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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NAVEXOS P-645

COMPUTER AND DATA PROCESSING, NORTH AMERICA

SIRIUS - FERRANTI ELECTRIC, INC. - HEMPSTEAD L.I., NEW YORK

Sirius, a new transistorized desk size computer is announced by Ferranti Ltd., London, and will be sold in the United States by Ferranti Electric, Inc.

Sirius weighs 560 lbs and measure 7' by 3'6" by 4' including a standard office desk. The desk is used to provide an operator's position but only the top surface is used, the drawers remaining available for their normal use.

The new computer is designed to provide a small and relatively inexpensive, but fast machine and its chief application is expected to be statistical analysis in industry, commerce, and laboratory where the rapid turn-around of statistical calculations can appreciably speed the continuity and flow of work. It will also be useful for a wide range of jobs and prove valuable as an ancillary machine for large computing installations.

The prototype has been under development for 2 years and has been operating for 6 months. It is now installed at the Ferranti Computer Center in London and is operating on a time rental basis.

The machine is binary coded decimal, and uses a new type of transistorized logical element and a magnetostriction delay line memory. Input and output are by means of punched paper tape. A set of 100 keys may be used to operate the machine and make entries directly into the main memory.

Sirius extends the range of Ferranti computers into the small size. The range currently includes Pegasus, Mercury, Perseue, Argus, and Sirius.

LIBRATROL-500 - LIBRASCOPE, INC. - GLENDALE, CALIFORNIA

Librascope, Inc., Glendale, California, a subsidiary of General Precision Equipment Corporation, has developed a highly flexible, versatile computerized control system adaptable to both existing and in-design industrial processing systems.

This new control system, the Libratrol-500, is especially suitable for use in petroleum and chemical industries, gas and electric utility plants, in steel mills and the aircraft industry, and in atomic energy plants.

The system receives incoming data from monitoring devices, processes the data through a high speed digital computer and provides accurate control information either for a human operator, or for automatic control elements within the processing equipment.

The basic building block of the process control system is a highly reliable general purpose electronic digital computer. The computer, operating on information supplied by the process instrumentation, performs the computations, logic manipulations, and decision making operations required to effect the control actions. Computer operation is serial, single address, fixed binary point, with internally non-volatile stored program.

Inputs to the computer are derived from standard process instrumentation and may be in the form of voltages from analog instruments, digitized transducer signals, and fixed data and similar information from the process operating personnel.

Input rate of the computer is 200 data words of 31 bit length per second. Inputs to the system are scanned and conditioned on command from the internal stored program regulating the computer functions. The program directing the computation and control system operations is stored in the computer and can be modified to incorporate desired operating functions.

Capabilities of the arithmetic unit include add and subtract times of 0.25 milliseconds, multiplication or division times of 15 milliseconds minimum. The magnetic drum storage unit has a capacity of 4096 words.

Outputs from the computer may be in the form of voltages to actuate control elements, digital data for presentation to operating personnel, or punched tape for further data processing operations.

Power requirements for the computer only are 115 volt, 60 cycle single phase, at 17 amperes. Input commutators, signal conditioners, conversion, actuating, and other complementary equipment for specific applications require additional power.

DISTRIBUTAPE - MONROE CALCULATING MACHINE COMPANY - ORANGE, NEW JERSEY

A new computer, the Distributape, has been developed for business usage by the Monroe Calculating Machine Company, a Division of Litton Industries, Inc. The equipment is especially designed to sort, merge, and summarize large quantities of merchandise and production transaction data.

Input and output data media is seven-channel perforated paper tape. Input transactions are processed at the rate of one thousand transactions per minute. A one-thousand-word magnetic memory drum system, having a word size of eleven decimal digits plus sign, permits the processing of up to one thousand different item classifications at one time. Internal number storage is in binary form, with automatic conversion of decimal coding to binary coding during input, and reconversion during output. The system features simple operator programming through the use of console controls. Input and output proof total audits, including paper tape parity code check are provided to guarantee correct processing of data. An off-line Monroe printer is used to record Distributape summary output tapes on business forms.

The first installation is providing sales analysis and inventory control data for twenty retail variety stores located in the northern New Jersey district of the W. T. Grant Company.

COMPUTING CENTERS

COMPUTER AND MATHEMATICAL SCIENCES LABORATORY - AIR FORCE CAMBRIDGE RESEARCH CENTER - L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

A detailed evaluation of radar detection and position location schemes is being carried out on the AFCRC Magnetic Computer (see Digital Computer Newsletter, January 1959). A library of target blip samples characterized by stochastic signals imbedded in noise has been generated on the computer for this purpose.

The simulation technique employed is particularly useful in assessing not only the validity of the end results obtained from the theoretical model, such as detection efficiencies, false alarm rates, and position accuracies, as functions of the data processor and target parameters, but also the validity of intermediate assumptions on the nature of the various probability distributions and how they are transformed.

The approach makes use of analog simulation techniques for data generation and digital simulation on a general purpose computer of the data processing schemes.

RICH ELECTRONIC COMPUTER CENTER - GEORGIA INSTITUTE OF TECHNOLOGY - ATLANTA, GEORGIA

The basic system of the new Burroughs 220 digital computer has been installed and operating satisfactorily since March of this year. Unscheduled Maintenance has been minimal.

A library of subroutines is available from the manufacturer and routines such as the Burroughs Assembler STAR I and Compiler RUNCIBLE have been utilized. A 650 Simulator on the 220 has proved to be faster in some programs than the corresponding run on the original machine. The additional magnetic tape storage units are to be delivered shortly and will undergo system tests with the basic complement of equipment.

A core-buffered punched card input and output unit (80 column) will be added to the Univac Scientific (ERA 1101) this year. Design of the buffer and modification of the 1101 is being done by the Computer Center's staff. The recent addition of a core storage unit will enable the Center to continue its computer components program, as well as providing for a more flexible and faster machine.

Two versions of a Management Decision Model for the IBM 650 have been utilized by the Indu trial Management School at the Georgia Institute of Technology. Industrial executives, as well as faculty and graduate students, have participated in several sessions. Because of extremely favorable reaction the Model is now offered in the undergraduate curriculum of the School. Together wi other computer oriented courses, this provides increased emphasis on the use of digital computer

DATA ASSIMILATOR - HOLLOMAN AIR FORCE BASE, NEW MEXICO

The first two parts of the "Data Assimilator," Loading Platform One and the Common Memory, have just been built. These have been constructed by Dr. H. W. Gschwind at Holloman AFB, N. M., to feed data from missiles or satellites directly into digital computers and make computations on this data in "real time" (a few milliseconds).

Loading Platform One is an additional core memory of the 1103-A Univac Scientific into which data is fed without either going through IOB or involving computer control. The data is fed to Loading Platform One from as many as 32 channels simultaneously at a rate of up to 750 samples per channel per second. (Thus the Platform will accept 24,000 36-bit samples per second.) By a stepping process, the first data word from each channel is moved down to accept the second data word, when both are moved down to accept the third data word. This continues until 16 data words are in the platform. When the 17th data word is received the oldest data word is lost to make a place for the newest data word. This is done for each of the 32 channels simultaneously. Thus the computer has available the 16 latest data words from each of 32 channels at all times.

Loading Platform One is so constructed that the data is addressable by the 1103-A without transfer to the conventional memory. For example, the data stored in the platform may be smoothed by multiplying the data by the stored constants and summing without first transferring from the platform to the conventional memory.

The Common Memory is a core memory used by the two 1103-A Univac Scientifics at Holloman Air Force Base. It consists of 512 36-bit words addressable by both computers. Data or programs can be passed from one 1103-A to the other. Furthermore, the computers can operate in parallel on a master-slave basis.

On 4 May 1959 the system was checked out with a demonstration. A 2-cycle-per-second sine wave was generated and recorded on a Sanborn Recorder. This sine wave was also sampled at 30 times per second in 10-bit binary words which were fed into Loading Platform One. From there they were transferred by the first 1103-A to the Common Memory. The second 1103-A picked up these words from the Common Memory and transferred them through IOB to a digital-to-analog converter. The resulting sine wave was plotted on an adjacent channel of the same Sanborn Recorder. The result was two sine waves that were drawn simultaneously. (There was actually a delay of about 20 microseconds, but of course, it was not detectable to the eye in a 2-cycle wave). The demonstration is very spectacular. It is impossible to tell from the curves which has been digitized and which has not.

On 6 May the demonstration was performed again with the additional feature that the digital computer was performing a "clipping" program of the sine wave.

These demonstrations were with a 30-samples-per-second digitizer. When the 24,000-samples-per-second digitizer arrives in midsummer, more spectacular demonstrations will be performed.

Additional parts of the Data Assimilator will be constructed soon. A detailed description has been submitted for publication in the Communications of the Association for Computing Machinery and will appear in a forthcoming issue.

COMPUTATION LABORATORY - NATIONAL BUREAU OF STANDARDS - WASHINGTON, D. C.

The NBS IBM 704 Computer was expanded from an 8,000 word memory to a 32,000 word core memory on May 11. The magnetic drum is being retained in addition to the increased core memory. The hourly rental has been increased to $210 per hour. The machine, currently operating nearly three shifts, continues to be available to other Government agencies. Major users, apart from the Bureau itself, include the Diamond Ordnance Fuze Laboratories, N.A.S.A., Weather Bureau, and Army Signal Air Defense Agency.

A program of research and experimentation in automatic translation of languages has been in progress for not quite one year. A program for Russian-to-English translation on the 704 is being written in sections. The approach is through syntactic and semantic analysis of the source sentence, rather than through empirical rules. The approach promises to be satisfactory from the standpoint of speed of automatic translation. Major emphasis is on beating the cost of 2.5 cents per word, an established price for the human translator.

A 704 program that is essentially a search and file editing data system has been prepared in connection with a frequency allocation problem of the Federal Airways Administration. In order to provide airlanes which permit aircraft to fly between airports in the absence of visible landmarks and terminal homing control for instrument landings, the FAA maintains a network of radio transmitters each of which emits a signal at a fixed operating frequency. Frequencies must be assigned to the transmitters in such a way that interference between station signals is reduced to a tolerable level. The minimum frequency separation of two stations is determined by their operation ranges and mileage distance. In general, the introduction of a new station requires changes in the frequency allocations to existing stations. A study is under way to construct an algorithm to determine the minimal number of frequency changes necessary to introduce a new station into the system at a given location and the related problem of initially assigning frequencies to stations in a system in such a way as to permit "maximal" introduction of new stations without reassignment of existing station frequencies. A program has been written to mechanize the selection of an operating frequency for a new station, and to determine if this can be done with no more than a single reassignment of any existing station.

A large number of problems from science and engineering are continually in progress. Among those started in recent months, the following deserve mentioning: A problem in magnetic scattering of neutrons by paramagnetic MnF_2, concerned with evaluating the differential cross-section and the second moment of neutron energy transfer for neutrons in the 1A range incident on MnF_2 at temperatures T such that $T >> |\theta|$, θ being the Curie-Weiss constant; a problem in the scattering of electrons from hydrogen atoms; a problem in statistical interpretation of electrocardiograms; solution of a system of nonlinear differential equations describing the dynamic behavior of pneumatic pressure reducers.

AEC COMPUTING AND APPLIED MATHEMATICS CENTER - NEW YORK UNIVERSITY - NEW YORK, N. Y.

During April 1959 the IBM 704 installation added a CRT unit for taking 35 mm pictures, and a large visual display tube.

In September 1959, it is planned to increase the core memory to 32,768 words and to remove the drum unit.

A committee has been set up to screen proposals for "no charge" use of the computing facilities at this center. Only work coming from non-profit making institutions can be considered. Physical Sciences and Mathematics are the areas for which approval may be obtained. No programming assistance (other than general advice) can be given. For further information write to: Professor Eugene Isaacson, Associate Director, AEC Computing and Applied Mathematics Center, New York University, 4 Washington Place, New York 3, New York.

FLAC I AND IBM 709 - RCA SERVICE COMPANY - PATRICK AIR FORCE BASE, FLORIDA

Data processing for the Atlantic Missile Range—a function and responsibility of the RCA Missile Test Project—is currently being implemented by FLAC I and available time on the IBM 709 Impact Predictor Computer located in the vicinity of the launching facilities. FLAC II was shut down on 15 May 1959 and work is proceeding according to schedule for preparation of the area to accommodate an IBM 709 system. In addition to the equipment listed in the January 1959 issue of the Digital Computer Newsletter, three more 709 Magnetic Tape Units have been placed on order.

The input-output operation of the Data Reduction 709 system will be predominantly magnetic tape with only a minimum usage of the on-line card reader, card punch and printer anticipated. Cards will be punched with accounting information, and the printer may record information on job identification, error messages, and other communications which will help to insure an unhindered operation.

The 709 system will be under control of a Data Reduction Control Program, devised and being implemented by the programming staff of RCA Missile Test Project. Reduction of production runs will be on a batch basis, i.e., many different runs can be processed with operator intervention normally relegated to changing tape reels when "end-of-tape" has been sensed. The Control Program will also supply identification information, end-of-run identification, and magnetic tape bad spot detection. Batch compiling runs will also be accomplished.

Raw data and program information and constants are normally available on paper tape and cards, but to preserve the magnetic tape operational concept, these data will be converted off-line to magnetic tape prior to their introduction into the computer. The modified 727 magnetic tape unit for on-line FLAC-formatted tape will provide for raw data input of field-recorded tapes. Output to magnetic tape normally will be required in binary and binary-coded decimal, the latter for printing purposes. A Flight Test Reports Writer program, prepared from RCA Missile Test Project specifications by IBM personnel, will be used to format reduced data for off-line report printing.

To facilitate magnetic tape operation, primarily by eliminating unnecessary tape reel changing, three magnetic tape units are switchable off-line to the card-to-tape converter or the off-line printer.

The DTS equipment provides a real-time input and recording facility for FPS-16 radar data.

709 AND RAYDAC SYSTEMS - U. S. NAVAL MISSILE CENTER - POINT MUGU, CALIFORNIA

RAYDAC. The RAYDAC Input-Output System, for acceptance of missile instrumentation data, has been completed and passed acceptance tests. The Input System includes an IBM 407 Tabulator, a Ferranti Paper Tape Reader, and Potter Model 905 Magnetic Tape Unit. The Output System uses 407 Tabulator, 523 Summary Punch, and a Talley Plotter.

The system has a Tape Interswitch Facility which permits using any of five RAYDAC tape handling mechanisms with any of the External Memory racks or with the Output System.

The RAYDAC has been operating up to 24 hours a day, as workload demands, with up to 80% good time for a week.

Magnetic tape input modes of operation include PDM/FM Telemetry, FM/FM Telemetry, FPS-16 Radar, MPS-26 Radar, and Tridop.

IBM 709. Installation of a 709 is scheduled to begin 1 June 1959 at the Naval Missile Facility, Point Arguello, California. The Point Mugu resident data reduction contractor (Land-Air, Inc.) is responsible for the operation of the computer. The primary functions of the computer are to provide range safety for missile and satellite launchings utilizing the Pacific Missile Range, and to perform essential post flight data reduction. To provide the information required by the Range Safety Officer, data from several FPS-16 radars will be transmitted directly into the computer for immediate processing and the results of the computations displayed on plotting boards.

NAVAL ORDNANCE COMPUTATION CENTER - U. S. NAVAL PROVING GROUND - DAHLGREN, VIRGINIA

UDT. Basic system checkout of the UDT (Universal Data Transcriber) has been successfully completed. Input-output devices thus far attached are Flexowriter, paper tape punch, IBM card reader and punch, and NORC tape mechanism. Other devices included in immediate plans are a general-purpose magnetic tape transport and a Remington-Rand card punch. Diagnostic and utility routines are nearing completion. An "operator program" is being prepared which will enable an operator to assert control at breakpoints by means of English language pseudo commands typed into the flexowriter.

NORC. Design has been completed for the addressing logic to be used with the 20,000 word core memory which will replace the existing 2000 word Williams tube memory in NORC. Since the NORC word is not large enough for three full-range addresses, the present three-address instruction format will be modified to include two full-range addresses and one limited address covering 20 locations. The limited address may specify either of the two operands or the result destination. Address modifiers with range 10,000 may be specified for the two full-range addresses. Studies have indicated that the limitation on the one address will not, in general, lengthen programs by more than five percent; this disadvantage is far outweighed by the advantages of the larger memory. A console switch will be provided to restore the system to its original 2000-word mode of operation, so that existing programs need not be revised. Delivery of the new memory is expected in late summer 1959.

ELECTRON COMPUTER BRANCH (CODE 280) - U. S. NAVY BUREAU OF SHIPS - WASHINGTON, D. C.

Some of the most significant problems completed at the Applied Mathematics Laboratory, David Taylor Model Basin, in 1958 include:

1. Calculation of the normal modes of a ship hull to which masses are attached with only elastic coupling.

2. Calculation of the effectiveness of certain continuous mounts in isolating non-rigid machines from non-rigid foundations.

3. Determination of the refraction of an electromagnetic wave travelling through air and impinging upon sea water.

4. Calculation of design data for ship propellers with optimum circulation when fore and aft propellers have a different number of blades.

5. Feasibility study of a computer navigation system, involving the simulation on the UNIVAC system of a shipboard computer receiving information from a Loran master station and slave stations and from mine detecting sonar equipment.

6. Prediction of the parting in various sea states of cables used for interconnecting or mooring vessels in such operations as Hardtack.

7. Determination of the back scattering of sound from a transducer located at the water surface.

8. Numerical estimation of power spectra as applied to the analysis of two simultaneous time series, for use in the analysis of ocean waves records by personnel of the Hydromechanics Laboratory.

9. Extension of previous calculations relating to the determination of effective minesweeping and mine-hunting procedures.

Members of the engineering staff of the Applied Mathematics Laboratory, have modified the Remington Rand High Speed Printer to the extent that it will accept computer program-formated IBM 704 magnetic tape input. In the process, a new reel hub adaptor was invented, and a patent application has been filed.

COMPUTERS AND CENTERS, OVERSEAS

EMIDEC 2400 - E.M.I. ELECTRONICS LTD., HAYES, MIDDLESEX, ENGLAND

The EMIDEC 2400 is a transister computer designed primarily for data processing work. Besides the general purpose parallel computer (37 bits per word) there is available a comprehensive set of both on and off-line peripheral equipment operating in a series-parallel mode. Details of some of these units were given in the October 1957 issue of the Digital Computer Newsletter.

The first installation is now under test at Hayes in England and contains most of the units available in the system. Various forms of test programs have been operated on the central computer over the last six months. Up till now paper tape has been used for input and output and the stage has just been reached of operating the unit with magnetic tape and line printer. The main store of the computer can be 4,000 or 8,000 words and this will later be raised to 16,000 or 32,000 words. The main highlights are as follows:

Storage	Two stores; the main one uses magnetic cores with an access time of 6 microseconds, and the other is a 64 word diode-capacity store with an access time of 1.5 microseconds.
In/Out	Up to four parallel channels of input or output, at 20,000 six bit alphanumeric characters each from magnetic tape. These operate in parallel with computing and use only two words of buffer storage each. A larger (up to 16) number of paper tape, punched card and printing units can be operated on-line in place of some of the magnetic tape channels.
Time Sharing	The magnetic tape units and other on-line units contain no local storage and are time-shared with computing to use the computer store. The computer program is also time-shared to communicate with operators and the off-line equipment.
Speed	A form of two address instruction is used with an order code of 64 instructions. Approximate operating times are:

20-30 μsec.	simple arithmetic orders and decision order
90 μsec.	multiplication
150-300 μsec.	division and conversion to and from binary

Program Interrupt — A facility for automatic transfer of program operation on receipt of a signal of important occurrences in the system. This allows the program to be used for controlling external equipment and monitoring errors and faults. This also simplifies the programming of such things as tape unit control.

The off-line equipment works to or from magnetic tape and contains units for off-line input, output and file processing. Two tapes of magnetic tape unit are available. A one-inch wide tape is used for general processing and storage and holds about 6 million alphanumeric characters per reel. To ensure high reliability the tape is used out of contact with the heads and a 10 bit self-correcting character code is used. The second tape is four inches wide and gives bulk storage of about 26 million characters per reel. The off-line equipment is being tested in parallel with the computer each unit being self-contained with its own control and power supplies.

The tape units in the system are used as a common bank and an electronic switching unit integrates them with the other equipment in the system. This arrangement can be controlled either manually or by the computer program and ensures high speed processing and little reel changing.

It is too early yet to give reliable operating statistics of this equipment but it is hoped to do so in a few months time.

FINAC-FERRANTI MARK I - INSTITUTO NAZIONALE PER LE APPLICAZIONI DEL CALCOLO - ROME, ITALY

Computer Maintenance. During the first three years of operation (30 June 1955-30 June 1958) the efficiencies were 89.1%, 91.2%, and 92.2%.

Valve Replacement	1st Yr.	2nd Yr.	3rd Yr.
6AL5	5%	12%	10%
EF55	15	12	20
EF50	45	40	30
12AT7	35	40	45
EF91	35	35	15
C.R.T. (for store)	70	25	70

Fault Causes	1st Yr.	2nd Yr.	3rd Yr.
Power Supplies	23%	1%	1%
Valves	17	18	12
Other Components	3	9	2
Construct. Faults	3	1	8
Basic Waveforms	3	12	28
C.R.T. Store	19	21	15
Drum	4	18	6
Input-Output	12	9	17
Other Causes	5	2	3
Unidentified Causes	11	3	2
Parallel Printer	—	6	6

Machine use (3rd year)	Time
Useful	1645 Hrs.
Not useful	60
Down time	93
Idle time	23
Engineering	844
Total	2665

Analysis of useful time:

	April 1, 1958 - June 30, 1958	July 1, 1958 - Sept. 30, 1958	Oct. 1, 1958 - Dec. 31, 1958	Jan. 1, 1959 - March 31, 1959
Production	304 Hrs.	189 Hrs.	338 Hrs.	332 Hrs.
Research	61	31	69	119
Training	17	3	4	1
Debugging	160	91	182	113
Demonstration	7	1	3	1

New Equipment Installed. Another Creed Model 25 Perforator has been provided. These paper tape punches have proved to be very reliable. The second punch has a speed of about 30 characters per second.

The double precision facility, for arithmetic on 80 bit word (see Digital Computer Newsletter, July 1958) has proved to be extremely useful and reliable.

A transistorized flip-flop register has been installed to monitor the address of the last jump-instruction performed by the machine. This facility is particularly useful in debugging and trouble shooting.

A set of transistor counters driving electromechanical counters is being installed for the purpose of analyzing the frequencies of occurrence for the various types of instructions.

The connection between valve circuits and transistor circuits is done through more or less conventional crystal diode circuits.

COMPUTER UNIT - UNIVERSITY OF LONDON - LONDON, ENGLAND

The University of London Computer Unit, which was set up in the second half of 1957, is now in full operation with a Ferranti Mercury computer installed in its premises at 44 Gordon Square, London W.C. 1.

This computer, equipped with 1024 words of magnetic core store, and 16,384 words on magnetic drums, was handed over in February and is providing facilities for members of the numerous colleges and institutes of London University. At present a single shift system is being worked, but it is expected that two daily shifts will become necessary towards the end of the year.

Performance during the first four weeks has been very satisfactory, as shown by the following figures:

	Hours
Scheduled maintenance	42.7
Useful computing time	150.2
Time lost through machine faults and other causes	7.4
Idle Time	14.9
Total	215.2

The Computer Unit has a total staff (including clerical and operating personnel) of about 16, led by Dr. R. A. Buckingham, Director and Dr. A. R. Edmonds, Deputy Director. Detailed programming of problems is mainly carried out by members of research departments in the University. The staff of the Unit offers programming courses, and general advice on numerical analysis and programming; they also assist with certain research projects, and are engaged in developing improved methods of using the computer. Although many problems are programmed directly in the standard code, which is a one-address system with extensive facilities for

symbolic addressing, extensive use is also being made of the Autocode system devised for Mercury by Mr. R. A. Brooker, of Manchester University.

MATHEMATICAL SERVICES DEPARTMENT - ROYAL AIRCRAFT ESTABLISHMENT - FARNBOROUGH, ENGLAND

The Royal Aircraft Establishment, Farnborough, is equipped with the following digital computers:

		Date of delivery
DEUCE (1)	The English Electric Co., Ltd.	July 1955
DEUCE (2)	The English Electric Co., Ltd.	Dec. 1956
Pegasus	Ferranti Ltd.	May 1957
Mercury	Ferranti Ltd.	May 1959

The Pegasus is mainly engaged on missile calculations; the others are operated as a general service to the Establishment.

The DEUCE Computers. The two machines at R.A.E. are essentially as described in the July 1955 Digital Computer Newsletter. The main extra facility is that 64 columns of the Hollerith card (instead of 32 as formerly) can now be read into or punched out from the computers. In addition, one machine has been equipped with 5-hole paper tape output, and will shortly have a similar input facility.

The full-time staff consists of 8-10 mathematicians and programmers, mostly graduates, together with 6 assistants employed on general duties. The work undertaken includes the preparation of library routines and standard programmes, advice on numerical analysis and programming, training of programmers and operators. The full-time staff is also engaged on the mathematical analysis, programming and coding of specific problems, but the majority of such work is now carried out on a part-time basis by staff from the 'user' departments (about 20 programmers).

The problems dealt with cover a wide range, reflecting the diverse activities of the Establishment. The following are cited by way of illustrations: Aerodynamic research, design and performance; aircraft flutter and vibration, including the calculation of aerodynamic derivatives; helicopter performance; structural analysis; wind tunnel design and control; machining of aerodynamic models; missile studies; analysis of time series; navigational aides calculations; performance of rocket fuels; miscellaneous statistical computations.

A proportion of the time is allotted to regular data processing - e.g., wind tunnel measurements, which are recorded automatically on punched cards; and missile trial data, which are recorded at the range on punched cards, transmitted by landline, and copied automatically on to further punched cards at Farnborough. The results, after analysis on DEUCE, are sent back in the same way.

About 30% of the total good computing time is spent on programme testing and pilot runs; about 10% on research in numerical methods and training; and about 60% on 'production' computing. Various simplified programming schemes account for about one third of the production time. The DEUCE library consists of several hundred subroutines and standard programmes, including a comprehensive set of 'bricks' for use with a general interpretive scheme.

A normal working week is from 8:30 a.m. to 10 p.m., Mondays to Fridays, with occasional weekend and night work. Scheduled maintenance averages about 10 hours per week per machine, with an engineering staff of 3-4. Operating statistics, up to December 1958, are summarized as follows:

Machine	Period	'Good' Computing Time (Hrs.) (G)	Unserviceable Time (Hrs.) (U)	Efficiency % (G/G + U)	Average 'Good' Hours per Normal week
1	1955 (Aug-Dec)	768	220	77	41
1	1956	1808	938	66	41
1	1957	2018	320	86	47
1	1958	2560	289	90	55
2	1957	2542	229	92	52
2	1958	3168	210	94	68
Total	——	12,865	2205	—	—

The trends towards increased efficiency and a greater number of good computing hours per week are apparent. The overall performance of the later machine (DEUCE 2) has been significantly better than that of the earlier one, which was a pre-production model.

PEGASUS. The R. A. E. Pegasus computer (see Digital Computer Newsletter, July 1955) has been mainly used for studying missile trajectories, including those of the Skylark upper atmosphere research vehicle, and the Black Knight rocket. Amongst a variety of other jobs done on this computer mention may be made of the analysis of kinetheodolite observations of the Sputniks which yielded new information on the earth's gravitational field.

The Pegasus is operating on a 5-day week, 2-hour daily maintenance basis. The following table illustrates its high degree of reliability.

Period	'Good' Computing Time (Hrs.)	Unserviceable Time (Hrs.)	Efficiency %	Average 'Good' Hours per Normal Week
1st year (1957/8)	1971	53	97.3	41
2nd year (1958/9)	2719	39	98.6	55

MERCURY. A Mercury computer (see Digital Computer Newsletter, October 1958) has recently been delivered and is expected to be operational in July. Although the basic digit frequency of this machine is the same as that of DEUCE (1 megacycle per second) the overall computing speed should be increased by a factor 5-10, due, in the main, to improved instruction modification facilities and a 1024-word immediate access store of ferrite cores.

Mercury is also provided with built-in floating point arithmetical facilities. This means that in many cases there is little loss of computing speed when a calculation is programmed in 'autocode' (a simplified programming scheme). It is expected that Mercury will be used for most of the larger new mathematical problems, leaving the DEUCES for data processing and for problems for which programmes are already available.

LIBRASCOPE LGP-30 - SCHOPPE & FAESER-GMBH - MINDEN/WESTFALEN, GERMANY

Schoppe & Faeser GmbH is now manufacturing the LGP-30 under a license from Librascope, Inc. To date they have delivered 4 machines.

The Royal McBee International, 18-20 Rue de Lausanne, Geneva, Switzerland acts as Sales Organization for this computer in Europe.

ADOLPH BASSER COMPUTING LABORATORY - UNIVERSITY OF SYDNEY - SYDNEY, AUSTRALIA

The SILLIAC (Sydney version of the ILLIAC), was constructed in Australia and installed in the Adolph Basser Computing Laboratory. Operation began on July 4, 1956.

The construction of the computer was made possible by funds donated by Dr. Adolph Basser, C.B.E. and the cooperation of the University of Illinois Computing Laboratory. The main financial support for the Laboratory comes from the Nuclear Research Foundation, a private foundation within the University of Sydney. The Laboratory is part of the Department of Physics.

A number of modifications have been made to the original Illinois design, but the main features of the ILLIAC remain unchanged (e.g. 1024 40-bit word C.R.T. storage, paper tape input at 200 characters per second and output at 60 characters per second). Auxiliary equipment includes a card-to-tape converter and a high-speed paper tape comparer-reperforator. At present, the first of four magnetic tape units, an Electrodata unit, is being attached to the machine, and this unit is expected to be available to users in mid-1959.

Performance statistics for the first two years of operation:

Year	Total Scheduled Operating Time	Daily Schedule
1956-57	1055 Hours 3 Minutes	7.0 Hours
1957-58	2095 Hours 36 Minutes	12.25 Hours

Total Scheduled Operating Time (T.S.O.T.)

Classification	% of T.S.O.T. 1956-57	1957-58
Production Time Lost (due to suspected machine error)	2.7	1.2
Development Time Lost (due to suspected machine error)	0.8	0.1
Stand-by	8.7	2.0
Unscheduled Maintenance	9.0	3.6
Total Useful Time	78.8	93.1

Analysis of Total Useful Time (T.U.T.)

Classification	% of T.U.T. 1956-57	1957-58
Production	60.2	78.5
Development of New Programs	34.6	17.3
Instructional	3.1	1.8
Demonstration	2.1	2.4

The distribution of Total Useful Time amongst the different users over the two years is as follows:

Physics Department	74.4 % of T.U.T.
Other University Departments	9.5 "
Non-University Organizations	16.1 "

As the figures show, the machine is used mostly for projects originating in the Physics Department. Most of this work is concerned with cosmic ray shower theory, and the processing of data (much of which is automatically recorded) arising from experiments in this field.

The laboratory issues quarterly reports of its activities which can be made available on request.

COMPONENTS

S401 AUTOMATIC PRINTING AND DISPLAY - BURROUGHS CORPORATION - DETROIT, MICHIGAN

An automatic printing device which can display a new message on local airfield weather observation in 1.2 seconds has been developed for U. S. Air Force testing by Burroughs Corporation.

The machine, designed to print out weather reports in plain language and display these reports in such strategic locations as the control tower, pilot ready room, Ground Control Approach Station, operations office, and weather offices, will be tested to determine its applicability to the 433L program, the Weather Observing and Forecasting System now being developed by the Air Force.

Called Display Device S401, the machine receives and prints by electrostatic process incoming messages on paper tape from data received via standard telephone party lines. It will also print from digital signals received from computers, punched paper tape, electronic message storing devices, or magnetic drums. Up to 12 of these devices may be operated across the same telephone line.

Characters, 5/8ths inches high by 3/8ths inches wide, can be viewed readily in a dimly lighted room at distances up to 12 feet. Airfield weather reports on temperature, visibility, wind direction and velocity, barometric pressure, and humidity automatically will be fed into an electronic message assembler which, in turn, will transmit the information by code to the device. The S401 will convert the code into plain language on the display tape.

The equipment is designed so that test data will change with every significant change in the weather, enabling users to keep aware of even the smallest important weather change. The Air Force expected the electrostatic display device to go on line testing within 18 months.

D101 MAGNETIC TO PAPER TAPE CONVERTER - DIGITRONICS CORPORATION - ALBERTSON L.I., NEW YORK

The Dycor D101 Converter is designed specifically for the purpose of converting data on magnetic tape (produced by any computer wherein the code is 6 bit parallel plus a parity bit, and serial by character) to its corresponding form on standard Teletype paper tape.

Magnetic tape data is accepted by the Converter in the computer code via a Dykor Tape unit fully compatible with the output plastic tape. For installations requiring metal tape or extra wide tapes, transports of the type supplied with the computer are used for input. The conversion operation is manually initiated, but proceeds automatically thereafter until the end of input tape data. Paper tape output is prepared by a Soroban Model GP-2 Tape Perforator in standard Teletype (Baudot) 5 level code.

Input and output data, although in different code, are completely identical in content, except for certain editing or format control characters appearing on the output paper tape. Such data (including figure and letter shift characters, blanks, carriage returns, and line feeds) are inserted in part automatically, and in part under control of a patchboard, as described below. The data thus inserted permits control of the remote Teletype printer without special programming of the computer.

Format Control. Patchboard Programmer is provided to permit insertion of carriage returns (CR), Line Feeds (LF), and Blanks (BL) independently of computer programming control. That is, the above characters are not necessarily contained on the input magnetic tape.

Self Checking. Advantage is taken of both the horizontal and vertical parity check bits available with the magnetic tape input data. Failure of the parity check causes an "Input Error" light, and the converter automatically takes remedial action to clear this error by a

"reread" of the error block. If the error is not cleared, the "Input Error" light will remain lit and operation halts with the machine ready to attempt another "reread" under operator control.

The vertical parity bits are carried in the internal storage of the D101 and thus provide a mechanism for memory error detection. Control circuits are checked by either taking advantage of certain internal timing relationships, or by duplication where necessary. A panel light is lit when an internal converter error occurs. Under this condition the equipment halts.

Operating Speeds. The tape transport moves the magnetic tape at speeds and densities compatible with the input tape; for example, 15,000 characters per second or 28,000 characters per second. With a maximum of 80 characters per input record, 80/15,000 seconds or 5.3 milliseconds are required to read a given record. With 120 characters per input 120/28,000 or 4.3 milliseconds are required. Together with up to 5 milliseconds for starting the magnetic tape between records, a total of about 10 milliseconds is the maximum input time required per record. The stopping time (also about 5 milliseconds) is overlapped with punching, so that it adds nothing to the overall time required to punch out a record.

A two speed shift register is used for transfer and storage of data. A sprocket formed from the input tape controls input to the shift register at a 15 kc rate. A maximum 80 kc sprocket rate is permissible. An internal clock is used to control output from the shift register at the maximum reliable operating speed of the punch. This speed is tentatively set at 180 cps and is variable by means of a feedback signal from the Soroban GP-2 which in turn triggers a variable delay element. This is used to give positive indication of completion of the punch operation, and in addition, by decreasing the delay, the speed may be increased to 240 characters per second.

Assuming an output rate of 180 characters per second, a record of 80 characters will be punched in 80/180 seconds or 445 milliseconds. Assuming up to 5 additional editing characters per block and 5 case shift characters, this speed will decrease to 90/180 seconds or 500 milliseconds per record—punching time correspondingly decreases as the punch speed is increased. Since tape input speed is so high relative to punching speed, no attempt is made to simultaneously read and punch. In the worst case, therefore, an 80 character record will be created on punched paper tape in 510 milliseconds, assuming punch operation at 180 characters per second.

MAGNETIC STORAGE DRUM - FERRANTI-PACKARD ELECTRIC, LTD - TORONTO, ONTARIO

The 1201A Magnetic Storage Drum is supported on an air bearing of 8" diameter with jet orifices designed to balance the thrust and lateral force components. The air bearing requires 3-4 cu. ft. of air per minute at 20 lbs. per square inch pressure. No contact wear is evident on the precision parts of the system.

Each head column can carry up to 80 heads spaced 0.1 inch apart. The spacing of the heads from the drum is automatically controlled with a very simple servo, operating from the existing air supply. This feature allows close spacing for maximum stacking and at the same time prevents signal variations due to thermal or centrifugal expansion.

If air failure should occur an emergency water brake is fitted to arrest the drum rotation quickly; and the head columns are arranged to rapidly move away from the drum surface.

Lifting equipment facilitates easy removal and interchangeability of the drum shell.

Drum size	12" diameter, 8" useable length.
Drum speed	1780-3540 RPM (dual speed).
Heads	50 to 300 kcs per second - Up to 80 heads per column.
Tracks	210 tracks spaced 0.037 inch.
	Clock track supplied as requested.

Ferranti-Packard components are sold in the U.S. by Ferranti Electric Inc., 30 Rockefeller Plaza, New York, New York

SERIES 1200 CHARACTER SENSING EQUIPMENT - INTERNATIONAL BUSINESS MACHINES CORP. - NEW YORK, N. Y.

The American Bankers Association has evolved a set of standards for machine sensing characters printed in magnetic ink on checks, deposit slips and similar banking instruments. The numerals and symbols are especially designed for easy reading by bank personnel but are printed in magnetic ink which will generate impulses when scanned by the machine. Under this system each printed character corresponds to a magnetic field.

Under the uniform ABA code, banks will issue checks with customer account numbers, bank identification, and reserve bank routing codes preprinted along the bottom in magnetic ink characters. All such imprints will be 3/16" from the bottom of the checks. The checks themselves may vary in size from 2-3/4" to 3-2/3" wide and from 6" to 8-3/4" in length. Thickness of paper or cards on which checks are printed may vary from .0035" to .0067" in thickness.

After checks have been cashed, routine bank processing will cause the printing of each check's amount and special operating codes alongside the preprinted account numbers. This will be done as an automatic by-product of the normal process of proving deposits and withdrawals. From this point on, the new machines automatically process checking data with guaranteed accuracy.

To meet the check handling needs of bankers, IBM has demonstrated its Series 1200 line. Initially, there are four pieces of equipment.

The 1201 Proof Inscriber, in one operation, inscribes checks and deposit slips with magnetic characters and distributes them according to as many as 32 processing categories (these include Reserve and correspondent bank accounts, bookkeeping breakdowns of a bank's own accounts, and special accounts such as industrial payrolls). At the same time, it lists, endorses, and proves all items.

The 1201 Sorter-Reader is the heart of a character sensing system. It completely automates the sorting of checks. For the further advantages of accounting systems, it reads information from checks directly into standard IBM data processing systems using any of a number of computers, magnetic memories, accounting machines, and printers.

The 1201 Sorter-Reader Control directs the flow of data from the Sorter-Reader directly into data processing systems.

The 1202 Utility Inscriber is a special electric typewriter for inscribing unmarked, illegible, or damaged documents, or for preparing carrier envelopes into which badly mutilated checks are placed for routine, automatic processing.

Examples of some of the ways the equipment can be tailored to bank's needs:

For growing banks of moderate size, they have designed the Unit Record System. Under this plan, the output of a Sorter-Reader is fed into a 407 accounting machine capable of generating and printing accounting information at the rate of 150 lines per minutes. At the same time the 407 senses information from current checks, processes punched cards representing the outstanding balances on accounts. Information from both sources is automatically combined to update every account in a bank at the close of each business day.

An intermediate system has been devised for banks in this operating range. Under this plan, data from the Sorter-Reader can be channeled directly into the console of a 650 data processing system. This adds the capacity of the medium-sized computer to the banking system. Series 1200 character sensing equipment plus the 650 makes it possible for a bank to achieve; (1) automatic account analysis, (2) automatic calculation and posting of service charges, (3) automatic daily trial balances to assure bookkeeping accuracy, and (4) automatic auditing.

For large banks, IBM offers the most advanced, most automated check and data processing system available. Under this plan, data from the Sorter-Reader is encoded on magnetic tape for handling on advanced data processing systems such as the 650-tape system, the 705, or the 7070 transistorized computer.

ELECTROCARDIOGRAMS - NATIONAL BUREAU OF STANDARDS - WASHINGTON, D. C.

The Data Processing Systems Division of the National Bureau of Standards, operating under a research program of the Veterans Administration, has designed and built a pilot facility for the study of electrocardiograms. The electrical signals from the heart are generally repetitive and relatively well-adapted for objective mathematical treatment. Once the feasibility of the method has been established, only minor modification of the equipment would be required for phonocardiography, ballistocardiography, hemodynamic pressure and flow curves, electroencephalography, and electromyography. The original 3-lead heart signals from about 100 patients are recorded on 3 FM channels of magnetic tape, while a fourth voice channel records the patients' names. The equipment devised at the Bureau permits the conversion of the analog signals, supervised by a medical technician using a scope display, to digital magnetic tape in a form suitable for the IBM 704 at NBS. In this form it is readily possible to make extensive statistical studies, mass screening of the population, and the handling of patients' records in large organizations such as the Veterans Administration; and any type of analysis desired can be carried out simply by writing a new program for the computer.

FOSDIC III - NATIONAL BUREAU OF STANDARDS - WASHINGTON 25, D. C.

The National Bureau of Standards has developed a new model of FOSDIC (Film Optical Sensing Device for Input to Computers) to assist the Bureau of the Census in processing the data to be received from the 1960 decennial census. This electronic machine rapidly reads microfilmed census documents and transcribes the data on magnetic tape for direct input to an electronic computer.

In the 1960 census, nearly 160,000 enumerators will be employed in collecting data on the people of the U. S. and their homes. The result of their work will be a vast amount of information about persons and households, amassed on nearly 50 million separate sheets of paper. To sum up all this information into convenient, useful tables and to produce this summation in the space of a few short months will require the services of four high-speed electronic computers.

Before the data is given to the computers for processing, an intermediate step must be performed. In the past, human operators have performed this task by transcribing the data onto punched cards. However, it was readily apparent that for the 1960 census, the extremely rapid processing speeds which electronic computers can achieve would be largely wasted in the absence of some means for mechanizing the input. Therefore, the Bureau was called upon to develop an instrument that would eliminate as much as possible the human drudgery heretofore required. The result has been FOSDIC III. This machine is already in service, and has assisted in several census surveys. For the 1960 census, four additional identical machines are being constructed by the Bureau of the Census.

The central element of FOSDIC III, like its predecessors, FOSDIC I and II, is an electronic scanning assembly. Light from the screen of a cathode ray tube is focussed upon the microfilm image, and the transmissivity of small, discrete areas on the film (corresponding to the hand-written marks on the original document) is measured with a photoelectric cell. By moving the electron beam around on the face of the cathode ray tube, any selected area of the image can be examined. Control of the position of the illuminated area, and interpretation of the signals from the photoelectric cells, are functions performed by the associated electronic circuitry. Through positional control, or scanning, the point of light travels in prescribed manner from one point to the next in turn. Since there is only one electron beam in the cathode ray tube, the scanning over the image is serial in its time sequence. Then, as soon as one image is scanned, the film is automatically advanced to the next frame.

Photographing the census documents on 16-mm microfilm provides a number of advantages. It separates the massive paperwork operation from the electronic equipment; FOSDIC can read microfilm images much faster than the paper sheets themselves. The high contrast of microfilm provides an enhanced signal-to-noise ratio, resulting in a low incidence of errors in machine reading. Moreover, film images of quality adequate for FOSDIC to read are also of sufficient quality for easy visual examination in a microfilm reader. Therefore, the original documents, once microfilmed, need not be saved; the storage problem is thereby reduced considerably. Documents can be photographed on a pile permitting rapid peel-off, the documents may be slightly tilted so that straightening is not continually required, and precise reduction ratio and exposure control are not necessary.

A system of notation easily recognizable by both man and machine is required for indicating information on census documents. The simplest system is "marking sensing", in which answer areas are marked with some writing instrument or left blank. The most familiar example is an "x" in a box to indicate a "yes", "no", or the correct answer to a multiple choice question. Numbers may be selected by choosing the desired digit from a column of ten digits. Mark sensing permits the use of ordinary pencils, allows erasures, and minimizes the weight of paper stock which the census enumerator must carry with him.

A complete census document is built up of groups of questions, with their possible answers and answer areas. Each group is located by an index mark—simply a black square which FOSDIC can easily find. Answer marking positions fall into an imaginary grid laid off from the index. The grid is made up of modules 0.15 in. square, and marking areas may be packed this closely together, horizontally or vertically. The actual marking area is a fine-lined circle, 1/2 module in diameter. Each index serves a grid as large as 16 x 16 modules.

A document may contain, within its overall limitations of size, as many index groups as are needed for the information content. Each group is an entity in itself, and need have no relation in position with any other group.

Registration marks are located at the left and top borders of the document. These marks are included to determine the tilt and span of the document image as it appears to FOSDIC's scanning equipment, and to provide a starting point for examining the image.

FOSDIC can read off any part or all of the information on a document, depending on the programming instructions. The instructions are in terms of the horizontal and vertical coordinates of the index mark next to the desired information. Program control is through a plugboard into which the detection logic has been wired.

MISCELLANEOUS

TAPE TO TAPE CONVERTER INSTALLATION - DIGITRONICS CORPORATION - ALBERTSON, L.I., N. Y.

The ability of Merrill Lynch, Pierce, Fenner and Smith's two electronic computers to communicate with almost 130 branch offices has been greatly increased by the delivery of the first of Digitronics Corp.'s Model D101 Converters. (For specification details, see Components section of this issue).

The D101, specially designed for the brokerage house, takes the magnetic tape output of the computer which has the record of stock market transactions for the day, and translates it into teletype paper tape code. The punched paper is then fed directly into teletype transmitters which control printers at the various branch offices. Although many format control features do not appear on the magnetic tape, characters such as figures and letter shift, carriage return, line feed, etc. are inserted automatically under control of a plugboard.

The speed of communications is greatly increased over the present system which requires conversion from magnetic tape to cards, and thence to perforated paper tape. In Merrill Lynch branch offices, clients, brokers, customer men, and investors will have the results of

the day's transactions within a few hours after the closing of the New York Exchanges. The converter also saves valuable computer time enabling the operator to edit the information from the computer by means of the plugboard.

To handle the output of Merrill Lynch's two IBM 705 computers adequately and to satisfy their customers throughout the country another converter will shortly follow the first.

HONEYWELL 800 INSTALLATION - MINNEAPOLIS-HONEYWELL - NEWTON HIGHLANDS, MASSACHUSETTS

Associated Hospital Service of New York (Blue Cross) has ordered the first Honeywell 800 electronic data-processing system (see Digital Computer Newsletter, April 1959). The system is now under construction and will be delivered to their headquarters at 80 Lexington Avenue in October 1960.

SEMINAR ON U.S.S.R. COMPUTER ACTIVITIES

Four computer specialists, Professors Alan J. Perlis, James E. Robertson, Norman R. Scott, and John W. Carr III, were invited by the Office of Naval Research to present impressions of their trip through the Soviet Union to an open audience on 12 November 1958.

The proceedings are now available and may be purchased from the Office of Technical Services, Department of Commerce, Washington 25, D.C. Their catalog number for this proceedings is PB 151634 and the price is $3.00. Checks should be made payable to the Treasurer of the United States.

U.S.S.R. ACTIVITIES - WESTERN RESERVE UNIVERSITY - CLEVELAND, OHIO

Mr. Allen Kent, of Western Reserve's Center for Documentation and Communication Research, made a six week trip overseas this fall to inspect at first hand the documentation and translation activities in the U.S.S.R. and other European countries. He visited the All-Union Institute of Scientific Information, the Linguistics Institute, and other centers in Russia active in this field. He was impressed by the great effort being put forth by the Russians. He saw components of the high speed literature searching machine, which should be assembled by now for experimental searches. He discussed problems of language analysis with members of the Russian group working on mechanical translation whose experiments employ a modification of the semantic factoring system which has developed at the Western Reserve Center, as the basis for machine searching of encoded abstracts.

Reports on this trip have appeared in American Documentation, January 1959; Product Engineering, January 12, 1959; and Harper's Magazine, April, 1959.

CONTRIBUTIONS FOR DIGITAL COMPUTER NEWSLETTER

The Office of Naval Research welcomes contributions to the NEWSLETTER. Your contributions will assist in improving the contents of this newsletter, and in making it an even better medium of exchange of information, between government laboratories, academic institutions, and industry. It is hoped that the readers will participate to an even greater extent than in the past in transmitting technical material and suggestions to this Office for future issues. Because of limited time and personnel, it is often impossible for the editor to acknowlege individually all material which has been sent to this Office of publication.

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Communications should be addressed to:

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