. Householder, and the Chairman) will be reviewed. The possible roles of the ACM in the post-sputnik educational revival will be mentioned.

74. DISCUSSION ON THE UNIVERSITY COMPUTING CENTER

The discussion covers the following topics and questions with the hope that the ideas presented and the questions raised may be of assistance to universities having or planning to have computing centers and corresponding sets of courses in numerical analysis.

(a) Acquisition problems

(b) Financial support of the Center

(c) Position of the Center within the University's table of organization

(d) A curriculum in mathematics or diffusion across departmental boundaries?

(e) Research in Numerical Methods

(f) Training problems, assistantships, and recruiting

WHO'S WHO IN THE COMPUTER FIELD

(Supplement)

A full entry in the "Who's Who in the Computer Field" consists of: name / title, organization, address / interests (the capital letters of the abbreviations are the initial letters of Applications, Business, Construction, Design, Electronics, Logic, Mathematics, Programming, Sales) / year of birth, college or last school (background), year of entering the computer field, occupation / other information such as distinctions, publications, etc. An absence of information is indicated by - (hyphen). Other abbreviations are used which may be easily guessed like those in the telephone book.

Every now and then a group of completed Who's Who entry forms come in to us together from a single organization. This is a considerable help to a compiler, and we thank the people who are kind enough to arrange this. In such cases, the organization and the address are represented by . . . (three dots).

Following are two sets of such Who's Who entries.

I. Corporation for Economic and Industrial Research, 1200 Jefferson Davis Highway, Arlington 2, Va.

Cooper, Charles G / Asst to Dir of Compg Div, . . . / AELP / '32, Rutgers Univ, '54, elec engr

Fassberg, Harold E / Sr Mathn, . . . / AM / '19, Amer Univ, '55, mathn

Hellerman, Eli / Mathl Prgmr, . . . / ABLMP, lin prgmg, matrix systems / '17, G Wash Univ, '56, mathn

Lewist, Reinwald / Project Analyst (Prgmr), . . . / ALMP / '26, Clark Univ, '56, geographer and statistician

Moshman, Jack / Dir, Mathl and Statl Services Div, . . . / AMP, statistics / '24, Univ of Tenn, '48, statn / secy, Assocn for Compg Machinery; assocn repr on Natl Res Council; publns on Monte Carlo theory, simulations, statl aplns

Orchard-Hays, William / Director, Compg Services Div, . . . / ABMP, information handling / '18, UCLA (MA in math) '51, / numerous papers on theory and techniques of lin prgmg

Robinson, Herbert W / Pres, . . . / AB, system design / '14, Balliol Coll, Oxford, Eng, '55, executive / book "The Economics of Building," P. S. King, London; many papers, chapters, articles on operational analysis, economics, etc.; Fellow Royal Statistical Soc; member, Operations Research Soc, many other orgnzns

Treadway, Robert B / Project Analyst, . . . / BMP / '28, Western Maryland Coll, Amer Univ, '51, mathn and compr prgmr

II. System Development Corporation, Sage Bldg, Truax Air Force Base, Madison, Wisc., and 2500 Colorado Ave., Santa Monica, Calif.

Abel, Robert R / . . . P / -, Univ of Ill, '57, prgmr

Allard, Roger J / Mathn, . . . / AMP / '24, Univ of Texas, '57, assy testing

Bjerke, Gerald / . . . / P / '35, Luther Coll, '57, prgmr

Blancett, Richard C / Unit Head, . . . / ABDLMP / '28, Kansas Univ, '56, prgmg

Boose, Richard W / Asst Mathn, . . . / LMP / '26, Univ of Akron, '57, prgmr

Bunn, Oscar J, Jr / . . . / P / -, St. Mary's, '57, prgmr

Cannon, Norman D / . . . / P / '34, Harvard, '56, compr prgmr

Chaney, Thomas A / . . . / P / '30, Kearney State Teachers Coll, '57, prgmr

Christman, Ann M / . . . / P / '28 Pembroke Coll, '57, prgmr

Collerd, Paul D / . . . / P / '27, Northwestern, '56, compr prgmr

Coln, James M / . . . / LMP / '34, Oklahoma Univ, '57, prgmr

Condon, William H / Adm Asst, . . . / BP / '27, Boston Univ, '57, admnstr

Damman, Daryl D / . . . / AMP / '30, Kansas State Teachers Coll, '57, prgmr

Dickinson, Martin B / Fld Site Ldr, . . . / LMP / '23, Oregon State Coll, '55, Mathn

Drews, Carl M / Asst Mathn, . . . / MP / '35, Univ of Calif, '57

Engdahl, Sylvia L / . . . / LMP / '33, Univ of Cal at Santa Barbara, '57, prgmr

Feldstein, Harold / . . . / P / '19, Drexel, '56, -

Hamer, Robert W / . . . / P / '28, Southwest Mo. State Coll, '57, prgmr

Hansford, Earle A / . . . / ALMP / '31, Univ of Missouri, '57, prgmr

Henrikson, Harold T / . . . / A / '26, Washington State Coll, '57, teacher

Henry, Clayton G / . . . / P / '23, State University of Iowa, '56, compr prgmr

Hermance, Kenneth E / Asst Mathn, . . . / LMP / '35, Worcester Poly Inst, '57, prgmr

Holtkamp, Esther / . . . / P / '30, Univ of Colorado, '57, prgmr

Hughes, Frank L / . . . / P / '17, Cornell Univ, '57, prgmr

Kahn, Michael / . . . / AP / '20, Univ of Chicago, '57, prgmr

Kline, Thomas P / . . . / AMP / '29, Hillsdale Coll, '57, prgmr

Koeske, Tom J / . . . / AMP / '30, Marquette Univ, '56, prgmr

Lackey, Helen / . . . / P / '32, Mt. St. Mary's Coll, '57, prgmr

Levine, Martin A / . . . / ABLP / '27, Brown Univ, '57, prgmr

Lewis, William J / . . . / P / '26, Univ of Michigan, '57, prgmr

Marks, Thomas F / . . . / ABLMP / '23, Univ of Wisc, '57, prgmr

Melly, Richard E / . . . / BLPS / '20, Concordia Coll, '57, prgmr

Miller, Howard R / Asst Mathn, . . . / P / '28, Marquette Univ, '57, prgmr

Morrisette, Robert J / . . . / AP / '29, Montana State Coll, '57, prgmr

Murphy, Jackson J / . . . / BMP / '31, Drake Univ, '57, prgmr

McAuliffe, John J / . . . / AMP / '32, Boston Coll, '57, prgmr

Nagle, Joseph W / . . . / ABP / '29, Depauw Univ, '56, prgmr

Naphtali, Leonard / . . . / P / '31, Univ of Wisc, '57, prgmr

Olson, Richard L / . . . / BP / '31, North Dakota State Univ, '57, prgmr

Olson, Warner J / Asst Mathn, . . . / AMP / '29, Univ of Minn, '57, school tchr

Osterber, Thomas W / Asst Mathn, . . . / MP / '32, Univ of Wisconsin, '57, prgmr

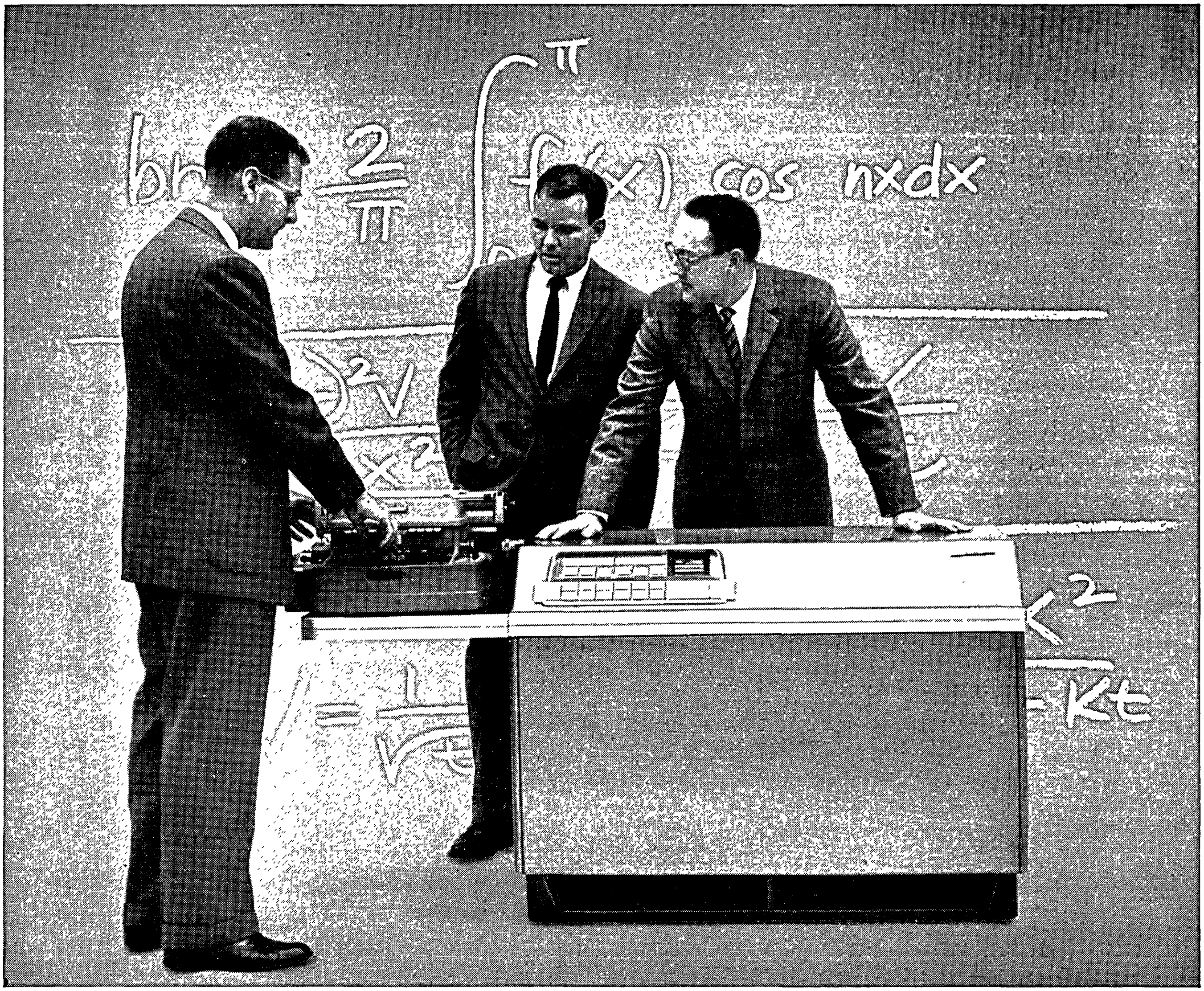
Plante, John M / Site Leader, . . . / LP / '27, Univ of N H, '55, prgmg

Player, Donald / . . . / AP / '27, Univ of New Mexico, '56, prgmr

Pulliam, Delores / . . . / AP / '32, Colorado State Coll of Ed, '56, prgmr, instr - utility system
Pulliam, Marvin L / Asst Mthn, . . . / LP / '35, St. Louis Univ, '57 /
Rubin, Paul M / . . . / ABP / '32, Univ of Maryland, '56, prgmr
Schuminski, Richard P / . . . / ALMP / '30, N.S.T.C., Aberdeen, S.D., '57, prgmr
Scroggins, John L / Mathn, . . . / P / '32, Purdue Univ, '57, pers mgt, tchr
Sell, Gene D / Mathn, . . . / M / '27, Coe Coll, '57, -
Shelton, Wayne / . . . / P / '32, Univ of Minn, '57, prgmr
Shoaf, Ernie R / Asst Mathn, . . . / ALP / '30, Stanford Univ, '57, prgmr
Skrukrud, Allan M / Asst Mathn, . . . / L / '31, Univ of Minnesota, '57, -
Smith, James L / . . . / LMP / '30, Oklahoma A&M, '57, prgmr
Spain, Delbert H / Asst Mthn, . . . / LMP / '15, Univ of Okla, '57, prgmr
Stratter, Stewart P / . . . / P / '23, Univ of Wisc, '57, prgmr
Torrero, George / . . . / ALMP / '28, Brooklyn Coll, '53, prgmr
Weed, Gerald D / Mathn, . . . / MP / '26, NW Missouri State Coll, '57, -
Wenzel, Edward C / . . . / LMP / '34, Wisc State Coll, '56, prgmr
Wheeler, Kenneth J / . . . / ABEP / '30, Univ of Wisc, '57, prgmr
Wood, Kenneth R / . . . / MP / '32, KSTC, Pittsburg, '57, prgmr
Yost, Emil L / Mathn, . . . / MP / '29, Hastings Coll, '57, -

ADVERTISING INDEX

Following is the index of advertisements. Each item contains: Name and address of the advertiser / page number where the advertisement appears / name of agency if any.



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ROYAL PRECISION LGP-30

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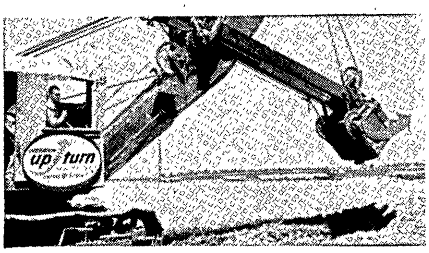
ARTICLE 4 VOLUME 1

COMPUTER DEPARTMENT LAUNCHES OPERATION UPTURN WITH NEW MILLION-DOLLAR PLANT IN PHOENIX, ARIZONA

General Manager H. R. Oldfield, Jr., is pictured at the controls of the Operation Upturn steam shovel which recently broke ground for the new 104,000 square foot permanent plant which is expected to be completed by December of 1958.

"Our business is good and getting better," Oldfield said. "We're going to continue to expand during the year, adding perhaps a hundred or more people." The department now has over 800 employees.

The 160 acre site is located in Deer Valley Park, northwest of Phoenix along the west side of the Black Canyon Highway and south of the intersection with Thunderbird Road.



COMPUTING SERVICES GROUP HANDLES COMPLEX ORIGIN-DESTINATION STUDY FOR WESTERN CITY

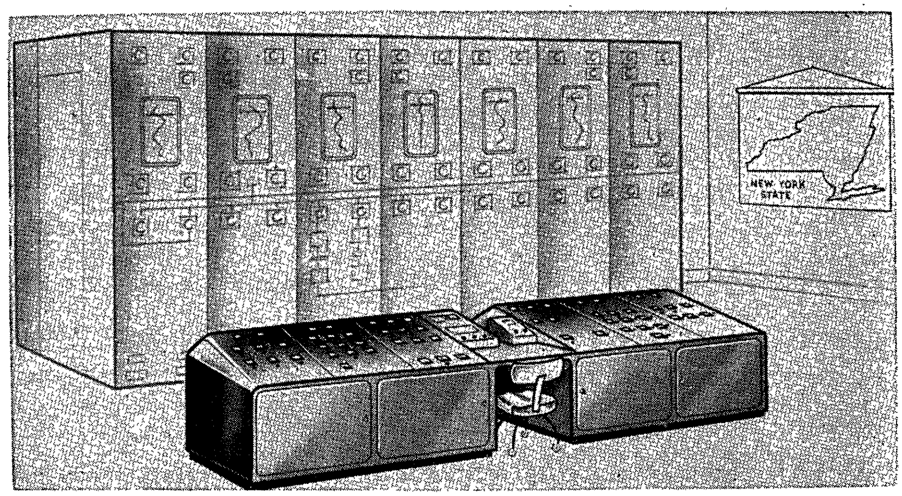
The Computing Services Center of the G-E Computer Department recently completed an origin-destination tabulation for the Phoenix-Maricopa County Traffic Study Group in Phoenix, Arizona. The results of this tabulation, when analyzed, will enable the group to plan the street and highway development program of this desert metropolis for years to come.

The original survey information was obtained by the city-county personnel using the interviewing procedures set up by the U. S. Bureau of Public Roads. The data was put on punched cards and then turned over to G-E for processing and tabulation.

Using manual, or simple computing methods, such tabulations often take many months—sometimes years—to complete. However, using General Electric's giant computer on a rental basis, the job was completed in just a few weeks. The Computer Department also performed the difficult programming job.

(Programming, simply stated, is the translation of the solution method into the language a computer can understand, and the issuance of instructions to the computer so that it will process the information it is fed.)

NEW ECONOMIC DISPATCH COMPUTER SCHEDULES POWER INTERCHANGE BETWEEN FOUR AREAS FOR EASTERN UTILITIES



This new transistorized Economic Dispatch Computer, developed by G-E's Computer Department for the Niagara-Mohawk Power Corp. and the New York State Electric & Gas Corp., represents a significant advancement in the field of dispatch computers.

The computer simulates the equivalent of four power systems as separate operating areas, whereas all previous computers represented either a single system or a group of utilities as a single system. Since it includes Niagara-Mohawk's three operating areas and N.Y.S.E. & G., it represents a large part of the power system of upper New York State. It also incorporates equivalent representation of certain neighboring utility systems.

This special purpose analog computer will produce solutions in a matter of seconds for operating problems which in some cases would take hours or days of manual calculation. It considers individual generating unit efficiencies, fuel costs and transmission losses to assure minimum use of fuel. It automatically computes the optimum schedules of power flow between the four operating areas and the corresponding power flow in the individual interconnecting transmission lines between areas. The computed generating plant outputs and power flows are used by the system dispatcher to schedule system operation. This computer will also be used to determine cost and value of power transactions where large amounts of power are transmitted from one system to another and facilities of a third system may be involved.

Today's rapidly increasing demands for electrical energy have increased the need for this type of complex inter-area scheduling. The problems of operating multi-area systems where transmission line losses are involved have become so complex that a system operator must have a modern computer to accomplish his task adequately.

Although the understanding of how to achieve economic dispatch for such a system has been known for several years, the technique to make the theory practical has only recently been established. Basic theory for the system was developed by Dr. L. K. Kirchmayer and associates of General Electric's Analytical Engineering Section.

The Computing Services Center of G-E's Computer Department is staffed with 125 analysts, programmers, coders—all leaders in the computer field. Their services are available, along with time on the large and versatile type 704 computer, to handle the problems of industry, business, government and education.

For more information contact your nearest Apparatus Sales Office, or Computer Department—Room 224, General Electric Company, 1103 North Central Avenue, Phoenix, Arizona.

CPA-8

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ARTICLE 4 VOLUME 1

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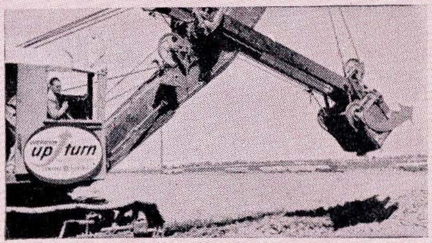

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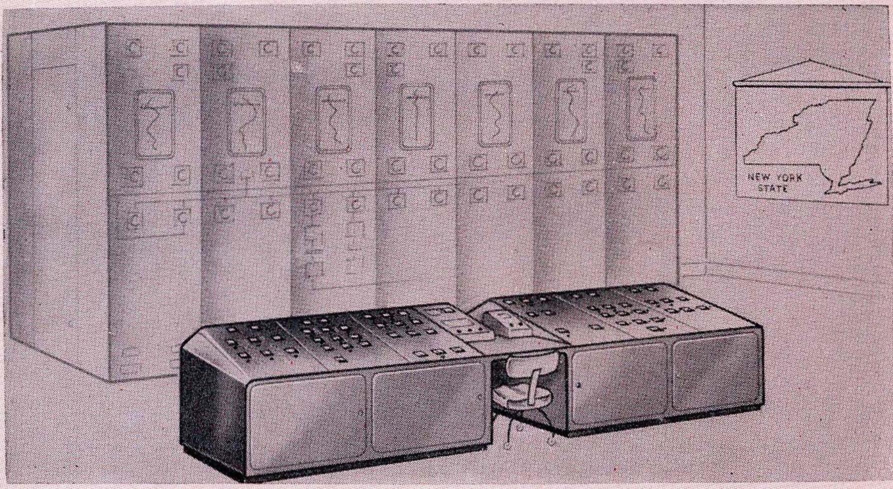

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