DIGITAL COMPUTER NEWSLETTER

The purpose of this newsletter is to provide a medium for the interchange among interested persons of information concerning recent developments in various digital computer projects. Distribution is limited to government agencies, contractors, and contributors.

OFFICE OF NAVAL RESEARCH · MATHEMATICAL SCIENCES DIVISION

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Approved by
The Under Secretary of the Navy
16 August 1954

NAVEXOS P-645

COMPUTERS, U.S.A.

AIR FORCE ARMAMENT CENTER, ARDC, EGLIN AFB, FLORIDA

Delivery of the UNIVAC High Speed Printer to be used with the existing UNIVAC Scientific Computer System is expected in October 1956. This printer will be capable of on-line or off-line operation. In the off-line mode, a Uniservo Magnetic Tape Unit prepared by the computer will drive the printer. (See also DCN, April 1956 issue.)

In mid-June the computer operation was extended to a second shift, bringing the utilization of the machine to approximately 90 hours per week. This increase in time was necessary to meet the computational requirements of an increasing test project workload and the transfer of responsibility for preparation of bombing tables from Aberdeen Proving Ground to the Air Force Armament Center.

A study was initiated to devise an improved compiling routine for the UNIVAC Scientific Computer based on the present compile-interpreter, I,i. The following additional features are being planned:

1. Ability to compile a subroutine with or without execution, on programmer's option.

2. Ability to handle subroutines with multiple entries.

3. In order to provide for programs whose length exceed Electrostatic Storage, the ability to segment a program on command, saving previous segments in auxiliary memory (drum or tape) and a record of how such segments were made and stored.

4. Ability to prepare another region of ES which would remain invariant between segments.

5. Built in provision for other interpretive coding systems such as FLIP.

ON-LINE DATA REDUCTION (TUNNEL E-1, GAS DYNAMICS FACILITY, ARNOLD ENGINEERING DEVELOPMENT CENTER)

The first application of on-line data reduction at GDF occurred in September 1955, when a heat transfer, developmental problem was investigated for an outside contractor. Since that time, the on-line system has been used practically full time for tests run in Tunnel E-1, which is the GDF tunnel now operating full time.

The term "on-line" signifies that the test data is fed directly from test instruments into a computer without any manual operation except the depression of a "take-data" button. This system has reduced the presentation time to a few seconds after the completion of a test. An on-line system includes the sensing of the parameters, conversion to the equivalent digital value, accumulation in a digital computer, computations on the data, and the presentation of the calculated data as decimal tabulations or X-Y plots.

Most input instruments are digitized by means of Coleman rotation to binary converters.

For pressure measurements, the Wianoko system is used, which is monitored by digitized millivolt indicators or recorders, and a digitized, automatic readout electromanometer, manufactured by Consolidated Electrodynamic Corporation. This is a servo-type system which is accurate and repeatable to 0.1 percent of full scale.

The link between the test instruments and the computer is the scanner, which sequences the instrument outputs to the computer input. A total of 252-scanner input positions are available, with each position being read once during a scan cycle. The maximum scanning rate is 20 positions per second; thus approximately 12.5 seconds are required to enter 252 channels of data into the computer. The data is entered into the computer in any desired order, which is determined by connections on plugboards located in the lower portion of the scanner. Also, the

scanner may be connected to scan all or a group of positions over and over again until manually stopped by the operator or control system. This is in contrast to the normal operation in which the scanner automatically stops after it has scanned the positions selected on the plugboards.

The ERA 1102, a general-purpose digital computer, is used for on-line operation with these tunnels. The word size for internal computer operations is 24 bits, which is equivalent to 7 decimal digits. Word size of inputs from on-line instrumentation is 15 bits, which is equivalent to 4 decimal digits plus sign.

The test data arrives from the scanner in the form of 15-bit binary numbers. These numbers, representing pressures, temperatures, forces, manual inputs, and so forth, are temporarily stored in the data input register and punched on paper tape. During on-line operation, the computer monitors the data input register using the test information as required in the problem solution.

The three types of output devices presently being used with the digital computer are electric typewriters, a high-speed punch and X-Y point plotters. Any of the computed data may be tabulated on the typewriters, or punched on tape, and any two quantities may serve as coordinates for plotting curves. At present, a maximum of five typewriters, one punch, and four plotters may be used simultaneously with the computer.

One of the basic concepts considered in designing the control system was simplicity of operation, particularly for personnel operating the tunnel. Consequently, they were provided with "take-data" and "end-data" buttons; depressing these control buttons is the only manually initiated function required to start and complete a test run.

It is interesting at this point to make a comparison between the present on-line method and the methods previously used which consisted of marking strip—chart recorders, doing the calculation with desk calculators, and tabulating and plotting the results.

	On-Line	Manual
Measuring & Recording 74 points	56 seconds	20 minutes
Calculating & Tabulating	2-3/4 minutes	1 hour 20 minutes

Time studies have shown that a calibration test that formerly took three to four weeks to complete can be done with the on-line method in one week. Besides this saving of time, a more accurate calibration is obtained.

It is necessary when using an on-line system to program the computer before the test starts. This operation takes times which was not shown in the above figures; however, it can be done while another test is in progress, and therefore does not utilize wind-tunnel test time. Sometimes calibration curves and constants are not known until shortly before the test begins; however, these parts of the program can be left open and added at the last minute. This is accomplished by inserting them manually into the computer and having the computer punch out its complete program on a high speed teletype punch.

In case the computer is employed on other computing work, it is possible to record only. In this operation, the raw data is punched on paper tape and later fed into the computer for computation and tabulation similar to the semi-automatic on-line method of data reduction mentioned earlier.

Times involved in the present on-line system consists chiefly of tabulating time. This time can be substantially reduced by tabulating on more than one machine simultaneously. However, this method has the disadvantage of splitting the tabulated data into as many sheets as there are tabulators. It is usually more convenient to present final data on a single sheet. Proven high-speed printout devices will substantially reduce this printout time.

BUREAU OF SHIPS, ELECTRONIC COMPUTER DIVISION

Plans have been completed, and programming has been started to mechanize the Comptroller Division appropriation accounting operations of the Bureau of Ships through the use of large scale electronic processing equipment. This is a long range project and embraces one of the largest areas of application that has been attempted in the Bureau in the field of data processing. The Univac computer at the David Taylor Model Basin will be used to test out each phase of the overall problem and aid in a final determination of the ultimate equipment and techniques required to process this type of work most efficiently.

The second Univac I, which the Bureau is renting, is now installed and operating at the Applied Mathematics Laboratory, David Taylor Model Basin. This computer is being used on a full three shift schedule for nuclear reactor designs. The computer will be exchanged for a Univac II as soon as one is available (before the end of Fiscal Year 1957). The nuclear reactor computing load remains so large that the equivalent of more than one Univac time is being obtained on other Univacs throughout the country, in addition to one hundred hours per month obtained on the high speed NORC computer at Dahlgren, Virginia. A contract has been signed with the Sperry-Rand Corporation requiring the delivery of a LARC computer to the Applied Mathematics Laboratory at the David Taylor Model Basin by December 1958.

DIGITAL COMPUTER AND DIFFERENTIAL ANALYZER COMBINATION (BENDIX COMPUTER DIVISION)

The Bendix Computer Division has recently announced the development of a general purpose digital computer and digital differential analyzer system, which provides versatility for solving complex technical problems in the easiest, most economical way. A full complement of input-output equipment is available. Delivery of the first production models will be made this October.

Specifications on the G-15D general purpose computer which forms part of the computer system were given in the April, 1956, Digital Computer Newsletter. Input-output equipment specifications are as follows:

INPUT AND OUTPUT EQUIPMENT

Type	Input Speed	Output Speed
Typewriter*	Manual operation	10 char/sec
Paper Tape*	200 char/sec (average)	17 char/sec
Paper Tape (PTP-1)		60 char/sec
Magnetic Tape	430 char/sec	430 char/sec
Card	17 char/sec	11 char/sec
Graph Plotter		0.01 inch increments
Graph Follower	(in 0.01 inch increments)	at 20 increments/sec

*included in basic price of G-15

DESCRIPTION OF ACCESSORY EQUIPMENT

MTA-2 Magnetic Tape Unit.

For auxiliary storage, up to 4 MTA-2 Magnetic Tape units may be connected to a G-15D. Each unit will store up to 300,000 words on standard 1/2 inch magnetic tape on 10-1/2 inch NARTB reels. Tape may be searched for either blocks of up to 108 words or for file sections consisting of any arbitrary number of blocks. Read-write speed is 7.5 inches per second. Search speed is 45 inches per second.

DA-1 DIGITAL DIFFERENTIAL ANALYZER

This accessory establishes the digital differential analyzer features in the G-15D system. The result is a system performance similar to the Bendix D-12 Digital Differential Analyzer, in addition to the general purpose actions. Through the DA-1, use is made of the magnetic memory drum of the G-15D to form 108 integrators and 108 constant multipliers. Operation speed is 34 iterations per second.

AN-1 ALPHANUMERIC PAPER TAPE INPUT-OUTPUT ACCESSORY

The AN-1 accessory accepts alphanumeric paper tape input in any code and enters it directly into the computer's memory. After setting selector switches on the AN-1, a special conversion routine may be used to translate the original input into the internal language of the G-15D. After computation, output is reconverted to the original code and punched out by the PTP-1 Tape Punch that is part of the AN-1. Conversion can be accomplished on any code that can be placed on paper tape in 5-hole code.

AN-2 ALPHANUMERIC PAPER TAPE INPUT-OUTPUT ACCESSORY

Same as above, except punch is 7-hole to accommodate 6 or 7-hole codes. Eight-hole codes can be used, but punch must be supplied by purchaser.

PTP-1 HIGH SPEED PAPER TAPE PUNCH

This device will increase the output punching speed of the computer to 60 characters per second. It is available in a 5-hole code model for use directly with the standard G-15D or, when purchased as part of the AN-1 Alphanumeric Input-Output Accessory, in models that punch up to 7 holes.

CA-1 PUNCHED CARD ACCESSORY

With the Model CA-1 Punched Card Accessory, serial punch card equipment can be coupled through a plug connector to the G-15D Computer. The maximum reading speed for cards with one column of information is 44 cards per minute, while fully punched cards are read at the rate of 12 cards per minute.

PA-1 GRAPH PLOTTER AND PFA-1 GRAPH PLOTTER/FOLLOWER

Two graphical devices, capable of receiving and emitting incremental information representative of functions, are available for use with the DA-1. These are the incremental Graph Plotter Model PA-1 and the incremental Graph Plotter/Follower Model PFA-1. Any two of these devices may be used at one time. The Plotter/Follower or the Plotter may be used to draw a graph showing the relationship between any two variables generated by the computer in 0.01 inch increments on paper up to 12 inches by 18 inches. Normal plotting speed is 20 increments per second. The Plotter/Follower, when used as a curve follower, has one axis driven in 0.01 inch increments corresponding to any variable generated by the computer, and enters into the computer increments of the functional variable of the graph on the follower. The Follower is a photoelectric device capable of following dark pencil or ink lines on light paper.

A supplementary programming system, INTERCOM 101, has been developed for those not trained in the use of any computer. It is a quick, efficient method for the programming of short-run problems. This system makes use of the G-15 as a single address, decimal, floating point computer with B registers. Its command list contains 31 orders and 18 instructions that call up subroutines written in standard G-15 language. Although designed as a supplementary programming system, it is being effectively used for major programs such as data reductions for turbo jets and a program to determine complex roots of real polynomials.

Recent up-time figures of one customer's G-15A installation show 110 hours of continuous 24 hour per day error-free operation, with unattended operation during the night.

O. Paul Staderman has been appointed head of the newly organized marketing division. Expansion program for this department has to this date established regional offices in Washington, D. C. under Robert A. Sweet and Dallas, Texas, under Richard F. Walz. Canadian representative is now Computing Devices of Canada, Ottawa, Ontario.

Dr. Harry Huskey of the University of California and the Bendix Computer Division, conducted a course in Advanced Programming Techniques at the Wayne University Computation Laboratory summer program. Laboratory equipment for the workshop sessions included the Bendix G-15A.

Facilities for the Computer Division have been increased by the addition of a manufacturing plant in El Segundo, California, and Customer Training classrooms and offices and Customer Engineering Offices in Hawthorne, California. Remodeling of the main plant in Los Angeles is in progress to accommodate administrative and marketing personnel, with ground to be broken soon for the engineering research and development building, which will double the Computer Division facilities.

FIRST SAGE COMPUTER INSTALLED

The first large-scale computer for the nation's vast, new electronic air warning network, known as the Semi-Automatic Ground Environment (SAGE) system, has been set up at the McGuire Air Force Base in New Jersey. This computer fits into the integrated complex of radar, ships, jet aircraft, communications networks, missiles, and people that is rapidly taking shape as the continental air defense system.

It combines the ability of digital electronic computers to receive information, to memorize, to calculate, and to record answers in order to present an instantaneous graphic picture of the location, speed, and direction of all planes within radar range. With a knowledge of flight plans of friendly planes available in the computer, hostile planes can be identified immediately and the most effective defense action taken—again on the basis of computer information and instruction.

The computer was designed by the International Business Machines Corporation at its Military Products Division Laboratory, Poughkeepsie, N. Y., in cooperation with the Massachusetts Institute of Technology Lincoln Laboratory, and was manufactured at the Kingston Military Products Division plant of IBM.

Information about aircraft anywhere within the radar area is relayed continuously and automatically to the computer by telephone line or UHF radio link. The computer, called the AN/FSQ-7, digests all of this information plus Ground Observer reports, flight plans, and weather information as fast as it is received and translates it into an overall picture of the air situation. These TV-like pictures show the air battle as it develops and provide the basis for the necessary human judgments.

The computer automatically calculates for the operator the most effective employment of such defensive weapons as guided missiles, antiaircraft batteries, and jet interceptors. In the case of the intercepting jets, the aircraft is controlled by directions fed by radio directly from the computer to the automatic pilot in the plane. Missiles are controlled similarly. At any time, the air battle commander can have the computer display the overall air situation or whatever part of it he wishes to monitor in detail. As the battle moves, information is transferred spontaneously to an adjacent computer.

The AN/FSQ-7 is designed to operate 24 hours a day, 7 days a week. Facilities are provided so that preventive maintenance can be performed on the machine while SAGE data continues to be processed. The equipment going to McGuire is the first production computer. Engineering models of the computer have been installed for several months at Kingston and at the Lincoln Laboratory of Massachusetts Institute of Technology in Lexington, Mass., where the system is being tested.

LARC (LIVERMORE ATOMIC RESEARCH COMPUTER)

The LARC, deriving its name from the first system being built for the University of California Radiation Laboratory, Livermore Site, and hence called "Livermore Atomic Research Computer," is a large-scale, high-speed digital computer system being built by the Remington Rand Univac Division of Sperry Rand Corporation. This computer system is a general purpose computer, to solve varied and extensive problems in the fields of science and engineering. It utilizes solid-state circuitry, modular construction, overlapping of execution of instructions, automatic error-correction, and a large memory; to provide improved speed, flexibility, expansibility and easier maintenance.

The basic computer system contains two stored program computers. One is an input-output processor designed primarily to provide flexible, parallel, and coordinated control of the input-output equipment and the auxiliary drum file memory (See Chart I). The second is a parallel computing unit designed to perform the arithmetic functions of the system in both fixed- and floating-point arithmetic operation. Except for certain intercommunication facilities, the computing unit and the input-output processor operate independently and can carry out their programs simultaneously. For situations requiring more computing capacity or dual problem handling, a second computing unit can be added to the system.

A high-speed magnetic core memory is shared by the processor and computing units. The memory is divided into units, each capable of storing 2500 computer words of 11 decimal digits plus a sign digit. The high-speed memory may be expanded to a maximum of 39 units, which is the equivalent of 97,500 words. These memory units are equipped with separate memory switches and may be addressed by different units in parallel, for near-simultaneous service thus yielding an effective memory cycle of two or less microseconds.

The high-speed memory is backed up by a magnetic drum file memory. Up to 24 magnetic drums may be included in the system. Each drum is capable of storing 250,000 computer words of 12 decimal digits. The magnetic drums feature a new and tested air-floated read-write head assembly which achieves a new order of reliability, with higher pulse densities, because of the absence of mechanical contact between the head and the drum surface.

The system includes both an operator's console and an engineering control console.

The input-output terminal equipment can include a wide variety of units, as follows:

CHART I

UNIVAC II - Type Magnetic Tape Units (UNISERVO's)

High-Speed Printer Head

Keyboard and Typewriter Printers on Consoles

(Optional) Charactron Display and Photographic Recorder Unit

(Optional) Card Reader

(Optional) Off-Line Equipment for Tape-to-Card, Tape-to-Printed Sheet and Magnetic Tape-to-Punched Tape Conversions.

All of these units and the drum file are under the direct control of the processor.

The inclusion of 8 high-speed index registers and 18 high-speed arithmetic registers, together with 4 control counter registers and 3 instruction registers, reduces data interference and permits flexible programming, for real-time overlapping of instructions. The number of high-speed registers can be increased to a total of 100.

With an overlapping of execution of instructions, typical machine speeds can be represented by the following instructions:

Floating Point Add:	4 microseconds
Multiply:	8 microseconds
Divide:	28-32 microseconds

These execution times are all-inclusive, including memory access, etc.

Enough checking circuits are included in the system to ensure an extremely low probability of undetected errors. Error detection circuits supply sufficient information to enable the computer to correct single errors without operator intervention.

The processor is a specialized stored program computer which frees the computing units of all input-output functions; thus the computing unit can concentrate upon the arithmetic functions for which it is especially adapted.

The processor gives flexibility in the choice of the size of the memory area to be filled or emptied and the input-output device to be used, with only limited need for separate high-cost-per-digit, inflexible, buffer storage units.

A typical installation comprises one processor, eight core memory units, twelve drum files, four tape units, one computing unit, an operator's console and an engineer's console.

NAVAL AIR TEST CENTER (NAVAL AIR STATION, PATUXENT RIVER, MARYLAND)

Delivery of one Magnetic Tape Control Unit and one Magnetic Transport Unit for use with the Datatron 204 Computer will be made in September. The addition of these units will add an auxiliary memory capacity of 400,000 computer words.

The Datatron 204 Computer continues to operate on a single 8.5 hour shift with overtime as required. The operating statistics for the three calendar months ending 30 July are as follows:

	May		June		July	
	Hours	%	Hours	%	Hours	%
Useful Time	193.5	93.0	174.7	96.6	176.2	94.9
Down Time	14.6	7.0	6.2	3.4	9.5	5.1
Total Time	208.1	100.0	180.9	100.0	185.7	100.0
	Breakdown of Useful Time					
Code Checking	90.6	43.6	97.5	53.9	18.6	10.0
Production Computing	26.3	12.6	22.6	12.5	107.8	58.1
Demonstrations	4.6	2.2	4.1	2.3	0.4	0.2
Scheduled Preventive	27.5	13.2	21.0	11.6	22.3	12.0
Maintenance Idle	44.5	21.4	29.5	16.3	27.1	14.6
Total	193.5	93.0	174.7	96.6	176.2	94.9

Mr. R.A. Sweet, who was instrumental in the formation of the NATC Digital Computer Facility, has resigned from government service and is presently connected with the Bendix Computer Division. Mr. Sylvan H. Chasen has been selected to head the Computer Facility and will be assisted by Mr. William A. Kelley.

NAVAL PROVING GROUND (DAHLGREN, VIRGINIA)

During the first half of 1956, the good operating time of the Naval Ordnance Research Calculator (NORC) averaged 88 percent of scheduled operating time.

A new and larger (40-ton) cooling system for the main frame of the calculator was installed to eliminate the frequent breakdowns which the original system experienced. Several minor

logical changes have been accomplished, including the addition of a new order which provides for the extraction of selected groups of digits from words.

The ARC and ADEC are available for use as needed on a one-shift schedule.

PENNSTAC (PENNSYLVANIA STATE UNIVERSITY)

PENNSTAC was completed on July 1, 1956, after being under construction for approximately two and one-half years. It was built almost entirely by students and University faculty.

The machine is being used for scientific computation related to sponsored research for approximately one-half of the time, while the other half of its computation time is devoted to educational use, either directly in formal class work or graduate thesis computation.

The machine has not been in operation long enough to gather any operating statistics.

RAYDAC (NAVAL MISSILE TEST CENTER, PT. MUGU, CALIFORNIA)

The addition of a second high speed mercury delay line memory to RAYDAC has been completed. This addition has increased the internal storage capacity of RAYDAC from 1,024 to 2,048 words with an average random access time of 150 microseconds and an access time of 10 microseconds with forced coding.

Considerable progress has been made in the design and fabrication of high-speed input-output equipment for RAYDAC. A Clary line printer has been obtained to replace the directly connected teletype printer now in use. This replacement will make it possible to print out the contents of the internal storage via the directly connected Clary printer because of its slow print out time. During the solution of problems on RAYDAC, results are recorded on magnetic tape located on one of the four external memory units. The magnetic tape is removed from the external memory unit and placed on output equipment to obtain a tabular listing. In order to do away with the manual changing of tapes, a facility has been added for electrically interchanging the external memory units and output equipment.

RAYDAC computing services are available for the solution of problems originating at other Government activities and with prime contractors to the Department of Defense. These services may be obtained by contacting the Bureau of Aeronautics, Code EL-733.

The western operations of Computer Control Co., Inc., which operates and maintains the RAYDAC, are now under the direction of G. G. Crissman. Mr. Crissman assumed this position after his retirement from the Navy in July.

STOCK EXCHANGE AUTOMATION (TORONTO, CANADA)

The Toronto Stock Exchange has become the first stock and commodity market in the world to be electronically "automated." The Teleregister Corporation, a subsidiary of the Ogden Corporation, maintains the automatic electric stock quotation boards in the brokerage offices in this country and designed and built the new system for the Toronto Stock Exchange.

The new system is an outgrowth of the Exchange's Dial Service which has been in operation since 1947 and which provides brokers with bid-asked prices on listed stocks. However, in order to obtain prices under the dial system, it is necessary for the broker to dial a code number in order to receive a printed quotation on a given stock, with a separate dialing necessary for each quotation requested.

The new system provides brokerage offices with a display panel which instantaneously and automatically displays latest bid and asked prices on any 50 stocks the broker may select. As each quotation is recorded from the Exchange floor, an Exchange operator punches it up on a keyboard which transfers the price to a rotating magnetic drum which is located in the Exchange

building. The prices are sent out automatically by direct wires to all subscribers offices, and at the same time they instantaneously appear on the display panels.

The new service was ordered last year by the Toronto Stock Exchange to enable its members to cope with the phenomenal volume of recent markets which had ranged to a high of 13-1/2 million shares in a single session. This trading far exceeds even that of the New York Stock Exchange or any of the Continental exchanges. Toronto's 1955 trading of 1.5 billion shares more than doubled its 1954 record, and 1956 figures are heading for a new peak.

While the dial system normally responds in about 3 seconds, on heavy trading days it sometimes takes up to 50 seconds. With the advent of the Display System the demand on the dial system, which is now about 50,000 calls per day, will be greatly reduced and consequently the latter will respond more rapidly.

Teleregister's network of electro-mechanical stock and commodity quotation boards in the United States has grown into a system which includes at present 400 boards in 46 cities. Toronto's original Bid Asked Dial System was recently equipped with an electronically operated magnetic drum memory, using techniques developed by Teleregister in the field of special purpose digital computers. Similar systems are now used by America's leading airlines. Teleregister has built or is building such systems for American Airlines, United Airlines, Pan American World Airways, Braniff International Airways and National Airlines.

The New York Central, the Santa Fe and the New Haven Railroads will soon have automatic reservation systems in service. These three systems will be inter-connected to form a coast-to-coast network, allowing even inter-line reservations to be made quickly. These systems will store all train reservations inventories for seven months in advance.

SYLVANIA DATA PROCESSING SYSTEM UNVEILED

The unveiling of a nationwide, 18,000-mile private communication network and data processing system at Sylvania Electric Products Inc., Camillus, N. Y. on June 26 marked a revolutionary step in the application of automation and electronics to industry.

The focal point of the system is the new Data Processing Center at Camillus, where a Univac computer receives and processes data transmitted over a network of 71 Sylvania plants and offices. Connected to the Center by a leased Western Union network, these Sylvania facilities are located in 61 cities and towns in 20 states.

The specialized communications facilities link Sylvania's 45 plants, 19 laboratories, 27 sales offices, 17 warehouses, 10 divisional headquarters, and executive offices. These installations feed financial and production information via the Western Union network to the Data Processing Center. At the center, the large digital computer and subsidiary electronic equipment quickly converts the information into summarized data on which can be based decisions at the corporate divisional, or plant level.

The centralization of Sylvania's data processing functions—including the gathering, recording, computing and classifying of a great variety of information concerning volume, sales, billing, and many other types of business activities—was made necessary, by the company's rapid expansion in many diversified fields. Expanding plant and laboratory operations, enlarged distribution, and continually broadening markets make high-speed processing of operating data, a necessary tool for efficient operation of the organization.

UNIVAC SCIENTIFIC 1103A

This month the Univac Scientific Model 1103A, the first in a new series of Remington Rand Univac Computers, goes into operation in the computing center at Lockheed's Missiles Systems Division in Palo Alto, California.

Up to three magnetic-core units of 4096 words storage each may be incorporated in the Univac Scientific 1103A in addition to the 16,384 words of magnetic drum storage. The Uniservo magnetic tape storage units will each store as many as 384,000 words and up to ten may be used to provide total storage of nearly four million words.

The computer will be applied to problems encountered in missile research and development. Because flight can be simulated with the Univac Scientific computing system, much valuable time will be saved in the missiles program. Ten Univac Scientifics have been installed at various Defense department agencies.

Other users include, Georgia Institute of Technology, Convair, National Advisory Committee for Aeronautics, Westinghouse, Johns Hopkins University, and Ramo-Wooldridge. A Model 1103 has been in use at the Remington Rand Univac plant in St. Paul, Minnesota, since last February.

A new program has been designed to expedite the preparation of instructions for the Univac Scientific Computer by interpreting a language which is natural to the non-professional programmer. A user of the system may set down his problem in normal algebraic expressions and include statements regarding the manipulation of such expressions.

There is now available to Univac Scientific (1103) users and service bureau customers a program for multiple correlation (regression) analysis. The program will handle up to 30 variables and up to 400 observations on each variable. The program is designed to make good use of the great facility of the Univac Scientific for this type of computation; hence, it is very flexible, economical, and extremely fast. The program will complete an analysis, including input-output, for the maximum case of 30 variables and 400 observations in as little as 9 minutes.

Several analyses of Variance routines are currently being developed for the Univac Scientific Computer. A current routine provides for an analysis of 3 factors with up to 10 levels and virtually infinite replications. Work has begun on a 5-factor, 7-level analysis routine. These routines are designed for card, paper tape or magnetic tape input of 4 decimal digit datum.

Service Bureau work is now being handled on the Univac Scientific (1103) computer at Remington Rand Univac, St. Paul, Minnesota. The bureau is newly formed, and is expanding its activities rapidly.

In December 1955, the users of the Univac Scientific (1103A) computer System formed a cooperative organization known as USE - Univac Scientific Exchange.

A working draft of a linear programming routine for the Univac Scientific (1103) is now in operation. The routine finds a basic set of values of the variables in a linear form, which maximize or minimize the value of that linear form subject to a set of linear restraints. The method followed is the Alternate Algorithm of the Revised Simplex Method of Dantzig. Zero suppression is used throughout for maximum efficiency of routine operation. The routine will handle a system of up to 106 restraints and up to 257 variables. The total computer time including input-output for a system of 63 restraints and 88 variables is approximately 15 minutes.

UNIVERSAL DIGITAL OPERATIONAL FLIGHT TRAINER (MOORE SCHOOL, UNIVERSITY OF PENNSYLVANIA)

A contract has been let by the Navy Training Device Center, Office of Naval Research, to Sylvania Electric Products, Inc., for construction of the Universal Digital Operational Flight Trainer (UDOFT) to the design specifications of the Moore School of Electrical Engineering. The contract calls for construction of the complete UDOFT, including all the cockpit equipment of 2 specified airplanes. The UDOFT system consists of the ultra high-speed sequential-parallel digital computer, analog-digital conversion equipment, instrumentation, and digital and analog recording devices.

Work is continuing on the improvement of digital flight trainers. The basis for the use of stability charts has been extended to include exact prediction of numerical solution of linear

include two machines, since the UNIVAC SCIENTIFIC (ERA 1101) Computer has been in operation since August, 1955.

The Rich Electronic Computer Center joined the U. S. Bureau of Public Roads, the Southeastern Association of State Highway Officials and the Georgia State Highway Department in sponsoring a "Conference on Increasing Highway Engineering Productivity," which was held at Georgia Tech on July 9, 10, 11, 1956. Over 250 persons from twenty states, the District of Columbia, and Puerto Rico, attended the sessions. Special emphasis was placed on the applications of electronic digital computers to highway location, design, and construction, including traffic studies and bridge design. Demonstrations of problem solving in these fields were given on the Computer Center's machines, as well as on the Univac 120, and the Librascope LGP-30.

UNIVERSITY OF HOUSTON (COMPUTING AND DATA PROCESSING CENTER)

The University of Houston in cooperation with business and industry has established a Computing and Data Processing Center on the campus. The Center provides a computing service where actual problems of management can be solved. In addition, training of business and engineering personnel in the techniques of high-speed computation is available through formal credit courses, inplant training, short courses, and special programs.

Specifically the Center is prepared to render the following services:

1. Consultation in diverse areas
2. Programming of specific problems
3. Computing and data processing at hourly rates on the IBM 650 EDPM
4. Formal University training.

Services are tailored to the requirements of individual clients. In general the Center has found that each company has its own unique problems requiring a separate and carefully formulated program.

To arrange programs and for further information contact Dr. Elliott I. Organick, Director, Computing & Data Processing Center, University of Houston, Texas.

THE INSTITUTE FOR ADVANCED STUDY (ELECTRONIC COMPUTER PROJECT)

The new drum has been in successful operation since the middle of June. It is superior to the old drum not only in speed and capacity (both by a factor 6-8) but also in reliability.

The computer at IAS will serve, in the future, as a tool for the solution of a great variety of problems of varying length and complexity. Most of the coding will be done by the customers themselves ("open shop" policy) rather than by professional coders. In addition, the new drum must be incorporated in our coding systems.

These changes will require a considerable amount of work, such as writing manuals, service codes, subroutines, compilers, interpreters, etc., and also a certain amount of engineering, which will establish the full usefulness of the present equipment.

A series of five meetings was held to plan this work in close cooperation with Institute mathematicians, engineers and future "customers." The subjects of these meetings were: (1) Notations, (2) New Drum, (3) Drum Utilization and Subroutines, (4) New "FLINT" (= Floating point Interpretive) code, (5) New Manual.

It is hoped that the backbone of the new system will be ready by the end of this year and that it will be in full operation in the summer of 1957.

MURA (MIDWESTERN UNIVERSITIES RESEARCH ASSOCIATION, MADISON, WISCONSIN)

The Midwestern Universities Research Association is a not-for-profit corporation incorporated under the laws of the State of Illinois in September 1954.

Its main objective is the establishment and operation of a research institute in the Midwest which will provide facilities for research and instruction in the field of high energy nuclear physics and is to be open to all qualified scientists who can make sufficient use of its facilities.

At the present time fifteen educational institutions make up the Principal Members of this cooperative organization. They are Iowa State College, Purdue University, Michigan State University, Northwestern University, University of Chicago, University of Illinois, State University of Iowa, Indiana University, University of Kansas, University of Michigan, University of Minnesota, University of Notre Dame, University of Wisconsin, The Ohio State University, and Washington University of St. Louis.

In undertaking the study of new methods of particle acceleration the technical group of MURA found that purely analytical methods would not suffice. From the very beginning of these studies liberal use was made of the Electronic Digital Computer of the Graduate College of the University of Illinois, the ILLIAC. As of mid-1956 this usage has grown to the order of 150 hours per month. Since even more computing time is necessary and since the technical group has moved to Madison, Wisconsin, MURA has decided to set up a computation laboratory of its own.

To implement such a goal MURA intends to be in possession of, either through purchase or rental, the best computing equipment available at any given time. To begin with, an IBM 704 has been rented for delivery to Madison in October, 1956.

The computation group is a division of the MURA technical group, other divisions of which are the theoretical physics group and the experimental physics group. Since MURA is a pure research and educational organization operated by and for the mid-western universities, the technical staff will hold positions which are similar in nature to academic positions.

The availability of the MURA computer and the cooperation of the MURA computational staff can go far in helping to stimulate and augment strong and effective programs in numerical analysis and computer use in the various MURA universities. Certainly the use of the computer in connection with the various research projects within the MURA universities will go far in stimulating interest in and appreciation for modern computers and the power they are able to bring to bear toward the solution of problems in many fields.

ORACLE APPLICATIONS PROGRAM

The services of the ORACLE (Oak Ridge Automatic Computer and Logical Engine), Oak Ridge National Laboratory's high-speed electronic digital computer, will be made available to universities throughout Southeastern U. S.

The new ORACLE Applications Program is being conducted by the University Relations Division of the Oak Ridge Institute of Nuclear Studies and the Mathematics Panel of Oak Ridge National Laboratory. (ORINS is a non-profit educational corporation of 34 Southern universities, operated under direct contract to the Atomic Energy Commission. ORNL, also a direct contractor to the Commission, is operated by Union Carbide Nuclear Company, a Division of Union Carbide and Carbon Corporation.) This program is in line with the Commission's effort to increase the number of trained personnel for work with the growing atomic-energy industry.

Dr. Theodore W. Hildebrandt has been appointed to the staff of the ORINS University Relations Division to direct the program. He will work with the ORNL Mathematical Panel, headed by Dr. Alston S. Householder, in preparing university-originated problems for ORACLE computation.

systems with forcing functions. A systematic procedure for programming UDOFT for any airplane is being developed.

Two new families of transistor switching circuits have been developed with potential application to both digital computers and telephone switching offices. One family uses both pnp and npn transistors; its main attraction is that it permits design of systems with relatively low standby current.

WHIRLWIND I (FOR APRIL, MAY, AND JUNE 1956)

Applications

During the past 3 months, the Scientific and Engineering Computations Group, in conjunction with various departments at MIT, processed 95 problems for solution on Whirlwind I. The problems are described in the Project Whirlwind Summary Reports submitted to the Office of Naval Research and cover some 20 different fields of applications. The results of 32 of the problems have been or will be included in academic theses. In these 32 problems, there are represented 25 doctoral theses, 3 Naval Engineer's, 5 master's, and 4 bachelor's. Twenty-six of the problems have originated from research project sponsored at MIT by the Office of Naval Research.

Academic

There are a number of graduate subjects in automatic computation, numerical analysis, and now electronic data processing, offered at MIT. The following is a table of subjects directly related to machine computation. The number of students is a total of the enrollment for both fall and spring terms.

Course	Description	Year	Instructor	# of Students
2.215	Methods of Engineering Analysis	G	S. H. Crandall	18
6.25	Machine-aided Analysis	4	W. K. Linvill	153
6.535	Digital Computer Coding and Logic	G	D. N. Arden	97
6.538	Electronic Computational Laboratory	G	F. M. Verzuh	26
6.54	Pulsed-Data Systems	G	W. K. Linvill	60
6.567	Switching Circuits	G	S. H. Caldwell	48
6.568	Switching Circuits	G	S. H. Caldwell	30
15.542	Management Information Systems	G	R. H. Gregory	22
M 39	Methods of Applied Mathematics	G	F. B. Hildebrand	253
M 411	Numerical Analysis	G	F. B. Hildebrand	45
M 412	Numerical Analysis	G	F. B. Hildebrand	16

Systems

Since 1954 the MIT Servomechanisms Laboratory has been using the WWI manual intervention and display equipment in the development of high-speed data reduction techniques. In order for them to expand their research into computer applications, it was essential that more versatile manual inputs be made available on the WWI computer. Besides requiring additional on-off switches, many of the new programs will be so complex and will require so many parameters that the only reliable way to instruct them will be to use specially designed mnemonic

languages and translation programs. In order to have this general language structure available on a manual intervention basis, it is necessary to have a keyboard such as a Flexowriter for direct input to the computer.

The MIT Scientific and Engineering Computations Group have contemplated the following applications for the new facility:

1. Demonstration programs would be a great deal more effective if this form of input were available for control purposes.

2. Typewriter input for Comprehensive System Flexowriter and post mortem request tapes. Short program modifications and Post Mortem requests can presently be inserted in the insertion registers. However, errors are easily made because the required vocabulary is awkward. A typewriter input facility would make available a normal mnemonic vocabulary for such purposes.

3. Experimental use of a typewriter facility for direct operator control of the computer. Here we would consider using the typewriter to replace the button-pushings required of the operator during normal operations. Vocabulary similar to that of Director tapes and performance requests would be devised for these purposes. This could easily prove to be an extremely convenient and efficient method of computer operation.

The new input installation will be available for use by 4 July 1956. Much of the information to be inserted via the keyboard will be the same as is now introduced via a free running photoelectric tape reader using punched paper tapes. The keyboard input will also be treated as a free running device, i.e., selection of the facility by the computer may be followed by an arbitrary number of read instructions, each of which reads the next character which has been struck on the keyboard. The total equipment requirements amount to 15 relays and 20 tubes.

WWI RELIABILITY 9 March - 31 May 1956

The following is the WWI Computer Reliability for the past quarter:

Total Computer Operating Time in Hours	1915
Total Time Lost in Hours	24.3
Percentage Operating Time Usable	98.7
Average Uninterrupted Operating Time Between Failure Incidents in Hours	28.6
Total Number of Failure Incidents	66
Failure Incidents per 24-Hour Day	1.2
Average Lost Time Per Incident in Minutes	22
Average Preventive Maintenance Time per Day in Hours	1.8

COMPUTING CENTERS

GEORGIA INSTITUTE OF TECHNOLOGY (RICH ELECTRONIC COMPUTER CENTER)

An IBM 650 Magnetic Drum Data-Processing System was installed on June 1, 1956, at the Rich Electronic Computer Center, Georgia Institute of Technology, and has been in successful operation since that date. The facilities of the Rich Electronic Computer Center therefore now

The ORACLE Application Program is designed to make available to university personnel not only computer time, but also the combined experience and knowledge of members of the Mathematics Panel, to assist universities with computational problems arising in connection with their research activities. One object of the program is to aid in extending to university campuses a wider awareness of the capabilities of modern high-speed computing equipment, which is finding increasing use in research laboratories, business, and industry. The program will also assist university research programs by speeding some computations and making feasible others which time and cost have hitherto made prohibitive.

Further information on the ORACLE Applications Program may be obtained by writing Dr. T. W. Hildebrandt, ORACLE Applications, University Relations Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tennessee.

COMPUTERS, OVERSEAS

CENTRO STUDI CALCOLATRICI ELETTRONICHE (C.S.C.E.), PISA, ITALY

This Institute at the University of Pisa was founded about a year ago and intends to construct a large-scale digital machine for scientific research. It is hoped to build the central part within the next year and to add a drum memory and fast input and output equipment in 1958.

The computer will be a parallel type machine with a word length of 36 bits. The main memory will consist of magnetic cores and will have a capacity of 1024 words, which may be expanded to a capacity of 4096 words. The drum will hold 12,288 words. Input will be by photoelectric tape reader and output will be by parallel printer.

A synchronous d.c. coupled logic is contemplated. Numbers are represented in a fixed point, two's complement system. The arithmetic unit will have two accumulators, one of which will be used as multiplier register.

The instruction has a full-word length of 36 bits, though it is essentially of the single-address type. Out of the 36 bits, 6 are used for function character (thus allowing 64 different instructions) and 12 for the ordinary address. The remaining 18 bits are used for addressing ordinary memory cells, with a function similar to that of the "B-lines." Furthermore, the possibility exists of modifying all instructions more than once, without employing any special device.

DEUCE (THE ENGLISH ELECTRIC CO. LTD., STAFFORD)

The English Electric Company has now completed and installed seven DEUCE Computers and a number of other equipments are in advanced stages of completion.

Installations already completed indicate an extremely high percentage of good operating time and most of these are already operating considerably in excess of 40 hours per week. At least two frequently exceed 100 hours, and a number of trouble free runs in excess of 100 hours have been achieved.

The table below shows the operating figures in hours for the last four weeks in one of the recent DEUCE installations, which is maintained by the users own engineers.

Week Ending	On	Scheduled Maintenance	Good operational Time	Unserviceable Time	% Efficiency
23/7	101	10	82	9	90%
30/7	100	6	77	17	82%
6/8	62	19	43	-	100%
13/8	122	12	96	14	87%
TOTALS	385	47	298	40	88%

These figures must be regarded as being due in a large extent to the very high standard of the Acceptance Tests.

These tests demand that the input and output organs shall be used continuously, and without error, for two periods of two hours. The number of cards handled in these tests total 30,000, involving the handling of over 11 million binary digits.

The tests also demand that 16 problems occupying 30 minutes computer time each shall be completed in eight hours with not more than two failures during that time. These tests are normally all different, and anticipate only a computer in first class order.

A considerable amount of research and development work to extend the facilities of the Standard Deuce is being undertaken, and a modification for automatic instruction modification is already available. It is anticipated that a magnetic tape system will be operating in conjunction with a standard Deuce early in 1957. This additional storage capacity, augmenting the mercury and magnetic drum stores, will permit the Deuce to be used even more widely on many accountancy and data processing operations and will also be useful in certain large-scale technical calculations.

ELLIOTT BROTHERS (LONDON) LIMITED

As described in earlier editions of the Digital Computer Newsletter, the first Elliott 405 Business Computer began operating at Borehamwood, Herts, in January, 1956. Three cabinets of extra computing equipment, including Compiler, Magnetic Film Slave units, Magnetic Film Output unit and Punched Card input, together with extra Power cabinets, were added to this machine during the last two weeks of August, thus demonstrating in practice the "unit construction" principle on the 405. It was then moved to the London headquarters (at 206-216, Marylebone Road) of the National Cash Register Co. Ltd., who are now marketing the Elliott 405 for business applications in Great Britain.

"Compuprinter" electric typewriters, with a speed of 20 characters per second and a carriage width of 170 characters, are being fitted to Elliott 405 systems, either operated directly by the computer or remotely by magnetic film. A new magnetic disc store holding 32,768 32-digit words, but otherwise similar to the standard Elliott disc of 16,384 words is now available as a large capacity intermediate-access storage unit.

EUROPEAN UNIVAC CENTER

A 20-ton Remington Rand Univac electronic computing system, the first of its kind ever flown across the Atlantic, took off on August 6th from Idlewild International Airport via Seaboard & Western Airlines, and landed the following day at Frankfurt, Germany.

The Remington Rand International Division of Sperry Rand Corporation is establishing the first large-scale computer service center in a specially designed building at the Battelle Institute, Frankfurt. Scheduled for opening this fall, the European Univac Center will provide business, government and science in western Europe with services comparable to those available at the Univac Centers in New York and Los Angeles.

The Battelle Institute has, in the short time of its existence, gained European renown as a non-profit research institute. In addition to its facilities in Frankfurt, the Institute has laboratories and offices in Geneva, Switzerland; London, England; Paris, France; Milan, Italy; and Madrid, Spain.

In charge of the European Univac Center is Dr. Carl Hammer, noted American mathematician, born in the United States and educated in Germany.

COMPONENTS

CARDATRON (PUNCHED CARD INPUT-OUTPUT SYSTEM)

The CARDATRON, manufactured by ElectroData Division of Burroughs Corp., is a specialized multiple input-output buffer system, which provides direct, flexible, high-speed, simultaneous communication between various types of card machines or printers and the DATATRON central computer under control of the central computer. The CARDATRON controls any combination of card machines up to seven units. Complete alphanumeric card reading, computation, card punching and line printing occur in the same time cycle and at a rate well matched to the speed of the computer.

Input-Output Facility

The following variety of standard punched card machines may be used with the CARDATRON's Input and Output Units:

Input Devices*

Type 089 Collator

Type 528 Reproducing Punch

Type 523 Gang Summary Punch

Output Devices*

Type 407 Tabulator

Type 419 Tabulator

Type 523 Gang Summary Punch

Buffered Operation

Within each Input and Output Unit, a small magnetic drum acts as temporary storage for information. The DATATRON Computer receives input information from the buffer drum of an Input Unit and delivers output information to a buffer drum of an Output Unit. Thus, the relatively long time required for mechanical movement of punched card device is not deterrent to computer operation.

Simultaneous Operation

The buffering feature of the CARDATRON system permits simultaneous operation of readers, punches, or printers. In a multiple printing situation, the computer can calculate the first

*Manufactured by International Business Machines Corp.

set of answers and load the buffer drum associated with the first line printer. Then, while the first printer is operating, the computer can proceed to calculate and load the buffer drums associated with the other line printers in order. By the time the first printer has finished printing, the computer will have loaded the other buffer drums and is able to reload the first buffer drum again. In this way, the computer can utilize up to seven printers continuously, all operating at maximum speeds.

A similar situation exists during input operations and output operations using a combination of printers and punches.

Automatic Editing

The CARDATRON system can perform a variety of editing functions on the information handled. The buffer drum of each Input and Output Unit contains five format bands. These format bands control the scaling and alphanumeric translation of information. Any of the five format bands on a buffer drum may be selected to edit a given card or line or information in the following ways.

Deleting Digits—Any character may be removed on input and output.

Inserting Zeros—On Input only, zeros may be added at the beginning or end of an information field, or inserted between characters in a field.

Inserting Blanks—On Output only, blank columns may be added at the beginning or end of an information field, or inserted in the field.

Zero Replacement—On Input only, characters on an input card may be replaced by zeros.

Alphanumeric Operation and Automatic Code Conversion

The CARDATRON System handles both alphabetic and numeric characters on input and output, in any combination. Numeric digits may be used in an alphabetic field.

The CARDATRON System automatically translates between standard 80-column card coding and the equivalent DATATRON coding.

DATATRON FLOATING POINT CONTROL UNIT (AUTOMATIC FLOATING POINT OPERATION FOR DATATRON COMPUTER)

The DATATRON Computer is the first medium-sized data processor to make available the convenience and coding simplifications of automatic floating decimal arithmetic for the operations of addition, subtraction, multiplication, and division.

This facility is provided by the Floating Point Control Unit, which is optional with the computing system. This unit performs arithmetic operations in a floating decimal manner on numbers which are normalized and which have an associated power of 10 (scale factor) stored with them in the computer's memory, leaving the answer in normalized form. It has a number range of $10^{-51} \leq N < 10^{49}$.

The advantages of automatic floating decimal operations are:

1. Shorter codes, taking up less memory space.
2. More than proportionate reductions in coding and checking times.
3. Eliminates problem scaling to a large extent.
4. Improves utility of the computer in a wide range of problems.
5. Reduces machine running time.

In general, the time required to fetch an order and perform an arithmetic operation in the floating point mode will be equal to or less than its fixed point counterpart: for example,

Floating Point Add	2.5 ms
Floating Point Subtract	2.5 ms
Floating Point Multiply	10.1 ms
Floating Point Divide	13.5 ms.

MISCELLANEOUS

"As of August 31, 1956, International Business Machines had delivered twenty-five type 704 Electronic Data Processing Machines and twenty-eight Type 705's, thus bringing the total number of delivered "700-Series" machines, including 701's and 702's, to eighty-six. Four hundred and five Type 650 Magnetic Drum Data Processing Machines will have been delivered by August 31."

Establishment of an ElectroData Division of Burroughs Corporation to produce and sell electronic data processing systems has recently been announced.

The new division will have responsibility for manufacturing and distribution of DATATRON, a high-speed, general purpose digital computing system developed by ElectroData. It also will be responsible for distribution of the Series E desk-sized electronic digital computer produced in the Main Plant, Detroit; the Series G high-speed printing, tabulating and card-punching equipment being produced by Control Instrument Company, a Burroughs subsidiary in Brooklyn, N. Y.; and new electronic products as they are developed by the Corporation's divisions or subsidiaries.

ElectroData was established as an independent affiliate of Consolidated Electrodynamic Corporation of Pasadena in 1953, after having been formed originally as the Computer Division of the latter corporation.

"As of 1 September 1956 Remington Rand Univac has delivered approximately 100 large-scale electronic digital computers. This includes classified installations, 30 Univac I's and 18 Univac Scientific's. In addition, the first Univac File Computer was delivered in August 1956. Remington Rand Univac now has well over a hundred firm contracts for the Univac File Computer."

Underwood - ELECOM recently delivered the first ELECOM 125 and 120A Computers of the current production series from its Long Island City plant to the Sandia Corporation at Albuquerque and the Texas Company at Houston, respectively.

Sandia's ELECOM 125 included, in addition to the basic computer, 4000-word memory and power-supply cabinets, three magnetic-tape units and peripheral equipment for high-speed paper-tape read-in and write-out to and from the computer.

The ELECOM 120A Computer purchased by the Texas Company features base registers and floating decimal operation and will be used for calculations attendant geophysical oil exploration.

The Norden-Ketay Corporation announces that a West Coast Department of the Norden Laboratories Division was established in February 1956. This organization is responsible for the advanced developments in the field of digital control, data handling and special-purpose digital developments and is headed by Mr. H. H. Sarkissian. This new department has developed a digital comparator for use in a thirteen-bit parallel binary servo. Other developments include a digital airborne television generator, transistorized airborne computing amplifier and other related equipment. In the process of development is a high-speed printer and linearizer.

Beckman Instruments of Fullerton, California have introduced their Model 111 Data System, the first of which has been installed at a major southern refinery. This equipment is designed for use in the continuous process industries and acts as a connecting link between input transducers and final printed logs and recorded data compatible with computing equipments. The system accuracy and reliability permits continuous, round-the-clock operation. One of the features of the equipment is the digital "pinboard" control which permits complete flexibility in the operations to be performed upon each data channel. Operations of simple algebra, linearizing, square rooting, establishing alarm limits, etc., are all accomplished by means of the pinboard, using the true physical units of the variables involved.

UNIVERSITY OF PENNSYLVANIA (The Moore School of Electrical Engineering). Graduate courses of special interest to computer scientists and engineers to be offered in 1956-57 are listed below.

New offerings:

EE 608 Sampled-Data Control Systems

EE 667 Linear Programming and an Introduction to the Theory of Games

Previous courses being repeated:

EE 523 Introduction to Digital Computers

EE 616 Statistical Theory in Communication and Control Circuit Analysis

EE 621 Matrices and Tensors in Circuit Analysis (includes topology applied to switching circuits)

EE 624 Engineering Solution of Differential Equations

EE 628 Digital Computers-Engineering Principles

EE 629 Digital Computer Solution of Engineering Problems

EE 632 Switch Circuits

EE 634 Applications of Large-Scale Digital Computers to Business and Industrial Systems

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NEW HOUSE ORGANS

DDA SUMMATION, reporting digital differential analyzer methods in computation and control.

Litton Industries, Computer and Controls Division, 336 N. Foothill Rd., Beverly Hills, California.

THE PINBOARD, published by Burroughs Corporation as a service to users of the E101 Computer.

Computer Section, Burroughs Corporation, 1616 Walnut Street, Philadelphia 3, Pennsylvania.

CONTRIBUTIONS FOR DIGITAL COMPUTER NEWSLETTER

The NEWSLETTER is published four times a year on the first of January, April, July and October and material should be in the hands of the editor at least one month before the publication date in order to be included in that issue.

The NEWSLETTER is circulated to all interested military and government agencies, and the contractors of the Federal Government. In addition, it is being reprinted in the Journal of the Association for Computing Machinery.

Communications should be addressed to:

A. J. Neumann, Editor
Digital Computer Newsletter
Office of Naval Research
Washington 25, D. C.